Unified Quantum Gravity Field Equation Describing the Universe from the Smallest to the Cosmological Scales

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Abstract

This paper introduces a new quantum gravity field equation that is derived from collision space-time. It show how changes in energy (collision-space) is linked to changes in matter (collision-time). This field equation can be written in several different forms. Gravity, at the deepest level, is linked to change in gravitational energy over the Planck time. In our view, this is linked to the collision between two indivisible particles, and this collision has a duration of the Planck time. We also show how an equation of the universe, that was revently derived from relativistic Newtonian theory, can also be derived in a new way from the quantum gravity field equation presented in this paper. This equation gives a new explanation for a cosmological redshift that does not seem to be related to expanding space or the big bang hypothesis. Also, the 13.95 billion years of Hubble time do not seem to be at all related to the age of the universe, but to the collision time of the mass in the universe.

Keywords: quantum gravity, quantum mechanics, quantum gravity field equation, Friedmann equation, Haug universe equation, relativistic mass.

1 Background

To fully understand this paper, one should first read some of our background material on collision space-time [1–3]. In the first paper, we published a theory about collision space-time that unifies gravity and quantum mechanics. We tired initially to force it into Minkowski [4] space-time. This, we have come to see, led to a few inconsistencies in the set-up, and it is now clear that our theory predicts, and is consistent with, a three-dimensional space-time, something that will be discussed and that we have already suggested in our first paper on collision space-time. However, we go into much more depth about three-dimensional space-time in the working paper and book chapter referred to above. Our three-dimensional space-time can also be seen as a six-dimensional space and time theory, as there are three time-dimensions and three space-dimensions. Still, as the collision-space and collision-time are just two sides of the same coin, it is more correct to label it a three-dimensional collision space-time than a six-dimensional space and time theory. However, the label is not of great importance; the mathematics and its predictions are much more important.

Einstein [5] already suggested in 1916 that the next theory to explore in gravity was quantum gravity. He worked for much of the remainder of his life in the hope of coming up with a unified quantum gravity theory, but with little or no success. Eddington [6] in 1918 was likely the first to suggest that quantum gravity should somehow be linked to the Planck length (Planck scale), but without telling how. We will claim that little or no progress has been made for more than 100 years, despite massive efforts by very many researchers to come up with an acceptable and powerful quantum gravity theory. Super string theory and quantum loop theory have been nice attempts, but I suggest they have significantly failed. Collision space-time is a new and very promising quantum gravity theory that we will explore further in this paper.

Max Planck [7, 8] introduced the Planck units in 1899, the Planck length, $l_p = \sqrt{\frac{G\hbar}{c^3}}$, the Planck time $t_p = \sqrt{\frac{G\hbar}{c^5}}$, the Planck mass $m_p = \sqrt{\frac{\hbar}{Gc}}$, and the Planck temperature $T_p = \sqrt{\frac{\hbar c^3}{Gk_B^2}}$. It has, since that time, been assumed that one needs to know G and the Planck constant to find the Planck units. However, in recent years, it has been shown how one can find the Planck length and other Planck units independent on G and $\hbar$, see [9–12]. This is of great importance, as it indicates we can indeed detect the Planck scale and, as we will discuss further here, this even leads us to a full quantum gravity theory. This paper's main focus is on a new quantum gravity field equation and what it predicts for gravity and cosmology.

2 Mass is collision-time and energy is collision-length

In collision space-time, rest mass is defined as:

$$\bar{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}} = t_p\frac{l_p}{\bar{\lambda}} \tag{1}$$

where $\bar{\lambda}$ is the reduced Compton [13] wavelength of the mass in question. We could also have used notation $\bar{m}_0$ for the rest mass. The relativistic mass is given by:

$$\bar{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}\gamma = t_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{2}$$

Further, the rest-mass energy as collision length is given by:

$$\bar{E} = l_p\frac{l_p}{\bar{\lambda}} \tag{3}$$

and the relativistic energy is given by

$$\bar{E} = l_p\frac{l_p}{\bar{\lambda}}\gamma = l_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{4}$$

Further, we have the following (which holds for both relativistic and non-relativistic mass and energy):

$$\bar{E} = \bar{m}c \tag{5}$$

This is different from Einstein's $E = mc^2$, and it is therefore easy to dismiss this equation as inaccurate and nonsensical, but it is actually fully consistent with Einstein's formula. To get joule and kilogram we must multiply each side with $\frac{\hbar c}{l_p^2}$. It is just that we use a different definition for mass and energy; one that is a more complete definition than the kilogram definition; see [2].

The kinetic energy is calculated by:

$$\bar{E}_k = \bar{m}c\gamma - \bar{m}c \tag{6}$$

when $v << c$ this correspond to $\bar{E}_k = \frac{1}{2}\bar{m}\frac{v^2}{c^2} = \frac{1}{2}t_p\frac{l_p}{\bar{\lambda}}\frac{v^2}{c^2}$ which is consistent with experiments.

