Gravity is the Accretion of Energy by Matter to Conserve the Continually Increasing Angular Momentum of the Universe

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ABSTRACT

In a previous hyperverse theory paper, it was argued that particles of matter exist in order to conserve centripetal force and angular momentum at the small energy quantum level. Because the angular momentum of the observable universe is continually increasing, and because the energy of quanta shrink with expansion, particles of matter must continually accrete additional quanta of space in order to conserve these quantities. We show here that the fractional increase in particle energy matches, surprisingly, the Hubble constant, and that the increase in the potential energy of particles matches the accretion rate of energy. The centripetal force of the vortex, or quantum, is shown to match gravitational energy; they are the same entity. Gravity is the absorption of space by matter and, like time, is a manifestation of the expansion of space.

Subject headings: accretion of quanta; Hubble constant; hyperverse; matter absorbs space; model of gravity; quantum gravity

Introduction

In [1], the universe was postulated as being the three dimensional surface volume of a four dimensional, spinning, hollow hypersphere, called the hyperverse. It was demonstrated that the hyperverse surface volume, and every point in the universe is part the surface volume, is moving radially at twice the speed of light, or 2c. The Hubble constant was shown to be the fractional, or percentage, increase in energy of the universe. In [2] a model of time was presented based on the 2c radial expansion rate and the nature of the surface vortices, which were modeled as miniature versions of the hyperverse. In [3] it was argued that the hyperverse is undergoing a geometric mean expansion and that this expansion creates quantum levels. At least two quantum levels are produced. One quantum level, termed the 'small energy quantum,' or SRQ, is very small, whereas the other quantum level, referred to as the 'small energy quantum', or SEQ, is claimed to be the quantum of our quantum world. It was proposed that the quantum levels conserve angular momentum against the whole of the observable universe, and that each level must also conserve angular momentum within its own level. In [4] a case is presented that matter, elementary particles, are created by the universe in order to conserve angular momentum and centripetal force at the SEQ level, explaining why all particles of a kind are identical. Simply stated, matter is condensed space.

This paper continues the discussion of the creation of matter and shows that elementary particles are not static entities, but are dynamical, their number and mass both increasing as the universe expands. The universe continues to expand and its angular momentum continues to increase. This requires that more particles be created, and that all particles continue to accrete energy. We will show that this ongoing accretion of energy is gravity. The rate of accretion of energy of particles is, surprisingly, the Hubble constant. And we will see that the centripetal force of the vortices of space matches the gravitational force; they are the same.

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

In [4], the equation of the idealized particle mass was given as $\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}$ and the idealized particle radius as $\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}$, where G is the gravitational constant, $\hbar$ is the reduced Planck constant, l_p is the Planck length and R_H is the radius of the hyperverse. Note that both mass and radius are functions of the radius of the hyperverse, meaning they both change with expansion. The term 'idealized' is conjectured as the target, or ideal, value that the universe is aiming for. The differences in electrical charges of the particles cause the specific mass and radius to vary from the target value. 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 on particles.

The mass of particles decreases with a doubling:

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

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

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

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

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

The number of SEQ within a particle increases with a doubling:

$$\frac{\text{number of SEQ within particle now}}{\text{number of SEQ within particle then}} = \frac{\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}}{\left(\frac{\frac{R_H}{2}}{2l_p}\right)^{\frac{2}{3}}} = 2^{\frac{2}{3}} = 1.\,587\,401\,051\,968\,20 \tag{4}$$

Even though the mass of particles decreases with expansion, the number of contained small energy quanta increases. This is because the small energy quanta themselves are shrinking at a faster rate than the particle and because the particles are accreting the quanta of space:

$$\frac{\text{mass of SEQ now}}{\text{mass of SEQ then}} = \frac{\frac{\hbar}{cR_H}}{\frac{\hbar}{c\frac{R_H}{2}}} = \frac{1}{2} \tag{5}$$

The SEQ shrink by one-half with a doubling, but the particle shrinks by about 0.7937 with a doubling. By comparison to an SEQ, a particle grows by $2^{\frac{2}{3}}$ times, or $1.\,5874$.

