Galileo's Undone Gravity Experiment: Part 2 — Basic Physics, Astrophysics, and Cosmology

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Abstract. —
The truthfulness of accelerometers leads our intrepid alien Rotonians (introduced in ***Part 1*** [1]) to a model of gravity having profound cosmological consequences. To make ***Part 2*** relatively self-contained, some overlap with ***Part 1*** is included. Empirical observations underpin the Rotonians' new model, whose coherence is most compactly stated by its simple expression for Newton's constant G. A pattern of interconnections emerges amongst G and a family of other physical constants and pure numbers, as they have appeared in humanity's quest to understand the Universe, from its smallest to its largest extremes. Rotonians are wary of most Earthian cosmological ideas. They see standard physics and cosmology as a fragmented, incoherent recipe of doom, especially as compared to their new formulation of an ever-flourishing, self-organizing, eternal Universe. Most important is that the cosmology based on their ***Space Generation Model*** of gravity (SGM) is ***testable*** — in a local laboratory or an orbiting satellite. If the Small Low-Energy Non-Collider experiment (proposed by Galileo in 1632) supports the Rotonian prediction that the test object does not oscillate, then our understanding of the rest of physics and the Universe will be transformed, roughly as follows.

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1. Introduction: Simple Truth, Beautiful Ideas, and Empirical Evidence

> *To my mind there must be, at the bottom of it all, not an equation, but an utterly simple idea. And to me that idea, when we finally discover it, will be so compelling, so inevitable, that we will say to one another, "Oh, how beautiful. How could it have been otherwise?"*
>
> John A. Wheeler : PBS video : 1985 [2]

> *As scientists, what we really seem to do is engage in a form of art criticism: "my theory is **prettier** than yours." . . . I don't think that's something to be ashamed of. My personal view is that our esthetic sense is the only reliable guide we have.*
>
> *I feel that we are now, at this moment, going through a new period of epicycles in cosmology . . . We seem to be able to barely fit the data only with the aid of some rather convoluted mathematics . . . We have contrived to glue the various parts of our world view together to fit the data.*
>
> *There is no trick to fitting the data. What one has to be able to do is fit to the data elegantly.*
>
> Arno Penzias : Nobel Laureate : 1985 [Emphasis added.] [3]

There's no accounting for taste. The cogency of the above prophecy by Wheeler and critique by Penzias therefore depends on what we are ready to see as *simple, beautiful* and *elegant*, or *contrived* and *convoluted*. If we are not ready to give up the preconception that material bodies are static chunks of stuff, then a suggestion to the contrary may be thoughtlessly judged as false and ugly, no matter how accurate and elegant it really is.

The aesthetic sense of Rotonians is much different from Earthians. Figure 1 is a collage of physics-related images based on Earthians' eons old idea that matter is "made of" static chunks of stuff. This base notion has been combined with the fantastic idea that the Universe *began* when it was unimaginably dense and hot, this "primordial egg" exploded, and is now dispersing so its spatial volume increases, while its matter content stays the same. [4] A state of bleak frigid emptiness is the predicted fate of the Universe. Because of the patently fragmentary character of this picture, and especially because it denies the truthfulness of accelerometer readings, *these* are the ideas that Rotonians find shockingly grotesque.

How are we to assess whether Earthian or Rotonian sensibilities harmonize better with the *physical truth*? The difference comes down to whether or not accelerometers are schizoid liars. Earthian physicists think accelerometers' truthfulness *depends* on the *mathematical* purpose of the moment.

Earthian students are taught about gravity using two different conceptual/mathematical "frameworks." According to the first, Newton's mechanical framework, an accelerometer sitting on Earth — *which gives a POSITIVE reading* — is not really accelerating. The truth of the reading is denied because it is tacitly deemed to be more important to persist in regarding the Earth as a static chunk of stuff. An accelerometer falling near Earth — *which gives a ZERO reading* — is regarded as accelerating because it is supposed to be under the influence of a magical force of attraction. (See Figure 2.)

According to the second, Einstein's relativistic framework, the readings of accelerometers falling near or fixed to Earth's surface are *sometimes* taken to mean what they say. But this act is self-contradictory because here too the Earth is explicitly regarded as a static chunk of stuff. ***Static matter and truthful accelerometers are contradictory concepts.*** Earthians believe in static matter. Rotonians believe the accelerometers. But one of these beliefs is provably false.

The General Relativity (GR)-inspired marketing ploy of *momentarily* pretending accelerometers tell the truth is not motivated by *physics*. It is motivated by the desire to entertain lay audiences. (See *Equivalence Principle* discussion in ***Part 1***, pp. 7–9.) It is cute and entertaining to say a positive accelerometer reading means "the floor comes up." But no physicist really believes it. [5] *Albert Einstein Institute* physicist Markus Pössel conveys the accepted approach: "Whether or not objects accelerate towards the floor is a matter of reference frame." [6] With total disregard for the truth-value of accelerometer readings, this statement *falsely* empowers humans to *decide* whether accelerometers falling near or fixed to Earth's surface are accelerating or not (regardless of their readings) by picking an abstract "reference frame" to suit our whim. Rotonians think this charade reflects a delusional state as pernicious as pre-Copernican geocentrism. By half-heartedly promulgating a cute and entertaining hallucination, a schizoid and ambiguous *thought* experiment, Earthian physicists have produced and perpetuate a horribly mucked up state of affairs.

According to this way of teaching the physics of motion — often called the *relativity* of motion, as promoted by Albert Einstein — any evidence that oneself (or a given accelerometer) is undergoing acceleration or not can be denied (or "transformed away") by claiming that it's really "*at least locally*" the rest of the Universe moving in the opposite direction. Earthians have long had a problem facing and understanding the reality of accelerated motion, of distinguishing that which is accelerating from that which is not. Earthians' relationship with accelerometers is thus one of mud and fog. Whereas Rotonians' relationship with accelerometers is one of crystal clarity. Most importantly,

Rotonians are eager to put their ideas to the test, to determine empirically the ultimate truthfulness of accelerometers, by doing the experiment proposed by Galileo 391 years ago: to build and operate Earthians' and Rotonians' first Small Low-Energy Non-Collider.

Our imaginary aliens (who evolved in a huge and distant rotating cylinder) abhor the muddiness of Earthian thinking, their stubborn refusal to believe accelerometers. Of course Rotonians understand that truth is *sometimes* an elusive thing. But this is not one of those times. Starkly definitive answers are within reach. The no-wiggle-room truth about accelerometer readings is "hiding" right under our noses. Before using the scientific method to expose that truth, to yield clear, concrete answers to fundamental questions about motion, let's put what lies ahead in a nutshell.

2. Outline; Empirical Foundation

> *If you have a tyranny of ideas, so that you know exactly what has to be true, you act very decisively, and it looks good—for a while. But soon the ship is heading in the wrong direction, and no one can modify the direction any more.*
>
> Richard Feynman : 1956 [7]

2˙1. *Content*

The Rotonian perspective involves regarding accelerometers as *reliable conveyors of truth*. An illustrative example will follow. From ***Part 1*** we also revisit Earthian physicists' attempts to insulate themselves from this truth by weaving elaborate yarns of motion-denying abstraction. After many decades and centuries of "knowing" that these yarns "have to be true," Earthians' have become entrenched. Their resistance to a change in direction is formidable. A humble amateur surely cannot know better than the tyrannical experts. Maybe an alien civilization of free-thinking Rotonians, or perhaps only Nature itself can nudge (or whack?) the delusional horde onto a truer course.

In §3 we acknowledge the troubled state of physics and cosmology by citing a few authorities who are decidedly unimpressed with the status quo. Section 4 describes the essential nature of gravity, according to Earthian physicists, as a process of the *removal of space* (sometimes expressed by the quip: *gravity sucks!*). This is implied by the usual interpretation of Newton's constant G as an effectively *negative* constant. Gravity is regarded as an *attractive*, energy-conserving force. This perspective is especially obvious in Big Bang cosmology, which sets the stage for the contrasting Rotonian perspective according to which gravity is the process, not of space *removal*, but of space *creation*; space is actively *generated* by matter.

The core physical concepts of the Rotonian perspective are summarized in Sections §5 – §9. Here we connect Rotonian ideas about accelerometers and gravity to quantum theory, different kinds of mass and energy, hyper-dimensionality, the large-scale Universe, and a lot in between. Several seemingly cogent objections are also addressed head-on. Especially for readers familiar with the current state of physics and cosmology, this synopsis of the model's main features is essential reading.

In §10 we build up the Rotonian gravity model's cosmological consequences in more detail. Beginning with some historical background, the first model (by Willem deSitter) to predict a redshift-distance relation is highlighted. Some curious numerical relationships that suggest a deep connection between atomic physics and cosmology are also discussed. We consider one cosmological

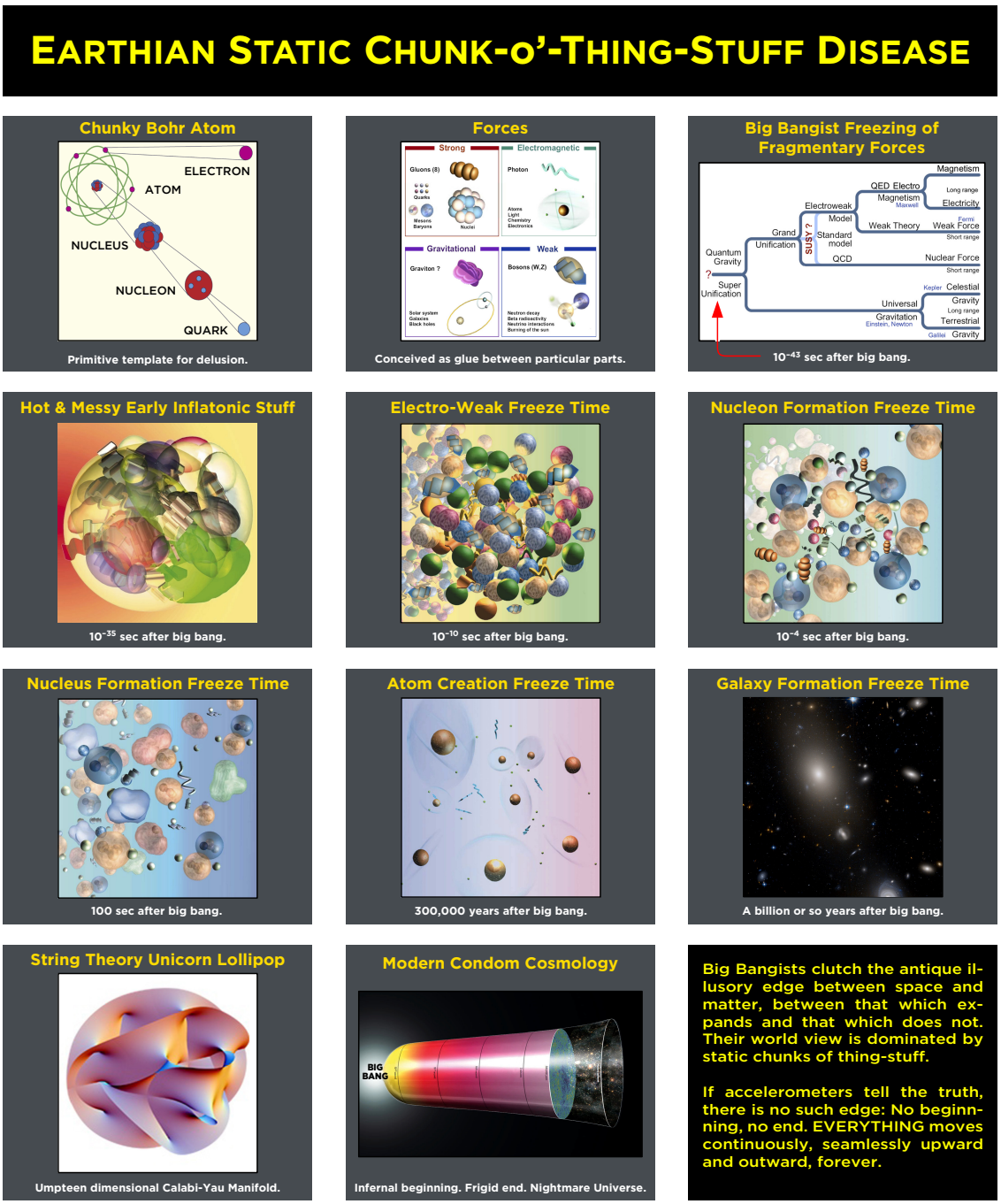

Fig. 1. **Sickly State:** Earthian physicists will admit that the discontinuous components of a Bohr atom make it a gross misrepresentation of reality. The edgeless pulsing waves of a Schrödinger atom are a more accurate representation. The Bohr atom is nevertheless ubiquitously clutched and advertised — in classrooms and corporate logos worldwide — because it bolsters the primitive notion of chunks of static matter. In combination with the bizarre idea of a *temporal* edge to the Universe, static stuff has come to permeate "modern" conceptions of physical reality. Most of these images are from a UC Riverside physicist's 2008 presentation (John Ellison) [4]. With a delusion-inducing theme at the heart of their world view, what follows gets ever more grotesque. By contrast, Rotonians urge adopting a conception of reality based on the truthfulness of accelerometer readings, and *testing* it. Galileo's Small Low-Energy Non-Collider experiment would reveal the truth of the matter.

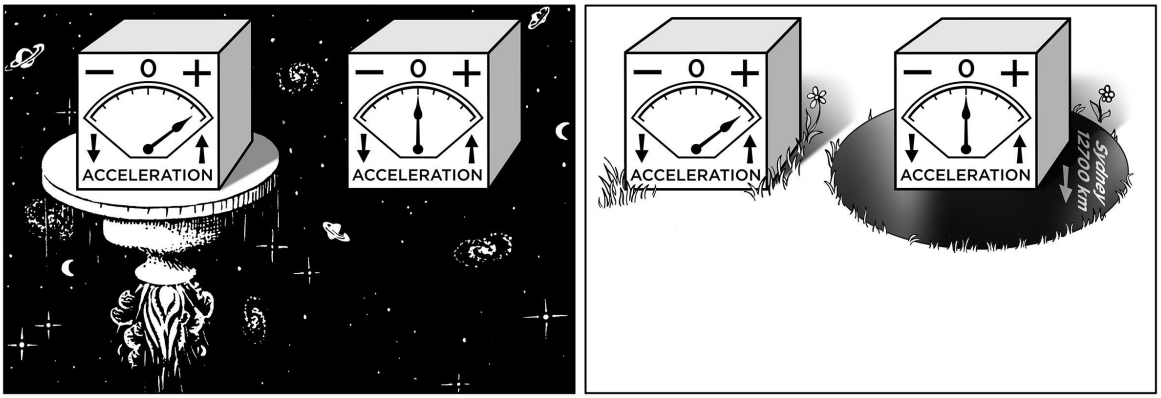

Fig. 2. **Accelerometers and their Readings:** LEFT — It is widely understood that an accelerometer in outer space that is being accelerated gives a positive reading. If the accelerometer is not accelerating because it is not rotating and has no source of propulsion, then it gives a zero reading. RIGHT — In the Newtonian framework, when a large massive body is nearby *this logic is discarded* because now one is supposed to imagine the existence of a mysterious force of attraction. The large body (planet) is presumed to be *statically at rest*, so the accelerometer giving the positive reading is presumed to be *not* accelerating (in contradiction to its reading). Whereas the accelerometer dropped into the hole, whose reading is zero, is presumed to be accelerating (in contradiction to its reading). In the general relativistic framework, the terms *acceleration* and *rest* are variably applied to any one of these accelerometers, depending on one's mathematical purpose. To the general relativist, having an abundance of mathematical options — no matter how schizoid — is a higher priority than figuring out what's really going on, physically. ***The Rotonians' priority is to figure out what's really going on, physically.***

parameter at a time, en route to a simple expression that connects Newton's constant G with other fundamental physical constants.

Sections §13 and §14 harshly criticize modern cosmology's "foundational" ideas of *Inflation*, *Exotic Dark Matter*, *Dark Energy*, and the idea that the *Cosmic Background Radiation* (CBR) represents a source of information about the allegedly "*early* Universe."

Astrophysical *formation problems* that plague conventional models are discussed in §13. The Rotonian prediction for Galileo's Small Low-Energy Non-Collider experiment, if true, provides a simple, intuitively compelling beacon for all astrophysical formation problems. In the end, Rotonian cosmology promises to win the *prettiness* contest hands down — especially as it encourages withholding this judgment until the results of Galileo's Small Low-Energy Non-Collider experiment are in.

Section §14 provides an Epilogue of Summaries of the whole essay. Section §15 is a brief parting shot that includes a few sentences of autobiographical background. Due to the new model's radical nature, Rotonians were invented as a playful device to make the new perspective more palatable. Earthians may nevertheless resist it due to centuries of entrenched preconceptions.

Section §16 is a concise list of 10 predictions that correspond to or follow from a positive outcome of the Small Low-Energy Non-Collider experiment — i.e., under the assumption that the test object does not oscillate.

2˙2. *Inspirational Example; Foundational Problem*

A crucial clue regarding the *physical truth* (or falsity) of our conceptions of motion, may lie in the following simple, yet extremely important puzzle. Please bear in mind that, if we do not conduct

Fig. 3. **Gravity-Induced Collision Experiment:** What happens to the ball if there is no collision? A scaled-down apparatus with a hole through the center would provide the answer. Is it more truthful to say the ball accelerates downward (*contrary* to a co-moving accelerometer's reading); or that the ground accelerates upward (in *agreement* with accelerometer readings)? To find out we need to build and operate humanity's first Small Low-Energy Non-Collider.

this exercise properly, if we conclude inaccurately, prematurely, or otherwise end up with pieces in the wrong place, it will adversely affect everything that follows. This is the *zeroth* step. We simply *must* get it right.

Having lived on Earth our entire lives, we all *know* that if we drop a ball, it *descends* to hit the floor. Or does it? Maybe it's the floor that *ascends* to hit the ball. (Recall how such questions relate to the Equivalence Principle, ***Part 1***, pp. 7–9.) Instead of claiming that the statements are *equivalent* due to the "relativity of motion," Rotonians advise pursuing the matter to its absolute, *unequivalent* resolution. One of these statements is truer than the other: The ball accelerates downward to hit the floor. Or: the floor accelerates upward to hit the ball. (See Figure 3.) By the process of elimination, a good scientist will *empirically* reach the correct conclusion.

Momentarily postponing the question as to the *direction* of motion, we begin with the *direction-*

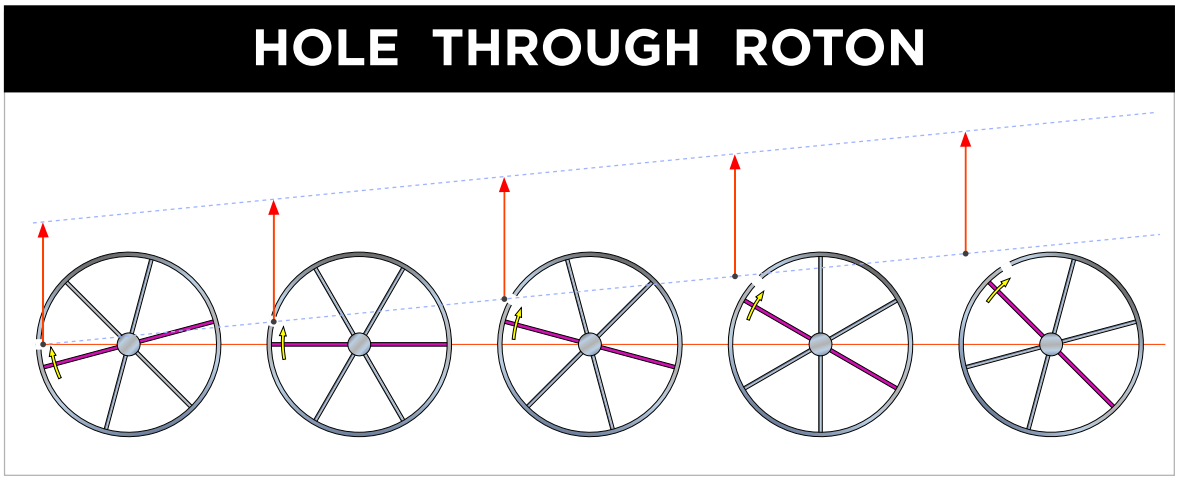

Fig. 4. **Falling Into a Hole:** If Rotonians drop an object through the rim of their world, it would remain in the state of motion it had when it was released. It would exit the "bottom" and fly off on a tangent. Most importantly, with respect to Roton or any astronomical body, falling motion (also known as a state of *weightlessness*) is *always unaccelerated*, as indicated by a co-moving accelerometer.

independent fact that, immediately after the ball's release, its *distance* to the floor, h decreases with an acceleration of g: $(h \approx h_\circ - \frac{1}{2}gt^2)$. Being ourselves attached to the Earth, *we* ***see*** *the ball accelerate downward*. But a co-moving accelerometer attached to the ball says it does *not* accelerate. Accelerometers attached to the floor and ball confirm *the ball's perception that we and the floor are accelerating upward*.

Stuck here on Earth, humans' *visual* impression is that we are "at rest"; but our *tactile* experience is that we are undergoing upward acceleration. Clearly we have a conflict between our visual impression and tactile evidence. The Rotonian perspective is a sharp tool that motivates our scientific obligation to resolve the conflict. Having evolved on a rotating space station where they understand all "dropped" objects to be flying on tangents, Rotonians know that collisions between their "floor" and falling objects are due to the *absolute acceleration* of the floor. If the object were released over a hole that goes all the way through the floor, it would remain on the tangent it started on; it would fly away from Roton on that tangent. (See Figure 4.) This proves that on Roton an intact floor *comes up* to hit the falling object. The component of accelerated motion *toward the axis* causes the collision.

If it were feasible to dig a hole all the way through the Earth, a similar experiment would settle the matter. More practically, the question can be settled by building a scaled-down version (Small Low-Energy Non-Collider). *If* a uniformly dense sphere with a hole through its center were a *static* thing, and a dropped object *accelerates* through the hole (even though a co-moving accelerometer reads zero) it will pass the center with a maximum speed and reach the opposite surface before falling back down, and repeat. This is the standard prediction. (See Figure 5.)

But *if accelerometers tell the truth* about their state of motion — as Rotonians think they do — then the falling test object will *not* pass the center. The object never *feels* any acceleration, so its trajectory is analogous to the *uniform* tangential motion back on Roton, *not* to linear oscillation. As explained in ***Part 1*** (pp. 18, 32) and as we'll discuss more later, this result would represent a stark *violation of the energy conservation law*; it would prove that *gravity has nothing to do with attraction*; it would explain the irreversibility of time (*time only increases because space and matter also only increase*); and it would reveal the existence of a *fourth spatial dimension*, i.e., $(4+1)$-dimensional spacetime.

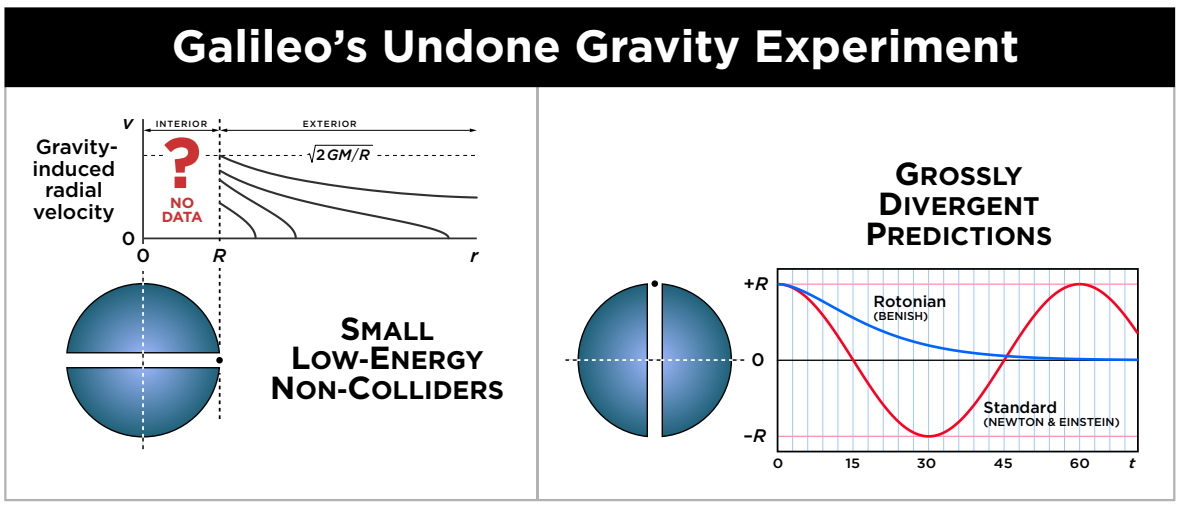

Fig. 5. **Two Graphs:** Left — Velocity with respect to radius. We have plenty of data pertaining to falling objects *over* the surface, but *no data* for objects falling inside matter, near the center. Right — Radius with respect to time, for the special case of an object dropped from the surface into a hole through the center. If accelerometers tell the truth, the falling object never passes the center.

Rotonians admit that, *if* the dropped object *does* oscillate in the hole, then accelerometers are indeed schizoid liars; energy is conserved; gravity is a force of attraction; the arrow of time remains an enigma; and $(3+1)$-dimensional spacetime is sufficient to accommodate our gravitational experience. If this were the case, then the truth about gravity would remain a slippery (though monetarily lucrative) pork barrel of ugly, contrived and convoluted gravitons, amplituhedrons, dark multiverses and holographic stringbranes. But to accept any part of such nightmarish cartoons without first *testing* the arguably simpler, more beautiful alternative, Rotonians see as unconscionable.

Rotonians think that leaving this exercise unfinished is an act of self-delusion, because the accepted state of "progress" (i.e., the standard *guess*) contradicts the testimony of accelerometers. Having not yet been demonstrated, the result of Galileo's Small Low-Energy Non-Collider experiment fits into the big picture in some *unknown* way. Without actually having done the work to obtain this huge piece of the puzzle, Earthian physicists only *pretend* to know what it looks like and how it fits. They only *pretend* to know the result of this experiment that has not yet been done. Instead of completing the exercise — in defiance of the empirical ideals they cheerfully pay lip service to — Earthian "scientists" rest their case on popular preconceptions and god-like authorities. Unthinkingly, they have succumbed to a "tyranny of ideas."

2̇3. *Tragic Note*

The Rotonians' story is sometimes presented with an imminent happy outcome. They've been portrayed as working alongside enlightened Earthian scientists to uncover the truth by enacting plans to build a Small Low-Energy Non-Collider. Sadly, after thousands of attempts to communicate their urgent message to Earthian physicists, although they sometimes seem to get their foot in the proverbial door, rejection is virtually always the end result. Rotonians have pondered the psychological implications, as they strive to understand this patently unscientific response. [8,9]

The current state of affairs is largely influenced by Albert Einstein, one of whose missions in life, it seems, was to convince himself that he never moved. All instances that may have appeared to be his own motion, Einstein was perfectly happy to chalk up to the motion of the whole rest of the Universe around him. This is the essence of Einstein's "principles" of relativity. He said as much on many occasions, as cited in ***Part 1*** (pp. 4–9). Some of his peers complained, but Einstein's century-long status as the *Chosen One* has ultimately squelched his detractors.

The combination of this cult-like reverence for Einstein and the entrenched notion that matter is made of static chunks of stuff has resulted in the world-wide *denial of self-motion*, as exemplified by rampant disbelief in accelerometer readings, which dominates Earthian physics to this day. By studying the history of Earthians' struggles to understand motion, Rotonians grasp the roots of the ongoing tragedy. Among many other influences and indicators, were pronouncements by Einstein such as this (from ***Part 1***):

> The theoretical scientist is compelled in an increasing degree to be guided by purely mathematical, formal considerations in his search for a theory, because the physical experience of the experimenter cannot lead him up to the regions of highest abstraction. [10]

With his god-like authority, Einstein effectively blessed the math-geeky, untestable theorizing that has turned physics into an entertainment industry. A recent (April 2020) issue of *Scientific American* provides a tear-jerkingly sad example. In a two-page *advertisement*, the prestigious Kavli Institute thought it worthwhile to *pay money* to promote the work of Alan Guth, inventor of cosmological *inflation*. Inflation is exactly the kind of "convoluted mathematics" that Penzias complained about

in our opening quote. With a flagrant disrespect for critical thinking, inflationary slogans and buzz-words are fed to the fantasy-craving public:

> We are living in one of [an infinite number of] pocket universes. And even though the pocket universes keep forming, there's always a volume of exotic repulsive gravity material that can inflate forever, producing an infinite number of these pocket universes in a never-ending procession. [11]

In the name of science, the promo features a condom-shaped picture of *our* "pocket universe" and presents a menagerie of other contrived and convoluted crap. Read it and weep.

2˙4. *Cheerful Note*

Happily, Rotonians are an optimistic bunch. They surmise that there must be, somewhere in this world, somebody who is willing to see Einstein's influence for what it is; someone with a penchant for scientific reasoning who also has access to the resources needed to build a Small Low-Energy Non-Collider. So the Rotonians (who are me) keep writing essays, sending cards and letters and persisting at their mission every way they can think of. As they wait to connect with an influential ally, Rotonians take comfort in the bountifully supportive Universe, whose beauty is not just in their mind's eye, not just a matter of taste, but is there as a truth to behold, as when our first Small Low-Energy Non-Collider is built and operated to reveal it.

3. Testable Alternative; Testable Alternative; Testable Alternative

> *Once a herd is established in a subject, it can only be broken by the most **crass** confrontation with opposing evidence.*
>
> Thomas Gold : 1989 [12]

3˙1. *Grumblers: Introduction.*

A well-worn mantra for effective written communication is Strunk and White's advice — repeated three times: "Omit needless words. Omit needless words. Omit needless words." [13] The state of modern physics and cosmology includes its share of grumblers — from both within and beyond recognized institutions. Why should we regard their grumbles as more than ineffectual whining when they so rarely include (you guessed it) ***testable alternatives***? The most common, grossly insufficient kind of grumble is the mere *reinterpretation* existing data. Rotonians surmise that standard models, with all their shortcomings, will nevertheless prevail over the hopeless competition until we acquire *new data* from previously uncharted territory that *crassly* breaks the status quo.

Tests of incrementally "new" ideas are sometimes proposed for some nearly unreachable technological extremes. Barely measurable differences may be predicted at some far-off decimal place, as some tiny deviation from standard physics. In the grand scheme of things, such hypotheses strike the Rotonians as up-the-wrong-tree quibbling, because they ignore the most basic thing that needs to be understood about gravity: its ***direction***. [14] Standard practitioners and grumblers alike are almost unanimous in *assuming* that gravity's direction is *downward*. Rotonians regard this as the pivotal — and perhaps crassly *wrong* — assumption in greatest need of being tested.

3˙2. *Phipps Grumbles*

Overlooking this need, critics are often quite serious about other perceived flaws. For example, Thomas Phipps, Jr. (one of whose quotes opens ***Part 1***) was suspicious of Special Relativity and standard interpretations of Maxwellian electrodynamics. Anticipating an eventual upheaval, Phipps asked: ***"How far into the foundations, when it comes, must the revolution penetrate?"*** [15] A Harvard graduate, Phipps was also an ardent empiricist, dedicated to the scientific ideal of basing theory on physical evidence. Seeing that theoretical physicists had, in many ways, lost touch with their ideals, he summarized his objections:

> Physics, a microcosm of the larger society, has suffered its own invasion by barbarians; viz., hordes of pseudo-mathematicians. It is typical of barbarians through the ages that they have no feeling, respect, nor understanding for the cultures they invade and destroy... Devoid of feeling for the physical, [the mathematical barbarians] acknowledge no limitations on imagination and obliterate all distinction between science and science fiction.

From an article about quantum gravity, Phipps quotes University of Cambridge theorist, Gary W. Gibbons as a representative of the barbarians and their "frontier skirmishing." The quote (omitted for brevity) reads like an even more fantasy-laden sermon than our earlier quote from Alan Guth. Then Phipps concludes:

> These are not the words of the greatest satirist since Swift, nor of the most gifted stand-up comedian since Goliath. They are the words of Gary W. Gibbons, lecturer, etc. They could be the words of any bonded and certified, card-carrying, professional "theoretical physicist" active in the twilight years of the twentieth century.
>
> I can discover in principle no defenses for mankind against such excesses of idiotic logic, idiotic mathematics, idiotic "science" in general, except the traditional ones of common sense and good judgment. It will not be lost upon the reader that common sense and good judgment are precisely the enemies that logicians, mathematicians, and (of late) theoretical physicists have targeted for discreditation in the world's eyes. [15]

Accurate and appropriate as this critique may be, Rotonians are dismayed that Phipps did not see fit to trace the problem back to static chunks of stuff, the attraction of gravity, and disbelief in accelerometer readings.

3˙3. *Smolin Grumbles*

The deterioration of physics portrayed by Phipps only got worse in the ensuing decades. Out of desperation and boredom ("only game in town") physicists were soon to launch the grotesquely dubious enterprise known as *String Theory*. A one-time insider, Lee Smolin eventually escaped the bandwagon. Smolin's highly acclaimed 2006 book, *The Trouble with Physics*, contains lots of physical and sociological insight as to how physics got so far astray and how it could regain its bearings. Smolin sets up his critique with the query: "Are we asking the right questions?" and then admits:

> We are missing something big... Every physicist I know will agree that probably at least one big idea is missing... It is a fantasy to imagine that foundational problems can be solved by technical problem solving within existing theories... Even if everyone can see that a revolution is

> necessary, the most powerful parts of our community have forgotten how to make one . . . Seers are compelled, by their desire for clarity, to grapple with the deepest problems in the foundations of physics . . . We are horribly stuck, and we need real seers, and badly [because of] their rejection of assumptions that most of the rest of us believe in. [16]

Though Smolin's book raised a stir for a while, 15 years later String Theory is still attracting disciples who keep cranking out useless gobbledegook.

Smolin's critique included positive recommendations for relieving physics of its *Trouble*. He mused: "I strongly suspect the key is time. More and more I have the feeling that quantum theory and general relativity are both deeply wrong about the nature of time . . . We have to find a way to *unfreeze time*." [16] Appealing to a classic mystery story device, Smolin anticipates: "Sometimes the key things are right in front of us, there for the seeing. Hiding in plain sight."

Picking up this thread in his 2013 book, *Time Reborn*, Smolin suggests a connection to gravity: "Key aspects of the common experience of falling remain hidden in plain sight . . . One thing that remains hidden about gravity is its relation to time." [17] Smolin seeks to "unfreeze time" and identify its fluidity in gravity. Ironically, he ignores the flattening of his undersides. Smolin fails to see — right under his nose — the simplest, most *temporally fluid* way to explain the cause of this primal fact of experience: *Believe accelerometers*. (See Figure 6.) And *test* what they say about falling, time, and our experience at a planet's surface by observing the fall of a body (using a scaled-down apparatus) *all the way to the center*. Obscured as it may presently be, gravity's relation to time can be revealed by building and operating humanity's first Small Low-Energy Non-Collider.

Sadly, Smolin's most recent work indicates a serious relapse into ideas as far-fetched and useless as SuperSymmetric StringBranes: Spaceless emergent "information" holograms, causal set event

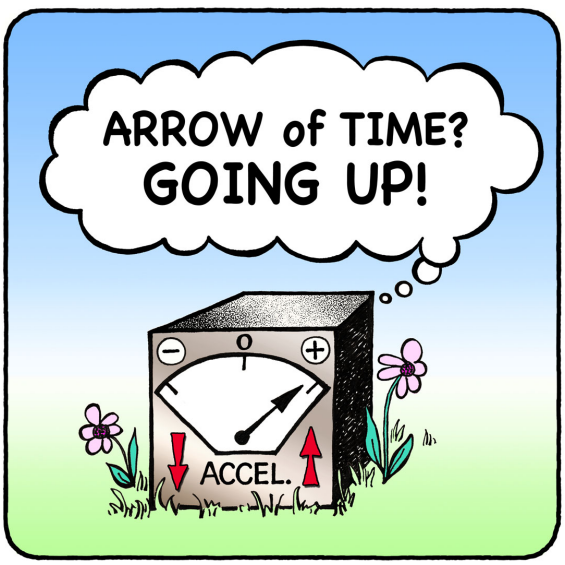

Fig. 6. **Thoughtful Accelerometer:** Loudly and clearly, accelerometers tell us they are accelerating, and in which direction: The indicated arrow strongly implies that ***Time only increases because space and matter also only increase.*** *Everything* perpetually flows upward and outward. Alas, because of their static-chunk-o-stuff based preconceptions, Earthians are blind to this implication. Instead of believing concrete tactile evidence, Earthians believe magical "highest abstraction": traditions spun by godly authorities such as Newton and Einstein. So rigid is their faith, Earthians deny the need to *test* these beliefs. They refuse to build a Small Low-Energy Non-Collider.

histories, and other empirically vacuous, vague, book-sellable fantasy fluff. [18, 19] Accurate and appropriate as Smolin's earlier insights and criticisms may have been, Rotonians are dismayed that he did not follow through and trace the problems back to static chunks of stuff, the attraction of gravity, and disbelief in accelerometer readings.

3˙4. *Lopez-Corredoira and Disney Grumble*

Arguably the biggest single Earthian step toward establishing cosmology as a *science* was the Copernican Revolution and its resulting *Heliocentric Theory*. Insofar as they challenged the prevailing religious account of the world, Copernicus, Galileo and a few others were *dissident cosmologists*. These days, standard Big Bang cosmology has sometimes been likened to a dogmatic religion. Due to its resemblance to the Bible Story of *Genesis*, it has even received Papal endorsement. [20, 21]

That its theme resembles *Biblical creation* and that one of the Big Bang's founders was an Abbey (Lemaitre) may, however, be only a coincidence. The story is usually told soberly and (to be charitable) with a minimum of religious undertones. Charitability aside, one does sometimes find modern cosmologists using obvious religious allusions as marketing tools.

Be that as it may, among the last century's most famous dissident cosmologists were Fred Hoyle, Thomas Gold, and Herman Bondi. For various reasons their challenge to the Big Bang orthodoxy, known as Steady State theory, has lost its appeal. The main feature of Steady State theory is its proposal that the Universe had no hot beginning and would have no cold death, because it maintains a constant density forever. Later incarnations (ca. 2000) by Hoyle and his new collaborators, Jayant Narlikar and Geoffrey Burbidge, modified the story substantially (but not very plausibly, in my opinion). [22] We will later refer to one of the key aspects of the original Steady State theory; specifically, that its law of exponential expansion corresponds to deSitter's 1917 cosmological solution to Einstein's field equations.

Over the years, as the Big Bang grew more complicated (with epicyclic help from particle theorists such as Alan Guth) and as it attracted more followers, the older dissidents faded away or died, leaving only a smattering of mostly low-profile grumblers to bear the torch. One of the noteworthy (alive and kicking) champions of the dissident tradition — not for the sake of rebellion, but as needed for ferreting out the truth — is Martin Lopez-Corredoira.

Being a professor of both astrophysics and philosophy, Lopez-Corredoira can be heard lecturing all sides of his cosmological subjects with firm, even-handed equanimity. [23] His writings reflect the same demeanor, sometimes exhibiting resignation that the bad guys have already won — or at least have the game hopelessly rigged in their favor (as in his book and summary paper by the same name: *The Twilight of the Scientific Age*). [24]

One of Lopez-Corredoira's review papers begins: "The present-day standard model of cosmology (the 'Big Bang') gives us a representation of a cosmos whose dynamics is dominated by gravity." [25] Without stopping to inquire as to what we know and don't know about gravity, Lopez-Corredoira summarizes seven *alternatives* to the Big Bang theory and then seven *variations* of the Big Bang itself. His exposition makes it clear that there is no *single* approach that accounts for observational evidence without serious weaknesses or contradictions. Echoing Penzias' assessment that the subject appears plagued by epicycles, Lopez-Corredoira laments that the Big Bang has, in spite of its weaknesses, maintained its dominance at the expense of a freer marketplace of ideas:

> The development of modern Cosmology is somewhat similar to the development of the Ptolemaic epicyclic theory. However, in this race to build more and more epicycles, the Big Bang model is allowed to make ad hoc corrections and add more and more free parameters to the theory to solve

> the problems which it finds in its way, but the alternative models are rejected when the gaps or inconsistencies arise.
>
> The huge mass of cosmologists dedicated to polishing and refining the standard theory [exemplify] the present-day methodology of research in cosmology [which] does not favour the exploration of new ideas. [25]

One of Lopez-Corredoira's colleagues is the retired astrophysics professor from Cardiff University, Mike Disney. In a BBC interview Disney echoes and amplifies the above critique:

> It is as if somebody put Humpty Dumpty together and covered him all over with a bit of Elastoplast. One's not convinced that Humpty Dumpty looks like that at all. If you took off the Elastoplast he'd fall apart and might look like something completely different. So we have a situation where the whole thing is held together by entities which we don't know exist at all, and they have no physical basis.
>
> Some of these cosmologists pretend the subject's nearly over: We've just got to do a few more observations, a few more computer calculations. I think they're missing the whole message of scientific history, which is: The greatest obstacle to progress in science is the illusion of knowledge, the illusion that we know already what's going on, when we don't. [26]

Accurate and appropriate as Lopez-Corredoira's and Disney's assessments may be, Rotonians are unimpressed insofar as they too have failed to trace the trouble back to static chunks of stuff, the attraction of gravity, and disbelief in accelerometer readings. None of the grumblers mentioned in this section or elsewhere — to my knowledge — provide a viable, unequivocally robust, much less pretty, ***testable alternative***. The scene is ugly and hungry for a Small Low-Energy Non-Collider.

4. Removal of Space vs. Creation of Space

> *What is gravity?... What is inertia?... Is our much-exalted axiom of the constancy of mass an illusion based on the limited experience of our immediate surroundings?... How are we to prove that what we call matter is not an endless stream, constantly renewing itself and pushing forward the boundaries of our universe?*
>
> Arthur Schuster : Letter to *Nature* : 1898 [27]

Let's now work more constructively toward the heart of the matter. Not surprisingly, Newton was among the first to contemplate the cosmological implications of his theory of gravity. His thoughts were famously recorded, for example, in his letters to Richard Bentley. [28] Newton considered two possiblilities: 1) that the Universe was a finite cluster of bodies in infinite space. In this case Newton deduced that gravity would cause the bodies to collapse upon one another. This cannot correspond to our Universe, so Newton regarded as more probable 2) that matter was distributed uniformly throughout infinite space. This possibility also proved implausible. Ultimate collapse was prevented only by the most "miraculous power" — likened to balancing an infinitude of needles on an infinite plane of glass. [29]

Neither "solution" was satisfactory, but few people worried about it till around 1900, when it was addressed by William Thompson, and a few others. Soon thereafter, Einstein, Seeliger and others also revisited the problem. (Edward Harrison discusses this history in [30].) It was realized that

an array of scattered material bodies could maintain a stable average density (without collapsing) if gravity's inverse-square law were modified somehow — as, for example, by adding an *ad hoc* repulsive force to work against ordinary attraction at large distances.

Guth has suggested that a proper understanding of the problem needed mathematical ideas not yet invented in Newton's time: specifically, "flux integrals." [31] Newton conceived (and many still think of) gravity as a *linear* force between bodies; whereas the flux integral framework puts more emphasis on the *volumetric* character of gravity.

The collapse predicted by unmodified Newtonian gravity is due to the assumption that Newton's constant G is an effectively *negative* quantity. If the physical dimensions are designated L for length, M for mass and T for time, then G breaks down as:

$$G \to \frac{L^3}{MT^2}\,, \tag{1}$$

which may be thought of as ***acceleration of volume per mass***. The negative G, *attraction* picture regards a spherical volume that contains massive bodies as effecting the perpetual *suckage* of the surrounding space out of existence, in proportion to the total mass M contained therein. The rate of volumetric suckage, *for any distance*, is: $-4\pi GM$. The *linear* "acceleration due to gravity" is the result of dividing by the enclosed sphere's surface area, $4\pi r^2$. I.e., $g = -GM/r^2$.

G's presumed negativity becomes especially clear in the context of cosmology. According to the Big Bang theory, it is widely understood that gravity constantly works *against* the initial violent creation of space. If the global density exceeds a critical value, gravity's attraction would stop the "recession of galaxies" and suck all space back out of existence. The idea is analogous to the calculation for escape from a single attracting body: If an array of projectiles is launched from a planet of a given mass with sufficient upward speed, they will recede forever. But if the speed is too slow then after reaching a maximum distance, gravity will suck away the intervening space; the whole array will be sucked back to the surface. The same principles that apply to the launched projectiles apply also to the galactic motion pattern Big Bangedly presumed to exist in our Universe. A detailed exposition of this analogy is given in Chapter 16 of Edward Harrison's popular textbook, *Cosmology*. [32]

Note that in the cosmological setting, the process of space removal takes place everywhere, all the time, whether falling bodies (distant galaxies) are visibly there to trace the motion or not. The suckage $-4\pi GM$ caused by every material body of mass, M, does not depend on distance. In the simplest Big Bang models the cosmic speed between all unbound bodies outwardly decreases over time, or inwardly increases because of the corresponding changes in density and the *perpetual gravitational removal* of the intervening space. Every massive body in the Universe contributes to the process. On a cosmic scale, matter-produced attractive gravity has this simple effect: to suck away the space produced by the Big Bang.

These days the accepted scenario is less simple, and the hope of a re-crunch (reverse Big Bang) is pretty much given up because it includes an overpowering repulsive *dark energy*. To the ordinary *matter-produced* attractive gravity (suckage) is added a purely and even more mysterious *space-produced* repulsive gravity (blowage) which gives the Big Bang an increasingly large boost as time goes by. We'll address dark energy in more detail later. The new magical gravitational repulsion out of empty space is negligibly small for small distances, but it becomes significant for cosmological distances. As noted above, adding a long-distance repulsive force (or tinkering with the attractive inverse-square law) was contemplated even in the Newtonian model. So it's nothing really new in general relativistic cosmology. In either case, the long-distance repulsive force (or reduced long-

distance attraction) amounts to a counteracting *ad hoc* space-*blowage* which not only assures collapse-prevention, it accelerates dispersal and ultimate cosmic doom.

Presently, Rotonians underscore how this picture exemplifies the *fragmentary* character of modern physics and cosmology. The disjointedness is apparent, first, in that there is no known connection between G and the other fundamental constants. Nobody knows how gravity is related to the other forces of Nature. Though these forces are alleged to have been "unified" in the first infernal split second of the Universe, soon thereafter they are supposed to have "frozen out" as fragmentarily separate things — never to be reunited in our living experience (as diagrammed in Figure 1). Furthermore, nobody knows the mechanism of gravitational "attraction." Surely it is a reasonable guess that gravity's mechanism and the value of Newton's constant G are related to the other forces and constants *somehow* — not just in the ancient past, but right now and always.

Conceiving the Universe as the result of an explosion whose ingredients (both stuff and fundamental forces) are growing ever more frigid and unrelated is not conducive to seeing the harmony that Rotonians suspect permeates a more accurate conception of the cosmos. Physicists claim to be in search of "unification" as they crank up their collision energies and blast to ever more smithereens the tiny chunks of stuff harnessed in their Large Hadron Collider machine. They dream of blast energies approaching those of the Big Bang itself.

In 1957 J. Robert Oppenheimer wrote:

> The whole of physics for the last 30 years [90 years — accounting for publication date] has been directed towards questions more or less exclusively evoked by doing abnormal things with matter rather than by simply observing its normal behavior. [33]

In 1979 P. C. W. Davies colored this assessment: "Subatomic physics presents scientists with a whole range of microscopic objects and the common method of investigation is to hit them hard and see what happens." [34] Decades later, this cartoonish caveman-barbarian strategy (*VROOM! SMASH! BAM! KAPOW!*) continues. Rotonians think the dominance of this approach is a bad sign. Should we be surprised that these crude methods and this fragmented world view have resulted in an ugly mess? Collisions and explosions may *sometimes* be revealing, but in general they are *destructive*, and not the best way to probe the inner workings of anything. Being neither constructive nor wholesome, and possibly addictive, smash-ups and explosions strike Rotonians as marginally useful, at best. The Universe is not a video game. *Duh!*

Modern cosmologists' Big Bang explosion is supposed to cause cosmic *space* to keep increasing *independent of matter*, in the form of bodies that are now coasting from the initial blast. Space expands; matter does not. The galaxies are supposed to scatter forever as so many static chunks of stuff, receding to an ever colder, more isolated and permanent death. As we will see, a critical rethink of the evidence provides the starkest of contrasts: like night and day; increasingly cold bleak emptiness vs. constantly regulated harmonious fullness.

The result of Galileo's experiment would indicate which of these extremes more accurately characterizes our Universe. Schuster's 125 year old question: *"How are we to prove that what we call matter is not an endless stream, constantly renewing itself and pushing forward the boundaries of our Universe?"* now has a definitive answer: By building and operating one of the gentlest conceivable physics experiments, in which we simply observe matter's normal behavior. Set up a well-designed Small Low-Energy Non-Collider, sit back and watch. Does the test object oscillate or not? If it doesn't, then we'll have discovered that matter *IS* an "endless stream constantly renewing itself . . . "

5. The Whole Ball of Wax,[1] Condensed

> *It is imperative in science to doubt . . . To make progress in understanding we must remain modest and allow that we do not know. . . . You investigate for curiosity, because it is* ***unknown****, not because you know the answer.*
>
> RICHARD FEYNMAN : 1956 [35]

5˙1. *Introduction*

Having illustrated a few key elements of the Rotonian perspective, before moving into cosmological details, let us first address a few potential objections and present the core elements of Rotonian physics. Let us roughly sketch the model as a whole to provide a little more assurance that the essential idea is viable and to bring our goal into sharper focus.

If we accept the Rotonian dictum to believe accelerometers, one of whose corollaries is that *the floor really comes up*, then how to explain satellite orbits and other simple gravitational phenomena that Newtonian physics seems to neatly explain? If gravity is really a process of outward motion and the Small Low-Energy Non-Collider experiment confirms the Rotonian prediction, then how does this necessitate the continuousness of matter and space, and lead to a cosmological model whose density remains constant?

How can such a radical and ambitious scheme be reconciled with quantum theory and the physical phenomena that are encompassed — if not always completely, then at least preliminarily — by standard energy-conserving, $(3+1)$-dimensional physics? In other words, how are we to understand that such a radical new hypothesis doesn't make predictions than can already be shown to conflict with known evidence?

Why is it such a big deal to have an expression for Newton's constant, relating it to other constants; and how can we be sure it is not some kind of numerical accident? If the redshift from distant galaxies is not caused by a Doppler-like recession effect, then how is it explained by the Rotonians? And does their model have any bearing on the contrivances of *exotic dark matter* and *dark energy*? These, among other questions will be addressed in the next several sections.

Our purpose for the moment is not to provide in-depth, comprehensive answers — which will follow later or have been presented in other documents. Rather we'll give a kind of whirlwind treatment whose purpose is to provide a convincing enough *preview* to see that the scope of the model is vast, and remains coherent as it grows.

5˙2. *Small Low-Energy Non-Collider; Energy Non-Conservation*

Diving right in, suppose Galileo's Small Low-Energy Non-Collider experiment yields a non-oscillation result. How does this square with the energy conservation law? The energy conservation law is violated. If not the first, then this would certainly be the most dramatic violation ever discovered, because Newton's and Einstein's predictions for this experiment are a veritable showcase of the principle's strict validity. The violation predicted by Rotonians is severe and unmistakable.

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[1] AKA enchilada, kit-and-kaboodle, nine yards, shebang.

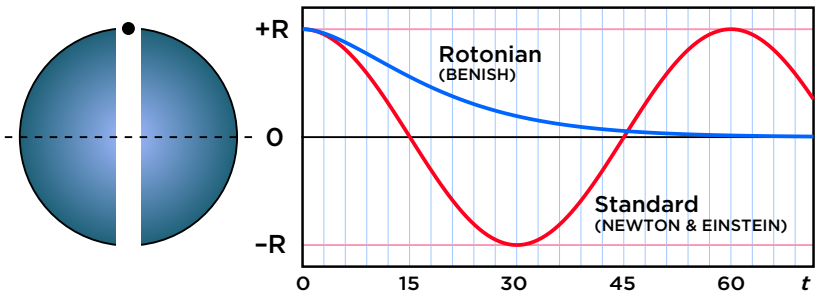


Fig. 7. **Comparison of Predictions:** Newton's and Einstein's theories of gravity predict that the test object oscillates in the hole. For a sphere having the uniform density of lead, the period of oscillation would be about one hour. The symmetrical back-and-forth quality of the red cosine curve indicates that energy of the motion is conserved. Based on their belief in accelerometer readings, Rotonians predict that nothing ever pulls the test object downward, so it never passes the center. The blue curve, which approximates a hyperbolic secant $sech(t)$, asymptotically approaches the axis, suggesting an apparent loss of energy of the test object. But it actually indicates the ever-*increasing* energy of the source mass. It indicates that *material bodies are inexhaustible sources of perpetual propulsion*.

Energy conservation requires the forth-and-back symmetry of the cosine curve in Figure 7. A video of the motion looks the same whether it's played forward or backward. Whereas the SGM curve *seems* to indicate *loss* of energy of the falling body. A video of the motion only makes physical sense played forward. What it means is not *loss* of energy, but rather, the perpetual *increase* in energy of the source mass and the surrounding space.

Observations made *over* the surface (where, moving inward the acceleration *increases*) appear to satisfy the law. But *below* the surface, inside matter (where, moving inward the acceleration *decreases*) and *we have not yet looked*, is where we expect a violation to be exposed. We might expect this simply on the basis of accelerometer readings. The acceleration indicated by an array

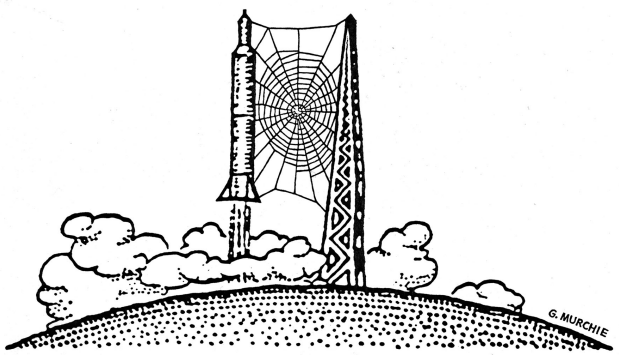


Fig. 8. **Hovering:** Earth need not burn fuel to keep up with the blasting rocket. The rocket needs to burn fuel to keep up with the Earth — to match the "thrust" of the Earth's ever-increasing matter and space. *Matter is an inexhaustible source of perpetual propulsion*. Gravity is the process whereby matter regenerates itself and produces all cosmic space. Walt Whitman seems to have gotten it right when he wrote: "All goes onward and outward, nothing collapses." [36]

of accelerometers on the surface — being radially outward, not angular — indicates an *inexhaustible source of perpetual propulsion*. See Figure 8.

A cosmological application of this consequence comes immediately to light. In defense of his Steady State model, Fred Hoyle invoked the "spontaneous generation of matter" in a spatially expanding Universe to maintain a state of constant ("steady") density. One of the benefits Hoyle deduced from this hypothesis is that it explained the otherwise enigmatic arrow of time:

> Given creation of matter . . . the other [temporally asymmetrical physical processes] follow inevitably. . . . We can say that if the physical laws are such that matter is created then time's arrow is explained and understood. [37]

Unfortunately, Hoyle did not believe accelerometer readings. Along with his colleagues, he still regarded gravity as a force of attraction. Hoyle's spontaneous generation of matter was conceived as individual elementary particles discontinuously popping into existence one at a time all over intergalactic space. New humans do not come from storks. They come from existing humans. Similarly, Rotonians conceive spontaneous generation of matter not as discontinuous magic, but as naturally taking place out of all matter that already exists. They've identified the process as gravity. They find it worthwhile to repeat: ***Time only increases because Space and Matter also only increase.***

5˙3. *Energy Non-Conservation in Quantum Theory*

In defense of this prediction, Rotonians appeal to a fact from quantum theory, where violation of energy conservation is intermittently allowed. This is commonly explained as a consequence of Heisenberg's time/energy uncertainty relation ($h \lesssim \Delta t \cdot \Delta E$) and the emission and reabsorption of virtual particles. Concerning this feature of quantum theory, in one of Erwin Schrodinger's last published papers, he wrote:

> The said uncertainty relation is usually taken to mean that in principle an infinite time is required for finding out the exact value of the energy. It is difficult to see how "after" doing so we should still manage to ascertain that the value we have found does not change with time.
>
> The detailed validity of the conservation law. . . is the point under discussion that I do not take for granted. [38]

In most cases the energy measured at the end of an experiment equals the energy measured at the beginning (at least in principle). Schrodinger's point is that we cannot be sure energy is not changing uniformly over time so as to effectively camouflage a perpetual violation. By empirically probing gravity-induced radial motion inside matter, we may discover the usual accounting methods to yield grossly divergent before/after energy measurements.

5˙4. *Unstable Matter; Infinite Self-Energy*

The stability of matter has long been a thorny problem in quantum theory and even in classical electromagnetic theory. Why don't atoms collapse? Why don't electrons explode? The first question was often discussed as the "ultraviolet catastrophe." A chunky Bohr-like electron orbiting a chunky Bohr-like nucleus is supposed to continuously emit radiation of ever-higher frequency, as it plunges into the nucleus. The problem was deemed to have been solved with the advent of wave mechanics and the Schrodinger equation, whereby the collapse is prevented because there is no

chunky electron at all. *Quantum uncertainty energy*, the *Pauli exclusion principle*, and the *wave nature of matter* keep atoms propped up.

A more serious stability problem concerns the concentration of like charge in a single electron. When conceived as a point particle, a single electron's charge distribution is supposed to give it "infinite self-energy," blowing the thing apart, as like charge components repel one another. Various means have been proposed to "explain" the electron's stability — to bring its calculated boundless energy back to the realm of the finite: From "Poincare stresses" to modern "renormalization." Not everyone is happy about or convinced by the current state of affairs.

It is much less due to theory than to *observation* that we've come to expect that the pent-up energy of charged electrons does not cause catastrophic blow-ups all over the the Universe. We can *see* that matter maintains a stable state. Yet theoretical explanations for why electrons *shouldn't* blow up are more convoluted than simple (superficial?) arguments explaining that they *should*. To get the electron's self-energy to remain finite physicists invoke "cut-offs" to exclude the full range of possibilities. That this procedure (renormalization) actually makes the theory more workable is marvelous, but has often been regarded as dubious, nevertheless.

5˙5. *Embarrassing Mismatch; Infinite Vacuum Energy*

Then there's the notorious energy of the *vacuum* of "empty space." Even the vacuum, far from any (fermionic) particles of matter, is predicted by quantum theory to have *infinite* repulsive energy. [39] Here too, a cut-off is usually presumed to limit the damage. The most popular prediction is not infinite, but constrained by the *Planck-scale* — which is still 10^{120} times greater than what is claimed to have been "observed." The cut-off comes from quantum theory (with Newton's constant G thrown in as a numerical plaything). Insofar as the domain this prediction applies to is the whole Universe, it is usually associated with Einstein's cosmological constant Λ (and/or the *dark energy*) thought to be operating between the galaxies.

Since the "observed" value had long been presumed to be zero and is at most extremely small, the huge discrepancy with the theoretical prediction is often called an *embarrassment* to physics. Well known theorist Anthony Zee quoted one of his colleagues as saying: "The cosmological constant paradox is more than a paradox: it's a profound public humiliation of theoretical physics." [40] Cosmologist Michael Turner says: "This disparity is the greatest embarrassment in all of theoretical physics." [41] And a recent issue of Scientific American contained an article the title of whose web version is The Cosmological Constant is Physics' Most Embarrassing Problem. [42]

The Rotonians' cosmological model has no need for Λ, but it accommodates the prediction (sans Planck-scale) from quantum theory as follows. The predicted infinite self-energy of *electrons* clearly may be regarded as originating inside matter, operating *from the inside out*, as it were. Now combine this with the energetic vacuum, whose repulsive action operates, effectively, *from the outside in*, from empty space back toward matter, pushing everything further apart. Perhaps we should regard these as opposing pushes, one of whose effects dominates, but only slightly. Perhaps matter and the vacuum "effectively" neutralize — or *nearly* neutralize — each other, resulting in a kind of *dynamic* stability, a kind of self-regulated outflow.

This possibility is echoed in the speculation of Nobel Laureate, Frank Wilczek, who has suggested that:

> Gravity might be derived from the other fundamental forces. Because it is a small (feeble) effect, maybe gravity is a by-product, a small residual after the near-cancellation of effects of opposite electric or color charges. [43]

Wilczek's remarks are recent (2008) and novel for their time, because they suggest a connection between micro and macro-physics (in the present-day Universe) the likes of which have mostly fallen out of favor since the 1960s (give or take a decade).

Prior to Penzias and Wilson's discovery of the CBR in 1965, the original Steady State cosmology still had a few proponents. Ideas lending themselves to an eternal Universe in which a *forever* micro-to-macro connection made sense to contemplate, could be found in the literature. Perhaps the best example is that of E. J. Zimmerman, who adds considerable flesh to the skeletal idea suggested by Wilczek above:

> There is an *a priori* argument that the structure of the universe should be related to the properties of its microscopic parts . . . It is therefore plausible that the constants which we believe describe the cosmos are in some way related to the constants which we believe furnish an adequate micro-physical basis for observable physical properties.
>
> The concepts of charge renormalization and of other vacuum polarization effects, the new "ether" theories of Dirac and Kaempfer, and similar theories involving some kind of all-pervading background or environment which is formally infinite or very large, are suggestive that a description of some large-scale structure may be necessary in a complete microphysical theory. [44]

Zimmerman's remarks are at least *consistent* with the idea that the infinities found in micro physics could be operative on a cosmological scale; i.e., that they are related to gravity. The ubiquitous outwardness thereof — upward accelerometer readings and the flattening of our undersides — appear to all be of the same physical process. The "residual" dominance of the outwardness of matter is the net effect. Here is from where we get the ***inexhaustible source of perpetual propulsion***. Rotonians suppose this is the essence of gravity and all things.

5˙6. *Stationary Motion; Generation of Space; Rotation Analogy*

Even if this is true, gravity is not to be thought of as the simple expansion of matter in $(3+1)$-dimensional spacetime. It is to be thought of as the perpetual generation of space and the outward movement of matter in *(4 + 1)-dimensional* spacetime. We arrive at this conclusion via the following line of thought. Even as they seem to love their chunky Bohr atoms and constituent chunky particles, physicists (such as Sabine Hossenfelder)

> Don't think of them as little balls; they are not, because of quantum mechanics . . . Better think of them as clouds that can take on any shape. [45]

The often-discussed quantum wave nature of matter tells us that there is no edge. However pulsatively *quantized* matter may be, it is continuous with space. Gravity then, as a "residual" effect whose energy, whose source appears as the endless dance of elementary particles, is mostly about the generation of *space*. Spatial volumes occupied by tangible material bodies are small compared to their extensions in seemingly empty ("outer") space. Rotonians conceive that *matter regenerates itself*. The simultaneous generation of the surrounding *space* is the *cause and essence* of all manner of gravitational phenomena. Rotonians thus call their hypothesis the Space Generation Model (SGM).

For all their differences, the SGM and GR share certain key features. The most important common ground is non-Euclidean geometry. A pivotal insight that helped Einstein to invent his General Theory of Relativity (GR) — especially the need for non-Euclidean geometry — was an analogy between gravitational bodies and *uniformly rotating* bodies. [46, 47] Uniform rotation has sometimes been referred to as *stationary* motion, because the range of accelerations and speeds found on a uniformly rotating body persist in time, as it perpetually moves *in place*. The speed and acceleration of

the *axis* are *zero*. If r is the radial distance and ω is the angular velocity, then the stationary speeds and stationary accelerations are:

$$v_{\text{ROT}} = r\omega \qquad \text{and} \qquad a_{\text{ROT}} = r\omega^2 \,. \tag{2}$$

Though the acceleration is important, the gravitation-rotation analogy is primarily expressed in terms of the speed $r\omega$ and its square $r^2\omega^2$.

An observer — and in general, all material subcomponents of a system undergoing the rotation specified above — are subject to the *flat* spacetime consequences of Einstein's Special Theory of Relativity (SR). An effect on clocks and rods (in the direction of motion) is expected:

$$f_{\text{ROT}} = f_\circ \sqrt{1 - \frac{r^2\omega^2}{c^2}} \qquad \text{and} \qquad l_{\text{ROT}} = l_\circ \sqrt{1 - \frac{r^2\omega^2}{c^2}} \,, \tag{3}$$

where $f_\circ$ is the frequency of a clock, and $l_\circ$ is the length of a rod, at rest with respect to the axis. Einstein argued that an observer on the rim of the disk, with her shortened rods laid circumferentially end-to-end (or leap-frogging with a single rod from one position to the next) would measure the circumference L as being greater than $2\pi r$. Specifically, it would come out as $L = 2\pi r / \sqrt{1 - r^2\omega^2/c^2}$. Because of this conflict with Euclidean geometry, and because the magnitude of the effects varies continuously with radial distance, Einstein was motivated to invoke non-Euclidean geometry, to accommodate the "warpage" of effects that increase with increasing rotation speed, further from the axis.

To bring gravity into the picture, Einstein hit on the idea that the squared speed quantities ($r^2\omega^2$) from Eq 3 were analogous to the Newtonian gravitational potential $\Phi = GM/r$, whose dimensions are also speed squared. It is important to recognize the limitations of the analogy, i.e., the differences between the two phenomena. With rotation, for the purposes of the analogy, we have an essentially discontinuous rotating body located in a flat background space. Any semblance of unflat geometry would apply only to the rotating body, not to the background. Whereas the new potential-derived curvature would have to occur throughout the spatial *volume* both within and surrounding massive bodies. Even though the deduced effects trace back (by analogy) to stationary ***MOTION***, Einstein persisted in assuming that gravity-produced curved spacetime was essentially ***STATIC***.

To get a fuller picture of how the Rotonian interpretation of the analogy compares with Einstein's, let us display the pertinent coefficients of curvature as they appear in the most famous of GR equations, often referred to as the *static Schwarzschild exterior solution*:

$$ds^2 = c^2dt^2\left(1 - \frac{2GM}{rc^2}\right) - dr^2\left(1 - \frac{2GM}{rc^2}\right)^{-1} - r^2(d\theta^2 - sin^2\theta d\phi^2) \,. \tag{4}$$

We immediately notice that the coefficient for *spatial* curvature (multiplied by dr^2) is the *reciprocal* of the coefficient for *temporal* curvature (multiplied by dt^2). The combination of radially shortened rods and slowed clocks yields the spacetime curvature that, in Einstein's theory is responsible for all the other effects of gravity.

Often uttered in the context of such discussions (as though it were an explanation) is the slogan: *"Matter tells spacetime how to curve and spacetime tells matter how to move."* Rotonians smell a rat because of what is *not* said. How are these orders carried out? What is hiding behind the word *tells*? What exactly does matter *DO* to make spacetime curve? Not only does GR not provide any

answers, the Schwarzschild solution predicts *singularities* — which are commonly regarded as very ugly, nonsensical things.

By contrast, the singularity-free answers proposed by the Rotonians are (as we've come to expect) based on the truthfulness of accelerometers — and in this case, on the physical validity of the light speed limit. Combining the light speed limit with uniform *rotation* suggests non-Euclidean (curved) spacetime geometry. Combining the light speed limit with uniform *linear acceleration* suggests curvature coefficients that never go to zero or infinity. This becomes apparent by appeal to the standard Special Relativity (SR) equation representing the increase in speed due to uniform (i.e., constant) linear acceleration, a.

Where the Newtonian speed, v would be unlimited, $v = at$, as time t keeps increasing, the light speed limit-preserving ("relativistic") equation is well known to be:

$$v = \frac{at}{\sqrt{1 + a^2t^2/c^2}}\,, \tag{5}$$

where a is the constant reading of an on-board accelerometer, and t is the time kept by a clock in the original inertial frame. Because they accept the truthfulness of accelerometers, Rotonians see the cause of gravitational spacetime curvature as analogous to the *stationary motion* of uniform rotation. A gravitating body may get more massive and/or more dense, but its stationary speed V_S must remain slower than light. Rotonians therefore replace the time-produced speed at in Eq 5 with the mass-and-gravity-produced speed $\sqrt{2GM/r}$:

$$V_S = \frac{\sqrt{2GM/r}}{\sqrt{1 + 2GM/rc^2}}\,. \tag{6}$$

This suggests replacing the Schwarzschild coefficients with the coefficients that we get by squaring Eq 6:

$$V_S^2 = \frac{2GM}{r(1 + 2GM/rc^2)}\ . \tag{7}$$

Applying this idea to the respective predictions for gravity's effect on the rates of clocks, as between GR and the SGM, for example, we have

$$f_{GR} = f_\circ\sqrt{1 - \frac{2GM}{rc^2}} \quad \approx \quad f_{SGM} = \frac{f_\circ}{\sqrt{1 + 2GM/rc^2}}\,. \tag{8}$$

The approximation is true as long as $2GM/rc^2 \ll 1$. Since GR entails *subtracting* $2GM/rc^2$ from unity, when $2GM/rc^2 \geq 1$ clocks stop ticking and various other non-sensical consequences are turned into Hollywoodesque pork barrels. Whereas, according to the SGM, which *adds* $2GM/rc^2$ to unity, the sum is unconstrained. Clocks never stop ticking. No singularities; nothing fantastic at all.

The reciprocal coefficient applies to radial length measurements. Analogous to a rotating observer finding the circumferential length to be greater than $2\pi r$, an observer on a gravitating body would measure greater lengths between two *radially* separated points than a distant observer would deduce based on the assumption that spacetime is uniformly Euclidean.

An important distinction must be pointed out. Given an extremely large disk-like structure with

a very fast rim speed and populated with many observers — i.e., a world like Roton — the effect that uniform rotation has on clocks and rods is fully accessible to our view. We can clearly see the effect as being due to stationary motion *through* a background space that "pre-exists." In the case of gravitation, though we have the same (analogous) readouts from motion-sensing devices, accelerometers and clocks, we are ourselves immersed in the motion and do not get so clear a view of it as such. That's because gravitational stationary motion is not motion *through* pre-existing space. It is the motion *OF* space. This very distinction, indeed, suggests the need for a higher spatial dimension — a vantage point from which *the curvature produced by the motion* is clearly seen as indicating — *requiring* — the existence of a higher spatial dimension *to curve into* (or *outfrom*).

By this reasoning we are at last onto the *cause* of gravitational spacetime curvature. It is caused by the *stationary outward motion* of the system, which can never reach the light speed limit ($= c$). The speed is not *through* space; it is the speed *of* space. The difference between the GR coefficients and the SGM coefficients is typically so small as to not be measurable for "weak fields" such as in our Solar System.

$$(9) \qquad \left(1-\frac{2GM}{rc^2}\right)_{\text{GR}} \approx \left(1+\frac{2GM}{rc^2}\right)^{-1}_{\text{SGM}} \quad : \quad \left(\frac{2GM}{rc^2} \ll 1\right) .$$

The above ideas, leading to the meaningful comparison expressed by Eq 9, establish the SGM as a gravitational contender — not so much because its predictions for the exterior field closely match the predictions of GR, but because the SGM's consequences include the novel, testable, and grossly contrasting *interior* predictions. The analysis leading to Eq 9 and its application to interior solutions is discussed in more detail in my paper, *Maximum Force* . . . [48]. Reasons to be suspicious of GR's interior solution (derived by Karl Schwazschild in 1916) are discussed in more detail in my paper *Gravitational Clock* . . . [49].

The rotation analogy's implication for the SGM interior solution is straightforward: The center of a gravitating body is analogous to a rotation axis, where there is essentially zero motion and therefore maximum clock rate. Contrast with Newtonian/Einsteinian thinking could hardly be more stark. Both Newton and Einstein deny that any speed or acceleration exists on a gravitating body because they think of it as a static chunk of stuff. All parts of gravitating bodies have *zero speed*. Yet they magically force distant bodies to be attracted and to move toward them. This magic is represented by the gravitational *potential* — an abstract mathematical thing that has never been directly measured.

In Einstein's theory the rate of a clock is correlated with gravitational potential, so that the location of the slowest clock is also the location of the minimum potential, i.e., the *center*. Rotonians think this is absurd, because there is virtually *no motion* at the center; no *physical* reason for a clock there to tick slow. This potential magic is also GR's reason for predicting that the maximum speed of a body falling into a hole through the center is at the center. The minimum clock rate, minimum potential, and maximum falling speed are all correlated with one another. ***None of them have been tested.*** Because the effects are correlated, a test of one of them — e.g., the falling prediction — would provide convincing evidence concerning the other two: clock rate and potential. Rotonians think all three GR predictions will fail, because they contradict the truthfulness of accelerometers.

Adding even more contrast to the Einsteinian vs. Rotonian world views, recall (from ***Part 1***, p. 5) that, although Einstein intelligently used the rotation analogy to deduce the physical applicability of non-Euclidean geometry, his logic also took a preposterously wrong turn. Einstein (tyrannically?) "knew" that bodies of gravitating matter are static chunks of stuff. Having found a family of similar effects on both gravitating and rotating bodies, *Einstein claimed that rotating observers are justified to*

think of themselves as being at REST, as if a rotating body were also a static chunk of stuff. Being in a state of rotation means the whole rest of the Universe is revolving around you. Einstein really tried to defend this patently absurd point of view. Each of us supposedly has the right to look at the world this way: I *never* move; it's *always* the other guy, the rest of the Universe *moving around me*. What a mess! *Totally nuts!* But Earthian "physicists" dare not complain. They suffer the double debilitation of being under His Almighty spell and believing the popular delusion that accelerometers are schizoid liars.

Concluding then, the ***abstract*** basis for GR's curvature (static potential) is so radically different from the ***physical*** basis for SGM's curvature (stationary outward motion), that, although the corresponding predictions for weak-field exterior phenomena are nearly the same, predictions for the interior are drastically different. The simple, yet hugely important remaining task is to see the predictions ***tested*** by constructing and operating humanity's first Small Low-Energy Non-Collider.

5˙7. *Inverse-Square Law; Fourth Spatial Dimension*

The magnitude of acceleration produced by material bodies varies with distance according to an inverse-square law because of how a volumetric flux distributes itself outwardly from a localized source. Imagine an extremely tall tower planted on the surface of a uniformly dense sphere. (See Figure 9A.) Accelerometers attached at various heights along the tower show us, for example, that the acceleration at $2R$ is $1/4$ of its magnitude at $1R$. If the floor comes up at $1R$ four times faster than at $2R$, how come it does not close the separation distance and disintegrate the whole structure? This seems indeed impossible to explain in $(3+1)$-dimensions of spacetime. (The $+1$ in this notation refers to *time*; the other number in the sum refers to dimensions of *space*.) The coherence of material bodies undergoing a range of radial accelerations becomes intuitively understandable by allowing the existence of one more spatial dimension.

Note first that, when a rigid body is undergoing ***uniform rotation*** a range of ***inward*** (centripetal) accelerations along the body persist as such, without disintegration. (See Figure 9B.) This suggests, by analogy, that the extra dimension needed to accommodate stationary ***outward*** acceleration may be (at least partially) pictured as a rotation in a direction we do not immediately see. This idea becomes more plausible — or even expected — because it follows from the *curvature* that we've already explained in terms of the perpetual outward motion of gravitating bodies. (For a more detailed discussion of gravity and hyper-dimensionality, see ***Part 1***, pp. 20–27.) In what follows we will sometimes repeat a few of the key points from the ***Part 1*** discussion.

When a one-dimensional line begins to curve, it intuitively obvious that it enters a *second* spatial dimension; it sweeps out an *area*. When a two-dimensional plane begins to curve (e.g., if it begins to bulge as a spherical surface or to curve with respect to a linear axis, as a cylinder) it enters a *third* spatial dimension; it sweeps out a *volume*. Before extending the pattern to the "next" spatial dimension, we need to ascertain our bearings with respect to the very meaning of dimension in general and *spatial* dimension, in particular. We need to assess these questions with regard to their *mathematical* and *physical* implications — and the utterly crucial difference between them.