Further, as discussed in [2, 3], the collision-time mass and the collision-length energy are both vectors in three- dimensional space-time (three space dimensions and three time dimensions). So basically, we have:

$$\bar{\boldsymbol{m}} = (\bar{m}_x, \bar{m}_y, \bar{m}_z) = \left(\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{i}, \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{j}, \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{k}\right), \tag{7}$$

where $\bar{\lambda} = |\bar{\boldsymbol{\lambda}}|$, and $\boldsymbol{i}$, $\boldsymbol{j}$, $\boldsymbol{k}$ are the unit vectors of the Compton wavelength.

Further, for energy we have:

$$\bar{\boldsymbol{E}} = (\bar{E}_x, \bar{E}_y, \bar{E}_z) = \left(l_p\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{i}, l_p\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{j}, l_p\frac{l_p}{\bar{\lambda}}\gamma\boldsymbol{k}\right), \tag{8}$$

3 Quantum gravity field equation

Let's first concentrate only on the x-axis. Then we have:

$$\frac{\partial\bar{m}}{\partial t_x} = \frac{l_p}{\bar{\lambda}}\gamma \tag{9}$$

and

$$\frac{\partial\bar{E}}{\partial x} = \frac{l_p}{\bar{\lambda}}\gamma \tag{10}$$

In other words, we have this:

$$\frac{\partial\bar{E}}{\partial x} = \frac{\partial\bar{m}}{\partial t_x} \tag{11}$$

This can be seen as a differential equation for changes in collision-time and collision-length (space) along the x-axis. It describes how changes in mass (collision-time) are related to changes in energy (collision-length). We already introduced this equation in one dimension in 2020; see [2] and again in the summer of 2021 [3] in a book chapter, but we did not discuss many of its implications. To extend it to three-dimensional space-time, we must use:

$$\nabla\bar{E} = \nabla_t\bar{m} \tag{12}$$

where we have the following collision-space and collision-time operators: $\nabla = \frac{\partial}{\partial x}\boldsymbol{i} + \frac{\partial}{\partial y}\boldsymbol{j} + \frac{\partial}{\partial z}\boldsymbol{k}$ and $\nabla_t = \frac{\partial}{\partial t_x}\boldsymbol{i} + \frac{\partial}{\partial t_y}\boldsymbol{j} + \frac{\partial}{\partial t_z}\boldsymbol{k}$.

This field equation describes the relation between energy and mass, as well as between gravitational mass and gravitational energy as they are ultimately the same thing. It also explains the relation between space and time, as energy is collision-space and mass is collision-time.

In our theory, we cannot move in time without moving in space. Further, if we, for example, only move in the y direction of space, then we can only move in the t_y direction of time. Collision-space and collision-time are two sides of the same coin, so collision space-time. Space and time are deeply connected, even more so than in Einstein's theory and its Minkowski space-time, in which time can move without anything moving in space; something that is absurd, in our view. Assume, for example, a light clock: how could it tick without the photon moving in space, and moving in a direction? It could not. One could claim a photon clock is just a tool to measure time and that it has nothing to do with time itself. This, we think, would be a big mistake. Recent research indicates that matter is a light clock that ticks at the Compton periodicity, see [1, 14, 15]. So, in our theory, rest mass consists of photons that are indivisible particles moving, at the speed of light, back and forth over the reduced Compton wavelength of the particle (for example, an electron). For the particle to collide at the Compton frequency, the duration of each collision is the Planck time. This is not an assumption, as this is the time we get from calibrating such models to observable gravitational phenomena; see the papers referred to above.

The field equation above, eqn. (12), is a very general field equation that looks unfamiliar to those used to standard physics and general relativity theory as well as standard quantum mechanics. Field equations, used in standard physics, are typically linked to energy and momentum, and not directly to mass. Our new field equation can also be written in a form that we call Compton momentum, as the Compton momentum we have previously defined as: $\bar{p}_c = \bar{m}c\gamma$, which is identical to the collision-length energy.

That is, as shown correctly in our new theory, there is no difference between energy and momentum (Compton momentum). Our theory is, surprisingly, still fully consistent with the standard relativistic energy momentum relation $E^2 = p^2c^2 + m^2c^4$, because this is linked to standard momentum that is linked again to the de Broglie wavelength, which is a derivative of the Compton wavelength. For example, while the de Broglie wavelength does not exist and is not even mathematically defined for a rest-mass particle, the Compton wavelength is always well defined for any $v < c$. Also, absurdities such as a close to infinite long de Broglie wavelength, when the particle is almost at rest, is avoided by instead using the real matter wave, namely the Compton wavelength. So standard momentum is a derivative of the Compton momentum (collision-space energy) so, if re-written from the Compton momentum, the relativistic energy momentum relation can be simplified to $E^2 = p_c^2c^2$, where $p_c = mc\gamma$ and even to $\bar{E} = \bar{p}_c$. A mathematical proof for this was given in [2]. We will here show the same proof, but even more clearly, as well as discuss the implications of this below.

