The Graviton in an Equilibrium Universe and the Holographic Principle

Introduction

The difference between macro and micro physics arises specifically in reference to those (normally quantum law obeying) particles conglomerating into macro entities. We should (in a broad sense) expect that these quantum laws still apply, yet there will be particular instances where they provide neither reliable approaches nor predictions. Common intuitions are often right and often wrong as well. The natural intuition that mass, or energy should somehow occupy space is quite common, the idea that to exist one needs a radius of some sort is even stronger, but are these simple notions correct?

As Max Planck observed, "There can be no doubt that the constant *h* plays a definite role at an emission center of the elementary oscillation process…" The Planck Interaction is ubiquitous and integral, and determines quantic availability for all mass and energy. The universal frame (as we find it below), points to this convergence that is fundamental for any and all interactions. This paper notes, that the general behavior of spin particles, neutrons, protons, electrons, and photons clearly implies that there is no fundamental **solid** particle defining the physics of particles, but rather an electromagnetic, and gravitational domains interaction, which pervades all things in wave-like motion. The foundation of all this, is the mass/radius relationship of the universe as a whole, which we find to be in equilibrium.

I. Explaining what is meant by Equilibrium Universe

The concept of equilibrium implies a certain finiteness, in which there is a balance between forces. It also implies stability or constancy. Equilibrium solutions in a **dynamical system** do not change with time.

A system is in equilibrium when the sum of all forces is zero.

$$\sum \overrightarrow{\{F\}} = 0$$

Stephen Hawking, Alan Guth, and other physicists have shown that in our approximately spatially homogenous universe, the negative gravitational energy perfectly balances the positive energy represented by matter, thus the total energy of the entire universe is exactly zero. That is.

$$E_U + E_G = 0$$

This immediately urges us to determine that the universal constant (G) is actually the result expected from a sum total of all the available, and equally distributed mass in the universe. At some specified radius, the acceleration "G", at this incredibly large radius (almost a perfectly straight line), that very, **very** slight curvature, might somehow hold the passing of light in its feather grasp.

Essentially then the universal gravitation G, is strictly (or perfectly) proportional to the universal mass M_u.

$$G \propto M_U$$

a. A simple definition: The Natural Radius

For any mass whatsoever, at some radius (r_N) we would encounter acceleration where the surface gravity (***k***) is equal to G (***k***=G), and from this relation

$$\boldsymbol{k} = \frac{GM}{r^2}$$

where the acceleration ***k*** is equal to G (***k***=G), we have

$$r_N = \sqrt{\frac{\cancel{G}M}{\cancel{k}}} = \sqrt{M}$$

Of course, this would be a naturally appearing radius for any mass or ideal spherical group of masses whatsoever. It is however, a key to unlocking some aspects of our search.

b. The Equilibrium Solution

A related solution would be the Schwarzschild solution for an acceleration of G. The constant of acceleration G is Universal, so then, at what radius (R_u), and at what **mass** (M_U) would we find electromagnetic energy contained by an acceleration of G? This would be the Schwarzschild radius for an acceleration of G.

This radius, at which the acceleration k is equal to G *(k = G)* will **also** be the Natural radius for that same mass, generating that same acceleration G, as an equivalent solution.

$$\mathbf{R_u = \sqrt{M_U} = \frac{c^2}{2G} = \frac{2GM_U}{c^2}} \qquad (1)$$

This equivalence radius is $6.733e^{26}$ m, and its mass is $4.534e^{53}$ kg. The solution is singular.

In this model, the universal radius is simply the square root of the universal mass, (in meters); it is a singular finite solution, resolves to its own Schwarzschild radius, and is unique to this total mass value alone.

c. A Unique Solution

So now we have some numbers, radius = 6.733 e ^{26} m, and mass = 4.534 e ^{53} kg, so how do they compare with current estimates of the universal mass and radius? Well the following chart shows us.

