General Relativity Theory Violates the Energy Conservation Law, which is the Fundamental Law of Physics

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Abstract: The violation of energy conservation law is a death sentence for the General Relativity Theory (GRT). This paper investigates the correctness of the General Relativity Theory by studying the energy conservation during the relativistic free fall of a small test body in a uniform gravitational field. The paper compares predictions of energy conservation obtained from the GRT and from the Metric Theory of Gravity (MTG). It is found that the gravitational mass dependence on velocity in the GRT is not correct, because this dependency leads to a prediction of violation of energy conservation while the MTG having a different gravitational mass dependency on velocity predicts correctly the energy conservation.

Introduction: The theories describing the free fall motion in a uniform gravitational field of a test body are well understood in both; the GRT and the MTG. In the GRT the inertial mass and the gravitational mass are assumed identical with identical dependencies on velocity. In the MTG, on the other hand, the gravitational mass depends on velocity differently than the inertial mass [1, 2]. It is thus simple for both theories to derive equations describing the free fall velocity and from that the energy of a test body that falls in a uniform gravitational field that also possesses the curved space-time metric.

Theories: It is well known that the gravitational field distorts the space-time. It is thus necessary to use the metric describing this distortion. However, the metric that is used for the analysis was not derived from the GRT for the uniform gravitational field, but was derived and is described in the previous publication [3] with its differential metric line element as follows:

$$ds^2 = \frac{(cdt)^2}{\left(1 - g \cdot z / c^2\right)^2} - \frac{dz^2}{\left(1 - g \cdot z / c^2\right)^2} \tag{1}$$

Here it was considered for the sake of simplicity that the motion occurs only in the negative *z* direction $z \le 0$ with the uniform gravitational acceleration equal to a constant *g*. It is also worth noticing that the speed of light in the *z* direction in this space-time is not affected by the gravitational field and retains its vacuum value *c*. The motion will be analyzed using the well-known and ages tested Lagrange formalism. The Lagrangian characterizing the small body free fall in this curved space-time is therefore as follows:

$$L = \frac{(cdt/d\tau)^2}{\left(1 - g \cdot z / c^2\right)^2} - \frac{(dz/d\tau)^2}{\left(1 - g \cdot z / c^2\right)^2} \tag{2}$$

The corresponding Euler-Lagrange equations are then readily found following the formalism:

$$\frac{d}{d\tau}\left(\frac{\partial L}{\partial (dz/d\tau)}\right) = \frac{\partial L}{\partial z} \tag{3}$$

First for the time variable the result is:

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$$\frac{dt}{d\tau} = \left(1 - g \cdot z / c^2\right)^2 \tag{4}$$

where the constant of integration was suitably selected such that at the origin $z = 0$ the $dt = d\tau$. For the space variable the computation is slightly more complicated with the first step as follows:

$$-\frac{d}{d\tau}\left(\frac{(dz/dt)(dt/d\tau)}{\left(1-g\cdot z/c^2\right)^2}\right) = \frac{(dt/d\tau)^2 g}{\left(1-g\cdot z/c^2\right)^3} - \frac{(dz/d\tau)^2 g/c^2}{\left(1-g\cdot z/c^2\right)^3} \tag{5}$$

This formula can be simplified using Eq.4 and the definition of velocity $v = dz/dt$ as follows:

$$\frac{dv}{dt} = -\frac{g\left(1-v^2/c^2\right)}{\left(1-g\cdot z/c^2\right)} \tag{6}$$

The Lagrangian itself is also the first integral ($L = c^2$) and this leads to the following relation:

$$\frac{1}{\left(1-g\cdot z/c^2\right)^2} = 1 - \frac{v^2}{c^2} \tag{7}$$

It is now easy to verify that the energy is conserved during the fall. Using Eq.7, taking the square root of the formula, multiplying the result by c^2 and by the rest mass of the falling body m_0, we can write:

$$\frac{m_0 c^2}{\sqrt{1-v^2/c^2}} = m_0 c^2 - m_0 g \cdot z \tag{8}$$

This clearly indicates that relativistic mass-energy is properly and exactly conserved ($z \le 0$) during the fall as expected, thus satisfying the energy conservation rule. This result also confirms that the metric introduced in Eq.1 is a correct metric for the uniform gravitational field space-time.

In the next steps we will find equation for the force that the uniform gravitational field exerts on the falling body. This is important for a comparison of MTG and GRT theories. Using Eq.7 in Eq.6 the formula for acceleration as a function of velocity can be found:

$$\frac{dv}{dt} = -g\left(1-v^2/c^2\right)^{\frac{3}{2}} \tag{9}$$

This equation can be rearranged and multiplied by the rest mass of the falling body with the result:

$$\frac{d}{dt}\left(\frac{m_0 v}{\sqrt{1-v^2/c^2}}\right) = -m_0 g \tag{10}$$

This formula is the relativistic forces balance equation where the left hand side is the inertial force formula and the right hand side is the gravitational force formula. The force that is acting on the falling body is thus clearly constant and independent of velocity.

However, in the previous publications [4] it was claimed that the gravitational mass in MTG depends on velocity differently than the inertial mass in contrast to the GRT dependency. This apparent discrepancy needs to be now reconciled.

