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Planck Quantized General Relativity Theory Written on Different Forms

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Abstract: This paper is a brief review of our own work on the Planck quantized version of general relativity theory. It demonstrates several other straightforward methods to simply rewrite the same equations that we have already presented.

Keywords: genera relativity; planck quantization; compton frequency; composite constant G; quantum gravity

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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 which gives: $E_p = \sqrt{\frac{\hbar c^5}{G}}$. These are today known as the Planck units.

Einstein [3] already suggested the next step in gravity in 1916. In 1918, Eddington [4] 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 [5,6] for in more depth about our theory. This paper is simply about how what we already have presented easily can be re-written by using several different Planck units, for in depth understanding of the theory the papers just mentioned is a good start.

Haug [7] outlined a theory in 2014 where matter consisted of an indivisible length, which he later proved had to be the Planck length, and that matter also contained a wavelength known as the Compton wavelength, so wave-particle duality, even with a quite different interpretation than in standard theory. In 2016, Haug [8] 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 [6,9]), 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 [10], thus making it possible to express Einstein's [3] field equation in the following form:

$$\begin{aligned} R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} &= \frac{8\pi G}{c^4}T_{\mu\nu} \\ R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} &= \frac{8\pi l_p^2}{c\hbar}T_{\mu\nu} \end{aligned} \tag{1}$$

Additionally, Haug [11–14] 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 [15,16]. This means one can avoid the circular argument presented by Cohen [17] in 1987 and that has been repeated at least until 2016 [18], which stated that one needs to know G to find the Planck units, thus 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 argument

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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 [19] do so, as discussed by for example Hodges and Sean [20,21]. Furthermore, Haug [12] has claimed that any kilogram mass can be expressed simply by solving the Compton [22] wavelength formula: $\lambda = \frac{h}{mc}$, which gives:

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

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 [23].

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

$$\begin{aligned} ds^2 &= -\left(1-\frac{2GM}{c^2r}\right)c^2dt^2+\left(1-\frac{2GM}{rc^2}\right)^{-1}dr^2-r^2d\Omega^2 \\ ds^2 &= -\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{l_p}{\bar{\lambda}_M}\right)^{-1}dr^2-r^2d\Omega^2 \end{aligned} \tag{3}$$

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

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

and

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

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:

$$\begin{aligned} ds^2 &= -\left(1-\frac{2GM}{c^2r}\right)c^2dt^2+\left(1-\frac{2GM}{rc^2}\right)^{-1}dr^2-r^2d\Omega^2 \\ ds^2 &= -\left(1-\frac{2ct_p}{r}\frac{t_p}{\bar{t}_c}\right)c^2dt^2+\left(1-\frac{2ct_p}{r}\frac{t_p}{\bar{t}_c}\right)^{-1}dr^2-r^2d\Omega^2 \\ ds^2 &= -\left(1-\frac{2t_p}{r}\frac{l_p}{\bar{t}_c}\right)c^2dt^2+\left(1-\frac{2l_p}{r}\frac{t_p}{\bar{t}_c}\right)^{-1}dr^2-r^2d\Omega^2 \end{aligned} \tag{6}$$

This is simply a choice we have made to express 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. Recent research indicates also that matter ticks at the Compton frequency, see [24,25].

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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:

$$
\begin{aligned}
R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} &= \frac{8\pi G}{c^4} T_{\mu\nu} \\
R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} &= \frac{8\pi\hbar}{m_p^2 c^3} T_{\mu\nu}
\end{aligned} \tag{7}
$$

and Schwarzschild metric can now be written as:

$$
\begin{aligned}
ds^2 &= -\left(1 - \frac{2GM}{c^2 r}\right) c^2 dt^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} dr^2 - r^2 d\Omega^2 \\
ds^2 &= -\left(1 - \frac{2l_p}{r}\frac{M}{m_p}\right) c^2 dt^2 + \left(1 - \frac{2l_p}{r}\frac{M}{m_p}\right)^{-1} dr^2 - r^2 d\Omega^2
\end{aligned} \tag{8}
$$

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 [8] 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 essencial to understand gravity at its deepest level .