Description	(G)	Light sq.	Mass (kg)	Natural radius (r_u)	Schwarzschild radius (m)	Local BH gravity (g)	Schwarzschild radius Force Parameter (u)
WMAP Total	6.674E-11	8.988E+16	3.140E+54	1.772E+27	4.663E+27	9.636E-12	3.025847E+43
WMAP all masses	6.674E-11	8.988E+16	8.855E+53	9.410E+26	1.315E+27	3.417E-11	3.025847E+43
WMAP in atoms	6.674E-11	8.988E+16	1.520E+53	3.899E+26	2.257E+26	1.991E-10	3.025847E+43
Planck Total	6.674E-11	8.988E+16	3.041E+54	1.744E+27	4.516E+27	9.950E-12	3.025847E+43
Planck all masses	6.674E-11	8.988E+16	8.857E+53	9.411E+26	1.315E+27	3.416E-11	3.025847E+43
Planck in Atoms	6.674E-11	8.988E+16	1.460E+53	3.821E+26	2.168E+26	2.072E-10	3.025847E+43
Avg Mass/Star	6.674E-11	8.988E+16	1.700E+53	4.123E+26	2.525E+26	1.780E-10	3.025847E+43
Hoyle in atoms	6.674E-11	8.988E+16	1.680E+53	4.099E+26	2.495E+26	1.801E-10	3.025847E+43
Hoyle total	6.674E-11	8.988E+16	3.500E+54	1.871E+27	5.198E+27	8.645E-12	3.025847E+43
Comoving Radius				4.300E+26			
Equilibrium universe	6.674E-11	8.988E+16	4.534E+53	6.733E+26	6.733E+26	6.674E-11	3.025847E+43

Table 1 - The mass values for WMAP, and The European Space Agency's Planck Telescope here are all derived from the appropriate density parameters and the commoving radius (4.3 e ^{26} m). (ref)

As you can see, most of these estimates are clearly in the "same ballpark" so to speak. Using the Hubble commoving radius (4.3 e ^{26} m), the data for the observable universe (Total), derived from the WMAP study for the Hubble constant, and the resulting critical density of 9.3 e^{-27}, place it plainly within its own black hole (by a factor of ten) with a total mass of 3.14 - 3.35 e ^{54} kg. The same is approximately true for the European Space Agency's Planck Telescope (Total) data. The Hoyle estimates as well as the adjusted average mass/star counting methods are also in the same field.

It appears that we are living inside of a classical black hole where the smooth "featureless" event horizon is under the influence of a greatly distributed mass, the force of which creates a "mother" background field and such space curvature; the acceleration of which approximates "G".

We also note here, that the only model above that exhibits "G" as its surface gravity is the Equilibrium Universe. Whether the universe has a surface gravity equal to G or not, might well be debated, yet from the table, though the individual gravitational Black Hole surface accelerations vary, the singular force required to contain electromagnetic energy is unchanging for all models. The acting force in all cases is equivalent to ¼th of the Planck force; the "Schwarzschild force", being equivalent for any and all black holes.

The solution above was arrived at in an attempt to explore at what mass, and at what radii would the universal constant G, be present, and yet also contain electromagnetic energy. It should be obvious that if the universe were not in some sort of equilibrium, then the constants would not be constant. This "obvious" deduction of course could only apply to the "universe" because it includes **all** existence.

All black holes (that we can "detect") exist within a greater Schwarzschild (black hole) event horizon, i.e. the universe. However, we can only observe matter that has not fallen into these smaller event horizons.

Evidence for this can found in the following relations.

d. How much does a black hole weigh?

The universal model (described above) indicates a total mass (per meter) of $6.733e^{26}\ kg$

It turns out that all black holes weigh that same amount per meter. If this interchange between space and mass really is valid at Planck scales, then we would expect results like the following for the Planck mass

$$\frac{M_p}{R_{s_p}} = constant = 6.733e^{26}\ kg/m$$

Suppose we take any black hole and divide its mass by its Schwarzschild radius?

$$\frac{M_x}{R_{s_x}} = constant = 6.733e^{26} kg/m$$

So this is a universal constant for black holes!