It is essential to realize, for example, that in the physical world there is no such thing as a *line*, nor a *surface*. These are *abstractions* that facilitate certain kinds of analyses (and analogies, as we'll see later). But physically, they are barren concepts. Linear-looking things and planar-looking things are really spatially fuzzy and volumetric. Lines and surfaces are illusions. Before considering the question as to the physical reality of *volumetric* things, we ask whether it is logically meaningful to conceive of *any* seemingly separable dimension as an independent, physical thing. Pursuing this question, we find not only that physical dimensions such as *Mass*, *Space*, and *Time* are utterly dependent on one another, but that each of the seemingly separable or numerable ***spatial*** dimensions

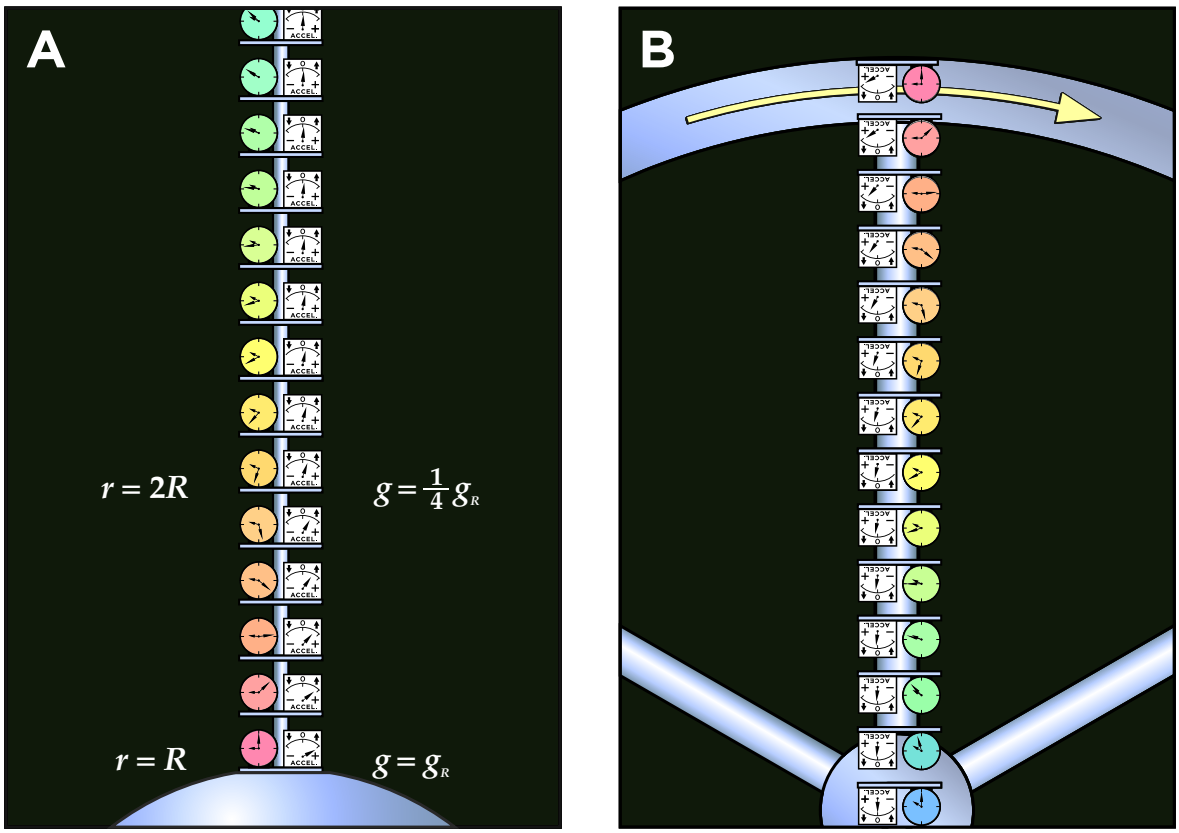


Fig. 9. **Radial and Angular Stationary Motion :** Left — With greater distance over a gravitating body's surface, stationary upward acceleration and speed decrease, so clocks get faster. Clock rate is indicated by spectral color. The frequency varies because each clock's radially upward speed is of the same magnitude as the apparent downward speed of objects falling radially from "infinity" — as though such falling objects are analogous to a rotation axis. Right — With greater distance from the rotation axis, constant angular motion causes greater stationary acceleration, greater stationary speed and slower clocks. The fact that a *range* of accelerations exist on the rigidly *rotating* member suggests that the *range* of accelerations found on the seemingly rigid *gravitating* body is due to an analogous (though not directly visible) "rotation" with respect to a fourth spatial dimension. This is a corollary of the idea that the rotating body exhibits stationary motion *through* space, whereas the gravitating body exhibits stationary motion *OF* space.

are also utterly dependent upon one another. It is thus arbitrary, however mathematically useful, to designate — as in Figure 10 — a numerable order or hierarchy of dimensions

The vast literature on hyper-dimensionality famously includes imaginary beings that have only two spatial dimensions (as in Abbott's, *Flatland* [50]). Bearing the above caveats in mind, it is nevertheless insightful to contemplate the experience of two-dimensional Flatlanders, or *Two-Worlders*, as we will call them in what follows.

Imagine a community of Two-Worlders living on a spherical surface. Even though they do not themselves extend into the "third" dimension, above or below the surface, they may nevertheless *deduce* its existence because of their world's *curvature*. They begin by testing Euclidean geometry

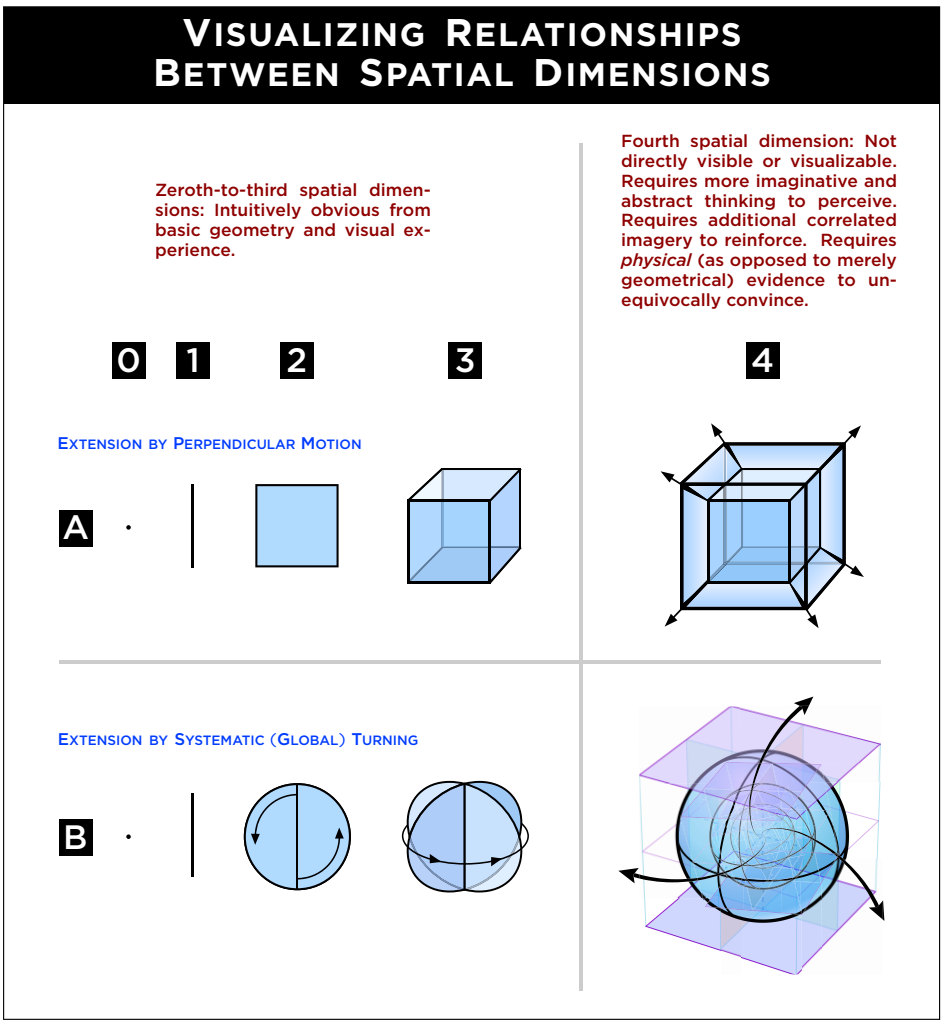


Fig. 10. **Abstract Spatial Dimensions:** The relationship between basic geometrical entities (point, line, square, cube, circle, sphere) can be organized to see that the *motion* of a "lower"-dimensional entity into a new direction traces out (generates) the next "higher" dimension. A "lower" dimension is a *projection* — sometimes called a *shadow* or *cross-section* — of the next higher dimension. The "higher" dimension is a perpendicular extension of *every* point of the "lower" dimensional element. **A.** — Rectilinear Extensions. **B.** — Rotational Extensions. *Curvature* indicates the existence of a dimension higher than that of the entity that turns. The turning/curving of a *plane*, for example, as a rotation with respect to a linear axis, is only possible if another spatial dimension exists *to curve into*. The celebrated empirical evidence of curvature of our seemingly $(3+1)$-dimensional world apparently indicates (difficult though it may be to visualize) that our world includes a $(4+1)$-dimensional direction *to curve into*. Beware, however, of ascribing *physical* meaning to any one dimension considered *separately*. In fact, none of them are physically separable from the others.

on the surface, and eventually they circumnavigate the whole sphere. Two-Worlders find that two-dimensional Euclidean geometry fails. Triangle angle sums $\neq 180°$ and a "straight" line turns back on itself. Whereas allowing the existence of one more spatial dimension would enable explaining their experience. They deduce that non-Euclidean spatial curvature and hyper-dimensionality appear to go with each other.

Two-Worlders comprehend the first step of the pattern we started with: A curved line exhibits

a second spatial dimension because it sweeps out a surface (it extends perpendicularly into the next dimension). They appear to be on the verge of discovering that a curved surface exhibits a third dimension because it sweeps out a volume (extending also into the next dimension.) They are on the verge of discovering a "physical" connection between non-Euclidean geometry and hyper-dimensionality.

Before continuing the Two-Worlders' exploration, we anticipate where this is taking us, to ask whether the analogy can be extended one step further? Just as the Two-Worlders deduce the existence of the otherwise invisible third dimension by geometrical measurements, we Earthlings (Three-Worlders) can deduce the existence of a fourth spatial dimension by geometrical measurements, measurements that, in this case are also *physical* measurements of the geometrical structure of the physical world, as affected by gravity.

Several different tests of Einstein's General Theory of Relativity (GR) have established the space-time curvature caused by the Earth's or the Sun's gravity. Standard practitioners of GR celebrate these observations, yet deny the need for a fourth spatial dimension. (See, for example, Hobson, Efstathiou, and Lasenby [51], as discussed in ***Part 1***, p. 24.) Rotonians think it is obvious that the conclusion of such authors is premature, because they have not yet looked *inside* matter; they have not yet built and operated a Small Low-Energy Non-Collider. The need for this overdue inspection is seen as such by extending the inter-dimensional analogy discussed above.

Local measurements of the geometry of spherical Two-World indicate failure of Euclidean geometry. The sum of angles of a triangle laid out on the surface (the more so the bigger the triangle) exceeds 180°. But the community of stick-in-the mud Two-World geometers (2D analogs of Hobson, Efstathiou and Lasenby) refuse to consider that this indicates a third spatial dimension because, they argue, all locations on the surface are still identifiable using only two coordinates (e.g., latitude and longitude). This is the so-called *intrinsic* perspective.

Concerning the exploratory path by which Two-Worlders return to their starting point without ever changing direction, they argue that this is impossible to explain *except* by invoking one more spatial dimension. As Three-Worlders looking in on these Two-World affairs, we Earthlings can easily see that the stick-in-the-mud Two-Worlders are wrong and the explorers are right. Circumnavigation of the surface thus opens a floodgate for new discoveries on Two-World because it clinches the argument for the inhabitants who propose the existence of a higher spatial dimension.

Not only is Two-World a mere cross-section, embedded in a much more vast world of three spatial dimensions, acknowledging the fact allows explaining a wide range of otherwise mysterious phenomena for which Two-Worlders, up to this point, had only fanciful, implausible explanations. Insisting that two-coordinate coverage of their surface means only two spatial dimensions *exist* makes it impossible to explain circumnavigation of their sphere. From Earthians' higher dimensional perspective it is *obvious* that the simplest explanation is to perceive the existence of a third spatial dimension. This perspective is called *extrinsic*. It entails freedom from the constraint of Two-World's surface. It allows freedom to move both *over* and *within* Two-World from a higher dimensional perspective, a perspective whose existence Two-Worlders cannot directly *see*, but yet *cogently deduce*.

Jumping up one dimension, the intrinsic (3 + 1)-dimensional perspective of establishment GR theorists seems sufficient to them because three spatial coordinates suffice to identify all locations in space and — more crucially — because Earthians do not yet possess the counterpart for the Two-Worlders' argument-clinching circumnavigation. What might that counterpart be?

In the case of a spherical *surface*, the clinching evidence is gotten by traveling in a *single direction around* the sphere's *surface*. By analogy, in the case of a spherical *volume*, the clinching evidence should be accessible by probing a *single direction through* the sphere's *center*. Our analogy strad-

dles the abstract and the physical world, the world of pure imagination and the empirical world of physical experiment. Not only are Two-Worlders themselves utterly impossible, their local measurements and their alleged expedition around the sphere are even more impossible because their "world" contains nothing that could possibly propel them, to allow motion.

Whereas, with the jump to the third spatial dimension, it becomes reasonable to include *mass* (i.e., volumetric matter) as part of the picture. And mass is the source of gravity, by which the volume-involving experiment transcends imagination and becomes doable in the real world.

Based on their trust in accelerometer readings, Rotonians deduce the prediction that the rates of clocks at the center of a massive sphere are a *maximum*—not a minimum. This prediction corresponds with the prediction that a test object dropped into a hole through the center of the sphere will not pass the center. It will not proceed up to the opposite side and oscillate along the length of the hole. If confirmed, the truth of accelerometer readings would be vindicated, and so too the stationary outward motion of matter into or outfrom a fourth spatial dimension. It is this perpetual stationary motion of seemingly $(3+1)$-dimensional matter that *causes* spacetime curvature and simultaneously reveals matter, space and time to be $(4+1)$-dimensional, as *generating* one more dimension ***to curve into***. The Small Low-Energy Non-Collider experiment thus has the potential to open the door to many other discoveries.

It is worthwhile to dispel some of the more pernicious discussions of hyper-dimensionality in the literature. In his book, *Cosmos*, for example, Carl Sagan appeals to a *Flatland*-like analogy similar to our Two-World vs. Three-World comparison above, but he uses the analogy as a basis for some wholly unjustifiable claims. [52] Sagan suggests that a patch of the surface of Two-World can be extracted by three-dimensional creatures and reinserted somewhere else on the surface. If the "patch" is a two-dimensional creature itself (i.e., a Two-Worlder) then she could supposedly even be "flipped over" or inserted into a "locked room" to which previous access was impossible.

Because of the inseparability of one dimension from another, this kind of scenario is absurd. Remember, ***there is actually no such thing as a physical surface.*** Therefore, even though the exercise is possible to imagine as a mathematical abstraction, it makes no physical sense. It is even more absurd that Sagan proposes the existence of "4D creatures" existing in a higher realm than lowly Earthians. By analogy Sagan endows Four-Worlders with the power to pluck us from our 3D world, turn us inside out and plop us back into locked volumetric rooms.

The Russian philosopher P. D. Ouspensky was one of the more astute authors who preemptively chimed in on such matters. Recognizing that dimensions are inseparable from one another (making scenarios such as Sagan's ridiculous) Ouspensky came to the following poignant deduction:

> We must find the fourth dimension, if it exists, in a purely experimental way… If the fourth dimension exists, one of two things is possible. Either we ourselves possess the fourth dimension, i.e., are beings of four dimensions, or we possess only three dimensions and in that case do not exist at all. [53]

From this patently rational insight we not only support the conclusions reached above, we also come to suspect faulty reasoning in the many Kaluza-Klein-inspired discussions that invoke *compactified* extra dimensions to defend string theory or propose equally absurd schemes for "unifying" the fundamental forces of Nature. In such schemes extra dimensions are often ascribed an extremely small (and so unobservable, compactifed) *size*.

Our prior discussion and Ouspensky's remarks support the patently more rational conclusion that ***physical spatial dimensions don't have sizes***. As many dimensions as there are in the Universe, they are all as sizeless as the rest, all as inseparable from the others as the rest. There is no higher $(n+1)$–D world, somehow separated from ours, from which its residents can torture Earthians as

hapless playthings. It is much more sensible to conceive that all creatures, all things in the Universe are of the same dimension as all others. This is the simplest, most rational possibility. No matter how entertaining their stories may be, those who concoct *abstract* mathematical things and sell them as *physical* things, give science a bad name. The whole expanse of the Universe, with all its dimensions, is to be discovered as it exists. Not by unbridled mathematical abstraction, fanciful stories and hocus-pocus, but by careful observation and physical experiment.

If straight line paths on Two-World's spherical surface turn back on themselves, then how else to

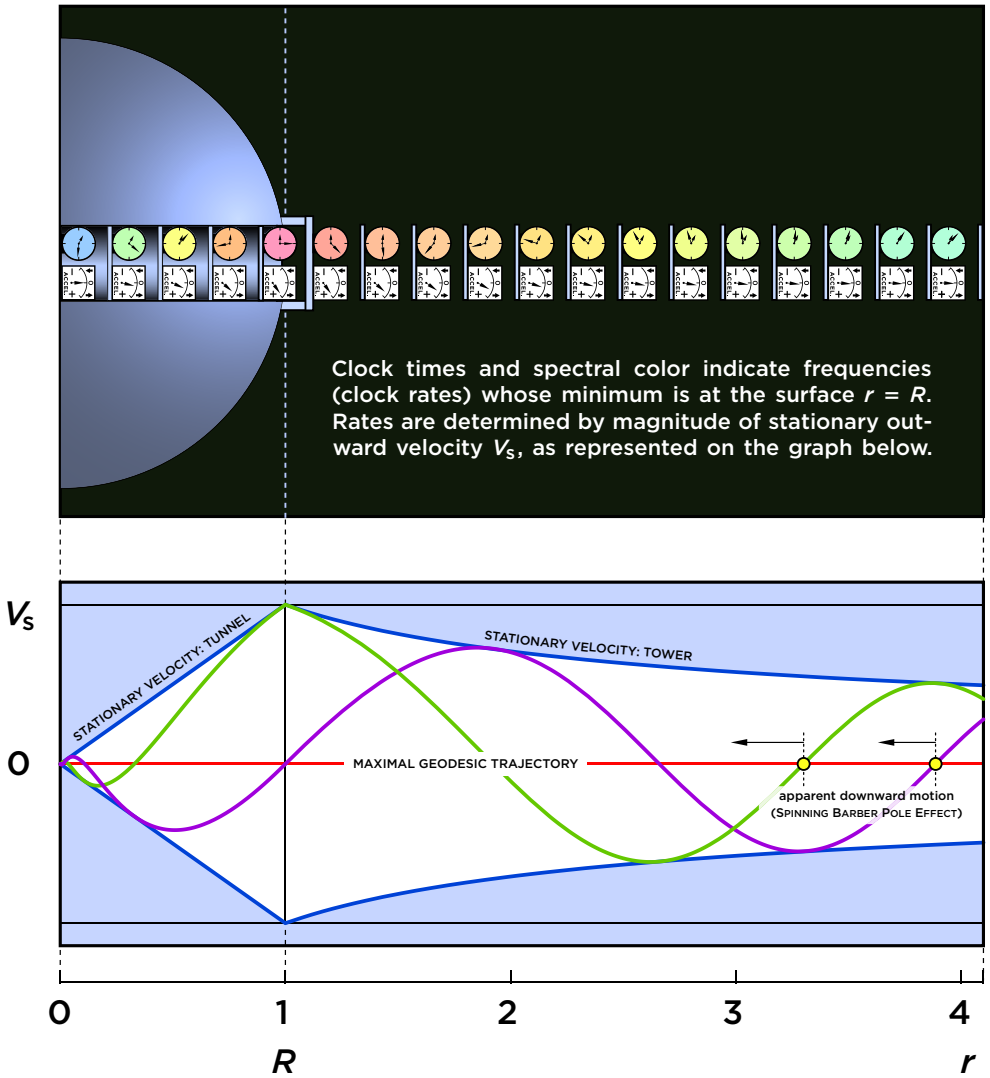


Fig. 11. **Tubular Model of (4 + 1)–Dimensional Radial Stationary Motion:** Top — Physical circumstance represented in the graph below; i.e., a uniformly dense sphere with a tunnel to its center and a tower attached to its surface. Bottom — V_s–axis represents stationary outward velocity; i.e., stationary motion of the system — into or outfrom a fourth spatial dimension. When the cross-sectional graph is conceived as rotating around the r-axis, helices drawn on the tube at 45° to the axis facilitate visualizing the falling motion of *maximal geodesics*: An object falling from infinity maintains the speed of a projected intersection of the axis with one of the rotating curves (like the apparent axial motion of a spinning barber pole). As indicated by the height of the outer envelope, the speed (stationary motion) is a maximum at the body's surface and goes to zero at the center.

explain this except by conceiving of an "extra" dimension for these paths to curve into? From our Three-World perspective, looking in on Two-World we applaud the inhabitants for their patently correct deduction. This seems indeed to be a clinching argument.

If the falling test-object in Galileo's Small Low-Energy Non-Collider experiment does not pass the center, then how else to explain it except by conceiving of matter and gravity as a process of outward motion? Is this not a similarly cogent, clinching argument? Assuming non-oscillation to be the result of the experiment, we Three-Worlders would argue that accelerometers have been speaking to the the outwardness of matter and space all along. We have evidence of both stationary outward acceleration and stationary outward velocity, and also spacetime curvature. Because of the inhomogeneity of the stationary outward velocity (analogous to the case of uniform rotation) the effect on rods and clocks results in non-Euclidean spacetime curvature.

The curvature and the "extra" dimension coexist. Consistent with the pattern revealed by our exploration of "lower" dimensions, the next higher dimension is needed to provide a new direction to curve into. Accelerometer readings — as in Figures 9 and 11 — are thus regarded as telling the physical truth, that matter is an inexhaustible source of perpetual propulsion. Not as a rocket along a line *through* pre-existing space, but propulsion as accelerating volumetric expansion — the perpetual *movement OF space itself, the regeneration of matter itself*, into or outfrom (along) the fourth spatial dimension. There is no single graphic image that fully captures the idea. But Figures 9–11 at least scratch the surface of its logic. And a Small Low-Energy Non-Collider is the apparatus by which we can test it.

The bottom graph in Figure 11 is to be thought of as rotating around the horizontal axis. The envisaged "space" is $(4+1)$–dimensional, as it represents the whole of the seemingly $(3+1)$–dimensional spacetime and source masses (self-regenerating material bodies) to be moving *perpendicular to themselves* — in a stationary way — at the range of speeds given by Eq 6.

The curvature of spacetime around the Sun has been confirmed by observations of light-bending, Mercury's perihelion advance, and the Shapiro Time-Delay test. Many other confirmations are in the books. Conventional GR admits only $(3+1)$ spacetime dimensions and still seems to work — at least for weak *exterior* fields. But GR utterly fails to explain how the curvature comes to be. *What exactly does matter DO* to curve its surrounding space? The SGM explains the curvature as being due to motion, *stationary motion* into or *outfrom* a fourth dimension of space, as the $(4+1)$–dimensional physical *process* of gravitation.

6. Saturation Densities, Cosmic Everything Chart, and Newton's Constant *G*

> *Still today "mass is a mess" . . . As a perusal of modern textbooks shows, contemporary definitions of these concepts [of inertial mass (m_I), passive gravitational mass (m_P), and active gravitational mass (m_A)] are no less problematic than those published almost a century ago.*
>
> *Thus, in spite of all the strenuous efforts of physicists and philosophers, the notion of mass, although fundamental in physics, is . . . still shrouded in mystery.*
>
> MAX JAMMER : 2001 [54]

We have plenty more consequences of the SGM to cover, as they pertain to basic physics. This certainly includes discussing the status of the *concepts of mass*, as they are used — explicitly or implicitly — in gravitational physics. I am nevertheless eager to momentarily jump ahead to our Cosmic Everything Chart by way of a prominent feature found therein: i.e., *saturation density*.

Being a physical concept that played a tacit role in our earlier discussion about the stability of matter, *Encyclopedia Britannica* defines it thus: "**Saturation**, *any of several physical or chemical conditions defined by the existence of an equilibrium between pairs of opposing forces or of an exact balance of the rates of opposing processes*." [55] From §5.3 – §5.5 we deduce that we don't see electrons blowing up or atoms collapsing on themselves because, however vigorous the motions taking place inside matter may be, they are somehow kept in balance. A state of long-term equilibrium evidently prevails.

The example of present interest concerns atomic nuclei. The number of (positively charged) protons in an atom determines its chemical species. Atomic nuclei are concentrated into a much smaller volume than that of the surrounding cloud of electrons they reside in. Nuclei of all but the lightest atoms therefore exhibit a large concentration of positive electric charge, whose self-repulsion would blow the thing apart were it not for the so-called *nuclear strong force*. Electrically neutral *neutrons* of equal or slightly greater numbers as the protons are also participants in this strong attractive interaction, both within and between nucleons. The internal packing of neutrons and protons is a function of the balance between the attractive strong force and the repulsive electric force. The resulting equilibrium, i.e., *saturation*, means that nuclei of all but the lightest atoms have the same *density*.

The opposing forces *saturate* when:

$$\rho_{\mathrm{N}} \approx 2.85 \times 10^{17}\,\mathrm{kg\ m^{-3}}, \tag{10}$$

which is known as the *nuclear saturation density*. Over a wide range, adding nucleons increases mass, but scarcely affects density.

Neutron stars are the result of collapsed normal stars whose nuclear protons have absorbed most of the surrounding electrons. The opposite charges cancel each other, transforming the proton-electron pairs into neutrons. This happens when the outward force of gravity has overwhelmed the outer electron clouds' ability to resist compression. The circumstances leading to this state are complicated, but it happens. Bodies with masses greater than the Sun can collapse down to the size of a city, and have densities comparable to or several times greater than nuclear saturation density ρ_{N}, which is about 10^{14} times the density of common material substances.

Recall that, according to the SGM, gravity is not a force that causes falling bodies to be attracted towards central concentrations of matter, but rather *the process whereby falling bodies are* ***engulfed*** *by the outward movement of central concentrations.* As component bodies get ever more numerous and centrally concentrated, densities can increase enormously. The observed existence of neutron stars indicates that the state of saturation found in atomic nuclei is echoed in stars, where in the latter case gravity's role as collapsing agent is balanced by nuclear matter's resistance to collapse. As suggested by their appearance on the Cosmic Everything Chart (Figure 12), neutron stars occupy a zone of stable structures, taking their place on a key saturation level and mixing it up amongst other stars in galaxies.

The Universe exhibits a handful of other saturation densities. The most familiar example is that *range* of densities occupied by stable atomic and molecular matter. At the high end of the range we find the densest metals and at the low end, planetary atmospheres. As shown on the Cosmic Everything Chart (Figure 12) the range spans about four orders of magnitude. It includes virtually all material bodies in our experience.

The existence of saturation densities — as zones of material stability, in ranges both wide and narrow — is due to various phenomena and relationships found in atomic physics. Certain ratios of physical constants are ubiquitous. Especially, α, the fine structure constant:

(11) $$\alpha = \frac{h}{2\pi\, m_e\, a_\circ\, c} \approx \frac{1}{137}\,,$$

where h is Planck's constant, m_e is the mass of an electron and $a_\circ$ is the Bohr radius. And the proton-to-electron mass ratio:

(12) $$\frac{m_p}{m_e} \approx 1836\,.$$

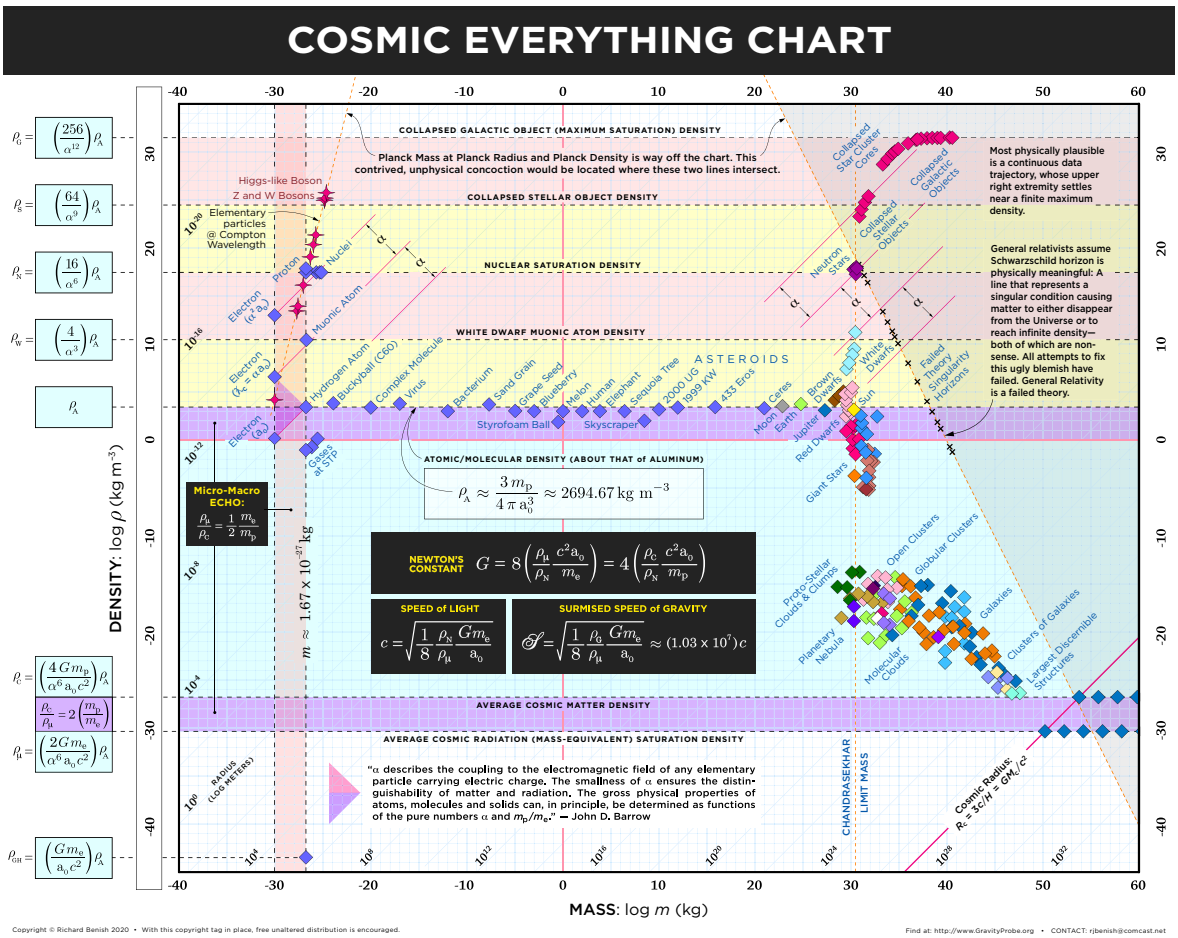


Fig. 12. **Cosmic Everything Chart: Log Mass vs. Log Density (vs. Log Radius at 45°)**—With data points gotten from the physics and astronomy literature, the wide horizontal stretch of more or less familiar bodies (atomic/molecular density) is readily apparent. As masses approach those of stars, gravity's role begins to dominate, as seen on the vertical stretch near the Chandrasekhar Limit Mass. The absurdity of black hole singularities and the utter failure of GR is strongly implied by the abrupt and wholly unnatural discontinuity at the Schwarzschild line. Data points above this line represent a logical, continuous alternative. The roles of the fine structure constant α, the proton/electron mass ratio, Newton's constant G, and the significance of key saturation densities are duly accentuated. Rotonians think of the Chart as a treasure map. [56]

Rhetorical question: Might a ratio of saturation densities serve to define Newton's constant and bridge the microcosm to the macrocosm with an expression for G built up from the constants of atomic and cosmic physics? Ought we not to expect the Universe at large to exhibit *minimum* and *maximum* saturation densities?

Gravity compresses some late stage stars to the extremes of nuclear density: neutron stars, as mentioned above, and also *white dwarfs*. (See Chart.) Neither infinite density nor the general relativistic disappearance of matter into "spacetime singularities" make physical sense. *We therefore expect a finite maximum* which may be approached by the enormously massive bodies found in the centers of most if not all galaxies.

In this extreme regime the SGM differs from GR. GR allows dividing by zero and so predicts nonsensical black holes. Since the arguments of the SGM coefficients in Eqs 6–9 (i.e., $2GM/rc^2$) are added to unity instead of being subtracted from unity, the SGM does not allow dividing by zero. The new model predicts extremely Dark, Compact Astrophysical Objects, but not totally black or infinitely dense ones. Unlike GR, in the SGM material clocks never stop ticking. They may slow way down. From great distances the objects may appear to behave like black holes, but actually their behavior is much more physically reasonable. (No horizons; no singularities.)

At the other extreme (outer space) we seem to have this balancing act ("near-cancellation") of opposing forces: repulsive vacuum vs. infinite self-energy electrons, whose "residual" effect may be gravity itself. This act plays itself out in interstellar and intergalactic space. In this case the *minimum* density of seemingly empty cosmic space would appear to be the mass-density equivalent of the energy-density of the cosmic background radiation:

$$\rho_\mu = \frac{\mu}{c^2}\,. \tag{13}$$

Insofar as the background radiation is customarily measured and described as a *temperature*, a possibly helpful visual is to imagine the Universe as having a ***body temperature*** — as an infinitely vast, minimally and maximally saturated organism. Most essential is the *interconnection* and the *undivided wholeness* of the seemingly disparate parts. Any one of the four seemingly separate forces is inseparable from the others. No one component is excludable without wrecking the whole thing.

Mystically poetic as this description may sound, the imagery is not too unlike speculations by the well-respected theorist and experimentalist Robert Dicke. In an effort to justify a "Machian" cosmological model, suggesting an interdependence between local physics and the Universe as a whole, Dicke wrote an equation ($GM_C/R_Cc^2 = 1$) that relates the cosmic radius R_C and the mass within that radius M_C to Newton's constant G and the speed of light. In the early 1960s Dicke surmised the equation is always true under the assumption:

> [If] the gravitational constant is fixed . . . [the equation could mean that] the masses of the particles would adjust themselves appropriately, in such a way as to give M_C/R_C the appropriate value.
>
> It is as though the Universe is a giant servosystem, [organism?] continuously and automatically adjusting particle masses to the value appropriate to the feedback condition $GM_C/R_Cc^2 = 1$. [57]

In the SGM the meaning and behavior of M_C and R_C are not the same as what Dicke assumes. Yet the equation (which appears also in the Mach-inspired work of Dennis Sciama and others) indicates a cosmic *relationship* that could hold true, as Rotonians propose it does, for quite non-Machian reasons. In such a micro-macro feedback Universe, where all the forces are edgelessly coordinated, operating everywhere all the time, it is reasonable to expect Newton's constant G to be representable as an expression that includes key members of the vast range of sizes, forces, masses,

and densities. Going beyond Dicke's speculations in a direction he is not likely to have ever tried, the Rotonians find:

$$G = 8\left(\frac{\rho_\mu}{\rho_N} \cdot \frac{c^2 a_\circ}{m_e}\right), \tag{14}$$

The fact that modern physics has not previously found G's relationship to the other constants is a symptom of its disjointed (messy) state. In a rare instance of insight in this regard, in 1991 physicist I. J. R. Aitchison speculated:

> Could the dimensions of Newton's gravitational constant be explained . . . [by] a theory of gravity characterized by a fundamental mass (or length) and a dimensionless strength? Could we then unify all the forces?. . . Something new is needed. [58]

In Eq 14 we see that all of Aitchison's desiderata are fulfilled. The density ratio is that of the minimum mass-equivalent density of the cosmic background to the nuclear saturation density. The fundamental mass and length are those of the electron and the Bohr radius, respectively. Note that the least well known of the quantities in Eq 14 is the nuclear saturation density:

$$\rho_N = 2.85 \times 10^{17}\,\mathrm{kg\ m^{-3}} \pm \approx 6\%\,. \tag{15}$$

Given the value in the middle of this range, Eq 14 is almost, if not exactly true, Rotonians strongly suspect that Eq 14 is not a fluke, not just a coincidence, but is the most important product of their exploration. As we will see later, Eq 14 is tied to a handful of other cosmic parameters (constants) that altogether hold some promise, Rotonians believe, of satisfying Penzias' standard of elegance. How many more good reasons are needed before Earthians at last build and operate their first Small Low-Energy Non-Collider? Even in the absence of a contending model of gravity, the experiment ought to be done, of course — if only to satisfy the empirical spirit of Galileo.

7. Harsh Critique of Relativistic Thinking

> THE PRINCIPLE OF THE ABSOLUTENESS OF THE SPEED OF LIGHT: *Whatever might be their nature, space and time must be so constituted as to make the speed of light absolutely the same in all directions, and absolutely independent of the motion of the person who measures it.*
>
> THE PRINCIPLE OF RELATIVITY: *Whatever might be their nature, the laws of physics must treat all states of motion on an equal footing.* —
>
> KIP THORNE : 1994 [59]

As though citing scripture, Kip Thorne lays down the law, what the physical laws "must" be. Such stark ***tyrannies of ideas*** may be expected in cults or places of worship. In science, they are poison, sinful poison. This will be made painfully clear in what follows.

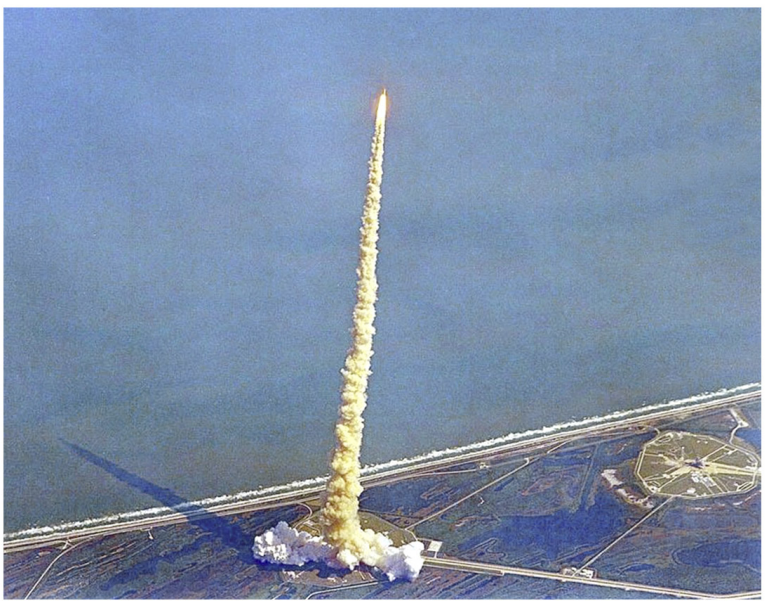
Rotonians think the crazy Schwarzschild horizon line on the Cosmic Everything Chart is further evidence that, in singularity-plagued relativistic dogma, mass is indeed a mess. We think the mess

traces back to disbelief in accelerometer readings. The mess of mass is due to the mess of motion. The data trajectory rises up from white dwarfs to neutron stars, and then what? It either jumps off the Chart or takes an abrupt, wholly unnatural downward turn. It's nonsense. GR predicts nonsense. It is a broken theory, not just at this intersection, but arguably across the board.

Further evidence of the perniciousness of relativistic thinking is found in an article by high-profile physics popularizer, Ethan Siegel. The following critique of Siegel's article launches us into a more incisive investigation and critique of Einstein's *Special* Theory of Relativity (SR). SR's core postulates have been re-written by Thorne (above) with all undue reverence.

By cogently raising doubts about this widely acclaimed pillar of modern physics, our minds will then (ideally) be prepared to receive a presentation of the Rotonian alternative. This latter perspective, as it pertains to the *electrodynamics of moving bodies*, will then be explored with some perhaps tedious detail in Sections §8 – §11. Reading it all will be worth the effort. The various messes in modern physics can be straightened out, one step at a time.

7˙1. *Siegel's Rocket Up-Down Confusions*



The acceleration that someone on board this rocket would feel is downward: in the opposite direction of the rocket's acceleration.

Ethan Siegel : *Forbes Magazine* author and internet physics guru : 2020 [60]

What you're seeing and what you're reading is not what's happening.

Donald Trump : Sociopathic conman and child torturer : 2018 [61]

The title of the article from which the above quote by Ethan Siegel appears is "*How Do We Feel Acceleration In Space? And what role, if any, does gravity play?*" It must first be pointed out that no matter where we are, we are *ALWAYS* "in space." Semantic quibbling aside, the plethora of

errors, contradictions and misconceptions in Siegel's piece perfectly characterize the muddle of contemporary academic physics.

For example, in the caption to the second figure in the article, Siegel writes that "the sensation of weightlessness . . . is not a perceptible sensation." Really? If you were accelerating you would surely perceive the flattening of your undersides. When the acceleration ceases and your undersides are no longer flattened, can you not perceive the difference? Siegel would evidently have you think the *cessation* of this flattening (i.e., weightlessness) is not perceptible. This is not only absurd on its face, it is also contradicted by Siegel's equally absurd assertion that "Only if you removed every possible barrier — every object that would push back on you if Earth's gravity pulled you into it — would you actually feel your acceleration."

The latter description is of the state of weightlessness. *Now* Siegel is saying not only that you *would* perceive it, but that you feel it *as acceleration* — even though you're undersides are *not flattened* and a co-moving accelerometer would read *zero*. How then do we reconcile this quagmire with the above caption to a 1992 Columbia Shuttle lift-off, which says that accelerating *upward* is "felt" as *downward* acceleration? Among the article's other hopelessly confused statements is that "the sensation of acceleration doesn't have anything to do with gravity at all." Altogether, the article is reminiscent of a typical speech by Donald Trump. Over and over again Siegel denies reality. He would sell the fake fizzix "alternative fact" that down is up.

If the Shuttle is blasting *upward* in the space above Earth's surface, this is obviously no reason to say that an occupant feels her motion to be *downward*. It is a *BIG* (and preposterous) *lie*. The acceleration a passenger feels both *before* and after lift-off is *upward*. When a rocket blasts through space the perceived acceleration of an occupant is in exactly the same direction as that of the rocket itself; exactly the same as what an accelerometer says it is. (See Figure 2, p. 4.) You don't have to be a Rotonian to understand this. But Earthians are so damned confused about motion — mostly due to having lived their whole lives on their 5.97×10^{24} kg ball of matter — that even their trained experts say the dumbest things about it.

Insofar as Aristotle was right that by accepting one ridiculous proposition a lot more ridiculousness would follow, the "relativistic" perspective deserves the following attack, to trace Siegel's folly to its origins, to weed out the faulty propositions and start over. Two arguments will be presented, both supported by lots of empirical evidence, and both amplified by considering extreme cases that are available only in thought. The first argument appeals to the experience of observers on two identical disks, one that rotates and one that does not. The second argument appeals to the fact that we live in a Universe populated by stars and galaxies, extending many megaparsecs, as far as the eye can see.

Suppose we have two large identical disks, A and B, located within optically-aided sight of each other in parallel (like bread slices at the ends of a tall sandwich). Rapidly rotating in its own plane is A. Whereas B does not rotate at all. Observers on A suffer the well known effects of rotation; observers on B do not. Observers on both A and B agree that, because of A's rotation, it *weighs* more than B. Better than agreeing with each other, the weight difference is (ideally) established by measurements! For example, the weight of both disks can be determined by arranging to accelerate them with rockets. Suppose identical rockets are attached to the disk's centers, perpendicular to their planes. The rocket attached to the rotation axis of A has a harder time accelerating it because it is heavier, because it rotates. Even relativists — including those that reside on these disks — will agree that the extra resistance to acceleration corresponds to the extra inertial mass as given by

$$m(r) = \frac{m_\circ}{\sqrt{1 - r^2\omega^2/c^2}}\,, \tag{16}$$

where r is the radial distance and $m_\circ$ is an element of mass in the rim as it would be measured if it were not undergoing rotation.

Now suppose the components of A are suddenly released to fly off on tangents (in uniform motion). According to Einstein, each tangentially flying observer is entitled to the claim of being *at rest*. All of a sudden (supposedly) they now have the right to regard the whole of the non-rotating system B as moving away from themselves, as therefore having all of its component masses (energies) relativistically increased. All of a sudden every one of the tangent-flying observers is allowed to reach a conclusion *opposite* to what they had concluded prior to the tangential release. It would be the *opposite* of recently acquired empirical evidence.

Clearly B did not suddenly gain mass or energy because of A's disintegration. But relativity rests heavily on the concept of *symmetry*, of reciprocity. Defending the principle of symmetry is problematic when comparing those that rotate with those that don't. That's why relativists will agree that, before disintegration, A weighed more than B even though they are identical except for A's rotation. Relativists will admit to some degree of asymmetry (absoluteness) in the case of non-inertial (rotating, accelerating) systems. But once the components of A are released on trajectories of *uniform* motion, they are suddenly endowed with the right to claim self-rest and ascribe any effect of motion (e.g., weight increase) to *others* in *other* reference frames. The non-rotating B and any one of the scattered components of A are now supposed to be *symmetrical* with regard to who is *really* moving.

Allegiance to the relativistic perspective would thus seem to require losing one's memory and being oblivious of one's surroundings. The relativistically allowed conclusion — that any component of B now weighs more than the identical counterpart component of A — would clearly be suspicious, if not patently false. Each of the now uniformly moving, now broken up members of A is susceptible to this conclusion, induced by relativistic amnesia and blind allegience to the god of symmetry.

The poignancy of this critique is amplified by contemplating our second argument. The heart of it traces back to a proposition put forth by Albert Einstein. Concerning any two inertial systems, K' and K (where a non-zero velocity pertains with respect to the pair) Einstein wrote:

> One has to accept as an expression of experience (e.g. from the Michelson experiment): the systems K' and K are equivalent with respect to the law of light propagation. Experience shows that [with respect to K' and K] . . . all directions are optically equivalent. [62]

By appealing to facts from the real physical world ("Michelson experiment") Einstein clearly intends that his "systems K' and K" are sufficiently physical to justify his conclusion.

Rotonians vehemently object. Saying that for any two of these systems "all directions are optically equivalent" is like Donald Trump saying he won the United States 2020 presidential election. He can get away with it provided he is speaking only to his cult. In the broader cosmic discourse he will be rebuked and ridiculed. Why then, does Einstein say this? Why is his cult so widespread on Earth that the rebuking and ridiculing is so scarce?

It's a long story, but the gist of it is that Einstein's remark can be *contrived* to appear true, provided the supporting experiments are conducted only in *perfectly insulated, non-rotating, windowless boxes;* only if one follows absurdly restrictive methods for measuring the speed of light: i.e., insisting that an *average* speed is "*THE*" speed of light. Without specifying the need for these restrictive conditions, three high-profile physics popularizers follow in the footsteps of Kip Thorne by categorically denying their need, claiming that the speed of light equals c ***"no matter what."*** (Sean Carroll, Brian Greene, and Matthew Strassler. [63-65]) Another reason Einstein and his groupies get away

with this "optical equivalence" delusion is that the speed of light is extremely fast. The motions of observers in free space or on virtually any astronomical body are very slow by comparison.

The falsity of the conclusion — i.e., the extreme *optical UNequivalence* of "inertial and freely falling frames" — is convincingly exposed by applying one of the well known consequences of SR to an assortment of inertial frames. Suppose we have many observers moving uniformly in various random directions, all traveling close to the speed of light. "Relativistic aberration" (aka the *headlight effect*) then kicks in. For each one of these observers, distant light sources (stars and galaxies) appear bunched up to nearly a point in the direction of motion. [66] The temperature and the frequency of light in that direction also increase enormously. In the opposite direction the spatial concentration, temperature, and frequency are correspondingly spread out, cold, and dark. (See Figure 13.)

These observers will be in utter disagreement as to the angular direction of these effects. Patently obvious, purely optical effects prove that the directions are grossly *UNequivalent*; grossly in-your-face unequivalent. Yet Einstein would say the observers each have the right to think of themselves as being at rest; at rest in a grotesquely lopsided cosmos that rushes past each one of them in different directions at nearly the speed of light. If they can maintain the integrity of their perfectly insulated, non-rotating, windowless boxes, they'd never see the lopsidedness and could persist in

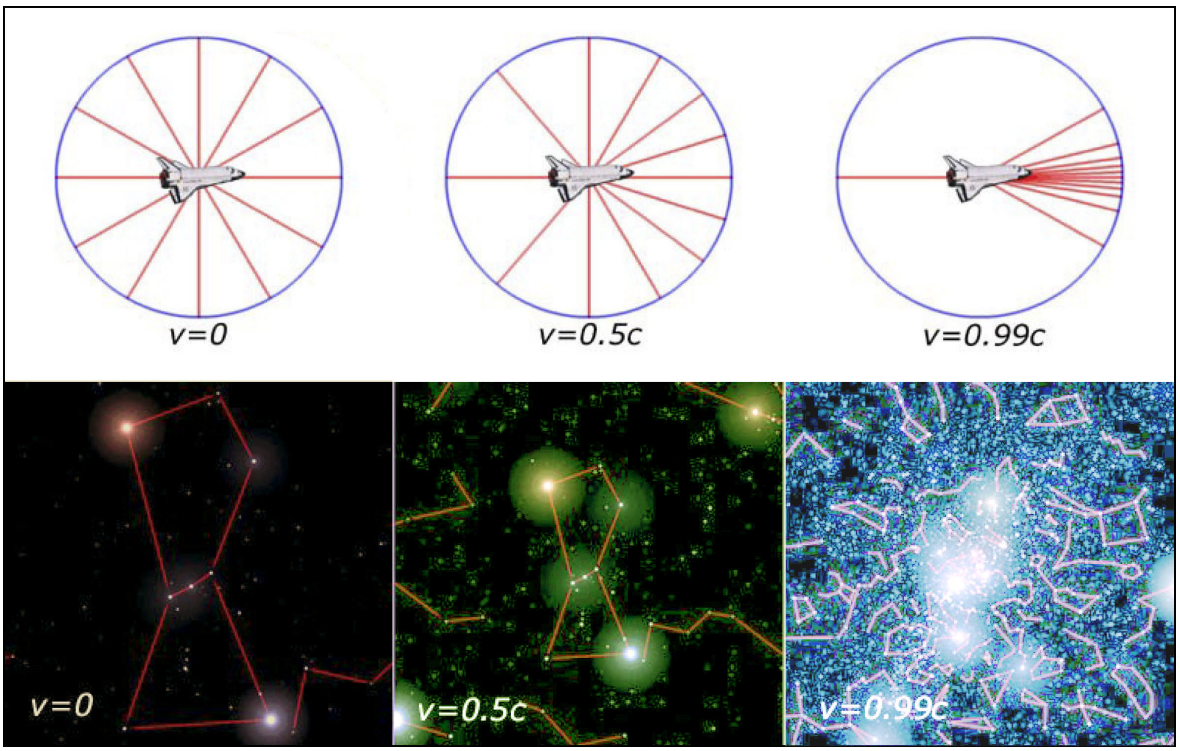


Fig. 13. **Anisotropic Propagation of Light.** The sky looks much different, depending on one's location, speed and direction through it. Because the speed of light can vary greatly with direction in different "inertial systems," such systems are, in general, *grossly*, patently *in*equivalent. Symmetry is an abstract mathematical thing that, when claimed as being physical, is ultimately a delusion. Every location and every direction in this magnificent Universe is *unique*, not at all "optically equivalent" to any other. Rotonians think that any physicist who claims the symmetries of "relativity" to be physical is guilty of pushing the **Big Lie**. The only thing that's really symmetrical is *nothing*. (Figure image adapted from A. Patruno. [67])

their weirdly isolated — frankly *insane* — self-delusion.

This delusion, and the degree to which it permeates the souls of modern-day physicists, can be further illustrated by the following life-or-death scenario, which illustrates what Rotonians call the ***cogency of the extreme case.*** By applying "well known" consequences of Special Relativity to a case in which the underlying assumptions appear absurd, we argue that the whole "relativistic" edifice begins to look similarly absurd.

Suppose a "fleet" of three shuttles traveling at $v = 0.99c$, as the one on the right side of Figure 13, is cruising through the cosmos. The ships are so far separated from each other that light signals between them would be delayed by a matter of hours. Suppose that a passenger on the ship midway between the other two is a physicist named Dr. Carroll, whose equally beloved twin sons are passengers on the forward and rearward ships, respectively. Dr. Carroll's sons, unfortunately both suffer from a terminal disease which could end their lives at any moment. While en route, a medical doctor on the middle ship discovers and informs Dr. Carroll of a simple cure whose formula could be transmitted to the ships upon which his sons are traveling. The cure could be administered within seconds of receiving the message. The cruel hitch is that Dr. Carroll is allowed to transmit only one message in one direction. At least one of his sons will be denied the cure.

Dr. Carroll routinely teaches the doctrine of SR, as put forth by Thorne and many others. As per Einstein's remark about the *optical equivalence* of inertial systems, scripture insists that light propagates *isotropically* for all inertial observers: "No matter what . . . everyone measures exactly the same speed of light [= c]." [63] If that's true, then deciding which direction to send the formula for the cure may just as well be left to a coin flip. With the news that one, and *only one*, of his sons could receive the cure, however, Dr. Carroll duly re-contemplates whether the speed of light really is the same in all directions "no matter what." Might one direction actually be preferable because the message would be received more quickly and so increase the likelihood that one of his sons gets the cure before he dies?

Dr. Carroll has also taught his students about "relativistic" aberration. He knows that the front end of his ship is hotter than the back end. Is this because the whole Universe is rushing past him at $0.99c$ and the speed of light with respect to him is still equal to c? Or is it because his own speed toward the incoming light waves from the forward direction means the oncoming light speed with respect to him is much faster than c? Does the cold and sparse view to the rear look that way because the whole Universe is moving away from him, leaving, however, the speed of light with respect to him still equal to c? Or does his speed away from the light waves from the rear mean that the speed of those waves with respect to him is much slower than c? In reality, is not the speed of light with respect to Dr. Carroll the *sum* of the base speed ($= c$) plus or minus his own speed through the "ether" of the Universe?

It's crazy, Dr. Carroll at last muses, to deny the reality of the ether, to insist he is at rest and to really believe the whole Universe is moving past him. In a flash he thus decides against the coin-flip idea. Instead he decides to send the signal backward, downwind to his son who — because of his speed $0.99c$ into the signal — would receive the cure hours or days before his other son in the forward ship (with respect to whom the signal' speed would be only $0.01c$).

Ironically, and tragically, the political parallel is that Donald Trump arranged for himself and his wife to get vaccinated from the 2020 pandemic with no fanfare, even though such fanfare — by advertising a good example as President — would have saved many lives. Instead, he *publicly* kept downplaying the lethality of the Covid-19 virus and the effectiveness of vaccines to save lives. (As a result, many more Trump supporters died from Covid than Biden supporters.) Similarly, Dr. Carroll *publicly* keeps worshipping Einstein, saying the speed of light always equals c *"no matter what"* — even though when a life-or-death situation arises, his actions would almost certainly be to deny scripture, and admit that light propagation is almost always *an*isotropic. Einstein's principles are

not only a nonsensical source of enormous confusion, in extreme cases blindly abiding by them could very well cost lives.

Common sense and human lives be damned. Einstein was *committed* to his philosophical strategy. He stuck to his guns by granting everyone the right to say they never move. The ruling establishment insists that that right must be upheld at all costs. To Einstein, it's *always* the other guy, *the whole rest of the Universe* that moves. Rotonians see denial of self-motion as a most debilitating symptom, a horrible corollary of Static-Chunk-O'-Thing-Stuff Disease.

Einstein inherited this philosophical proclivity — to bow to isotropic, symmetrical "relativity" — from Mach, Poincaré, and others. He clutched this "principle," this investigative "strategy" in spite of its ultimate absurdity. The root of the delusion springs from the tiny narrowness of its beginnings: the "truth" of relativistic principles in a purely abstract imaginary Universe. In an infinite formless background one is free to conceive motion or rest (of a body A, for example) any way one pleases. Upon introducing a second body B, for example, Einstein insisted that uniform (inertial) motion between these two bodies must appear *symmetrical* with respect to each other. In this itsy-bitsy context it makes no sense to conclude that either A or B moves and the other does not. In this contrived itsy-bitsy context it is impossible to tell, one way or the other. *So what!* A *trivial* fact.

Einstein wanted the ambiguity (*relativity*) of this picture to be equally applicable to physical reality, to put triviality on a pedestal. No matter what else exists, no matter what happens when speeds approach that of light, and no matter how real material bodies may actually populate and disrupt the blankness of the empty background — ***to Einstein, Einstein never moved***. Over the decades relativists have maintained their views, and have defended Einstein, largely by muddying the language of motion. For example, saying that SR is always *at least LOCALLY* (itsy-bitsily) true. They call this *Local Lorentz Invariance*. As Phipps has observed, relativists have devolved into "debating tacticians," to the detriment of their capacity to think like rational scientists.

When accelerated motion — especially rotational and gravity-induced motion — and the whole Universe are allowed into the picture, everything makes a lot more sense when motion is referred to the visible (window exposed) background. This includes a motional state with respect to which galaxy positions, spectra, and temperature will appear nearly isotropic: a "preferred" frame of reference. Local motions are inevitably some combination of inertial, rotational and gravitational motion. That is, some combination of motion *through* space and motion *OF* space. Because this involves extreme complexity in the directions, magnitudes and bodily configurations, there will inevitably be a multitude of "preferred" frames scattered all over the Universe. (A multitude of fuzzy, ephemeral pockets of approximately preferred frames.) Their most important distinguishing characteristic, Rotonians suppose, is a *maximum clock rate*. One of the jobs of a physicist is to disentangle these components of motion for any given observer. Not an easy task, especially when Einsteinian gospel discourages even *thinking* about it.

The inescapable upshot of the Rotonian approach is the blasphemous conclusion that all (***ALL***) motions are absolute. Rotonians think *relativity of motion* — like the Earthian concepts of *gravitons* or *geocentrism* — is among the worst ideas in human history. "*Mass* is a mess" in the Einsteinian scheme because *motion* is also a mess. One of the reasons the mess is not cleaned up is that it inspires a veritable porkbarrel of incremental quibblings — a boondoggle of publishing opportunities: books, articles, and high-budget video productions — to be consumed, regurgitated and argued about *ad infinitum*.

Prior to lift-off astronauts are accelerating upward. *Upon* lift-off they begin accelerating upward even more rapidly. That's what accelerometers say, *unequivocally*. Why do humans think their primitive preconceptions have greater weight than the readings of robust scientific apparatus? They clutch their beliefs largely out of fear of the unknown. Professional followers of Einstein who exhibit confusion or misplaced confidence about whether they are accelerating or not, whether they

move absolutely through the Universe or not, and in which direction, must be held accountable for spewing disinformation and perpetuating dubious mythologies. Ought they not to be recognized as low-grade *entertainers* who ostentatiously pretend to know things they don't really know?

Curiously, Rotonians admit that Einstein's theories have some value. By adopting their postulates and applying standard practices, many theoretical problems are greatly simplified. Empirical support is obtainable for an impressive range of physical circumstances. The problem is that standard practitioners won't admit that the serious problems encountered for *extreme* cases indicate that the whole scheme is ultimately false. They won't admit that their adherence to scripture is defensible (if at all) as only a *game*, employed for convenience on a case-by-case basis, and must not be taken as an actual representation of reality. Instead, they carry on as wriggling literalists, as loyal drone delusionoids.

Rotonians are dismayed by the perverse gullibility of humans — especially as revealed by their allegiance to cult leaders. The calamity of Trumpism in the USA $\approx$ 2020 is paralleled (though much less maliciously) by the calamity of Einsteinism world-wide for over a century. Insofar as Einsteinian thinking is the incitement for Siegel's bizarre article on acceleration and gravity (and for bazillions of cubic megaparsecs of Dark mudfog disseminated more generally — by Dr. Carroll and others — over the last century), Rotonians have grown weary of being delicate about calling it out. Anymore they insist on bluntly telling it like it is, based on their physical experience.

Just as it makes no sense to blindly deny the truthfulness of accelerometers, in what follows we will discover that it makes no sense to claim that light waves are sources of gravitational fields; i.e., that light possesses active gravitational mass. The cult of Einstein makes such claims based on mathematical abstraction, not rational thought or physical reality. Having thus vented, Rotonians urge their readers to pay close attention to the following physical arguments, whose ultimate validity will be supported or refuted by building and operating humanity's first Small Low-Energy Non-Collider.

8. Kinds of Mass; Kinds of Energy

8˙1. *Effects of the Light Speed Limit and the Rates of Clocks*

> *The energy — and therefore the mass — of a gravitational field is a slippery eel indeed, and refuses to be pinned down in any clear location.*
>
> *Even before we need consider the mysterious effects of quantum theory, our theories of physics tell us that there is something very odd and counter-intuitive about the nature of matter. We cannot at all draw a clear dividing line between what we call 'matter' or 'substance' and what we call 'empty space' — supposedly, the voids entirely free of matter of any kind. Matter and space are not totally separate types of entity. Actual substance need not be clearly localized in space. These are hints that our treasured intuitive views as to the nature of physical reality are less close to the truth than one would have thought . . . We must expect, also, that future theory will provide us with yet further shocks to our cherished intuitions.*
>
> Roger Penrose : 1991 [68]

The above comments by the newly Laureated physicist Roger Penrose are yet another indication of the vague and unsatisfactory state of modern physics, especially gravitational physics. We have already foreshadowed this fact with the opening quote for §6 by the illustrious scholar, Max Jammer. For he has augmented Penrose's assessment, by complaining that the concept of "Mass is a mess."

[69] In this and the following three sections concerning particular kinds of mass and energy, we'll come to discover that it is not just the *location* of gravitational mass — or its energy "equivalent" — it is also its *magnitude* that is questionable. We'll return again to Jammer's commentary later, as we uncover several thorny, and important mass-related questions in need of being sorted out, in order to deepen our understanding of gravity. Where establishment physicists have largely resigned themselves to wallow in the general relativistic muddle of the last few decades, our new Rotonian analysis promises an alternative that is as robust as it is comprehensive, and of course, ***testable***.

Some of these issues were discussed in my earlier paper, *Strong Field Gravity in the Space Generation Model*. [70] Given their fundamental import and their contrast with standard views, it is worthwhile to re-examine these matters more carefully. We will find that the SGM serves to put otherwise grossly unresolved or dubious assessments of the nature of mass and energy into a coherent, intuitively satisfying order.

Physical evidence and experimental methods devised up to now are insufficient to settle these particular questions. Analyses of the empirical data gathered so far are not conclusive. Happily, the novel Rotonian approach once again leads back to the Small Low-Energy Non-Collider experiment, whose result (predicted by the Rotonians) would substanitially illuminate these issues. If confirmed, the Rotonians' prediction would provide cogent support for their radical interpretation of gravitational mass and energy.

Among the concepts that we will rethink is the commonly discussed distinction, or lack thereof, between *gravitational* mass m_G and *inertial* mass m_I. It is especially important to recognize m_G as being insufficiently clear with respect to the not quite as common sub-distinction: *active* gravitational mass m_A and *passive* gravitational mass m_P. To my knowledge, Einstein never referred explicitly to active gravitational mass. According to Wolfgang Rindler, m_A is the *only* mass in GR, which is *assumed* (usually tacitly) to be equivalent to m_I. [71]

Especially in the context of Newton's theory of gravity, *active* gravitational mass refers to the gravitational effect (attraction) *caused* by a given source mass. Whereas, *passive* gravitational mass refers to a given body's *response* to a gravitational field. The Newtonian force of gravity is thus given by $F = GM_A m_I / r^2$, where the distinction between two different *kinds* of mass M_A and m_I as active vs. passive is usually not explicitly stated as such. But sometimes it is.

We will also need to discuss another key mass-related concept — arising especially in the context of Einstein's theories: *relativistic mass*, which is not without some controversy. The concept of *energy* enters this discussion largely because of the light speed limit. A moving body's energy is not merely proportional to the square of its speed, as in Newtonian mechanics. As the speed of light is approached, this energy increases much faster than Newtonian theory predicts. As it may concern the "relative" motion of two bodies past each other, the excess in energy increase — beyond the Newtonian amount — is sometimes regarded as a non-Newtonian ("relativistic") increase in *inertial* mass. Insofar as the effect is supposed to be *reciprocal* (symmetric) as between these two bodies, relativists are loath to attribute the increase to any internal structural change in the bodies involved (because any such internal transformation would seemingly need to be *absolute*, not relative).

The problem comes into better focus when we consider its application to a system undergoing *uniform rotation*. In this case the effect would show up as an increase in the rotating body's *weight* (as measured by an analytical balance). Because of the stationary quality of a rotating body, the measured effect is difficult to explain as *anything other* than an absolute change in internal structure. Is there any way for observers "riding" on the rotating body to discover structural differences that make the rotating body physically different from an identical body that is not rotating? The answer is an emphatic ***YES!*** Rotonians conceive the mass/weight increase in terms of a net "bunching" up of internal wave motion. Their analysis is bolstered by appeal to experiments involving light propagation around the rim of a rotating body (Sagnac interferometer), as well as experiments

involving more localized, perpendicular light paths (Michelson interferometer).

Regardless of the validity of the Rotonian explanation, there is little doubt that the measured weight of the rotating body would come out as that predicted by the Special Relativity equation:

$$m(r) = \frac{m_\circ}{\sqrt{1 - r^2\omega^2/c^2}}\,. \tag{17}$$

To both relativists and Rotonians it is clear that this would be the measured *inertial* mass. It is not so obvious, however, that the increase would also correspond to the *active gravitational mass* of the body. A key fact that raises some doubt is that the mass *increase* corresponds to an inversely proportional clock rate *decrease*. As the light speed limit is approached, the decreasing clock rate approaches the cessation of all ticking whatsoever.

Contrasting with the *clock-like nature of matter*, is that *light itself is well known to be timeless*. This consequence is sometimes characterized on a space-time diagram showing that, whereas moving objects have a component of motion through space and a component that moves through time, *light* moves *entirely* through space — its component through time being constantly zero. Rotonians question whether that which is timeless can create anything beyond itself. Surely creation is an act, a *process*, that requires time. Rotonians regard gravity not as a manifestation of static geometry — which magically appears out of static matter — but as the perpetual creation of space by matter. They therefore regard timeless light as being incapable of creating a "gravitational field." They see light as *just passing through*; as having *no* active gravitational mass at all.

This view is in flagrant contradiction with the GR-based edict that all forms of energy are sources of gravity; sources, in effect, of *active gravitational mass*. Relativists do not trouble themselves with explaining exactly how a photon, for example, traveling at the speed of light causes distant bodies to be attracted toward it. What does the photon *DO* to make this happen? To the Rotonians, this is a fatal conundrum. There is no explanation because the idea just doesn't make any sense. The question as to whether the energy of light is or is not a source of gravity evokes further questions

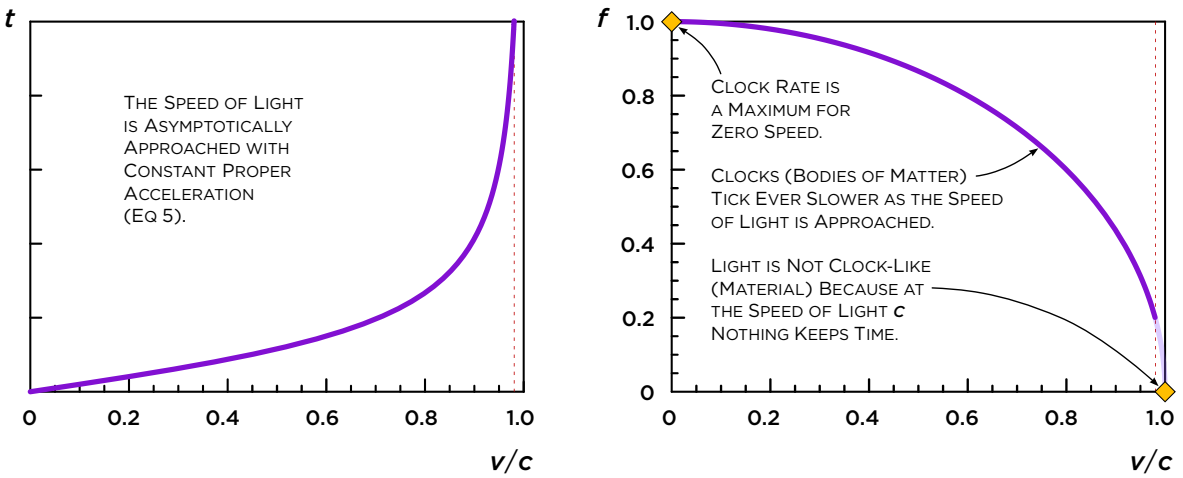


Fig. 14. **Speed and Clock Rate Graphs:** Left — If constant proper acceleration can be maintained for a long time, the speed of light will be approached, but never reached, as per Eq 5 (on p. 22). Right — Clocks have maximum frequencies when their speeds are small compared to light speed c. Only light itself travels at the speed of light. As that speed is approached, material clocks slow way down, but never stop ticking entirely.

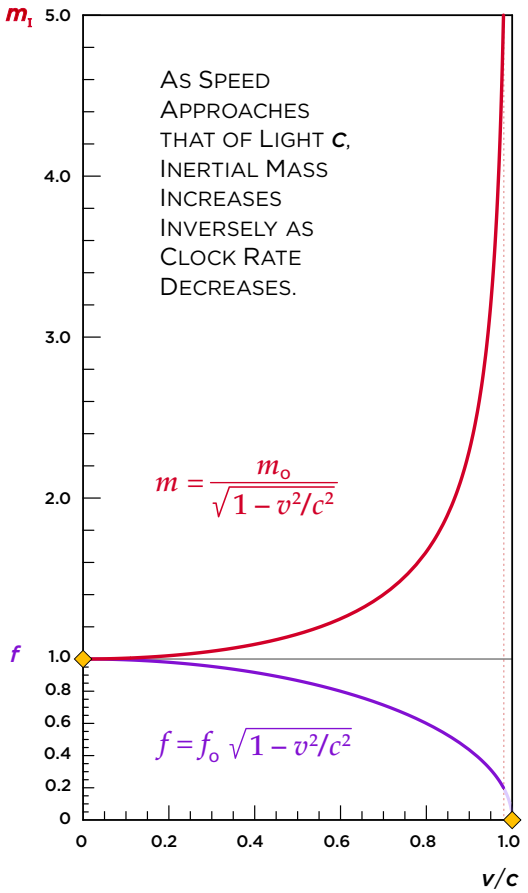


Fig. 15. **Inertial Mass and Clock Rate Graphs**: BOTTOM — The clock rate (frequency) curve from Figure 13 is flattened to accommodate the taller curve above. Its equation is shown in matching color. TOP — Inertial masses increase with increasing speed, inversely as clock rates decrease. The alleged *symmetry* of these effects for so-called *inertial systems* is not found in rotating systems. The *absoluteness* of the mass-increase effect, for example, can be measured as such — at least in principle — by weighing the system with a balance that bears against the axis, perpendicular to the rotation plane. This curve and its equation are also shown in matching color.

as to whether other forms of energy are or are not sources of gravity; i.e., whether or not they exhibit non-zero active gravitational mass. Moreover, how would any such change be related to corresponding changes in *inertial* mass, if any? For example, how do these questions relate to the electromagnetic structure of matter and "potential" energy?

Light speed c and zero clock rate are found at one extreme, but only for light itself. For material bodies, slower speeds and faster clock rates are found on a *continuum* between the extremes $0 < v < c$. Figure 14 graphs this range of speeds with respect to time for a body undergoing constant proper acceleration (LEFT) and with respect to the effect this speed has on the rates of moving clocks (RIGHT). Figure 15 rescales the latter graph to juxtapose it under the corresponding graph showing how inertial mass increases inversely to the decrease in clock rate.

What actually happens to a physical body to bring about these changes? Curiously, this question is rarely asked, because the context in which it typically arises is Einstein's Special Theory of Relativity, according to which there is no *absolute* answer. The effects are presumed to *depend* on which

of two uniformly moving systems is chosen to be the *rest frame*. The effects are always ascribed to the *other* system. This logically unsatisfactory answer is typically couched in terms of *spacetime geometry*, which is adduced to be the cause. As though it makes sense to ascribe physical agency to mathematical abstractions.

The most poignant complaint against Einstein's relativity theories is that his starting point was wrong. Being ill-founded, the relativity program was destined to lead to confusion and unsupportable claims. Einstein started with the most artificial, unphysical situation: an *inertial system*, and then another, claiming an *equivalence* between them. But there is no such thing. His whole theoretical edifice hinges on the validity of conclusions reached for inertial systems, which have, however, no physical reality (even with the fudge/qualifier "at least locally"). Inertial systems are sterile, imaginary things, both locally and globally.

A more coherent theoretical system could have been built, Rotonians suppose, if the starting point was not an inertial system, but *accelerometer readings*. Being effectively equivalent to the degree of flattened (or unflattened) undersides, accelerometer readings are as ubiquitous as they are informative. Their cosmic significance is probably impossible to overstate. Einstein had his chance, but he majorly missed the boat. His prowess as a sales guy is a large part of the reason why, over a century later, we are still immersed in a "mysterious mess" of "slippery eels."

Rather than argue the matter from the traditional context of two inertial frames, we gain more insight by beginning with a uniformly rotating (*non*-inertial) system; a system that exhibits a well-defined, distance-dependent *range* of different speeds and accelerations. In this case the effects of clock-slowing and inertial mass increases are patently *asymmetrical and absolute*. This Rotonian strategy becomes pivotal in connection with the difference between active gravitational mass and inertial mass. The connection appeals to a key fact from quantum theory, according to which the *mass* of a "particle" is proportional to its clock rate, i.e., its *frequency*. Smaller masses correspond to lower frequencies.

If this is true, then how can it be that the inertial mass of a rotating body *increases* as the rates of the clocks it is composed of all *decrease*? In standard physics this apparent contradiction is never satisfactorily reconciled. Whereas in Rotonian physics the answer is all about the distinction between inertial mass and active gravitational mass. Reduced clock rates correlate with active gravitational mass. Whereas increased inertial mass correlates with the bunching up of matter waves inside the rotating body. The generation of space by matter — i.e., the essence of Rotonian gravity — is a *process* that take place in *time*. If clocks (material bodies) tick slower, they generate space more slowly. The net bunching of matter waves is analogous to what happens with light waves propagating around a rotating body, as we will later demonstrate mathematically and graphically. Figure 15 may thus be seen as representing the decrease in active gravitational mass of the same body whose inertial mass is increasing in inverse proportion.

Rotonians argue, by analogy, that these illustrated physical effects are found not only on bodies moving *through* space (rotation) but also on bodies responsible for motion *OF* space (gravity). The factors, $\sqrt{1-v^2/c^2}$, $\sqrt{1-r^2\omega^2/c^2}$, $1/\sqrt{1+2GM/rc^2}$ and their inverses represent not so much the static "geometrical properties of spacetime" as the *states of MOTION* of the bodies they refer to. Rotonians regard bodies rotating with extreme speeds as being analogous to astrophysical bodies with strong gravitational fields

Extreme "relativistic" effects start to become significant at about the size, mass, and therefore density of *neutron stars*. The concepts and analysis presented in this section pave the way for extension and culmination into the next section, where real astrophysical bodies are brought into the discussion and where the "mass defect" paper by Ghose and Kumar motivates a set of graphs that convey the extreme fragmentary deadness of the GR approach, as compared to the coherent aliveness of the SGM approach, from stellar to galactic masses, and beyond.

As is often the case in this essay, in the course of presenting the conceptual, mathematical, and graphical comparisons between GR and the SGM, we sometimes digress to reflect on their historical origins and the corresponding sociological and philosophical underpinnings. Three subthemes that will continue to be echoed as we work our way to the Rotonians' cosmological model, are: 1) The dichotomy between clock-like matter and timeless light. 2) The relationship between motion *through* pre-existing space (linear and rotational motion) and the higher-dimensional motion *OF* space (gravitational motion). And 3) The fact that ***staticness*** and ***acceleration*** are contradictory, mutually exclusive concepts.

8˙2. *Inertial and Gravitational Mass: The Equivalence Principle & Beyond*

> *Einstein's view of gravity is that things don't fall; the floor comes up! That easily explains why heavy objects don't fall faster than light objects. But don't take it too literally . . .*
>
> LEWIS CARROLL EPSTEIN : 1988 [72]

> *Boris Johnson flippantly declared: "My policy on cake is pro having it and pro eating it." Quite. Just goes to show how delusional and self-absorbed the man is.*
>
> ALPHA CRC : Isabelle Weiss, Linguistic Director : 2022 [73]

Having proposed that the essence of *time*, specifically, the perpetual increase thereof, *goes with* the perpetual increase of space and matter (Figure 6) and conceiving that the source of *space* is its perpetual generation by matter (Figure 8), Rotonians now work toward untangling another pair of persistent puzzles in Earthian physics: The *"origin of mass,"* which is sometimes discussed alongside the *"origin of inertia."* Another subject often arising in these origin discussions is the empirically well-supported, yet often still challenged, equivalence of *inertial mass* m_{I} and *gravitational mass* m_{G}. Let's rethink these problems from a Rotonian perspective.

Insofar as the word *origin* implies a *beginning*, it is the wrong word, the wrong question. Rotonians see no evidence of a beginning, but rather perceive an endless continuation. A better question is therefore to inquire as to the *essence* of matter. What is its most essential characteristic? Insofar as *inertia* is but one of the physical manifestations of mass, the more general physical concept is mass itself. What is the essence of mass? Rotonians propose that both its inertial properties and its gravitational properties are perpetuated (not originated) by a physical process that emanates out of *itself,* as the following discussion is intended to clarify.

It is sometimes explained that m_{G} can be broken into *active* and *passive* parts. Before giving the Rotonian account, which regards maintaining this distinction as the physically most sensible strategy, let's consider Galileo's apocryphal Leaning Tower of Pisa falling experiment. Galileo's purpose was to dispel the common misconception that heavy objects fall faster than light ones. In the legendary experiment Galileo drops one of each at the same time from the top of the tower. Witnesses on the ground see them land at the same time. Especially when extended to less intuitively obvious examples as the fall of a feather and a hammer in a vacuum (as on the Moon), some physicists entertain lay readers by "explaining" the equal falling fact as being due to the "equivalence" between gravity pulling downward and the ground accelerating upward.

Sam Lilley, for example, sets the scene of an observer dropping objects within a cabin on board a rocket ship whose engines are firing. It's easy to see the "falling" objects land together because the engines accelerate the floor of the cabin upward. In the rocket ship it is obvious that *the floor comes up*. Reflecting then on our experience with gravity at Earth's surface, Lilley writes:

> The falling-with-the-same-acceleration behaviour [receives the] simplest interpretation of what we observe [by saying] that ***we*** are accelerated . . . It looks as if there may be *some* sense in saying that the [attractive] force of gravity is an illusion that arises because we deny being accelerated when we really are. [74]

Another example is found in a recent text on *Modern Cosmology*, wherein John F. Hawley and Katherine A. Holcomb write:

> When we drop a ball, it occupies an inertial frame . . . and is actually *not* accelerating while it falls. Thus it is ***we*** who are accelerated; and if a ball falling downward is not accelerated, then we must be accelerated upward. Hence what we call gravity is **equivalent** to an upward acceleration.
>
> . . . But if you are sitting motionless, then how can you be accelerated? And if you are in free fall, are you not accelerated, with acceleration g, toward the center of the Earth? How can we **reconcile** our usual view of gravity as an acceleration with the claim that freely falling observers are unaccelerated? [75] [Original italics; Bold added.]

The short answer is that reconciliation is ***impossible***. In physics "cakeism" just doesn't fly. To see physicists trying to make it fly is embarrassing. Serious attempts to "reconcile" these patently contradictory ideas marks one as "delusional and self-absorbed." Gravity-induced ***downward acceleration*** **and** ***unaccelerated falling*** **do not co-exist** in the physical Universe. It's one or the other, not both. For the ground-based observer, to "sit motionless" and be accelerated at the same time is ***impossible***. In each case one of the descriptions is patently wrong.

Rotonians refuse to adopt the modern physicists' penchant for scrambling the meanings of words and denying irrefutable facts. Truth is the *contrary*, the *exclusion* of falsity. Acceleration is the *contrary*, the *exclusion* of a state of motionlessness. Flattened undersides (or stretched oversides) indicate the *existence* of a state of acceleration. If one's undersides are not flattened and one's oversides are not stretched, this indicates the *absence* of acceleration; i.e., a state of free fall. If radially falling bodies are not accelerating, then the large body over which they fall is obviously not static. A collision is about to happen. Which body is really, absolutely moving? If the falling bodies are not accelerating, then the large body below is obviously not static. But Einstein and his followers insist that it is. In a flagrant, yet socially acceptable act of "physics" gaslighting, the terms *acceleration* and *staticness* have been schizoidedly scrambled. It's insane.