2. The Percentage Increase in Particle Energy Equals the Hubble Constant

From [1]. we saw that the Hubble constant can be expressed as the fractional increase in the energy of the universe:

$$H = \frac{\Delta E_o}{E_o} \tag{6}$$

where E_o is the energy of the observable universe and delta E_o, or ΔE_o, is the change in energy of the observable universe. From [3], delta energy of the observable universe is equal to $\frac{c^5}{2G}$, where c is the speed of light. We can calculate delta E for a particle, $\Delta E_{particle}$, by dividing the rate of change of energy of the observable universe, ΔE_o, by the number of particles:

$$\frac{\Delta E_o}{\text{number of particles}} = \frac{\frac{c^5}{2G}}{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}} = \Delta E_{particle} = 1.112\,106\,810\,712\,833\,910\,4 \times 10^{-29}\,\frac{\mathrm{m}^2}{\mathrm{s}^3}\,\mathrm{kg} \tag{7}$$

Thus, about 1.1×10^{-29} joules of energy are added to a particle each second.

To find the fractional increase of energy of a particle, we can take the ratio of $\Delta E_{particle}$ to $E_{particle}$:

$$\frac{\Delta E_{particle}}{E_{particle}} = \frac{\frac{\frac{c^5}{2G}}{\left(\frac{R_H}{2l_p}\right)^{\frac{4}{3}}}}{\frac{c\hbar}{R_H} \times \left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}} = \frac{2c}{R_H} = 2.285\,027\,734\,440\,597\,113\,7 \times 10^{-18}\,\mathrm{m/\,s/\,m} = H \tag{8}$$

where $E_{particle}$ is the energy of a particle.

The amazing result is the Hubble constant. The percentage increase of the energy of a particle is the same as for the whole of the observable universe; particles and the observable universe have identical fractional or percentage growth in their energies. We saw in [1], which was quickly reviewed here, that the Hubble constant is actually a measure of energy. Although it is scaled down to the size of a particle, the Hubble constant gives us the growth rate of particles of matter, quite a surprising discovery.

3. Particles Continuously Accrete the Quanta of Space

Particles are not static over time; they are growing, accreting SEQ with expansion, their mass and radius changing as the universe expands. Particles add the quanta of space with expansion, and they are apparently doing so to conserve angular momentum [4].

The concept of frame advances was introduced in [2] and [3], the idea being that space is radially advancing in increments of one vortex radius. Each radial advancement of a vortex radius is considered a frame advance.

The number of SEQ within one particle is $\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}$. There have been $\left(\frac{R_H}{2l_p}\right)^{2}$ frame advances since expansion started. This gives us the number of SEQ absorbed per frame advance per particle:

$$\frac{\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}}{\left(\frac{R_H}{2l_p}\right)^{2}} = \left(\frac{2l_p}{R_H}\right)^{\frac{4}{3}} = 6.128\,686\,714\,971\,424\,166\,1 \times 10^{-82} \text{ SEQ/frame/particle} \tag{9}$$

The volume absorbed per particle per frame is $\frac{\text{number of SEQ}}{\text{Frame advance}} \times \frac{\text{volume}}{\text{SEQ}}$:

$$\left(\frac{2l_p}{R_H}\right)^{\frac{4}{3}} \times 2\pi^2 \left(R_H 4l_p^2\right) = 2\pi^2 \left(\frac{(2l_p)^{10}}{R_H}\right)^{\frac{1}{3}} = 3.316\,087\,367\,219\,182\,637\,8 \times 10^{-123} \text{ m}^3\text{/frame} \tag{10}$$

This is the volume of 'raw', full radius SEQ. Logic, and calculations not presented here, indicate that the quanta shrink as they approach the absorbing matter, so that the ultimate volume absorbed, the volume of the compressed SEQ, is much less than the 'raw' volume.

The number of frame advances per second is the number of frame advances divided by the age of the universe:

$$\frac{\left(\frac{R_H}{2l_p}\right)^{2}}{\frac{R_H}{2c}} = 2c\frac{R_H}{4l_p^2} = 1.506\,053\,303\,548\,235\,063\,6 \times 10^{104} \text{ frames/sec} \tag{11}$$

Note that the inverse of this number, $6.639\,859\,798\,408\,221\,496\,7 \times 10^{-105}$ seconds, is the value of 'small time', from [3].

