Qualitative Analysis of the Metric Expansion of Space

Joe Charlier
Aepryus Software
developer of the Universe
denting iOS app
Oovium

PREFACE

"Do not keep saying to yourself, if you can possibly avoid it, 'But how can it be like that?' because you will get 'down the drain,' into a blind alley from which nobody has yet escaped." - Richard Feynman

Since graduating with a B.A. in Physics from the University of Chicago in 1994, it has been my intention to one day make sense of the unintuitive aspects of modern Physics; namely the laws of Special Relativity, General Relativity and Quantum Mechanics. Until March 21, 2013, I was unaware there was a 4th unintuitive aspect of Physics.

On that day researchers for the Planck cosmology probe released data that the probe had acquired. Through news stories relating the event, I became aware of the Metric Expansion of Space; the notion that distant objects are receding from one another, not just because of their inertial momentum, but because the space between them itself is expanding.

This paper is a result of thought experiments motivated by a desire to make sense of that Metric Expansion of Space, combined with my ambient desire to make sense of the other three unintuitive aspects of modern Physics.

METRIC EXPANSION OF SPACE

In 1927, Georges Lemaître derived what would become known as Hubble's law, which is the observation that all objects in space are receding from Earth and

from each other and that the rate of the recession of any two objects is proportional to the distance between them.

$$v = H_0D$$

Where v is the rate of recession, H_0 is the Hubble constant and D is the distance between the objects. This notion was based on the observation that light coming from distant objects always exhibited a redshift. It is important to note that this expansion is not because of the inertial motion of the two objects, but rather is in addition to their inertial motion. In an effort to make sense of this, let's consider the following thought experiment:

Take an entirely empty universe and place two tennis balls in the same inertial frame 1 Mpc apart.
- Are the two tennis balls getting further apart?
- Do the two tennis balls remain in the same inertial frame?

The aforementioned Planck cosmology probe recently measured the Hubble constant H_0 to be equal to 67.8 (km/s)/Mpc. Mpc is a megaparsec which is equal to about 3,260,000 light-years. The nearest galaxy to our Milky Way galaxy, Andromeda, is about 0.78 Mpc's away.

Normally the phrase, 'same inertial frame' is a way of stipulating that there is no relative motion between some set of objects. But, here a paradox seems to arise; Hubble's law says the tennis balls will be moving away from one another at 67.8 km/s, meaning there is relative motion between the two objects.

Does that imply that there is some force acting on them; that the Metric Expansion of Space acts as an ambient force on all things pulling them away from one another?

Let's modify our experiment slightly. Let's provide a switch that allows us to turn on and off the expansion of the universe instantly. Let's begin our experiment with the switch in the off position. We place the two tennis balls 1 Mpc apart with no relative motion. This is a fairly simple system, there is no motion, no momentum and the distance between the two tennis balls remains constant.

Now, we flip the switch, instantly turning the expansion on. The two tennis balls immediately start receding from one another at 67.8 km/s. But, have we applied a force to the tennis balls? Do the tennis balls now have momentum?

Before we attempt to answer that lets now flip the switch back to the off position. We stop the expansion instantly. Do we now assume that the tennis balls stop receding from one another? Or do we assume that the tennis balls continue their relative velocity indefinitely?

One aspect of expansion that may give us some guidance on this question is that although Special Relativity tell us that one can not travel faster than the speed of light there is no such limitation on the expansion of the universe. Using Hubble's law we can calculate the following (converting H_0 to meters; c is the speed of light):

$$v = H_0 D$$
$$c = 67{,}800\ D$$
$$D = c / 67{,}800 \approx 4.42\ \text{Gpc}$$

Which tells us any two objects in space separated by distance greater than 4.42 Gpc (Gigaparsecs) will be receding from one another at a rate greater than c. From this we can argue that this expansion is not inertial in nature.

When we turn the expansion switch of our universe off the two tennis balls stop dead relative to one another. Throughout the experiment the tennis balls never had any momentum. Newton tell us that momentum is equal to the mass times the velocity ($p = mv$), but perhaps we should modify that equation a bit in order to account for Hubble's law:

$$p = m (v - H_0 D)$$

So, returning to our original question: are the tennis balls getting further apart? -- yes. Are the tennis balls remaining in the same inertial frame? -- yes, their relative momentum remains zero.

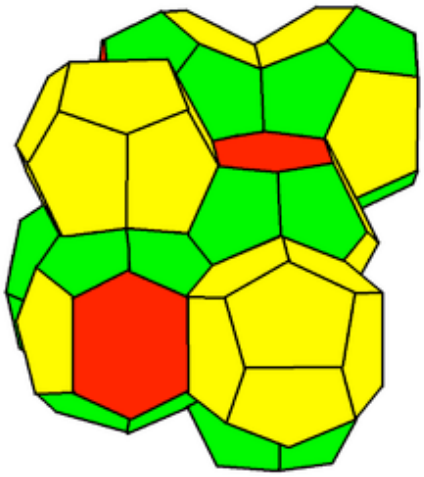
But, conceptually, how could this possibly be the case? How could something be moving further away and not have momentum?

Imagine a checkerboard; on the checkerboard we place two checkers on opposite ends of the board. We can count the number of spaces between the two checkers; 7 for instance. Now keeping the checkers stationary we modify the grid of the checkerboard making each of the squares smaller. For instance we could divide each square into 4 smaller squares. Now we count the number of spaces between the two checkers and its 14. Divide the spaces again and now there are 28 spaces between the two checkers.

In this way we have caused the "expansion" of the checkerboard without effecting the position of the checkers themselves. We have simply redefined distances as being the number of spaces between the checkers instead of our normal concept of distance.

However, there is another way we could perhaps accomplish this. Instead of making the spaces on the checkerboard smaller, let's (carefully) chop the checkerboard in half between the two checkers. Now, let's place a new checkerboard in the middle of the two halves of the old checkerboard. The checkers are now 15 spaces apart; their distance is further apart also, but at the same time neither checker has moved from it's original space. Rather than redefining the notion of distance, we could simply adjust our notion of momentum from being *distance* traveled per time to being *spaces* traveled per time.

This conceptualization is highly evocative of the idea that space itself is quantized. Let's posit that space itself is made of tiny cells upon which matter sits. Hubble's law could than be explained to simply be the result of the creation of new instances of these little cells, let's call them *vacuels*. The concept of momentum would no longer relate to matter's velocity, but rather to the rate at which matter moves across the vacuels.