Rotonians urge an empirical investigation to discover which of these ideas is wrong, by building and operating a Small Low-Energy Non-Collider. Whereas Hawley and Holcomb echo their colleagues who promulgate unphysical contradiction-laden geometrical word games that characterize the dysfunctional dance of cognitive dissonance, the self-gaslit ritual known as General Relativity.

There is no gravity-induced downward acceleration because this contradicts what accelerometers tell us. Lilley is being logical to suggest that the simplest (and therefore most likely correct) interpretation is that ground-based observers are really accelerated. The positive accelerometer readings of observers on the ground ***tell us*** **they are** ***accelerating***. The zero readings of those that fall tell us they are not. The readings mean that ***matter is an inexhaustible source of perpetual propulsion***. No matter anywhere is "sitting motionless." Motionless matter is one of the biggest delusions; one of the most pernicious falsities. We can find out if these Rotonian answers are correct or not by pursuing our observations of falling objects *beyond mere collisions with the floor*. We need *collisionless* observations that have no floor, right through to the center of the larger gravitating body.

Though the alleged equivalence between downward gravity and upward gravity is not exactly the same thing as the alleged equivalence between inertial and gravitational mass, from the above we see that discussions about them overlap. The interrelationship is not consistently dealt with in

the literature because, as Callender and Okon have written, "There are almost as many Equivalence Principles as there are authors writing on the topic." [76] The reason modern scholars concern themselves with the equivalence of gravitational and inertial mass is that the Principle (as it pertains to either acceleration or mass, or both) served as one of the bases of Einstein's GR.

Recall that *inertia* is that property of matter by which a given body *resists* deviating from uniform motion, i.e., by which it *resists* being accelerated. Rotonians explain the equivalence as follows: A body ***resists*** being accelerated in ***one*** direction because it is itself accelerating in ***every*** direction, i.e., by virtue of and in relation to the amount of volumetric space it is generating. One and the same *physical process* is responsible for both manifestations: gravitational mass and inertial mass.

But an important distinction needs to be made between two different kinds of gravitational mass. Most discussions of the matter (e.g., those by Einstein) fail to point out the logical need to recognize m_G as a veil that hides the important difference between *passive* gravitational mass m_P and *active* gravitational mass m_A. It is too often *tacitly assumed* that these two kinds of mass are equivalent, and it only remains to argue that they are equivalent also to *inertial* mass m_I. Some authors more carefully distinguish between active and passive gravitational mass, and/or explain the historical and physical significance of the distinction. [77-81]

One of the two kinds of gravitational mass — i.e., passive gravitational mass m_P is clearly equivalent to inertial mass m_I because resistance to deviation from uniform motion — response to an applied force — is the same whether a given body is being pushed or pulled by muscles, a rocket, or the ground below. It is this equivalence that has been tested to extreme accuracies. Whereas tests to distinguish between m_P and m_A are mostly non-existent and certainly not conclusive.

Experiments that have been done can be understood by considering the mechanisms of an ideal spring balance and accelerometer. These mechanisms can be quite similar. A spring balance measures m for constant a; an accelerometer measures a for constant m. The mass to be weighed by a spring balance is introduced to the system from without, whereas the mass employed to measure the acceleration by an accelerometer is held constant from within.

Suppose a spring balance is calibrated while very far from any large gravitating bodies, by providing a constant acceleration and setting the readout to zero when nothing is being weighed and to 1 kg when the pan pushes against a 1 kg body. Under these conditions, the reading will remain 1 kg regardless of the composition of the pushed body (whether it is made of carbon, platinum, muonic atoms, or anything else).

Now suppose this same balance is placed on a planet such that a 1 kg reading does not vary when any kind of 1 kg body is placed on the pan. This means that the acceleration due to gravity at the planet's surface is exactly the same as the acceleration used to make the initial calibration. In this case, if $m_I = m_P$, then not only would the 1 kg bodies mentioned above still *weigh* the same, any such bodies allowed to *fall* on this planet would do so with the same apparent acceleration. Accelerometers co-moving with the falling bodies will all read *zero*.

If in some cases inertial mass did *not* equal passive gravitational mass — as speculated by some quantum gravity enthusiasts — then the results of these latter measurements would sometimes be different. Either the weights or the accelerations would *depend* in some unknown way on the composition of the bodies. The difference could supposedly be revealed whether the bodies are being weighed (accelerated) or are allowed to fall — in which case the prediction of a small non-zero reading for some oddball kind of matter would indicate refutation of the Principle. As the Rotonians see it, Earthians imagine the difference to be *possible* because they perversely equate "being accelerated" with "falling" — i.e., they either invoke a magical force of attraction or *static* spacetime curvature to explain the effects of gravity. Rotonians see Equivalence Principle violations as being *impossible* because they instinctively believe the simplest interpretation, as per Lilley; i.e., they believe their

accelerometers. They conceive gravity as the upward acceleration of the ground. ***Falling bodies never accelerate downward — their co-moving accelerometers always read zero — because there is no force of attraction.***

Having explained why Rotonians regard inertial mass and passive gravitational mass to be identical, we turn now to *active* gravitational mass m_A. This is what *produces* a gravitational field, where gravitational field means: 1) the attractive force of gravity, 2) *static* spacetime curvature, or 3) *motion-produced* spacetime curvature — depending on whose gravity model is closest to the truth. In both possibilities (1) and (2) how the field gets produced is utterly mysterious. What exactly does matter *DO* to make bodies attract one another? What does matter *DO* to cause spacetime curvature? Such questions are rarely asked, much less answered. That's why the situation is a mess. Whereas possibility (3) contains the mechanism of production in its description: *motion-produced*.

Whatever the mechanism may be, we can see that qualitatively, m_A is different from m_I and m_P: *Making* gravity vs. *Responding* to gravity. For various reasons, a few authors have ventured to suggest that the magnitude of m_A may not be the same as m_I and m_P. In one high-profile test of the equivalence, the question was framed in terms of a *substance-variety dependence* (i.e., fluorine vs. bromine). [82] That test's character was similar to Equivalence Principle tests that looked for differences in the free-fall of different substances. Do bodies having the same inertial mass but different atomic/molecular species fall differently (m_P) or produce different gravitational fields (m_A)? No substance-dependence has ever been found for either kind of mass.

But m_A could differ from m_I and m_P for other reasons. Seemingly more radical than other examples, Nieuwenhuizen's 2007 analysis determined that m_A is twice as large as m_I. [83] But the difference is camouflaged by our method of defining the value of Newton's constant G. Though Nieuwenhuizen is a prolific veteran physicist, the only citation I could find of his paper is one that harshly criticizes it. [84]

Less radical, more often cited, but still controversial, is the 1992 work of W. Bonnor, [85] whose analysis found m_A to be generally (and virtually always unmeasurably) *smaller* than m_I. Soon after Bonnor's paper was published, an article by Herrera and Ibanez built on Bonnor's result by explaining the $m_I - m_A$ difference as being due to the "work" required to assemble a given body from its otherwise dispersed components. The reasoning is consistent with the analysis by Ghose and Kumar from their 1976 paper. [86] The latter authors showed that, according to GR, the ratio between "proper" masses that are *at first widely dispersed*, to the total active gravitational mass in the *collapsed end-state*: m_I/m_A reaches a maximum value (≈ 2.3562). Back in 1938 F. Zwicky made the same prediction on essentially the same basis. [87] Ghose and Kumar refer to the difference as a *mass defect* caused by gravitational *binding energy*. Especially since many authors claim, or tacitly assume $m_P = m_I = m_A$, it is noteworthy that Herrera and Ibanez conclude their paper with an unanswered question:

> On the basis of all these comments it is clear that the total energy of the body [m_A] and m_P as defined by (4) should be different. The question is whether it makes sense to describe the inertial properties of a body by a parameter which is not a measure of its total energy. [88]

This conclusion implies acceptance of the standard assumption that expending "work" to assemble the body causes a negative contribution to the whole (because it is due to a force of *attraction*).

Suppose the body is initially given in the collapsed state. Some considerable energy is then required to break it up and disperse it to remotely separated locations. After dispersal, if the distances between components are still finite (and outward dispersal speeds appear to come to zero — as at aphelion, for the Sun), then letting the process reverse itself back to the collapsed state results in a reduced mass/energy (because of the negative potential) unless the kinetic energy of

the collapsing bodies is added back in to keep the total energy unchanged (conserved). In other words, mass/energy would be conserved if the motion of collapse were somehow arranged to persist without any energy-sapping collisions. More realistically, the heat from such collisions is mostly (or entirely?) radiated away in the course of collapse. Consequently, the remaining product m_A suffers the *mass defect* calculated by Zwicky, and Ghose and Kumar. I.e., it is *smaller* than the initial sum of dispersed components m_I.

Herrera and Ibanez ask whether the reduction in m_A is possible without also reducing m_I. General relativists assume that the reduction in m_A does indeed coincide with a reduction in m_I. What it means physically is that the force needed to push or pull the collapsed object is smaller than the sum of the forces needed to push or pull the dispersed objects prior to collapse. *And* that this reduction in force is proportional to the reduction in the strength of the collapsed object's gravitational field.

Curiously, the predicted effect is the *opposite* of the standard prediction for the arguably analogous case of a *rotating* body. A staunch relativist will perhaps see it as a kind of *anti*-analogy. The stationary motion of a rotating body is supposed to cause both the inertial and the active gravitational masses to *increase*. But GR's warped spacetime is supposed to cause both inertial and active gravitational mass of an allegedly ***static*** body to *decrease*.

Rotonians think this "logic" is absurd, because it contradicts Isaac Newton's *Rules of Reasoning in Philosophy*. (See ***Part 1***, p. 6.) Abiding by these rules means that the same measurable *effects* are likely to have the same *cause*: ***stationary motion***. If inertial mass increases in one case it is likely to increase in the other. If active gravitational mass decreases in one case, it is likely to decrease in the other. Rotonians much prefer the latter logic, for being consistent with Newton's *Rules*.

Until we build and operate a Small Low-Energy Non-Collider, we won't know for sure which logic is physically correct. Meanwhile, the unsettled questions pointed out by Penrose, Jammer, and others have been echoed more recently by other prominent physicists. In a blog discussion mostly concerning the possibility of negative mass, Sabine Hossenfelder addressed the question of active gravitational mass, asserting:

> Active and passive gravitational masses are identical in almost all theories I know … ([There is one] exception that comes to mind.) I doubt it is consistent to have them not be equal, but I am not aware of a proof for this. [89]

In a long presentation on such matters, experimentalist K. Lammerzahl draws the conclusion:

> [Presently, we have] no model … for active ≠ passive mass. This is a symmetry of physics which unfortunately is not yet well analyzed. [90]

These quandaries about active and passive gravitational mass, the quantum theory-based arguments that cast doubt on the validity of the Equivalence Principle ($m_I \neq m_G$), among other confusions, motivate serious consideration of the Rotonian strategy for grasping these "slippery eels."

The reader will no doubt have noticed our *growing* list of examples for which the phenomenon of *uniform rotation* helps to understand *gravitational* phenomena.

According to GR it is not just the mass of *matter* that gravitates, it is also *energy*. We touched on this fact in the Herrera-Ibanez result discussed above, wherein the energy of *work* is represented as expended *potential* energy. The work of assembly is allegedly released (somewhere, somehow) such that the potential's lower value near the center makes the *total* energy of the assembled pieces diminish, reaching a minimum in the fully collapsed state. The decreased *energy* supposedly corresponds — according to GR — to a decrease in *mass*, both inertial and active gravitational.

Two other, more tangibly physical forms of energy are light — perhaps the "purest" form — and that of motion: kinetic energy of moving material bodies. Yet another kind of energy is that found in the electromagnetic fields residing within matter. What are the roles of these kinds of energy in *responding to* or as *sources* of gravity?

As usual, clarity is maximized by considering extreme cases: 1) Does the kinetic energy of a body moving near the speed of light give it more *active* gravitational mass than when it is at rest? And 2) Does light itself have any active gravitational mass at all? GR answers *yes* and *yes*. Rotonians doubt these answers because they suspect a deep connection between the passage of time (rates of clocks) and gravity. If clock rates are diminished, should not the rate at which space is generated — i.e, gravity — also be diminished?

In GR gravity has no cause. *Static geometry* is deemed sufficient to "explain" gravitational phenomena. Even though light is regarded as timeless ("photons don't experience any time at all" [91]) its *energy* is still deemed capable of causing spacetime curvature. *How does it **DO** that?* Rotonians think that light's timelessness means that it does not cause any spacetime curvature; it has no active gravitational mass: $m_A = 0$. Light waves are only passing through.

If the timelessness of light means it does not possess active gravitational mass, we can see it as an extreme limiting case whose continuum of less extreme cases corresponds to the spectrum of clock rates for massive bodies having speeds in the range: $0 < v < c$. Clocks moving close to light speed are slowed way down. In the unreachable limit ($v \to c$) clocks stop. Rotonians conceive gravity as a physical process dependent on the passage of time, and as characterized by a stationary upward velocity $0 < V_S = \sqrt{2GM/r(1 + 2GM/rc^2)} < c$. For a given mass M, the space generated by bodies with slower clocks (corresponding to smaller r-values) is generated more slowly than for less dense bodies (larger r-values). As the stationary velocities increase, *inertial* mass *increases*. As the rates of clocks on the body *decrease*, the *active* gravitational mass decreases in the same proportion because clock rate correlates with rate of space generation.

Remember that the above inference with respect to *active* gravitational mass is consistent with quantum theory, which regards a particle's *mass* as being proportional to its *frequency*. In what follows this conception of active gravitational mass will be related to corresponding effects on physical size and *inertial* mass, by once again appealing to *uniform rotation* for guidance. Rotation serves as a conceptual bridge between uniform motion and curved spacetime, illuminating questions concerning mass (all kinds), clock rates, and light propagation. Uniform rotation is one of the most potent analogies for helping to understand gravity.

8˙3. *"Relativistic" Mass*

> *"Relativistic mass"... makes increase of energy of a particle with velocity or momentum appear to be connected with some **change in internal structure** of the particle. In reality increase of energy with velocity originates in geometric properties of spacetime itself.*
>
> EDWIN F. TAYLOR and JOHN ARCHIBALD WHEELER : 1966 [92] [Emphasis added.]

Whenever we see or hear it expressed that some definite physical phenomenon is caused by ("originates in") the "geometric properties of spacetime itself" we can know that a con job is afoot. The perpetrator is most likely taken in by the same con and so comes across as authoritatively confident. Don't buy it. In what follows we will discern the source of the delusion and the likely explanation for what's really going on. The misconception arguably stems from a time when faulty conclusions

had been made about rotation, and when there was no understanding at all that the Universe has a virtually uniform background temperature and a virtually uniform distribution of light sources (galaxies). It was a time when such grandiose agency could be attributed to the "geometric properties of spacetime itself" and people would believe it.

The opposing banks that the *bridge of rotation* connects are those of uniform motion in flat spacetime (domain of SR) on one side, and gravity-induced motion in curved spacetime (domain of GR or the SGM) on the other. Suppose we have a large and sturdy circular disk whose center (axis) is propped up so that the whole disk's weight is bearing on the pan of a huge analytical balance. The idea is to take a weight measurement before and after the disk is made to rotate. Among the props attached to the upper surface of the disk is a dense concentric ring of matter, located near the disk's rim. For purposes to be made clear later, suppose the ring is broken into many short solid segments laid end to end and lightly touching one another when the system is not rotating.

Suppose the mass of the ring represents the bulk of the whole assembly's weight — as given by the balance. Suppose a pin through the center of each segment fastens each one to the disk, but permits contraction of the ends (in the circumferential direction). This assures that the segment's *distance to the axis remains constant*, while allowing changes in the circumference-to-radius ratio to take place, as between *proper* measurements made by rotating observers, and measurements made by observers in the axis/rest frame. With suitably extreme rotation speed, the disk may well transform into a more *spoke*-like structure. Because of the rim's high speed, gaps open up between segments so that the sum of their proper lengths *plus* the proper size of the gaps adds up to exceed the Euclidean value $2\pi r$. Einstein once got around the gap problem by supposing the "disk" to be in liquid form, allowing it to solidify only after reaching its final speed. [93, 94]

The equipment of the observers — who we imagine as riding on the disk without being thrown off, as would more realistically happen — includes light sources and optical apparatus for sending signals around the rim in both directions and in more localized forth-and-back circuits. In what follows we will appeal to various empirical facts that are typically used as supporting evidence for SR. Our concluding interpretation of the facts indicates a hypothesis that contradicts certain assumptions built into GR.

If the dense ring weighs $m_\circ$ when not rotating, then SR says it weighs

$$m_1 \simeq \frac{m_\circ}{\sqrt{1 - r^2\omega^2/c^2}} \tag{18}$$

when its rotation speed is $v = r\omega$. This equation is an approximation, as it neglects to account for the radial extent of the ring. It is exact in the limit of infinitesmally thin cylindrical increments (or if r is regarded as a *mean* radial distance). The speed is never close enough to c to enable actually making such a measurement (with present technology). But the physical principles involved come clearly to light in this idealized *thought* experiment.

That the ring's balance-measured weight increases when the disk is set into motion, is reasonable because making it move requires kinetic *energy*, and kinetic energy and inertial mass are proportional to each other. Expressions of the form (Eq 18) have been the subject of a long, tedious, mudfoggy polemic in the literature since the 1980s (if not earlier). One faction argues to avoid such equations. The complaint often refers to consequences such as that pointed out by Taylor and Wheeler that an increase in mass implies a change in internal structure. In the context of uniform (i.e., unaccelerated) motion, relativistic philosophy is to regard all effects as being *reciprocal*. Perfect *symmetry* is assumed as between one frame of reference and another. This is what *relativity* is all about: validation of the claim to be always *at rest* so as to ascribe all effects of motion to the other guy, to the rest of the Universe.

That the Rotonian perspective is more rational and promises a more secure foundation, becomes evident at least partly by negation — by seeing the absurd tangles that Einstein-inspired thinking leads to, as we have already discovered in Siegel's "cakeist" treatment of the up-down acceleration of a blasting rocket. (Section §7.1.)

9. Reduced Clock Rates; Increased Wave-Bunching

> *There is a preference not to remember or not to overstress the significance of something which may be seen as vaguely disreputable to the field.* ***It is a characteristic aspect of physics that to pose a problem or a question may, in itself, be taken as a sign of bad character.***
>
> Daniel Kennefick : 2007 [Emphasis added.] [95]

At the heart of the mystique of Einstein lies a complex and admittedly lovable character. Though Rotonians are often critical of Einstein's pronouncements about physics, they are happy to also find many profound statements that ring true. For example:

> Every system is to be considered as a "clock" which by virtue of internal laws and periodically occurring processes is endowed with a specific frequency, that is, e.g., an atom that can emit or absorb a certain spectral line. [96]

Rotonians see the key to sorting out the mass and energy of gravitating bodies as the recognition that material bodies are also bundles (knots?) of electromagnetic energy comprised of a multitude of ticking clocks. Though plenty of mystery yet remains, much about the essence of matter has been illuminated by atomic physics, i.e., quantum theory (QT) and its empirical confirmations.

Among the key features of our knowledge (as discussed in §5.4 and §5.5, concerning renormalization) is that the *finiteness* of electromagnetic energy within matter has not yet been definitively ascertained. On the contrary, our theories give reason to instead suspect an *infinite reservoir*. From the same essay as that quoted earlier, Penrose thus writes:

> [The electromagnetic] field is intimately involved in the forces that bind particles together to form atoms. *There must be a substantial contribution to any body's mass from the electromagnetic fields within it.* (Though, unfortunately, this contribution is incalculable, on present theory — which gives infinity as its provisional, but unhelpful answer!) [97] [Emphasis added.]

The clock-like ticking of matter may thus be conceived as a kind of *regulation*, a rhythmical governing of the perpetual, inexhaustible outflow. In support of this idea, consider the following ideas of the renowned physicist David Bohm:

> We shall eventually have to understand the so-called "elementary" particles as structures arising in **relatively invariant patterns of movement** occurring at a still lower level than that of these particles. In such structures even the "rest energy" of an elementary particle would be treated as some kind of **"inner"** [clock-like] **to-and-fro reflecting movement**, on a level which is even below that on which nuclear transformations take place.
>
> If rest mass is "inner" movement, taking place even when an object is visibly at rest on a certain level, it follows that something without "rest mass" has no such inner movement, and that *all* its

> movement is outward, in the sense that it is involved in displacement through space. So light (and everything else that travels at the same speed) may be regarded as something that does not have the possibility of being "at rest" on any given level, by virtue of the cancellation of inner "reflecting" movements, because it does not possess any such inner movements. As a result it can exist only in the form of "outward" movement. [98] [Emphasis added.]

Knot-like matter ticks. Untied light does not. Let's return then to our rotating disk system with the heavy segmented ring near its rim. The system is also equipped with optical apparatus: specifically, (1) a Michelson interferometer with which to conduct tests using localized perpendicular light beams. And (2) a system of light paths that travel in opposite directions all the way around the circumference, so as to turn the whole ring into one large Sagnac interferometer.

Unrealistic as it may be in practice, we will consider the results yielded by these devices when the rotation speed of the rim is extreme: $r\omega = v = (\sqrt{3}/2)\,c = \sqrt{0.75}\,c \approx 0.866\,c$. Einstein's relativity theory and the SGM both invite *thought* experiments involving extreme (practically impossible) cases where the most important consequences are often found. The extreme speed $\sqrt{0.75}\,c$ is particularly convenient because it makes the common expression $\sqrt{1 - v^2/c^2}$ come out as $= 1/2$. Clocks are slowed to $1/2$ their normal frequency. Rod lengths are contracted (in the direction of motion) to $1/2$ their normal size; and the inertial masses of bodies increase to *twice* their normal weight. These predictions are uncontroversial consequences of Einstein's theory (even as some quibbling may be found as to how best to describe and understand them).

We will start by counting light waves as they would exist in beams transmitted around the circuit in opposite directions. Then we'll compare this result to that obtained using the local perpendicular light paths of a Michelson interferometer. Finally, we'll apply the implications of these results to continuous matter. In the next section we'll extend the argument to idealized astrophysical gravitating bodies.

Happily, the scalability of relativity and the SGM extends also to physical parameters such as wavelength and wave number. We therefore choose, for arithmetical convenience, a number of waves that cover the whole path around the circuit for a non-rotating ring that multiplies roundly for a ring rotating at our chosen speed. We bear in mind also that the frequency of the light for the rotating ring is $1/2$ of that when it does not rotate. This circumstance is illustrated in Figure 16.

The opposing light paths in the rotating case are more easily understood by first analyzing the simpler case when the disk is not rotating. In this case the speed of the waves with respect to observers on the disk is the same as it is with respect to any other observer at rest with respect to the axis. Also the rates of clocks are the same for everyone, so the time for a beam to complete the circuit (in either direction) is measured as being the same for all observers. Calling the length of the circuit $2\pi r = L$, we have $t_\circ = L/c$.

As shown in the Figure, our wavelength is such that 15 crests and troughs distribute evenly around the ring. This number can be expressed as either a length ratio

$$N_\circ = \frac{L}{\lambda_\circ} = 15\ , \tag{19}$$

or as a product of the frequency and the time:

$$N_\circ = f_\circ \frac{L}{c} = f_\circ\, t_\circ = 15\ . \tag{20}$$

Now when the disk rotates, the most prominent measurable effect is due to the speed of light with respect to rotating observers being less or greater than c, depending on whether it's transmitted with or against the direction of rotation. If we call the rotation speed $r\omega = v$, the time to complete the circuit (as measured by an axis observer) becomes:

$$(21)\quad \text{DOWNWIND:}\quad t_{\downarrow} = \frac{L}{c+v} = \frac{L}{c}\frac{1}{(1+v/c)} \qquad \text{and} \qquad \text{UPWIND:}\quad t_{\uparrow} = \frac{L}{c-v} = \frac{L}{c}\frac{1}{(1-v/c)}\ .$$

For speeds much less extreme than $\sqrt{0.75}\,c$ this effect is what a Sagnac interferometer is designed to detect. For laboratory-size devices (or for the mile-long experiment conducted by Michelson and Gale in 1925 [99]) it is measured as a *phase shift* — as between a complete-circuit light path and a shorter reference path. In the case of the whole Earth, beams relayed around the Global Positioning System reveal the speed difference as atomic clock-measured *time* differences. For signals sent around the equator in opposite directions, the time difference is about 4.1×10^{-7} sec. Failing to account for this would result in positioning errors of about 124 meters. The GPS is over 100 times more accurate than that because it does in fact account for the anisotropy of the speed of light.

The effect depends primarily on the first order speed ratio v/c and does not depend on "relativistic" effects, such as the slowing of clocks. Although localized component bodies (e.g., the individual segments of the dense circumferential ring) are subject to length contraction, the circum-

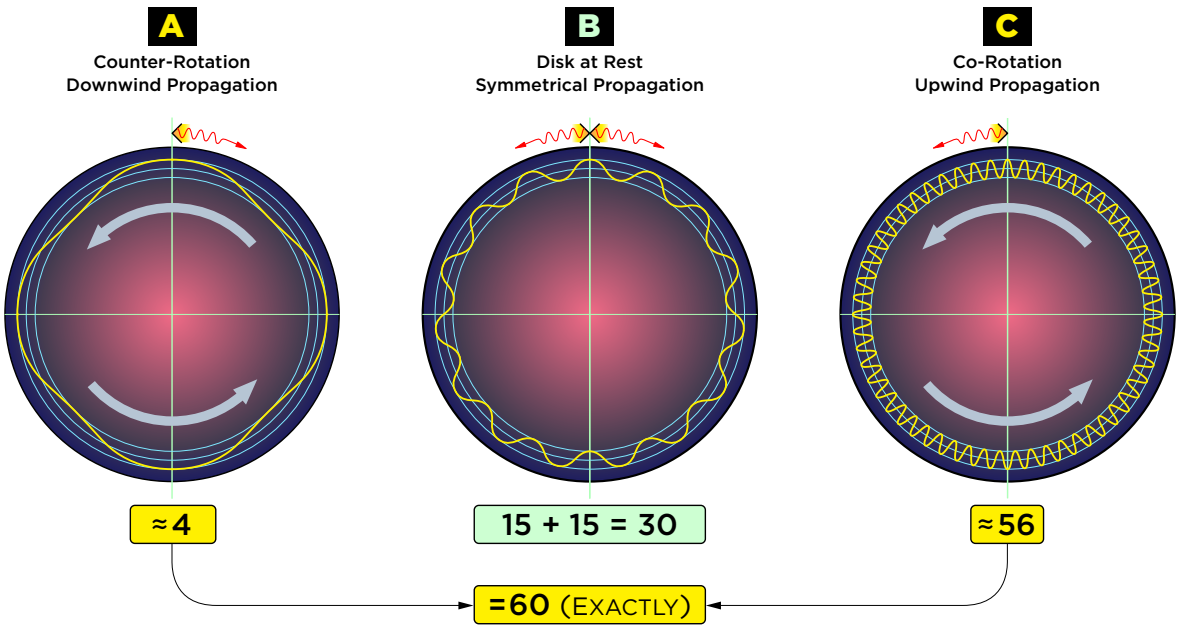


Fig. 16. **Rotating Frame Light Propagation for Rotation Speed** $= \sqrt{0.75}\,c$**: A.** — Emission opposite the direction of rotation. **B.** — For a non-rotating disk, emission in opposite directions appears symmetrical. **C.** — Emission in the same direction as the rotation. Stretching or bunching of the waves (variation in the number of wavelengths) is a consequence of the source's speed with respect to the rotation axis and the direction of propagation. The waves are stretched in the downwind direction and bunched up in the upwind direction. As seen from the axis frame, it may be regarded as a Doppler effect. Even when the speed-induced lower frequency is accounted for, the sum of waves for the downwind + upwind directions is twice that of the count for the out-and back light paths of a non-rotating disk.

ference as a whole is not. $L = 2\pi r$ is the length of the circumference as measured in the axis frame. If shortened (Lorentz-contracted) rods were used to measure the circumference (as by laying them end-to-end or by leap-frogging one after the other) the result would not be L but $L/\sqrt{1 - v^2/c^2}$.

While we are comparing measurements made in the axis frame with those made in the rotating frame, let's do the same for clock rates. A Michelson interferometer may be regarded as a set of perpendicularly aligned *light clocks*. One forth-and-back path may be regarded as a single "tick." Given that the rest-frame arm lengths are equal, ticks obtained from perpendicular directions (and any other angular orientation) are of the same duration only because the arm parallel with the direction of motion is shortened by $l = l_\circ \sqrt{1 - v^2/c^2}$. And this duration is shorter than it is for an identical clock in the axis frame by the same factor $t = t_\circ \sqrt{1 - v^2/c^2}$. Rod shortening and clock slowing (time dilation) thus *go with* each other. And so too inertial mass increase.

Early in the 20th century, when SR was first applied to the problem of a rotating disk and the question as to its circumference arose, many a head was scratched over what was sometimes referred to as the *Ehrenfest paradox*. [100] Contemplation of the problem by Einstein was at least part of his inspiration for GR, as its solution motivated application of non-Euclidean geometry. (See, e.g., Stachel [101].)

We'll return to Lorentz contraction again later. Presently we make sure to include the reduced clock rate of our light sources to count the waves propagated in opposite directions around our apparatus. Since the frequency reduction is given by $f = f_\circ \sqrt{1 - v^2/c^2}$ and the wave speed with respect to the ring is $c \pm v$, appeal to Eq 21 and substitution into Eq 19 gives

$$(22)\quad \text{DOWNWIND:}\quad N_\downarrow = \frac{L}{c+v} \cdot f_\circ \sqrt{1 - v^2/c^2} \quad \text{and} \quad \text{UPWIND:}\quad N_\uparrow = \frac{L}{c-v} \cdot f_\circ \sqrt{1 - v^2/c^2}\,.$$

From the parameters we've specified ($v = \sqrt{0.75}\,c$ and $L/\lambda_\circ = f_\circ\, t_\circ = f_\circ\, L/c = 15$) the result, as shown in the figure, is:

$$(23)\qquad N_\downarrow + N_\uparrow \approx 4.0192 + 55.9808 = 60 \text{ (exactly)}\,.$$

Curiously, though a *Sagnac* interferometer definitively establishes that, with respect to a rotating body, the speed of light is $c + v$ or $c - v$ in opposite directions, a *Michelson* interferometer was invented first and yielded a null result. Why is that? For a Michelson interferometer, instead of traversing around the circumference, the light path is split up to travel typically much shorter perpendicular paths. The comparison is between the *average* out-and-back speed in these paths. Would Einstein have so emphatically asserted that, for all inertial systems "all directions are optically equivalent" if the Sagnac interferometer had been invented first?

As explained in the river swimmer analogy from ***Part 1*** (pp. 13–15), the pre-relativity prediction is that the upwind-downwind (upstream-downstream) average would take longer to traverse than twice the crosswise path. Michelson and many others were surprised to *not* find this time difference. The null result famously inspired Lorentz and Fitzgerald to deduce their explanation involving the *contraction* of the device in the upwind-downwind direction. Subsequently, Einstein invented his theory whose heart is the "Lorentz transformation" which accommodated observations, and the rest is history.

Rotonians accept the logic of the length contraction hypothesis, especially as it would apply to a Michelson interferometer mounted near the rim of the rotating disk. What it means is that each

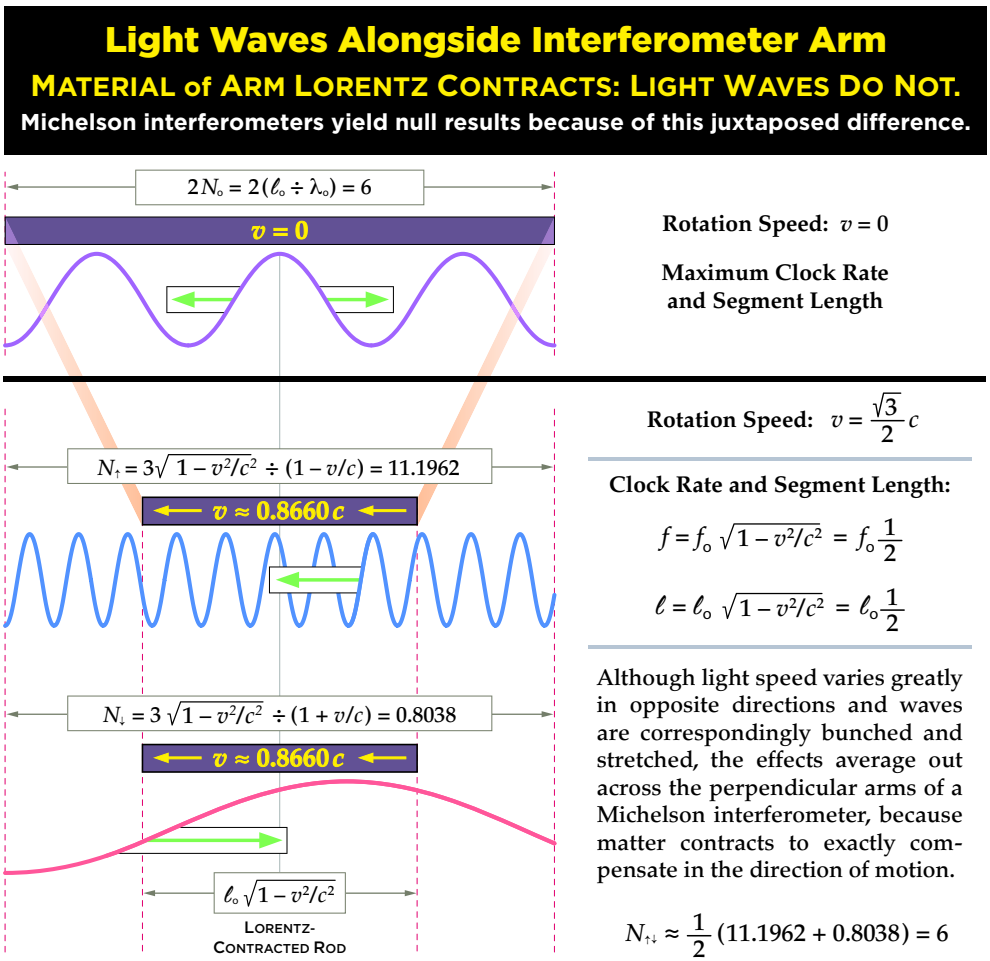


Fig. 17. **Effect of Rotation Speed on Light and Matter Juxtaposed Over a Short (Nearly Straight) Segment:** Light propagating in the relatively vacuous space outside the material structure of the disk or the arms of the interferometer is subject to bunching and stretching, but not Lorentz contraction. Whereas, a separated segment of the rotating ring *is* contracted, in this case, by $\sqrt{1 - v^2/c^2} = 1/2$ and the frequency of the rotating light source is also reduced by the same factor. The Lorentz contraction of the interferometer arm in the direction of motion is what causes the *average* speed to be measured as being the same as the speed in the perpendicular direction and thus responsible for Michelson interferometer null results. Whereas the *one-way* speed of light, and therefore also the one-way wave bunching-stretching are extremely asymmetrical. The net excess wave number increases the *inertial mass* in the same proportion. See Figure 18.

separate segment of the ring would contract so as to open up gaps between them. This shortening is enough to make the times to traverse the perpendicular paths of the Michelson interferometer exactly the same, which explains the null result.

It is important to appreciate the significance of the light beams traversing the arms of a Michelson interferometer being effectively discontinuous from the matter of the arms themselves. This light is therefore not subject to the Lorentz contraction. Also, any inertial mass that resides in the light waves is negligible as compared to the mass of the matter itself. And that matter, by virtue of traveling at the speed $\sqrt{0.75}c$ weighs twice as much as it would if it were not rotating. The matter

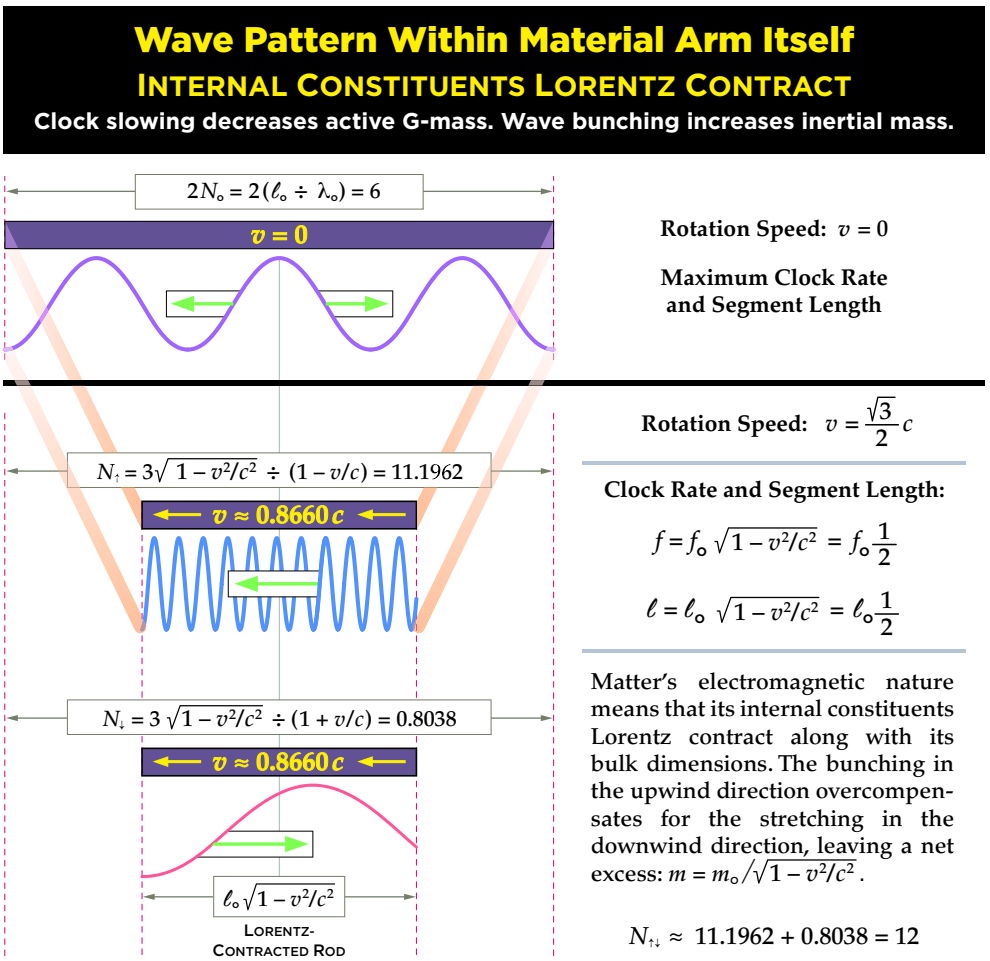


Fig. 18. **"Inner To-and-Fro Reflecting Movements" Within a Short (Nearly Straight) Segment:** Electromagnetic fields of matter are subject to the same speed-induced asymmetries (stretching and bunching) as light waves in the vacuum. The extreme case: $v = \sqrt{0.75}\,c \approx 0.8660\,c$ means a separated segment of the rotating ring is contracted by $\sqrt{1 - v^2/c^2} = 1/2$ and the frequency of the rotating light source is also reduced by the same factor. After these effects are accounted for, the number of wave crests is the sum of extremely stretched waves in the downwind direction plus extremely bunched waves in the upwind direction. The result comes out as double the number found for the non-rotating case. The physical size is reduced by $\sqrt{1 - v^2/c^2} = 1/2$. But the number of wave crests is increased by the inverse $1/\sqrt{1 - v^2/c^2} = 2$. We thus find an intuitive explanation for speed-induced inertial mass increase, as would be revealed by weighing the whole rotating system on an analytical balance.

of the ring segments and the interferometer take up $1/2$ the volume, but weigh twice as much as they would if they were not rotating.

Rotonians think this means the same wave bunching and stretching pattern caused by the disk's rotation taking place in the relatively vacuous space *outside* the interferometer arms also takes place *within* the material components of the arms themselves. The pattern for both the external light waves and the internal matter waves is illustrated in Figures 17 and 18. Therein lies the essential features of the Rotonian explanation for the inequality of inertial and active gravitational mass.

Suppose both disk/ring systems are in outer space, far from other astronomical bodies. To gauge how heavy they are we attach identical rocket engines to their centers, perpendicular to their planes. For the same amount of thrust, the rocket attached to the non-rotating disk forces it to move with twice the acceleration because it weighs 1/2 as much. Whereas the rotating system weighs twice as much because its internal to-and-fro movements are twice as concentrated. The extreme bunching in the upwind direction overcompensates for the extreme stretching in the downwind direction, leaving a net change given by the coefficient $1/\sqrt{1-v^2/c^2}$. The matter is twice as heavy, but because its clocks tick at 1/2 the frequency, it is generating space 1/2 as fast. I.e., its active gravitational mass is 1/2 that of the non-rotating system.

Rotonians are satisfied that this logic is sound, intuitively plausible, and not contradicted by any empirical evidence. By Newton's *Rules of Reasoning in Philosophy*, it is applicable to the analogous case of gravitating bodies. Rotation and linear motion (as by rocket or ballistic hurl) are well-characterized as motion through space; *through* "pre-existing" space. Whereas gravity is well-characterized as motion *OF* space; the generation of new space out of matter. The dimensions and meaning of Newton's constant: $G \rightarrow L^3/T^2M$ (acceleration of volume per mass) are most logically inferred to correspond — not to a *negative* (attraction, suckage) effect but — to a *positive* (creation, blowage) effect. In any case, both kinds of motion are limited by the speed of light, as exemplified by the standard equation for speed increase under constant rocket-like propulsion (repeat of Eq 5):

$$v = \frac{at}{\sqrt{1+a^2t^2/c^2}} < c\,, \tag{24}$$

and the analogous SGM equation for stationary upward velocity (repeat of Eq 6):

$$V_s = \frac{\sqrt{2GM/r}}{\sqrt{1+2GM/rc^2}} < c\,. \tag{25}$$

This light speed constraint and the simple fact that the *effects* due to motion through space are also found on gravitating bodies — which have traditionally been thought of as static chunks of stuff — suggest that in both cases, the *cause* of the effects is *motion*. The same logic with respect to inertial and active gravitational mass would then follow: The net bunching of internal waves causes inertial masses to increase in proportion to the increases graphed in Figure 15, and illustrated in Figures 17 and 18. The corresponding slowing of clocks causes the active gravitational masses to be smaller in inverse proportion. In the next section we will apply this reasoning to idealized astrophysical bodies.

10. Dark Compact Astrophysical Objects

> *Singularities . . . are intolerable from the point of view of classical field theory because a singular region represents a break-down of the postulated laws of nature . . . A theory [such as GR] that involves singularities and involves them unavoidably, moreover,* ***carries within itself the seeds of its own destruction.*** *—*
>
> PETER G. BERGMANN : Long-time assistant to Albert Einstein [Emphasis added.] : 1980 [102]

> *The almost unanimous opinion among physicists is that only a quantum theory of gravity, a marriage of General Relativity with quantum mechanics, can provide the necessary mechanism for preventing the occurrence of singularities and* ***save the consistency of General Relativity****. —*
>
> TIAN YU CAO : [Emphasis added.] : 1997 [103]

Let us reflect again on the remarks from Penrose, Einstein and Bohm concerning the possibly *infinite reservoir* of internally ticking electromagnetic energy. Especially after the above application of these ideas to the case of a rotating body, we are now poised to build on our non-standard interpretation. Rotonians think of material bodies as assemblies of an astronomical number of clocks, quintessential clocks, whose inner to-and-fro movements keep exquisite time. Whereas *light* is the quintessential *non-clock*, being more like a wobble through jello, a wobble whose frequency is determined by the electromagnetic jiggling (or a shift thereof) of matter at the emitting end and is detectable as such at the receiving end. The "jello" is *produced* by matter, via gravity — produced *because of* matter's clock-likeness. But light itself is "just passing through." Rotonians infer that light, due to its lack of internal to-and-fro movements, does *not produce space* and therefore has no active gravitational mass.

Logically consistent and easily testable as the Rotonian model may be, it is unknown or ignored by the establishment. Remarks from scholarly experts such as Einstein, Penrose, Bohm, Bergmann, Schrödinger, Cao, and the many others can therefore lend support to the SGM only indirectly. Mostly the chosen comments have the character of harsh criticisms of prevailing theories that do not apply to the SGM. Just above, for example, we have Bergmann effectively predicting the ultimate *destruction* of GR, and Cao admitting to its lack of *consistency*. Another expert witness to GR's fragility underscores the seriousness of the situation, as we see in cosmologist Joseph Silk's review of a recent book by Stephen Hawking, wherein he writes:

> The classical [i.e., relativistic] view of a black hole is marred by one ugly feature: At the core of the black hole lies a singularity . . . [where] literally **all hell may break loose.** [104] [Emphasis added.]

The decades old dream is that a "marriage with quantum mechanics" will somehow save GR from its otherwise inevitably hellish demise. Efforts along these lines have appealed to *gravitons, loops, string-branes* and other grotesque abstract concoctions whose primary product is mountains of useless (empirically fruitless) documents, publicity campaigns, and an irrationally stubborn insistence that the members of the couple to be joined are both suitable for joining.

GR is understood as a theory of large-scale matter and the Universe. Whereas QT is a theory pertaining primarily to small-scale matter. The problem is not — as the Rotonians see it — that QT is unfit to be applied to large-scale matter and the Universe, but rather that GR's singularity disease is utterly fatal. The "marriage" will never be consummated because the idea is a nightmarish cartoon, something like marrying a healthy bride (QT) to a decaying corpse.

The SGM is clearly more viable because it has no singularities from which it needs to be rescued. Compatibility is indicated, rather, by (among other things) the harmonious interrelationships between time, frequency, energy, and mass. As we will see again in the development of SGM cosmology, a key to the SGM scheme is deBroglie's expression relating mass to frequency:

$$f = \frac{mc^2}{h} \qquad \therefore \qquad m = \frac{hf}{c^2}\,, \tag{26}$$

where h is Planck's constant. To augment Einstein's statement about the clock-like nature of all matter, we may add UC Berkeley physicist Holger Mueller's pithy assessment:

> There is no exception to the rule that "rocks" (massive wave packets) are clocks. [105]

Recalling that Rotonians see gravity as a process that unfolds in time and that the rates of fundamental clocks dictate the rate of space generation (which is what gravity is) let us "marry" these ideas to Eq 26. The SGM proposes that, while active gravitational mass globally *increases* with cosmic time, it is locally *diminished* in proportion to frequency reductions due to speed — most importantly, *stationary motion* as by rotation or gravity.

We thus reiterate the idea that, for those stretches of matter that remain continuous (such as the individual segments of our rotating ring) and do not open up to form gaps, the same kind of bunching and stretching pattern takes place, as for the forth-and-back light circuit around the disk. Atoms and molecules cohere because of electromagnetic forces. The infinite reservoir of energy released intermittently as rhythmical to-and-froing inside clock-like matter is a manifestation of these forces. So it makes sense to expect analogous bunching and stretching behavior, especially as by doing so we are enabled to explain "relativistic" increase of inertial mass.

Contrary to Taylor and Wheeler's assertion that the mass-energy increase is not structural, but depends only on the "geometrical properties of spacetime," we can clearly illustrate the physical change taking place inside matter. Like counting apples in a basket, we can measure how changes in speed yield concrete, physical numbers representing inertial mass increase.

A similarly intuitive picture obtains for the corresponding frequency reduction that indicates a *decrease* in active gravitational mass. Since the idea and its consequences are so straightforward for the case of rotation (stationary motion *through* space) we expect the same to be true (even if a little more complicated) for the case of gravity-induced stationary motion *OF* space. Figure 19 is a schematic representation of the idea, to be followed by a more mathematical analysis by which we can quantify the magnitude of these effects. When massive bodies are small and far enough from one another that the gravitational fields they produce result in speeds much smaller than that of light, they generate near the maximum amount of space per mass because their clocks are also ticking at near the maximum rate. When these bodies and the space they generate are concentrated into a small volume, the stationary speeds can approach that of light, clocks slow down, internal waves get bunched up and the rate of space generation is diminished.

The weighable increase in inertial mass deduced from the example depicted in Figures 16, 17, and 18 — as expected for our rotating disk and ring — is kept simple and true by specifying that the bulk of the system's mass is concentrated in a dense segmented ring. The analysis would have become more complicated if we had wanted to calculate the effects pertaining, for example, to a whole uniformly thick (ringless) disk — because the rotation speed varies with radius.

For the case of gravity, which also varies with radius, we similarly expect an increase in complexity. The situation is simplified somewhat by specifying *constant density*. Even though this is

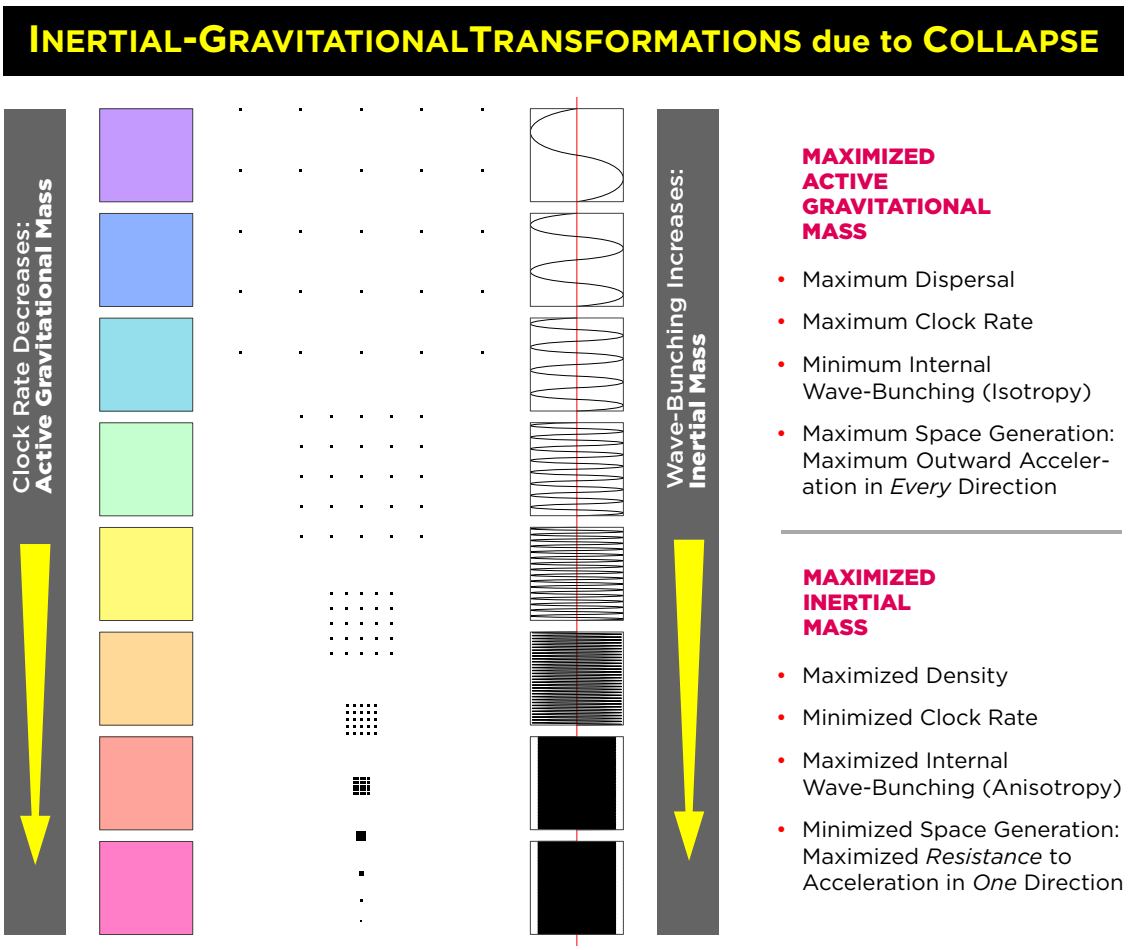


Fig. 19. **Conceptual/Visual Schematic:** Comparing inertial mass with active gravitational mass, as their magnitudes change depending on the size, density, and stationary velocity of the configuration. Spectrum of colored squares indicates clock rate, *decreasing* toward the bottom, which Rotonians suppose is proportional to the change in active gravitational mass (as suggested by Quantum Theory). Corresponding waveforms indicate the net bunching of internal matter waves (as suggested by David Bohm) *increasing* toward the bottom, proportional to the change in inertial mass. Both effects are expected consequences of *stationary motion*, whether that of uniform rotation or gravity. This illustration facilitates understanding the graphs in Figures 20–22, which represent the gravitational predictions corresponding to the idealized case of uniform density.

not strictly valid for astronomical bodies (being invariably denser near their centers) we are undeterred in our assumption, just as Karl Schwarzschild was undeterred by the same problem in 1916 pertaining to his well known *interior solution* to Einstein's field equations.

Idealized though it may be, Schwarzschild's solution and the SGM analysis to follow provide a basis for understanding the consequences of mass accumulations the size of stars and greater. The solutions become especially illustrative for large m/r ratios such as pertain to *neutron stars* and other extreme-case astronomical species.

From basic Euclidean geometry and as explained by Robert M. Wald [106], the mass within a spherical body of constant density, $\rho_\circ$ for both Newtonian theory and GR is given by

$$m(r) = \frac{4}{3}\pi r^3 \rho_\circ \,. \tag{27}$$

Schwarzschild regarded the constant density of his interior solution as representing an *incompressible fluid*. If the matter is indeed incompressible, and if there are no "relativistic" effects (such as length contraction and clock slowing) then Eq 27 would be true for any size. The curve of this equation (blue) is shown in each of the figures: 20–22 (six graphs). Since the increase of mass is proportional to the cube of the radius, the log-log plot of the last graph of the bunch represents the increase as a straight line.

The Newtonian curve's significance in the context of GR can be understood in reference to the first graph (Figure 20, Left). This figure also includes the so-called *mass-defect* curve, which corresponds to the total mass of the body if its components were widely dispersed. As explained by Ghose and Kumar — whose 1976 paper [86] derives the maximum mass-defect result (as indicated in Figure 20) — the idea is that the *gravitational potential energy* is a maximum in the configuration of maximum dispersal. Customarily this corresponds to a potential energy $\Phi \approx 0$ (interdistances $\rightarrow \infty$). But as collapse ensues the potential becomes increasingly *negative*. And since energy is supposed to have its mass "equivalent," the body has a *minimum* mass in the maximally collapsed state. The ratio between the mass left over after collapse and the initial, pre-collapse maximum mass $m_\circ$ is $(m_{\text{COLLAPSE}}/m_\circ)_{\text{MIN}} = 4/3\pi \approx 0.4228$. (See Zwicky's original calculation from 1938. [87])

In other words — referring to the red dots in the Figure — if the mass deduced from orbital motion around the body (i.e., the active gravitational mass) were that of the lower dot, then if sufficient energy were provided to break it up and disperse the components to "infinity," the sum of the component masses would now add up to the upper dot. The process of collapse under gravity thus causes the mass of the end-product to decrease. An interesting question that we will not pursue here is where does this lost ("gravitational binding") energy *go*?

Perhaps the most noteworthy thing about the GR curve is that *it just stops.* In the simplified ("geometrized") units of Figure 20 (Left) this happens when $M = 1$ and $r = 2$. It corresponds to the well known *Schwarzschild horizon* at which stationary clocks stop ticking, within which time turns to space, space turns to time, and there's no escape from the ugly center, where "all hell breaks loose."

Rather than wait another century (or eternity) for QT to come to the rescue, Rotonians suggest escaping this dubious mythology by a simple change of arithmetical sign $(+/-)$ and all the physical implications that follow. In GR the key term, the *argument* of the Schwarzschild metric coefficient $(2GM/rc^2)$ is *subtracted* from unity: $(1 - 2GM/rc^2)$. This follows according to the "geometric" interpretation of gravity, whereby the field is treated as being *utterly static* and $2GM/rc^2$ is regarded as a *length* ratio — the Schwarzschild radius $2GM/c^2$ divided by a "coordinate radius" r. When $2GM/c^2 \geq r$ the coefficient ≤ 0, which is hellish nonsense. Rotonians thus call this regime of GR *Divide-by-Zero Land*. See for example the upper-right grayed out wedge on the Cosmic Everything Chart: Figure 12, p. 32.

More reasonable, Rotonians suppose, is that a gravitational field is best characterized as something that *moves endlessly outward*, such that $2GM/rc^2$ should be regarded as a *velocity squared* ratio. Though the latter quantity can exceed unity without limit, it is not subtracted from, but rather *added to* unity and appears in the denominator for the speed expression. The final speed thus remains always less than c, analogous to the approach to c by uniform acceleration:

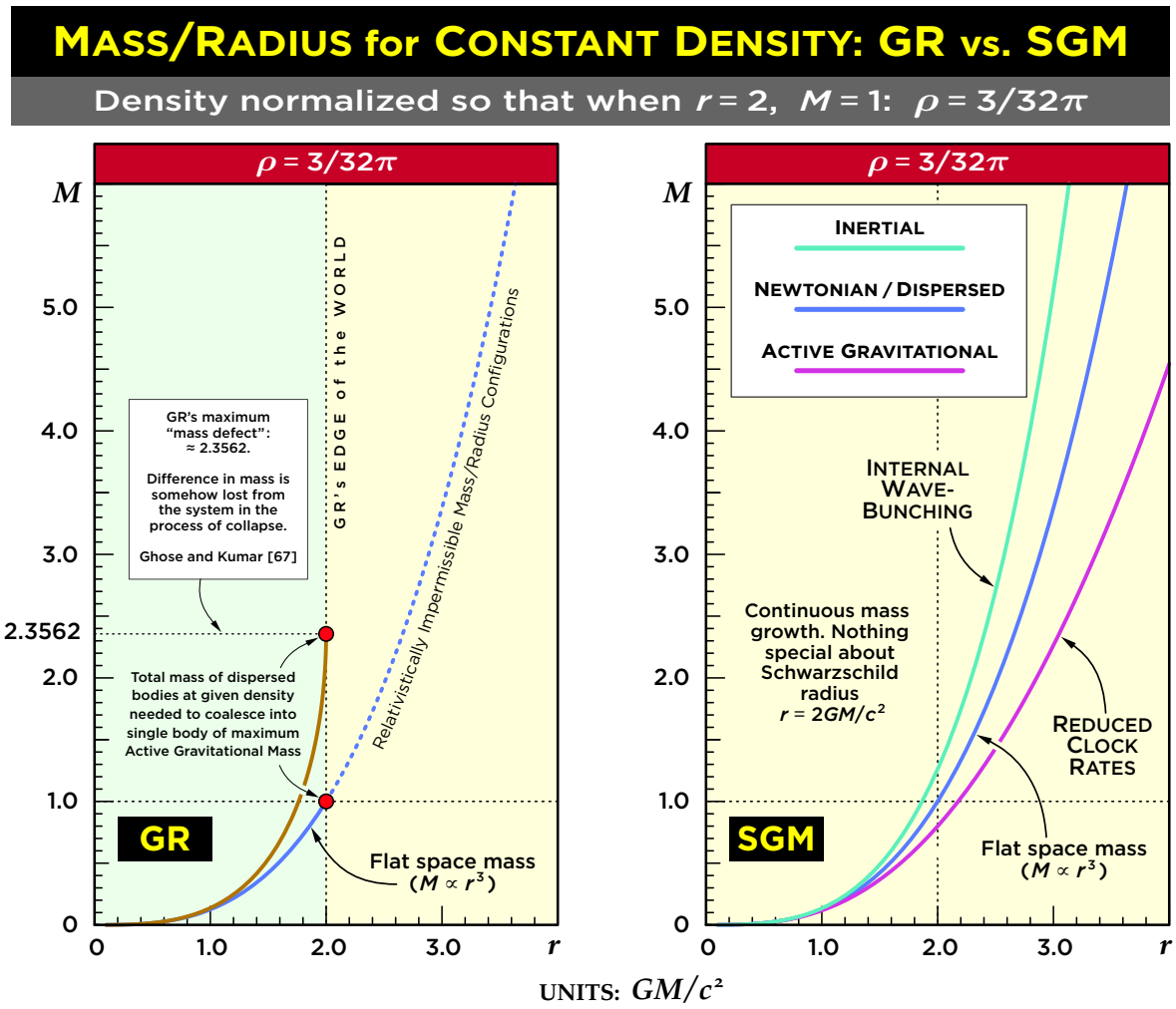


Fig. 20. **Concepts of Mass Compared with Normalized Units:** Massive bodies of uniform density are not realistic for astronomical objects whose centers, because of gravity, are invariably denser than their outer regions. For simplicity, uniform density is nevertheless assumed (as in the Schwarzschild Interior Solution) to get an idea of the changes accruing for ever larger bodies due to gravity. Common objects are represented by the curves very close to the origin, where differences are so small as to be unmeasurable. LEFT — Due to the plague of singularities in General Relativity, this theory predicts a *maximum* ratio comparing the sum of masses of dispersed bodies and their total weight when concentrated into a much smaller spherical object (red dots). RIGHT — In the Space Generation Model internal wave-bunching causes an *increase* in inertial mass and reduced clock rates cause a *decrease* in active gravitational mass, as compared with the component bodies when they are widely dispersed. In the SGM these changes are not limited by horizons or singularities.

(28) $$v = \frac{at}{\sqrt{1 + a^2t^2/c^2}} < c\,,$$

As explained earlier, the analogous SGM equation for stationary upward velocity,

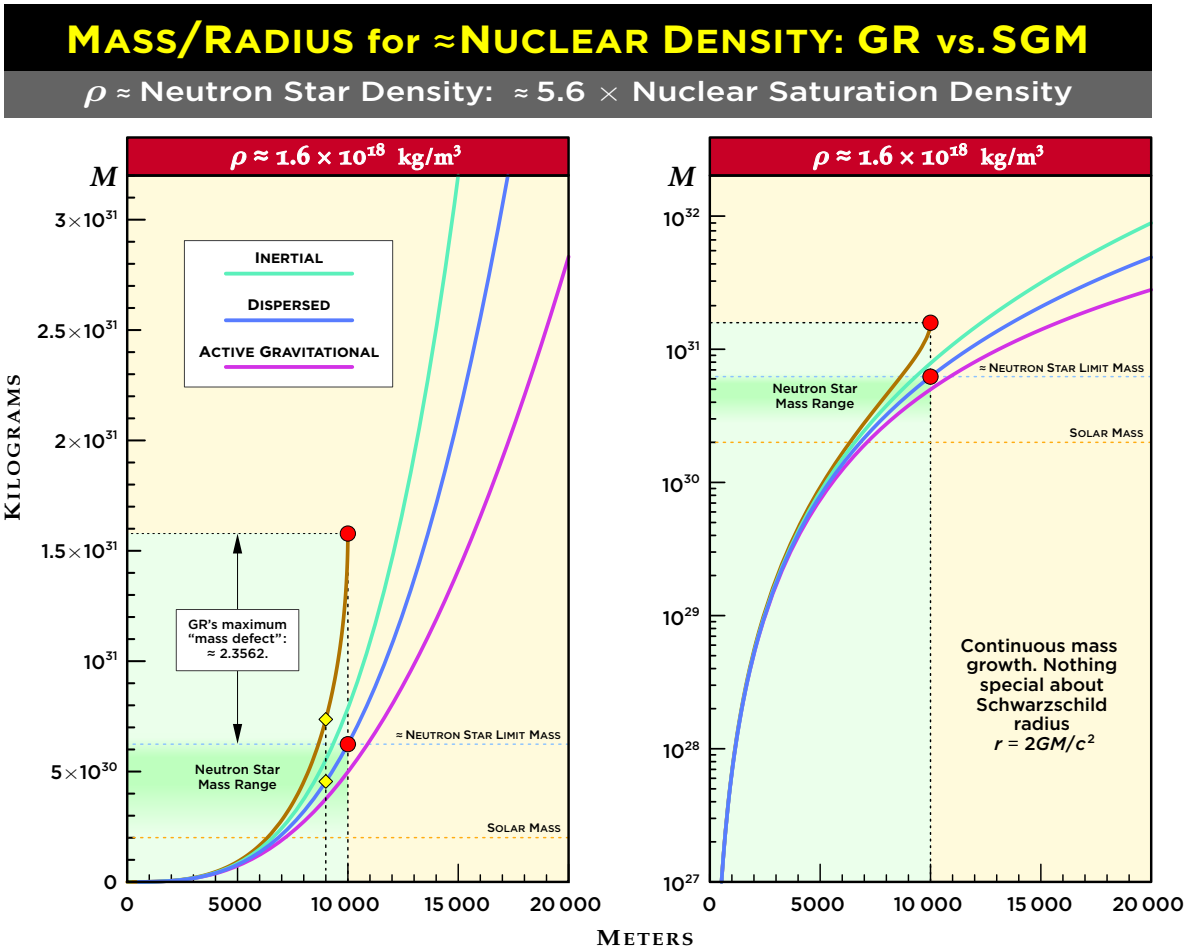


Fig. 21. **Focus on Neutron Star Density Regimes.** Axes are now labeled with physically realistic dimensions. LEFT — For a density corresponding to the core (or perhaps average) of a general relativistically barely permissible neutron star, the size is about that of a typical Earthian city. (See Figure 29.) If a little more mass of the same density were added (yellow diamond to red dot) the star would be pushed past the edge. According to GR it would suddenly collapse to a singularity. The instability of neutron stars has to do with nuclear physics and the effect of extreme gravity — according to both GR and the SGM. The precariousness of its state is greater according to GR, but similar in the SGM. In the SGM the transition would not be to an absurd singularity, but to a zone of stability about seven orders of magnitude ($\approx 1/\alpha^3$) greater, as indicated on the Cosmic Everything Chart (Figure 12, p. 32.) RIGHT — The same circumstance with a log-mass ordinate, to facilitate seeing a broader expanse. Bear in mind that the astrophysically "measured" masses are deduced by motion of surrounding bodies, and so correspond to ***active*** gravitational masses.

(29) $$V_s = \frac{\sqrt{2GM/r}}{\sqrt{1+2GM/rc^2}} < c\,,$$

increases, not with time, but with increasing M/r ratio, which can itself increase without limit, without ever resulting in a horizon, a singularity, or causing superluminal speeds.

By this reasoning the SGM analogs for the GR (Schwarzschild) coefficients are $(1+2GM/rc^2)$

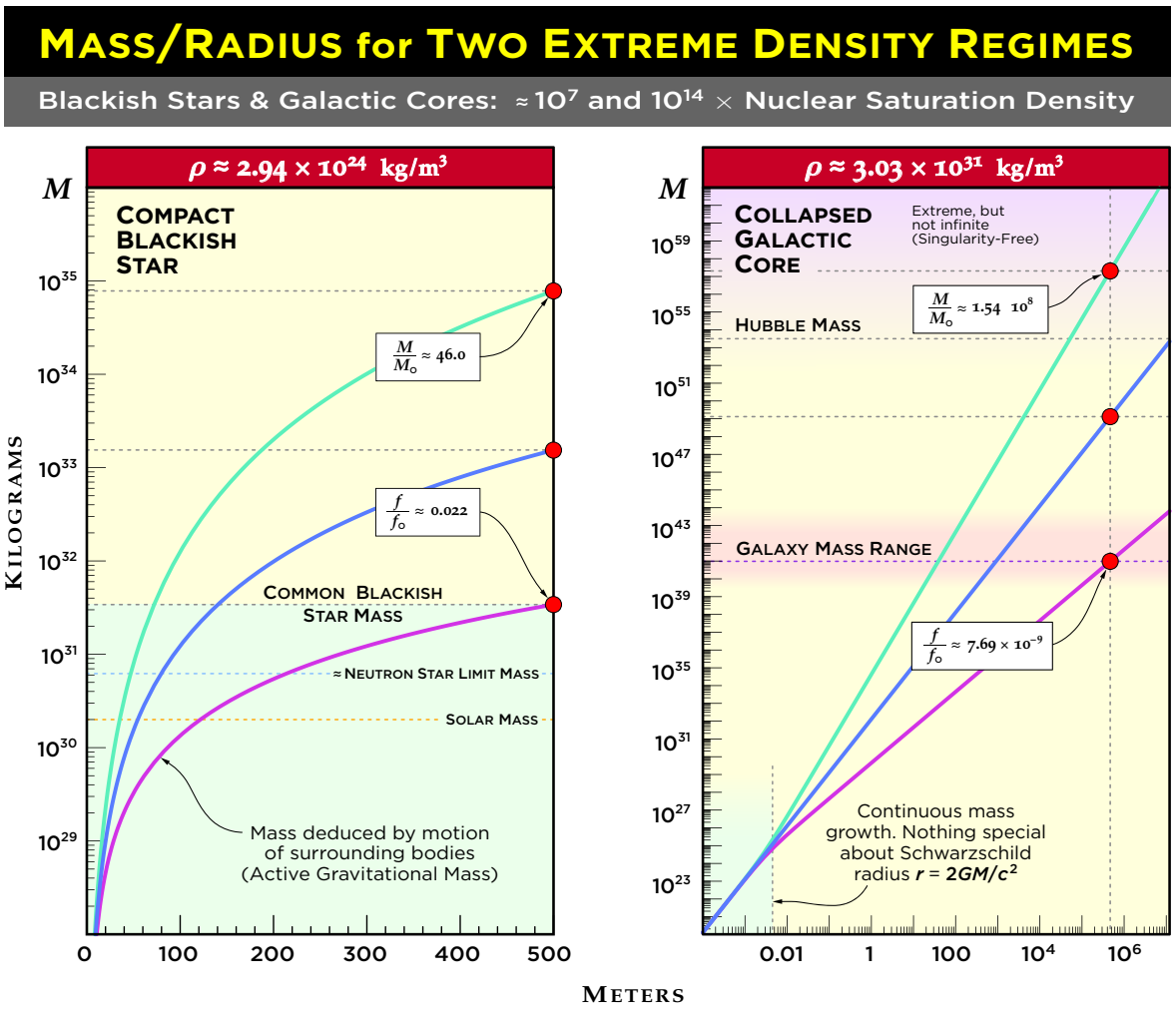


Fig. 22. **Dark Compact Astrophysical Objects — Extreme Mass, Radius, and Density Regimes:** LEFT — When nuclear "degeneracy pressure" is no longer strong enough to withstand the enormous gravitational force of neutron stars, collapse to the next stability zone — about seven orders of magnitude ($\approx 1/\alpha^3$) denser — takes place. The length axis units indicate the small physical size of these dark compact objects. RIGHT — The centers of most, if not all galaxies contain even more hugely massive, but amazingly small dark bodies, whose densities are another $\approx 1/\alpha^3$ greater — approaching a ***cosmic maximum***, as indicated on the Cosmic Everything Chart. (Figure 12, p. 32.) Since the masses of these objects are deduced by observing the motions of surrounding bodies, it is a measurement of *active* gravitational mass, whose corresponding dispersed mass total and inertial masses are orders of magnitude more enormous. The time needed to accumulate such large masses far exceeds the alleged age of the Universe.

and its reciprocal. When we add instead of subtract there is no hellish division by zero. As shown in Figure 23, the left extremities (or asymptotes) of the curves are shifted from $r = 2GM/c^2$ to the axis.

For bodies such as the Sun or Earth the difference in exterior-field curvature between the two models is too small to measure. For strong fields and interior solutions, however, the corresponding curvatures are very different. The static GR picture yields singularities; the motion-based SGM picture is singularity-free. We now extend the SGM logic to contemplate the implications for inertial

and active gravitational mass. I.e., we explain the derivations of the equations that yielded the graphs in Figures 20–22.

Unlike *exterior* solutions for which M is fixed and only r changes, we now have M depending on r. For a uniformly dense sphere the mass at $r = (1/2)R$, for example, is $1/8$ of the whole sphere. Assuming constant density, the mass within a given distance r from the center is simply the volume times the density:

$$m(r) = V\rho = \frac{4}{3}\pi r^3 \rho\,. \tag{30}$$

This follows also by integration:

$$m(r) = 4\pi\rho \int r^2\, dr \;=\; \frac{4}{3}\pi r^3 \rho\,, \tag{31}$$

which is unnecessary except that it facilitates seeing how integration sums up the infinitesimal shells of surface area $4\pi r^2$.

The corresponding GR or SGM integrals account for the variation in rod length and/or clock rate depending on radial distance. The extreme circumstance (according to GR) corresponding to surface radius $r = R = 2$ enclosing total mass $M = 1$ such that $2GM/rc^2 = 1$, as illustrated in Figure 20, facilitates calculating a convenient dimensionless density by substitution. Assuming momentarily that $c = G = 1$, we get:

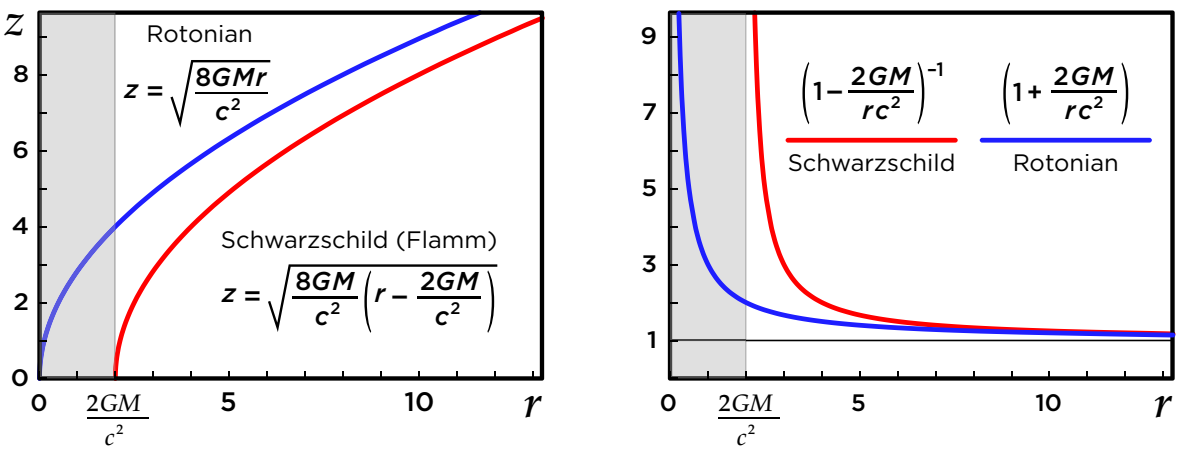


Fig. 23. **GR vs. SGM. Shifted Coefficient Curves:** In the strong field regime the curvature implied by the SGM deviates markedly from GR. Left — Profile of the usual Flamm paraboloid (red) compared with the profile of the SGM (blue). Right — The Schwarzschild coefficient goes to infinity at the "horizon," $r = 2GM/c^2$. In the SGM, since M must be zero if $r = 0$ (because it is impossible for any mass to be contained within zero volume) coefficients of the form $1/0$ are never encountered. Spacetime in the SGM is well-behaved from the body's surface (however small) to ∞. The interior is similarly well-behaved. When $2GM/c^2$ is small compared to r the curves in both graphs nearly coincide (weak exterior field agreement).

$$\frac{2GM}{rc^2} = 1 = \frac{2G(4/3)\pi\rho r^3}{rc^2} = \frac{8\pi}{3}\cdot\frac{G\rho r^2}{c^2} \quad \therefore \quad \rho = \frac{3}{32\pi}\,. \tag{32}$$

The quantity $8\pi G\rho r^2/3c^2$ in Eq 32 serves as the argument of the SGM (and GR) coefficient corresponding to the magnitude of the rod length and clock rate effects at any given radius. GR's proper mass with respect to coordinate radius (Figure 20, Left) is gotten by integration:

$$M_{\text{GR}} = 4\pi\rho\int \frac{r^2}{\sqrt{1-\frac{8\pi}{3}\frac{G\rho r^2}{c^2}}}\;dr\,. \tag{33}$$

Near $r = 0$ spacetime is nearly perfectly flat, so the mass near the center adds up nearly identically to that shown by the Newtonian curve. As expected, the result of the integration (gotten from the computer math program, *Mathematica*) diverges from the Newtonian result to reflect the increasing spacetime curvature for larger masses.

The output equation is complicated and — to reiterate — exhibits the curious property of ***ending*** when $8\pi G\rho R^2/3c^2 = 1$, i.e. — in dimensionless terms — when $r = 2$ and $M_{\text{GR}} = 3\pi/4 \approx 2.3652$. Remember also that the latter is the *larger* quantity of mass needed to give the appearance (i.e., to have the gravitational effect) of the *smaller* (active gravitational) mass, collapsed so as to obey the Newtonian curve — but only out to the *edge* of the hellish abyss $r = 2GM/c^2$. (Refer again to Figure 20, p. 64.)

Rotonians think this reasoning is ugly and incorrect. They are eager to propose the alternative, which includes the same argument in its coefficient: $8\pi G\rho R^2/3c^2$. Upon being *added* to unity, the whole coefficient $\sqrt{1+8\pi G\rho R^2/3c^2}$ appears either in the denominator or the numerator, depending on whether it represents the slowing of clocks (and active gravitational mass) or the net bunching of internal waves (inertial mass):

$$M_{\text{A}} = 4\pi\rho\int \frac{r^2}{\sqrt{1+\frac{8\pi}{3}\frac{G\rho r^2}{c^2}}}\;dr \qquad \text{and} \qquad M_{\text{I}} = 4\pi\rho\int r^2\sqrt{1+\frac{8\pi}{3}\frac{G\rho r^2}{c^2}}\;dr\,, \tag{34}$$

respectively.

As shown in Figures 20–22, the curves from the corresponding (also complicated) *Mathematica* integrations straddle the Newtonian curve as an ever widening sandwich — out to the largest astrophysical systems in the known cosmos. Remember that these results are based on a simplifying idealization (uniform density). Real physical systems — with their decidedly more centralized matter concentrations — would nevertheless exhibit the same characteristics in general.

11. Quantum Theory, Stars, and the Universe: Cosmic Everything Chart 101

> *A big misconception is that a black hole is made of matter that has just been compacted to a very small size. That's not true. A black hole is made from warped space and time.*
>
> *Matter . . . shrinks down to the very center where it gets destroyed in a singularity, a region of infinite warped space and time. And it's gone. When it's gone there is nothing left except the warped space and the warped time.*
>
> Kip Thorne : "Legendary Astrophysicist" : *Discover* Interview and PBS *Nova* [107, 108]

11˙1. *Introduction*

In his book *Black Holes and Time Warps*, Kip Thorne reaffirms the principle upon which his Hollywoodesque conclusions (above) are founded:

> *The principle of the absoluteness of the speed of light:* Whatever might be their nature, space and time must be so constituted as to make the speed of light absolutely the same in all directions, and absolutely independent of the motion of the person who measures it. [109] (Original emphasis.)