$$
\begin{aligned}
\bar{E} &= \bar{m}\gamma c \\
\bar{E}^2 &= \bar{m}^2c^2\gamma^2 \\
\bar{E}^2 &= \bar{m}^2c^2\gamma^2 - \bar{m}^2c^2 + \bar{m}^2c^2 \\
\bar{E}^2 &= \frac{\bar{m}^2c^2}{1-v^2/c^2} - \bar{m}^2c^2 + \bar{m}^2c^2 \\
\bar{E}^2 &= \frac{\bar{m}^2c^2}{1-v^2/c^2} - \frac{\bar{m}^2c^2(1-v^2/c^2)}{1-v^2/c^2} + m^2c^2 \\
\bar{E}^2 &= \frac{\bar{m}^2c^2}{1-v^2/c^2} - \frac{\bar{m}^2c^2 - \bar{m}^2v^2}{1-v^2/c^2} + m^2c^2 \\
\bar{E}^2 &= \frac{\bar{m}^2v^2}{1-v^2/c^2} + \bar{m}^2c^2 \\
\bar{E}^2 &= \bar{p}_b^2 + \bar{m}^2c^2 \\
\bar{E} &= \sqrt{\bar{p}_b^2 + \bar{m}^2c^2}
\end{aligned}
\tag{13}
$$

where $\bar{p}_b = \bar{m}v\gamma$, so not yet the standard momentum $p = mv^2\gamma$. Further, to go from the collision-time definition of energy to the standard joule energy definition, one needs to multiply $\bar{E}$ with a composite constant $\frac{\hbar}{l_p^2}c$, that is $\bar{E}\frac{\hbar}{l_p^2} = E$, further $\bar{m}\frac{\hbar}{l_p^2} = m$. So, by multiplying both sides with $\frac{\hbar}{l_p}c$, we get the well-known relativistic energy momentum relation.

$$
\begin{aligned}
\frac{\hbar}{l_p}c\bar{E} &= \frac{\hbar}{l_p}c\sqrt{\bar{p}_b^2 + \bar{m}^2c^2} \\
E &= \sqrt{p^2c^2 + m^2c^4}
\end{aligned}
\tag{14}
$$

That is, the relativistic energy momentum relation, which is a core principle in standard physics, is nothing more than a derivative of a much simpler and deeper relativistic energy mass relation. To go from the standard relativistic energy momentum relation to our collision space-time relativistic energy mass relation, we need to multiply both sides with $\frac{G}{c^4}$ (which is identical to multiplying with $\frac{l_p^2}{\hbar c}$)

$$\begin{aligned}
E &= \sqrt{p^2c^2+m^2c^4} \\
\frac{G}{c^4}E &= \frac{G}{c^4}\sqrt{p^2c^2+m^2c^4} \\
\frac{G}{c^4}E &= \frac{G}{c^4}\sqrt{m^2v^2\gamma c^2+m^2c^4} \\
\bar{E} &= \sqrt{\bar{m}^2v^2\gamma^2+\bar{m}^2c^2} \\
\bar{E}^2 &= \frac{\bar{m}^2v^2}{1-v^2/c^2}+\bar{m}^2c^2 \\
\bar{E} &= \bar{m}\gamma c
\end{aligned} \tag{15}$$

So here, every m is multiplied by G and divided by c^4 to get gravity into the equation. To go to the standard relativistic energy mass principle, we now need to divide by G and multiply by c^4 on both sides. Pay attention also to $\frac{c^4}{G}=\frac{\hbar^2}{l_p}c$, the factor needed to go from collision-length energy to joule. We are then left with joule energy and kilogram mass

$$\begin{aligned}
\bar{E} &= \bar{m}\gamma c \\
\frac{c^4}{G}\bar{E} &= \frac{c^4}{G}\bar{m}\gamma c \\
\frac{c^4}{G}\bar{E} &= \frac{c^4}{G^2}\sqrt{\bar{m}^2v^2\gamma^2+\bar{m}^2c^2} \\
E &= \sqrt{p^2c^2+m^2c^4}
\end{aligned} \tag{16}$$

where $p=mv\gamma$.

That is, the standard relativistic energy momentum relation, which is the cornerstone in today's quantum mechanics, contains no information about gravity. As demonstrated, our theory can provide the same equation, but we are then throwing out all information related to gravity, so how can we then expect to make a quantum gravity theory from $E=\sqrt{p^2c^2+m^2c^4}$? It is simply "impossible".

