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Planck Quantised General Relativity Theory Written on Different Forms

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Abstract

This paper is a brief review of our work on the Planck quantized version of general relativity theory. It demonstrates several straightforward methods to rewrite the same equations that we have already presented in other papers. We also explore a relatively new general relativity-inspired field equation based on the original Newtonian mass, which is very different from today's kilogram mass. Additionally, we examine two other field equations based on collision space-time, where both energy and matter can be described simply as space and time. We are thereby fulfilling Einstein's dream of a theory where energy and mass are not needed, or are just aspects of space and time. If this is extended beyond the 4-dimensional space-time formalism of general relativity theory to a 6-dimensional framework with 3 space dimensions and 3 time dimensions, this ultimately reveals that they are two sides of the same coin. In reality, it is a three-dimensional space-time theory, where space and time are just two sides of the same coin.

Keywords

General Relativity, Planck Quantization, Compton Frequency, Composite Constant G, Quantum Gravity, Unification, Collision Space-Time

1. Multiple Ways to Write Haugs' Planck Quantized General Relativity Theory

Max Planck [1] [2] introduced what today is known as the Planck units already in 1899. He came up with what he called natural units: length: $l_p = \sqrt{\frac{G\hbar}{c^3}}$, time: $t_p = \sqrt{\frac{G\hbar}{c^5}}$, mass: $m_p = \sqrt{\frac{\hbar c}{G}}$, and temperature: $T_p = \frac{1}{k_b}\sqrt{\frac{\hbar c^5}{G}}$. The Planck energy is simply the Planck temperature multiplied by the Boltzman constant

(k_b) which gives: $E_p = \sqrt{\frac{\hbar c^5}{G}}$. These are today known as the Planck units. The Planck length is assumed to play an important role in quantum gravity; see, for example, [3] [4] [5] [6].

Einstein [7] already suggested the next step in gravity in 1916:

> Because of the intra-atomic movement of electrons, the atom must radiate not only electromagnetic but also gravitational energy, if only in minute amounts. Since, in reality, this cannot be the case in nature, then it appears that the quantum theory must modify not only Maxwell's electrodynamics but also the new theory of gravitation. —A. Einstein

In 1918, Eddington [8] proposed that quantum gravity had to be linked to the Planck length. String theory and Loop Quantum Gravity (LQG) are today the best-known attempts to develop quantum gravity. In our view, they are failed attempts, even though much interesting mathematics and concepts emerged from string theory. Over the last few years, we have developed a very simple and, we believe, powerful quantum gravity theory. In this paper, we will briefly outline multiple ways to formulate this new quantum gravity theory. We ask the readers to look up [9] [10] [11] for in more depth about our theory. This paper is mostly about how what we already have presented easily can be re-written by using several different Planck units, because in depth understanding of the theory the papers just mentioned is a good start.

In 2014, Haug outlined a theory where he proposed that matter consists of an indivisible length, which he later demonstrated had to be the Planck length. Additionally, he suggested that matter also has a wavelength known as the Compton wavelength, thus incorporating wave-particle duality, albeit with a significantly different interpretation compared to standard theory [12]. In 2016, Haug [13] introduced a Planck quantized version of Einstein's field equation in general relativity by simply assuming that all masses consisted of Planck masses, essentially regarding the Planck mass as the ultimate particle. Additionally, Haug assumed that the so-called Newtonian gravitational constant, which Newton never invented nor used (see [10] [14]), could be expressed in composite form simply by solving the Planck length formula for G, yielding $G = \frac{l_p^2 c^3}{\hbar}$ see [15], thus making it possible to express Einstein's [7] field equation in the following form:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi l_p^2}{c\hbar} T_{\mu\nu} \tag{1}$$

Additionally, Haug [16] [17] [18] [19] later demonstrated that one can find the Planck length independently of any knowledge of G and $\hbar$ and even c for any kilogram mass, ranging from the smallest to the largest, including cosmological objects and even the Hubble sphere [20] [21]. This means one can avoid the circular argument presented by Cohen [22] in 1987 and that has been repeated at least until 2016 [23], which stated that one needs to know G to find the Planck units, so there is no reason to express G in terms of Planck units as it would lead back to G. However, Haug has solved this circular problem for any mass in the papers mentioned above. It is also important to note that Newton never invented nor used G in his theory, nor did Cavendish [24] do so, as discussed by for example Clotfelter and Sean [25] [26]. Furthermore, Haug [17] has claimed that any kilogram mass can be expressed simply by solving the Compton [27] wavelength formula: $\lambda = \frac{h}{mc}$, which gives:

$$M = \frac{h}{\lambda}\frac{1}{c} = \frac{\hbar}{\bar{\lambda}}\frac{1}{c} \tag{2}$$

where $\bar{\lambda}$ is the reduced Compton wavelength and $\hbar = \frac{h}{2\pi}$ is the reduced Planck constant also known as the Dirac constant. This naturally does not mean composite masses have a single Compton wavelength. Rather, it simply means that the Compton wavelength derived from a composite mass, found by $\lambda = \frac{h}{mc}$, must be equal to the aggregate of the physical Compton wavelengths of all elementary particles (and photons) making up the composite mass, as discussed in [11].