Everyone *must* find the speed of light to be isotropically equal to *c*, *geometry destroys matter*, and Donald Trump won the 2020 USA presidential election. *Amen*. Welcome to Perfectly Insulated Windowless Box, Static Chunk O' Stuff, Divide-by-Zero Land. Rotonians refuse to heed the loyalty oath to Funny Farm Fizzix that Thorne was suckered into; to consume the *Kult of Big Al* Koolaid that he and his colleagues have all imbibed. Rotonians would instead highlight how their patently more sensible, singularity-free conception of gravity (and light propagation) compares with GR in the realm of collapsed astrophysical bodies, beginning with white dwarfs and neutron stars. Ironically, an understanding of these fascinating tiny stars begins with some understanding of the much tinier world of atoms and molecules.

Among the important things to notice on the Cosmic Everything Chart (Figure 12, p. 32) are the *echos* from one extreme to another. The echo between the {electron mass/proton mass} and {cosmic energy-density/matter-density} will concern us later. Presently, consider the two vertical zones of mass data on either side of the long stretch of nearly constant density in the middle of the Chart. On the left we have particle masses, on the right we have astronomical masses. The midline of the right side column is the Chandrasekhar mass limit. The mass ratio from left to right is nearly 60 orders of magnitude (which grows to nearly 80 orders of magnitude for the largest discernible cosmic structures). The *size* ratio between particles and stars is about 20 orders of magnitude.

The indefiniteness in the sizes of astronomical objects is easy to appreciate, even as certain zones of size are straddled by zones of emptiness. The fuzziness of the size of *microscopic* objects is, however, a more fundamental and a more obscure matter. How exactly we are to conceive microscopic objects — commonly called *particles* — remains, after centuries of thought and investigation, a controversial question. What we learn by studying the connection between particle physics and astrophysics will serve as a foundation upon which the Rotonian cosmological model will eventually emerge.

A recurring theme of this essay is that bad Earthian physics ("*mass* is a mess," cosmology is a patched up Humpty Dumpty, Einstein's theory of gravity "carries within itself the seeds of its

own destruction," *the direction of time* is a bewildering enigma, etc.) is perpetuated primarily by misconceptions about ***motion***. Rotonians see the biggest failure as that of refusing to trace the problems back to static chunks of stuff, the attraction of gravity, and disbelief in accelerometer readings. If the *building blocks* of matter are not static chunks of stuff, then what are they?

11˙2. *Chunks of Stuff — or What?*

That serious unresolved problems yet plague the subject of "particle physics" may be inferred by the quip that there are as many answers to the question, "what is a particle?" as there are physicists:

> "What is a particle?" seems like a simple question . . . [writes the *Discover Magazine* interviewer]. "But if you pose that to twelve different physicists," says MIT physicist Alan Guth, "you'll probably get twelve different answers." [110]

Even if each answer contains a *facet* of the truth, Rotonians find the wide range of answers and the contradictions therein intolerable. Surely a more unequivocal understanding is possible. Surely the truth of the matter would emerge if only we would *ask the right questions* and *perform the right experiments*. Before combining certain features of QT with our new conception of gravity, as they apply to understanding collapsed astrophysical objects like white dwarfs and neutron stars, I'll cite a few of the many complaints about the idea of particles as static chunks of stuff. In a 2013 *Scientific American* article, Meinard Kuhlmann wrote:

> Particle physics is a misnomer: despite the fact that physicists keep talking about particles, there are no such things. [111]

Kuhlmann is not alone. Among the many physicists cited by Passon, *et al* in their recent article, 'Pitfalls in the Teaching of Elementary Particle Physics,' [112] is Art Hobson. The title of Hobson's *American Journal of Physics* article is: 'There are no particles, there are only fields.' Hobson continues:

> There are overwhelming grounds to conclude that all the fundamental constituents of quantum physics are fields rather than particles. Rigorous analysis shows that, even under the broadest definition of "particle," particles are *inconsistent with the combined principles of relativity* and quantum physics. [113] [Emphasis added.]

Note that, among the follow-up commentary on Hobson's paper published by the *American Journal of Physics* were those that agreed about the non-existence of particles, but argued that quantum "fields" are equally suspect, due to their *abstract* character. [114, 115] It is important to understand that *field* is not so concrete an idea as *wave*. Fields are mathematical things that just sit there. Waves are physical things that move. These arguments as to the non-existence of quantum fields as well as particles are similar to the one presented by Kuhlmann, in his *Scientific American* article cited above.

Before we consider a few more expert opinions, note the smallness of the steps proposed above, however right the direction might be. Another incremental step — or perhaps just another argument for taking this one — is contained in one of the more insightful ideas of Stephen Hawking. Concerning the persistent enigma of QT's wave-particle duality, Hawking wrote:

> Quantum mechanics deals with [the simultaneous unknowability of both the position and velocity of a particle] . . . via a class of quantum theories in which particles don't have well-defined positions and velocities but are represented by a wave. These quantum theories are deterministic in

> the sense that they give laws for the evolution of the wave with time. Thus if one knows the wave at one time, one can calculate it at any other time. The unpredictable, random element comes in only when we try to interpret the wave in terms of the positions and velocities of particles. But maybe that is our mistake: *maybe there are no particle positions and velocities, but only waves*. [116] [Emphasis added.]

To reiterate, complaining about particles may be helpful, but it is *insufficient* as long as relativistic dogma is also slavishly adhered to. Irreconcilable contradictions are bound to persist as long as the "solution" involves requiring consistency with the *principle of relativity*.

A more recent (2020) forum concerning the same questions makes the Rotonians' contrasting perspective all the more inviting. Natalie Wolchover's *Quanta Magazine* article 'What is a Particle?' [117] gathers views from a diverse group of world-class experts. After citing a wide range of mostly cartoonish hooba gooba — e.g., by haruspex-like "amplitudeologists" (no kidding) — Wolchover concludes by quoting MIT's quantum gravity enthusiast, Netta Engelhardt. The latter author provides a "more sophisticated phrasing" of the question in the article's title: "What are the fundamental building blocks of the Universe on its most fundamental scales?" Engelhardt admits "'We don't know' is the short answer." Happily humble as this answer is, Rotonians lament that the idea of "building blocks" is still rather Neanderthal.

Earthians unfortunately keep asking the wrong questions or keep trying to conform their answers to the wrong dogma (relativity). Instead of asking what a fundamental material thing *IS*, more enlightening (at least potentially) would be to ask what does a fundamental material thing *DO*? What is the most fundamental, the most *essential action* that all bodies of matter engage in?

This question doesn't occur to Earthian physicists because their gravity and particle experts still think of vast collections of particles as being *STATIC*. Gravitating bodies like Earth are "relativistically" conceived as *STATIC* energy-conserving chunks of stuff. They don't *do* anything; they just sit there. So surely their component particles must also exhibit this property of staticness and energy conservation. Earthians are oblivious of the flattening of their undersides and the readings on the nearest accelerometer. Contrary to their own Equivalence Principle-inspired mind-game and geometrical newspeak about the upwardly accelerating floor, physicists still think of the accelerometer in Figure 24 as being *at rest* because it is sitting on a *static* body of matter. For all their tiny particles' vigorous internal oscillations, the averaged out motion is still regarded as *zero.*

Earthian physicists cannot find a consistent description of their cherished static chunks of stuff because this unquestioned condition (staticness) is the crucial property that particles *NEVER, EVER* exhibit — however many their number, *on any scale*. Earthians need to first realize (or at least contemplate the possibility) that *no* collection of particles of *any* size is justifiably thought of as being at rest. In other words, *relativity must be declared dead and buried, because assuming it to be alive and suitable for marriage with QT is a debilitating fantasy.* (Recall Cao and Bergmann's comments on p. 60.)

Imagining that accelerometers tell the truth facilitates seeing the dire need to build and operate a Small Low-Energy Non-Collider. The experiment's result, Rotonians suppose, would at last facilitate, in turn, understanding what a particle *is* because it would reveal the more essential understanding of what a particle *DOES*. Figure 24 strongly implies that particles resist linear acceleration by generating space. They gravitate. They forever extend themselves and the bodies they comprise along the $(4+1)$ dimensions of our eternally growing, yet stationary Universe.

Understanding this about "particles" then facilitates a better understanding of stars, galaxies and everything else. Even a quick glance at the Cosmic Everything Chart could arouse suspicion that white dwarfs and neutron stars are of crucial importance, as implied by their residence near or at a prominent pivot, a *cosmic inflection point*, a key transition zone of the gravitational world.

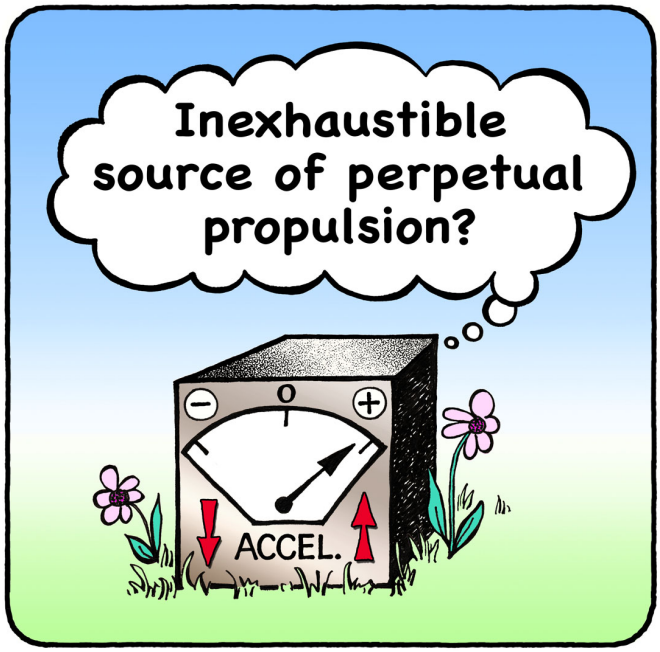


Fig. 24. **Thoughtful Accelerometer Again.** Physicists frequently ask (rhetorically, or otherwise) what is matter *made of?* Thinking mostly in terms of static "building blocks" (particles, loops, inflatonic amplituhedrons, holographic string-branes, etc.) they assiduously avoid the more important question, what does matter incessantly *DO*? What does any component of matter, in any number of units or at any scale, *DO*? Our own bodies (by the flattening of their undersides) and the nearest accelerometer never stop yelling out the answer: ***Going up! Everything is getting bigger and bigger, faster and faster, all the time!***

11˙3. *Electron Sea via Pauli Exclusion*

As noted above, a key feature of the Cosmic Everything Chart (Figure 12, p. 32) is the vertical Chandrasekhar Mass Limit. It represents the zone where a family of astronomical bodies — for one reason or another — are found to have m/r ratios such that gravity overwhelms electromagnetic forces inside matter, and the bodies collapse to extreme densities. *White dwarfs* are the end states of most stars, representing the least extreme class of these collapsed objects. *Neutron stars* represent the next most extreme class.

At the m/r ratio where m is a little less than 1.44 $\times$ the mass of the Sun ($M_\odot$) and r is about the radius of Earth, a star's gravity becomes strong enough to squeeze the electrons out of their host atoms to a much denser communal "electron sea." The nuclei (e.g., carbon, oxygen, etc.) retain their characteristic chemical signatures, but the electron clouds are packed so tight that they flow without attachment to any particular nucleus. This state is called *electron degeneracy*. As the "Degenerate Matter" Wikipedia article explains:

> Most stars are supported against their own gravitation by normal thermal gas pressure [produced by thermonuclear fusion] while in white dwarf stars the supporting force comes from the degeneracy pressure of the electron gas in their interior. In neutron stars, the degenerate particles are neutrons. [118]

Electron degeneracy pressure is commonly associated with a key feature of QT known as the *Pauli*

Exclusion Principle, which was mentioned on p. 19 in reference to the stability of matter. A NASA web page dramatizes the importance of the principle thus:

> **Pauli Exclusion Principle: Why You Don't Implode. Explanation:** Why doesn't matter just bunch up? The same principle that keeps neutron stars and white dwarf stars from imploding also keeps people from imploding and makes normal matter mostly empty space. The observed reason is known as the Pauli Exclusion Principle . . . The reason why the Pauli Exclusion Principle is true and the physical limits of the principle are *still unknown*. [119] [Emphasis added.]

Another expression of the consequence of this mysterious principle is found on the Einstein Online web page:

> If anyone attempts to concentrate electrons in a small volume of space, they will start to flit back and forth madly (cf., Heisenberg's Uncertainty Principle). Just like with regular gases, this flitting back and forth leads to pressure, in this case to what is called degeneracy pressure . . . [which] for instance, stabilizes a white dwarf, preventing further collapse. [120]

Let's stop to reflect on the common cliché (in the NASA page quoted above) that matter is *mostly empty space*. Every instance of this expression questionably implies the contrasting existence of a little chunk of stuff which is NOT "empty space" — like a pea rattling in a can (the tiny chunk of stuff "flitting madly back and forth").

Unfortunately — and contrary to the particle-denying ideas presented by the authors quoted above — the National Science Foundation and Lawrence Berkeley Laboratory would instead promote the pea-in-a-can conception, as indicated on their glitzy graphic propaganda (Figure 25). Seekers of the truth no doubt find the contradictions tiresome and confusing. Rotonians thus invoke another example of un-particle-like behavior, as described by the stability-of-matter expert, Eliot Lieb. According to Lieb's more intuitive account:

> An electron is like a rubber ball, or a fluid . . . It costs energy to squeeze it and this accounts for the stability of atoms.
>
> Bulk matter is stable, and has a volume proportional to the number of particles, because of the Pauli exclusion principle . . . Effectively, the electron behaves like a fluid [which] limits the compression caused by the attractive electrostatic forces. [121]

From this description we can get a more meaningful estimate of the minimum *size of an electron* by taking the cube root of the volume of a white dwarf divided by the number of electrons found therein, near the Chandrasekhar limit. Let us first, however, briefly explain the rationale for the claims that an electron is no bigger than 10^{-18} m. Physicists sometimes engage in smashing things with huge machines that give the impression of collisions that seemingly must have been caused by pointy little things, little things whose points are deduced to be smaller than 10^{-18} meter.

As Erwin Schrödinger argued, however, these phenomena that seem to require pointy particles to explain them are easier to imagine being caused by continuous un-chunky waves than it is to imagine phenomena that scream un-chunky waviness being caused by pointy particles. A white dwarf is a good example, but the logic applies also to a single hydrogen atom.

Schrödinger's famous equation (whose validity has been established beyond doubt) describes a *single* electron in a hydrogen atom as having (among many many others) the fuzzy cross-sections depicted in Figure 26. It is absolutely impossible to create these patterns by supposing them to be the result of any kind of time-lapse trajectories of a single little chunk of stuff. Rotonians suppose it's because *there are no single tiny chunks of stuff*.

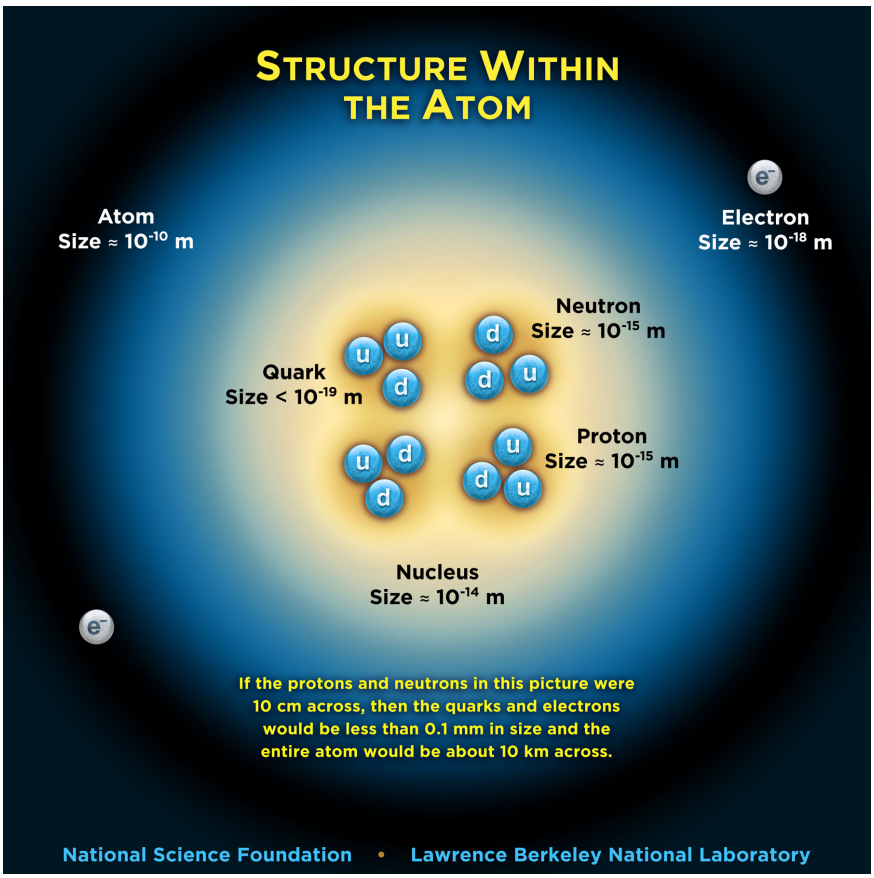


Fig. 25. **Static Chunk o' Thing-Stuff Disease.** A "mostly empty space" atom is the product of ancient Greek tradition and decades and many billions of dollars spent on high-energy *collision* experiments. The statically, fragmentation, and terminality of this entrenched condition Rotonians see as a major obstacle to human civilization and enlightenment. Conceiving the gentle, continuous, eternally fluid growth of gravity may be the antidote. Earthians must at last get around to building and operating their first Small Low-Energy *Non*-Collider.

From Lieb's description of electrons, we infer that a white dwarf may be likened to a huge fluid ball whose rubberiness is provided by whatever that mysterious cause is that validates the Pauli Exclusion Principle. Most of the ball's mass (by a factor of $\approx$ 2000 or more) is contained in the much smaller atomic *nuclei* that are suspended and distributed throughout the rubbery goo. From the Cosmic Everything Chart and from astrophysical observations, we find that white dwarfs near the Chandrasekhar Limit Mass ($M_{\text{WD}} \approx 1.44 M_{\odot}$) are rare — where $M_{\odot}$ is the mass of the Sun. More commonly, their numbers cluster around $M_{\text{WD}} \approx 0.6 M_{\odot}$. Since we are mostly concerned with extreme cases, to estimate the size of an electron, let's start with the example of one of the most massive white dwarfs ever observed. This star — known as REJ 0317-853 — has a mass $M_{\text{WD}} \approx 1.38 M_{\odot}$. [122, 123]

Given that REJ 0314-853's radius — in terms of the solar radius $R_{\odot}$, is $R_{\text{REJ}} \approx 0.0032 R_{\odot} \approx 2.2272 \times 10^6$ meters, we can calculate the density, volume and number of electrons. The mass of the star is almost entirely the sum of the masses of its nuclei. The number of nucleons is given by

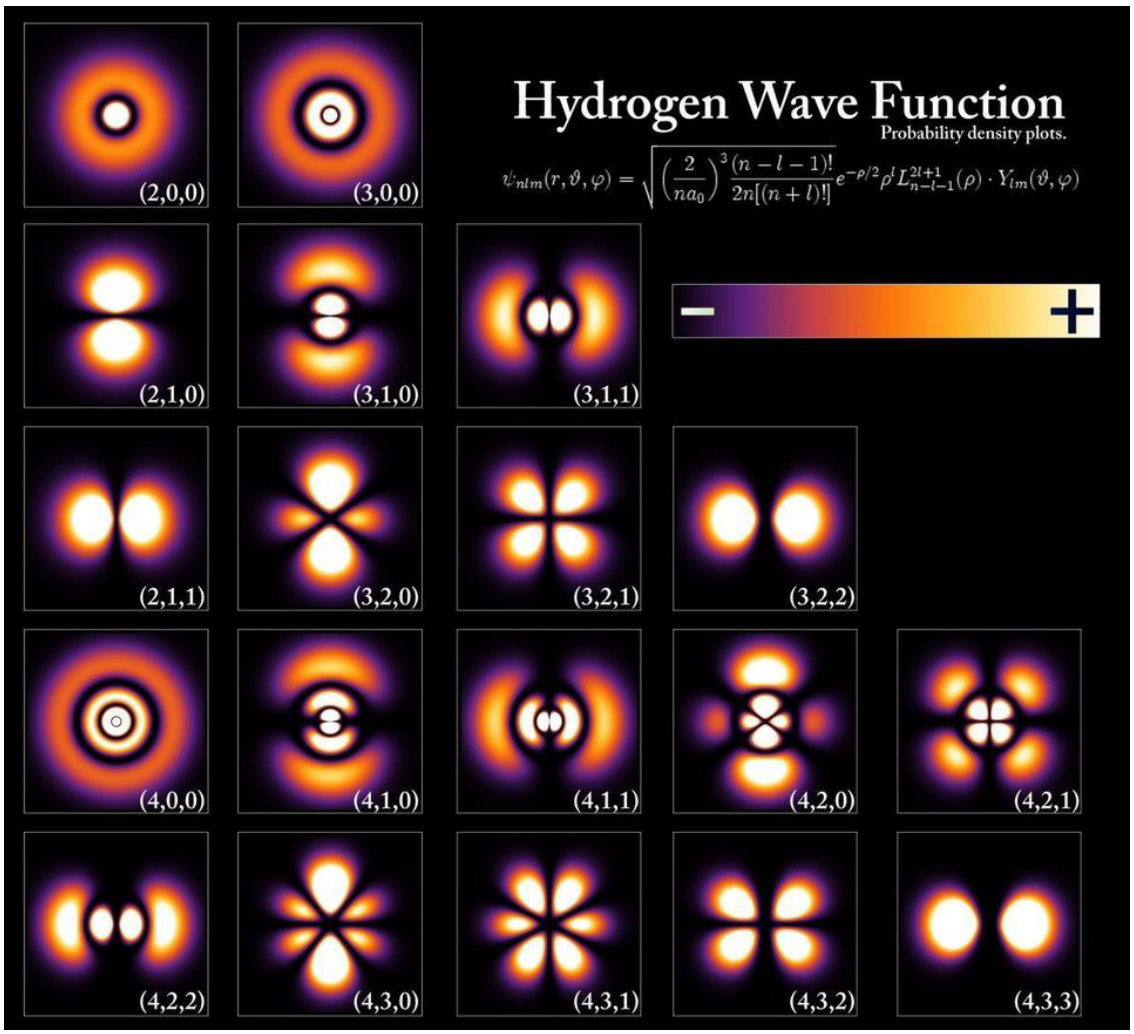


Fig. 26. **Single Electron States in a Hydrogen Atom According to the Schrödinger Wave Equation.** Many physicists regard the brightness gradients in these patterns as corresponding to the *probability of finding* a particulate electron, a much smaller speck of matter within the indicated areas. [124] If this were true, then it would be possible to construct a linear path that the tiny thing actually follows, such that a time-lapse exposure of the path would reveal the same pattern. But this is *impossible*. The idea that an electron in an atom is a *point* or a super-tiny chunk-of-stuff therefore makes no sense. Chunky Bohr atoms and billiard ball building block particle charts, endorsed (tacitly or explicitly) as truthful representations of reality, are *conceptual poison*, akin to geocentric-Ptolemaic "solar system" maps circa the Copernican Revolution. Earthian physicists need to let go their binky and grow out of it.

$$n_{\text{NUCLEONS}} = \frac{M_{\text{REJ}}}{m_{\text{N}}} \approx \frac{2.748 \times 10^{30}\,\text{kg}}{1.672 \times 10^{-27}\,\text{kg}} \approx 1.642 \times 10^{57}\,. \tag{35}$$

Assuming that the white dwarf's mass mostly comprises nuclei with equal numbers of protons and neutrons, and the number of electrons equals the number of protons, the number of electrons is

about 1/2 that of Eq 35, i.e., $\approx 8.21 \times 10^{56}$. (If the initial mass composition were entirely hydrogen then the factor 1/2 would not apply.) The volume of an electron in a white dwarf is the volume of the star $V_{\text{WD}} = (4\pi/3)R_{\text{REJ}}^3$ divided by the number of electrons:

$$V_{\text{e}} = \frac{V_{\text{REJ}}}{n_{\text{e}}} \approx 5.637 \times 10^{-38}\,\text{m}^3\,. \tag{36}$$

If an electron's shape is spherical, the radius is given by

$$r_{\text{e}} = \sqrt[3]{\frac{3V_{\text{e}}}{4\pi}} \approx \sqrt[3]{1.346 \times 10^{-38}}\ \text{m} \approx 2.379 \times 10^{-13}\,\text{m}\,. \tag{37}$$

Referring again to the Cosmic Everything Chart, we see that this is close to the size of a muonic atom $r_\mu \approx 2.845 \times 10^{-13}$ m, which is just a little smaller than the electron's barred Compton wavelength. The 10^{-18} meter figure given by the Berkeley Laboratory was deduced from extremely high-energy collision experiments. But in their normal state, according to the above calculation, electrons clearly manifest as $\approx 10^5$ times larger. Of what significance is it that the larger size is close to the product of the *fine structure constant* α and the Bohr radius: $\lambda\!\!\!^{-} = \alpha a_\circ \approx 3.862 \times 10^{-13}$ m? This small range of distances and densities on the microscopic side of the Chart is echoed by the small range of radii and densities of white dwarfs on the astronomical side. Rotonians love empirical facts.

11˙4. *Exotic Star Picture Gallery and Stability Graphs*

To put more of a face on the data points on the Cosmic Everything Chart (and Figures 20–22) this subsection gathers an assortment of figures for this purpose. The subject of electron degeneracy pressure arose earlier in connection with the Pauli Exclusion Principle as somehow preventing collapse of ordinary matter and as propping up masses comparable to the Sun's, even after thermonuclear processes cease and the force of gravity becomes enormous. We'll add a few facts and ideas here, especially as *electron* degeneracy gives way to *neutron* degeneracy, whereby stars jump from, or jump right past the stable stage of white dwarfs to the much denser stable stage of neutron stars and beyond.

Figure 27 is an adaptation of a commonly displayed graph, showing accurately scaled orbs, representing the white dwarf range of size. Figure 28 compares white dwarfs with the Earth and Sun, and displays a cut-away artist's conception of a carbon-rich white dwarf core. Though typically only slightly more massive than white dwarfs, neutron stars are much smaller, as shown in Figure 29, where the super-dense spheres are juxtaposed over typical Earthian cities.

In simple terms, the size and density jump from white dwarfs to neutron stars occurs when the compression strength of the already highly compressed "rubber ball" gives way even further to the extreme, relentless outwardness of gravity. Negatively charged electron clouds get squeezed so hard that they merge with the positively charged nuclear protons. Once-positively-charged nucleons morph into a dense sea of charge-neutral nucleons, i.e., neutrons.

Insofar as stability and saturation are related concepts, we may assess three physically manifest saturation zones (and anticipate two more) as follows: 1) When gravity's force is small compared to

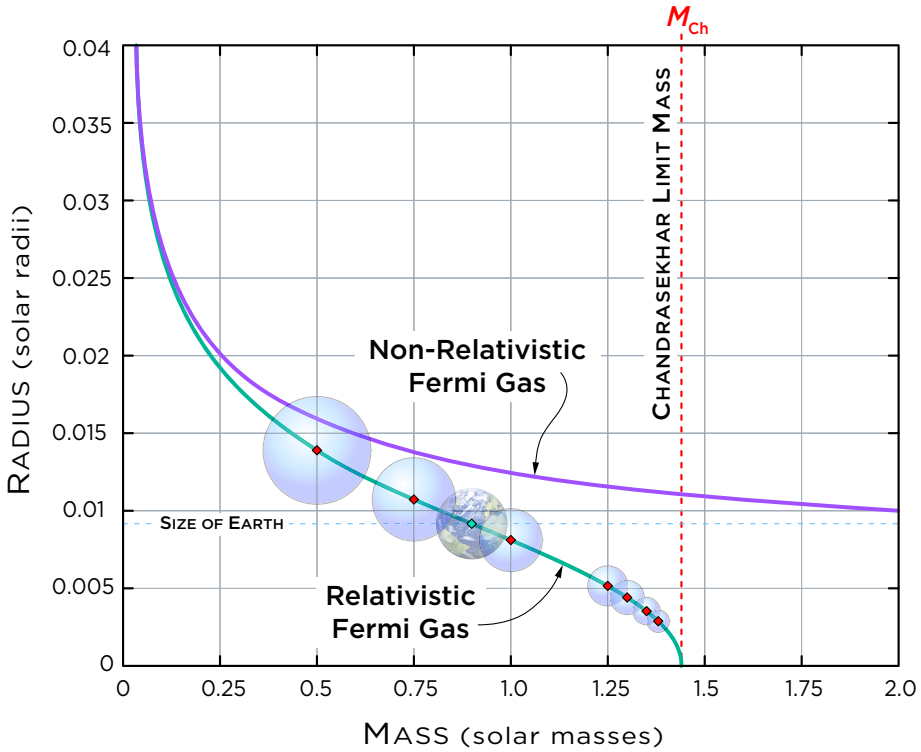
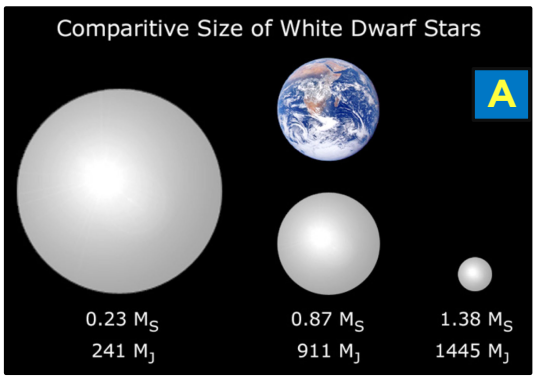
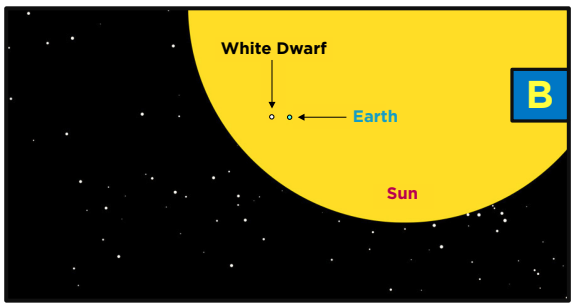


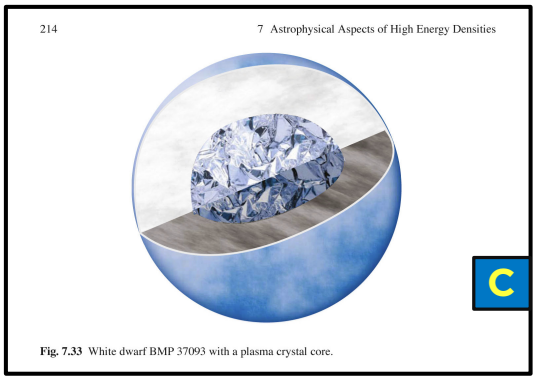
Fig. 27. **White Dwarf Mass-Radius Graph:** Scaled star (and Earth) sizes superimposed over the graph, commonly found in the literature, showing how white dwarfs shrink as they get more massive.

the electric force, electrons and nuclei "saturate" at the density range of common matter. 2) When gravity overwhelms the "puffy" electron clouds of diamond, gold, and other kinds of molecular matter, the nuclei are squeezed so tightly together that they essentially share one another's electrons. The nuclear separation distance decreases drastically, but it is still large compared to the characteristic size of nuclei themselves, so they maintain their species integrity.

And 3) When the last bit of *electronic* rubberiness succumbs to yet further gravitational compression, the much denser *neutronic* rubberiness takes over, as the nucleons are now packed so tight as to disallow any electron cushioning at all. As astrophysicist Vladimir Fortov has put it: "For convenience a neutron star may therefore be seen as a huge atomic nucleus 10 km in size." [125]







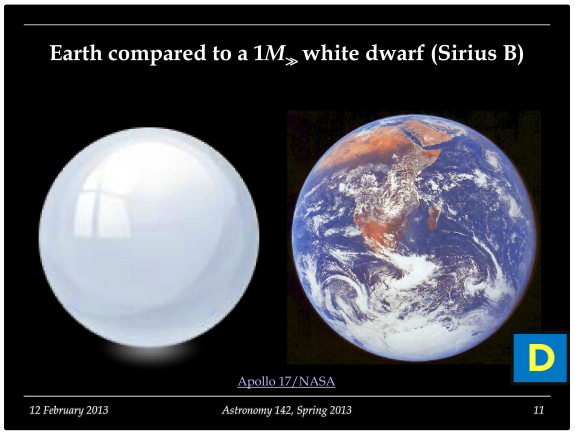


Fig. 28. **White Dwarf Images from the Internet and Printed Literature: A** — M_S and M_J refer to the masses of the Sun and Jupiter, respectively. [126] **B** — Planets and white dwarfs dwarfed by the size of the Sun. [127] **C** — Diamond-like core of a carbon-rich white dwarf. [128] **D** — One more side-by-side comparison from an Astronomy class lecture. [129]

As can be seen on the Cosmic Everything Chart (Figure 12, p. 32) and has often been reported in the literature (e.g., [130]) the whole star's average density (and therefore especially its *center*) exceeds the saturation density of nuclear matter. Atomic identity therefore disappears, as the spacing between nucleons is minimized and homogenized throughout the star. The alternating stable/unstable/stable zones of Figure 30 roughly illustrate these steps. The Cosmic Everything Chart predicts the next two, each of which is approximated by downward *size* jumps on the order of $\alpha \approx 1/137$ and upward *density* jumps on the order of $1/\alpha^3 \approx 10^6 - 10^7$, as noted above. Notice the curious echo of this density pattern on the microscopic end of the Chart.

The pair of white dwarf and neutron star mass/radius graphs shown in Figure 30 are similar to others, commonly found in the literature. The graphs are derived from the combination of theories having to do with electrodynamics, thermodynamics, nuclear structure, and gravity. This theoretical synthesis is used to derive so-called *Equations of State*, which relate pressure and density in terms of temperature and forces; from which emerge predictions indicating which m/r configurations are stable and unstable.

The size and density of *white dwarfs* is such that neither nuclear physics nor any extreme space-time curvature due to gravity (GR or SGM) have much of an effect on the stability/instability predictions. Gravity's role is adequately accounted for using only Newton's gravitational equations.

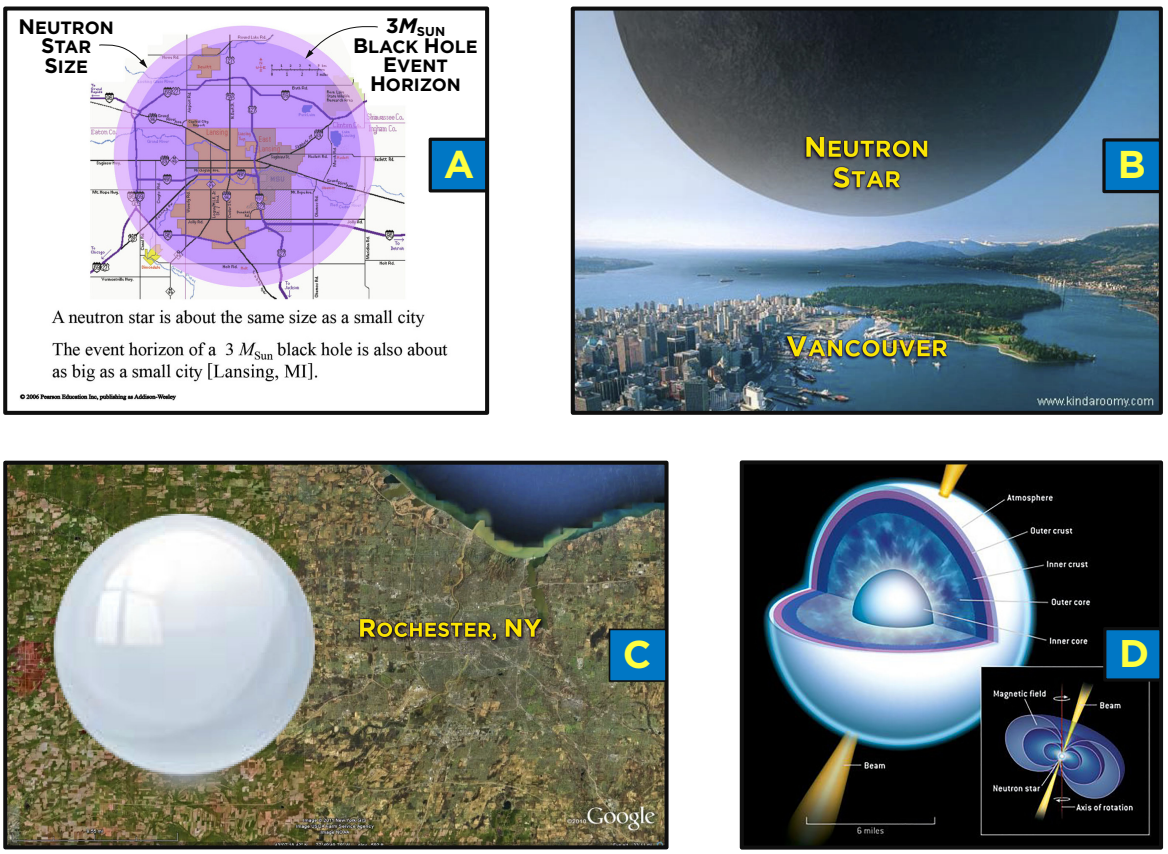


Fig. 29. **Neutron Star images in the literature: A, B, C —** Sizes of typical neutron stars juxtaposed over Earthian cities: Lancaster, Michigan; Vancouver, British Columbia; and Rochester, NY. [131-133] **D** — Cutaway of hypothesized inner structure. [134] Notice that **A** also shows the "event horizon" of a "black hole." According to GR, by approximately doubling its mass, a neutron star becomes an ugly, "*all hell broke loose*," imaginary, monstrous thing. Its matter vanishes forever as it enters the fantasy abyss into *Divide-by-Zero Land*.

Primarily, it's the light speed limit in the context of SR that is responsible for deviations from the Newtonian "non-relativistic" predictions — as illustrated in Figure 27. The physics of white dwarfs is not very controversial. When support from *electron degeneracy* succumbs and transitions to *neutron degeneracy* and beyond, however — as we will see in what follows — we encounter a wider gulf of disagreement and uncertainty. Astrophysicist Pawel Haensel thus writes:

> Neutron stars play a unique role in physics and astrophysics. They contain matter under extreme physical conditions, and their theories are based on risky and far extrapolations of what we consider reliable physical theories of the structure of matter tested in laboratory.
>
> When the density increases the models become more numerous and different but less reliable. [135]

With their substantially increased m/r ratios, neutron stars thus represent a big step toward pushing the limits of GR and nuclear theory to accommodate their existence. In the 1930s the predicted mass for a neutron star was even smaller than that for a white dwarf ($\approx 0.7 M_{\odot}$). With the

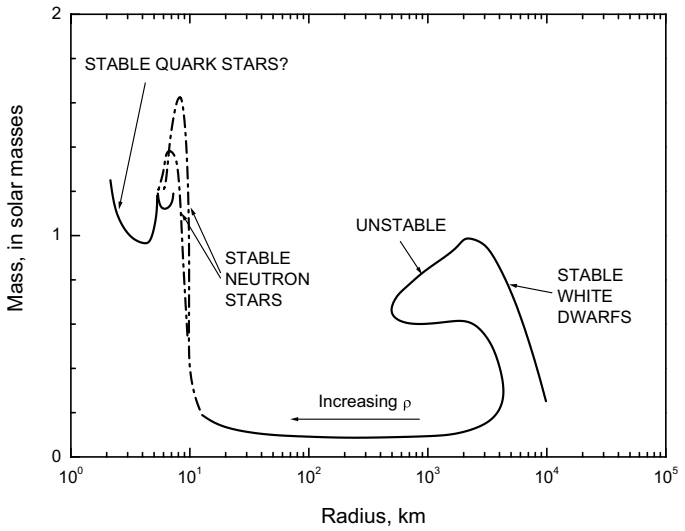


Fig. 7.41 Transition to neutron and quark stars [83].

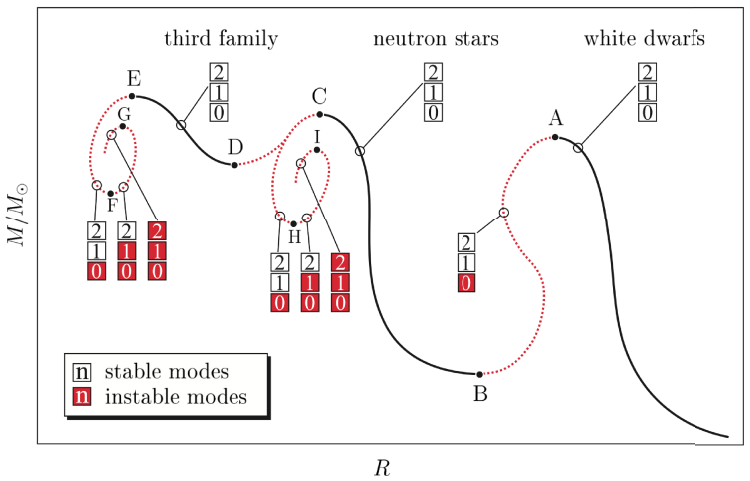


Fig. 30. **Collapsed Star Stability Graphs:** Commonly found in the literature of the last few decades are graphs showing the zone *between* white dwarfs and neutron stars as an unstable physical state. Standard speculations as to a "third" family of stable states — smaller and denser than neutron stars — are tightly constrained, as they are up against the abyssmal edge of the catastrophic black hole line. TOP — Fortov, 2011 [136]. BOTTOM — Seubert [137]. (See following Figures in this essay and the Cosmic Everything Chart.)

ensuing evolution of nuclear physics in later decades, the neutron star mass estimate surpassed the white dwarf estimate. Various uncertainties have to this day, however, prevented a firm prediction. In fact, the wide range of possibilities and theoretical ideas has resulted in graphs like that in Figure 31, where each one of this zoo of curves represents a unique Equation of State.

Clearly it is a messy, yet delicate business. Care is needed to prevent predicting a state that would collapse. Referring to the left sides of the graphs in Figure 30, we note that Fortov's "Stable Quark Stars" and Seubert's prediction of a "third family" of compact stars are tightly constrained and questionable. As argued by Lattimer and Prakash [138] such exotic equations of state typically predict *lower*, not higher limit masses.

The difficulty for Static Chunk-O'-Stuff theorists is evident in Figure 21–left (p. 62) showing an example (yellow diamonds) in which the mass and the size of a neutron star-like body are very near the maximum. The precariousness of the situation is more intuitively illustrated in Figure 29A, which shows that, if a neutron star's mass is about doubled, the object disappears as a material body and suddenly becomes a singularity-containing black hole whose horizon is about the same size as an Earthian city. The SGM does not suffer from these problems because it predicts that clock rates *increase* to a central *maximum* inside material bodies. No *physical* circumstance warrants dividing by zero. As seen on the Cosmic Everything Chart (p. 32), density rises to a *finite maximum*.

The final two Figures in this section (32 and 33) are graphs from the literature superimposed over the corresponding portion of the Cosmic Everything Chart. As the simpler of the two, Figure 32's linear Mass coordinate is stretched compared to the log-Mass coordinate of the Cosmic Everything

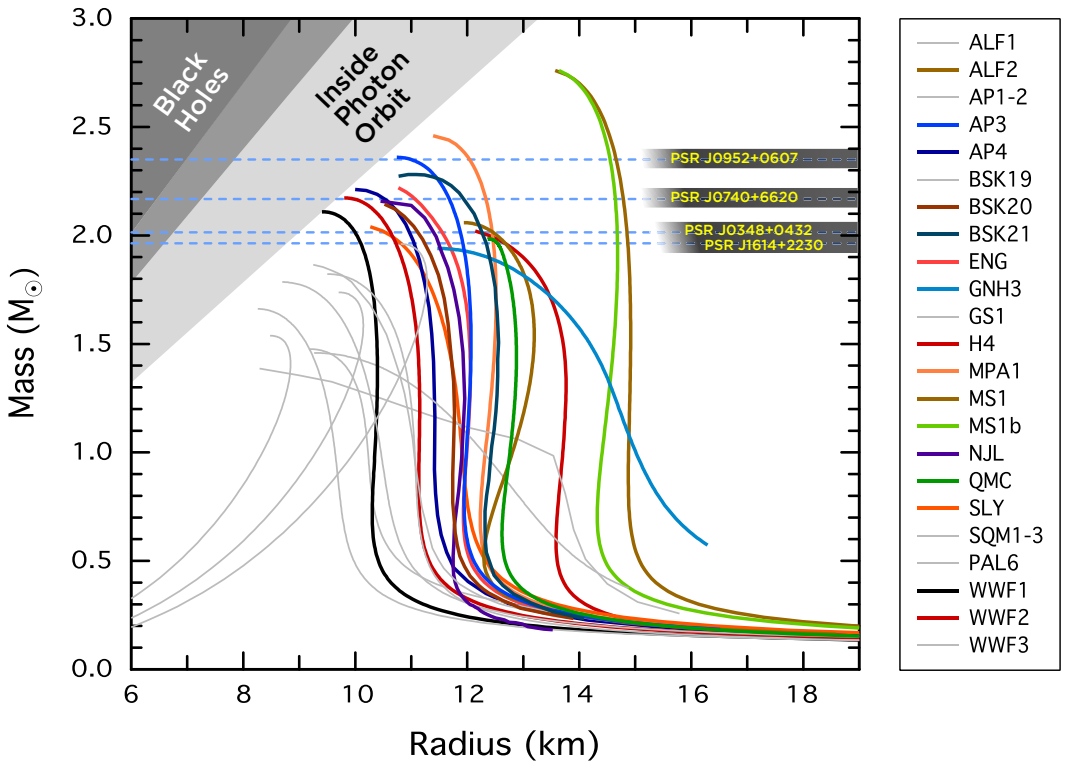


Fig. 31. **Singularity-Fearful Equations of State for Neutron Stars:** Adapted from Figure 7 in Ozel and Freire's review paper, cited above. [130] General Relativity predicts that inside massive bodies clock rates diminish to a central *minimum*. Largely for this reason, when stars a few times more massive than the Sun collapse to a few times nuclear saturation density, it becomes theoretically challenging to prevent the complete stoppage of clocks and the ensuing catastrophic creation of a dread singularity. This challenge has inspired many different approaches, as listed above. Those whose maxima lie below the observed neutron star PSR J0952+0607 are clearly missing something. Rotonians suspect these "risky and far extrapolations" are actually missing a lot.

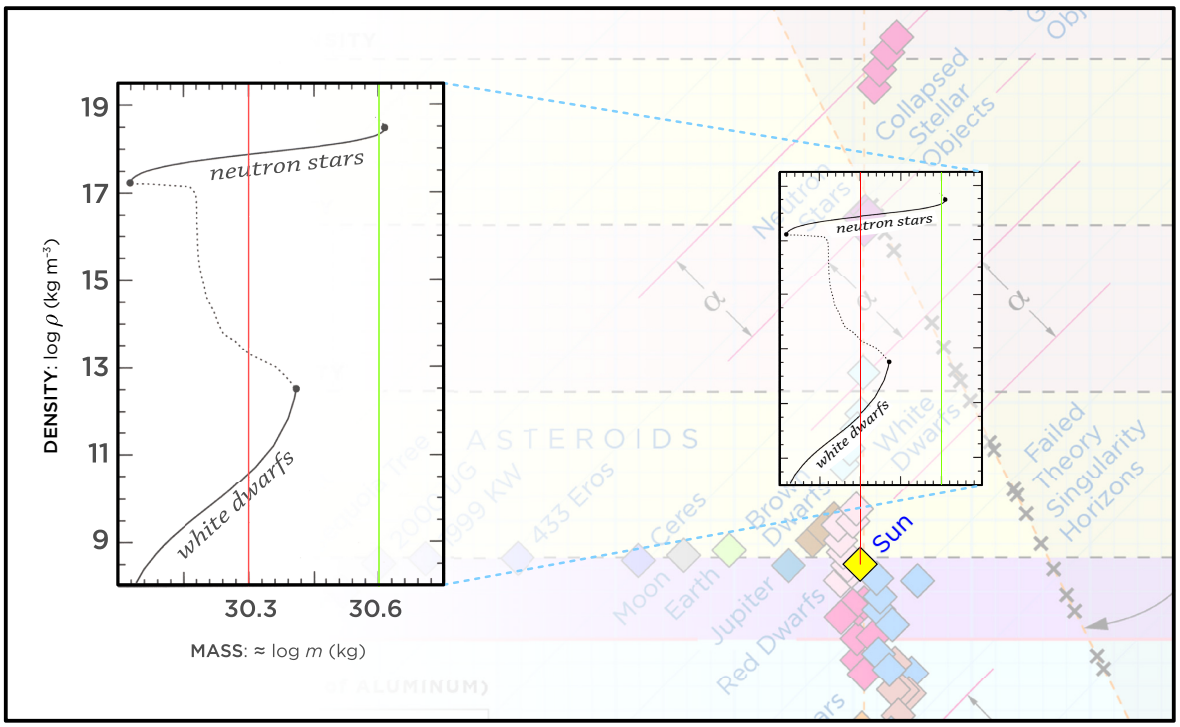


Fig. 32. **Collapsed Star Stability Graph Superimposed on Cosmic Everything Chart:** The original graph's ordinate [139] is log-Density, so it fits perfectly; whereas the Mass coordinate is linear. Superimposing the graph on the more comprehensive Chart means having to imagine it being squished from the left and right toward the red line, whose extension would go through the Sun.

Chart. It nevertheless facilitates seeing the respective ranges of stability and surrounding instability for both white dwarfs and neutron stars.

In its original [140], the superimposed graph in Figure 33 was presented upside-down with respect to the Cosmic Everything Chart. It includes information concerning the collapsed object's origin and evolution. The larger the initial mass (up to that of giant stars) the more likely the end result is predicted to become a black hole. Somewhat less massive stars go supernova to become neutron stars. And stars whose masses are closer to that of the Sun (the majority) go nova to become white dwarfs. Another possible evolutionary scenario involves mass growth by *accretion*. When a white dwarf gains mass this way, it may end up going supernova (Type Ia). Notice that any scenario involving catastrophic collapse results in a majority of the initial material being blasted away by the explosion. This mass loss is represented by the leftward veering arrows.

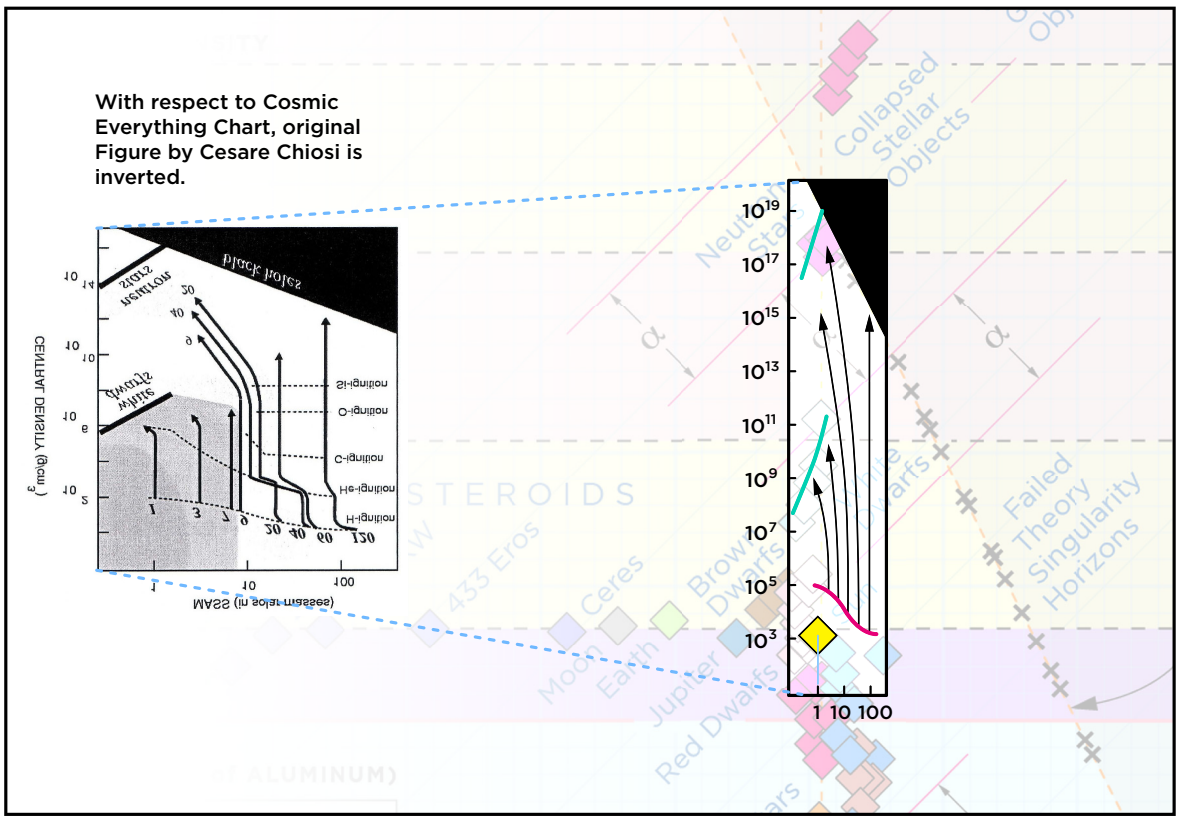


Fig. 33. **A More Detailed Collapsed Star Stability Graph Superimposed on the Cosmic Everything Chart:** In the original gray-scale graph (at Left) [140] data were displayed inverted with respect to the Chart. When scaled to fit (Right) the log-density and log-mass inset indicates approximate masses of stars — up to about 100 Solar masses. Thermal and pressure configurations of these objects are conducive to eventual nova or supernova events in whose explosions most of the mass is shed, leaving behind white dwarf, neutron star, or (allegedly) black hole remnants. Considering the tight corner near the top (blue-green curve approaching the black patch) we can see that attempts such as Seubert's, in Figure 30, are hard-pressed to justify any "third family" of stable material remnants that don't pass the edge to oblivion. Rotonians suspect that Nature contains no such unphysical black wall: Instead, they suppose the data trajectory continues upward, where the next stable "family" resides at a density another $1/\alpha^3$-fold or so higher. (Faded red diamonds above inset.)

11˙5. *Cosmic Everything Chart 101: Conclusion*

The literature on collapsed stars, electron and neutron degeneracy, etc., is not only vast and thick, it also sometimes includes discussion about the *deeper cosmic significance* of the micro-macro connections implied or revealed therein. For example, in their 2013 paper 'Astronomical Reach of Fundamental Physics,' Burrows and Ostriker write:

> Not only is everything connected, but that everything is connected quantitatively.
>
> The masses of nuclei, atoms, stars, and galaxies are set by a restricted collection of basic constants that embody the finite number of core natural laws. [141]

Though not always with the same purpose, many other authors over the last several decades have written about this interconnectivity. In 1975 Weisskopf published: 'Of Atoms, Mountains, and Stars: A Study in Qualitative Physics.' [142] Barrow and Tipler's 1986 classic *The Anthropic Cosmological Principle* is a treasure trove of data, ideas and references. [143] Many of the same themes and some new ones of his own, are found in Hogan's 2000 paper 'Why the Universe is Just So.' [144] With the increasingly entertainment-oriented themes taking prominence in physics and cosmology more recently, Adams' 2016 title contains a bit of cinematic appeal: 'Constraints on Alternate Universes: Stars and Habitable Planets with Different Fundamental Constants.' [145]

I've highlighted these works not only to encourage gleaning the facts and insights contained therein, but to draw attention to what is *lacking* across the board. Coming closest, perhaps, to filling this lack are Barrow and Tipler, whose book contains many figures, a few of which even partly resemble the Cosmic Everything Chart. But the others, if they contain any figures at all, provide only limited snapshots of relatively small corners of the world. Important corners, no doubt, but without seeing their connection to the whole, not nearly as enlightening as they could be.

Basic mathematical analysis is central to these works, appealing sometimes to unconfirmed or unconfirmable hypotheses. Conspicuous to a Rotonian is that they all fail to mention *the suspiciously disjointed role of gravity*. The other constants — as found in thermodynamics, electromagnetism, nuclear and quantum physics — are all interrelated and can be expressed in terms of one another. Newton's constant is not connected to any other constant, but stands alone. ***Rotonians see this as a profound indicator of how very lost Earthians are in trying to figure out the Universe.***

Even if some areas of study get by without explicit consideration of gravity, it is nevertheless ubiquitously there on every scale throughout the Universe. Surely this is an indication that it should be possible to express Newton's constant in terms of the others *somehow*. Earthians just haven't discovered yet how to do it. Rotonians think they've made this discovery, as we'll see later.

Another thing these prior treatments have in common is their caveat that — when attempting to connect micro to macro physics — they do so only *roughly*, only to *order of magnitude* in the relationships. Rough connections are sometimes sketched out. Does not this, of itself, loudly imply the likelihood of sharpening the focus to *exact* relationships? One of the reasons exact relationships are generally not even looked for is that many of the key parameters and phenomena are supposedly destined to *change*, as the Universe fizzles out and *dies*.

Not only is humanity and all biological life doomed, white dwarfs and all other stars are also destined to coldly die and cease being born. Only frozen collapsed corpses, bleakly scattered over increasingly vast distances will remain. With that being our predicted fate, any physical, conceptual, or numerical connectivity seemingly found at the present "cosmic epoch" is arguably just a coincidence. For this reason many physicists are skeptical of any alleged connection. Making the rejection of cosmic harmony more emphatic, some cosmologists even suspect that the "constants" also change with time, or that the physical laws themselves "evolve." If this recipe of a fragmentary, frozen, final death prevails (as it does) then the numerical micro-macro harmony that may seem to exist for the moment is of no deeper physical significance. Just a meaningless, random fluke. Dreadfully depressing.

An indication of how (from this point of view) the Universe is already fizzling out and dying is some of the cited authors' misguided emphasis on the so-called *Planck Scale*. Supposedly relevant 10^{-43} seconds after the big bang, Rotonians see the Planck Scale as an utterly useless contrivance. All the natural forces were supposedly "unified" at this so-called Planck *Time*. But (as shown in Figure 1, p. 3) the forces have meanwhile "frozen out" from the primoridal soup of the so-called *unification era*, never to be re-united ever again. From this perspective, as adopted by Earthian theoretical physicists, the connection between gravity and the other forces is an untestable academic exercise, representing the dream-time "birth" of the Universe, and fantasized as the eye-blink mar-

riage between QT and the monstrosity that is GR. Ugly. So damned ugly.

Another terminal symptom of the *Frigid-Doom* version of our Universe is the divide-by-zero edge of black hole horizons. If the authors who've seen fit to at least partially connect micro-physics to the stars would have laid out the whole Chart, surely they'd see how awkward and unnatural is the Dark Wedge of the hellish void on the other side of the Schwarzschild line. Alas, all of these prior authors either tacitly or explicitly accept this artificial edge as a real thing, within which matter is destroyed and only Hollywoodesquely warped spacetime remains. This is where data points from the real world come to a full stop. This is where (just above neutron stars) data points supposedly either fly entirely off the Chart (because only bodies of *real* matter remain on it) or the data trajectory takes a sharp downward turn. How clunky and inelegant is that? Rotonians feel certain that Nature would never bow to Earthian geometers, to exhibit such flying-off-the-Chart nor to bounce back from an imaginary divide-by-zero wall. Would not this unnatural disharmony be glaringly obvious if Earthians would draw out the whole Chart? Maybe that's why establishment physicists never do draw out the whole thing. Maybe they can't bear to look at the grossly necrotic thing they've invented.

In any case, the fact that the sizes, masses densities, etc., of stars rigorously depend on the physics of nuclei and atoms surely suggests this to be true not only when accumulations of matter get so large (near the Chandrasekhar limit) that gravity seemingly competes with electromagnetic and nuclear forces, but that these forces are somehow *manifestations of one another*, and that the interrelationships do not stop at stars, but extend to galaxies, to the Universe as a whole with all its large-scale properties. These are not interrelationships that devolve, that coldly come to a stop in a Universe that fizzles out and dies. *Their very nature is to maximize their own stability across the whole gravity-saturated cosmos, and to perpetuate themselves forever.*

As we await the crucial test of these ideas by building and operating our first Small Low-Energy Non-Collider, this glimpse into collapsed stars and their place on the Cosmic Everything Chart propels us to the next step in building up the SGM cosmology.

12. Micro-Macro: Basic Cosmic Facts, Ideas, and Models

> *In our everyday world everything is either gravity or electromagnetism. And that's why alpha [the fine structure constant] is so important.*
>
> Holger Müller : UC Berkeley Physicist : 2020 [146]

> *[Alpha] describes the coupling to the electromagnetic field of any elementary particle carrying electric charge . . . The smallness of α ensures the distinguishability of matter and radiation . . . The gross physical properties of atoms, molecules and solids can, in principle, be determined as functions of the pure numbers α and [the proton-electron mass ratio] m_p/m_e.*
>
> J. D. Barrow and F. J. Tipler : 1986 [147]

12˙1. *Introduction*

"In our everyday world everything is either gravity or electromagnetism." Rotonians suppose they are seamlessly and eternally merged with each other; manifestations of the cosmically fundamental perpetual growth of the Universe as a whole and every seemingly separate thing in it.

This *wholistic* idea contrasts starkly with the purported Big Bangist "unification" at the Planck scale "beginning" of the Universe, whose frigid end we are supposed to be rapidly approaching, whose grotesque fragmentation makes Rotonians shudder.

As Rotonians see it, Quantum Theory's treatment of electromagnetism is at least *consistent* with the conception of *space* being *generated by matter*. Rotonians infer the relationship between matter and space as not mere static co-existence, nor the disjointed increase of one without the other, but as a *perpetual process of co-creation*. The basis of this reconceptualization of Quantum Theory traces back to the "infinite self-energy of electrons." It is bolstered by remarks such as Schrodinger's on the time/energy uncertainty relation (see p. 18) which implies that a world in which energy conservation appears true for a wide range of circumstances may be *the same* as a world in which energy is actually perpetually changing in accordance with a globally regulated process of growth, of outward movement, manifest as a perpetual increase in total energy.

This is gravity. The essence of gravity and matter is perpetual growth. It would be revealed as such if the result of Galileo's Small Low-Energy Non-Collider experiment agrees with the Rotonian prediction. It would be revealed if only physicists would see fit to probe gravity in the most ponderous half of the gravitational Universe by looking inside matter.

The essential connection between gravity and electromagnetism inheres in the above description because the "space" proposed to be created by gravity is the same space that is sometimes referred to as the *ether*, the *medium* that facilitates propagation of electromagnetic waves. It is the same space in the denominator of mass/volume ratios indicating *characteristic density regimes* where matter can accumulate in stable configurations, where locally operating forces of Nature *saturate* and reside in a kind of dynamic equilibrium. Further clues and facts as to the relationship between gravity and electromagnetism will be presented in the next two sub-sections.

Rotonians think the evidence that the Universe is flying apart and growing ever colder is extremely flimsy. The first and still most important empirical fact claimed as the primary argument for the Big Bang theory is that *the redshift of light from distant galaxies increases with distance*. From this evidence physicists have (prematurely?) inferred that the Universe is still suffering the aftermath of a stupendous "initial" explosion.

Prior to the discovery of this evidence, the *first* cosmological model based on Einstein's GR equations to *predict* a redshift-distance relation was a solution derived by Willem deSitter in 1917. Curiously, the cause of the redshift in this model was *not* galactic recession. Sometimes called the *deSitter effect*, the cause of the spectral shift of distant light in deSitter's model is not a global explosion-produced velocity but the slowness of distant clocks — the more so the further they are located. Cosmologist Robert W. Smith explains the deSitter effect as follows:

> The wavelength of light should increase — that is, shift toward the red — with increasing distance from the origin of the coordinates. The effect that deSitter predicted was not due to a real recession of distant stars or nebulae. Instead the intrinsic properties of space and time in [deSitter's solution] cause clocks to appear to run more slowly the further they are from the observer, and so the atomic vibrations within a far-off galaxy appear to slow down, the frequency of light decreases, the wavelength of light thereby increases and a redshift is observed. [148]

Because of the transit time required for light to travel across intergalactic space, cosmological *distances* correspond to earlier cosmological *times*. Therefore, a logical inference of the deSitter effect is that *the rates of clocks increase as cosmic time increases*.

Note that this is consistent with the active gravitational mass discussion in §8. The rates of clocks, the magnitude of active gravitational mass, and space generation capacity are all correlated. Cosmologically, they all increase together — with some local variability.

From quantum theory (specifically, the deBroglie relations [149]) we learn that greater frequencies (shorter wavelengths) of elementary particles correspond to greater masses. In the Rotonians' SGM cosmology, the observed redshift is due to the *masses* of distant bodies being smaller at the times they emit the light we see. Since *light* is not clock-like, but rather "timeless," its energy does not change while en route. But (according to the Rotonians' model) the mass-energy of all intervening clock-like bodies does increase. In other words, the "spontaneous generation of matter" out of all material bodies that already exist, increases the clock rates of bodies near or through which light travels. Distant bodies are thus revealed to have smaller masses and slower clocks because we are seeing them as they existed at earlier times. Active gravitational mass increase and cosmic clock rate increase (deSitter-like effect) are the same thing.

This happens in a cosmos whose intergalactic distances exponentially expand but always *appear* essentially constant. Exponential expansion is also a characteristic of deSitter's cosmological model, as explained by cosmologist Dennis Sciama:

> The exponential curve is self-similar, that is, one cannot tell where one is along it by intrinsic measurements; it has no natural origin . . . The Universe does not evolve from a dense state to a dilute one. [150]

A huge measuring rod spanning the distance between redshifted galaxies would thus reveal that galaxies do not generally recede from one another. Space expands, but so do the intervening galaxies and so do measuring rods of all sizes, all in like proportion. (See Figure 34.) In the general relativistic context, neither the deSitter effect nor the exponential increase in cosmic distances have

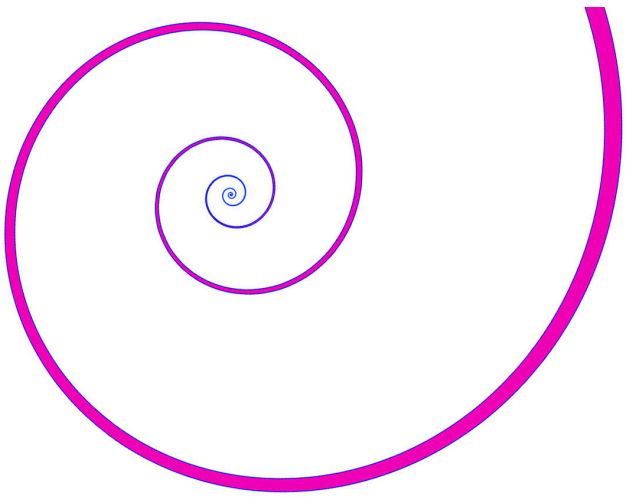


Fig. 34. **Exponential expansion. deSitter's 1917 Solution and the SGM cosmology both have this characteristic:** As stated by Sciama (see text): 'The exponential curve is self-similar, that is, one cannot tell where one is along it by intrinsic measurements; it has no natural origin . . . The Universe does not evolve from a dense state to a dilute one." The key difference is that deSitter's expansion is purely geometrical and has no physical cause; whereas in SGM cosmology, *matter* is the cause of the expansion. The process whereby this happens is gravity. Matter and space always maintain the same proportions, so both the matter-density and the radiation-density are constants. The cosmos maintains a state of constant *saturation* as it expands. There is no beginning and no end. Being eternal and originating in matter, agents of the cosmological process should be identifiable and quantifiable in terms of nuclear and atomic physics.

a physical explanation. In fact, deSitter's model is often characterized as being "empty" of matter, so it is not really physics, it's just geometry.

Whereas, by believing accelerometers and deducing that gravity is not a force of attraction, but the generation of space by matter — i.e., by flipping the sign of gravity so that it is conceived as a process of outward, not inward motion — Rotonians provide a physical explanation that connects the large-scale cosmos to deBroglie's matter wave equation. In between we have the familiar effects of gravity. They are all part of the same pattern: a saturated "servo system" of perpetual growth.

12.2. *Strength and Comprehension in Numbers*

More details about the deSitter model and its role in the decades since its inception will follow. The connection between electromagnetism and gravity will first come to the fore by comparing the respective forces, as they operate within a hydrogen atom, where the proton and electron are oppositely charged and exhibit a characteristic separation distance called the *Bohr radius* $a_\circ$:

$$F_E = \frac{e^2}{4\pi\epsilon_\circ a_\circ^2} \qquad \text{and} \qquad F_G = \frac{G m_p m_e}{a_\circ^2}\,, \tag{38}$$

and where e is electric charge and $\epsilon_\circ$ is the electric permitivity constant. The hugeness of the ratio between these forces

$$\frac{F_E}{F_G} \approx 2.67 \times 10^{39} \tag{39}$$

is often pointed out. It so happens that the characteristic *length scales* of these forces yields a ratio of similar magnitude:

$$\frac{F_E}{F_G} \approx \frac{R_{COSMIC}}{a_\circ}\,. \tag{40}$$

While the Bohr radius $a_\circ$ is the pretty much undisputed *characteristic length* of atomic physics, regarding R_{COSMIC} (or R_C) as the characteristic length of gravity will need some justification. Starting around 1930, this justification began to take hold in the context of GR-based cosmology. Some physicists thus began to seriously contemplate the curious "large number coincidence" indicated by Eq 40. The force ratio and the Bohr radius had been established empirically, whereas the exact definition of R_C and its physical value were unknown, or debatable, at best.

Recall, however (from p. 32) that Robert Dicke was among those who posited the simple idea that the cosmic (gravitational) radius should (or at least may) be defined in relation to Newton's constant and the speed of light, such that:

$$\frac{G M_C}{R_C c^2} = 1 \qquad \text{or} \qquad R_C = \frac{G M_C}{c^2}\,, \tag{41}$$

where M_C is the mass within the cosmic radius. M_C is another unknown, but if we can get a reasonable estimate (or definition) of the average *density*, then we can get a comparably reasonable

estimate for both the mass and the radius. This is made possible by measurements of the redshift-distance relation (characterized by the Hubble constant, $H_\circ$) and standard cosmological equations involving the so-called *critical density* and the dimensionless density parameter Ω_{M}. Magnitudes for all of these parameters are *predictable*, according to the SGM-based assumption that they are all *bona fide constants*.

The thought process leading to the SGM predictions for these numbers is actually based on an assumption that brings us back to the merger between electromagnetism and gravity. As noted in §11, Rotonians expect that the stability/saturation pattern revealing itself as between molecular matter, white dwarfs, and neutron stars should be echoed not only between stellar physics and particle physics (as it is) but on the grander scale of the cosmos as a whole. Rotonians expect the Universe as a whole to be eternally stable because they infer a ubiquitous, and arguably indestructible (i.e., *permanent*) harmony in the pattern. They are inspired by both empirical evidence and the "esthetic sense" invoked by Penzias as "our only reliable guide." (Recall quotation from p. 1.)

From this perspective then, to the average cosmic *matter* density ρ_{M}, the average cosmic *energy* (i.e., radiation) density μ_{C}, or its mass-equivalent $\rho_\mu = \mu_{\text{C}}/c^2$, should be added as a key parameter. Rotonians expect these two densities to crucially fit into the emerging pattern. If the average cosmic *matter* density remains constant, this clearly implies that the average cosmic *energy* (radiation) density must also be constant. Given that force and length ratios are echoed, as between atomic and cosmic physics (as per Eqs 39 and 40), Rotonians anticipate that the ratio between cosmic densities ρ_μ and ρ_{M}, will also be echoed in atomic physics. Fortunately, the background energy-density has been fairly well-measured in connection with the Cosmic Background Radiation (CBR) *temperature*. This echo is represented on the Cosmic Everything Chart as the two prominent horizontal lavender bands at $\approx 10^0$ and 10^{-30} (Figure 12, p. 32).

The obvious place to check for the atomic side of the echo is in atoms. Compact *nuclei* represent the vast bulk of the mass of material bodies. Whereas *electrons* function as a kind of electromagnetic gateway — an etheral buffer zone — between nuclei and the far-away, more vacuous ether. Electrons do have mass. But in any given atom the electron/nucleus mass ratio is very small ($\approx 1/1836$ — (hydrogen) or $\approx 1/3672$ — (other atoms) even though it is almost entirely the electrons that give an atom its volumetric *size*. One of the most profound predictions of QT, as explained by P. W. Atkins, is that:

> Matter can turn into radiation. The probability that an electron will disappear in this fashion is proportional to the strength of its coupling to the electromagnetic field, and hence varies as α. Put another way, an electron spends α [$\approx 1/137$] of its time as electromagnetic radiation. Fortunately α is small; if it were closer to unity, matter and radiation would be indistinguishable. [151]

Rotonians interpret this remark to mean, in effect, that the relationship between matter and radiation is neither perfectly hard nor perfectly soft. It is a happy medium characterized by α. The echo between the extremes is arguably revealed by the fact that the mass-energy equivalent of the CBR, $\rho_\mu = \mu_{\text{C}}/c^2$, compares to the average matter density ρ_{M}, as very nearly $1/2$ the electron-proton mass ratio:

$$\frac{\rho_\mu}{\rho_{\text{M}}} \approx \frac{1}{2}\frac{m_{\text{e}}}{m_{\text{p}}}. \tag{42}$$

Based on a common estimate of the value of ρ_{M} — the least well known of these numbers — cosmologist Eiichiro Komatsu gives this ratio as $1/3250$, as compared to $1/3672$, according to the

Rotonian prediction. [152] Under the assumption that Komatsu's estimate is a little off and the Rotonian prediction (Eq 42) is exactly correct, the specific density emerging therefrom can be used to yield specific values for R_C, Ω_M, and $H_\circ$. The latter two parameters are at least roughly measurable. As we'll see in what follows, the Rotonian predictions agree quite well with measurements.

Following the trail suggested by the possibility that Eq 42 is exactly true, since three of the four constants in that equation are already well-measured, we are enabled to derive an exact cosmic matter density, which in turn yields (as we'll see in more detail later) an exact cosmic distance R_C. Also made exact along this trail is the otherwise approximate Eq 40, where twice the inverse fine structure constant comes out as the exacting coefficient: ($2/\alpha \approx 274$) :

$$\frac{F_E}{F_G} = \frac{2}{\alpha}\frac{R_C}{a_\circ} . \tag{43}$$

The fine structure constant α thus makes another dramatic appearance, connecting electromagnetism to gravity, and micro-physics to the physics of the Universe in a cosmically intuitive way.

The most profoundly far-reaching result of the exploration is the following expression, whereby Newton's constant G relates to five other constants whose sphere of applicability spans the whole scale of the Universe, from nuclei to molecular matter to the ethereal background:

$$G = 8\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{c^2 a_\circ}{m_e}\right) . \tag{44}$$

Note that c^2 can be removed from Eq 40 by substituting ρ_μ for μ_C itself. Showing this, and other substitutions that more directly connect G to α we have:

$$G \;=\; 8\left(\frac{\mu_C}{\rho_N}\cdot\frac{a_\circ}{m_e}\right) \;=\; \frac{4}{\pi\alpha}\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{hc}{m_e^2}\right) \;=\; \frac{\alpha^3}{2}\left(\frac{a_\circ}{R_C}\cdot\frac{c^2 a_\circ}{m_p}\right) . \tag{45}$$

The far right side expression separates two factors of the Bohr radius $a_\circ$ within the parentheses to maintain the pattern of one *dimensionless* factor (in this case a length ratio) times one factor whose dimensions are those of G, i.e., *acceleration of volume per mass*. Notice in the two middle expressions that the poorly measured ρ_M drops out of the equation, leaving the nuclear saturation density ρ_N as the constant with the least well known value ($\pm\Delta \approx 6\%$). (See [153] for details.) An empirical estimate commonly found in the literature ($\rho_N \approx 2.85 \times 10^{17}$ kg/m^3) makes Equations 44 and 45 almost exactly true.

In any case, Rotonians propose that they *are* exactly true — not by coincidence, but by some not yet fully grasped *necessity*. Their simple numerical/algebraic expression implies a cogent connection amongst the physical constants and cosmic parameters, emerging as the *essence*, the veritable structural matrix of the eternally self-regulating, ever-growing Cosmos. Much of this is already implied or waiting to be found in the Cosmic Everything Chart. That's why Rotonians call it a treasure map. The obvious place to check for the atomic side of the echo is in atoms. It only remains to test the scheme by building and operating our first Small Low-Energy Non-Collider. Meanwhile, let us now construct and explore the model, not just in summary, but in more methodical detail.

12˙3. *Historical and Empirical Basis: Context for Comparison*

> *G stands mysteriously alone, its history being that of a quantity which is extremely difficult to measure and which remains virtually isolated from the theoretical structure of the rest of physics.*
>
> George T. Gillies : 1997 [154]

> *Could the dimensions of Newton's gravitational constant be explained . . . [by] a theory of gravity characterized by a fundamental mass (or length) and a dimensionless strength? Could we then unify all the forces? . . . Something new is needed.*
>
> I. J. R. Aitchison : 1991 [155]

"*G* stands mysteriously alone," Rotonians suppose, because Earthians don't believe accelerometers. Disbelief in accelerometers also causes Earthians to think the galaxies are flying away from one another so that the space between them increases while they themselves and all things in them stay the same size. Anyone under the spell of this dubious belief system who is nevertheless open to some doubt and receptive to new ideas, will benefit from the following, in which we bolster the Rotonian argument with a little more historical and theoretical background about deSitter cosmology, electromagnetism, Steady State cosmology, misguided appeals to the cosmological constant, and other supporting arguments.

The deSitter model, as we recall, explains the redshift-distance relation without any galactic recession velocity. Curiously, the "self-similar exponential expansion" was adopted by so-called *Steady State* cosmologists, Hoyle, Bondi, Gold, and others, because they also supposed the average cosmic density remains constant. But even these maverick cosmologists did not believe accelerometers. To them, galaxies were still conceived as flying away from one another, so they felt the need to invoke the idea of brand new particles of matter magically popping into the world to maintain constant density. A schematic illustration of this idea is depicted alongside the Big Bang and SGM ideas in Figure 35.

