The Physical Cause of Quantum Gravity Due to Interactions with the Vacuum Energy

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Abstract:

This theory of Quantum Gravity will describe the physical process which causes the force of Gravity due to interactions between the Vacuum Energy and matter/energy in the universe. Mass/energy interacts with the quantum vacuum and create locally uneven distribution of the vacuum energy density. All mass and energy will be accelerated towards the area of the vacuum with a lower energy density. The acceleration will occur in discrete, quantized amounts due to statistical interactions with the vacuum energy while avoiding the near instantaneous collapse of the universe in to a singularity most theories involving vacuum energy predict. This theory predicts the acceleration due to gravity, proper value of G, gravitational lensing of light, and time dilation within this quantized gravitational field.

Introduction:

We decided to tackle the current belief of the quantum vacuum and how it affects the world. We are attempting to find a proper solution to quantum gravity, and how it leads to the perceived normal gravity, as it seems that no reasonably complete solution has been found in the 100+ year search for the answer. We have a theory that may explain a lot of quantum gravity questions, which is what is shown below in the rest of this paper.

A good way to start this is an explanation of how we first thought of this theory. We were playing around with some Planck size black holes (mathematically) and we started to try putting photon pressure into the universe. We figured out that the pressure required to create force the same as gravity, needs a massive amount of photon pressure. The required pressure calculated was the same as the pressure of the vacuum energy theorized many years ago: 10^{113} joules/meters^3. So then we decided to try using bigger black holes and we found that if we compensated for the lower density, the correct gravity was also predicted. We then tested for normal mass and found that the correct value of gravity was predicted. We then tested with photons and found that it caused gravitational lensing. The wavelength of light becomes smaller and smaller as It becomes closer to the black hole. This shows that our theory is consistent with general relativity.

The core of this concept is that gravity is simply pressure from a high energy field;

$$F(Gravity) = E_{field} * Area\ of\ R_1 * (Blocked\ Ratio) * (Density\ Correction\ factor)$$

Which equates to:

$$F = \left(\frac{E_{field} * Ap * G}{c^4}\right) * \left(\frac{M_1 * M_2 * G}{D^2}\right)$$

If $\left(\frac{E_{field}*Ap*G}{c^4}\right) = 1$, then this simplifies to $F = \frac{M_1 M_2 G}{D^2}$

The Vacuum Energy field is assumed to come from all directions at an extremely high energy density and place a pressure on any mass/energy similar to photon pressure. As shown in Figure 2, most pressure of the field has no net effect as it is canceled by an equivalent pressure on the opposite side of the mass. The only net effect is the partial void between the 2 masses. This area is not the same as the Casimir effect of excluded wavelengths; this is an area of lower energy due to absorption and emission in a random direction. The field is assumed to not immediately fill back in must originate from outside the local region with a maximum speed of C.

For normal mass, a very small amount of this field is absorbed and reemitted with the amount proportional to the cross sectional area normal to the direction of the field and proportional to the density of the mass. For a Planck size black hole, total absorption would occur, and therefore for simplicity of the equation any mass of less density, a correction for density needs to be applied.

You would need a massive amount of field strength due to the field mostly canceling itself out due to the geometric structure proposed in this paper to create the gravitational pressure. The massless particles come from *The Field*, which is giant; 10^113. If 2 black holes are next to each other because of massless particle pressure they will move together because there are less massless particles in between the black holes .

Discussion:

For the purpose of this paper, a few things will need to be assumed.