This means the Schwarzschild metric can be written on the form:

$$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2 \tag{3}$$

The important point to understand here is that the term $\frac{l_p}{\bar{\lambda}_M}$ represents the reduced Compton frequency per Planck time: $f = \frac{c}{\bar{\lambda}_M}t_p = \frac{l_p}{\bar{\lambda}_M}$, which represents the quantization of matter and gravity. This is discussed in more detail in Haug's papers on the topic, particularly in [9]. Here, we will briefly mention that we could also naturally express the same idea using Planck time and Compton time instead. This yields $G = \frac{t_p^2 c^5}{\hbar}$, and Einstein's field equation can be rewritten as:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi c t_p^2}{\hbar}T_{\mu\nu} \tag{4}$$

and

$$M = \frac{h}{\lambda}\frac{1}{c} = \frac{h}{t_c}\frac{1}{c^2} = \frac{\hbar}{t_c}\frac{1}{c^2} \tag{5}$$

where $t_c = \frac{\lambda}{c}$ is the Compton time, and $\bar{t}_c = \frac{\bar{\lambda}}{c}$ is the reduced Compton time, which give a Schwarzschild metric of the form:

$$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r}\right)c^2 \mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2ct_p}{r}\frac{t_p}{\bar{t}_c}\right)c^2 \mathrm{d}t^2 + \left(1 - \frac{2ct_p}{r}\frac{t_p}{\bar{t}_c}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{t_p}{\bar{t}_c}\right)c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{t_p}{\bar{t}_c}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2 \tag{6}$$

This is simply a choice we have made to express the quantization in the Schwarzschild metric in terms of Planck time instead of Planck length. The term $\frac{t_p}{\bar{t}_c} = \frac{l_p}{\bar{\lambda}_M}$ and is still representing the reduced Compton frequency per Planck time, which is the quantization in matter and gravity. Recent research indicates also that matter ticks at the Compton frequency, see [28] [29].

Alternatively, we could have expressed it in terms of Planck mass, which would yield $G = \frac{\hbar c}{m_p^2}$, with Einstein's field equation as:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi\hbar}{m_p^2 c^3} T_{\mu\nu} \tag{7}$$

and Schwarzschild metric can now be written as:

$$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r}\right)c^2 \mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{M}{m_p}\right)c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{M}{m_p}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2 \tag{8}$$

where $\frac{M}{m_p}$ both represent the number of Planck masses in the gravitational mass and the reduced Compton frequency per Planck time, this was basically what Haug [13] did already in 2016 where he called $\frac{M}{m_p}$ for *N*. However back then we had not linked this yet to the reduced Compton frequency per Planck time, which is essential to understand gravity at its deepest level.

We could also have done it through Planck energy this would give $G = \frac{\hbar c^5}{E_p^2}$ and Einstein's field equation as:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi\hbar c}{E_p^2} T_{\mu\nu} \tag{9}$$

and Schwarzschild metric can now be written as:

$$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{E}{E_p}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{E}{E_p}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2 \tag{10}$$

where $\frac{E}{E_p}$ represents both the number of Planck masses (in rest-mass energy form) in the gravitational mass and the reduced Compton frequency per Planck time.

The theory can be fully integrated with quantum mechanics, but only after making slight modifications to quantum mechanics as described in [11].

Table 1 summarizes different approaches to incorporating the Planck scale into Einstein's field equations. The last two entries in the table pertain to Einstein-inspired field equations using the original Newton mass (the second to last entry) and the recently introduced collision-time mass and collision-length energy (the last entry). We will cover these two field equations first in sections 2 and 3.

Table 1. Different ways one can express Einstein's field equation related to Planck units.

Form:	Einstein's field equation:	Corresponding G:
Standard form:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$	G
Planck length:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi l_p^2}{c\hbar} T_{\mu\nu}$	$G = \frac{l_p^2 c^3}{\hbar}$
Planck time:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi c t_p^2}{\hbar} T_{\mu\nu}$	$G = \frac{t_p^2 c^5}{\hbar}$
Planck mass:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi\hbar}{m_p^2 c^3} T_{\mu\nu}$	$G = \frac{\hbar c}{m_p^2}$
Planck energy:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi\hbar c}{E_p^2} T_{\mu\nu}$	$G = \frac{\hbar c^5}{E_p^2}$
Planck force:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi}{F_p} T_{\mu\nu}$	$G = \frac{c^4}{F_p}$
Form:	Einstein's inspired field equations:	Corresponding G:
Newton mass or energy: $E_n = M_n c^2$:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi}{c^4} N_{\mu\nu}$	No need even if S.I. units.
Collision space-time: $\bar{E} = \bar{M} c$:	$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = 8\pi E_{\mu\nu}$	No need even if S.I. units.

Table 2 summarizes how to express the Schwarzschild metric in various Planck-quantized forms; they are all essentially the same.

As demonstrated by Haug the reduced Compton frequency per Planck time which is equal to $f = \frac{c}{\bar{\lambda}} t_p = \frac{l_p}{\bar{\lambda}_M} = \frac{t_p}{\bar{t}_c} = \frac{M}{m_p} = \frac{E}{E_p} = \frac{g}{a_p}$ can be found independent on knowing *G*, see [30], and even for the critical mass in the Friedmann universe [21].

In a similar way, one can re-write other metrics derived from general relativity, such as the Reissner-Nordström [31] [32], Kerr [33], Kerr-Newman [34] [35], and Haug-Spavieri [36] metrics. This means one is incorporating both the Planck scale and quantization through the reduced Compton frequency per Planck time in these metrics.

Table 3 summarizes how to express the extremal solution of the Reissner-Nordström metric and the Haug-Spavieri minimal solution of general relativity; they are essentially the same. However, the standard form of writing it does not uncover the quantization of gravity, while the alternative ways of writing this metric do so.

The extremal solution of the Reissner-Nordström [31] [32] metric, as well as the minimal solution of the Haug-Spavieri metric, is given by:

$$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r} + \frac{G^2 M^2}{c^4 r^2}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2} + \frac{G^2 M^2}{c^4 r^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

Table 2. Different ways one can write the Schwarzschild metric.