Let's define a new dimension: vacuels traversed per time, denoted with the Japanese syllable ひ (hi, pronounced 'hee').

$$p = m\ ひ$$

Apparently, the concept that space is quantized is not entirely new. Max Planck calculated a fundamental unit of distance called the Planck length whose physical significance is not well understood.

$$\ell_p = \mathrm{sqrt}(\hbar G/c^3) \approx 1.616\ 199(97) \times 10^{-35}$$

As a working assumption let's assume that the vacuel is approximately the size of the Planck length.

CELLULAR AUTOMATA

"If everything when it occupies an equal space is at rest, and if that which is in locomotion is always occupying such a space at any moment, the flying arrow is therefore motionless." - Zeno

With the development of the computer and increasingly so as computers became ubiquitous, people began experimenting with a class of problems known as Cellular Automata.

The basic concept is that you divide some finite dimensional space into a number of discrete homogenous units called cells. Each of these cells is able to store state, which could be a simple on/off or could be any number of scalar and/or vector values.

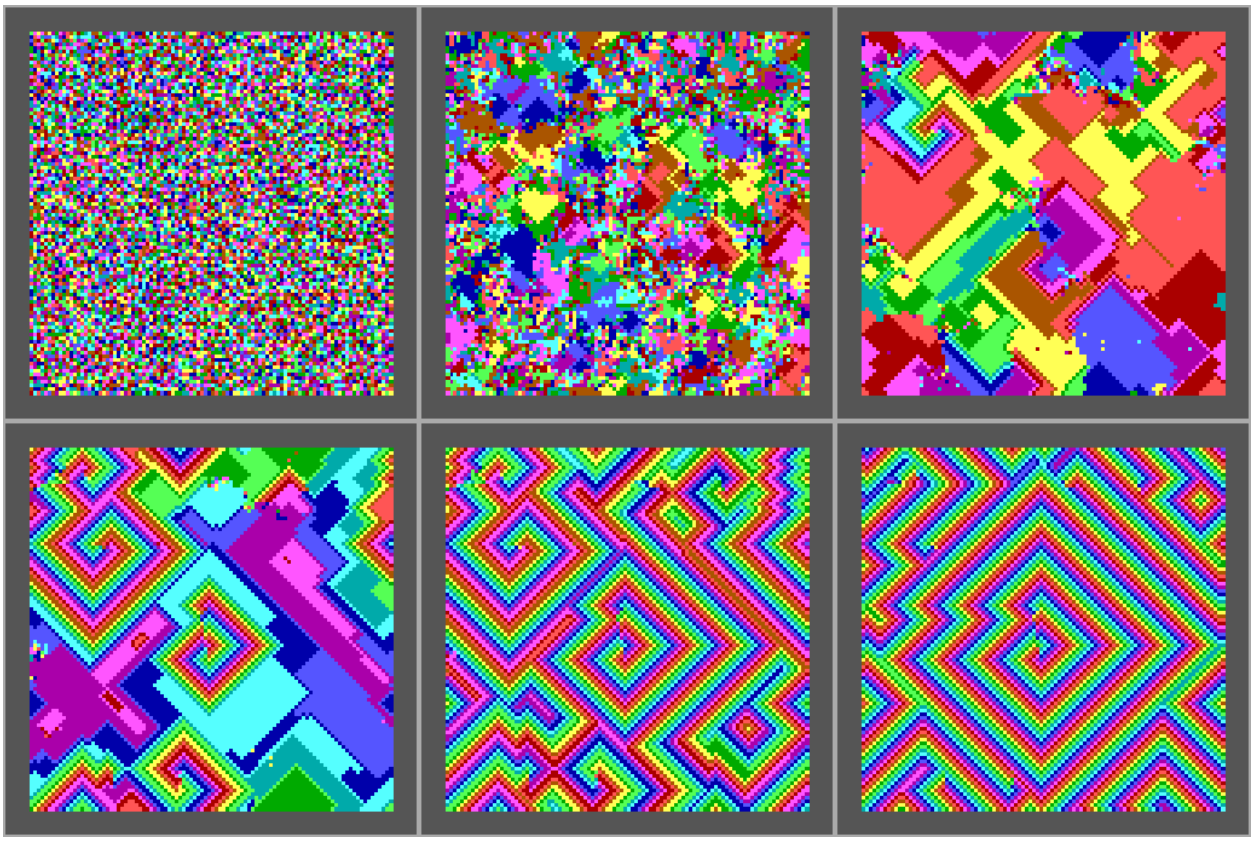
The system than progresses using a discrete concept of time called a time step. Inherent in the system is some static set of rules that dictate how the state of each cell progresses for each time step. This progression is a function of the current state of the cell and current state of each of the cell's neighbors.

One such system is called a Cyclic Cellular Automaton, developed by David Griffeath, a math professor at the University of Wisconsin - Madison. This system allows for an arbitrary number of dimensions, with each cell having a fixed number of possible states. Let's consider a 2-dimensional variant with 12 states.

A plane is divide into a square grid (like a checkerboard) with each space on the grid representing a cell. Each cell is randomly assigned one of 12 states; numbered 0 through 11. A neighbor is defined to be one of the 4 cells directly above, below or to the side of the cell.

The rule of the system is that any cell with state n, will 'capture' any neighbor cells that are of state n-1 (state 0 cells capture state 11 cells). A captured cell will take on the state of it's capturer. However, a capturer may, itself, be captured in the same time step, having its state changed also.

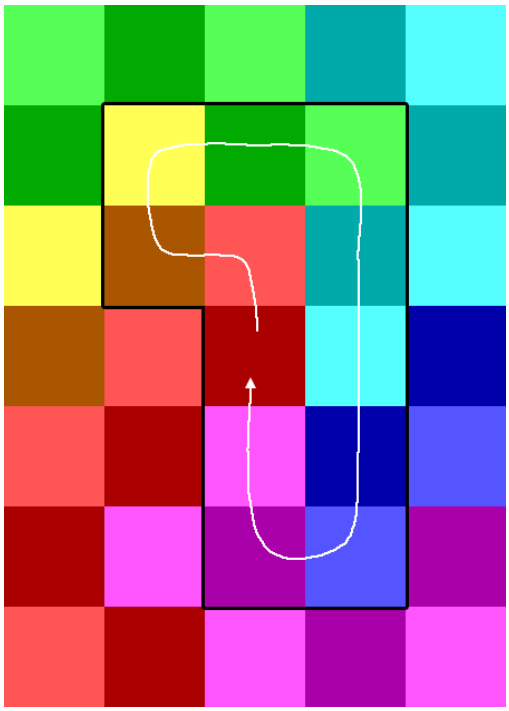
Each of the states is represented by a different color. We randomly seed the states of the cells to begin with and then let the system progress until it achieves a steady state.



