Richard Benish and the Professors: Introduction to Correspondence

Richard Benish • June 27, 2019

"The very real possibility of testing your ideas changes the complexion of the matter."

John Schuster — Email to Benish, December 24, 2015

"Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."

Bradley Schaefer, Astronomer

The latter quotation strikes me as one of the clearest statements of the *ideals of science*. When a physicist needs to be reminded of the importance of living up to these ideals, it is well-nigh impossible—I have learned from experience—to convince them of the fact, to effect a change of course. Owning up to a lack of humility is just not part of their training.

The documents collected here support the impression that physicists are just as capable as anyone else of trampling their own ideals by *pretending to know things they don't really know*. If there is a *sin* in science, this is it: Feigned "knowledge"—sometimes called *proof by ethos*. Newton said so. Einstein said so. So I say so; we *all* say so—*or else*. Some predictions, some beliefs don't need to be supported by evidence. Illustrious authorites and sacred "principles" will suffice.

Curiously, all the while this course of action (or inaction) is being taken, the *word* of authority is to simultaneously *pay lip service* to the importance of empirical evidence. It is well understood how important it is to *advertise* objectivity, which is indeed adhered to in practice in many, if not most, cases. But not always. I seem to have stumbled into a case in which lip service suffices and evidence does not matter.

As stated elsewhere on this website and in my written works, my mission is to bring attention to the fact of the current *absence of physical data* that would be gained by performing a simple experiment proposed by Galileo in 1632. (See the figure on the next page.)

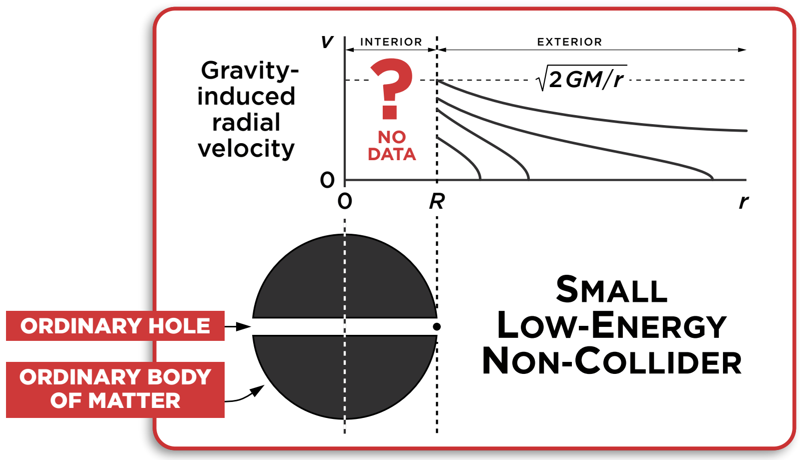
In addition to submitting works for publication, entering them in essay contests, and otherwise making them available for public consumption, over the last few decades, I've also engaged in an ongoing direct marketing campaign by writing to professors with requests for feedback. I've reached out to thousands of physicists, astronomers, philosophers, historians, and a few psychologists and sociologists. (See, for example, the correspondence with Yale Professor John Bargh.)

Mostly I get no response. But many of the responses I do get are revealing, if not encouraging, on multiple levels. I am very grateful for all of them. The 23 correspondences gathered here (so far) reveal a curiously wide range of positive and negative comments. For example: "Nice… A very charming article" approves Harvard Professor Gerald Holton. "Belongs in the trash can… babyish ignorance" grumbles Nobel Laureate Gerard 't Hooft. "I have thought about doing exactly what is in your paper" echoes apparatus-builder George Herold. "Please send a copy to my co-author" asks Astronomer Virginia Trimble. "[You are] a crackpot of the highest order" flames Harvard Professor Matthew Strassler. "Great card. I like your style a lot, and was very happy of receiving it" beams Italian phyicist and author Carlo Rovelli.

Note that Strassler's remarks appear, not in private email, but on his public weblog (*Of Particular Significance*) whose Comment Section I chimed into in April 2015.

Four of the correspondents (Davis, Mueller, Shoemaker, and Weiss) characterized Galileo's experiment as one that would be "fun" to do. Others agree it "must" be done (Lombardi). They say it sounds "fascinating," "interesting," or that it would be "worthwhile" to do.

A pattern that I sometimes allude to or address in the Prefaces is the *consistency* with which the recipients move on their way—after the correspondence plays itself out—*denying themselves* this "fun" and withholding from the physics community their views on how "worthwhile" it would be to carry out this classic experiment that's never been done.



Recurring Figure: Performing this experiment—i.e., building and operating humanity's very first Small Low-Energy Non-Collider—is the most clearcut way to replace the big red question mark with concrete physical data. Doing so would represent a *tour de force* of "exploring unexplored regions" and conducting a "critical test of standard wisdom."

Nobel Laureate Rainer Weiss goes so far as to state that the experiment (which he refers to as a "gravitational clock") has "*passed its time*." How can an experiment that has never been done have "passed its time"? It doesn't make sense. Scientifically speaking, it just doesn't make sense to leave the experiment undone. But they all do—even the kindest, most encouraging and seemingly conscientious respondents fail to *publically* air any sense of *need* to do the experiment.

Possible reasons for this failure are presented in some of the Prefaces. These preambles to the dialogs (like this Introduction) tend to be more blunt than the correspondence itself. In the actual dialogs, I have endeavored to maintain all due politeness and respect.

When contemplating an appropriate title for this Introduction, one possibility that I rejected because of its contentious connotation was "Richard Benish *vs*. the Professors." I am clearly not *against* professors. But they often come across as being, if not against me, then as adopting a *defensive* position with respect to the status quo, with respect to *the decision to NOT do Galileo's experiment*.

It never ceases to amaze me how difficult it evidently is for a physicist to simply admit: "Hey, yeah! We've missed a spot. We've completely overlooked the need to provide data to support the well known 'hole to China' problem. It's about time we took care of that. Let's do it right away!" Why isn't this patently scientific response a no-brainer? By contrast, tacit or explicit support for the decision to *not* do the experiment, and even the mere apathy of inaction, strikes me as negligent and indefensible.

I have long understood that, in a debate with a physicist, I cannot possibly lose because *Nature is the fairest judge*, and it is *I* who consistently defer to Nature's evidence to decide the matter. It is the *professors* who illogically claim to have all the evidence they need. It is *they* who claim that Nature has already said enough; their *theories* fill in the rest. Their *theories* suffice to replace the big red question mark.

For the moment they get away with neglecting physical evidence because they have more stature than I do. One may rightly ask: who, in the cosmic scheme of things, is being truer to the ideals of science? The amateur who would rest his case on the *result of an experiment* proposed by the Father of Modern Science, an experiment that beckons to be done? Or the professional dogmatist who appeals to *predictions*, based on *assumptions*, based on *inadequately tested principles*—i.e., "standard wisdom"?

The situation may be likened to a *game* whose outcome is for now undecided because the professionals refuse to let me (an amateur outsider) call the hand by showing the cards (Nature). "C'mon, let's see what you've got." Note that Rovelli proposed a bet with 100-to-1 odds that my prediction was wrong. When I immediately took him up on it, he backed out. How unimpressive . Everybody wins when we at last look at the cards. Not playing out the hand to its natural conclusion is an exercise in denial of reality. Why, in this particular case, do physicists have so little interest in physical reality? Plenty of sociological evidence emerges in what follows. You decide.

List of Correspondents

1. Professor Gerald Holton —
Harvard University
(Physics, History and Philosophy of Science)

2. Dr. Julian Barbour —
Oxford University
(Visiting Physicist and Author)

3. Professor Rainer Weiss —
MIT, LIGO
(Physics, 2017 Nobel Laureate)

4. Professor Carlo Rovelli —
Centre de Physique Theorique de Luminy • Aix-Marseille University
(Physics, Author)

5. Professor Holger Müller —
University of California, Berkeley
(Physics)

6. Professor Daniel Kennefick —
University of Arkansas
(Physics, Author)

7. Professor Francis Everitt —
Stanford University
(Physics)

8. Professor David Shoemaker —
MIT, LIGO
(Physics)

9. Professor Virginia Trimble —
University of California, Irvine and University of Maryland
(Astronomy)

10. Professor Robert Geroch —
University of Chicago
(Physics)

11. Professor John Bargh —
Yale University
(Psychology)

12. Professor Scott Aaronson —
University of Texas at Austin
(Theoretical Computer Science)

13. Rev. Scott Gerard Prinster —
University of Wisconsin
(PhD Candidate, History of Science)

14. Professor Marc Davis —
University of California, Berkeley
(Astrophysics)

15. Professor Bryce DeWitt —
University of Texas at Austin
[Physics (Deceased)]

16. Professor Olimpia Lombardi —
University of Argentina
(Philosophy)

17. Professor John Morack —
University of Alaska
(Physics)

18. Professor Robert Jacobsen —
University of California, Berkeley
(Physics)

19. Professor James Schombert —
University of Oregon
(Physics)

20. Professor John Schuster —
University of Sydney
(History and Philosophy of Science)

21. Professor Matt Strassler —
Harvard University
(Physics)

22. Professor Gerard 't Hooft —
Institute for Theoretical Physics, University of Utrecht
(Physics, Nobel Laureate)

23. Francesco Sorge, PhD —
Instituto Nazionale de Fisica Nucleare, Sezione de Napoli
(Physics)

NOTE WITH REGARD TO COPYRIGHT: With the exception of George Herold—whose comments are embedded in some of the listed correspondences—permissions to publish the letters or emails were not obtained.

Even though the publication is, so far, only on my website (and not a book, for example) it would still be, I understand, *best practice* to obtain written permissions.

My reasons for this omission range from laziness to the publicity value of initiating a dispute. For the most part, I'm inclined to think I am in the clear under the *Fair Use* clauses, which apply especially to writings that are copied for the purposes of "criticism, commentary, news reporting, teaching, scholarship, and research."

This seems especially applicable as all my correspondents are affiliated with institutions that are either publicly funded and/or profess to have "research"as one of their primary purposes. The correspondents are presumably acting more or less as representatives of their institutions. Most broadly, this is the global community of physicists or academicians. One may therefore argue that *the public has the right to see what these researchers say in response to questions about our understanding of gravity.* I'd guess most of them would be happy to let their views be known.

In conclusion, I surely don't expect any objections to sharing these correspondences. If any such objections were to arise, I would welcome them as continuations of the public record.

Gerald Holton

PROFESSOR of PHYSICS • PROFESSOR of HISTORY & PHILOSOPHY of SCIENCE

Harvard University

Email Correspondence

July 28 – 30, 2015

PREFACE

Holton's career is nearly as illustrious as it is long (or is it the other way around?). As I write, he is 96.

In response to emailed copies of my essay and Mr. Natural graphic, instead of hitting the "reply" button, Holton started a new message with the subject: "Nice," and wrote: "a very charming article."

Unfortunately, he then continues by exhibiting his evident failure to get the point that, with modern technology, Galileo's experiment is quite feasible. Grateful as I am for Holton's kindness and good intentions, I lament the ultimate communication breakdown.

Yet again.

holton@physics.harvard.edu, 7/28/15 10:54 PM -0800, Galileo's Gravity Experiment **1**

To: holton@physics.harvard.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Mr-Natural-Says-LR.pdf>

Dear Professor Holton,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Gerald Holton, 7/29/15 -0800, Nice **2**

To: Richard J Benish <rjbenish@comcast.net>
From: Gerald Holton <holton@physics.harvard.edu>
Subject: Nice
Attachments:

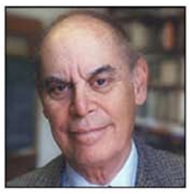
> Dear Professor Benish,
>
> A very charming article.
>
> As an experimentalist, I see some difficulty in drilling that hole (P.W.Bridgman was drilling through a big block of Carboloy to make a new press. After the second day I congratulated him on his success. He said simply: "Thereis nothing to it. You just work on it for 18 hours").
>
> So, let's propose to NASA they will drill though a smaller body than the Earth, say an asteroid.
>
> Best,
>
> Gerald Holton

To: Gerald Holton <holton@physics.harvard.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Nice
Attachments: <SLENC-as-Clock-Smalley-1975.pdf> <Missing Measurement PP-24-03.pdf>

> Dear Professor Holton,
>
> Many thanks for your kind reply.
>
> Fortunately, there is no need to involve astronomical bodies. In the 1960s and 1970s NASA was pondering the possibility of measuring Newton's constant with what I call a "Small Low-Energy Non-Collider." See attached paper by Larry Smalley, who calls the apparatus a "gravitational clock." The plans remain on the drawing board.
>
> Since the cost of launching such a device into orbit is still rather high, I have myself proposed doing the experiment on the ground with a modified Cavendish balance. (See second attachment.)
>
> George Herold, an apparatus-builder at TeachSpin in Buffalo, NY once expressed an interest in doing the experiment. More recently, Holger Mueller at UC Berkeley, has agreed that doing it would be fun and worthwhile. I am hoping for further developments, but fear these interests have fizzled.
>
> I sometimes fancy that, if Galileo were alive and had access to the resources needed to perform a scaled down version of his experiment, he would not hesitate for a second. No matter how often the presumed result is stated in textbooks and class discussions, I think Galileo would want to see the thing unfold before his own eyes, as would a good detective or curious child.
>
> By the way, I am not a professor.
>
> Best wishes,
>
> Richard Benish

Faculty: GERALD HOLTON

Mallinckrodt Professor of Physics and Professor of the History of Science, *Emeritus*



Jefferson Lab
17 Oxford Street
Cambridge, MA 02138
(617) 495-4474
holton@physics.harvard.edu

Selected Books (full-text access):

- Holton, Gerald James, *The scientific imagination: case studies.* Cambridge, [Eng.] ; New York: Cambridge University Press, 1978. [440 pages] http://nrs.harvard.edu/urn-3:FHCL:19365131 https://dash.harvard.edu/handle/1/23975376
- Holton, Gerald James, *Thematic origins of scientific thought: Kepler to Einstein.* Cambridge, Mass.: Harvard University Press, 1973; revised ed. 1988. [520 pages] http://nrs.harvard.edu/urn-3:FHCL:19365132
- Holton, Gerald James, *Science and anti-science.* Cambridge, Mass. : Harvard University Press, 1993. [232 pages] http://nrs.harvard.edu/urn-3:FHCL:19365133
- Holton, Gerald James, *The advancement of science, and its burdens: with a new introduction.* Cambridge, Mass. : Harvard University Press, 1998. [402 pages] http://nrs.harvard.edu/urn-3:FHCL:19365134
- Holton, Gerald James, *Einstein, history, and other passions: the rebellion against science at the end of the twentieth century.* Cambridge, Mass.: Harvard University Press, 2000. [256 pages] http://nrs.harvard.edu/urn-3:FHCL:19365135
- Holton, Gerald James, *Victory and vexation in science: Einstein, Bohr, Heisenberg, and others.* Cambridge, Mass.: Harvard University Press, 2005. [229 pages] http://nrs.harvard.edu/urn-3:HUL.InstRepos:32676360

▸ All books and essays available on DASH (Digital Access to Scholarship at Harvard).

▸ Curriculum Vitae

Julian Barbour

Visiting Physicist

Oxford University

Email Correspondence

January 25–26, 2016

Preface

Though never having taken an academic position, Barbour has developed a high profile amongst certain theoretical physicists—especially those whose works stress "philosophical" underpinnings. In the 1990s Barbour co-edited a compendium on *Mach's Principle*. In recent years he has focused his efforts to argue that *time is an illusion* (consistent with views sometimes espoused by Einstein).

I'm not aware of any empirical consequences that would distinguish Barbour's work from others. Experiment is not really his thing. Be that as it may, Barbour's response that Galileo's experiment has been "effectively" done already exhibits the recurrent failure to see that measurements of static *forces* do not allow making conclusions about through-the-center *MOTION*.

I had hoped Barbour would take an interest in Galileo's experiment because of its bearing on the *direction* (and therefore *reality*) of *time's arrow*. If the result of the experiment is that the test object oscillates, then the temporal reversibility of gravity would be supported. A video of the oscillation prediction looks the same whether played forward or backward.

Whereas, a video of the *non*-oscillation prediction is asymmetrical and only makes physical sense in the forward direction. If this prediction were to be supported by an actual experiment, it would unequivocally reveal the unidirectionality of time's arrow: *Time only increases because space and matter also only increase.* By establishing the *interdependence* of the dimensional elements of the world, this result would also indicate a profound *unifying* principle of the physical Universe.

Alas, though Barbour thought my thesis was "well written," he still didn't get it.

Julian.Barbour@physics.ox.ac.uk, 10/14/15 11:36 PM -0800, Galileo's Gravity Experiment 1

To: Julian.Barbour@physics.ox.ac.uk
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Mr-Natural-Says-LR.pdf>

Dear Professor Barbour,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Julian Barbour, 10/15/15 1:36 AM -0700, Re: Galileo's Gravity Experiment 2

From: Julian Barbour <BarbourJ@physics.ox.ac.uk>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Date: Thu, 15 Oct 2015 09:36:19 +0100

> Dear Richard Benish,
>
> I have read your paper, which is well written. My suspicion is that effectively Galileo's experiment has been performed. I think there must have been tests of free fall within mines, from which first deviations from the Newton/Einstein predictions would have shown up. Moreover, atomic clocks are now incredibly sensitive and I am sure some are being used in deep mines. Any effects large enough to be detected in the kind of experiment in space that you propose would also show up.
>
> Best wishes, Julian Barbour.
>
> Julian Barbour
> Emails: julian.barbour@physics.ox.ac.uk or julian@platonia.com
> Website: http://platonia.com

Julian Barbour, 10/15/15 9:04 AM -0700, Re: Galileo's Gravity Experiment 3

Date: Thu, 15 Oct 2015 08:04:59 -0800
To: <julian.barbour@physics.ox.ac.uk>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: SLENC as Clock Smalley 1975.pdf

>> Dear Professor Barbour,
>>
>> Many thanks for reading my paper and your thoughtful reply.
>>
>> In response, it should be pointed out that the free fall tests that you refer to all have the character of EXTERIOR solution tests. With respect to the Earth, this is because the distance over which the fall takes place is still extremely small compared to the radius of Earth as a whole. Moreover, the Earth is not uniformly dense. It's density increases toward the center, so that the acceleration of gravity also increases toward the center far below the crust, well into the mantle.

> A similar argument applies to clock rates. The GPS and and other "experiments" involving clock rates either involve large distances over the surface or small distances near the surface. The huge region within a massive body where the acceleration decreases and goes to zero at the center has never been probed with regard to either clock rate or gravity-induced radial motion.
>
> Even with the marvelous advances in atomic-clock technology, for laboratory-sized bodies, predicted clock rate differences are still too small to measure.
>
> Therefore, I maintain that Galileo's experiment has never been performed, even "effectively."
>
> In addition to my email message I've also sent you a hard copy version of the second attachment (Mr. Natural postcard), upon which I've pointed out that the Small Low-Energy Non-Collider experiment also serves as a test of time-reversal invariance. Of course, I understand that physicists have reasons to expect that a time-reversible result would be found (harmonic oscillation). But it must be admitted that, until the experiment is actually carried out, this is just a guess.
>
> In freshman physics class we learn the "result" of Galileo's experiment and carry on through our careers assuming that we really know it. The truth is that the actual physical experiment represents a rather large (centrally located) stone in the garden of physics under which nobody has yet looked.
>
> I thank you again for your kind response and your curiosity about gravity.
>
> Sincerely,
>
> Richard Benish
>
> PS: I have attached a paper (*NASA Technical Memorandum*) in which Larry Smalley reviews proposals (ca 1975) for doing Earth-orbit versions of Galileo's experiment. None of them ever got beyond the drawing board. A less expensive way of doing it would be in an Earth-based laboratory with a modified Cavendish balance.
>
> Cheers,
>
> RB

October 12, 2015

Dear Dr. Barbour,

TIME-REVERSAL INVARIANCE is among the fundamental principles that would be tested by conducting Galileo's SMALL LOW-ENERGY NON-COLLIDER experiment. It is widely ASSUMED that the test object (time-reversibly) oscillates in the hole. But nobody has ever SEEN this happen. What if it doesn't? Do we understand gravity well enough to be certain that the experiment's result would not reveal the one-way direction of time? Why don't we settle the matter by doing the experiment?

Reasons for the failure of academic physics to even ASK such questions, as well as the positive consequences of finally doing so, are suggested in what follows.

Einstein strongly advocated letting the imagination run wild, toward the extremes of "highest abstraction." [IDEAS & OPINIONS, p. 282] After decades of voluminous work in this direction, our efforts to quantize and unify gravity remain fruitless. The long-sought evidence of gravitational waves remains elusive. And speculations about various invisible extreme conditions of the cosmos are well-characterized by literal and figurative DARKNESS.

Perhaps undervaluing and misinterpreting direct physical experience were among Einstein's gravest errors. Perhaps we have overlooked some crucial clue hiding right under our noses, our real physical noses.

It is commonly believed that weak-field General Relativity has been well-tested on scales from mm to the Solar System. True as this may be for the Schwarzschild EXTERIOR solution, it is not at all true for the INTERIOR solution.

The most physically significant feature of the interior field of a uniformly dense sphere is that the rates of clocks are supposed to decrease to a central MINIMUM. So it is predicted. Humanity has not yet tested this prediction on any scale. The simplest manifestation of spacetime curvature and the motion it is supposed to produce within the most ponderous half of the gravitational Universe (under our noses) thus remains INVITINGLY UNOBSERVED.

One of the kinematic consequences of the central clock rate minimum (as commonly treated in Newtonian gravity) is the oscillation of a test mass dropped into a hole through the center of a larger massive body. Evidence bearing on the kinematics and (indirectly) clock rate could be gotten by conducting Galileo's experiment, as described on the front of this card. It could be done in an Earth-based laboratory (with a modified Cavendish balance) or in an orbiting satellite.

I would therefore urge you to please help to generate interest in performing this experiment that Galileo proposed so long ago. To be truly diligent in our investigation of gravity and the physical world, should we not bring Galileo's proposal to fruition by building and operating humanity's very first SMALL LOW-ENERGY NON-COLLIDER?

Thanks for your good work.

Sincerely,

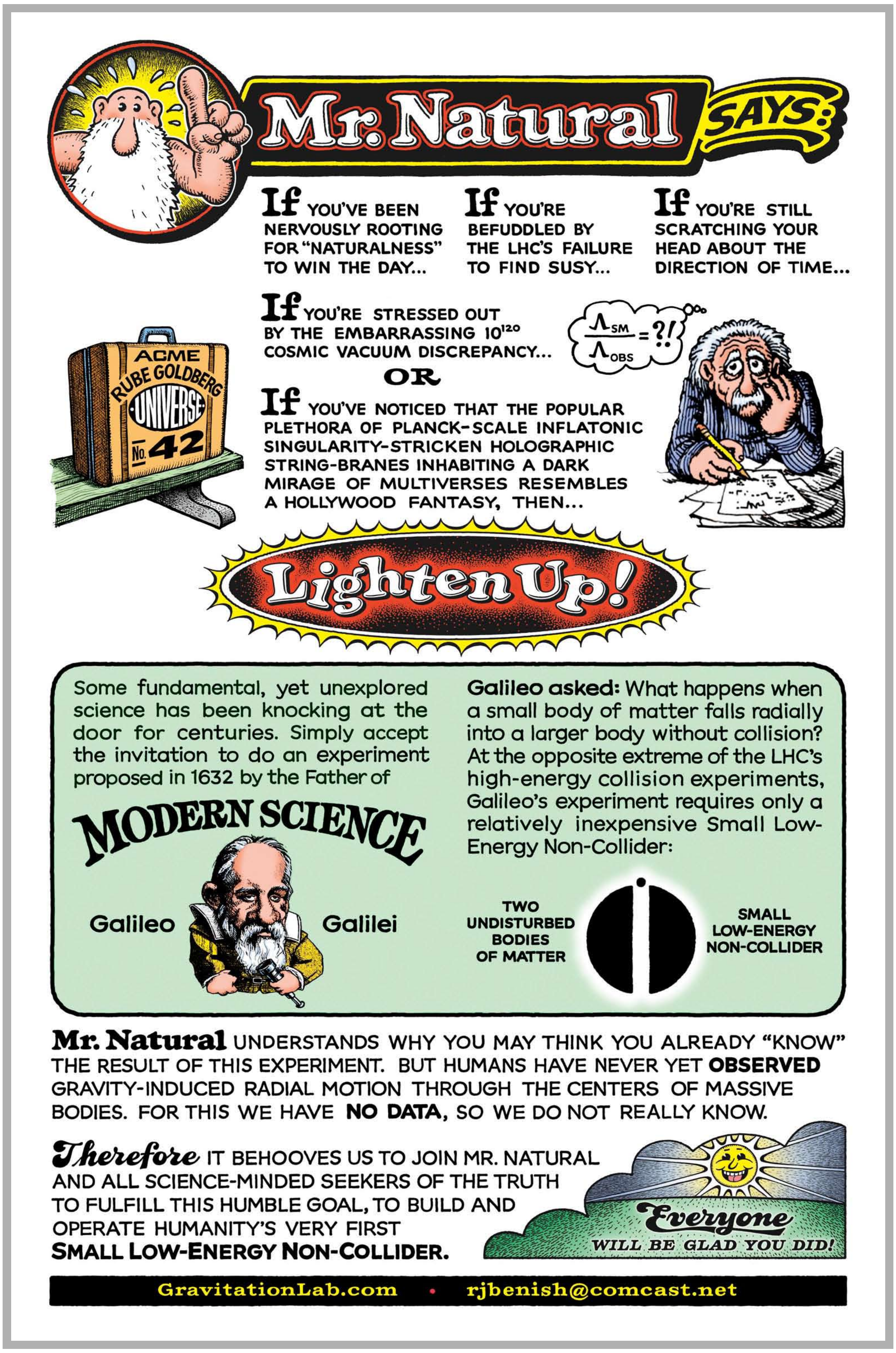
Richard Benish

Post Card

THIS SIDE FOR THE ADDRESS

To: Dr. Julian Barbour
College Farm
South Newington, Banbury
Oxon, OX15 4JG
UK

GLOBAL | USA | FOREVER | 2014



Mr. Natural SAYS:
If you've been nervously rooting for "naturalness" to win the day...
If you're befuddled by the LHC's failure to find SUSY...
If you're still scratching your head about the direction of time...
If you're stressed out by the embarrassing 10^{120} cosmic vacuum discrepancy...
ACME RUBE GOLDBERG UNIVERSE No. 42
$\frac{\Lambda_{SM}}{\Lambda_{OBS}}$ = ?!
OR
If you've noticed that the popular plethora of Planck-scale inflatonic singularity-stricken holographic string-branes inhabiting a dark mirage of multiverses resembles a Hollywood fantasy, then...
Lighten Up!
Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of
MODERN SCIENCE
Galileo Galilei
Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:
TWO UNDISTURBED BODIES OF MATTER
SMALL LOW-ENERGY NON-COLLIDER
Mr. Natural understands why you may think you already "know" the result of this experiment. But humans have never yet OBSERVED gravity-induced radial motion through the centers of massive bodies. For this we have NO DATA, so we do not really know.
Therefore it behooves us to join Mr. Natural and all science-minded seekers of the truth to fulfill this humble goal, to build and operate humanity's very first SMALL LOW-ENERGY NON-COLLIDER.
Everyone WILL BE GLAD YOU DID!
GravitationLab.com • rjbenish@comcast.net

Fri Mar 15 10:07:56 PM Richard Benish

fqxi.org/grants/large/awardees/view/__details/2008/barbour

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2008 Foundational Questions in Physics and Cosmology
2008 Awardees

2006 Foundational Questions in Physics

Dr. Julian Barbour
Oxford University

Co-Investigators

Joseph Silk, *University of Oxford*
Hans Westman, *Perimeter Institute, Waterloo, Canada*
Edward Anderson, *Pembroke, University of Cambridge, UK*
Sean Gryb, *Perimeter Institute, Waterloo, Canada*

Project Title

Machian Quantum Gravity

Project Summary

Einstein's general relativity and quantum theory describe different things, gravity and atoms, and have remarkably different structures. To overcome this disharmony, theoreticians must unify the two theories in quantum gravity. This is the aspiration of string theory and loop quantum gravity, but I believe that both these leading projects fail to take proper account of an essential issue. I have spent many years studying the foundations of general relativity, in which Einstein sought to find an alternative to the absolute space introduced by Newton to define the motion of bodies. Being invisible, this problematic concept was criticized by Mach (1883), who argued that the positions of bodies are determined relative to each other. Einstein attempted to implement this idea, now known as Mach's Principle, but did so indirectly and thus created confusion despite the great success of his theory. My collaborators and I have clarified the precise manner in which motion is relative in Einstein's theory and thereby identified its irreducible essential principle. The aim of the Machian Quantum Gravity Project is to use this insight to unify the principles of quantum theory and general relativity. It will be a third route to quantum gravity.

Show Technical Abstract

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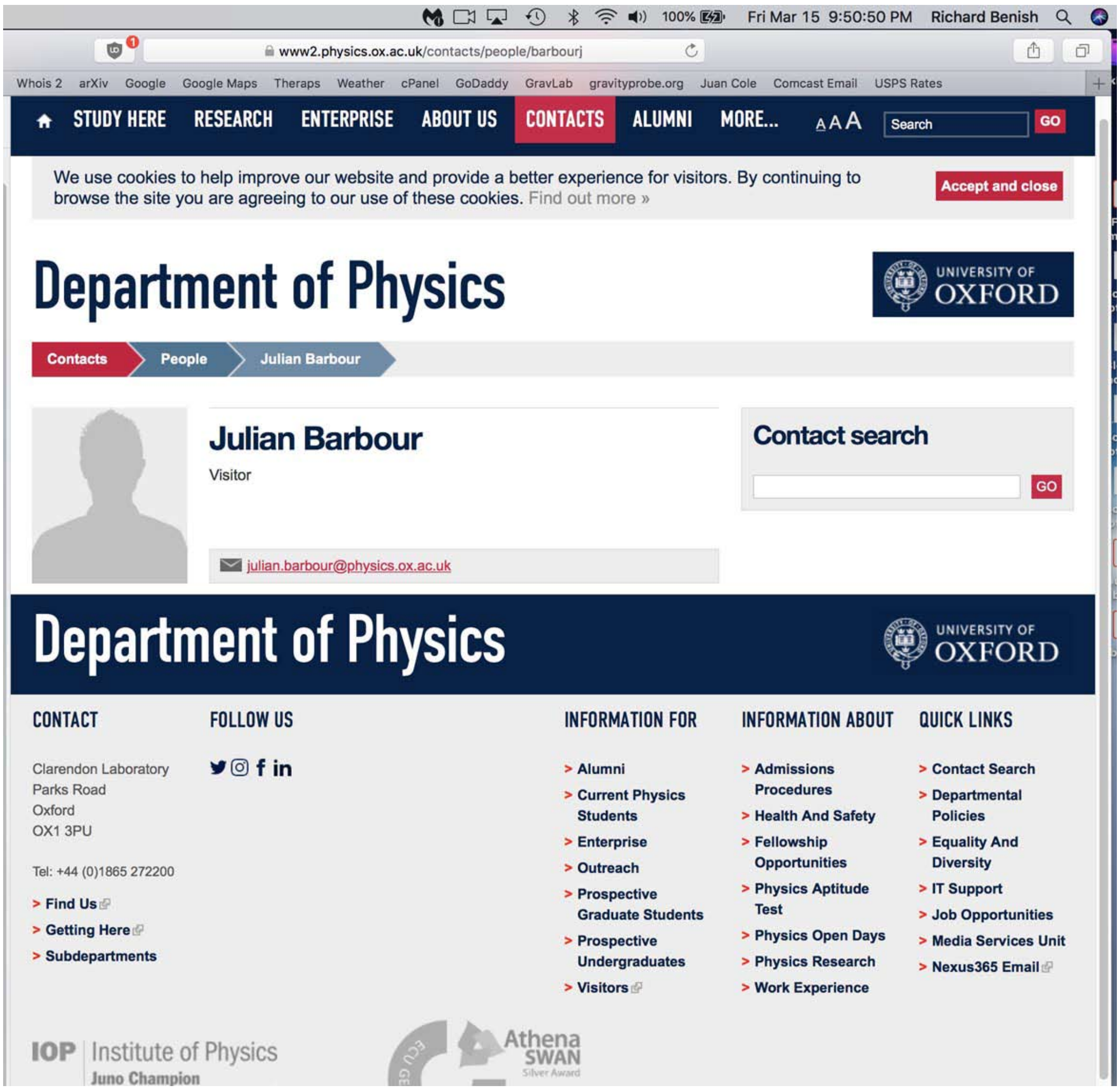
Fri Mar 15 9:50:50 PM Richard Benish
www2.physics.ox.ac.uk/contacts/people/barbourj
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Rainer Weiss

PROFESSOR of PHYSICS • NOBEL LAUREATE (2017)

Massachusetts Institute of Technology • LIGO

Email Correspondence

January 9 – April 1, 2017

PREFACE

On two separate occasions (one in 2015, one in 2017) Weiss replied to my queries about doing Galileo's Small Low-Energy Non-Collider experiment. In the second instance no mention was made of the first. In both instances—more explicitly in the first—Weiss expressed his familiarity with the idea, as it arose in his early days as a professor at MIT. A Small Low-Energy Non-Collider was to function as the mechanical heart of an experimental proposal (Masters Thesis) by one of his graduate students. The motivation was then drastically different from mine. As per the usual, Weiss and his student *presumed* that a pair of massive bodies—one large, with a hole through its center and one small, to be dropped into the hole—would function as an "oscillator," i.e., a gravitational *clock*. And as per the usual, the plans were left unfulfilled.

Echoing an ironically common theme in my respondents' replies, Weiss refers to the idea of actually doing Galileo's experiment as "fun." For no good reason, Weiss and the others deny themselves this fun.

To put Weiss' comments in better perspective, consider that the most basic gravitational effects associated with, say, a uniformly dense sphere—the typical textbook case—are two: *Force* = mass × acceleration (where the acceleration is commonly measured with an accelerometer); and *Speed* (where the meters/second are measured by visual monitoring). These are typically regarded as *Newtonian* effects, as they are predicted with great (though not perfect) accuracy by Newton's theory of gravity.

With the advent of Einstein's even more accurate theory, General Relativity (GR), subtle effects on space and time have often come to the fore. The effect of *spatial* curvature is tiny and usually extremely difficult, if not impossible, to measure. Whereas the effect of *temporal* curvature has, since the 1960s become directly measurable in some important cases, and clearly bears on the matter at hand because of the theoretical link between Newton's theory and Einstein's theory.

That link is called the gravitational *potential*, which is a mathematical thing having the dimensions of velocity squared. As such, it correlates directly with the degree to which clocks are slowed by gravity. As the square-root of the potential, speed is thus also correlated with time dilation (rates of clocks).

Measurements so far obtained—almost entirely in *exterior* gravitational fields, i.e., the regions of space *over* the surfaces of gravitating bodies, like our sphere—show the magnitudes of all three effects increasing together as the surface of the sphere is approached from a further distance: Acceleration increases, speed increases and gravity's effect on clock rates increases. These are empirical facts.

Because of its *relationship* to temporal curvature, spatial curvature is important to consider—even though its measurable effects are small. Note first that its physical reality has been firmly established by carefully measured effects in the Solar System. The curvature of *space*, as distinct from the curvature of time, reveals itself in the advance of the perihelion of Mercury, light-bending around the Sun and Shapiro's *Time Delay* test, as predicted by GR.

One of the things that makes GR's prediction of spatial curvature especially curious is that its relationship to temporal curvature *changes* inside matter. Outside matter (over the surface) the coefficient of spatial curvature $(1-2GM/rc^2)^{-1}$ is everywhere the *reciprocal* of temporal curvature $(1-2GM/rc^2)$.

But *inside* matter GR predicts that the magnitude of these effects abruptly diverges from the pattern established outside matter. Zero curvature corresponds to coefficients that = 1. The maximum deviation for the *spatial* coefficient occurs at the *surface* (similar to *acceleration*, which is also a maximum at the surfsace). Whereas the maximum deviation for the *temporal* coefficient is supposed to occur at the *center*. Spatial curvature is zero at $r = \infty$ and at $r = 0$. Whereas temporal curvature is supposed to be zero only at infinity, and exhibits an extremum at the center of massive bodies.

Why do the predictions for the "metric coefficients" exhibit this curious divergence? Why should they not relate to each other the same way (reciprocally) both outside and inside matter? The theoretical answer is that it is a *consequence of Einstein's field equations*. But *there is no intuitive, physical answer*. That spatial curvature should go to zero at the center is probably more intuitive because of the correlation with acceleration, which also goes to zero. The effects cancel "by symmetry." The question thus becomes: Why does *temporal* curvature not go to zero? Why does the temporal coefficient supposedly exhibit *maximum* deviation from unity at the center? Why do clock rates drop to a minimum at the center? What causes that? Nobody knows.

The general relativistic prediction for *temporal curvature* is directly correlated with the prediction for the Newtonian potential. And the *potential* is directly related to the standard prediction for the gravitational oscillator (i.e., the harmonic oscillation prediction for Galileo's experiment). Therefore, doing Galileo's experiment would not only be a direct test of Newton's theory where it has not yet been tested, it would also provide very convincing (though somewhat less direct) evidence for the temporal curvature prediction of Einstein's theory.

These issues are all clearly discussed in the papers that I sent to Weiss (especially *Gravitational Clock*...). Yet Weiss sees fit to conclude that Galileo's experiment—i.e., the idea of building and operating a Small Low-Energy Non-Collider—is *obsolete*. He writes: "the gravitational clock has passed its time." Really? The thing has never even been born. A gravitatioinal clock has not yet sounded a single tic. But Weiss says it has "*passed its time.*"

This assessment flies in the face of Bradley Schaefer's characterization of progress in science, which is echoed abundantly with many variations throughout the literature of physics: ***"Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."*** My papers and my plea to Weiss humbly suggest that we explore the unexplored gravitational interiors and test the standard prediction ("wisdom") to see if it holds up when compared directly with Nature.

If Weiss had cited some evidence that the standard oscillation prediction has been directly verified, then and only then, would it be justifiable to claim the experiment to have "passed its time." He seems to be entirely uninterested in such data, as he stoicly admits only to having missed out the "fun" of gathering it. Sadly, Weiss chooses to turn his back on the unknown, *pretending* instead that he already knows it full well. By re-trampling the path of dogmatic authority, Weiss slams the door in my face. More tragically, he slams the door in the face of the spirit of humble inquiry.

No fun in that.

weiss@LIGO.MIT.EDU, 10/28/15 5:10 PM -0800, Galileo's Gravity Experiment **1**

To: weiss@LIGO.MIT.EDU
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf:> <Mr-Natural-Says-LR.pdf>

Dear Professor Weiss,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

Among the fundamental principles that would be tested by doing the experiment are time-reversal invariance and energy conservation.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Rai Weiss, 10/29/15 9:56 AM -0700, Re: Galileo's Gravity Experiment **2**

Date: Thu, 29 Oct 2015 12:56:24 –0400 (EDT)
From: Rai Weiss <weiss@ligo.mit.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment

> Richard,
>
> What you are describing was the subject of a Physics Master's Thesis at MIT in 1968. The reference is:
>
> *The Feasibility of a Gravitational Clock to Test the General Theory of Relativity*, Michael Gordon Blitch, MS Thesis, 1968.
>
> The idea was to look for changes of G, the Newtonian gravitational constant, as a function of the time. The notion of G changing in time came from Dirac and then was adopted by Pascual Jordan and Robert Dicke in the middle 1960s when experimental tests of gravitation became part of general physics. The concept for the gravitational oscillator is exactly what you call the Galileo second test. The idea was to launch a satellite with a large round ball of highly homogeneous material which had a diametric hole bored in it. A small ball was placed in the hole and if the gravity gradients in space and the electrostatic charging could be well enough controlled, the ball would exert sinusoidal oscillations in the diamateric hole. The period of the oscillations is given by
>
> 3*pi
> period = SQRT{------}
> G*rho
>
> where rho is the density of the large ball with hole bored in it. With a density say of 4 gms/cm^3, the oscillation period of the ball in the hole is 90 minutes. We went so far as to propose this to NASA but at the time NASA was not interested. It could probably be done now as a free flyer experiment. Unfortunately, the space station has too large gravitational gradients. A tricky bit for

---

* I have never called this experiment "Galileo's second test." I usually refer to it simply as "Galileo's experiment"—the one whose apparatus is a Small Low-Energy Non-Collider, as in the essay sent to Weiss.

> the experiment is that although the small ball is stable for diametric motions (bounded by sinusoidal oscillations), it drifts and becomes unstable for motions perpendicular to the bored diameter. A servo system which does not exert radial forces is needed to stabilize the motion (stop the small ball from hitting the walls of the hole). Nowadays one would do this with lasers and the radiation pressure of light. With more cleverness one could try to make the system operate on Earth using a diamagnetic superconducting suspension. The difficulty will be to reduce the magnetic forces along the diametric hole to a level where the Newtonian gravitational force of the large ball dominates.
>
> I think the gravitational clock has passed its time. We now know that G changes fractionally less than 10^−12/year from the lunar ranging experiments. I don't agree with you that the Galileo second test is necessary to believe in General Relativity or even Newton. There is such good evidence that the gravitational theory we have works. This does not say that building a gravitational oscillator would be a waste. It would be fun but it is not needed to prove that we understand weak field gravitation.

Rai Weiss, 10/29/15 11:56 AM -0700, Re: Galileo's Gravity Experiment **3**

To: Rai Weiss <weiss@ligo.mit.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments: <SLENC as Clock Smalley 1975.pdf> <Rethinking Einstein's Rotation Analogy.pdf> <Maximum Force Nov 17 2011.pdf> <Max Force Annotation.pdf>

>> Dear Professor Weiss,
>>
>> Many thanks for your thoughtful reply.
>>
>> It is a pleasure to receive your insightful details on the early space-based G-measurement proposals. I've attached a copy of a 1975 review by Larry Smalley, which includes your name on the "Distribution" list (p. 37). What I have called a Small Low-Energy Non-Collider is indeed the same thing as what Smalley refers to as a "Gravitational Clock."
>>
>> The technical difficulties you raise (among others) certainly make finding any changes in G—or even measuring G itself to any impressive degree of precision—quite challenging. Suppose, however, that we are not interested in fine-tuning our knowledge of G, but simply want to demonstrate the predicted oscillatory behavior as a first approximation.
>>
>> This should be quite doable in a satellite experiment, or even as an Earth-based laboratory experiment. The apparatus builder, George Herold (at TeachSpin in Buffalo, NY) contemplated constructing such a device (modified Cavendish balance) for this purpose, just because nobody has done it yet.
>>
>> I understand that the abundance of evidence in support of Newton's and Einstein's theories of gravity gives one great confidence that any further weak-field tests will yield similar support. Yet we've never witnessed gravity-induced radial motion through the center of a source mass. Is this not a rather large physical domain to leave unobserved? Is this not an invitation to explore?
>>
>> I've attached another paper (Rethinking Einstein's Rotation Analogy) which proposes a perspective from which doing Galileo's experiment becomes a matter of course. A reference is provided therein to a third

> > paper (also attached) that defends this position with a bit more rigor (*Maximum Force*...).
> >
> > Using an argument similar to one used by Tangherlini, the latter paper shows that agreement with known evidence of space-time curvature OUTSIDE a gravitating body, need not mean that the corresponding INTERIOR solution would be that of GR.
> >
> > What does matter DO to make the rate of a clock at the center of a source mass a local minimum? Since we don't know the answer to this question, should we not probe the interior field in any way possible to gather evidence? Direct clock rate comparisons for this case are not possible. But indirect (and I think compelling) evidence would be gotten by conducting a kinematic (gravitational clock) test.
> >
> > Even if the (admittedly radical) ideas in the attached papers strike you as implausible, it remains that the test proposed by Galileo nearly 400 years ago has never been done. With respect to gravity-induced radial motion, the Schwarzschild interior solution has never been tested. Someday they will be. Why not now?
> >
> > Thanks again for your generous response.
> >
> > Sincerely,
> >
> > Richard Benish

End 2015 Correspondence

To: weiss@ligo.mit.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Testing Gravity
Attachments: <Gravitational Clock Pt 1.pdf>

Dear Professor Weiss,

The attached paper concerns an elaborate and expensive gravity experiment that has been proposed recently, and a simpler, much less expensive experiment that I think should be performed first.

Please send feedback.

Thanks for your good work.

Sincerely,

Richard Benish

P S

Are you having any luck at corroborating LIGO data with simultaneous electromagnetic wave signals?

Thanks again.

RB

Rai Weiss, 6/15/17 9:03 PM -0700, Re: Testing Gravity 2

Date: Fri, 16 Jun 2017 00:03:23 -0400 (EDT)
From: Rai Weiss <weiss@ligo.mit.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Testing Gravity

> Richard,
>
> The idea of a self-contained gravitational oscillator has been thought about for years. The reason for making such a device was originally to test the strong principle of equivalence—that the laws of physics, even gravitation, are independent of the gravitational potential. Or simply that a reference frame freely falling anywhere, even near a strong source of gravity, would be equivalent to any other freely falling frame.
>
> The gravitational oscillator on Earth would be a test of the 1/r^2 character of gravitational force. Some of the experiments that have been done by the Adelberger group at the University of Washington with specially formed plates do this better than the sphere with a hole in in.
>
> You ask if there has been any identification of gravitational wave sources with electromagnetic counter-parts. Up to now there have been no such identifications. The black hole binaries are more likely to have eaten any accretion disks around them which could be the sources of electromagnetic waves. Even so I hope people will keep looking as we are not so sure of this. The more likely source to have an electromagnetic counterpart is the neutron star binary which could well be a source of gamma rays.
>
> R W

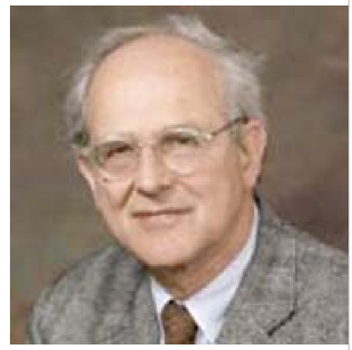
To: Rai Weiss <weiss@ligo.mit.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Testing Gravity
Attachments:

> Dear Professor Weiss,
>
> Many thanks for your reply.
>
> I understand that various tests of the validity of the inverse-square law are regarded as sufficient reason to have no doubts as to the correctness of the standard prediction for the "self contained gravitational oscillator."
>
> Any yet nobody has ever seen nor built one.
>
> I sent my *Gravitational Clock* essay to all six authors of the *Deep Space* paper (attached last time) which proposed turning one on for the first time in the hinterlands of the Solar System.
>
> Virginia Trimble replied, asking if I had sent a copy to Michael Feldman, "the most enthusiastic member of our group." Before I replied that I had, Trimble more emphatically asked if I would "please" send Feldman a copy.
>
> No reply from Feldman.
>
> Should we be so sure there is no need to build a near-space proof-of-concept version of the experiment, or should we take the more cautious approach to, yes, build such a near-space version? Are we so sure the inverse-square law represents a force acting on the falling body? I would make the radical suggestion that we cannot really be sure of this before we actually witness this force yanking the falling object back and forth past the center.
>
> And then there is the General Relativity-inspired question, what exactly does matter DO to make the rates of clocks slow to a central minimum? Maybe this is not what happens at all: Another reason to try the experiment—the sooner the better, in my humble opinion.
>
> Congratulations on the latest LIGO observation.
>
> Cheers,
>
> Richard Benish

End 2017 Correspondence

MIT DEPARTMENT OF PHYSICS

Faculty



RAINER WEISS, SB '55, PHD '62
Professor of Physics, Emeritus
2017 Nobel Laureate

EMAIL: weiss@ligo.mit.edu

PHONE: [Office] 617-253-3527 [LIGO Lab] 617-253-4824

OFFICE: [1] NW22-281 [2] NW17-161

ASSISTANT: Marie Woods (617) 253-4824

RELATED LINKS:

- LIGO MIT
- LIGO Group at MIT Kavli Institute for Astrophysics and Space Research
- MIT Libraries Open Access resources on LIGO & gravitational waves

Areas of Physics:

Experimental Atomic Physics, Atomic Clocks, Laser Physics, Experimental Gravitation, Millimeter and Sub - millimeter Astronomy, Cosmic Background Measurements

Research Interests

Writing this at 73 and having shed the august responsibilities of a full fledged faculty, it is natural to be retrospective rather than to look at prospects.

Currently working on the LIGO project, a joint Caltech and MIT effort, to observe gravitational waves and use them to study gravitation and astrophysics. My role now is to be the equivalent of a grad student. Very much enjoy this. Over the years have worked on cosmological studies with Robert Dicke and David Wilkinson at Princeton. Began physics in atomic beams with John King and Jerrold Zacharias at MIT. If you are really interested, you can read the standard stuff here [PDF].

Major Projects

Atomic Clock development
Balloon program to measure Cosmic Background Radiation,
Science Working Group Chairman, COBE satellite program,
Laser Interferometer Gravitational - Wave Observatory (LIGO)

Biographical Sketch

RAINER WEISS (NAS) is a Professor Emeritus at Massachusetts Institute of Technology (MIT). Previously Dr. Weiss served as an assistant physics professor at Tufts University and has been an adjunct professor at Louisiana State University since 2001. Dr. Weiss is known for his pioneering measurements of the spectrum of the cosmic microwave background radiation, his inventions of the monolithic silicon bolometer and the laser interferometer gravitational wave detector and his roles as a co-founder and an intellectual leader of both the COBE (microwave background) Project and the LIGO (gravitational-wave detection) Project. He has received numerous scientific and group achievement awards from NASA, an MIT excellence in teaching award, the John Simon Guggenheim Memorial Foundation Fellowship, the National Space Club Science Award, the Medaille de l'ADION Observatoire de Nice, the Gruber Cosmology Prize, and the Einstein Prize of the American Physical Society. Dr. Weiss is a fellow of the American Association for the Advancement of Science, the American Physical Society, The American Academy of Arts and Sciences; and he is a member of the American Astronomical Society, the New York Academy of Sciences, and Sigma Xi. He received his B.S. and Ph.D. in physics from MIT. Dr. Weiss is a member of the NAS and has served on nine NRC committees from 1986 to 2007 including the Committee on NASA Astrophysics Performance Assessment; the Panel on Particle, Nuclear, and Gravitational-wave Astrophysics; and the Task Group on Space Astronomy and Astrophysics.