Form:	Schwarzschild metric:
Standard form:	$\mathrm{d}s^2 = -\left(1 - \frac{2GM}{c^2 r}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck mass quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2Gn_p m_p}{c^2 r}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2Gn_p m_p}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck length quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r} \frac{l_p}{\bar{\lambda}_M}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r} \frac{l_p}{\bar{\lambda}_M}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck time quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r} \frac{t_p}{\bar{t}_c}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r} \frac{t_p}{\bar{t}_c}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck mass quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r} \frac{M}{m_p}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r} \frac{M}{m_p}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck energy quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r} \frac{E}{E_p}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r} \frac{E}{E_p}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$
Planck acceleration quantized:	$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r} \frac{g}{a_p}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r} \frac{g}{a_p}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$

Table 3. Different ways to express the extremal solution of the Reissner-Nordström metric and the Haug-Spavieri minimal solution of general relativity; they are all essentially the same. However, the standard form of writing it does not uncover the quantization of gravity, while the alternative ways of writing this metric do so.

Form:	Extremal solution Reissner-Nordström metric or Haug-Spavieri minimal solution:
Standard form:	$ds^2 = -\left(1-\frac{2GM}{c^2 r}+\frac{G^2M^2}{c^4r^2}\right)c^2dt^2+\left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1}dr^2+r^2d\Omega^2$
Quantized form:	$ds^2 = -\left(1-\frac{2Gn_pm_p}{c^2 r}+n_p^2G\frac{m_p^2}{r^2}\frac{G}{c^4}\right)c^2dt^2+\left(1-\frac{2Gn_pm_p}{rc^2}+n_p^2G\frac{m_p^2}{r^2}\frac{G}{c^4}\right)^{-1}dr^2+r^2d\Omega^2$
Quantized form:	$ds^2 = -\left(1-\frac{2Gn_pm_p}{c^2 r}+n_p^2k\frac{q_p^2}{r^2}\frac{G}{c^4}\right)c^2dt^2+\left(1-\frac{2Gn_pm_p}{rc^2}+n_p^2k\frac{q_p^2}{r^2}\frac{G}{c^4}\right)^{-1}dr^2+r^2d\Omega^2$
Planck length quantized:	$ds^2 = -\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}+\frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}+\frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)^{-1}dr^2+r^2d\Omega^2$
Planck time quantized:	$ds^2 = -\left(1-\frac{2l_p}{r}\frac{t_p}{\bar{t}_c}+\frac{l_p^2}{r^2}\frac{t_p^2}{\bar{t}_c^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{t_p}{\bar{t}_c}+\frac{l_p^2}{r^2}\frac{t_p^2}{\bar{t}_c^2}\right)^{-1}dr^2+r^2d\Omega^2$
Planck mass quantized:	$ds^2 = -\left(1-\frac{2l_p}{r}\frac{M}{m_p}+\frac{l_p^2}{r^2}\frac{M^2}{m_p^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{M}{m_p}+\frac{l_p^2}{r^2}\frac{M^2}{m_p^2}\right)^{-1}dr^2+r^2d\Omega^2$
Planck energy quantized:	$ds^2 = -\left(1-\frac{2l_p}{r}\frac{E}{E_p}+\frac{l_p^2}{r^2}\frac{E^2}{E_p^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{E}{E_p}+\frac{l_p^2}{r^2}\frac{E^2}{E_p^2}\right)^{-1}dr^2+r^2d\Omega^2$
Planck acceleration quantized:	$ds^2 = -\left(1-\frac{2l_p}{r}\frac{g}{a_p}+\frac{l_p^2}{r^2}\frac{g^2}{a_p^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{g}{a_p}+\frac{l_p^2}{r^2}\frac{g^2}{a_p^2}\right)^{-1}dr^2+r^2d\Omega^2$

$$ds^2 = -\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}+\frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}+\frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)^{-1}dr^2+r^2d\Omega^2 \quad (11)$$

The Schwarzschild metric is a weak field approximation of this. In our view, the extremal solution is the most important and perhaps even the only practically valid spherical solution from Einstein's field equation. In the Reissner-Nordström metric, one has:

$$ds^2 = -\left(1-\frac{2GM}{c^2 r}+\frac{r_q^2}{r^2}\right)c^2dt^2+\left(1-\frac{2GM}{rc^2}+\frac{r_q^2}{r^2}\right)^{-1}dr^2+r^2d\Omega^2 \quad (12)$$

where $\frac{r_q^2}{r^2}=k\frac{qq}{r^2}\frac{G}{c^4}$, the $\frac{G}{c^4}$ is just to convert the electromagnetic Joule energy into collision length (see also Section 3). Thus, $\frac{r_q^2}{r^2}$ is essentially the electrostatic Coulomb force converted to what is relevant for gravity by the factor $\frac{G}{c^4}$. In the extremal case of the Reissner-Nordström metric, it is well known that we have:

$$\frac{r_q^2}{r^2} = k\frac{qq}{r^2}\frac{G}{c^4} = G\frac{M^2}{r^2}\frac{G}{c^4}$$

$$k\frac{qq}{r^2} = G\frac{M^2}{r^2} \tag{13}$$

This means that gravity and electromagnetism are unified in the extremal solution of the Reissner-Nordström metric. The electrostatic force is normally considered extremely much higher than the gravitational force. The electrostatic force between a proton and an electron relative to the gravitational force between a proton and a electron is given by:

$$\frac{|F_C|}{|F|} = \frac{k\frac{e^2}{r^2}}{G\frac{M_P m_e}{r^2}} \approx 2.26\times 10^{39} \tag{14}$$

In other words, the electrostatic force appears to be extremely much stronger than the gravitational force. However, in the special case of the Coulomb force between two Planck charges, this is identical to the gravitational force between two Planck mass particles (micro black holes), as we have:

$$\frac{|F_C|}{|F|} = \frac{k\frac{q_p^2}{r^2}}{G\frac{m_p^2}{r^2}} \approx 1 \tag{15}$$