Initially, the system starts out with a rather uniform distribution of noise. Eventually little fiefdoms of state begin to develop creating splotches of solid areas throughout the system that grow over time. Then something interesting happens: a loop gets created of some length that contains all 12 states. These loops are called 'demons'. The length of a demon's loop is the number of cells contained in the loop which can be as little as 12, one for each state. The number of time steps it takes a demon to do a full rotation of its loop will be equal to the number of cells contained in the loop.

These demons will eventually crowd out the single state fiefdoms and dominate the entire board. However, the system will not have achieved steady state yet. The shorter a demon's loop is, the quicker it will be able to expand its area of influence. A demon with a 12 cell loop will be able to rotate through each of its states in 12 time steps. A demon with a 14 cell loop will rotate in 14 steps. This will allow the 12 cell demons to eat away at the less efficient demons, eventually destroying them.

Usually, at least one or more 12 cell demons will appear as it did in the above instance. The system will achieve stead state once the 12 cell demons finish eating up their slower competitors. At that point all cells on the board will get captured each time step.



Previously, I asked that we posit that space itself, is made up of little tiny cell *upon which matter sits*. Now, we have a conceptual framework to discuss what is perhaps meant by the phrase 'upon which matter sits.'

At times matter has exhibited properties consistent with the idea that it is made up of particles. At other times matter has exhibited properties consistent with the idea that it is a wave. Perhaps what matter actually is, is a relatively stable state loop.

If we posit that space is made up of tiny vacuels; we can also posit that each of these vacuels is capable of maintaining state. If a vacuel's change in state is a function of the vacuel's current state and the current state of its adjacent vacuels then stable state loops could arise as we have previously seen with Cyclic Cellular Automaton. These relatively stable state loops could be the basis of what we consider to be matter.

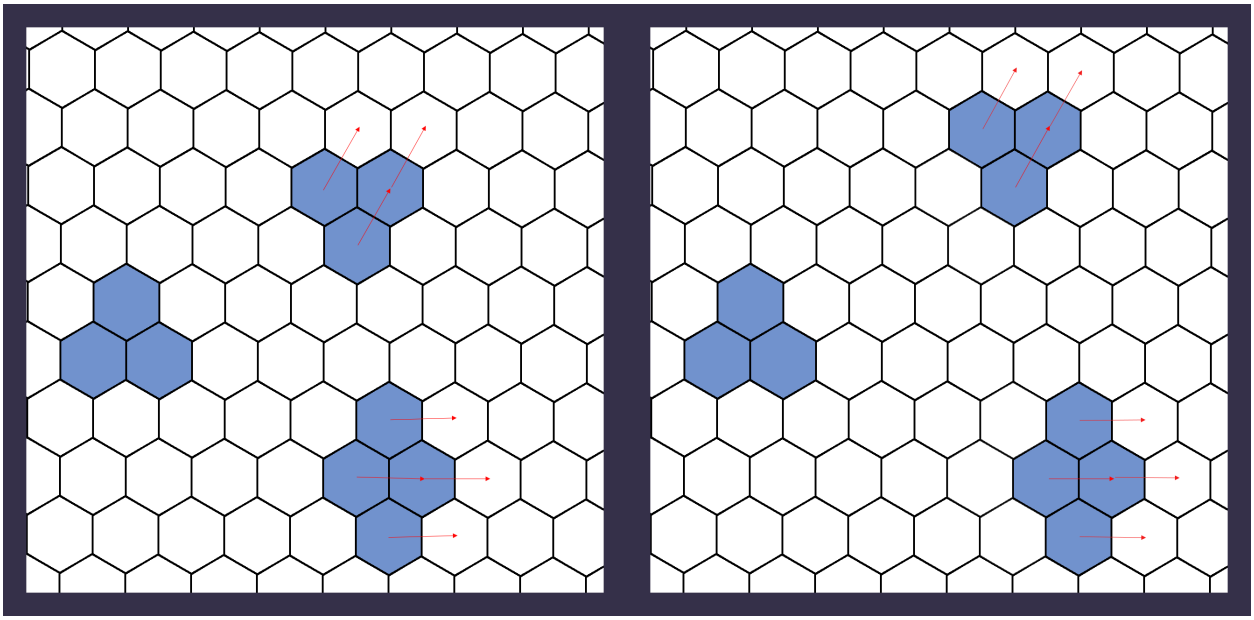
Now of course unlike the demons in our Cyclic Cellular Automaton, matter actually moves. It is perhaps important then to develop a conceptual framework to figure out how motion would be possible with such a system.

Mathematicians use the term 'translate' to describe the shifting of an object across a space. In order for this state loop model to be an accurate representation of our universe, there would need to be a mechanism that would allow a state loop to translate across the vacuel field.

Let's create a new Cellular Automaton, that is a 2-dimensional space tiled, this time, with hexagons. Each cell, this time will have two variables of state. One will be a simple binary on / off switch; the other will be a vector, which will either be length 0 or 1 and if 1 will point in the direction of one of the 6 sides of the hexagon.

The rule will be this: If a cell is on and it's vector is 0 then it will remain on and the vector will remain 0. If an adjacent cell is on and it's vector is pointing to the cell, then the cell will be turned/left on and it's vector will be set to the adjacent cell's vector. (for completeness sake let's say if multiple adjacent cells point to the cell, than the cell just turns off). In all other cases, the cell turns off and it's vector is set to 0.

