Authors note:
The comfort level with this paper is not as high as most. One would think the effect predicted here should have already been detected and measured; the absence is somewhat surprising. Currently, however, no reference has been found, and thus it seems best to rely on Conan Doyle character, Sherlock Holmes quote "Once you *eliminate the impossible*, whatever remains, no matter how improbable, must be the truth."
DT

An Alternative to Gravitational Waves

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ABSTRACT

In earlier papers by the author [4], [5], [6], an alternate locally conserved theory of gravitation has been proposed, exploring gravitation as a gradient in c. This creates an issue for the existence of gravitational waves since it is difficult to understand how a gradient in c could transmit energy or cause the pulsar orbits to decay. Since it is an experimental fact that binary pulsars do radiate away energy, there is a necessity for some other mechanism that explains the energy loss. It is developed here that radiation as illustrated in the Larmor and gravitational radiation are not the province of electromagnetic or gravitational forces, but are one in the same and are a general property of accelerated mass. Also proposed here is falsifiable experiment for testing the validity of the proposition.

Introduction

In the authors paper "Gravitation is a Gradient in the velocity of light" an alternate theory of gravitation is presented in which the acceleration of gravitation in effectuated by a gradient in the velocity of light. This creates two problems in regard to gravitational radiation. First, there is an implication that the nature of gravitation is electromagnetic, and second, it is hard to envision how a gradient in c having no energy, can radiate energy. It is certain however that an orbiting body in a gravitation system does radiate energy. In 1974 Russell Hulse and Joseph Taylor, discovered a binary star system losing energy exactly as predicted, and received the Nobel Prize for their work [1], [2].

To date however, no direct evidence of gravitational radiation has been found. Measurements of the cosmic background data from the Planck satellite, the BICEP2 experiment, and the super sensitive Ligos installations have as yet revealed no signs of gravitational waves. If there are gravitational waves, the lack of detection is not entirely surprising however, since the relative strength of electromagnetic force vs. gravitational force differs by 40 orders of magnitude.

Although the loss of energy in orbiting binaries is indicative of radiational loss, it does not necessarily require that the energy is being radiated as gravitational waves. Dicke in 1957 [3], as well as others have speculated on the possibility that gravitation has an electromagnetic origin, leading to the result that gravitational radiation could be electromagnetic. Dicke's theories have generally been discredited, and fallen as a result of the developments in GR.

Mechanism

For a particle in circular motion around a central force there is a continuous change in the direction of acceleration, and thus an acceleration of acceleration, or jerk. Subjecting a charged particle with radiation properties described by the Larmor formula to acceleration provided by a central force shows a reaction force proportional to this jerk in the opposite direction to the velocity. It is the symmetry in the radiation process that gives indication of a more universal process.

The Larmor radiation formula for an accelerated charge regardless of the acceleration mechanism is:

$$P_E = \frac{2}{3}\frac{q^2}{c^3}\dot{v}^2 \tag{1}$$

And for the radiated power of two equal gravitating masses [7]:

$$P_G = \frac{2}{3}\frac{Gm^2}{c^3}\dot{v}^2 \tag{2}$$

This is the value of the power radiated form the linearized form of the GR equations [7], and is the experimentally verified, relation for the energy radiated by orbiting pulsars [1].

For equal masses and charges in a circular orbit, using the centrifugal force relations, the charge, and gravitational, couplings constants in both Eq.(1), and Eq.(2), can be replaced with:

$$f_E = \frac{q^2}{r^2} = m\frac{v^2}{r} \qquad \rightarrow \qquad q^2 = mv^2 r \qquad (3)$$

And:

$$f_G = \frac{Gmm}{r^2} = m\frac{v^2}{r} \qquad \rightarrow \qquad Gmm = mv^2 r \qquad (4)$$

Both Eq.(1), for charge and Eq.(2), for gravitation then yield the same identical dynamic expressions for the power radiated:

$$P = \frac{2}{3}\frac{m}{c^3} r v^2 \dot{v}^2 \qquad (5)$$

Since in the case of the charge, from Eq.(1), the radiation is independent of the type of accelerating force the acceleration mechanism could as well be a string between the masses, rather than the charge on the other particle. The radiation from the gravitational and electrically bound particles are the same for particles in the same dynamical condition, and at least for the electrical particle the radiation is independent of the type of central force.