The infamous fudge factor known as the Cosmological Constant Λ, has a non-zero value in deSitter's model. Λ represents a distance-dependent repulsion out of space itself. Since the late 1990s, it has often been labeled as the mysterious *dark energy* that is supposedly *accelerating* the expansion of the Universe. At sufficiently large distances Λ has the effect of overpowering the alleged attraction of gravity and making the creation of space that began with the Big Bang push material bodies in the Universe ever further apart, ever faster. The Big Bang and Λ make space.

At the beginning, it's just the Big Bang because distances are too small for Λ to have an appreciable effect. As the end approaches, it's just Λ because both gravity and the impetus from the initial blast are dwarfed ever more as things fly ever more vastly and more rapidly apart. This latter feature is commonly characterized as the Universe asymptotically approaching a *deSitter state*. There's nothing *physical* about this doubly fantastic creation. It's just magic. It is decreed to be so: Out of the infinitely dense primordial egg, ***BLAM!*** — we suddenly get space. When enough space has been created, ***WHOOSH!*** — Λ takes over to create ever more, ever faster. Having no *physical* cause, this weird pattern is described with geometry. The allegedly attractive force of gravity — having a similarly mysterious geometrical character, and operating predominantly in the stage *between* the initial and final extremes described above — ever more hopelessly removes, or "tries" to *remove* space, to "pull" things back together. Rotonians are aghast at what a conflicted, implausible mess Earthians have dreamed up.

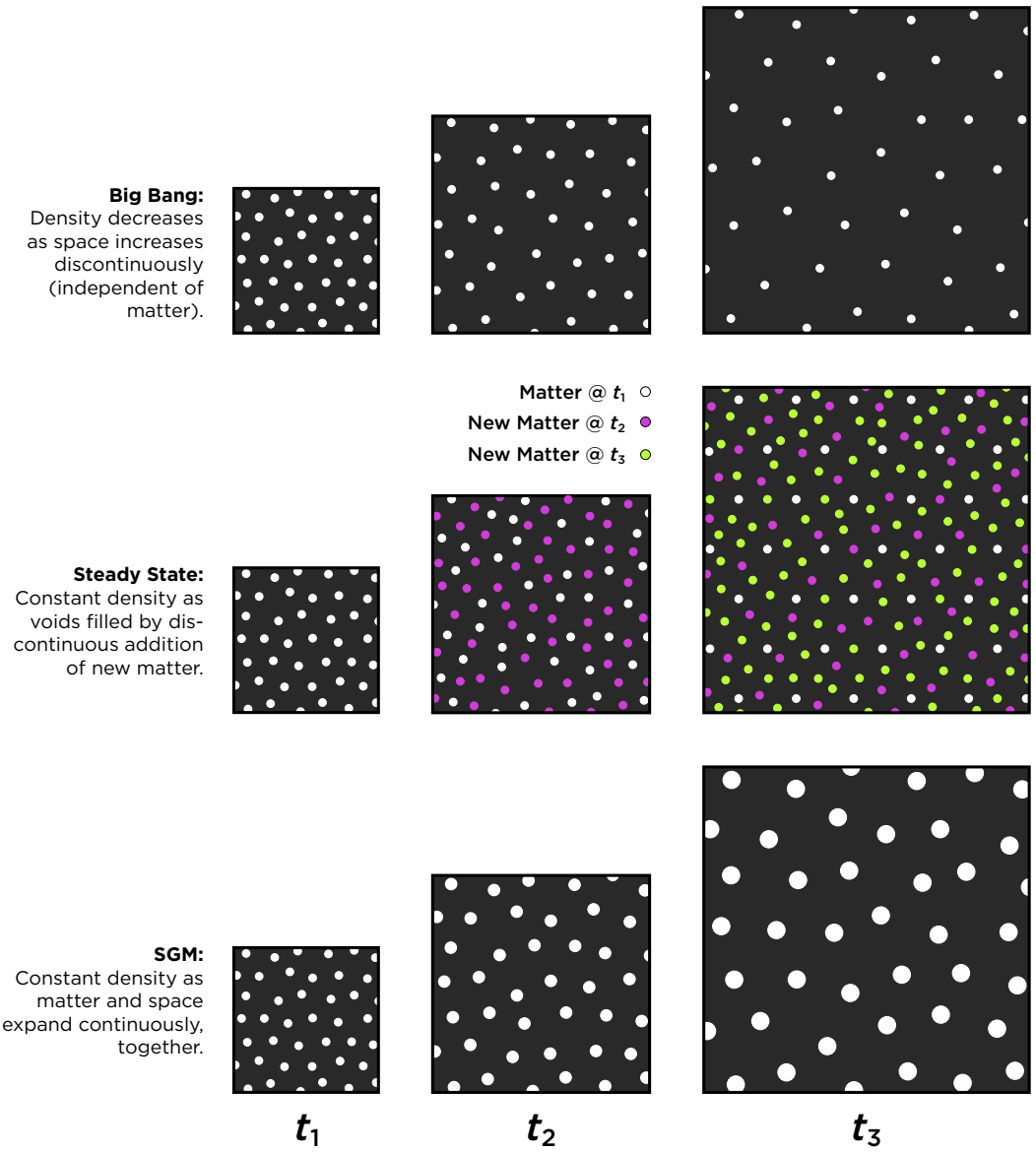


Fig. 35. **Basic Cosmological Ideas:** The Big Bang and "Steady State" models feature stark discontinuities and independence as between matter and space. Whereas the SGM features perpetual matter-space continuousness and *interdependence*, i.e., ***unification***.

Particle physics enters the picture because the so-called "Standard Model" of particles predicts not a small value of Λ, but a stupendously enormous value. Strictly speaking, the value is infinite. But a cut-off is invoked at the *Planck Scale* that renders the ratio between prediction and observation: $\approx 10^{120}$. Often lamented as the greatest failure in theoretical physics [40-42] the discrepancy is seen by Rotonians as an irrelevant, illogical fantasy. Like the difference between a butterscotch and a polkadot unicorn, the *Planck scale* has no physical significance.

Rotonians have no need for the cosmological constant for the same reason they have no need for

discontinuous "spontaneous generation of matter" as particles suddenly popping into existence. Rotonians' belief in accelerometer readings means that *spontaneous generation of matter occurs continuously out of every body of matter that already exists.* Rotonians call it gravity. The expansive increase of *space* of the Universe is caused by the expansive increase of the *matter* of the Universe.

Among other things, this means that fundamentally, there is no edge separating matter from space — on any scale. Recalling Penrose's comment about the infinite reservoir of energy in electromagnetic mass (p. 41) we conceive that the accelerometer in Figure 24 (p. 72) had it about right: "Matter is an inexhaustible source of perpetual propulsion." It keeps filling the Universe to its maximum capacity.

In the fragmented Big Bang picture, the stable configurations: molecular matter, white dwarfs and neutron stars have no cosmic significance. As Barrow and Tipler write: "gravitational effects do not saturate." Contrary to this conclusion, Rotonians conceive that gravity and the Universe actually do "saturate," because gravity and electromagnetism are eternally unified. Belief in accelerometers leads to this unified "Rotonian cosmology," this very testable cosmic hypothesis.

Molecular matter saturates (manifests states of equilibrium) because of the bipolar nature of electromagnetism. Opposites neutralize and balance each other, not statically, but with a rhythmical, microscopic space-creating dance. White dwarfs and neutron stars represent two stages of collapse when the accumulation and concentration of sufficient matter means mono-polar gravity has grown so large that it crushes the foaminess of atoms into dense rubbery fluid (white dwarfs) and a step further in which the rubber is crushed into a *super*-dense state (neutron stars) where the saturation of nuclear forces ("degeneracy") still provides some resistance to total collapse.

When a little more matter is added, even the neutron degeneracy is destabilized. But this next state of collapse does not mean popping out of the world by the dictates of static geometry, to leave only a ghost of warped space and time — as Kip Thorne has stated. In the SGM this next jump in density remains finitely *physical*. Clearly finite size and density are more sensible predictions. On much larger scales — i.e., those of globular clusters and galaxies — one more jump is expected, to what is probably a cosmic *maximum* density, as shown on the Cosmic Everything Chart.

Moving in the opposite direction, toward the realm of seemingly "empty space," Barrow, Tipler and their colleagues disallow gravity from saturation because they see it as an attractive force that is utterly unrelated to electromagnetism. They see it as a product of "gravitons," or some such abomination that ultimately loses the battle with the force of the Big Bang and the Λ-repulsion that takes over and explosively increases at sufficiently large times and distances.

This fragmentary doomsday scenario has somehow taken hold among the throng of physicists who seem happy to keep trampling the spirit of Galileo. With their total ignorance of gravity-induced radial motion through the centers of massive bodies, they nevertheless *pretend* to understand gravity well enough to create the monstrosity known as ΛCDM (Lambda–Cold Dark Matter) cosmology. They blindly flounder about, in their ignorance of how gravity connects to the other forces, as though it doesn't matter. A few authors in their midst have occasionally displayed some modesty, such as in this section's opening quotes, or have provided clues to a more wholesome, rational conception. For example, recall F. Wilczek's supposition that:

> Gravity might be derived from the other fundamental forces. Because it is a small (feeble) effect, maybe gravity is a by-product, a small residual after the near-cancellation of effects of opposite electric or color charges. [43]

When this possibility is combined with Aitchison's suggestion that "the dimensions of Newton's gravitational constant [could] be explained . . . [by] a theory of gravity characterized by a fundamental mass (or length) and a dimensionless strength," the new thing that is needed to "unify the forces"

may be the synthesis whereby the "repulsive vacuum" does not grow (expand) to the *exclusion* of matter. It grows *because of* the ever-outward action of matter. The seemingly "renormalizable" or "unrenormalizable" infinitude of electromagnetic and gravitational energies balance (saturate) on a cosmic scale because they are ultimately of the same (unified) substratum. Always have been, always will be.

All of the desiderata of Aitchison are fulfilled — and the unifying hypothesis of Wilczek is expressed — by Equations 44 and 45, Rotonians suppose, because accelerometers never lie.

12˙4. *Trail of Numbers*

Let's now return to the trail indicated by assuming Eq 42 is physically true (p. 89). Along this route we can more concretely *quantify* the picture described above, to make it even more testable. Exponential expansion is the result when a quantity keeps increasing in proportion to how much exists at a given time. If we and all of our surroundings were participating in such an increase and the sources were distributed perfectly uniformly, we would not be able to tell this was happening.

On a cosmic scale, the distribution is *nearly* uniform. But locally the sources are quite inhomogeneous. There is the Earth; and there is the sky. Physically measurable manifestations of the local inhomogeneities include gravity's inverse square law and stationary upward velocity. (See Figures 9 and 11; and in ***Part 1***, Figures 13, 15 and 17.) Picturing how the infinitude of local space-generating motion adds up to a global exponential expansion is facilitated by imagining a reference frame that does not participate in the expansion. Totally imaginary, but useful — if not essential — for the analysis. From this fictional non-expanding perspective, linear distances of the actual physical world increase exponentially. Let's call the "initial" size of a cosmic distance $r_\circ$. From our imaginary frozen perspective we'd then see it grow with time:

$$r(t) = r_\circ \, e^{\beta t} \,. \tag{46}$$

Spatial *volumes* V therefore increase as the third power of the length:

$$[r(t)]^3 = (r_\circ \, e^{\beta t})^3 = V(t) = V_\circ \, e^{3\beta t} \,. \tag{47}$$

To keep the *density* (mass per volume) constant, masses also increase by the cube of the base:

$$m(t) = m_\circ \, e^{3\beta t} \,. \tag{48}$$

Recalling Müller's comment that "all rocks are clocks," and deBrogile's expression relating mass to frequency,

$$f = \frac{mc^2}{h} \,, \tag{49}$$

application to cosmology evidently means:

$$f(t) = f_\circ \, e^{3\beta t} \,. \tag{50}$$

That is, clock frequencies increase in proportion to the mass increase. It is reasonable to suppose t is the time a light ray takes to travel from source to observer r/c, and that β is the inverse time (something like a *Hubble constant*) $c/R_\circ$. From these assumptions and the fact that *wavelengths* relate *inversely* to frequencies, Eq 50 yields the redshift law:

$$z \;=\; e^{3\beta t} - 1 \;\;=\;\; e^{3r/R_{\rm C}} - 1 \,. \tag{51}$$

Note that for small z (relatively nearby galaxies) we have $z \approx 3r/R_{\rm C}$. Whereas in standard cosmology, the corresponding equation is $z \approx H_\circ r/c = r/R_{\rm H}$, where $R_{\rm H} = c/H_\circ$ is the *Hubble radius* and $H_\circ$ is the Hubble constant. The SGM's cosmic length, $R_{\rm C}$ is thus three times larger than the corresponding length in standard cosmology.

Even without knowing the absolute value of $R_{\rm C}$, seeing that it compares with $R_{\rm H}$ by a factor of three enables us to compare the key mass densities arising in the respective models. The relation for the cosmic mass density in the SGM is gotten by appealing to Eq 41, which can be rearranged to give the mass contained within the cosmic radius, $M_{\rm C} \;=\; R_{\rm C}\, c^2/G$. Dividing this mass by the volume $(4/3)\pi R_{\rm C}^3$ gives the equation for the average cosmic matter density,

$$\rho_{\rm M} = \frac{3c^2}{4\pi G R_{\rm C}^2} \,. \tag{52}$$

In standard cosmology the *density parameter* $\Omega_\circ$ represents a density ratio which, for a *flat* Universe (such as those required by *inflation*) equals unity. The denominator in this ratio, known as the *critical density*, is given by

$$\rho_{\rm CRIT} = \frac{3H^2}{8\pi G} = \frac{3c^2}{8\pi G R_{\rm H}^2} \,. \tag{53}$$

If Eq 52 were used to find a corresponding density ratio, using $R_{\rm H}$ would give

$$\Omega = \frac{\rho}{\rho_{\rm CRIT}} = 2.0 \,. \tag{54}$$

The factor of three difference, $R_{\rm C} \;=\; 3R_{\rm H}$, means that the SGM density parameter is nine times smaller:

$$\Omega_{\rm M} = \frac{\rho_{\rm M}}{\rho_{\rm CRIT}} = \frac{2}{9} = 0.222\ldots \tag{55}$$

These days the purported inflationistic flatness of the Universe corresponds to a density parameter $\Omega_\circ$ whose unit value is assumed to be the *sum* of the radiation density ratio Ω_{RAD} (which is very small and so often omitted), the matter density ratio Ω_{M} and the *dark energy* density ratio Ω_Λ :

(56) $\Omega_\circ = \Omega_{\text{RAD}} + \Omega_{\text{M}} + \Omega_\Lambda = 1$: Lambda–Cold Dark Matter(ΛCDM) Inflation .

Ω_{M} is often broken down into baryonic and *exotic dark* components: $\Omega_{\text{M}} = \Omega_{\text{B}} + \Omega_{\text{DM}}$ — the dark and mysterious component being the dominant one of the two. The subscript for Ω_Λ is sometimes expressed explicitly as referring to *dark energy*. Rotonians have no need for either of these fantasy fudges, whose primary purpose in ΛCDM cosmology is to induce confidence in the theory, to get people (including cosmologists) to keep buying it. Like a clown in a used car sales lot. Step right up! (Phipps would have pointed out that it's a *solemn* clown. $erious busine$$ — wink, wink.)

Prior to the turn of the last century it was often hoped that the matter density ratio alone would assure flatness by amounting to the critical value of one. In the face of evidence that the matter density was but a small fraction of one, it was also not uncommon to find some cosmologists anticipating the need for non-zero Λ. When observations of supernovae in the late 1990s seemed to empirically justify a positive value of Ω_Λ (i.e., dark energy density) many more theorists were happy to make the total $\Omega_\circ = 1$ by adding dark energy to the equation. In order to assess the viability of the SGM prediction that $\Omega_{\text{M}} = 2/9$ in light of these developments, it is worthwhile to consider some history and the current state of cosmic density measurements.

13. Dubiousness of the Big Bang

> *We understand gravity just fine, thank you.*
>
> SABINE HOSSENFELDER : Sometimes snooty PhDizzix Blogger : 2016 [156]

13˙1. *Purple-Winged Horsie Cosmology: Unbelievable yet Popular*

> *The problem with inflation isn't the idea per se, but the overproduction of useless inflationary models . . . There are literally infinitely many models that one can think up, giving rise to infinitely many different "predictions."*
>
> *Inflation . . . doesn't explain anything . . . It is a wonderfully productive model that allows cosmologists to churn out papers . . . Inflation is not a scientific theory . . . It's not good scientific practice . . . because it results in papers, not . . . advances [in] science.*
>
> SABINE HOSSENFELDER : Sometimes insightful PhDizzix Blogger : 2017 [157]

In response to the above quotations, Rotonians insist that modern "physicists" scarcely understand gravity ***at all***. It is hubris for them to claim an adequate understanding prior to conducting Galileo's Small Low-Energy Non-Collider experiment. Rotonians think "the problem with inflation" is not just "the overproduction of useless inflationary models," but *also* "the idea *per se*."

Hossenfelder's 2017 criticism was in response to the ostensibly even more authoritative criticism published in *Scientific American* by Ijjas, Steinhardt, and Loeb, which raised quite a stir at

the time. The *Scientific American* (*SciAm*) authors were unusually harsh — going so far as to claim that Inflationary cosmologists were effectively "promoting the idea of some kind of nonempirical science." [158] Four highly acclaimed inflationary cosmologists responded by drafting a letter of complaint that was co-signed by 29 more influential physicists. The letter and further commentary were published in the *Scientific American* weblog called *Observations*, under the title: "A Cosmic Controversy." [159] Even *Wired Magazine* picked up on the affair in a piece titled: "Physicists Can't Agree on What Science Even Means Anymore." [160]

In line with the critiques of Phipps, Smolin, Lopez-Corriedoira and Disney, from §3, Rotonians regard this new round of quibbling as inconsequential, insofar as it does not trace the problems back to static chunks of stuff, gravitational *attraction*, and disbelief in accelerometer readings. The depth of belief in static chunks of stuff, gravitational attraction and that accelerometers are schizoid liars has caused many scholars to think it's OK to divide by zero, to say the Universe *had a beginning*, and, for the inflationists, that an *infinite number* of "universes" keep appearing out of the "multiverse," fragmentalize, and (at least "ours") is well down the road to certain doom.

The *SciAm* authors, Hossenfelder, and other critics have a problem with inflation's "multimess," as the *SciAm* authors call it, but they are fine with most of the rest of the Big Bang mythology. Specifically, they are fine with treating galaxies as effectively static chunks of stuff. Their primary role is to try to pull back at one another, to counteract the runaway creation of ever more space — to the discontinuous exclusion of matter. Space emerged from the initial Biblical blast and is now supposedly emerging with an ever-increasing push, as *Dark Energy* accelerates the alleged galactic recession. Even Inflation theory's critics are fine with regarding the flattening of their undersides as a result of the hypothetical pulling force, which, *in physical reality* manifests itself not as a *pull*, but as an *outward* acceleration.

This upside-down state of affairs is exacerbated by the likes of cosmologist Chanda Prescod-Weinstein, who, in her recent *New Scientist* commentary admits to a "dominant" potentially dubious influence:

> Some of the most dominant religious traditions *teach us* that there is a definite beginning. [The Big Bang]... moment when our universe came to be... might satisfy the intuition [inculcated] for example, in my family's Jewish tradition, [whose] origin story for the universe begins quite similarly. [161] [My emphasis.]

Do religions teach or do they preach? Teaching is about *knowledge*; preaching is about *belief*. Are we to seek verifiable facts from which we can form a rational, testable hypothesis, or are we being urged to *believe* something, as though we can *know* something that is not really known? — as comforting (or scary) stories that have been repeated by our unenlightened elders?

Rotonians perceive in Earthian cosmology that knowledge and facts are too often replaced by beliefs and suppositions. At its base the prevailing Earthian myth includes the tacit assumption (unfounded *belief*) that accelerometers are schizoid liars. Regarding accelerometer readings as true would mean adopting the Rotonian perspective. The corresponding prediction for Galileo's Small Low-Energy Non-Collider experiment, if confirmed, would invalidate boatloads of traditional "knowledge." It would at last tell a cogent, *fact-based* story supporting the picture of matter, space and time increasing together in a beginningless, endless cosmos whose matter and radiation densities are eternal constants, gravity operates in *unison* ("giant servo system") with the other superficially distinct forces, and accelerometers always tell the truth.

Meanwhile, and not surprisingly, when such a huge error (disbelief in accelerometers) remains unquestioned and is built upon as though it were true, the edifice as a whole will eventually require the invention of subsidiary myths and fudge factors to give an at least patch-job semblance of

coherence and support. In this and the next Section, we will encounter a few of these so-called *pillars* of support. We'll show them to be quite wobbly, and that no sensible builder would trust the resulting death trap to hold up a hill of beans, much less an entire Universe.

13˙2. *Fickle Status of Ω in Cosmological Fashion*

Assessments of the average cosmic matter density $\Omega_\circ$ present more reasons to question modern cosmology. As discussed in §12.4, $\Omega_\circ$ represents a ratio by which the actual density is compared to a theoretical *closure* or *critical* density. $\Omega_\circ$ plays a pivotal role not only in Inflationary cosmology, but in pre-inflation models, such as that of Einstein and deSitter from 1932.

Here we will outline some of the key features of this history in order to better assess the present situation and especially the SGM prediction. We begin with P. J. E. Peebles, who recently received a Nobel Prize for his work in cosmology. What are we to make of the SGM prediction that $\Omega_\circ = {}^2/_9 = 0.222\ldots$?

In Peebles' 2004 paper titled, "Probing General Relativity on the Scales of Cosmology," [162] he opens with the statement: "Particularly impressive is the abundance of evidence that the matter density parameter is in the range

$$0.15 \lesssim \Omega_m \lesssim 0.3\,." \tag{57}$$

Since $\Omega_\circ = {}^2/_9$ is almost exactly in the middle of this range, the SGM prediction looks viable, indeed. But from decades prior to and following Peebles' assessment, some valuable insight is to be gained concerning both cosmology itself and the sociology thereof. Let's see what we find.

In his paper Peebles presents a list of 13 different kinds of measurements and data used to support the above estimation. Rather than reproduce the list, I've simply included Peebles' assessment as a data block (green) within a graph that encompasses prior and more recent measurements and predictions (Figure 36). Measuring techniques have no doubt improved a little since Peebles' 2004 paper was published, but arguably not so much as to justify some estimates that give impressively (if suspiciously) small error margins — especially near the upper end of the range given by Peebles: $\Omega_m \approx 0.3\,.$

As though to anticipate such a tendency, Peebles acknowledges the insidious influence of peer pressure and theoretical prejudice — even confessing to having made a measurement $\Omega_m = 0.65 \pm 0.25$, a few years earlier, when higher values were preferred. To illustrate the point, Peebles presents a graph of measurements of neutron half-lives — only indirectly, if at all related to cosmology — showing a similar trend of societal influence. Peebles' section on "Systematic Errors" begins:

> The considerable number of entries in [the list of 13 observational estimates] allows us the luxury of considering the considerable variety of potential sources of systematic error, under the headers of astronomy, physics and sociology.

Continuing on this theme, Peebles writes:

> We also have to bear in mind that scrupulously careful measurements can be influenced by our respect for social norms. The reluctance to stray more than one or two standard deviations from what is generally accepted is illustrated [in the graph of neutron half-lives mentioned above.]...One sees the same effect in the history of estimates of Ω_m. In 1980...I got

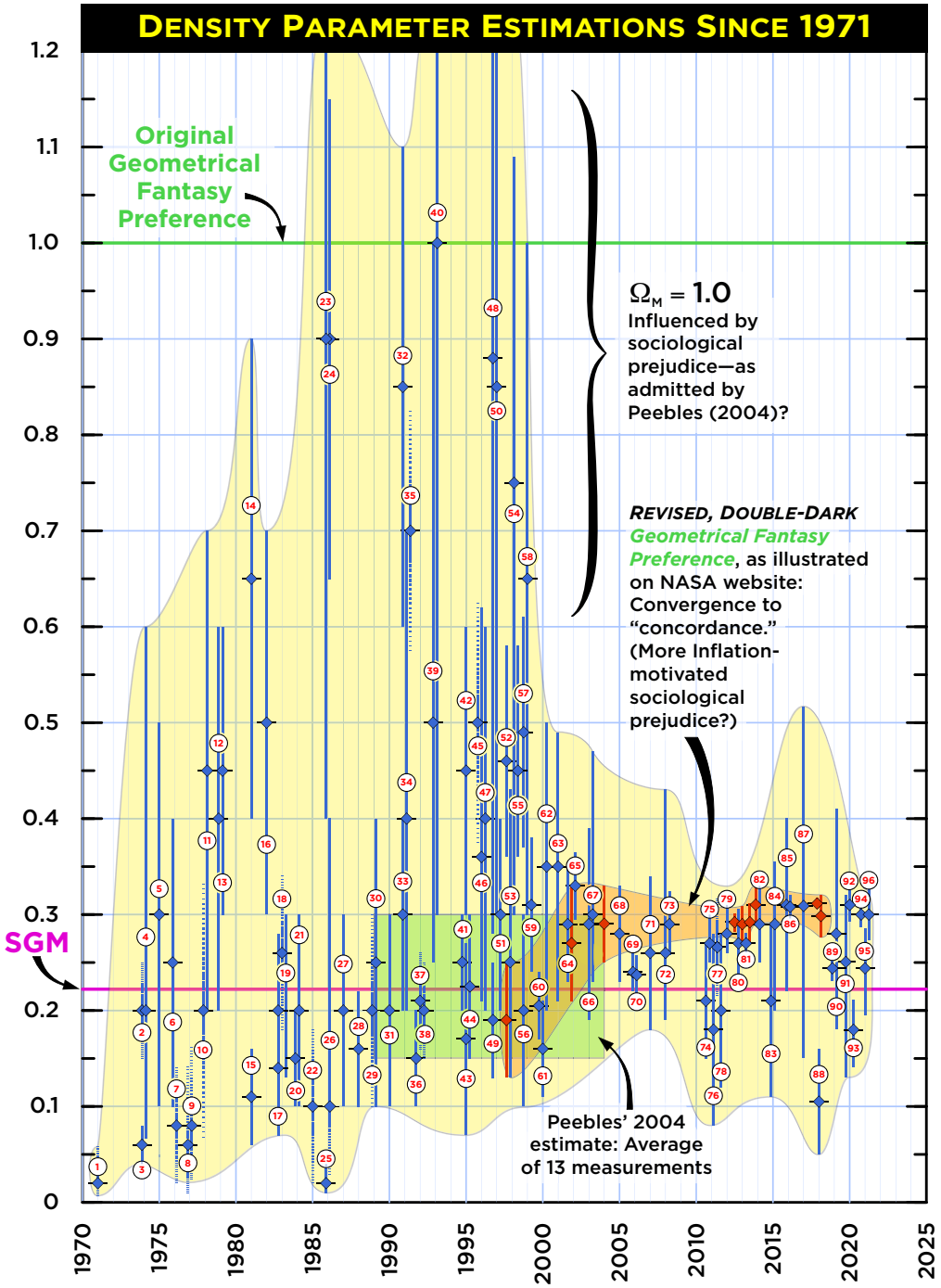


Fig. 36. **Density Parameter Ω_m–Time Graph:** Measurements and estimations since 1971. In the Einstein-deSitter model the average matter density of the Universe is exactly the critical density, which means $\Omega_m = \Omega_\circ \equiv 1.0$. The Universe insists on contradicting Earthian Geometers, as reflected by the measured fractional values. In their misguided persistence, Earthians have concocted the existence of gobs of *exotic dark matter* and *dark energy*. When *matter*-density estimations are augmented with hypothetical Dark *Energy* density Ω_Λ, their *sum* is now supposed to add up to one. The Geometers have thus re-justified their fantasy, and carry on as though the Universe will eventually conform to it. (The numbered sources are listed in Figure 37.)

1. 1971 — PEEBLES: "consistent with Zwicky, 1937."
2. 1974 — EINASTO, et al
3. 1974 — GOTT, et al
4. 1974 — OSTRIKER, et al
5. 1975 — FALL
6. 1976 — FALL
7. 1976 — GOTT
8. 1977 — GUNN
9. 1977 — BAHCALL
10. 1978 — WHITE & REES
11. 1978 — DAVIS , et al
12. 1979 — PEEBLES
13. 1979 — FABER & GALLAGHER
14. 1981 — PEEBLES
15. 1981 — FORD, et al
16. 1982 — DAVIS & HUCHRA
17. 1983 — BEAN, et al
18. 1983 — KIRSHNER, et al
19. 1983 — DAVIS & PEEBLES
20. 1984 — REES
21. 1984 — PEEBLES
22. 1984 — VITTORIO & SILK
23. 1986 — LOH & SPILLAR
24. 1986 — HOFFMAN
25. 1986 — VALTONEN & BYRD
26. 1986 — SHAYA
27. 1987 — TRIMBLE
28. 1988 — OEMLER, JR
29. 1989 — CADITZ & PETROSIAN
30. 1989 — FUKUGITA
31. 1989 — KOLB & TURNER
32. 1991 — KAISER, et al
33. 1991 — SCARAMELLA, et al
34. 1991 — FREUDLING, et al
35. 1991 — HEAVENS
36. 1992 — TAMMANN
37. 1992 — COUCHMAN & CARLBERG
38. 1992 — BAHCALL & CEN
39. 1993 — HAMILTON
40. 1993 — DEKEL
41. 1995 — OSTRIKER & STEINHARDT
42. 1995 — LIDDLE, et al
43. 1995 — SHAYA, et al
44. 1995 — BAHCALL, et al
45. 1996 — DEKEL, et al
46. 1996 — IM, et al
47. 1996 — SMAIL, et al
48. 1997 — PERLMUTTER, et al
49. 1997 — CARLBERG, et al
50. 1997 — SADAT, et al
51. 1997 — BAHCALL, et al
52. 1998 — WEINBERG, et al
53. 1998 — EFSTATHIOU, et al
54. 1998 — BLANCHARD, et al
55. 1998 — EKE, et al
56. 1999 — ROCHA, et al
57. 1999 — HENRY
58. 1999 — BORGANI, et al
59. 1999 — ROOS
60. 2000 — DAVIS
61. 2000 — BAHCALL, et al
62. 2000 — JUSZKIEWICZ, et al
63. 2001 — PEACOCK, et al
64. 2002 — ROOS
65. 2002 — TURNER
66. 2003 — LOKAS & MAMON
67. 2003 — FELDMAN, et al
68. 2005 — TONRY, et
69. 2005 — TEGMARK, et al
70. 2006 — SANCHEZ, et al
71. 2007 — SANTOS & LIMA
72. 2008 — SANTOS, et al
73. 2008 — KOWALSKI, et al
74. 2011 — LAGANA, et al
75. 2011 — HOLANDA, et al
76. 2011 — CONLEY, et al
77. 2011 — NUSSER & DAVIS
78. 2011 — BILICKI, et al
79. 2012 — CAMPANELLI, et al
80. 2013 — HEYMANS, et al
81. 2013 — MANDELBAUM, et al
82. 2014 — BETOULE, et al
83. 2015 — RISALITI & LUSSO
84. 2015 — CAO, et al
85. 2016 — KWAN, et al
86. 2016 — PLANCK COLLAB.
87. 2017 — CAO, et al
88. 2018 — KARACHENTSEV
89. 2019 — HOLANDA, et al
90. 2020 — GONZALEZ, et al
91. 2020 — HILDEBRANDT, et al
92. 2020 — HAMAUS, et al
93. 2020 — ABBOTT, et al
94. 2021 — HOU, et al
95. 2021 — GONZALEZ, et al
96. 2021 — APPLEBY, et al

Fig. 37. **Density Parameter Ω_m Reference List:** Literature sources in chronological order, from Figure 36.

> $\Omega_m = 0.65 \pm 0.25$. My prejudice then was no secret: I argued that the only reasonable case is the Einstein-deSitter model, with $\Lambda = 0$ and $\Omega_m = 1$, and I was glad to see that my estimate was not significantly off the *right answer*. [Emphasis added.]

I've quoted Peebles at length not only because the sociological influence on our subject is relevant, but because he refers to the importance of the Einstein–deSitter model. Satisfying the model seems to require both *exotic dark matter* and *magical dark energy*. These imaginary things have come to dominate the discussion in recent times.

The Einstein–deSitter model was celebrated for decades because it is one of the simplest solutions of Einstein's field equations (a special case of the more general FLRW model). As noted by Peebles, it predicts that $\Omega_m = 1$ and $\Lambda = 0$. Also according to this solution, the Universe's *curvature* is zero. The model's physical implications depend only on the measured mass density, Hubble's constant $H_\circ$ (i.e., the speed of light and the scale length, $R_H = c/H_\circ$) and *time*. Note that $H_\circ$ is actually not a constant, but shrinks as R_H gets bigger. Why? The traditional story is so written. *Amen*.

Actually, there is nothing *physical* about the Einstein–deSitter model. It is just geometry. Some

people think it looks nice, or that it harmonizes with religious stories about the "origin" of the world. But it raises the question: What about the time $t = 0$, when all the mass of the Universe was squeezed into a point? The prevailing mythology is arguably absurd. But it was invented by the icon of genius. And to some it generates warm and fuzzy psychological reverberations. So the gullible ones in charge have held it up, coddled it for years and then, in the process of comparing it with the real world, replaced it with its more complicated but more versatile parent (FLRW metric) because the "simplest" geometry vs. reality connection just got too strained, even for them.

After Inflationary Cosmology was invented in the early 1980s, attempts to salvage the Einstein–deSitter model enjoyed one last gasp *circa* 1986 with the questionable measurement methods of Loh and Spillar, and a few like-minded hangers on — when they claimed that $\Omega_{\rm m}$ was indeed very nearly equal to one. This instance and the enveloping trend are prominent as the tall hump in Figure 36. Many of Loh and Spillar's colleagues were doubtful that $\Omega_{\rm m}$ could actually equal one and began to take more seriously Peebles' assessment of the matter density; i.e., that $0.15 \lesssim \Omega_{\rm m} \lesssim 0.3$ was closer to the truth; that $\Omega_\circ = 1$ could be attained as a total only by the addition of a substantial cosmological constant, i.e., a magical *Dark Energy* component. The prevailing mythology was saved by making it more fanciful, more complicated.

Note that other empirical constraints were also factors in these attempts to hammer out a rational cosmology. For example, by extrapolating backwards to $t = 0$ the age of the Universe seemed to be younger than — or perhaps just barely consistent with — the ages of *globular star clusters*. (See Figure 38.) Maybe the ages of globular clusters should be found to have been over-estimated. Maybe, in the interest of harmony with tradition, someone, some group, would rid cosmologists of

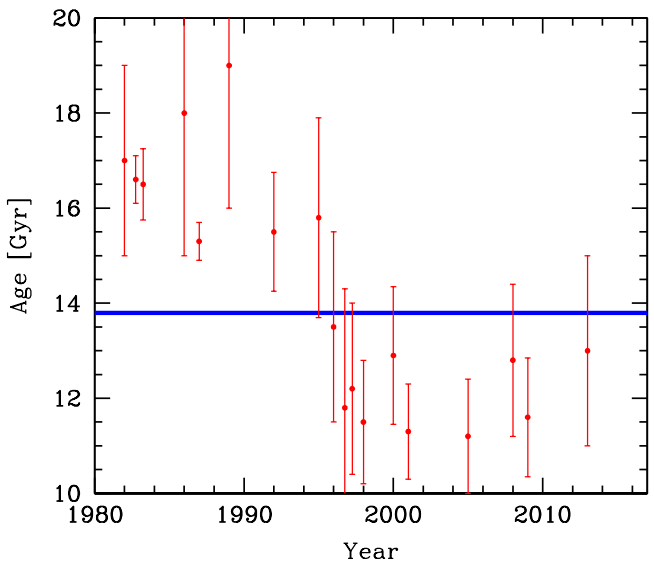


Fig. 4. — Estimated ages of the oldest globular clusters, taken from a representative set of review-like articles. The preferred value dropped dramatically in the mid-1990s. The blue band is the current best-fitting value for the age of the Universe . . .

Fig. 38. **Globular Cluster Ages:** From Douglas Scott's 2018 essay: *The Standard Model of Cosmology: A Skeptic's Guide.* [163] The abrupt shift in "preferred value" is reminiscent of the kind of change in the "measured" value of the density parameter Ω_Λ that Peebles suggested as being influenced by sociological factors. Such obsequious followers we find, who would rid cosmology of its meddlesome contradictory evidence.

those meddlesome geezery (way too old) globular clusters by officially re-estimating them as being younger than the Universe. A glance at Figure 38 gives the impression that something like this happened, nearly in sync with the new dark energy "observations." How convenient!

Being concerned about humanity's manifest susceptibility to corruption and self-deception, Rotonians think this is another instance. In response, they put forth another prediction, one whose accuracy the Small Low-Energy Non-Collider test results will eventually lead to: A re-re-estimation of globular cluster ages to their *circa* 1980s status, or higher. Rotonians expect globular clusters to be extremely old structures, and galaxies are way way much much older — in an ageless Universe.

13˙3. *CBR (Cosmic Background Radiation)*(2)

> *Either ΛCDM is ruled out…[or] a systematic in the Planck angular spectra data must be present. In conclusion, our result calls for new observations and stimulates the investigation of alternative theoretical models and solutions.*
>
> ELEANORA DI VALENTINO, ET AL : "Investigating Cosmic Discordance" 2021 [164]

Shown in Figure 39 is a Table of Data presented by a subset of the several hundred scientists who have been or are now members of the *Planck Collaboration*. They were especially active in the 2010s when their satellite was in orbit acquiring data. The satellite was launched in 2009 to measure the fine structure of the CBR — tiny deviations from the near uniformity of the background sky, whose base temperature ($\approx$ 2.7 K) was impressively measured in the 1990s by the precursor COBE mission satellite. Figure 40 illustrates how Planck's superior sensitivity improved on the COBE anisotropy measurements, as well as on those of the interim WMAP mission.

Planck generated images of the microwave sky at several different frequencies to measure both the temperature differences and the polarization of the received radiation. (See Figures 41 and 42.) The mission indubitably provided a treasure trove of raw data whose essence is the pattern of deviations in brightness from the otherwise smoothed out background of a uniform $\approx$ 2.7 K blackbody spectrum. The big question is: *What does it all mean?*

Rotonians find it disconcerting and unsatisfactory to discover rampant hubris and ill-advised over-confidence in the prevailing interpretation. The prevailing interpretation is that the sky maps represent an imprint of the Universe at the "surface of last scattering," about 400,000 years after the Big Bang beginning. Cosmologists admit to the existence of some problems with this interpretation, but typically only by regarding such problems as *details* that will someday be hammered into place by incremental adjustments in analytical strategy and/or by new observational methods and technology.

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(2) Cosmic Background Radiation (CBR) is often referred to as Cosmic Microwave Background (CMB or CMBR). The eminent cosmologist P. J. E. Peebles used "CBR" in his book *Principles of Physical Cosmology*. This fact and just personal preference motivate using CBR in this essay. In either case, the intended meaning is the sky radiation observed *between* all foreground sources, especially as left over after any residual contamination by unwanted foregrounds is subtracted from the whole. The energy density measurements peak in the microwave region of the spectrum.

Sometimes it is suggested that "new physics" will be needed to more convincingly harmonize observations with theory. But even here the envisaged *new physics* is at an extreme level of abstraction whose effect would scarcely alter prevailing faith in Newtonian gravity or ancient conceptions of static matter. For practical purposes, any such *new physics* would thus only be incrementally "new" — some small adjustment to the presently entrenched story.

Planck Collaboration: *Planck* 2018 results. VI.

Table 2. Parameter 68% intervals for the base-ΛCDM model from *Planck* CMB power spectra, in combination with CMB lensing reconstruction and BAO.

Parameter	TT+lowE 68% limits	TE+lowE 68% limits	EE+lowE 68% limits	TT,TE,EE+lowE 68% limits	TT,TE,EE+lowE+lensing 68% limits	TT,TE,EE+lowE+lensing+BAO 68% limits
$\Omega_b h^2$	0.02212 ± 0.00022	0.02249 ± 0.00025	0.0240 ± 0.0012	0.02236 ± 0.00015	0.02237 ± 0.00015	0.02242 ± 0.00014
$\Omega_c h^2$	0.1206 ± 0.0021	0.1177 ± 0.0020	0.1158 ± 0.0046	0.1202 ± 0.0014	0.1200 ± 0.0012	0.11933 ± 0.00091
$100\theta_{MC}$	1.04077 ± 0.00047	1.04139 ± 0.00049	1.03999 ± 0.00089	1.04090 ± 0.00031	1.04092 ± 0.00031	1.04101 ± 0.00029
τ	0.0522 ± 0.0080	0.0496 ± 0.0085	0.0527 ± 0.0090	$0.0544^{+0.0070}_{-0.0081}$	0.0544 ± 0.0073	0.0561 ± 0.0071
$\ln(10^{10}A_s)$	3.040 ± 0.016	$3.018^{+0.020}_{-0.018}$	3.052 ± 0.022	3.045 ± 0.016	3.044 ± 0.014	3.047 ± 0.014
n_s	0.9626 ± 0.0057	0.967 ± 0.011	0.980 ± 0.015	0.9649 ± 0.0044	0.9649 ± 0.0042	0.9665 ± 0.0038
H_0 [km s^{-1} Mpc^{-1}]	66.88 ± 0.92	68.44 ± 0.91	69.9 ± 2.7	67.27 ± 0.60	67.36 ± 0.54	67.66 ± 0.42
Ω_Λ	0.679 ± 0.013	0.699 ± 0.012	$0.711^{+0.033}_{-0.026}$	0.6834 ± 0.0084	0.6847 ± 0.0073	0.6889 ± 0.0056
Ω_m	0.321 ± 0.013	0.301 ± 0.012	$0.289^{+0.026}_{-0.033}$	0.3166 ± 0.0084	0.3153 ± 0.0073	0.3111 ± 0.0056
$\Omega_m h^2$	0.1434 ± 0.0020	0.1408 ± 0.0019	$0.1404^{+0.0034}_{-0.0039}$	0.1432 ± 0.0013	0.1430 ± 0.0011	0.14240 ± 0.00087
$\Omega_m h^3$	0.09589 ± 0.00046	0.09635 ± 0.00051	$0.0981^{+0.0016}_{-0.0018}$	0.09633 ± 0.00029	0.09633 ± 0.00030	0.09635 ± 0.00030
σ_8	0.8118 ± 0.0089	0.793 ± 0.011	0.796 ± 0.018	0.8120 ± 0.0073	0.8111 ± 0.0060	0.8102 ± 0.0060
$S_8 \equiv \sigma_8(\Omega_m/0.3)^{0.5}$	0.840 ± 0.024	0.794 ± 0.024	$0.781^{+0.052}_{-0.060}$	0.834 ± 0.016	0.832 ± 0.013	0.825 ± 0.011
$\sigma_8\Omega_m^{0.25}$	0.611 ± 0.012	0.587 ± 0.012	0.583 ± 0.027	0.6090 ± 0.0081	0.6078 ± 0.0064	0.6051 ± 0.0058
z_{re}	7.50 ± 0.82	$7.11^{+0.91}_{-0.75}$	$7.10^{+0.87}_{-0.73}$	7.68 ± 0.79	7.67 ± 0.73	7.82 ± 0.71
$10^9 A_s$	2.092 ± 0.034	2.045 ± 0.041	2.116 ± 0.047	$2.101^{+0.031}_{-0.034}$	2.100 ± 0.030	2.105 ± 0.030
$10^9 A_s e^{-2\tau}$	1.884 ± 0.014	1.851 ± 0.018	1.904 ± 0.024	1.884 ± 0.012	1.883 ± 0.011	1.881 ± 0.010
Age [Gyr]	13.830 ± 0.037	13.761 ± 0.038	$13.64^{+0.16}_{-0.14}$	13.800 ± 0.024	13.797 ± 0.023	13.787 ± 0.020
z_*	1090.30 ± 0.41	1089.57 ± 0.42	$1087.8^{+1.6}_{-1.7}$	1089.95 ± 0.27	1089.92 ± 0.25	1089.80 ± 0.21
r_* [Mpc]	144.46 ± 0.48	144.95 ± 0.48	144.29 ± 0.64	144.39 ± 0.30	144.43 ± 0.26	144.57 ± 0.22
$100\theta_*$	1.04097 ± 0.00046	1.04156 ± 0.00049	1.04001 ± 0.00086	1.04109 ± 0.00030	1.04110 ± 0.00031	1.04119 ± 0.00029
z_{drag}	1059.39 ± 0.46	1060.03 ± 0.54	1063.2 ± 2.4	1059.93 ± 0.30	1059.94 ± 0.30	1060.01 ± 0.29
r_{drag} [Mpc]	147.21 ± 0.48	147.59 ± 0.49	146.46 ± 0.70	147.05 ± 0.30	147.09 ± 0.26	147.21 ± 0.23
k_D [Mpc^{-1}]	0.14054 ± 0.00052	0.14043 ± 0.00057	0.1426 ± 0.0012	0.14090 ± 0.00032	0.14087 ± 0.00030	0.14078 ± 0.00028
z_{eq}	3411 ± 48	3349 ± 46	3340^{+81}_{-92}	3407 ± 31	3402 ± 26	3387 ± 21
k_{eq} [Mpc^{-1}]	0.01041 ± 0.00014	0.01022 ± 0.00014	$0.01019^{+0.00025}_{-0.00028}$	0.010398 ± 0.000094	0.010384 ± 0.000081	0.010339 ± 0.000063
$100\theta_{s,eq}$	0.4483 ± 0.0046	0.4547 ± 0.0045	0.4562 ± 0.0092	0.4490 ± 0.0030	0.4494 ± 0.0026	0.4509 ± 0.0020
f_{2000}^{143}	31.2 ± 3.0			29.5 ± 2.7	29.6 ± 2.8	29.4 ± 2.7
$f_{2000}^{143\times217}$	33.6 ± 2.0			32.2 ± 1.9	32.3 ± 1.9	32.1 ± 1.9
f_{2000}^{217}	108.2 ± 1.9			107.0 ± 1.8	107.1 ± 1.8	106.9 ± 1.8

Fig. 39. **Cosmological Parameters *a la* Planck :** On the basis of various questionable assumptions, the raw data gathered from the Planck satellite have been analyzed to yield the above "cosmological" parameters. If the assumptions turn out to be wrong, then these "measurements" are ***not really measurements.*** The analysis is worthless. If the Universe has always existed and gravity is a process of outward motion and the generation of space (as per the Rotonian conception) then these numbers have no physical significance. [165]

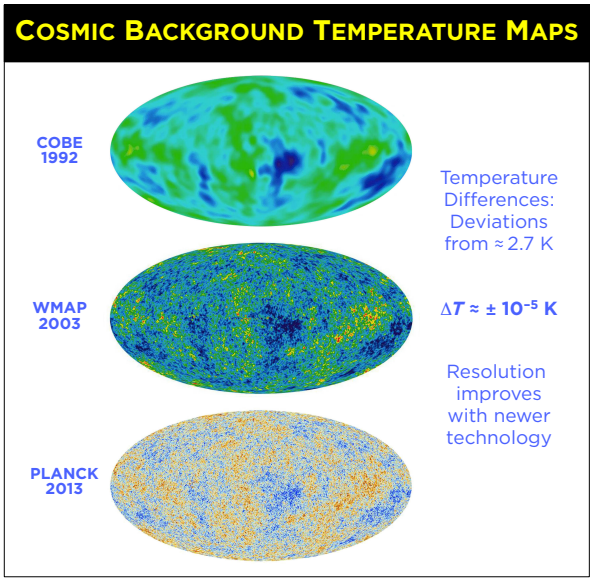


Fig. 40. **Sky Maps of Background Temperature:** The first satellite mission to measure the background temperature itself and differences thereof was COBE in the early 1990s. The next two missions did not measure the temperature itself, but successively improved measurements of the *temperature differences*.

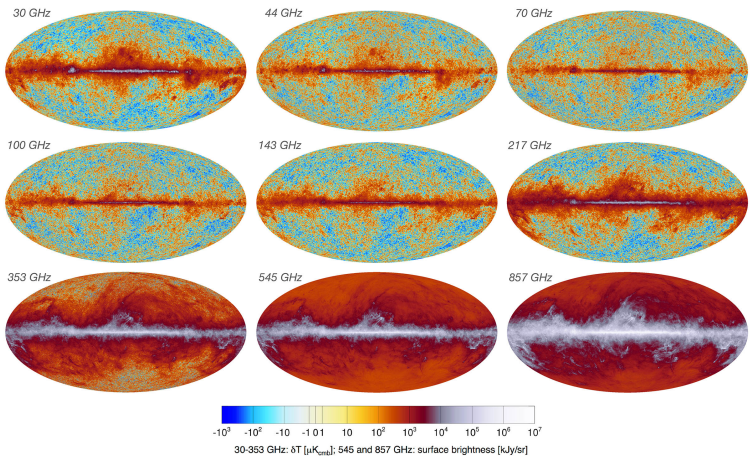


Fig. 41. **Sky Maps at Nine Different Frequencies:** The brightness distribution varies with frequency. [166] Prominent in these sky maps is the horizontal zone, which indicates the contribution from the Milky Way Galaxy. One of the serious challenges of deducing the far background temperature, and variations thereof, is that of modeling the Galactic foreground component so that it can be subtracted from the total (as seen in the more uniform pattern seen in Figure 40).

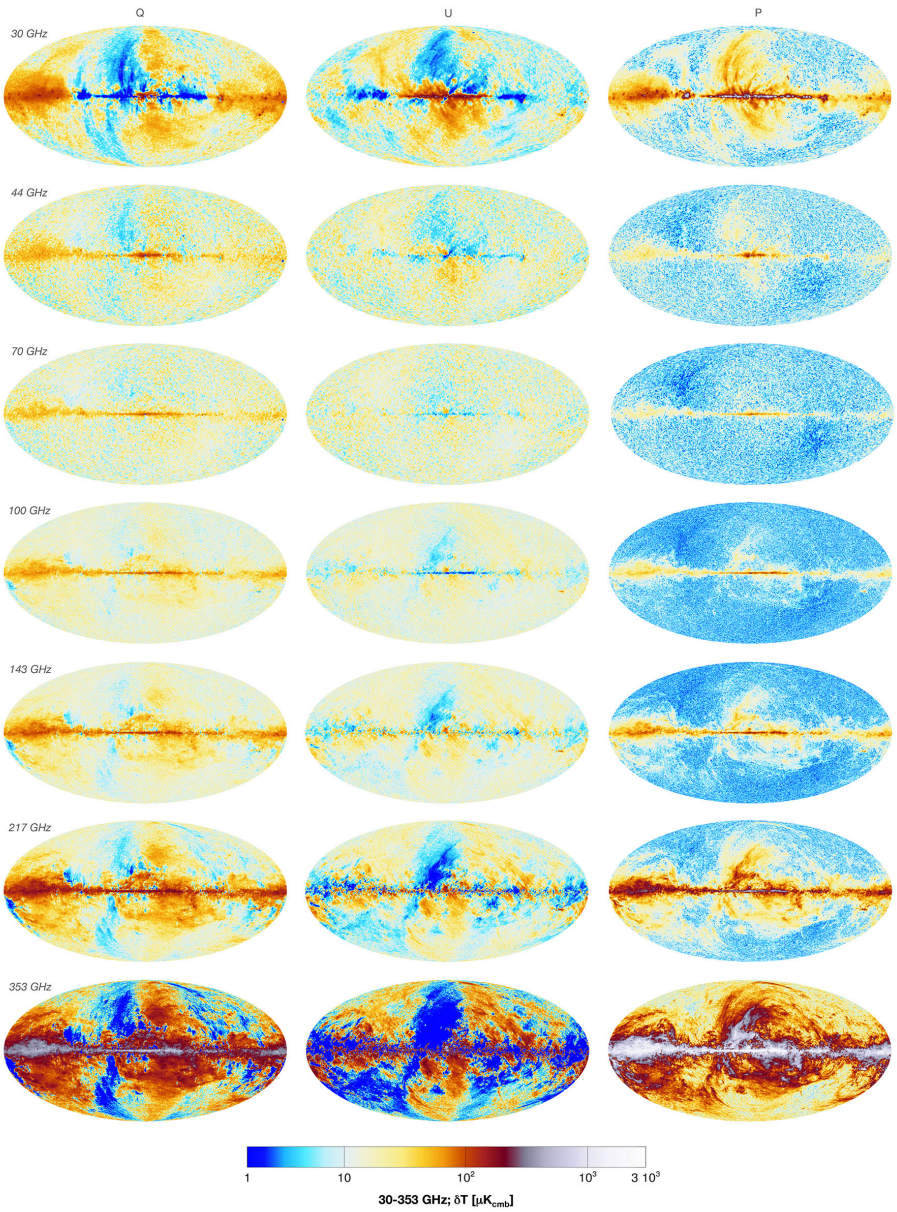


Fig. 42. **Polarization:** Input for analytical gymnastics, curling, and figure skating — *on steroids.* [166]

13˙4. *Lambda Cold Dark Matter: Assumptions, Doubts, and Some Competition*

The standard interpretation goes by the name: *Lambda Cold Dark Matter* (ΛCDM or LCDM). Even those *new physics* advocates who strongly disagree with certain aspects of ΛCDM — for example, proponents of MOND (Modified Newtonian Dynamics) — nevertheless share common ground with

the status-quo by abiding by nearly universally held assumptions:

1. Matter is made of static chunks of stuff.
2. Gravity is a force of attraction.
3. Accelerometers are schizoid liars. (See Figure 2, p. 5.)

Continuing the list with another group of three assumptions, we have the foundations of Big Bang cosmology:

4. Recession of Galaxies,
5. Primordial Origin of the CBR, and
6. Primordial Nucleosynthesis.

The currently favored ΛCDM variation of Big Bangism rests on another set of three, sometimes enumerated assumptions (e.g., Di Valentino, et al [167]) that we group in consecutive order:

7. Existence of "the inflaton" (Inflation).
8. Existence of Exotic Dark Matter, and
9. Existence of Dark Energy.

Assumptions 4–6 have sometimes been dramatically advertised with the stately Greek motif of marble pillars, as in Figure 43.

Having thus laid out the hierarchical support structure of modern cosmology, note that critics sometimes try to chip away at one or more of the upper and sometimes even middle pillars, and that it is sometimes fruitful to witness the blow-by-blow when the critics' arguments are well-reasoned. A specific case that we will encounter later involves the arguments that MOND-ists inveigh against the ΛCDM-ists and that the ΛCDM-ists inveigh against the MOND-ists. (Insightful examples of such discussions include video presentations featuring Stacy McGaugh, Pavel Kroupa, and others: [168, 169].)

Be that as it may, Rotonians predict that all nine assumptions (*pillars*) are destined to collapse. The first three (static chunks, gravitational acceleration, lying accelerometers) are so deeply ingrained and "self-evident" as to escape being stated or questioned. The ΛCDM-ist vs. MOND-ist disputes represent minor quibbles, as these parties and all Big Bangists generally agree that the Universe is an ever-more fragmentary soup of discontinuous particles, getting colder and colder, more and more tenuous as its inevitable doom is rapidly approached.

As astrophysicist L. Verde (and many others) have explained, to cosmologists, whole galaxies are treated as "points" — points whose distances from one another, on average, increase ever faster, while their static "pointiness" persists until their temperature approaches zero and they die. [170] Only the space *between* particles (i.e., these galactic "points") is regarded as expanding. Extrapolating this picture backwards in time brings us to the purported origin of the density fluctuations seen by Planck, which later evolved to become galaxies, clusters of galaxies, "walls" of superclusters, and all the smaller sub-structures within them.

Remarkably — and *unbelievably* — all the astronomical structures in the Universe are supposed to have been "seeded" by the intense activity alleged to have taken place in the "first" tiny fractions of a second. Having no idea what *actually* took place at this imaginary time, cosmologists simply fast forward to the point when the activity is seemingly tractable with assumption-laden theories. Rotonians find much to question, much to doubt, as we will see.

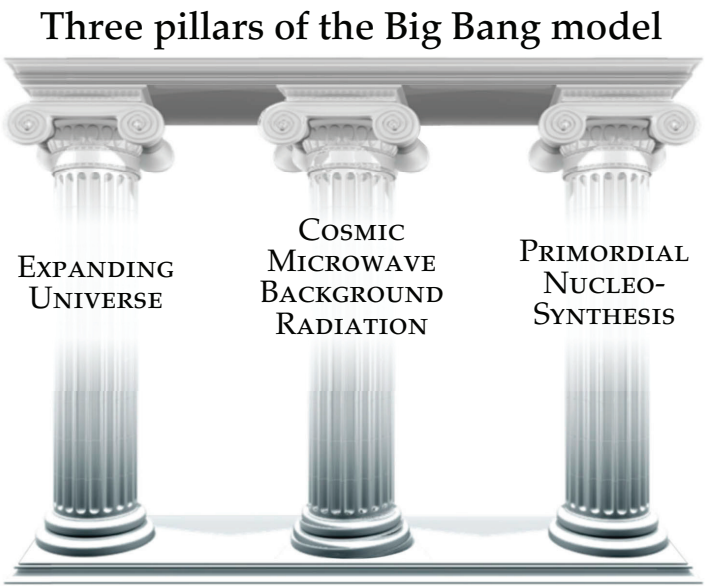


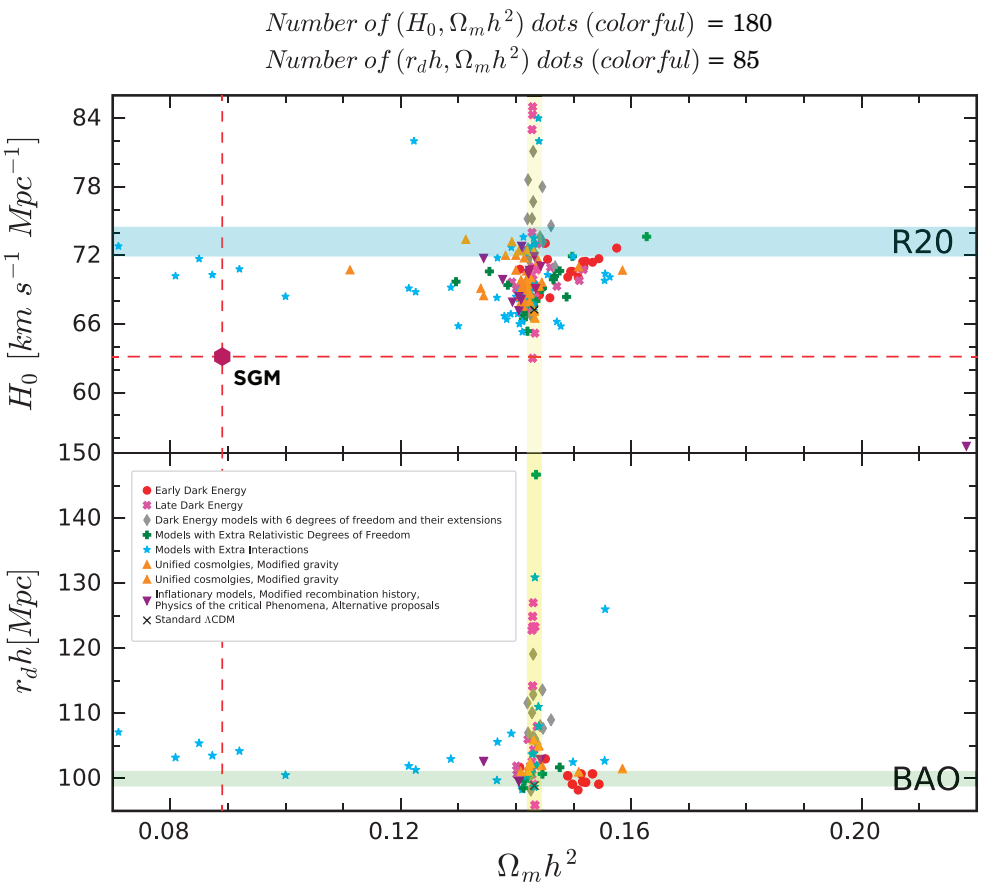
Fig. 43. **Ancient Greece–Inspired Bastions of Discontinuous–Static–Chunk–O'–Stuff Disease:** Rotonians think these traditional "supports," as presented by Associate Professor Dragan Huterer at the University of Michigan, are not what standard cosmologists think they are. The redshift-distance relation does not indicate fragments that fly apart. The background radiation does not originate from a decoupling era near the "birth" of the Universe. And the idea that nuclear physics as developed in modern Earthian laboratories applies to the "first" few minutes of the Universe is absurd. So say the Rotonians. [171] Compare with Figure 61.

13˙5. *Too Many Theories?*

Before elaborating on the rickety fragility of standard theory, it is useful to grasp what we're up against by locating a pair of predictions from the Rotonians' new Space Generation Model cosmology on a graph whose purpose is to compare nearly *200* competitors with one another. (Figure 44.) If nothing else, the crowded field shown here gives the distinct impression that cosmology has become a major enterprise — a veritable industry for cultivating variations in theory. The strategy of the participants seems to be this: *If the garbage stinks, try rearranging it a little bit. What else is there to do? We certainly can't throw it out. Nothing to be embarrassed about; we're just doing our jobs!*

The location of the SGM prediction on this graph (distinctly removed from the dominant cluster) is not something Rotonians worry about because both the standard predictions and to a large extent also the standard "observations" are highly *model-dependent*. (See [172].) As we recall from §12.4 (p. 95) the SGM predicts the density ratio: $\Omega_{\text{M}} = 2/9$. Whereas in standard cosmology it is an *adjustable parameter* which is supposed to be the sum of baryonic matter density Ω_{B} plus exotic Dark Matter density Ω_{DM}, where the mysterious Ω_{DM} needs to be about five times greater than Ω_{B}.

Note that the values of Ω_{M} and Ω_{DM} (that change with cosmic time) are supposed to be components of the larger (unchanging) sum $\Omega_{\circ}$, as predicted by inflation and as concocted by invoking the even more mysterious Dark Energy Ω_{Λ}. Clearly evident is how grotesque and cumbersome this scheme is. (See Figure 45.) Cosmologists continue juggling these tortured parameters, it seems, because they really don't know what else to do. Building and operating humanity's first Small Low-Energy Non-Collider is surely not on their priority list.



In this plot we have an estimate of the density of the available cosmological models proposed to solve or alleviate the Hubble constant tension over the past couple years. We have therefore accumulated the values of Ω_m, h^2, H_0 and $r_d h$ from various earlier figures . . . into a single plot for a better understanding on the entire theme.

Fig. 44. **Theories upon theories upon theories:** The parade of bandwagons of Big Bang Theory variants cluster mostly incrementally close to one another. Meanwhile, the SGM predictions for the Hubble constant and the density parameter, based as they are on entirely non-standard conceptions of matter and the Universe, sit firmly removed from the beaten path. Adapted from Di Valentino, et al. [172]

Considering the Hubble constant and the coefficient h appearing in Figure 44, note that h is commonly used to express a value for the Hubble constant, where

(58) $$h = \frac{(\text{deduced or predicted value})}{100\ \text{km}\,\text{sec}^{-1}\,\text{Mpc}^{-1}}\,.$$

Disagreements (euphemistically called *tensions*) over the value of h are the main reason for many of the reassessments being proposed — to "explain" the disagreement and restore some harmony to the scheme. As noted above, in standard cosmology Ω_M is one of the terms in the sum of densities

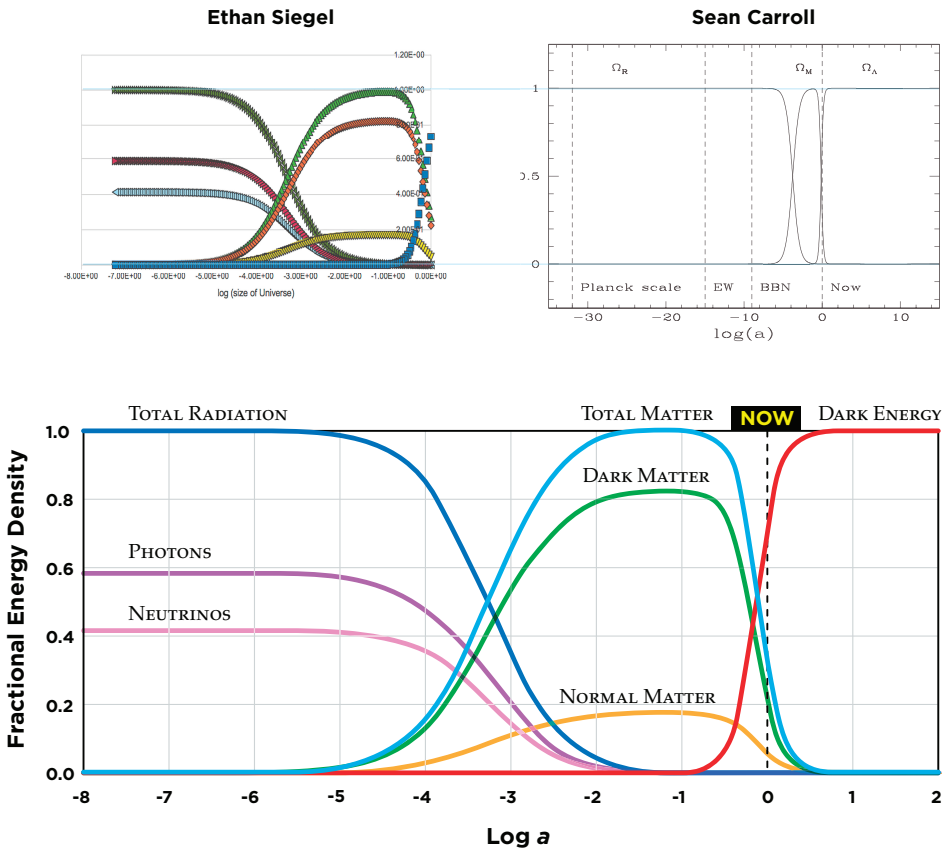


Fig. 45. **Big Bangs are Preposterously Messy and Unlikely:** Each of the multitude of ingredients (alleged or real) of the Universe has its own alleged *evolution* of relative influence. Log a represents the relative scale size of the Universe, where its present size is normalized to unity. Siegel illustrated this in a clunky way for a shorter stretch of time than Carroll did (upper left and right). Carroll's graph is less cluttered because its main purpose was to point out the *coincidence problem*: The fact that the Dark Energy and matter densities happen to be of the same order of magnitude only at the present skinny slice of time. Carroll's discussion of the graph appears in a section called "The Coincidence Scandal," where he acknowledges how unlikely the standard conclusion is, and characterizes it as nevertheless "not completely ridiculous." The Rotonian assessment, by contrast, is that the contrived and convoluted contraption ***is indeed completely ridiculous.*** [173, 174]

(59) $$\Omega_\circ = 1 = \Omega_\Lambda + \Omega_{\rm M} \quad : \quad \Omega_{\rm M} = \Omega_{\rm DM} + \Omega_{\rm B} + \Omega_\nu + \Omega_{\rm RADIATION} + \Omega_{\rm K}\,.$$

where Ω_ν is the contribution by neutrinos and $\Omega_{\rm K}$ is the contribution by *curvature*. In order to keep $\Omega_\circ$ always equal to one (at least after departing the Land of Oz "inflation epoch") the terms on the right side need to undergo some rather convoluted "scandalous" changes as the Universe evolves.

By contrast, in the SGM

(60) $$\Omega_\circ \equiv \Omega_{\rm M} = \frac{2}{9} \approx \Omega_{\rm B}\,.$$

There is no Exotic Dark Matter and no Dark Energy. The total matter density ratio Ω_{M} is only slightly larger than Ω_{B} because electrons are not baryons. There are about as many electrons as there are baryons, but their mass ratio is $m_{\text{e}}/m_{\text{p}} \approx 1/1836$. Even radiation (whose "mass equivalent" *energy* is of a similar magnitude) does not contribute to the matter total, because only clock-like energy (i.e., matter) gravitates, i.e., possesses active gravitational mass. Light is timeless — *not* clock-like — so it does not contribute to the gravitational mass density sum. Similar reasoning applies to *neutrinos*, which are conventionally regarded as "relativistic" particles. Traveling at nearly the speed of light means having nearly zero clock rates, and so nearly zero active gravitational mass — as discussed in §8 – §10.

Comparing the matter density ρ_{M} with the mass equivalent of the radiation density ρ_μ (as we recall from §10) we have

$$\frac{\rho_{\text{M}}}{\rho_\mu} = \frac{2m_{\text{p}}}{m_{\text{e}}} \approx 3672\,, \tag{61}$$

which is also *constant forever.* (See Cosmic Everything Chart, Figure 12, p. 32.)

13.6. *Hubble Constant*

We'll return to cosmic densities again later. For now, let us reconsider the Hubble constant, noting first that, over the decades its value has been measured hundreds of times. (See Figure 46.) It is important to understand that the alleged "measurements" of cosmological parameters by analyses of CBR data do not really qualify as *physical measurements* of the things purported to have been measured. They have the character, rather, of measurements of detailed properties of the trail presumed to have been left by Sasquatch — within a community of fervent believers in the existence of Sasquatch — to be measurements of Sasquatch himself.

Most of the measurements plotted in Figure 46 were made by other methods — many, if not most of them by what has appropriately been called the "distance ladder" method (a complicated, but at least rational procedure). The idea is to deduce the distances of objects (e.g., galaxies) by some means other than their redshifts so that then a comparison with a given redshift-distance law yields the factor H that brings the law and the measurements into agreement.

The dimensions of H are $1/T = 1/\text{Time}$, and are customarily interpreted as *kilometers per second per megaparsec*, i.e., a velocity of recession that increases with increasing distance. It need not be thought of and broken down into these units, of course. A constant with dimensions $1/T$ can also be thought of as a kind of *frequency*, as is often the case. In this case it represents — according to the Rotonian model — an apparent difference in *clock rate* with increasing distance, due to the light from distant sources being delayed by the finite speed of light c. The longer the distance the greater the delay. Matter, all clocks, have frequencies that increase with cosmic time. Looking back through space we see ever slower ticking rates with ever further distances because our nearby clocks tick faster than the clocks we see ticking long ago, the more so the further in space we look.

As noted in Eq 58, Hubble's constant is often expressed as a ratio which compares a *deduced* value with a *fiducial* value: $h_\circ = H_\circ/100$ km s^{-1} Mpc^{-1}. For the SGM we have $h_{\text{SGM}} \approx 0.634$, as indicated in Figure 46. Remember that in 1917 deSitter predicted a distance-redshift relation whose physical meaning was nearly the same as what it is in the SGM cosmology. The *deSitter effect* represents a slowing of time for distant clocks. (Discussion on pp. 86–87. [148].) A robust and rational alternative to the standard recession-velocity interpretation has thus existed since the birth

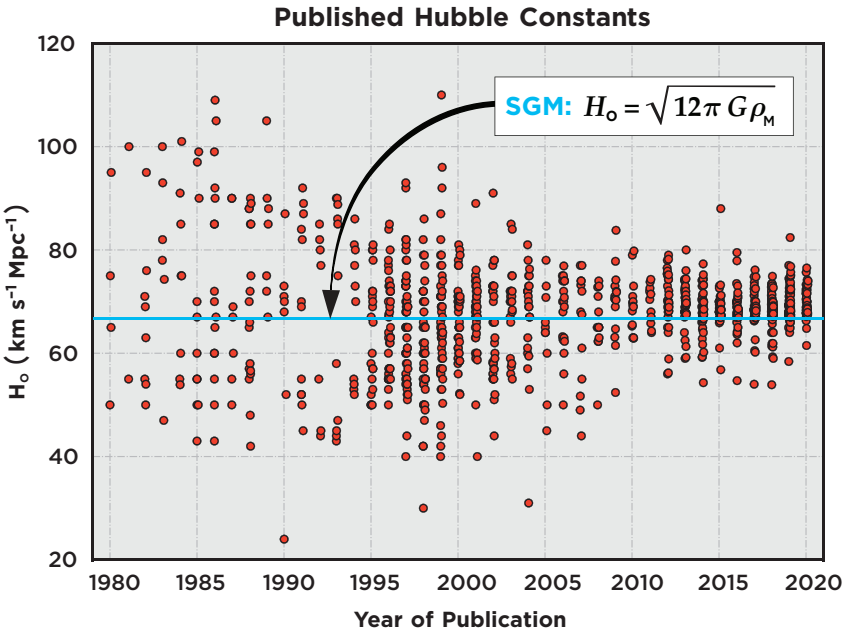


Fig. 46. **Hubble Constant Measurements Since 1980:** The SGM prediction for the Hubble constant is slightly on the low side of the median of the most recent of these many measurements. Unlike the Big Bang interpretation, according to which the number is one of several that is not really constant, but changes over time (as an *adjustable parameter*) the SGM number is predicted to be a *bona fide* constant. It is directly related to Newton's constant G and the average matter density, which are directly connected to the other constants of physics by Equations 40 and 41. (See also Cosmic Everything Chart: §5, p. 32.) [175]

of relativistic cosmology. Whatever the physical meaning of $H_\circ$ may be, even the distance ladder measurements are based on many assumptions concerning the nature of "standard candles" and the steps required to jump up the "rungs" of the ladder out to cosmological distances. Largely obscured by modern trends is an older group of observational cosmologists (Sandage, Tamman, *et al* [176]) who argued for values of $h_\circ \approx 0.62$. Whereas the newer community of astrophysicists who use distance-ladder methods have settled on values closer to $h_\circ \approx 0.73$. [175]

Curiously, these latter values are in "tension" with the values deduced from WMAP and Planck. The latter groups have claimed h to be ≈ 0.67. Ironically, the values given by the Planck group are closer to the SGM prediction. Yet Rotonians are more suspicious of the methods used to arrive at such values. Rotonians regard the CBR-based measurements as not really measurements because standard cosmologists *presume* their temperature maps to be the result of a Universe that was once infinitesimally small and infinitely dense. Rotonians think this is absurd. If the assumptions that underlie the analysis of the CBR maps in Figures 41 and 42 are wrong, then the values deduced for the various parameters, including h, are useless phantoms. Being unaware of the Rotonian alternative, standard cosmologists such as Ethan Siegel admit the presumptuousness of their method:

> The early relic methods, as a group, are more complicated in detail, but not necessarily more complicated as a concept. Instead of starting here on Earth and working our way out, deeper and deeper into the distant Universe, we start way back at the Big Bang, and calculate some initial imprint at some stupendously early time. We then measure a signal that's observable today that's affected in a specific way by that early imprint. [177]

"We start way back at . . . " a ***dream*** and "***calculate*** some initial imprint at some *stupendously early time*." Rotonians see this as tantamount to a confession of self-delusion. The idea that modern guesses qualify as *precision cosmology*, as is often claimed, becomes all the more suspect when it is acknowledged that even the distance-ladder strategy is not as robust as is also often claimed. To this point, a glimmer of humility shines through in a recent *New Scientist* article about the ongoing "*Cosmic Confusion*," wherein Leah Crane works in a quote from astronomer Barry Madore:

> Other astronomers have pointed out that even a 5-sigma ["gold standard"] discrepancy doesn't rule out the possibility of errors or systematic uncertainty in our measurements of stars. "It doesn't matter how many sigma away you are, it's whether you have determined all of the potential errors out there that had led to that place," says Barry Madore at the Carnegie Institution for Science in California. [178]

On one hand, attempts to improve on distance-ladder measurements of Hubble's constant are worthwhile science, because the redshift-distance relationship is a real thing, even if it does not represent recession velocities.

On the other hand, being based on the absurdity of an infinitely hot and dense beginning, from which follows the assumed validity of "stupendously early times," almost all of the data listed in the table of Figure 39 are — however *precise* — almost certainly *inaccurate* measurements of Sasquatch. This is the playground within which math geeks can pretend to acquire useful information by flexing their singularity-stricken theories in illogically extreme pseudo-physical situations, dependent on phantasmagorical Dark Stuffs to $ell to themselves and the entertainment-hungry tax-paying public.

What we've ended up with, in effect, is a gallery of maps harkening back to their medieval counterparts, whose perimeters were surrounded by all manner of scary monsters: Dark Photons, Holographic Stringbranes, Wimpzillas, Planck-Scale Inflatons, 11-dimensional SuperSymmetric Amplituhedrons, and more . . . all smothered by a thick swamp of Darkest Fluid. Standard theorists take these things seriously because they were concocted by the most sophisticated geometrical, dynamical, and statistical analyses and simulation algorithms known to man. But not for any *GOOD* reason. Not because, for example, anyone has thought to contemplate the possibility that their undersides are flattened because accelerometers tell the truth. Not because anyone has thought to finish gathering utterly essential gravitational data by doing the Small Low-Energy Non-Collider experiment proposed by Galileo in 1632. Standard theorists tacitly, and sometimes explicitly, regard such ideas and tasks as beneath their dignity, beneath their Einstein-endorsed "highest abstraction" level of sophistication. So they wallow in ivory tower mythological madness.

These criticisms may seem cheap and cynical: the out-gassing of a bitter rebel. Short of confirming the Rotonian prediction for the Small Low-Energy Non-Collider experiment, which would arguably justify them, the Rotonian assessment can be at least provisionally supported by adding more factual details.

It is essential to understand, as emphasized by the Planck team in their 2020 *Overview* paper, that the CBR enterprise is all about *statistical analyses*, whose main product is the *power spectrum* curve shown in Figure 47:

> The maps of CMB anisotropies [as shown in Figures 41 and 42, are typical of those] . . . on which we base our analyses of the statistical character of these fluctuations. . . . The information content in the CMB comes from its statistical properties. . . . Essentially all of the cosmologically-relevant information in the CMB anisotropies resides in their correlation functions or power spectra. . . . It is

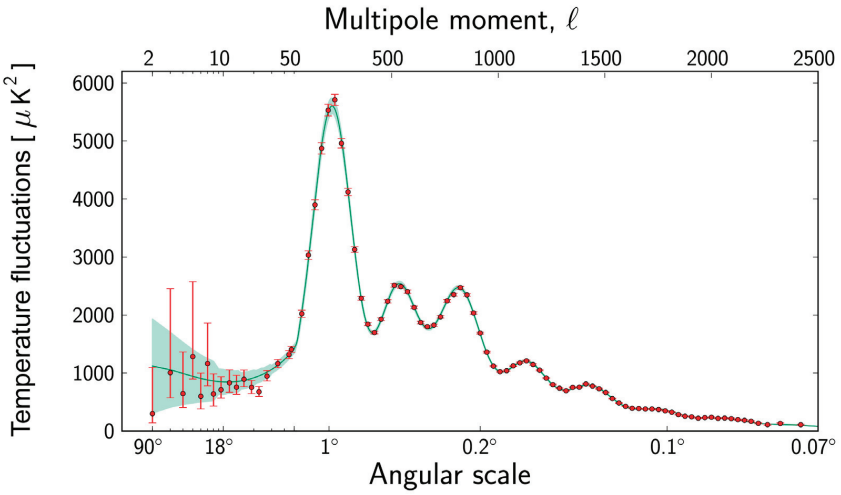


***Figure 4**. Anisotropies in the temperature of the CMB as measured by the Planck satellite. The acoustic peaks are clearly visible.*

Fig. 47. **Planck Power Spectrum:** As displayed in the Nobel Committee for Physics background document for the 2019 Nobel Prize, awarded to P. J. E. Peebles. Readily apparent is the seemingly impressive agreement between the theoretical curve and the Planck team's empirical data analysis. [179]

> natural to treat the positions of the individual peaks in the power spectra as empirical information that becomes part of the canon of facts now known about our Universe. [180]

Being an almost "perfect black body," the background sky's spectrum has the character of noise. It is sometimes mentioned that about 1% of the noise found between channels on a TV set is in fact received from the cosmic background. Noise is understood to be a collection of seemingly random signals, whose proper method of analysis is — especially when comparing the signals from different angles on the sky — statistical. The sky maps are in some ways analogous to sound waves that are analyzed by Fourier decomposition. The main difference is that, instead of being linear, or two-dimensional (as a trace on the screen of an oscilloscope) the pattern is across the whole sky, i.e., three-dimensional.