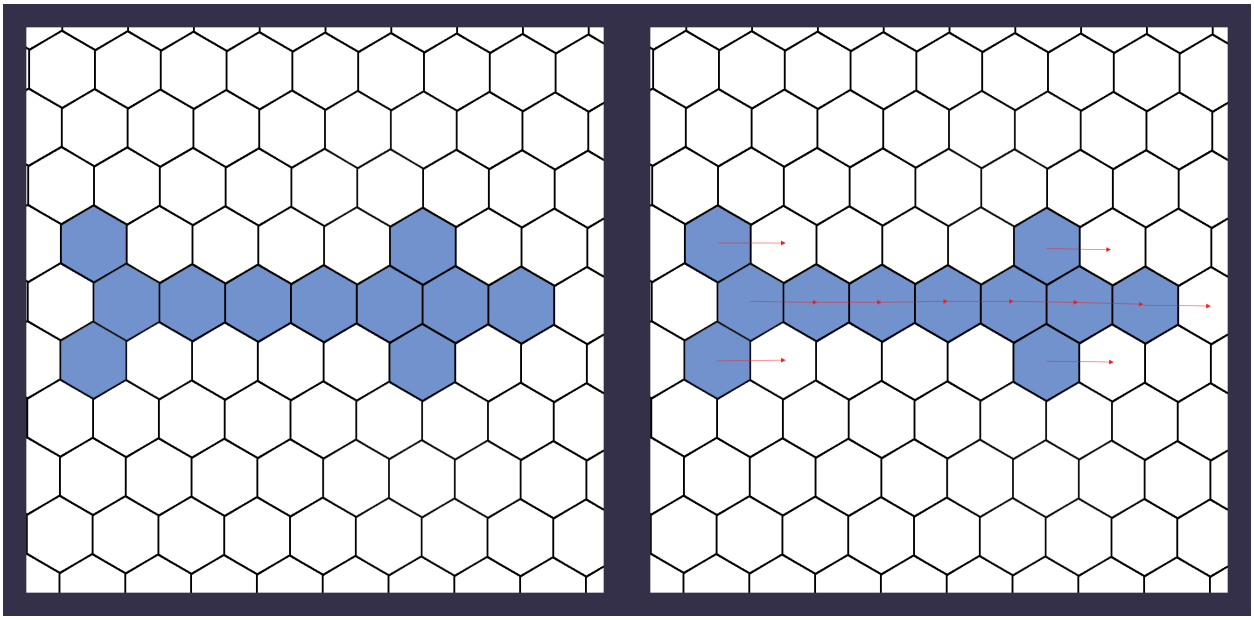
Let's look at a time step of a simple instance of this automaton:



In this system we have three 'particles'. The particle on the left has 0 length vector states and so remains stationary. The particle in the upper right has vector states pointing up and to the right, so it's pattern translates up and to the right in the next time step while passing its vector states on to its new cells.

Similarly the particle on the bottom right's vector are pointing to the right, so it translates one step to the right also maintaining its vector states.

For the sake of Zeno, let's do one more example:



Now in this case, I'm not looking at the progression of a single system, but rather comparing a single time step of two separate systems.

Currently, this model is explicitly displaying the vector states. But, one could imagine a new version that doesn't bother to display the vector states (such as in nature). In such a case, looking at a single time step of the two systems it is impossible to differentiate the two. However, just because the systems are indistinguishable to the eye does not mean that they are indistinct.

To solve Zeno's paradox we must simply note that although in a single instant the momentum state is not visible to the eye, it does not mean that the momentum state does not exist and it doesn't mean that it is not different in the two systems described.

SPECIAL RELATIVITY

So, perhaps, it's possible to create some little toy algorithms that are able to model exceptionally simple behavior. But, what does that have to do with all the subtlety, all the craziness, all the magic that is the universe? For example, how would one even begin to try to replicate some of the phenomena demonstrated by Special Relativity using Cellular Automata?

Actually, rather then being a difficulty, perhaps Special Relativity is a direct consequence of Cellular Automata.

Previously, we have posited that space is populated by vacuels. These vacuels contain state and perhaps among those state variables is a momentum vector that allows matter to translate across the vacuel field. Let's further assume that each vacuel has a finite number of adjacent vacuels (perhaps 12 or 14 for example, if the geometry matched the Weaire–Phelan structure.) and let's assume that each vacuel only communicates with its adjacent vacuels.

Special Relativity says that nothing can go faster than the speed of light; how could vacuels explain that?

One would imagine that there would be some time delay from the moment that a vacuel received a signal to the time that it took to pass that signal on. Previously, we have guessed that the size of the vacuel is equal to the Planck length. Using the Planck length and c, the speed of light, it should be possible to calculate that delay.

$$t_P = \ell_P / c = 1.6162 \times 10^{-35} / 299{,}792{,}458 = 5.3911 \times 10^{-44}$$

Here again, we can see Max Planck's footsteps have arrived ahead of us. This is a known quantity called the Planck time. For our purposes, let's call this unit of time a *tic*.

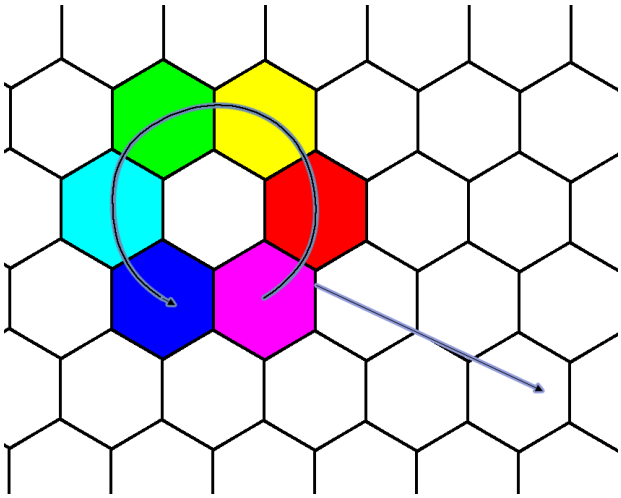
Now all of a sudden, a fundamental value of the universe, the speed of light goes from being the seemingly arbitrary 299,792,458 meters per second, to

instead being the intuitive, one vacuel per tic. And the explanation for why nothing can travel faster than the speed of light becomes rather trivial.

But, of course, Special Relativity, says more than just you can't go faster than the speed of light. It says that particles without mass, will move at the speed of light and particles with mass, will move slower than the speed of light.

But, I think here again our Cellular Automata are instructive of why that might be. Our second automaton with momentum vectors might be reasonable representation of the photon. Whatever vacuel states that make up the photon it seems that the state propagation moves in a straight line that allows / requires the photon to translate across the vacuel field at one vacuel per tic.

Particles with mass however, might be better represented by our Cyclic automaton. The rotational aspect of the state loop requires that the particle moves less than 1 vacuel per tic. Which is to say that it is not possible for the entire state loop to translate a full vacuel in a single tic.