Education

- 1955 - SB, Massachusetts Institute of Technology
- 1962 - PhD, Massachusetts Institute of Technology

Major Positions

- 1960-1961: Instructor of Physics, Tufts University
- 1961-1962: Assistant Professor of Physics, Tufts University
- 1962-1964: Research Associate in Physics, Princeton University
- 1964-1967: Assistant Professor of Physics, MIT
- 1967-1973: Associate Professor of Physics, MIT
- 1973-2001: Professor of Physics, MIT

Carlo Rovelli

PROFESSOR of PHYSICS

Centre de Physique Theorique de Luminy
Aix-Marseille University

Email Correspondence

March 14–15, 2015

PREFACE

For decades Rovelli has been a major proponent of the quest to quantize the gravitational force known as *Loop Quantum Gravity*. He is a well known participant in physics activities such as FQXi-sponsored essay contests and conferences, and Perimeter Institute-sponsored lectures and symposiums. Rovelli is the author of abstruse technical monographs as well as physics books for general audiences.

A figure and snippet of text from the "popular" book, *Reality is Not What it Seems* [Riverhead, 2017] appears below.

Figure 13.1 An intuitive representation of quantum gravity

Exhibit A — In the text surrounding this figure, Rovelli writes: "The world revealed by quantum gravity... is a world that does not exist in space and does not develop in time... Quanta of space mingle with the foam of spacetime, and the structure of things is born from reciprocal information that weaves the correlations among the regions of the world. A world that we know how to describe with a set of equations... I want to go and see it."

To judge the value of any model of gravity that purports to explain its essence or its effects, it is clearly relevant to ask what it says about *accelerometer readings*. How are we to understand *non-zero readings* as indicated by the perpetual flattening of our undersides, and the *zero readings* as indicated by falling bodies? What is the *physical explanation* for these two starkly different circumstances? Like most of Rovelli's colleagues, he never asks such questions.

A hodge-podge of fractalized triangles and flowery incoherent prose about "the structure of things [being] born from reciprocal information" is a *mockery of physics*. It supports the impression that fundamental theoretical physics has become an entertainment industry, much like religion.

Some practitioners do a better job than Rovelli at paying lip service to empiricism and sticking to a more or less coherent story line. A decade or two ago it was fashionable, in vaguely progressive circles, to admit how badly stuck and confused fundamental theoretical physics has become. Anymore, the prevailing schtick is to tell fantastic dreamy stories of the shimmer of the glimmer on the vanes on the feathers of the purple-winged horsies, just over the horizon.

It was *Big Al* himself (leader of the crowded band of *Smartypants Charlatans*) who set the example and gave the green light to dissing "the physical experience of the experimenter" and striving, via mathematics, to reach "up to the regions of highest abstraction." [*Ideas and Opinions*, Crown (1982) p. 282.] Even this iconic god, this maestro sales guy must roll in his grave at the absurdities that now pass for science. What hath *Big Al* wrought? What *Big Al* hath wrought is a throng of Rovelliesque entertainers, trained at and sponsored by Hooba Gooba Headquarters such as Perimeter Institute and similar institutions around the world.

Happily, Rovelli does have a sense of humor, as evidenced by his appreciation for my Mr. Natural postcard, which actually motivated Rovelli to contact me. Having then also looked into some of my other work to find my radical prediction for the result of Galileo's experiment, Rovelli proposed a bet to settle the matter. Sadly, Rovelli's money is not where his mouth is. He backed out after failing miserably to defend his reasons for boldly offering me 100-to-1 odds.

Note that the gist of Rovelli's argument echoes the status quo idea that Galileo's experiment has been "effectively" done. We don't need to really do it because we already know the answer. As I've stated or implied elsewhere, this is just lame, sloppy, inexcusable pseudo-science.

Nothing like a Small Low-Energy Non-Collider has ever been operated by humans—not even close.

From: carlo rovelli <rovelli@cpt.univ-mrs.fr>
Date: Sat, 14 Mar 2015 17:29:00 +0100
Subject: !
To: rjbenish@comcast.net

I got your (great) card. I like your style a lot, and was very happy of receiving it.
But I could bet 100 to 1 that it does not slow down, it oscillates...
c

~~~~~~

carlo rovelli
centre de physique théorique de luminy
aix-marseille university
ph +33 6 14 59 38 85, +39 348 22 51 583
rovelli@cpt.univ-mrs.fr

~~~~~~

carlo rovelli, 3/15/15 3:16 AM -0800, Re: ! 1

To: carlo rovelli <rovelli@cpt.univ-mrs.fr>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: !
Attachments: <Galileo's-Belated-Experiment.pdf > < SGM-CN-and-DE-Sep-6-09.pdf >

> Dear Professor Rovelli,
>
> OK, you're on!
>
> Whatever you can get 100 of, I guess I should be able to get one of them.
>
> But seriously, if gravitational physics were in a healthy state, would the result of an experiment proposed by Galileo be the subject of a WAGER? Should it not already be an empirical FACT?
>
> When do we get started?
>
> Thanks for your interest and your sense of humor. :)
>
> Cheers,
>
> Richard Benish
>
> P S
>
> As you can see from the attached papers, I am willing to bet that accelerometer readings will turn out to be more accurate indicators of our actual state of motion than our visual impressions that falling objects accelerate downward. It does *not* oscillate.
>
> R B

carlo rovelli, 3/15/15 3:43 AM -0800, Re: ! 2

From: carlo rovelli <rovelli@cpt.univ-mrs.fr>
Date: Sun, 15 Mar 2015 12:43:25 +0100
Subject: Re: !
To: Richard J Benish <rjbenish@comcast.net>

> > well, just the name"non-collider"would be a good enough reason for trying the experiment…
> > but:
> >
> > > But seriously, if gravitational physics were in a healthy state, would the result of an experiment proposed by Galileo be the subject of a WAGER? Should it not already be an empirical FACT?
> >
> > not really.
> >
> > every slightly redesigned experiment is something new, and, to be infinitely open-minded, one could expect something new to happen. So, EVERYTHING can be subject of a wager. how do you know gravity would just stop tomorrow, for instance?
> >
> > but, except for few interesting cases every experiment is a version of something we have already tried many times. and therefore just a bit of being reasonable, or perhaps just a lot of induction from centuries of observations that Nature likes to be consistent, imply that by far our best bet is that things will keep happening in the way we have observed to do.
> >
> > it is true, as you say that, strictly speaking, the galileo experiment has not be done, but many observations very close are common. a very well known, for instance, is that inside the solar system, or inside a galaxy, the observed observation of an object is always very precisely given by the sum of the forces from all the surrounding bits of matter. if there was ant tiny discrepancies from that, we would have detected it, for instance in the very precise Solar System measurements. For what you expect to happen, there should be a dramatic violation of Newton gravitational law at these scales.
> >
> > Everything is possible, but it is more likely that tomorrow I happily realise I can fly by agitating my arms…
> >
> > c

carlo rovelli, 3/15/15 11:27 AM -0800, Re: ! 3

To: carlo rovelli <rovelli@cpt.univ-mrs.fr>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: !
Attachments: <Maximum Force Nov 17 2011.pdf >

> > > Dear Professor Rovelli,
> > >
> > > Did I just see a Rovelli-Bird fly by my window?
> > >
> > > Ah yes, all sorts of silly things can be imagined as being possible. I'd better not get started with the list from modern academic physics.
> > >
> > > Your argument that observations from existing experiments are "very close" to verifying Galileo's experiment as well, I have heard many times. Among the reasons that I find it unconvincing are

certain differences between the accepted exterior solutions of gravity and the extrapolated interior solutions.

The idea that gravitational potential continues to decrease from the surface inward corresponds to the GR idea that the rates of clocks continue to decrease to a central minimum. This entails the TEMPORAL coefficient in the corresponding Schwarzschild solutions. Curiously, the SPATIAL coefficient does not follow the same pattern. OUTSIDE matter the spatial coefficient is everywhere the inverse of the temporal coefficient. But INSIDE matter the spatial coefficient diverges, going to unity (flat space) at the center.

In some ways similar to the arguments of Tangherlini (cited in the attached paper; see especially pp. 9-10), my arguments suggest instead that the temporal and spatial coefficients are ALWAYS reciprocals of each other. (They BOTH go to unity at the center.)

In either case, the predictions have not been tested.

As also argued by Tangherlini, it is possible to find a solution that is empirically indistinguishable from Schwarzschild's exterior solution that may nevertheless correspond to INTERIOR solutions that differ markedly from the standard predictions of GR, and even Newton.

I understand your reasoning based on the idea of attractive forces summed over every bit of matter within a given volume. I understand how "self-evident" this reasoning may seem and how radical it is to propose any "dramatic violation of Newton gravitational law at these scales."

The advice of Herman Bondi, if taken to heart, means that, without direct empirical support, we should nevertheless remain unsatisfied with such arguments because a mathematical extrapolation from the outside to the inside is not an acceptable substitute for a physical fact:

> "It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is doing so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called speculation."

From this advice (and the arguments above) it follows that existing empirical observations are actually nowhere near sufficient to establish the validity of the interior solutions of Newton and Einstein. However embarrassing it may be to admit, modern gravitational physics suffers from a large and profound gap in empirical data.

I hope you are still interested in following through with your bet, to settle up only after the result of Galileo's experiment is in the record books.

Thank you very much.

Sincerely,

Richard Benish

From: carlo rovelli <rovelli@cpt.univ-mrs.fr>
Date: Sun, 15 Mar 2015 21:49:04 +0100
Subject: Re: !
To: Richard J Benish <rjbenish@comcast.net>

wait: "exterior" and "interior" to a body has nothing to do with "exterior" and "interior" of an event horizon. * in the bodies you want to test we are always "outside" the event horizon.
the real question is not what happens inside or outside, but whether there is room for any violation of Newton theory at velocities and potentials << c.

How can a stone know if it is "inside" or "outside" of anything? The gravitational potential is just the linear sum of the potentials of each bit of matter, and the acceleration is its gradient. What could be the *possible* theory that could give your strange prediction and be consistent with all we do with gravity in the Newtonian limit?

c

* One of the most commmon misunderstandings in my correspondence with physicists is that they regard my reference to INTERIOR solutions as referring to inside the "event horizon" of a black hole. I'm talking about the reality under our noses, inside the nearest body of ordinary matter. But they misconstrue and seem to insist on thinking the world revolves around their exotic fantasies.

carlo rovelli, 3/15/15 1:31 PM -0800, Re: ! 1

To: carlo rovelli <rovelli@cpt.univ-mrs.fr>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: !
Attachments: <Max Force Annotation.pdf>

Dear Professor Rovelli,

A free stone does not know if it is inside or outside of anything, as you say.

But if an accelerometer is attached to the (ideally massless) stone, it gives either a zero or non-zero reading depending on whether it is falling or not. I understand that the idea of taking accelerometer readings for face value at first sounds absurd because it violates the usual way of calculating motion from a potential.

The paper attached last time (*Maximum Force Derived from Special Relativity, the Equivalence Principle and the Inverse-Square Law*) gives a fairly readable account of the "theory" (better *model*) on which I base the prediction that the test object does not oscillate in the hole. According to the model, gravity is not a force of attraction at all, but rather the process by which matter generates space. The process requires a fourth spatial dimension.

I've attached an Annotation that describes how the paper "almost" got published in the *International Journal of Theoretical Physics*.

I hope you have time to take a look at the paper.

Independent of my radical theoretical ideas, I still maintain that a thorough investigation of gravity should include an empirical test of Galileo's experiment.

Thank you very much.

Sincerely,

Richard Benish

From: carlo rovelli <rovelli@cpt.univ-mrs.fr>
Date: Sun, 15 Mar 2015 22:35:24 +0100
Subject: Re: !
To: Richard J Benish <rjbenish@comcast.net>

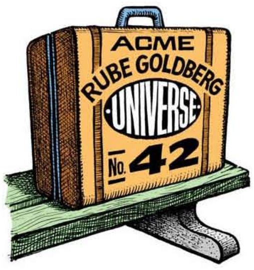
> > > > > > ok... will read... i am far from convinced...
> > > > > > an accelerometer attached to something falling reads nothing at all...
> > > > > > ...but i will read...

Mr. Natural SAYS:

If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...

If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...

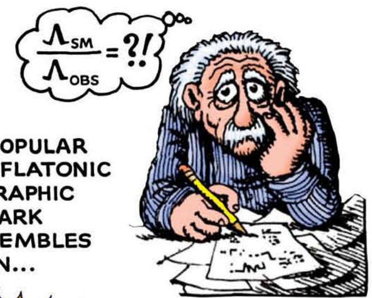
If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...



If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...

OR

If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...



Lighten Up!

Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of

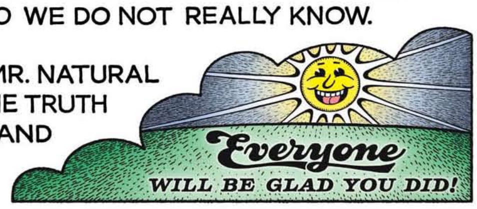
MODERN SCIENCE

Galileo Galilei

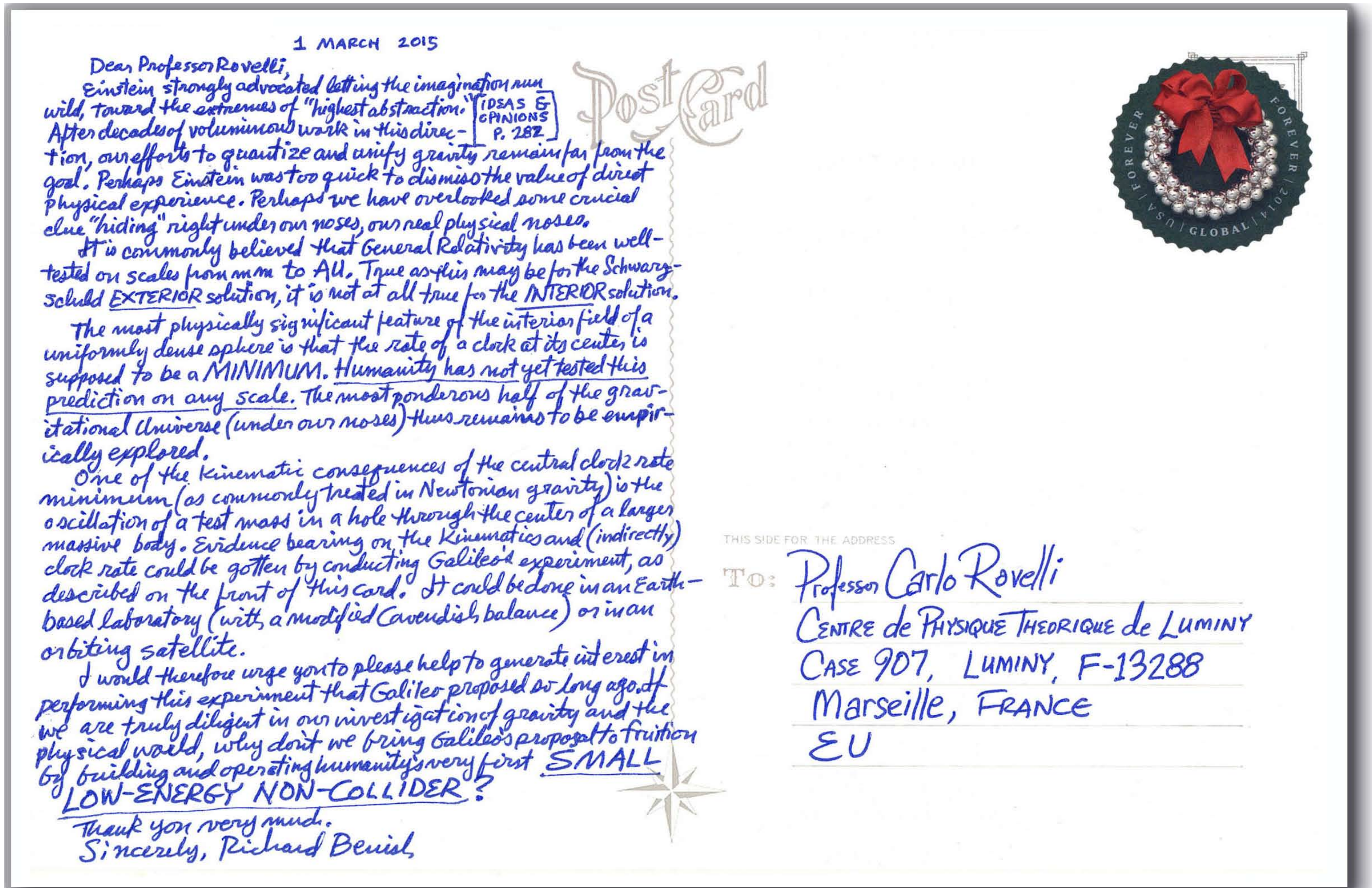
Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:

Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET **OBSERVED** GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE **NO DATA**, SO WE DO NOT REALLY KNOW.

Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST **SMALL LOW-ENERGY NON-COLLIDER.**



GravitationLab.com • rjbenish@comcast.net



1 MARCH 2015

Dear Professor Rovelli,

Einstein strongly advocated letting the imagination run wild, toward the extremes of "highest abstraction." [IDEAS & OPINIONS P. 282] After decades of voluminous work in this direction, our efforts to quantize and unify gravity remain far from the goal. Perhaps Einstein was too quick to dismiss the value of direct physical experience. Perhaps we have overlooked some crucial clue "hiding" right under our noses, our real physical noses.

It is commonly believed that General Relativity has been well-tested on scales from mm to AU. True as this may be for the Schwarzschild EXTERIOR solution, it is not at all true for the INTERIOR solution.

The most physically significant feature of the interior field of a uniformly dense sphere is that the rate of a clock at its center is supposed to be a MINIMUM. Humanity has not yet tested this prediction on any scale. The most ponderous half of the gravitational Universe (under our noses) thus remains to be empirically explored.

One of the kinematic consequences of the central clock rate minimum (as commonly treated in Newtonian gravity) is the oscillation of a test mass in a hole through the center of a larger massive body. Evidence bearing on the kinematics and (indirectly) clock rate could be gotten by conducting Galileo's experiment, as described on the front of this card. It could be done in an Earth-based laboratory (with a modified Cavendish balance) or in an orbiting satellite.

I would therefore urge you to please help to generate interest in performing this experiment that Galileo proposed so long ago. If we are truly diligent in our investigation of gravity and the physical world, why don't we bring Galileo's proposal to fruition by building and operating humanity's very first SMALL LOW-ENERGY NON-COLLIDER?

Thank you very much.

Sincerely, Richard Benish

THIS SIDE FOR THE ADDRESS

To: Professor Carlo Rovelli
CENTRE de PHYSIQUE THEORIQUE de LUMINY
CASE 907, LUMINY, F-13288
Marseille, FRANCE
EU

FQXi COMMUNITY

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Georgina Woodward: "The cosmos still existing as it is seen is a product of the mind. By that I..." *in* Black Hole Photographed...

Steve Dufourny: "Let it be clear, we are on a planet with so many beautiful creations, but..." *in* Information as Fuel — A...

Anonymous: "Again, thanks Steve, it is in your wheelhouse. So if you and others wish to..." *in* Thermo-Demonics

Steve Dufourny: "Considering primordial informations.The supermassive BHs are fascinating,we..." *in* Information as Fuel — A...

Lorraine Ford: "The above post was from me." *in* The Nature of Time

Anonymous: "I'm arguing that information doesn't float in some hypothetical ether...." *in* The Nature of Time

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FQXI ARTICLE

April 24, 2019

The Spacetime Revolutionary

Carlo Rovelli describes how black holes may transition to "white holes," according to loop quantum gravity—a radical rewrite of fundamental physics.

by Colin Stuart

FQXi Awardees: Carlo Rovelli

December 13, 2016

You might call Carlo Rovelli a reluctant physicist. "I wasn't one of those kids who was enamoured with science at an early age," he says. "I only decided to study physics after the exclusion of everything else."

Carlo Rovelli
CTP Luminy, Marseille

Rovelli, now at the Centre for Theoretical Physics, in Luminy, Marseille, France, certainly didn't think it would become his career—or that he might one day be known for co-founding a radical new theory to explain the origins of spacetime, loop quantum gravity. He is now investigating whether evidence for this model could be found in the form of "white holes," formed as black holes turn themselves inside out, spewing, rather than swallowing, matter.

Rovelli recounts that he only went to university in order to delay enrolling in Italy's compulsory military service. So he freely concedes that he was far from a model student. Attending university in the Seventies he was swept up in political activism, a legacy from the halcyon days of the late Sixties. "I was more into trying to change the world than studying," he admits. But Rovelli soon realised he wasn't getting vary far with his political revolution. It was only then that he started studying relativity—Einstein's ideas on gravity that involve weaving space and time together into a four-dimensional fabric—and quantum mechanics—the theory governing the world of the very small—in more detail. He describes what came next as a flash. "It was incredibly beautiful," Rovelli says. "I fell in love with it."

One Brief Lesson on Physics-Writing

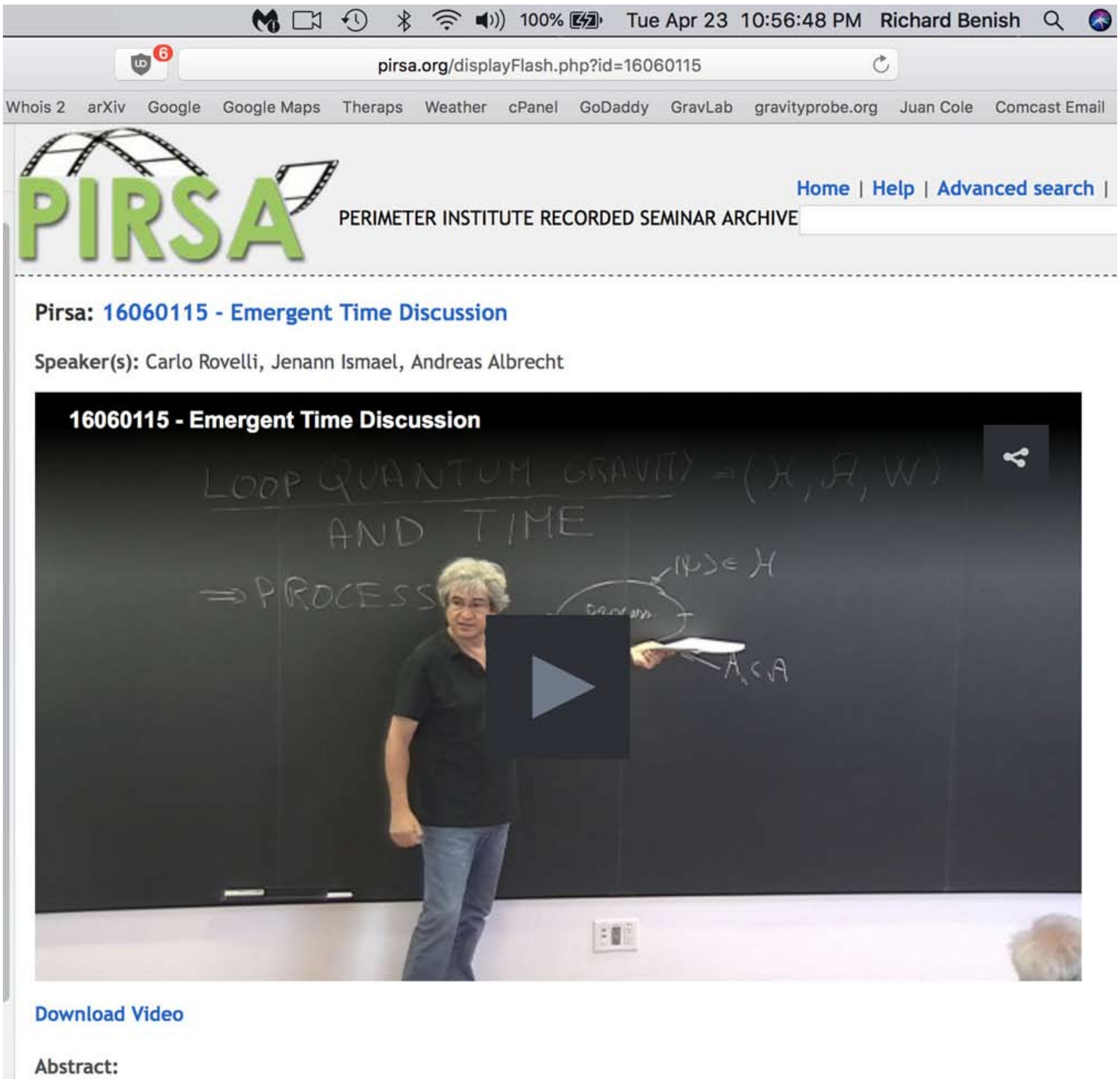
Carlo Rovelli discusses his international bestseller, "Seven Brief Lessons on Physics," with Colin Stuart.

LISTEN:

Go to full podcast

Immersing himself in physics, Rovelli's studying habits changed. During a wander around the library at the University of Bologna he stumbled across a review article on quantum gravity—the quest to unite Einstein's theory of gravity and quantum mechanics—by British physicist and FQXi member Christopher Isham. It would change everything. Rovelli was captivated by how the subject required us to completely change our views about space and time. "I thought wow, this is better than LSD. I want to do this!" he says. He then realised that physicists might be able to change the world even more than political revolutions do. "I think that Copernicus and Dirac and Einstein changed the world quite a lot," Rovelli says. "I wanted to be part of this common adventure."

Rovelli then went on to do a PhD, at the University of Padua, Italy, but unusually for a doctoral student he didn't publish any papers, instead choosing to focus on mastering the different approaches to quantum gravity. Doctorate complete, he set out on his own,


Tue Apr 23 10:56:48 PM Richard Benish
pirsa.org/displayFlash.php?id=16060115
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Speaker(s): Carlo Rovelli, Jenann Ismael, Andreas Albrecht
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LOOP QUANTUM GRAVITY
AND TIME
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Abstract:

Holger Müller

PROFESSOR of PHYSICS

University of California, Berkeley

Email Correspondence

January 8 – 11, 2015

PREFACE

The whiz kid Müller (first patent at age 14) sees the "fun" in doing Galileo's experiment, thinks it "could be worthwhile," but has insufficient curiosity to take any action to make it happen.

Has Müller tragically lost the inquisitive spirit of childhood? Of a detective in search of the truth, in commitment to leaving no stone unturned? Even if he has no "doubt about the outcome," are we to just leave it at that? Or do we probe *Nature* to justify this peculiar (unscientific) appeal to human *confidence*?

Friendly as his response certainly is, I will never cease to be bewildered and unimpressed by this kind of underlying smugness and loyalty to authority.

Same as it ever was.

To: hm@berkeley.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Mr-Natural-Says-LR.pdf>

Dear Professor Mueller,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Holger Mueller, 7/11/15 5:50 PM -0800, Re: Galileo's Gravity Experiment 1

From: Holger Mueller <hmberkeley@gmail.com>
Date: Sat, 11 Jul 2015 18:50:19 -0700
Subject: Re: Galileo's Gravity Experiment
To: Richard J Benish <rjbenish@comcast.net>

> Dear Richard,
>
> I think this is a fun idea. Frankly, I don't think there can be any doubt about the outcome, and so doing the experiment would be more for fun and for instructional purposes, but could be worth doing nevertheless.
>
> Let me estimate the resonance frequency of an object inside a sphere of radius *R* with density rho. Just at the surface, the force is 4 pi G *m* *R* rho/3, so the "spring constant" is 4 pi G *m* rho/3 and the resonance angular freq. is (4 pi G rho/3). For rho=10 g/cm^3, this is about 1 cycle/hour. Is this correct?
>
> How to check it? I'm thinking about a torsion balance holding a pair of little spheres, inside a hole in big spheres that cause the potential…
>
> Holger
>
> Btw, wow about the slide. Are you a professional designer?

To: Holger Mueller <hmberkeley@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments: < NewtonOscillationPeriod.jpg >

Dear Professor Mueller,

Your estimate is indeed correct. The equation for the period is:

$$T = \sqrt{\frac{3\pi}{G\rho}},$$

If the density is that of lead (1130 kg/m^3) then the period is almost exactly one hour.

I am very glad that you think doing the experiment would be both fun and worthwhile. Having the demonstration executed would allow all the textbooks and discussions of the prediction (which are many) to at last be accompanied by references to those who carried it out. Whereas the presently accepted practice is to avoid discussing the need for (or at least desirability of) empirical evidence.

The apparatus builder, George Herold, of TeachSpin in Buffalo, New York, once expressed an interest in doing the experiment (with a modified Cavendish balance).

I am also grateful for your feedback on the graphic. Yes, I have a background in visual art. (A few of the elements were "borrowed" from others, notably, R. Crumb.)

Some of my correspondents have shared that gaining the funding to do Galileo's experiment—because its result is presumed to be known—would be a major obstacle. I understand this as a practical reality, of course. And yet it sometimes strikes me as a weak excuse, especially given the high cost of so many other experiments that have been proposed, are under way, or have been carried out.

Do you have any suggestions for how to convince those with the needed resources that doing Galileo's experiment would be a worthwhile endeavor?

Thank you very much.

Sincerely,

Richard Benish

P S

The equation is both pasted in the body copy and attached as bona fide attachment because sometimes only the latter works.

R B

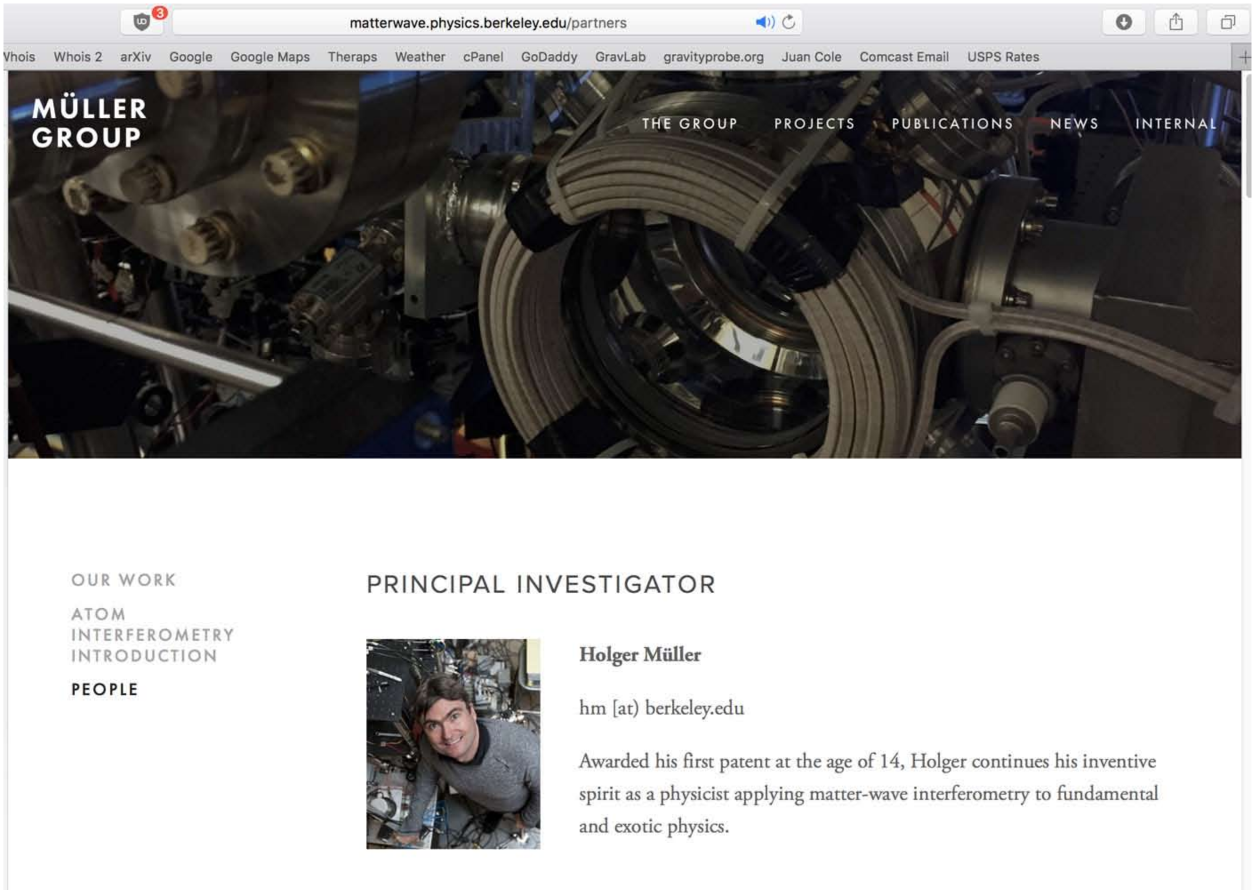
From: Holger Mueller <hmberkeley@gmail.com>
Subject: Re: Galileo's Gravity Experiment
Date: Sun, 12 Jul 2015 15:34:38 +0200
To: Richard J Benish <rjbenish@comcast.net>

> > > To convince funding agencies, we'd need to show that some new science can be gained from it, such as a new limit in deviations from the $1/r$ law at cm distance sales. Do you happen to know how well this has been verified?
> > >
> > > Another possibility would be to ask how well we know the "inside" potential of a sphere. But that would be harder to argue, because we never enter the material itself…
> > >
> > > Holger
> > >
> > > Sent from my iPhone

To: Holger Mueller <hmberkeley@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

> > > > Dear Professor Mueller,
> > > >
> > > > In 1985 Hoskins et at (*Phys Rev D*, Vol **32** #12 p. 3084) reported on a beautiful experiment involving a torsion arm and a tall movable cylinder (into which the test mass was suspended). The result was that deviations from the inverse-square law had to be smaller than about 10^(−4 or −5). this cast doubt on some of the "fifth force" speculations being contemplated in those days. More recently, I think the EotWash group has yielded even tighter contraints.
> > > >
> > > > I think your idea of measuring the POTENTIAL, on the other hand, is excellent. As you have impled, we have yet to "enter" this kind of measurement inside matter. As I understand it, the potential could be measured two ways: 1) by allowing free-fall motion over a wide range inside a massive body (direct).
> > > >
> > > > Or 2) to measure the rate of one or more clocks insde matter (indirect). This amounts to measuring the gravitational red-shift, as has been done over Earth's surface. Unfortunately, the latter idea would be virtually impossible due to the smallness of the effect for any conveniently accessible bodies. Which therefore leaves us with (1): motion through the center.
> > > >
> > > > Another way of looking at the above relationship is that an experiment involving free-fall motion past the center is an INDIRECT way of testing the Schwarzschild INTERIOR solution, which predicts that clock rates get slower toward, and reach a minimum at, the center. Even though indirect and crude compared to other tests of GR, the test would nevertheless serve to ascertain, as a first approximation, whether clocks do indeed get slower toward the center. (Presently, we have to admit that we don't

> > > > really know.)
> > > >
> > > > I like calling the needed aparatus a Small Low-Energy Non -Collider. Sadly, this marketing angle has not yet proven to be of much benefit in selling the idea. Pointing out that the idea was first proposed by the Father of Modern Science, yet remains to be fulfilled, strikes me as a strong selling point. But I'm still knocking on doors.
> > > >
> > > > Thanks for your suggestions.
> > > >
> > > > Sincerely,
> > > >
> > > > Richard Benish



matterwave.physics.berkeley.edu/partners

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ATOM INTERFEROMETRY INTRODUCTION

PEOPLE

PRINCIPAL INVESTIGATOR

Holger Müller

hm [at] berkeley.edu

Awarded his first patent at the age of 14, Holger continues his inventive spirit as a physicist applying matter-wave interferometry to fundamental and exotic physics.

Daniel Kennefick

PROFESSOR of PHYSICS

University of Arkansas

Email Correspondence

September 23 – November 29, 2014

PREFACE

Kennefick is probably best known as the author of a book about gravitational waves, *Traveling at the Speed of Thought* [Princeton, 2007]. More obscure is Kennefick's essay about the difference between *belief* and *imagination* in children's movies and literature: *A Few Beasts Hissed: Buzz Lightyear and the Refusal to Believe.**

I began my correspondence with Kennefick by suggesting a connection between these seemingly disparate categories: gravitational physics and children's fiction. Kennefick expressed some appreciation and amazement that I had read his work in both fields. So we were off to a good start.

In his second paragraph Kennefick agrees that it would be a good idea to perform Galileo's Small Low-Energy Non-Collider experiment. A couple weeks after the dialog had fizzled out, I tried to rekindle it by referencing Martin Beech's essay on the *Tunnel-Through-the-Earth* thought experiment. To illuminate this context, I have inserted my communication with Beech in the following pages.

My dialog with Kennefick continued after I sent him a few hard-copy documents. He subsequently offered to introduce me to the Canadian physicist and General Relativity expert, Eric Poisson. But this never happened.

Coming back to where our communication started, a striking parallel presents itself. The pattern is revealed, on one side, as a key theme in Kennefick's *Buzz Lightyear* essay. On the essay's first page, Kennefick begins explaining the difference between, and significance of, *belief* and *imagination* in childhood development and adult society, by recounting a tension-filled scene in the early 1900s story *Peter Pan*. (See enclosed.)

In the storybook dreamworld called *Neverland*, the magical fairy, Tinkerbell is dying, as an audience of children and imaginary creatures look on. Peter Pan implores the audience to clap as a way of keeping her alive. At this juncture it is written: "Many clapped. Some didn't. A few beasts hissed." Following Kennefick's analysis, these words also bring his essay to a close, because we should now be able to answer the question he opens with: "*Why did those beasts hiss?*" In Kennefick's first paragraph, he begins his answer:

> "The children who believe in fairies were the ones who didn't clap. The more vocal of them might have hissed."

How, if at all, does this scene relate to the current state of gravitational physics? I think a connection can be made as follows. First consider Kennefick's observation:

> "Peter's appeal [presumes] that fairies cannot continue to live unless we believe in them. Nothing admits disbelief more than the demand that we must all believe or what we each believe will no longer be true."

Kennefick's argument here is that the belief that Peter's plea is intended to evince is *conditional*—in two ways: 1) It regards belief as a largely communal act, dependent on and

* In the collection of essays, *The Galaxy is Rated G*, Eds. R. C. Neighbors and Sandy Rankin (McFarland, Jefferson, North Carolina, 2011) pp. 83–95.

influenced by the words and actions of others. And 2) It requires a kind of ritualistic gesture (clapping) to make the believed thing "come true" or remain true. (Echoes of *religion* are inescapable.)

Now consider the over-arching context: It's the fantasy world of a child, which also resembles a dream-like state—both of which may be likened to a *level of consciousness*, a level of consciousness in which thoughts and ideas are not constrained by physical reality. Different responses to the problem (Will Tinkerbell die? Do fairies exist?) evidently reflect different states of slumber or wakefulness; child-likeness or maturity; delusion or enlightenment. To hiss, not clap, or clap.

The latter responses reflect a spectrum upon which hissing, I would argue, represents the least enlightened, most aggressive perpetuation of the fantasy state. (*My world is real! Don't need no stinkin' clapping!*) This interpretation is bolstered by the fact that in the original story it was only beasts who hissed—the ones whose "reality" is most definitely threatened by lack of belief. (Even as the successfully revived Tinkerbell said she wanted "to get at the ones who had hissed"—about which more below.)

Note that Kennefick reasons that older children who would rather grow up or be treated more as adults may also be among the hissers, because it is insulting to be implored to "believe on cue." This is a different reason for hissing than that of the beasts. So Kennefick's argument is more complicated than my simple one which, in any case, is more conducive to comparison with the *belief system of academic physics*.

With that in mind, now consider the next steps on the spectrum. *Not clapping* is more ambivalent, but leaning toward an implicit acceptance of things as they are (fantasy).

Whereas clapping reflects at least some acknowledgment of cause and effect. *What we end up believing depends to some extent on our conscious action.* By consciously *deciding* what to believe our actions could even cause our beliefs to transform. Consistent with this analysis is that "Tinkerbell did not think of *thanking* those who believed" (clapped) because doing so would evoke thoughts of the opposite; it could fuel the alternative of *not* believing. Whereas the thought of revenge on the angry hissers would thicken the plot and thereby deepen and perpetuate the fantasy state. Tinkerbell's investment in fantasy is 100%.

Conscious reinforcement of fantasy by politely clapping may thus be the most "mature" action of the three. But it falls woefully short of the fully adult response of perceiving the need to awaken from the dream and face the real world, either by gradually evolving (growing up) or snapping out of it. To neither hiss nor clap, nor passively accept, but to put an end to all the hooba gooba by recognizing the story for what it is: *just a story*.

With this pattern in view, the following parallel may thus be drawn: We illustrate the pattern by following the same progression up the spectrum outlined above. A few of my correspondents (most notably Strassler and 't Hooft) appear to have felt it worthwhile to reply to my pleas to perform Galileo's experiment by "hissing," by exhibiting defensive umbrage at the idea of doubting Newton and Einstein (fairies? gods?). *How dare you question my reality. How dare you suggest that my reality needs validation by more empirical evidence than we already have.*

The thousands of recipients who have *ignored* my pleas correspond (roughly) to the unclapping characters in the story. I.e, those who are comfortable enough with the status quo, to not be bothered with advancing science by looking under any unturned stones. *No worries. Tinkerbell will be fine.*

Those who clap politely (civilized email reply)—being more common than hissers—do so, perhaps, *to convince themselves* that Galileo's experiment need not be done: It's already "been done" or it's been "effectively" done. These "clappers" open themselves to a further response from me, in which I point out the wishful, unscientific character of their arguments; to engage their "better angels," as it were. What better angel is there than the spirit of Galileo himself ("father of modern science")? Would Galileo say, "I already *know* the result of the undone, yet doable, experiment," or would he rise to the occasion and actually *DO* it?

In the interest of transcending the storybook options, up the spectrum (by quantum leap?) to a state of enlightened wakefulness, I repeatedly pound the Galileo connection, urging that we live up to the scientific ideals that he also urged. So far, my correspondents have not yet been compelled into action by such arguments. Somehow they justify ignoring the ideals of science. (*Not my department. Nothing worth investigating. Ignorance is bliss.*) In the best cases, they just wish me luck and go on their merry ways.

Yet I persist. Surely somebody out there is awake enough to understand that we really ***MUST*** replace the big red question marks in the *Small Low-Energy Non-Collider* graphs with physical data. (See next page.) Surely a higher level of consiousness corresponds to having obtained the result of Galileo's experiment by actually doing it. Surely.

Now to the role of *imagination*. How does childhood imagination differ—if at all—from adult imagination, in quality, quantity and significance? And what has it to do with *belief*?

Imagination is the tool of invention and discovery. It's what makes us human. What we imagine can be used for bad or good; to foster delusion or enlightenment. It is the driving force from which we acquire both belief and knowledge. Curiously, the word *knowledge* does not appear in Kennefick's essay even once.

A long time ago humans imagined intentionally planting seeds to grow food in an organized way (agriculture); we imagined a thin slice of a rolling stone (wheel); we imagined printing presses, radios, cars, rocket ships, geodesic domes, computers and robots. We've drawn pictures of these things, built them and discovered that they work! *Hallelujah!* The imagined ideas come true—not by arbitrary rituals, but by sweaty trial-and-error, because they are consistent with the actual facts of the Univere. This short list represents a vast store of reliable empirical *knowledge*, all of which originates in human imagination, and which grows ever larger by its conscious application.

Humans have also imagined monsters under the bed; tyrannical gods who we're supposed to fear lest they send us to Hell. We've imagined colorful muscular superheros (*Vroom! Smash! Bam! Kapow!*) who make us feel small and weak. We've imagined Earth being the center of the Universe. We've imagined magical forces of attraction "mediated" by loopy or stringy "gravitons," which flavor of thinking has also spawned dark inflatonic stringbrane holograms and an overall portrait of a bizarre, fragmented and grotesquely ugly Universe. We've imagined a Universe that supposedly *began* pretty much like it says in the *Bible*; multiverses, singularities and static chunks of stuff. And that a Small Low-Energy Non-Collider (Galileo's experiment) produces an oscillatory motion between the extremities. All of these imagined things are consistent with the *Neverland* belief that a *real world* accelerometer reading does not have to mean what it says. Regardless of reading, it either is or is not accelerating, the choice is yours.

Unlike the inventions listed in the paragraph just prior to the last one, though some of these latter imagined things can be drawn, none of them represent reliable *knowledge*. They are not thoroughly, if at all, *tested* in the court of physical reality. They are just and only stories; beliefs, not knowledge, contrary to impressions sometimes given by academic authorities.

We might come to expect such a babelesque view of the world, given the truth in Kennefick's assessment of the connection between belief and imagination:

> By practice one's imaginative faculty becomes able to maintain a single belief for long long periods, essentially indefinitely. Then one has achieved adulthood and one is expected not to "play around" with this belief any longer…It is considered bad form in the adult world to play with belief.

As justification for resigning oneself to the world of adult belief, Kennefick appeals to examples such as the widespread use of paper money. In my opinion, such social practices are less about "belief" than agreements about the meaning of *symbols*. Do we *believe* in the letter Q or the number 17? No, we simply agree on what they mean.

As noted above, Kennefick refrains from connecting imagination with *knowledge*, by contrast with its clear connection to *beliefs*, both harmless and pernicious. Nevertheless, Kennefick acknowledges that: "There is no more empirical evidence for the existence of God than for the existence of the Tooth Fairy, in fact there is rather less!" He also makes the hugely important point:

> [Children] are freer to run through [beliefs] more quickly [than adults]. Thus we could say they are *more* imaginative to the extent that they have *less* belief, because by stopping more briefly at each imaginary place they can visit more widely amongst them than is true of those (for instance, adults) with more belief.

Physicists' adamant refusal to believe accelerometer readings is, I believe, an exercise in stunted imagination run amok. Since they are now adults, physicists are no longer inclined to "play around" with this disbelief. It's their story and they're sticking to it. If only they would have retained more of their child-like flexibility, they would happily revisit the possibility: "Hey, maybe accelerometers tell the truth. Let's play with this; let's test it."

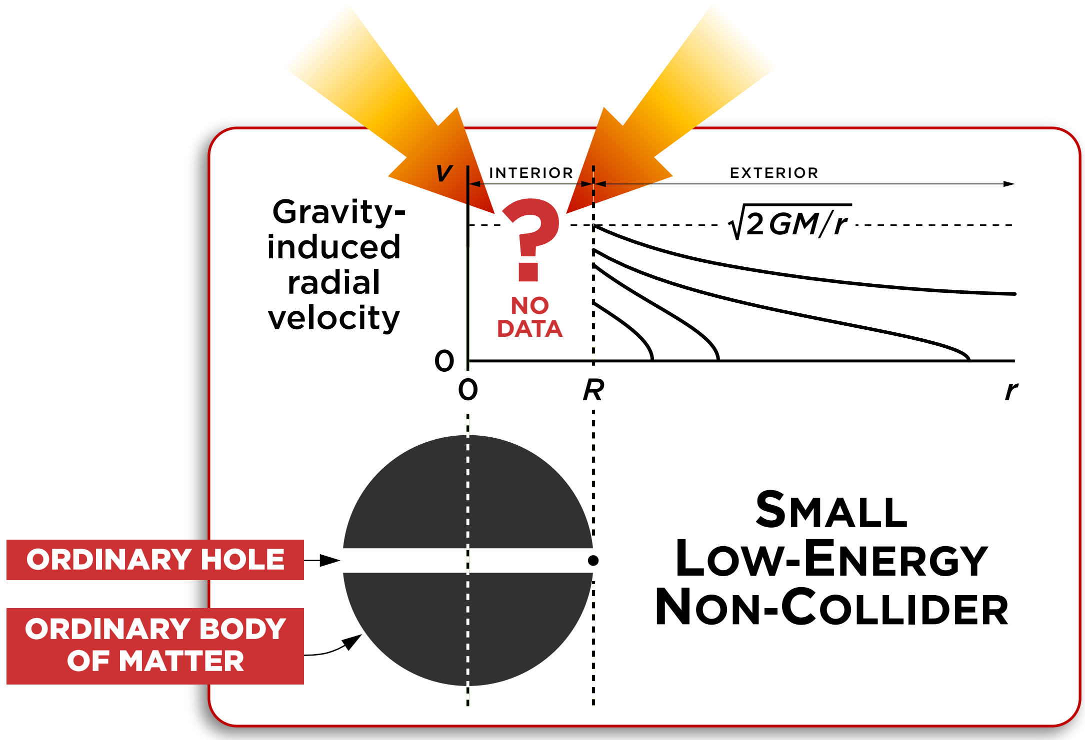
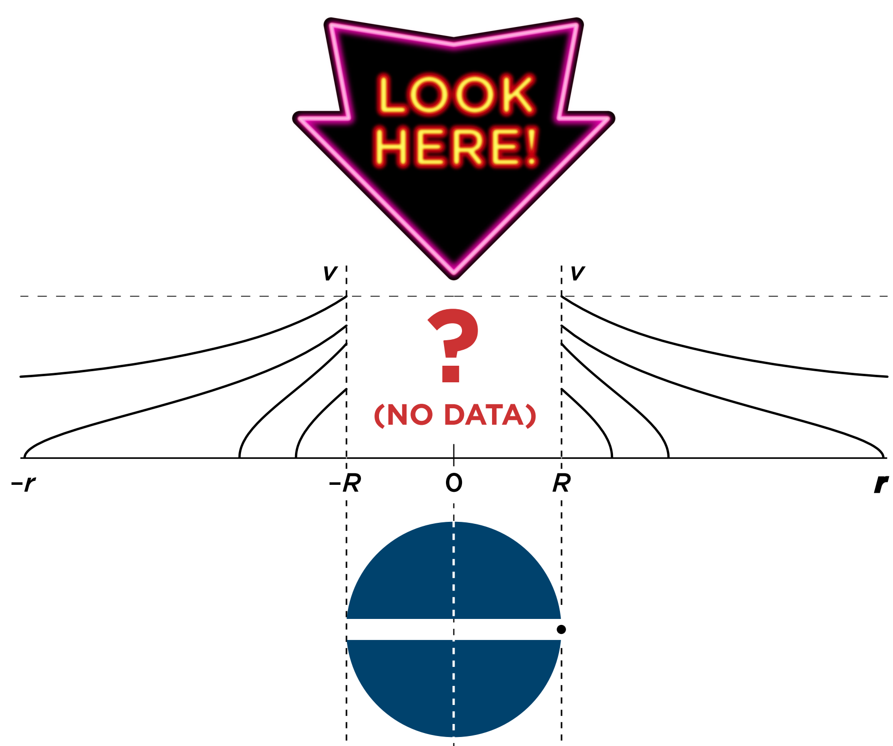


Figure X. Evidence gathered from above the surfaces of large bodies of matter like the Earth or Sun allow plotting the curves for the exterior region as shown. In the case of Earth, some evidence has been gotten from shallow holes close to (essentially *at*) the surface. But from well below the surface, especially near the center, we have no data. (As indicated, with some modest exaggeration.) The data is there to be gotten, not from astronomical bodies, but from laboratory sized bodies of matter. Instead of merely *assuming* that we know how to complete this graph for the interior region, conducting a preliminary demonstration on or near Earth would be a prudent first step before sending such a device to deep space.