In any case, having the purpose of studying the noise and not the more ordered foreground signals, one of the challenges is to mask out or somehow subtract foreground signals from the mix. Assuming this could be done perfectly (which it cannot) we'd be left with an almost "pure" background, whose imperfections (fluctuations) from purity reveal, however, tiny angle-dependent deviations from uniform temperature, at the order of 10^{-5} K. These fluctuations are alleged to be the result of density inhomogeneities and "acoustic oscillations" caused thereby, taking place way before the Universe could say *Jack Sprat*.

13.7. *Power Spectrum; Possible Meanings; Excessive Tweakability*

When tweaked and combined in allowance with the flexibility of the ΛCDM model, various input parameters do indeed yield the curve in Figure 47. It is also true that the curve could be the result of physical circumstances having nothing to do with ΛCDM cosmology. Martin Lopez-Corredoira thus explains:

> Understanding how much information is in the power spectrum is important for key questions in the discussion of the fundamentals of cosmology. [Q:] Should we consider the fact the power spectrum contains oscillations a successful prediction of the standard cosmological model that cannot be produced by any other means? . . . [A:] The presence of peaks in the power spectrum is a rather normal characteristic expected from any fluid with clouds of overdensities that emit/absorb radiation or interact gravitationally with the photons, and with a finite range of sizes and distances

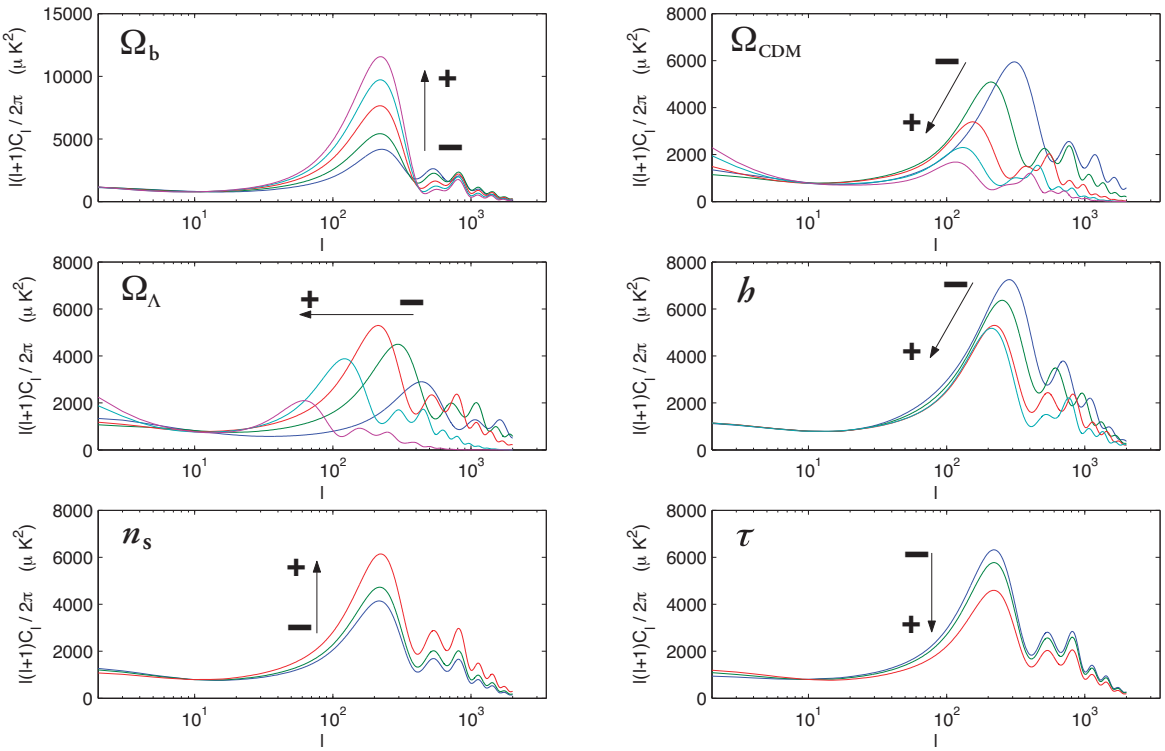


Figure 3. Dependence of the temperature power spectrum C_ℓ on some relevant cosmological parameters (the spectra have been computed with the CMBFAST code).

Fig. 48. **Tweakability of the Planck Power Spectrum:** A wide (infinite?) range of curves can be created by adjusting the values of key cosmological parameters (indicated in the upper-left corner of each graph). The arrows indicate the directions that correspond to increasing or decreasing the respective parameter values. When the curve is massaged into place, so as to match the statistical analysis of the data, are we to regard the resulting values of the parameters as *predictions* or *measurements*? No way! Rotonians are not impressed with this way of doing "cosmology." Figure is adapted from Martinez, 2009. [181]

> for those clouds. Apart from the standard cosmological model, other scenarios may also follow these conditions. The interpretation of "acoustic" peaks is just a particular case; peaks in the power spectrum may be generated in scenarios that have nothing to do with oscillations due to gravitational compression. [182]

Figure 48 conveys the fact that the shape of the power spectrum curve is highly adjustable. See also the series of animations at Wayne Hu's website [183], where the continuous magnitude-change of one parameter at a time shows the resulting effect on the curve as a whole. Cosmologists did not start with a robust theory that gave a robust set of predictions to compare with observations, to be rejected when the predictions and observations were shown to disagree. No. They started with a rough sketch of some highly questionable, often half-baked ideas, hammered into a mudfoggily analyzable contraption that they've been coddling and tinkering with for decades.

13˙8. *Nobel Prize Sociological Digression*

Insofar as ***those who claim to know are much less likely to be telling the truth than those who admit they don't***, we are well advised to pay more attention to those few scholars who are eager to point out weaknesses in the standard model than those who are eager to sell it to you. Let us here digress to make explicit a pattern that tacitly permeates this whole essay. Some benefit will accrue by spelling it out more directly. From the many literature quotations having the character of critiques — negative or positive — we will have begun and will continue to notice a range of attitudes that span something like grumbly dissatisfaction at one end and something like smug gung-ho propaganda at the other. It's the latter, more popular extreme from which arises the self-congratulatory labels: "Concordance Model" and "Precision Cosmology." Sadly, from this end of the spectrum we also sometimes find flagrant lies. The phenomenon of lying in the name of science raises lots of sociological and psychological questions. Leaving such questions aside for the moment, consider a high-profile example.

In celebration of receiving the Physics Nobel Prize in 2011, Brian P. Schmidt delivered a customary lecture about the work that earned him the prize. Presented to an audience of lay persons and others in the fancy auditorium, the lecture featured many visual aids. (See Figure 49.) A transcript of the monologue leading up to the moment of Schmidt's most serious deception runs as follows:

> Here I have a little picture of the Universe which, thanks to the wonders of a computer, I can magnify. If I magnify that and I then overlay the two bits of the Universe, *you can see what you would see*. From this reference point every object is moving away from us. The nearby objects are moving a little bit, the distant objects are moving a lot. The further away you are the faster you're moving. *Just what Hubble saw*. [Emphasis added.] [184]

I'm sure Schmidt knows quite well that neither he himself, Hubble, nor anyone else has ever *seen* what he claims to have been seen in this presentation. Schmidt clearly deceives his audience.

The image at the bottom of the Figure could be a superposition of two images: 1) an array of galaxies painted on a plane wall, and 2) the appearance of those same galaxies if the wall were moved some distance further back perpendicular to the line of sight. The further wall of painted galaxies would then subtend a smaller angle to the observer, visually displacing the galaxies toward the perpendicular line of sight. But astronomers never see anything like this. The "You Are Here" notation, suggests that our location is random. Being immersed in an effectively infinite soup of galaxies, would mean, according to Big Bang cosmology, that the galaxies are all moving away in proportion to their distances. Therefore instead of seeing their *positions* on the sky change, we'd see

them get *smaller*. Or we'd be able to measure that their redshifts had changed. ***Nobody has ever seen either of these things.*** Even if the intergalactic space of the Universe were really expanding, to the exclusion of the galaxies residing therein, it would take millions of years to actually *see* it or to measure a systematic change in the redshift of each galaxy, to count as an *observation*.

So why would Schmidt show an image with galaxies at *changed* positions and claim the representation means "you can see what you would see," giving this patently false impression? Why not explain that we'd supposedly see the galaxies *maintain* their positions, as they got smaller due to their increasing distances, if only we could wait many millions of years? Partly, I suppose, is that our actual ignorance of such matters is too painful for him to admit. Schmidt is the expert and perhaps thinks he is doing the audience a favor by "dumbing down" the imagery, dumbing it down to the point of falsehood. Virtually all of Schmidt's colleagues see the world pretty much the same way he does and they are a tight-knit club whose members are not likely to call one another out for such inconsequential(?) errors or ill-conceived communication strategies. Whatever the reason, the

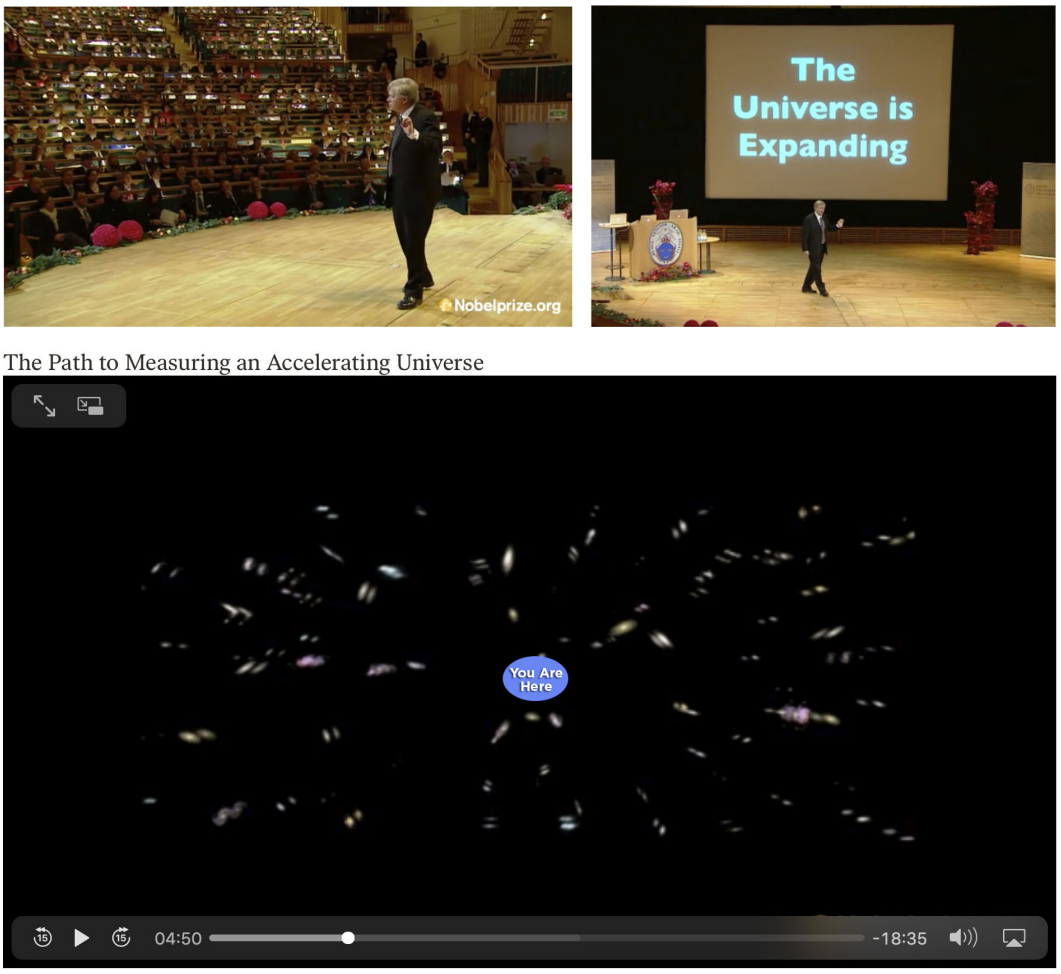


Fig. 49. **Nobel Laureate Spewing Falsehoods:** Before the rapt audience at Aula Magna, Stockholm University (December 8, 2011) Brian Schmidt pitches the Big Bang schtick by bearing false witness to Edwin Hubble and promulgating other phony balonies—in the name of science. [184]

effect of lying to his audience can only be bad. By spreading falsehoods, everybody loses. It's an embarrassment to humanity. Schmidt's final sentence in the above passage is the most egregious: "Just what Hubble saw."

Typically overlooked in the Big Bangist literature is the fact that, not only is it physically impossible for Hubble to have seen what Schmidt claims he saw, Hubble himself took issue with the whole idea of an expanding Universe. A more honest account is that given by science historian Helge Kragh (2019):

> Evidence based on Hubble's publications suggests that he never embraced a universe in expansion. He consistently adopted an agnostic and empirical attitude, stressing the explanation of the redshift-distance relation could not yet be decided by means of observation. [185]

It is pertinent to quote from Hubble directly:

> If the recession factor is dropped, if red-shifts are not primarily velocity-shifts, the picture is simple and plausible. There is no evidence of expansion and no restriction of the time-scale, no trace of spatial curvature, and no limitation of spatial dimensions. [186]

Those who would hope for the world to transcend the insidious grip of misinformation and sloppy thinking, those who seek to reap the benefits of a more conscientious, sustainable, scientific basis for actions that affect our fellow humans, deserve much better than what passes for science under the auspices of the illustrious Nobel Committee these days. The above account is just one of many examples that give Rotonians the impression that modern physics and cosmology have devolved into *entertainment industries*. We can, and perhaps should, judge their performances as media events whose narratives hold convincingly together, or not. Way too often *not*. It's mostly not even good entertainment.

Rotonians think it is pertinent that Kragh has referred to Hubble's attitude as *agnostic*. The religious undertones of modern physics are implied also in an oft-quoted comment by the behavioral biologist Robert Sapolsky. Lamenting the implicitly "softer," less rigorous status of his particular area of expertise, Sapolsky explains the soft-to-hard science spectrum as follows:

> This is a classic case of what is often called physics envy, a disease that causes behavioral biologists to fear their discipline lacks the rigor of physiology, physiologists to wish for the techniques of biochemists, biochemists to covet the clarity of the answers revealed by molecular geneticists, all the way down until you get to the physicists who confer only with God. [187]

Insofar as religion may also be likened to an entertainment industry, Rotonians consider as a viable marketing strategy that their model, too, be judged for its "entertainment value." (If you can't beat 'em, join 'em. By *any* standard, Rotonians suppose, their SGM cosmology will prevail.) Insofar as performance acts are judgable by their aesthetic quality, readers are encouraged to assess what they consume by its *beauty*. The story of the Big Bang, Rotonians think, is *so ugly* that they explain its popularity as being almost entirely due to the establishment's enormous marketing budget, and their pitiable desperation at having nothing better to sell. Whereas the lack of interest in the Rotonians' alternative cosmology is simply due to a lack of exposure (essentially zero marketing budget).

Being ugly and complicated, the Big Bang is unlikely to be true; being beautiful (arguably) and simple, the SGM has a greater chance of being true. Its author works in obscurity, knowing that, at any moment, just *one* member of the PhDizzix club could turn the tide by choosing to publicly

advocate for carrying out Galileo's Small Low-Energy Non-Collider experiment. If the result is as the Rotonians predict, then the roles and the performances of truth, beauty and simplicity will merge in transcendent harmony unlike any previous act ever witnessed by humanity.

13.9. *Conclusion*

A sub-theme of this section (and others) has been to attune the reader to a range of criticisms of modern cosmology, not only by the Rotonians, but also from within the community of standard cosmologists. These may sometimes be characterized as left-handed compliments, lame excuses, semi-inadvertant slips, or much-weaker-than claimed empirical "supports" — none of which reflect well on the standard dogma. SGM cosmology stands in stark contrast, for its clear-cut verbal, mathematical and graphical expressions — none of which would count, of course, without equally good, if not better *empirical* support.

Before moving on to the sometimes tedious facts of Primordial Nucleosynthesis, Baryon Acoustic Oscillations, and such, I feel compelled to throw in, on this day, February 12, 2022, a science news item that I received just yesterday. The piece is one of a regular stream of articles about astrophysically observed objects that fall under the category: "Too old-looking to be early," or "Not enough time to have formed so soon after the beginning." Summarizing the original research in the *Astrophysical Journal*, Enrico de Lazaro's article in the web outlet *SciNews* is called: "Two Protoclusters of Galaxies Spotted in Early Universe." Citing, first, Professor Gillian Wilson and then Dr. Benjamin Forrest at the University of California Riverside, the article states:

> [Wilson:] We are seeing this protocluster as it appeared when the Universe was less than 2 billion years old. . . . It is as if you took a cluster like the Coma Cluster, the nearest rich cluster of galaxies to Earth, and plopped it into the early Universe.
>
> [Forrest:] At the heart of MAGAZ3NE J0959 is an ultramassive galaxy that has already formed a mass of more than 200 billion suns. . . . Why this ultramassive galaxy and so many of its neighbors formed most of their stars and then became inactive when the Universe was still so young, in contrast to other known protoclusters from the same time, is a big mystery. Why its galaxies are so unlike those in all the other known protoclusters, and so similar to those in Coma Cluster, is a complete mystery. A new scenario of protoclusters existing in a diversity of states in the early Universe would have to be adopted. With many member galaxies quenching in the first two billion years, this would almost certainly pose signifcant challenges for current models of galaxy simulation. [188]

In the spirit of the right hand not knowing (or caring) what the left hand is doing, the many puff-pieces about the success of ΛCDM cosmology typically neglect discussion about the "complete mysteries" and "significant galaxy-simulation challenges" posed by the many objects and patterns astronomers keep finding that do not conform to the ever-evolving ΛCDM predictions.

In the summer of 2022 the James Webb Space Telescope is scheduled to begin providing a trove of data from observations of even higher-z (more distant, supposedly younger) objects. Rotonians predict that the too-old-looking-to-be-early objects JWST finds will strain ΛCDM models farther than many cosmologists will accept (at first). And that enough data will accrue to bring ΛCDM to its breaking point (eventually). A more receptive climate for consideration of alternative models should follow — perhaps even including the SGM cosmology and the test that would unequivocally make it or break it: Galileo's Small Low-Energy Non-Collider experiment. If the result of this experiment agrees with the Rotonian prediction, it would support their proposition that the Universe

is the same now as it has always been, and as it always will be. It's not just intergalactic space that expands, but also the galaxies themselves, because cosmic average density is a *constant* in an eternally saturated Universe, and gravity is the process whereby space is created out of matter. So say the accelerometers.

14. CBR, Primordial Nucleosynthesis and Dark Dead Ends

14.1. *Introduction: More Radical than MOND*

> *It appears that this [2001 astronomy conference] was the juncture in which the field suffered a psychotic break. We are not operating on the same set of basic facts. There has been a divergence in personal realities ever since.*
>
> *Arthur Kosowsky gave the summary talk at the end of the conference. He told me that he wanted to address the elephant in the room: MOND. I did not think the assembled crowd of luminary cosmologists were mature enough for that, so advised against going there. He did [anyhow], and was incredibly careful in what he said: empirical, factual, posing questions rather than making assertions. Why does MOND work as well as it does?*
>
> *The room dissolved into chaotic shouting. Every participant was vying to say something wrong more loudly than the person next to him. (Yes, everyone shouting was male.) Joel Primack managed to say something loudly enough for it to stick with me, asserting that gravitational lensing contradicted MOND in a way that I had already shown it did not. It was just one of dozens of superficial falsehoods that people take for granted to be true if they align with one's confirmation bias.*
>
> *The uproar settled down, the conference was over, and we started to disperse. I wanted to offer Arthur my condolences, having been in that position many times. Anatoly Klypin was still giving it to him, keeping up a steady stream of invective as everyone else moved on. I couldn't get a word in edgewise, and had a plane home to catch. So when I briefly caught Arthur's eye, I just said "told you" and moved on. Anatoly paused briefly, apparently fathoming that his behavior, like that of the assembled crowd, was entirely predictable. Then the moment of awkward self-awareness passed, and he resumed haranguing Arthur.*
>
> Stacy McGaugh : Questioner of the status quo : 2021 [189]

The controversial idea that McGaugh (above quote) takes seriously (MOND) the Rotonians characterize as *incremental*, because it proposes only a small "correction" to standard gravity theories. In defense of his "intellectual honesty" — which was disingenuously challenged by Michael Turner at the event referred to above, McGaugh shone through as being less in favor of any particular idea (e.g., MOND) than as a seeker of the truth. Rotonians have deduced that on Planet Earth — in spite of all the lip-service paid to its pursuit — ***truth is a non-standard goal***. McGaugh's equanimity and moral fortitude, unshaken by the loud and immature behavior of the macho "luminary" astronomers who oppose him, is most admirable. When I finish this essay, McGaugh will be one of those with whom I will be eager to share it. The sociological challenge becomes obvious, however, insofar as McGaugh has paid more than ample dues to the club in which he is a distinguished, if not always respected member. How much more rudely will the unaffiliated Rotonians be treated, as they advocate for the need to build and operate humanity's first Small Low-Energy Non-Collider?

Rotonians regard McGaugh's MOND ideas as woefully not-radical-enough because he still accepts the Big Bang as having happened. He still thinks of gravity as a force of attraction between

static chunks of stuff, and that accelerometers are schizoid liars. These dogmatic *foundations* were drilled into McGaugh's psyche even more intensely and more frequently than the peripheral dogmas of cosmology. So it would be truly remarkable for him to step back and question their "truth," and to *test* them by urging to do an experiment proposed by the *Father of Modern Science*. MOND challenges standard ideas only superficially, as it fails to probe and expunge the rotten center.

Let us return, then, to the more technical matters at hand, by way of some historical facts. In what follows we will dig pretty deeply into the weeds of Big Bang cosmology in order to further assess the support alleged to be provided by its "Pillars": the CBR and Primordial Nucleosynthesis; and the Dark Fudge Factors alleged to permeate everything.

In the early days of Big Bang cosmology it was guessed that all the chemical elements were produced in the "primordial fireball." (See Figure 50.) As calculations and knowledge of nuclear physics grew (especially in the 1950s) it became clear that only a few of the lightest elements could have been born that way. Big Bang theorists eventually came to decide that elements 1–3 (hydrogen, helium and lithium) were primarily the products of *primordial nucleosynthesis* — with traces of element 4 (berylium) also being produced in the first few minutes of the Universe. In their landmark 1957 paper, calculations by Margaret and Geoffrey Burbidge, Fred Hoyle and William Fowler established that perhaps even these and certainly the heavier elements were formed by astrophysical processes in the centers of stars, in stellar flares, by collisions between stars (one of the presumed causes of gamma-ray bursts) and other high-energy astro-phenomena. [190]

Being an important staple in discussions about synthesis and abundances of isotopes and the chemical elements, the graph in Figure 50 exhibits the characteristic descending sawtooth pattern. Since we will be mostly concerned with the first few entries, the left end of the graph has been expanded slightly. Notice also that, from the work of Morley, et al, I've added data points for deuterium abundances on particular planets in the Solar System. This is noteworthy because,

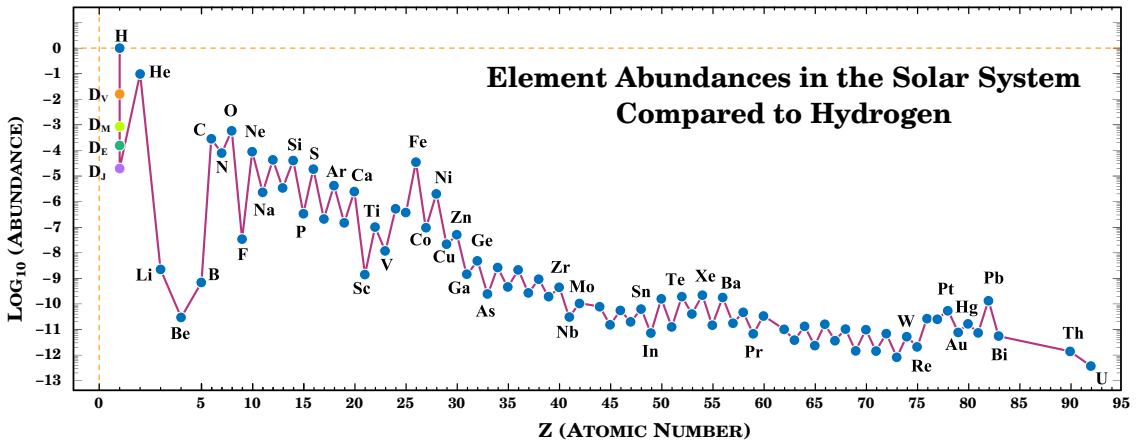


Fig. 50. **Solar Neighborhood Element Abundances:** The mostly zig-zag, mostly descending-with-complexity pattern of abundances is clearly illustrated. Big Bangists would have that the entries at the left end of the chart — expanded for clarity — were created in the mythological *Primordial Fireball*. Rotonians think that *all* the elements are produced by astrophysical phenomena that have been, and will be taking place forever. The four entries under hydrogen represent the *deuterium* abundances of Venus, Mars, Earth, and Jupiter. [191] The Jupiter ratio is close to the one claimed to be primordial. Rotonians regard the dispersion of values here and in high–z objects as suggesting a Universe that produces deuterium in sufficient quantities and rates to agree with observations without an infinite temperature, infinite density, or a fantasy beginning to everything. See figures and text to follow.

among other reasons, these abundances are significantly greater than that which is alleged to apply to the cosmos as a whole. Claims of accuracy in "measured" abundances are to be carefully judged, on a case-by-case basis. It's a tricky business, as we shall see.

14˙2. *Exotic Dark Matter Madness & the Uselessness of Schramm Plots*

As we recall from Figure 48 (and in the animations on the Wayne Hu website) among the sliders by which the power spectrum curves can be adjusted are those representing the baryon mass fraction Ω_{B}, Exotic Dark Matter fraction Ω_{DM}, Dark Energy fraction Ω_{Λ}, and total mass fraction Ω_{M}, combined (or not) with the Hubble parameter: $\Omega_{\text{B}}h^2$, $\Omega_{\text{DM}}h^2$, $\Omega_{\Lambda}h^2$, and $\Omega_{\text{M}}h^2$. Constraining the possible combinations of all these adjustments to conform to $\Omega_{\circ} = \Omega_{\text{TOTAL}} = 1$, results in a most unlikely (arguably absurd) Universe. Using somewhat less disparaging words Hu and White nevertheless imply a similar conclusion in their 2007 *Scientific American* article:

> We are led by degrees to an improbable conclusion: most of the Universe today is composed of invisible dark matter and dark energy. [192]

Chiming in with a brief yet revealing quip, in what was probably the most humble moment of P. J. E. Peebles' 2019 Nobel Lecture, the illustrious cosmologist admits:

> We have this ridiculous dark matter put in by hand. [193]

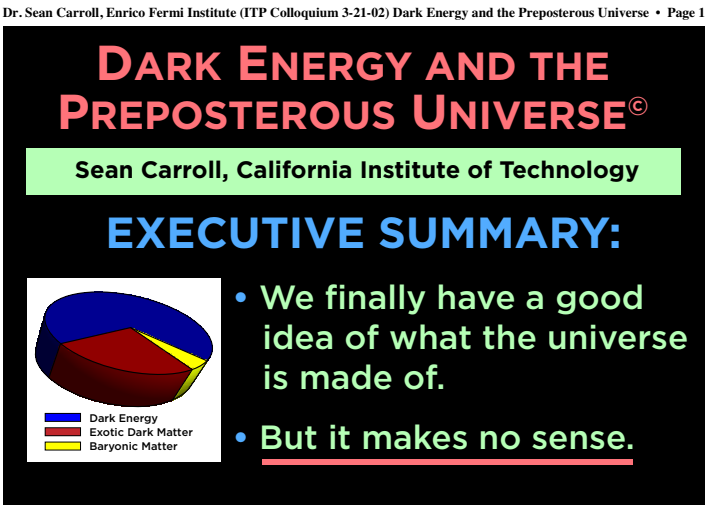


Fig. 51. **Nonsensical Universe for Sale:** In his pitch, Sean Carroll admits that what he's selling "makes no sense." If there's one thing we learned from the Trump presidency, it's that the most wicked and absurd things will not be held against you by a frighteningly large percentage of the population (e.g., injecting bleach, bragging about grabbing womens' genitals, torturing children by separating them from their parents, killing his own followers by discouraging them from getting vaccinated, worshiping evil dictators, trying to destroy the USA, etc.) as long as you never admit that it would have been better to do something else. Similarly, Carroll contradicts himself (a *good idea* that *makes no sense*?), is motivated to assert copyright for the expression "Dark Energy and the Preposterous Universe," and, with no evidence of compunction, proceeds to dazzle and justify his boondoggle with all manner of high-falootin "analysis." *Step right up!*

ALLEGED PRIMORDIAL NUCLEOSYNTHESIS:

Evolution of Predictions

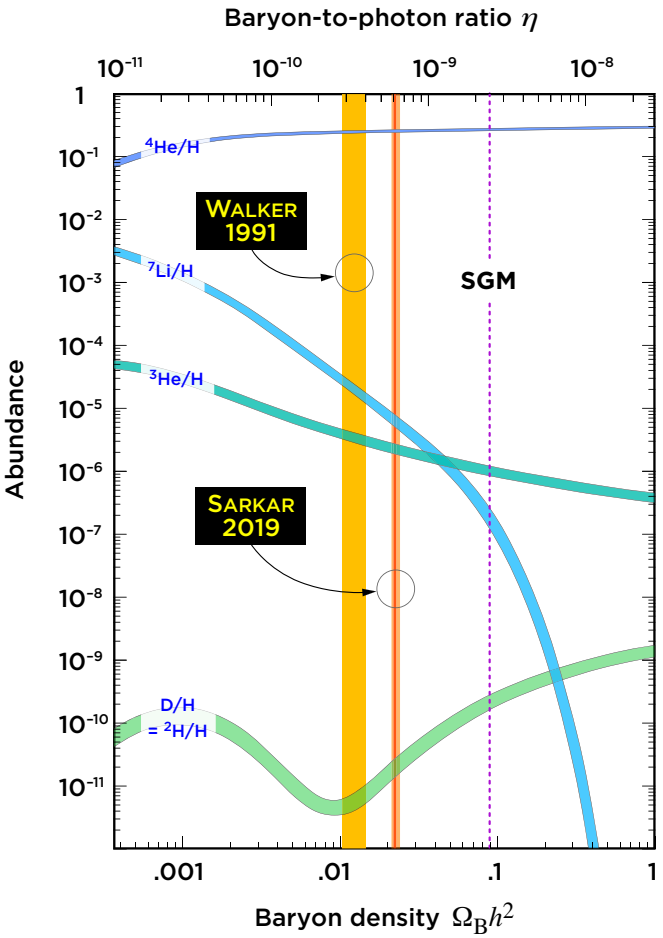


Fig. 52. **Alleged Primordial Nucleosynthesis:** Under the assumption that the conditions in the first few minutes of the Universe were essentially the same as the conditions found in high-energy particle colliders, physicists have calculated the relative abundances of light nuclei — compared to hydrogen — supposed to have been produced by the Primordial Fireball (left-to-right curves). [194] Failing to match "measurements," predictions from the early 1990s were later revised to reflect newer astrophysical data. Note that the SGM prediction for the baryon content of the universe reflects the assumption that **there was no *Primordial Era.* *Where the curves intersect the SGM line is meaningless.*** Relative abundances of the elements have nothing to do with a fantasy Primordial era. Rotonians suppose, rather, that they are due to production and depletion mechanisms in stellar and galactic environments, over an infinite span of time.

Not surprisingly, this remark does not appear in the *written* version of Peebles' lecture. Cosmologists admit to being "led" to an "improbable conclusion," to the "ridiculousness" of what they're doing. They sometimes openly call the fruit of their labor a "Preposterous Universe.©" (Figure 51.) [195] Yet they run with it, undeterred, uninterested in *testing* the foundational assumptions upon which this ridiculous, preposterous improbability rests. Instead, they claim some partial corroboration, not from astrophysics, but the Standard Model of *Particles* — and call it a *pillar* of support.

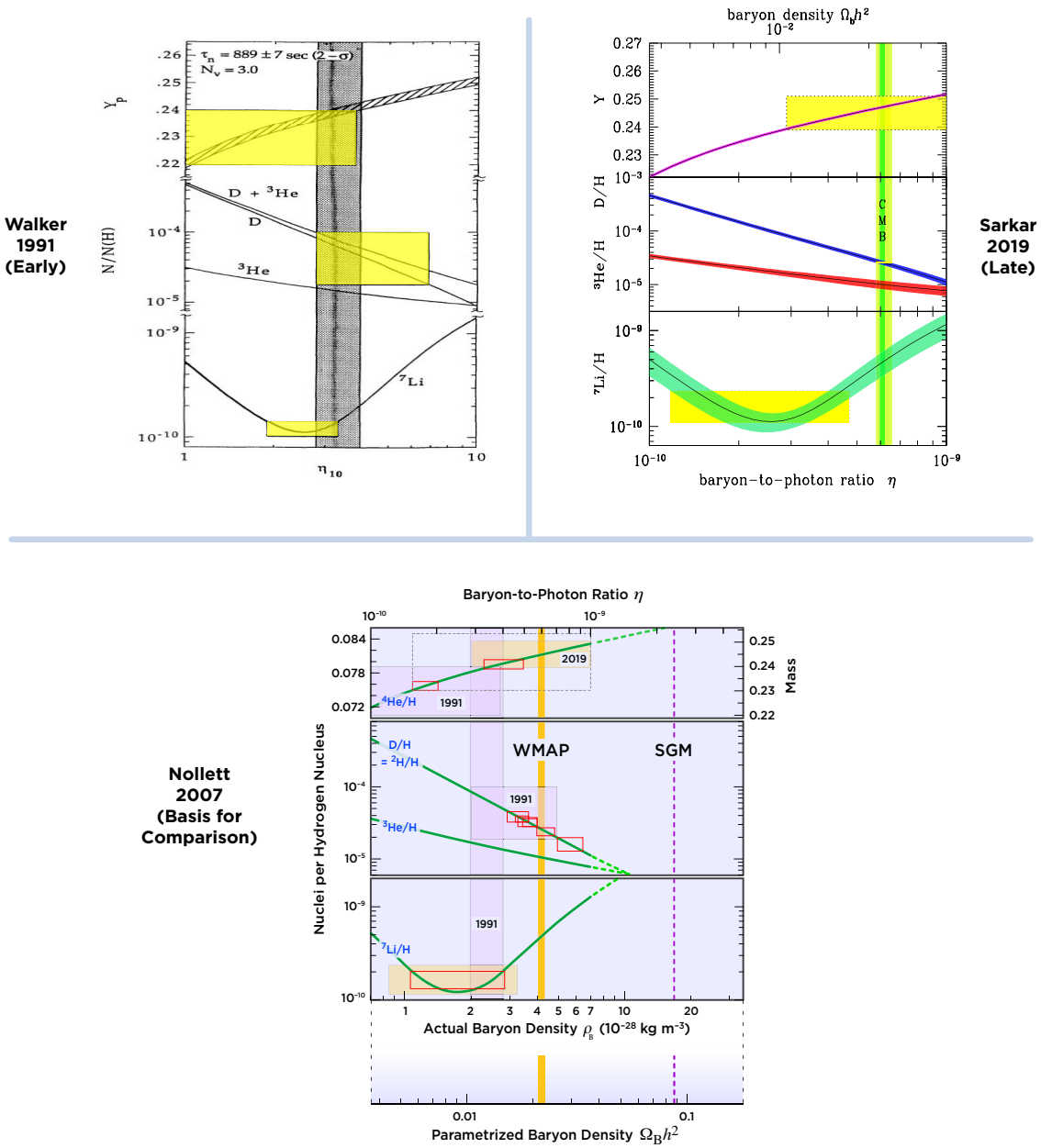


Fig. 53. **Predictions Converge, Or Not:** Upper Left — Plot from 1991 indicates a cosmic baryon prediction about 1/2 that of later predictions. Notice the dependence on neutron half-life and the number of neutrino species. Upper Right — Most noteworthy on the 2019 plot are the pronounced shift in ^{4}He (Y) in both the prediction and the observational data; and the tiny yellow patch showing remarkable agreement for the deuterium abundance. More will be said about this in what follows. Bottom — Partial consolidation of data, based on Nollett's 2007 plot, showing changes in helium and possibly more accurate deuterium measurements. The "lithium problem's" location has remained essentially unchanged as its uncertainty has grown. Note that Nollett's bottom x–axis indicates actual mass per volume for the baryon density. For consistency, a scale is added in the usual parametrized units, and the plot is widened so that it reaches the SGM prediction. [196-198]

Illustrated in Figures 52 and 53 are *Schramm plots*, indicating the abundances of the light elements for a given cosmic baryon density or cosmic baryon-to-photon ratio. Unlike the thousand-fold x-axis expanse included in Figure 52, such plots typically include only the narrower range of x-axis, as at the top of Figure 53. In Figure 53 we also find boxed areas indicating how astrophysical data compare to the predictions. The abundance curves are derived from the theory of *Primordial Nucleosynthesis* (sometimes called *Big Bang Nucleosynthesis, BBN*).

Seeing no good reason for believing that the Universe had a beginning, Rotonians regard **Primoridial Nucleosynthesis** as a kind of 21st century *astrology*: A vaguely entertaining myth, perhaps. But a flimsy, grotesque mockery of science. This perspective emerges by considering first the confidence with which its practitioners advertise their art. Without a shred of humility, David Schramm toots the Big Bang horn:

> The power of homogeneous BBN comes from the fact that essentially all of the physics input is well determined in the terrestrial laboratory. The appropriate temperature regimes, 0.1 to 1 MeV, are well explored in nuclear physics laboratories. Thus, *what nuclei do* ***under such conditions*** *is not a matter of guesswork, but is precisely known*. In fact, it is known for these temperatures far better than it is for the centers of stars like our sun. [Emphasis added.] [199]

Schramm's claim, and therefore the validity of his eponymous plots, is obviously questionable because *his premise is false*. The "conditions" in the two circumstances he claims to compare cannot possibly be the same, so it is nonsense to extrapolate dozens of orders of magnitude from one to the other. For starters, what is observed in nuclear physics laboratories may well involve *localized regions* at the specified temperatures and energies. But the Big Bang is the most extreme *opposite* of a localized region. What happens in the alleged "early Universe" is supposed to happen quite globally, to the whole Universe. Nothing local about it, so the implication of some kind of equivalence, an alleged validity to such a vast *extrapolation* is wishful thinking at best and arguably, *absurd*.

Most important is the huge difference in both the *ingredients* and the *products*, as between this allegedly cosmic nuclear cookout and the tiny manufactured laboratory collisions. In the "primordial" case, only $\approx 15\%$ of the material ingredients are supposed to be baryonic matter. Whereas, in the localized laboratory case nearly 100% of the material ingredients are baryonic matter. In the primordial case 85% of the matter content is a magical fantasy substance called "Dark Matter" (which we more judiciously call *Exotic* Dark Matter, because most "ordinary" matter is also dark).

Before pursuing the implications of the recipes being so drastically different (cosmic vs. local, input vs. output), consider the question of exactly how and when Exotic Dark Matter is supposed to have come into existence. The *how* part of the question is totally mysterious. But discussions about the *when* part can be found. An essential feature (bug?) of the whole ΛCDM scheme is that Exotic Dark Matter needs to exist close to $t = 0$ so that it can amplify density fluctuations in a steady way to serve as "seeds" for the formation of structures such as stars and galaxies. Without a huge primordial supply of Exotic Dark Matter everything would have just been blown to smithereens and we wouldn't be here. Because this is assumed to be true, Big Bangists want you to believe that Exotic Dark Matter exists. That's the essence of their "argument." The European Space Agency (ESA) explains:

> After the end of Inflation, [$t \approx 10^{-33}$ sec] the Universe consisted of a more or less uniform bath of fundamental particles… [including] dark matter particles, an unknown type of massive particle that does not interact with photons and is therefore dark (as it does not emit light). At this time there was slightly more matter than anti-matter, but as the particles collided with their anti-particles they annihilated, leaving the Universe dominated by particles, and anti-matter

> disappeared. Quarks then teamed up in trios, forming protons or neutrons — the constituents of atomic nuclei as we know them today. This all happened within the first cosmic second after the Big Bang.
>
> The seed fluctuations that were present at the end of inflation . . . would draw more matter from their surroundings, growing denser and more massive. However, ordinary matter at this epoch was coupled to the photons, and the radiation pressure of photons pushes away any concentration of matter that may be created under the effect of gravity. This phenomenon prevents any fluctuations in the distribution of ordinary matter to grow denser as long as matter is coupled to the photons.
>
> At the same time, dark matter particles were not bound to the photons, since the two species do not interact with one another. Hence, fluctuations in the distribution of cold dark matter can grow denser and more massive even [at these early times]. [200]

Being less specific about its purpose, but more specific about *when* Exotic Dark Matter was born, Ethan Siegel states:

> Dark matter . . . must have existed from very early times . . . Dark matter could have been created from the very moment inflation ended; it could have been created from high-energy interactions that took place immediately afterwards; it could have arisen from high-energy particles up at the GUT scale; it could have arisen from a broken symmetry (such as a Peccei-Quinn-like symmetry) slightly later; it could have come about from right-handed Dirac neutrinos when they gained ultra-heavy masses from a cosmic see-saw mechanism. [201]

Though Siegel's timeframe is broken down to particular kinds of events, it is consistent with the timeframe discussed in the ESA article. The reader will have noticed that both accounts resemble fairy tales or nursery rhymes:

> It could have been created in a boat.
> It could have been eaten by a goat.
> Its magic infuses a leg of mutton.
> It's hiding in your belly button.

Now back to the accounting problem in Primordial Nucleosynthesis, which comes to light because of the common claim asserted so boldly by Schramm, that it's "not a matter of guesswork." For the purposes of calculating expectations pertaining to *the beginning of the Universe*, it has been stated as a fact that "what nuclei do is *precisely known*." Note, however, that the *primordial* product supposedly also includes a scant portion of magical stuff called "Dark Energy." Though its proportions started out small, they are eventually supposed to dominate the energy content of the Universe. The transition from negligibleness to domination is predicted to be underway right now (recall Figure 45) as the presumed chunks of static stuff (galaxies) have scattered sufficiently far from one another so that the discontinuous space between them widens ever more rapidly, because *(**Abracadabra! Presto-Change-O!**) Dark Energy makes it so.*

Is this what would happen in our laboratories if we could make them big and powerful enough and we waited long enough? Can our high-energy particle beams be fine-tuned to also create Dark Energy? Dark Matter? If not, then the processes are obviously much different. What we know about high-energy collisions taking place in our atom smashers is obviously insufficient to explain or predict what happened in the alleged first three minutes of the whole Universe.

The common-sense point is simply to notice that cosmologists have been calmly making these hyper-extreme extrapolations and express no concern for how dreamy they are. Recalling that the whole scheme depends also on the zippity-quick miracle of primordial *inflation*, we see that the array of mystical things needed to give the impression of coherence to this "precision" "concordance" cosmology is as absurd as it is *ugly*. Frankly, it *reeks* of half-baked "guesswork."

For all its dubiousness, Exotic Dark Matter maintains its lofty status in the establishment paradigm because of its key alleged property: it is *collisionless*. [202, 203] Standard theorists' idea of collisionless matter means also being effectively *inertialess*. If this magic gravitational stuff is *inertially* undetectable, what then to make of General Relativity's alleged equivalence between gravitation and inertia? Is it reasonable to suggest that a body of matter exhibits one but not the other? Exotic Dark Matter cannot be weighed on a balance used for weighing ordinary matter because it would *fall right through*. The stuff is completely *unfeelable*. ***It LITERALLY makes no sense!***

Matter whose inertia we feel is feelable because of the electric and magnetic fields that give it coherence and prevent independent bodies from occupying the same space. But Exotic Dark Matter is so exotic as to be "uncoupled" from the energetic fields out of which it was alleged to have been born. The intuitive understanding of how the mass of matter (as a rotating body) can change with speed, as discussed in §8, cannot work in this case because *we cannot weigh the stuff even in principle*. Exotic Dark Matter *thwarts* understanding. Sold as a panacea, it is actually conceptual *poison*.

It is important to realize that a standard tenet of the Big Bang is that *everything* in the Universe is supposed to have *STARTED* as "pure energy." As the "primordial egg" cools, a small fraction of this energy morphs into ordinary matter, a much larger fraction morphs into Exotic, unfeelable Dark Matter, and the (initially small, but eventually) largest fraction morphs into fantasy Dark Energy. It is possible to make up this story, it is even possible to find people who will buy it, invest in it, and sell it to others. Like imagination, gullibility evidently knows no bounds.

In particle-smashing laboratories such as those appealed to by Schramm, it is only by carefully accounting for the matter and energy *input* and *output* that meaningful discoveries can be made. If there were a factor of five or twenty deficit or excess on either end, it would not go unnoticed. It would be big news. In the *primordial neverland* "laboratory" a gross Exotic Dark Matter/baryonic matter imbalance is claimed to exist — it simply *MUST* exist. In Big Bang cosmology the imbalance is essential for the creation of galaxies. Supposedly being five times more abundant than ordinary matter, Exotic Dark Matter has the character of snarfs and unicorns. It will never be found because it doesn't exist. ***Exotic Dark Matter is a mental problem*** that is only exacerbated by the equally misguided notion of Primordial Nucleosynthesis — or ***Primordial*** anything else.

Earthians' recipe of creation ***requires*** a *collisionless* (unfeelable) magical substance that just makes no physical sense. They ***admit*** that it makes no sense, but continue trying to pawn it off as though it were an ingenious invention of great value. The snake oil charade gives Big Science a bad name. It gives the impression of being not so much science as an entertainment business.

Exotic Dark Matter was invented and is claimed to exist because of some astronomical gravitational puzzles. To solve the puzzles, should we not try the more *scientific* strategy of extending our *empirical* knowledge of gravity by probing untested regimes of our gravity theories — like the *insides* of every body of *ordinary* matter, by building and operating a Small Low-Energy Non-Collider? Heck no! It's way more fun to just invent some ghost glop, set up stages all over the world, and sell the stuff! Exotic Dark Matter is *weird*, *preposterous*, *unnatural*, *improbable*, *ridiculous*, most likely *non-existent*, and yet monetarily *profitable*. *Get yours today!* An endless carnival of "not guesswork" for math geeks and entertainers alike. All in the name of Science. *Whoopee*!

14˙3. *Lithium and Deuterium*

Though Schramm plots have the guise of illustrating the abundances of actual *physical* (baryonic) matter, having a wizardly cauldron of stuff and circumstances as their starting point (*Primordial Nucleosynthesis*, indeed) their purpose of bolstering faith in *ridiculous un*-physical *Exotic Dark Matter* is not fulfilled. By consistently indicating a serious problem with *lithium*, the convoluted astrological charts and monster-bordered world maps have backfired.

Before saying more about lithium, note first that one of the reasons *helium* (^{4}H) is not regarded as an especially sensitive cosmic "baryometer" is that it is continually being produced in stars. Observations of its abundance face the challenge — as is actually true for all the isotopes — of looking in the right places to maximize the chance of seeing "pristine" (i.e., as close to "primordial" as possible) environments. Though at least one critic of the Big Bang theory (Eric Lerner) [204] has argued that Helium observations fail badly to match predictions, most astronomers and cosmologists are satisfied that observations and predictions are at least reasonably consistent with each other. More worthy of our attention, therefore, are the particular observation-vs-theory issues of lithium and deuterium.

Concerning *lithium* abundances, it is widely agreed that, no matter where they look, the predicted amount is at least three times greater than the observed amount. This discrepancy should raise a red flag on the whole business. Remarks concerning the seriousness of the problem are sometimes found in the literature, as in the Wikipedia article 'Cosmic Lithium Problem':

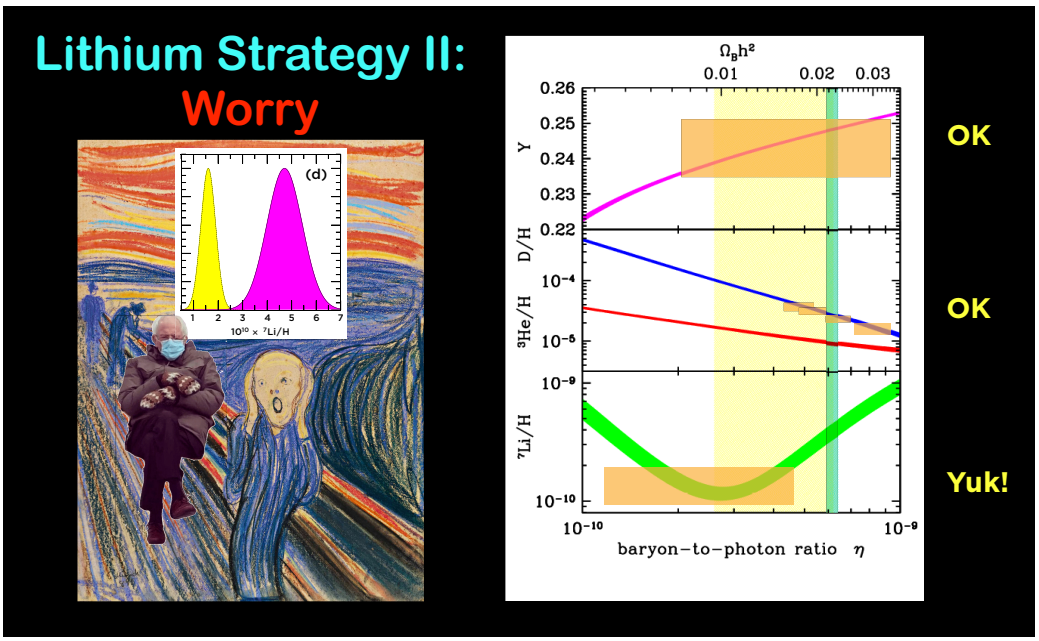


Fig. 54. **Politics, Fine Art and Pseudo-Cosmology:** The theory of Primordial Nucleosynthesis predicts over three times the lithium that is found by astronomers. Worry is OK if it motivates creative, illuminating solutions; not if it induces denial and hallucinations that established theories work just fine. *I tawt I taw a naked emperor. I did! I did! I did tee a naked emperor!* Rotonians recommend raining on this embarrassing parade and starting over. Begin by building and operating humanity's first Small Low-Energy Non-Collider. [205, 206]

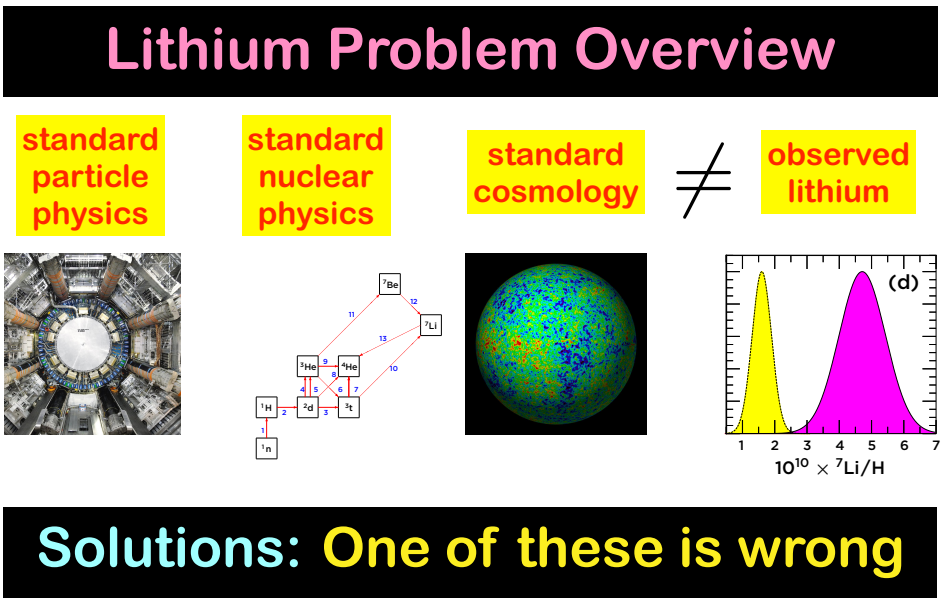


Fig. 55. **Problematic Inequality:** Rotonians suspect that the main culprit is "Standard Cosmology." The *influence* Standard Cosmology has had on the other components is arguably more to blame than the components themselves, independent of cosmology. Fixes are unlikely to be initiated from within the establishment, whose members are all wired to seek out only incremental modifications. It is well-nigh impossible for them to conceive that the problem traces all the way back to the absurd idea of gravitational *attraction*. A surprise result from a Small Low-Energy Non-Collider experiment would, however, have the power to convince. [205]

> The most widely accepted models of the Big Bang suggest that three times as much primoridal lithium, in particular Lithium-7, should exist. [207]

Striking the same note, a recent *Physical Review Letters* article states:

> Model predictions seriously overestimate, by more than a factor of three, the primordial abundance of lithium inferred from the observation of metal-poor stars (the so-called Spite plateau). Such a discrepancy is known as the cosmological lithium problem. [208]

Graphically, the problem is sometimes presented with humor, as in Figure 54, and sometimes with seriousness, as in Figures 55, 56, and 57. (Note that Figure 56 effectively *combines* the lithium problem with the deuterium problem, as explained in what follows.)

For decades this problem has persisted with no solution in sight. In a paper devoted to explaining the range of possibilities, with a hint of understatement, Makki, *et al* conclude: "The lithium problem is really challenging." [209] As implied earlier, Rotonians suspect the problem is the idea of (astrological?) *primordialness*. The abundance of lithium — which is deduced primarily by observations of old, metal-poor stars — (as seen in Figure 57) fails to live up to the BBN predictions. Rotonians suppose this is because lithium distribution is subject to relatively localized production and depletion mechanisms that have existed *forever*.

That physicists continue to maintain that BBN is a robust pillar of support for the ΛCDM model,

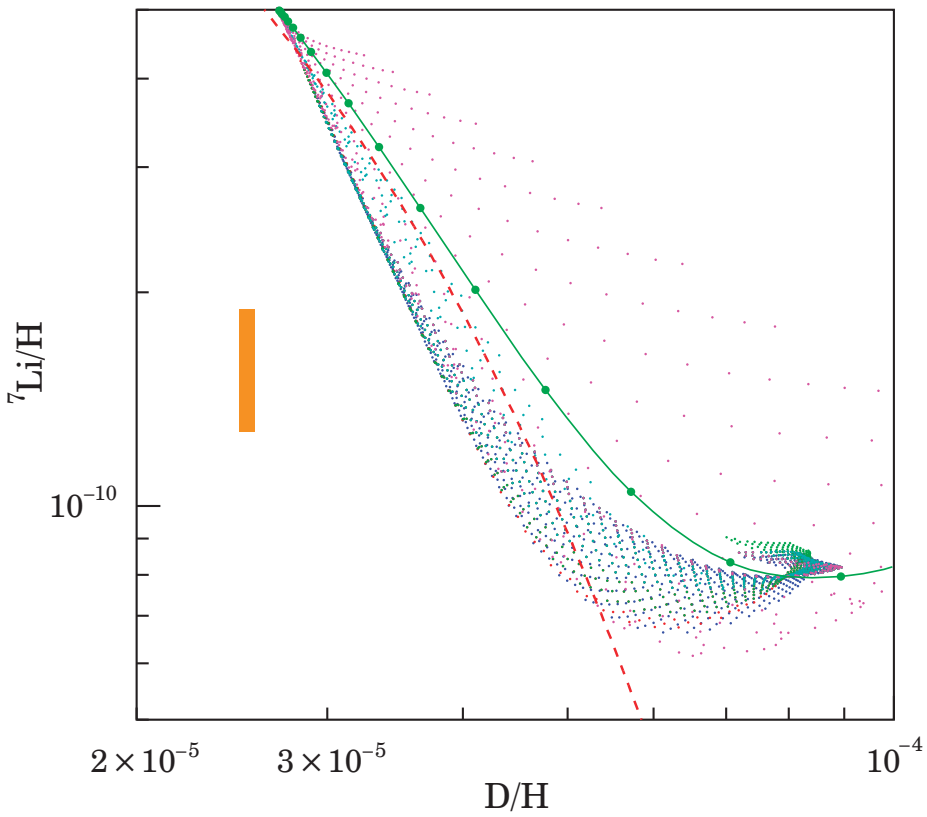


Fig. 6. Each dot is the prediction of a model[57] in the space (D/H, ^{7}Li/H). The rectangle corresponds to the D/H observational limits of Ref. 19 together with those from Ref. 13 for lithium. The blue, red and green dots correspond to n-n' oscillation models the light blue dots correspond to resonant annihilation models and the pink dots to particle decay models. The green curve with filled circles corresponds to the non–resonant annihilation model. The dashed line is a qualitative explanation of this anti–correlation.[20] This demonstrates that no model can be in agreement with both lithium-7 and deuterium.

Fig. 56. **Deuterium-Lithium Primordial Incompatibility:** The lonely orange rectangle on the left side of the graph indicates how far from harmony are the primordial nucleosynthesis predictions from agreement with observations. [210]

when one of its "legs" is a factor of three too short, is embarrassing. The world's academic institutions nevertheless keep selling the damn thing.

Often touted as one of the crowning successes of astro-particle-cosmo-physics, the story of the next isotope of interest, *deuterium*, is also questionable. To the Rotonians deuterium abundances often look as contrived-to-fit as the re-determination of globular cluster ages to be younger than the Universe (Figure 38): Data pounded into place in a flagrant manifestation of "confirmation bias." To see this, we should first acknowledge one of deuterium's properties that is often presented as one of the reasons it is regarded as the optimal "baryometer." Though it is a stable isotope, it is also *fragile*. The kinds of astrophysical environments in which deuterium could be created are also the kinds of environments in which it will be easily, and *more commonly, destroyed*. Under the assumption that the Universe evolves, its deuterium abundance is supposed to steadily decline. This means that in

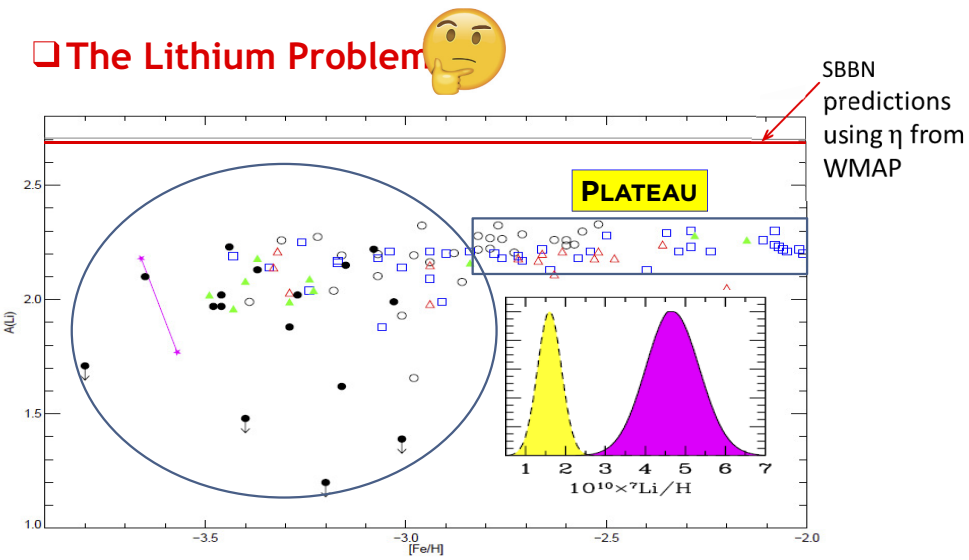


Fig. 57. **Lithium (aka "Spite") Plateau:** Another lecture presentation slide illustrating the failure of Big Bang Nucleosynthesis to match empirical measurements of lithium abundance. [211]

nearby "late" environments deuterium abundance should be substantially lower than in far-away "early" environments, where the abundance should be much closer to "primordial."

Seeing deuterium's significantly larger-than-primordial abundance on Mars, Venus, and Earth's oceans (left side of Figure 50) makes one wonder how such high concentrations seem to endure nevertheless. Are these just planetary exceptions, or do we also find anomalous abundances elsewhere? The observational data as of 2006, broken into location categories, is shown in Figure 58.

One of the key questions in discussions about deuterium is whether astrophysical *creation* processes exist and are common enough to produce this isotope in sufficient quantities fast enough to compensate for the *depletion* processes. Contemplating exactly this question back in 1998 were the astronomers D. J. Mullan and J. L. Linsky:

> Contrary to a widespread assumption, deuterium is *not* simply destroyed in stars: deuterium is also synthesized in the atmospheres of active stars. This nonprimordial synthesis of D arises when protons accelerated in flares interact with the atmosphere, create a flux of free neutrons, and these neutrons then undergo radiative capture on atmospheric protons. Estimates of the amount of flare-created D are subject to considerable uncertainties, but we find, using stellar parameters within permitted ranges, that flares may contribute significantly to the current ISM [Interstellar Medium] D content. Observational data indicate that different clouds of gas in the ISM exhibit variations in the value of D/H.
>
> Winds from such stars have much higher fractional contributions of active region material (where D is produced) than in the Sun.
>
> We conclude that *flare stars contaminate the ISM with D more effectively than the Sun. We therefore propose that the current ISM contains a D component that is nonprimordial.* [Original emphasis.] [212]

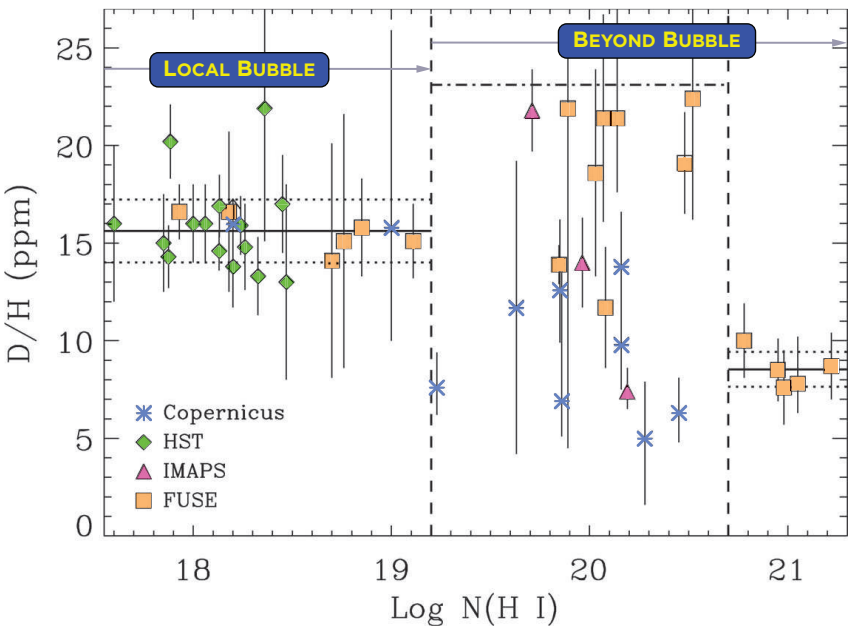


Figure 2. From Linsky et al. (2006): Deuterium abundance vs hydrogen column density measured along several Lines of Sight in the LISM.

Fig. 58. **Deuterium Abundance in the Milky Way:** In the text accompanying this often-reproduced graph, Tosi, *et al* explain: "If we look at the distribution of D/H with column density N(HI) (which can be considered a proxy for distance)... it is apparent that D/H varies significantly." Possible reasons for the dispersion have been proposed, but "the question is still open." [213]

Tijana Prodanovic and Brian D. Fields, astronomers having a substantial investment in primordialness and its expression in Big Bang Nucleosynthesis, responded to Mullan and Linsky's challenges about five years later, with their own prejudicial proposal:

> Deuterium plays a crucial role in cosmology because the primordial D/H abundance, in the context of big bang nucleosynthesis (BBN) theory, yields a precise measure of the cosmic baryon content. Observations of D/H can limit or measure the true primordial abundance because D is thought to be destroyed by stars and thus D/H monotonically decreases after BBN. Recently, however, Mullan & Linsky have pointed out that D arises as a secondary product of neutrons in stellar flares. We have considered the production of D in stellar flares. We find that [this possibility] does not allow for Galactic D production at a level that will reverse the monotonic decline of D.
>
> There is no significant astrophysical production site except for the big bang... Any measurement of D is a solid lower bound on the primordial abundance... In sufficiently primitive environments D should be essentially primordial. [214]

Importantly, Mullan and Linsky were acknowledged in the above paper for "discussions that stimulated this work." Perhaps even more importantly, Prodanovic and Fields conclude with a mixed signal:

> Finally, we note that while flare star radiative capture synthesis of D is insufficient to alter the [Big Bang-loyal] conclusions of ELS [Epstein, Lattimer and Schramm, 1976], *it is certain that the process does occur at some level* — the flares exist and must produce neutrons [and therefore deuterium]. [Emphasis added.]

The opening statement from Prodanovic and Fields begins: "Deuterium plays a crucial role in cosmology because…" where the rejoinder amounts to: Belief in primordialness, our pillar of a "*theory* yields a precise measure of baryons." *Belief-laden theories*, of course, do not yield *measures*, they yield only wishful *predictions*. "Observations of D/H can limit or measure the true primordial abundance" only if the idea of "true primordialness" makes sense. Being unconvinced that it does, Rotonians instead warn that misguided application of dubious theories — especially when extrapolated dozens of orders of magnitude — is bound to "yield" all kinds of crazy things. No matter how *precise* — when such theories monopolize the scene, as they have — they increase neither *accuracy* nor *understanding*; they become obstacles that distract the mind and obscure the truth. The assessment of these authors, to be charitable, seems to be that, however *uncertain* the frequency and magnitude of non-primordial deuterium production may be, the Big Bang theory is nevertheless correct. "At some level" it must be, because our wobbly, lithium-overdosed "pillar" supports it. *Nobody* should be impressed by this standard "logic."

A few years after the above exchange, results from NASA's Far Ultraviolet Spectroscopic Explorer (FUSE) satellite were published (2007). The press release stated:

> The FUSE satellite has surveyed the local deuterium concentration in the galaxy and found far more than expected.
>
> In the 1970s, NASA's Copernicus satellite found deuterium distribution in the Milky Way galaxy to be patchy. There was more in one direction and, inexplicably, far less in other directions. Early FUSE observations confirmed this, a perplexing result because deuterium should be evenly mixed and as readily available as other elements for the creation of new stars. [215]

In our neighborhood of the Milky Way Galaxy (called the *Local Bubble*) FUSE found deuterium abundance to be only about 15 parts per million and "values as low as 5 parts per million elsewhere": *smaller* than expected. On the other extreme FUSE found Galactic "concentrations as high as 23 parts per million." The high side of the FUSE measurements were *greater* than expected because they were too close to the alleged "primordial concentrations [i.e.,] about 27 parts per million… Scientists had assumed, based on theory, that at least a third of the local deuterium would have been destroyed over time." But the arithmetic gives: $(1 - {}^{23}/_{27}) \approx 0.15$, indicating that "only about 15% of the deuterium has been destroyed" (not 33%).

Not wanting to upset the status quo, theorists, including FUSE team members, began hypothesizing possible explanations for both the unexpected low and high levels: Perhaps "deuterium, compared to hydrogen, might preferentially bind to interstellar dust grains, changing from an easily detectable gaseous form to an unobservable solid form," (a process called *fractionation*). If operative, this process might leave only 5 parts per million observable in some places. On the other end, perhaps disruptions of these dust grains by supernovas will suddenly re-release high concentrations into gaseous form. Or perhaps "much more primordial gas has rained down onto our galaxy over its lifetime than had been thought." Whether such hypotheses are true or not, as team leader Jeffrey Linsky states, the fact remains that, "Since the 1970s *we have been unable to explain why deuterium levels vary all over the place*." [Emphasis added.]

Reflecting on the new data's significance, another mission scientist, George Sonneborn concludes:

> Our models of the chemical evolution of the Milky Way galaxy will have to be revised significantly to explain the new result. [215]

In 2009 an International Astronomical Union Symposium (No. 268) convened and featured lots of discussion about deuterium and the FUSE measurements. In a summary paper, one of the editors, Monica Tosi, focused on

> Two key questions: [1] "What should be taken as representative abundance of D in the Local Interstellar Medium [LISM]? And [2] How can we explain the dispersion of D abundances measured in high-redshift, very low metalicity environments? [213]

Both questions are about deuterium *dispersion*. Whether locally or cosmically (i.e., *intra* or *extra*-galactically) "we have been unable to explain why deuterium levels vary all over the place."

Bearing in mind the patch job explanation having to do with dust "fractionation" and intergalactic deuterium "rainfall," Tosi's remark serves as a segue to consider that the problem — contrary to impressions given by tiny yellow error boxes (recall the 2019 Schramm plot in Figure 53) — persists also in high-redshift intergalactic space.

In the last 25 years or so astronomers have looked for, and sometimes found and measured the signatures of deuterium in so-called Lyman Alpha clouds or DLAs (Damped Lyman Alpha systems)

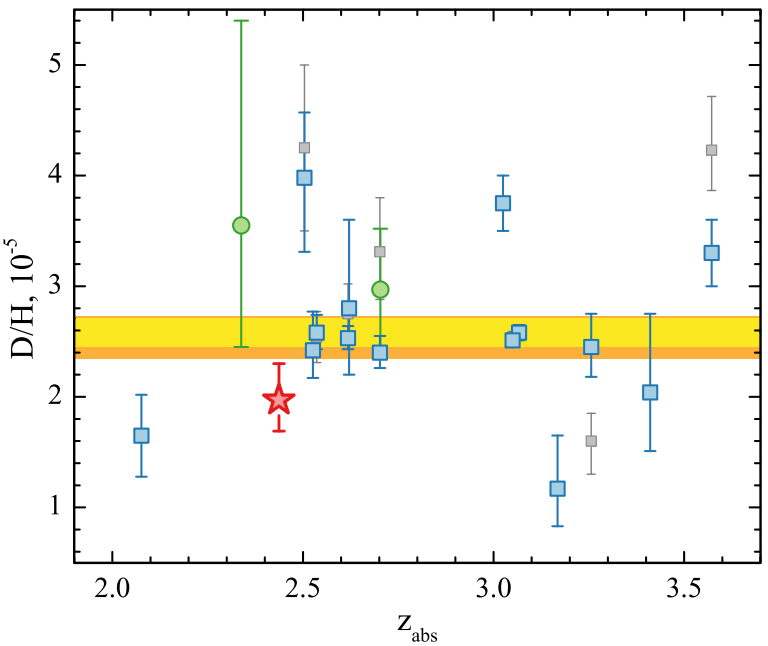


Figure 7. D/H values measured in QSO absorption line systems as a function of absorption redshift. The red star represents the new case reported here (J 1444+2919). . . . The bands mark the corresponding unweighted mean value (orange) and the standard BBN prediction pased on the Planck data (yellow) with their 68.3% confidence intervals.

Fig. 59. **Deuterium Abundance at High Redshift:** In QSO absorption line systems spanning about $2.0 \lesssim z \lesssim 4.0$ deuterium abundance does not settle to some allegedly *primordial* value. It remains dispersed, as though under the influence of local synthesis and depletion mechanisms. [216]

that lie along the line of sight to the very luminous, very distant objects known as quasars or QSOs (Quasi Stellar Objects). The DLAs in these studies have redshifts $z \approx 2.0 - 4.0$, corresponding to $1/8$ to $1/4$ the alleged age of the Universe. The deuterium abundance found in them has been expected to be very close to "primordial."

The problem is that the abundances found vary considerably from one DLA to another, as seen in Figure 59. In the paper from which this figure was borrowed, the authors, S. A. Balashev, *et al* duly state:

> A conspicuous feature of the sample is that the scatter of the D/H values about their mean value considerably exceeds the errors of the individual measurements. The most plausible reason for this is that errors in some (or even in all) measurements have been underestimated. [216]

Such statements are common, as Balashev, *et al* appear to have echoed Pettini and Cooke (2012) who wrote:

> There is a *troublesome* dispersion between the 11 measurements, well in excess of the quoted errors. In at least some cases the errors quoted may well be underestimates, and the values reported may suffer from biases that are unacccounted for. [Emphasis added.] [217]

In a more recent PhD dissertation, Tahani Ramez Makki writes:

> There are so far only around 18 measurments of primordial deuterium values. These show a large dispersion in the mean values and the estimated errors, making the status of the primordial deuterium abundance *puzzling*. [Emphasis added.] [218]

Oxford astrophysicist Subir Sarkar has commented on the situation: "The observed scatter is *not* consistent with fluctuations around an average value!" [219] [Original emphasis.] And the cosmic deuterium-seeking team, Riemer-Sorensen, et al, have characterized the observational data as exhibiting "an unnaturally large scatter." [220]

None of this is puzzling, inconsistent, or unnatural, of course, if we just ***cut the "primordial" crap***. Deuterium varies in abundance from one place in the Galaxy to another, and from one high-redshift cloud to another due to local production and depletion processes. There is no such thing as "primordial" deuterium, or primordial anything else. Rotonians surmise that eventually Earthians will have to — and will most likely even learn to be *happy* to — get over it.

Until that time comes, among present-day academicians the investment in primordialness is, alas, obscenely high. As we might expect, the *Meddlesome-Data Re-Analysis Squad* therefore springs into action. In a lecture presentation on the subject, Molaro's slide #15 shows the original scattered graph before and after having been culled, improved, and re-analyzed. (See Figure 60.)

Let us recap the status of BBN as "pillar" of Big Bangism. The factor-of-three *lithium problem* persists with no solution in sight. Deuterium estimations — though frequently presented as glowingly robust supports — require some rather unctuous salesmanship to pitch as such. The "puzzling," "troublesome," "inconsistent" features of excessively "conspicuous scatter" are routinely tucked behind the curtain; magically shrunk into theory-yielded tiny error boxes, as the disingenuous wizards pretend everything is hunky dory in ΛCDM-land.

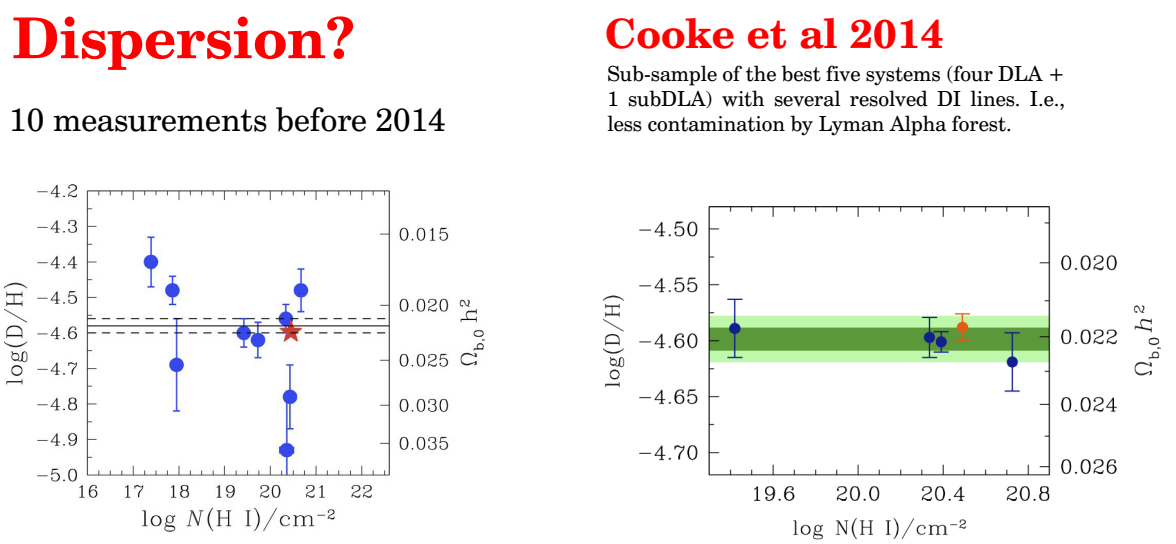


Fig. 60. **"All Over the Place" Deuterium Abundance Meets the *Meddlesome-Data Re-Analysis Squad*:** Is it not remarkable that when physical data are reanalyzed to make "measurements" more "accurate," the result usually inclines *toward* some pet theory, struggling to be loved? Are there examples of it going the other way? Maybe. In this case, the new mo' betta result scarcely needs to be averaged to look "good." The error bars make it look spot on. Should we be impressed, or wary? Rotonians are wary, because the basis of the contrived contraption is so far removed from physical reality. [221]

Returning, then, to the need for non-primordial mechanisms for deuterium production, we already have the stellar flare idea proposed by Mullan and Linsky. Recall that even the idea's detractors admit that the phenomenon is physically manifest "at some level." Presently, let's acknowledge another possible mechanism.