1. A) The observable universe is filled with a high energy field, which has an energy density of 4.63068 * 10^{113} joules/meters^3. This will be called *The Field*. (woah)
   B) A non-uniform density can be formed when the field interacts with waves or particles.
2. A maximal density sphere (Planck size black hole) has an energy density of 4.63068 * 10^{113} joules/meters^3.
3. Any object with a density less than the maximal density can be corrected in any equations used to calculate maximal density objects with a number known as the

'density correction factor'. (Honestly, it's a lot easier to calculate with a known value than use many different numbers)

4. *Ap* is the cross-sectional area of a maximal density sized sphere to generate the density correction factor. With maximal density meaning equal to energy density of *The Field*.
5. We will be using the term spheres for the objects that will be calculated. These spheres are assumed to be maximal density. One would be able to substitute the spheres with maximal density black holes, and the math would work out exactly the same. (Just saying)

Here are a few equations that will need to be known to go along with this:

- $r = \frac{2GM}{c^2}$ (This is for calculating the radius of the sphere, where *M* is the mass of the sphere and *R* is the radius)
- $V = \frac{4}{3}\pi r^3$ (This is simple geometry for calculating the volume of a sphere, where *V* is the volume, and *r* is the radius of the sphere)
- $A = \pi r^2$ (Again, simple geometry for calculating the area of a circle, where *A* is the area and *r* is the radius of the circle)
- $A = 4\pi r^2$ (Simple geometry for calculating the area of a sphere, where *A* is the area and *r* is the radius of the sphere)
- $F = \frac{M_1 M_2 G}{D^2}$ (This is a standard equation of gravitational force)

The properties of our field are stated as follows:

1. Standard Mass and Energy interacts/absorbs the energy field with a probability proportional to the Energy/mass
2. Objects that absorb the Energy Field will always emit it back in a random direction
3. The Energy Field produces no drag on moving particles due to thermal equilibrium
4. This field does not have a high probability with interacting with itself.
5. Again, it has a very high Energy Density, of $4.63068 * 10^{113}$ joules/meters^3
6. It has a relatively uniform Energy Density within our observable regions of space
7. Any energy emitted will be converted when considering that the field interaction and the particle that is interacting with it are a closed system
8. Local Regions of space will have a non-uniform Energy Density in the presence of standard matter and energy

9. The field is the quantum vacuum field predicted by application of Heisenberg's Uncertainty Principle

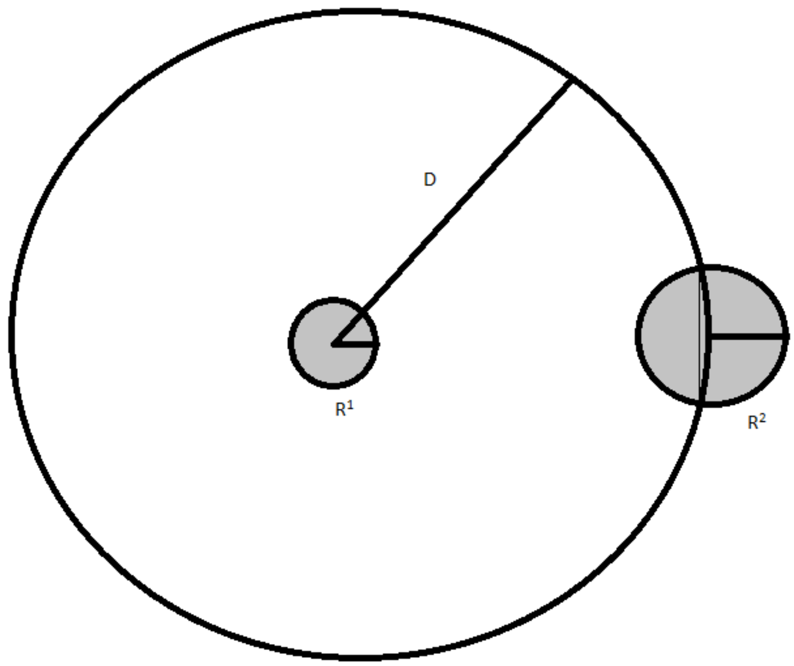

Figure #1

This diagram shows 2 spheres, and the relationship in distance between them. We are currently assuming they are fully dense, but if in any equation they will not be, a density correction factor can be inserted into the equation. *D* is the distance between the centers of each sphere. The thin line shown is a representation of a 2-D circle for simpler calculations.