We could also have done it through Planck energy this would give $G = \frac{\hbar c^3}{E_p^2}$ and Einstein's field equation as:

$$
\begin{aligned}
R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} &= \frac{8\pi G}{c^4} T_{\mu\nu} \\
R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} &= \frac{8\pi\hbar}{E_p^2 c} T_{\mu\nu}
\end{aligned} \tag{9}
$$

and Schwarzschild metric can now be written as:

$$
\begin{aligned}
ds^2 &= -\left(1 - \frac{2GM}{c^2 r}\right) c^2 dt^2 + \left(1 - \frac{2GM}{rc^2}\right)^{-1} dr^2 - r^2 d\Omega^2 \\
ds^2 &= -\left(1 - \frac{2l_p}{r}\frac{E}{E_p}\right) c^2 dt^2 + \left(1 - \frac{2l_p}{r}\frac{E}{E_p}\right)^{-1} dr^2 - r^2 d\Omega^2
\end{aligned} \tag{10}
$$

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 slightly modifying quantum mechanics. This will become clear over time as we publish more papers on the topic.

Table 1 summarizes different ways of incorporating the Planck scale into Einstein's field equations.

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Table 1. The table describe different ways one can express Einstein's field equation related to Planck units.

Form :	Einstein's field equation :	Corresponding G :
Standard form :	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$	G
Planck length :	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi l_p^2}{c\hbar}T_{\mu\nu}$	$G = \frac{l_p^2 c^3}{\hbar}$
Planck time:	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi t_p^2}{c^3\hbar}T_{\mu\nu}$	$G = \frac{t_p^2 c^5}{\hbar}$
Planck mass:	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi\hbar}{m_p^2 c^3}T_{\mu\nu}$	$G = \frac{\hbar c}{m_p^2}$
Planck energy:	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi\hbar}{E_p^2 c}T_{\mu\nu}$	$G = \frac{\hbar c^3}{E_p^2}$
Planck force :	$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = \frac{8\pi}{F_p}T_{\mu\nu}$	$G = \frac{l_p^2 c^3}{\hbar}$

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

Table 2. This list different ways one can write the Schwarzschild metric.

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

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 [26], and even for the critical mass in the Friedmann universe [27].

In a similar way one can re-write other metrics derived from general relativity, such as the Reissner-Nordström [28,29], Kerr [30], Kerr-Newman [31,32] and Haug-Spavieri [33] metric. This means one are incorporating both the Planck scale and quantization through the reduced Compton frequency per Planck time in these metrics.

2. 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 [10], but ultimately, they all converge to his initial expression, which is based on the Planck length and the reduced Compton wavelength. This approach incorporates both wave-particle duality in

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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.

Conflicts of Interest: The author declare no conflict of interest.

References

1. M. Planck. *Natuerliche Masseinheiten*. Der Königlich Preussischen Akademie Der Wissenschaften: Berlin, Germany, 1899. URL https://www.biodiversitylibrary.org/item/93034#page/7/mode/1up.
2. M. Planck. *Vorlesungen über die Theorie der Wärmestrahlung*. Leipzig: J.A. Barth, p. 163, see also the English translation "The Theory of Radiation" (1959) Dover, 1906.
3. A. Einstein. Näherungsweise integration der feldgleichungen der gravitation. *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften Berlin*, 1916.
4. A. S. Eddington. *Report On The Relativity Theory Of Gravitation*. The Physical Society Of London, Fleetway Press, London, 1918.
5. E. G. Haug. Quantized Newton and general relativity theory. *Qeios*, 2023. URL https://doi.org/10.32388/6ASRSQ.
6. E. G. Haug. Different mass definitions and their pluses and minuses related to gravity. *Foundations*, 3: 199–219., 2023. URL https://doi.org/10.3390/foundations3020017.
7. E. G. Haug. *Unified Revolution, New Fundamental Physics*. Oslo, E.G.H. Publishing, 2014.
8. E. G. Haug. Planck quantization of newton and Einstein gravitation. *International Journal of Astronomy and Astrophysics*, 6(2):206, 2016. URL https://doi.org/10.4236/ijaa.2016.62017.
9. E. G. Haug. Newton did not invent or use the so-called Newton's gravitational constant; G, it has mainly caused confusion. *Journal of Modern Physics*, 13:179, 2022. URL https://doi.org/10.4236/jmp.2022.132014.
10. E. G. Haug. Progress in the composite view of the Newton gravitational constant and its link to the Planck scale. *Universe*, 8(454), 2022. URL https://doi.org/10.3390/universe8090454.
11. E. G. Haug. Can the Planck length be found independent of big G ? *Applied Physics Research*, 9(6):58, 2017. URL https://doi.org/10.5539/apr.v9n6p58.
12. E. G. Haug. Finding the Planck length multiplied by the speed of light without any knowledge of G, c, or h, using a newton force spring. *Journal Physics Communication*, 4:075001, 2020. URL https://doi.org/10.1088/2399-6528/ab9dd7.
13. E. G. Haug. Demonstration that newtonian gravity moves at the speed of light and not instantaneously (infinite speed) as thought! *Journal of Physics Communication.*, 5(2):1, 2021. URL https://doi.org/10.1088/2399-6528/abe4c8.
14. E. G. Haug. Planck units measured totally independently of big G. *Open Journal of Microphysics*, 12:55, 2022. URL https://doi.org/10.4236/ojm.2022.122004.
15. E. G. Haug. Extraction of the Planck length from cosmological redshift without knowledge off G or $\hbar$. *International Journal of Quantum Foundation, supplement series Quantum Speculations*, 4(2), 2022. URL https://ijqf.org/archives/6599.
16. E. G. Haug. CMB, Hawking, Planck, and Hubble scale relations consistent with recent quantization of general relativity theory. *International Journal of Theoretical Physics, Nature-Springer*, 63(57), 2024. URL https://doi.org/10.1007/s10773-024-05570-6.
17. E. R. Cohen. *Fundamental Physical Constants, in the book Gravitational Measurements, Fundamental Metrology and Constants*. Edited by Sabbata, and Melniko, V. N., Netherland, Amsterdam, Kluwer Academic Publishers, p 59, 1987.
18. M. E. McCulloch. Quantised inertia from relativity and the uncertainty principle. *Europhysics Letters (EPL)*, 115(6):69001, 2016. URL https://doi.org/10.1209/0295-5075/115/69001.
19. H. Cavendish. Experiments to determine the density of the earth. *Philosophical Transactions of the Royal Society of London, (part II)*, 88:469, 1798.
20. B. E. Clotfelter. The Cavendish experiment as cavendish knew it. *American Journal of Physics*, 55:210, 1987. URL https://doi.org/10.1119/1.15214.
21. L. Sean. Henry Cavendish and the density of the earth. *The Physics Teacher*, 37:34, 1999. URL https://doi.org/10.1119/1.880145.