The number of SEQ absorbed per second per particle is

$$\frac{\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}}}{\frac{R_H}{2c}} = \frac{2c}{R_H}\left(\frac{R_H}{2l_p}\right)^{\frac{2}{3}} = 9.230\,128\,873\,494\,893\,867\,2 \times 10^{22} \text{ SEQ/second/particle} \tag{12}$$

The volume of SEQ absorbed per particle per second is $\frac{\text{volume}}{\text{particle/frame}} \times \frac{\text{frames}}{\text{second}}$

$$2\pi^2 \left(\frac{(2l_p)^{10}}{R_H} \right)^{\frac{1}{3}} \times 2c\frac{R_H}{4l_p^2} = 2\pi^2 2c \left(R_H^2 16 l_p^4\right)^{\frac{1}{3}} = 4.994\,204\,334\,255\,019\,305\,4 \times 10^{-19} \frac{\text{m}^3}{\text{s}} \quad (13)$$

The energy absorbed per second is the number of SEQ absorbed per second per particle times the energy per SEQ, matching (7) above:

$$\frac{2c}{R_H} \left(\frac{R_H}{2l_p} \right)^{\frac{2}{3}} \times \frac{c\hbar}{R_H} = \frac{2c}{R_H} \frac{c\hbar}{\sqrt[3]{R_H 4 l_p^2}} = \frac{2c}{R_H} \frac{c\hbar}{R_{SEQ}} = 1.112\,104\,896\,164\,221\,812\,6 \times 10^{-29} \frac{\text{m}^2}{\text{s}^3}\,\text{kg} \quad (14)$$

Since the term $\left(\frac{1}{4G} \frac{\hbar^2}{R_H} \right)^{\frac{1}{3}}$ is the particle mass, this equation can also be expressed as:

$$\frac{2c}{R_H} \times \frac{c\hbar}{R_{SEQ}} = \frac{2c^3}{R_H} \left(\frac{1}{4G} \frac{\hbar^2}{R_H} \right)^{\frac{1}{3}} = \frac{2c}{R_H} E_{particle} \quad (15)$$

The percentage increase in energy is, again, the Hubble constant:

$$\frac{\text{energy absorbed per second}}{\text{energy of a particle}} = \frac{\frac{2c}{R_H} \frac{c\hbar}{\sqrt[3]{R_H 4 l_p^2}}}{\frac{c\hbar}{R_H} \times \left(\frac{R_H}{2l_p} \right)^{\frac{2}{3}}} = \frac{2c}{R_H} \quad (16)$$

Looking at the observable universe, we can show that the energy absorbed by all particles, over the age of the universe, is the same as the energy absorbed per particle:

$$\left(\frac{R_H c^4}{4G} \right) \Big/ \left(\left(\frac{R_H}{2l_p} \right)^{\frac{4}{3}} \right) \Big/ \left(\frac{R_H}{2c} \right) = \frac{c^3}{R_H} \left(\frac{2}{G} \frac{\hbar^2}{R_H} \right)^{\frac{1}{3}} = 1.112\,105\,534\,346\,726\,290\,1 \times 10^{-29} \frac{\text{m}^2}{\text{s}^3}\,\text{kg} \quad (17)$$

Our rate of addition of energy to particles, divided by the particle energy, is the Hubble constant:

$$\frac{1.112\,104\,896\,164\,221\,812\,6 \times 10^{-29} \frac{\text{m}^2}{\text{s}^3}\,\text{kg}}{4.866\,923\,572\,019\,502\,859\,7 \times 10^{-12} \frac{\text{m}^2}{\text{s}^2}\,\text{kg}} = 2.285\,026\,423\,175\,903\,855\,4 \times 10^{-18} \text{ per second } = H \quad (18)$$

Particles are accreting energy, or quanta of space, at a rate equal to the Hubble constant.

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

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

$$U = G\frac{Mm}{d} \tag{19}$$

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:

$$U = G\frac{Mm}{2r} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)^2}{2\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)} = -\frac{1}{8}\left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = \frac{1}{8}E_{particle} \tag{20}$$

The value, $-\frac{1}{8}E_{particle}$, is what we get for two adjacent particles, whereas we want to consider the total energy absorbed per particle. Any particle is surrounded by many particles. With particles touching, a distance of two radii means the volume of the adjacent masses is eight times greater, so that the total of the adjacent masses is eight times greater than one particle mass. With the correct adjacent mass, we find that U, the gravitational potential energy, matches the particle energy:

$$U = G\frac{M\,(8m)}{2r} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\right)}{2\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)} = \left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = E_{particle} \tag{21}$$

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:

$$\frac{U}{T} = \frac{G\frac{m(8m)}{2R}}{\frac{R_H}{2c}} = \left(\frac{2c}{R_H}\right)\left(\frac{c^6}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}} = 1.112\,105\,534\,346\,726\,290\,2 \times 10^{-29}\,\frac{\mathrm{m}^2}{\mathrm{s}^3}\,\mathrm{kg} \tag{22}$$

where T 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.

