Attempt at self-consistent description of gravity wells and energy flows
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Abstract: If general relativity is true, then G should not be constant for all observers, and therefore gravitational redshift should be exhibited at large scales. The resulting effects would explain phenomena currently described by dark energy and dark matter, and would also reconcile the ages of the universe derived by CMB and supernova data. If the initial hot dense state of the universe is taken as maximum energy density over the current volume of the universe, then the Big Bang can be modeled as a purely thermodynamic process precipitated by random cooling that leads to a phase change, much like a soap bubble popping, which should immediately produce the cosmic web structure exhibited in the CMB. Gravity emerges from chaotic energy flows with a normal probability distribution, and time can be expressed as the average number of iterations it takes for chaotic flows to produce a given state. Observed gravitational wave phenomena are explained as an effect on the path of light due to energy flows. Assuming that not all forces are perfectly balanced, the underlying fields will tend to rotate around the axis of energy flow, creating vortices in spacetime that would tend to result in mutual attraction between immediately adjacent objects. The sum of the attractive forces thus generated can be equated with gravity in the far field and magnetism in the near field.

(This is based on my impressionistic understanding of the theory and evidence of physics and the rudiments of logic. Real physicists, mathematicians, and philosophers, please don't be offended.)

We know the moon hasn't crashed into the earth lately, or we would be dead. This fact tells us that, in every frame of reference that fits in the same universe with us, the orbit of the moon has been stable for about four billion years. Therefore, we hold the force of gravity constant in our equations, and all observers everywhere must get an answer that agrees with the answer we know to be true over that timeframe.

This is a strong claim, and one that conflicts with general relativity's prohibition on special status for observations from any particular place. While general relativity does not require us to assume we are dead somewhere else in the same universe, it is also not necessary to hold gravity perfectly constant for all observers just to keep us alive. We need only assume that causality could not be affected by any change in gravity that is observed.

Maybe the moon will crash tomorrow, but if we got a signal today then someone could take off in a rocket and avoid it. For causality to hold in our theory, we need to rule out the possibility of such a message getting through. Therefore, the place to look for evidence is more than four billion light-years away, beyond the distance at which information could be sent back to somehow change the outcome for anyone. What we see at that distance and beyond is redshift in all directions, increasing proportionally with the distance.

Gravitational redshift is needed in general relativity to explain the stretching of light waves that we see when a light source is falling into a strong gravitational field. If we allow the gravity of every object to get stronger very slowly (alternatively, if we acknowledge that right now the theory is missing any counterbalancing force for gravity or any explanation for why gravity would "pull" to some arbitrary point and just stop there), then gravitational redshift, an independently-motivated mechanism, would explain the universal redshift.

Increasing gravity that leads to slow gravitational redshift would simultaneously account for the acceleration seen in the universal redshift with increasing distance. If you measure the distance between objects in terms of their own radii, and those objects shrink at a constant rate, then the distance (number of radii) between them will increase at an accelerating rate as that distance becomes a greater percentage of those radii. For an analogy, picture a bunch of grapes slowly drying into raisins in the sun. The space between the raisins increases, but the mechanism is evaporation that causes shrinkage, not a new force that causes space to expand. Measure the raisins each day, and record the distance between them as expressed in daily-raisin-diameters. Not only will the distance increase every day, but with a shrinking denominator and increasing numerator, the rate of increase will get larger every day. In this same way, light emitted from a shrinking source to a shrinking receiver would seem to be stretched more and more as time goes on. Moreover, evaporation is consistent with the fact that the centers of the grapes do not move, and the angles of the stems do not change, whereas the space-expansion model turns those expected facts into additional mysteries to be solved.

For a model that can be reproduced in the lab and run at a reasonable pace, tie two balloons to a ruler and deflate them at either a constant rate or with a constant aperture. If the aperture is constant, that would lead to a slowly decreasing rate of deflation; to maintain a constant rate of deflation, either the aperture or the pressure would have to increase. Empirical data is needed to determine which option is appropriate. However, the latter claim requires some mechanism to change the system (by increasing the aperture or pressure over time), so the former claim is the simpler one; therefore, for now we will say the aperture is constant.

Gradually increasing gravity would also explain why we can’t find evidence for dark energy nearby. In the first place, its effects could only be seen at very large distances because the combination of causality, the speed of light, and our continued existence would mean that gravity must need a very long time to grow noticeably stronger. More importantly, we are inside the gravity well that is getting stronger, so we and all of our yardsticks are shrinking right along with it.

Anomalous gravitational lensing like that seen in the Bullet Cluster could also be explained by allowing every gravity well to get deeper over time. The light that reaches us from the farther object was emitted billions of years before it passed the nearer object. If we hold that spacetime was necessarily defined by the configuration of objects at that time, then those photons started out traveling along geodesics defined in part by the wide and shallow gravity well of the nearer object off to one side. The nearer object was moving laterally at high velocity, and in this proposal it was shrinking at the same time. The photons that reach us from the nearer object were emitted billions of years after the farther, older photons. Therefore, they were emitted from a deeper, steeper gravity well than the one that originally defined the course of the older, farther photons. The combination of lateral motion and shrinkage will cause the deflection of the older light—and the apparent location of the farther object—to be offset to one side of the nearer object (behind it on its path of travel), rather than directly behind it as one would expect from gravitational lensing with no increase in gravity over time. Specifically, the path of the farther photons will look like a partial spiral that flattens out after passing the nearer object, not a smooth curve.

Testable prediction: Anomalous gravitational lensing will always be directly related to the distance between the lensed and lensing objects and their lateral velocity relative to the observer.

Further, if spacetime is defined by the mass and energy that are present, and if objects can only move along geodesics of that spacetime, then increasing gravity would increase the apparent rotational velocities of galaxies. Let a galaxy or cluster of galaxies sit in relative isolation for several billion years, with no other massive objects approaching the neighborhood. At that point, the mass and energy of that galaxy/cluster has defined all the possible places that any object could go because there is nothing else around to offer any different geodesics. If gravity has increased in those years, then the depth of the well will be greater and the walls will be steeper. Seen from far away, it will appear that the galaxy or galaxies are rotating faster than expected for their size and mass. Seen from the inside, all would necessarily appear normal, as there is very literally nowhere else that things could be.