In 2002 the *Astrophysical Journal* published a paper by Jason Pruet, Shannon Guiles, and George M. Fuller called 'Light Element Synthesis in High Entropy Relativistic Flows Associated with Gamma Ray Bursts.' Emphasizing the possibility of a non-primordial source of *deuterium* (^{2}H), they state:

> With conditions characteristic of Gamma Ray Bursts (GRBs) we find that deuterium production can be prodigious, with final abundance values $^2\mathrm{H/H} \gtrsim 2\%$.... High entropy relativistic flows thought to accompany catastrophic stellar endpoint events like binary neutron star mergers... and collapsars... may be a source of interesting light element synthesis. In particular, we find that under the right circumstances a significant fraction of the relativistic ejecta can be turned into ^{2}H. [222]

Admitting that the analysis is subject to some unknowns, "open and important questions"—because, for example, certain phenomena are "too complicated to allow reliable statements about nucleo-
synthesis"—they nevertheless concluded confidently:

> For essentially all reasonable fireball parameters, there is time to form interesting abundances of ^{2}H... We see that GRBs, and relativistic flows in general, associated with compact objects will be

accompanied by substantial deuterium production.

The authors opine that "the mechanism discussed here can only contribute to the overall present day deuterium abundance at the level of about 0.1 percent." But this estimate appears to depend on tacit assumptions having to do with a presumed *age* of the galaxy and *age* of the whole Universe. The authors admit to a variety of uncertainties and "open questions." When the unasked time-scale question is answered with effective **eternity**, it becomes plausible that the "GRB collapsar" mechanism of deuterium synthesis is the source of a much larger percentage of the ever-replenishing whole.

14.4. *More Radical than Steady State, Tired Light, and other Alternatives*

With the intriguing ideas and analysis of Pruet, *et al* thus added to our record, let us now discuss the status of non-mainstream cosmologists, a few in particular and all in general. Given that these "grumblers" are still, after decades of effort, struggling to have their work taken seriously, we ask: to what extent could this be due, not so much to what sets them apart, as to what the iconoclasts *share* with the status quo?

Probably every physical theory that gets labelled as such has at least some element of truth to it. Newton's theory of gravity predicts an inverse-square acceleration law (even if it gets the *sign*, and the thing that accelerates wrong). Einstein's theory predicts that clock rates and distance measurements are affected by the presence of matter, in magnitudes determined by Newton's gravitational constant G, even if its proponents never ask *how* or *why*. Why don't they ask: What exactly does matter ***DO*** to warp spacetime? If only they'd ask, they'd eventually arrive at the possibility that accelerometers are the key: Just suppose they tell the truth. As dedicated geometers, General Relativists exhibit little interest in physical reality, as though the idea of believing accelerometers is repugnant to them. They believe *equations*; not the *flattening of their undersides*. They abide by Einstein's lofty "highest abstraction," not the lowly "physical experience of the experimenter." This assessment is not based on what the world's foremost gravitational physicists *say*, but what they *do*, and of course, what they *fail* to do.

Key elements of the GR-based Big Bang theory are the redshift-distance relation and a thermal background radiation. Certain empirical facts of physical reality are thus *accommodated* by these theories, even if many others are wrongly interpreted. The prevailing fragmentary, static geometry-laden interpretations have been entrenched for over a century; metaphysical inertia has prevented them from budging. The reason might not be because they paint a satisfactory picture. Physicists often let slip their opinions as to the "ridiculous," "embarrassing," "preposterous," "nonsensical," "scandalous," "ugliness" of their monstrous edifice. They continue clutching it, Rotonians think, because the interpretations offered by known grumblers tend to get even more far-fetched. "Alternative" theories may be motivated by valid grumbles about the status quo, but the picture *they* paint is even uglier. So the prevailing theories do indeed prevail.

So-called "Steady State" theories propose to accommodate the basic features of the cosmos without invoking a primordial beginning, but agree with the Big Bang prediction that galaxies are receding from one another. They invoke spontaneous creation of discontinuous chunks of matter to defend their hypothesis. So-called "Tired Light" theories conceive that the space of the Universe does not expand at all. They disagree with the Steady State idea that new matter is continually popping into existence to fill the spaces opened by the recession of galaxies. To explain the redshift-distance relation Tired Light models propose unconfirmed and questionable (at best) mechanisms to explain why light from distant galaxies gets more redshifted, the greater the distance. *Somehow*

the light gets "tired" while en route, even though the distance between galaxies, on average, does not increase. (There's no Doppler effect.) The idea of tired light in a static Universe fails, to the Rotonian mind, to even explain Olber's Paradox. Whatever that thing is that absorbs or "tires" intergalactic light would surely heat up and ultimately contradict the fact of a dark night sky.

MOND is not really a comprehensive cosmological model, but an adaptation to conventional thinking that merely proposes a change to the allegedly attractive force of gravity for very small accelerations. Its authors admit to not knowing *why* this strategy seems to accommodate rotation curves of spiral galaxies more elegantly than the ΛCDM cosmology — even as it rejects the existence of Exotic Dark Matter. Aside from these small acceleration-related effects, MOND does not cogently impinge on the other prevailing dogmas of the Big Bang model.

Claims by various *Plasma* cosmologists to have fewer contradictory predictions and to improve on the accuracy of others — though true in some cases — is even less well-received in the scientific community. One of the most well-known Plasma cosmologists is Eric Lerner, whose 1991 book, *The Big Bang Never Happened*, seems to have increased public awareness of problems with the standard model. The gist of this critique, to my mind, is one of the most humble and cogent indictments of the prevailing mythology to be found. Yet Plasma cosmology has its own share of problems, which are typically admitted. This comes out in a 2014 *Sci-News* article about some observations that seem to contradict ΛCDM's expansion prediction:

> Therefore if the Universe is not expanding, the redshift of light with increasing distance must be caused by some other phenomena — something that happens to the light itself as it travels through space.
>
> "We are not speculating now as to what could cause the redshift of light." Mr. Lerner said. [223]

This lack of a clear-cut explanation for the redshift-distance relation is serious. In its absence, the Plasma-Universe.com website [224] (within which Lerner is approvingly profiled) presents a list of 24 proposed redshift-distance (or redshift-*something*) mechanisms that have been published over the years. A very serious omission is *the **first** cosmological redshift-distance relation* proposed in deSitter's 1917 cosmological solution to Einstein's field equations (aka the *deSitter effect*). This prediction precedes Friedmann's more famous 1922 prediction by five years. Why is this — perhaps the simplest, most rational — explanation for the observational evidence so often overlooked?

Pertinent to this subject of "alternative explanations" for physical things, is the *Rational Wiki* website's publication of a well-written compendium of "Alternative Cosmologies." [225] In their own separate categories are *Steady State*, *Quasi Steady State*, and *Plasma* cosmologies. Following them is a list of 33 (!) other alternatives, spanning a range from curiously inventive to crackpot crazy. Some of these 33 come with, or are based on, an alternative model of gravity — e.g., *pushing gravity*. This idea is sometimes advocated as an explanation for gravity, whose mechanism is a swarm of "gravitons" that don't fly around *yanking back* at things to magically *pull* them toward one another, but rather as a swarm of gravitons that fly around *pushing* everything together with a downward force from above, as it were. It thus represents *a whole new way to disbelieve accelerometers!* Many other dubious features are prevalent in the list, as is the common final assessment: *Not seriously considered by establishment scientists*.

The purpose of acknowledging all this other work — as a group — is that it serves as a stark contrast with the present Rotonian/SGM cosmology. The most important difference is that none of these models propose a simple laboratory experiment whose result has the potential to irrefutably falsify Big Bangism, or perhaps support it. A secondary purpose is to reiterate the point that standard ΛCDM cosmology prevails, not because it is in unequivocal agreement with empirical

evidence, but because of the traditions it upholds and the financial backing it receives from a gargantuous and persistent Marketing Conglomerate. They have a truly lousy product (Embroidered Garbage™). They do not have, and are not really interested in inventing or finding anything better to sell. They persist with foisting their one-trick lame pony (dead horse?)—and get away with it—***because the competition is so weak***. The usual cast of grumblers lack the robust *unequivocal* evidence needed to even come close to making a game of it.

As I write, the news sometimes reports on how 90% of the Russian population think of their barbarous army and government as the *good guys*, as they slaughter Ukranian men, women, and children just for the hell of it. This is in stark contrast with empirical facts. Eye-witness evidence from the scenes of the crimes *proves* that the Russian army and government are—like the Nazi regime of the 20th century—***obviously*** *the bad guys*. But flagrant lies are reportedly swallowed hook-line-and-sinker by most Russians (and MAGA Republicans) because of the wickedly crafted propaganda machines built by Monster Putin, Devilish Rupert Murdoch and their greedy, short-sighted spineless underlings.

Big Bang cosmology is obviously not an evil thing. In a certain sense it may, however, be even more detrimental than a few horrible wars to the overall enlightenment of humanity. Rotonians see it as a crime against rational thought, for it to be sold as though it were the milk-and-honey, the crowning "Concordant" triumph of modern science. See, for example, Michael Turner's 1999 piece of salesmanship, *Cosmology Solved? Quite Possibly!* wherein he writes that

> We have a well-established foundation in the hot big bang model . . . I think I can see the top of the mountain emerging through the haze . . . [as I contemplate nonsensical questions such as:] . . . Does the quantum gravity era of cosmology, which occurs before inflation, leave a detectable imprint on the Universe? . . . By any measure, cosmology is entering a Golden Age.
>
> I believe the hot big bang theory will be viewed as one of the great intellectual triumphs of the 20th century. [226]

As though a scripted and predictable sequel to this self-congratulatory assessment, the same tired song keeps being sung 23 years later. From the CERN Department of Theoretical Physics, Kai Schmitz has recently chimed in:

> We are indeed able to reconstruct the history of our Universe all the way back to the first second of its existence. Despite the countless open questions that remain to be answered in cosmology, it is therefore fair to say that *the big bang did indeed happen*—in the sense that, 13.8 billion years ago, the Universe was indeed filled by a rapidly expanding hot thermal plasma that gradually became cooler and more and more dilute while giving birth to all of the visible matter that permeates the cosmos today . . . The big bang will always remain embedded in the more fundamental theory that is going to succeed it. [Original emphasis.]
>
> Now in the era of precision cosmology . . . it is clear that cosmology is facing a bright future in the coming years and decades . . . We thus find ourselves on the eve of a golden age of cosmology. [227]

The "Golden Age of cosmology," as anticipated in 1999 and again in 2022—sporting all the dubiousness of Big Bangism—is ever something to be *sold*, but never to *arrive* as advertised. Like children who are old enough not to, but still believe in Santa Claus, the perpetrators justify the deception as innocent, not a deception at all, but as based on science. "Look, NSF grants under the tree!"

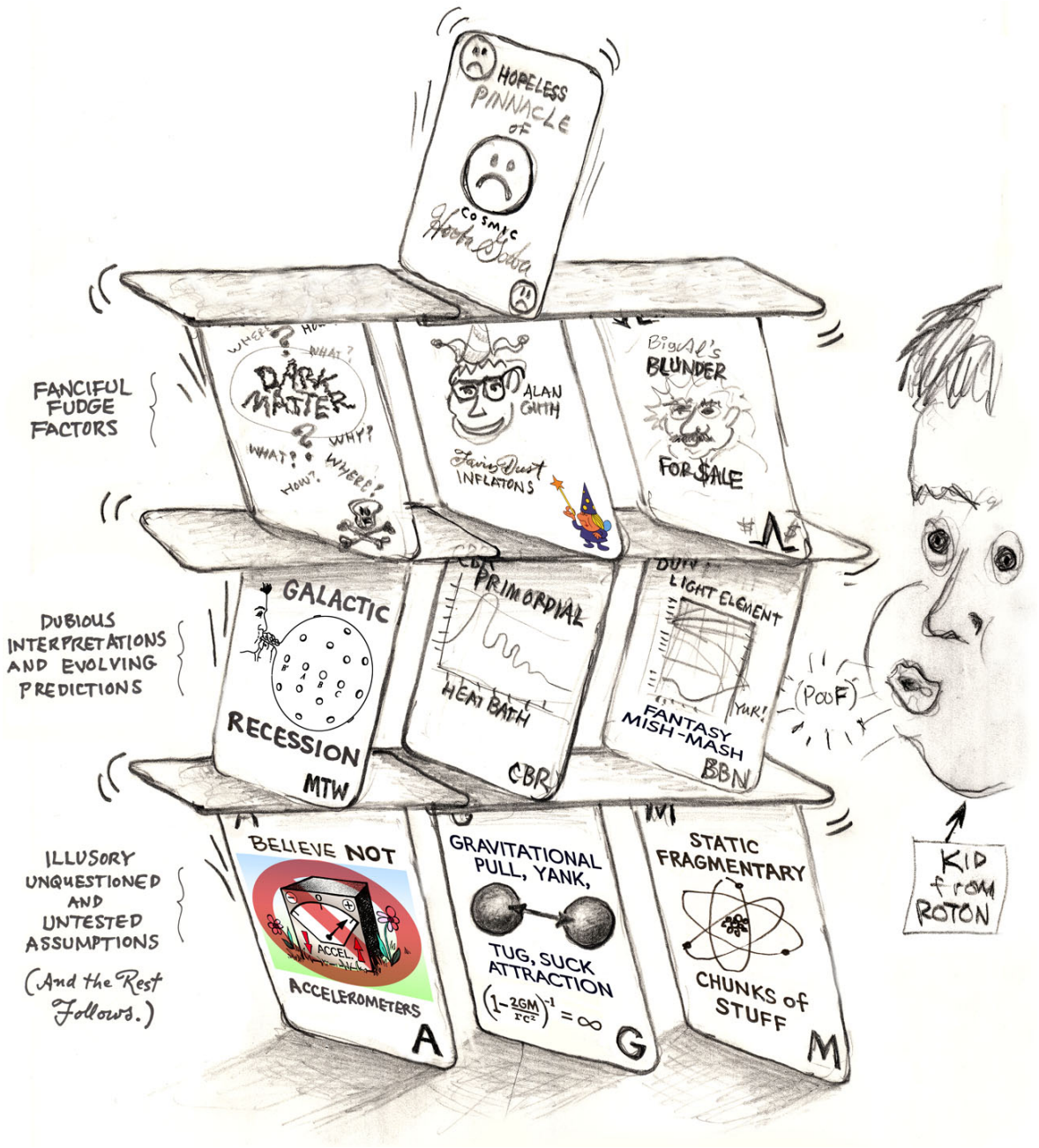


Fig. 61. **Kid from Roton Meets the Wet-Noodle "Foundations" of Modern Cosmology:** Poof! Would-be Earthian cosmologists hope to paint an accurate picture of the Universe while still accepting the bottom three foundational cards (assumptions) as true. It is a futile effort, destined to result in a grotesque monstrosity. Like building a "house" with rubber nails and wet pudding. Neither standard theorists, nor the "alternative" cosmologists mentioned in the text can conceive a sensible Universe because none of them understands the *first thing about gravity*, because they all think accelerometers are schizoid liars. The first thing to understand about gravity and the Universe — what is understood by every kid from Roton — is that *accelerometers always tell the truth.* There is no such thing as a *static* anything. *Everything* outwardly *moves*. [228]

Those "alternative" others who would provide many many good reasons to be suspicious — i.e., empirical evidence that puts Big Bangism in serious doubt — share some of the same foundational, yet *untested*, assumptions of the status quo, and lack the robustly testable alternative and the marketing clout needed to motivate any change among the faithful. Most Russians think their army and government are the good guys. Most Republicans pretend to think Donald Trump won the 2020 Election. And most consumers of science news think Big Bangists tell the truth. That's how it is with cults, propaganda, big-enough lies, and the gullible squishiness of human brains. Painful to realize, that's what the Rotonians and those of similar spirit are up against.

A graphic representation of the situation is illustrated in Figure 61.

14.5. *Baryon Acoustic Oscillations*

> *We are too ignorant to be sure we are not interpreting a perfectly 'ordinary' phenomenon in a foolish way.*
>
> JAMES PEEBLES : Early cosmological humility : 1971 [229]

In the interest of completeness, one more ΛCDM-based argument should be discussed. It goes by the name of *Baryon Acoustic Oscillations* (BAO) which derives from an analogy with sound waves. Supposedly still observable in the modern distribution of galaxies, is a primordially imprinted density inhomogeneity pattern caused by the back and forth tug-of-war alleged to have taken place in the early Universe. Opposing forces responsible for the oscillating "tugs" were supposed to have been the gravitationally attractive pockets of Exotic Dark Matter, and the extremely hot furnace of electromagnetic radiation. The alleged soup of primordial baryons tended to collapse due to the former and then tended to get blown back apart due to the latter.

Figure 62 is a schematic of this primordial dance. The graph in Figure 63 plots the resulting redshift-distance relation — as alleged to support the BAO theory in particular, and alleged to support the ΛCDM cosmology, in general. The pattern of density inhomogeneity that was supposed to have been produced in primordial times persists to this day in the distribution of galaxies. In Figure 63 we see that this is an example of a prediction that can be directly compared with the SGM. As shown, both BAO and the SGM agree — not exactly, but very closely with measurements.

Building on the sound wave analogy, Wayne Hu and Martin White expound at some length on the BAO story in a 2004 *Scientific American* article called "The Cosmic Symphony." On the first page they write: "The cosmic symphony is produced by some *very strange players* and is accompanied by *even stranger coincidences*." [My emphasis.] The authors' narrative traces BAOs from their primordial beginnings during the Fantasy Epoch of Inflation, through to their alleged manifestation in the distribution of modern-day galaxies and the pattern of inhomogeneities in the microwave spectrum of the CBR:

> The theory of inflation . . . provides a physical mechanism for triggering the pirmordial sound waves and the seeds of all structure in the Universe. The theory posits a new form of energy carried by a field dubbed the "inflaton," which caused an accelerated expansion of the Universe in the very first moments after the Big Bang . . . Quantum fluctuations in the inflaton field . . . become fluctuations in the energy density from place to place in the primordial plasma. [230]

Invoking the absurd logic of claiming a "physical mechanism" to be "provided" by theoretical abstractions, the authors claim that these fluctuations are supposed to eventually become measurable

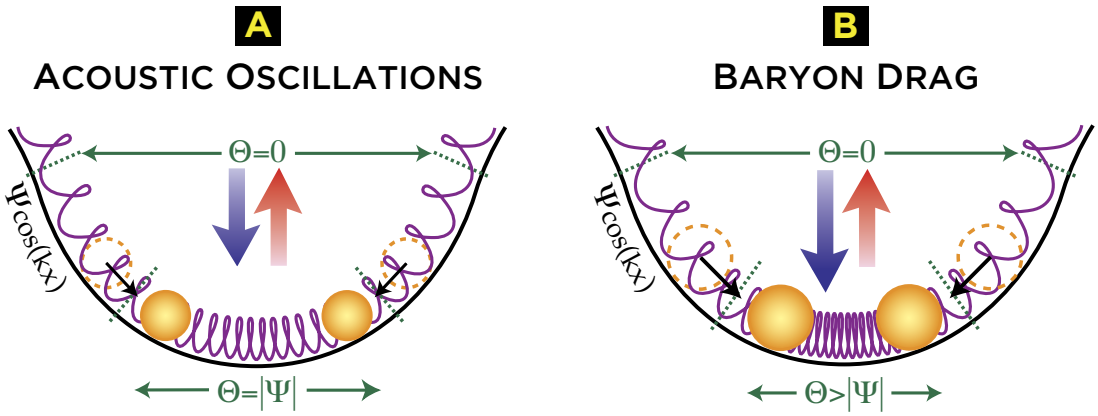


Figure 1. **(A)** Acoustic Oscillations. Photon pressure resists gravitational compression of the fluid setting up acoustic oscillations…Springs and balls schematically represent fluid pressure and effective mass respectively. Gravity displaces the zero point. The displacement is cancelled by the redshift…a photon experiences climing out of the well. **(B)** Baryon Drag increases the gravitating mass, causing more infall and a net zero point displacement, even after redshift. Temperature crests (compression) are enhanced over troughs (rarefaction) and Doppler contributions.

Fig. 62. **Boing! Boing! Boing!:** In the alleged first 10^{-33} second or so of the Universe, *Fantastic Inflation* is supposed to have set up this circumstance of baryons bouncing in and out, toward and away from primordial Exotic Dark Matter concentrations. Exotic Dark Matter-powered gravity supposedly pulls the baryons inward, an intense bath of radiation pushes them back outward, and repeat. Haruspice-like physicists pretend to know this about the "early Universe." They pretend to see evidence of it in the modern Universe. [231]

in the CBR power spectrum (Figure 47). Readers are encouraged to believe the enormous backward extrapolation from current observations of galaxies and the cold sky back almost 14 billion years to the alleged birth of the Universe ($t = 10^{-33}$ seconds). The authors build up to a confession of the apparent irrationality of their "strange" scheme as follows:

> An abundance of [exotic] cold dark matter was needed to keep the gravitational potential wells sufficiently deep [or else the bounce in Figure 62 would never happen]. Researchers have determined that the density of [exotic] cold dark matter must be roughly five times the baryon density. Therefore, [exotic] dark matter constitutes about 25 percent of the [geometrically desired] critical density today.
>
> Unfortunately, these calculations of the modern Universe's matter and energy leave about 70 percent of the critical density unspecified. To make up the difference, theorists have posited a mysterious component called dark energy, whose relative influence has grown as the Universe has expanded. We are thus led by degrees to an improbable conclusion: most of the Universe is composed of invisible dark matter and dark energy. Worse yet [coincidence scandal; see Figure 45.]… What is more, another mysterious component, the inflaton, dominated the very early Universe and seeded cosmic structure. **Why should we believe a cosmological model that is based on the seemingly *fanciful introduction of three enigmatic entities*?** [230] (Emphasis added.)

In the sequel, the authors weave the usual yarn in defense of the standard "reasons" for believing in the "fancifully enigmatic entities" (as shown on the *top* level of the card house in Figure 61). Rotonians are not persuaded even a little bit. They maintain, rather, that none of the offered reasons are good reasons. None of them make sense because they are all based on the flimsy unquestioned

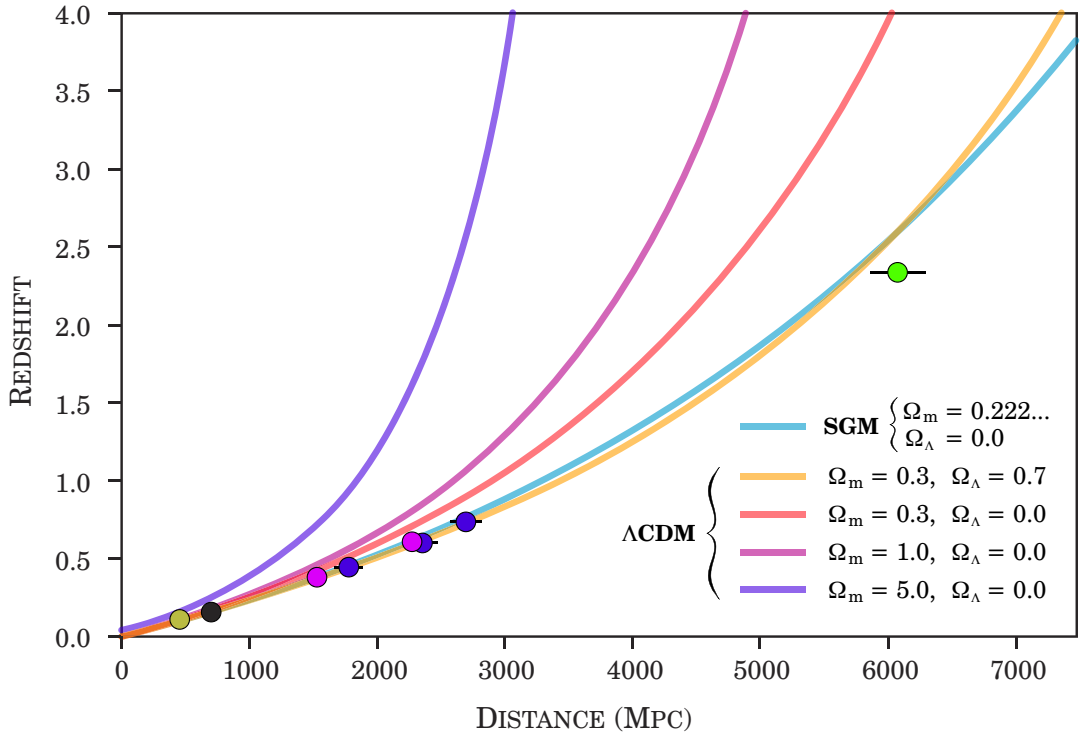


Figure 4. THE STANDARD COSMOLOGICAL MODEL includes matter and dark energy acted on by gravity as described by the General Theory of Relativity. The curves here show redshift versus distance for different recipes of matter density and of dark-energy density… Data from a handful of baryon acoustic oscillation surveys (colored dots) consistently support a spatially flat cosmos with $\Omega_m = 0.3$ and $\Omega_\Lambda = 0.7$.

Fig. 63. **ΛCDM vs. SGM Redshift-Distance Relations:** Baryon Acoustic Oscillations. Or not. [232]

assumptions shown at the *bottom* level. The time to question and test these assumptions is decades ago. When at last Galileo's Small Low-Energy Non-Collider experiment is carried out, Rotonians suspect that the whole ΛCDM house of cards will collapse. In its place, and by the same test, SGM cosmology would emerge intact — predictably, perhaps — because its crowning discovery is the simple, compelling definition of Newton's constant:

$$G = 8\left(\frac{\rho_\mu}{\rho_N} \cdot \frac{c^2 a_\circ}{m_e}\right) . \tag{62}$$

See discussions in §6 and §12, in connection with the Cosmic Everything Chart (Figure 12) — and the SGM cosmological scheme.

15. Astrophysical Formation Issues: Models Compared

Once a theoretical idea has been acquired, one does well to hold fast to it until it leads to an untenable conclusion.

Albert Einstein : 1950 [233]

Not all gas clouds in the Milky Way [or any galaxy] can form stars at all times. More often than not, the cloud is confused about what to do next. Actually, astrophysicists are the confused ones here. We know the cloud wants to collapse under its own weight to make one or more stars. But rotation as well as turbulent motion within the cloud work against that fate. So, too, does the ordinary gas pressure you learned about in high-school chemistry class. Galactic magnetic fields also fight collapse: they penetrate the cloud and latch onto any free-roaming charged particles contained therein, restricting the ways in which the cloud will respond to its self-gravity. The scary part is that ***if none of us knew in advance that stars exist, front line research would offer plenty of convincing reasons for why stars could never form.***

Neil deGrasse Tyson : [Emphasis added.] 2007 [234]

15˙1. *Introduction: Warm Gas and Debris*

Following Einstein's advice (quoted above) we have yet to find anything untenable about regarding accelerometers as reliable tellers of the truth. Under this assumption, we arrive at the idea of a Universe in a perpetual state of dynamic equilibrium, as its matter and spatial content both increase exponentially, which leaves their proportions (average density) eternally constant.

Among the many other reasons for "holding fast" to the truthfulness of accelerometers is that, by disbelieving them, we are plagued with uncertainty about how astronomical bodies — planets, stars, galaxies — can form. In the above quote, Neil deGrasse Tyson admits that standard physics struggles to explain the existence of stars. Implicit in this assessment is acceptance of the standard gamut of physical laws — including the assumption that gravity is a force of attraction. Tyson exhibits admirable humility by admitting that, despite the obvious evidence to the contrary, there are "plenty of convincing reasons why stars could never form." For similar reasons, the origins of planets and galaxies are no less problematical.

By contrast, when the problem is reframed on the basis of the SGM conception of gravity, it becomes evident that formation of astrophysical bodies would be at least much easier, and perhaps even obvious and inevitable.

Furthermore, we find in the standard literature support for the idea that small ($\approx$ cm–sized) fragments of ordinary matter may forever populate galactic and intergalactic space, serving not only to thermalize a low temperature background radiation, but to make the idea of Exotic Dark Matter appear as needless fantasy fluff. Having an infinite time scale, the SGM cosmology becomes all the more plausible, supporting the picture of a dynamically active, yet globally stationary, saturated and equilibrious, ever self-replenishing Universe.

15˙2. *Meinel & Wollman*

> *The concordance values for the cosmological parameters really are extraordinary — many of our colleagues regard them as crazy.*
>
> MALCOLM S. LONGAIR and CHRIS SMEENK : 2019 [235]

In November 2006 Bertram Schwarzschild wrote a *Physics Today* article in which he reviewed recent work on galaxy collisions in the context of ΛCDM cosmology. In May 2007 the respected organ of the physics community published a letter in response to Schwarzschild's review by the veteran astronomer, Aden Baker Meinel. Being a junior faculty member at Yerkes Observatory in the early 1950s, Meinel names his illustrious senior colleagues: Subrahmanyan Chandrasekhar, Gerard Kuiper, William Morgan, Gerhard Herzberg, Lyman Spitzer, and Martin Schwarzschild. Meinel wrote that

> Those notables generally agreed that only the gas in each galaxy collides and is combined and left behind. All condensed matter, stars, and failed stars down to gram-sized debris proceeded without significant collisions, affected only by the gravitational field of the galaxies and perhaps of some individual stars.
>
> Kuiper was adamant that most of the baryonic matter in the nascent galaxies never condensed into stars, remaining invisible but discrete entities. He pointed out that the optical cross section per gram of matter drops rapidly with increasing size, thus the effect of this dark matter on optical extinction would be minimal. Because of this dependence, he stated his opinion that most of the baryonic matter in the universe would be invisible to detection except by gravitational effects.
>
> Herzberg agreed that dark matter would have no spectroscopic signature in the observable spectral regions. Spitzer added that this dark matter would be heated by the stellar radiation field to a temperature of a few degrees kelvin, a function of the stellar radiation intensity distribution in each galaxy and the albedo of the matter. At that time there was no prospect on the horizon that detection of dark matter at 3–5 K would become possible.
>
> In the 1950s model that arose from the discussions, there was no need for ***exotic*** dark matter. That simple model of a collision between galaxies and the role ordinary dark matter plays in such an event deserves to be restated, since it seems to have become eclipsed when exotic dark matter took center stage. [Emphasis added.] [236]

The care and conscientiousness of Meinel is evident down to the clarification to distinguish *ordinary*, non-shining (dark) matter from *Exotic* Dark Matter. Most importantly, we behold a plausible argument which motivates questioning and reinterpreting two of the main components of Big Bang theory: Exotic Dark Matter and the allegedly primordial origin of the CBR.

14 years prior to Meinel's letter, E. R. Wollman's 1992 *Astrophysical Journal* paper echoes Meinel's ideas with greater specificity. Wollman's analysis accounts for pertinent orbital and thermal speeds, material grain sizes and densities, time scales, optical depths, etc. Contemplating the possibility — like Meinel — that ordinary baryonic matter, in and beyond the confines of galaxies, obviates the Exotic Dark Matter of standard cosmology and perhaps even explains the cosmic background radiation, Wollman summarizes his conclusions as follows:

> Finally, the proposition that the dark matter is composed of large solid grains has implications regarding the microwave background radiation. The fluid of large grains is an effective cosmic

> thermalizing agent. This thermalizing action smooths inhomogeneities in any primordial component of the microwave background radiation. *If the grains are sufficiently old*, then primordial inhomogeneities are completely erased. On the other hand, because the grains absorb and reradiate galactic luminosity, they are a source of nonprimordial microwave radiation, and galaxies will be warm spots in the microwave sky.
>
> Because the grains are a thermalizing agent, the background radiation need not necessarily be primordial.
>
> In light of the cosmic thermalizing capability of the grains, it is also tempting to reconsider the proposition that the helium is not primordial. As was pointed out by Wagoner, Fowler and Hoyle (1967), if the helium has been produced more recently from hydrogen, then the energy released is sufficient, if thermalized, to account for the background radiation. [237] [Emphasis added.]

Wollman thus accommodates a theme that recurs in the context of Steady State and Quasi Steady State theories. Specifically, he proposes connecting the thermal energy of helium production from hydrogen to the temperature of the widely dispersed "grains of matter." This idea clearly at least begins to *question* that other alleged "pillar": Primordial Nucleosynthesis. Accordingly, Wollman's paper ends with the sober conclusion:

> The very existence of unidentified dark matter, which apparently dominates the mass of the Universe, raises doubts [about] the correctness of the standard model.

Wollman exhibits full awareness of where his ideas conflict with the status quo, as he navigates them in the prestigious establishment journal. The SGM approach is yet more radically far-reaching of course, so it helps to acknowledge a few more points from Wollman's analysis. He assumes, along with the Big Bangists, that the overall density of the Universe is "critical"—diverging from the standard model only in that he assumes the whole of it is ordinary, baryonic matter (no Exotic Dark Matter and no Dark Energy).

In the context of Big Bangism, this corresponds to a "flat" Universe, as anticipated from belief in the simple Einstein-deSitter model. Since this assumption conflicted with the preponderance of astrophysical evidence back in 1992 that $\Omega_{M} \approx 0.15 - 0.30$ (see p. 98) the more complicated FLRW model was adopted to allow adding the cosmological constant (Lambda) density Ω_{Λ}.

Wollman's model entails the need for a large population of matter grains to be loosely distributed in intergalactic space. Because of their low optical cross-section and tenuous distribuution, the grains would be difficult to detect either optically or dynamically. There would be little directionality to any gravity-induced velocities (except for those caused by galaxy or galaxy cluster inhomogeneities).

The assumption of critical density $\Omega_{\circ} = 1.0$ means that instead of adding Dark Energy to make the total

$$\Omega_{\circ} = \Omega_{DM} + \Omega_{B} + \Omega_{\Lambda} = 1 \qquad \rightarrow \qquad \Omega_{\circ} = 0.28 + 0.05 + 0.67 = 1\,, \tag{63}$$

(where the numerical values have been updated to be consistent with the *Planck* mission values listed in Figure 39, p. 103) Wolman implicitly proposed $\Omega_{DM} = \Omega_{\Lambda} = 0$, so that

$$\Omega_{\circ} = \Omega_{B} = \Omega_{M} = 1 \qquad \rightarrow \qquad \Omega_{\circ} = 1 = 1 = 1\,. \tag{64}$$

Though the SGM predicts only 2/9 of this value, Wollman's prediction was ostensibly plausible because of the implied intergalactic location of the matter grains. Being unassociated with any particular galaxy or cluster from which to contribute to a gravity-induced velocity, the loose population of grains fails to provide the density *contrast* needed to directly reveal its existence. Whereas the matter within galaxies and galaxy clusters does provide the needed contrast. When the contrast is blurred by fading into intergalactic space, it becomes inevitable that measurements based on gravitational dynamics would yield a significant *underestimate* of the actual average, because the volume *between* clusters is much larger than the volume of the clusters themselves. In Wollman's words:

> If the cosmic density of [ordinary] dark matter is approximately critical, then a significant fraction of the [ordinary] dark matter apparently resides outside of galaxy clusters.

It is relevant to point out that the Exotic Dark Matter haloes invoked by standard cosmologists to explain flat galaxy rotation curves have densities (in their outer regions) that diminish approximately as $\rho \propto 1/r^2$. In Wollman's model as well as in the SGM, the density would vary the same way, but with *ordinary* matter instead of *exotic* matter.

Observations typically fail to find an edge where the velocity transitions (diminishes) to a Keplerian curve. Except for MOND (about which more later) prevailing gravity models (and the SGM) agree that a $\rho \propto 1/r^2$ density gradient corresponds to the *observed* flat rotation curves. This implies that the average density of intergalactic space gradually approximates to some finite ("grainy") minimum. Since the volume between galaxies or clusters is much greater than the volume of the galaxies or clusters themselves, this is where a significant fraction of the mass of the universe resides. But it's not exotic; it's ordinary baryonic matter. It doesn't shine because it is mostly not congealed into stars.

In any case, Wollman's idea is surely more rational than the far-fetched (*strange, extraordinary, crazy* and *ridiculous*) notions being sold under the Big Bang banner. It becomes even more rational in the SGM, whose density is not $\Omega_\circ = \Omega_B = \Omega_M = 1$, but $\Omega_\circ = \Omega_M = 2/9$, and whose time scale is explicitly infinite.

Since we reject most of the assumptions of standard cosmology, $\Omega_\circ$ being $\neq 1$ no longer means the geometry of the Universe as a whole is "curved." It no longer means the density and temperature approach *zero* as the initial blast eventually kills everything, or that our inevitable doom would instead be caused by the eventual re-collapse of the galaxies.

Consider the SGM's expressions for cosmic density:

$$\frac{\rho_M}{\rho_\mu} = 2\left(\frac{m_p}{m_e}\right) \qquad \text{and} \qquad \rho_M = \frac{3c^2}{4\pi G R_C^2}\,, \tag{65}$$

where we recall that the SGM's cosmic radius R_C is three times greater than the ΛCDM's Hubble radius. The matter-density ρ_M and the "mass equivalent" of the radiation density ρ_μ are both *constants* — in a constantly saturated Universe. Being 2/9 less dense than the Big Bang's critical density means that the Universe is 4.5 times more *transparent* than Wollman predicts — a more defensible prediction, given the large numbers of more highly redshifted objects observed since Wollman wrote his paper.

Most importantly, the left side of Eq 65 is *measurably* at least *very nearly true*, as we recall from Komatsu's estimate on p. 89. [152] According to the SGM, it is exactly true, as it serves to express the cosmic saturation condition of clock-like matter immersed in a thermal bath of timeless electromagnetic radiation. (See Cosmic Everything Chart: Figure 12, p. 32.)

15˙3. *Regener, Sciama & Trimble*

> *Nature is an inveterate thermalizer, rushing toward the thermodynamic state in ways more subtle than we anticipate.*
>
> Fred Hoyle : 1989 [238]

In Meinel's 1950's account of galaxy collisions, he refers to a dark (ordinary) matter temperature of "3–5 K," implying that a background of this order could be produced by a diffuse distribution of "gram-sized debris." The "gram-sized" and other sizes of debris and gas have not only thermodynamic, but also gravitational significance. In what follows we will continue jumping back and forth between these aspects, as it becomes apparent that they compliment each other, in bolstering the Rotonians' picture of a globally stationary Universe that maintains a constant temperture, constant density, and facilitates the local formation of all manner of astrophysical structures.

Some of Meinel's and Wollman's ideas find an echo in the lore of alternative cosmologies, as similar and related ideas have sometimes been suggested by astrophysicists of comparable prestige as Meinel's colleagues. In 1995 a review of this work by Brazilian physicists Assis and Neves appeared in the fringe journal *Apeiron*, wherein it is argued that

> Models based on a Universe in dynamical equilibrium without [recession of galaxies] predicted the 2.7 K temperature prior to and better than models based on the Big Bang. [239]

In their paper, the work of the cited authors goes back to what appears to be the first estimate of the temperature of the background sky by C. E. Guillaume in 1896. Others include A. S. Eddington, Nobel laureate Walther Nernst, A. McKellar and G. Herzberg. Also mentioned were the more recent summary remarks of Dennis Sciama, who added to the discussion the fact that the energy density of cosmic rays — i.e., the mysterious bath of high-energy material particles coming in toward the Milky Way uniformly from all directions — and the interstellar magnetic fields are of a similar magnitude as the microwave background:

> The cosmic ray flux almost certainly fills the Milky Way, and corresponds to an energy density . . . comparable with the energy density of starlight, the turbulent kinetic energy density of the interstellar gas and . . . the energy density of the interstellar magnetic field. This is the basis of our statement that the cosmic rays are dynamically important. They constitute a relativistic gas whose energy and pressure cannot be ignored. The near-equality of the various energy densities is probably no accident, but despite many attempts, a full understanding of it has not yet been achieved. [240]

Since the observations indicate that cosmic rays have an extragalactic origin, Assis and Neves infer that

> If this is the case, then three extragalactic modes of excitation (the cosmic ray flux, magnetic fields and the CBR) would be in thermal equilibrium with one another and with energy fields generated inside our own galaxy, such as starlight and turbulent gas clouds. The easiest way to understand this fact is to conclude that the Universe as a whole is in a state of dynamical equilibrium.

The authors emphasize that the historical background temperature measurements they refer to cluster more closely to the modern value without referring to a hot, dense, primordial beginning.

Meanwhile, Big Bangists predicted a more discordant range of magnitudes, and even "Steady State" theorists could claim only after-the-fact retrodiction:

> Our conclusion is that the discovery of the CBR by Penzias and Wilson is a decisive factor in favor of a Universe in dynamical equilibrium, and against models of [galactic recession] such as the Big Bang and the Steady State.

In a paper published a few years later (2006)—which did not advocate for any particular model—astrophysicist Virginia Trimble nevertheless shone a light on some of the same points as Assis and Neves. Trimble's purpose was more to the effect of correcting and clarifying certain misconceptions in the historical record. She refers to some of the same original work as Assis and Neves and does an even better job of elucidating certain shortcomings of Big Bang pioneer George Gamow and his wide range of CBR temperature predictions. Most importantly for our purposes, Trimble echoes the observation of Assis, Neves and Sciama:

> Eddington (1926) estimated that the local energy density in starlight is 7.67×10^{-13} ergs/cm^3, corresponding to an effective or bolometric temperature of 3.18 K. He called this "the temperature of interstellar space," but made completely clear that the radiation has the wavelength distribution of dilute starlight, a gray body, not a black body at that temperature. Not long after, Regener (1933) found that cosmic rays contribute a comparable local energy density. It remains true, incidentally, that the local densities (or pressures) due to cosmic rays, starlight, magnetic field, and gas turbulence are all about the same in the galactic disk, and all are about equal to the CMB energy density. This last is surely a coincidence. The others presumably not. [241]

Trimble does not elaborate on *why* she thinks the near equality of these energy densities may or may not be coincidental. But the conclusion of Assis and Neves, which infers these facts to indicate "a Universe in dynamical equilibrium," Rotonians think has a resounding ring of truth to it.

15.4. *Within, Beyond, and in Between all Kinds of Astrophysical Structures*

> *It's not easy to make a planet.*
>
> MARCUS WOO : *Scientific American* : 2018 [242]

Nature is not only an inveterate thermalizer, it is both a maker and a cleaner-upper of messes. Cosmic debris of many different sizes, shapes, and chemical compositions is strewn far and wide, is often swept back up, recycled and, according to the SGM, forever.

An important feature of empirical evidence of how cosmic matter is distributed—from its largest multi-galactic structures, to stars and planets, to familiar objects, dust, molecules and particles—is its *statistical* nature. On the largest scales events in the Universe unfold so slowly as to make a whole human's lifetime appear as just one freeze frame. Even with perfectly functioning apparatus and a flawless observing strategy, one observation at one time, in one direction in one wavelength range, etc. is not expected to tell a complete or accurate story. For the most part, extended exposures in astronomy serve only to maximize the light and sharpen the image of seemingly unmoving parts of the sky, not to reveal any actual motion across the frame. Many observations are needed in many directions to enable hypothesizing what is really going on.

Reliable conclusions about the motions matter undergoes are most convincingly ascertained by observations that span a range of times, long enough so that the thing or things observed do change

their positions across the frame (time-lapse video). This becomes less and less possible as we look out further in space to ever larger objects (galaxies) whose positions change much too slowly to be measurable by Earthian observers.

Near the Sun we are of course close enough to be able to track the motions of planets over many cycles. In the middle of our galaxy the motion of stars around the center — over a period of years or decades — due to their very high speeds, can also be tracked over large enough angles to measure motion across the sky. But for most cases, the motion of planets and stars far beyond the Solar System — when trackable at all — involve only very short, indiscernible angular changes.

The transformations that a given body of matter undergoes over the course of billions of years is typically deducible only on the basis of various theories and hypotheses that are supported (or not) by indirect interpretations, extrapolations, and assumptions, rolled into statistical analyses that are typically tentative, and in need of ever more empirical corroboration, fine-tuning, and *physical insight*. It is always beneficial to organize the fruits of observational and statistical endeavors into quickly understood graphics, as in Figure 64.

To avoid going astray on all of this, it is especially important to ascertain the accuracy of one's foundational assumptions. As seen by our Kid from Roton (Figure 61) the standard picture of cosmology is arguably quite wrong, because it is based on: 1) disbelief in accelerometer readings; 2) the assumption that gravity is a force of attraction; and 3) the ancient picture of matter as static, discontinuous chunks of stuff.

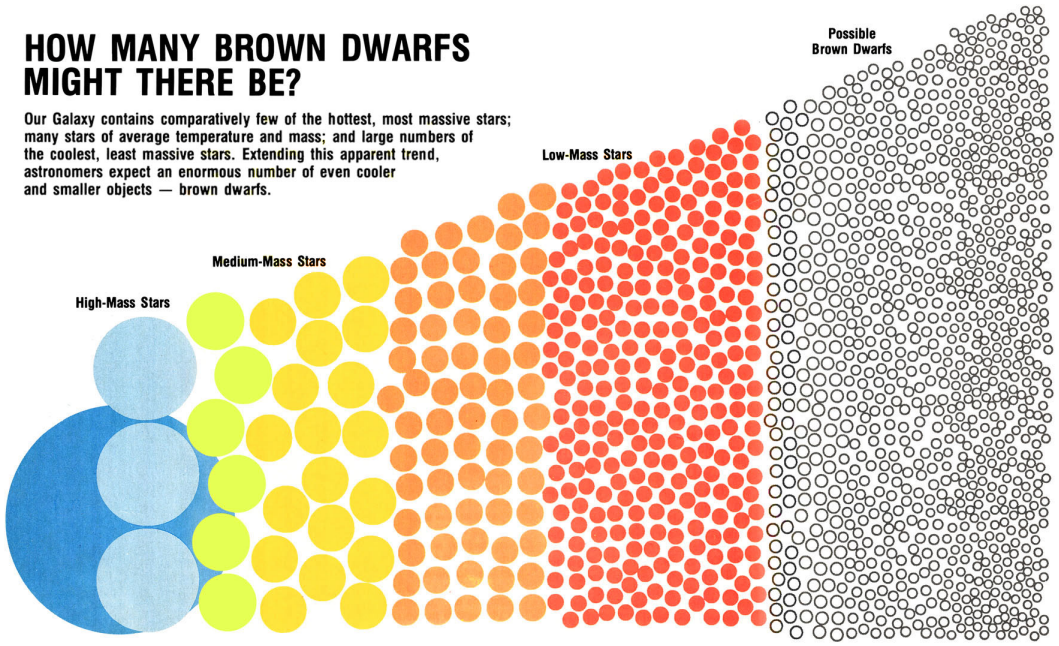


Fig. 64. **Astrophysical Size Distribution:** How far does this pattern extend, and how exactly does it vary in the broad range of cosmic and galactic environments? Many factors contribute. With insights from empirical observations, chemistry and various research strategies, a more complete picture is slowly coming into view. Note that this illustration is from a 1989 *Astronomy* article reporting on the then *tentative* status of the existence of Brown Dwarfs. Many of these objects have since been observed. More recent observations are filling in the cosmic-object panoply with, among other things, extra-solar planets — both homies and rogues. [243]

In contrast to the indirect statistical character of most cosmological and astrophysical research, it is of the ***UTMOST*** importance that the above three assumptions be tested starkly and *unequivocally*. They all need to either be shown to fail (be refuted) or be so robustly tested as to *earn* the status as worthy foundations. We first need to understand *that his has not yet been done*, and then to realize that it *can* be done by conducting (in principle) just *one* empirical observation (just one relatively short time-lapse video).

In practice many research laboratories will repeat the experiment. But the final product of each such instance would be a single short-duration video clip or space-time graph. If the Small Low-Energy Non-Collider is well-designed and is operated by competent experimentalists (and the source mass is made of lead) just one 15-minute observation would suffice to establish either that we are destined to remain in our state of muddled confusion about the nature of gravity and the structure of the Universe, or to drastically change the course of human history, by opening a door to a profoundly new expanse of physical perception.

In each respective 15-minute (or one-hour) run of Galileo's experiment, it would be unequivocally established either that the test object oscillates over the entire length of the hole (as per Newtonian/Einsteinian gravity) or that it fails to pass the center (as per the Rotonian's Space Generation Model of gravity). The result would not be subject to any statistical fluctuations, selection effects, confirmation bias, or high-falootin philosophical nuance. It does not involve an effect hiding in a far off decimal place; it will scream its character — and possibly unexpected *sign* — in the *zeroth* decimal place. Nothing subtle or statistical about it. Night or day, on or off unequivocality.

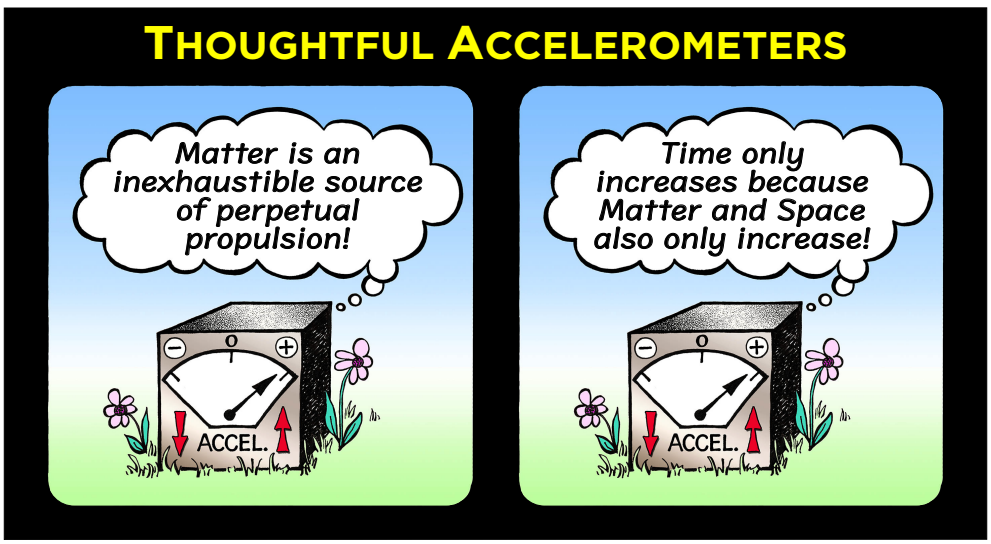


Fig. 65. **Accelerometers Contemplate What Happens to Them and What They are Doing:** If an accelerometer gives a positive reading, it means it is accelerating in the direction of the applied force. If an array of accelerometers around a body like Earth all give positive readings, they would seem to be telling us that matter is an inexhaustible source of perpetual propulsion. If true, the implications are boundless. It means a test object in a Small Low-Energy Non-Collider will not pass the center. Also — by a solid chain of reasoning — we should expect light from distant galaxies to be redshifted according to an exponential law. It means *matter, space and time are* ***interdependent*** *elements of the world*, and that the seemingly separate forces of Nature are not phantasmagorically "unified" only at the imaginary beginning of the Universe. They are unified all the time, as suggested by the definition for Newton's constant: $G = 8\,(\rho_\mu/\rho_N)\cdot(c^2 a_\circ/m_e)$.

If accelerometers tell the truth, matter is an inexhaustible source of perpetual propulsion; and gravity is the process whereby matter incessantly regenerates itself and continuously creates new space by an ever-outward, ever-upward curvature-producing stationary movement into or outfrom the fourth spatial dimension.

Fig. 66. **Gravity Definition Based on Our Flattened Undersides:** When soft bodies such as ours are located on the surfaces of large bodies of matter such as the Earth, the degree of flattening we experience corresponds to the magnitude of acceleration that Earth's matter produces at its surface. Water balloons work better than human flesh. Properly manufactured and calibrated accelerometers work even better. The omnidirectionality of the acceleration indicates that matter is the source of space. The process whereby this happens is gravity.

Lots of ink, synapses, bandwidth, and time could have been saved by doing this experiment a long time ago. Meanwhile, therefore, to provide yet more incentive to at last get the experiment done (not that any should be needed) it makes sense to explore the astrophysical consequences, in anticipation of a not-pass-the-center (truthful accelerometer) result.

The thoughts of the "thoughtful accelerometers" in Figure 65 imply the definition of gravity shown in Figure 66. Following from this logic is that the Universe has always been, and will always be, globally the same as it ever was. Which means the constant background temperature is something like an organismic *body temperature*. It maintains itself by a variety of local processes, principles, and phenomena, including, for example, the break-up of stellar matter into supernova remnants, and the reassembly of gas, dust, and larger pieces of cosmic debris back into new stars and planets.

Since the time-scale over which this happens (over and over again) is infinitely long, it is reasonable to expect that the ejecta of gas, dust and larger pieces of cosmic debris typically remain un-reassembled for many billions of years, which facilitates reaching thermodynamic equilibrium. This state of saturated equilibrium corresponds quantitatively to the temperature of the Cosmic Background Radiation, which is directly related to the constants of atomic physics.

15˙5. *McGaugh, Trefil & Tyson; Galactic Mystery*

It is embarrassing that 95% of the Universe is unaccounted for.

Martin Rees : *The Lord Rees of Ludlow, President of the Royal Astronomical Society* : 2004 [244]

According to Big Bangist cosmology, serious formation problems arise immediately in the "early Universe," and would never be "solved" without the Magical Fudge Factor: *Exotic Dark Matter*. Though compelling reasons for the non-existence of Exotic Dark Matter have already been presented in previous sections, at the risk of overkill, we will pile on a few more arguments, as espoused by a few more grumbling authorities. We start at the alleged post-inflationary epoch's planting of the magic seeds of galaxies — and work our way down to stars, planets and smaller bodies. The standard strategy is presented with critiques from within, from the fringe, and beyond the status quo. We pile on — to the point of exaggeration — how far-fetched, barren, and unlikely the standard strategy is, to open our minds as wide as possible to the Rotonian proposition that accelerometers tell the truth and Exotic Dark Matter is a hopeless nightmare.

The Big Bangists' initial act of magic is admittedly "crazy," and "embarrassing" when exposed as such. Yet they want you to believe that neither astronomical bodies nor ourselves would exist without their hand-waving presto-chango invocation of Exotic Dark Matter. A Nobel Prize-winning Big Bangist (P. J. E. Peebles) admits that Exotic Dark Matter is "ridiculous." Alas, they are desperate and have to make a living somehow. Tragically, having nothing of lasting value in stock, they try to sell what they've got: ridiculousness. Rotonians have proposed the patently more rational alternative springing forth from belief in accelerometer readings. The contrast between these options is yet further brought to light by considering the perspective of critics who are suspicious of some features of standard Big Bangism, but still think accelerometers are schizoid liars.

A high profile example of a theory and theorist/observer in this category is Modified Newtonian Dynamics (MOND) and one of its outspoken proponents, Stacy McGaugh: Chair of the Astronomy Department at Case Western University. Empirical tests of MOND are inconclusive, at best, because, by design they involve *tiny* deviations from Einstein's theory in some far away decimal (and physical) place. The model is not only *ad hoc*, but manifestly *feeble*. Nevertheless, McGaugh is sufficiently aware to have noticed:

> Something really weird was going on...
>
> That something weird was non-baryonic [i.e., *exotic*] cold dark matter (CDM). For structure to grow, it needed the helping hand of the gravity of some unseen substance. Normal matter did not suffice. The most elegant cosmology, the Einstein-deSitter universe, had a mass density $\Omega_m = 1$. But the measured abundances of the light elements were only consistent with the calculations of big bang nucleosynthesis if normal matter amounted to only 5% of $\Omega_m = 1$. This, plus the need to grow structure, led to the weird but seemingly unavoidable inference that the universe must be full of invisible [exotic] dark matter. This [exotic] dark matter needed to be some slow-moving, massive particle that does not interact with light nor reside within the menagerie of particles present in the Standard Model of Particle Physics. [245]

The "weird" idea that we know of only 5% of the contents of the Universe has been characterized by the United Kingdom's Astronomer Royal as *embarrassing*. Sadly, in the absence of robustly *Testable Alternatives*, the show goes on, the cringeworthy fiasco gets ever more entrenched.

In the latter part of the 20th century a few astronomers conceived that the Universe really ought to be made of "ordinary" matter (i.e., primarily *baryons*, such as protons and neutrons found in ordinary atoms). In the interest of Occam's simplicity principle and as anyone "in blissful ignorance of [*highest abstraction* Earthian] cosmological theory" would think, in 1988 Augustus Oemler, Jr. wrote:

> The mass density in dark [galaxy] halos is consistent with the mass density in baryons, there is no particular need to invoke other forms of matter.
>
> An outside observer, studying the observational data in blissful ignorance of cosmological theory, would, I think, be astonished by the suggestion that the universe is dominated by some exotic form of dark matter. [Various kinds of evidence]...all imply that the universe is dominated by baryons, of density sufficient to give $\Omega_\circ \approx 0.15$, and the baryons reside in galaxies and their halos.
>
> Occam's razor remains a useful guide. To abandon the straightforward interpretation of observations for a much more convoluted explanation requires a very compelling justification. [246]

That compelling justification has never materialized. In spite of objections like Oemler's, due to an assumed lack of alternative models, cosmologists stick with their Exotic Dark Matter fantasy.

With exceptional clarity, James Trefil has illustrated the essence of the problem as being traceable to the "early Universe." By the very title of Chapter Four of his book *The Dark Side of the Universe* — "Five Reasons Why Galaxies Can't Exist" — Trefil indicates the stakes of the game. By design, these five reasons all exclude the existence of exotic Dark Matter, and rely entirely on conventional physics and ordinary matter. Echoing our above discussion and setting up his readers to be receptive to the invocation of Exotic Dark Matter, Trefil explains:

> If galaxies have to wait until after radiation decouples before they can start forming, they'll never make it. Gravitational collapse from a uniform distribution of matter is too slow to counteract the Hubble expansion. It follows that the universe has to come out of the decoupling with the galaxies already well along on the way to completion . . . The universe must be seeded with some kind of mass concentrations that can trigger the process of gravitational collapse.
>
> Ordinary concentrations of matter could never do this. They would be blown apart by radiation pressure long before they could serve as a condensation nucleus for a galaxy. Whatever "seed" was made early on must be able to survive the buffeting of the radiation for long periods. The "seeds" must, therefore, be made of some type of matter that does not interact strongly with radiation.
>
> [These reasons] suggest strongly that the galaxy problem is in reality a small part of a much larger question — the question of the overall structure of the universe. [247]

In later chapters it becomes evident that Trefil is convinced that Exotic Dark Matter does exist. He repeatedly refers to its having been "discovered." Trefil's presentation of the *Five Reasons* has the character of detective work serving to rule out possibilities by the process of elimination so as to arrive at the one remaining suspect: Exotic Dark Matter.

Though Trefil's book is from 1988, the situation has scarcely changed since then. In a 2021 book, *Cosmic Queries*, in which Trefil teams up with pop-media astrophysicist Neil deGrasse Tyson, the only difference is the increased befuddlement at not having found or identified Exotic Dark Matter. In anticipation of Trefil's assessment that, of the 33% of the Universe's *total* energy content attributed to *matter*, according to which 85% of it is Exotic Dark Matter, let us recall the arithmetic from Eq 63, p. 145. The values are consistent with the *Planck* Mission table in Figure 39 and McGaugh's assesment that only 5% of cosmic matter is supposed to be baryonic. We get $\Omega_{\text{M}} = \Omega_{\text{B}} + \Omega_{\text{DM}} \rightarrow 0.33 = 0.05 + 0.28$ and:

$$\frac{\Omega_{\text{DM}}}{\Omega_{\text{M}}} \approx \frac{0.28}{0.33} \approx 0.85\,. \tag{66}$$

Trefil thus explains:

> Recall that matter couldn't clump into galaxies before neutrally charged atoms formed, because radiation in the plasma blows concentrations of charged matter apart as soon as they start to form. Dark matter, however, invisible and impervious to the destructive radiation, accumulated before the universe became transparent. Thus, when atoms formed, they found themselves in wombs of dark matter — within which gravitational attraction could begin and persist.
>
> Dark matter . . . [which perhaps] should instead be called "dark gravity" . . . is the source of 85% of all [attractive] gravity observed in the universe — thereby solving the clumping problem.

> Although we still haven't a clue what dark matter is . . . [we stick to our deduction] that it primed the early universe for matter to gather and become galaxies, ready to form stars, planets, and people — the universe we know today. [248]

In the name of science, literally *everything* hinges on the "crazy," "weird," "embarrassing," "nonsensical," magical unknown. Without the dreamy "wombs of [exotic] dark matter" created at the earliest times, "the universe we know today" supposedly could not exist.

By contrast, if only the *first* thing to know about gravity were actually known — as surmised by the average Rotonian, as based on their trust in accelerometer readings — we'd get a drastically different, more coherent, more sensible picture: The Universe has no need for fantasy primordial *wombs* of Exotic Dark Matter or imagined "early" *beginnings*. Bodies of matter have been incessantly producing positive accelerometer readings *forever!* Centrally concentrated galaxies, stars and planets are the natural offspring of a beginningless, endless process of outward movement.

15.6. *Rotonian SLENC Prediction Indicates Ease of Astrophysical Formation*

> *Where has the angular momentum gone?*
>
> MICHAEL D. SMITH : *The Origin of the Stars* : 2004 [249]

One of the most serious *galaxy* formation problems is the alleged time constraint of less than 14 billion years. Being mostly of more recent vintage, *stars and planets* in the present era nevertheless still pose formation problems that are puzzling in the context of conventional physics. Some of these puzzles will be addressed in the next sub-section. Presently, we outline the essence of the SGM logic as it applies to these problems. The argument is simple. From the Rotonian prediction for the result of Galileo's Small Low-Energy Non-Collider experiment, it becomes clear that the formation of seemingly "collapsed" astronomical bodies out of diffuse clouds is practically obvious and inevitable.

Standard astronomers often attempt to understand star formation using computer simulations. They keep looking for just the right combination of ingredients, magnitudes and timing of the many processes involved to find one from which stars will be robustly, reliably born. Though Rotonians have not produced simulations, their conceptual, visual argument clearly indicates qualitatively, yet cogently, that "collapse" from a diffuse cloud to a dense core of a body is much easier according to the SGM than any model that assumes gravity is a force of attraction.

Many factors contribute to the ultimate congealment and collapse of matter to create a star (and/or planet). Yet, as we recall from Tyson's opening quote (p. 143) many of these factors act not to promote, but to *hinder* collapse. Due to the complexity of the process itself and the fact that our attempts to understand it derive from what are effectively just *snapshots* — thousands or millions of snapshots of many different systems all around the Galaxy and beyond — *statistical analysis* and computer simulations are the primary tools for such understanding.

Though gravity is surely the most important physical influence leading to what looks like a collapse, the existence of many other factors makes it less than obvious in most cases, exactly how to disentangle one effect from the others. The huge difference between gravitational *attraction* and gravity according to the SGM comes into play in these considerations because they involve, in effect, the motion of a vast collection of *test objects*, as the space between them diminishes — especially at or close to their centers, due either to gravitational attraction (standard view) or because space is being pushed outwardly past them as they "fall" (SGM).

One of the reasons standard theorists have such a hard time producing a convincing model of galaxy, star and planet formation (especially without Exotic Dark Matter) is that, if gravity acts alone, the expected speed of the test objects toward the center is supposed to be a *maximum* there — resulting in the test object passing rapidly through, or colliding and bouncing away or breaking up — preventing the collapse from taking place. Standard theorists, of course, see no alternatives. To them gravity is obviously a force of attraction that would cause exactly such a disruptive pattern of motion.

It is essential to bear in mind the extremely low initial densities of stellar birth places (compared to Earth's atmosphere or even industrial-grade *vacuums*). These places are called *giant molecular clouds*. Collisions, especially collisions that end with the colliding objects sticking to each other, are very rare. So the radial motions or elongated orbits of one component body within such systems are ideally supposed to be symmetrical with respect to starting and ending distances, for one cycle. If gravity is a force of attraction, then special (non-gravitational) circumstances are clearly needed to reduce orbital energy and angular momentum, to facilitate the accumulation of matter at the center.

From the simple prediction that the test object in a Small Low-Energy Non-Collider experiment will not (according to the SGM) pass the center, it becomes obvious that gravity is not disruptive at all. No special circumstances are needed for a loose swarm of bodies to eventually congeal with one another. If it weren't for the ubiquity of the other disruptive processes, even more collapsed objects (galaxies, stars, and planets) would be created because ***gravity is not matter falling in on itself; it is matter moving outward around itself.*** The speed at the center is not a disruptive collision-producing maximum. It is a gently accumulative minimum.

According to the SGM, the Universe has settled into a dynamic harmony in which it perpetually regenerates itself — replete with localized violent events (e.g., supernovas) that disperse a wide range of smaller objects, only to settle back into slowly changing cloud formations that may eventually "collapse" to form stars, and repeat.

15˙7. *Tyson Echoed; Stellar & Planetary Mysteries*

> *[Stars] form when cold interstellar dust clouds contract and condense into dense, massive objects . . . [Upon examining] this hypothesis . . . we immediately encounter three difficulties: (i) The contracting gas clouds must radiate energy in order to continue their contraction;* ***the potential energy that is liberated in this pre-stellar phase must be observable somehow, but we have yet to detect and identify it.*** *(ii) The angular momentum that resides in typical interstellar clouds is many orders of magnitude higher than the angular momentum we compute for the relatively slowly spinning young stars;* ***where and how has the protostar shed that angular momentum during contraction?*** *(iii) Interstellar clouds are permeated by magnetic fields that we believe to be effectively frozen to the contracting gas; as the gas cloud collapses to form a star, the magnetic field lines should be compressed ever closer together, giving rise to enormous magnetic fields, long before the collapse is completed. These fields would resist further collapse, preventing the formation of the expected star; yet we observe no evidence of strong fields, and the* ***stars do form, apparently unaware of our theoretical difficulties.***
>
> Martin Harwit : 1986 [Emphasis added.] [250]

The exact role of magnetic fields in the act of star formation is one of the subject's persistently puzzling unknowns. Nevertheless, in Harwit's quote above we see at once that his "difficulty (i)" is completely resolved in the SGM. Nobody has detected any "liberated potential energy" because

none exists. Rotonians regard so-called *gravitational potential energy* as a myth, a purely mathematical phantom. Rotonians expect the outer components of cloud-like swarms on non-circular orbits to centrally "settle" as the inner components gently overtake them. Outside dense bodies of matter, negative potential energy may be a useful concept, as applied to elliptical orbits and swinging pendulums. But its ultimate falsity — according to the SGM — should be revealed in exactly this case: gravity-induced radial motion through the center. There is no "potential energy" to get converted to kinetic energy inside matter. Observations reveal only that falling gas and debris are gradually swallowed by the more centrally located bodies. There is no energetic outflow to balance the allegedly lost potential energy. Stars are born without any manifestation of this contrived, imaginary balancing act. Rotonians thus chalk up one observational success right off the bat. Harwit's (i) is in the bag. It's a non-problem for the SGM.

Number (ii) is at least partly solved by the same arguments by which Number (i) is solved. The angular component of an elongated, approximately elliptical path is subject to a similar "decay" mechanism as that which applies to a perfectly radial path. According to the SGM, since the radial component of an object moving in the extremely tenuous environment of a molecular cloud goes to zero speed at the center of mass, this loss affects the total and so inevitably transfers to a loss in *angular* momentum as well. The object will therefore not get back up to the same height from which it started. Both energy and angular momentum will appear to get lost. The idea is schematically depicted in Figure 67. The creation of a star begins with a molecular cloud that has a lot of angular momentum. It ends with a star whose angular momentum is much smaller — several ***orders of magnitude*** smaller — because gravity is not a force of attraction, because accelerometers tell the truth.

Harwit's number (iii) is somewhat thornier, and persists as a problems to this day, even as astronomers attempt to solve it with more sophisticated, more complicated ideas and methods. The problems (ii) and (iii) are also deeply *intertwined*. Magnetic fields, for example, are supposed to have a "braking" effect on the angular momentum. The difficulty is largely due to the need for these and other effects to transition across many orders of magnitude of density, speed, temperature, size, field strength, etc. without contradicting observational constraints. Witness again the recurring resignation to *the fact of the brute existence of stars* in seeming defiance of humans' persistent failure to understand how they got there under the assumption that gravity is a force of attraction ("theoretical difficulties").

This is not the place to thoroughly review the present state of the art, nor to offer rigorous alternative predictions. But it is worthwhile to at least introduce the names and brief descriptions of some of the devices that fill the star formation astronomer's toolkit, and to roughly sketch the SGM alternative, whose roughness does not hinder perceiving its emergence as an at least potentially superior physical basis.

No doubt some, or most of the tools and devices referred to above do play a role in the admittedly complicated process of star formation. The key difference introduced by the SGM is that — considered all by itself — the effect of gravity is no longer to produce test object speeds that reach a maximum at the center. Instead, as per the SLENC graph in Figure 7, p. 17, gravity effects an asymptotic approach to zero speed. Gravity is the facilitator of gentle formation, not the disruptor that needs to be somehow "braked" and neutralized.

For decades the process of *ambipolar diffusion* has been studied and appealed to as a drifting magnetic field-evolving mechanism, whose delicate presence in molecular clouds affects the process of star formation. The effect depends on, among other things, the proportions of charged vs. uncharged particles. While the charged particles align with the magnetic field lines, the neutral particles travel along paths under the influence of gravity, turbulence, angular momentum and other factors. Collisions with the ionized particles then slowly transform the field, and over time,

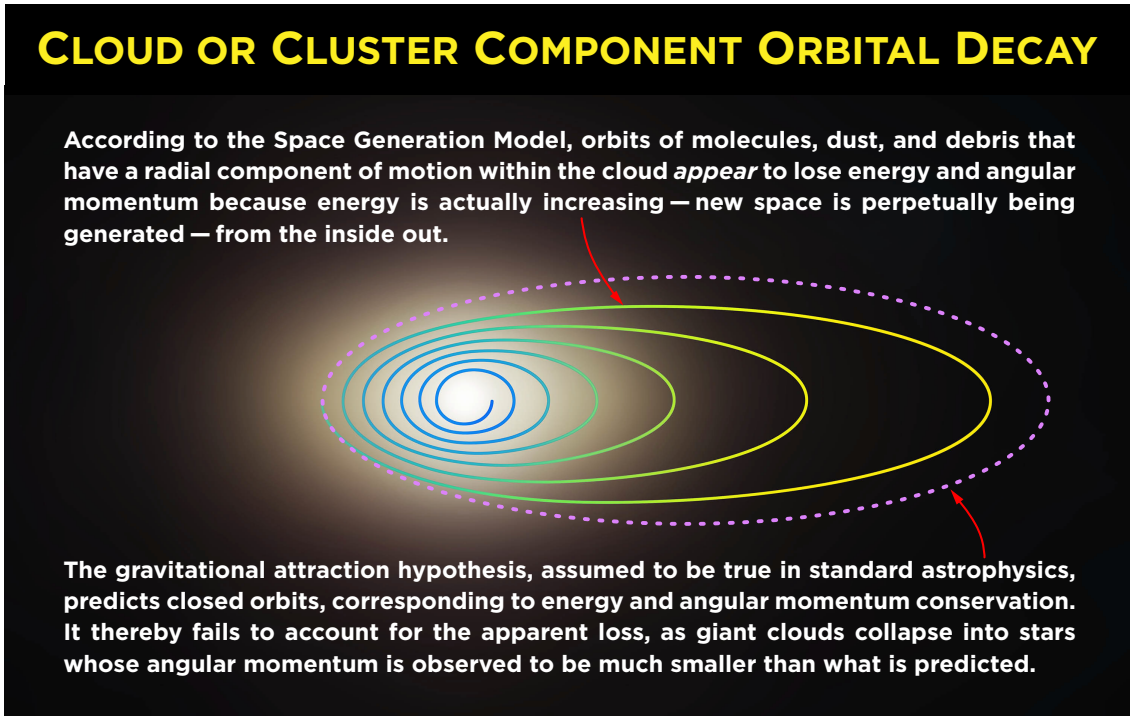


Fig. 67. **Giant Molecular Cloud Orbit Schematic:** If accelerometers tell the truth, then the extent to which the path of a molecule, speck of dust, or other object in a large diffuse cloud has a *radial component*, the orbit will appear to "decay." It will not turn back on itself or otherwise maintain constant total energy. According to standard physics, decaying orbits need to be accompanied by emission of radiation or some other energy transfer, to "conserve" the total. Whereas in the SGM, gravity-induced *radial* motion of a test body *within* a massive body will always *appear* to lose energy without a visible transfer. What is actually happening, as accelerometers incessantly tell us, is that energy keeps *increasing*, from the inside out.

accumulations near the center would thereby occur. [251]

This and other effects or devices that go into star formation simulations include:

1. Gravitational attraction
2. Ambipolar diffusion / Magnetic braking
3. Ohmic dissipation
4. Turbulent recombination.
5. Radiative feedback.
6. Dynamical feedback
7. Hall effect
8. Sink particles

One class of simulations is based on what has come to be known as *Ideal* Magneto-Hydrodynamics (MHD), which is to be distinguished from *Non-Ideal* MHD. The main difference is the latter's inclusion of (especially) ambipolar diffusion and ohmic dissipation. Though results based on the latter

approach appear to be more successful at building stars, questions remain, not just as to *fine-tuning*, but as to *ballpark estimations* of the input parameters.

One of the central issues is the need to find a happy combination that results not only in a central object with reasonable angular momentum and magnetic field strengths, but also the need to allow the formation of spinning ("Keplerian") disks of gas, dust and debris from which planets are to form. Figure 68 is an illustration of a recent simulation which compares the ideal and the non-ideal cases. [251] In a brief review paper that takes account of this result, UC San Diego astrophysicist Kielan Wilcomb writes:

> It is still not completely understood how stars and their circumstellar disks are formed out of lightly ionized molecular clouds. Many issues arise including the conservation of angular momentum, the need for redistribution of the magnetic flux so it doesn't pile-up in the center of the collapsing system, and the need for rotationally stable circumstellar disks. [252]

Even the authors of the original work conclude with the caveat:

> Last but not least, large uncertainties remain in the models used to estimate the resistive coefficients because of poor constraints on the dust size properties (charge, size distribution) and on the chemistry at play in the high density and temperature regions of protostellar collapse. As a result, it is currently not clear which non-ideal effects dominate in the different parts of the collapsing cloud, particularly for the Hall and ambipolar resistivity that strongly depend on the local physical and chemical conditions. [253]

Another common tool routinely implemented to maximize the appearance of stars at the late-time stages of the simulations is the so-called *Sink Particle*. In some ways a sink particle is analogous to Exotic Dark Matter. It's not a mysterious new substance. A sink particle is supposed to represent real (or at least *virtually* real) matter: When certain conditions are satisfied in certain phases of star formation simulations, a region of model space is simplified by excluding detailed properties and

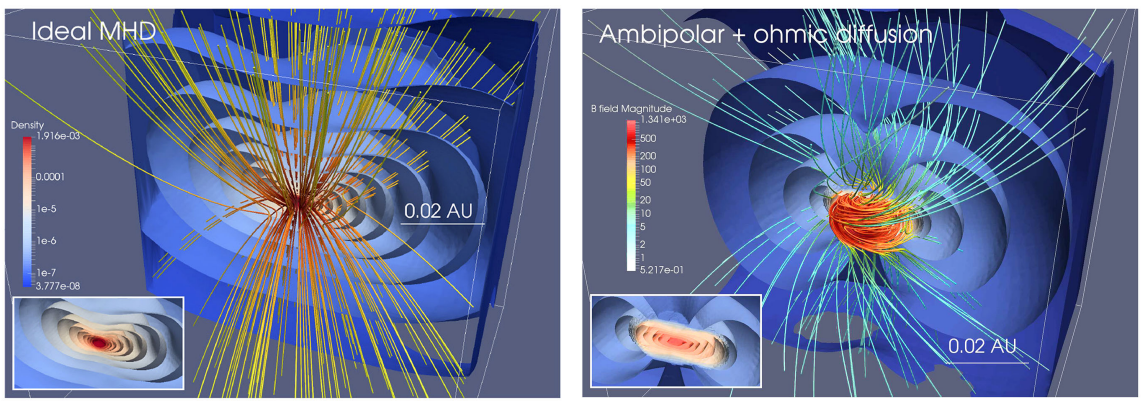


Fig. 68. **State of the Art Star Formation Simulations: *Ideal* Magnetohydrodynamics (MHD) vs *Non-Ideal* Magnetohydrodynamics:** The latter method (RIGHT) is more conducive to production of planetary disks with a closer approximation to the observed magnetic field strengths.

behaviors, retaining only those mechanical ones of attraction and angular momentum. As explained by one of the inventors of the idea (and his co-authors) Matthew R. Bate:

> Once fragmentation has produced a protosar, we replace the constituent particles with a single sink particle. These sink particles, used in the simulation to follow the newly formed stars, interact only through gravitational force and by accretion of gas particles that fall into their sink radii. [254]

As implied by their name, sink particles have things fall into them, but nothing comes out. They are there only to accumulate (accrete) matter, to get heavier and to spin.

In a recent simulation that seemed to produce promising results, the authors concluded by identifying a variety of "limitations" of their strategy, including the input parameters for sink particles:

> We used an aggressive merging scheme for the sink particles, meaning that every sink particle that enters the accretion radius of another, more massive one is immediately merged. We purposely chose to merge all the overlapping sinks in order to favor mass accretion and the formation of massive stellar sources. [255]

It is noteworthy that the "accretion radii" used in these simulations was 20 AU ($\approx 3 \times 10^{12}$ meters), which is half the distance from the Sun to Pluto. And the density was about 10^{-11} kg m^{-3}. This density is not much greater than that of the clouds from which they condensed. As seen on the Cosmic Everything Chart (Figure 12, p. 32) and as implied by the modeler's caveats, many details are still missing along the path from giant molecular clouds to shining stars.

To help clarify how to assess the state of affairs reported above, let us borrow a conclusion from Wilcomb, which serves also as a segue to the problem of *planet formation*.

> Planet formation occurs in the early stages of star formation, after the disk has formed around the protostar. In those early stages the disk is still interacting with the core and is delivering mass and angular momentum to the forming disk. The disk needs to be able to fragment in order to form planets. But . . . magnetic fields suppress disk fragmentation . . . This consequence isn't solved by moving from ideal MHD to non-ideal MHD effects. So the problem is far from being solved. [252]

Insofar as planet formation is inextricably linked with star formation, it will suffice to add a few points relating more specifically to planets than to stars. Considering the size chart in Figure 64, we note first that the objects at the far right, the Brown Dwarfs, have masses in the range $0.080M_\odot \gtrsim \mathrm{M_{BD}} \gtrsim 0.013M_\odot$, where $M_\odot$ is the mass of the Sun. Another key characteristic that separates Brown Dwarfs from large planets is that planets do not undergo nuclear transformations that generate any significant heat, whereas Brown Dwarfs do feature some deuterium fusion. This is much less energetic than helium fusion — which is what makes normal stars so hot — but suffices, especially in their youth, to give Brown Dwarfs their "brownish" glow.

It has been deduced that almost all planets originated in collapsing circumstellar disks. Some of the many *rogue*, or *Free-Floating* planets that have been found recently have likely been effectively kicked away from their parent star — either by the dynamics of neighboring planets within their own system, or by perturbations from other large passing bodies.