Small Low-Energy Non-Collider

Figure Y. Huge gap in gravitational data. Almost all published evidence in support of Newton's and Einstein's theories of gravity is based on observations made *over* the surfaces of large massive bodies such as the Earth or Sun. Though discussions of the interior falling (i.e., Galileo's) experiment that would replace the question mark with data are common in physics classrooms and the literature, it has never been done. The results are therefore unknown, as indicated.

Kennefick provides an explantion for why this hasn't happened. Childhood experience, as reinforced by adults, seems to support the widely held belief—because it's as *obvious* as the non-motion of Earth, if not more—that matter is composed of static chunks of stuff and gravity causes downward motion. Being a kind of default background belief from ancient, primal experience, this conception of matter and gravity has sunken into the deepest psychic depths and has remained there intact because, as children:

> We flex and develop our belief muscle until it is strong enough to withstand the rigorous exercise of adulthood.

Adults will sometimes indulge the fantastic imaginings of children, just as physicists will sometimes indulge the fantastic imaginings of crackpot/amateurs. But in both cases, the traditional authority figure "knows" they know best—which, I freely admit, they *almost* always do. Unfortunately, due to the disproportionate rigidity of their belief muscle they are generally unprepared for those exceptional cases in which they are wrong. Maybe the child/amateur has imagined up a new idea that will withstand testing against physical reality. This must be judged on a case-by-case basis, and tested by experiment whenever possible.

In the present case, the idea is to test an idea imagined by Galileo. It remains in the literature as a (Neverland) *thought* experiment, and not a *real* (Science) experiment, because of the widespread *belief in authorities* whose human fallibility renders them as mere pipsqueaks (fairies) compared to *Nature*.

In my imagination the factual evidence gathered by physicists and astronomers can be cogently woven into a picture according to which the Universe is actually as eternally durable as it is beautiful and harmonious. It is nothing at all like the inflatonic Cold Dark Matter monstrosity envisioned by the beastly authorities. But they've made enormous investments in their beliefs, beliefs which, Kennefick tells us, they are not at all inclined to "play around" with. So they refuse to wake up to the possibility that the world would benefit from a *PUBLIC* endorsement to do Galileo's experiment. They might hiss at the idea in public (as in Strassler's blog). In personal correspondence they might offer encouragements to do the experiment: "The experiment is worth doing…the reward [might] be enormous." Why must such positive responses *remain* private? They seemingly come only with the tacit rejoinder: *Just leave me out of it.* Don't expect me to make any recommendations to my colleagues (who would surely judge me harshly for doing so).

In conclusion, for all the thoughtful replies I've gotten from kind and generous respondents like Kennefick, it seems to me they remain in a state of slumbering belief, of feigned knowledge. Their *imaginations* have not yet escaped the bondage, the insidious influence of peer pressure. In other words, I think their imaginations are grossly *underdeveloped* because they've been suckered into the dreams of others, as though *gullibility has become the new imagination*.†

In the age of Trump, when 40% of the US population still can't see that their leader is a narcissistic psychopathic cowardly conman, perhaps it's not surprising that the same malady (i.e., gullibility) touches even physics, the king-daddy of the sciences. Welcome to the world of gravitons and multiverses, ruled by math-geeky divide-by-zeroists and Marvel Comics, where nobody has time to contemplate the scientific unacceptability of the big gravitational question marks inside matter.

Extending our metaphor slightly, what's needed is a sufficiently *sustained* or sufficiently *loud* clap to alarm the herd members to disperse; to dissolve the frighteningly real beast of conformity; to consciously exit the ancient (static-chunk-o-thing-stuff) stomping ground and explore new gravitational territory, inside matter. As a solitary fly on the hide of this beast, I've not yet figured out how to get through. With amazing, if discouraging consistency, my correspondents routinely fall back into their belief-filled, copycat dreams. They continue to *pretend to know* or to not care if they don't. Meanwhile, their gravitational *Neverland* has blossomed into a most lucrative entertainment industry.

† Tired of trying to invent your own reality? No problem. I've got a dozen of 'em right here. Get yours now! Two for a dollar. *Step right up!*

To: danielk@uark.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Gravity Experiment
Attachments: <Gravity-Experiment-in-Waiting.pdf>

Dear Professor Kennefick,

I think your sensitivity to the human aspects of physics is as exceptional as it is valuable.

This impression sprouted upon reading your book, *Traveling at the Speed of Thought*. More recently, it was reinforced by reading *A Few Beasts Hissed*, which was not intended to pertain to physics, but I think maybe it does.

That something as unrigorous and unphysical as "folk memory" could play a role in modern physics suggests that adult physicists' beliefs can form—e.g., as a face-saving gesture—by "believing on cue," even if this is at the expense of the ideals of science.

By sending you the attached paper, I am consiously running the risk of "remembering and overstressing something which may be seen as vaguely disreputable to the field." Following this paraphrase from your book (p. 183) is the disconcerting observation that:

"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."

The attached paper urges physicists to perform a simple experiment that Galileo proposed 382 years ago. Even though the prediction for its result is common fare in freshman physics texts, we have no direct empirical support for the prediction because the experiment has never been done.

Finding a physicist who thinks it would be a good idea to do the experiment has been difficult, I think, because it is immediately understood that the physics community unanimously believes they already know the result and because to admit that there actually is no empirical evidence to support the belief is embarrassing ("vaguely disreputable to the field").

Surely the many discussions about the result of the experiment deserve to be based on direct empirical evidence. I hope you see that it is less important to save face than to discover the truth and let it be known.

I'd be grateful for any feedback.

Thank you for your good works.

Sincerely (and intending only the best of character),

Richard Benish

Date: Fri, 26 Sep 2014 12:51:01 –0500
From: Daniel Kennefick <danielk@uark.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravity Experiment

> Dear Richard,
>
> Thank you for your letter with its kind remarks about my book and essay. I am amazed that you happen to have read both!
>
> Your experiment sounds fascinating and I am sure you are right that it has never been performed before. I agree with you that an experiment is worth doing even when physicists are sure they know what the result will be. Even if physicists are usually right, the reward from one experiment that confounds all expectations is likely to be enormous.
>
> In the field of experimental gravity the main caveat is likely to be, how difficult will the experiment be to perform, how much will it take in the way of resources? What do you think it would cost to perform?
>
> Best wishes,
>
> Dan

To: Daniel Kennefick <danielk@uark.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravity Experiment
Attachments: <SLENC as Clock Smalley 1975.pdf>

>> Dear Professor Kennefick,
>>
>> I am extremely grateful for your insightful response.
>>
>> Concerning cost, it depends a lot on the method. The ideal method—apparatus in an orbiting satellite—is known to be expensive. Somewhere I recall hearing of 6 or 7 digit dollars per kilogram, plus design and execution issues.
>>
>> Compared to the cost of many experiments underway or on the drawing board, this is still only a "modest" drain on resources.
>>
>> Note that one of my correspondents, David Levi—when he was of high school age—entered the recent world-wide contest to propose an experiment to be conducted in the International Space Station. He proposed Galileo's experiment. It was not selected, but David's video won an honorable mention:
>>
>> http://magnetovore.wordpress.com/2011/12/11/lets-look-inside-gravity/
>>
>> Note also that in the early 1970s, various proposals were considered to make a space-based measurement of Newton's constant using a Small Low-Energy Non Collider as a clock. The attached paper by Larry Smalley is a review of these proposals.
>>
>> As for Earth-based methods, my correspondence with the apparatus-builder, George Herold is pertinent. When I learned of Herold's work at the Buffalo, New York company, TeachSpin, I sent him a brief essay that proposed conducting the experiment with a modified Cavendish balance.

> > Herold's first response was encouraging:
> >
> > At 10:40 AM –0400 7/2/09, George Herold wrote:
> > > *I have thought about doing exactly what is in your paper.*
> >
> > Later in our correspondence I inquired about the price to make such a thing. Herold replied that it depended on issues like whether it was to be a prototype for a mass-production run or a one-off deal. When it became apparent that he was not going to give me a figure, I wrote back (half in jest): "Evidently the cost would be about as I expected: half a million bucks, give or take half a million bucks."
> >
> > To my surprise, Herold wrote back saying, "That sounds like some serious money."
> >
> > From this inadvertent and very rough estimate, it seems safe to guess that Galileo's experiment could be done in an Earth-based laboratory for less than a million dollars.
> >
> > Putting it in perspective, an experiment proposed by Craig Hogan, reported in *Scientific American* (Feb 2012, p. 34) gives the impression that we are in the realm of small change. Hogan was awarded $2 Million and the article made light of it, stating: "The experiment is so cheap because…"
> >
> > My dream is to be able to get back to George Herold with a check for two or three hundred thousand dollars, upon which occasion I'd ask: "Is this enough to get you started?"
> >
> > As I see it, the spirit of Galileo ought not to have to wait any longer.
> >
> > Thanks again for your interest.
> >
> > Best regards,
> >
> > Richard Benish

Date: Wed, 22 Oct 2014 08:29:23 –0500
From: Daniel Kennefick <danielk@uark.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravity Experiment

> > > Dear Richard,
> > >
> > > I am sure you are right as regards cost, i.e. expensive in space, "relatively" cheap on Earth, but not so cheap that anyone is going to fund from our pocket of expenses. Unfortunately, I am no help whatever in giving advice as to where to get money of this kind, but I do know funding agencies are very unlikely to go for it.
> > >
> > > Even getting a few hundred thousand dollars from them is very competitive and they are likely to want to select more topical problems. There is no doubt that there is a real dearth of funding sources for just this kind of project.
> > >
> > > Dan

Start: Martin Beech Offshoot

danielk@uark.edu, 11/6/14 10:30 PM -0800, Eric Poisson? 5

To: danielk@uark.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Eric Poisson?
Attachments: <Hole Through Earth Beech 2013.pdf> <Physics World TeachSpin.pdf>
<GR Interior Oscillator Taylor 1961.pdf>

> Dear Professor Kennefick,
>
> In my continuing mission to generate interest in doing Galileo's Small Low-Energy Non-Collider experiment, I found a recent paper by Martin Beech that reviews the history of its discussion in the literature (attached).
>
> Since Beech's review includes discussion of the experiment only in the context of Newtonian gravity, I sent him references to its appearance in the context of General Relativity (copied below or attached).
>
> Beech teaches at the University of Regina in Canada. He did not reply to my last message, but I have a hunch that he forwarded my message eastward to Eric Poisson in Guelph. This hunch is based on the appearance the next day of a conspicuously large download of documents from my website to the server at the University of Guelph, where Poisson is the resident General Relativity expert.
>
> My hunch may be quite wrong, of course. But if it is right, since Poisson has been one of your co-authors, perhaps you have an ally with respect to my (dangerously subversive?) ideas.
>
> I hope all is well in Arkansas.
>
> Gratefully,
>
> Richard Benish
>
> http://www.gravitationlab.com/

Martin.Beech@uregina.ca, 10/12/14 4:41 PM -0800, Gravity Experiment 6

To: Martin.Beech@uregina.ca
From: Richard J Benish <rjbenish@comcast.net>
Subject: Gravity Experiment
Attachments: <Gravity-Experiment-in-Waiting.pdf>

Dear Professor Beech,

I have recently purchased your book on the *Pendulum Paradigm* and have inquired as to obtaining a copy of your *Observatory Magazine* article on the Earth tunnel problem.

I look forward to reading the details you've provided about this experiment, initially proposed by Galileo. In the meantime, I am eager to share with you my thoughts about it, as expressed in the attached paper.

Everybody knows about the harmonic oscillation prediction, but nobody has ever seen it happen (gravity-induced radial motion through a massive body's center).

Would it not be worthwhile to obtain the empirical evidence to support the well known prediction? Would it not be a wondrous thing to see it unfold?

I'd be grateful for any feedback.

Thanks for your good works.

Sincerely,

Richard Benish.

Martin.Beech@uregina.ca, 10/13/14 11:35 PM -0800, One More Thing 8

To: Martin.Beech@uregina.ca
From: Richard J Benish <rjbenish@comcast.net>
Subject: One More Thing
Attachments:

> Dear Professor Beech,
>
> I forgot to mention David Levi's proposal to do Galileo's experiment on the International Space Station. NASA and others sponsored a world wide contest a few years ago for high school aged students whose winners would have their experiments carried out on the ISS.
>
> David's idea was not chosen, but it did get an honorable mention:
>
> http://magnetovore.wordpress.com/2011/12/11/lets-look-inside-gravity/
>
> Cheers,
>
> Richard Benish

Martin Beech, 10/13/14 12:39 PM -0800, Re: Gravity Experiment 8

Date: Mon, 13 Oct 2014 14:39:16 –0600
From: Martin Beech <Martin.Beech@uregina.ca>
To: <rjbenish@comcast.net>
Subject: Re: Gravity Experiment

>> Hi Richard,
>>
>> Many thanks for your email. I hope that you enjoy the *Pendulum Paradigm* and I have attached a copy of the *Observatory* paper I put together about the Earth tunnel problem. I look forward to reading through your paper and will get back to you once I have had a chance to think the details through. It certainly would be a wonderful experiment to conduct.
>>
>> With best wishes,
>>
>> Martin

To: Martin Beech <Martin.Beech@uregina.ca>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravity Experiment
Attachments: <Intro GR Tangherlini 1961.pdf> <Physics World TeachSpin.pdf>
<GR Interior Oscillator Taylor 1961.pdf>

Dear Professor Beech,

Marvelous! Now I've got the skinny on the history between Galileo and modern times. I was especially surprised to learn of how Euler botched the problem.

Since your paper refers only to treatments based on Newtonian theory, I thought you might be interested in a few general relativistic treatments.

I was directed to a couple of them by the thorough bibliography given in L. Marder's *Time and the Space Traveler* (1971).

I've attached one of them (Taylor). Another is in F. R. Tangherlini's succinct Introduction to GR, which appeared in *Nuovo Cimento Supplement*, vol 20, series 10 #1 (1961). (The Earth-tunnel problem is given on p. 66.)

In both cases the main focus is the comparison of clock rates and elapsed times as between falling observers, observers at rest at the center, and observers at rest on the surface. Tangherlini points out the seemingly paradoxical fact that, contrary to the common result from Special Relativity, it's the falling observer whose accelerometer reading stays zero, that is supposed to age slower than the "stay-at-home" positive accelerometer reading surface observer.

In addition to Misner, Thorne, and Wheeler's brief treatment in their classic tomb (on p. 37) the solo Wheeler devoded a whole 9-page chapter to the subject in his *Scientific American* volume A *Journey into Gravity and Spacetime* (1990). Wheeler calls the oscillation "boomeranging."

I've also attached a review paper by L. Smalley which mentions the space-based G-measurement proposals of Forward-Berman and Worden-Everitt. Too bad none of these were brought to fruition.

You may also be interested to learn that in response to one of my brief essays on the subject, the apparatus builder, George Herold (of TeachSpin in Buffalo, New York) remarked that he had "thought of doing exactly what is in [my] paper." By this he meant an Earth-based demonstration using a modified Cavendish balance. Curiously, Herold also mentioned that he thought his idea to do the experiment was going to appear in *Physics World*. I learned about Herold's work from a *Physics World* interview, which did not include any mention of the experiment. (Also attached.) Evidently, I saw the published version of the interview before Herold did, because he said that his suggestion to do the experiment was discussed; he seemed a little surprised to learn that this part of the interview did not appear in print.

If you have an interest in pursuing the idea of doing the experiment, connecting with Herold might be a good place to start.

Regarding the "many (many)" theoretical discussions of the problem, I find it disconcerting that none of them (to my knowledge) voice any concern about providing *empirical evidence* to make sure the standard prediction is correct. Maybe it isn't. Intuitively, it makes more sense to me that the rate of a clock at the center would be a maximum, not a minimum (as argued, e.g., from the rotation analogy). This corresponds to a very non-Newtonian result: no harmonic oscillation. We cannot know for sure what happens until Nature is allowed to testify.

Thanks for the paper and your good work.

Sincerely,

Richard Benish

End: Martin Beech Offshoot

Date: Fri, 7 Nov 2014 07:56:21 -0600
From: Daniel Kennefick <danielk@uark.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Eric Poisson?

Dear Richard,

I got your package of materials, by the way, thank you for sending them on. It might well be that Eric was asked about your work. He is very conscientious and would certainly not comment without first checking into your actual work rather than speaking off the top of his head. You could write to him yourself, if you like, or I could introduce you if you prefer. If it did happen that he had already looked over your work then his opinion would certainly be valuable.

best wishes,

Dan

Daniel Kennefick, 11/8/14 11:44 AM -0800, Re: Eric Poisson? 11

Date: Sat, 8 Nov 2014 11:44 AM–0800
To: Daniel Kennefick <danielk@uark.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Eric Poisson?

> Dear Professor Kennefick,
>
> I would feel honored to be introduced to Eric Poisson by you.
>
> In anticipation of such an eventuality, I've ordered Poisson's recent book (co-authored by Clifford Will, 2014) on *Gravity*, and I've begun watching his (2012) lectures on advanced General Relativity for his course taught at the Perimeter Institute.
>
> By now you will have notcied that, depending on circumstances, I have tried to carry out my "mission" by using two distinct strategies. *Plan A* appeals to childlike curiosity and the empirical ideals of science. Galileo's experiment ought to be done if only to affirm that these scientific attributes are alive and well in the world of academic physics.
>
> *Plan B*, once revealed to a given audience, pretty much disallows going back to *Plan A*, because it involves divulging an all out interrogation and possible replacement of ideas like the attraction of gravity, energy conservation, black hole horizons, and other huge mental investments. I am fully prepared to put *Plan B* into effect, as I have begun to do in papers such as *Maximum Force*… and *Rethinking Einstein's Rotation Analogy*. As far as I can tell, the positon of the "Rotonians" (in the latter paper) is perfectly defensible.
>
> After their first encounter with a "planet," Rotonians perceive the possible need to describe the circumstance using differential geometry in (4+1)-dimensional spacetime. They conceive a body of matter not as static and attractive ("telling spacetime how to curve") but as an inhomogenous outwardly moving matter-space-time continuum. Their deep trust in clocks and accelerometers inspires the Rotonians to conceive that matter and space are in perpetual states of motion; that this motion is the cause of spcetime curvature.
>
> In response to Sean Carroll's invitation to revise his list of *Top 10 Questions in Cosmology*, I have briefly described the Rotonian position:
>
> http://www.preposterousuniverse.com/blog/2014/10/03/ten-questions-for-the-philosophy-of-cosmology/
>
> [about 2/3 of the way down the comment list, under Richard Benish, Oct. 7, 12:38 pm.]

> The question comes back, as it must, to empirical evidence. The Rotonians allow that their Earthian hosts, with their bi-polar views on gravity, may be correct. But the verdict is not up to the cultural conditioning, nor the mathematical whims of sentient beings. It is up to *Nature*, whose answer is not likely to be revealed before we conscientiously "look under the hood" of a body of matter (i.e., by conducting Galileo's experiment).
>
> For a child or a Rotonian, the appropriate course of action is obvious: do the experiement. For those who have been rigorously trained extremely otherwise, seeing the logical imperative of this course of action requires exceptional mental flexibility, such as you have already demonstrated.
>
> With feelings of enormous gratitude, I want you to know that I am eager to engage in a critical discussion with Eric Poisson or any other physicist on these matters.
>
> Sincerely,
>
> Richard Benish

Tue Jun 4 9:38:43 AM Richard Benish

fulbright.uark.edu/departments/physics/directory/index/uid/danielk/

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Daniel John Kennefick

Associate Professor

J. William Fulbright College of Arts & Sciences

(PHYS)-Physics

Phone: 479-575-6784

Email: danielk@uark.edu

Map

Download CV

Daniel Kennefick is an astrophysicist and historian of science working on gravitational waves, the spiral structure of disk galaxies and the history of 20th century relativity and astronomy.

Publications

Traveling at the Speed of Thought: Einstein and the Quest for Gravitational Waves

Daniel Kennefick (Princeton Univ. Press, 2007)

An Einstein Encyclopedia

Alice Callaprice, Daniel Kennefick and Robert Schulmann (Princeton Univ. Press, 2015)

Francis Everitt

PROFESSOR of PHYSICS

Stanford University

Email and Hard Copy Correspondence

September 17, 2014 • September 24, 2015

PREFACE

For over 40 years Everitt was the principle investigator and driving force behind the NASA-funded misssion known as Gravity Probe B. He responded to my email query and brief essay attachment in 2014. Everitt also responded to my Mr. Natural postcard, with its succinct experiment proposal on the address side in 2015. (Both sides, attached below.)

Since Everitt is such a diligent experimentalist, it was disappointing to learn that he didn't "know what to say" about Galileo's experiment. Why is it so hard to simply say, "Hmm, yes, looks like we've missed a spot. Let's take care of that right away. The sooner the better. Yep."?

Having gotten so many similar rejections, I've deduced that the main reason is personal and collective *embarrassment*. Everybody already "knows" the result. So why bother? Why draw attention to a gap in our actual knowledge that we can get away with pretending doesn't exist.

To actively promote doing the experiment is tantamount to admitting that we don't really know its result, and/or that the physics community dropped the ball by not conducting the experiment already. Much too embarrassing. Just pretend we've got it covered and move on. That seems to be the prevailing strategy.

This situation is especially curious because of the uncanny *consistency* with which physicists respond—as if hard-wired to a collective mind, like the Star Trekian Borg. They've all dedicated decades of their lives to the same rigorous training: mathematical, theoretical, and sociological.

As Galileo rolls in his grave.

To: francis1@stanford.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Gravity Experiment
Attachments: <Gravity-Experiment-in-Waiting.pdf>

Dear Professor Everitt,

After so many years of hard work by so many dedicated scientists, the successful completion of Gravity Probe B is a marvel to behold.

By stark contrast, then, is the experiment discussed in the attached paper. It is one that Galileo proposed in 1632, but remains undone. I am writing in hopes that you would see fit to help generate interest in conducting Galileo's experiment, which has been waiting nearly 400 years.

Thank you very much.

Sincerely,

Richard Benish

Francis Everitt, 9/18/14 7:33 AM -0800, Re: Gravity Experiment 1

Date: Thu, 18 Sep 2014 08:33:51 -0700
To: Richard J Benish <rjbenish@comcast.net>
From: Francis Everitt <francis@relgyro.stanford.edu>
Subject: Re: Gravity Experiment

> Dear Richard Benish
>
> Thank you for forwarding that paper. I don't know what to say about the proposed Galileo experiment, but physics is full of unanswered questions. To me the most extraordinary one is the weakness of the gravitational force. Take two electrons: there is an electrical repulsion between them and a gravitational attraction. The attraction is 42 orders of magnitude smaller than the repulsion. Most people don't have an intuitive feel for what 42 orders of magnitude means. The image I like is that it is the ratio of the mass of the sun to the mass of the eye of a flea.
>
> Regards,
>
> Francis Everitt

To: Francis Everitt <francis@relgyro.stanford.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravity Experiment
Attachments:

> Dear Professor Everitt,
>
> Thank you very much for the kind reply.
>
> I am puzzled by your silence on the Galileo experiment.
>
> Would it not be a good idea to see this experiment come to fruition? Ought we not to provide the empirical evidence to directly support the well known prediction?
>
> Respectfully,
>
> Richard Benish

Mr. Natural SAYS:

If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...

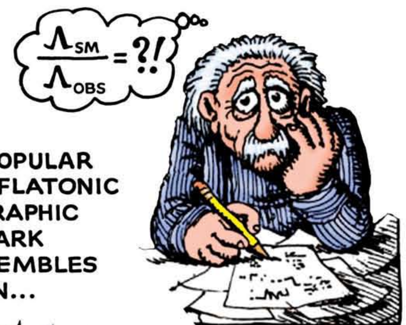
If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...

If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...

If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...

OR

If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...



Lighten Up!

Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of

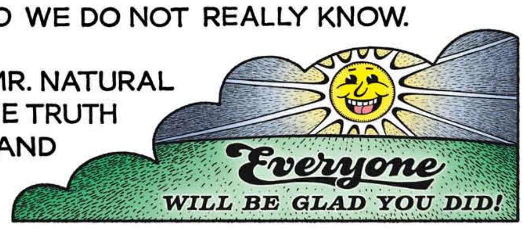
MODERN SCIENCE

Galileo Galilei

Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:

Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET **OBSERVED** GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE **NO DATA**, SO WE DO NOT REALLY KNOW.

Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST **SMALL LOW-ENERGY NON-COLLIDER.**



GravitationLab.com • rjbenish@comcast.net

June 17, 2015

Dear Professor Everitt,

Your legendary pursuits in experimental gravity are a true inspiration. Curiously, like almost all other empirical probes, Gravity Probe B also measured effects found above the surface of the gravitating source mass (Earth). Whereas gravity induced radial motion through the center of a source mass has never yet been observed.

The impressive results of your experiment contribute to the common belief that GR has been well-tested on scales from mm to AU. True as this may be for the Schwarzschild EXTERIOR solution, it is not at all true for the INTERIOR solution.

In terms of GR, the most physically significant feature of the interior field of a uniformly dense sphere is that the rate of a clock at its center is supposed to be a MINIMUM. So it is predicted. Humanity has not yet tested this prediction on any scale. The most ponderous half of the gravitational Universe (under our noses) thus remains to be empirically explored.

One of the kinematic consequences of the central clock rate minimum (as commonly treated in Newtonian gravity) is the oscillation of a test mass dropped into a hole through the center of a larger massive body. Evidence bearing on the kinematics and (indirectly) clock rate could be gotten by conducting Galileo's experiment, as described on the front of this card. It could be done in an Earth-based laboratory (with a modified Cavendish balance) or in an orbiting satellite.

I would therefore urge you to please help to generate interest in performing this experiment that Galileo proposed so long ago. To be truly diligent in our investigation of gravity and the physical world, should we not bring Galileo's proposal to fruition by building and operating humanity's very first SMALL LOW-ENERGY NON-COLLIDER?

Thank you very much.

Sincerely,

Richard Benish

Post Card

THIS SIDE FOR THE ADDRESS

TO: Professor FRANCIS EVERITT
GRAVITY PROBE B
W.W. HANSEN EXPERIMENTAL PHYSICS LAB
PHYSICS/ASTROPHYSICS BUILDING • 1ST FLOOR
452 Lomita Mall
Stanford University, MC 4085
STANFORD, CA 94305-4085

Date: Thu, 24 Sep 2015 12:44:48 -0700
To: rjbenish@comcast.net
From: Francis Everitt <francis@relgyro.stanford.edu>
* Subject: Tunnels Through the Earth

Reply to hard copy of Mr. Natural Postcard:

"Tunnels Through the Earth"? Ahh, yes, another exhibition of the *Art of Missing the Point.*

Dear Richard Benish

Thanks for your June 17 card. My recollection the calculated time of fall of a mass through a tunnel from one side of the Earth to the other is 88 minutes, whatever the direction of the hole. No one has ever done or is ever likely to do the experiment but it is an elegant calculation to reverify for oneself.

Regards

Francis Everitt

To: Francis Everitt <francis@relgyro.stanford.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: tunnels through the Earth
Attachments: <Galileo's-Belated-Experiment.pdf>

> Dear Professor Everitt,
>
> Many thanks for your reply.
>
> Assuming uniform density, the predicted period is about 84 minutes, so a trip from one side to the other would take half that time.
>
> More importantly, the essence of Galileo's experiment has no need for a whole planet.
>
> What I have called a "Small Low-Energy Non-Collider," Larry Smalley has called a "Gravitational Clock," as in the title of his 1975 NASA Memorandum, which reviewed proposals for using such a device to measure big G:
>
> http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19750014902.pdf
>
> None of these proposals were ever carried out.
>
> A less expensive Small Low-Energy Non-Collider would be a modified Cavendish Balance installed in an Earth-based laboratory. The apparatus builder George Herold (at TeachSpin in Buffalo, NY) once expressed an interest in building the device. Perhaps his interest in doing so could be revived.
>
> In any case, since the result of the experiment is routinely presented in elementary physics texts, wouldn't it be nice to finally back up the prediction with empirical evidence? Hasn't the spirit of Galileo been waiting long enough (too long)?
>
> Thanks for your good work.
>
> Sincerely,
>
> Richard Benish

Francis Everitt

Francis Everitt	
	
Francis Everitt at a NASA press conference	
Occupation	Physicist
Known for	Gravity Probe B, relativity

C. W. **Francis Everitt** (b. 8 March 1934) is a US-based English physicist working on experimental testing of general relativity.

Everitt was educated at Imperial College London and the University of Pennsylvania in low-temperature physics.[1] He is Professor at the Hansen Experimental Physics Laboratory of Stanford University and is also an Associate Member of the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC).

Everitt is Principal Investigator of the Gravity Probe B mission mainly aimed to test frame-dragging at an expected accuracy of 1%. According to general relativity, it is an effect induced by the rotation of the Earth on orbiting gyroscopes. Everitt spent more than 40 years on the project and was awarded with the NASA Distinguished Public Service Medal. The results were published in Physical Review Letters in May 2011.[2] The results confirm general relativity's predictions, though not to the project's ambitious goal of 1% precision.

Bibliometric information

As of November 2013, according to the NASA ADS database, the h-index of C.W.F. Everitt is 18, with a total number of citations (self-citations excluded) of about 900. The tori[3] index and the riq[3] index are 12.1 and 62, respectively.

References

1. Kahn, Bob (May 9, 2005). "Stanford physicist Francis Everitt awarded NASA Distinguished Public Service Medal" (http://news.stanford.edu/pr/2005/pr-everitt-051105.html). *Press release*. Stanford University. Retrieved May 5, 2011.
2. Everitt; et al. (May 11, 2011). "Gravity Probe B: Final Results of a Space Experiment to Test General Relativity" (http://prl.aps.org/abstract/PRL/v106/i22/e221101). *Paper*. Physical Review Letters. Retrieved Dec 4, 2011.
3. Pepe, Alberto; Kurtz, Michael J. (November 2012). "A Measure of Total Research Impact Independent of Time and Discipline" (http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0046428). *PLoS ONE*. **7** (11). arXiv:1209.2124 (https://arxiv.org/abs/1209.2124). Bibcode:2012PLoSO...746428P (http://adsabs.harvard.edu/abs/2012PLoSO...746428P). doi:10.1371/journal.pone.0046428 (https://doi.org/10.1371%2Fjournal.pone.0046428). e46428. Retrieved 8 November 2013.

External links

- Prof. Everitt webpage (http://www.stanford.edu/dept/physics/people/faculty/everitt_cw_francis.html)
- NASA Distinguished Public Service Medal to Francis Everitt (http://news-service.stanford.edu/pr/2005/pr-everitt-051105.html)
- Gravity Probe B homepage (http://einstein.stanford.edu/)

David Shoemaker

SENIOR RESEARCH SCIENTIST • FORMER LIGO SPOKESPERSON

Massachusetts Institute of Technology • KAVLI Institute

Email Correspondence

May 28, 2017

PREFACE

Shoemaker's position as LIGO Spokesperson ended in March 2019. He was kind enough to respond to my query while he was there.

Echoing the common response that building a Small Low-Energy Non-Collider "sounds like a fun experiment," Shoemaker nevertheless felt compelled to drizzle on the would-be parade: "I can't say I know it needs to be done."

Why do they do this? The experiment is doable. It was proposed by Galileo 387 years ago. It's never been done and it would provide the empirical back up that is presently *absent* in a plethora of publications and physics classrooms where the *hole to China* (*gravitational clock, gravity train,* etc.) problem is routinely discussed.

The experiment ***OBVIOUSLY*** needs to be done. The sooner the better.

C'mon, say it!

PS,

In the following exchange, Shoemaker recommends writing a proposal to the National Science Foundation (NSF) for funding to do Galileo's experiment.

To be taken seriously by the NSF one needs to be a member of an established academic institution.

Perhaps now that Shoemaker is no longer in charge of LIGO public relations, I should get back to him to see if he'd like to endorse the project. Seriously, this idea is now on my to-do list.

dhs@ligo.mit.edu, 5/28/17 12:11 PM -0800, Testing Gravity **1**

To: dhs@ligo.mit.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Testing Gravity
Attachments: <Gravitational Clock Pt 1.pdf>

Dear Professor Shoemaker,

The attached paper concerns an elaborate and expensive gravity experiment that has been proposed recently, and a simpler, much less expensive experiment that I think should be performed first.

Please send feedback.

Thanks for your good work.

Sincerely,

Richard Benish

David Shoemaker, 5/28/17 1:34 PM -0800, Re: Testing Gravity **2**

Subject: Re: Testing Gravity
From: David Shoemaker <dhs@mit.edu>
Date: Sun, 28 May 2017 17:34:09 -0400
Cc: dhs@ligo.mit.edu
To: Richard J Benish <rjbenish@comcast.net>

> I took a quick look at the notion. It sounds like a fun experiment, although I can't say I know it needs to be done.
>
> I think your best approach would be to write a proposal to the NSF gravity program and let the peers at the idea — it will fly or not!
>
> thanks
>
> David

Shoemaker, David H.

Senior Research Scientist

Leader, Advanced LIGO

NW22-269

Contact Information

office: 617-253-6411

dhs@ligo.mit.edu

MIT LIGO

March 2017
David Shoemaker named spokesperson for LIGO Scientific Collaboration
Senior MIT research scientist to speak for international collaboration for gravitational wave detection research.
MIT News

In the late 70s, I worked in Rai Weiss' lab on the COBE satellite FIRAS interferometer that measured the Planck Spectrum, and then moved to the interferometric detection of gravitational waves in the early 80s. I spent a few years at Max Planck in Garching, Germany and the CNRS in Paris, France, developing specific technologies for gravitational wave detection, then returned to MIT in '89. I led the Advanced LIGO Project. The team delivered detectors in March 2015 which, after commissioning and observing, enabled the first detection of gravitational waves in September 2015. in March 2017 I was elected for a 2-year term as Spokesperson of the LIGO Scientific Collaboration.

LIGO and gravitational wave resources in DSpace@MIT

I work on instrumentation to enable the observation of gravitational radiation via precision measurement techniques.

Research Areas and Projects

Strong Gravity & Gravitational Radiation

Gravitational Wave Detection

High Energy Astrophysics

High Performance Computing

Radio Astronomy

LIGO

Quantum Measurements

Virginia Trimble

PROFESSOR of PHYSICS & ASTRONOMY

University of California, Irvine • University of Maryland

Email (and hard copy) Correspondence

December 26, 2016 – April 2, 2017

PREFACE

Virginia Trimble is a veteran astronomer who, since the early 1970s, occupied professorships in her home state at the University of California, Irvine and at the University of Maryland. This arrangement was partly motivated by her long-time marriage to Joseph Weber, who reigned at the East Coast institution. The late Weber was well known as the man who launched experimental gravitational wave research with his famous (yet ultimately ill-conceived) aluminum bar antennas.

In 2016 Trimble was one of six co-authors of a paper that proposed sending, essentially, a Small Low-Energy Non-Collider to deep space (beyond 25 AU; i.e., between the orbits of Uranus and Neptune), under the assumption that the device would function as a clock, and thereby enable measuring Newton's constant G:

https://arxiv.org/pdf/1605.02126.pdf

I sent each of these authors a hard copy of my paper (attached and linked) that directly responds to their proposal by pointing out (among other things) that the basic mechanism for their device has never been shown to work. I warned that the apparatus might not function as a clock; that its basic operating mechanism should first be tested with a less expensive, less demanding apparatus on or near Earth:

http://vixra.org/pdf/1612.0341v1.pdf

Trimble was the only one of the six who replied, first, by asking: "Have you also sent it to Michael Feldman, who is the most enthusiastic member of our group?"

At the time I received this reply I was finishing up a brief proposal for measuring G, based on an operating mechanism that has been known for many centuries to function as a clock: I.e., to have a test mass orbit a source mass in *circular* motion instead of *radial* motion through its center. (See attachment.) During this delay in getting back to Trimble, she sent a more emphatic message asking: "Could you please send this to the most enthusiastic (and youngest) member of our collaboration, Michael Feldman."

Of course I let her know then that Feldman had been sent a copy along with my new proposal. Three months later I received a final email of thanks, and an implicit indication that the whole thing had fizzled out. I sent one more email—to which I received no response—addressing the feasibility of a "near space" Small Low-Energy Non-Collider and inquiring about the actual status of her "deep space" proposal.

I still think my proposal (to measure G with *circular* motion) has merit. I suspect that the gravity-induced *radial* motion apparatus proposed by the six co-authors was shelved because of objections such as those spelled out by veteran gravitational experimentalist (and Trimble's colleague, Emeritus Professor at UC Irvine) Riley Newman. This impression is based on my independently initiated correspondence with Newman at about the same time, to which he responded about nine months later. At this later time Newman acknowledged his advisory communication with Trimble about the Feldman, et al proposal. My correspondence with Newman is significant also (though not included here) because it ended up being another example of failure in communication.

The pertinent communication with Newman began with a hard copy of my *Gravitational Clock* paper (sent January 11, 2017)—wherein my objective is clearly stated as being only "to observe the general character of the internal motion, at least as a first approximation," and *not* to measure *G*, nor to precisely measure tiny static forces inside a source mass. Newman nevertheless persisted in misunderstanding my purpose. He got off on long tangents about various technical problems that would pertain only to the stringent needs of the delicate experiments that he mistakenly thought were my main concern. Newman never seemed to get that my interest in measureing *G* is minimal; that my interest in measuring deviations from the inverse-square law are virtually non-existent; that I primarily want only to ascertain whether or not a Small Low-Energy Non-Collider functions even roughly as a clock.

Though Trimble did understand this, she exhibited only the faintest degree of curiosity about fulfilling Galileo's proposal. (Doing Galileo's experiment "would certainly make sense, if…") Whereas if Galileo (or anyone else) deigns to start with a rudimentary device that is not suitable for a precision measurement of Newton's *G*, well then, let's just call the whole thing off. Let's just conclude that, in practice, it *really does not* "make sense" to build the thing for such a humble purpose. No need to roughly test the mechanism at the heart of our scrapped *fancy* experiment by conducting a *grossly simpler* experiment, because our *theories* already tell us that it would work as planned. *Of course* our dream apparatus is a mighty fine clock. *Of course* the test mass would oscillate in the hole. *Of course* we don't need to actually see it to believe it. Duh! *Evidence schmevidence, science schmience*.

If there were a commandment whose purpose is to guide one to a righteously scientific attitude (and perhaps even a general life-path toward wisdom) it might be this:

Thou shalt not pretend to know things one does not really know.

Violate this commandment at your peril (even if you get away with it temporarily).

December 26, 2016

Professor Virgina Trimble
Department of Physics and Astronomy
University of California, Irvine
Irvine, CA 92697

Dear Prosessor Trimble,

I was very pleased to learn of your recent proposal to measure *G* with a deep space gravitational clock. If the plan moves forward (or even if it doesn't) I hope you see the benefit of building a simpler preliminary apparatus that would demonstrate the same principles, as discussed in the enclosed paper.

Thanks for your good work.

Sincerely,

Richard Benish
4243 E. Amazon Dr.
Eugene, OR
97405

rjbenish@comcast.net
enclosure

Date: Mon, 09 Jan 2017 18:21:06 –0500
To: rjbenish@comcast.net
Subject: Gravitational Clock
From: vtrimble@astro.umd.edu (Virginia Trimble)

Many thanks! Have you also sent it to Michael Feldman, who is the most enthusiastic member of our group?

Cheers etc

v

Virginia Trimble, 1/10/17 4:57 PM -0700, Gravitational Clock paper 2

Date: Tue, 10 Jan 2017 18:57:17 –0500
To: rjbenish@comcast.net
Subject: Gravitational Clock paper
From: vtrimble@astro.umd.edu (Virginia Trimble)

> Richard -
>
> Could you please send this to the most enthusiastic (and youngest) member of our collaboration, Michael Feldman
>
> mrf@m--y.us
>
> danke schoen
>
> v

To: vtrimble@astro.umd.edu (Virginia Trimble)
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Gravitational Clock paper
Attachments: <GravClockOrbit Trimble Jan 11 2017.pdf>

> Dear Professor Trimble,
>
> I am sorry for the delay in responding to your email from yesterday.
>
> It was due to being in the process of bringing to presentable form an alternative idea for measuring G. (See attached.) I have it in mind to share this latest development as well as the initial "Gravitational Clock" paper with Professor Riley Newman and others who may be interested. The attached document is a generic version of the presentation that I intend to personalize for each recipient.
>
> A hard copy version of the paper that I sent to you a couple weeks ago has already been sent to Michael Feldman, as well as to your other co-authors. Due to your encouragement, I will forthwith send Feldman a pdf version by email.
>
> Many thanks for your interest.
>
> Sincerely,
>
> Richard Benish

Date: Sat, 01 Apr 2017 18:44:43 -0400
To: rjbenish@comcast.net
Subject: "gravitational clock"
From: vtrimble@astro.umd.edu (Virginia Trimble)

> Richard -
>
> Did I ever thank you for your preprint? If not, a very belated "thank you!"
> A local test of the gravity train would certainly make sense, if you can
> figure out a way to do it, in presence of earth *g* and electromagnetic
> effects.
>
> Best regards,
>
> Virginia

To: vtrimble@astro.umd.edu (Virginia Trimble)
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: “gravitational clock"
Attachments:

> > > > Dear Professor Trimble,
> > > >
> > > > Your belated thanks is happily accepted and reciprocated. I thank you for giving attention to my paper.
> > > >
> > > > In response to your comment about feasibility, I should recount my interactions with the physics apparatus-builder George Herold (of TeachSpin, in Buffalo, NY). Herold and his work were featured in a July 1 2009 *Physics World* article:
> > > >
> > > > http://www.iop.org/careers/workinglife/articles/page_39058.html
> > > >
> > > > The article gave me the impression that Herold might be interested in building a “gravity train” (“gravitational clock,” “Small Low-Energy Non-Collider”). So I sent him an essay similar to the one that I sent you and requested a comment.
> > > >
> > > > This happened before Herold saw the *Physics World* article. In response, he mused as to whether his discussion with the interviewer about just such an experiment was included in the printed interview:
> > > >
> > > > At 10:40 AM -0400 7/2/09, George Herold wrote:
> > > >
> > > > > I have thought about doing exactly what is in your paper.
> > > > > (I did mention these ideas to the editor at *Physics World*, and I haven’t received my copy of the article yet so maybe it is discussed?)
> > > >
> > > > This happy coincidence was followed by some correspondence concerning the details about how to build the device and even to a rough estimate as to its monetary cost.
> > > >
> > > > Unfortunately, the dialog was not pursued to fruition. But I was left with the impression that Herold regarded the project as being well within the realm of feasibility. I should add that I would also guess this to be true. It is quite amazing to behold the enormous technological progress and investment that goes into physics experiments of much greater complexity these days.
> > > >
> > > > Notwithstanding the challenges you have mentioned, the only missing thing needed to carry out Galileo’s belated gravity experiment, as far as I can tell, is DESIRE. Those with access to the resources have no desire to see it through because they all PRETEND to already “know” the experiment’s result. I don’t think Galileo would have been very impressed by this attitude, so I will keep trying to generate interest.
> > > >
> > > > How are things coming along with your deep space gravitational clock? Would you really send the thing out there before performing a near-space-proof-of-concept version?
> > > >
> > > > Best regards,
> > > >
> > > > Richard Benish

PHYS ORG

Deep space experiment could measure the gravitational constant with nearly 1,000 times improvement in accuracy (Update)

17 May 2016, by Lisa Zyga

In the proposed experimental setup, a host spacecraft (right) shines a femtosecond laser pulse onto a retroreflector moving in the tunnel of a sphere (left). The period of the retroreflector's harmonic motion provides information on the value of G. Credit: Feldman et al ©2016 IOP Publishing

(Phys.org)—Scientists have proposed an experiment that could measure the value of Newton's gravitational constant, *G*, from deep space instead of an Earth-based laboratory. The researchers predict that the deep space experiment could estimate *G* with an improvement in precision of nearly three orders of magnitude, since it would avoid the influence of Earth's gravity.

The researchers, Michael Feldman *et al.*, have published a paper on the proposed experiment in a recent issue of *Classical and Quantum Gravity*.

Uncertainty with Big G

Newton's gravitational constant, *G*, determines the strength of the gravitational force between any two objects anywhere in the universe. Over the past century, a dozen or so Earth-based experiments have used torsion balances, atom interferometers, and other tools to measure the value of *G* to be approximately 6.67408 x 10^{-11}, with an uncertainty of 4.7 × 10^{-5}.

Although this may sound precise, it is not very precise at all compared to many other physical constants, which have uncertainties that are many orders of magnitude smaller than this. In recent years, the large variations in the measured values of *G* have caused scientists to question if *G* is truly constant at all. (Currently, the overwhelming consensus is that *G* is constant, and that the variations are due to large systematic measurement errors.)

G is currently the least well known of all the fundamental physical constants, which is embarrassing," Feldman told *Phys.org*. "A more precise number, and the possibility that *G* could vary with time, location, or the type of matter involved, could link to improvements in Einstein's general relativity, including quantum gravity."

One of the main reasons that *G* is so difficult to measure accurately is that experiments must account for the influence of Earth's gravity, *g* (sometimes called "little *g*" in contrast to "big *G*"). Little *g* is the acceleration due to gravity specifically on Earth, where it has a constant value of approximately 9.8 m/s^2. Elsewhere in the universe, this value changes, since it depends on the Earth's mass and the distance between the Earth and another object. However, the value of big *G* does not depend on these factors, and so it remains the same everywhere in the universe.

Deep space lab

In the new paper, the researchers suggest that the best way to avoid the effects of Earth's gravity on measurements of *G* is to perform the experiment in deep space, which refers to space outside our solar system.

The scientists propose to launch their apparatus into deep space, likely by "piggybacking" on a major mission. Out there, where the gravity of planets and stars would be negligible, the host spacecraft would release a spherical object that has a 1-cm-wide tunnel through its center. Then (this would likely be the most difficult part), the host spacecraft—which is constantly spinning the whole time—would eject a much smaller oscillating object into the tunnel in the sphere at just the right angle and speed so that the object would move back and forth through the tunnel, without bouncing off the walls.

The host apparatus would continually shine femtosecond laser pulses on the object as it oscillates in the tunnel, and the object (a retroreflector) would reflect these pulses back to the host spacecraft. These pulses would provide data on the period of the object's harmonic motion, which is directly dependent on the value of *G*. The data would then be sent back to Earth via radio communication for interpretation.

If everything goes as expected, the researchers' simulations showed that this experiment could measure *G* with an uncertainty of 6.3×10^{-8}, which is nearly three orders of magnitude more precise than the current best measurement.

Even though the deep-space experiment wouldn't have to deal with the Earth's gravity, it would still have to contend with other, smaller non-gravitational accelerations that would also affect the retroreflector's motion. These influences include solar radiation pressure, solar tidal effects, cosmic rays, and the momentum from the laser pulses. Some of these effects could be dealt with through careful design—for example, the sphere could be shielded from solar radiation pressure by positioning it in the shadow of the host spacecraft. But the researchers explain that any acceleration greater than 10^{-17} m/s^2 must be modeled and accounted for when interpreting the data.

Why measure G?

The National Science Foundation in the US recently issued a solicitation for new approaches for measuring *G* (Ideas Lab: Measuring "Big G" Challenge). The NSF webpage says that measuring a more precise value of *G* will benefit many fields of physics and metrology, such as understanding the Casimir effect, improving the spring constants that are used to calibrate atomic force microscopy cantilevers, and understanding intermolecular forces in DNA. A precise value of *G* might also be used to test proposed theories that unify gravity with quantum electrodynamics.