Testable prediction: Excess rotational velocities of galaxies and clusters will be less in direct proportion to their distance in the past (less time to deepen the well) and their diffuseness (less mass to deepen the well).

Also, the geodesics that are defined by a large object will be different from one side to the other. The geodesic from the near side to us will be a straight line that dips "down" toward the object; that is, the geodesic will get longer over time, but won't seem to curve from our perspective. The geodesics from the far side will follow the shortest path along the walls of the gravity well--they will actually get shorter as the well gets deeper, but those that pass close to the center will be deflected more strongly around it.

Testable prediction: Type 1A supernovas on the near edge of a distant galaxy will be redshifted more than those on the far side of the same galaxy.

Testable prediction: The far-side SN1A's might even appear to be blueshifted if the gravity well passed some sort of inflection point (from "shallow" to "steep," however those are defined) shortly after the supernova event.

Testable prediction: The far-side SN1A's that are directly behind the center of gravity will appear slightly larger and brighter than expected, due to gravitational lensing caused by the change in shape of the gravity well. This would be very hard to see since the distance to the center is necessarily small in relation to the time needed for gravity to strengthen, but in general the effect should be like that in the visualizations of black hole accretion discs. The brightness of said SN1A’s would therefore need to be corrected for this effect, to improve their reliability as standard candles.

As with dark energy, this scenario also explains why we can’t see evidence of dark matter locally. Not only would we need to observe a system for billions of years to see it, but if it is local then we would necessarily be part of the matter and energy defining the local gravitational field. Therefore, we would not see its effects because we are inside the gravity well as it shrinks.

Testable prediction: We might be able to see a differential in the shrinkage from one side to the other of a system that contains us if we are far to one edge of that system, as we are in the Milky Way.

Testable prediction: We might be able to detect the rotational velocity of our own cluster by observing the apparent velocity of distant objects from whose perspective we should seem to be rotating. We should find that the same degree of excess rotational velocity applies to us as to everywhere else.

So far, we have changed exactly one assumption about the way general relativity is applied, but we have changed none of the mathematical machinery of the theory. In fact, we have strengthened the postulates that no frame of reference is more correct than any other and that causality must hold true. In this way, increasing gravity is more self-consistent than the prevailing view where G is constant. As a result, we arrived at several new results and testable predictions using only the existing observational data without the need for undetectable inputs.

The idea that objects shrink in on themselves over time does not reconcile easily with the Big Bang. The Big Bang assumes an initial hot dense state, followed by inflation, then everything slows down as it cools off. The conflict that arises is that we have already seen that universally shrinking objects can explain apparent expansion of the type that is described by inflation. If both models are true then it becomes necessary to explain why their effects are not compounded.

Inflation allows for the creation of the space that is necessary for the energy flows and cooling of the universal medium that must precede nucleosynthesis. When most materials cool and go through phase changes, they also shrink. Cooling is the result when energy flows create one spot that is less hot than its surroundings. If we assume that energy flows were chaotic in the early universe, we cannot rule out the possibility that random chance led to some place becoming cool enough to undergo a phase change (from whatever state is hotter than nucleosynthesis down eventually to plasma), and then that bit of the universe condensed. Therefore, we can just as easily posit that energy flows led to cooling that created space, rather than the other way around. If inflation is not needed, we do not need to explain the subsequent slow-down, either. Familiar thermodynamic processes are the driving mechanism for both epochs once we allow gravity to get stronger, as there is always someplace smaller for things to condense into.

The irreducible component of the Big Bang is the hot dense state. Density is content over volume. If we take a very large space and fill it with energy to the point that it cannot hold any more, then by definition we have reached maximum density. Thus, we could let the universe start out at its current size, and with complete consistency also say that it was nevertheless filled with energy to the point of being hot and dense. (This reinforces the notion that the early expansion was only apparent. If everything started out basically where it is today, then it is not necessary to say anything moved or to explain how.)

If, as we assume in general relativity, the same physical laws are true throughout time and space, then we must not curtail the role of normal thermodynamics in the early universe unless we have strong evidence. Therefore, with an initially large envelope and increasing gravity, the clumping of mass will be due to thermodynamics and any self-interactive properties of the mass itself. If nothing else is present, then nothing else can influence the outcome.

To visualize the expected effects of a system ruled entirely by thermodynamics, watch a slow-motion video of a soap bubble popping.

- The first thing that happens is a thin spot in the soap film develops due to evaporation or temperature changes, then weakens and breaks.

- Immediately, the inherent surface tension of the soap solution takes over the entire system and pulls the film apart into an even-yet-random distribution of small droplets arranged in filaments separated by voids.
- The voids then appear to get rapidly larger, but in fact, the voids do nothing--they never change size or position relative to the original bubble. All of the work and all of the changing is done by the material of the filaments as they collapse in on themselves.
- If the video is slow enough, you will see some droplets being flung from the inner edge of one void toward the other side of their filament, where they crash into other droplets being flung in the opposite direction.
- At the end, there is almost no soap film left in sight, and the voids grow faster and faster until they are are all that is left of the bubble. The soap film does not disappear, but it retracts and condenses to the point that it falls out of the air.

Similarly, the beginning of the universe in the proposed model would happen very quickly.

- This thermodynamic model would entail the immediate formation of filaments and voids with an overall-smooth-but-granularly-lumpy distribution.
  - This structure is the first thing we would see because it would be the first thing that happened.
  - There is no reason to assume that there would be any apparent center or pattern to the cosmic web thus formed; unlike a soap bubble, the universal medium is not assumed to have any orientation or surface, as we have no evidence to support such strong claims.
- The voids should seem to get larger over time, and the material of the filaments will mostly seem to stay in place, although some clumps will be flung around at high speed and collide with other clumps.
  - Almost immediately, these collapsing and colliding masses of gas should form stars and galaxies.
- The collapse of the universal medium is governed entirely by the "cooling and condensation" process and any attraction or repulsion that the medium has for itself.
  - The specific rules of this self-interaction would probably change as the medium underwent phase changes, and that would probably lead to definable epochs of development.
- The earliest clumps and filaments would not tend to be centered on the largest local mass; on the contrary, they would be formed along lines of weakness (or cold spots) in the medium. If cooling only occurs when heat flows out, it stands to reason that some of the largest early clumps (hottest spots) will be right next to the coldest spots, on the extreme edges of filaments, because the energy that left the cold spot had to flow somewhere nearby, and it had to have an effect on the place it went to.