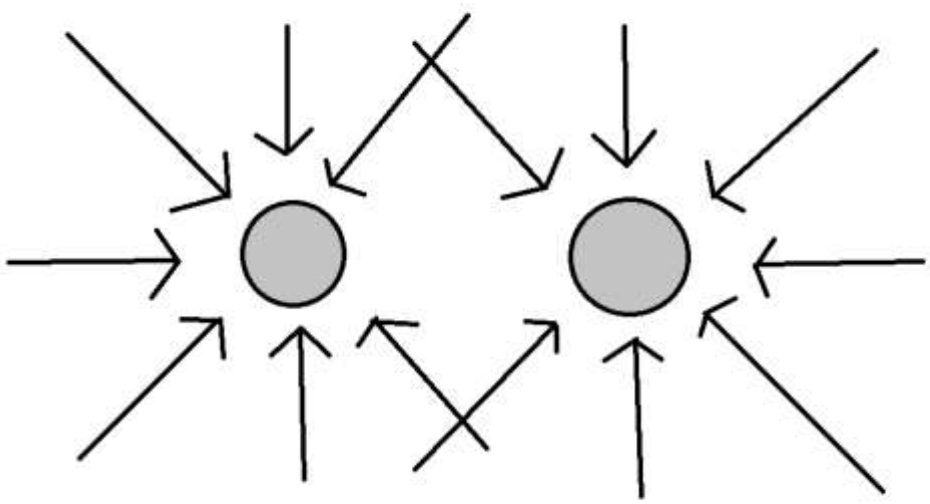

Figure #2

This diagram shows how massless particles interact with spheres. Massless particles have a property known as massless particle pressure, where any object hit by a massless particle will move in the direction the particle is traveling, because of the Law of Conservation of Momentum. Massless particles seem to logically come in and hit both spheres from all available angles. These massless particles are hitting these shown spheres in every direction and angle possible.

After the particles hit the spheres, the energy will be quickly absorbed, and then emitted back out again in a random direction.

In empty space, the spheres experiences a pressure similar to photon pressure. This can be substituted for any other massless particle, so we will call the force *MPS* (Massless Particle Pressure). These spheres do not have any net movement because an equal amount of pressure is being exerted from each side of the sphere. In a system like the one shown above, where the spheres are relatively close to each other, there is one spot where pressure is not exerted. In the space between the spheres. Since the spheres are close to each other, some of the particles that should be hitting one sphere are being blocked by the other sphere, so there is a 'gap' of pressure in between the two spheres.

Using this knowledge, one would be able to see that the spheres would start to be pushed towards each other. Since *MPS* is being exerted from all sides except the sides where they are facing each other, the net pressure is not 0, and like air moves into a vacuum to fill it up, the spheres will move towards each other. Gravity, anyone?

In order to calculate this, we will use an equation called the 'blocked ratio', which can tell us what percentage of massless particles being blocked by R_2. From Figure #1, the equation used would be $Blocked\ Ratio(\%) = \frac{Size\ of\ chord\ of\ r_2}{Area\ of\ Sphere\ D_1}$. This can be translated into:

$$Blocked\ Ratio(\%) = \frac{\pi r_2^2}{4\pi D^2}$$

This can be simplified to:

$$Blocked\ Ratio(\%) = \frac{r_2^2}{4D^2}$$

The cross-sectional area normal to the non-canceled field (most potions canceled out due to symmetry) of fully saturated mass is $Ap = \pi r^2$. Therefore $R = \sqrt{\frac{Ap}{\pi}} = \frac{lp}{\sqrt{\pi}}$

In order to find the gravitational force of R_1, this equation will be used:

$$F(Gravitational) = E_{field} * Area\ of\ R_1 * \frac{r_2^2}{4D^2}(Blocked\ Ratio) * \frac{\frac{lp}{\sqrt{\pi}}}{r_1} \frac{\frac{lp}{\sqrt{\pi}}}{r_2}(Density\ Correction\ factor)$$

In real terms, that equation would look like this:

$$F = E_{field} * \pi r_1^2 * \frac{\pi r_2^2}{4\pi D^2} * \frac{\frac{lp}{\sqrt{\pi}}}{r_1} * \frac{\frac{lp}{\sqrt{\pi}}}{r_2}$$

