On the Origin of Matter and Gravity: What They Are and Why They Exist

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ABSTRACT

We show a group of equations that appear to represent target values for the mass, radius, and number of elementary particles in the universe: the values of an 'ideal particle'. Quanta and particles are not static; they change with time. The angular momentum of the universe is continually increasing, and this requires a dynamical response to conserve angular momentum. The creation, collapse, and coalescence of quanta conserves angular momentum, resulting in the creation of particles of matter. Matter is condensed space. The increase in the gravitational potential energy of particles matches the accretion rate of energy predicted by this model. This gives a simple, universe-wide mechanism for the creation of matter, and is the reason all elementary particles, of a kind, are identical. The centripetal force of a particle of matter matches the gravitational force; they are the same entity. Gravity is the ongoing accretion of the quanta of space by particles of matter.

Subject headings: absorption of space; accretion of quanta; creation of elementary particles; creation of matter; conservation of angular momentum; conservation of centripetal force; Hubble constant; hyperverse; model of gravity

1. Gravity

NOTE: This paper is part 2 of the Origins of Matter and Gravity paper.

It is included within that paper and is placed here a second time to basically hold the placement in Vixra

If you have read the Origins of Matter and Gravity paper, then skip this paper

2. Introduction

In [1], we showed that the universe can be modeled as an expanding, four dimensional hypersphere, a 'hyperverse', that is radially expanding at twice the speed of light, circumferentially at the Hubble constant, and its three dimensional surface volume, which is our universe, is composed of energy. Space is energy.

We hypothesize in [2] that the hyperverse surface energy consists of a matrix of four dimensional, spinning, vortices, self-similar to the whole. These vortices comprise both space and matter. Their energy dynamics, when combined with the 2c radial expansion, produce a model of time, complete with relativity.

Space is undergoing a geometric mean expansion [3], an expansion allowed by the creation of two levels of quanta, one being the quantum of our quantum mechanics. We find that quanta are not static entities, but change with time and expansion.

This paper continues the development of the hyperverse model and geometric mean expansion of space. The primary concepts of this paper are:

1. The universe conserves angular momentum and centripetal force by coalescing and collapsing the quanta of space into particles of matter.
2. Because the angular momentum of the universe is continually increasing, the conservation of angular momentum becomes a 'moving target', making the process of creation, coalescence, and collapse, an ongoing process. The size, mass, and number of elementary particles change with time and expansion; matter is dynamical.
3. This ongoing accretion of the quanta of space, by particles of matter, is gravity.

We will make the following claims:

- The geometric mean expansion model produces a set of equations that appear to represent target values for the mass, radius, and quantity of an ideal elementary particle.
- From these equations, we can see that matter is not a static entity. We will show that the mass and radius of elementary particles decrease with time, while the number of particles increases.

- It appears the universe creates particles of matter to conserve angular momentum and centripetal force.

- The small radius quantum conserves angular momentum, but the small energy quantum cannot conserve angular momentum in its native state. By coalescing a specific number of the quanta of space into the volume of one SEQ, the universe can conserve angular momentum; but this alone is not sufficient.

- Centripetal force must also be conserved, and to do this, space must also collapse, or shrink, to a particular radius. This combined coalescence and collapse of space conserves both angular momentum and centripetal force, creating particles of matter.

- The model gives a simple reason why all particles of matter, of a kind, are everywhere identical in the universe. For example, all electrons are the same because they are conserving the same value of centripetal force and angular momentum, and those values are the initial values we calculated in the geometric mean paper, [3].

- The mass of the component quanta shrink with expansion. This, combined with the continually increasing angular momentum of the universe, forces particles to continually accrete the quanta of space, to shrink in size, and to grow in number. Matter is not static; it is dynamic. For example, an electron today is not the same as an electron that existed in the past or will exist in the future.

- Gravity is the ongoing accretion of energy, or absorption of the quanta of space, by particles of matter.

- We find that the centripetal force of the vortices of space matches the gravitational force; they are the same force.

- Matter is made of the collapsed and coalesced quanta of space. The continually increasing angular momentum of the hyperverse forces matter to continually accrete space, and we experience this continuous accretion of space as gravity.

- Matter and gravity exist because space expands.

This paper consists of two parts, Matter and Gravity.

If you have read the Origins of Matter and Gravity paper, then skip this paper

3. Particles and Quanta Are Not Static Entities. The Effects of Doubling the Size of the Hyperverse Radius on Particle Dimensions

In Part One, equations 15-17, we gave the parameters of the ideal particle, repeated here:

$$\text{particle radius} = \left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}} = \frac{R_H}{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}}$$

$$\text{particle mass} = \left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = \frac{\left(\frac{R_H c^2}{4G}\right)}{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}}$$

$$\text{particle number} = \left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}$$

They are all functions of the radius of the hyperverse, R_H, meaning their values change with expansion. Let us use the 'now and then' approach, where 'now' refers to the current condition, and 'then' refers to the time when the hyperverse radius was one-half the current size, or $\frac{R_H}{2}$, to see the effects of doubling.