Compare and contrast this with the observational data and with the Big Bang Model.

- The cosmic microwave background is the earliest signal we can see, and it already shows the structure of filaments and voids that dominates the cosmos to this day, but the voids were relatively smaller in the past. This is exactly as expected from the soap bubble analogy.
- The Big Bang necessarily entails a highly diffuse state after inflation, and then gravity causes clumping of matter which leads to the formation of stars.
  - This takes a certain amount of time that has to be fit into the model before the formation of stars or even the CMB, and it requires dark matter to provide the gravity.
  - The initially small state and outward expansion of the Big Bang also implies some kind of center, the absence of which requires an explanation, entailing additional theoretical machinery and assumptions.

  - Neither scenario gives a straightforward or timely path to any structure like the cosmic web that we see from the beginning.
- The earliest stars and galaxy clusters are too big and too lumpy and too early to be formed on the timeline expected in the Big Bang.
  - The first stars are so young and so large that it is difficult to find enough mass and gravity and time in the theory to form them.
  - If gravity did it, the galaxies and clusters should be centered on masses, which they are not.
  - If something else moved the gases into clumps that then generated the gravity that led to stars, then we need another force, but that force can't be allowed do anything else in the theory that would change what we see.
  - We are corralled into a necessary sequence of events--stars should almost always form after galaxies in a gravitationally-driven model.
- In the proposed model, on the other hand, we would expect very early formation of big, lumpy structures and stars largely because gravity does not play any significant role in the evolution of the early universe.

Similar arguments carry over to expectations for the size and timing of early supermassive black holes and quasars.

We can also contrast the two models on their predictions for the age of the universe.
- The Big Bang Model allows us to estimate the age of the universe using the cosmic microwave background on the one hand, or (Cepheid) supernova data on the other. These two estimates are in conflict, and some estimates based on the supernova data make the universe younger than some of the stars it contains.
- The proposed model can use exactly the same methodologies for placing an age on the universe, but the data would have to be adjusted for the shrinkage of objects over time.
  - Supernova data (from our current era, more or less) will necessarily make it look like everything is moving faster than it did in the past because everything is smaller than it used to be. Therefore, this data should be corrected by reducing the apparent speed of expansion by a factor derived from the increase in gravity over time.
  - CMB data, on the flip side, will be much less affected by deepening gravity wells. If the CMB really comes from the very beginning, there had not yet been any time for gravity wells to form or deepen when it was emitted.
  - CMB data could be affected by intervening gravity wells that formed/deepened in the meantime, but the effects would probably be mostly random.
- In other words, the two estimates should be brought into neat alignment by the inclusion of steadily strengthening gravity, if this theory is correct.

Testable prediction: If we take the factor needed to account for increasing gravity in the dark energy and dark matter regimes, and apply that factor to the ratio of the CMB-derived age of the universe to the SN1A-derived age, that will bring the two ages into exact agreement.

So far, we have changed one presupposition about gravity, and that forced us to flip the Big Bang on its head, but otherwise we have preserved and even strengthened the postulates of general relativity. We have also imported by stipulation, in almost or completely unaltered form, all the observational data and mathematical underpinnings of physics.

That's a lot of hand-waving. You will have noticed that I didn't do any math yet; I've just made assertions and claimed the existing math and solutions can be applied. That should be true, if I really did only change one thing about G, but it has to be proven.

Speaking of G, we have to come up with a different name for it in the proposed model--it can't be a constant. Similarly, the Hubble constant would not be a constant, either. These values might be called factors or ratios.

Testable prediction: The variation in the Hubble constant derived from CMB data vs. SN1A data implies that the value increases by about 0.7% per billion years, if the CMB is taken as the starting point and the age of the universe is 14 billion years. That would also mean that the strength of gravity (for relativity isolated objects (see galaxy clusters and lensing above) would increase by about 0.7% per billion years. That would come out to about:

- 4.64 X 10^(-13) m^3/(kg/s^2) of increase in G in the last billion years, versus
- 4.25 X 10^(-13) m^3/(kg/s^2) of increase in G in the first billion years, or
- averaging to about 4.4 X 10^(-22) m^3/(kg/s^2) of increase in G per year over the life of the universe.

(Finally, a little math! But I did it wrong--at the least, the rate of change should be adjusted for the reduced deflation rate that is implied by a balloon-with-constant-aperture model.)

Despite the speculative nature of this model, there are at least two good reasons to keep going. One is that the mechanisms of the proposed model do not call for any phenomena that have not been detected, let alone those that in principle cannot be detected. Another reason is that the expected outcomes of the proposed model, at least the initial sketch of what those predictions should be, are much more in line with actual observations.

What we haven't addressed yet is that question that no one else has ever answered: What is gravity? Newton refused to say what the force of gravity really was. Einstein reduced it to a pseudo-force due to the curvature of spacetime. Unfortunately, spacetime couldn't be a real thing, according to Michelson and Morley, so the curvature of that thing did not actually explain how it constrained the motion of real objects. And here, as well, we keep talking about it, and relying on it to do things, but we have not said how it works.

In this model, gravity doesn't really need to exist as a distinct force. So far we have thermodynamics and self-interaction driving all the motion and evolution from initial conditions. Objects are flung about and then they collide, but that is all because of the equivalent of surface tension followed by inertia. The claims we've made about initial conditions are very weak—energy density is at maximum, energy flows are chaotic, a phase change is possible if sufficient cooling occurs in some location, and there is no orientation or surface (no interior/exterior). Causality and relativity are inviolable. That's about it.

Wait, we missed a big one: All objects do shrink under the influence of gravity in this model. However, that is actually a special case; it only happens in regions that can be defined as “local.” We haven’t defined that yet, but it is hinted at in the way that galaxies and clusters and lensing objects behave “in isolation.” There is a clear path to define “local” as a distance at which some non-gravitational fundamental force can be understood to operate. The same force that is “like surface tension” in the early universe would be the prime candidate for making things (seem to) pull closer together in the later universe.