The Newtonian gravitational constant G is actually just a universal composite constant that, in reality, consists of $G=\frac{l_p^2c^3}{\hbar}$, see [16]. When G is multiplied by the kilogram mass, it is to get $\hbar$ out of the mass and l_p^2 into the mass, thus turning the kilogram mass into a collision space-time mass. When we divide the collision-time mass by G, we are taking the Planck length out of the mass and getting the Planck constant into the mass. Even if the Planck constant is linked to quantisation of matter, it is the Planck length that is needed for gravity, as the Planck constant contains too little information about the quantization, as discussed in, for example, [1]. But how can this be, since Newton clearly did not know about the Planck length or the Planck constant? Actually, Newton never introduced or used any gravity constant, his formula as stated in Principia [17] was $F=\frac{Mm}{R^2}$. The gravity constant was introduced in 1873 by Cornu and Baille [18], at about the same time as the kilogram mass definition became popular in the scientific community, and the notation G for the gravity constant was first introduced in 1894 by Boys [19]. The gravity constant was found from calibration to gravity phenomena in, for example a Cavendish apparatus. Its value represents something missing in the mass. When G is multiplied by the mass, it cancel outs the Planck constant in the mass, and introduces the Planck length into the mass. This is not needed if we instead start out with a more complete model of what matter is, namely collision-time.

The idea of expressing the gravity constant in form of Planck units began at least as far back as 1984, when Cahill [20] suggested $G=\frac{\hbar c}{m_p^2}$ but, as pointed out by Cohen [21] in 1987, this seemed to only lead to a circular problem as it seemed that one had to know G to find m_p or any other Planck unit. This is a view held until recently and has, for example, been repeated as late as 2016 by McCulloch [22]. The first breakthrough came in 2017 when for the first time was demonstrated that the Planck length can easily be extracted without knowledge of G, and later we showed it can be extracted with no knowledge of G and $\hbar$.

In other words, to use the standard mass and energy definition is taking gravity out of both energy and mass. This works well if we only work with standard energy and mass, and are not also interested in gravity. Standard energy are linked to frequency and standard mass are linked to a Compton frequency ratio see [23]. At end of each Compton time $(\frac{\bar{\lambda}}{c})$ there is collision between two indivisible particles (in elementary particles such as an electron) where the collision itself lasts the Planck time. This collision-time is totally missing in standard energy and mass, and this is the aspect of energy and mass that is causing gravity. Standard energy and mass are incomplete mass and energy definitions. However this is indirectly fixed by multiplying M with G in standard gravity theory, but gravity is missing from all other parts of physics, such as standard quantum mechanics.

Further, the standard relativistic mass energy principle is also unnecessarily complex and has therefore led to unnecessarily complex quantum mechanics. Our field equation $\nabla\bar{E}=\nabla_t\bar{M}$ is consistent with the much deeper, relativistic, energy mass collision space-time relation. It is the field equation that can describe anything from quantum mechanics to quantum gravity; and even from macroscopic objects up to, and including, the cosmological scale, as we will demonstrate in this paper.

Our theory is not linked to Minkowski space-time, but three-dimensional space-time. It is also hard to see how it is related to gravity before we work with our field equation a bit, as we will do below:

$$\begin{aligned}\nabla\bar{E} &= \nabla_t\bar{M}\\ c^3t_p\nabla\bar{E} &= c^3t_p\nabla_t\bar{M}\\ \frac{c^3t_p\nabla\bar{E}}{R^2} &= \frac{c^3t_p\nabla_t\bar{M}}{R^2}\end{aligned} \tag{17}$$

Now, pay attention to $c^3t_p\nabla_t\bar{M}$ being equal to $c^3\bar{M}$, which again is equal to GM, so we have:

$$\begin{aligned}\frac{c^3t_p\nabla\bar{E}}{R^2} &= \frac{GM}{R^2}\\ \frac{c^3t_p\nabla\bar{E}}{R^2} &= g\end{aligned} \tag{18}$$

That is, the gravitational acceleration field is created by gravitational energy (collision-length) over the Planck time. The gravitational acceleration field g is still the same as before, $g = \frac{GM}{R^2}$, which also can be written as $g = \frac{c^3\bar{M}}{R^2}$.

So, it does not give new predictions for gravitational acceleration, at least not at first glance, but we will look at some interesting special cases later in this paper.

Still, even at this stage, this field equation gives deep insight into how gravity is linked to the Planck scale. Gravity is, in this view, detection of the Planck scale and is why we, in recent years, have been able to demonstrate how to find the Planck length and Planck time from a series of gravitational observations without any knowledge of G or $\hbar$. The Planck scale is not only something we can derive from dimensional analysis, as Max Planck did, but gravity is also the Planck scale. Each single Planck event (collision between two indivisible particles) is so incredibly small (the Planck length radius) and has such a short duration of the Planck time, that it is impossible now, and likely in any future time, to detect a single such event directly. However, a macroscopic amount of matter contains an enormous amount of these Planck events, so we can easily detect the aggregate of them as gravity, even doing so from a handful of matter. And since we also can find the Compton frequency in matter, we can even extract the information about a single such event from a long series of observable gravity phenomena. And when this is understood, we can also predict all sorts of observable gravity phenomena from just two constants, namely the Planck length and the speed of gravity $c_g = c$. For example, even in a clump of matter half a kilogram in weight, we can measure, for example, the gravitational acceleration it causes on a much smaller body by using a Cavendish apparatus.