The mass of particles decreases with a doubling:

$$\frac{\text{particle mass now}}{\text{particle mass then}} = \frac{\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}}{\left(\frac{1}{4G}\frac{\hbar^2}{\frac{R_H}{2}}\right)^{\frac{1}{3}}} = \left(\frac{1}{2}\right)^{\frac{1}{3}} = \frac{1}{2}2^{\frac{2}{3}} = 0.793\,700\,525\,984\,100 \qquad (82)$$

The radius of particles also decreases with a doubling, and at the same rate as mass:

$$\frac{\text{particle radius now}}{\text{particle radius then}} = \frac{\left(\frac{(2l_p)^4}{R_H}\right)^{\frac{1}{3}}}{\left(\frac{(2l_p)^4}{\frac{R_H}{2}}\right)^{\frac{1}{3}}} \left(\frac{1}{2}\right)^{\frac{1}{3}} = \frac{1}{2}2^{\frac{2}{3}} = 0.793\,700\,525\,984\,100 \qquad (83)$$

The number of particles increases with a doubling of the hyperverse radius:

$$\frac{\text{number of particles now}}{\text{number of particles then}} = \frac{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}}{\left(\frac{\frac{R_H}{2}}{2l_p}\right)^{\frac{4}{3}}} = 2\sqrt[3]{2} = 2.\,519\,842\,099\,789\,75 \qquad (84)$$

In the geometric mean paper, [3], we gave the effects of doubling on the quanta. Table 2, below, is a combination of the results from Table 7 of that paper, showing quanta, with our particle doubling results. The quanta and particles all change with time.

	observable	SRQ	SEQ	Particle
Radius	$R_H = 2x \uparrow$	$R_{SRQ} = \frac{1}{2}x \downarrow$	$R_{SEQ} = \sqrt[3]{2}x \uparrow$	$R_{particle} = \left(\frac{1}{2}\right)^{\frac{1}{3}} x \downarrow$
Volume per unit	$V_o = 8x \uparrow$	$V_{SRQ} = \frac{1}{8}x \downarrow$	$V_{SEQ} = 2x \uparrow$	$V_{particle} = \frac{1}{2}x \downarrow$
Energy per unit	$E_o = 2x \uparrow$	$E_{SRQ} = \frac{1}{32}x \downarrow$	$E_{SEQ} = \frac{1}{2}x \downarrow$	$\left(\frac{1}{2}\right)^{\frac{1}{3}} x \approx 0.7937x \downarrow$
Number of units	1	$64x \uparrow$	$4x \uparrow$	$2\sqrt[3]{2}x \uparrow$
Total E = E x #	$2x \uparrow$	$2x \uparrow$	$2x \uparrow$	$2x \uparrow$
Energy Density	$\frac{1}{4}x \downarrow$	$\frac{1}{4}x \downarrow$	$\frac{1}{4}x \downarrow$	$2^{\frac{2}{3}}x \uparrow$
Angular Momentum	$4x \uparrow$	one: $\frac{1}{64} \downarrow$; all: 1	one: $\left(\frac{1}{4}\right)^{\frac{1}{3}} \downarrow$; all: $2\sqrt[3]{2} \uparrow$	one: 1; all: $2\sqrt[3]{2} \uparrow$

Table 2. Effects of doubling on aspects of the hyperverse. This table is a repeat of Table 7 from [3], with the particle doubling and angular momentum information added.

4. Particles Continuously Accrete the Quanta of Space

1. If a particle stopped accreting the quanta of space, then, with a doubling of the hyperverse radius, the energy of a particle would drop by one-half, as that is the rate that the SEQ declines in its energy value, and matter is composed of SEQ.

2. A particle adds quanta with expansion, the number of contained SEQ climbing by $\frac{\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}}{\left(\frac{\frac{R_H}{2}}{2l_p}\right)^{\frac{2}{3}}} = 2^{\frac{2}{3}} = 1.\,587\,401\,051\,968\,199\,474\,8$

3. The decrease in energy per quantum, multiplied by the increase in the number of quanta, $\frac{1}{2} \times 2^{\frac{2}{3}} = \frac{1}{2}2^{\frac{2}{3}} = 0.793\,700\,525\,984\,099\,737\,38$ gives us the decrease in the energy per particle, as shown in Table 2.