If the force we are dealing with is truly local, meaning it acts only between immediately adjacent objects, then gravity becomes the effect you see when two connected objects have never gotten disconnected by some external force. That is, if an object will only move when a force is applied, then two objects that are co-traveling will continue to do so until some force causes one of them to move away. This entails two things that imply a third:

- External energy is required to cause things to move apart, which is thus equivalent to getting hotter.
- If two things approach each other without any external input, they must give up energy, i.e., get cooler, in order to do so.
- Cooling is a precursor to condensation, therefore shrinkage of objects on gravitational timescales is equivalent to condensation due to cooling.

The most common way that objects give up energy to their environment is by the emission of photons. In fact, every kind of object we have discussed so far is one that emits a lot of photons. Here, all of these objects are posited to shrink slowly but steadily over time as they emit photons prodigiously and steadily. If cooling is a loss of energy, and shrinkage is one result of cooling, then the emission of photons must act as a cooling mechanism that leads to the very gradual shrinkage of objects.

(The evaporation analogy could also work, with photons being the equivalent of water leaving the raisins, but that implies a substance that fills things and a place for it to evaporate to. The cooling model brings less intuitive baggage.)

This implies that photons are the inverse of gravitons. Anything that takes in a net positive amount of photons will get hotter and larger, and anything that loses photons on net will get cooler and denser (denser in terms of mass per volume, not energy--need two different word for two different kinds of density. Balloon analogy and inflated/deflated?).

> Total side note: This aligns with the functioning principle of solar sails and points to the question of the mass of the photon. A photon has the effect of pushing on an object, but this could just be the release of the pull that was coming from that direction.

This also means that the densest (greatest mass per volume) objects must be the coldest objects. Black holes would necessarily have strong correlations with thermodynamics and entropy, as discovered by Hawking and Bekenstein, because they would have to be defined as "cold;" they would have to lie at the opposite end of the spectrum from the initial state of maximum density, i.e., maximum energy content. They would necessarily be black because they have reached a state where they are incapable of giving up any more photons; that is, they have no ability to shed energy into their environment because everything around them is hotter to the point that entropy prevents outward energy flow. Gravity is a side effect of a black hole, not a cause.

- This implies you could reverse a black hole by heating it up with enough photons, say, a high-power laser (which presumably would have to be the size of a quasar).

An unspoken item in this discussion has been the place and role of zero in the model. By saying that gravity wells can always get deeper without limit, we are essentially removing zero from this model of the universe. You can use zero for bookkeeping, but it is an unphysical quantity. You cannot physically have nothing of something, in that you cannot use the verb “have” to accurately or sensibly describe your physical situation. You can only use “have” to describe a counterfactual situation where there is a something to be had, something you imagine or hope for. Zero is a memory, a frustrated expectation, not a quantity of things in the real world. You can save a seat for a friend who maybe never shows up, but a rock cannot hold a place for the other rock that used to be under it. A squirrel can look for the nuts it buried, perhaps even find them, but no nut has ever been able to look for a squirrel.

For purposes of calculation, all equations in this model would have to be stated in terms of ratios, not zeroes. "x-y=0" becomes a nonsensical proposition, but "x=y" is allowed, with the understanding that both x and y must be real things, and no thing can ever be nothing.

This model would thus rule out the possibility of singularities. In every instance where you use a zero in an equation, you are necessarily talking about an unreal thing. Rather than saying "the identity is zero," you are saying "there is nothing here, so there is no identity to be had."

Black holes could not be singularities, but they would not need to be. The notion of zero volume is not outlawed; it is obviated. So long as an object has energy to give up to its environment, it can cool and condense relative to its environment. Relative to itself, it stays the same size. That is, the Planck length is also relative in this model, becoming the local minimum length. This implies that in the early universe, the Planck length was the width of the universe because there were no distinguishable states or locations.

Gravitons per se also can't exist because that would mean allowing a zero in the model. That is, you can give up a photon, but you can't send an invoice for one. If looked at from an information/network theory standpoint, the shining of a star is the equivalent of broadcasting the news that it has given up some of the energy that it had bound within it. As a result, it is relaying the information that its component parts have changed configuration and become more dense (in terms of mass, not energy).

If the relaying of this information is tied to causality, and strict adjacency is in effect, then this leads to gravitational waves. Eventually. Circuitous discussion follows.

Two connected objects share the very relationship of being connected; that shared relationship is part of their relationship with the rest of the universe. If all relationships must remain true at all times (in keeping with causality), then any change to one relationship must be accompanied by simultaneous changes to all related relationships. Then "connected" and "simultaneous" and "related" must be defined. Let "connected" mean that two objects are exchanging energy, let "related" mean connected by strict adjacency, and let "simultaneous" mean affecting all strictly adjacent connections at the same time. If A is connected to B and C, then A:B and A:C must change at the same time, or neither can change. That means the change cannot happen unless there is enough energy available to change both at once.

This means that the more connected an object is, the more energy it will take to change its state. In other words, we have just set an effective speed limit for the propagation of any change by directly relating it to the energy content of the object undergoing the change. The highest density (by mass) objects are the coldest, which equates to the coldest objects being the most interconnected (number of strictly adjacent internal relations that are distinct). More connections means it will take the distribution of more energy to more specific places in order to allow a change to occur.

One could equate the rate of change propagation to time if the speed of energy flow is fixed, but that requires an arbitrary/unexplained value for that fixed speed and the (possibly hidden) machinery of time to enforce it. Alternatively, the rate of propagation could be reduced to probability. Say you have chaotic energy flows, so there is an equal chance of energy flowing to or from all spots in your system. If a specific set of spots reach a specific energy level at the same time, that will cause a change in the configuration of the spots and the energy they hold; but if any one condition fails, the whole change fails, like a lock with a sticky tumbler or a broken pin. Now add some energy and wait some units of Planck time, and that specific configuration of energy will probably occur. When all the bits of energy happen to be in the right places at the same time, all the connections are released to the new configuration. Now the rate of propagation of a given change in state is limited by the average number of iterations needed to achieve the prerequisite conditions by chance. If measured in Planck units, that amount of time will be a range around the average. A wide range of values will seem the same to us because Planck time is so short, but the range will not be very wide if the probability distribution is normal. In other words, should expect the time for an event to occur to seem the same to us, even though it is slightly different in every instance.