More information: Michael R. Feldman *et al.* "Deep space experiment to measure *G*." *Classical and Quantum Gravity*. DOI: 10.1088/0264-9381/33/12/125013
Also at arXiv:1605.02126 [gr-qc]

Virginia Louise Trimble

From Wikipedia, the free encyclopedia

Virginia Louise Trimble (born 1943) is an American astronomer specializing in the structure and evolution of stars and galaxies, and the history of astronomy.[2] She has published more than 600 works in Astrophysics,[3] and dozens of other works in the history of other sciences. She received the NAS Award for Scientific Reviewing in 1986, "for informing and enlightening the astronomical community by her numerous, comprehensive, scholarly, and literate reviews, which have elucidated many complex astrophysical questions," the Klopsteg Memorial Award from the American Association of Physics Teachers in 2001, and the George Van Biesbroeck Prize in 2010, for "many years of dedicated service to the national and international communities of astronomers, including her expert assessments of progress in all fields of astrophysics and her significant roles in supporting organizations, boards, committees and foundations in the cause of astronomy."[4] She is famous for an annual review of astronomy and astrophysics research that was published in the Publications of the Astronomical Society of the Pacific, and often gives summary reviews at astrophysical conferences.[5] In 2018, she was elected a Patron of the American Astronomical Society, for her many years of intellectual, organizational, and financial contributions to the society.[6]

Virginia Louise Trimble

Virginia Trimble at the 75th Anniversary of The Shapley–Curtis Debate in April 1995

Born	November 15, 1943 (age 75)
Nationality	American
Education	UCLA, Caltech, Cambridge
Known for	Annual reviews of Astronomy and Astrophysics Research Studies of telescope productivity
Spouse(s)	Joseph Weber
Awards	NAS Award for Scientific Reviewing Klopsteg Memorial Award George Van Biesbroeck Prize honorary doctorate from the University of Valencia
	Scientific career
Fields	Astrophysics, Cosmology, History of Astronomy, History of Science
Thesis	*Motions and structure of the filamentary envelope of the Crab Nebula* [1]
Doctoral advisor	Guido Münch
Influences	Jesse L. Greenstein, Jan Oort, Richard Feynman, James Gunn, Fred Hoyle, Martin Rees
Website	http://www.faculty.uci.edu/profile.cfm?faculty_id=3060

Contents [hide]

Life [edit]

Trimble "grew up the only child of a chemist father and a mother with a flair for language, within easy driving distance of both UCLA and Caltech."[7] While attending UCLA in 1962, she was the subject of a *Life* article titled "Behind a Lovely Face, a 180 I.Q."[8] The following year, she was selected to promote The Twilight Zone television show as "Miss Twilight Zone" in a national publicity tour. [9] She received her B.A. from UCLA in 1964 and her Ph.D from the California Institute of Technology in 1968. At the time, the California Institute of Technology did not admit women students "except under exceptional circumstances,"[10] and she was only the second woman allowed access to the Palomar Observatory.[11] Following a year of teaching at Smith College and two years postdoctoral work at the Institute of Theoretical Astronomy in Cambridge, Trimble joined the faculty of the University of California, Irvine in 1971, where she is now Professor of astronomy. In 1972, she met and 11 days later married University of Maryland, College Park Professor Joseph Weber, a pioneer in gravitational wave physics. From then until his death in 2000, she spent half of each academic year as a visiting professor at the University of Maryland.[12] She was vice president of the International Astronomical Union's Executive Committee from 1994-2000,[13] and vice president of the American Astronomical Society from 1997-2000.[14]

Honors [edit]

- The main-belt asteroid 9271 Trimble, discovered by astronomers Eleanor Helin and Schelte Bus in 1978, was named in her honor.[2] The official naming citation was published by the Minor Planet Center on 31 January 2018 (M.P.C. 108696).[15]

Selected works [edit]

- Trimble, Virginia (1992). *Visit to Small Universe*. Masters of Modern Physics. Springer Science & Business Media.

Tue 12:55:42 PM

"Virginia Trimble" - Google Search

http://www.google.com/search?hl=en&source=hp&biw=&bih=&q=%22Virginia+Trimble%22&gbv=2&oq=%22Virginia+

Official NBA Video SpaceMix Hakobune Eno Whois Whois Google Juan Cole Ishq Lotus FatCow Whois Weather Grav Lab X-Word

Maps Play YouTube News Gmail Drive More

Richard Benish

"Virginia Trimble"

All Images Videos News Shopping Maps Books

About 43,300 results

Virginia Louise Trimble - Wikipedia
https://en.wikipedia.org/wiki/Virginia_Louise_Trimble
Virginia Louise Trimble (born 1943) is an American astronomer specializing in the structure and evolution of stars and galaxies, and the history of astronomy. She has published more than 600 works in Astrophysics, and dozens of other works in the history of other sciences.
Life - Selected works

Images for **"Virginia Trimble"**

Q&A: **Virginia Trimble** on 50-plus years in astronomy - Physics Today
https://physicstoday.scitation.org/do/10.1063/PT.6.4.20180313a/full/
Mar 13, 2018 ... **Virginia Trimble** stumbled into astronomy. Archaeology, her field of choice, wasn't offered to undergraduates at UCLA. She had to declare a ...

Meet the Astronomer Who Has Chronicled the Field for 16 Years ...
https://www.wired.com/.../the-woman-who-knows-everything-about-the- universe/
Apr 4, 2018 ... For 16 years, **Virginia Trimble** read every astronomy paper in 23 journals. Now, her review papers are part of the canon.

Virginia Trimble Honored by AAS and IAU | American Astronomical ...
https://aas.org/posts/news/.../**virginia-trimble**-honored-aas-and-iau
Feb 15, 2018 ... **Virginia Trimble** The AAS Board of Trustees has elected longtime AAS member Virginia L. Trimble (University of California, Irvine) as a patron ...

March 23, 2018 - Dr **Virginia Trimble** - YouTube

https://www.youtube.com/watch?v=dEbHAfszAWs
Jun 21, 2018 - 51 min -
Uploaded by Faculty of Science, University of Manitoba
Renowned American astronomer, Dr. Virginia Louise Trimble, a professor of Physics and ...

Virginia Trimble | IAU
https://www.iau.org/administration/membership/individual/2401/
Nov 15, 2018 ... **Virginia Trimble**. University of California Irvine Physics-Astronomy Department 4575 Physics Irvine CA 92697-4575. California (CA)

Existence and Nature of Dark Matter in the Universe - Annual Reviews
https://www.annualreviews.org/doi/abs/10.../annurev.aa.25.090187.002233
25:425-472 (Volume publication date September 1987) https://doi.org/10.1146/annurev.aa.25.090187.002233. **Virginia Trimble**. Download PDF Article Metrics.

Virginia Trimble interviewed in Physics Today | UCI Physics and ...
https://www.physics.uci.edu/node/13190
Mar 19, 2018 ... **Virginia Trimble** stumbled into astronomy. Archaeology, her field of choice, wasn't offered to undergraduates at UCLA. She had to declare a ...

Virginia Trimble Fest | UCI Physics and Astronomy
https://www.physics.uci.edu/trimblefest
Jun 25, 2018 ... **Virginia Trimble** Fest. The UC Irvine Department of Physics & Astronomy proudly hosts: Trimble Fest. In honor of **Virginia Trimble's** 75th birthday ...

Virginia Trimble's research works | University of California, Irvine, CA ...
https://www.researchgate.net/scientific.../11263249_Virginia_Trimble

Virginia Louise Trimble

American astronomer

Virginia Louise Trimble is an American astronomer specializing in the structure and evolution of stars and galaxies, and the history of astronomy. She has published more than 600 works in Astrophysics, and dozens of other works in the history of other sciences. Wikipedia

Born: 1943 (age 76 years), Los Angeles, CA
Spouse: Joseph Weber
Thesis: Motions and structure of the filamentary envelope of the Crab Nebula
Education: California Institute of Technology, More
Books: Visit to a small universe
Influenced by: Fred Hoyle, Richard Feynman, Jan Oort, Martin Rees, Jesse L. Greenstein, James E. Gunn

People also search for

Fred Hoyle | Jesse L. Greenstein | Jan Oort
Vicent J. Martinez | James E. Gunn | Martin Rees

Robert Geroch

PROFESSOR of PHYSICS

University of Chicago

Email Correspondence

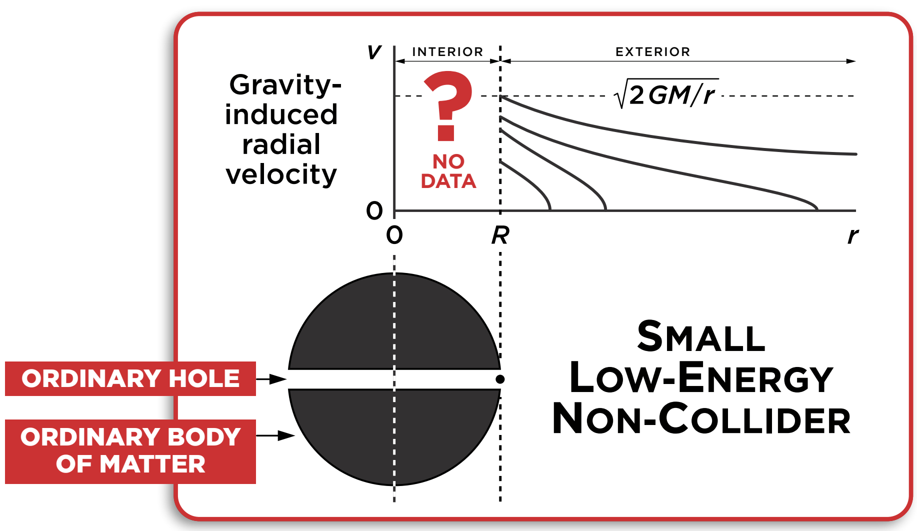
January 6 – 11, 2016

PREFACE

I had not yet learned the word, *gaslighting* when this dialog took place. Looking back on it, my question now is whether Geroch began his reply with the intent to gaslight me or it just got more irresistable for him as the correspondence unfolded.

Until just before the end, I consistently gave Geroch the benefit of the doubt, even as he struck me as opaque, obstinate, and practiced in the art of missing the point. It all comes down to this: Geroch proposes that the absence of authoritative desire to perform Galileo's Small Low-Energy Non-Collider experiment is explainable by an absurd analogy.

Geroch argues (more like it, *plays*) the idea that the huge interior/exterior data gap (big red question mark) can be likened to the gaps pertaining to any experiment that fails to account for the *color* of the test mass or for which barnyard animals may be watching at the time it is performed (no kidding). He refuses to ackowledge the "insight" to be gained by doing Galileo's experiment—even if it only confirms the standard prediction.



Doing the experiment would give all physics instructors and others who discuss the problem as a *thought* experiment the data needed to give *substance* to the question as one that has been answered by *real empirical evidence* (no longer *just* a thought experiment). This would *obviously* be a significant step in the progress of science. Nature's say in the matter would at last have been witnessed and recorded. Alas, Geroch effectively ridicules the insight to be gained by the direct probe of Nature, by a probe designed to turn the big red question mark into concrete data.

If only Geroch's fervor for messing with me could be re-channeled to fuel some basic scientific curiosity. But no. Such a waste. Such a snotty, disrespectful waste.

To: geroch@uchicago.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Gravity-Sociology.pdf>

Dear Professor Geroch,

I hope you find the attached documents to be within your scope of interest.

I'd be grateful for any feedback.

Thanks for your good work.

Sincerely,

Richard Benish

On Thu Jan 7 2016 at 9:12 AM Robert Geroch <geroch@uchicago.edu> wrote:

> Richard Benish,
>
> Thanks for your message, and for the copy of your paper. Presumably, the experiment you propose has not been done, and I certainly agree with you that the result, if it were done, might be surprising.
>
> But there is also a problem here. It is easy to invent millions of experiments that have not been done, such that the result, if they were done, might be surprising. For example: Nobody (as far as I know!) has measured the acceleration of gravity by dropping a billiard ball painted blue with orange spots, all the while witnessed by a male duck. Why not carry out this experiment?
>
> The point I am trying to make is that one must choose which experiments one will do — there isn't time to do them all.
>
> Thus, the failure to do the experiment you propose may not be because scientists are self-assured, or lack scientific rigor: It may only be that they are off doing experiments that they regard as more promising. And your burden, again in my opinion, is to argue, not merely that your experiment has not been performed and may give a surprising result, but also that the liklihood that it will give a surprising result is higher than that for various alternative experiments.
>
> I hope that these remarks are of some use to you.
>
> Robert Geroch

To: geroch@uchicago.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: Geroch Email Out Jan 9 2016.pdf Maximum Force Nov 17 2011.pdf Max Force Annotation.pdf Rethinking-Rotation-Sep-5-2012.pdf

---

On Thu Jan 9 2016 at 11:12 AM Richard J Benish <rjbenish@comcast.net> wrote:

> Dear Professor Geroch,
>
> Many thanks for your thoughtful reply.
>
> Due to length and readability concerns, I've reformatted my response as a pdf attachment (Geroch Email...). Please read it.
>
> Thanks again.
>
> Best regards,
>
> Richard Benish

On Thu Jan 10 2016 at 6:52 AM Robert Geroch <geroch@uchicago.edu> wrote:

>>> Richard (if I may),
>>>
>>> Look, I don't think that I'm a very good correspondent for these matters, for I'm not an experimentalist, and I'm not particularly skilled at judging which experiments are "worthwhile".
>>>
>>> My introducing the experiment of the painted billiard-ball observed by a male duck was intended, not to belittle your experiment, but only to make one, tiny point:
>>>
>>> You have, in my opinion, the burden of arguing, not merely that your experiment hasn't been done, and that it might yield an interesting result. You must also argue that this experiment is more promising (in terms of the insight it will yield) than various other, alternative, experiments.
>>>
>>> I don't know how to make this point any clearer than this, but let me take one more shot at it.
>>>
>>> Suppose that I pressed you to work on my billiard ball/duck experiment. I would argue that gravity is supposed to work independently of the color of the billiard ball and of which animals are watching, but we have virtually no data to support this supposition. This is a gap in the empirical evidence. We need to acknowledge such gaps, and fill them. To fail to do so, using instead mere mental extrapolation would be fraught with serious errors. A major reason this hasn't been done is that Galileo made no mention of animals watching his experiment, so people merely <assume> that this factor is irrelevant. Indeed, in every case I know of in which falling bodies are discussed, there is no mention of their color or who is watching. Confidence in the presumed answer is probably due to the track record of well-worn theories. However none of these theories have been <tested> in the regime of various colors of the billiard ball and various animals

> > > observing the falling billiard ball. The absence of any evidence on this issue is conspicuously unmentioned in every one of the many scientific treatments of this problem. History is full of experiments whose purpose is merely to improve accuracy. So, why not carry out the accuracy-improvement reflected in this experiment. The burden here is not on me — to argue that there is something interesting about this experiment — but on the authorities. They maintain the status quo opinion, offering abstract "solutions" that are not backed up by any direct physical evidence. This experiment (and some others I have ready) should be done for the sake of scientific completeness. If Galileo were around today, and this experiment were suggested, do you think he would say "Nah, why bother? We already knows what happens."?
> > >
> > > Well, you get the idea … I am NOT trying (of course!) to argue that my experiment is on a par with yours, nor am I trying to make fun of your experiment. What I AM saying is that you have the burden to make an actual argument for this experiment, and not merely the stuff of the paragraph above. As I said before, I'm not a good judge of these things. But for me, an "actual argument" would begin with a viable, alternative theory of gravity, that makes a different prediction from the standard one. Then, at least, we would know what we are looking for …
> > >
> > > Robert

Addendum
On Thu Jan 10 2016 at 8:12 AM Robert Geroch <geroch@uchicago.edu> wrote:

> > > > Let me try to say this in a (slightly) different way. I think that I've made a pretty good case for carrying out my experiment. This is an experiment that you could perform. Are you willing, in the interest of completeness in science, to carry out my experiment? If not, why not?
> > > >
> > > > Robert

Robert Geroch, 1/11/16 8:34 AM -0800, Re: Addendum 4

To: Robert Geroch <geroch@uchicago.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Addendum
Attachments: <Clock-Rates-GR-vs-SGM-Weak.pdf> <SLENC w Graph & Caption.pdf> <Clock-Rate-GR-SGM.pdf>

> > > > > Dear Professor Geroch,
> > > > >
> > > > > Thanks for your comments and questions.
> > > > >
> > > > > I would have no interest in carrying out your experiment because you have ill-advisedly shifted focus from the SOURCE MASS to the test object. As you know, very many experiments have demonstrated that test masses having a wide variety of properties (substance, color, etc.) behave under gravity with no regard to such properties.

> > > > > Recall that the main argument for dismissing your absurd suggestion is that it neglects to consider—as does your reply and addendum—the graph in Figure 1. This graph is all about the SOURCE MASS. I.e., the material body having the dominant role in any nearby gravitational effects.
> > > > >
> > > > > The "stuff" of the paragraphs urging to do Galileo's experiment and proposing to explain lack of interest in doing it as products of unscientific "folk memory," etc. all pertain to the HUGE gap in this graph. We have lots of data establishing that the detailed properties of test masses are irrelevant. But we have NO DATA pertaining to gravity-induced radial motion through the centers of massive bodies.
> > > > >
> > > > > Standard wisdom—borne of our favorite theories of gravity—states that the test object oscillates in the hole. But we have never OBSERVED what happens in the hole—not even as a first approximation. Our favorite theories of gravity have not been tested here.
> > > > >
> > > > > "Science advances by exploring unexplored regions and by performing critical tests of standard wisdom." I maintain that SUFFICIENT reason to take the trouble to do Galileo's experiment is that the gap is very large (the most ponderous half of the gravitational Universe); it is unexplored, and with respect to it, tests of standard wisdom have not yet been carried out. It is obvious that science will make an appreciable advance by filling this conspicuously large gap.
> > > > >
> > > > > Far smaller gaps and much tinier regions of the unknown (far down the line of decimal places) have sufficed to fund some extremely fancy and expensive experiments. For some reason you place more stringent and demanding requirements on the idea of doing the fundamental experiment proposed by the Father of Modern Science. Why not help to generate interest in doing this experiment for the simple, patently scientific reasons I've presented? Aren't you at all curious? Wouldn't it be cool to watch a Small Low-Energy Non-Collider in action?
> > > > >
> > > > > If you insist on maintaining an exceptionally high standard for Galileo and his experiment, then I should point out that the papers sent last time do present the basis for what I have argued is a viable alternative model of gravity. The most unequivocal test of the model would be one that probes the interior of massive bodies. The model is demonstrably in agreement with data that supports the Schwarzschild exterior solution, but its predictions deviate dramatically from those of the Schwarzschild interior solution. I've attached graphs of key predictions.
> > > > >
> > > > > I am grateful for your questions and the opportunity to answer them.
> > > > >
> > > > > Best regards,
> > > > >
> > > > > Richard Benish

On Thu Jan 11 2016 at 10:37 AM Robert Geroch <geroch@uchicago.edu> wrote:

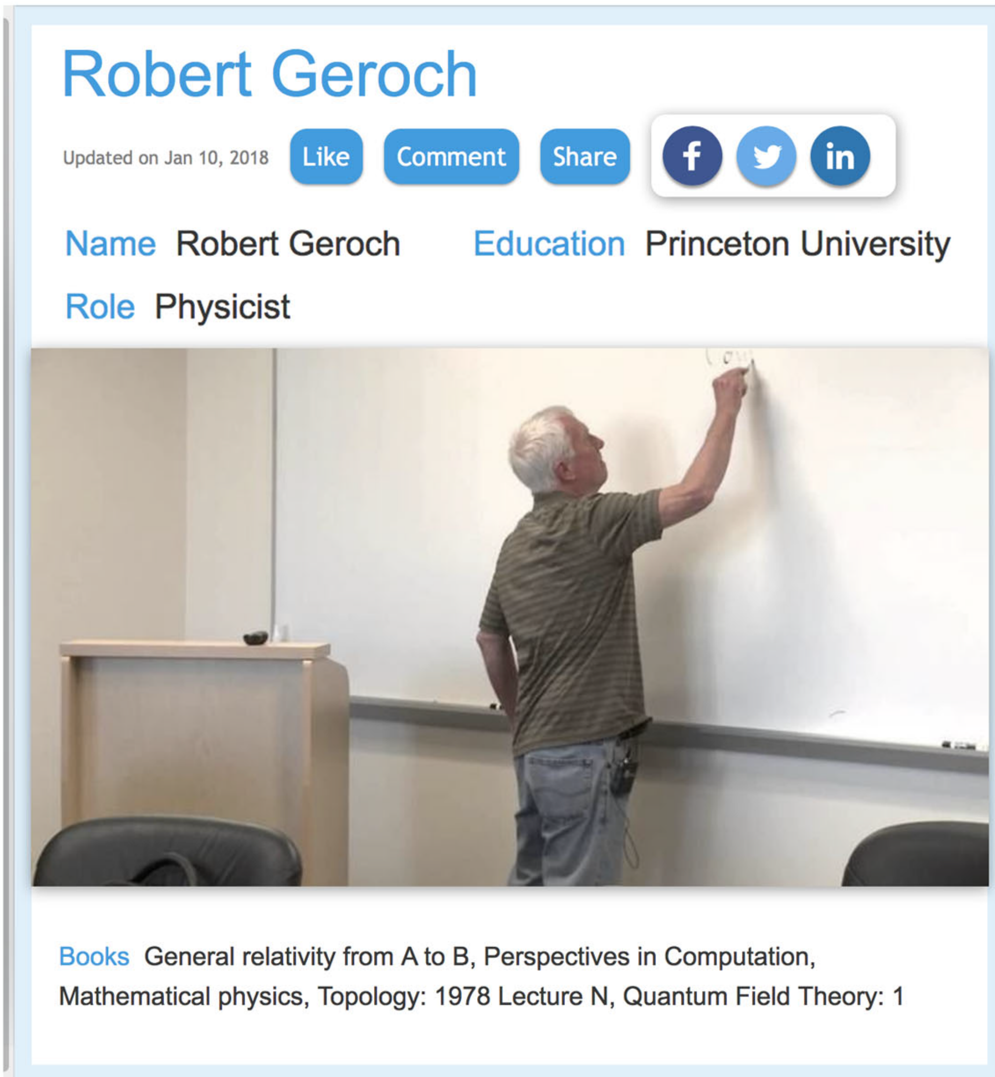
> > > > > > > I would have no interest in carrying out your experiment because you have ill-advisedly shifted focus from the SOURCE MASS to the test object.
> > > > > >
> > > > > > Exactly. And your experiment shifts focus from other experiments that also might be performed. And your burden is to argue that this shift of focus is a good idea.
> > > > > >
> > > > > > > As you know, very many experiments have demonstrated that test masses having a wide variety of properties (substance, color, etc.) behave under gravity with no regard to such properties.
> > > > > >
> > > > > > But my experiment (blue, orange polka dots, male duck) has NEVER been performed. Are you just saying that my experiment "won't yield anything new," based on some unjustified extrapolation from other experiments? What about completeness in science?
> > > > > >
> > > > > > Robert

From: Robert Geroch <geroch@uchicago.edu>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Addendum

> > > > > > > I think I have rather effectively argued that the shift in focus to a huge, unexplored, yet accessible domain of physical reality is a good idea. When, in science, is that not a good idea? I rest my case on the factual content of Figure 1.
> > > > > >
> > > > > > The issue of the acceleration of gravity when watched by various barnyard animals is also a huge, unexplored, yet accessible domain of physical reality. I take it, then, that you would agree that a shift in focus to this area is a good idea ...

Robert Geroch, 1/11/16 2:35 PM -0800, Re: Addendum

> > > > > > Dear Professor Geroch,
> > > > > >
> > > > > > If you define "hugeness" by the number of absurd and trivial conceivable variations of a given experiment, then you might have a point.
> > > > > >
> > > > > > Obviously—I mean really, quite obviously—that's not the sense of "huge" that I intend. By huge, I mean the physical domain INSIDE any body of matter. What we think we know about gravity-induced radial motion is based entirely on observations OUTSIDE bodies of matter.
> > > > > >
> > > > > > We have not yet gathered empirical evidence for gravity-induced radial motion from the huge domain inside and through the centers of massive bodies. You seem intent on either missing this point or equating it with gnat poo.
> > > > > >
> > > > > > This dialog therefore suffers from more than one kind of blind spot. I have failed in my efforts to divert your attention from your bizarre examples of barnyard animals to serious problems in gravitational physics.
> > > > > >
> > > > > > It is getting tiresome. Goodbye.
> > > > > >
> > > > > > Richard Benish


Robert Geroch
Updated on Jan 10, 2018
Like
Comment
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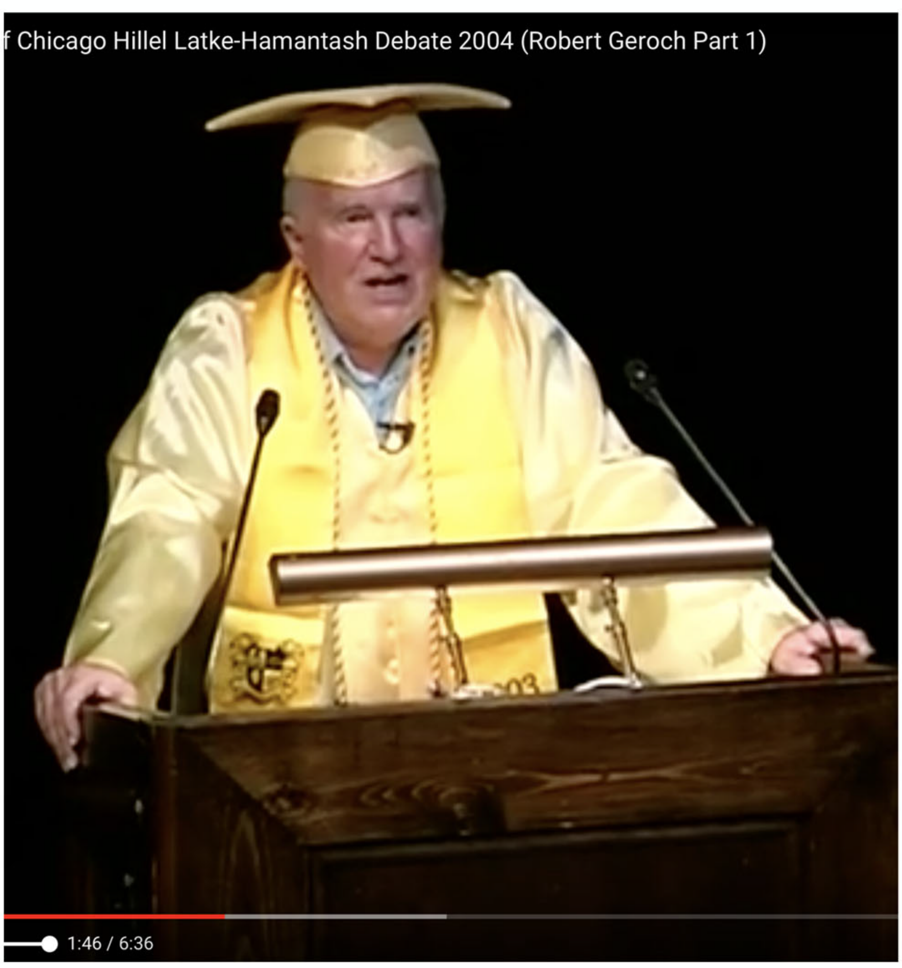
Name Robert Geroch
Education Princeton University
Role Physicist
Books General relativity from A to B, Perspectives in Computation, Mathematical physics, Topology: 1978 Lecture N, Quantum Field Theory: 1


f Chicago Hillel Latke-Hamantash Debate 2004 (Robert Geroch Part 1)
1:46 / 6:36

John Bargh

PROFESSOR of PSYCHOLOGY

Yale University

Email Correspondence

December 20, 2015 – January 12, 2016

PREFACE

In late 2015 I launched an attention-seeking campaign designed to reach a wider audience than just physicists. A few hundred hard-copy postcards and a similar number of digital versions were sent to scholars of not just physics, but also chemistry, history, philosophy, psychology and others. At the end I've attached the image-side of my "Sociology Experiment" postcard and a typical address-side and message. Yale psychology Professor John Bargh was sent only the email version. Among the few responses I received, his was one of the most noteworthy.

In response to Bargh's question: "why me…as I'm not a physicist?" I stated my impression that "physics departments have serious psychological problems." The ensuing discussion revealed Bargh's receptivity to how this may indeed be true. Bargh shared some work he was interested in or co-authored.

Our discussion and Bargh's work on the "warm/cold dichotomy" reminded me of an essay I had written on *Gender-Related Influences on Resource Use*… For no particular reason I failed to send Bargh the essay, but I've included it here, as an enclosure. The societal pattern discussed therein (masculine aggression and displays of violence and wasting resources as a mating strategy) at least peripherally bears, I think, on the present state of theoretical and experimental physics. I would argue that there's a connection between these general traits of human males and the invention of, and preponderance of devotion to hypothetical Big Bangs, Black Holes, various high-energy collisions (*Vroom! Smash! Bam! Kapow!*) nearby, or in the Darkest reaches of the Holographic String-Brane Multiverse.

I sometimes point out the stark contrast between all this adolescent fantasy-like stuff and what is arguably the simplest, most gentle (more feminine?) physics apparatus that remains neglected by status quo academicians. Why have we not built this apparatus (Small Low-Energy Non-Collider) so that we may at last inspect physical reality under our noses, inside matter, into the most ponderous half of the gravitational Universe? The answer is complex; it surely involves tacit psychological and sociological factors. Perhaps it has *more* to do with our level of consciousness (psychological stage of development) than with our scant knowledge of physics.

The essay *Climbing the Depths of Gravity* (enclosed) also dicsusses the underlying societal influences on physics and their possible origins. My correspondence with Daniel Kennefick—a physicist who has written on both the sociology of physics and the significance of belief and imagination in life in general—also broadens the perspective that is touched on here.

To: john.bargh@yale.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Gravity-Sociology-Dec-2015.pdf>

Dear Professor Bargh,

I hope you find the attached documents to be within your area of interest.

I'd be grateful for any feedback.

Sincerely,

Richard Benish

On Sat, Dec 26, 2015 at 6:47 AM, John Bargh <johnbargh@yale.edu> wrote:

> Hi Richard,
>
> I find this very interesting. Thank you for sending it to me. I'm curious as to "why send it to me?" as I'm not a physicist, but this is just curiosity on my part. I did find your paper and the poster intriguing.
>
> all best
>
> John

To: John Bargh <john.bargh@yale.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments: Holton-Benish Email Jul 2015.pdf

>> Dear Professor Bargh,
>>
>> Many thanks for your reply.
>>
>> In a nutshell, I've sent the documents to you because, after a protracted and still ongoing experience of sending them to physicists, I've gotten the impression that Physics Departments have serious psychological problems!
>>
>> After receiving your reply, I looked a bit further into your work, at least as far as your YouTube interview with June Gruber. I am intrigued by the universality of the warm/cold dichotomy in assessment of personalities. Could such judgments have some applicability on a collective scale? With respect to Physics Departments, an affirmative answer would seem to be supported by others. For example, physicist and social historian Helene Goetschel has written of the "unwelcoming culture of physics." [*Cult Stud of Sci Edu* (2014) 9:531-537.] Are Physics Departments unduly "cold"?
>>
>> Another example of a psychology-related malady(?) has been pointed out by physicist Daniel Kennefick. After experiencing a challenge by a more senior physicist as to the history of gravitational wave research, Kennefick reflected on the sociology of physics to explain his experience. Note first that the challenge came in response to Kennefick's presentation to an audience of veteran gravitational wave researchers a point that, perhaps, made physicists look a

little less than heroic. Kennefick writes:

> "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." [*Traveling at the Speed of Thought*, Princeton U Press (2007) p. 183.]

The RESULT of the experiment proposed by Galileo is so "well known" among physicists, that they are virtually blind to the fact that it has never been done. It is embarrassing for them to admit that they actually don't know the result. And it is a sign of "bad character" for me, (especially as an outsider) to suggest that they admit the fact and take care of the matter in a scientific manner.

I've attached a copy of an email exchange between myself and Harvard (Physics and History of Science) Professor Gerald Holton. You will see that he appraised my essay as "Nice… A very charming article." And yet, after I suggested that the appropriate course of action would be to actually do the experiment, communication (coldly?) stopped. I have often succeeded at making a good first impression, to evoke a positive response from physicists. Yet none of them have seen fit to pursue the matter to its (to me rather obvious) natural conclusion—to at long last perform the experiment proposed by the Father of Modern Science.

I would therefore encourage you to please consider carrying out the sociological experiment described on the poster.

Thanks again.

Happy New Year!

Richard Benish

John Bargh, 1/10/16 8:32 AM -0700, Re: Galileo's Gravity Experiment 2

Date: Sun, 10 Jan 2016 10:32:13 -0500
Subject: Re: Galileo's Gravity Experiment
From: John Bargh <john.bargh@yale.edu>
To: Richard J Benish <rjbenish@comcast.net>
Attachment: < Devil_made_me_do_it_Proofs_01092016.pdf >

Hi Richard

Did I ever send you the (attached) chapter? It is my take on how ideology shapes scientific findings, in the domain of unconscious influences. I have heard of similar efforts right now concerning evolutionary psychology — maybe someday we can all join forces in a book or something.

The warm/cold effect has now been confirmed by several neuroscience investigations, mainly by Naomi Eisenberger and colleagues at UCLA. Same (small) area of insula is active both when texting to family and friends as when holding something warm. We (Kang et al 2011) had earlier shown that being betrayed in an economics game activated same small (different) area of insula as when holding something cold. By "collective scale" I assume you mean, warm climates = warm people and cold climates = cold people but the evidence on that is mixed, it seems to be the contrast between outside and inside that matters (warm home in cold climate). Hans IJzerman of Free University of Amsterdam is the leading researcher on this topic nowadays.

There are certainly social aspects to science, despite the lay belief it is "objective" — scientists are people and just as prone to bias and motivated reasoning as everyone else. In fact they might be more prone because of their (arrogant) assumption that they are being objective. Emily Pronin in Princeton Psychology dept has great research showing that when we have disagreements with others, we believe that we are being objective, thus they must be motivated or biased to disagree with us — if they were objective, then of course they would see things the way we do.

all best

John

To: John Bargh <john.bargh@yale.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

Dear Professor Bargh,

Thanks for your thoughtful comments and book chapter.

I enjoyed the piece a lot, for its overall wholesome positivity and for several details that struck a resonant chord from my own experience and observations.

Before mentioning a couple parallels, I should first clarify from our earlier exchange what I meant by the "collective" application of the warm/cold dichotomy. To put this in proper perspective I should mention that I've often been involved with groups of visual artists or art students. More recently, my day job involves frequent immersion in groups of "Direct Support Professionals" (= persons whose job it is to help people with developmental disabilities). In these cases, I have often felt a kind of collective warmth, inclusion, and receptivity toward those not in the group.

By contrast, my experience with the physics community has often left me with an impression of collective chilliness, exclusion, and smugness toward those not in the group. I mentioned a possible echo of this impression by social historian Helene Gotschel: "the unwelcoming culture of physics." I have not noticed any geographical or climate-related connection to this pattern.

Now in light of your essay, I would mention two further dichotomies that may somehow connect with that of conscious/unconscious, and prevailing notions as to its significance. The perhaps to-be-connected dichotomies are: inner/outer and feminine/masculine.

You may recall from the Galileo's Belated Gravity Experiment paper, that the experiment in question—proposed by Galileo in 1632—would probe the INSIDE of a body of matter and test the INTERIOR solutions of established theories of gravity (Newton and Einstein). In principle, it is a very simple experiment: Drop a pebble into a hole through the center of a larger body of matter. In practice, the experiment requires overcoming certain technological challenges (mostly to do with neutralizing the influence of the large and spinning planet Earth). But it is quite feasible, and would cost substantially less than many gravity experiments that have been done, have been proposed, or are underway.

As mentioned last time, Harvard Professor Gerald Holton (among others) has saluted my arguments to the effect that Galileo's experiment is overdue to be carried out. Yet he (and others) has fallen short of taking steps to actually bring it about. Why is that? I believe you hit on the general problem in your conclusion:

"As all-too-fallible human beings in search of underlying scientific truths, we should be on our guard against the deep currents and traditions that lead us to cheer for one horse against the other."

In the present case, the "horse" physicists are betting on is the traditional lesson, repeated over and over again in early physics training, that the RESULT of Galileo's experiment is "well known" (on the basis of various theoretical arguments that I will omit here).

Daniel Kennefick—who I quoted last time—has referred to such deep-seated background assessments as being entrenched in "folk memory." Physicists REMEMBER the result of Galileo's experiment along with any mention of the problem, even though no such result actually exists. To suggest that physicists actually don't know the experiment's result is disruptive to their rigorously trained psychic recollection.

Folk memory thus seems to override doing the scientific thing, to consult NATURE for the result. Folk memory induces physicists to refuse to take the steps needed to probe and test this INNER mental memory with an explicit, outwardly manifest physical experiment. Why do the experiment if they already "know" what happens?

In this case, physicists are evidently blind to the innards of their own psyches and thus fail to critically assess their refusal to do an experiment whose purpose is to look INSIDE a common body of matter, where they have not yet looked. We thus find a kind of compounded failure to look inside, both mentally and physically. The reason for this seems to be that "executive function" is in cahoots with folk memory—a sometimes dangerous combination, as your account of Hitler makes frightfully clear.

Now to the other dichotomy: feminine/masculine. When I write to female physicists I sometimes suggest that they may be especially interested to contemplate that Galileo's experiment may be the GENTLEST conceivable experiment involving two bodies of matter. For it involves observing, for the first time, the behavior of two massive bodies—isolated and undisturbed—that are left to interact with each other so that one slowly nests inside the other with NO COLLISION at all. This is by contrast with prevailing experimental methods that often entail highly energetic, penetrating, violent collisions, using very expensive, monumental (masculine?) machines. (Vroom! Smash! Bam! Kapow!)

Note that Gotschell's article, cited earlier, emphasized that the culture of physics is especially unwelcoming to women. It is well known that men dominate the field. If "feminine energy" had a comparable role and voice in physics, I'd guess that a Small Low-Energy Non-Collider would have been built long ago. We'd long ago have conducted the gentle probe to test our gravitational interior solutions.

I find it encouraging and enlightening to learn that developments in psychology sometimes echo what I think are sorely needed developments in physics and cosmology.

I am grateful that you've seen fit to share your insightful work with me.

Warm regards,

Richard Benish

Date: Sun, 17 Jan 2016 11:04:06 -0500
Subject: Re: Galileo's Gravity Experiment
From: John Bargh <john.bargh@gmail.com>
To: rjbenish@comcast.net
Attachment: < von Hippel & Buss 2016.docx >

Dear Richard

The culture of cognitive science is like that too, at least to outsiders such as social psychologists. It is a very condescending attitude. It is very much like the reasons people are racist or sexist. Just by mere virtue of not being black or not being a woman, a white male can feel good about himself, just by his category membership. Cognitive scientists can feel that the worst of their lot is better than the best of the social psychologist lot. And it is so they can feel good about themselves regardless of their own merits. Maya Angelou I believe has been preaching this point about racism recently. It is only there for the dominant group to feel good about themselves.

That is too bad about physics, maybe studying cold matter makes them cold people, as you suspected. It is hard to point out the obvious when such smart people feel bad inside for not knowing it already, so they avoid the topic. Maybe one day you can find someone, probably in a non US physics department, willing to do the study. I am sure it takes a lot of expertise and expensive equipment of course.

Scientists are people and subject to the same motivated reasoning and self esteem maintenance as everybody else. But they pretend to be objective and above such petty motivations. As for motivated reasoning in social psychology I am attaching a fascinating manuscript about resistance to evolution because social psychologists' ideologies (esp regarding sex differences) makes them not want to believe these things are true. It is very disheartening. The manuscript is confidential, please don't share, as it is not yet in press — thanks.

all best

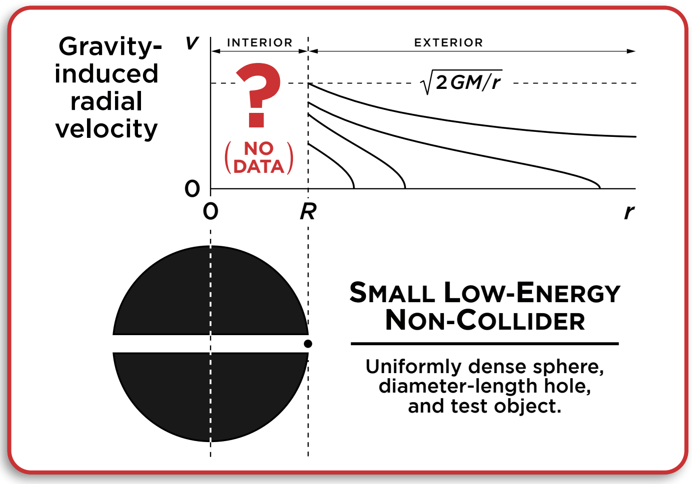
John

Just out of curiosity, you may like to try the following **experiment** in the sociology of physics.

START BY ASKING — **Q:** Can anyone in your local

PHYSICS DEPARTMENT

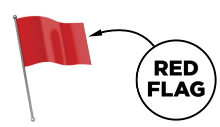
tell you where to FIND the DATA to complete the interior region of this graph concerning the basics of gravity?



YOU WILL FIND THE ANSWER TO BE — **A:** **NO**, because the experiment needed to fill in the missing data has not yet been done.

THE OBVIOUS FOLLOW-UP QUESTION BECOMES — **Q:** Why doesn't someone in the local Physics Department ***DO*** the experiment? That is, why don't they build and operate a Small Low-Energy Non-Collider?

STUDIES HAVE SHOWN THAT THE MAJORITY OF PHYSICISTS WILL RESPOND SOMETHING LIKE THIS — **A:** "We already know how to complete the graph for this experiment without actually ***DOING*** the experiment."



AN APPROPRIATE RESPONSE WOULD BE — **Q:** Isn't that *CHEATING* on the empirical ideals of science? Isn't *GUESSING* by extrapolation an unacceptable substitute for real physical data?

In the sequel, be especially alert for behavior that reflects: appeal to popular beliefs or authorities, evasion, condescension, arrogance, self-image, group-image, defensiveness, excuses about money, apathy, equivocation, and thinly-veiled embarrassment.

The rarest, and so far unobtained response, is that the queried physicist candidly ***echoes your curiosity*** about the physical question at hand.

What exactly happens to the falling test mass? If you get a response to the effect: *"Hey! Yeah, it looks like we've missed a spot. We've never actually OBSERVED what happens. Let's take care of that right away. Small Low-Energy Non-Collider ... the sooner the better!"* then you'll have hit the jackpot. You may then celebrate with exuberant joy and anticipation at the prospect of at last filling a large outstanding gap in our empirical knowledge of gravity.

GOOD LUCK!

GravitationLab.com • rjbenish@comcast.net

May 9, 2017

Post Card

Dear Professor Räsänen,

When conducting the sociological experiment proposed on the front of this card, please be sure to take careful notes.

And don't settle for anything less than the truth!

Thank you very much.

Sincerely,

Richard Benish

THIS SIDE FOR THE ADDRESS

To: Professor Syksy Räsänen
University of Helsinki
Department of Physics &
Helsinki Institute of Physics
P.O. Box 64 • FIN-00014
University of Helsinki • FINLAND

John Bargh | Department of Psychology

http://psychology.yale.edu/people/john-bargh

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Home » People » John Bargh

John Bargh

James Rowland Angell Professor of Psychology and Sch of Management
Ph.D., 1981, University of Michigan

john.bargh@yale.edu
203-432-4547
K308

Website
CV
Publications

ACME LAB
AUTOMATICITY IN COGNITION MOTIVATION + EVALUATION

MEMBERS PUBLICATIONS IN THE NEWS ALUMNI JOIN

Director:
John Bargh

The Automaticity in Cognition, Motivation, and Evaluation (ACME) lab focuses on unconscious or automatic ways in which our current environmental surroundings cause us to think, feel, and behave in ways without our conscious intention or knowledge. Past research has shown that these automatic processes play a role in stereotyping and prejudice, social behaviors such as aggression and politeness, as well as our liking and disliking of people, places, and things.

More recently, ACME Lab research has shown how social goals such as achievement and cooperation can become activated and then operate outside of awareness, guiding our behavior over extended time periods, without our intention or awareness of the goal we are pursuing. ACME research pays special attention to demonstrating how these effects are triggered by the commonly encountered features of real life, such as thinking about the important people in our lives, as well as common situational contexts and physical experiences.

Recent Lab News

Congratulations to John for winning the 2014 Distinguished Scientific Contribution Award, recognizing his significant contributions to the field of psychology. (August, 2014)

Lab Members
Erica Boothby
David Melnikoff
Robert "Bud" Lambert
Yimeng "Allie" Wang
Anton Gollwitzer

Contact Information
Prof. John Bargh
Department of Psychology
Yale University
P.O. Box 208205
New Haven, CT 06520-8205
203-432-4547 (phone)

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Scott Aaronson

PROFESSOR of THEORETICAL COMPUTER SCIENCE

University of Texas at Austin

Email Correspondence

January 24–25, 2016

PREFACE

Although gravitational physics is not Aaronson's area of expertise, he ventured an interesting reply, revealing some knowledge of current empirical research. He was included in my list of possible correspondents, partly because of his membership in FQXi: *Foundational Questions Institute*. FQXi members include many prestigious physicists. The organization sponsors annual essay contests, three of which I have entered. Aaronson's professorship at U Texas has just started, coming after nine years at MIT.

Aaronson's reply is discouraging because it appeals to an illogical faith-based "counter-argument." Gravity experiments have to do with measurable quantities of distance, time, and matter, which are often found in practice as *mixtures* such as speed, acceleration, force, and angle (direction). As indicated by the figures on the following page, there is a huge gap in the *radial speed* vs. *distance* graph. I point this out in every attempt I make to generate interest in doing Galileo's experiment.

We have never observed how the speed of falling bodies changes between surface and center, *inside* gravitating bodies. Our *predictions* for how speed is *supposed* to change have never been tested. On his own blog Aaronson displays a quote from physicist Asher Peres: "*Unperformed measurements have no results.*" Is this not a call to action, a plea to do less *talking* about measurements (experiments) that *could* be done by actually *doing* them?

Many of my correspondents refer—explicitly or implicitly—to measurements of so-called *static forces* inside massive bodies. Such measurements may be carried out with torsion balances on a laboratory scale, and with seismic data on a planetary scale. They are *assumed* to correlate with the speeds supposedly produced thereby. This assumption is compounded upon the deeper assumption that a downward gravitational force is felt by *falling* bodies. Integrating the force over distance then gives the cumulative speed (squared) of a falling body as it changes inside. The oscillation prediction is a consequence of this kind of analysis.

Actually, however, the falling body *never* feels this alleged attractive force. A co-falling accelerometer *always* reads zero. As suggested by the *non-zero* (upward) readings found on accelerometers attached to the source mass, maybe the force is *only* felt by bodies that maintain contact. The gravitational force measured by an accelerometer is *always* upward, *never* downward. Insofar as this is an accurate characterization of the force of gravity, there is no reason to expect a falling body to pass the center, because nothing every forces it downward. Both possibilities cannot be right. Accelerometers either tell the truth or they don't. The test object oscillates in the hole or it doesn't. Only by doing the experiment can we test the validity of the standard assumptions and discover the facts of the matter.

Instead of perceiving this fundamental character of Galileo's experiment—i.e., that doing it would be a significant contribution to science even if it only confirms the standard prediction—Aaronson sides with the complacent status quo. Aaronson seemingly wants me to concede that there's no convincing reason to do the experiment because physicists are as *confident* in their *prediction* as they are in the impossibility of the Easter Bunny.

As if confidence counts for anything in the eyes of Nature. As if humans have not before deluded themselves about gravity and motion. As if science were impervious—without heightened awareness and persistent questioning—to the toxicity of faith in authority.

It's almost as fascinating as it is disheartening how virtually all members of the "scientific" community consistently fail to see the question marks on the following graphs as beckoning opportunities to deepen our knowledge of gravity. Instead they pretend; they carry on as if they already know, as if Nature's voice can be safely neglected. What a shame.

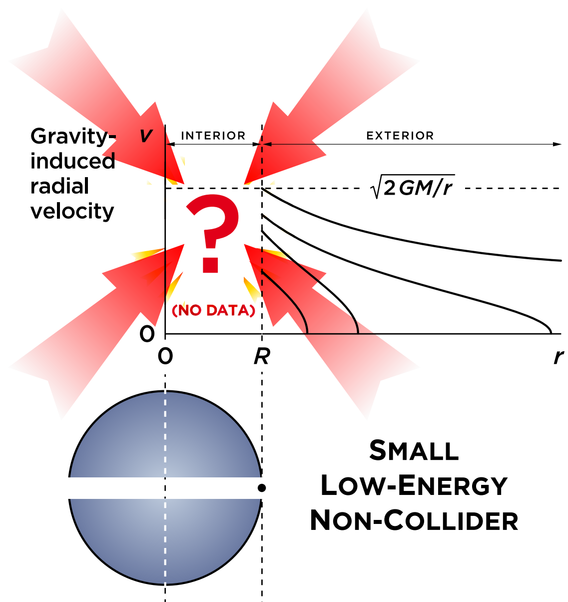
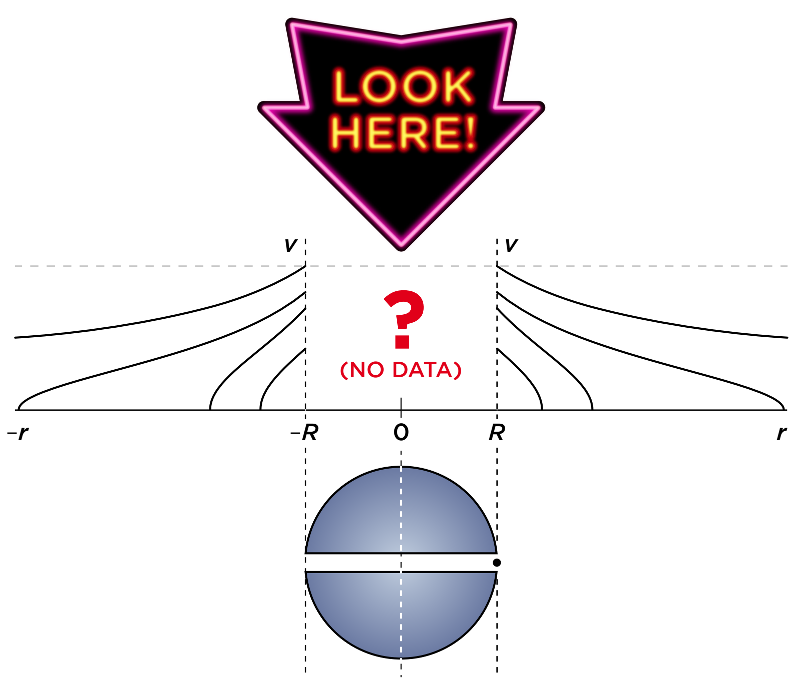


Figure X. Evidence gathered from above the surfaces of large bodies of matter like the Earth or Sun allow plotting the curves for the exterior region as shown. In the case of Earth, some evidence has been gotten from shallow holes close to (essentially at) the surface. But from well below the surface, especially near the center, we have no data. (As indicated, with some modest exaggeration.) The data is there to be gotten, not from astronomical bodies, but from laboratory sized bodies of matter. Instead of merely ***assuming*** that we know how to complete this graph for the interior region, conducting a preliminary demonstration on or near Earth would be a prudent first step before sending such a device to deep space.