4. With a doubling of the hyperverse radius, the number of elementary particles in the observable universe increases by $\frac{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}}{\left(\frac{\frac{R_H}{2}}{2l_p}\right)^{\frac{4}{3}}} = 2\sqrt[3]{2} = 2.519\,842\,099\,789\,746\,329\,5$

5. With a doubling, the overall increase in total energy, of all particles, also doubles: $\frac{1}{2}2^{\frac{2}{3}} \times 2\sqrt[3]{2} = 2$

5. Particles Accrete Energy at a Rate Equal to the Hubble Constant

We see that particles are simultaneously experiencing shrinkage of the component quanta, and absorbing additional quanta. Let us look at the rate of energy absorption of particles of matter.

The number of SEQ absorbed per second per particle is the number of SEQ within a particle, divided by the age of the universe:

$$\frac{\text{number of SEQ absorbed}}{\text{second per particle}} = \frac{\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}}{\frac{R_H}{2c}} = \frac{2c}{\sqrt[3]{R_H 4l_p^2}} = \frac{2c}{R_{SEQ}} = \frac{9.230\,128\,873\,494\,893\,867\,1 \times 10^{22}}{\text{s}} \tag{85}$$

The energy absorbed per particle is the number absorbed, multiplied by the energy of an SEQ:

$$\frac{\text{energy absorbed}}{\text{second per particle}} = \frac{\text{number of SEQ absorbed}}{\text{second}} \times \frac{\text{energy}}{\text{SEQ}} \tag{86A}$$

$$\frac{\text{energy absorbed}}{\text{second per particle}} = \frac{2c}{\sqrt[3]{R_H 4l_p^2}} \times \frac{c\hbar}{R_H} = 1.112\,104\,896\,164\,221\,812\,6 \times 10^{-29}\,\frac{\text{m}^2}{\text{s}^3}\,\text{kg} \tag{86B}$$

To find the fractional, per point, absorption of energy, we divide (86B) by the energy of particle:

$$\frac{\frac{\text{energy absorbed}}{\text{second}}}{E_{particle}} = \frac{\frac{2c}{\sqrt[3]{R_H 4l_p^2}} \times \frac{c\hbar}{R_H}}{\left(\frac{1}{4G}c^6\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}} = \frac{2c}{R_H} \tag{87}$$

The result is surprising: energy is being absorbed by particles of matter at a rate equal to the Hubble constant. We saw in [1] that the Hubble constant is a measure of the rate that energy is added to the universe, and here we see that it is also a measure of the rate that energy is added to a particle of matter.

The overall energy of particles is decreasing with time, and this is due to the reduction in the energy of each quantum with time. It is the addition of new particles of matter to the universe, with expansion, that takes up the missing energy. We see this by dividing the mass of the universe, by the number of particles, by the age of the universe, which gives us the energy absorbed per particle:

$$\left(\frac{R_H c^4}{4G}\right) \Big/ \left(\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}\right) \Big/ \left(\frac{R_H}{2c}\right) = \frac{c^3}{R_H}\left(\frac{2}{G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = 1.112\,105\,534\,346\,726\,290\,1\times10^{-29}\,\frac{\mathrm{m}^2}{\mathrm{s}^3}\,\mathrm{kg} \qquad (88)$$

6. A Relationship between the Hubble and Gravitational Constants

Multiplying the number of SEQ absorbed per second (85), by the 'raw' volume of an SEQ, gives the SEQ volume absorbed per second per particle:

$$\frac{2c}{\sqrt[3]{R_H 4l_p^2}} \times 2\pi^2\left(R_H 4l_p^2\right) = 2\pi^2 2c\left(R_H^2 16 l_p^4\right)^{\frac{1}{3}} = 4.994\,204\,334\,255\,019\,305\,4\times10^{-19}\,\frac{\mathrm{m}^3}{\mathrm{s}} \qquad (89)$$

By raw volume, we are referring to the volume of a small energy quantum in its native state.

Dividing that value, by the mass of a particle, gives the volume absorbed per second per kilogram:

$$\frac{2\pi^2 2c\left(R_H^2 16 l_p^4\right)^{\frac{1}{3}}}{\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}} = 32\pi^2\frac{G}{H} = 32\pi^2 G T_o = 9.222\,585\,461\,078\,392\,916\,1\times10^{9}\,\frac{\mathrm{m}^3}{\mathrm{s\,kg}} \qquad (90)$$

We get the ratio of the gravitational constant to the Hubble constant, or equivalently, the gravitational constant multiplied by the age of the universe.

We will refer to the ratio "volume absorbed per second per kilogram" as the "absorption constant", or absorption parameter", or "A".

$$\frac{\text{Volume absorbed}}{\text{second kilogram}} = A = 32\pi^2 \frac{G}{H} \qquad (91)$$

Although a particle's total energy decreases with time as a result of shrinkage of the energy of the component SEQ, the particle continually accretes additional quanta of energy, and this rate of accretion is the Hubble constant.