Fewer relationships to maintain independently means fewer connections, a higher overall energy state, and greater ease or speed of making changes. If the initial state of the universe had all points at maximum energy, then no two points could be differentiated. Thus, there was only one relationship to be tracked, which can be equated with having only one dimension. If so, then dimensions would be able to develop only as differentiable relationships arose, but causality and relativity are needed to force that development. That is, if it makes no difference which path or set of steps were taken to reach a given state, then relativity tells us that we cannot assign the notion of "true" to either path. The only thing that can define a relationship is the relative state of the things in the system. Therefore, it is circular to claim there are more dimensions if no additional relationships can be defined.

Once you do have more relationships than you can capture with one dimension, you will quickly fill up two dimensions and have to move to three. Let relationships be represented as distance across a surface. As soon as the relationships reach a certain complexity (relationships of relationships, second order), it becomes impossible to keep them all distinct while staying within the plane. You can call it a manifold and let the surface have bumps and curves, but that's really hiding the third dimension with math.

Causality finally takes over when you can't make do with three dimensions anymore. If a certain state could only be achieved by passing through another state, and that state could only be achieved under some other specific conditions, you have a chain of causality, a necessary sequencing of events. Let multiple necessary sequences of events interact, and you get to relationships of necessary sequences of relationships, which we will call third order. At this point, in order to keep causality and relativity and everything else true through every step from initial conditions to now, you need a fourth dimension. And that's how Father Time met Mother Nature.

In this view, the first three dimensions of this model fit into the familiar three-dimensional spatial framework because those relationships can all be equated to adjacency, or to distance in space, or to energy gradient, or to distance in number of steps to get from one state to another. None of those notions is in necessary conflict with the others; you can be three steps away and five degrees hotter, and so on. Time as the fourth dimension is necessarily different from the first three because it is forced to exist by the appearance of third-order relationships. Once you need to know what had to precede this state, and what cannot possibly follow, you are talking about things that are not real at this time. You cannot be three steps away and eight steps away on the same line; one of those things might have been true before or could become true later, but at least one is false right now. Time is the set of counterfactual states (configurations of things in the familiar three spatial dimensions) that must hold true.

- We track time in memory and imagination, but in this model time has to exist independently of humans or consciousness. It's about the states of things, not about us.

The question of the arrow of time is unavoidable. If time has a necessary direction, the model must address why. In this model, we have already referred to zero as unphysical, an artifact of memory. In the same way, we must differentiate our experience of time from the thing described in this theory.

You can remember yesterday but not tomorrow, and no one else has ever remembered tomorrow; therefore we know time goes in only one direction. That is too strong a claim. Really, we can only say that no one has remembered time going the other way. If we take the state of our brains as part of the state of the universe, then if time ran perfectly backwards it would necessarily erase our memories. By definition, if it failed to erase the memory, then it would not have run in perfect reverse. Thus, all we can claim about the arrow of time is that we cannot prove that it does not run backwards, but we would not expect to be able to remember it.

Prediction, not very testable: This theory allows the experience of deja vu to be an instance of time reversal being remembered. In this view, the partial memories that are not erased are such that they cannot affect causality--you only realize after the fact that the event seems familiar, therefore you cannot do anything to change it before the fact.

Back to gravity waves. If we are saying gravity doesn't exist per se and the way we experience time is not equal to the physical dimension of time, then the fact that gravity waves have been detected might be a problem. However, what we see when detecting gravity waves is a change in the interference pattern of two light beams.

- Above, we claimed that photons are the broadcasting of information about the shedding of energy by a system, and that the propagation of that broadcast must proceed by strict adjacency.
- Also, the state of a given relationship between any pair of objects is a part of the relationship of that pair with the rest of the universe.
  - Therefore, if a pair of objects undergoes a change of state, that change affects the relationship of that pair with everything else, and that information must be propagated by strict adjacency.
- Remembering that we can't send an invoice for a photon, we must look for ways that such changes would affect other photons indirectly.
- If photons travel along geodesics of spacetime, and spacetime is necessarily defined by the configuration of objects at the time, then the exact path of a given photon between A and B will be changed by any change in relationships over at C.
- If A is closer to C than B is, then the change in relationships at C will reach A before B, affecting the geodesics at A.
- A will then send its photons along a slightly different geodesic, while B will keep its old geodesic.
- Slightly later, the change at C will reach B, and B will now start sending photons along geodesics defined by the same conditions that A sees.
- In that moment after the news of the change reaches A but before it gets to B, A and B will transmit different information to each other.
- The blip in the interference pattern is the result when the two streams of information drop out of alignment, then snap back into agreement about the state of things.
  - This means there will always be a slight lag between the gravity wave passing through and its detection.

- The time it takes for light to travel from A to the point of interference determines when the blip starts.
- The additional time it takes for the change to reach B, plus the time for the light from B to reach the interference point, determines when the blip stops.
- The differential should give direction and declination above or below the plane containing A and B. If spacetime were flat, A and B would form a line, but that line is embedded in a gravity well, which makes AB into an arc segment, so it effectively reduces to a plane when you look outward.

In this interpretation, light and gravity waves move at the same speed because the emission of light is the broadcasting of information about changes in state, and gravity is the sum of the states being transmitted.That is, gravity waves are just an observed effect on the path of light due to the flow of energy; they don't actually move in their own right. Conversely, a gravity wave will necessarily reach you before the light from that source can because the light has to follow the path being defined by the changing landscape. Finally, the blip will only be able to occur after the gravity wave has passed through the location where it is detected because the wave had to reach one arm of the detector first in order for you to see any signal, the location where the blip is detected will necessarily be between the two arms, and the second arm has to send a signal back.

So if A is on the direct line between B and C, the two light beams are at 90 degrees, and A and B are equidistant from the intersection point, then the start of the blip will be delayed by the time it takes light to travel from A to the intersection of the beams. Let that be one unit of time. The wave will reach B (the square root of 2) units of time later, and then B will send its new information down its own, one-unit-long arm of the detector. Therefore, the blip in the interference pattern will start one unit of time after the wave hits A, and it will end (the square root of 2) units of time later. Adjust the blip length for angle of C above or below plane holding AB.

So far we have equated time and gravity on large scales with the interactions of thermodynamics, causality, and a strict locality. Moreover, the time we experience is reduced to an artifact of our memory of prior states, while the time that is a thing in the model is the probability that you will have to wait X number of iterations for chaotic energy flows to create a state that causes a change. In other words, both time and gravity become functions of chaotic energy flows and probability. That pushes us firmly into quantum territory.