$$\frac{U}{T} = \text{accreted energy per unit time} \tag{23}$$

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

5. 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:

$$F_G = G\frac{m(8m)}{d^2} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)}{\left(2\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)^2} = \frac{1}{4}\times\frac{c^4}{2G} \tag{24}$$

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'd 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 equals the centripetal force:

$$F_G = G\frac{m\,(8m)}{r^2} = G\frac{\left(\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)\left(8\left(\frac{1}{4G}\frac{\hbar^2}{R_H}\right)^{\frac{1}{3}}\right)}{\left(\left(\frac{16l_p^4}{R_H}\right)^{\frac{1}{3}}\right)^2} = \frac{c^4}{2G} \tag{25}$$

At a distance of one radius, the centers of the masses are at a distance equal to the radius of a particle. 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 within the particle, but beyond the particle boundary, it is seen as the gravitational force. This greatly simplifies the situation, leaving us with just one force.

A centripetal force does not say anything about the nature of a force, except that it is directed towards the center. The gravitational force is something we can now connect to the accretion of matter. We can ask if the centripetal force existed prior to the formation of the first particle in the universe, and presumably it did. If so, then gravity and the centripetal force are consequences of whatever force drives the vortex to spin, and the gravitational force is produced by this more basal force.

6. Some Comments on the Energy of Matter

In [4] we noted that matter appears to have an energy equal to the energy of space. If we sum the one unit representing the energy of space, the one unit for the energy of matter, and a negative unit of energy of gravity, we are left with one unit of energy. It is common thinking these days to say that the energy of the universe is countered by the energy of matter, so that the net mass or energy is zero. We find this to be partly true in hyperverse theory, as the creation of matter appears to be associated with the creation of a negative unit of gravitational energy. However, in hyperverse theory, energy comes via quantum formation and shrinkage, due to expansion. Matter and gravity are both created, and although they can be said to cancel one another, the net energy of the universe is still the energy of space. If all matter were to 'uncompress', and expand back into space, the net energy would still be one unit of energy, the energy of space. The universe would still exist, albeit without any matter.

In [3] two mass estimates were discussed, the Hoyle estimate, $\frac{R_H c^2}{4G}$, and the Carvalho estimate,$\frac{R_H c^2}{2G}$. They differ by a factor of two, the Carvalho estimate being twice that of the Hoyle figure. In light of this work, it could be argued that both mass estimates are correct, as the Carvalho estimate represents the gross mass or energy of the universe, while the Hoyle estimate represents the net mass or energy, the gross energy minus the gravitational energy.

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

Particles are not static, unchanging entities; they are dynamical entities, formed as a means for the expanding universe, at the SEQ level, to conserve angular momentum while maintaining centripetal force. The energy and radii of the component SEQ within a particle 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 mass, the faster space moves, just like water nearer a drain moves faster than water farther away. The speed that space moves towards matter varies with distance, in an inverse square relationship, and this is what is commonly interpreted as curved space. Matter does not curve space; matter absorbs space.

We saw in [3] that the universe is undergoing a geometric mean expansion, in which the large quantities get larger and the small get smaller, and the initial values, which we know as the Planck values, are conserved as the geometric means of their products. The hyperverse has spin, and with expansion, the angular momentum of the observable hyperverse increases. To conserve angular momentum, expansion produces two quantum levels, one based on the energy of the observable hyperverse, and one on its radius. The small radius quantum conserves angular momentum in a simple and straight-forward manner, but the small energy quantum, the quantum of our quantum physics, conserves angular momentum by collapsing and coalescing. To conserve centripetal force and angular momentum, space is crushed into particles of matter. All particles of a kind are identical, having the same mass and radius, because they all are conserving the same initial value of angular momentum.

But expansion is ongoing, the angular momentum of the observable hyperverse constantly increasing, and thus the universe, at the SEQ level, must create more particles of matter, and the mass of each particle must continually increase. It is a dynamical process, and we see this relentless accretion of space as gravity. To understand matter is to understand gravity, as the same process creates them both. Matter and gravity exist as a result of a simple and fundamental principal of physics, the conservation of angular momentum. Gravity, like time, is a manifestation of the expansion of space in our daily lives; gravity exists because space expands.

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