Based on this, we see that it is possible to write the Reissner-Nordström metric element: $\frac{r_q^2}{r^2}$ as:

$$\frac{r_q^2}{r^2} = k\frac{qq}{r^2}\frac{G}{c^4} = n_p^2 k\frac{q_p q_p}{r^2}\frac{G}{c^4} = n_p^2 G\frac{m_p m_p}{r^2}\frac{G}{c^4} \tag{16}$$

where $n_p = \frac{l_p}{\bar{\lambda}_M}$ is the reduced Compton frequency of the mass M per Planck time. This means the extremal solution (see [37]) can be written as:

$$\mathrm{d}s^2 = -\left(1-\frac{2GM}{c^2 r}+\frac{G^2M^2}{c^4r^2}\right)c^2\mathrm{d}t^2 + \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2$$

$$\begin{aligned}\mathrm{d}s^2 = &-\left(1-\frac{2Gn_p m_p}{c^2 r}+\frac{G^2n_p^2m_p^2}{c^4r^2}\right)c^2\mathrm{d}t^2 \\ &+\left(1-\frac{2Gn_p m_p}{rc^2}+n_p^2 G\frac{m_p^2}{r^2}\frac{G}{c^4}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2\end{aligned}$$

$$\begin{aligned}\mathrm{d}s^2 = &-\left(1-\frac{2Gn_p m_p}{c^2 r}+n_p^2 k\frac{q_p^2}{r^2}\frac{G}{c^4}\right)c^2\mathrm{d}t^2 \\ &+\left(1-\frac{2Gn_p m_p}{rc^2}+n_p^2 k\frac{q_p^2}{r^2}\frac{G}{c^4}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2\end{aligned} \tag{17}$$

This means that gravity is quantized, and the electrostatic force is also quantized. The quantization arises from the reduced Compton frequency per Planck time $n_p = \frac{l_p}{\bar{\lambda}_M}$. Furthermore, both the gravitational force and the electrostatic force are incorporated; they are one and the same force at the Planck scale. Haug has suggested that gravity and all matter are related to a Planck mass particle coming in and out of existence at the reduced Compton frequency. This gives the correct mass for all observed particles, for example the mass of the electron is then;

$$m_e = m_p \frac{l_p}{\bar{\lambda}_e} \approx 9.11 \times 10^{-31}\ \text{kg} \tag{18}$$

Thus, for a macroscopic mass, there are clearly many such Planck mass particles coming in and out of existence per Planck time window. The particle itself only exists for the Planck time and can be seen as a photon-photon collision, even inside matter. The relevant Planck mass particle has properties equal to a Planck mass micro black hole, as described by the extremal solutions of the Reissner-Nordström metric. It has a radius equal to the Planck length, Planck charge, zero Hawking radiation within the Planck time window (see [38] [39]), and remarkably zero entropy within the Planck time window. Edery and Constantineau [40] have demonstrated that extremal black holes have zero entropy and are time-independent throughout spacetime. If a Planck mass particle (micro black hole) has a lifetime equal to the Planck time and a radius equal to the Planck length, this means there is zero entropy in a time interval equal to the Planck time and a space interval equal to the reduced Compton wavelength of the Planck mass extremal black hole, which is the Planck length. In other words, there is zero entropy in what we can call Planck space-time. This fulfills another dream Einstein had, namely that one could derive a particle from gravity itself. Einstein and Rosen [41] actually came up with the mathematics for what today is known as wormholes not to predict wormholes, but to predict particles from general relativity theory, or as they themselves said in their paper: "*a particle being represented by a 'bridge' connecting these sheets*", the Einstein-Rosen bridge.

At the deepest level the extremal solution is simply:

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M} + \frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M} + \frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2 \tag{19}$$

So, compared to the Schwarzschild metric at the quantum level, it has the following term in addition: $\frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}$.

2. The Newton Mass General Relativity Type Inspired Field Equation

Most physicists today are not aware that Newton never introduced the so-called Newton's gravity constant G, nor did he try to do so or have any interest in doing so, see [10] [14]. In 1686, in *Principia*, Newton stated his gravitational force formula in words corresponding to the following formula:

$$F = \frac{M_n m_n}{r^2} \tag{20}$$

where we purposely use different notation for the Newton mass M_n and m_n compared to the modern kilogram mass. Newton was clear that mass was the quantity of matter. However, the dimensions of the Newton mass were [$L^3 \cdot T^{-2}$], that is, length cubed divided by time squared. Cavendish [24] also never measured nor tried to measure the gravitational constant; what he did was measure the density of the Earth relative to the known density of a known substance such as lead. However, multiple researchers, including Feynman, have mistakenly mentioned that Cavendish measured the gravitational constant, see [25] [26]. Maxwell [42] used the original Newton formula as late as early 1873, where he, for example, used the following formula for the gravitational acceleration: $\frac{M_n}{r^2}$ (rather than today's well known formula $g = \frac{GM}{r^2}$) and pointed out that the mass in Newton's theory indeed had the dimensions [$L^3 \cdot T^{-2}$]. For small, handleable masses on Earth, pounds were used in Great Britain and kilograms in France, but for astronomical-sized objects, the Newton mass was used. The same mass definition for both small and astronomical masses was preferable. One could have decided to go for the Newton mass, but instead, the kilogram mass was chosen.