For example, let's say that a particle is the result of a state loop. In this case we have a particle that is made up of the states of 6 vacuels. The magenta vacuel state transfers to the red vacuel, the red state to the yellow, yellow to the green, green to the cyan, cyan to the blue and the blue back to magenta. If while the the particle is dealing with it's own rotation it is also moving across the vacuel field, then some states while rotating are moving with the translation while others are moving against it.

Thus, if this particle were moving across the vacuel field at one vacuel per tic. The states moving against the translating motion of the particle would be moving slower than one vacuel per tic and the states moving with the translation would need to move faster than one vacuel per tic.

This would violate the principle that the new state of each vacuel must only depend on the vacuel itself and its directly adjacent neighbors.

Perhaps, this is what truly differentiates a particle with mass with one without. A particle with mass has a cyclic state loop while a massless particle has a straight line state "loop".

For photons we know this to be the case. The photon is a slinky'esk progression of electric and magnetic fields in a straight line.

Time Dilation

But, what about time dilation? How could time dilation possibly come into play and if it did how would vacuels explain the mechanism? I suspect the interpretation of time dilation to perhaps be slightly off.

When time is dilating what is actually happening? How do we actually measure time? In all cases our measurement of time is simply observing the time it takes some physical system to move. Whether that physical system is a clock or the biological aging process, we are ultimately not really measuring time, but rather measuring the motion of a physical system.

So, rather than describing this phenomenon as time dilation perhaps it would be more accurate to describe it as the 'alacrity coefficient'; the rate at which physics works.

Potentially in our example of a particle that is both rotating through its various states and moving at the same time there is a point when the rate of the translating motion starts to interfere with the ability of the particle to progress through its state loop.

As the translating motion gets faster and faster relative to a static vacuel field it doesn't have time to deal with it's own internal looping. In this case, clocks and biological systems all start to slow their rate of animation. Their 'alacrity coefficient' gets closer and closer to 0 as their translating motion gets closer and closer to one vacuel per tic.

Let's use the Japanese syllable あ (a, pronounced ah) to represent the alacrity coefficient. For a system that is stationary on a vacuel field time is moving at full speed and in that case あ=1. As the translation of a system gets closer and closer to one vacuel per tic, the rate at which the animation occurs slows down, so あ moves towards 0, but never reaches 0. For a system translating against a vacuel field, a second will take longer, such that:

$$s' = s / あ$$

where s' is the true duration of one perceived second in the translating frame of reference.

The Twin Paradox Resolved

The twin paradox is a thought experiment where a pair of twins on Earth are separated. One twin stays on Earth while the other twin travels very rapidly (near the speed of light) to Alpha Centauri and back.

Using the Lorentz calculations by plugging in the the traveling twins velocity, say 0.9c. One finds that one twin has aged more than the other. However, the Lorentz equations should work equally well for either twin since the basic premise of Special Relativity is that there are no special frame of reference. And as such, it isn't clear which of the twins should have aged quicker.

One of the solutions put forth for the twin paradox is that the twin that traveled to Alpha Centauri was the one that felt the inertial acceleration therefore he is the one that would be affected by the time dilation.

However, it is pretty easy to come up with a new thought experiment that torpedoes that explanation. Let's call it the Russian Nesting Doll Paradox:

Take an empty universe and a place a Russian Nesting Doll in it, sitting in an inertial frame. Open up doll A and remove doll B from inside. These nesting dolls have rockets attached (of course) and now doll B blasts off from doll A accelerating to close to the speed of light very rapidly (within less than a day for

example). Doll B is the one that has felt the inertial acceleration so its the doll experiencing the time dilation, not doll A. After the acceleration is complete doll B turns off it's rocket and floats through space; now, in it's own inertial frame.

At this point, we open up doll B and remove doll C. As before doll C blasts off again accelerating to close to the speed of light very rapidly. As before doll C is the doll that feels the inertial acceleration so it is the one that is experiencing the time dilation. So, time for C is moving slower than time for B and time for B is moving slower than time for A.

However, when doll C blasted off from B, it blasted off in the direction of doll A. And as a matter of fact it accelerated until it returned exactly to doll A's inertial frame. So, either doll A and doll C are now in the exact same inertial frame experiencing different time dilation or even though doll C was the one that experienced the inertial acceleration its time became faster than doll B not slower.

This of course creates the situation where when something accelerates you can't be sure which frame is going to experience the faster time and which will experience the slower time.

Up until this point this vacuel theory has theoretically dovetailed with existing physics. It hasn't disagreed with current beliefs it has simply created a different representation for what is going on.

However, now we have our first distinction. Vacuel theory says that there is, in fact, a special frame of reference. That time moves quickest, i.e., that alacrity coefficient, あ is 1 in any time frame that isn't translating against the vacuel field.

The velocity used in the Lorentz transformation should always be the velocity relative to the static vacuel field.

Time moves quickest when one isn't moving across the vacuel field. In order to figure out which twin will experience faster time or slower time, one must simply compare the twins' velocities relative to the vacuel field.

Calculating Ones Translation Across the Vacuel Field

Using this fact it is perhaps possible to determine what ones speed (vacuels per second) is relative to the vacuel field. As one's inertial frame increases in velocity relative to the vacuel field あ will decrease towards 0. However, the Planck time will remain constant.

If a test were created that enabled one to determine the number of gradients of a second of time in their frame, they should be able to determine what their velocity is relative to the vacuel field using the number of tics they measure during the duration of one of their own seconds.

GRAVITATION

"That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it." - Isaac Newton

Up until this point we have limited our discussion to basic kinematics. Let's move further afield and try our hand out on gravitation.

Our theory holds that space is made up of vacuels and that light travels at one vacuel per tic. But, almost instantly when considering gravitation a serious issue arrises.

Given the existence of black holes and the fact that light can't escape from them how could this possibly be reconciled with our vacuel theory. Even if gravity were warping the geometry of the vacuels, squeezing them into an increasingly dense configuration, there would still be a finite number of them and light would eventually be able to escape from the black hole.

One could perhaps imagine the vacuels flowing into the black hole at a rate greater than the speed of light in order to keep the light from escaping, but it would seem that very quickly the vacuel density inside the black hole would get untenable. It would seem our vacuels are incompatible with black holes.

Unless somehow the black holes were destroying the vacuels. If the black hole were destroying the vacuels at a rate that required them to flow into the black hole faster than the speed of light, then light trying to translate across the vacuel field would never be able to escape. It would be like a jogger riding on treadmill thats speed is set too high.

