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Time, Uncertainty and Graviton Emission

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Abstract

The purpose of this article is to consider the external and internal periods of an energized graviton. The external period of any such graviton is given by the constant value of: $T = i\pi$, a number integral to the Euler identity. The internal period of a graviton, however, is not constant. Instead it is calculated to be: $T = \left(7.39634309x10^{-27}\pi\frac{i}{\sqrt{N}}\right)$. Where N is the sum of two integers related to the amount of energy absorbed by a graviton. Because gravitons oscillate internally, it indicates string theory may be applied, to provide a deeper insight into the world of gravitons.

Keywords: general relativity, string theory, graviton emission, quantum physics, graviton time, uncertainty principle

1. Introduction

In this article the infinitesimal world of gravitons is developed from general relativity and quantum physics. Each of the three intersecting structures of nature are equipped with their own set of physical principles. (Allori, 2013), (Heisenberg, 2019), (Briggs, G.A.D, Butterfield J. N., & Zeilinger, A., 2013). Taken together, the triad forms a more complete set of natural laws and measurable attributes. (Gribbin, 2019), (Musser, 2015)

Development of the graviton world requires a spacetime metric, which describes a field of oscillating gravitons. Upon acting on the graviton metric $g_{\mu\nu}$ with the general relativistic wave equation, an energy momentum tensor is produced. From it elementary particle mass can be determined and shown to be in precise agreement with experiment. The N-valued energies from the energy momentum tensor, can be combined with the uncertainty principle of energy-time, enabling calculation of both internal and external periods of energized gravitons.

2. Particle Creation

In our previous paper we constructed a spacetime metric $g_{\mu\nu}$ from normal coordinates and a Lagrangian representing a system of oscillating particles (Christensen, 2007), (Musser, 2015). The resulting metric is given by:

$$g_{\mu\nu} = e^{i(\omega t)\sqrt{N}}\eta_{\mu\nu} \tag{1}$$

Where $N \equiv n + m^2$, such that $n\, and\, m \in \mathbb{Z}$. These integers are constrained by the condition that $m + n \leq \pm 104$. In regard to our complex metric, during 1945 Einstein published a paper on the generalization of the relativistic theory of gravitation. In that article he proposed the use of a complex metric. Therein, Einstein defined a tensor $g_{\alpha\beta}$ as having complex components: $g_{\alpha\beta} \equiv s_{\alpha\beta} + ia_{\alpha\beta}$. (Einstein, 1945). He imposed the conditions that $s_{\alpha\beta} = s_{\beta\alpha}$ (*symmetric*) and $a_{\alpha\beta} = -a_{\beta\alpha}$ (*antisymmetric*). By acting on our metric $g_{\mu\nu} = e^{i(\omega t)\sqrt{N}}\eta_{\mu\nu}$ with general relativistic equations, yields the energy momentum tensor:

$$G_{\mu\nu} = \left[R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R\right] \Rightarrow T_{\mu\nu} =$$

$$\frac{c^4}{16\pi G}\begin{pmatrix} -\frac{3}{2}N\omega^2 & 0 & 0 & 0 \\ 0 & \frac{1}{2}N\omega^2 & 0 & 0 \\ 0 & 0 & \frac{1}{2}N\omega^2 & 0 \\ 0 & 0 & 0 & \frac{1}{2}N\omega^2 \end{pmatrix} \tag{2}$$

From this energy momentum tensor, and the energy levels necessary to form elementary particles, an energy equation was calculated:

$$E_{n,m} = (n + m^2)\left(1.42580x10^{-19}\frac{J}{grav}\right) \tag{3}$$

The preceding energy equation can be easily converted into the mass equation, from which any Standard Model particle mass can be calculated in SI units:

$$m_E = (n + m^2)\left(1.586418216x10^{-36}\frac{kg}{grav}\right) \tag{4}$$

Moreover, the integers n and m are constrained by $N = m + n \leq \pm 104$. When $m = 0$, it allows n to take on negative integer values of $n = -1, -2, -3, \cdots$, resulting in negative mass results. A condition first introduced in quantum mechanics by Paul Dirac. (Bacelar Valente, 2020). Furthermore, since all Standard Model particles are generated from energized spacetime gravitons, it provides fundamental reasons why Dirac's theoretical negative mass was made evident in the world of quantum physics. However, because the integer m squared is always positive, the sum of the two integers will cause negative mass to eventually be added away and to be so rare as to only be manufactured in laboratories, that or during particle collisions and discovered in cosmic rays (APS, 2004). As an example of particle mass creation, the Higgs Boson particle is shown to be in precise agreement with experiment:

$$m_E = (n + m^2)\left(1.586418216x10^{-36}\frac{kg}{grav}\right) =$$

$$2.171806538x10^{-25}kg + 5.552463756x10^{-27}kg = 2.227331176x10^{-25}k \tag{5}$$

Comparing this theoretical mass value rounded off to: $2.227x10^{-25}kg$, with the experimentally measured Higgs Boson mass of: $2.227x10^{-25}kg$ (Hrynevich, 2023), it is very apparent the graviton approach is in precise agreement with the experimentally measured mass value of the Higgs Boson. In addition, we have shown equation (5) can produce all Standard Model particles. (Christensen Jr., Between Quantum Mechanics and General Relativity. , 2024)

3. The Uncertainty Principle of Energy-Time

The unifying factor for the triad of structures (that of the large scale world of general relativity; the intermediary world of quantum physics; and the infinitesimal graviton world) is the uncertainty principle of energy-time. Rearranging the equation and combining it with the energy equation (3), which represents the n-valued energy for any elementary particle (*originally derived from the energy momentum tensor of general relativity*), yields:

$$\Delta t = \frac{1}{2}\frac{\hbar}{\Delta E} = \frac{7.396343409x10^{-16}s}{2(n+m^2)} \tag{6}$$

This uncertainty formula represents the maximum time allowable for a graviton to become excited, and to decay back to ground state. At the end of the decay process, an elementary particle is emitted belonging to the Standard Model of particle physics. (Christensen Jr., Between Quantum Mechanics and General Relativity. , 2024) After emission, the graviton becomes massless and vibrates with angular velocity ω. Such massless gravitons represent those belonging to the general relativistic universe. Note: As positive integers n and m increase, the time allotted for uncertain time Δt, becomes smaller, while the energy and mass of the particle being generated, increases. This relationship is necessary to maintain the laws of physics in the general relativistic and quantum physics worlds.

As an example, we apply the uncertainty of time to the Higgs particle. Hence the maximum time permitted to generate the Higgs particle is calculated to be:

$$\Delta\mathrm{t} = \frac{7.396343409x10^{-16}s}{2(32+37^2)} = 5.279x10^{-19}s \tag{7}$$

The actual time to generate the Higgs particle can be less, but not exceed this calculated time of $5.279x10^{-19}s$. (ATLAS, 2024). Also note, that the mechanism producing the Higgs particle, and the time to produce it, are both cosmological in origin (Liao, 2003).

4. Graviton Time

We now arrive at the focus of this paper, which is to determine the external and internal periods of energized gravitons from first principle. Returning to the spacetime metric $g_{\mu\nu} = e^{i(\omega t)\sqrt{N}}\eta_{\mu\nu}$ where:

$$i\sqrt{N}(\omega t) = i\sqrt{N}\left[(2\pi)x10^{-12}\,{}^{rad}\!/_{sec}\right][t(sec)] = \sqrt{-4\pi^2x10^{-23}Nt^2} \tag{8}$$

and with $N \equiv n + m^2$. The metric becomes:

$$g_{\mu\nu} = e^{\left(\sqrt{-4\pi^2x10^{-23}Nt^2}\right)}\eta_{\mu\nu} \tag{9}$$