In the above equation, *lp* stands for Planck length. Since lp^2 can be simplified to *Ap* (Planck area), the equation can be simplified to:

$$F = \frac{E_{field} * \pi * r_1 * r_2 * Ap}{4 * D^2 * \pi}$$

We can now replace every instance where either r_1 or r_2 comes up with the equation r=$\frac{2GM}{c^2}$. To keep track of which sphere is being mentioned where, the subscripts will be moved to the *M* in the equation.

$$F = \frac{E_{field} * Ap * 4 * G * M_1 * M_2 * G}{4 * c^4 * D^2}$$

This can be simplified to:

$$F = \frac{E_{field} * Ap * G * M_1 * M_2 * G}{c^4 * D^2}$$

Now, to simplify this to make it more comfortable and well known, we will cut it into two parts:

$$F = \left(\frac{E_{field} * Ap * G}{c^4}\right) * \left(\frac{M_1 * M_2 * G}{D^2}\right)$$

An equation that was already defined is $F = \frac{M_1 M_2 G}{D^2}$, which is a standard equation for gravity that is accepted as a practical equation.

If $\left(\frac{E_{field}*Ap*G}{c^4}\right) = 1$, then our equation

$$F = \left(\frac{E_{field} * Ap * G}{c^4}\right) * \left(\frac{M_1 * M_2 * G}{D^2}\right)$$

is basically equal to the current equation used to calculate gravity $F = \frac{M_1 M_2 G}{D^2}$.

From the equation $\left(\frac{E_{field} * Ap * G}{c^4}\right) = 1$ one can calculate G from Energy of the field, Planck area, and the speed of light.

From the science world's knowledge, we have already calculated the numbers for a lot of the constants in this equation. The speed of light is 2.997 * 10^8. Planck area is 2.6121 * 10^{-70}.

The energy density of *The Field* can be calculated by $\frac{c^2 Mp}{Vp}$, where *Mp* is the Planck mass and *Vp* is the Planck volume. $Mp = 2.1765 * 10^{-8}$ and $Vp = 4.2217 * \ 10^{-105}$.

If $E_{vac} = \frac{c^2 Mp}{Vp}$ is correct, then we can solve it by substituting in the values. When we do that, we get $E = 4.63068 * 10^{113}$(This number, after these calculations, was realized to be basically the Plank energy density, which is $\frac{c^7}{\hbar G^2}$).Then, to calculate G from this, we would use the equation $G = \frac{c^4}{Ap * E_{vac}}$. By substituting in the variables, we get $G = 6.66979 * 10^{-11}$. The accepted value for *G* is $G = 6.67384 * 10^{-11}$. The difference between these two values of *G* are only within a 0.405% difference, which is within the tolerance for the values used in the calculations.

These calculations above assume a static physical system with the spheres of a stable size and mass. As the masses are absorbing a significant amount of energy from *The Field*, the spheres will either grow in size of need to emit an equal amount of energy. For the purposes of this paper, we have assumed these spheres would be in thermal equilibrium. If the energy density inside of the sphere equals the energy density outside the sphere with equal temperature and density, there may be energy exchanged, but no net change in density of the sphere.

When energy is absorbed by the sphere, and an equal amount emitted, the direction of emission will be a random direction if the temperature is uniform on the perimeter of the sphere.