There are outstanding problems that would motivate a review of the Standard Model by qualified scientists. The first problem that confronts us when looking at the intersection of cosmology of quantum mechanics is the lack of antimatter. The second is the vacuum catastrophe. Both of these could be artifacts of the construction of the theory.

(The zeroth problem is that not only am I not qualified, but I know even less about quantum mechanics than I do about gravity, and most of that was learned by falling down. I am venturing into this area only to address the questions that are unavoidable when trying to build a self-consistent description of gravity emerging from energy flows. Nevertheless, it is the existence of these outstanding problems that creates the opening for any discussion, so I really can’t avoid them. Apologies in advance to everyone who knows anything.)

In the Big Bang, all particles should have have been created in matter/antimatter pairs, according to quantum mechanics. Nowadays, there is plenty of matter around, but no one can find any antimatter, so we need to explain where all the antimatter went. The vacuum catastrophe is called that (that's the official name) because it is the worst scientific prediction ever. The theory requires that particles be constantly created and destroyed in pairs from the vacuum at a certain rate; since they have non-zero mass or energy, these particles should generate gravity; but the observed gravity in the universe is 120 orders of magnitude less than predicted by quantum mechanics.

The requirement that particles be created in pairs is a part of the theory, and embedded in it is the presupposition of particles. Among the observational data supporting the theory is the double slit experiment. In the original experiment, a single light source was shone through a pair of slits on to a screen, and that produced an interference pattern that looked just like the crossing waves that result when you drop two stones in a pond.

- Therefore light must be a wave, and it must interfere with itself when you split it into two narrowly separated beams.

Later, physicists figured out how to use very low light sources, and then how to emit a single electron at a time. The experiment was run again, and this time only a single spot appeared on the screen, just as though a particle shot through like a bullet.

- Therefore light must be a particle.

But if you run the experiment one photon or electron at a time and shine the light on to a photographic plate or electronic sensor, the original interference pattern builds up over time, as though the particles are interfering with each other like waves (even though they are not traveling simultaneously).

- Therefore, photons and electrons must be particles and waves at the same time.

There are at least two claims here that may be too strong: A thing that looks like a wave must be a wave, and a thing that looks like a particle must be a particle. If either of those identities is not necessarily true, then the conclusion that photons are both is less solid. If we want to challenge any such theory, though, we have to find an alternative that fits all the facts.

If energy flows are chaotic in the proposed model, and photons are bits of energy, then photons must travel chaotically. We must define chaotic in this context. Here we mean that a photon emitted in a given direction will probably go straight in that same direction until it hits something, but it could be deflected at any point on its path and end up somewhere that is not in a straight line (i.e., it will obey inertia and equal reaction, but spacetime will be changing underfoot). This implies that the destination of a single photon will probably be directly in front of the emitter, and that the probability of landing somewhere else decreases with the distance from the expected destination. The distribution of probable landing points in such a scenario will be a smoothly fading circle centered on the most likely point (straight line from emitter).

In the double slit experiment, the light source is effectively forced to act as two light sources. The marginal distribution of two independent variables forms not a circle but a smoothly fading oval, with the long axis defined by the distance between the two points. If it stopped there, then the double slit experiment should produce a nice oval on the screen, but it does not. We see light and dark bars, therefore light is interpreted as a wave.

However, the light is not emitted from the slits, it is only filtered by them. The probability distribution from the source is still a circle, but most of the possible results have been ruled out before the light can reach the screen.

- The possible results for slit A are what's left after subtracting most possibilities; and the subtraction is heavily biased against the areas to either side of the slit. The same holds true for slit B.
- Overlapping the two patterns might still produce an oval, but it might not.

- If the distance between the slits is a certain ratio to the distance from the emitter and the distance to the screen, then every other possibility from A is made less likely, and every other possibility from B is made less likely.
- If those two distributions overlap in a constructive way, then you will see a wave interference pattern resulting from the parts of the joint distribution that have not been subtracted.

Sorry, that's just my impression of math again, but it is plausible enough for me to claim this mechanism could produce the results of the original double slit experiment. I believe that this amounts to a weaker claim than the standard interpretation--"I see something that looks like a wave, therefore it must be a wave" sounds to me like affirming the consequent.

If it is possible to produce an interference pattern strictly from chaotic energy flows that are filtered in a structured way, then light might not be a wave. And so far, we also do not have very hard evidence that it is a particle. In the later double slit experiments, what we see is a bright spot on the screen where each photon or electron hits. This is human language; we are interpreting what we see with "real-world" analogues. It is not necessarily true that something "hits" the screen, or that that location is even "a spot." Again, if we are going to challenge these presuppositions, we must provide a plausible alternative.

To this point, we have posited chaotic energy flows (as defined above) proceeding according to thermodynamic laws and probability. This model has "objects," but we have yet to specify what that means. The only thing we have really put a name to is photons, but even that is larded with linguistic baggage. Note that we also talked about gravity and gravity waves, even while arguing that they don't exist as things in their own right. The use of commonly understood words is shorthand, not science. So we have to be clearer about what a photon might be in this model.

The only "thing" in our theory so far is energy that flows back and forth, and we have specifically equated photons with chaotic energy flows that follow a probability distribution. Before that, we equated the emission of photons with the shedding of energy from a system, akin to heat flowing from hot to cold reservoirs. A simple option would be to say that a photon is a particle that carries the energy shed by one system to another system. However, we are right now asking if particles have to exist in the theory, so saying a photon is a particle is again too strong a claim; it begs the question we are trying to discuss. A weaker claim, and the simplest option, then, is to say that what we see when we we see a photon is just evidence that energy has passed through or into a region.

If we say a photon is the visible trace of energy passing through/into a given location, and we stop there, then we are begging the question again. We have to say what that energy is, how it passes, what it travels through, etc.

The initial state of the universe in this model was the hot dense state that condensed when enough energy flowed out of some place to such a degree that a phase change occurred at that spot and space was created. There was no space or time before that, nothing for energy to flow through or around; the chaotic accumulation and dispersal of energy itself created the differentiation of states that led to the appearance of space and then dimensions. All of these proceeded purely according to chaotic principles and the probability of changes of state occurring.

Thus, at any point after the beginning, we will have places for energy to flow to and from. We have said energy can only flow to strictly adjacent places, and we still have the concept of geodesics out there. If we go back to the balloons on a ruler, we can imagine stuffing those balloons into a box, so that they are forced to fill the entire volume. Now we can posit that space, and therefore the geodesics along which light must travel, is equivalent to the interface between the surfaces of the balloons.