We interpret the exponent under the radical sign given by $-4\pi^2x10^{-23}Nt^2$, to be analogous to the period squared of a simple gravity pendulum, given by: $T^2 = 4\pi^2L/g$. In which the gravitational acceleration g, is related to the universal gravitational constant G. However, for the spacetime graviton period, the entire exponent under the radical sign, must represent its period of oscillation, given by: $T^2 = -4\pi^2x10^{-23}Nt^2$. This periodic result makes physical sense simply because the metric was developed from a field of oscillating gravitons. Note: Time t is a unitless parameter due to its pairing with the angular frequency ω having inverse units of seconds. Because general relativity is a dualistic interpreted theory, that is to say it is primarily of geometric design, yet it is often interpreted as a graviton particle theory, arising from linearized gravity theories. Such gravity approaches originally goes as far back as 1939 with Wolfgang Pauli and Markus Fierz. It re-emerged along the way, when in 1962 it was resurrected by Richard Feynman and others afterward. Each with their own development of a graviton theory (Fierz, 1939), (Huggins, 1962), (Fang, 1996). The geometric interpretation of gravity together with its particle view, allows one to consider L as representing the ‘spherical geometric diameter, or length, of a vibrating graviton particle. Setting the time component of the spacetime metric to $\mathrm{g}_{00} = \mathrm{e}^{\sqrt{T^2}} = e^T$, results in the time-period relationship, given by:

$$\mathrm{g}_{00} \equiv \mathrm{e}^T = e^{\sqrt{-4\pi^2x10^{-23}Nt^2}}\eta_{00} = -e^{i(2\pi t)(\sqrt{N})x10^{-12}} \tag{10}$$

Where $\eta_{00} = -1 = i^2$. Taking the natural log on both sides of the equation, yields the total oscillating period for an energized graviton:

$$T = i\left(\pi + 2\pi\sqrt{N}x10^{-12}t\right) \tag{11}$$

Replacing time t by the uncertain time, $\Delta\mathrm{t} = \frac{7.396343409x10^{-16}s}{2(N)}$, produces the final form of the total period of oscillation for an energized graviton:

$$T = i\left(\pi + 7.39634309x10^{-27}\frac{\pi}{\sqrt{N}}\right) \tag{12}$$

The total period T decreases with the increase of integer N. Its increase is limited by the constraint of: $N = m^2 + n \leq \pm 104$. Also note that T is measured in radians, which is not a true unit. Here, m and n belong to the set of integers. We assume the total period is comprised of both the external and internal periods. The first term $i\pi$ results from the natural long acting on negative sign of the time component, of Minkowski metric. It represents the constant external period, and is computed to be:

$$T = i\pi \tag{13}$$

This imaginary number is also of fundamental importance to Euler’s identity:

$$e^{i\pi} + 1 = 0 \tag{14}$$

In an unexpected way, the beauty of this mathematical identity, offers proof that nature is fundamentally elegant, rather than chaotic. (Complex, 2024)

The internal period is given by:

$$T = \left(7.39634309x10^{-27}\pi\frac{i}{\sqrt{N}}\right) \tag{15}$$

Just as an equipartition divides the external and internal energy levels for molecules, N reveals the existence of various possible internal energy levels and periods of oscillations for gravitons, limited by the constraint: $N = m + n \leq \pm 104$.

5. Summary

The main feature of this article was to explore the period of oscillations for an energized graviton. What has been determined is that the external period for energized gravitons is constant and calculated to be: $T = i\pi$, whereas the internal period was determined to have a variable period of: $T = \left(7.39634309x10^{-27}\pi\frac{i}{\sqrt{N}}\right)$. Increasing positive integer N, decreases the internal period. Because the internal period of gravitons is variable, it indicates string theory may be applied successfully to both massive and massless gravitons. (Lüst, 2021) In doing so, the hope is that it will provide deeper insights into the graviton world and its workable relationship to general relativity and quantum physics. Moreover, because it was argued that n-valued energetic gravitons generate all Standard Model particle mass, including those yet to be discovered, future work may provide a possible explanation for Dark Matter. This triad approach requires further development, e.g. the mechanism that gives rise to particle spin and charge. Overall, we have argued that nature is comprised of three fundamental structures, each containing its own set of natural laws and physical attributes. And that they combine in such a way, as to form a more complete, interrelated description of nature at its essential level.

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