Somehow the total universal mass is in equilibrium with the constants, and **it has a direct and inverse correlation with all black holes.**

This is evidenced in direct correlations with both the Planck area and the Holographic Principle

II. What the Equilibrium Universe "sees" in a black hole; the Holographic Principle and the Planck Area

Jacob Berkenstein calculated the unit growth constant in area, equal to $2\frac{G\hbar}{c^3}$ for all black holes, (including the universe) which is briefly

$$\delta A = R_s \delta R = 2\frac{G\hbar}{c^3} = 2l_p^2 \ = 5.2242\ e^{-70}\ m^2$$

This is a universal constant; two squared Planck lengths ($2l_p^2$), and is not (but represents in surface area) the quantum incremental (single bit) change in mass/energy of a black hole, in area.

This is the basis of the Holographic Principle. Taking its root we get

$$\sqrt{5.2242\text{e}^{-70}\ \text{m}^2} = \ 2.28565\ \text{e}^{-35}\ \text{m}$$

The root value is remarkably, 0.707 times the Schwarzschild radius of the Planck mass as seen here

$$\frac{2.28565\ \text{e}^{-35}\text{m}}{3.23239\text{e}^{-35}\ \text{m}} = .707$$

It sits right flat in the middle of the most famous quantum mass interaction known, the Planck Interaction. So then, **any** universal model "sees" this value as the quantum incremental (single bit) change in mass/energy of a black hole for change in mass. This is a quantum effect.

a. The source of "probability" in the quantum universe, Space-time Structure and the Planck Area.

The Planck Interaction is universal, integral, and ubiquitous, and the Planck particle, as is well known, exists within its own Schwarzschild radius.

$$\mathbf{R}_{s_p} = \mathbf{2}\boldsymbol{l_p} = \mathbf{2}\lambda\!\!\!^{-}_{\boldsymbol{p}}$$

And, it obeys the Berkenstein Holographic principle shown above

$$\mathbf{2}\boldsymbol{l_P^2} = \mathbf{2}\lambda\!\!\!^{-2}_{\boldsymbol{P}} = \mathbf{2}\frac{G\hbar}{\boldsymbol{c^3}} = \boldsymbol{R_x}\lambda\!\!\!^{-}_{\boldsymbol{x}} \qquad \textbf{(2)}$$

However, please note that the product $\boldsymbol{R_x}\lambda\!\!\!^{-}_{\boldsymbol{x}}$ represents the Schwarzschild radius times the de Broglie radius **for any mass whatsoever** (including the Planck mass). The quantity $\boldsymbol{R_x}\lambda\!\!\!^{-}_{\boldsymbol{x}}$ is equal to $2l_P^2$, (the same Holographic constant mentioned above). We propose that this value is equated to, is "seen" as mass by the universe at large. It is not mass, but it is that surface which must be occupied, in order for the universe to "recognize" mass. This

relation to mass is a black hole property known to represent a quantum incremental change in the energy (or mass) of all black holes. Yet being valid for any mass whatsoever, it also strongly suggests that all mass has a not only a de Broglie radius, but also a Schwarzschild radius. As such then, mass exists as a de Broglie/Schwarzschild product within both Heisenberg and Lorentz limits.

It seems counter intuitive that trans-Planckian particle constructs are possible, for this reason alone, the idea of an electron or proton having a Schwarzschild radius has generally been rejected. However, the Heisenberg relation permits such radii to exist intermittently, as if the Planck interaction field was "blinking," effectively permitting such normal mass (as we know) it to exist. In contraposition to this, we find that the "Big Bang" as contained in its own de Broglie radius; is highly unlikely, but as will be shown below, possible within the Heisenberg limits. Discussion of the Lorentz limits and their function will be addressed in a forthcoming document.