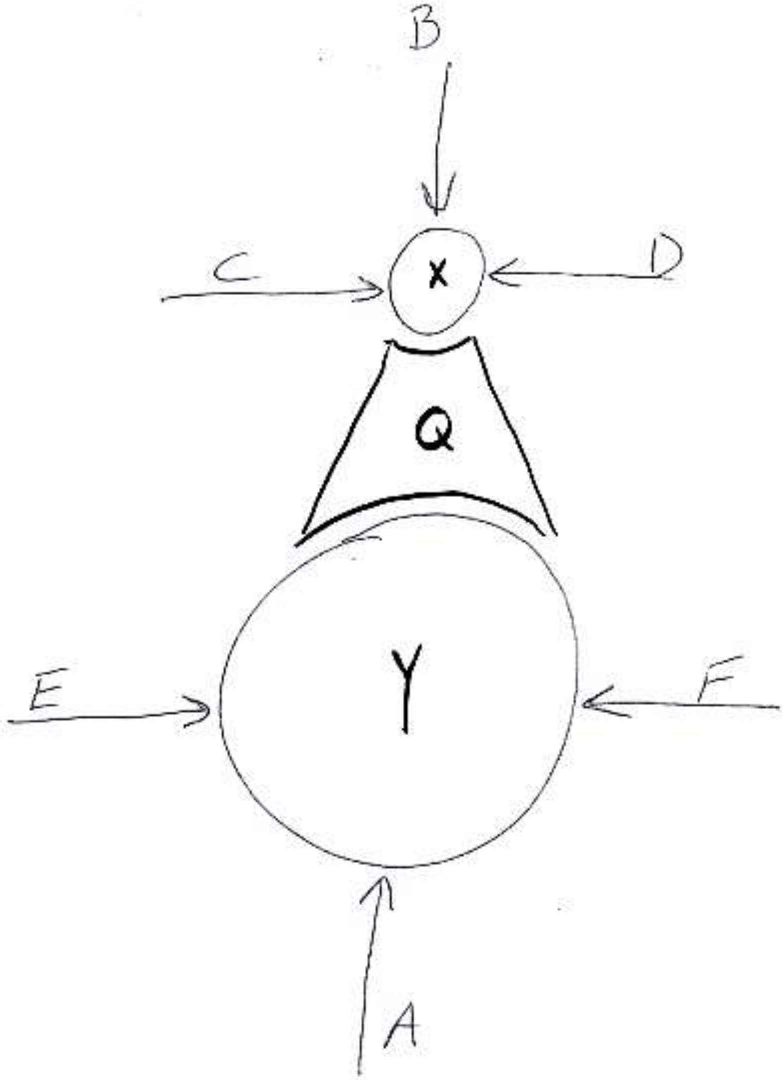

Figure #3

A,B,C,D,E, and F are all part of the Energy Field, interacting on 'blobs' of mass and energy X and Y. If C and D are exerting forces on mass X at an 180^{o}, then the net force would be 0. This same logic works for Energy Field Particles E and F and mass Y. Region Q will have a non-uniform energy density.