To use kilograms or pounds is just a matter of choice; they are both arbitrary human-decided units of matter that gravity does not care about. On the other hand, switching from the Newton mass definitions to kilograms or pounds has major implications; it not only changes the unit but also the dimensions of mass. Anyway, it was decided to go for the kilogram, even though the Newton mass could have been incorporated for small masses as well. After incorporating kilogram mass in the Newton formula, the original Newton formula could no longer be used to predict gravitational phenomena. The kilogram mass was somehow not sufficient, so a gravitational constant had to be introduced to fix it. This was done somewhat ad hoc for the first time in 1873 by Cornu and Baillie [43], who used the symbol f for the gravitational constant. First in 1894, Boys [44] suggested using the symbol G that we use today. Einstein used the symbol k for the gravitational constant in most of his general relativity papers. Naturally, it is just a matter of taste and what has become standard for which symbol for the gravitational constant one uses. It is important to note that the Newton formula was used successfully for several hundred years without any gravitational constant. Thüring [45] pointed out in 1961 that the gravitational constant was introduced ad hoc and had no physical counterpart. Recent research demonstrates that it was simply needed to fix an incomplete mass definition, the kilogram, so it could still work to predict gravitational phenomena.

The Newton mass at a deeper level is given by:

$$M_n = c^2 l_p \frac{l_p}{\bar{\lambda}} \tag{21}$$

Furthermore, we have that:

$$M_n = GM = c^2 l_p \frac{l_p}{\bar{\lambda}} \tag{22}$$

This means Newton's original gravitational force formula is equal to:

$$F = \frac{M_n m_n}{r^2} = \frac{GMGm}{r^2} = G^2 \frac{Mm}{r^2} \tag{23}$$

Many will think this must be wrong. However, this formula can be used just like the modern 1873 modified Newton formula we use today. If one uses the original Newton formula, for example, to derive things such as escape velocity, one must use the masses M_n and m_n everywhere. The modern 1873 way of writing the Newton formula mixes two different masses without being aware of it. We have:

$$F = G\frac{Mm}{r^2} = \frac{M_n m}{r^2} \tag{24}$$

That is a formula where one uses the Newton mass for the large mass and the kilogram mass definition for the small mass. This can be done because in all formulas derived to predict something observable, one is always using GM or $GM + Gm$ and never GMm, see **Table 4**.

The G is needed to remove the Planck constant and get the Planck length into the mass. To make a long story short, our methods can be used to turn almost any gravity theory into a proper quantum gravity theory. If we decide to define mass as Newton originally did and additionally define Newtonian energy as $E_n = M_n c^2$ (energy will then have dimensions [$L^5 \cdot T^{-4}$], then we can write an Einstein general relativistic-inspired field equation using the Newton energy as:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi}{c^4} N_{\mu\nu} \tag{25}$$

This new field equation was recently suggested by Haug [46] [47]. The gravitational constant is now omitted, but the energy in the energy tensor $N_{\mu\nu}$ must be related to the energy and mass as we just defined it. This leads to the following Schwarzschild-type solution:

$$\mathrm{d}s^2 = -\left(1 - \frac{2M_n}{c^2 r}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2M_n}{rc^2}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right) c^2 \mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)^{-1} \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2 \tag{26}$$

This is identical to the quantized version of the Schwarzschild metric we derived from Einstein's field equation. However, here we never had to use G at all. It is not that we have set $G = 1$ as we still can work with S.I. units; it is simply

Table 4. A series of gravitational predictions given by general relativity theory and Newton in the standard form with GM and when using the original Newtonian mass M_n, as well as at the deeper quantum level. Note that there is no Planck constant at the deeper quantum level, nor any gravitational constant.

Prediction	Formula:
Gravity acceleration	$g=\frac{GM}{r^2}=\frac{M_n}{r^2}=\frac{c^2 l_p}{r^2}\frac{l_p}{\bar{\lambda}_M}$
Orbital velocity	$v_o=\sqrt{\frac{GM}{r}}=\sqrt{\frac{M_n}{r}}=c\sqrt{\frac{l_p}{r}\frac{l_p}{\bar{\lambda}_M}}$
Orbital time	$T=\frac{2\pi r}{\sqrt{\frac{GM}{r}}}=\frac{2\pi r}{\sqrt{\frac{M_n}{r}}}=\frac{2\pi r}{c\sqrt{\frac{l_p}{r}\frac{l_p}{\bar{\lambda}_M}}}$
Velocity ball Newton cradle	$v_{out}=\sqrt{2\frac{GM}{r^2}H}=\sqrt{2\frac{M_n}{r^2}H}=\frac{c}{r}\sqrt{2Hl_p\frac{l_p}{\bar{\lambda}_M}}$
Frequency Newton spring	$f=\frac{1}{2\pi r}\sqrt{\frac{GM}{x}}=\frac{1}{2\pi r}\sqrt{\frac{M_n}{x}}=\frac{c}{2\pi r}\sqrt{\frac{l_p}{x}\frac{l_p}{\bar{\lambda}_M}}$
Gravitational red shift	$z=\frac{\sqrt{1-\frac{2GM}{r_1c^2}}}{\sqrt{1-\frac{2GM}{r_2c^2}}}-1=\frac{\sqrt{1-\frac{2M_n}{r_1c^2}}}{\sqrt{1-\frac{2M_n}{r_2c^2}}}-1=\frac{\sqrt{1-\frac{2l_p}{r_1}\frac{l_p}{\bar{\lambda}_M}}}{\sqrt{1-\frac{2l_p}{r_2}\frac{l_p}{\bar{\lambda}_M}}}-1$
Time dilation	$T_R=T_f\sqrt{1-\frac{2GM}{rc^2}}=T_f\sqrt{1-\frac{2M_n}{rc^2}}=T_f\sqrt{1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}}$
Gravitational deflection	$\theta=\frac{4GM}{c^2r}=\frac{4M_n}{c^2r}=4\frac{l_p}{r}\frac{l_p}{\bar{\lambda}_M}$
Advance of perihelion	$\sigma=\frac{6\pi GM}{a\left(1-e^2\right)c^2}=\frac{6\pi M_n}{a\left(1-e^2\right)c^2}=\frac{6\pi l_p}{a\left(1-e^2\right)}\frac{l_p}{\bar{\lambda}_M}$
Schwarzschild radius	$r_s=\frac{2GM}{c^2}=\frac{2M_n}{c^2}=2l_p\frac{l_p}{\bar{\lambda}_M}$

that we do not need G. Some might say we have incorporated G into M_n since $M_n=GM$. However, there is more to it than this. One needs less information to find M_n and GM than to find G and M and then multiply them together. This is actually why the GPS system of the National Mapping Agency of the USA does not rely on G and M, but instead directly on $GM=M_n$, or as stated in their own words [48]:

> "The central term in the Earth's gravitational field (GM) is known with much greater accuracy than either "G", the universal gravitational constant, or "M", the mass of the Earth." (pages 3-3 WGS 84 third version)

It would not be wrong to claim that the National Mapping Agency, in their GPS system, relies on this new Einstein-inspired field equation using the original

Newton mass and corresponding energy rather than the kilogram mass and a gravitational constant, even without their knowledge of doing so. That is we now have a deeper explanation why they get better precession in this way, see [47] for in detail discussion on this important point.

However, it is important to understand that this new field equation gives all the same predictions as Einstein's original field equation, with the only exception being that one does not need to rely on finding G and M. This can actually lead to higher precision in most predictions, as demonstrated in the paper we just referred to.

3. Using Collision-Time as Mass and Collision-Length as Energy

Here, we will outline how one can develop a general relativity theory where everything is simply length and time. This was one of Einstein's dreams that he was not able to fulfill in his lifetime. There is actually no need for mass or energy, as mass will be a special form of time, which we have previously coined *collision-time*, and energy will be a special type of length we have coined *collision-length*. Since time and length are closely connected, we will call this the *collision space-time theory* (CST). In this paper, we will create a general relativistic version of it and demonstrate that it gives exactly the same predictions as general relativity theory. However, it offers the advantage of higher precision in many predictions, similar to the Newton mass-energy inspired general relativity field equation described in the section above.

By multiplying the kilogram mass by $\frac{G}{c^3}$ or alternatively by $\frac{l_p^2}{\hbar}$, it transforms from kilogram mass to time, or more precisely what we call collision-time mass:

$$\bar{M} = \frac{G}{c^3} M = t_p \frac{l_p}{\bar{\lambda}} \tag{27}$$

where again $\frac{l_p}{\bar{\lambda}}$ is the reduced Compton frequency per Planck time. We call the mass in Equation (26) collision-time since the reduced Compton frequency per Planck time represents the number of Planck mass events in the gravitational mass of interest within the Planck time and the output dimensions is simply time. At the end of each reduced Compton time interval, there is a photon-photon collision giving rise to a Planck mass particle lasting the Planck time. Derivations show that this particle has the mathematical properties of an extremal Reissner-Nordström Planck mass black hole, which remarkably has zero black hole entropy and zero Hawking radiation inside the Planck time window. It is a single microstate and the building block of all masses.

Similarly, if we multiply the Joule energy E by $\frac{G}{c^4}$, we get what we have previously coined collision-length energy:

$$\bar{E} = \frac{G}{c^4}E = l_p \frac{l_p}{\bar{\bar{\lambda}}} \tag{28}$$

This means we also have $\bar{E} = \bar{M}c$, which is fully consistent with $E = Mc^2$ as one just have multiplied each side with a constant, namely by: $\frac{G}{c^4} = \frac{l_p^2}{\hbar c}$. The case is that we actually do not need the kilogram definition for mass, nor do we need the Joule, nor the Planck constant, to describe quantized energy or quantized gravity. This is more than simply changes of units. It is also changes of dimensions. Going from kilogram to pound is a simple change of units, to go from kilogram to collision-time and from Joule energy to collision-length is change in dimensions and units. One cannot do gravity with kilogram mass without first turning it either original Newton mass or collision-time mass, this involves multiplying it with a constant.

To go in depth of collision space-time theory we ask readers to study our papers [49] [50]. If one only adopts the collision-time mass definition and collision-length energy definition, then one is simply left with collision space-time. Einstein supposedly had a dream of linking energy and mass to simply space-time; this is what we have now done. If we then try to formulate an Einstein general relativistic inspired field equation based solely on incorporating the collision-time mass and collision-length energy, we end up with [46]:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = 8\pi E_{\mu\nu} \tag{29}$$

where the energy tensor: $E_{\mu\nu}$ is now linked to collision-length energy. Einstein, with his field equation $R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = 8\pi\frac{G}{c^4}T_{\mu\nu}$, is doing this indirectly. The part of the Einstein constant $\frac{G}{c^4}$ is indeed used to convert the Joule energy Tensor: $E_{\mu\nu}$ to a length, and this length is the same as the collision-length defined above. However, by doing it directly instead of indirectly, we get rid of the gravitational constant G from the very start. This leads to the following Schwarzschild metric solution:

$$\mathrm{d}s^2 = -\left(1 - \frac{2\bar{M}c}{r}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2\bar{M}c}{r}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2\bar{E}}{r}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2\bar{E}}{r}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2$$

$$\mathrm{d}s^2 = -\left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)c^2\mathrm{d}t^2 + \left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)^{-1}\mathrm{d}r^2 + r^2\mathrm{d}\Omega^2 \tag{30}$$

So, at the deepest level, it is the same as the quantized version of general relativity theory. It is a type of general relativity theory.

We must personally say we do not think 4-dimensional space-time-three space and one time dimension-is the ultimate answer to reality.