III. Entanglement is the Rule

It has been argued that the universe is in fact, very well entangled. If we take the de Broglie radius of the known universal mass at around 10^{-97th} m we see that the universe already must have been generating its own Schwarzschild radius, from "moment one" so to speak. The space was already created, so that the entanglement was defined as well. The Plenum Aether has come back (reformulated) from the trash can of modern thought, and now dictates to us all the quantum probability/availability of our very existence. We are "entangled" in a universe that pulls on us from all sides, yet provides the internal energy that drives us forward.

So then, in which universal model might we find a direct relation to this quantity?

a. The Universe as a Particle

Supposing we looked at this proposed "equilibrium universe" in a special mirror… a mirror that might help to define where we are at?

Evidence I

If we were to take the Natural/Schwarzschild radius of our equilibrium universe to be equivalent to the de Broglie radius of its own Graviton/boson, **we might define a surface**, qualified to accommodate both gravity and quantum mechanics.

Let's take the radius of our universe, and call it the de Broglie radius of an *imaginary* mirror particle, a virtual particle, a Graviton…representing the image-space of the whole universe.

To solve for the "mass" (not rest mass) of this imaginary particle is simple. We know that to determine the mass of a particle at c the formula is…

$$m = \frac{\hbar}{\lambda c}$$

Using the equilibrium radius value of our universe; 6.7334 e ^{26} m as the de Broglie radius value (ƛ), of this "virtual", and calculating its "virtual mass", we get a mass of 5.2242 e^{-70} kg, which is remarkably, the same numerical value (in kilograms) as the universal holographic surface area constant of 5.2242 e^{-70} m^2. This is possibly the Graviton, a virtual particle that the universe may well "see" as mass.

Evidence II

Suppose we take the "Equilibrium Universe" as a particle and calculate $\boldsymbol{R_x \lambda_x}$?

$$\boldsymbol{2l_P^2 = 2\lambda_P^2 = 2\frac{G\hbar}{c^3} = R_x \lambda_x}$$

Using the "Equilibrium" mass value of *4.534 e ^{53} kg*, we get *7.759 e^{-97} m,* for the de Broglie radius.

Multiplying by the universal "Schwarzschild/Natural" unique equilibrium radius (6.7334 e^{26}m) above by the de Broglie radius *7.759 e^{-97} m* of the same mass, we arrive at the Berkenstein Holographic constant, all in meters, we get

$$6.7334\ e^{26}\ m * 7.759e^{-97}m = \boldsymbol{R_x \lambda_x = 2l_P^2} = 5.2242\ e^{-70}\ m$$

Without a doubt, the Equilibrium Universe modeled here, also points directly at this universal constant, which is uniquely involved in all things, and space itself.

Evidence III

The Graviton would be the most fundamental particle, but in normal space it is a "virtual" particle. It defines **all mass and energy** as we know it (see Equation 2), and of course, as shown below, it obeys Heisenberg-Schrodinger principles, promotes entanglements, and displays the superpositions of its own unique quantum probability wave envelope, the universe.

The Graviton value works by relating what the "universe" sees as "mass" to all particles. Consider the "Natural" radius of this graviton where its virtual mass generates a surface gravity (k), equal to G. It defines a "Natural radius" (as defined above) of

$$\sqrt{5.2242\text{e}^{-70}\ \text{kg}} = \ 2.28565\ \text{e}^{-35}\ \text{m}$$

This value is also remarkably, 0.707 times the Schwarzschild radius for the Planck mass. I note here that this is a "virtual" particle. It provides only the specific "information" that we call mass, the universe "sees" this virtual mass and radius as derived from the specific radii of the universe. However it obeys the Heisenberg principle, and our virtual graviton particle, with a **virtual** mass of 5.2242 e^{-70} kg, has a **specific** surface area of $2l_p^2$ or 5.2242 e^{-70} m^2, and gives some remarkable results. It is where the equilibrium solution for the universe points.