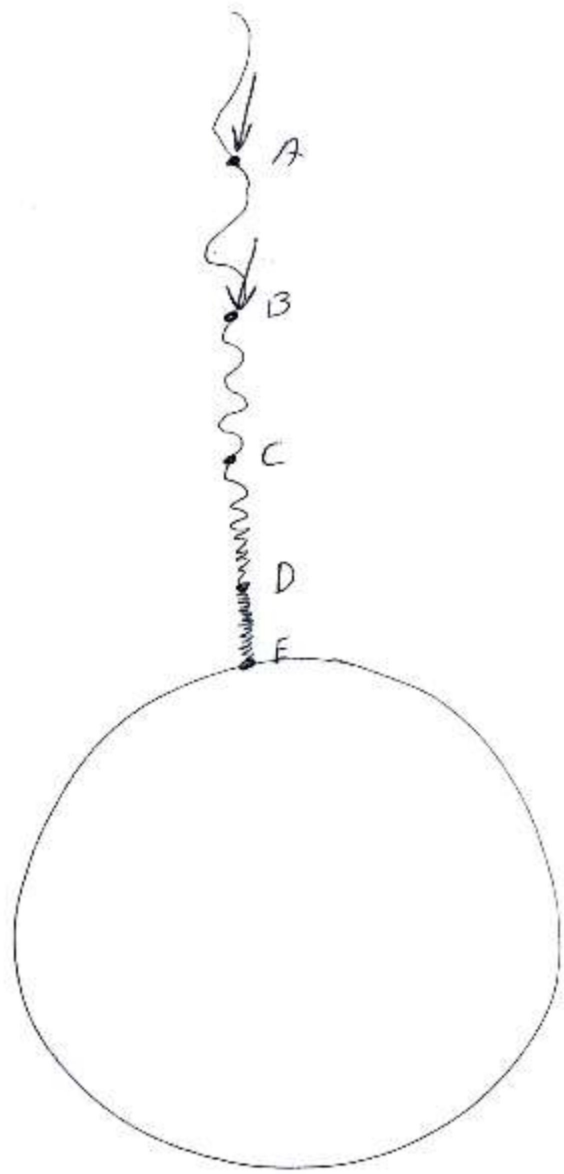

Figure #4

Quantized gravity:

A,B,C,D, and E in figure #4 represent quantized points where the target photon statistically could interact with the Energy Field. The energy (frequency and velocity) of the photon is increased with each interaction A,B,C,D,E leading to quantized, gravitational acceleration of the photon. Other interactions would occur at different angles, but they statistically cancel out (see Figure #4) with the interactions from the opposite direction.

The above paragraph helps explain how our theory is complaint with the classical tests of general relativity, such as 'Gravitational Redshift.' The above diagram shows the wavelength of light being shorter and having a higher energy as it moves towards the larger source of gravity. This will lead to a time going slower closer to the massive body than the time away from the massive body (perceived source of gravity).

It also can be seen in figure #4 that Gravitational Lensing of light would occur near a massive dense object due to the interaction with the field. This lensing would be the same curvature as predicted by general relativity as the gravitational force has been shown to be the same.

This quantized gravitational change in energy may be able to be verified with experiments, but it is unlikely in the near future.

This theory is compliant with general relativity and special relativity. We will list all of the necessary points to each theory, and we will show that our theory is compliant with each of these points.

1. *The speed of light must be constant for all observers.* The speed of light and the vacuum are set to C in this theory with nothing traveling faster that C through space. As no changes were made from Classical physics, I see no reason why our theory isn't complaint with this, so why not?
2. *All rules of the universe must be consistent with all inertial reference frames.* Again no changes from classical physics were assumed, therefore there is no part of our paper that says otherwise…
3. *This theory is compliant with the equivalence principle.* An object in free fall will feel the same force acting upon it as if it was floating in space, which is nothing. This theory is compliant as an object in this quantized gravitational field would feel no effects relative to any non-supported object within the local region.
4. *The curvature of spacetime due to gravity:* This theory can be considered compatible with curved space if curved space is defined as the path light takes near a massive body. The curvature of space may be viewed as a change in the energy

density of the vacuum within local regions as photons will curve towards the area with less vacuum energy density. Also, if the energy density changes as space increases this would lead to the acceleration of the universe.