To get a model big enough for this discussion, let the two balloons in a box be hundreds of rubber balls in a ball pit, all squished together so there is no air between them. (Some balls might be cubes, others could look like soccer balls, but the tendency toward equilibrium in any given ball will tend to make every ball into a more or less regular shape.) Let energy flow only between the surfaces of the balls. If one ball is about to give up some energy, and that energy has an equal chance of flowing to any adjacent ball, and there are more balls in contact on one side than the other, then probability dictates there will be a greater chance of the energy flowing toward the side with more contacts (in the direction where there are more places to go to). Under these conditions, the net energy flow will tend to be in the direction of the greatest local mass. A geodesic will be the path that both obeys strict adjacency and reaches the destination in the fewest possible steps.

As energy flows, we cannot rule out that it might encounter obstructions; it could be absorbed by an object along the way or it could be reflected.

- As we know that some materials are transparent to some wavelengths of light but not others (sunlight and glass versus X-rays and flesh), we have to allow that the materials that act as absorbers or reflectors will vary with the type and frequency of the energy.
- We also should not assume perfection in any process, so we will say that in every instance some energy is absorbed and some is reflected; the value of “some” has to be non-zero in this model, but we don’t know more than that a priori.
- Any object that absorbs some energy will thereby gain a slightly higher energy state. That may change its configuration with other relationships, and that change must be propagated.
- Thermodynamics dictates that the object will tend to give up some energy if it is hotter than its surroundings. Therefore every time energy is absorbed, there is a good chance that some energy will be re-emitted shortly thereafter.
  - Again, “some” is simply non-zero, and it is also not necessarily equal to the originally absorbed energy. The amount re-emitted will depend on the relative state of things at that moment in that location.

Already we can see that it was too simplistic to say that photons "are" the cooling of an object or "are" the broadcast of information about that object's relationships. Photons, if taken as simply packets of energy, are necessarily involved in both processes. Moreover, we can observe that photons are radiated in a sphere by any hot object; there is not just one photon emitted in most events. Any photon that reaches our retina must be a small subset of the total energy emitted or reflected. Thus, a single photon could be regarded as the minimum energy needed to convey information about changes of state in relationships that are removed from us by any number of steps.

Getting back to that ball pit, we had the balls exchanging energy, and now we have some small part of that energy being reflected or absorbed and re-emitted. In effect, the photons that reach us are leakage from the energy-exchange event itself. The total energy involved in the originating event must have been greater in proportion to the number of objects involved and their original energy state, to the cube of the distance (because of spherical emission), and to the opacity of the intervening medium.

Any further details along these lines of description/speculation will require hard data. Let us hold here with a conceptual description of objects exchanging energy in a chaotic and leaky way, but with tendencies to flow (1) from hot to cold and (2) toward the direction of more mass. We can now address the necessary question of what those objects are, and how they exchange energy.

Again, we said above that the only "thing" in the model so far is energy. If we do not add something new, then the objects must be energy fields, whose strength and size is related to the total energy they contain.

- As the only objects, these fields must be the only thing that defines the shape of spacetime in this model.
- The chaotic flow of energy causes some energy fields to be more or less energetic than the surroundings. This differentiation of localities is the cause of the emergence of space and dimensions.
- Thus, the very possibility of energy flows leads to the probability that places will develop for energy to flow to, our version of the Big Bang.

That's either pure relativism or entirely circular. Assuming it can hold water, we have energy fields involved in one-to-one exchanges of energy, and some of that energy leaks out to the surrounding fields in the form of photons. Can we finally say anything for or against particles in this model?

If we take the "spot" where a photon "hits" as the locus of the energy exchange, then that spot would be point of contact between the two fields where the energy is absorbed/re-emitted or reflected. That location itself is not a thing, but just the interface between two fields that are differentiated in some way. Each field would necessarily take turns becoming more then less energetic--thermodynamics states that energy will tend to flow from hot to cold, so the moment one side gains energy, it will tend to give up energy to the other side. The photon that reaches us is the bit of energy that leaked in our direction; in the later double-slit experiments, it would be the energy absorbed by the photographic plate or collector and recorded thereon. The "thing" we see, in this model, is just the photon reaching us from the location where energy was exchanged.

In all of this, the energy fields come closest to being something that could be described as a particle. However, as fields of energy, they have more characteristics and possible states than would be easily described by a thing you could properly call a particle. Rather than reifying fields into a new structure that describes their overall behavior in a given circumstance, it is better to say they are just fields, with all the structure and complexity that implies, and allow fields to carry out mutual exchanges of parts of themselves. However, it should be okay to use "particle" as a shorthand description of a field that is exhibiting certain behaviors; otherwise we'll never manage to finish saying anything. In this context, every particle is really a quasi-particle, a collection of more or less stable characteristics that we define, but which is not the totality of the thing or set of things that have those characteristics.

Again, assuming any of that made sense, we may have arrived at a model that does not require waves or particles. Instead, we could get the results of double-slit experiment, both the light and dark bars of the interference pattern and the individual dots on the screen, from the gradual accumulation of individual energy exchanges that are strictly chaotic, adjacent, and probabilistic.

If that is the case, then there is nothing in this model to imply that energy is created or destroyed at any time; the only energy we have posited is the amount present in the initial state, which is subsequently exchanged back and forth, and we have no mechanisms to produce or consume any of it. Barring evidence to the contrary, the total energy never changes, it just moves around.

Going back to the antimatter problem, if particles are really just quasi-particles that describe sets of characteristics of energy exchanges, that undermines the quantum mechanical requirement that particles are always created in pairs with their antiparticle counterparts. The exchange of energy between two places only tends to occur when there is an imbalance; therefore, we cannot require every exchange to be balanced, or we remove the very motivation for the exchange. Moreover, we have a balancing mechanism built in by virtue of the fact that the resulting state will have new (relatively) hot and cold reservoirs, which means the flow of energy will then proceed according to the same thermodynamic principles as before. It will not necessarily return to its previous state, but it will be balanced somehow by a subsequent energy flow.