Small Low-Energy Non-Collider

Figure Y. Huge gap in gravitational data. Almost all published evidence in support of Newton's and Einstein's theories of gravity is based on observations made *over* the surfaces of large massive bodies such as the Earth or Sun. Though discussions of the interior falling (i.e., Galileo's) experiment that would replace the question mark with data are common in physics classrooms and the literature, it has never been done. The results are therefore unknown, as indicated.

To: aaronson@csail.mit.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Mr-Natural-Says-LR.pdf>
<Gravity-Sociology-2015.pdf>

Dear Professor Aaronson,

I hope you find the attached documents to be within your scope of interest.

I'd be grateful for any feedback.

Thanks for your good work.

Sincerely,

Richard Benish

On Mon, Jan 25, 2016 at 1:24 PM, Scott Aaronson <aaronson@csail.mit.edu> wrote:

> Hi Richard,
>
> Thanks for the paper! I'm hardly an expert, but I know that physicists now *can* measure the gravitational attraction between small terrestrial objects—indeed, there were experiments maybe a decade ago that tested Newton's law down to the ~1 millimeter range. And if you wanted, you could easily set up one of those experiments so that the gravitating objects were being lowered into a hole in the earth (not all the way *through* the earth, of course! :-) ... but you could still measure the gravity from the objects). At least, that would seem like the obvious place to start, if you were serious about trying this sort of experiment.
>
> I'd caution you, however, that just because no one has tried some particular experiment, doesn't mean we can't have a clear expectation about the result. If you believe we can't, then you're open to the response:
>
> "Aha, but how do you know that the Easter Bunny won't suddenly appear, if we boil mangoes and celery in a purple cauldron in Greenland on February 14? After all, no one has actually TRIED that before! And even if we did try it, and it didn't work ... well, how do you know it wouldn't work if we tried the same thing on March 23?"
>
> I fear that many physicists would see a breakdown of gravity in the situation you describe, as roughly as likely as the Easter Bunny appearing in Greenland. I'm sure you'd disagree, and that's fine! But my point is, the burden is on you to make the case to physicists, not merely that no one has tried this specific experiment before, but that there's a high enough chance that something new or exciting would come out of it to make it worth the effort.
>
> Hope that helps and best regards,
>
> Scott

Of course physicists can and do have "a clear EXPECTATION about the result." The question is, of what VALUE is this compared to an ACTUAL RESULT? The obvious answer is: NOT MUCH!

The value could even be NEGATIVE because an *untested expectation* may not only be wrong, it could result in delusional self-confidence.

To: Scott Aaronson <aaronson@csail.mit.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments: < Rethinking Einstein's Rotation Analogy.pdf > < Max Force Annotation.pdf > < Maximum Force Nov 17 2011.pdf >

Dear Professor Aaronson,

Ah, yes, the Easter Bunny maneuver—I've encountered it often. Robert Geroch used the variation of painted spots on the test object, observed by a male duck.

This maneuver is ineffective because:

An infinite number of variations can be dreamed up, each one as physically inconsequential as the others. The variations have no reasonably argued connection to the stripped down question at hand, which concerns only MASS and MOTION. Physicists are supposed to be interested in MASS and MOTION, not Easter Bunnies or male ducks.

Yes, we have data involving STATIC forces inside matter. One of the first was by Hoskins et al [*Physical Review D,* vol 32, no 12, pp. 3084-3095, 15 December 1985]. Since then, improvements have been made by the folks at U Washington and perhaps elsewhere.

We are of course free to GUESS what the consequence of these forces would be in the case of an object falling into a body of matter. Confidence in this guess seems to be reasonably founded on observations of falling objects OUTSIDE matter or near the surface. I get all that.

Yet gravity remains a big mystery. In terms of General Relativity, predicted kinematic consequences correspond to predictions concerning clock rates. In the present case, the predicted oscillation in the hole corresponds to the rate of a clock at the center of the source mass being a local minimum. What causes that? How do we know it is a minimum? We don't know, because the Schwarzschild interior solution has never been tested.

The gravitational field outside matter may be characterized as a domain where the acceleration g INcreases toward the center. Whereas inside matter g DEcreases toward the center. This domain inside matter, where the sign of the gradient of g reverses, has never been probed with respect to either clock rate or motion through the center.

This is therefore a rather large physical domain that we have left unexplored.

If you are not swayed by such physical arguments, then, out of respect for Galileo, ought we not to do the experiment anyway? In probably hundreds of physics classrooms every semester around the world, students are given the "hole to China" problem and its "answer." On the Internet Neil deGrasse Tyson is among the many figures shown falling into the hole, as viewers are told what supposedly WOULD happen.

https://www.youtube.com/watch?v=9d3d2fqi0Ok

In NONE of these cases is EMPIRICAL EVIDENCE given to support the predicted textbook answer. No good detective or curious child will be satisfied with this. Such researchers would, rather, want to see with their own eyes what actually happens; they want FACTS, not predictions or video simulations. Insofar as physicists may be likened to detectives and curious children, in my opinion, physicists should not be satisfied either.

Are we not therefore overdue to DISCOVER by OBSERVATION what actually DOES happen?

I've attached two papers that argue, one from an imaginary alien perspective, that the standard prediction for the experiment is indeed highly questionable. The result may indeed be a big surprise. I hope you have the time and curiosity to consider this perspective.

> > Thanks for your thoughtful reply.
> >
> > Sincerely,
> >
> > Richard Benish

On Mon, Jan 25, 2016 at 2:59 PM, Scott Aaronson <aaronson@csail.mit.edu> wrote:

> > > OK then, I guess there's nothing to say except that I wish you luck in getting your experiment done! I'm a theoretical computer scientist, not a physicist at all (let alone an experimentalist), so I almost certainly can't help you — but, I dunno, have you tried coming up with a cost estimate and a proposed design for your experiment?

To: Scott Aaronson <aaronson@csail.mit.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

> > > > Dear Professor Aaronson,
> > > >
> > > > Not your field: fair enough. I am grateful that you have engaged as far as you have.
> > > >
> > > > As to design and cost, my interactions with the apparatus-builder, George Herold at TeachSpin in Buffalo, NY provide rough answers.
> > > >
> > > > A few years ago I sent Dr. Herold an essay similar to the one I sent you, except that it included more detail on the "modified Cavendish balance" design. Herold replied:
> > > >
> > > > At 10:40 AM -0400 7/2/09, George Herold wrote:
> > > > > I have thought about doing exactly what is in your paper.
> > > >
> > > > In our later correspondence, I inquired as to the cost of having TeachSpin build the apparatus. By this time Herold had learned that I am an amateur. For that reason, I guess, he began to be a bit evasive; he would not give me a definite price. I attempted to light-heartedly close the correspondence with the quip: "Well I guess that pretty much confirms my guess. The device would cost about half a million bucks, give or take half a million bucks."
> > > >
> > > > To my surprise, Herold replied: "That sounds like some serious money."
> > > >
> > > > There's my estimate.
> > > >
> > > > To put it in perspective, note that a $2 million dollar experiment proposed by Craig Hogan has been characterized as "so cheap." [*Scientific American*, Feb 2012, p. 34.]
> > > >
> > > > The big question mark on the graph in my previous documents could be turned into data-filled facts, evidently, for less than a million dollars. Meanwhile, physicists pound their heads with Planck-scale stringbranes, inflatonic multiverses, and lots of Darkness. Guess who's not impressed?
> > > >
> > > > Good luck with your quantum computing efforts.
> > > >
> > > > Best regards,
> > > >
> > > > Richard Benish

The University of Texas at Austin
Computer Science

Home › New Faculty

Scott Aaronson - Quantum Computing

Ph.D. 2004, University of California, Berkeley

Quantum Computing
Computational Complexity

Scott Aaronson's research focuses on the capabilities and limits of quantum computers, and more generally on computational complexity and its relation to physics. His recent interests include how to demonstrate a quantum computing speedup with the technologies of the near future (via proposals such as BosonSampling, which Aaronson introduced in 2011 with Alex Arkhipov); the largest possible quantum speedups over classical computing; the computational power of closed timelike curves; and the role of computational complexity in the black hole information paradox and the AdS/CFT correspondence. In addition to research, he writes a widely-read blog, and has written about quantum computing for Scientific American, the New York Times, and other popular venues. His first book, Quantum Computing Since Democritus, was published in 2013 by Cambridge University Press.

Aaronson received his bachelor's from Cornell University, and his Ph.D. from UC Berkeley under Umesh Vazirani. He also did postdoctoral fellowships at the Institute for Advanced Study in Princeton as well as at the University of Waterloo. Before coming to UT, he spent nine years as a professor in Electrical Engineering and Computer Science at MIT. He's received the National Science Foundation's Alan T. Waterman Award, the United States PECASE Award, the Department of Defense Vannevar Bush Faculty Fellowship, and MIT's Junior Bose Award for Excellence in Teaching.

FQXi
FOUNDATIONAL QUESTIONS INSTITUTE

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Member	Institution
Scott Aaronson	MIT

www.scottaaronson.com/blog/?p=3975

« CS and quantum information at UT Austin: come join us! Boof »

"Unperformed measurements have no results." —Asher Peres

Rev. Scott Gerard Prinster

Ph.D. Candidate • Department of the History of Science

University of Wisconsin

Email Correspondence

December 22 – 25, 2015

Preface

Though most of the targets of my marketing campaign are physicists, my audience was broadened by the postcard (attached) urging any and all academy members to hold their local physics departments up to their own standards of empirical evidence.

The outgoing message to Dr. Prinster deviates from the typical boilerplate due to his unique overlapping interests in both science and religion. Prinster's response happily echoes my impressions on the religiosity of physics and reflects genuine curiosity on the scientific question at hand.

It is worthwhile to note another scholar who has written in detail about how the historical "Enlightenment" transitions from a world dominated by the Church to a world dominated by science. Margaret Wertheim's book *Pythagoras' Trousers* [W. W. Norton, 1995] argues that the transition should be characterized less as a victory of science over religion than as a kind of hand-off from one dogmatic patriarchy to another:

> Despite the supposedly secular character of twentieth century science, some physicists are once again demanding that we see them as high priests, leading humanity "upward" toward transendental, even divine knowledge of the world.

Wertheim's excellent book discusses many examples of this trend—often, if not especially, as it relates to the oppression of women—throughout history.

Be that as it may, Prinster's concluding statement is double-barrelled: "It will be interesting to see whether anyone pursues your research question by actually testing it experimentally." Prinster's remark and my sociology postcard echo each other by raising two empirical questions: 1) In Galileo's physics experiment, does the test mass oscillate through the source mass, or not? And 2) How long must we wait for physicists to behave like physicists instead of like failing subjects of a sociological experiment?

To: prinster@wisc.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Gravity-Sociology-Dec-2015.pdf>

Dear Dr. Prinster,

I hope you find the attached documents to be within your scope of interest.

If I may suggest a connection, it is that, if you were to investigate the matter, I think you'd find that it reveals a very close connection between religious belief and science. Specifically, what is often presented as "knowledge" of what happens when Galileo's experiment is performed, is actually a clear-cut case of belief.

The experiment has never been done. So physicists routinely invoke the authority of Newton, Einstein, or various principles that have stood up to various tests in OTHER physical domains and circumstances. But Galileo's experiment involves a very large and distinctly different domain where these authorities and principles have, in fact, never been tested. Yet belief in them blindly persists.

Characteristics of religion, no?

I'd be grateful for any feedback.

Sincerely,

Richard Benish

Scott Gerard Prinster, 12/23/15 12:42 PM -0800, Re: Galileo's Gravity Experiment 1

> Dear Mr. Benish,
>
> Thank you for the provocative article and diagram. You're absolutely correct that the actual practice of science has involved many ideological commitments that are similar to religious beliefs. My work is in the history of science, and overlaps considerably with the sociological questions you raise in your documents. The corporate model of scientific research that has dominated American scholarship since the Manhattan Project, which we commonly call Big Science, discourages individual scientists from reflecting on how their work fits into a bigger picture—which, for the most part, works just fine on a daily basis. It will be interesting to see whether anyone pursues your research question by actually testing it experimentally.
>
> sincerely,
> Scott Prinster
>
> Rev. Scott Gerard Prinster
> Ph.D. candidate, University of Wisconsin
> Department of the History of Science
> prinster@wisc.edu
> http://www.scottprinster.com

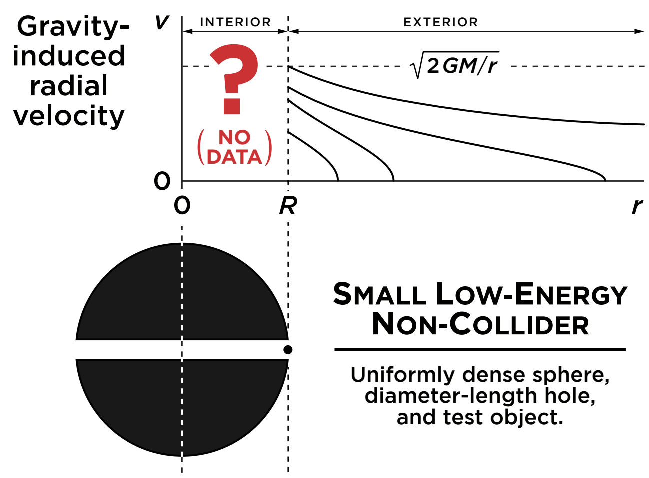
On 12/23/2015 12:47 PM, Richard J Benish wrote:

>> Dear Dr. Prinster,
>>
>> Many thanks for your thoughtful reply.
>>
>> Yes, it will be interesting to see how the drama plays out.
>>
>> Cheers,
>>
>> Richard Benish

Just out of curiosity, you may like to try the following **experiment** in the sociology of physics.

START BY ASKING

Q: Can anyone in your local **PHYSICS DEPARTMENT** tell you where to FIND the DATA to complete the interior region of this graph concerning the basics of gravity?



SMALL LOW-ENERGY NON-COLLIDER

Uniformly dense sphere, diameter-length hole, and test object.

YOU WILL FIND THE ANSWER TO BE

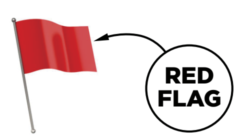
A: **NO**, because the experiment needed to fill in the missing data has not yet been done.

THE OBVIOUS FOLLOW-UP QUESTION BECOMES

Q: Why doesn't someone in the local Physics Department ***DO*** the experiment? That is, why don't they build and operate a Small Low-Energy Non-Collider?

STUDIES HAVE SHOWN THAT THE MAJORITY OF PHYSICISTS WILL RESPOND SOMETHING LIKE THIS

A: "We already know how to complete the graph for this experiment without actually ***DOING*** the experiment."



AN APPROPRIATE RESPONSE WOULD BE

Q: Isn't that *CHEATING* on the empirical ideals of science? Isn't *GUESSING* by extrapolation an unacceptable substitute for real physical data?

In the sequel, be especially alert for behavior that reflects: appeal to popular beliefs or authorities, evasion, condescension, arrogance, self-image, group-image, defensiveness, excuses about money, apathy, equivocation, and thinly-veiled embarrassment.

The rarest, and so far unobtained response, is that the queried physicist candidly ***echoes your curiosity*** about the physical question at hand.

What exactly happens to the falling test mass? If you get a response to the effect: *"Hey! Yeah, it looks like we've missed a spot. We've never actually OBSERVED what happens. Let's take care of that right away. Small Low-Energy Non-Collider... the sooner the better!"* then you'll have hit the jackpot. You may then celebrate with exuberant joy and anticipation at the prospect of at last filling a large outstanding gap in our empirical knowledge of gravity.

GOOD LUCK!

GravitationLab.com • rjbenish@comcast.net

Marc Davis

PROFESSOR of ASTROPHYSICS

University of California, Berkeley

Email Correspondence

December 31, 1995 – January 2, 1996

PREFACE

Davis suggests two analogies to support his guess that the standard prediction for Galileo's experiment is correct. He vehemently denies that it ***is*** a guess, because, as he proclaims: We "must believe [Newton's Laws]…[They] tell us absolutely how the ball falling in the earth will behave."

One of Davis' analogies involves *circular motion*. The other one involves *electricity*.

Circular motion obeys a cosine curve, as does the linear oscillation prediction for the Small Low-Energy Non-Collider experiment. In circular oscillation the distance remains constant, as does the force. By contrast, in linear oscillation, both the distance and the force dramatically *change* over the length of the path. Still, the analogy may be true. Why don't we test it?

Electricity is not gravity. Electricity is bi-polar (+)(–) (attractive and repulsive). Whereas gravity is monopolar (unidirectional). Both sets of phenomena exhibit behavior characterized by an inverse-square law. Therefore the analogy may be true. Why don't we test it (by doing the experiment with gravity)?

After Davis seemingly exhausts his plea to simply *surrender to untested predictions*, my next (and last) reply is to share some astronomical evidence that seems to support my model, or at least suggests the need to question Newton. In the intervening 23 years, my strategy has changed. So I interrupt the correspondence at this late point to give a more poignant response to Davis' final volley, and to put my astronomical arguments in perspective.

Those arguments culminated in my first published paper (in 2007) which includes an analysis of data gathered from observations of gravity-induced motion of stars in globular clusters. As noted in my "interruption," I still try to keep up with many developments in astronomy. But such observations—being of remote and complicated systems—lack the directness of the more accessible and purposeful Small Low-Energy Non-Collider, which is the singularly most potent method to provide the long-awaited unequivocally convincing physical evidence.

NOTE 1: The format of these email messages is different from more recent ones. Available technology and my archiving skills have evolved since 1996, when this exchange took place. The content is nevertheless clear enough. Davis is satisfied with guesswork and faith in human authority. He is not impressed with my insistent appeal to the authority of Nature.

NOTE 2: My final reply to Davis involves astronomical research that requires some context to appreciate. I have therefore provided this context as a "Hindsight (2019) Reply..." just prior to the actual chronological (1996) reply. In these two pages I also criticize Davis' last response for its logical fallacy (of misplaced concreteness).

To: marc@bkyast.berkeley.edu
From: rbenish@continet.com (Richard Benish)
Subject: Gravity-induced oscillation

Dear Professor Davis

I have a question concerning a gravity experiment which, to my knowledge, has never been done. It's the one often posed in elementary physics texts: Given a uniformly dense spherical mass with an evacuated hole through a diameter, show that a test object dropped into the hole harmonically oscillates.

This is easy enough to show theoretically, but is there any empirical evidence? I know of examples where the idea has been proposed to used the oscillation as a clock—whose frequency would give a measure of Newton's G (satellite experiment). And I've heard it said that stars can oscillate through the centers of star clusters. But I've never found any data to substantiate it.

This strikes me as curious. So I am asking you, if you can, to please tell me where the predicted oscillation has been physically demonstrated.

If you don't know of any evidence, perhaps this would be a worthwhile experiment to do. (Because it would replace an extrapolation for a concrete fact.) Using an apparatus resembling a Cavendish balance, but having the attracting masses sculpted so as to permit movement of the bobs through the center, I think it would not be too difficult, at least to demonstrate the oscillation as a first approximation.

I thank you very much for any comments or information.

Sincerely,

Richard Benish

Date: Sun, 31 Dec 1995 13:34:21 -0800
From: marc@coma.berkeley.edu (marc davis)
To: rbenish@continet.com
Subject: Re: Gravity-induced oscillation

Richard,

I agree that nobody has ever built an oscillator similar to what you describe. But a Cavendish experiment of this sort will be very difficult to build and isolate from other fields. Oscillations of stars in a cluster take much longer than a human lifetime.

I don't agree that this type of oscillation is "only theoretical". The x or y coordinate of a satellite orbiting the earth is undergoing oscillatory motion in a very similar manner as if the satellite were on a radial orbit. There will be no new physical principle involved for a satellite to actually move in a radial orbit, if that were possible.

It might be fun to try such an experiment, but there is no great theoretical interest in doing such an experiment.

Marc Davis

To: marc@coma.berkeley.edu
From: rbenish@continet.com (Richard Benish)
Subject: constant, angular vs. changing radial

Dear Professor Davis,

I am grateful for your quick yet thoughtful response.

I understand that in the case of a circular satellite orbit the motion projected on a given line in the same plane is simple harmonic, as is the prediction for radial motion through a uniformly dense sphere. So there is a close similarity, as you state. But qualitatively, the motions are clearly much different: the one is ANGULAR under CONSTANT gravitational potential, while the other one is RADIAL under widely CHANGING gravitational potential.

In Cavendish's original experiment, the first torsion filament he tried (a silvered copper wire) was not stiff enough to prevent the small masses from colliding with the wooden enclosure. They sensibly moved, due only to gravity. In an arrangement that allowed movement through the center, I guess air convection would be the biggest problem. But since great precision is not the goal, 19th century technology should still suffice.

"There is no great theoretical interest in doing such an experiment" because we have great confidence that our concept of gravitational attraction can be reliably extended to circumstances we have not yet explored. I just think it would be nice to actually explore the unexplored, even if there are no surprises. Then all those text book holey sphere thought experiments could be backed up by empirical evidence.

Thanks again.

Sincerely,

Richard Benish

Date: Sun, 31 Dec 1995 14:57:10 -0800
From: marc@coma.berkeley.edu (marc davis)
To: rbenish@continet.com
Subject: Re: constant, angular vs. changing radial

Richard,

If you want to try this experiment, it would probably be much easier if you did an analogous experiment with electrostatics. Consider a set of conncentric conducting spheres, all with a some charge on them. Then take another object with opposite charge, a small ball, for example. it should be possible to build metal concentric spheres all with a slot cut into them, which would allow a small ball to be suspended from a thin string. With no charge, the ball would oscillate like a typical pendulum. But then you could oppositely charge up the spheres and the ball, and the oscillation frequency should increase. The more concentric spheres you can build, the closer the experiment will be to a solid, uniformly charged volume.

Good luck.

Marc Davis

$\frac{1}{r^2}$

To: marc@coma.berkeley.edu
From: rbenish@continet.com (Richard Benish)
Subject: dipole vs. monopole

Dear Professor Davis,

Again I thank you for your quick reply.

The experiment you describe, with a pendulum swinging through concentric charged spheres must, of course, demonstrate something about electricity. The inverse square law that gravity has in common with electricity suggests, I suppose, that doing the experiment with electricity is the same as doing it with gravity.

But you are surely more aware than I am of the many differences between electricity and gravity.

I understand that, especially in astronomy, we often have no choice but to assume that our laws are applicable in circumstances in which we have never directly tested them. The kinds of experiments that have been done with gravity in recent years are vastly more difficult than the modified Cavendish experiment that I have proposed.

The only reason I can think of not to do it is that we are satisfied with the guess that we know the result. I myself am not satisfied with a guess.

Sincerely,

Richard Benish

Date: Tue, 2 Jan 1996 10:49:29 -0800
From: marc@coma.berkeley.edu (marc davis)
To: rbenish@continet.com
Subject: Re: dipole vs. monopole
X-Sun-Charset: US-ASCII

Richard,

You may not be satisfied, but in fact we are not "guessing" when we say the pendulum will oscillate with harmonic motion. If that were not so, Newtonian gravity would be inconsistent at the weak field limit, * and there is NO evidence that it is inconsistent. Checking for consistency is critical in physical science, but it is pointless to fuss overly much on experiments that cannot be executed, when there are alternative tests that can check the same physical principles. These tests have shown with great precision that Newton was correct, that the equations as he wrote them are consistent with most tests (barring the very small effects of General relativity, but that is another story).
Given that statement, the equations tell us absolutely how the ball falling in the earth will behave. You must believe them, because your life depends upon them every time you cross a bridge, or fly in an airplane.

Marc Davis

* There is no evidence that Newtonian gravity is inconsistent in the limited domains where we have looked. But why do we *REFUSE* to gather more evidence from places—even *HUGE* places—where we have not yet looked? Let's just stop looking and pretend to know what we'd find if we did. Is this science?

Hindsight (2019) Reply and Context for Understanding the Reply Given in 1996 (which follows)

Being abundantly confident of the correctness of his stance ("we are not guessing") Davis makes a valient effort to convince his amateur correspondent (me). I admit that the experiment—when it is at last carried out—may support the standard prediction. But until Nature stamps this prediction with her approval, the scientific thing to do is to put forth and execute a plan to expedite the day of reckoning (do the experiment)—not entrench oneself in the beliefs of human authorities.

Instead of doing the scientific thing, Davis commits a serious logical blunder: "You must believe [Newton's laws] because your life depends upon them every time you cross a bridge or fly in an airplane." Many a serviceable, life preserving bridge had been built and many a bird has flown for eons prior to Newton. Surely, lives depend on the *structural properties* of stone, aluminum, steel, air and feathers—not on the *abstract laws* that formalize quantification of these properties. More importantly, it is surely the responsibility of a physicist, perhaps even as a matter of life-and-death, to *test Newton's laws* in those accessible extreme regions where they have not yet been tested. That is, *inside matter*.

By failing to consider the possibility that his *assumptions* (predictions, equations, expectations, extrapolations) may be wrong, by instead asserting his FAITH in the validity of these untested abstractions, Davis thus commits the *fallacy of misplaced concreteness*. Unfortunately, this practice has become perniciously acceptable in modern physics.

The *prediction* for the result of the experiment counts for almost *nothing*. According to the ideals of science predictions have no enduring status until they are backed up by the concrete, empirical facts of physical reality. We can argue till we're blue in the face. Why not just shut up and arrange to hear what Nature has to say? *Why is it* that PhD "scientists" will not see this as the proper course of action? The answer lies in psychology and sociology, not physics.

As for my last reply, given in 1996, it reflects my research into astronomical evidence that seemed to bear on the question. Before having convinced myself that the data—though perhaps indicative—were ultimately too indirect to have the needed force to convince, I pursued the strategy and presented the results in my first published paper (*Laboratory Test of a Class of Gravity Models*, enclosed). In that paper I present my analysis of "proper" versus "radial" motion of stars in globular clusters. The evidence suggests an unsolved and mostly unrecognized anomaly in these marvelous swarms of gravitating bodies.

The most dramatic statement which acknowledges the problem without offering a clue as to how to resolve it, concerns Globular Cluster NGC 6752. The "measured" quantity serving as the key datum in this kind of analysis is the *distance*—sometimes referred to as the *kinematic* or *dynamic* distance. My analysis reveals a trend that violates expectations in a way that favors my gravity model. Astronomers have devised various methods for measuring distance, most of which, for a given object, are consistent with one another and so serve as ways of checking any stand-outs. NGC 6752 stood out so much as to evoke the authors' comment:

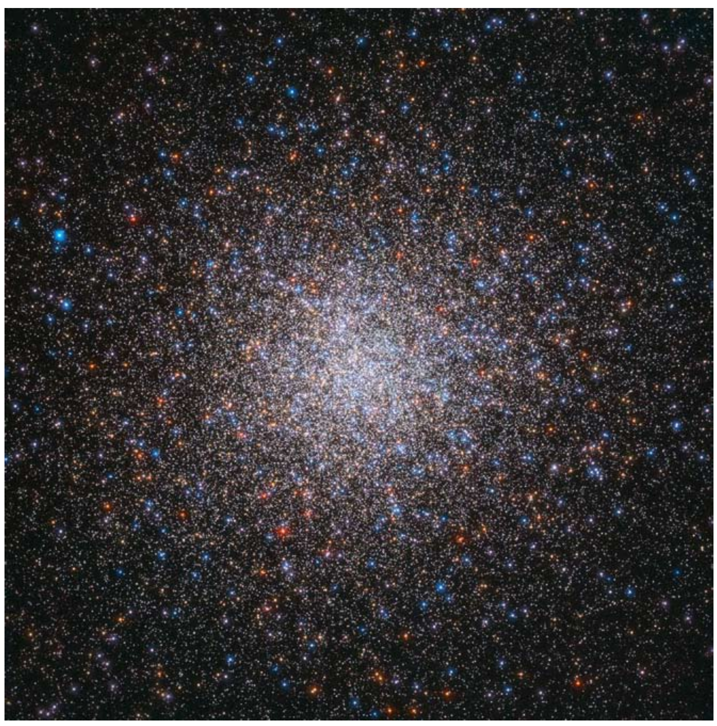
> While there is some uncertainty in the distance to NGC 6752, it is certainly known to better than the factor of roughly two which would be required to bring the two measurements [radial vs proper-motion velocity dispersions] into agreement… a most peculiar situation.

When I replied to Davis in 1996 I had not yet delved into the evidence from globular cluster analysis, but I was on the trail leading to it. Even while pursuing this line of thought, I recognized its possible long-term futility, because astronomers have way too much faith in Newton to be swayed by the resulting indirect and mostly obscure evidence. Even the "most peculiar situation" of NGC 6752 would fade as against all the apparent successes of their go-to theory of gravity. Therefore, although I continue paying attention to evidence from astronomy, my concentrated effort remains to urge building and operating humanity's very first Small Low-Energy Non-Collider.

If the result agrees with my prediction, there would be no way to save Newton's and Einstein's theories. They would have been proven to be ill-founded models whose usefulness in *exterior* fields would never diminish—within limits—but whose essential cores would be exposed as utter failures for making grossly incorrect predictions for test-object motion through the *interiors* of massive bodies.

Whereas if the result agrees with the standard prediction, then the astronomical anomalies will someday receive their proper Newton/Einstein-consistent explanations, and I would surrender to the revelation that my new gravity hypothesis is wrong.

Independent of any competing gravity model, however (I'll say it again) *we owe it to the spirit of Galileo to build and operate humanity's very first Small Low-Energy Non-Collider.* The sooner the better.



Globular Cluster Messier 2.

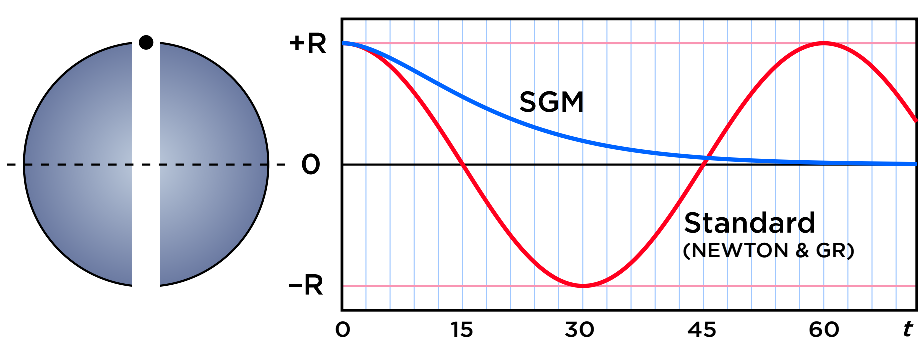


Figure 2. Schematic of Galileo's experiment with graph of competing predictions: The standard textbook answer is that the test object executes simple harmonic motion (red curve). But in none of the many textbooks, papers, and classrooms where this prediction is given do we ever find empirical evidence to back it up. Even without a competing model, therefore, doing the experiment is a valuable contribution to science. For our immediate purpose, the SGM's drastically different prediction (blue curve) would be unequivocally supported or refuted. The 60 minute oscillation period corresponds to a sphere whose density is about that of lead.

To: marc@coma.berkeley.edu
From: rbenish@continet.com (Richard Benish)
Subject: Interior vs. Exterior

Dear Professor Davis,

I thank you for your reply (1/2/96) and for your patience with me.

I am well aware that the evidence in support of Newton's and Einstein's gravity theories is abundant and seemingly quite compelling. Considering the better of the two (General Relativity) notice, however, that this evidence is entirely (or nearly so) in support of Schwarzschild's EXTERIOR solution. The Schwarzschild INTERIOR solution—which of course includes as a first approximation Newton's radial oscillation prediction for a uniformly dense sphere—has not been tested. (Taylor, 1961)

The various successes of the exterior solution instill great confidence that the interior solution should also be supported by physical evidence. The faintest hint of suspicion may perhaps be aroused, however, by the following anomalous astrophysical data:

(1) In an analysis of the dynamics of the Virgo cluster of galaxies (Shaya, 1986) in the section titled, 'The Dilemma of the Velocity Dispersion,' the author remains puzzled as to why the maximum apparent infall velocity is found well beyond the cluster's center; why are the higher velocities expected near the center not found?

(2) Similar results followed from an analysis which included 14 rich clusters (Cowie and Hu, 1986). Each of the 14 samples displayed the same effect: "The major point to note from Figure 1a is the 'swarming' of many of the galaxies in a low velocity population near the origin."

(3) On a smaller scale, an analysis of the motion of stars in the disk of our own galaxy (Lacey, 1984) indicated that the component of motion perpendicular to the plane of the disk was 10%-30% smaller than expected.

(4) Cooling Flows. "Perhaps the most surprising result in recent years is the discovery that in many clusters, 10 to 1000 M(sun) per year of hot gas is cooling and condensing out in the central cluster galaxy." (Helfand, 1995) Why should a "flow of material into the central regions" cool and condense? (Mushotsky, 1993). The question is reminiscent of the whole problem of star formation (especially low-mass star formation). The phenomenon responsible (gravity) for the condensation of a gas cloud into regions of high density is also supposed to produce high velocities in that region. How is this dispersive effect overridden by the condensing effect?

Because of the remoteness of these objects of study, this evidence must be considered indirect and inconclusive. But each case may be regarded as an "interior problem," whose problematic aspect would be lessened if we had any reason to EXPECT lower velocities in the central regions. Surely, it would be good to know, with absolute certainty, that we are justified in extending our model of gravity to the central regions.

I am grateful to Newton for our visit to the Moon, and I am grateful to Einstein for the knowledge that clocks in the attic tick faster than clocks in the basement. But it is not obvious to me that I "must believe" their interior solutions to be correct.

Assuming that extraneous forces can be sufficiently minimized, if the large spheres in the modified Cavendish experiment were made of lead, the torsion pendulum would have a period of less than an hour. Wouldn't it be nice to see the predicted oscillation actually happen?

I am truly grateful for your time.

Sincerely,

Richard Benish

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Cowie, L. L. and Hu, E. M. 'Kinematic Evidence of Satellite Galaxy Populations in the Potential Wells of First-Ranked Cluster Galaxies,' (1986) ApJ, 305 L39.

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Sat Mar 16 11:47:57 AM Richard Benish

astro.berkeley.edu/faculty-profile/marc-davis

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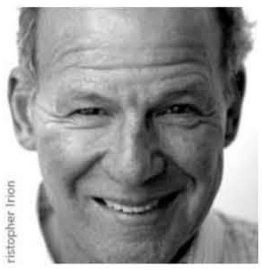

Marc Davis

Professor Emeritus of Astronomy, Physics

Office:
605S Campbell Hall

Contact:
E: mdavis@berkeley.edu
W: astro.berkeley.edu/~marc

Files:
Marc_Davis_memoir
Marc_skiiing_2017

Specialty Areas

Large-scale structure, cosmology, evolution of galaxies

Research Interests

My field is the study of large-scale structure. In the past this has taken the form of large redshift surveys combined with careful analysis of nbody simulations. We have used the Keck telescope to obtain the world's largest sample of galaxies at redshift one, which is extremely useful for study of the evolution of galaxies and the evolution of large-scale structure.

Biography

Marc Davis received his SB degree from MIT and his PhD in physics from Princeton. He continued at Princeton as a postdoctoral fellow and then went to Harvard as an assistant professor of astronomy. in 1981 he joined the Astronomy and Physics departments of UC Berkeley. He has received a number of honors for his work over the years, including a Sloan Fellowship, the Pierce prize, a Miller research professor, a member of the National Academy of Sciences, the American Academy of Arts and Sciences, the Heineman prize, an honorary PhD from the University of Chicago, and the Gruber prize.

The work was seriously hampered when he suffered a major stroke in June, 1993. A detailed summary of his life from high school to the present is given HERE.

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Department of Astronomy
501 Campbell Hall #3411
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Berkeley, CA 94720-3411
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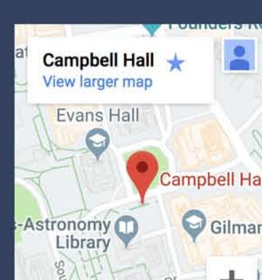

Bryce DeWitt

PROFESSOR of PHYSICS (Deceased)

University of Texas, Austin

Email Correspondence

January 17, 1996

PREFACE

De Witt (who died in 2004) had an illustrious career that spanned a wide variety of physics issues.

Unfortunately, though conversant with popular *theories* of gravity, DeWitt was not very curious about *gravity itself*. He thought he already understood it well enough to poo poo the idea of doing Galileo's exeriment with a modified Cavendish balance.

So it goes.

NOTE: The initial outgoing message to DeWitt was the same as the one sent to Marc Davis (enclosed) a couple weeks earlier. All that's left of the exchange is DeWitt's two-sentence response.

From: dewitt@lifshitz.ph.utexas.edu (Bryce DeWitt)
Date: Wed, 17 Jan 1996 14:00:36 CST
To: RJBENISH@TELEPORT.COM
Subject: Gravity experiment

Dear Mr. Benish,
The experiment you mention has never been done. It might be doable on an asteroid, but the money could be much better spent on other things.
Bryce DeWitt

WIKIPEDIA

Bryce DeWitt

Bryce Seligman DeWitt (January 8, 1923 – September 23, 2004) was an American theoretical physicist who studied gravity and field theories.

Bryce DeWitt	
	
Bryce (right) and Cécile (left)	
Born	Carl Bryce Seligman January 8, 1923 Dinuba, California
Died	September 23, 2004 (aged 81) Austin, Texas
Residence	United States
Nationality	American
Alma mater	Harvard University
Known for	DeWitt notation
Spouse(s)	Cécile DeWitt-Morette
Awards	Dirac Prize (1987) Pomeranchuk Prize (2002) Einstein Prize (2005)
Scientific career	
Fields	Theoretical physicist
Institutions	Institute for Advanced Study University of North Carolina at Chapel Hill University of Texas at Austin
Doctoral advisor	Julian Schwinger
Doctoral students	Donald Marolf

Contents

Life

He was born **Carl Bryce Seligman** but he and his three brothers added "DeWitt" from their mother's side of the family, at the urging of their father in 1950, after Bryce experienced anti-semitism as a "budding young scientist in Europe" (Seligman is a Jewish name; ethnically Bryce is part Jewish).[1] This is similar to Spanish naming customs, where a person bears two surnames, one being from their father and the other from their mother. Twenty years later this change of name is rumored to have so angered Felix Bloch that he blocked DeWitt's appointment to Stanford University and DeWitt instead moved to Austin, Texas.[2] He served in World War II as a naval aviator. He was married to mathematical physicist Cécile DeWitt-Morette. He died September 23, 2004 from pancreatic cancer at the age of 81. He is buried in France, and was survived by his four daughters.

Work

He approached the quantization of general relativity, in particular, developed canonical quantum gravity and manifestly covariant methods that use the heat kernel. B. DeWitt formulated the Wheeler–DeWitt equation for the wavefunction of the Universe with John Archibald Wheeler and advanced the formulation of Hugh Everett's many-worlds interpretation of quantum mechanics. With his student Larry Smarr he originated the field of numerical relativity.

He received his bachelor's in 1943, master's in 1947 and doctoral degrees from Harvard University in 1950. His Ph.D. supervisor was Julian S. Schwinger. Afterwards he worked at the Institute for Advanced Study, the University of North Carolina at Chapel Hill and the University of Texas at Austin. From 1953 to 1956 DeWitt was at the Lawrence Livermore National Laboratory. 1955 he earned the price "for the best two thousand word essays on the possibilities of discovering some partial insulator, reflector or absorber of gravity waves" by writing a "this is stupid" essay in one night. It finally led into the first "GR" conference at Chapel Hill 1957.

Olimpia Lombardi

PROFESSOR of HISTORY & PHILOSOPHY of SCIENCE

University of Argentina

Email Correspondence

September 30 – October 4, 2015

PREFACE

As a philosopher/historian, Lombardi kindly informed me of a few references—earlier than Galileo—to the Earth-tunnel problem. A well-written Wikipedia article about the *Theory of Impetus* covers some of this history:

https://en.wikipedia.org/wiki/Theory_of_impetus

A more detailed historical treatment appears in one of a series of lectures from 1975–1977 by Reijer Hooykaas [published posthumously by Kluwer in 1999, *Fact, Faith and Fiction in the Development of Science,* Chapter 5] wherein we find that several Middle-Age scholars preceded Galileo. The idea of falling into a hole through the center of Earth was typically raised for the contrasting hypotheses it inspired as against the prevailing Aristotilian views on motion. For the sake of name-recognition (marketing) reasons, I continue to associate the problem primarily with Galileo instead of those less familiar ones who preceded him.

Note that the Wikipedia article characterizes the idea as "…one of the most important thought experiments in the history of science, namely the so-called 'tunnel-experiment'." Isn't it curious that a *thought* experiment of such stature *remains* as a thought experiment hundreds of years later, when, with the advance of technology it could fairly easily be turned into a scaled-down *real* experiment?

In the book referred to above, Hooykaas inadvertantly illustrates this contrast after discussing one of the earliest (14th century) predictions for the result of the experiment:

> Suisseth [Richard Swineshead] proceeded like Newton, or any modern theoretical physicist: a mathematically formulated working hypothesis is put forward and its physical consequences are found by mathematical deduction… the modern physicist will next try to test the conclusion by some experience of physical reality.

Sadly, Hooykaas joins the medieval scholars he writes about and the huge community of 21st century "modern physicists" in failing to advocate for an actual empirical test of the many "tunnel experiment" deductions—whether ancient or modern—"by some experience of physical reality." Paying lip service to the ideals of science does not count as living up to them. We do not yet really know whether a test object oscillates through the center of a larger massive body or not. As though ignorance were bliss, the "modern physicist" cares not a whit.

Another connection to Lombardi's work that I might have appealed to (if I had been aware of it) in my correspondence with her concerns the *direction of time*. Having discovered this work long after our correspondence ended, due to its profound importance, and direct connection to Galileo's experiment, I'll briefly explain the matter here.

Though most of her writings concern the foundations of quantum theory, in a series of papers from about 2002 to 2013 Lombardi has also delved into

> *…the problem of the direction of time, one of the most longstanding debates on the conceptual foundations of theoretical physics.* [1]

Even after all their diligent work, it must be admitted, the contribution of Lombardi and her co-authors remains but one in a wide field of unsettled approaches to the matter. The gist of their argument is that, in conjunction with certain assumptions, the "geometrical properties of the universe," can be seen as perpetuating a particular temporal direction, i.e., *forward* (to the exclusion of its opposite, i.e., *backward*). This is presented as progress because the *dynamical laws* of physics are indifferent as to time's direction. Lombardi *et al* write:

> In general, the dynamical equations of fundamental physics are time-reversal invariant, e.g. the dynamical equations of classical mechanics, the Maxwell equations of electromagnetism, the Schrodinger equation of quantum mechanics, the field equations of quantum field theory, the Einstein field equations of general relativity. [1]

Thus, for the dynamical processes described by the fundamental equations of physics, backward is as likely as forward; a negative time variable is as logical as a positive time variable. So why is the forward direction "preferred" by Nature? Why does the time given by clocks only increase?

Lombardi *et al* argue that the unidirectionality of their global geometrical account of time "transfers" to local phenomena. They suppose the "energy flow" corresponding to the time direction of all local processes is a manifestation of the global temporal direction. In great detail they expound a constellation of "delicate points" needed to understand the picture. Note that the said energy flow refers to the multifarious motions of all matter and radiation everywhere.

> Once *we have established the substantial difference between past and future on global gounds* [original italics] and have decided that energy flows towards the future, we have a substantial criterion for discarding one of the [dynamically allowed temporal directions] and retaining the other as representing the relevant solution of the time-reversal invariant law. [1]

The "decision" that "energy flows toward the future" is, as noted above, based on a collection of "delicate points" whose purported global-to-local bridge remains, however, arguably fuzzy. I've included enough of their argument here to see its tentativeness ("once we've established…and have decided…") to provide contrast with a possibility that is neither delicate, fuzzy, nor based on a human decision, a possibility that is at once dramatically bold and physically unequivocal.

The heart of the new argument proposes that a more accurate model of gravity will turn out to be a paragon of *irreversibility*. Gravity's potently singular temporal direction, I would argue, is indicated by local accelerometers. (See Figures A and B on p. 4.) The appearance of and *assumption* that gravity (as described by Newton and Einstein) is a time-reversible phenomenon is due to a huge gap in our empirical evidence. We have not yet tested these theories *inside matter*, where the new model's validity would be most definitively determined.

One of the clearest demonstrations of the alleged temporal reversibility of gravity would be to conduct Galileo's *Small Low-Energy Non-Collider* experiment. A video of the predicted oscillation would look the same played forward or backward (cosine curve). If gravity is temporally unidirectional, on the other hand, (as suggested by accelerometer readings) then the test object will *not* oscillate; its path would approach an *irreversible* asymptote to the center.

The global (cosmological) implications of the non-oscillation result—which are similarly dramatic, though somewhat less direct and tangible—have been discussed in a few of my papers. The upshot can be meaningfully related to some work by the late cosmologist, Sir Fred Hoyle. Hoyle, recognized that his Steady State cosmological model would have established time's arrow because it involved the *creation of matter*. In a 1962 lecture and paper concerning *The Asymmetry of Time*, [Australian National University, 1965] Hoyle wrote:

> *We can say that if the physical laws are such that matter is created then time's arrow is explained and understood.*

Though Steady State models have fallen out of fashion, it is worthwhile to note that Hoyle (as well as Bondi, Gold and even Dirac) contemplated creation of matter—the sudden appearance of individual particles—essentially out of nothing, out of the deepest voids of space. Even a glacially slow creation rate, spread out over cosmological space, would suffice to maintain the average cosmic density, as the galaxies were still envisioned as receding from one another (and gravity was still conceived as a force of attraction).

I call the gravity model that predicts a non-oscillation result for Galileo's experiment the Space Generation Model. It makes this prediction because one of its central tenets is that accelerometers tell the truth about their state of motion. An accelerometer co-moving with the falling object reads *zero*, so it is *not* accelerating. By contrast, accelerometers attached to the source mass (except at the center) all give *positive* readings. This suggests that *matter is an inexhaustible source of perpetual propulsion*. Which means matter continuously regenerates itself, so that cosmologically, we have "creation of matter," not by discontinuous new particles popping into existence, but by the *ceaseless increase of all matter that already exists*. The *process* whereby this happens, i.e., the regeneration of matter, the generation of space, the perpetual increase (upwardness) of time, and the resulting expansion of everything in the Universe (whose average density remains *constant*) is gravity.

Time only increases because space and matter also only increase. (Unification.)

Here then is another reason to build and operate humanity's very first Small Low-Energy Non-Collider.

Does gravity yank the test object back and forth in accordance with a time-reversible dynamical law? Or do the zero readings on a co-moving accelerometer, in conjuction with the non-zero readings on accelerometers attached to the source mass, result in a path that does not pass the center? The latter result would indicate most extremely unequivocally the *gross asymmetry, the emphatic irreversibility of space, matter and time*. By building and operating humanity's very first Small Low-Energy Non-Collider, we may at last see, in stark clarity, how time's arrow is to be "explained and understood."

---

[1] Matias Aiello, Mario Castagnino, Olimpia Lombardi, 'The Arrow of Time: From Universe Time-Asymmetry to Local Irreversible Processes,' *Foundations of Physics*, vol. **38** (2008) pp. 257–292.

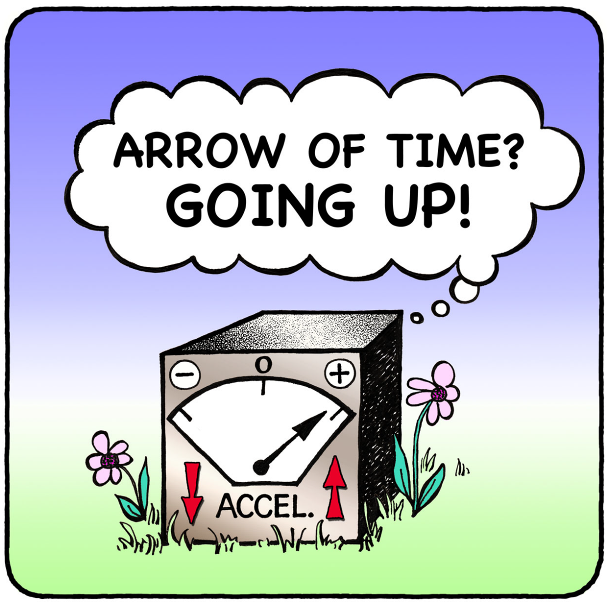

Figure A. If accelerometers are truthful about their state of motion, they seem to be telling us that the three basic elements of the physical world: *Matter, Space,* and *Time* are perpetually and *interdependently* increasing in proportion with one another. Corresponding to this possibility is that a test object falling in a hole through the center of a massive body will not pass the center. Whereas, if accelerometers are schizoid—as the prevailing relativistic perspective would have it—the test body will be yanked back and forth past the center even though a co-moving accelerometer reads zero. If the indicated arrow on the accelerometer corresponds also to the directions of matter, space and time, establishing this as an empirical fact would then represent a huge step toward revealing the essence of gravity and all that exists. The biggest unfilled gap in our knowledge of gravity and the physical world, is arguably the missing data corresponding to this experiment, which Galileo proposed 387 years ago. What are we waiting for?