doi:10.20944/preprints202403.1675.v1

22. A. H. Compton. A quantum theory of the scattering of x-rays by light elements. *Physical Review*, 21(5):483, 1923. URL https://doi.org/10.1103/PhysRev.21.483.
23. E. G. Haug. The Compton wavelength is the true matter wavelength, linked to the photon wavelength, while the de broglie wavelength is simply a mathematical derivative. *Qeios*, 2023. URL https://doi.org/10.32388/OZ0IRU.2.
24. S. Lan, P. Kuan, B. Estey, D. English, J. M. Brown, M. A. Hohensee, and Müller. A clock directly linking time to a particle's mass. *Science*, 339:554, 2013. URL https://doi.org/10.1126/science.1230767.
25. D. Dolce and A. Perali. On the Compton clock and the undulatory nature of particle mass in graphene systems. *The European Physical Journal Plus*, 130(41):41, 2015. URL https://doi.org/10.1140/epjp/i2015-15041-5.
26. E. G. Haug. God time = Planck time. *Open Journal of Microphysics, accepted and forthcoming*, 2024. URL hhttps://hal.archives-ouvertes.fr/hal-03769825/.
27. E. G. Haug. CMB, Hawking, Planck, and Hubble scale relations consistent with recent quantization of general relativity theory. *International Journal of Theoretical Physics*, 63(57), 2024. URL https://doi.org/10.1007/s10773-024-05570-6.
28. H. Reissner. Über die eigengravitation des elektrischen feldes nach der Einsteinschen theorie. *Annalen der Physics*, 355:106, 1916. URL https://doi.org/10.1002/andp.19163550905.
29. G. Nordström. On the energy of the gravitation field in Einstein's theory. *Koninklijke Nederlandsche Akademie van Wetenschappen Proceedings*, 20:1238, 1918.
30. R. P. Kerr. Gravitational field of a spinning mass as an example of algebraically special metrics. *Physical Review Letters*, 11:237, 1963. URL https://doi.org/10.1103/PhysRevLett.11.237.
31. E. Newman, E. Couch, K. Chinnapared, A.; Exton, A. Prakash, and R. Torrence. Metric of a rotating, charged mass. *Journal of Mathematical Physics*, 6:918, 1965. URL https://doi.org/10.1063/1.1704351.
32. E. T. Newman and A. I. Janis. Note on the Kerr spinning-particle metric. *Journal of Mathematical Physics*, 6:915, 1965. URL https://doi.org/10.1063/1.1704350.
33. E. G. Haug and G. Spavieri. Mass-charge metric in curved spacetime. *International Journal of Theoretical Physics*, 62:248, 2023. URL https://doi.org/10.1007/s10773-023-05503-9.