Similarly, the vacuum catastrophe is a consequence of the requirement in the theory that virtual particle/antiparticle pairs constantly be being created and destroyed from the vacuum. If "particle" is only a description we apply to some relationship between energy fields, then there would be no possibility of creating or destroying particles. They would exist when there are fields that stand in a relationship; they would not exist when there are no such fields or when two fields are not related. If it is true that energy cannot be created or destroyed, only moved, then no particles could come into existence from the vacuum, as that would require energy to come from nowhere. In this model, particles can only reflect the current state of the energy that was present initially.

We have explained almost one (1) of the phenomena that are covered by that field of inquiry. Nevertheless, we had to say that much about the energy flows in order to make anything like a coherent claim that such flows could lead to gravity.

Before getting back to gravity, though, we will be stupidly audacious enough to make another observation and a prediction about the quantum world. If it is correct that the initial state with the highest energy was also the epoch with the fewest dimensions, and that more dimensions arise as a result of causality and ever-increasing differentiation of states, then the universe will develop more dimensions as it continues to cool, its parts condense, and everything gets farther apart in spacetime. A question that has a seemingly arbitrary answer right now is, why are there only three generations of particles in the Standard Model? If the number of generations were determined by the orders of possible relationships between objects, and if time is considered the fourth dimension that arose together with third-order relationships, then we should expect there to be only three generations until such time as a fourth-order relationships arise.

Testable prediction: In this model, each order of relationships of states develops as the concentration of energy goes down, not up. Therefore, we would look for a fourth generation of particles at lower energy levels, not higher (look below electron, not above Higgs).

Finally, we are ready to link gravity to energy flows.

- Because spacetime is defined by the presence of matter and energy (and we are apparently holding that matter is nothing more than condensed energy fields), the effect of energy passing through a region will necessarily be to change the shape of that spacetime during that passage.
- If we take the ball pit as a representation of the model, and if we say that a ball will get bigger if it has more energy, then the transfer of energy from one ball to the next will cause each ball to inflate and deflate slightly.

- As energy flows from one side of the ball pit to the other, we can picture its passage like a snake eating a meal; but in this case, the snake is buried in sand (the other balls) that must be displaced along the way to allow the snake's stomach to expand at each point along its length.

- If it were a real snake, we would expect a few grains of sand to go back to exactly where they started, but many others would shift to slightly new positions. Similarly, the fields that are affected by the passage of energy from one place to another should be jostled about slightly; the probability that they would go back to exactly their original configuration goes down with every set of relationships that is involved.
- If there is any bias in the sum of forces in a region, the new configuration will be affected to some degree by that bias.
- The strongest claim we could make is that all forces are perfectly balanced at some arbitrary place or time. Therefore, we should assume that not all forces are balanced, and thus there is some bias in the outcome of the new configuration of spacetime.
- Wherever we can observe systems under the influence of subtle bias to one side or the other, we see a tendency toward rotation, as when water goes down a drain.
- In the proposed model, this kind of rotation would occur every time energy flowed through a location.
  - Let the initial state have one ball in contact with four others.
  - Energy flows from the first ball to one of the other four. This causes the first ball to shrink and the other one to expand.
  - The change in sizes causes all of the balls to shift position slightly, as their surfaces stay in contact.
  - If there is any biasing force acting on the system, all the balls will tend to settle in the direction of that force.
  - When the energy leaves the second ball, all the balls will again shift position slightly, and again they will tend to shift in the direction of the biasing force.
  - Let the flow of energy proceed through many iterations; the next time, it will probably flow through a different ball, and through yet another the time after that.
  - If the biasing force is not moving around, then the whole system of balls will tend to constantly reorient itself in the direction of that force.

In other words, the equivalent of drag and turbulence will produce a corkscrew motion in any set of fields that experiences an energy flow while under the influence of some unbalanced force. As perfect balance is unlikely, we predict that such corkscrew rearrangement of fields will be the norm. The relation of energy fields defines spacetime, therefore the passage of energy rearranges spacetime, therefore energy flows will tend to cause the affected fields to rotate around the axis of energy flow. Thermodynamics says that energy will tend to flow wherever there is an imbalance of hot and cold or high and low. If we continue to hold that perfect balance is the least likely state, we must assume that energy is constantly flowing back and forth in small amounts between all adjacent objects. This flow will create corkscrew motions, and the balance of the resulting forces will tend to pull objects toward each other even as they exchange the smallest units of energy. The balance of the balances of such forces will tend to pull objects toward the largest local mass. So maybe we have a thing we can call gravity after all; but it is still a pattern of effects that emerges from a more primitive, chaotic process. In this model, a vortex is a result of suction, not other way around.

The same mechanism could explain magnetism if we allow some materials to change the shape of spacetime according to not just their presence, but also their internal structure. If the crystals of a metal are such that they make it easier for energy to flow in one direction than the other, that will create a bias toward that kind of energy flow in that place. If two crystals of the same material are in close proximity, they will both affect the shape of spacetime. If they do so constructively, they will set up a preference for energy exchanges that flow in one direction much more often than any other; if destructively, they will tend to prevent the flow of energy along that direction. Placed next to each other, two such crystals would either attract or repel each other, depending on their orientation.

This also implies that magnetism is directly due to constant energy flows, which means that materials will lose magnetism when they are unable to exchange energy, i.e., at absolute zero.

(This probably also has ramifications for superconductivity. if magnetism is a result of a form of drag, and that drag arises wherever there is sufficient flow of energy, then superconductivity could only occur where such flows cannot occur. However, the free flow of energy under superconductivity will tend to set up the conditions for the type of energy flows that lead to drag. Perhaps a time crystal setup could be used to overcome this problem--energy flows freely through part of it, but that flow changes that part, but the change there causes some other part to become a free-flow zone, and that cycle keeps repeating.)

Possible states of pairs of non-zero relationships

On	On	On	On
On	On	On	Off
On	On	Off	On
On	Off	On	On
Off	On	On	On
On	Off	On	Off
On	Off	Off	On
Off	On	On	Off
Off	On	Off	On

This is nine, versus the eight relationships mediated by gluons.

If this model is refined in the future, it would make sense to derive more principles from primitives. For example, inertia and causality might be derived from a strict application of locality, thermodynamics, chaos, and probability in a system where the only "thing" is energy in various configurations.

Also for future, calculate total energy from portion of energy that was reflected and re-emitted. That is, if the photon reached you, how energetic did the original event have to be?