We actually believe three space dimensions plus three time dimensions represents the depth of reality. However, this is mostly out of the scope of this paper. Haug's [50] six-dimensional collision space-time theory where mass and energy are vectors, leads to the following quantum-gravity field equation:

$$\begin{aligned} \bar{\boldsymbol{E}} &= \bar{\boldsymbol{M}}c \\ l_p \nabla \cdot \bar{\boldsymbol{E}} &= c t_p \nabla \cdot \bar{\boldsymbol{M}} \end{aligned} \tag{31}$$

That is, collision-time and collision-length, which correspond to energy and mass, are two sides of the same coin. So the six dimensions are, in reality, three space-time dimensions with two different perspectives: one viewed through time (three time dimensions) and the other through space (length) (three space dimensions).

This collision-space-time field equation looks very different from Einstein's field equation but leads to surprisingly similar results to the extremal solution of the Reissner-Nordström metric and the Haug-Spavieri minimal solution. Therefore, the collision-space-time 6D field equation gives the following metric when solved for a spherical symmetric object:

$$0 = -\left(1 - \frac{2GM}{c^2 r} + \frac{G^2 M^2}{c^4 r^2}\right) c^2 \mathrm{d}t^2 - c^2 t^2 \mathrm{d}\Omega^2 + \left(1 - \frac{2GM}{rc^2} + \frac{G^2 M^2}{c^4 r^2}\right) \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$0 = -\left(1 - \frac{2\bar{E}}{r} + \frac{\bar{E}^2}{r^2}\right) c^2 \mathrm{d}t^2 - c^2 t^2 \mathrm{d}\Omega^2 + \left(1 - \frac{2\bar{E}}{r} + \frac{\bar{E}^2}{r^2}\right) \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$0 = -\left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M} + \frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right) c^2 \mathrm{d}t^2 - c^2 t^2 \mathrm{d}\Omega^2 + \left(1 - \frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M} + \frac{l_p^2}{r^2}\frac{l_p^2}{\bar{\lambda}_M^2}\right) \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2 \tag{32}$$

The space-time interval $\mathrm{d}s^2 = 0$ on the left hand side of the equation is in this theory always flat and equal to zero. That is, space-time does not curve, but space and time still curve. Space and time curve exactly the same and offset each other, so to speak. The space-time interval is the space interval minus the time interval, and we can see they cancel each other out perfectly in the metric above. If one studies it carefully, one will see that the time-component in the metric above is identical to that in the extremal solution of the Reissner-Nordström metric: $\left(1 - \frac{2GM}{c^2 r} + \frac{G^2 M^2}{c^4 r^2}\right) c^2 \mathrm{d}t^2$, while the space interval is not equal to that of the extremal solution of the Reissner-Nordström metric: $\left(1 - \frac{2GM}{rc^2} + \frac{G^2 M^2}{c^4 r^2}\right)^{-1}$, as it is equal to: $\left(1 - \frac{2GM}{rc^2} + \frac{G^2 M^2}{c^4 r^2}\right)$.

And the corresponding weak field approximation metric is given by:

$$0 = -\left(1 - \frac{2GM}{c^2 r}\right) c^2 \mathrm{d}t^2 - c^2 t^2 \mathrm{d}\Omega^2 + \left(1 - \frac{2GM}{rc^2}\right) \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$0 = -\left(1 - \frac{2\bar{M}c}{r}\right) c^2 \mathrm{d}t^2 - c^2 t^2 \mathrm{d}\Omega^2 + \left(1 - \frac{2\bar{M}c}{r}\right) \mathrm{d}r^2 + r^2 \mathrm{d}\Omega^2$$

$$0=-\left(1-\frac{2\bar{E}}{r}\right)c^2\mathrm{d}t^2-c^2t^2\mathrm{d}\Omega^2+\left(1-\frac{2\bar{E}}{r}\right)\mathrm{d}r^2+r^2\mathrm{d}\Omega^2$$

$$0=-\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)c^2\mathrm{d}t^2-c^2t^2\mathrm{d}\Omega^2+\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)\mathrm{d}r^2+r^2\mathrm{d}\Omega^2 \quad (33)$$

The time-component is basically identical to the Schwarzschild metric, but the space component is not as in the Schwarzschild metric: $\left(1-\frac{2GM}{rc^2}\right)^{-1}$, but $\left(1-\frac{2GM}{rc^2}\right)$.

This means that pure collision-space-time leads to flat space-time, but it still predicts all the same phenomena observed from the Schwarzschild metric. The reason for this is that only the time-component has been used to predict gravitational phenomena that have actually been observed, including gravitational time dilation, redshift, light bending, and orbital velocity.

There is no singularity at the event horizon $r=\frac{GM}{c^2}=\bar{E}$, in pure 6-dimensional collision-space-time, and in practice, there is no center singularity either. The smallest center that can be observed is a Planck mass black hole, which in the full metric leads to a black hole particle where the electrostatic and gravitational forces exactly offset each other, preventing the collapse of matter into a center singularity. These Planck mass black holes also have zero entropy and zero Hawking radiation in the Planck time interval. After the Planck time the two photons colliding leave each other.

4. Summary

Table 5 provides a comparison summary of standard general relativity theory, the new general relativistic quantum gravity, and Collision Space-Time (CST) theory. CST-GRT-4D is based on field equation (29), and CST-6D is based on the metric (31) that can be derived from the 6D collision space-time field Equation (30).