We can re-write the equation above as:

$$\frac{c^2l_p\nabla_t\bar{M}}{R^2} = g \tag{19}$$

That is, we can decide if we want to describe gravity as change in collision-space (energy) or, as here, as change in collision-time (mass). This is because collision-space and collision-time are two sides of the same coin. Again, one cannot move in time without moving the same in space, nor move in space without moving the same in time. Collision space-time is the very essence of gravity.

We can also re-write the field equation above as:

$$\frac{c^2l_p}{R^2}\nabla\bar{E} = g \tag{20}$$

and also we have

$$\frac{c^3t_p}{R^2}\nabla_t\bar{M} = g \tag{21}$$

In standard gravity, one often likes to express equations through energy density or mass density, and we can easily also re-write our equations to do this.

$$\begin{aligned}\frac{c^3t_p}{R^2}\nabla\bar{E} &= \frac{GM}{R^2}\\ \frac{c^3t_p}{R^2}\nabla\bar{E} &= \frac{c^3\bar{M}}{R^2}\\ \frac{c^3t_p\nabla\bar{E}}{R^3} &= \frac{\frac{4}{3}\pi c^3\bar{M}}{\frac{4}{3}\pi R^3}\\ \frac{t_p\nabla\bar{E}}{R^3} &= \frac{4\pi\bar{\rho}}{3}\end{aligned} \tag{22}$$

Or, if we use energy density (collision-space energy which is gravitational energy) instead of mass density, then we get:

$$\frac{l_p \nabla \bar{E}}{R^3} = \frac{4\pi \bar{\rho}_e}{3} \tag{23}$$

where $\bar{\rho}_e = \frac{\bar{E}}{\frac{4}{3}\pi R^3}$. We also get

$$\frac{l_p \nabla_t \bar{M}}{R^3} = \frac{4\pi \bar{\rho}_e}{3} \tag{24}$$

or we can re-write this to

$$\frac{t_p \nabla_t \bar{M}}{R^3} = \frac{4\pi \bar{\rho}}{3} \tag{25}$$

This last result is particularly nice because, in the special case of $R = R_h = \frac{GM}{c^2} = \frac{c^3 \bar{M}}{c^2} = \bar{M}c$, we get:

$$\begin{aligned} \frac{t_p |\nabla_t \bar{M}|}{\bar{M}^3 c^3} &= \frac{4\pi \bar{\rho}}{3} \\ \frac{1}{\bar{M}^2 c^3} &= \frac{4\pi \bar{\rho}}{3} \\ \frac{1}{\bar{M}^2} &= \frac{4\pi c^3 \bar{\rho}}{3} \end{aligned} \tag{26}$$

and if we set $\bar{\rho}$ equal to the mass density of the Haug universe ($\bar{\rho} = \bar{\rho}_u = \frac{\bar{M}_u}{\frac{4}{3}\pi R_h^3}$), then we have $H_0 = \frac{1}{\bar{M}_u}$ and therefore

$$H_0^2 = \frac{4\pi c^3 \bar{\rho}_u}{3} \tag{27}$$

Further $c^3 \bar{M} = GM$ so we have:

$$H_0^2 = \frac{4\pi G \rho_u}{3} \tag{28}$$

where $\rho = \frac{M_u}{\frac{4}{3}\pi R_h^3}$.

That is, we are using the kilogram mass instead of the collision-time mass, just so researchers familiar with the standard model (general relativity theory), and not our theory, can more easily see how it simultaneously both is similar to, and different than Friedmann's [24] theory. The Friedmann critical universe equation is expressed as:

$$H_0^2 = \frac{8\pi G \rho_c}{3} \tag{29}$$

So, this means that our new model predicts twice the mass density in the observable universe as does the Friedmann model when using only the critical mass of the Friedmann model. However, the Friedmann equation above is only valid for a critical universe, the full Friedman equation has a k parameter and, in addition, an ad-hock inserted cosmological constant. This we do not use or need in our model; neither if we derive our cosmological model from our quantum gravity field equation as demonstrated here, nor if derived from full relativistic Newtonian theory [25]. If derived from relativistic Newton mechanics, the k parameter is initially there but cancels out in the full derivation.

This is of great importance as it shows that the Haug universe equation, derived only based on considering relativistic mass in Newton mechanics, is consistent with, and can be derived from, our quantum gravity field equation. In the case of general relativity theory, the field equation of Einstein came first, then Friedmann developed his solution to it. In our case, we had the quantum gravity theory first with a field equation, but we did not go ahead and derive an equation for the cosmos from it. We only had the general field equation and only in one dimension. We then derived a new equation for the universe, considering relativistic mass in the Newton equation, but now we see that this also can be derived from our new quantum gravity field equation.

The cosmological redshift is given by:

$$Z = \frac{dH_0}{c} \tag{30}$$

where H_0 is the Hubble constant.