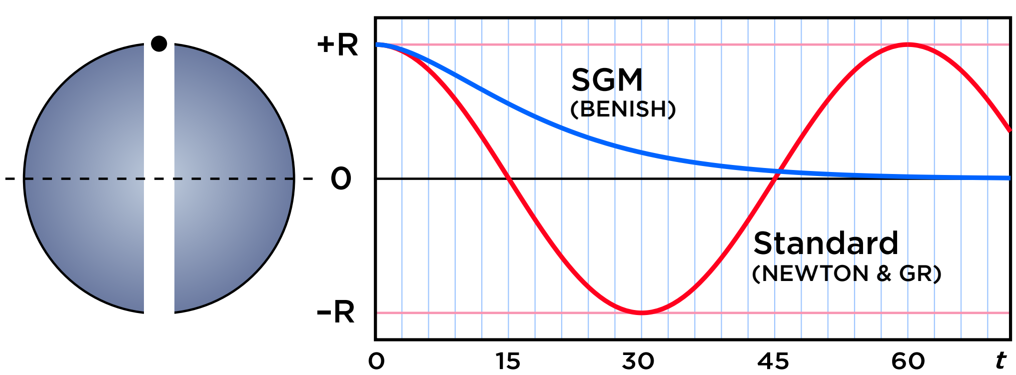

Figure B. Schematic of Galileo's experiment with graph of competing predictions: The standard textbook answer is that the test object executes simple harmonic motion (red curve). But in none of the many textbooks, papers, and classrooms where this prediction is given do we ever find empirical evidence to back it up. Even without a competing model, therefore, doing the experiment is a valuable contribution to science. For our particular purpose, the SGM's drastically different prediction (blue curve) would be unequivocally supported or refuted. The 60 minute oscillation period corresponds to a sphere whose density is about that of lead.

olimpiafilo@arnet.com.ar, 9/30/15 7:45 AM -0800, Galileo's Gravity Experiment 1

To: olimpiafilo@arnet.com.ar
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Mr-Natural-Says-LR.pdf>

Dear Dr. Lombardi,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Olimpia Lombardi, 10/2/15 4:29 AM -0800, Fwd: Galileo's Gravity Experiment 2

Date: Fri, 2 Oct 2015 09:29:09 -0300
Subject: Fw: Galileo's Gravity Experiment
From: Olimpia Lombardi <olimpiafilo@gmail.com>
To: rjbenish@comcast.net

> Dear Richard,
>
> You are right that the gap must be filled, but I'm not the right person to do that: I'm a philosopher of physics, not a physicist.
>
> Nevertheless, I can contribute to your work by saying that the first in proposing the experiment was not Galileo, but Jean Buridan in one of his *Expositio et quaestiones* on Aristotle's work: he predicted the oscillatory motion in terms of his theory of *impetus*. An the experiment was reproduced by his disciple Nicole Oresme, if I'm right, in his *Livre du Ciel et du Monde*, livre 1 chapitre 17. Middle Ages were not as obscure as many believe!!
>
> Very best
>
> Olimpia

Olimpia Lombardi, 10/2/15 7:39 AM -0800, Re: Fw: Galileo's Gravity Experiment 3

To: Olimpia Lombardi <olimpiafilo@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Fw: Galileo's Gravity Experiment
Attachments: <Hole Through Earth.pdf> <SLENC as Clock Smalley 1975.pdf>

>> Dear Dr. Lombardi,
>>
>> Thanks so much.
>>
>> I had a vague recollection of seeing an earlier reference to the experiment than Galileo's, but I could neither remember nor find it. I settled on citing Galileo's work because it is arguably more well

> known and accessible (though still somewhat obscure).
>
> Also, Galileo's discussion in his *Dialogue Concerning the Two Chief World Systems* is the earliest cited reference in the only paper I know of that explicitly addresses the history of the problem (see attached, p. 8). The attached paper focuses mainly on the last two centuries. You may find it interesting (surprising?) that Leonard Euler argued for a quite non-standard solution (p. 9).
>
> More relevant to the present concern is the reference to the modern (1970s) space-based proposals to carry out the experiment, using the predicted oscillation as a clock by which to measure Newton's constant *G*. (See second attachment.)
>
> Most important of all, as you've sensibly agreed, is that somebody should actually do the experiment to see whether Aristotle, Newton, or somebody else has made the right prediction.
>
> Although I've evoked a few temporary sparks of interest, the many hundreds of physicists that I've approached about the situation ultimately seem quite content to leave the experiment undone, to leave the prediction untested.
>
> The most noteworthy of these "sparks" may be that of Harvard Professor Gerald Holton, who wrote of my essay, "Nice… A very charming article." But nothing further. No expression of the need to turn the well known prediction into a physical fact. The status quo is thus maintained by PRETENDING to "know" the result. Not very scientific.
>
> Therefore, any mention that you might make—as a philosopher, or simply as a curious human being—of the existence of this gap in our empirical knowledge of gravity would be greatly appreciated. I speak of course for myself, but also, I think, for the neglected spirit of Galileo.
>
> Based on my experience, I should perhaps warn that any interest you may express in the need for empirical proof of the standard prediction will, in some circles, be met with scorn. So be careful and alert.
>
> Thanks again for your thoughtful reply.
>
> Cheers,
>
> Richard Benish

Olimpia Lombardi, 10/4/15 3:18 PM -0800, Re: Fw: Galileo's Gravity Experiment 4

Date: Sun, 4 Oct 2015 20:18:51 -0300
Subject: Re: Fw: Galileo's Gravity Experiment
From: Olimpia Lombardi <olimpiafilo@gmail.com>
To: Richard J Benish <rjbenish@comcast.net>

> > > Dear Richard,
> > >
> > > I suggest you to try to contact Professor Hasok Chang, from Cambridge, to send him your paper and the very interesting paper by Beech. He is a *very* famous philosopher and historian of science, particularly interested in what science discards or forgets: he thinks that the research on those forgotten parts of science may lead to a progress in science itself. Perhaps he might be interested in this very curious case.
> > >
> > > My best regards and good luck!
> > >
> > > Olimpia

Olimpia Lombardi, 10/5/15 8:02 AM -0800, Re: Fw: Galileo's Gravity Experiment 5

To: Olimpia Lombardi <olimpiafilo@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Fw: Galileo's Gravity Experiment
Attachments:

> > > > Dear Dr. Lombardi,
> > > >
> > > > Due to your suggestion, I've viewed Professor Chang's Inaugural Lecture at Cambridge and poked around some of his other work. Very refreshing.
> > > >
> > > > Thank you very much for steering me in this direction.
> > > >
> > > > I will follow up by sending Professor Chang the documents you recommended.
> > > >
> > > > Gratefully,
> > > >
> > > > Richard Benish

Grupo de Filosofía de la Ciencia

GFC

FCEN - UBA

El GFC · Novedades · Inicio · Contacto · Integrantes · Sitios de Interés · English

Dra. Olimpia Lombardi

Nombre: Olimpia Iris Lombardi
e-mail: olimpiafilo@arnet.com.ar

Formación de Grado:

- Licenciada en Filosofía por la Universidad de Buenos Aires.
- Ingeniera en electromecánica por la Universidad de Buenos Aires

Formación de Postgrado:

- Doctora en Filosofía por la Universidad de Buenos Aires.

Cargos Actuales:

- Investigadora Principal de la Carrera de Investigador Científico y Tecnológico del Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)
- Adscripto a la cátedra de Metafísica, Facultad de Filosofía y Letras, Universidad de Buenos Aires.
- Profesora Adjunta Interina a cargo del Área Filosofía de las Ciencias de la Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires.
- Profesora Adjunta Regular de la materia Lógica en la Licenciatura en Sistemas, Facultad de Ciencias Económicas, Universidad de Buenos Aires.
- Docente Libre de Humanidades Médicas, Cátedra de Historia de la Medicina, Facultad de Medicina, Universidad de Buenos Aires.
- Asesora Científica en las asignaturas Epistemología y Metodología de la

John Morack

PROFESSOR of PHYSICS

University of Alaska Fairbanks

Email Correspondence

January 13 – 17, 1996

PREFACE

At the time of our correspondence, Morack was Chairman of the Physics Department at the University of Alaska Fairbanks. My outgoing message was the same as in my correspondence with Marc Davis and Bryce DeWitt.

From these early days of my marketing efforts, we have another variation of the "been done" responses. In this case, Morack expects me to accept, as written in his final response (January 17, 1996) the validity of a kind of conceptual equation:

  Various measurements of static gravitational fields
+ Various unrelated investigations of simple harmonic motion

= Observation of oscillatory motion through the center of a gravitating body.

Insofar as the latter observation is beyond all human experience, the equation may be regarded as a *proposition*, but certainly not as a *fact*. It may in the end be true. But the only way to find out is to *test* it, to *actually, physically do the experiment*. Galileo's experiment has most certainly *not* "been done."

But Morack is in the position of authority. So there.

To: ffjlm@aurora.alaska.edu
From: rjbenish@teleport.com (Richard Benish)
Subject: gravity-induced radial oscillation

Dear Professor Morack,

I have a question concerning a gravity experiment which, to my knowledge, has never been done. It's the one often posed in elementary physics texts: Given a uniformly dense spherical mass with an evacuated hole through a diameter, show that a test object dropped into the hole harmonically oscillates.

This is easy enough to show theoretically, but is there any empirical evidence? I know of examples where the idea has been proposed to used the oscillation as a clock—whose frequency would give a measure of Newton's G (satellite experiment). And I've heard it said that stars can oscillate through the centers of star clusters. But I've never found any data to substantiate it.

This strikes me as curious. So I am asking you, if you can, to please tell me where the predicted oscillation has been physically demonstrated.

If you don't know of any evidence, perhaps this would be a worthwhile experiment to do. (Because it would replace an extrapolation for a concrete fact.) Using an apparatus resembling a Cavendish balance, but having the attracting masses sculpted so as to permit movement of the bobs through the center, I think it would not be too difficult, at least to demonstrate the oscillation as a first approximation.

I thank you very much for any comments or information.

Sincerely,

Richard Benish

John Morack,1/15/96 8:43 AM,Re: gravity-induced radial oscillation 1

Mime-Version: 1.0
Date: Mon, 15 Jan 1996 07:43:46 -1000
To: rjbenish@teleport.com (Richard Benish)
From: ffjlm@aurora.alaska.edu (John Morack)
Subject: Re: gravity-induced radial oscillation

Dear Richard,

The question of how the gravitational field varies inside of an object was raised and solved by Newton. There are numerous experiments to determine how the field varies inside the earth. Indeed the variation of the field has been measured in deep mines, etc and there have been no disagreements with Newton's Law of gravitation that I know about.

The concept of simple harmonic motion comes from the solution of Newton's second law for the case where the force is proportional to the displacement of the object. A simple case is an ordinary spring. There are numerous other examples and they indeed execute simple harmonic motion. The gravitational field inside of a sphere is another case that satisfies this condition and it therefore makes an interesting example which appears in many elementary physics texts.

What could be learned by performing the experiment? Probably not much. The field has been already been measured and simple harmonic motion is well understood. No one doubts that if you could set up the experiment, it would work. Your assummption that it would be a simple experiment to perform I don't think is correct. A simple experiment to measure the gravitational force constant is not trivial. During the search for the non existant "fifth" force a few years ago, there were over twenty experiments performed to look for slight variations in the gravitational field, all using very sophisticated technology, and it took about five years to convince people that Newton's gravitational law was correct. The gravitational force is extremly small compared to Nature's other forces and a laboratory experiment to show the simple harmonic motion of an object passing inside of another would not be trivial. It would be interesting (as any experiment that extends our experience is) but not one that anyone so far has thought important enough to perform.

In Morack's mind, evidently, one such as I, Richard Benish, does not count as "anyone."

There are lots of other experiments that are more important in terms of increasing our understanding of the gravitational field. The principal interest in the gravitational field now is to find a way to quantize it and then test this. This will be necessary in order to unify all four of the known forces and at this point no one knows how it can be done.

I hope this has been helpful.

John Morack

Printed for rjbenish@teleport.com (Richard Benish) 1

To: ffjlm@aurora.alaska.edu (John Morack)
From: rjbenish@teleport.com (Richard Benish)
Subject: Re: gravity-induced radial oscillation

Dear Professor Morack,

Thank you very much for your thoughtful comments about gravity and the radial oscillation experiment. You are obviously well aware of its theoretical and empirical status.

By way of some "old timer's" advice, I would like to respond especially to your comment: "What could be learned by performing the experiment? Probably not much. No one doubts that if you could set up the experiment, it would work."

First, there is the observation by Herman Bondi:

" It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is doing so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called speculation."

What little we know about gravity is almost entirely based on the observation of phenomena taking place OUTSIDE the gravitating bodies involved. Since the predictions of standard theory (especially general relativity) are so well supported by such exterior observations, the oscillation prediction is surely a reasonable extrapolation; but an extrapolation is still a guess. Knowing what the field strength is and how it varies inside a given body is not necessarily the same thing as knowing how a test object will move through that interior field. Perhaps if we did have a theory which unified the four forces we could justify our confidence in the extrapolation. But we don't; we still do not know how gravity works or what exactly it is. So the reasonable thing, it seems to me, would be to reserve judgement as to the motions it produces INSIDE gravitating bodies until we have witnessed them.

I also admire the attitude of Michael Faraday:

"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."

If we take the advice of Bondi and Faraday to heart, then, although the experiment under consideration would be difficult, since it is POSSIBLE and since WE DO NOT KNOW the result, we have no choice but to try it. Anyway, that's how I feel.

Thanks again.

Sincerely,

Richard Benish

Mime-Version: 1.0
Date: Wed, 17 Jan 1996 07:42:05 -1000
To: rjbenish@teleport.com (Richard Benish)
From: ffjlm@aurora.alaska.edu (John Morack)
Subject: Re: gravity-induced radial oscillation

Richard,
I think that you missed my point. The experiment has been done. The variation of the gravitational field inside the earth have been measured and simple harmonic motion has been well investigated.
John Morack

Robert Jacobsen

PROFESSOR of PHYSICS

University of California, Berkeley

Email Correspondence

July 28 – 30, 2015

PREFACE

Jacobsen echoes the most common response with uncommon brevity: "Been done." He thus claims, in two words, that Galileo's Small Low-Energy Non-Collider experiment has already been carried out. Even if he meant only that it has been *effectively* done, he is obviously quite wrong. Putting "gravitometers into deep boreholes" is nothing at all like observing the path of a test object moving all the way from the surface to the center of a source mass.

The appropriate response to a plea to do Galileo's experiment is, as suggested elsewhere, something to the effect: "Good catch. Looks like we've missed a spot. Let's take care of that right away." Out of personal or collective embarrassment, it seems, Jacobsen cannot bring himself to be so humble.

Instead, at best, Jacobsen feigns "logic" with a grossly unwarranted extrapolation. At worst, he perpetuates a lie, borne of insecurity and sloppy thinking. Insecurity and overconfidence are of the same cloth. Insofar as well-founded confidence and a scientific attitude would *invite* testing, and insecurity would *fear* it, the latter assessment seems, in this case, more likely. Either way, the spirit of Galileo is trampled once again.

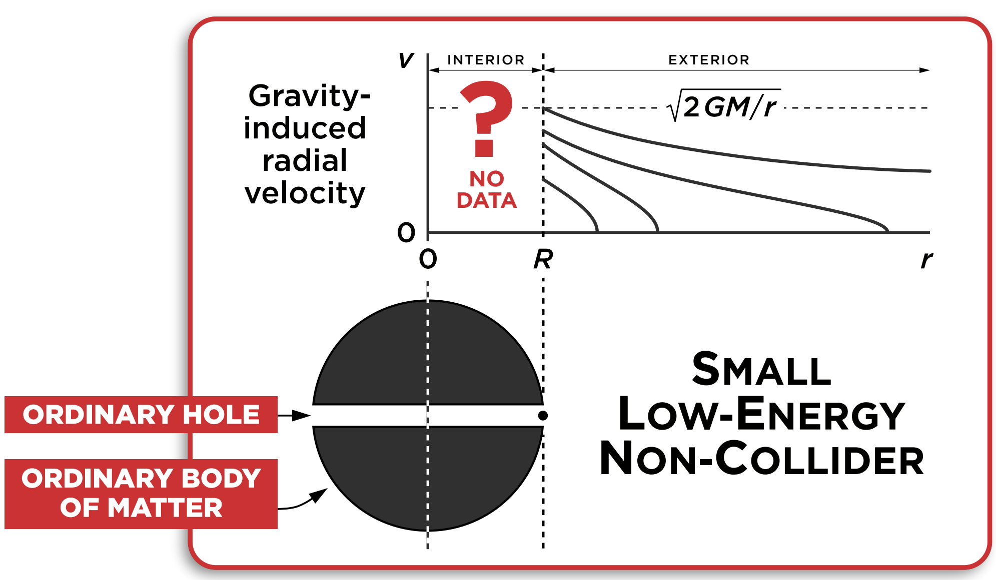

Figure 1. Recording gravitometer readings in tiny holes near the surface is not the same thing as tracking gravity-induced radial motion from the surface to the center of a massive body. (Duh!)

jacobsen@berkeley.edu, 7/28/15 11:55 PM -0800, Galileo's Gravity Experiment **1**

To: jacobsen@berkeley.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf:> <Mr-Natural-Says-LR.pdf>

Dear Professor Jacobsen,

The attached paper argues that until we do Galileo's experiment, we cannot be certain whether or not an important stone in gravitational physics has been left unturned.

I hope you have some interest in filling this large gap in our empirical knowledge of gravity.

Thank you for your good work.

Sincerely,

Richard Benish

Bob Jacobsen, 7/29/15 10:42 PM -0800, Re: Galileo's Gravity Experiment **2**

Subject: Re: Galileo's Gravity Experiment
From: Bob Jacobsen <jacobsen@berkeley.edu>
Date: Wed, 29 Jul 2015 23:42:38 -0700
To: Richard J Benish <rjbenish@comcast.net>

> Been done. It's routine to put gravitometers into deep boreholes, sometimes several km deep. No anomalies found. Usual equations work so well that people use them to back-calculate the geophysics, and the oil is found where the equations say it'll be.
>
> Bob

Bob Jacobsen, 7/30/15 7:09 AM -0800, Re: Galileo's Gravity Experiment **3**

To: Bob Jacobsen <jacobsen@berkeley.edu>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

>> Dear Professor Jacobsen,
>>
>> Thank you for the reply.
>>
>> The key thing about Galileo's experiment is that it involves observing the MOTION of a test object induced by gravity to MOVE radially toward and past the CENTER of a larger massive body.
>>
>> "Been done"? By whom?

> > I understand how knowledge of static forces inside a body (as obtained, for example by Spero, Hoskins, et al, 1985) suggests the possibility of deducing the motion that would seemingly result from the existence of these forces. But the motion has not actually been observed. Static forces and motion are not the same thing.
> >
> > If Galileo were alive and had the resources to do a scaled down version of his experiment, do you think he would just say, "Naw, I already know what happens"? My guess is that he would want to see it with his own eyes, as would a good detective or a curious child.
> >
> > Furthermore, the GR counterpart for the motion predicted by Newtonian theory is that the rates of clocks inside the source mass decrease to a minimum at the center. This weak-field prediction of GR has never been tested.
> >
> > The stone remains unturned. Why not simply admit it? Why not help to generate interest in finally doing the experiment proposed by Galileo 383 years ago?
> >
> > Sincerely,
> >
> > Richard Benish

Physics
@BERKELEY

BOB JACOBSEN

PROFESSOR
DEAN, UNDERGRADUATE STUDIES, COLLEGE OF LETTERS & SCIENCE

Office:425 LeConte

jacobsen@berkeley.edu

Main: (510) 708-5988

Other: (510) 486-7355

Back to Directory

Research Area(s): **Particle Physics**

BIOGRAPHY

Bob obtained a B.S.E.E. from MIT in 1978. He spent 1976 through 1986 working in the computer and data communications industry for a small company that was successively bought out by larger and larger companies. He left in 1986 to return to graduate school in physics, obtaining his Ph.D. in experimental high energy physics from Stanford in 1991. From 1991 through 1994, he was a Scientific Associate and Scientific Staff Member at CERN, the European Laboratory for Nuclear Physics, in Geneva Switzerland. While there, he was a member of the ALEPH collaboration concentrating on B physics and on the energy calibration of the LEP collider. He joined the faculty at Berkeley in 1995.

RESEARCH INTERESTS

Fundamental particle physics, particularly from the experimental perspective, is my primary research interest. Over the past 20 years the "Standard Model" of high energy physics has triumphed in precise tests of predictions of various quantities. The next step is to learn more about the unknown parameters, particularly in the neutrino sector, and to search for hints to the remaining phenomenological mysteries: Dark Energy and Dark Matter.

The LHC collider and experiments provides one powerful approach to these next steps. But it's also possible to make progress with smaller projects that address specific questions. For example, a number of different techniques are being used, and new ones are being proposed, for experimental searches for dark matter. My interest lies with using very quiet targets, for example heavily-shielded and high pure targets of liquid Xenon, and watching them with high-sensitivity phototube arrays to detect possible interactions with dark matter particles as they transit through the Earth. Much like the initial solar neutrino experiments of decades ago, this is an exercise in careful understanding of backgrounds and observation of very small, low-rate signals with high confidence levels. Experimentally, it's hard, but also a lot of fun. From a physics perspective, confirmed observations of dark matter particles would open up an entirely new window on fundamental physics.

Current Projects

The LUX detector is located 4850 feet underground at the Homestake Mine in Lead, South Dakota. In 2013 it published the best-yet limits on WIMP-type dark matter. In 2014 and 2015 we'll have a longer run to gather more data, along with new calibration methods to improve our ability to understand that data. After that, the next step is a larger detector, called "LZ". This 6+ tonne liquid Xenon detector will replace LUX in the cavern, and provide a large improvement in sensitivity. It's being designed now (2014) and will be constructed at LBL and other sites over the next few years. We expect "first dark", the initial operation, some time in 2018.

PUBLICATIONS

R. Assmann, et al. (The LEP Energy Group), "The energy calibration of LEP in the 1993 scan," Z. Phys. C 66, 567 (1995).

"LEP data confirm train timetables," CERN Bulletin 48, 95 (27 November 1995).

The BaBar collaboration, The BaBar Physics Book: Physics at Asymmetric B Factory, SLAC-R-0504.

James Schombert

PROFESSOR of PHYSICS

University of Oregon

Email Correspondence

March 14 – 19, 2015

PREFACE

Most of Professor Schombert's classes are in astronomy or cosmology. Among the reasons Schombert was on my recipient list is that he teaches at the University in my home town, and I found his webpages informative and lighthearted:

abyss.uoregon.edu/~js/

For kicks, I recently looked up Schombert on the "rate my professors" website. Evidently his students' impressions are consistent with the one I got from his brief reply to my email. One student described Schombert as "rude and belittling." A slew of "Awful" ratings were similarly critical.

Oh well.

jschombe@uoregon.edu, 12/30/15 11:37 PM -0800, Galileo's Gravity Experiment **1**

To: jschombe@uoregon.edu
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: < Galileo's-Belated-Experiment.pdf > < Mr-Natural-Says-LR.pdf >

Dear Professor Schombert,

I hope you find the attached documents to be within your scope of interest.

I'd be grateful for any feedback.

Thanks for your good work.

Sincerely,

Richard Benish

James Schombert, 12/31/15 12:45 AM -0700, Re: Galileo's Gravity Experiment **2**

Subject: Re: Galileo's Gravity Experiment
To: Richard J Benish <rjbenish@comcast.net>
From: James Schombert <jschombe@gmail.com>
Date: Wed, 30 Dec 2015 23:45:27 -0800

> **Oddly, I didn't find it interesting at all.**

James Schombert, 12/31/15 1:45 AM -0700, Re: Galileo's Gravity Experiment **3**

To: James Schombert <jschombe@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

>> Dear Professor Schombert,
>>
>> Not that the opinions of others should make any difference, but you may nevertheless be interested to know that Harvard Professor Gerald Holton replied:
>>
>> "Nice…a very charming article."
>>
>> Other reputable scholars have also replied positively.
>>
>> If you found it uninteresting then I find it curious that you should have been affected enough to feel motivated to share your negativity.
>>
>> Cheers,
>>
>> Richard Benish

Fri Apr 26 10:21:16 AM Richard Benish

honors.uoregon.edu/james-schombert

Google Maps Theraps Weather cPanel GoDaddy GravLab gravityprobe.org Juan Cole

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James Schombert

Professor of Physics

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Website

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Past Courses

HC 207H 21st Century Science

HC 441H The History of Space Flight

HC 441H Cosmology

Academic Background

Ph.D., Astronomy, Yale, 1984
B.S., Astronomy, University of Maryland, 1979

Research Interests & Current Projects

Professor Schombert is an observational astronomer whose research focuses on galaxy evolution and formation, as well as topics in cosmology. His recent papers have involved the star formation history of low surface brightness galaxies, the structure of ellipticals, and the baryonic and dark matter content of galaxies.

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John Schuster

PROFESSOR of HISTORY & PHILOSOPHY of SCIENCE

University of Sydney

Email Correspondence

December 22 – 24, 2015

PREFACE

The following happy dialog got off to a good start, in part, evidently, because Schuster found my attachments to echo some of his own interests: "I am a connoisseur of radical discovery claims and of the kinds of outlier challenges that can lead to them."

It was encouraging to receive Schuster's critique of my marketing tools: "I see that your poster is intended to get under the skin of the average professional, and it is well conceived to do so!" (This refers to my "Gravity-Sociology" postcard, attached at the end.) Assements of later attachments were also well received: Schuster found the Mr. Natural postcard to be "fantastic." And he expressed an interest in building on the "traction" that I had established with some correspondents to craft a "proto grant application" in hopes of ultimately getting Galileo's experiment carried out.

Schuster also inquired as to why I chose to write to him, and of the origin of my ideas and involvement in physics. So my reply as recorded in this exchange serves to answer these questions for any interested reader.

To: drjaschuster@gmail.com
From: Richard J Benish <rjbenish@comcast.net>
Subject: Galileo's Gravity Experiment
Attachments: <Galileo's-Belated-Experiment.pdf> <Gravity-Sociology-Dec-2015.pdf>

Dear Professor Schuster,

I hope you find the attached documents to be within your scope of interest.

I'd be grateful for any feedback.

Thanks for your good work.

Sincerely,

Richard Benish

John Schuster, 12/22/15 8:11 PM -0800, Re: Galileo's Gravity Experiment 1

Date: Wed, 23 Dec 2015 15:11:32 +1100
Subject: Re: Galileo's Gravity Experiment
From: John Schuster <drjaschuster@gmail.com>
To: Richard J Benish <rjbenish@comcast.net>

> Hello Richard, (please call me John)
>
> Thanks for these. I was trained, a bit, in physics, but if you know anything about me you know I am really an historian (of amongst other things, some small bits of physics). In fact, as if to prove I am no physicist or scientist at all, I was a couple of weeks ago elected as a fellow of the Australian Academy of the Humanities—my right location. So I must say I am not an active observer of these sorts of matters of current physics interest, although I can see you have been very active in trying to knock down some of the professional barriers on this and other potentially hot issues. So for science content per se, I am only an interested onlooker.
>
> However, my writ in history and philosophy of science has always also run to the socio-politics of scientists, their networks and institutions. I see that your poster is intended to get under the skin of the average professional, and it is well conceived to do so! I have known and worked with a number of deep thinking scientific mavericks—Ted Steele the neo-Lamarkian molecular geneticist, whom you might have come across; and also a brilliant quantum chemist turned gravity theorist (was theorizing vs the existence of the Higgs Boson with an alternative theory of gravity emergent from his quantum chemistry expertise) named Peter G Burton—like Steele an Aussie. I must say Steele has made some progress, his deep publications with difficulty being published mainstream and his theory claims slowly seeping into the mainstream—not that they are about to give him the Nobel Prize. So I am a connoisseur of radical discovery claims, and of the kinds of outlier challenges that can lead to them. (My main historical subject, Descartes, was exactly this on the topic of realist (not instrumentalist) infinite universe Copernicanism, as I now insist, although historians of philosophy are too drowsy to realise this or even see its importance in his work. He was also extremely careful to cover himself legally and to disguise a lot about his agendas—were he alive today he'd be more pushy and public.)

Anyway, I will certainly look at your documents with interest and an open mind. Whether I can throw any light on them, other than perhaps down the track maybe give you some counsel about how to engage the establishment, is an open question.

I wonder, can you tell me more about your background—for example how you came to know so much physics, and in particular find this intriguing difficulties (I have quickly looked up some of your other stuff). I take it, or perhaps I am wrong, that doing physics is not your main vocation, since you aren't employed in the field?

Oh, one more thing, Richard. Might you tell me how you stumbled across my existence in relation to history of physics?

Best regards,

JAS

Dr. John A. Schuster, FAHA

11 Red Sands Avenue

Shell Cove, NSW 2529

Australia

Honorary Research Fellow
Unit for History and Philosophy of Science &
Sydney Centre for the Foundations of Science
University of Sydney

Honorary Fellow
Campion College
Old Toongabbie, New South Wales 2146
Australia

Commissioning Editor
Early Modern Natural Philosophy
Studies in History and Philosophy of Science (Springer)

Past President, 1984-85; 1990-93; 2002-05
Australasian Assoc. for the History, Philosophy & Social Studies of Science

Website: descartes-agonistes.com

To: John Schuster <drjaschuster@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments: <Maximum Force Nov 17 2011.pdf> <Max Force Annotation.pdf> <Mr-Natural-Says-LR.pdf>

Hello John,

So nice of you to write. I found your comments to be most rare and insightful.

My background is in visual art. Long ago I stumbled into a curious idea about gravity that has sidetracked me because of its potential importance.

In 1984 I realized that the idea would be either permanently killed or elevated to high prominence, depending on the reslut of the "holey sphere/interior falling" experiment, that I only much later learned was proposed by Galileo in 1632. Seeing that this experiment would be the most dramatic and unequivocal test, I nevertheless endeavored, meanwhile, to see if I could kill the thing by other means. Perhaps some obervational data already collected would rule it out.

By this research I honed my skills as an amateur scientist. There were a few times when I thought I may have met my match, when I thought maybe the idea lost its viability for one reason or another. With dogged persistence, reading, studying, reading, studying and reading some more, I eventually came to realize that the idea (which goes by the name, *Space Generation Model*, SGM) explains all observations that I know of as well as, if not better than, General Relativity.

For several years I tried building the needed experimental apparatus, a Small Low-Energy Non-Collider, in my laboratory (= garage). This led to the discovery that my environmental controls, engineering and machining skills were inadequate for the task. An institution-grade laboratory is needed.

This effort ended in 2007, at which time I began to write with the intention of getting published. On the first page of my first paper I quoted another Schuster (Arthur) from an 1898 *Nature* article:

> 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 immedate 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?

Q: "How are we to prove…?" A: By doing Galileo's experiment.

What may be my best presentation of the SGM (attached with annotation) "almost" got published in the *International Journal of Theoretical Physics*. (See Annotation for what I mean by "almost.")

Harvard Professor Gerald Holton wrote favorably of the essay that I sent you last time: "Nice… A very charming article." That essay has been praised by others, including Julian Barbour of Oxford.

My efforts are two-pronged: Plan A is to simply point out that the experiment has never been done, it is doable, and that it was proposed by Galileo. Plan B invoves divulging that I think the result will be a surprise (based on the SGM).

Seeing that "fundamental" physics and cosmology have pretty much become an entertainment industry, and that serious papers that disrupt the status quo will not be accepted, I've resorted to a door-to-door marketing strategy. All first knocks appeal only to Plan A.

In response to recent attention given to a principle called "Naturalness," held up by many particle theorists and cosmologists as a worthy guide for constructing theories and understanding the Universe, I've lately tried adding humor to my approach. (See Mr. Natural attachment.) The sampling of responses is small but all over the map. Italian theorist Carlo Rovelli was duly amused and impressed. Whereas Nobel Laureate Gerard 't Hooft and Harvard Professor Matt Strassler did their best (independently) to flame my efforts. The latter two have seriously invested in the things the graphic makes fun of. Proof of their insecurity, as I see it.

I stumbled into your existence almost at random. Having just recently begun the "sociological campaign" with my new Red Flag postcard, in search of recipients, I Googled: "History of Science, Australia." When I got to your profile linked to the University of Sydney site, I almost decided not to bother you. Perhaps too far removed. But in time and space Descartes was pretty close to Galileo and Newton. I like the picture of you with your books, and item "2.c: Origins, so-called of Experimental Science(s)" tipped the scale. Lucky you! :)

In the last 10 months I've sent nearly 2000 emails and over 600 personalized hard copy postcards. My initial targets were participants at the various General Relativity Centennial celebrations all over the world.

I'm wide open to suggestions.

Many thanks for your interest and (sadly exceptional) curiosity.

Best regards,

Richard

PS: I'll look into the work of Steele and Burton.

R

Date: Thu, 24 Dec 2015 11:31:58 +1100
Subject: Re: Galileo's Gravity Experiment
From: John Schuster <drjaschuster@gmail.com>
To: Richard J Benish <rjbenish@comcast.net>

Hi Richard,

Thank you for this material. I'll study your paper and its useful annotation once I get some time after Christmas. The Mr. Natural poster is fantastic. History and Philosophy of science has generated a lot of irony, some penetrating, some mindless, but that is great. I can see that you cover a lot of territory, between your visual art and physics interests. That would be extremely satisfying, but even more so if more traction could be gained from the physics community; although I see you have indeed had some.

I am not a philosopher, of science or anything else, let alone modern physics. But there are lots of them—too many in my view—do you ever speak to any of those? I do see you have good feedback from Holton, a physicist and historian, and also an early collegue at Harvard of the young Thomas Kuhn who later was my main, but problematical mentor at Princeton, in their HPS program 1969–74. (I was teaching there last year, before we moved to England, then in 1980 to Australia. I am [still] American, in case you didn't realize it.

When it is not Christmas, I will also send you my "how the law of refraction was discovered" work, which appeared in 2000 in a collection (Gaukroger, Schuster and Sutton, *Descartes' Natural Philosophy* (Routledge, later in paperback too) and was reprised in my 2013 book about Descartes (and backed up there with an analysis of the development of Descartes' lense theory, which reconstruction supports my claims about how and when the law of refraction was found by him). But I shall not burden you now.

I am also interested in your sensitivity to the socio-politics of big time, professional science, including your interest in its professed "ideals." There has been quite a bit of discussion about all that, certainly since the 1930s, more under the label "social norms of science" going back to their invention by the Columbia sociologist Robert K Merton. These too have been subject to "ironic" deconstruction by other, less functionalist, sociologists. Then in the 1990s came a lot of attention to "trust" as the glue of modern science. I called attention to doubts about that in a long essay review of one of the key history of science books that made that claim. I'm just flagging that we may have a few things to exchange and discuss. Let's pick it up in early January—I'll write you then, having read through what you have sent.

Oh, just for amusement, I do attach a "book launch" talk I gave at a famous Sydney bookstore. The occasion was the publication of a popular book on the theme of Lamarck and my friend Ted Steele. The author, a very clever psychologist and marketing guru, had become interested in Steele as a famous Australian scientific rebel and he went to work, with some history of science mentoring from me. It is light and amusing, I trust, and gives a flavor for Steele's career (he is a card carrying member of the great Aussie scientific tradition, Nobel winning in some cases) in molecular genetics, focussed at the ANU and John Curtin School of Medicine there.)

Best regards,

JAS

John Schuster, 12/23/15 6:10 PM -0800, Re: Galileo's Gravity Experiment **6**

To: John Schuster <drjaschuster@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Galileo's Gravity Experiment
Attachments:

> Hello John,
>
> In the course of seeking potential recipients for my new explicitly sociological marketing campaign, I have encountered many references to Merton. I have it in mind to learn more about his work and infuence on more recent scholars. Also I am curious about other things you have mentioned. So please do share when you get the time.
>
> What I need is a team of clones. Do you know of a good clone service? I would like to dive into so many things, especially back into painting. But the number one priority is to get the gravity project resolved. So almost all of my "spare" time is devoted to knocking on doors by sending electronic and hard copy versions of my work. I get enough feedback to give me the impression that, considering my constraints, the strategy is a good one.
>
> It stands to reason that somebody out there will have the combination of perceptivity and resources needed to finally make Galileo's experiment a reality. I just haven't found him or her yet.
>
> Enjoy the holidays!
>
> Richard Benish

John Schuster, 12/23/15 7:34 PM -0800, Re: Galileo's Gravity Experiment **7**

Date: Thu, 24 Dec 2015 14:34:16 +1100
Subject: Re: Galileo's Gravity Experiment
From: John Schuster <drjaschuster@gmail.com>
To: Richard J Benish <rjbenish@comcast.net>

> Hi Richard,
>
> Yes I have studied (and used to teach) Merton and the post-Merton developments in sociology, and history of science for many years. I'll get to this in the new year. I will also make some, perhaps amateurish, suggestions to you about advancing the possibility of getting the Galileo experiment done—this has been swirling around my mind this morning. More anon on that.
>
> Must go, mid to late afternoon Christmas eve beckons, have a relaxed and thoughtful time in these holidays.
>
> Best

To: drjaschuster@gmail.com
From: Richard J Benish <rjbenish@comcast.net>
Subject: Scientific Facts
Attachments: <Rethinking-Rotation-Sep-5-2012 .pdf>
<Rethinking-Einstein-Annotation-Ltr.pdf>

Hello John,

Reading your Honeywill Book Launch Remarks compels me to add an echoeing element to our correspondence. The entire piece is certainly inspiring for the occasion at hand. But what struck me as the most enduring motivational part is the passage on what constitutes a "scientific fact."

This reminds me of the first day in my first college-level science class (which occurred only a short time ago). Intent on establishing how science operated, the instructor of *Chemistry 221*, Gary Mort, began the lecture by dropping a pen, saying that its acceleration toward the floor is an empirical fact. Sitting in the front row, I had to object: "or the floor moves upward." Having a sense of humor and wanting to proceed without further interruption, Mort smilingly repeated my comment and moved on.

On the basis of Einstein's Equivalence Principle, comments to the effect that "the floor comes up" are not uncommon in the popular gravitational literature. But they are not really taken seriously. There is no convincing attempt to reconcile such statements with the well known "fact" (another one) that balls of matter like Earth are accurately conceived (for gravitational purposes) as being STATIC.

The real scientific fact lying at the heart of the discussion—even in our present state of ignorance—is that *the distance between the pen and the floor decreases at an accelerating rate.* Only by the most mystically detached, absurdly nit-picky, or pseudo-scientific "reasoning" would we deny this as a bona fide theory-independent FACT.

The question thus remains: Is it more ACCURATE to say that the pen falls down or that the floor comes up? Our EYES tell us the pen falls down. But an ACCELEROMETER tells us the floor comes up! If we decide to at least tentatively believe the accelerometers, we are then obliged to pursue the consequences on a variety of radical levels. For example, we would eventually find that this path leads to the need for a fourth dimension of space. Seeing that this fits rather well with the empirical "fact" of the CURVATURE of the seemingly (3+1)-dimensional spacetime continuum, we proceed in search of a genuinely irreconcilable contradiction.

Eventually we hit upon the most clear-cut way to decide between the possibilities: Drop a test object into a hole that goes all the way through the center. By not allowing the radially falling pen to COLLIDE, we can DISCOVER which statement is closer to the Truth.

I've attached another paper that explores this line of reasoning from the point ov view of an imaginary civilization that has had no experience with gravity until their very recent first encounter with a "planet." You will find this paper to be a little less technical, shorter, and more entertaining than the *Maximum Force* paper sent last time.

Being another essay competition piece (sponsored by FQXi = Foundational Questions Institute), I've attached an annotation explaining its origin and giving a glimpse of how it was received.

I don't mean to bog you down with my work. But especially for one who is not readily familiar with the gravitational/relativistic literature, the order of reading makes a difference. *Rethinking Einstein's Rotation Analogy* should precede *Maximum Force*.

> I am very grateful for your interest and eagerly await further feedback.
>
> Merry Christmas,
>
> Richard Benish

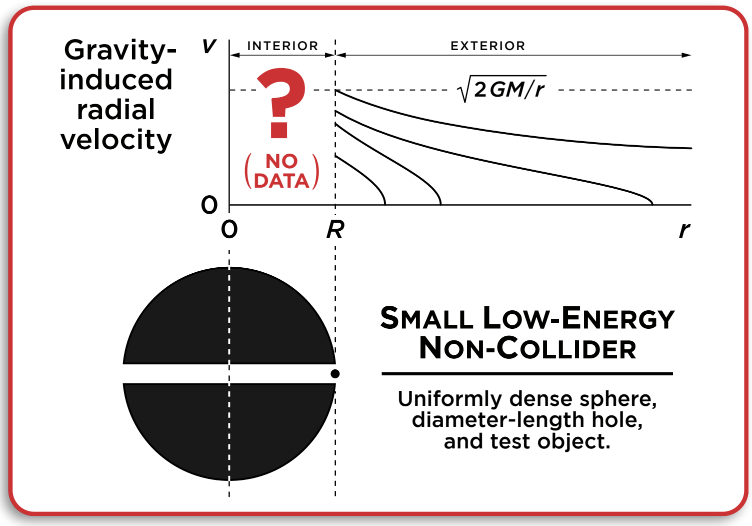
Date: Fri, 25 Dec 2015 07:45:41 +1100
Subject: Re: Scientific Facts
From: John Schuster <drjaschuster@gmail.com>
To: Richard J Benish <rjbenish@comcast.net>

> Hi Richard,
>
> Ok, that is useful and I shall place *Rethinking Rotation* first in the trajectory.
>
> The very real possibility of testing your ideas changes the complexion of the matter. Relatedly, again I see that some academic physicists take note of your views. It should be possible to assemble a little network of more "insider types" to apply for resources to support testing. Maybe you should revisit your links to sympathetic readers with that in mind. For example, can some kind of proto grant application be mocked up for serious development; any idea what such testing would cost anybody? The outcome would be significant either way perhaps very significant.
>
> Up too early Christmas morning… must go back upstairs and try to wake up my wife and persuade her that we need waffles or pancakes at this point in the proceedings. Have a good one.
>
> Best,
>
> JAS

Just out of curiosity, you may like to try the following **experiment** in the sociology of physics.

START BY ASKING

Q: Can anyone in your local **PHYSICS DEPARTMENT** tell you where to FIND the DATA to complete the interior region of this graph concerning the basics of gravity?



YOU WILL FIND THE ANSWER TO BE

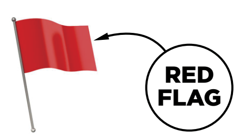
A: **NO**, because the experiment needed to fill in the missing data has not yet been done.

THE OBVIOUS FOLLOW-UP QUESTION BECOMES

Q: Why doesn't someone in the local Physics Department ***DO*** the experiment? That is, why don't they build and operate a Small Low-Energy Non-Collider?

STUDIES HAVE SHOWN THAT THE MAJORITY OF PHYSICISTS WILL RESPOND SOMETHING LIKE THIS

A: "We already know how to complete the graph for this experiment without actually ***DOING*** the experiment."



AN APPROPRIATE RESPONSE WOULD BE

Q: Isn't that *CHEATING* on the empirical ideals of science? Isn't *GUESSING* by extrapolation an unacceptable substitute for real physical data?

In the sequel, be especially alert for behavior that reflects: appeal to popular beliefs or authorities, evasion, condescension, arrogance, self-image, group-image, defensiveness, excuses about money, apathy, equivocation, and thinly-veiled embarrassment.

The rarest, and so far unobtained response, is that the queried physicist candidly ***echoes your curiosity*** about the physical question at hand.

What exactly happens to the falling test mass? If you get a response to the effect: *"Hey! Yeah, it looks like we've missed a spot. We've never actually OBSERVED what happens. Let's take care of that right away. Small Low-Energy Non-Collider... the sooner the better!"* then you'll have hit the jackpot. You may then celebrate with exuberant joy and anticipation at the prospect of at last filling a large outstanding gap in our empirical knowledge of gravity.

GOOD LUCK!

GravitationLab.com • rjbenish@comcast.net

Descartes Agonistes

http://descartes-agonistes.com/

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News May 2014

Thursday, 22 May 2014 05:51 John A. Schuster

John A. Schuster, *Descartes Agonistes: Physico-mathematics, Method and Mechanism 1618-1633*

(Springer, Dordrecht) xix + 631pp. + 69 figures, has appeared, See:

http://www.springer.com/philosophy/history+of+science/book/978-94-007-4745-6

Substantive Reviews:

John Henry, 'review of Descartes-Agonistes', *Intellectual History Review* 2013: 23:4, 586-589, DOI:10.1080/17496977.2013.846998

http://dx.doi.org/10.1080/17496977.2013.846998

Fokko Jan Dijksterhuis, 'Reworking Descartes' *mathesis universalis*', to appear in *Metascience*; published on–line 25 June 2014; DOI: 10.1007/s11016-014-9904-9

http://link.springer.com/article/10.1007/s11016-014-9904-9#page-1

Maria Rosa Massa Esteve, 'review of *Descartes-Agonistes*', *Zentralblatt MATH Database* 1931-2014; vol 1279.

http://emis.mi.ras.ru/ZMATH/msc/en/search/zmath/?q=an:pre06112287&format=complete

Or Zbl 1279.01004

The open access textbook on this site, "*The Scientific Revolution*" has been extensively revised for its translation into Chinese by Professor An Weifu and its publication by the Shanghai Scientific and Technical Educational Publishers. This has now appeared:

John A. Schuster [2013] 科学革命: 科学史与科学哲学导论. (上海科学技术出版社, 上海) 520pp. + 129 figures. ISBN 978-7-5428-5670-8 [*The Scientific Revolution: Introduction to the History & Philosophy of Science*. Trans. An Weifu (Shanghai Scientific and Technological Education Publishing, Shanghai)]

Anyone wishing access to any of the revised chapters in their English forms should contact me directly. The chapters on this site have not yet been updated.

Professor Matt Strassler

HARVARD UNIVERSITY

POST and SELECTED COMMENTS on the Professor's Blog:

OF PARTICULAR SIGNIFICANCE

Dark Matter: How Could the Large Hadron Collider Discover It?

April 13 – 17, 2015

PREFACE

Strassler's impressive CV includes education at Princeton, Stanford, and Rutgers. He was a visiting professor at Harvard when the following discussion took place. Comments by other participants have been excluded or grayed out. A hard copy of my Mr Natural postcard (p. 9/13a) was evidently received by Strassler at Harvard, as he alludes to it (with mixed feelings) in the exchange.

Strassler's initial blog post is included here even though it mentions the importance of gravity only once (near the top, colored red). I then skip to the Comments section where I chimed in two days later. Stressing the importance of testing our gravity models where they have not yet been tested, my comment is similar in spirit to those of prior commenters, who also emphasized the importance of gravity.

In the interest of both fairness and completeness, I have reinserted parts of my comments that were deleted (censored) by Strassler. This sometimes makes the document a bit choppy, typographically. But readers who follow along will then get a more accurate impression of the contentious communication Strassler and I were engaged in. I consistently argued for the importance of providing empirical evidence to support our theories. Whereas Strassler consistently argued for the importance of looking like an accomplished tough-guy authority who refuses to be impressed by an amateur who dares point out the fact that the Professor doesn't really know something he and his colleagues routinely *pretend* to know.

As a theorist working mostly within the framework of the "Standard Model of Particles," Strassler's research and popular postings typically involve his thoughts on the activities at the *Large Hadron Collider* at CERN. This sometimes involves cosmological puzzles such as that of *Dark Matter*, and gravitational theories such as *General Relativity*. Strassler also spent some time in 2014 teaching at the *Galileo Galilei Institute* in Florence, Italy. A few of Strassler's blog posts discuss the concept of *Naturalness*—one of them being from an international conference devoted to the subject (at the *Weizmann Institute of Science* in Israel, November 2014).

I don't know for sure why Strassler treated me and my work with such disrespect and presumptuousness. Maybe it's because the Mr Natural card makes some fun of Naturalness (ego, insecurity issues). Maybe it's because I've proposed a non-collider experiment to fill a gap in our empirical knowledge of gravity whose importance Strassler would arrogantly deny (face-saving knee-jerk reaction on behalf of the collective) or both. By the end, Strassler does calm down a little, but he remains steadfastly non-commital, if not opposed to endorsing the idea that someone really ought to perform the experiment proposed 387 years ago by the "Father of Modern Science."

I've added some after-the-fact commentary at key junctures (in red and yellow). I should perhaps address one issue straight away: On p. 7 Strassler advises me to not call the Galileo-inspired experimental apparatus a *Small Low-Energy Non-Collider* (SLENC). He claims that "almost every" experiment in his department could be given that name. This may be true for *some* experiments in which there is no test object following a trajectory to be observed, and the huge mass of planet Earth plays no role. But the word *non-collider* obviously implies a collision-free *path through space*. Virtually all experiments exhibiting friction, interactions with light, or non-zero accelerometer readings involve considerable size, energy, and/or collisions.

Experiments that come closest to satisfying the description are gravity-related falling experiments: orbital motion or radial falling. If the direction of fall is not radial, then initiating the trajectory requires an input of highly energetic collisions (propulsion). Insofar as most laboratory experiments involve some kind of mechanical or electromagnetic phenomena, they involve energies many orders of magnitude greater than those of a SLENC. Radial falling experiments in which a test body is obstructed from proceeding all the way to the center of the source-mass involve collisions (landing or bouncing). All rolling, or suspended pendulum experiments involve the hugeness of planet Earth, non-zero accelerometer readings and friction damping (collisions).

For the above reasons and because an ideal SLENC's test object permanently exhibits a *zero* accelerometer reading, the device is actually ***unique*** among physics apparatus. The thing itself and its name represent a patently *extreme case*, making it a highly desirable apparatus to study. Instead of ackowledging this and promoting the need to build and operate one, Strassler chooses to trivialize and misrepresent its significance. Why? I would guess that Strassler is *embarrassed*, personally, and as a member of a society which collectively *pretends to know* the result of an experiment they should have done long ago.* A SLENC is common as dirt and/or a crackpot waste of time to Strassler only, I guess, because he didn't think of how cool it would be to build and operate one himself.

Similarly adolescent thinking patterns are on display in what follows. Finally, Strassler claims to be "an empiricist…[who] always think[s] about the data." The empirical fact he insists on overlooking is that, for Galileo's experiment, ***we have NO DATA!*** We have *no data* to think about. Why must Strassler be so blind and hypocritical about this simple experiment?