Expression (5) does not specify the nature of the central force providing the acceleration, and the emitted power is a function of the particle dynamics. The dynamics insist on the same directional radiated power generated whether the force is electric mechanical or gravitational. The type of central force does not participate in the radiation, and it is concluded that radiation is universal property of a change in acceleration of mass, independent of the type of central force, and independent of the charge.

It is asserted that this relation (Eq.(5),) is more a more fundamental property of mass than either of the individual radiation formulas, and is a dynamical requirement of central force acceleration. (See Appendix for discussion of a rational to support the argument.)

Proposed Experimental Testing of the Theory

If a conservative central force on non-charged mass does generate radiation as expressed in Eq.(5), then it should be testable in a mechanical experiment.

Although the radiation produced from a mechanical system is small, would seem within the range of feasibility. Two balls rotating around a central point held by a wire should radiate and satisfy the basic configuration, but practically, however the radiated power is quite small, and a more robust experiment would be necessary.

It is suggested that a flywheel made of high quality steel spinning at its maximum velocity could produce detectable radiation.

The maximum velocity at the perimeter would be:

$$v^2 = \frac{8\sigma}{(3+\nu)\rho} \tag{6}$$

σ, is the maximum tensile strength, ν Poisson's ratio, and ρ, is the density [9].

The radiated power from Eq.(5), is:

$$p = \frac{4}{3}\frac{m}{c^3} r v^2 \left(\frac{v^2}{r}\right)^2 \tag{7}$$

For a mass of 1 kg on the perimeter of a 1 meter radius with tensile yield strength σ, of 2.617e10 dynes/cm², a Poisson's Ratio ν, of .2 and a density ρ, of 8 gm/cc, the rotation speed would be about 144 rps, and the radiation would be about 0.28 milliwatts. This is about equivalent to the blackbody radiation of a 10 cm sq area at 25 K, so low temperatures for the flywheel may be necessary.

This is a small but likely detectable level. A sinusoidal shaped perimeter for the flywheel could provide modulation to enhance signal detection.

Conclusion

Radiation from accelerated charged particles particularly electrons is relatively easy to generate and measure and radiation from the decay of gravitational orbits has been noticed and measured. The notion that radiation is emitted from any accelerated mass as a general dynamic property, does not seem to have been explored or discussed in the literature, and there does not seem to be any experiments testing such an effect. Since it is difficult to generate sufficient acceleration on uncharged mass to create measurable radiation, and such has not been anticipated, it is not surprising that such an effect has not been found.

It has been proposed here, an alternate more generalized theory of acceleration generated radiation asserting electromagnetic and gravitational radiation are aspects of the same phenomena. A testable experiment has been proposed to verify its merit.

References:

1. Hulse, R. A. & Taylor, J. H. 1975, ApJ, 195, L51

2. Joseph H. Taylor Binary Pulsars and Relativistic Gravity
Reviews of Modern Physics, 66 No. 3, 711–719, 1994

3. R. H. Dicke (1957). "Gravitation without a Principle of Equivalence". *Reviews of Modern Physics* **29** (3): 363–376. Bibcode:1957RvMP...29..363D. doi:10.1103/RevModPhys.29.363.

4. DT Froedge, The Gravitational Theory with Local conservation of Energy, V020914, http://www.arxdtf.org/css/grav2a.pdf

5. DT Froedge, Gravitation is a Gradient in the Velocity of Light, V020914, http://www.arxdtf.org/css/gravitation.pdf

6. DT Froedge, The Velocity of Light in a Locally Conserved Gravitational Field, V020914, http://www.arxdtf.org/css/velocity.pdf

7 Crochet and Wilson, Gravitational Radiation and Radiation Reaction in Linearized Theories of gravitation, www.gravityresearchfoundation.org/pdf/.../crochet_wilson.pdf

8. H. Fearn J. Bengtsson, Radiation Reaction Force on a Charged Particle. ArXiv:1212.4469v2 [physics. class-ph] 8 Jan 2014

9. Granta Material Intelligence Support, 3.3 Materials for Flywheels http://support.grantadesign.com/

10 Feynman, The Feynman Lectures on Physics **Lecture** #4

Appendix

Rational

The predictions and tests theorized here seem somewhat improbable, however if gravitation is a gradient in c as proposed in [5], and there are no gravitational waves, there must be electromagnetic radiation. The following gives a rational for the existence of radiation from neutrally charged accelerated mass:

Defining Relations

The Larmor radiation from an accelerated charged particle in orbit around a central point is.

$$P_L = \frac{2}{3}\frac{q^2}{c^3}\dot{u}^2 = \frac{2}{3}\frac{m}{c^3} r v^2 \dot{v}^2 \tag{8}$$

Note that this radiation is independent of the accelerating mechanism; It could be electrical, mechanical or gravitational.