What standard physics has not understood is that the Hubble constant is divided by the mass of the universe. Well, this is not the case in standard physics where one are using the incomplete kilogram mass. Further, the Friedmann critical mass is off by $\frac{1}{2}$ from what it is in our mode. However, the Hubble constant in our model is arrived at by:

$$H_0 = \frac{c\bar{\lambda}_u}{l_p^2} = \frac{1}{t_p \frac{l_p}{\bar{\lambda}_u}} = \frac{1}{\bar{M}_u} \tag{31}$$

The cosmological redshift is therefore given by:

$$Z = \frac{1}{\frac{c\bar{M}_u}{d}} = \frac{1}{\frac{c^3\bar{M}_u}{c^2 d}} = \frac{1}{\frac{GM_u}{c^2 d}} \tag{32}$$

which is nothing else than one divided by gravitational redshift. The reason why it is one divided by the standard gravitational redshift one can be understood by reading the next section.

4 Field equation taking into account M and relativistic mass m

Einstein [26], at the end of his famous 1905 paper, came up with incorrect suggestions for relativistic mass. He was likely also unaware that Lorentz [27] had published the correct relativistic mass formula already in 1899. Einstein and the general relativity community [28, 29] had abandoned relativistic mass before even fully investigating what it can lead to. The relativistic mass concept indeed does not seem fully compatible with four-dimensional Minkowski space-time but, instead of abandoning relativistic mass, one should have investigated other forms for space-time and looked at the many implications of introducing relativistic mass. Again, we are using a three-dimensional space-time. We have, in previous papers, shown that taking into account relativistic mass gives predictions that fit supernova data extremely well, without the need for the dark energy hypothesis [30], as well as giving us a new and simpler cosmology [25], and a perfect fit to the Planck scale for micro black holes, something that general relativity theory cannot do. Introducing relativistic mass also means wormholes are impossible and therefore just a hypothesis that is revealed as a mathematical artifact from an incomplete theory: GRT.

The field equations presented in the previous section do not consider relativistic mass for the small mass m that M is acting on. That is, they are for cases where m is moving slowly relative to the speed of light. Here, we will also extend this to when m can move close to the speed of light due to gravitational acceleration. We start with a relativistic modified Newtonian equation:

$$\bar{m}c^2\gamma - \bar{m}c^2 - \frac{c^3\bar{M}\bar{m}\gamma}{R} = 0 \tag{33}$$

Here, we use the collision-time mass and not the kilogram mass. However as G in standard theory is indirectly used, without the physics' community being aware of it, to turn M into a collision-time mass, this because $\frac{GM}{c^3} = \bar{M}$. So to make it easier to understand for researchers used to standard gravity theory, we can also start to work from the more standard GM notation. The only difference is that we are making m relativistic by multiplying it with the Lorentz factor: $m\gamma = \frac{m}{\sqrt{1-\frac{v^2}{c^2}}}$.

This gives us:

$$\begin{aligned} mc^2\gamma - mc^2 - \frac{GMm\gamma}{R} &= 0 \\ mc^2 - mc^2\sqrt{1-\frac{v^2}{c^2}} &= \frac{GMm}{R} \end{aligned} \tag{34}$$

The mass M is not relativistic as we are observing m from M (only m is relativistic relative to us). Solved with respect to v gives $v = \sqrt{\frac{GM}{R} - \frac{G^2M^2}{c^2R^2}}$, and replacing this back into the equation gives

$$\begin{aligned} mc^2 - mc^2\sqrt{1-\frac{2GM}{c^2R}+\frac{G^2M^2}{c^4R^2}} &= \frac{GMm}{R} \\ \frac{c^2}{R} - \frac{c^2}{R}\sqrt{1-\frac{2GM}{c^2R}+\frac{G^2M^2}{c^4R^2}} &= \frac{GM}{R^2} \end{aligned} \tag{35}$$

Next, keep in mind that $\bar{M} = \frac{G}{c^3}M = t_p\frac{l_p}{\bar{\lambda}_M}$ and that $\frac{\partial\bar{M}}{\partial t} = \frac{l_p}{\bar{\lambda}_M}$, $\bar{E} = \frac{G}{c^2}M = \bar{M}c = l_p\frac{l_p}{\bar{\lambda}_M}$ and $\frac{\partial\bar{E}}{\partial t} = \frac{l_p}{\bar{\lambda}_M}$, so we must have:

$$\begin{aligned} \frac{c^2}{R} - \frac{c^2}{R}\sqrt{1-\frac{2c\bar{M}}{R}+\frac{c^2\bar{M}^2}{R^2}} &= g \\ \frac{c^2}{R} - \frac{c^2}{R}\sqrt{1-\frac{2\bar{E}}{R}+\frac{c^2\bar{M}^2}{R^2}} &= g \\ \frac{c^2}{R}\left(1-\sqrt{1-\frac{2l_p\nabla\bar{E}}{R}+\frac{c^2t_p^2\nabla_t\bar{M}^2}{R^2}}\right) &= g \end{aligned} \tag{36}$$

where $g = \frac{GM}{R^2} = \frac{c^3\bar{M}}{R^2}$.