But, what is it about a black hole that could be causing it to destroy vacuels? A black hole isn't magical; it's simply a large enough accumulation of mass in one spot that allows it to prevent light from escaping.

If a black hole isn't special, than perhaps stars also destroy vacuels; perhaps the Sun destroys vacuels; perhaps the Earth destroys vacuels; perhaps all mass destroys vacuels. Perhaps...

Mass destroys space.

And as such is there any need for a gravitational field any longer? The reason why gravitational mass and inertial mass seem the same is because they are the same. It is the exact same phenomenon. In both cases they simply represent an object's resistance to being accelerated against a flow of vacuels.

There is no such thing as a gravitational field. Newton was correct to be uncomfortable with the notion of "action at a distance." Masses are not attracted to one another. Two masses only appear so because both of them are destroying the space between each other which is drawing them closer together.

I'm not going to pretend to understand the Hierarchy problem, but at the same time, I'm pretty sure this resolves it.

A Tantalizingly Simple Test

No gravitational force means that gravity has no ability to effect the momentum state of a particle on the vacuel field; the apparent gravitational force being simply an illusion caused by the tugging on the vacuel field.

Imagine a table with a table cloth on it with plates and glasses on top. In the center of the table is a small hole. Someone goes below the table and starts to pull the table cloth through the hole. The plates and glasses and such will appear to be attracted to the center of the table as they move towards it, but really they are just going along for the ride.

Let's calculate the velocity of the vacuels passing into the Earth, at the Earth's surface. We take an empty universe and place the Earth in it. Arbitrarily far away we place a tennis ball. Both the Earth and the tennis ball are not translating across the vacuel field. The Earth will be destroying vacuels and as it is doing so drawing in the tennis ball. Since gravity is not capable of adding momentum to the tennis ball, the tennis ball will exactly follow the vacuels it is sitting on towards the Earth.

Meaning, the velocity of the tennis ball when it hits the Earth surface (ignoring the atmosphere which doesn't effect the motion of vacuels) will be exactly equal to the velocity of the vacuels at the surface.

The potential at infinity is 0. The potential at the Earth's surface is GM_eM_t/r_e. The kinetic energy of the tennis ball is $M_tv^2/2$. Which gives:

$$M_tv^2/2 = GM_eM_t/r_e$$
$$v = \text{sqrt}(2GM_e/r) \approx 11{,}187 \text{ m/s}$$

Our theory states that the speed of light is a limitation on the rate at which photons translate across a vacuel field. It places no restrictions on the motions of vacuels themselves.

Therefore, the speed of a photon traveling towards the Earth at the Earth's surface will be $c + 11{,}187 \approx 299{,}803{,}645$ m/s and the speed of a photon

traveling away from the Earth at the Earth's surface will be c - 11,187 ≈ 299,781,271 m/s.

I initially thought this would be a simple test, it turns out to be a shockingly troublesome test. To date, there is no such thing as a one way speed of light measurement, due to problems created in synchronizing the clocks.

However, the GPS system, itself, makes use of the speed of light in order to determine the distance a GPS unit is from a satellite which it can then use to determine the position by combining data from 4 or more satellites. One complication however, is that light is delayed in traveling through the atmosphere (especially the ionosphere) and that delay might actually be greater than seen, because it is being masked by this phenomena. In addition to the atmospheric adjustment's there are a number of other empirical fudge factors applied to the calculation.

The GPS satellites are about 15 x10^6 m above the Earth, at that point the speed of space would be about 6k m/s. The effect on a signal sent by the satellite would be greatest for one directly overhead falling off at cos(theta) (measured from the Earth's center). Potentially, this adjustment could be applied to the GPS calculations; if it showed itself to be able to improve the location calculation that might be a useful indicator that this theory holds merit.

One quick aside, I would argue that this situation is analogous to our first experiment in the beginning where we switch on and off the universe's expansion. The tennis ball, as it falls towards the Earth, is not gaining any momentum what-so-ever. If we were to be able to instantly delete the Earth, the motion of the tennis ball would stop dead. Well, it would stop dead relative to the vacuel field. Depending on the dynamics of the compressibility of the vacuels themselves it may jiggle back and forth a bit as the vacuel field deals with the jolt. Also, I assume that the vacuels get compressed as they are drawn towards the Earth. So, they would relax, which would cause the tennis ball to actually recede from (the former position of) the Earth, but the point still remains -- the tennis ball gains no momentum, that is, no ability to translate across the vacuel field, as it falls towards the Earth.

The Rate that Mass Destroys Space

In order to get an idea of the metrics of the phenomena let's calculate the rate at which mass destroys space. Let the Japanese syllable た represent the rate at which mass destroys space measured in $m^3/kg/s$. The flux into the Earth will be the surface area of the Earth times the speed of space at the surface:

$$た = 4\pi r_e^2[\text{sqrt}(2GM/r_e)]/M_e = m^2 \times m/s / kg = m^3/kg/s$$

$$た \approx 9.552 \times 10^{-7}\ m^3/kg/s$$

which is just a bit under one cubic centimeter per kilogram per second (it is a cube measuring .984 cm per edge.)

Ramifications on Newton's Law of Universal Gravitation

As it stands now, Newton's Law states:

$$F = GM_1M_2/r^2$$

But, as Galileo and the photon have previously so eloquently pointed out, that second mass factor is of dubious value. Beyond that, we are arguing that gravity is not a force, rather it is an ambient acceleration. Let's re-render it as such:

$$a = GM/r^2$$

Now, there is a certain tautological aspect to our belief in Newton's Law. It's not something easily tested. We calculate measurements of the "mass" of astronomical bodies, by watching their motion and plugging it into Newton's Law and then declare Newton's Law valid because it is able to predict the motion of the bodies.

In the lab we can attempt to measure the attraction of extremely dense weights and we can determine that that attraction is proportional to their mass, but here again all we are really doing is determining that the proportionality factor is proportional to mass under laboratory conditions.

Let's create a new dimension denoted with the Japanese syllable ま (ma, pronounced ma), which is the vacuel destruction coefficient of a body. Newton's Law now becomes:

$$a = G\ ま/r^2$$

Now, it may entirely be the case that ま=M, but let's, for a moment, consider the possibility that they might not be equal.