However true this may be some or even most of the time, according to the SGM, we can reasonably expect that a significant fraction of Free-Floating planets would also have formed from "Free-Floating *Clouds*" of gas and cosmic debris. Whichever way planets form, it is important to understand that, as with star formation, many uncertainties yet plague the subject. For example, calculations have indicated that smallish stony objects (pebbles, chondrites, chondrules) and dust

may loosely congeal, to constitute somewhat larger bodies. But at around the 1-meter size range such bodies are easily broken apart by further collisions. Crossing the so-called *meter-size barrier* to the next larger size level on the way to planet-hood, thus remains puzzling. In a recent *Astrophysical Journal* paper, Amaya Moro-Martin and Colin Norman explain:

> The intermediate stage by which cm-sized pebbles grow into km-sized planetesimals poses several challenges, known as the meter-size barrier. As the cm-sized particles grow and become less coupled to the [surrounding] gas, their relative velocities and collisional energies increase, resulting in collisions that, rather than leading to efficient growth, lead to inefficient sticking, bouncing or fragmentation. [256]

Since the radial speeds of bodies falling close to the center of their system are predicted by the SGM to be much slower than the corresponding Newtonian speeds, we expect there to be no meter-size barrier. Well prior to the event of a central object becoming dense and massive enough to form a distinct outer surface, smaller bodies, pebbles, rocks, etc. (as seen in Figure 69) will slowly accumulate with small apparent speeds. The gathering bodies are as likely or more likely to *build*

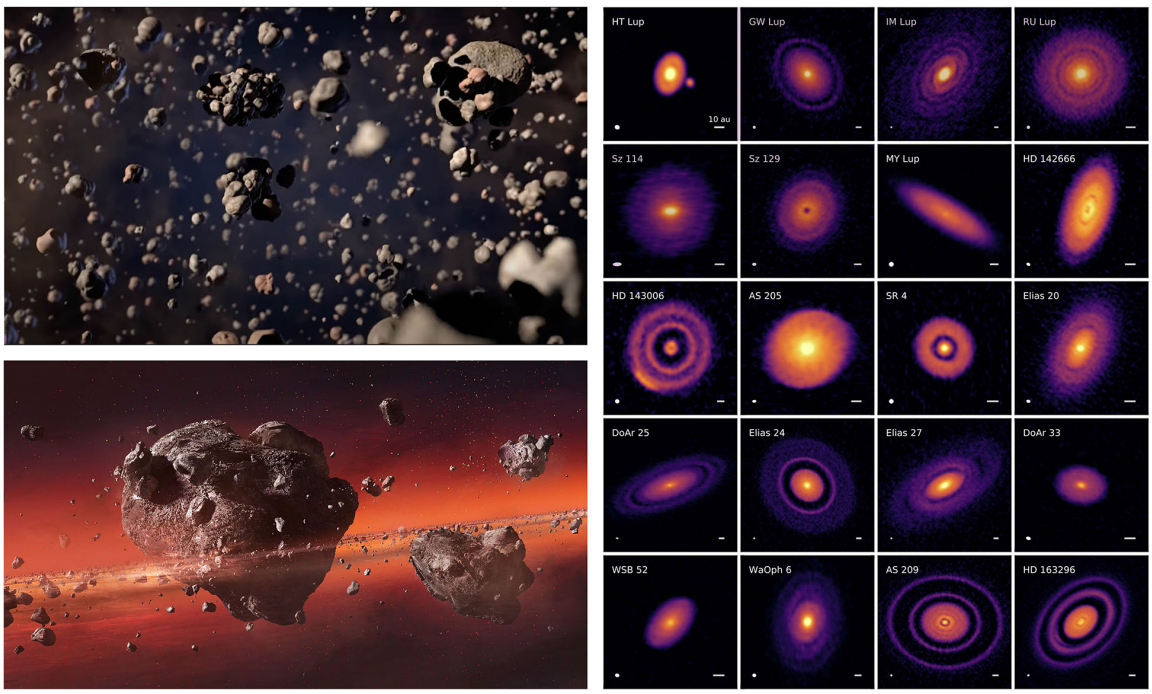


Fig. 69. **Gas, Dust, Pebbles and Rocky Debris Immersed in a Bath of Galactic and Cosmic Radiation :** LEFT — Imagined close-ups of interstellar debris, especially as it accumulates into proto-stellar and proto-planetary disks. Some of the gas, dust and debris inevitably escapes the neighborhood of stars and even galaxies. In that case it is not "cleaned up" by the less-than 100% efficient processes of star and planet formation. As this small fraction escapes to intergalactic space — over extremely long settling times — the random assortment of smallish material bodies cools off and approaches equilibrium with the background, at about 2.7 K. RIGHT — Whereas those molecules and larger bodies that are swept up by sufficiently massive and concentrated cores congeal with so much other matter that thermonuclear conditions are reached. Stars are born with their retinue of rings that turn into planets, moons and miscellaneous orbiting flotsam. [257-259]

up as to *break* up. Collisions near the center would definitely tend to be more gentle, according to the SGM. Slow congealment continues until the neighborhood is mostly cleaned up and a planet is formed.

An interesting recent discovery — one that is anomalous from the standard point of view — is also consistent with Rotonian gravity. An exoplanet that was discovered in 2017 appeared to be too "fluffy" to be consistent with standard planet formation scenarios. Follow-up observations "showed that the planet [WASP-107b] was even lighter than expected — about 10 times lighter than Jupiter but similar in size." The story: 'Fluffy Exoplanet Challenges Traditional Notions of Planet Formation,' was featured in a Feburary 16 2021 posting by the McGill University news publication, where it is written:

> WASP-107b's low density suggested that while the gas envelope comprises over 85% of its mass, its core is no more than four times the mass of Earth. This estimate is significantly lower than the previously believed threshhold of about 10 Earth masses considered necessary to form a gas giant.

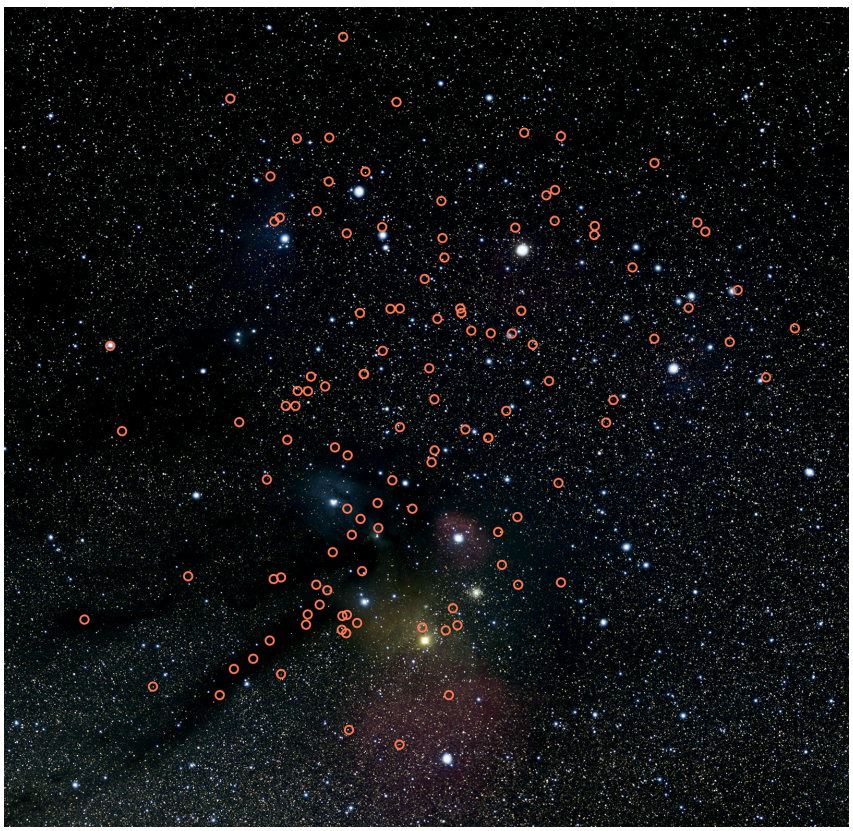


Fig. 70. **113 Free-Floating Planets in the Upper Scorpius and Ophiuchus Constellations:** An impressive research project in observational astronomy has determined the circled objects to be Free-Floating Planets, mostly by use of *proper motion* data. Archival data from several earlier surveys (going back to 2002) allowed comparing the positions of the objects on the plane of the sky. This allowed identification in or exclusion from the category of Free-Floating Planets. One of the advantages of this method is that it is conducive to follow-up observations of the same objects, to track their trajectories across the sky in the years to come.

> The biggest implication [is] that it doesn't take as much solid [material] as we thought to make a gas giant... The riddle that it poses was how could such a big planet form from such an apparently low-mass core? [260]

As the reader may now anticipate, the SGM is clearly more conducive to "fluffy" planets. By the standard conception, the assortment of radially falling debris would be as many high-speed hammer blows, contributing to the high compression of a central core. Whereas the speed of the blows, according to the SGM, would be substantially slower near the center of the accreting, still debris-enshrouded neo-planet. The SGM is more conducive to more planets, more exoplanets, more Free-Floating planets, and fluffier planets than standard theory expects.

Though perhaps still somewhat unusual, fluffy planets are not anomalous in the SGM. They are consistent with the picture of relatively slow and gentle congealment. With this in mind, extending the small end of Figure 64 then motivates conceiving that the collapsing clouds that were just sufficiently massive to produce Brown Dwarfs, are members of a broader *family*. The family would arguably have many siblings, many sons and daughters (i.e., smaller) neighboring and scattered clouds that would congeal into not only sub-thermonuclear "dwarf" stars, but into planets having a wide range of sizes, densities and chemical compositions.

Imagined debris fields that are the raw ingredients of planets and stars, as well as actual observational images of protostellar disks are shown in Figure 69. Figure 70 is an image provided by the

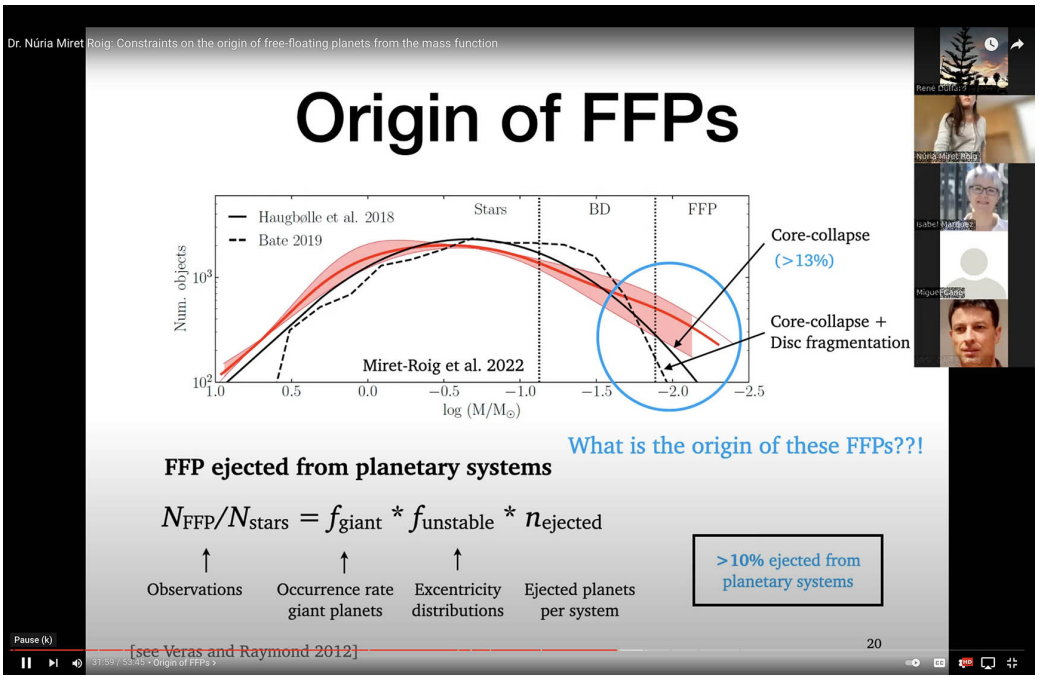


Fig. 71. **Unclear Origin of Free-Floating Planets:** This screen shot of a recent lecture by Nuria Miret-Roig is rich with implications. The red curve and enveloping pink area represent observations. The black curves represent model predictions. As indicated by the circled portion of the graph, two well-established models predict substantially lower abundances. The question thus remains: "What is the origin of these FFPs??!" If gravity is not a disrupting force of attraction, but is instead a more gently congealing process of outward movement, we would naturally expect a large population of Free-Floating Planets, as explained in the text.

European Space Agency in support of the original work by Miret-Roig *et al* concerning the recent discovery of 70–170 Free-Floating planets — whose abundance "excited" the discoverers. [261,262]

Among the reasons for excitement is that simulations based on prevailing theories of planet formation failed to predict such an abundant population. The origin of so many FFPs is unknown "(??!)." Figure 71 is from a lecture presentation of the research. Miret-Roig's slide clearly indicates that the model predictions come up way short of the observational data. In response to this situation Miret-Roig remarks: "It is evident that we observed many more Free-Floating Planets than what is predicted by these simulations." [263]

As stated at the outset, the main point of this section has not been to provide mathematically rigorous predictions by which to compare the SGM to the standard gravitational attraction-based predictions. Nevertheless, because of the stark difference in predictions for Galileo's Small Low-Energy Non-Collider experiment, by applying the predicted non-oscillation result to astrophysical circumstances, we cogently intuit that ***the SGM suffers no serious formation problems.***

Everything falls into place because falling does not mean being attracted at high speed into the center. It means "free-floating" as the nearest large mass concentrations generate space and move outwardly to engulf smaller bodies that surround it. Near the center, space generation happens more slowly because as $r = 0$ is approached there is less mass to do the generating. According to the inverse-square law, the acceleration of gravity goes to zero at the center because within zero radius there is zero mass. Similar reasoning applies to the maximum radial *speed* produced by a concentrated assembly of smaller bodies. Just as the acceleration is zero at the center, so is the speed. **Gravity *never pulls*** bodies toward one another. Regarding accelerometers as reliable indicators of physical truth means that gravity is an entirely upward and outward process.

16. Epilogue of Summaries

> *Fundamental challenges to disciplines tend to come from outside. It is customary for students to be introduced to their fields of study gradually, as slowly unfolding mysteries, so that by the time they can see their subject as a whole they have been so thoroughly imbued with conventional preconceptions and patterns of thought that they are extremely unlikely to be able to question its basic premises.*
>
> Martin Bernal : 1987 [264]

We are well on the way to painting a whole new picture of the world, a picture whose veracity depends on the result of a simple gravity experiment proposed by Galileo in 1632. Readers who have gotten this far will likely benefit from a look back at the territory we've covered, to assess the picture by considering its features in condensed form. Immediately following, therefore, will be a section-by-section recap of the most important points.

Section 1: The journey begins by asserting the fundamental importance of accelerometer readings, as inherited from the imaginary alien civilization of Rotonians. Regarding an accelerometer's reading as a truthful indicator of the device's state of motion deeply conflicts with much that is taken for granted by Earthian physicists. This is especially true for the Earthian preconception that matter is "made of" static chunks of stuff. Perhaps the most poignant illustration is that of the Big

Bangist prediction of static sized galaxies receding from one another as the discontinuous space that surrounds them expands: Static point-like galaxies immersed in magically expanding space, because accelerometers are regarded as schizoid liars.

Unimpressed by Earthian traditions, Rotonians add one empirical fact after another to bolster their perspective, knowing that their emerging scheme could be unequivocally *tested* by performing Galileo's Small Low-Energy Non-Collider experiment. Rotonians are thus in search of an ally, just one Earthian PhD with standing to bring attention to the need to conduct the experiment. Knowing also that physics PhDs will most likely have too much invested in the status quo to *change their mind* to contemplate the Rotonian perspective, Rotonians foresee a more likely scenario: Connecting with a well-resourced *non*-physicist (or plurality thereof?) who is (are) nevertheless savvy about the sorry state of contemporary physics and cosmology, and who perceive(s) the benefit to science and humanity as motivation to do Galileo's experiment without delay.

SECTION 2: The utility of accelerometers is demonstrated both on and around the world of Roton and on and around an astrophysical body like Earth. The upshot is that falling motion *always* correlates with *zero* accelerometer readings. Whereas being in direct contact with a material body will correlate with *non*-zero readings if the body is 1) rotating, 2) being propelled, as by muscles or rockets, or 3) the accelerometer is situated asymmetrically on a large and dense enough body so that its gravity becomes easily discernible. The latter effect is *always* present for *all* material bodies, but is often too small to notice for small m/r ratios.

Application of these facts to the case of gravity-induced radial motion through the centers of massive bodies leads to the prediction that such falling bodies will not pass the center. Accelerometers tell us that nothing ever pulls falling bodies downward. Material bodies are, rather, incessantly accelerating upward. A test mass dropped into a hole through the center of a larger body at first looks like it accelerates downward, but it eventually appears to slow down and ultimately appears to approach the center only asymptotically. Graphs of the gathered data, lack thereof (for radius vs. velocity) and corresponding predictions (for radius vs time) are shown in Figure 5.

SECTION 3: Prevailing theories of physics and cosmology suffer, and are sometimes acknowledged as suffering, because of Earthians' inadequate understanding of gravity. As perceived by a few practitioners — here represented by Phipps, Smolin, Lopez-Corredoira and Disney — prominent shortcomings are reason enough to be unimpressed and to express these grumbles publicly. Though in some ways insightfully on target, these complaints (like many others found in the literature) all fail miserably in the most important regard: The lack of a robustly *Testable Alternative*. Rotonians attribute this lack to the common failure to see the problems as being traceable back to 1) disbelief in accelerometers, 2) the assumption that gravity is a force of attraction, and 3) the belief — at least in the context of gravitational physics — that matter is made of static chunks of stuff.

Smolin suspects that the biggest problems in physics involve the significance of *time* — especially its one-way *direction*. He also suspects the problem's answer may be "hiding in plain view." Rotonians concur with and would amplify this suspicion by pointing to the flattening of Smolin's undersides (non-zero accelerometer reading, as shown in Figure 6). Incessantly impinging on his own physical body, in plain sight, the clue forcefully beckons, as Smolin sadly meanders away, nose up, into the abstract fluffiness of emergent loop quantum information holograms and Autodidactic Universes, as though the real physical world doesn't even exist.

Section 4: In 1898 Arthur Schuster wrote a letter to *Nature* in which he asked:

> What is gravity?... What is inertia?... Is our much-exalted axiom of the constancy of mass an illusion based on the limited experience of our immediate surroundings?... How are we to prove that what we call matter is not an endless stream, constantly renewing itself and pushing forward the boundaries of our universe? [27]

Along with Karl Pearson, who at least partly inspired Schuster's remark, we have, to my knowledge, the historically first hint of SGM-like conceptions of matter and gravity. The conventional assumption that Newton's constant G is effectively negative because it represents an *attractive* force, means that gravity's effect can be thought of as the *removal* of space ("gravity sucks"). This is especially clear in Big Bang cosmology, where gravity supposedly "tries" to eliminate the space created by the initial blast. This is the standard view of the world.

Rhetorically implying the opposite, Schuster asks "how are we to prove..." that gravity and matter are *not* well-characterized as processes of outward motion?: The self-regeneration of matter and the creation of space. With the laboratory and space technologies developed in the intervening 125 years, the answer is, of course: Build and operate humanity's first Small Low-Energy Non-Collider. If the test object does not pass the center, then we will have in fact proved that "what we call matter ***IS*** an endless stream, constantly renewing itself and pushing forward the boundaries of our Universe," as accelerometers have been telling us all along.

Section 5: This Section covers a lot of ground. It is important ground, worth restating, so its summary will be longer than others. If Galileo's Small Low-Energy Non-Collider experiment yields the result that Rotonians predict, the sacred principle of the *Conservation of Energy* will be unequivocally violated. Quantum theory famously allows intermittent violations of the principle, as per Heisenberg's time-energy uncertainty relation: $h \leq \Delta E \cdot \Delta t$. Erwin Schrödinger pointed out that this puts us in the position where, after measuring the energy, "It is difficult to see how... we should still manage to ascertain that the value we have found does not change with time." Schrodinger concludes: "The detailed validity of the conservation law... is the point under discussion that I do not take for granted."

Though the energy principle has no known empirical violations, Rotonians are eager to suggest that this is only because experiments have not yet probed gravity-induced radial motion through the centers of massive bodies. This is exactly the blind spot which, by at last uncovering it, would reveal gross violations of energy conservation, because *to sustain positive accelerometer readings, matter must be an inexhaustible source of perpetual propulsion.*

Other theoretical reasons for suspecting energy non-conservation include the infinite self-energy of electrons and the infinite energy of the quantum vacuum — both of which are presumably (but not convincingly) rendered finite by renormalization or other abstract "cut-off" procedures.

Nobel Laureate Frank Wilczek provides a potent clue to a scheme that regards gravity as the product of an ultimately unrenormalized, not-entirely-cut-off reservoir of endless energy:

> Gravity might be derived from the other fundamental forces. Because it is a small (feeble) effect, maybe gravity is a by-product, a small residual after the near-cancellation of effects of opposite electric or color charges. [43]

Accepting this, or something like it to be the case, we not only seek, but *find* ways to express it mathematically. The key ingredients of General Relativity's most famous solution — the Schwarzschild

exterior solution — are the coefficients corresponding to the magnitude of spacetime curvature for a given m/r ratio (or M/r ratio, as is sometimes written). A well known equation from *Special* Relativity (SR) serves the Rotonians as a kind of logical bridge to facilitate deriving curvature coefficients that agree with observations for weak exterior fields, but predict deviations from GR for strong exterior fields and even weak *interior* fields.

Constant proper acceleration, a, according to SR, yields an asymptotic approach to the light speed limit, c:

$$v = \frac{at}{\sqrt{1 + a^2t^2/c^2}}\,. \tag{67}$$

Similarly constrained by the light speed limit is the Rotonians' proposal of an analogous expression for increasing stationary upward speed V_S, due not to increasing time, but to increasing M/r ratio:

$$V_S = \frac{\sqrt{2GM/r}}{\sqrt{1 + 2GM/rc^2}} = \sqrt{\frac{2GM}{r + 2GM/c^2}}\,. \tag{68}$$

Three important consequences of this proposal are: First of all, extraction of the coefficient $(1 + 2GM/rc^2)$ and its inverse, as replacements for the usual coefficient $(1 - 2GM/rc^2)^{-1}$, and its inverse, which represent the magnitude of spatial and temporal curvature in the Schwarzschild solution. Second, having its origin in a *speed* equation, we see that the model entails a *physical cause* for the described effects: Spacetime curvature is caused by *stationary motion*. The resulting prediction for bodies like the Sun or Earth agrees extremely well with GR and all observations for such "weak fields." But the SGM description deviates from GR in strong field cases by remaining well-behaved and finite. The speed V_S obeys the light speed limit, so there are no singularities. The coefficients never become negative or entail dividing by zero.

Third, exact agreement with GR is obtained for the prediction of a *maximum force* in Nature: $f_{MAX} = c^4/4G$. (See Figure 72.) As discussed in detail in the paper 'Maximum Force…' [48] the SGM derivation of a maximum force is much simpler than the derivation based on GR (as derived, for example, by Christoph Schiller [265]). Is the simple one or the complicated one more compelling? Since GR is the accepted *standard* for comparison, surely the agreement between models for this maximum force prediction is the important thing, and stands as an *invitation* to empirically test their respective predictions that *do not* agree. One of the most dramatic differences in predictions is for Galileo's Small Low-Energy Non-Collider experiment, which tests the corresponding *interior* solutions. The big question is: **To Oscillate or Not to Oscillate?**

Significant is that we have, among others, two robust conceptual/mathematical connections between GR and the SGM: gravitational *curvature coefficients* based on SR's equation for speed due to constant acceleration; and a prediction for *maximum force* which follows very simply from the same curvature coefficient analysis. These connections motivate, in turn, exploring other consequences, not only with regard to interior solutions, but to the emerging model's implications with regard to cosmology and the *dimensions of space*.

The preliminary facts and ideas leading to the possibility that our world is at least $(4 + 1)$–dimensional begin as follows: Concerning the interior solution, both the stationary upward acceler-

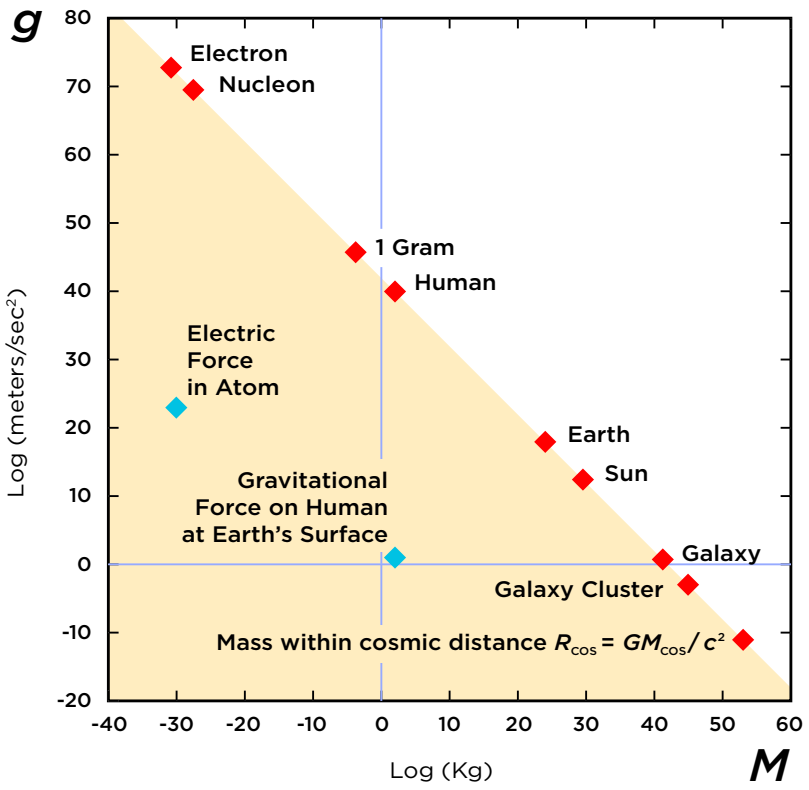


Fig. 72. Maximum Acceleration and Implied Maximum Force: The maximum acceleration, $g_{MAX} = c^4/4GM$, is given as the limit when $r \to 0$. Red Diamonds: The maximum force, $f_{MAX} = c^4/4G$, is gotten by multiplying this acceleration by the corresponding mass. Since massive bodies always have finite radii, these maxima are never attained in Nature. Blue Diamonds: Two examples of force whose magnitudes are more typical.

ation and the stationary upward speed are produced (for the simple case of a spherically concentric distribution of matter) by the mass *within* a given radial distance. The effect of the mass *beyond* this distance is canceled by symmetry for both acceleration and speed. Both Newton's and Einstein's theories agree that *acceleration* due to mass beyond a given radius is cancelled, as just described, and goes to zero at the center.

As for *velocity*, standard physics invokes the abstract, empirically unmeasured, concept of gravitational *potential* to claim that the presumed static central mass can cause enormous downward speeds for bodies that fall through the center. To Rotonians this makes no sense. Nothing ever pulls bodies downward, as indicated by co-moving accelerometers. More logical is to conceive that gravity-induced central speeds also go to zero at the center. Ultimately, the speed should be attributed not to the falling body, but to the matter that *produces* the speed (via gravity). There is no *downward attraction* of gravity. Gravity never causes falling accelerometers to give non-zero values. Since there is no downward acceleration, the apparent downward speeds we see with our eyes are not actually downward speeds, they are some fraction of the the maximum *upward* speed that could be caused by the body they seem to be falling toward. Beyond the body's surface this maximum upward speed is the same as the escape speed. It's the speed $\sqrt{2GM/r}$ that causes clocks to tick slow. Inside matter, below the surface, the clock-slowing speed is no longer escape speed, but has a

smaller magnitude (corresponding to only the matter within the given radial distance) which goes to zero at the center.

Figures 9 and 11 show the motion-sensing instruments (accelerometers and clocks) arrayed on a tower extending far above a gravitating body's surface and extending into a tunnel to the center. The essential difference between the prediction indicated by the top of Figure 11 and the corresponding Einsteinian predictions is the clock rate between the center and the surface, $0 \leq r \leq R$. Specifically, Einstein says the rate of the clock at $r = 0$ should be a *minimum*. Since the center is, for this system, the closest thing to a state of zero motion (zero acceleration and zero velocity) Rotonians predict the rate of the central clock to be a *maximum*. This difference corresponds to the different predictions for Galileo's Small Low-Energy Non-Collider experiment.

With the SGM (Rotonian) conception of gravity thus conceived, we come to the need for one more spatial dimension from two directions, for two seemingly different reasons: (1) Conceiving that bodies of matter are not actually static, but rather accelerometers really tell the truth, that "the floor really does come up," is not logically consistent under the assumption that the physical world has only three spatial dimensions; i.e., that spacetime is only $(3 + 1)$–dimensional. The motion indicated by motion-sensing devices would quickly cause the whole system to disintegrate if there were only three spatial dimensions.

And (2) Evidence that the geometry of our seemingly $(3 + 1)$–dimensional world is not Euclidean, but curved by gravity, suggests the need for one more dimension *to curve into*. To see this more clearly and to facilitate visualizing a world with one more spatial dimension, we appeal — as many others have appealed — to *analogies* involving challenges in perceiving higher dimensions, as faced by imaginary civilizations of lower-dimensional beings.

A seemingly "lower" dimensional entity can exhibit curvature — e.g., when a one-dimensional line turns back on itself into a two-dimensional circle, or when a two-dimensional surface turns back on itself into a three-dimensional sphere or cylinder. In the spherical case the existence of a new spatial dimension is manifest not just by the new appearance of *volume*, but is compounded by the appearance of violations of planar Euclidean geometry (on a sphere's surface triangular angles no longer equal $180°$). These transitions and relationships can only emerge by virtue of the existence of a "higher" spatial dimension for the "lower" dimensional entity *to curve into*.

Perhaps not always, but in many cases non-Euclidean geometry and hyper-dimensionality *go with* each other. Suppose $n = 1$ corresponds to the dimensionality of a line, $n = 2$ corresponds to the dimensionality of a surface, etc. The above argument is then expressible by saying that when an entity whose set of points is fully covered by n coordinates exhibits geometrical indicators of *curvature*, this appearance is attributable to the existence of one more $(n + 1)$ spatial dimension. This is called the *extrinsic* perspective. I.e., the perspective of observers who are of a dimensionality higher than that of the entity being observed. Whereas the *intrinsic* perspective is that of "inhabitants" of the observed lower dimensional world, inhabitants who we imagine to be effectively stuck, and not capable of seeing *perpendicular* to the surface, for example, that they entirely reside in.

Dwellers on a spherical surface — who we may call Two-Worlders — may suffer from the delusion that the whole world can be mapped by a two-coordinate grid comprising only an area (e.g., longitude and latitude). This again is the *intrinsic* perspective. Whereas dwellers in seemingly $(3 + 1)$–dimensions (Three-Worlders, such as ourselves) can easily see that the Two-Worlders' spherical world extends into another spatial dimension whose expanse includes infinitely greater spatial *volume*.

Though we are admittedly dancing on the fuzzy border between abstraction and physical reality, it appears true (as proposed above) that physical evidence of *curvature* of a lower-dimensional domain (n) indicates the actual existence of $(n + 1)$ spatial dimensions.

Empirical evidence of the curvature of our seemingly $(3+1)$–dimensional world includes tests of GR such as the bending of light around the Sun, the advance of the perihelion of planet Mercury and the Shapiro time delay test. The SGM proposes that the *cause* for the spacetime curvature that accounts for these phenomena is *motion*.

Appealing again to rotation, Rotonians propose that the stationary quality of the incessant motion of matter may be diagramed to include one more spatial dimension as at the bottom of Figure 11. The inhomogeneity of gravitational motion corresponds to the height variation of the outer envelope of the diagram. We do not directly see our movement into the "fourth" spatial dimension, just as Two-Worlders do not directly see above or below their surface. But the Two-Worlders deduce a $(3+1)$–dimensional existence by their experience in moving along the surface of their world. Especially by the fact that a "straight line" path along their spherical world takes them back to their starting point, Two-Worlders *deduce* the existence of a volumetric expanse of which their sphere is but a subset. From our higher-dimensional perspective, we can easily see that this deduction is correct.

An obvious limitation on our analogy between lower and higher dimensional worlds is that *motion* along the surface of a purely $(2+1)$–dimensional world is impossible, as are the "inhabitants." Motion becomes possible only in a world of at least $(3+1)$–dimensions, in which we have matter and gravity. Nevertheless, Rotonians argue that the analogy can still be drawn as between the Two-Worlders' clinching argument for the existence of a higher dimension (i.e., circumnavigation of their sphere) and the corresponding argument for Three-Worlders. For Two-Worlders the argument involves geodesic motion ***around their surface***. For Three-Worlders the argument involves geodesic motion ***through their volume***.

Three-Worlders stand to discover that, by virtue of matter and gravity, *perpetual motion* is not only the cause of spacetime curvature, it is responsible for and is indeed the very *essence* of their whole world. What stands to be revealed is that, it's not so much that the falling test object (undergoing geodesic motion) is caused to move through the sphere, but that the massive sphere regenerates itself and actively creates space by *moving outwardly to engulf the test object* (as indicated by the readings of accelerometers).

A lot more can be inferred from this simple experiment than the cause for and existence of a higher spatial dimension. Profoundly new revelations about the very essence of physical reality would also come to light. Just as Two-Worlders cannot see perpendicular to their surface, Three-Worlders cannot *directly* see the gravitational hyper-world perpendicular to seemingly static $(3+1)$–dimensional spacetime. But we can *deduce* its existence. We can provide compelling evidence for the existence of the perpetually moving $(4+1)$–dimensional Universe by conducting exactly this kind of experiment with matter and gravity. Illustrations like Figures 10 and 11 help to conceive how the Rotonian prediction is likely to be supported by its result.

Section 6: Applying the above ideas to astrophysics and cosmology, with some input from quantum theory and nuclear physics, here we discuss the cosmic significance of *saturation density*. When plotting the mass-density-radius relationships of the whole range of physical bodies in our Universe (as on the Cosmic Everything Chart, Figure 12, p. 32) we immediately notice the vast range of objects populating the middle of the Chart, on a density band spanning about four orders of magnitude. This region is that of molecular matter, where electromagnetic forces dominate the cohesion of material bodies.

As masses increase (rightward on the Chart) gravity eventually plays a dominant role in the coherence of planets, stars, and larger systems. Curiously, the upward fork of increasing density —

after passing through the zone of White Dwarfs ("degenerate" electron matter) — next encounters a density region (neutron stars) that echoes the density of nuclear matter, commonly referred to as *nuclear saturation density*, ρ_{N} .

It turns out, for reasons to be discussed in following sections, that an expression that defines Newton's gravitational constant, G, includes ρ_{N} as a crucial factor (denominator). Actually, it's the ratio of the mass equivalent of the cosmic background radiation ρ_{μ} as compared with ρ_{N}. This dimensionless ratio multiplies the constants that give the physical dimensions of Newton's constant (acceleration of volume per mass): $c^2 \text{a}_{\circ} / m_{\text{e}}$.

The significance of having G defined in terms of constants that span the Universe, from nuclei to the background, via the mass, distance and speed that play major roles in everything in between, can scarcely be overstated. Among the many physical implications of plotting the Chart to this point (Neutron Stars), is that the continued upward trajectory in density will not collide with any unphysical singularities (as is the case for GR) but will instead encounter other regimes of highly (but *finitely*) dense saturation. The next one corresponds to the extreme end state of collapsed stars. Beyond that, it seems most plausible that the regions of collapse at the centers of most galaxies, typically having billions of times the mass of the Sun, should approach a *cosmic maximum saturation density*.

This possibility is as much based on *physical intuition* as on the *shape traced out by the data points* on the Chart. It is nonsensical to suppose the data trajectory either stops, pops off to zero or infinity, or takes a "horizon"-defining abrupt turn, as GR would have it. It is patently more reasonable, more *physical* to assume the trajectory remains smooth, continuous and levels off at a well-defined maximum. Playing a key role in both bases (physical and visual), is the ubiquitous appearance of α, the *fine structure constant*, powers of which correspond to the magnitudes of the regions of interest.

The role of α will be expounded upon more fully in later sections. For now it suffices to point out that the expression for Newton's constant:

$$G = 8 \left(\frac{\rho_{\mu}}{\rho_{\text{N}}} \cdot \frac{c^2 \text{a}_{\circ}}{m_{\text{e}}} \right) , \tag{69}$$

allows substitutions with α appearing on the right side in at least two alternative expressions, as seen in Eq 45 (p. 90). Another arguably elegant feature of the emerging cosmology is that it relates the average mass density of baryonic matter to the cosmic background radiation density, as twice that of the proton-to-electron mass (Eq 42 or Eq 61; p. 89 or p. 110 — respectively):

$$\frac{\rho_{\text{M}}}{\rho_{\mu}} = 2 \left(\frac{m_{\text{p}}}{m_{\text{e}}} \right) . \tag{70}$$

Insofar as the Rotonians propose all these expressions to be *constantly, eternally true*, do we not behold a model of sufficient *prettiness* to impress Arno Penzias and many others? Prettiness should not be needed, of course, to motivate building and operating humanity's first Small Low-Energy Non-Collider. In a healthy scientific environment all that should be needed to motivate doing Galileo's experiment are that (1) The experiment is doable; (2) It has not been done; and (3) The data to be gathered would fill a large, glaring gap in our empirical knowledge of gravity. A healthy scientific environment, evidently, we have not. Seriously dysfunctional, more like it.

SECTION 7: Weaknesses in Einstein's theories of relativity in particular, and in the concept of *Relativity* in general, are at the heart of much confusion in the literature concerning the phenomena of motion — both uniform and accelerated. It's not just the lay public who are confused. Even professional physicists say patently false things, revealing a pernicious dysfunctionality to the whole business. In this section we focus on an especially egregious example. Referring to the image on p. 35, Ethan Siegel very completely scrambles up the concepts of acceleration, weightlessness, up and down and gravity. The result is an incoherent mess.

Rotonians strive for clarity by roasting Siegel's piece, and tracing its faults to the roots of relativistic thinking. Appealing to an imaginary scenario of an extreme ($v \to c$) fleet of three rockets, we come to a dramatic life-or-death decision. Rotonians illustrate that, if pressed to such extremes, even died-in-the-wool relativists are likely to admit — contrary to their own public pronouncements — that the speed of light is most certainly *not* always $= c$ "no matter what."

To say, as Siegel has, that occupants of the pictured upwardly accelerating rocket experience a "*downward* acceleration," to say, as Greene, Carroll and Strassler have, that the speed of light always equals c "no matter what," for Einstein to have given birth to this swamp of mudfog by proclaiming that, for any two uniformly moving systems we find "optical equivalence," is to present symptoms of a most serious sickness at the heart of physics. Relativistic thinking traces back to primitive concepts by Mach, Poincare, Einstein and others that, by design, strip away the whole world except for two dreamy "inertial systems."

The error has been to transfer properties that may well apply to the unphysical world of imaginary "inertial systems" to the spatial and temporal relationships in the *real physical world*. Utterly trivial conclusions about the ambiguity as to which of two non-existent, purely abstract "inertial" systems is "really" moving, have been misguidedly carried over, most famously by Einstein, to the real Universe, in which these conclusions have no counterpart and make no sense. ***To Einstein, Einstein never moved.*** He strived to justify the idea that he was *ALWAYS* at rest; that any evidence of motion was *ALWAYS* attributable to the other guy, to the whole rest of the Universe. Such nonsensical conclusions have damaged all of physics. Messes all over the place.

SECTION 8: Roger Penrose laments that the energy and mass of a gravitational field are as "slippery eels." Max Jammer laments that the concept of mass in physics "is a mess." In the context of gravitational physics three kinds of mass have been conceptually distinguished: Inertial mass, m_{I}, and two explicit kinds of gravitational mass: active gravitational mass, m_{A}, and passive gravitational mass m_{P}. Since m_{P} represents the response of a given body to the force of gravity, i.e., it is a measure of the body's *resistance to being accelerated*, it is arguably the same as (and is typically regarded as being identical to) inertial mass m_{I}. I.e., $m_{\text{I}} \equiv m_{\text{P}}$.

Much less clear — and much less frequently discussed in the literature — is the distinction as between m_{A} and either m_{P} or m_{I}. Some of the history of the matter is discussed, including empirical attempts to measure possible differences. This has been done by looking for different effects produced by bodies composed of *different substances*. No substance-dependent difference has ever been found.

Before spelling out how the SGM nevertheless predicts differences between m_{A} and m_{I}, especially for extreme (high speed, strong field) cases, the *Equivalence Principle* (EP) and the concept of *relativistic mass* enters the discussion. Addressing the EP first, we are reminded of the challenge, as implied by Callender and Okon's comment that: "There are almost as many Equivalence Principles as there are authors writing on the topic." [76] One of the problematic aspects of the discussion is that the "equivalence" applies to different, yet related things: Acceleration/Gravity;

Inertia/Gravity; Inertial Mass/Gravitational Mass. Often compounding the ambiguity is the concept of inertia itself. Does the EP refer to the *Law of Inertia*, involving inertial motion. Or to the *property of mass*, involving resistance to acceleration?

Probably the most common kinds of EP discussions in the popular literature are those that depict Einstein's accelerating elevator, and make claims to the effect that our experience of gravity on Earth is "equivalent." The Floor Comes Up! Entertaining as these discussions may be, their effect is ultimately pernicious because they always come back to the *untested assumption* that gravitating bodies like the Earth and their surrounding gravitational fields are ***STATIC*** things. After claiming also that "it is ***we*** [on Earth's surface] who are accelerated," Hawley and Holcomb ask how these patently contradictory concepts can be reconciled? They are evidently oblivious of the fact that *reconciliation is* ***IMPOSSIBLE***. It's one or the other.

Accelerometers tell the truth or they don't. It is foolish to endlessly keep *arguing* about it. Why not get the unequivocal answer by watching a falling test mass fall all the way to the center of a larger body (Small Low-Energy Non-Collider)? The failure to think of the problem in empirical terms, but to persist with mindless chatter about how this gravitational cake can supposedly be had and eaten too, reveals deep psychological and sociological problems in physics. It's as though participants have been indoctrinated into a cult — one of whose strictest tenets is that Big Al's theory of gravity (GR) must be defended at all costs.

Another indicator that the cult is plagued by conceptual corruption is the unresolved muddle about "relativistic mass." The subject actually arises in the context of Einstein's *Special* Relativity, according to which the energy of moving bodies is supposed to increase "relativistically" (more extremely than predicted by Newton's theory) as speeds approach the speed of light. This is supposed to happen for either one of any two inertial systems — depending on which one is adopted as the rest system.

Therefore, the effect is not supposed to actually affect the inner structure of the bodies involved, but is instead unctuously chalked up to "the geometrical properties of spacetime itself." [92] This claim is, however laid to waste by considering application of the prediction to a uniformly rotating body. A uniformly rotating body can be weighed in place, while it rotates, so as to yield a measurement indicating the increased mass with velocity, as predicted by SR. Whereas an identical non-rotating body weighs less.

It is not possible to explain the weight difference without accepting the inevitability that *the internal structure of the rotating body has somehow changed*, to give it not just more ***energy***, but also more ***mass***.

§8 takes the first step toward providing an intuitive explanation for the mass increase, which relates it to both the corresponding decrease in clock rate and consequences for the difference between inertial mass and active gravitational mass. The stage is set for the more detailed, graphically supported discussion to be presented in §9. The SGM strategy is thereby initiated — to at last grasp the slippery eel and to straighten out the mess.

SECTION 9: The phenomena of mass-increase and clock-slowing on a rotating body — as briefly mentioned in §7 and §8 — is illustrated here in detail. We appeal to empirical evidence as gleaned from both Michelson and Sagnac interferometers. The results from experiments using Michelson interferometers have been interpreted to mean that the speed of light is *isotropic*. Whereas the results from experiments using Sagnac interferometers have been interpreted to mean that the speed of light on rotating bodies is *anisotropic*.

With respect to observers rotating along with the body the speed is faster than c downwind (against the direction of rotation) and slower than c upwind (with the direction of rotation):

$$c^*{}_{\downarrow\uparrow} = c \pm r\omega\,. \tag{71}$$

Since $r\omega$ is a speed of rotation, it is not a far stretch to suppose that, when a component of the rotating body is released on a tangent, in *uniform* motion $r\omega = v$, a similar equation would apply:

$$c^*{}_{\downarrow\uparrow} = c \pm v\,. \tag{72}$$

As discussed in §7, Carroll, Greene, Strassler, and others say the speed of light always equals the famous constant: $c^* = c$ "no matter what" because it is a holy commandment that they must always swear to uphold or else go to hell. They will never attach physical validity to an expression like Eq 72 because to do so would get them burned at the stake. The community of "physicists" get away with this delusional tyranny in the name of Big Al. They are debating tacticians who avoid extreme cases like those presented in Section 7. They avoid thinking rationally about light propagation on a rotating body because such scenarios require conceiving the obvious fact that the speed of light is *almost NEVER = c*. They camouflage their silly game by calling an *average*, forth-and-back speed THE speed of light. It is a most counterproductive, foolish enterprise.

The sometimes contentious tone and wide range of views about how to reconcile the seemingly contradictory results of Michelson vs. Sagnac interferometers — as recorded, for example, in the symposium book, *Relativity in Rotating Frames* [266] — underscores once again the messy dysfunctionality of the academic "understanding" of motion. By appealing to the wave nature of matter and the Lorentz-Fitzgerald contraction — borne of early attempts to explain Michelson and Morley's pioneering results in the late 1800s — Rotonians illustrate what they think is really going on. Their picture removes the contradictions and paves the way for understanding the difference between active gravitational mass and inertial mass.

One of the key revelations that emerges by drawing out the propagation of light around a rotating body (as in Figure 16, p. 55, and what follows) is the stretching of the wave train in one direction (downwind) as compared with the bunching up of the wave train in the opposite direction (upwind). The analysis may seem tedious, but the gist of it is not too hard to visualize. Contemplating Figure 16A, the light *source* — which is coupled with a light *receiver* — at the top rotates very fast: specifically, $v = c(\sqrt{3}/2)$ to the left, and emits a continuous light wave in the *opposite* direction. This signal is received when the combined disk motion and light-wave motion reach their next point of coincidence at some new angular position, as viewed by non-rotating observers. Supposing the emitted wave train leaves a trace of itself on the disk, this would show the wave returning to its origin, as the emitter and receiver again coincide with each other. Given the specified parameters, the resulting image would look about as shown.

Similarly for Figure 16C. With the source again rotating very fast to the left, if the light wave is emitted in the *same* direction, the traced wave pattern would look very bunched up, as shown. Even accounting for the slower frequency (clock rate) of the emitter, the *sum* of wave crests in both directions for the rotating disk is, in the illustrated case, $1/\sqrt{1-(r\omega/c)^2}$, i.e., *twice* the sum for when the disk does not rotate. This pattern would persist as long as the light source is on. The waves in one direction remain stretched; in the opposite direction, they remain bunched up.

Another crucial component of the argument is the speed-induced contraction of material bodies in their direction of motion. Known as the Lorentz-Fitzgerald contraction, it was first hypothesized

to exist (by Lorentz and Fitzgerald) to explain the null result of the Michelson-Morley experiment. Being sensitive to second order in v/c, the experiment was initially expected to reveal Earth's motion around the Sun. But the expected positive effect would be camouflaged if the arms of the interferometer were contracted in their direction of motion by the factor $\sqrt{1 - v^2/c^2}$.

When applied to *rotating* bodies, this contraction effect was known as the *Ehrenfest paradox*. Einstein came to see the paradox as a step toward the need to invoke non-Euclidean (curved spacetime) geometry, because it seemed to indicate that, for observers attached to the rotating disk, its circumference would be measured as greater than the Euclidean value $C = 2\pi r$.

Einstein and others understood that, for extreme rotation speeds, measuring rods laid out circumferentially around the rim would contract in their direction of motion so as to open gaps between them. As specified in Section 8, visualizing the situation is facilitated by imagining the rods — each one a small fraction of the circumferential length — being pinned through their centers to the plane of the rotating disk so that they maintain their radial distance but are each free to contract and open up gaps between them. If these rods (or one of them, leap-frogged from one position to the next, all the way around) were used to measure the circumference, the result would be greater than $2\pi r$ by

$$C = \frac{2\pi r}{\sqrt{1 - r^2\omega^2/c^2}}\,. \tag{73}$$

From the description of the inner wave-like activity of matter by David Bohm (p. 54) and from Quantum Theory in general, we suppose the wave stretching and bunching pattern as found for light (outside matter) also takes place *inside* matter. The plausibility of this hypothesis is most forcefully manifest, as the ratio of wave number excess corresponds exactly with the special relativistic ratio of inertial mass excess, which is clear to see in the case of rotational motion.

Insofar as the net wave bunching effect coexists with a clock-slowing effect, Rotonians interpret the whole pattern to facilitate understanding the increase of inertial mass (net wave-bunching) as harmoniously co-existing with clock slowing. The latter effect indicates a reduction in the rate of space generation, i.e., gravity. This means that, as speed increases, *active gravitational mass decreases by the inverse of the factor by which inertial mass increases*. Rotonians surmise that both effects are absolute, not relative, and that the physical pattern by which they come about on a rotating body is echoed on gravitating bodies. Which is to be expected, as both phenomena are examples of stationary motion: Rotation is stationary motion *through* space and gravity is stationary motion ***of*** space.

SECTION 10: When $2GM/rc^2$ equals or exceeds one, GR *breaks*, because $(1 - 2GM/rc^2)$ becomes zero or negative and the theory stops making sense.

> **The fact that this extreme nonsensical case exists anywhere on the spectrum of seemingly more sensible solutions is an indicator that the theory makes no sense across the board.**

It's not just that the theory *suddenly* stops making sense *at* the event horizon or *at* the singularity. The whole theory makes no sense because in its spectrum of predictions, these ridiculous places exist. Assuming this to be true, what is the weakest link by which the nonsense can be exposed? ANSWER: *Gravity-induced radial motion through the centers of massive bodies.* GR has survived its empirical tests

because of the lucky accident that none of the ones that have been carried out involve watching one body fall through the center of another. Rotonians perceive that this is where the whole rigamarole of GR (and even Newtonian gravity) would utterly fail if put to the test proposed by Galileo in 1632. When will physicists at last fulfill the crucial task of building and operating humanity's first Small Low-Energy Non-Collider?

Insofar as even seemingly well-behaved (and empirically supported) coefficients correspond to the warpage of an explicitly *static* geometry (e.g., the exterior Schwarzschild solution) Rotonians deeply suspect the whole thing to be nonsense. Rotonians think the key indicator of nonsense is the idea that gravitational fields should be conceived as *static* things, magically emanating from *static* bodies of matter. How can an abstract static thing cause other *physical* things to move? It cannot! There is nothing static about matter or gravity. Inspired by accelerometer readings, Rotonians surmise that *gravity is all about perpetual physical motion*.

When the clock-slowing, wave-bunching ideas from §7 are applied to large gravitating bodies, we have another arena — *astrophysics* — within which to compare the consequences of the SGM with those of GR. Referring to the data on the Cosmic Everything Chart, we see that the trajectories thereof, where the zoo of large, bright shining stars transitions to White Dwarfs and Neutron Stars, GR runs into the nonsensical wall of divide-by-zero-land: Black Holes. In this context even the GR literature can be found to include discussions about the difference between *active gravitational mass* and *inertial mass*. It turns out (as seen in the work of Zwicke, and Ghose and Kumar) that the ratio m_A/m_I approaches a *minimum* $= 4/3\pi \approx 0.4244$. This doesn't mean that the body has two different mass values at the same time. Rather, it means that the *sum* of masses that would be added together as from an array of widely separated component masses, becomes smaller as the components come closer together. The difference $m_I - m_A$ is thus supposed to be attributed to the difference in gravitational *potential*. The potential is slightly negative even when the bodies are widely separated, and becomes increasingly more negative, so that the minimum specified above is approached when the component masses collapse into one highly compact body.

By contrast, in the SGM there is no gravitational potential. Nor is there a minimum m_A/m_I ratio. For bodies with increasingly large m/r ratios, both inertial mass and active gravitational mass will have different values at the same time. As the clocks of the body get slower with increasing m/r the active gravitational mass decreases inversely as the bunching of matter waves increases the inertial mass.

The idea is discussed and graphed for three key density regions: that of neutron stars; that of collapsed stellar objects (commonly regarded as stellar mass black holes); and that of collapsed galactic objects (commonly regarded as supermassive black holes). Among the many implications of the Rotonian scheme is the enormous ages of collapsed galactic objects. Their masses are deduced from astronomical estimates of the motions of surrounding objects, i.e., from their *active* gravitational masses. As shown in Figure 22 the inertial masses (i.e., the sum of widely separated masses) needed to yield the observed active gravitational masses found in the centers of galaxies is orders of magnitude more enormous. This suggests that the ages of these objects are many times the alleged age of the Universe.

Section 11: The vertical line on the Cosmic Everything Chart indicating the Chandrasekhar Limit Mass represents the zone where gravity begins to dominate and eventually electromagnetic and even nuclear forces give way to gravity. Starting with some basic features of atomic matter (e.g., the Pauli Exclusion Principle we apply these basics to astronomical bodies to conceive how and why such things as White Dwarfs and Neutron Stars should (or at least *can*) exist.

A curious fact — to be gleaned from the equation of state (EOS) graphs (Figures 30 and 31) — is

that the m/r values corresponding to White Dwarfs and Neutron Stars are surrounded by zones of instability, where no enduring astronomical bodies are to be found at all. The stability graphs of White Dwarfs and Neutron Stars shown in Figures 32 and 33 are directly superimposable onto the Cosmic Everything Chart, whereby we see the place, and to some extent the role, they play in the cosmic scheme of things. Especially in Figure 33 we see how GR amputates the natural extension of the emerging pattern, with its wedge of Black nonsense. Corresponding to the absurdity of astrophysical black holes is the even more absurd cosmological singularity which would not just amputate localized stellar or galactic objects, but kill the whole Universe *in time*—in both the extreme past and extreme future.

The naturally extended trajectory of data from Nuclear Saturation Density up to another $1/\alpha^3$ and $1/\alpha^6$–folded zones of density—where the latter jump represents a likely cosmic maximum—corresponds to the eternally singularity-free Rotonian cosmology. Burrows and Ostriker have written, almost poetically:

> Not only is everything connected, but that everything is connected quantitatively.
>
> The masses of nuclei, atoms, stars, and galaxies are set by a restricted collection of basic constants that embody the finite number of core natural laws. [141]

Rotonians think the wholesome spirit of these ideas is tragically negated by the fractured picture of standard physics and cosmology. It strains credulity that a universe as harmonious and beautiful as what exists could be consistent with schizoid accelerometers that only sometimes maybe whatever tell the truth; that it could have been *born* such a short time (13.8 billion years) ago; that matter is made of *static chunks of stuff*; that *geometry* magically dictates how things move; or that magical gravitons yank back on everything in the opposite direction from which they were emitted. If "everything is connected," and gravity is the most important force in cosmology, then without seeing what connects Newton's constant G to the rest of physics makes us virtually blind and prone to nightmares.

Whereas the perpetual continuousness indicated by the Space Generation Model of Cosmology, with its simple expression for how G is connected to the rest of physics:

$$G = 8\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{c^2 a_\circ}{m_e}\right), \tag{74}$$

amplifies the meaning of Burrows and Ostriker's statement and invites putting it to the test. Small Low-Energy Non-Collider anyone?

SECTION 12: The eternally unified picture of the Universe implied by Eq 74 acquires a degree of added support from another stretch of common ground, as between the SGM and GR. The most prominent empirical basis for Big Bangism is the redshift-distance relation, as it is interpreted to indicate the scattering of discontinuous galaxies from one another (velocity of recession per distance). As it turns out, *the historically first GR-based prediction for a redshift-distance relation was derived by Willem deSitter in 1917*. The solution involved *not* a recession velocity, but rather a slowing of clocks with distance. As we recall, Robert W. Smith explained:

> The effect that deSitter predicted was not due to a real recession of distant stars or nebulae. Instead

> the intrinsic properties of space and time in [deSitter's solution] cause clocks to appear to run more slowly the further they are from the observer. [148]

Where the SGM and GR diverge, however, is that deSitter's interpretation is purely geometrical, not physical. The effect is not caused by matter because *deSitter's Universe is explicitly empty of matter.* Whereas in the SGM the effect is *caused* by matter. Clock rates increase with cosmic time so that, as we look out over greater distances, we also look to earlier times when clocks were slower. We therefore see the spectrum of ever more distant galaxies ever more redshifted.

In this section we derive the SGM's redshift-distance law. We start with one of the famous *Large Number Coincidences*, involving the respective forces of electromagnetism and gravity in a hydrogen atom, as it seemingly relates to the ratio comparing the cosmic distance R_C to the Bohr radius a_o. Appealing to Dicke's "giant servo system" relation $GM_C/R_Cc^2 = 1$ and Komatsu's estimate that the average matter density compared to the mass-equivalent of the background radiation density is very nearly

$$\frac{\rho_M}{\rho_\mu} = 2\left(\frac{m_p}{m_e}\right), \tag{75}$$

we are enabled to derive a density parameter $\Omega_M = 2/9$, which agrees well with observations and adds support to the scaffolding from which the rest of SGM cosmology is built.

An intuitive reason to expect something like Eq 75 is as follows: In atoms, the comparatively ethereal electron clouds surrounding the much denser nuclei serve as an electromagnetic transition zone between nuclear matter and the tenuous background. Building on the imagery suggested by David Bohm [98], we suppose atomic electron clouds to be a kind of gateway, an interface, between the most vigorously ticking internal (clocklike) nuclear matter and the externally unfurled (non-clocklike) electromagnetic energy (light). Rotonians propose that the truth of this description in atomic matter is echoed across the cosmos as a whole. Hence the simple ratio of Eq 75 should persist as a universal *constant*. The coefficient of two in the equation may be due to the fact that for most atoms heavier than hydrogen, the nucleus-to-electron cloud mass ratio is about double that for hydrogen because of the inclusion of neutrons.

In any case, Figure 35 provides a clear illustration of how the SGM's continuous exponential expansion relates to the starkly discontinuous expansion of Big Bang and so-called "Steady State" cosmologies.

Though arguments about the importance of, and grumbles about the lack of a model that successfully "unifies" gravity with the other forces are very common, much less common is the idea that the unification would be effectively at hand if Newton's constant G could be expressed in terms of the other constants. The utter aloofness and disconnect between Newton's constant (gravity) from the rest of physics is well known, but doesn't really get much attention. Unfortunate as this disconnect may be, Rotonians are not surprised, given contemporary physics' affliction with fragmentary static-chunk-of-thing-stuff disease.

One of the unacceptable consequences of this wretched state can be understood in terms of the so-called Standard Model of Particles and Forces. Three of the forces: Strong, Weak and Electromagnetic, are found to overlap and coexist in various so called "interactions" of matter, where each force is "mediated" by its own corresponding bosonic field quanta. The force of gravity is regarded as being so weak compared to these other three, that it is entirely neglected in virtually all fundamental particle theories and experiments.

In effect, the standard view is that matter, space, and time would all still exist even without

gravity. The only thing missing is the alleged quanta of the gravitational interaction, i.e., *gravitons*. Even if gravitons were denied existence, then the only thing missing would be matter's ability to "warp spacetime." All the particles of matter would still exist; inertia would still exist, just without gravitational attraction. In standard physics it is not unreasonable to conceive a Universe without gravity. There'd be no galaxies, stars or planets, but the Universe would still be possible as a much more uniform soup of elementary particles. This fact is a *symptom* of static chunk-of-thing-stuff disease.

In the SGM, by contrast, nothing is possible without gravity. All forces and all three fundamental elements of physics: Mass, Space, and Time, are utterly *inter*dependent. None could exist without the others. Eq 74 and the reasoning behind it is the ultimate expression of this interconnectedness, which thereby gives the remark by Burrows and Ostriker much more meaning than even they had perceived. What it means, in simple terms (as stated before) is that *matter is an inexhaustible source of perpetual propulsion* and that *time only increases because space and matter also only increase*.

A reminder of one of the many ways the cure to static chunk-of-thing-stuff disease may be "hiding in plain view" (to use Lee Smolin's expression) is Aitchison's suggestion (which he effectively kicks away as fast as he makes it):

> Could the dimensions of Newton's gravitational constant be explained . . . [by] a theory of gravity characterized by a fundamental mass (or length) and a dimensionless strength? Could we then unify all the forces?. . . Something new is needed. [155]

Another reason for repeating this quote is, of course, to emphasize that the SGM expressions Eq 44 and 45 fulfill Aitchison's strategy in spades. All that remains is to find out whether the test object in Galileo's Small Low-Energy Non-Collider experiment oscillates or not. If not, then Newton's constant will no longer have to languish in "mysterious aloneness." All is connected, graphically, conceptually, quantitatively. All is whole. Forever.

SECTION 13: Even though one of the fundamental "pillars" of modern cosmology — i.e., the theory of *Inflation* — has received scathing criticism from within the community, more sensible ideas remain beyond both Inflation's practitioners and its critics. So they keep selling it, or grumbling about it, respectively. Joining Inflation on the upper layer of assumptions alledged to support the prevailing cosmological model are the existence of Exotic Dark Matter and the Existence of Magical Dark Energy.

9. Existence of the "inflaton" ; Inflation,
8. Existence of Exotic Dark Matter; and
7. Existence of Magical Dark Energy.

One level down, three more fundamental "pillars" are presumed to provide support:

6. Industry of the Recession of the Galaxies,
5. Industry of Primordial Nucleosynthesis, and
4. Industry of the Primordial Origin of the CBR.

These are referred to as "Industries" because of the huge publishing and promotional efforts involved in selling them to colleagues and potential recruits in the general public. In effect, we are

urged to believe — on the authority of Big Al and his disciples, that — once upon a time, at the "last scattering surface," 375,000 years after the beginning, we've found evidence of the last blink of Sasquatch. The fantasy branches out from there in many directions (Assumptions 4 – 9), each one being the veritable boondoggle pork-barrel of every delusionoid Borg Drone Pee-Aitch-Dee con-person's dreams. Please do not be assimilated. Resistence is not futile. Seek out the facts. The Truth will set you free.

As in any successful con or flourishing conspiracy theory, there is one or more elements of truth to it. In the present case, we find two important numbers that have real physical significance, but arguably not the same meaning as attached to them in Standard Cosmology. These numbers are $\Omega_\circ$ and $H_\circ$. Respectively, they are the density parameter and the Hubble constant. $\Omega_\circ$ has been presumed to equal 1.0 — as in the simple Einstein-deSitter model. This was prior to compelling observations (in the mid-to-late 20th century) indicating that the matter density is actually a much smaller fraction of unity. In the more complicated FLRW model, adopted largely because of these observations, $\Omega_\circ$ is chopped up into parts that go up and down with cosmic time. It is now the *sum* of these parts that is supposed to always equal unity. In *Latter Days* the biggest part is fantasy Dark Energy (the last, fatally endless *exhalation* of Sasquatch). The inescapable *ugliness* of Figure 45 reflects the scheme's implausibility, as suggested by Sean Carroll's understatement, "*not completely ridiculous*."

In the context of standard models, $\Omega_\circ = 1.0$ is supposed to mean that the geometry of the Universe is *flat*. Any other value is supposed to indicate either positive or negative *curvature*. The physical effects of curvature include geodesic paths that are not Euclidean straight lines, i.e., triangles whose angles do not add up to 180°.

While the Universe supposedly evolves and the hodge-podge of mass and energy ingredients that add up to 1.0 change, $\Omega_\circ$ itself remains constant. Whereas the Hubble parameter $H_\circ$ is not a constant at all, but changes with the alleged change in Hubble radius, $R_{\rm H}$. The pattern of change is complicated, as the alleged attractive force of gravity transitions from a losing battle with the Big Bang Blast to a shot at dominance, to negligibleness, ultimately yielding to the Doomsday takeover by Dark Energy.

In the SGM cosmology, by contrast, $H_\circ$ is a bona fide constant that has nothing to do with receding galaxies. In the SGM cosmology $\Omega_\circ$ is also a bona fide constant, even though its value is not 1.0, but $2/9$, and yet does not thereby represent any non-Euclidean behavior of test objects or light paths. On a cosmic scale the angles of triangles add up to 180°. And the galaxies do not recede from one another.

The status and meaning of these assumptions, parameters, and constants are discussed with an eye on a yet more basic foundational layer of "pillars" that are only tacitly presumed, but never explicitly acknowledged as a group, that seemingly supports Standard Cosmology's grotesque edifice. At the next level down, these three tacit assumptions ("pillars") are:

3. That matter is made of static chunks of stuff. In other words, that intergalactic space expands discontinuously from the gravitating static bodies comprising the galaxies; i.e., *space* expands, *matter* does not.
2. That gravity is a conservative force of attraction, and
1. That accelerometers are schizoid liars.

Section 13 exposes the standard model as a grotesque unstable thing by drawing attention to the dubiousness of its claims of knowledge, its far-fetched extrapolations, its absurd flexibility to "adjust as needed," the inclination of its proponents to be swayed by unfounded popular beliefs, and sometimes even their inclination to tell lies to the gullible public.

> Poison. Do you know what poison is? It's when someone tells you something that isn't true, and you believe it! — Ruth Rendell [267]

SECTION 14: Continuing with our critique of the most likely toxic "pillars" of modern cosmology, we attack Exotic Dark Matter first. It is not just the Rotonians who suspect the stuff doesn't exist. Other high-profile astrophysicists sometimes express their doubts, or divulge their feelings by referring to it as "crazy," "preposterous," "fancifully enigmatic," "ridiculous," etc. Perceiving no viable antidotes in their starved imaginations, status quo theorists, and even "observers" continue replaying their noxious nightmare. They clutch their dubious model, deriving some comfort, perhaps from high-budget research programs like the Planck satellite mission, that claim to have "measured" the fraction of Exotic Dark Matter contained in our Universe.

Another theoretical endeavor from which support is alleged to be provided, is Primordial (or Big Bang) Nucleosynthesis (BBN). The biggest red flag in the latter theory is its utter failure to correctly predict the cosmic abundance of *lithium*. In today's Universe, the lithium fraction is admittedly and persistently off by a factor of three. BBN is a suspicious enterprise for a variety of other reasons, as laid out in this section.

Big Bangists have spawned off yet another boondoggle enterprise known as Baryon Acoustic Oscillations (BAO). Elements of other theories converge here to paint a "fancifully enigmatic" image of bouncing baryons in primordial Exotic Dark Matter gravitational wells in the allegedly *first* few seconds of the Universe.

Plentiful as evidence for the shakiness of Big Bangism may be, establishment cosmologists as well as many "alternative cosmologists," sadly see no other viable possibilities. Alternatives that have received at least some air time are no better and often less well equipped to accommodate the empirical facts. Most cringeworthy, perhaps, are the pretentious claims by status quo spokespersons in 2022 (CERN theorist Kai Schmitz) and back in 1998 (University of Chicago cosmologist, Michael Turner) that we "find ourselves on the eve of a *golden age* of [Big Bangist] cosmology." Nauseating.

Any kid from Roton would expect to collapse the high-falootin Big Bangist house of cards with a single puff. With duly youthful spirit, the same kid proposes to affirm the demolition with the results of Galileo's Small Low-Energy Non-Collider experiment, and to lend confidence to the Rotonian prediction by putting forth, meanwhile, the corresponding expression for Newton's constant:

$$G = 8\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{c^2 a_\circ}{m_e}\right). \tag{76}$$

SECTION 15: Narrowing the focus from the whole cosmos to the localizable astrophysical objects it contains (mostly stars and planets) here we begin to contemplate how such objects come into existence and what happens to them. The answers depend enormously on whether gravity is a force of attraction or a process of outward motion. Under the prevailing assumption of attraction, serious disagreements are found in the literature as to whether or the extent to which, imaginary substances like Exotic Dark Matter and Dark Energy need to play a role in constructing a plausible story of the unarguably real components of the Universe.

From Neil deGrasse Tyson, James Trefil, Martin Harwit and others we learn that astronomers are still struggling to understand the formation of stars. They presume galaxy formation to have been made possible by Exotic Dark Matter in the "early" Universe. But then run into a wide range of

difficulties in providing details of how stars collapse out of the huge molecular clouds from which they emerge.

Continuity with previous sections and an apt segue to this one is provided by the discussion of Aden Baker Meinel and Eric Wollman, both of whom describe how the behavior of small "grains" of baryonic matter not only obviate Exotic Dark Matter, but also provide a thermalization mechanism that raises doubts about the standard interpretation of the CBR. Wollman's work in particular argues that the small grains may be very old and populate intergalactic space. The picture emerging thereby dovetails with the arguments of Neves and Assis, who point out the agreement between energy-densities of a variety of different phenomena. That agreement, they argue, seems to indicate an "eternal Universe in dynamic equilibrium."

Dennis Sciama and Virginia Trimble independently acknowledge a similar assortment of facts as those of the above authors, without, however explicitly suggesting that they support any particular alternative cosmology. They leave their readers to decide on the significance of the observed similarities in energy density. Rotonians regard the main hypotheses of Wollman, Neves, and Assis as plausible, especially as they cohere in the SGM cosmology.

The viability of this new scheme becomes especially clear in light of the admitted formation problems in astrophysics — from galaxies to stars to planets — in standard treatments as compared to the same problems when the Rotonian conception of gravity is brought to bear on them. To see this we need only contemplate the Rotonian prediction for Galileo's Small Low-Energy Non-Collider experiment, and apply it to astrophysical environments. The standard gravitational attraction hypothesis predicts that the test object reaches a maximum speed at the center, whereas the SGM predicts visible speeds that slow to zero at the center. The high speeds predicted by the gravitational attraction hypothesis cause radially falling components of large tenuous clouds to pass through the center, or (much more rarely) to collide with other falling objects, to break apart what might otherwise serve as "seeds" to stellar or planetary formation. Whereas, radially falling objects in the SGM accumulate slowly at the center without such disruptive behavior.

Cutting edge literature on star and planet formation are cited to identify the problems these researchers face, and to argue that the SGM largely ameliorates the situation, perhaps to the point of a total cure. If the Space Generation Model of gravity is essentially correct, there are no formation problems. Gravity is not a disruptive influence causing disintegration by high-speed inward radial motion. It is a gently congealing influence causing bodies to merge because of the centrally slow radially outward motion of gravitating matter.

17. Conclusion and Segue to Part 3

> ***That I may shut up, please let Nature speak.***
>
> Richard J. Benish

Just as everyone in the world deserves to know that the spherical Earth spins on its axis, everyone deserves to have the question mark in Figure 73 replaced with empirical data. It is not possible for Humans to *talk* or *write*, or *calculate*, or *think* their way to the answer. Glaringly obvious is that, since this is a question of natural science, *Nature* must be summoned to do the talking. The needed experiment could have been arranged decades ago. Plans have been proposed and remain on the

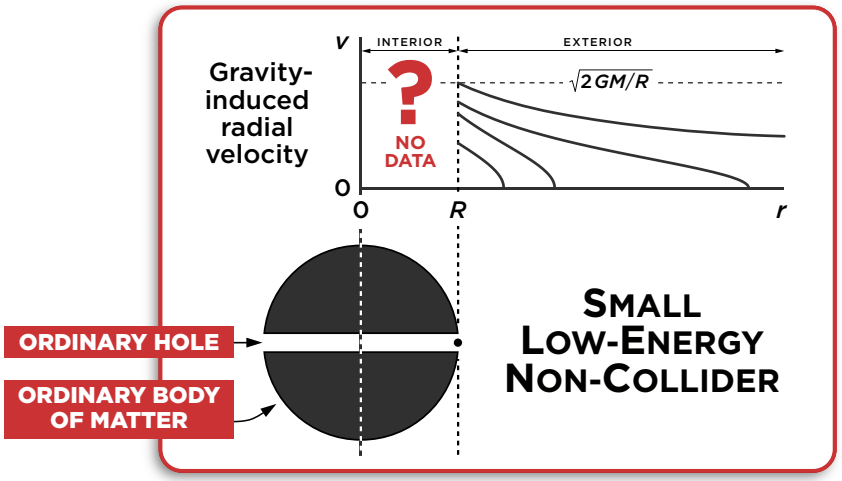


Fig. 73. **Big Red Question Mark:** Humans have never yet seen what happens when a small body is allowed to fall to the center of a larger body. The big red question mark indicates where Newton's and Einstein's theories of gravity have never been tested. Representing the insides of all familiar bodies of matter, under our noses, it corresponds to the most ponderous half of the gravitational Universe. Earthian physicists only just *pretend* to know what they'd see if they looked there. For this neglect and malpractice, their status as "scientists" is seriously called into question. One gets the impression that, for many of these academicians, physical reality is but an annoying obstacle to their inclination to behave instead like priests, entertainers and marketers.

drawing board (e.g., Smalley [268] and Feldman [269]). But such plans remain dormant, having never gotten to the production stage, much less yielding any fruit.

Meanwhile, physicists wax smug about the alleged success of GR, claiming that it has been tested over a range of 30 orders of magnitude. [270] The claim is a lie because the tests and observations pertain only to *exterior* solutions. Over this whole range the corresponding *interior solutions*—***the most ponderous half of the gravitational Universe***—*have never been tested.* Gravity-induced radial motion of one body inside and past the center of another body has never been observed.

If only the experiment had been carried out, it would (at least potentially) have saved lots of trouble. It certainly would have saved me a lot of trouble, because physics and math have never been high on my list of passionate pursuits. I wasn't the geeky kid who fixed all the broken radios in the neighborhood. I wasn't the math nerd who could do calculus at the age of 12. Rather, I was a visual arts-centered kid who dropped out of the advanced high school trigonometry class I was placed in, because the teacher presented the subject in such an opaque and boring way, and because I tended to be a delinquent. The point is that my involvement with physics was an *accident*. I thought it was going to be just a *detour* that, from its outset, I have never stopped hoping would be over soon. My original youthful passions have never subsided, only put on hold, to first "get this gravity thing out of the way." A few more autobiographical details can be found in *The Beauty of Gravity Itself*. [271]

18. Predictions Enumerated

Serving as an emphatic punctuation to this essay are the following 10 consequences that correlate with or directly follow from the result of Galileo's Small Low-Energy Non-Collider experiment — *if* that result supports the Rotonian non-oscillation prediction:

1. Energy is not conserved.
2. Time only increases because space and matter also only increase. (*Unification*.)
3. Gravity is not an attraction between bodies.
4. The *cause* of spacetime curvature is the generation of space by matter.
5. The *curvature* of spacetime caused by the gravitational motion of matter and space indicates the existence of a *fourth spatial dimension*, as required for the seemingly three dimensions of space to have a *new direction to curve into*.
6. Inertia is equivalent to gravity insofar as that which causes *resistance* to acceleration in *one* direction is the accelerated generation of space and regeneration of matter in *every* direction. For a given body the magnitudes of *inertial mass* and *active gravitational mass*, however, vary inversely as the coefficients that characterize them deviate further from unity (strong field and high-speed cases).
7. The positive results reported by the LIGO collaboration will turn out to have been caused by something other than gravitational waves. What are commonly regarded as "black holes" are not really black. Dividing by zero yields only unphysical nonsense.
8. The Universe is infinitely old because its density remains constant as the whole of it, the whole, saturated, dynamically equilibrious continuum, exponentially expands.
9. Matter is an inexhaustible source of perpetual propulsion.
10. The expression for Newton's constant (Eq 11) may also be expressed as follows (showing more explicitly its connection to atomic nuclei, electromagnetism and quantum theory):

$$G = 8\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{c^2 a_\circ}{m_e}\right) = \frac{4}{\pi\alpha}\left(\frac{\rho_\mu}{\rho_N}\cdot\frac{hc}{m_e^2}\right) = \frac{2}{\pi\alpha}\left(\frac{\rho_C}{\rho_N}\cdot\frac{hc}{m_p m_e}\right) = \frac{\alpha^3}{2}\left(\frac{a_\circ}{R_C}\cdot\frac{c^2 a_\circ}{m_p}\right), \tag{77}$$

where α is the fine structure constant, h is Planck's constant, ρ_C is the average cosmic matter density, and m_p is the proton mass. The two right-most expressions may appear model-dependent, because they include the cosmic matter density and the cosmic radius, neither of which have been well measured. But they bring out the importance of both α and the echoed proton/electron mass ratio.

As discussed above and in my prior work, the ultimate goal — in the spirit of Galileo — is to secure a plan to build and operate humanity's first Small Low-Energy Non-Collider, so that all of these predictions may be tested by what Michael Faraday called "the Ithuriel spear of experiment." [272]

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NOTE: The first of these links indicates: "No Sources Found" for the following reason. The paper was solicited in 2011 by the editor of the new publication, *What's Happening Magazine*, Dylan Fazel. The paper appears in the July 2011, Volume 6, Issue 7 edition. I own a hard copy — which is full of manuscript-to-press problems. But a Google Search yields nothing. Neither hard copy nor digital copy of the original are available. For its next issue the publication improved their style and communication problems, and now went under the name: *Astronomical Review*. In correspondence with Mr. Fazel, I was told that the corrected version would appear in the first issue under the new name. But this didn't happen, even though the ADS system evidently showed it as appearing there. Soon thereafter management of *Astronomical Review* was transferred to the reputable publisher Taylor and Francis. The "published" version of *The Direction of Gravity* evidently got irretrievably lost in the transition. Fortunately, the format and content of the second link (Academia.edu) is of high quality and is what was intended for the original *What's Happening* issue.

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In this impressively composed review, the authors explain the role of assumptions in modern cosmology:

To date, very few conclusions about the kinematics and/or dynamics of the Universe have been made without model assumptions in cosmology, typically in the form of a ΛCDM model or in the form of a Friedmann–Lemaitre–Robertson–Walker (FLRW) metric. The claimed ≈1% precision in cosmology is achieved at the expense of strong model assumptions. Additionally, the data reduction in the large cosmological surveys (employed before the cosmological model fit) is often achieved within the context of a ΛCDM fiducial model. (Page 7. Graph is adapted from Figure B1, p. 108.)

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> It is absolutely necessary that we should learn to doubt the conditions we assume, and acknowledge we are uncertain. . . . In the pursuit of physical science, the imagination should be taught to present the subject investigated in all possible and even in impossible views; to search for analogies of likeness and (if I may say so) of opposition — inverse or contrasted analogies; to present the fundamental idea in every form, proportion, and condition; to clothe it with suppositions and probabilities — that all cases may pass in review, and be touched, if needful by the Ithuriel spear of experiment.

Ithuriel is an angel in Milton's epic poem, *Paradise Lost*.