---

*Note also the contrast between Strassler's harsh objection to calling the apparatus a Small Low-Energy Non-Collider and Carlo Rovelli's lighthearted take: "well, just the name *non-collider* would be a good enough reason for trying the experiment."

Figure A: Gravity-induced collision experiment. What happens when the ball's trajectory is not interrupted even by the ground, as though it were a pop-fly that *never* gets caught, but *falls forever?* Nobody knows. This is why we need to build and operate humanity's very first Small Low-Energy Non-Collider.

NOTE: Since this discussion begins with and is dominated by particle physics, readers may want to skip to p 5, at which point the role of gravity takes center stage.

Of Particular Significance

Conversations About Science with Theoretical Physicist Matt Strassler

Dark Matter: How Could the Large Hadron Collider Discover It?

Posted on April 13, 2015 | 79 Comments

Dark Matter. Its existence is still not 100% certain, but if it exists, it is exceedingly dark, both in the usual sense — it doesn't emit light or reflect light or scatter light — and in a more general sense — it doesn't interact much, in **any** way, with ordinary stuff, like tables or floors or planets or humans. So not only is it invisible (air is too, after all, so that's not so remarkable), it's actually extremely difficult to detect, even with the best scientific instruments. How difficult? We don't even know, but certainly more difficult than neutrinos, the most elusive of the known particles. The only way we've been able to detect dark matter so far is through the pull it exerts via gravity, which is big only because there's so much dark matter out there, and because it has slow but inexorable and remarkable effects on things that we **can** see, such as stars, interstellar gas, and even light itself.

About a week ago, the mainstream press was reporting, inaccurately, that the leading aim of the Large Hadron Collider [LHC], after its two-year upgrade, is to discover dark matter. *[By the way, on Friday the LHC operators made the first beams with energy-per-proton of 6.5 TeV, a new record and a major milestone in the LHC's restart.]* There are many problems with such a statement, as I commented in my last post, but let's leave all that aside today… because it ***is*** true that the LHC can look for dark matter. How?

When people suggest that the LHC can discover dark matter, they are implicitly assuming

- that dark matter exists (very likely, but perhaps still with some loopholes),
- that dark matter is made from particles (which isn't established yet) and
- that dark matter particles can be commonly produced by the LHC's proton-proton collisions (which need not be the case).

You can question these assumptions, but let's accept them for now. The question for today is this: since dark matter barely interacts with ordinary matter, how can scientists at an LHC experiment like ATLAS or CMS, which is made from ordinary matter of course, have any hope of ***figuring out that they've made dark matter particles?*** What would have to happen before we could see a BBC or New York Times headline that reads, "Large Hadron Collider Scientists Claim Discovery of Dark Matter"?

Well, to address this issue, I'm writing an article in three stages. Each stage answers one of the following questions:

1. How can scientists working at ATLAS or CMS be confident that an LHC proton-proton collision has ***produced an undetected particle*** — whether this be simply a neutrino or something unfamiliar?
2. How can ATLAS or CMS scientists tell whether they are ***making something new and Nobel-Prizeworthy***, such as dark matter particles, as opposed to making neutrinos, which they do every day, many times a second?
3. How can we be sure, if ATLAS or CMS discovers they are making undetected particles through a new and unknown process, that they are actually ***making dark matter particles***?

My answer to the first question is finished; you can read it now if you like. The second and third answers will be posted later during the week.

But if you're impatient, here are highly compressed versions of the answers, in a form which is accurate, but admittedly not very clear or precise.

1. Dark matter particles, like neutrinos, would not be observed directly. Instead their presence would be **indirectly inferred**, by observing the behavior of other particles that are produced alongside them.
2. It is impossible to directly distinguish dark matter particles from neutrinos or from any other new, equally

undetectable particle. But the equations used to describe the known elementary particles (the "Standard Model") predict how often neutrinos are produced at the LHC. If the number of neutrino-like objects is larger that the predictions, that will mean **something new is being produced**.
3. To confirm that dark matter is made from LHC's new undetectable particles will require many steps and possibly many decades. Detailed study of LHC data can allow properties of the new particles to be inferred. Then, **if other types of experiments** (e.g. LUX or COGENT or Fermi) **detect dark matter itself, they can check whether it shares the same properties as LHC's new particles**. *Only then* can we know if LHC discovered dark matter.

I realize these brief answers are cryptic at best, so if you want to learn more, please check out my new article.

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This entry was posted in Dark Matter, LHC Background Info, LHC News, Particle Physics and tagged atlas, cms, DarkMatter, LHC. Bookmark the permalink.

79 RESPONSES TO "DARK MATTER: HOW COULD THE LARGE HADRON COLLIDER DISCOVER IT?"

M. Many | April 13, 2015 at 9:09 AM |

The question of today is : we observe gravitation effects , we infer that some gravitating something exists , but , is it possible that some unknown configurations of space itself is the cause of what we observe in the large scale with no such DM ???
N. B. : according to GR gravity assumed to be space configuration .

Matt Strassler | April 13, 2015 at 10:57 AM |

No one has proposed a theory — i.e., a set of consistent equations that makes detailed predictions and violates no known observations — where such an idea would make sense. If someone does, that would be very interesting.

Richard Bauman | April 13, 2015 at 3:13 PM |

Sorry ,but this is too easy. Such a theory is almost too simple. Where ever you need the force of gravity to be stronger , you increase the number tfo gravitons being exchanged over a give unit of time. To double the strength you double the number fo gravitons being exchanged. Should this be true it must apply to all massless bosons, and thats can be seen too. Now that doesn't happen in the solar system much. So the other conditions is that the faster gravitons ,and all massless bosons only go faster if they go through the same space. That's a long story why, but back to trying it out for gravity. So the slower one body moves off the line of sight in space the stronger the force. Results; between the centers of two galaxies a factor of 10, between a star and ihe center of a galaxy a factor of 2+ , in the bar of a galaxy up to 3 at the end of the bar, etc. Very close to what MOND and MOG state, only with a reason this time. Ever neutrinos do this, with mass, but only go faster than C in one direction, not both as is the case for massless particles. Two minor examples are Opera1 and Pioneer which now do not need some other made up story..

I would like to wait for the establishment of the ILC (International Linear Collider) which will be constructed in Japan. I visited the proposed site. It is a good place. The ILC would collide electrons with positrons. So a great energy will be produced and many particles will appear clearly without remnants. Scientists are talking about the first work for the ICL which will be the precise study of the Higg's particle.

Richard H | April 14, 2015 at 11:24 PM |

Matt, what could dark matter be if not particles?

> **Matt Strassler** | April 15, 2015 at 10:26 AM |
>
> Didn't I answer this question? Check around… if not I'll answer again. Maybe the answer disappeared.

plarryhotter | April 15, 2015 at 12:33 PM |

Mr. Strassler, thanks for the summary. I dont perceive it as cryptic at all, but as a concise abstract,

richardbenish | April 15, 2015 at 2:43 PM |

Insofar as the prevailing ideas about dark matter assume that General Relativity (GR) is right, and that our proper concern is "equations whose predictions agree with data," it is pertinent to point out a rather large gap in GR's confrontation with data.

In the local Universe, virtually all we know about gravity-induced motion comes from observations of phenomena *over* the surfaces of large bodies such as the Earth or Sun. In other words, the Schwarzschild *exterior* solution has seemingly been well-tested.

But throughout the range of these tests—from mm to AU—Schwarzschild's *interior* solution has never been tested. The most noteworthy feature of the interior field of a massive body is that—according to GR—the rate of a clock at its center is supposed to be a minimum. In terms of Newtonian gravity, this corresponds to the prediction that a test mass dropped into a hole through a larger body will oscillate between the hole's extremities. Neither of these predictions has ever been tested.

Almost 400 years ago Galileo proposed such a test. The apparatus needed to carry it out may be called a Small Low-Energy Non-Collider. Such an apparatus could be operated in an Earth-based laboratory (modified Cavendish balance) or in an orbiting satellite.

Because the unexplored domain is so large (the most ponderous half of the gravitational Universe) and because the idea to explore it has been on the books for so very long, it is clearly in the interest of science to conduct Galileo's experiment.

Furthermore, as suggested in: * **Deleted link re-inserted at top of next page**

* *[Link Deleted by Host. Why? (a) This is not an advertising site for individuals to promote their individual ideas. Submit papers to journals. (b) The host looked at the paper. It has not a single equation, calculation or simulation. It does not consider the possibility that properties of the Earth's geology, obtained via seismology, or properties of the Sun, or of neutron stars, constrain the properties of gravity already, and it does not show that the proposed experiment (which is practically impossible anyway) could potentially give stronger constraints. In short, it is not a scientific paper and is not suitable for this site.]*

at least one reason exists to suspect that the standard prediction may not be correct. If this turned out to be true, various cosmological assumptions would also have to be re-thought. But even independent of any such radical result, the fact that GR's (Schwarzschild's) interior solution has not been tested is surely reason enough to finally fill this gap in our empirical knowledge of gravity.

http://vixra.org/pdf/1503.0139v1.pdf
[*Galileo's Belated Gravity Experiment*]

Re-inserted link from previous comment.

richardbenish | April 16, 2015 at 12:29 AM |

Concerning the reasons given for deletion of a link in my previous comment, I should respond as follows:

a) My "individual idea" coincides, essentially, with Galileo's. Having been accused of advertising that idea, I stand guilty as charged.

* *[The host deleted the* {bulk of the} *previous post because it was far too long and directed purely at self-defense, and of no interest to anyone except the writer. Since the writer persists, the host will give him another chance to consider proper etiquette, but will not allow a long discussion by someone who has proven himself a crackpot of the highest order.]*

* See p 7/12a for full re-inserted comment.

The host may imagine the result of Galileo's experiment as "self-evident," even without direct empirical support. I'd guess that Galileo would have preferred to let *Nature* testify on the matter.

Matt Strassler | April 16, 2015 at 8:02 AM |

Your position is indefensible and there's no hope of saving it. (a) You've shown you have no sense, or physics understanding; it is impossible to build a tunnel through the earth, due to the immense geological forces and heat inside the earth, and even if you could it would cost more than you can fathom — it is as silly an idea as building a bridge to the moon. (b) Crackpots never know the difference between a wordy commentary and a true scientific paper. They learn from a few famous papers that were wordier than some — guess what! those are the ones they read! since the technical ones are too hard — so they imitate them without understanding that it is the small technical details in the famous papers are what made them famous. For example, read this Nobel-Prize-winning paper by Penzias and Wilson, http://adsabs.harvard.edu/full/1965ApJ...142..419P(c) pages 419-421; it's all words, no equations! Well, wait, and look closely. There are crisp statements, one after another, each one packed with information about the experiment. There's a reference to a longer paper that describes the experiment, too. And there are numbers, with uncertainties. This is a scientific paper par excellence. It's not just a set of **ideas**; it is a set of **results**. (c) Crackpots usually reach back to and appeal to someone very famous without regard for the fact that there's been a lot of work done by other people in the interim. They don't bother to read the work of those other people; they just don't have the time. Well, a lot has been learned in the last few centuries, and Galileo's idea is now known to be completely impractical, even though he did not know that. And more is known about gravity — empirically — than you realize. (d) Specifically, crackpots never consider carefully the full range of data that scientists have available, and never check what can be done with existing or easy-to-obtain data. I am an empiricist and do not take answers to physical questions as self-evident, so I always think about the data. There are in fact tests of gravity inside a body. For instance, our understanding of the sun is remarkably good, as evidenced by helioseismology and solar neutrino emission, which probe the interior of the sun; our understanding assumes standard gravity, and therefore tests it. I believe that you would also learn something from the seismology of the earth, though probably less than from the sun. Also, we exist OUTSIDE the sun, but INSIDE the earth-moon-sun system, and INSIDE the galaxy, so we do know something about gravity inside objects from that score. Now if you want to propose a hugely expensive and impractical experiment, it's *your* job to prove that other, cheaper methods haven't done, or can't do, a pretty good job. For instance, did you consider what you could learn from a neutrino beam sent through the earth? Maybe you would not learn much, but at least that's an experiment people *could* do someday, with a neutrino factory, for finite cost — so you should check. But oh, I know, that's too hard. Let's just listen to Galileo, because we're not smart enough to think for ourselves.

If Galileo's "idea" is narrowly regarded as a cannonball through Earth, yes. If regarded generally (more reasonably) as a small body through a larger body, then *absolutely not.*

Response to this flame-fest is at top of p 8/13.

richardbenish | April 15, 2015 at 8:29 PM | Reply

Concerning the reasons given for deletion of a link in my previous comment, I should respond as follows:

a) My "individual idea" coincides, essentially, with Galileo's. Having been accused of advertising that idea, I stand guilty as charged.

b) The host's interpretation of what constitutes a "scientific paper" is not particularly broad. An example of a scientific paper that was published without "equations, calculations or simulations" is that of Arno Penzias (in Societa Italiano de Fisica Conference Proceedings, vol 1, 1985, on the *Cosmic Background Radiation and Fundamental Physics*, p. 277).

Penzias' paper is nevertheless full of scientific *ideas*. I picked this example because Penzias was a harsh critic of the Inflation Model; his paper contains the following poignant quote, which I think still applies today:

"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 together to fit the data."

The paper that I linked to was not so harshly judgmental. It merely presents a variety of scientific *ideas*, the gist of which is that Galileo's Small Low-Energy Non-Collider experiment is overdue to be done. The experiment would test GR in a way that might conceivably bear on the Dark Matter problem.

Contrary to the host's assertion, the experiment is not "practically impossible anyway." In fact, it was proposed several times as a way of measuring Newton's constant, *G*. See the review paper by Smalley:

http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19750014902.pdf

The proposals reviewed by Smalley were not carried out because they would not have substantially improved on measurements made in Earthbased laboratories.

Also, an Earthbased version (using a modified Cavendish balance) is possible. My correspondence with experimentalists in this regard is recounted in one of my essays (whose link I hesitate to include).

Finally, it has sometimes been argued (as implied by the host's reference to various "constraints") that evidence in support of Newton's and Einstein's exterior solution make doing Galileo's interior solution experiment unnecessary. Countering this conclusion is the advice of Herman Bondi, who warned against needlessly assuming the validity of untested mathematical *extrapolations*, as from an explored domain to an empirically unexplored domain:

> "It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is dong so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called spectulation."

The host may imagine the result of Galileo's experiment as "self-evident," even without direct empirical support. I'd guess that Galileo would have preferred to let *Nature* testify on the matter.

Blog at WordPress.com. *The Coraline Theme.*

richardbenish | April 16, 2015 at 9:33 AM |

Response to flame-fest on p. 6/12.

As your opening premises imply, the validity of modern cosmology—which has come to include large quantities of exotic dark matter—depends on the validity of GR.

The large physical domain of GR encompassed by the interior solution has not been tested *with regard to gravity-induced motion*. Static and seismological measurements have been made, yes. But nobody has ever seen one body fall through the center of another body due to the gravity of only those two bodies.

The latter observation could be made by doing the experiment that Galileo proposed, with laboratory-sized bodies, of course. This is the experiment whose apparatus I have called a Small Low-Energy Non-Collider and that Larry Smalley has reviewed in the NASA Technical Memorandum linked here:

http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19750014902.pdf

I have never proposed drilling a hole through the Earth. That the host would suggest that I have indicates just one of the many ways that he has misunderstood and underestimated my work.

Matt Strassler | April 16, 2015 at 10:57 AM |

What "**work**"? Show me the work, and we can discuss. The paper you linked to here is a scientific paper by somebody else, proposed to measure something else. And if you don't want people to think you a crackpot, then stop acting like one, and also, stop calling this experiment a "Small Low-Energy Non-Collider". Almost every experiment in my physics department is a small, low-energy, non-collider experiment.

But the apparatus proposed in the paper to make the measurement is exactly the same thing as a Small Low-Energy Non-Collider. Nobody has ever ascertained whether such an instrument works as expected. Surely, it is in the interest of science to see if the operating mechanism of its apparatus works, or not.

Matt Strassler | April 16, 2015 at 11:05 AM |

p.s. and I recommend you not send cutesy little advertisements of your "work" to physics departments. [Can you imagine Einstein doing that?!] Your reputation was destroyed by that action. (I should be clear — your sense of humor was appreciated. But your scientific reputation? Trashed.)

See p 9/13a for "cutesey" Mr Natural postcard.

OakTree (@Class_of_78) | April 16, 2015 at 12:41 PM |

Anything ass... me up.

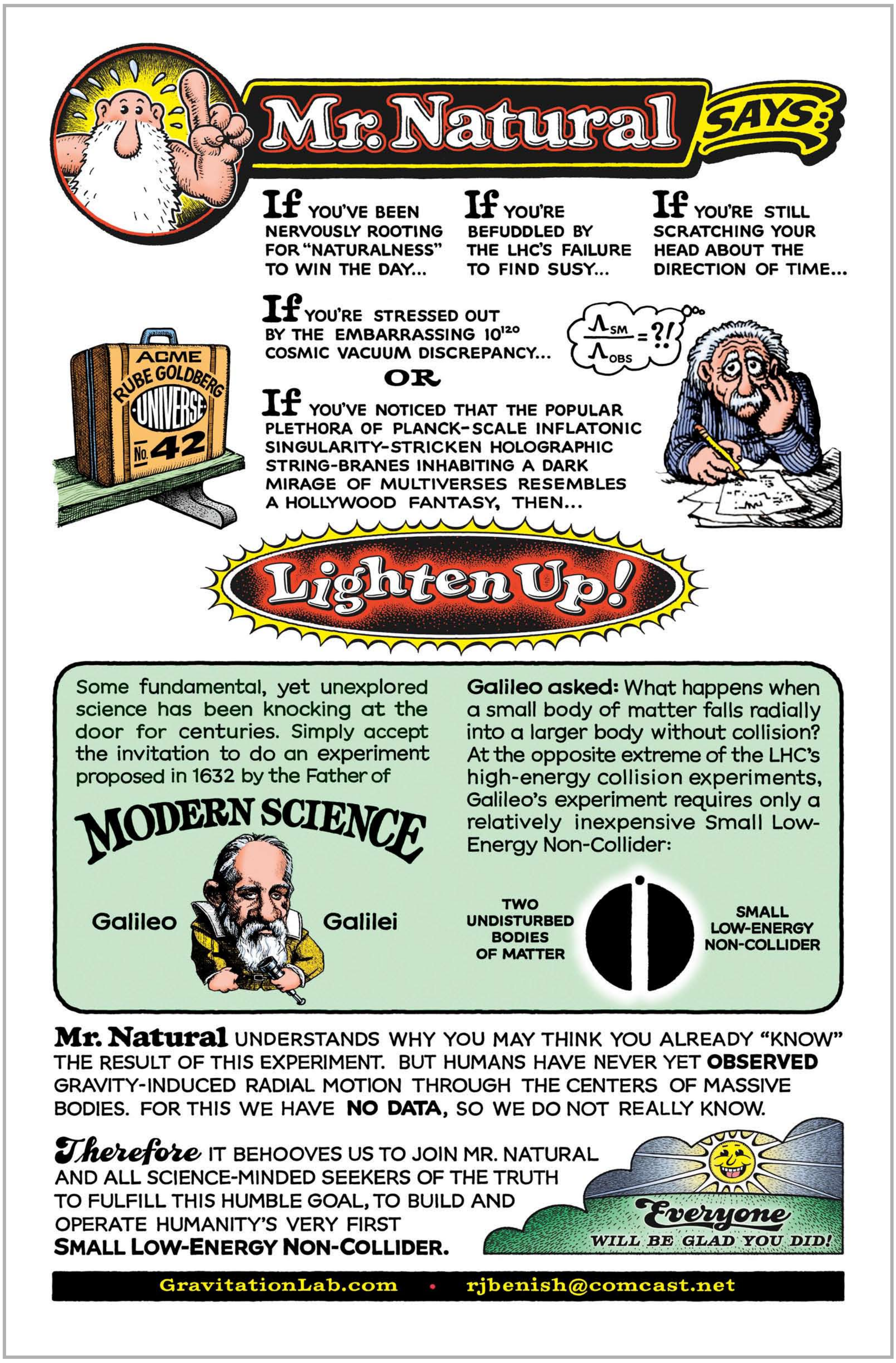
Notice how Trumpian Strassler's response is:

1. **Never apologize. Persist with all misconstruals.**
2. **Evade. Fib. Exaggerate.**
3. **Launch a vigorous *ad hominem* counter-attack.**

Kudzu

I don't kn... Say what you like but NASA's done some solid science and engineering.

In order to form a disk under the influence of gravity particles must be able to 'bump into' each other and emit energy. When normal matter 'cools' it initially is a cloud shape, a sphere. Bits of it are moving in all directions around the center. As they bump together they start cancelling out their movements; bits moving up cancel bits moving down, left bits cancel right bits and so on. The cancelling is done by the emission of EM radiation (Light, IR, radio waves...) This tends to move all the matter to the center.


Mr. Natural SAYS:
If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...
If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...
If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...
If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...
ACME RUBE GOLDBERG UNIVERSE No. 42
$\frac{\Lambda_{SM}}{\Lambda_{OBS}} = ?!$
OR
If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...
Lighten Up!
Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of
MODERN SCIENCE
Galileo Galilei
Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:
TWO UNDISTURBED BODIES OF MATTER
SMALL LOW-ENERGY NON-COLLIDER
Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET OBSERVED GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE NO DATA, SO WE DO NOT REALLY KNOW.
Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST SMALL LOW-ENERGY NON-COLLIDER.
Everyone WILL BE GLAD YOU DID!
GravitationLab.com • rjbenish@comcast.net

Page 13a

With dark matter particles can't cool. Gravity keeps trying to pull it towards the center but the motion can't get cancelled out. DM stays all puffy like a cloud of steam.

richardbenish | April 16, 2015 at 2:19 PM |

Thank you for inquiring about my work. The best example is probably a paper submitted to the *International Journal of Theoretical Physics*.

http://vixra.org/pdf/1209.0004v1.pdf

It was motivated by the discovery that the gravity model I'd been working on—whose premises differ greatly from Einstein's, nevertheless—predicts a *maximum force* of the same value as that derived from GR.

* [Abridged by host to remove inappropriate material.] * **Removed material re-inserted here.**

from GR. Being amply backed up by equations and graphs, the paper received favorable comments from the first reviewer:

"The manuscript is well written and well illustrated…The general topic of the manuscript and the results will be interesting enough for IJTP…I would recommend publication."

Unfortunately, this reviewer never pointed out exactly what the purported error was. I resubmitted the same manuscript a second time and was then rejected. (Still no error pointed out.) But I got another favorable response from the physicist Christoph Schiller, whose paper on maximum force published in the same journal was cited and discussed in mine. Schiller wrote:

"I like the clarity with which you expose all issues involved. I like this kind of clear thinking a lot."

There is a recurring irony in all this: As with the IJTP reviewers, you too have not yet pointed out any error in my ideas. It seems you are content to lump me in with all other crackpot-amateurs and dismiss me without carefully looking at what I've written.

Most importantly, the model of gravity alluded to above stands or falls depending on the result of Galileo's experiment. I am eager to defer to empirical evidence.

I still think the apparatus needed to conduct the experiment is nicely described as a particular (gravity-induced radial motion) kind of Small Low-Energy Non-Collider. Concerning the *result of this experiment proposed by Galileo, it seems that you would remain content to guess (i.e., to accept the authority of established ideas). Whereas I would prefer to see the result as revealed by the ultimate authority: Nature.*

Matt Strassler | April 16, 2015 at 3:09 PM |

It seems to me that your reasoning for the experiment you propose is premature. Do you have evidence that measurements of precisely timed satellites (such as gravity probe B), moving in the gravitational field of the Earth and the Moon INSIDE the Earth-Moon system, would not have an altered result? In other words, you should be able to say what the fields are when you are in the interior of a *system*, not just the interior of a solid body, and check that existing satellite orbits are consistent with these formulas.

If you are unable to do this because you only have equations for spherically symmetrical bodies, then

> I think you have a very weak argument. It's not clear you have sensible equations that, for instance, conserve energy and momentum.
>
> Independently of this, I have no objection to someone doing a motion-in-interior experiment, and would support a proposal to perform it as long as (a) it is very inexpensive, and/or (b) there is at least one other thing for which it is useful and for which there is a stronger argument than the one you give. If you want someone to do an *expensive* experiment, such as one that involves a satellite, you need to prove, beyond doubt, that you have a consistent set of equations, and that no existing experiment already rules it out.

My, my, how Strassler's tone has evolved: From *aggressively* condescending, arrogant and presumptuous, to just *vaguely* condescending, arrogant and presumptuous! What happened?

Richard H | April 16, 2015 at 10:52 PM |

Matt, let me rephrase my question–what physical substance might dark matter be composed of if not particles? What else is available for making matter?

richardbenish | April 17, 2015 at 3:46 AM |

Your comment is awaiting moderation. = Never cleared the censor.

Since my model has not yet been developed to the point of distinguishing the (arguably very small) effects that might exist for the circumstance you've described, I agree that the satellite version of the experiment should have lower priority than the laboratory version.

Upon sharing an essay that described the apparatus I had in mind (modified Cavendish balance) with a very reputable apparatus builder in New York, he replied: "I have thought of doing exactly what is in your paper." In subsequent correspondence the impression was given that the cost would be well within $1 million. Physics experiments costing twice this much have been called "cheap." (Scientific American, Feb. 2012, p. 32.)

Regardless of the cost, it remains a fact that no human has yet seen what happens when one body is allowed to fall, purely by gravity, through to the center of a larger body. To me, this unexplored territory beckons to be explored, all the more so because it tests Newton's and Einstein's theories where they have not yet been tested. But also for the pure and joyous wonder of seeing the curtain lifted, to expose a large and fundamental process of the Universe for the first time.

To say that my reasoning to want to do Galileo's experiment is "premature" (especially when it is a comparatively cheap and simple test) is to disrespect Galileo and the ideals of science. Astronomer Bradley Schaefer succinctly expressed these ideals: "Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."

The "consistent set of equations" that I yearn to test are those of Newton and Einstein. Why doesn't Strassler also yearn to test these equations, inside matter, where they have not yet been tested?

Strassler is evidently not interested in exploring the unexplored or testing standard wisdom—at least not when the advocate for doing so can be easily flamed as a "crackpot of highest order." Strassler appears content to punch down, to appeal to irrelevancies, and be a stick in the mud. Whereas Strassler has not the curiosity to remove the muzzle, I am eager to let Nature speak. Who is behaving like a scientist? Who is behaving like—if not a crackpot, then—an intransigent bully dogmatist?

Of Particular Significance

Conversations About Science with Theoretical Physicist Matt Strassler

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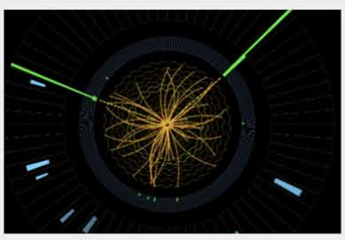
This site addresses various aspects of science, with a current focus on particle physics. I aim to serve the public, including those with no background knowledge of physics. If you're not yourself an expert, you might want to click on "New? Start Here" or "About" to get started. If you'd like to watch my hour-long public lecture about the Higgs particle, try ``Movie Clips".



A Higgs particle is produced in a proton-proton collision at center, and decays to two photons (particles of light, indicated by green towers) in an LHC detector. Tracks emerging from center are from remnants of the two protons.

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About Me

Hi and welcome! I'm Matt Strassler, theoretical physicist. My research since 2002 or so has been related mainly to the Large Hadron Collider, though I've written many papers on a wide variety of topics in string theory, quantum field theory and particle physics.

I believe deeply that science is one of the world's great spectator sports, and should be a source of joy and excitement for the public, especially for kids and for kids at heart. This is particularly true of particle physics, which is at a watershed, with the Large Hadron Collider (or LHC) exploring all sorts of new territory and having recently discovered the long-sought Higgs particle! But particle physics can be especially hard for non-experts to follow... so I'm working to make it more accessible, even to those with no science background at all. My goal is to make the major challenges and discoveries and disappointments in the field understandable to everyone, and to reflect on the process of science and its roles in history and in modern society.

My website has many articles with background information about the particles and forces of nature, about the universe, and about experiments being done to understand them more deeply. Some of these articles are more technical than others; if you're lost, start with some of the articles listed here. There's also a blog where I post links to new articles as I complete them, discuss breaking news in particle physics and beyond, and announce public talks or other events at which I'll be speaking. (I have some of my talks linked at my video clips page.) If you like, you can follow me on Twitter or Facebook.

More details: I went to college at Simon's Rock (the first "early college.") I got my undergraduate degree from Princeton and got my Ph. D. at Stanford. I worked as a postdoc at Rutgers University and a long-term member at the Institute for Advanced Study, and was a faculty member at the University of Pennsylvania and the University of Washington, before becoming a full professor at Rutgers University. In 2007 I was elected as a member of the American Physical Society. In 2011 I went on leave from Rutgers to pursue other interests, including this website, and I decided to resign my position in 2013. After that I was a visiting scholar and visiting professor at Harvard, a position which concluded in August 2015. In fall 2015 I also spent six weeks as a Simons Foundation fellow at the Galileo Galilei Institute in Florence, Italy.

Gerard ’t Hooft

PROFESSOR of PHYSICS • NOBLE LAUREATE

Institute for Theoretical Physics • University of Utrecht

Email Correspondence

May 20 – 24, 2015

PREFACE

As a youngster, Nobel Laureate ’t Hooft’s goal in life was quoted as being “a man who knows everything.” In his Nobel Prize Autobiographical essay, ’t Hooft explains that all he meant was that he wanted to be a “scientist.”

Virtually all of ’t Hooft’s work is so abstract and abstruse as to defy any brief summary explanation, much less any clearcut connection to physical reality. As in the Preface to my correspondence with Carlo Rovelli, I reiterate my standard of judgment: Does the new work purporting to be about gravity (dark Planck-scale holographic string-brane, divide-by-zero-land inflatonic multiverse) help to explain our actual *experience* of gravity? What does matter *do* to make spacetime curve? What does matter *do* to produce non-zero accelerometer readings at Earth’s surface and zero readings for falling accelerometers?

’t Hooft is but one member of a vast community of academic scientists who never ask such questions. From their work and, I think, from the following correspondence, it becomes clear that—at least in ’t Hooft’s case—he thinks of himself as being *above* such elementary concerns; he thinks of himself as such a superior scientist that he regards those who ask simple questions as authors of “babyish ignorance.”

In the course of flaming—er, “explaining”—this to me, ’t Hooft reveals his own ignorance of, for example, the Schwarzschild *interior* solution. By misquoting me as referring to “the interior of a Schwarzschild solution,” he seems to construe my concern as being about the never-neverland of what lies within the geometrical “event horizon” of a Schwarzschild *exterior* solution. (That is what the entertainment industry of gravitational PhDizzix is largely concerned about.)

My attempt to re-direct from this misunderstanding to more concrete matters reveals that ’t Hooft *intends* only to miss the point. Readers are given ample evidence from which to decide whether or not ’t Hooft has fulfilled his dream of becoming a scientist, or perhaps just a smartypants bully.

Finally, note that ’t Hooft’s concluding assessment of documents that I attached or cited for him implies that he thinks their *age* contributes to making them “totally wrong.” Those references are entirely consistent with Schwarzschild’s highly acclaimed 1916 original—as well as more modern ones, of which ’t Hooft is evidently unaware. Their age is obviously irrelevant. If they are incorrect, the onus is on ’t Hooft to identify the errors.

As though the Pythagorean theorem has a shelf-life. *Oiy vay!*

NOTE: The Mr. Natural postcard that ’t Hooft replied to was not sent to him. I suspect it was given to him by his colleague, Tomislav Prokopec—at the same institution, in the same department—to whom I sent a card a few weeks prior to the following correspondence. Both front and back sides of the card to Prokopec are attached at the end.

From: Hooft, G. 't <G.tHooft@uu.nl>
To: rjbenish@comcast.net <rjbenish@comcast.net>
Subject: wrong experiment
Date: Wed, 20 May 2015 08:33:53 +0000

L S ⁜ L S is a common Dutch salutation, which means "Lectori Salutem."

I found on my desk a postcard with on it a childish idea for an "experiment" by a "Mr. Natural." Before placing this postcard where it belongs (the trash can), let me just explain a few of the misconceptions that it displays.

First misconception is that modern science could be helped by any such experiment: Experiments of many kinds, including table-top experiments, have been done thousands of times by school kids and students. There are two possible outcomes: wrong ones (the majority, after all, these are school kids), and ones that confirm what we already know about nature's forces.

Second misconception: "easy" and "cheap" experiments won't contribute to science at all. If, for instance, one would want to know what Newton's gravity theory says about the outcome, one finds forces that cause motion on the one hour time scale, far too weak for any school kid to detect. One *can* detect such forces (the Cavendish experiment) but those are very sophisticated, difficult experiments. They have been done much better than the set-up suggested on the post card. For instance, what science is really interested in is how gravity may work at scales below a small fraction of a mm. Such experiments have indeed been done but they are very difficult. No deviation from Newton's law was detected.

So please don't think that science "does not know" what the outcome will be from a stupid, ill conceived idea such as on the post card. The statement "we do not have any physical evidence" confirms the babyish ignorance of the author.

G. 't H

Hooft, G. 't, 5/20/15 9:57 AM -0800, Re: wrong experiment **2**

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments: <Galileo's-Belated-Experiment.pdf>

> Dear Professor 't Hooft,
>
> Many thanks for your comments on the Mr. Natural postcard.
>
> One of its purposes, of course, is humor: to "Lighten Up!" and laugh at ourselves. Your colleagues Carlo Rovelli and Matt Strassler were kind enough to convey that, to them, the card fulfilled this purpose.
>
> As for its scientific content, this is based on the fact that, with regard to gravity-induced MOTION, General Relativity's (Schwarzschild's) INTERIOR solution has never been tested.

> Specifically, Galileo's kinematic experiment would test GR's prediction that the rates of clocks inside matter get slower toward, and have a local minimum at, the center.
>
> Also, I just think it would be a cool experiment to see. I'd guess that Galileo—perhaps because he was a child at heart—would have liked to see it too. (See attachment.)
>
> Cheers,
>
> Richard Benish
>
> PS,
>
> I am reminded of a comment by one of your fellow Laureates:
>
> "No experiment is so dumb that it should not be tried." —
>
> [Walter Gerlach, Physics Today, Dec. 2003, p. 54.]
>
> RB

Hooft, G. 't, 5/20/15 10:01 AM -0800, Re: wrong experiment 3

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Wed, 20 May 2015 18:01:20 +0000

>> Maybe I receive too much crackpot mail. Sorry. But you still seem to think that this might be real science…

Hooft, G. 't, 5/20/15 12:42 PM -0800, Re: wrong experiment 4

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Cc: warshafsky@comcast.net
Attachments:

>>> Dear Professor 't Hooft,
>>>
>>> Apology accepted.
>>>
>>> According to the astronomer, Bradley Shaefer, "Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."
>>>
>>> Since we have not yet empirically explored the motion of falling bodies through the centers of larger bodies, and standard wisdom is to pretend to know what we would find if we did, how would doing Galileo's experiment NOT be "real science"?
>>>
>>> Best regards,
>>>
>>> Richard Benish

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Thu, 21 May 2015 08:20:01 +0000

> Because much more accurate experiments have been done — many times. ⁜
> No unexpected forces were found.
>
> Your mass-with-a-hole-in-it is not exactly an interesting case of "the interior of a Schwarzschild solution." It is scientifically very uninteresting. Because any expected force, even any unexpected force, would not be detected that way. ⁜
>
> G. 't H.

⁜ The logic of 't Hooft's first sentence is like this: **Q:** How deep is the ocean? **A:** We don't need to measure the ocean because we've done "much more accurate" measurements of the depth of swimming pools.

Note also that MIT professor and Nobel Laureate, Rainer Weiss, proposed a similar experiment to look for *changes* in the the gravitational force. This proposal was the Master's Thesis of one of his graduate students in 1968. (See Weiss Correspondence.) It required extreme long-term stability, unlike what would be needed to simply demonstrate the predicted oscillation, which is my much more humble goal. Any change in the "expected force" would certainly be as "scientifically very interesting" as an unexpected force *per se*. Weiss' more stringent demands were too difficult to achieve, so the experiment was never done. Galileo's experiment is no less interesting because *no human has yet seen gravity-induced radial motion of one body through the center of another.* It's unexplored territory.

Hooft, G. 't, 5/21/15 9:10 AM -0800, Re: wrong experiment 5

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

> Dear Professor 't Hooft,
>
> I understand your reasoning, I really do.
>
> But please consider an analogy between Galileo's experiment and the kinds of gravity experiments that have been done inside matter. Galileo's experiment involves witnessing the MOTION produced by gravity from one extremity of the source mass to the other. Whereas, experiments inside matter such as you have alluded to may all be characterized as STATIC measurements, experiments that, as you have pointed out, measure FORCES on bodies that are somehow constrained not to move very far.
>
> It may seem that measuring such forces suffices to deduce the motion they would produce. And yet we have never actually SEEN such motion unfold inside matter. Measuring the forces is analogous to hearing the sound and smelling the gun powder of a gun, but not seeing the bullet—never witnessing any effect of the bullet.
>
> For the sake of completeness and to provide empirical support to the many references to this experiment (e.g., freshman physics texts), I think we need to PROVE that the gun (Newton's and Einstein's theories of gravity) is not shooting blanks. I know how unlikely that may seem, given their enormous success outside material bodies. But we have not yet conclusively established that the success with regard to gravity-induced motion extends inside material bodies.
>
> Finally, note that your reasoning has the character of extrapolation: You extrapolate empirical success outside matter, and you extrapolate from the presence of static forces to the motion you expect these forces to produce. Therefore, I would like to close with some advice from Herman Bondi on the danger of being satisfied with such extrapolations:

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

> > > > > > "It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is doing so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called speculation."
> > > > >
> > > > > From all of the above, I'd say your judgment that actually doing Galileo's experiment (i.e., building and operating a Small Low-Energy Non-Collider) is not "real science" is rather harsh and inaccurate. On the contrary, isn't doing the experiment a way of being an especially thorough and conscientious scientist?
> > > > >
> > > > > Respectfully,
> > > > >
> > > > > Richard Benish

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Fri, 22 May 2015 09:19:33 +0000

> > > > > > But your experiment is not at all about being "inside" matter: you're inside a hole in matter, but all the atoms are outside your measuring device, whatever it is. And the motion you talk about will be so slow that expecting any effect from that is unreasonable. I think it would be a fruitless exercise. Of course you'd be welcome to do such experiments, but don't expect anything unusual apart from errors
> > > > > >
> > > > > > G. 't H

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments:

Dear Professor 't Hooft,

If it's not about being "inside" matter, then I wonder why Schwarzschild and those who continue to call his solution for a uniformly dense sphere the "INTERIOR solution" have named it so. The hole, of course disrupts the uniformity, but only to a negligible degree for experiments that would clearly TEST this (to my mind) suitably named interior solution.

Should we not be grateful that Nature allows probing GRAVITY by such interior tests, as compared with atomic matter, which we never actually get to the center of? In the realm of atomic matter we rely primarily on COLLISION experiments (e.g., the Large Hadron Collider, Relativistic heavy Ion Collider, etc.). Gravity is evidently the only force of Nature whose essence may be probed by using a Small Low-Energy Non-Collider—no collision at all!

Slow though the motion may be, the whole point is that nobody really knows what that motion is, because nobody has ever SEEN it. Everybody agrees what Newton's and Einstein's PREDICTIONS are, but nobody has ever TESTED them. If you think testing the predictions of the theories of these illustrious scientists by performing an experiment proposed by the veritable Father of Modern Science would be "fruitless," then I would have to disagree with your conception of what science is supposed to be.

Best regards,

Richard Benish

PS:

The motto of the Royal Society is "Nullius in verba," which roughly means: "Take nobody's word for it." On the Royal Society's website they expand this meaning thus:

> [The motto]…is an expression of the determination of Fellows to withstand domination of authority and to verify all statements by an appeal to facts determined by experiment.

The idea thus reinforces Bondi's advice to not accept as "self-evident" that which authorities (or equations) suggest would be found where we have not yet actully looked.

The predictions of Newton and Einstein concerning Galileo's interior solution test have not yet been "verified by appeal to facts determined by experiment." I would therefore guess that Galileo, Newton and Einstein would have not only "welcomed" an experiment such as Galileo proposed, they would more forcefully have ENCOURAGED those with the needed resources (modern technology) to not delay in actually performing it. If "nothing unusual" happens, then we will at last be able to justify asserting this as a physical FACT.

Finally, why not be more ENTHUSIASTIC about filling the conspicuous gap in our empirical knowledge of gravity? Is it because it's a little embarrassing that nobody has thought to do so before? If so, is this a sufficient reason?

R B

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Sat, 23 May 2015 07:36:19 +0000

First of all, you were thinking of an "experiment on matter," but all matter we can use is so extremely tenuous that all gravitational forces are linear in its density. This has been tested. It has NOTHING to do with Schwarzschild, which is non-linear. What shape your matter takes (be it a sphere with a hole in it) is immaterial, for the grav. force is trivial to compute. Actually, experiments that are of the type you suggest, are frequently carried out for the planet earth itself, when gravitational anomalies are measured (from space or from holes in the ground).

This is just a lie—a flagrant, ridiculous, Trump-like lie.

Please, it is known in meticulous detail how to do that. And we have a pretty good idea what motion is. How would you think NASA can shoot its space shuttle anywhere it likes to, if NASA didn't know what motion is?

I frequently get nonsense mail like this.

G.'t H

To: Hooft, G. 't <G.tHooft@uu.nl>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Attachments: < GR Interior Oscillator Taylor 1961.pdf >

Dear Professor 't Hooft,

It seems you are unaware that Schwarzschild derived two separate solutions to Einstein's field equations. The most well known one, the EXTERIOR solution is of course highly non-linear because it relates to the inverse-square gravity field over a body's surface—used by NASA and as the basis for most of the well known tests of GR.

Schwarzschild's INTERIOR solution, on the other hand, relates explicitly to the case of a uniformly dense sphere. This solution is the basis of N. W. Taylor's treatment (attached) of the harmonic oscillation predicted thereby, and the related effect on clock rates (one at rest at the center, one at rest on the surface, and one falling between the extremities).

[See also F. W. Tangherlini, 'Introduction to the General Theory of Relativity,' *Nuovo Cimento Supplement*, 1961, No 1, pp 66–68. And Adler, Bazin and Schiffer, *Introduction to General Relativity*, 1965, pp. 280–295.]

Experiments such as you have mentioned involving "gravitational anomalies" on or around Earth all relate to the EXTERIOR solution, and do not directly pertain to my immediate purpose.

Whereas Galileo's Small Low-Energy Non-Collider experiment, which has been the focus of the Mr. Natural postcard and most everything else I've written to you, has EVERYTHING to do with the Schwarzschild INTERIOR solution. As implied in the paper by Taylor, the central clock rate minimum, which this solution prediccts, has a direct Newtonian counterpart in the simple harmonic motion prediction, as frequently discussed in freshman level texts.

In my opinion, readers of these texts (and everyone else) deserves to have the predicted pattern of motion VERIFIED by direct empirical evidence. To me, the act of performing Galileo's experiment would represent living up to the ideals of science, as stated in the Royal Society motto, by Bradley Schaefer, Herman Bondi (as quoted earlier) and many others. Doing the experiment would turn an assumption (a prediction) into a physical fact. This is desired—or even REQUIRED—because physical facts are the veritable currency, the FRUIT of science.

I think it is sad that you see this mission of seeking empirical evidence to back up a common prediction as "fruitless." You seem to regard the ASSUMED result of a test of the prediction as being sufficient. This strikes me as reflecting an utterly unscientific attitude.

Such is the difference between us. In spite of my earnest efforts to disregard your condescending tone, so that we might communicate about physics, you continue to find ways to misunderstand the simplest things I've said.

If you cannot provide references to empirical evidence proving the correctness of the gravity-induced radial simple harmonic oscillation prediction, and if you have no interest in having the experiment performed, then let's call this correspondence over, because it has become rather tiresome.

Thanks for your feedback.

Sincerely,

Richard Benish

From: Hooft, G. 't <G.tHooft@uu.nl>
To: Richard J Benish <rjbenish@comcast.net>
Subject: Re: wrong experiment
Date: Sun, 24 May 2015 17:48:52 +0000

As far as I can see this is an ancient reference and totally wrong.

Secondly, your "experiment" will reveal nothing about the Schwarzschild solution interior or exterior, but just Newtonian gravity. Schwarzschild also does not refer to a solution with a solid sphere.

Please don't think that we don't know or have no information about, gravity inside matter. Think of the insides of a star or a planet. There, relativity *does* give observable corrections. All this has been investigated extensively.

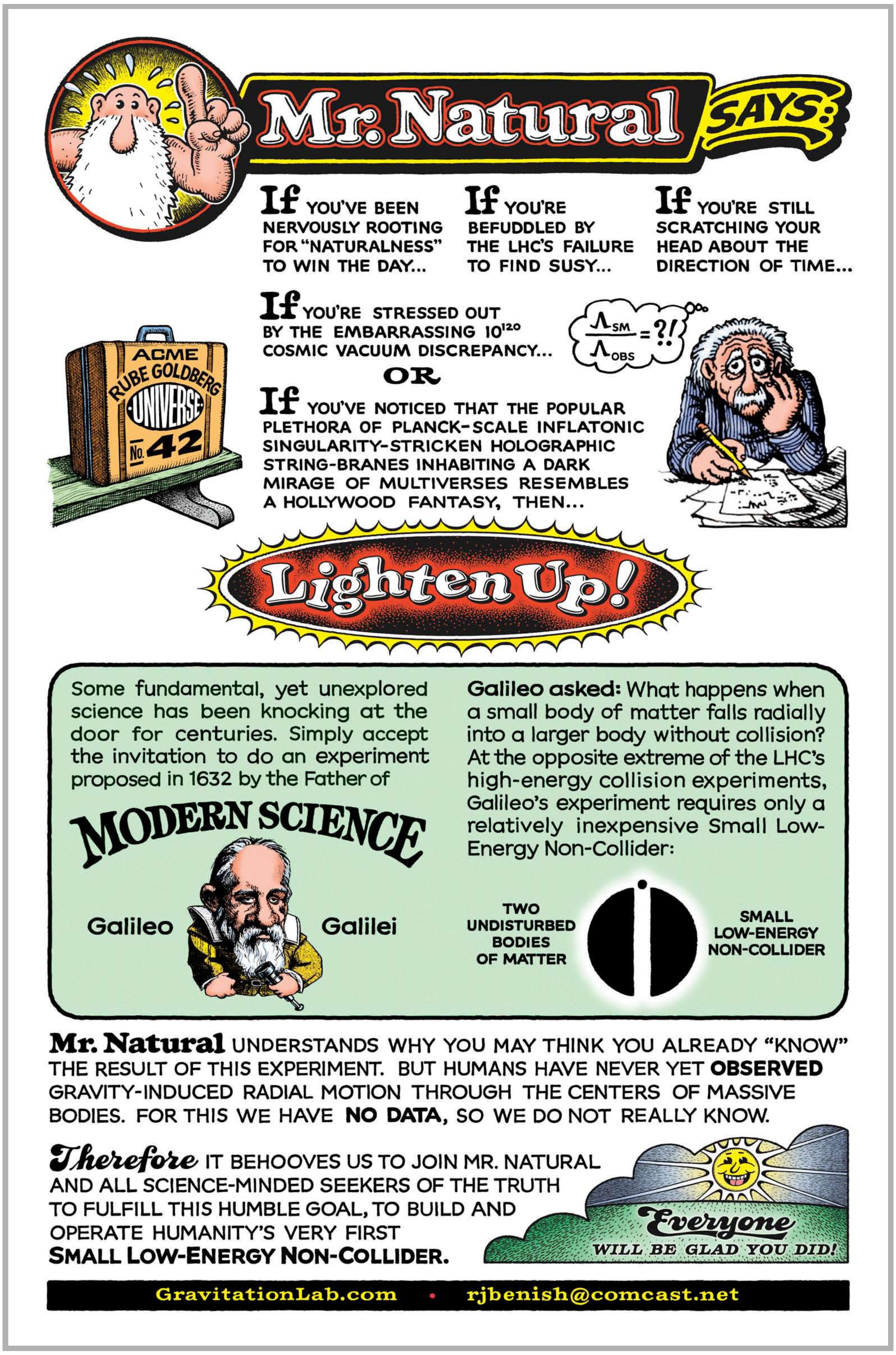
Don't think Mr. Natural, or any such person, can measure departures from the clock rate inside matter—that would be an extremely difficult measurement considering the accuracy required.

If I misunderstand the simplest things you said it is because they are totally wrong. I'm sorry.

G. 't H

"Sorry" don't pay the bills.

***Sheesh*, wutta jerk!**


Mr. Natural SAYS:
If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...
If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...
If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...
If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...
OR
If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...
ACME
RUBE GOLDBERG
UNIVERSE
No. 42
$\frac{\Lambda_{SM}}{\Lambda_{OBS}} = ?!$
Lighten Up!
Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of
MODERN SCIENCE
Galileo Galilei
Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:
TWO UNDISTURBED BODIES OF MATTER
SMALL LOW-ENERGY NON-COLLIDER
Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET OBSERVED GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE NO DATA, SO WE DO NOT REALLY KNOW.
Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST SMALL LOW-ENERGY NON-COLLIDER.
Everyone WILL BE GLAD YOU DID!
GravitationLab.com • rjbenish@comcast.net

APRIL 20, 2015

Dear Professor Prokopec,

Einstein strongly advocated letting the imagination run wild, toward the extremes of "highest abstraction." [IDEAS & OPINIONS, p.282] After decades of voluminous work in this direction, our efforts to quantize and unify gravity remain fruitless; the long sought evidence of gravitational waves remains elusive, and speculations about various invisible extreme conditions of the cosmos are well-characterized by literal and figurative <u>darkness</u>. Perhaps Einstein was too quick to dismiss the value of <u>direct</u> physical experience. Perhaps we have overlooked some crucial clue "hiding" right under our noses, our real physical noses.