The Heisenberg relation

In the Heisenberg relation, the modern inequality

$$\sigma_x \sigma_p \geq \frac{\hbar}{2}$$

where $\hbar = h/2\pi$, and σ_x, σ_p are the standard deviations of position and momentum.

With a **virtual** momentum (mc) of 1.5661 e^{-61} kgm /s, we are effectively allowed for the standard deviation of position, ½ of the Equilibrium Universe radius R_u, from which our Graviton is derived.

$$\sigma_x \geq \frac{\hbar}{2\sigma_p} = \frac{R_u}{2} = 3.33667\text{e}^{26}\,\text{m}$$

Using ΔE as our parameter converting the **virtual** mass 5.2242 e^{-70} kg to energy, we arrive at

$$\Delta t \geq \frac{\hbar}{2\Delta E} = \frac{c}{4G} = 1.123e^{18}\ s$$

This value is ¼ th of how long would it take to get to the speed of light (c), accelerating at G!

Well that's easy enough, let's see…

$$t = \frac{v_f - v_0}{a}$$

Starting at zero, and ending at "c", with "G" as our acceleration, we have…

$$t = \frac{c-0}{G} = \frac{c}{G} = 4.49205\ e^{18}\ s.$$

We know that distance or space "S" is given by the formula…

$$s = \frac{1}{2}at^2$$

So using "G" for our acceleration and t = 4.49205 e^{18} s for our time, we get as our space (radius)…

$$R_U = \frac{1}{2}Gt^2$$

This would be then our simple universal radius "R_U" which equals 6.7334 e^{26} m.

This radius, we must conclude is the limit of our equilibrium universe. AS explained above, the universal radius contains all its light within it, which clearly means electromagnetic energy. Setting our Schwarzschild radius to this value

$$R_U = \frac{2GM}{c^2} = 6.7334e^{26}\ m$$

We can solve for the Mass…

$$M = \frac{R_u c^2}{2G} = 4.5339e^{53}\ kg$$

Our universe in equilibrium (as seen above) now contains all electromagnetic energy, it is a black hole!

Finally, taking the graviton's standard deviation of time Δt to be

$\frac{2l_p^2}{c} = \frac{5.2242\text{e}^{-70}\text{m}}{c} = 1.7426\text{e}^{-78}\text{s}$, we arrive at a **virtual** potential energy of

$$\Delta E \geq \frac{\hbar}{2\Delta t} = 3.02585 \text{ e}^{43} \text{ J}$$

Where one Joule, the SI unit of energy, is equal to 1 N/m. This fits quite nicely with our acting black hole force, the "Schwarzschild force", being equivalent for any and all black holes at 3.02585 e ^{43} N or ¼ th of the Planck force.

Conclusion

This study concludes that the universe is necessarily in equilibrium, that all black holes weigh the same per meter, and occupy the same force, and that the universe "sees" a specific value as the Graviton, the quintessence of existence, being equivalently, a surface or a mass. This virtual particle is equal to the Schwarzschild /de Broglie product of any mass or particle whatsoever. The relation confirms that the source of all things is the Planck Interaction, and also, that all particles and all masses should be defined by their Schwarzschild radii, as well as by their de Broglie radii. Further we conclude that the universe is indeed holographic (as described above), yet with the appearance that it is also a finite black hole, and we being observers within it, exist within a predefined space, as governed by the natural constants. It was noted, that we can only observe matter that has not fallen into smaller event horizons. As such, this state includes us as observers. We can observe all matter within our defined space (the universal event horizon), but beyond this space (either larger or smaller) we can observe nothing.

Special thanks is given to CNPq, LAQA, UFPB, and to this beautiful country called Brazil, for all their support and patience.

David Harding