The Abraham–Lorentz radiation reaction force per Feynman is found by integrating the Larmor radiation by parts:

$$E = \int_{t1}^{t2} P dt = \int_{t1}^{t2} f \cdot v dt = \int_{t1}^{t2} \frac{q^2}{c^3}\frac{dv}{dt}\cdot\frac{dv}{dt} dt = \left.\frac{q^2}{c^3}\frac{dv}{dt}\cdot v\right|_{t1}^{t2} + \int_{t1}^{t2}\frac{q^2}{c^3}\frac{d^2v}{dt^2}\cdot v dt \tag{9}$$

With the resulting the radiation force being opposite the velocity vector and the radiation being in the direction of the velocity:

$$f = \frac{q^2}{c^3}\frac{d^2v}{dt^2}\cdot v \tag{10}$$

The assertion by Feynman based on the force is that there is no radiation from a uniformly accelerated charge, only the time derivative of the acceleration participates in the radation*.

From electromagnetic theory, the electric and magnetic fields for a charged particle at the location of a stationary observer, and the directed power flux is:

$$\vec{E} = \frac{q}{r^3}\left(\vec{r} - r\frac{\vec{v}}{c}\right)\left(1 - \frac{v^2}{c^2}\right) + \frac{q}{r^3c^3}\left(\vec{r}\times\left[\left(\vec{r} - \frac{r\vec{v}}{c}\right)\times\dot{v}\right]\right), \quad \vec{B} = \frac{q}{r}\frac{\vec{r}\times E}{c}$$

$$P = -\frac{c}{4\pi}\int_S\left(\vec{E}\times\vec{B}\right) \tag{11}$$

Points

1. For a charged particle the Larmor radiation is independent of the type of force applying the acceleration; electrical, mechanical, or gravitational.

2. For a moving charge if the tangential acceleration being supplied by a central force, the radiation is in the direction of the velocity. The radiation is unchanged if the acceleration long the radius vector is positive or negative, or the charge is positive or negative. It is asserted here of course, that the accelerated mass radiates with or without being charged.

Consider a thought experiment in which an apparatus containing two small charged balls one positive and one negative are in a circular motion about a central point. Presume the balls are sufficiently separated that the radiation as specified in Eq.(9), is such that that there is no interference. An observer at a position in the plane of the orbit would see two flashes of radiation as the apparatus approached the observer. The total radiated energy would be the integral of:

$$P_E = \frac{2}{3}\frac{q^2}{c^3}\dot{v}_1{}^2 + \frac{2}{3}\frac{(-q)^2}{c^3}\dot{v}^2 \tag{12}$$

As the particles in the apparatus are moved close together the radiation as determined by current theory becomes:

$$P_E = \frac{2}{3}\frac{\left(q_1 - q_2\right)^2}{c^3}\dot{v}_1^{\ 2} \rightarrow 0 \tag{13}$$

The question is: Will the power generated by the charges be defined by $\left(q_1 - q_2\right)^2$ or $\left(q_1\right)^2 + \left(-q_2\right)^2$. Does the superposition of the E and B of Eq.(11), annihilate the photon radiation, or does the self force radiation specified by the Larmor radiation, and the Abrams-Lorentz force remain.

It is argued here that, as in the case of the emission from double slits, the energy may interfere, but the total energy radiated from two oppositely charged particles charged particles experiencing the same acceleration remains the same when they are merged into a neutral particle. The number of photons generated remains the same.

It is pointed out that; if the content of the experiment were in a black box, the quantity of radiated energy should not change as a result of the propinquity of the charge. It is theorized that these particles can and will synchronize in a mode of stimulated emission, and thus **two opposite charges particles forming a neutral mass body, undergoing the same acceleration will radiate in accordance with Eq.(5), and be subjected to the Abrams-Lorentz reaction force.**

* Feynman argues and has pointed out[10], that the radiation reaction force (and therefore the radiated power) is proportional to the third derivative of position, not the uniform acceleration, and thus the radiated energy from a particle in a central force is only along the direction of the velocity.