We can also write it as:

$$\frac{c^2}{R} - \frac{c^2}{R}\sqrt{1 - \frac{2ct_p\nabla_t\bar{M}}{R} + \frac{c^2t_p^2\nabla\bar{E}^2}{R^2}} = g \tag{37}$$

When $v << c$ then $\frac{G^2M^2}{c^4R^2}$ will be insignificant relative to $\frac{GM}{R}$, so we can then skip this part and simplify the equation above to:

$$\frac{c^2 l_p\nabla\bar{E}}{R^2} = g \tag{38}$$

as well as

$$\frac{c^3 t_p\nabla\bar{E}}{R^2} = g \tag{39}$$

These are the same equations we got directly from our general field equation when not considering that the gravitational mass M reacted on was relativistic ($m\gamma$). Also, here we see that the gravitational acceleration field is linked to the change in gravitational energy (collision-length) over the Planck time.

We can alternatively write this as:

$$\frac{c^3 t_p\nabla_t\bar{M}}{R^2} = g \tag{40}$$

as well as

$$\frac{c^2 l_p\nabla_t\bar{M}}{R^2} = g \tag{41}$$

It can perhaps seem absurd that we can link the gravitational acceleration field only to changes in collision-space ($\nabla\bar{E}$) or only to changes in collision-time ($\nabla_t\bar{M}$), but this is no mystery as soon as one understands time and space are just two sides of the same coin. This is naturally inconsistent with Minkowski space-time which, in our view, is an incomplete and actually flawed model of reality. Despite Minkowski space-time's great success, it has not led us to any accepted unified quantum gravity theory.

In the extreme case where $v = c$, we get $R = \frac{GM}{c^2} = \bar{M}c = R_h$. This is not the Schwarzschild radius $R_s = \frac{2GM}{c^2}$, but the Haug [25] radius R_h, because we are taking into account relativistic mass, which is ignored in general relativity theory and also therefore also in the derivation of the Schwarzschild metric and the Schwarzschild radius. In this special case (when m are at the Haug radius), we get $v = \sqrt{\frac{GM}{R} - \frac{G^2M^2}{c^2R_hR}} = \sqrt{\frac{GM}{R_h}} = c$, and so we have that:

$$\begin{aligned}
\frac{c^2}{R_h} - \frac{c^2}{R_h}\sqrt{1 - \frac{GM}{c^2R_h}} &= \frac{GM}{R_h^2} \\
\frac{c^2}{R_h} - \frac{c^2}{R_h}\sqrt{1 - \frac{GM}{c^2\frac{GM}{c^2}}} &= g_h \\
\frac{c^2}{R_h} &= g_h \\
\frac{GM}{R_h^2} &= g_h \\
\frac{t_p\nabla\bar{E}}{R_h^2} &= g_h
\end{aligned} \tag{42}$$

where $g_h = \frac{GM}{R_h^2} = \frac{c^3\bar{M}}{R_h^2}$. We also have

$$\frac{c^2 l_p\nabla\bar{E}}{R_h^2} = g_h \tag{43}$$

that also can be written as

$$\frac{c^3 t_p\nabla_t\bar{M}}{R_h^2} = g_h \tag{44}$$

That is consistent with:

$$\frac{c^2 l_p\nabla_t\bar{M}}{R_h^2} = g_h \tag{45}$$

Further $g_h = \frac{GM}{R_h} = \frac{c^4}{GM}$. In general relativity theory, one would have $g_s = \frac{GM}{R_s^2} = \frac{c^4}{4GM}$. Further, in our theory we have:

$$\begin{aligned}\frac{c}{\bar{M}} = &= \frac{c^4}{GM} \\ \frac{c}{\bar{M}} = &= \frac{1}{\frac{GM}{c^4}} \\ \frac{1}{\bar{M}c} = &= \frac{1}{\frac{GM}{c^2}}\end{aligned} \tag{46}$$

and since $H_0 = \frac{1}{\bar{M}_u} = \frac{1}{t_p \frac{l_p}{\bar{\lambda}_u}}$ where $\bar{\lambda}_u$ is the reduced Compton wavelength of the mass in the Haug universe, then we have:

$$\frac{H_0}{c} = \frac{1}{\frac{GM_u}{c^2}} \tag{47}$$

Next we multiply on both sides by the distance to the observed gravitational redshift, and we get:

$$\frac{dH_0}{c} = \frac{1}{\frac{GM_u}{dc^2}} \tag{48}$$

and since $\frac{dH_0}{c}$ is also an observable in relation to d and cosmological redshift, we can now understand that the cosmological redshift is nothing more than a special form of gravitational redshift. The cosmological redshift is, in other words, predicted from our new quantum gravity theory, while in standard theory it is a separate phenomenon that need a separate constant: the Hubble constant. In our model, the Hubble constant is simply one divided by the collision-time mass of the observable universe. And since the collision-time mass multiplied by c is the collision-length energy, then the cosmological redshift is the distance to the observation (emitter) divided by the collision-length energy of the observable universe (the Hubble sphere).