Our theory of matter is that everything is some sort of stable state progression of the vacuels; photons being a progression in a straight line, matter with mass being a progression in some sort of loop. There are 61 particles in the standard model. Each of these 61 particles will have a different type of state progression pattern.

It is possible that the state progression of each particle with mass destroys vacuels at a rate exactly proportional to its mass. However, I could also imagine that some of the mass particles' state progression involves vacuel destruction and some does not. I could also imagine that the number of vacuels destroyed during a single iteration of a loop was constant, such that the rate of vacuel destruction was a function of the particle's current alacrity coefficient, あ.

For example, perhaps vacuel destruction is the result of the Strong interaction only, and only occurs in protons and neutrons; and perhaps each destroy vacuels at a different rate. In this case, under laboratory conditions, the proportions of nucleons in an object will be proportional to that object's mass, while their alacrity coefficient あ will be basically constant, which allows mass to become a proxy for the destruction factor in the lab. But, that proportionality may break down at the cosmological scale. In this model where the Strong interaction is consuming vacuels as part of its progression, we have the following equation for ま.

$$ま = ま_p \sum_{i=0}^{P} あ_i + ま_n \sum_{i=0}^{N} あ_i$$

To reiterate, I'm not saying this is necessarily the case. There may, in fact, be some inherent reason why all particles with mass destroy vacuels proportional to their mass and independent of their animation factor. However, it's also believable that perhaps an electron, for instance, does not destroy vacuels. Or that the rate of vacuel destruction is effected by the alacrity coefficient.

Ultimately, when we measure the mass of some astronomical body using Newton's scale, we aren't really measuring the mass, we are measuring it's vacuel destruction coefficient.

It's not clear to me what the discrepancy is that cause people to posit the existence of Dark Matter. Given this theory, however, Dark Matter is simply an unaccounted for vacuel sink. If there is a discrepancy between ま and M, then Dark Matter may simply be that discrepancy.

An interesting experiment, which of course I would imagine would be exceedingly difficult to conduct would be to attempt to determine if an electron actually gravitational attracts other matter, which is to say whether an electron actual destroys vacuels. Perhaps a small variation in gravitational force would be possible to discern for a highly ionized sample.

OTHER TOPICS

Metric Expansion of Space Revisited

Given our new found insights, lets revisit the expansion of space. But first, let's go over a quick conceptually overview of the universe and define some terms.

The creation of vacuels has been described as the “expansion of the universe” or the “expansion of space”. But, the universe and space itself appear to be concepts separate from vacuels.

Let’s define the Universe as the sum total of everything we can observe and interact with; Space or Void as the 3 dimensional area of that universe. It is plane old ordinary space, no warping, no curving, just void. In deference to the Ancients lets refer to the vacuel cloud as the Aether.

The Universe is not expanding. Space is not expanding. Possibly the Aether is expanding. Well, we don’t know anything about the Universe or Space, so what I should say is that when people say the Universe is expanding or Space is expanding, what they actually mean is that the Aether is expanding. But, before we declare the Aether to be expanding, let’s explore that question a little more.

Let’s take a new universe, the void of this universe is an infinite tube with some radius r. We fill the tube with aether. We then place 2 stars each of vacuel destruction coefficient ま in the tube each with a radius a bit less than r. We give the stars just enough separation velocity v to escape each other’s gravitational pull.

As the stars move apart, the amount of vacuels between them is going to increase at a constant rate due to their motion, however the volume between them is going to expand at the exact same rate, so the net effect is neutral. At the same time each of the stars are going to be destroying vacuels at a rate of たま, half will be destroyed from outside of the stars, half from in between the stars.

This means over time the vacuel density between the two stars will continually drop. As the vacuel density in between the two stars decreases there will be a flow of vacuels around the edges of the stars from the outside to the inside in order to equalize the density.

That flow of vacuels in between the two stars will cause the “space” between the two stars to expand, therefore giving you the “expansion of space”.

However, nothing is really expanding. All that appears to be happening is that the Aether is flowing to fill the vacuel debt between the stars and it's not clear to me that you would need Dark Energy in order to explain that.

The next obvious question then is where do vacuels come from? Antimatter has mass, but as we have conjectured possibly ⱷ≠M. If the state loop of a proton destroys vacuels, perhaps the state loop of an antiproton creates vacuels. Giving antimatter a repulsive gravitational "force". In this way antimatter would never be able to form larger objects, because it would always be pushing away. Perhaps the universe is permeated with antimatter dust which continually produces vacuels.

One final note, I'm not sure how much of the Big Bang theory still relies on the "expansion of the universe", but this scenario would argue that no matter what the initial state of the universe was, distant objects would recess from one another and that the recession is caused by the aethereal flow due to vacuel pressure deficit between any two gravitational bodies that are receding from one another and not because of some ancient explosion.

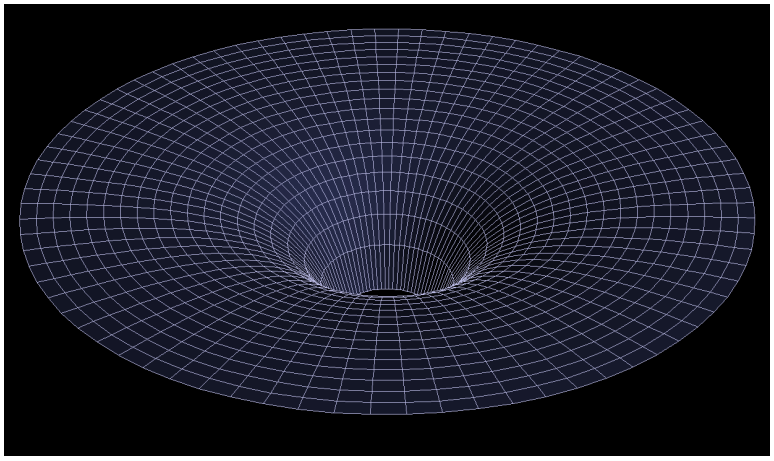
General Relativity

I haven't explicitly stated it, but implied in much of this analysis is the assumption that the theory and math behind General Relativity are describing the compaction of the vacuels as they flow towards their doom into a gravity well, as well as the decrease in the alacrity coefficient as the velocity of the vacuels increase.