The gravitational constant, G, is given as cubic meters per kilogram per second squared. Big G is often viewed as nothing more than a constant of proportionality, but in the hyperverse model, the dimensions of big G, cubic meters per kilogram per second squared, have a physical meaning, as we can talk about a volume of space being absorbed by a kilogram of matter. The 'seconds squared' part of big G is not intuitive though, and is difficult to understand.

Equation (91) says the gravitational constant, G, is the product A times H, explaining the 'seconds squared" aspect of G. The Hubble and gravitational constants should be related, as each is a measure of something being added to a particle: G speaks of volume, and H of energy. Equation (91) gives us the relationship between the two. Both H and A vary with time, and in such a manner that G is constant with time.

7. Gravitational Potential Energy Accumulated per Second is the Accreted Energy

The general equation of gravitational potential energy of mass m is:

$$U = G\frac{Mm}{d} \qquad (92)$$

where M is the attracting mass and d is the distance between the centers of the masses. Recall that particle energy is $\left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}$. Let both masses be the particle mass, and the distance between the centers of the two masses be two times the particle radius (the particles are just touching), so that:

$$U = G\frac{M^2_{particle}}{2r} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)^2}{2\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)} = \frac{1}{8}\left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = \frac{1}{8}E_{particle} \qquad (93)$$

The value of $\frac{1}{8}E_{particle}$ is the gravitational potential energy for two adjacent particles. To get the gravitational potential energy for the full volume around a mass, not just one adjacent mass, we need to cube the distance, which is an increase of eight times. The gravitational potential energy of the adjacent volume of mass is eight times a particle mass. Thus U, the gravitational potential energy, matches the particle energy:

$$U = G\frac{M_{particle}\left(8M_{particle}\right)}{2r} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\right)}{2\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)} = \left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = E_{particle} \qquad (94)$$

Taking this gravitational potential energy of a particle, and dividing it by the age of the universe, we get a value for the rate of addition of gravitational potential energy per second, to a particle:

$$\frac{U}{T_o} = \frac{G\frac{M_{particle}\left(8M_{particle}\right)}{2R}}{\frac{R_H}{2c}} = \left(\frac{2c}{R_H}\right)\left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = 1.112\,105\,534\,346\,726\,290\,2\times 10^{-29}\,\frac{\mathrm{m}^2}{\mathrm{s}^3}\,\mathrm{kg} \qquad (95)$$

where T_o is the age of the universe.

This value matches our value of energy accreted per second by a particle. The potential energy added per second is identical to the accreted energy.

$$\frac{U}{T_o} = \text{accreted energy per unit time} \qquad (96)$$

The gravitational potential energy of a particle is the accreted energy.

8. Gravitational Force is the Extension of the Centripetal Force beyond the Particle Radius

In order for a vortex to spin, an inward, or centripetal, force must exist. Centripetal force, F_C, was defined as $\frac{c^4}{2G}$.

Looking at the gravitational force between two particles in direct contact, so that the distance between their centers is two times their radii, we have:

$$F_G = G\frac{m(8m)}{d^2} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)}{\left(2\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)^2} = \frac{1}{4}\times\frac{c^4}{2G} \qquad (97)$$

At a distance of two radii, the gravitational force is very close to the centripetal force of a particle, off by a factor of 4. This distance of two times the radius is outside the particle, and we would expect any centripetal force that existed there to be less. Since the distance, in this case, is twice the distance of a radius, and given that force drops by the inverse square law, we would expect a doubling of the distance to produce a reduction in the force by 1/4, just as we have calculated.

If the distance between the particles was one radius (the particles are overlapping), the gravitational force will equal the centripetal force:

$$F_G = G\frac{m\,(8m)}{r^2} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)}{\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)^2} = \frac{c^4}{2G} \qquad (98)$$

At a distance of one radius, the centers of the masses are on each other's circumference.

We can conclude that the gravitational force, and the centripetal force of the particle, are identical forces, forming a continuum of force, so that the centripetal force can be said to be the force at the particle boundary, but centripetal force also extends beyond the particle boundary, where it is experienced as the gravitational force. Or we can say that the centripetal force is the force of gravity. The two forces are the same force, simplifying the situation, leaving us with just one force.

9. Quantum Gravity is the Accretion of the Quanta of Space by Particles of Matter

Elementary particles are not static, unchanging entities; they are dynamical, formed as a means for the expanding hyperverse to conserve angular momentum, while maintaining centripetal force. The energy of the quanta decrease with expansion. To preserve angular momentum, particles must continually accrete energy; that is, they must keep absorbing the quanta of space. It is an ongoing process, driven by expansion, and this is gravity.

The absorbed space pulls along the matter embedded in it. The closer to the absorbing matter, the faster space moves, just like water near a drain moves faster towards the drain the closer the water is to the drain. Matter does not curve space; matter absorbs space, incorporating the quanta of space into the necessary mass and volume to conserve angular momentum and centripetal force.

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