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LETTER

Dissipation of modified entropic gravitational energy through gravitational waves

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Abstract The phenomenological nature of a new gravitational type interaction between two different bodies derived from Verlinde's entropic approach to gravitation in combination with Sorkin's definition of Universe's quantum information content, is investigated. Assuming that the energy stored in this entropic gravitational field is dissipated under the form of gravitational waves and that the Heisenberg principle holds for this system, one calculates a possible value for an absolute minimum time scale in nature $\tau = \frac{15}{16}\frac{\Lambda^{1/2}\hbar G}{c^4} \sim 9.27 \times 10^{-105}$ seconds, which is much smaller than the Planck time $t_P = (\hbar G/c^5)^{1/2} \sim 5.38 \times 10^{-44}$ seconds. This appears together with an absolute possible maximum value for Newtonian gravitational forces generated by matter $F_g = \frac{32}{30}\frac{c^7}{\Lambda\hbar G^2} \sim 3.84 \times 10^{165}$ Newtons, which is much higher than the gravitational field between two Planck masses separated by the Planck length $F_{gP} = c^4/G \sim 1.21 \times 10^{44}$ Newtons.

Keywords Gravitational radiation · Entropic gravitation · Absolute minimum time scale · Absolute maximum gravitational field

1 Modified entropic gravitation between two bodies

In a recent paper (de Matos 2012), the author derived a new gravitational type force law, (1), starting from Verlinde's entropic approach to gravitation, and assuming Sorkin's hypothesis that the total amount of information in the Universe is directly proportional to the Universe four-Volume.

$$F = 3\frac{\Lambda^{1/2}G^2\hbar}{c^3}\frac{M_0 m_0}{R^3} \sim 5.93 \times 10^{-106}\frac{M_0 m_0}{R^3} \tag{1}$$

Where G is Newton's universal gravitational constant, $\hbar$ is the Planck constant divided by 2π, $\Lambda = 1.29 \times 10^{-52}$ [m^{-2}] is the cosmological constant (Spergel 1984), and M_0, m_0 are the respective masses of the interacting bodies whose center of mass are separated by the distance R. Since this force contains a proportionality constant $\Lambda^{1/2}G^2\hbar/c^3 \sim 5.93 \times 10^{-106}$ which is extremely small (to say the least), It is easy to conceive that this new type of gravitational force has never been experimentally detected in the context of the gravitational interaction between massive bodies. From the force law (1) one deduces that the total mechanical energy stored in a gravitating binary system orbiting under the single influence of this force is:

$$E = \pm\frac{3}{2}\frac{\Lambda^{1/2}G^2\hbar}{c^3}\frac{M_0 m_0}{R^2} \tag{2}$$

For the moment one does not make any assumption with respect to the attractive or repulsive character of the force F. This explains why we consider two possible signs for the total mechanical energy of the system (negative if the force is attractive, positive if the force is repulsive).

2 Gravitational radiation emitted by a binary system under the single influence of a modified entropic gravitational force

Let one consider that the two bodies have identical masses, $M_0 = m_0$, and that they are spinning with angular velocity ω about the center of mass of the binary system. Thus they form a kind of spinning dumbbell. General relativity

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