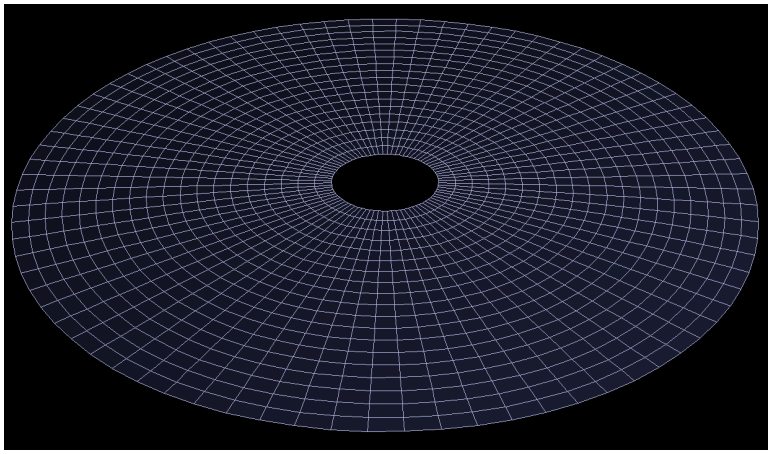
As the vacuels flow into the well, they get increasingly dense and their volume gets increasingly tiny. Since, momentum is not p=mv, but rather p=mϑ, those squished vacuels will have an effect on the motion of particles through the well, which, for example, is the additional bending of light that we see.

Often a picture such as this on the right is used to describe General Relativity's "warping of spacetime".

However, I think we can perhaps replace it with a much more accurate and descriptive picture entirely in 2D which shows the Aether's vacuels increasing density and decreasing area as they get drawn into the gravity source. Such an image of the "squeezing of the aether" will then be much easier to mentally extend to 3D.



Along these lines this concept really folds General Relativity into Special Relativity. For example, previously we calculated that the speed of vacuels flowing into the Earth at it's surface is equal to sqrt(2GM/r) ≈ 11,187 m/s.



The time dilation indicated by Special Relativity by the Lorentz factor is: 1/sqrt(1-v^2/c^2). If we plug in the vacuel speed this gives us our time dilation due to gravity as 1/sqrt(1-2GM/r/c^2).

In General Relativity this same problem is solved using the Schwarzchild metric. The calculation of the time dilation due to a non-rotating massive spherically-symmetric object is 1/sqrt(1-2GN/r/c^2); exactly as we had just calculated using special relativity and this vacuel theory.

Quantum Mechanics

Given the vacuel underpinning of the Aether, it perhaps, becomes rather trivial to explain the Heisenberg Principle and other such phenomena observed within Quantum Mechanics.

I'm not exactly sure, what the flaw in Bell's Theorem is but it seems that the flow of 2.37×10^{104} vacuels/m^3 of unknown geometry at 11,187 m/s through the

experiment apparatus is more than enough "unknown local variables" to account for the *statistical* variation in the results seen.

Perhaps, it's time to let God put his dice away. Perhaps, it's time to stop killing cats.

Faster Than Light Travel
Given this theory perhaps the restrictions of light speed aren't quite as strict as before. Certainly, nothing will be able to translate across a vacuel field faster than 1 vacuel per tic. However, the motion of vacuels themselves have no such restrictions. And as such, opens up the possibility for faster than light travel.

I can imagine two scenarios: Imagine humans set up a colony on Alpha Centauri 4 light years away. Traveling through the vacuel field and back takes a very long time (at least 8 years) even if you could create a ship that traveled at 0.99 c.

But, in order to facilitate travel between the two stars, the humans set up a vacuel stream that flows in an oval at an extremely fast rate between the two stars, say 4 c. Humans could than take a ship and move into the vacuel stream moving substantially less than c through the stream, but flowing along with the vacuels in order to arrive at Alpha Centauri in less than a year.

In another instance one could perhaps imagine a vacuel raft, that somehow is able to squeeze in between vacuels by slicing through the aether, allowing it to travel at arbitrarily fast speeds.

Additional Questions to Explore
- What are the fluid mechanics behind the Aether?

Since aether itself is not a manifestation of the vacuel state, it is not subject to the same rules and limitations as matter; Special Relativity doesn't apply. For example, in order to keep light trapped in a black hole vacuels *must* travel into the black hole faster than the speed of light.

So, what are the properties of this fluid, what is its viscosity and compressibility? Theoretically, it would be possible to create a compression wave in the aether,

what would that look like? I suspect measuring the various properties of this fluid would answer questions such as how fast does gravity travel?

If I suddenly pop a new star into existence one lightyear away from an existing star how long would it take for the existing star to start accelerating towards the new star? Depending on the parameters of the aethereal fluid, I'd imagine it could be pretty quick, perhaps even instantaneous.

- What are the dynamics of a vacuel itself?

What are all of the vacuel's state variables? A momentum vector? An electric field vector? A magnetic field vector? Color, Charge?

Looking at the 4 fundamental forces of nature. Gravity can move the vacuel and it can destroy the vacuel, but it can not effect the vacuel's state, so its out.

Perhaps, the Strong interaction is the main mechanism responsible for cyclic state loops that allow matter to exist. Figuring how the mechanism works and then determining each of the state loops for each of the relevant particles of the standard model seems like a doable task given all the data that those particle accelerators have collected over the years. I would hope that spin and the Pauli exclusion principle and other such behaviors would elegantly fall from the model.

I strongly suspect that the electromagnetic force alone is responsible for changes to the momentum vector. All motion, all translation across the vacuel field is only possible because of the electromagnetic force. And perhaps that is all the electromagnetic force does; it's sole job is to enable translation across the Aether; that is to say, to enable motion.

As for the Weak interaction, I have no intuition as to its role or purpose. Perhaps, it helps the Strong interaction; perhaps its just another aspect of the electromagnetic force. Or perhaps, its some sort of messenger between the two forces. A type of tendon that connects the Strong interaction with the electromagnetic force; the bone to the muscle.

CONCLUSION

When I first started learning about Math and Physics, I was continually struck by its beauty and magic. It was an amazing confluence of aesthetics and logic. The first time I saw the Lagrangian used to solve for the equations of motion, I just thought it was the most beautiful thing.

But, then Relativity and Quantum came along and all that beauty and logic shifted into dissonance and confusion. Van Gogh and Mozart had morphed into Stravinsky and Picasso. I just could never accept their vision of the universe.

I'm cognizant of the absurd, hubristic and preposterous nature of this entire document. And yet, the concepts just seem to snap into place. They just seem to fit. All that dissonance seems to diffuse away.