Gravity is much easier to quantize than previously assumed. The key to this major breakthrough has been understanding that the gravitational constant is just a composite constant that can be expressed as $G=\frac{l_p^2c^3}{\hbar}$ and that any kilogram mass can be expressed as $M=\frac{\hbar}{\bar{\lambda}}\frac{1}{c}$, further that the Planck length and Planck time can be found totally independent on any knowledge off G and $\hbar$, as has been demonstrated in recent years. When multiplied together, the Planck constant and anything related to the kilogram cancel out, leaving us with $GM=c^2t_p\frac{l_p}{\bar{\lambda}}$, where the last part $\frac{l_p}{\bar{\lambda}}$ is the reduced Compton frequency per Planck time. Unifying gravity with quantum mechanics requires an in-depth discussion of the de Broglie [51] wavelength versus the Compton wavelength, as

Table 5. Comparing standard general relativity theory (GRT) with the recently proposed quantum gravity theories.

Incorporated:	Standard GRT	Quantized GRT	Newton mass GRT	CST-GRT-4D	CST-6D
Quantization:	No	Yes	Yes	Yes	Yes
Compton frequency:	No	Yes	Yes	Yes	Yes
Planck scale:	No	Yes	Yes	Yes	Yes
Particle from gravity:	"Yes"	Yes	Yes	Yes	Yes
Particle as black hole:	Yes	Yes	Yes	Yes	Yes
Mass-energy from space-time:	No	No	Yes	Yes	Yes
Mass is time:	No	No	No	Yes	Yes
Energy is length:	No	No	No	Yes	Yes
Curved space:	Yes	Yes	Yes	Yes	Yes
Curved time:	Yes	Yes	Yes	Yes	Yes
Curved space-time:	Yes	Yes	Yes	Yes	No
Conservation of space-time:	No	No	No	No	Yes
Deepest level identical to GRT:	Yes	Yes	Yes	Yes	No
Unification:	**Standard GRT**	**Quantized GRT**	**Newton Mass GRT**	**CST-GRT-4D**	**CST 6D**
Gravity + electromagnetism:	"No"	Yes	Yes	Yes	Yes
Gravity + modified QM:	No	Yes	Yes	Yes	Yes
Metrics:	**Standard GRT**	**Quantized GRT**	**Newton Mass GRT**	**CST-GRT-4D**	**CST 6D**
Schwarzschild type metric:	Yes	Yes	Yes	Yes	"Yes"
Extremal metric:	Yes	Yes	Yes	Yes	"Yes"

well as the Heisenberg [52] uncertainty principle, something that we [11] have recently done. Please refer to this paper to understand how it unifies with quantum mechanics.

5. Conclusions

We have demonstrated other trivial ways to re-write and express Haug's Planck quantized version of general relativity theory. Even more forms can be derived based on the composite forms of G given in [15], but ultimately, they all converge to Haug's initial expression, which is based on the Planck length and the reduced Compton wavelength. This approach incorporates both wave-particle duality in matter and demonstrates that the true quantization in matter is represented by the reduced Compton frequency, corresponding to the number of Planck mass events per Planck time in the gravitational mass off interest.

We have in addition demonstrated a general relativistic field equation can be expressed from the original Newton mass concept: $R_{\mu\nu}-\frac{1}{2}Rg_{\mu\nu}=\frac{8\pi}{c^4}N_{\mu\nu}$. This does not require the gravity constant G even when working with S.I. units. It also gives higher precision than standard general relativity theory and is indirectly already in use by the GPS system without the GPS researchers understanding fully the reason from a deeper perspective. Relying on GM is more precise than first finding G and then M. In reality, they are using the original forgotten Newton mass and indirectly the new field equation: $R_{\mu\nu}-\frac{1}{2}Rg_{\mu\nu}=\frac{8\pi}{c^4}N_{\mu\nu}$.

In addition, we have shown a general relativistic inspired field equation can be formed based on the recent collision-space-time mass concept, which gives: $R_{\mu\nu}-\frac{1}{2}Rg_{\mu\nu}=8\pi E_{\mu\nu}$. Here mass is linked simply to time and energy to length and thereby fulfills Einstein's dream of that one could have a theory only about space and time where mass and energy are simply not needed in addition. This also does not require any gravity constant G even when working with S.I. units. Except for precision in predictions, these two new field equations are from a deeper perspective identical to general relativity theory.

Collision space-time can also be formulated in a 6-dimensional theory with three space and three time dimensions that are two sides of the same coin. In this theory, one gets flat space-time and, importantly, conservation of space-time. This quantum gravity theory still remarkably gives the same predictions for phenomena that have been observed as the Schwarzschild metric time component in weak gravitational fields and the external solution of Reissner-Nordström in strong gravitational fields. Its predictions therefore seem to fit all observations, such as gravitational time dilation, gravitational redshift, light bending, orbital velocity, microlensing, etc. However, it has the great advantage that space-time is conserved. In standard theory, space-time starts as infinitely curved at the predicted Big Bang and then ends up almost flat in the predicted cold death of the universe. How can it be that energy is conserved while space-time is not? This seems inconsistent. Collision space-time theory in 6 dimensions seems to totally avoid this paradox, as both space-time and mass-energy are conserved in this theory. However, we still have gravitational time dilation and gravitational length contraction. The space-time interval is, however, always conserved.

Our method to create quantum gravity theories is simple and general and can be used to quantize a series of gravity theories as well as link them to the Planck scale. This is accomplished by understanding the gravity constant is simply a composite constant. The so-called Newton gravity constant was never invented, nor tried to be invented by Newton, but was ad hoc introduced in 1873 to fix the kilogram mass after replacing the original Newton mass also in gravitational theory in 1873. It is only when one understands the gravity constant is a composite constant and that the true matter wavelength is the Compton wavelength and not the de Broglie wavelength that one is able to quantize gravity and unify it with quantum mechanics, as we have outlined in a series of papers in recent years. We have good reasons to think our theory will outcompete both string theory and loop quantum gravity theory.

Data Availability Statements

No data was used for this study.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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