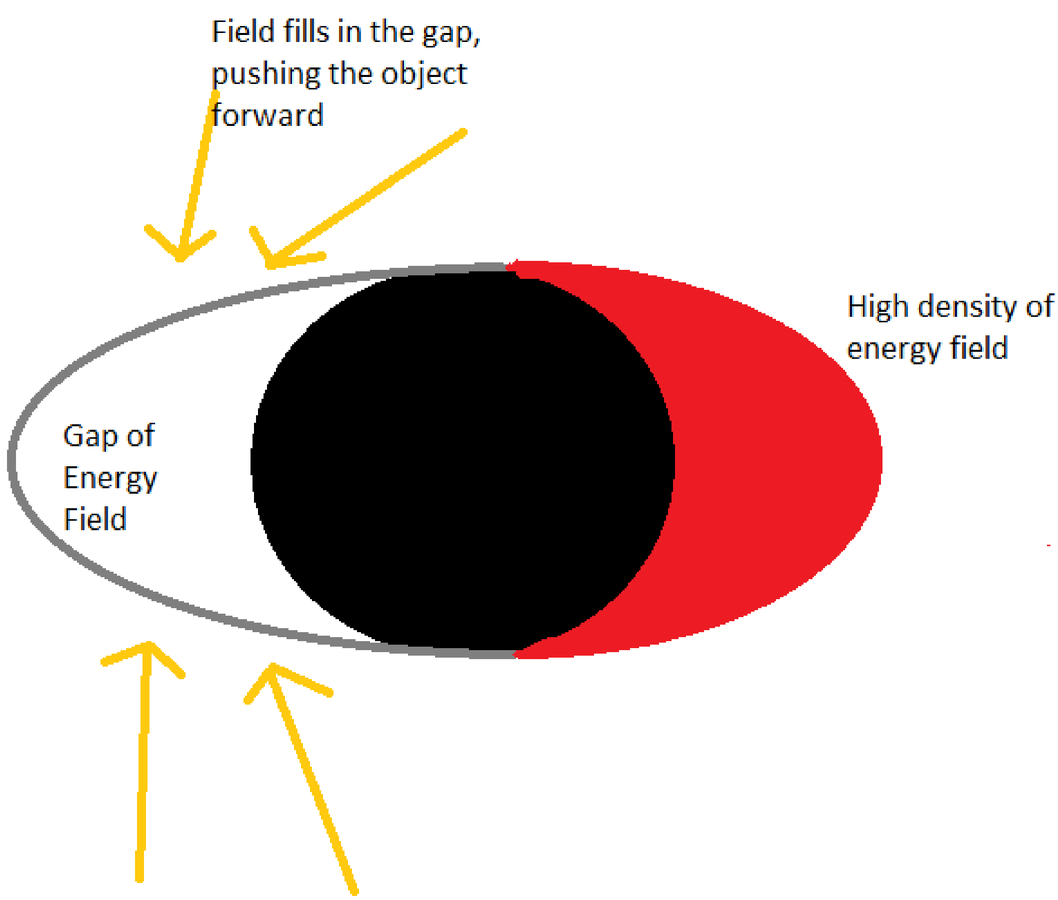

Figure #5

This diagram shows how there would be no drag in a closed system with only an accelerating sphere and the Energy Field. An argument that could be made against the energy field theory could be "There would be so much energy in front of an object for it to be able to even move". This is wrong, because the energy behind the sphere would be less than the energy density in all other places, so the energy field would fill in the 'empty' space, propelling the ball forward with the same speed that the ball in being push back at, causing a net force from the energy field of 0, meaning it would move normally. The best way to view this is from a thermodynamics point of view. The leading edge of the sphere would be hot, the trailing edge is cold. This would force more field emission on the redshifted trailing edge than the blueshifted leading edge.

It should be obvious how the gravitational attraction becomes reduced at very close distances in this theory due to absorption of the scattered emitted energy of the other local masses. Masses will be gravitationally attracted towards each other, but unlike classical theory, no singularity will occur even in a black hole as gravitation attraction will diminish as objects become very dense and very close. In the center of the black hole the masses form a big clump of matter like kitty litter which losses the gravitationally attraction and can be viewed as a thermal equilibrium in the field. This is different from standard theory and is testable if anyone goes into the center of a black hole. The problem with the test is that there might be some casualties in the process. If the energy density becomes lower as time/space evolves, this would produce an acceleration of expansion; cosmological constant. This would require a very small reduction in energy density many orders of magnitude smaller than can be measured directly.

With this theory of gravity, one surprising result is the vacuum energy density does not lead to a near instantaneous gravitational collapse of all objects in the universe as many have predicted and therefore have dismissed the reality of a vacuum energy of this magnitude.

Conclusion:

This theory seems to properly predict the acceleration due to gravity, and is consistent with Special and General Relativity including, gravitational lensing of light, and time dilation within this quantized gravitational field. This theory also allows for the theorized vacuum energy to fill space rather than the current view that the vacuum energy should be dismissed as not part of reality due to the certainty of a near instantaneous collapse of our universe into a singularity. On small scales, these quantum effects can be predicted and hopefully tested.

Now I conclude this paper by stating that this is just a theory and we may wrong. But I strongly believe something in here is somewhat useful in more of our theories that we will work on in the future. And that is where I would like to end this paper on quantum gravity.