The cosmological redshift has likely nothing to do with expanding space, and there was likely no big bang. Any large volume with a given density of mass-energy (collision space-time) will have an information horizon, which is, in this case, identical to the Hubble radius, the Haug radius, and also to the Schwarzschild radius of the Friedmann critical universe. This is because $R_h = \frac{GM_u}{c^2} = \frac{2GM_c}{c^2}$, because the mass density is predicted to be twice as high in our model as in the Friedmann model. That is $M_u = 2M_c$.

Much of modern cosmology is interpreted through a mathematical lens. This lens has been general relativity theory. It has not been able to unify with quantum mechanics, nor the Planck scale. Our new theory is a new and more powerful mathematical lens (model) that unifies quantum mechanics as well as quantum gravity from the smallest to the largest scales of the universe.

It is said that the age of the universe is about $\frac{1}{H_0}$ $approx.$13.95 billion years, using a Hubble constant of 70 (km/s)/Mpc. However, in our model, the Hubble constant is one divided by the collision time of the universe, so the Hubble time of the universe is the collision-time of the universe.

$$T_H = \frac{1}{H_0} = \bar{M}_u = t_p \frac{l_p}{\bar{\lambda}_u} \approx 13.95 \text{ billion years} \tag{49}$$

This has nothing to do with the age of the universe, but with the fact that there are $\frac{l_p}{\bar{\lambda}_u} \approx 8.16 \times 10^{60}$ collisions per Planck time, and that each last one Planck time per Planck time, which, when aggregated, is 13.95 billion years. Is it as though you have an enormous quantity of clocks standing in the same room and ticking; each tick lasting, for example, for one second, and you aggregate, for example, 1,000 clocks in the room, and say that together they have ticked 1000 seconds per second. It has nothing to do with the fact that 1,000 seconds have gone by since something; it is just that you have 1,000 clocks that have each ticked one second. The 13.95 billion years have, in other words, nothing to do with a big bang and the age of the universe or time since the hypothetical big bang. The universe is likely everlasting and infinite. But there is an information horizon which is linked to the Hubble radius. Inside this radius is the aggregated ticking time per Planck time from all the particles in the universe, that each tick at their Compton frequency, but where the collision of each of these Compton periodicities is the Planck time, so this adds up to 13.95 billion years per Planck time. This naturally goes strongly against the big bang model. Despite the popularity of the big bang model, we hope researchers not ascribing to prejudice will reject this model, after studying it carefully to make up their minds. Our new collision space-time theory, after all, unifies the Planck scale with gravity in a very simple and powerful way.

5 Conclusion

We have presented a new general field equation $\nabla\bar{E} = \nabla_t\bar{m}$ that describes quantum gravity and quantum mechanics at the deepest level. We can also write $l_p\nabla\bar{E} = t_pc\nabla_t\bar{m}$ which corresponds, and explains $\bar{E} = \bar{m}c$ that is consistent with $E = mc^2$. However, the joule energy and kilogram mass have taken gravity out of the energy and mass definition. We have also proved that $\bar{E} = \bar{m}c$ leads to $E^2 = p^2c^2 + m^2c^4$ when taking gravity out of the collision-time mass and the collision-length energy. Today's physics is nothing more than an overly-complex derivative of a much simpler and deeper reality. We say the deepest level because current quantum mechanics is just a derivative of this deeper quantum gravity mechanics. It describes gravity at the quantum level, which is again related to macroscopic level and even the cosmos. All gravity is directly linked to the change in gravitational energy over the Planck time, but also the change in mass over the Planck time; these are two sides of the same coin. The Planck scale has, in recent years, been detected [10] or, we should say, understood to a much deeper extent than before. Detection of gravity is detection of the Planck scale.

Our field equation also leads to a new universe equation (model) linked to the Hubble scale of the universe. This can be seen as an alternative to general relativity theory and the Friedmann equation. It shows that the Hubble constant is, in reality, one divided by the collision-time of the observable universe. It shows that cosmological redshift is nothing more than a special type of gravitational redshift. It has likely nothing to do with the hypothetical expansion of the universe and the big bang hypothesis. Also, the Hubble time has likely nothing to do with the age of the universe; this is simply the collision-time of the whole mass of the observable universe. It is like having $8.16 \times 10^{6}0$ clocks each ticking the Planck time per Planck time, so the aggregated tick time of all these clocks (that ultimately are mass) is approximately 13.95 billion years per Planck time. This simply means there are a lot of particles in the observable universe, but also that mass is linked to Compton periodicity, which is linked to the Planck time. At each Compton time, there is a collision between indivisible particles lasting the Planck time.

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