It is commonly believed that GR has been well-tested on scales from mm to AU. True as this may be for the Schwarzschild EXTERIOR solution, it is not at all true for the INTERIOR solution.

The most physically significant feature of the interior field of a uniformly dense sphere is that the rate of a clock at its center is supposed to be a MINIMUM. So it is predicted. <u>Humanity has not yet tested this prediction on any scale.</u> The most ponderous half of the gravitational Universe (under our noses) thus remains to be empirically explored.

One of the kinematic consequences of the central clock rate minimum (as commonly treated in Newtonian gravity) is the oscillation of a test mass dropped into a hole through the center of a larger massive body. Evidence bearing on the kinematics and (indirectly) clock rate could be gotten by conducting Galileo's experiment, as described on the front of this card. It could be done in an Earth-based laboratory (with a modified Cavendish balance) or in an orbiting satellite.

I would therefore urge you to please help to generate interest in performing this experiment that Galileo proposed so long ago. To be truly diligent in our investigation of gravity and the physical world, should we not bring Galileo's proposal to fruition by building and operating humanity's very first <u>SMALL LOW-ENERGY NON-COLLIDER</u>?

Thank you very much.

Sincerely,

Richard Benish

Post Card

THIS SIDE FOR THE ADDRESS

To: Professor Tomislav Prokopec
Minnaertgebouw 405
INSTITUTE for THEORETICAL PHYSICS
Leuvenlaan 4
3584 CE Utrecht • The NETHERLANDS

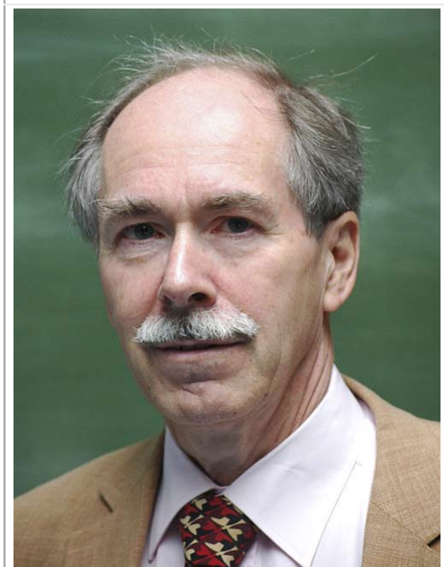
WIKIPEDIA

Gerard 't Hooft

Gerardus (Gerard) 't Hooft (Dutch: [ˈɣeːrɑrt ət ˈɦoːft]; born July 5, 1946) is a Dutch theoretical physicist and professor at Utrecht University, the Netherlands. He shared the 1999 Nobel Prize in Physics with his thesis advisor Martinus J. G. Veltman "for elucidating the quantum structure of electroweak interactions".

His work concentrates on gauge theory, black holes, quantum gravity and fundamental aspects of quantum mechanics. His contributions to physics include a proof that gauge theories are renormalizable, dimensional regularization and the holographic principle.

Gerard 't Hooft



November 2008

Born	July 5, 1946 Den Helder, Netherlands
Nationality	Dutch
Alma mater	Utrecht University
Known for	Quantum field theory, Quantum gravity, 't Hooft–Polyakov monopole, 't Hooft symbol, 't Hooft operator, Holographic principle, Renormalization, Dimensional regularization
Awards	Heineman Prize (1979) Wolf Prize (1981) Lorentz Medal (1986) Spinoza Prize (1995) Franklin Medal (1995) Nobel Prize in Physics (1999) Lomonosov Gold Medal (2010)
Scientific career	
Fields	Theoretical physics
Institutions	Utrecht University
Doctoral advisor	Martinus J. G. Veltman
Doctoral students	Robbert Dijkgraaf Herman Verlinde

Contents

Personal life

He is married to Albertha Schik (Betteke) and has two daughters, Saskia and Ellen.

Biography

Early life

Gerard 't Hooft was born in Den Helder on July 5, 1946, but grew up in The Hague, the seat of government of the Netherlands. He was the middle child of a family of three. He comes from a family of scholars. His grandmother was a sister of Nobel prize laureate Frits Zernike, and was married to Pieter Nicolaas van Kampen, who was a well-known professor of zoology at Leiden University. His uncle Nico van Kampen was an (emeritus) professor of theoretical physics at Utrecht University, and while his mother did not opt for a scientific career because of her gender,[1] she did marry a maritime engineer.[1] Following his family's footsteps, he showed interest in science at an early age. When his primary school teacher asked him what he wanted to be when he grew up, he boldly declared, "a man who knows everything."[1]

Francesco Sorge

PH.D in PHYSICS

Instituto Nazionale de Fisica Nucleare • Sezione di Napoli

Email Correspondence

July 31 – December 24, 2018

PREFACE

Professor Sorge was on the *Participant List* for the prestigious *Fifteenth Marcel Grossmann Meeting* which, last year (July 2018) was held in Rome. To almost all of the 800-some participants I sent an email message like the one I sent to Sorge, including my *Gravitational Clock* paper as an attachment. Since the inception of these gatherings in 1975 the purpose has been to "provide opportunities for discussing recent advances in gravitation… emphasizing mathematical foundations, physical predictions and experimental tests."

During the several weeks that it took to launch this marketing campaign, the traffic on my website increased, and I received a few direct communication nibbles, but none quite so friendly and promising as that from Sorge.

Over the course of our correspondence, I discovered that I already had some of his works in my library. For example, he was a participant in a 2004 symposium on *Relativity in Rotating Frames* [eds. Rizzi and Ruggiero, Kluwer].

Due to Sorge's explicit receptivity to my initial package of ideas, more quickly than usual, I sent to him additional essays and documents expanding on the background and consequences of my gravity model. Sorge put forth six numbered questions and comments that I subsequently addressed in a separate essay (letter) tailored for the purpose. (I've attached that document at the end of the email correspondence, as indicated also on page 5.) The questions themselves and Sorge's response to my answers indicate that he gave them considerable thought. Sorge's sense of humor also comes through in his facile adoption of the "Rotonian" point of view.

At the end, after a lapse of a couple months, Sorge sent a brief Christmas greeting. I returned the gesture, and that was it.

Other correspondences included here, and the psycho-sociological analyses sprinkled therein, will likely contribute to the reader's assessment of the significance of my interaction with Sorge. I should perhaps add that, for all his evident playful open-mindedness, Sorge's own work suggests a long-term investment in the status quo and virtually no publically discussed doubts about the value or essential correctness of standard theories such as Einstein's theories of relativity.

In aftermaths such as this—i.e., after a seemingly promising correspondence fizzles out—I always ask myself if any other style or rate of delivering my ideas would have brought about a more positive outcome. Could the dialog possibly have unfolded in such a way that Sorge would enthuse *publically*, to endorse doing Galileo's experiment? Though I can't be certain, I tend to doubt it. Scientific scholars sometimes do entertain fringe ideas in their field. Entrenched theories and the corresponding entrenched world views, may well admit incremental adjustments and quibbles over interpretation here and there. But allegiance to the status quo dies very hard, and will not tolerate the kind of upheaval the Rotonians have in mind.

This is true even for those light-hearted ones who may *privately* consider ideas having a deeply subversive character. Even if the validity of such ideas hinges on a simple experiment proposed nearly 400 years ago by the *Father of Modern Science*.

Politicians in USA's Democratic Party are often shown on the TV news telling of their repugnance and disdain for President Trump. They sometimes tell of how their Republican Party colleagues may *privately* express similar reactions. The latter politicians nevertheless—because they are Republicans—*publically* sing Trump's praises and support his policies.

The world is nuts. But the potential to make it sane is still alive. Galileo's experiment must be done. I'm not giving up.

To: francesco.sorge61@gmail.com
From: Richard J Benish <rjbenish@comcast.net>
Subject: Testing Gravity
Attachments: <Gravitational Clock Pt 1.pdf>

Dear Professor Sorge,

Fascinating and important as it is to study the huge, distant and violent extremes of the Universe, and the most abstract extremities of popular theories involving gravity, I'd like to draw your attention to an unanswered question involving the opposite extremes that are easily accessible in concrete physical reality.

In 1632 Galileo proposed the following experiment: Given a spherical body with a hole through its center, what happens when a test object is released from one end of the hole? The needed apparatus may be called a Small Low-Energy Non-Collider.

A plethora of textbooks, papers, classrooms, and YouTube videos present or simulate the standard answer (harmonic oscillation). Unfortunately, this predicted oscillation has never been observed.

In the attached paper arguments are presented to urge that we satisfy Galileo's empirical ideals by at last building and operating humanity's very first Small Low-Energy Non-Collider.

I would be grateful for any feedback.

Thanks for your good work.

Sincerely,

Richard Benish

Francesco Sorge, 8/8/18 1:48 AM -0800, Re: Testing Gravity 2

From: Francesco Sorge <francesco.sorge61@gmail.com>
Date: Wed, 8 Aug 2018 11:48:11 +0200
Subject: Re: Testing Gravity
To: Richard J Benish <rjbenish@comcast.net>

> Dear Professor Benish,
>
> Thank you very much for your email. I have now read your interesting manuscript. It seems a quite interesting issue, deserving further investigation.
>
> I think it is really a severe task to experimentally check Galilei's proposal in a laboratory test: there are a lot of technical difficulties.
>
> Nevertheless, the idea is undoubtedly stimulating from a theoretical point of view, and I would be pleased to consider the topic in deeper detail with you, if you agree.
>
> I will think about the issue and I'll let you know about further thoughts in the next weeks.
> Keep in touch.
>
> Best wishes,
>
> Francesco Sorge

To: Francesco Sorge <francesco.sorge61@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Testing Gravity
Attachments: <Rethinking-Rotation-Sep 5 2012.pdf> <Rethink-Universe-Aug-23-2017.pdf>

> > Dear Professor Sorge,
> >
> > I am so glad to have piqued your curiosity. Thank you very much for reading my work.
> >
> > Moving forward, I would suggest adopting an other-worldly, but quite possible perspective. I think our understanding of gravity may be unduly colored by our privilege of residing on a 5.97 × 10^24 kg spherical planet.
> >
> > Therefore, please imagine the perspective of a civilization that has had no experience with such large concentrations of matter. They have evolved on a large rotating world. (So I call them Rotonians.) They are technologically and mathematically sophisticated, but have no understanding of gravity.
> >
> > Their theories of motion accommodate the limiting speed of light, but asymmetries in this speed are freely acknowledged (as they are measured in opposite directions around the rim of Roton).
> >
> > Their most valuable and basic motion-sensing devices are clocks and accelerometers. Of particular importance is that, in their experience, the direction of motion indicated by accelerometers is ALWAYS the same as the direction of the force that causes the acceleration.
> >
> > With this background, suppose the Rotonians were to encounter an Earth-like ball of matter for the first time. Suppose they manage to softly land on this planet's surface. What would they make of this experience? How would it affect their conceptions of the curvature and dimensionality of space, the nature of matter, the direction of time, and the Universe as a whole?
> >
> > I've attached two documents that develop these ideas further. I hope you enjoy them and I look forward to your feedback. By the way, I'm not a professor.
> >
> > Thanks again.
> >
> > Sincerely,
> >
> > Richard Benish

Francesco Sorge, 8/30/18 5:54 AM -0800, Rotonians 2

From: Francesco Sorge <francesco.sorge61@gmail.com>
Date: Thu, 30 Aug 2018 15:54:50 +0200
Subject: Rotonians
To: Richard J Benish <rjbenish@comcast.net>

> > > Dear dott. Benish
> > >
> > > Thank you for the two last papers about the—so to say—Rotonian issue. I found both of them quite interesting and suggestive.
> > >
> > > Here are some sparse considerations (hoping I understood your papers correctly):
> > >
> > > 1) Nobody knows the very nature of spacetime inside a spherical matter distribution. You mentioned the most popular interior Schwarzschild solution (a perfect fluid with constant proper

> > > density), pointing out the curious different behavior of the space and time metric coefficients, where a non-flat limit result for the time coefficient is reached at the center of the body. To be honest, I don't bother as much about this. The center has a privileged position in space, not in time. In that point the pressure is not zero (actually, it may become infinite in the black hole dynamical limit); hence such point couldn't be considered on equal foots as a point in flat spacetime.
> > >
> > > 2) Nevertheless, the issue deserves further investigation. As you stressed, there are other interior solutions satisfying the spherical symmetry requirements, and an open question is what is the correct one. In that respect your proposed experiment could undoubtedly represent an interesting test.
> > >
> > > 3) According to Rotonians' point of view, acceleration requires motion. So they eventually argue that gravity should imply a kind of motion of space through a new spatial dimension.
> > >
> > > 4) However, such motion cannot fully resemble that of their rotating world. Rotonians should experience—I suppose—also other non-radial accelerations, as the Coriolis acceleration, which they indeed do fail to detect on Earth.
> > >
> > > 5) Furthermore, the idea that the origin of gravity could reside in some motion of space through space, assumes that non-inertial motion is a sort of natural property of space(time). In other words, one is led to believe that inertia has nothing to do with matter distribution through the Universe.
> > >
> > > 6) But, on the contrary, it could be that inertia is dictated just by matter distribution (geometrodynamics? – recall Mach's principle). So what Rotonians do experience could be indeed the manifestation of gravity.
> > >
> > > Please, let me know your opinion about the above points.
> > >
> > > I'm looking forward to hearing from you soon.
> > >
> > > Best wishes,
> > >
> > > Francesco Sorge

Francesco Sorge, 9/12/18 9:45 AM -0800, Re: Rotonians 5

To: Francesco Sorge <francesco.sorge61@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Rotonians
Attachments: <Sorge Email Sep 12 2018.pdf> <Tubular Array (4+1)-D w Cap.pdf> { This figure also attached at end.

Enclosed separately and/or downloadable at gravityprobe.org. { <FundaGravity Feb 2 2018.pdf> <Maximum Force Nov 17 2011.pdf> <Max Force Annotation.pdf> <CosEvthg-Sorge-Sep-12 2018.pdf>

> > > > Dear Professor Sorge,
> > > >
> > > > I am very grateful for your interest and your insightful comments. To facilitate formatting of equations, figures, and references, I've put the bulk of my reply in pdf format (attached). { See 8-page letter attached at end.
> > > >
> > > > I look forward to another round of questions and comments, if you see fit.
> > > >
> > > > In addition to the attachments explicitly referred to in my reply, I've also attached two other papers that may interest you. One of these is a paper that "almost" got published in the

> *International Journal of Theoretical Physics,* as explained in the *Annotation* (also attached).
>
> Thanks again.
>
> Sincerely,
>
> Richard Benish
>
> PS,
>
> I'm not even a doctor. I grew up on Roton, where they don't confer academic degrees, but encourage independent learning (and a good sense of humor). 🙂
>
> RB

Francesco Sorge, 9/18/18 9:36 AM -0800, Re: rotonians 6

From: Francesco Sorge <francesco.sorge61@gmail.com>
Date: Tue, 18 Sep 2018 19:36:38 +0200
Subject: Re: Rotonians
To: Richard J Benish <rjbenish@comcast.net>

> Dear Richard,
>
> I would be happy to follow Rotonians' habits, avoiding academic degrees...
>
> So, if you agree, let us call each other by our first name.
>
> Thank you very much for the novel stimulating papers you sent me.
>
> I will be away for a while, attending to a meeting. I'll be back at the end of the month.
>
> I just started reading your last email. There are still several interesting issues making me a bit confused.
>
> Yet, I was very impressed when comparing your ideas with those appeared in Tangherlini's work you cited (see your paper about Maximum Force).
>
> I hope to reply in a short time, as soon as I'm home.
>
> Get in touch soon.
>
> Best,
>
> Francesco
>
> Il giorno mer 12 set 2018 alle ore 19:45 Richard J Benish <rjbenish@comcast.net> ha scritto:

To: Francesco Sorge <francesco.sorge61@gmail.com>
From: Richard J Benish <rjbenish@comcast.net>
Subject: Re: Rotonians
Attachments: Fig-6-Tang-Shell-Pot-4-2-14.pdf { Attached, page 11.

Dear Francesco,

Thank you. I am delighted to see that you are eager to not only inquire further into "Rotonian physics," but to graciously adopt features of their culture!

I am also very pleased that you've looked into the *Maximum Force* paper deeply enough to appreciate the Tangherlini connection. A prior correspondent, Tom Martin, was similarly pleased to learn of Tangherlini's work, as he thought it allowed an extension of his "spatial flow" model of gravity inside matter. There is a longer story behind this, but I'll simply provide a link to Martin's paper in which he derives graphable shell solutions based on Tangherlini's analysis.

http://www.gravityresearch.org/pdf/GRI-010515.pdf

Using the latter, I plotted graphs for four cases that serve as a more exact version of Figure 6 in the *Maximum Force* paper. (See attachment and link below.) That earlier graph showed approximately the correct shape, which is however inaccurate with regard to the magnitude and *r*-value of the maximum.

http://vixra.org/abs/1404.0076

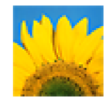
I should add that Martin suspected that the repulsive effect predicted by this interior solution might be physically real. I myself never thought it made physical sense. Evidence later brought to Martin's attention also convinced him to change his views.

We still need a Small Low-Energy Non-Collider to shed the most illuminating light on what goes on with gravity inside matter.

I hope your meeting is productive and enjoyable. And I eagerly look forward to your comments when you return home.

Best regards,

Richard Benish



From: Richard Benish <rjbenish@comcast.net>
Subject: **Re: Merry Christmas**
Date: December 24, 2018 12:24:35 PM PST
To: Francesco Sorge <francesco.sorge61@gmail.com>

On Dec 24, 2018, at 10:13 AM, Francesco Sorge wrote:

Dear Richard,

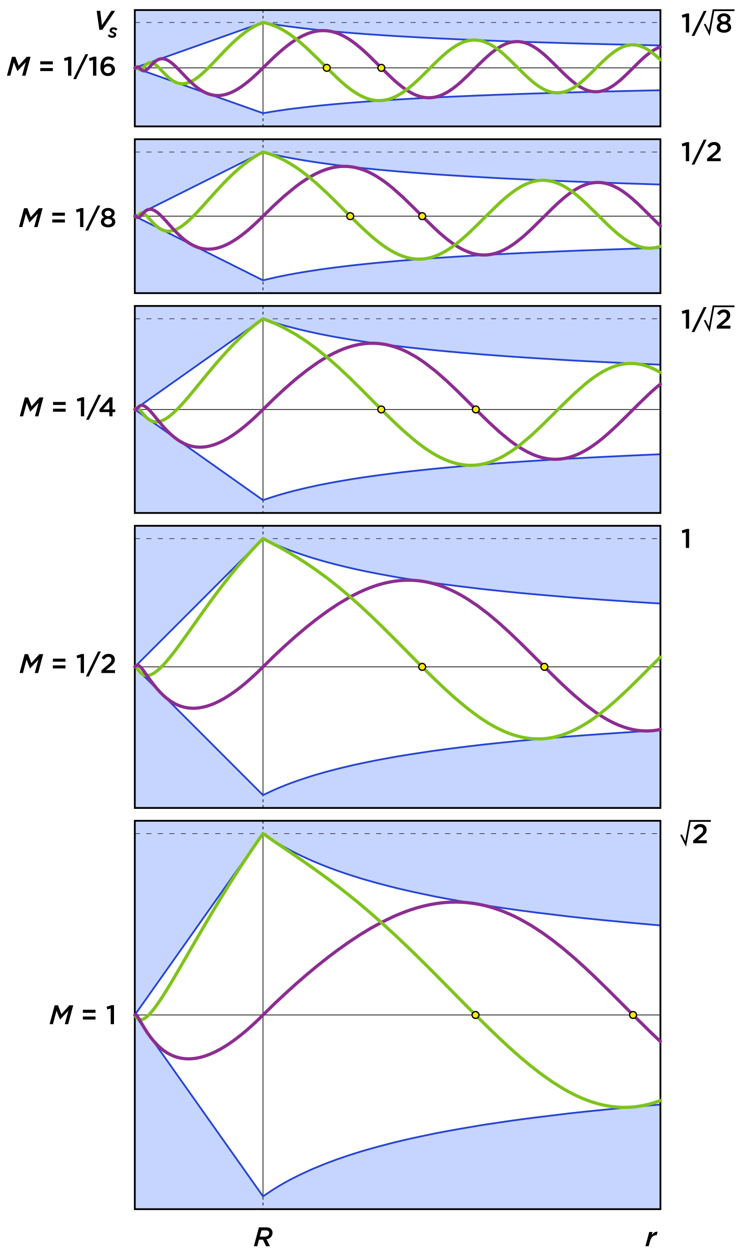
I wish you, and yours, a very Merry Christmas!

Best regards,

Francesco

On Dec 24, 2018, at 12:24 PM, Richard Benish wrote:

> Dear Professor Sorge,
>
> And a very Merry Christmas to you and yours as well!
>
> Happy New Year too!
>
> Best regards,
>
> Richard Benish



Abreviated Caption: As the tubes turn, projected intersections of the helices (purple, green) on the axis appear to move toward the origin with the same speed as that of a body freely falling from infinity [= $(2GM/r)^{1/2}$]. Since all tubes have the same angular speed, the taller ones exhibit correspondingly greater apparent speeds—as also indicated by the correspondingly longer wavelengths. Points on the outer envelope correspond to states of *stationary outward motion*, as exhibited by the tower-mounted clocks and accelerometers depicted in the next figure.

Comprehensive Caption: The vertical axis is stationary outward velocity, V_S. The horizontal axis is radius, r. Peaks of curves correspond to r = surface radius, R. *Density* thus increases with graph height. M represents a fraction of the arbitrary fiducial mass M=1. These are to be thought of as cross-sections of tubes, each of which rotates with the same frequency. The purple and green curves are thus helices. Upon turning, these helices project an angle onto the r-axis that is always = 45°.

This means that the rotational speed of the tube's envelope is everywhere equal to the speed at which any projected intersection of a helix appears to travel along the r-axis. For the appropriate rotation direction, this also means, therefore, that the apparent projected speed is exactly that which an object falling radially from infinity would appear to have at any given r. I call the trajectory of this limit case (the r-axis itself; also the rotation axis) a *maximal geodesic*.

The corresponding change in speed (outside the surface, R) thus corresponds to the acceleration due to gravity g. Since the stationary outward velocity inside the body decreases to zero at the center, the acceleration of the projected intersection below the surface appears to become "repulsive." This velocity-dependent effect is not to be thought of as any kind of "force," in the traditional sense. An object released into a hole through the center, for example, would still initially appear to have a downward acceleration of magnitude $g = GM/r^2$.

Since this object will also never quite reach the center (according to the Space Generation Model) here too the motion eventually slows down, giving the appearance of a repulsion. This is an illusion created by the non-uniformity of the *stationary outward velocity* and *stationary outward acceleration*, both of which are empirically measurable with motion-sensing devices (accelerometers and clocks).

Eventually, the scheme needs to be adapted to explicitly accommodate trajectories of test objects released not only from infinity and the surface, but from any radial distance with any initial radial velocity.

One of the primary motivations for the diagram is to represent the (4+1)-dimensionality of gravitational stationary motion. Think of the outer envelope as representing a tall pole planted on the surface of a massive body. Although the pole visually appears to be at rest, accelerometer readings and the rates of clocks tell us that it is everywhere undergoing stationary motion.

If we try to represent this motion in the radial direction in pre-existing (3+1)-dimensional spacetime, the thing flies apart. It is not at all stationary; it is impossible. But if spacetime is in fact (4+1)-dimensional, then we are justified to represent the motion as being "perpendicular" to the pole in the manner shown in the drawing, i.e., perpendicular to the plane of the page.

Gravity may thus be conceived as a kind of "rotation" of (3+1)-dimensional spacetime into (or *outfrom*) a new dimension, the magnitude of which depends on the local distribution of mass. As we should expect, we cannot directly see this motion. Since it is manifest empirically by our motion-sensing devices, we nevertheless have reason to expect it to be physically real. In a sense it is more real than our visual impression.

Visually we see falling test objects accelerate. But the accelerometer readings of such objects is zero. Perhaps tactile evidence is more indicative of what is actually happening. Only accelerometers attached to the massive body give positive readings, indicating that acceleration is a property of matter—exhibiting itself as an inexhustible source of perpetual propulsion. For this to be true, another (fourth) spatial dimension is needed. Evidently, space is being perpetually generated by matter according to the inverse-square law.

Since the rotation period of every massive body "tube" is everywhere the same, it must be related to the value of Newton's constant, G. A more complete representation of the vast range of sizes and masses would show them scaled in terms of the velocity ratio V_S/c, which would be indicated by a horizontal asymptote (unreachable light-speed maximum).

With such scaling, the tube diameters of common gravitating bodies like stars and planets would be small fractions (small M values) such that we'd have many helical turns per radial (r-axis) distance interval, instead of the few turns, as shown here.

The key idea is that this extent in *stationary outward velocity space*, this motion into a hyper-dimension, is the very essence of matter and gravity. An unturning tube collapses to a dead abstract *line*. Without this state of perpetual outward motion, there would be no gravity, no matter, no space, no time, no life, no Universe.

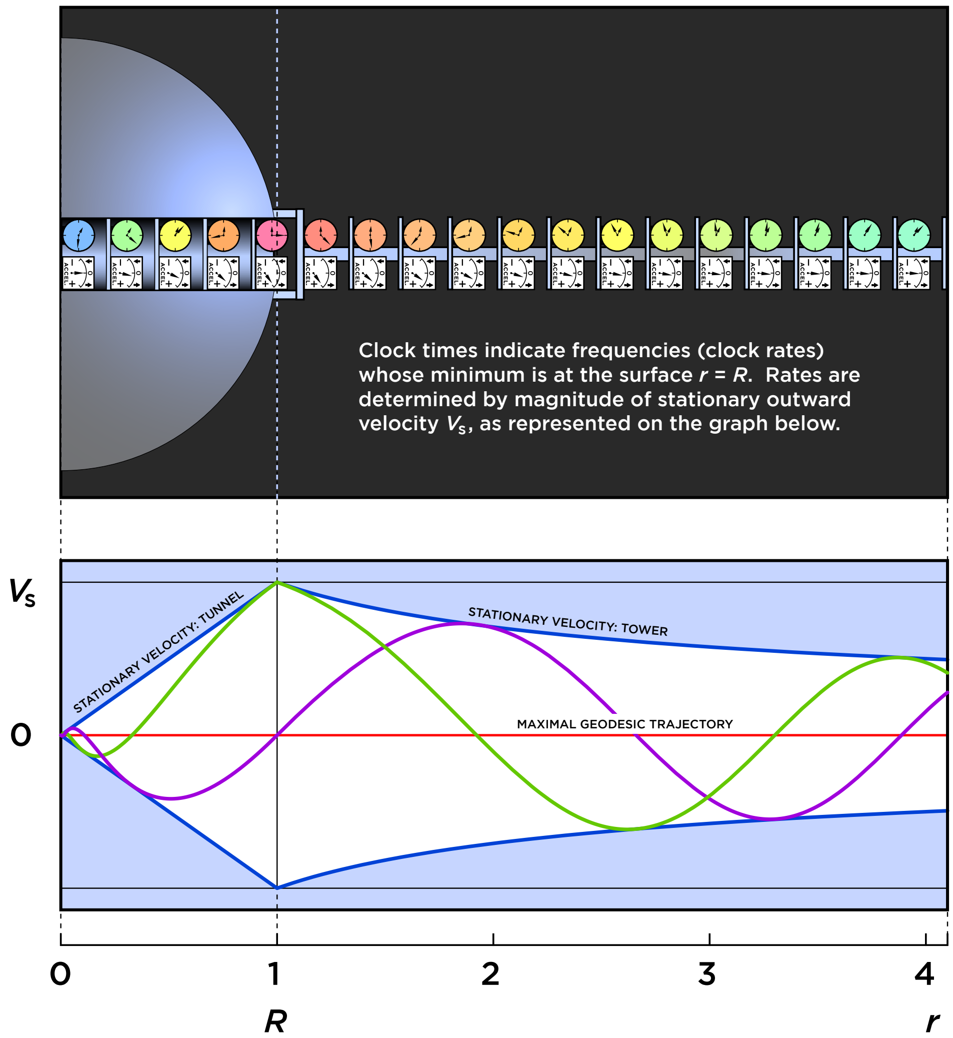


Fig. 5 Tubular model of (4+1)–dimensional radial stationary motion. **Top:** Physical circumstance represented in graph below; i.e., a gravitating body and an imaginary tower attached to its surface. **Bottom:** V_s–axis represents stationary outward velocity; i.e., the stationary motion of space into or outfrom a fourth spatial dimension. Think of the cross-sectional graph as rotating around the r–axis. Helices drawn on the tube at 45° to the axis facilitate visualizing the falling motion of maximal geodesics.

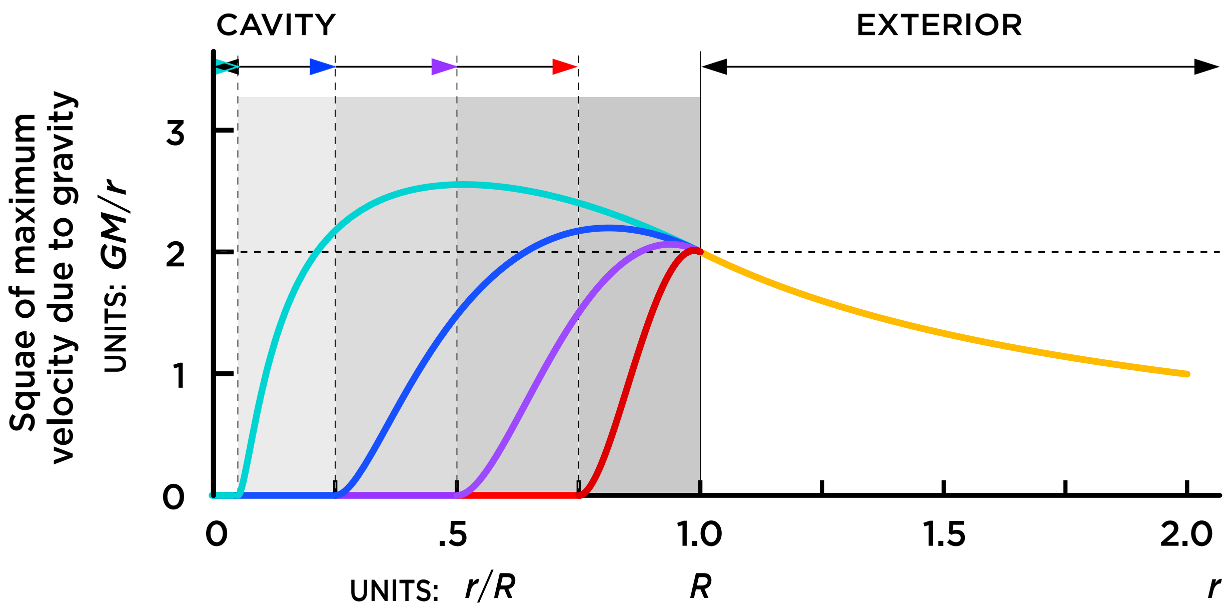


Fig. 6. Tangherlini shell potentials. Outside the shell's surface, gravity abides by the Schwarzschild exterior solution. But inside, the behavior deviates from both Einstein's and Newton's theories of gravity. An object dropped into a hole through the shell from the outer surface or radially falling from the outside to the inside, would never enter the inner cavity. This behavior corresponds to the equations predicting that the rate of a clock inside the cavity is the same as the rate of a clock at infinity.

Figure from *Novel Consequences*... Attached to email message of September 19, 2018 (page 7).

September 12, 2018

Francesco Sorge
Istituto Nazionale de Fisica Nucleare (INFN)
Sezione de Napoli
Complesso Universitario di M. S. Angelo
Ed. 6 giorni - Via Cintia 80126 Napoli
Italy

Dear Professor Sorge,

In continuing our email correspondence—especially in response to my papers, *Rethinking Einstein's Rotation Analogy* and *Rethinking the Universe*—you've enumerated six areas of discussion. Your comments seem to exhibit two or three clusters of linked ideas. My response treats #1 and #2 as one group and #3 – #6 as another. I've added one more section that focuses especially on the cosmological implications raised in #5 and #6.

1 # 1 and # 2:

"The most popular interior Schwarzschild solution" as an idealized starting point to compare with "other solutions" and the Rotonian point of view.

As has often been pointed out in the literature [1–3], the Schwarzschild interior solution can never be an *exact* representation of spacetime within a massive body because it assumes perfectly uniform density—a condition not physically possible due to inevitable non-uniform pressure caused by non-uniform gravitational force. The solution is nevertheless useful as a point of reference from which to discuss expected deviations from its exact unphysicality. Most of these discussions concern astrophysical bodies such as neutron stars.

I am sometimes amused by the wide range of theoretical possibilities often characterized by the mass/radius graphs representing different equations of state, with their multitude of bird-like s-curves, bounded by the dread singularity. (See Figure 1.)

Be that as it may, for our purposes we are presently concerned only with *ordinary* bodies of matter having densities similar to our own (or within a few orders of magnitude). In the weak-field (ordinary body) regime these astrophysically motivated variations all reduce to the Newtonian limit, where the *potential* and corresponding *mass defect* are as predicted under the *assumptions* that gravity is a force of attraction and that the rates of clocks are a *minimum* at the center. I question all of these variations by proposing a singularly drastic departure according to which gravity is *not* a force of attraction and clock rates approach a central *maximum*, not minimum.

The volumes of work involving the strong-field, high-pressure situation might ultimately prove to be premature and misguided because *we have not yet confirmed the weak-field, zero pressure situation*. Astrophysicists claim to have made sensible models of exotic stars prior to validating our understanding of gravity inside a common lump of coal. Rotonians are not uncurious about neutron stars, but their sense of priority dictates the need to first explore the

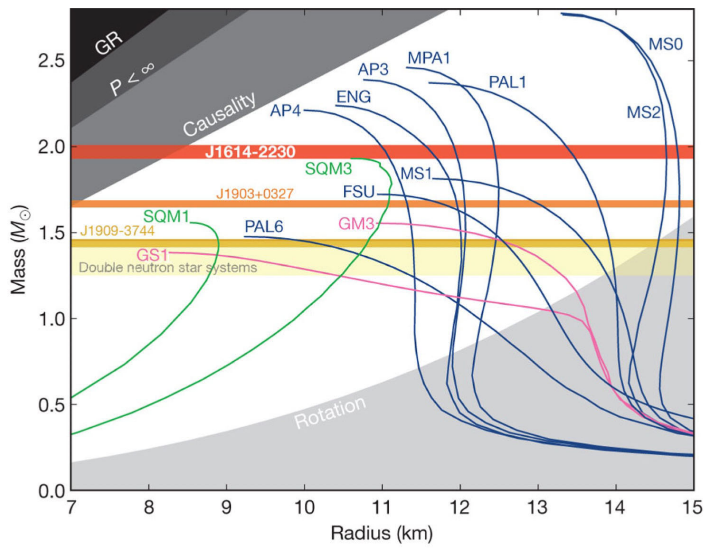


Figure 2.1: NS mass-radius diagram for various EoS (see [Demorest10] for details). The horizontal bands in red, orange and dark yellow show the current observational constraints from several pulsars while in light yellow for double NS binaries. Any EoS line which does not intersect the red band ($m_{\mathrm{NS}} = 1.97 \pm 0.04 M_\odot$) is ruled out. Reprinted from [Demorest10] .

Figure 1: Equations of State determine the mass-radius relation of neutron stars. Might such pretty graphs be as embellishments on snarks and unicorns? Before taking them seriously ought we not to first confirm the underlying theory's validity inside ordinary, accessible bodies of matter? From Schlögel 2016. [4]

gravitational behavior of a much smaller (easily manufactured) body with a hole through its center. In this case the pressure in the hole is zero. Yet Earthians say a clock at the center ticks slower than all the rest. Why? What causes that?

The only thing that causes clock rates to deviate from a maximum rate, in the Rotonians' experience is *motion*. In a concentric evacuated cavity, or in a tube through the center of a gravitating body there is no matter to cause any motion. So why should a clock there tick slower than one on the surface? Is it scientifically acceptable to merely *assume* the Earthian prediction is true, or should we seek to test it by experiment?

For laboratory-sized bodies of matter the difference in clock rate, as between the center and the surface, is so small as to be immeasurable. Central to this discussion, however, is the idea that the clock rate question is indirectly—though convincingly—testable by observation of *motion* that the clock rate is theoretically correlated with. In other words, *the big red question mark pertains to both questions:* Motion though the center and clock rates inside ordinary bodies of matter. (See Figure 2.)

Even though doing Galileo's experiment would answer both questions, physicists typically assume instead that both questions have been sufficiently *answered by theory*. This approach—to leave the base assumption physically untested—is sloppy science. Theory is not capable of definitively answering empirically questions. If he were alive today, would Galileo be satisfied with *pretending* to know the result of his experiment or would he insist on actually doing it?

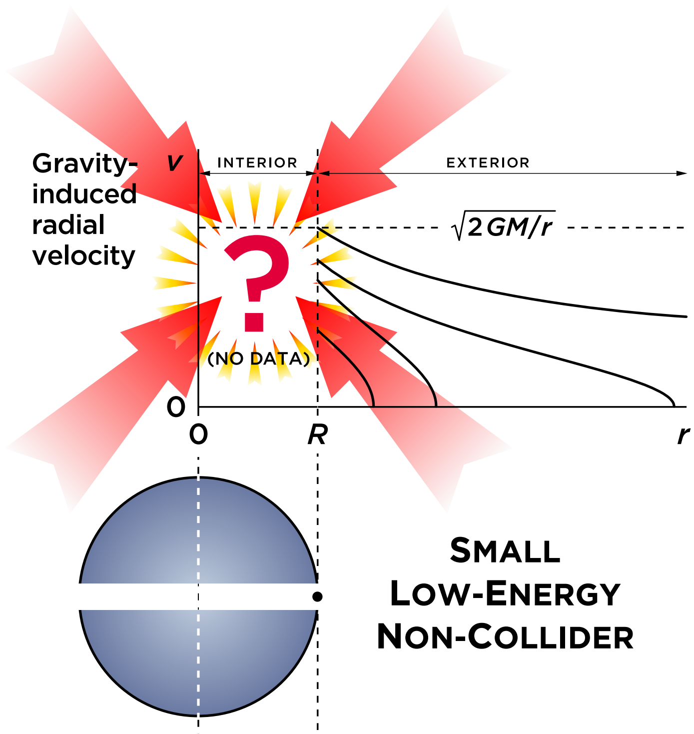


Figure 2: Huge gap in gravitational data. Though discussions of the interior falling experiment that would replace the question mark with data are common in physics classrooms and in the literature, it has never been done. The results are therefore unknown, as indicated (with some modest exaggeration).

Your acknowledgment of our ignorance of the answers to these gravitational questions and agreement that they should indeed be answered by experiment is much appreciated.

2 #3 – #6:

Motion *through* space vs. motion *of* space. Limits of analogy. Spatial dimensions and spacetime curvature. Implications for the "origin of inertia." Mach's Principle and the Universe.

I'm delighted that you've taken hold of the idea—crucial to the Rotonian conceptions of mass, space, and time—that we can meaningfully distinguish between motion *through* space vs. motion *of* space.

By contemplating the possibility that Einstein's approach to his rotation analogy was backwards, Rotonians come to clearly see not only the limits to the analogy (i.e., where the compared cases diverge) but also the new ideas needed to uphold the analogy's validity to the greatest extent possible. It all traces back to Rotonians' instinctive belief in the truthfulness of accelerometer readings.

Rotonians see it as nonsensical to adopt Einstein's view that rotating bodies can be regarded as *static*. The measurable effect on clocks, rods, and accelerometers due to uniform rotation *means* the same measurable effects found with respect to massive bodes are to be explained by the *same cause*, i.e., motion.*

This "sameness" cannot reasonably be expected to be exact because the situations are clearly different. Analogies are obviously not identities. Uniform rotation is an everyday occurrence which we scarcely think of as needing the qualification: *motion through space*. What other kind of motion is there?

Our answer is more clearly understood by appeal to another analogy. In this case we consider the experience of an imaginary sub-dimensional, though intelligent life-form whose experience leads to the same question. Thinking of their world as a plane wherein motion is only possible in two dimensions, inhabitants of this world eventually discover that a long enough "straight" line returns to its starting point. How do they explain this? Being mathematically savvy, they deduce that it indicates the flatness of their plane to be a local illusion. They actually live on the surface of a sphere which extends into another dimension.

Prior to circumnavigating their world, these folks had already noticed that when triangles drawn on their surface are large enough, they exhibit deviations from Euclidean (plane) geometry. The sums of the angles exceed $180°$. Rotonians thus discovered the need for a non-Euclidean ("curved") geometry. And only later—after their circumnavigation added inescapable clarity to the picture—did they begin to conceive the *connection* between curvature and higher dimensions.

I think our experience as seemingly $(3 + 1)$-dimensional beings residing on a seemingly static sphere of matter is analogous to the above scenario. Thanks to Einstein and his followers, we now have an abundance of evidence indicating that our world is most accurately described by non-Euclidean geometry. I think spacetime curvature is a firmly established empirical fact. These non-Euclidean conceptions are routinely described in the context of gravitational physics. The prevailing theory of gravity (General Relativity) that accommodates spacetime curvature also purports to explain accelerometer readings and distortions of space and time as being due to an essentially *static* picture of matter, having no need for more than $(3+1)$ dimensions. One of the quirky (and, Rotonians think, highly questionable) consequences of this development is the appearance of intuitively contradictory expressions such as "gravitational acceleration of a particle at rest." [Möller, Rindler]

Meanwhile, arrays of accelerometers all over the world perpetually *scream*: We are moving! We are accelerating upward! Their motion is not the common, visually apparent circumstance of motion through space. Earthians are blind and numb to regard it as motion at all because of their habitual refusal to believe their motion-sensing devices. Whereas Rotonians—who have learned to deeply trust their motion sensing devices—see and feel the motion clearly: It is the motion *of* space into (or outfrom) a fourth spatial dimension. Matter is obviously not static; it produces the "gravitational field" by perpetually generating space and regenerating itself. Matter is thus conceived as an inexhaustible source of perpetual propulsion.

Rotonians see their proposal to test their hypothesis as being analogous to the two-

*Newton's *Rules of Reasoning in Philosophy* state: "Nature does nothing in vain, and more is in vain when less will serve; for Nature is pleased with simplicity, and affects not the pomp of superfluous causes.... Therefore to the same natural effects we must, as far as possible, assign the same causes." [5]

dimensional creatures' proposal to follow a "straight" line as far as they could. Just as proof of the existence of a *third* spatial dimension was provided by traveling all the way *around* their "locally flat" surface, proof of the existence of a *fourth* spatial dimension may be forthcoming if only Earthians would see fit to arrange for a test object to forcelessly travel all the way *through* a seemingly static $(3+1)$-dimensional chunk of matter. Geodesic travel around a sphere proves the existence of the third spatial dimensions. The attempt to geodesically travel through a massive sphere proves (according to the Rotonian hypothesis) the existence of the fourth spatial dimension, because a rocket will be needed to get back up to the opposite side.

Rotonians suspect the test object will not pass the center, indicating that the force of gravity (disregarding tidal effects) is conveyed only by contact with the material source of space. The apparent pattern of motion of objects over the surface is due to the inverse-square law by which space is generated, and to the curvature of that space due to the limiting speed of light and as manifest by the slowing of clocks and radial shortening of rods.

Among the attachments you will find one—Tubular Array $(4+1)$-D—that augments the above discussion by referring to a set of $(4+1)$-dimensional rotating tubes, similar to those depicted in Figure 1, *Rethinking Rotation*, and Figure 5, *Rethinking the Universe*.

3 #5 – #6:

"Origin of inertia." Mach's Principle and cosmic implications.

You will notice that the final sentence of the long caption to the just-mentioned attachment asserts that the stationary motion deduced by the Rotonians is the *essence* of matter, without which we would obviously not have a Universe.

Before delving too far into a discussion of these cosmic matters, it is pertinent to recognize what a foggy muddle has often been made of them in the literature. The principle by which Einstein is sometimes credited as having identified inertia with gravitation (*Equivalence Principle*) has been characterized as being so vague (by having been stated in too wide a variety of indefinite ways) that "There are almost as many equivalence principles as there are authors writing on the topic." [6] The same can be said for "Mach's' (alleged) Principle." An "Index of [*twenty-one!*] Different Formulations of Mach's Principle" is included in Barbour and Pfister's book on the subject. [7]

This dubious state of affairs (about which much more could be said) gives Rotonians the impression that, above all else, Einstein was a great salesman.

Curiously, as is often the case with innovative thinkers, even if a coherent picture has not yet emerged, kernels of truth may yet be contained in their ideas so as to render them worthy of inspection from as yet unexplored perspectives (e.g., that of the Rotonians). Being fresh and virtually unencumbered by the weight of Earthian gravitational dogma, Rotonians take a special interest in Newton's gravitational constant G. Most significantly, they notice that Earthians haven't the foggiest idea how this fundamental constant relates to their wide assortment of other interrelated constants. Surely G must ultimately be interrelated in a similar way; surely it must somehow be expressible as a combination of the others.

Many details will be left out here. But it is worthwhile to point out that conceiving G as a fundamental *acceleration of volume per mass* is conducive to relating inertia to cosmology in, I think, a rather elegant way. Skipping directly to the end product, Rotonians have come upon the following very nearly (at least) empirically true expression:

$$G = 8\left(\frac{\rho_\mu}{\rho_{\rm N}} \cdot \frac{c^2 {\rm a}_0}{m_{\rm e}}\right), \tag{1}$$

where ρ_μ is the mass-equivalent of the CBR energy density, $\rho_{\rm N}$ is the nuclear saturation density, c is the light speed constant, $\rm a_0$ is the Bohr radius, and $m_{\rm e}$ is the electron mass.

Concerning the persistent disconnect between G and the rest of physics, 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?” [8] Note that Eq (1) satisfies all of Aitchison’s desiderata.

If Eq (1) is true—so as to validate the gist of the Rotonian conception—one of the first consequences to consider is the implied unification between inertia and gravity. Inertia, the resistance a body poses to acceleration in *one* direction (line) is due to and is essentially the same thing as gravity, the *process* by which material bodies generate space in *every* direction (volume).

The connection to cosmology is facilitated by contemplating another contrast to the standard view. Einstein’s cosmological constant, which represents the accelerative creation of space out of *nothing*, has a positive value in deSitter’s famous cosmological solution of 1917. Because this solution entails an exponential cosmic expansion, its metric was adopted by the Steady State cosmologists of the 1950s. It has been reincarnated in modern times as the state to which the cosmos supposedly approaches asymptotically, as the “attractive” influence of matter shrinks toward zero, as compared with the ultimate domination of the Universe by the ever-more cold and repulsive vacuum of space.

One of the reasons Rotonians are unimpressed (if perhaps a little tickled by its irony) with this scheme is that it perpetuates the imaginary discontinuity between matter and space with regard to what expands and what does not. That is, what “tries” (but fails) to pull things back together (static matter via attractive gravity) and what (supposedly successfully) increases the distances between them (“dark energy”). Surely this is a most inelegant (ugly) conception of the Universe.

I suppose you already anticipate the Rotonian alternative: We don’t need a cosmological constant because there is no gravitational attraction. *Matter* is the generative, active source of the Universe’s exponential expansion.

Perhaps you are familiar with Robert Dicke’s efforts to understand Mach’s Principle’s connection to particulate matter. (Dicke is listed as the 19th entry in Barbour and Phister’s *Index*.) In his 1964 essay, *The Many Faces of Mach* [9] after presenting the commonly encountered Mach’s Principle-based cosmic equation: $GM/Rc^2 \approx 1$, Dicke entertains the idea that:

> A scalar field, generated by all the matter in the universe and acting on the particles in the universe, could conceivably affect all their masses in such a way as to keep M/R constant ... the masses of the particles would adjust themselves appropriately, in such a way as to give M/R the appropriate value.

It is as though the Universe is a giant servosystem, continuously and automatically adjusting particle masses to the value appropriate to the feedback condition

$$\frac{GM}{Rc^2} = 1. \quad (2)$$

Dicke continues by suggesting a connection to a few of the ”Large Numbers” coincidences as expounded upon by Dirac. These “coincidences” also play a role (where they are found to be not coincidental, but profoundly meaningful) in Rotonian cosmology.

Even though Dirac's and Dicke's conceptions of gravity were quite unlike the Rotonian conception, we nevertheless find this curious “kernel” of overlap as regards cosmology and the possible interplay between the cosmically small and the cosmically large. According to Rotonian cosmology, the global *feedback* field consists in the connection—via the fine structure constant—to the nuclear saturation density and a possible maximum matter density, both of which play a role in maintaining cosmic proportions (i.e., masses of particles, the value of Newton's constant, the cosmic scale length, among others). Just as nuclear forces “saturate” to balance electromagnetic forces in an atomic nucleus to maintain stability, Rotonians conceive the Universe as being *saturated* by the unifying effect of all the forces (giant servosystem?) whose prominent large scale manifestation is gravity.

I've attached a Cosmic Everything Chart which compactly graphs some of these connections. For more details, see also my long essay: *Light and Clocks* [10].

In closing, I should say that, much more important than the validity (or not) of these wild ideas, is the fact of the ever-beckoning big red question mark. The spirit of Galileo still waits for his experiment to be done. We have yet to build and operate humanity's very first Small Low-Energy Non-Collider. If the result is that the test object oscillates, then we can safely disregard most of the above ideas. But if the result agrees with the Rotonian prediction, humans will have a fun time reassessing everything!

Once again, many many thanks for taking an interest in Rotonian physics.

Cheers,

Richard Benish

PS,

On the attached Chart, please note the datum between Melon and Elephant. ⌣̈

RB

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[7] Barbour, Julian; and Pfister, Herbert; *Mach's Principle—From Newton's Bucket to Quantum Gravity* (Birkhäuser, Boston, 1995) p. 530.

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[10] Benish, Richard, 'Speed of Light and Rates of Clocks in the Space Generation Model of Gravitation, Part 1,' < http://vixra.org/abs/1406.0090 >. Accessed 11 September, 2018.