From the general contravariant expression for the gravitational force vector acting in a curved space-time that was introduced in previous publication [4] the *z* component can be written as:

$$F_g = -g^{zz} \frac{\partial \varphi}{\partial z} m_0 \sqrt{g_{tt}} \sqrt{1 - v^2/c^2} \tag{11}$$

where φ is the gravitational potential. Using the metric coefficients introduced in the differential metric line element the gravitational force acting on the test body is thus evaluated with the help of Eq.7 to be:

$$F_g = -\frac{\left(1 - g \cdot z/c^2\right)^2 g \cdot m_0}{\left(1 - g \cdot z/c^2\right)\left(1 - g \cdot z/c^2\right)} = -m_0 g \tag{12}$$

This is very interesting result. While the gravitational mass changes with velocity differently than the inertial mass: $m_g = m_0 \sqrt{1 - v^2/c^2}$, the force on the falling test body stays constant. This is the effect of a curved space-time. This result now provides the tool to investigate the GRT mass dependence on velocity and consequently its effect on the conservation of energy during the fall. This result also justifies the calculation of energy when slowly lifting the test body by the distance *z* as is being acted upon by this constant force. The gained potential energy is calculated simply as follows:

$$E_g = m_0 g \cdot |z| \tag{13}$$

Using now the same approach for the GRT force as was used above for the MTG force it is clear that by modifying Eq.12 for the GRT gravitational mass dependence on velocity the gravitational force on the test body according to GRT is:

$$F_{grt} = -g^{zz} \frac{\partial \varphi}{\partial z} m_0 \sqrt{g_{tt}} \frac{\sqrt{1 - v^2/c^2}}{\left(1 - v^2/c^2\right)} \tag{14}$$

This results in the following GRT forces balance equation:

$$\frac{d}{dt}\left[\frac{m_0 v}{\sqrt{1 - v^2/c^2}}\right] = -g \frac{m_0}{\left(1 - v^2/c^2\right)} \tag{15}$$

The formula in Eq.15 can be rearranged and simplified resulting in the relation for the small test body acceleration as is valid in the GRT:

$$\frac{dv}{dt} = -g\sqrt{1 - v^2 / c^2} \tag{16}$$

In the next step it is necessary to rearrange this relation as a function of distance *z*. This can be accomplished as follows:

$$\frac{dv}{\sqrt{1 - v^2/c^2}} = -g \frac{dt}{dz} dz \tag{17}$$

After integration the result is:

$$\sqrt{1 - v^2/c^2} = 1 - g \cdot |z|/c^2 \tag{18}$$

The energy difference will be calculated by comparing the potential energy that is exerted by lifting the test body very slowly in the uniform gravitational field *g* by a distance *z* to the energy that is gained when the body falls back the same distance $z \le 0$.

$$\Delta E = \left(m_0c^2 + m_0 g\cdot|z|\right) - \frac{m_0c^2}{\sqrt{1-v^2/c^2}} = \left(m_0c^2 + m_0 g\cdot|z|\right) - m_0c^2\left(1+\frac{g\cdot|z|}{c^2}+\left(\frac{g\cdot z}{c^2}\right)^2+\cdots\right) \tag{19}$$

By expanding the result into a power series as is shown in Eq.19 and neglecting the higher order terms the energy difference becomes as follows:

$$\Delta E \cong -\frac{m_0c^2}{4}\left(\frac{2g\cdot z}{c^2}\right)^2 \cong -\frac{m_0c^2}{4}\left(\frac{v^2}{c^2}\right)^2 \tag{20}$$

This is a very strange result. It seems that the falling body is gaining some additional energy from an unknown source on top of the energy that is predicted from the standard relativistic energy formula:

$$E = \frac{m_0c^2}{\sqrt{1-v^2/c^2}} \tag{21}$$

This is not reasonable and it is pointing to a problem that exists in the GRT for a long time. The gravitational mass cannot depend on velocity the same way as the inertial mass. The conservation of energy in GRT is thus violated. The GRT is, therefore, not a valid theory of gravity.

For a better understanding of the amount of energy violation a graph is shown below in FIG.1.

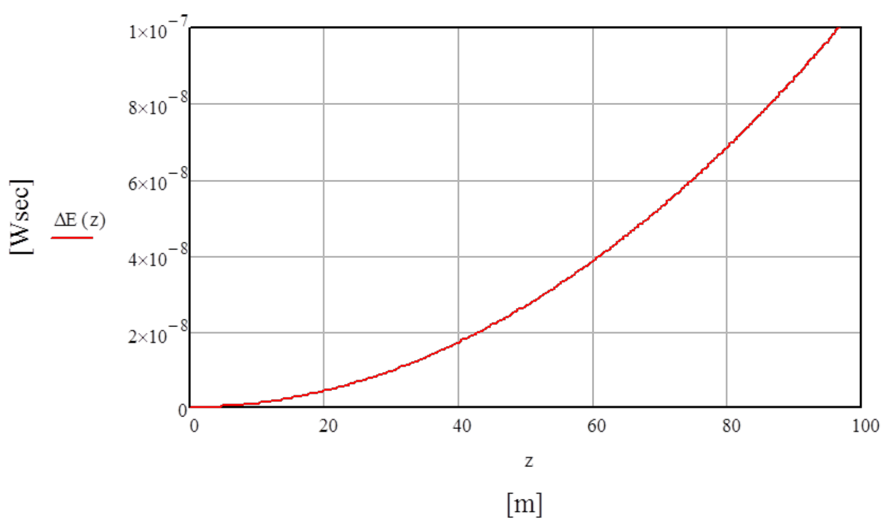

FIG.1. the violation of energy conservation law in dependence on a distance of fall *z* for a mass of 10,000kg and the Earth's gravitational acceleration $g = 9.80665\, m/s^2$ according to GRT

Conclusions: The paper derived simple expression for the energy conservation during the small test body free fall in a uniform gravitational field that also included the effect of gravity on the curvature of space-time. It was shown that the energy conservation derived according to the GRT mass dependence on velocity is violated. This is unacceptable and this fact proves the invalidity of GRT. The paper thus clearly verified that this problem has its root cause in the identical dependency of inertial mass and gravitational mass on velocity in GRT.

Fortunately the new MTG theory of gravity was recently developed where the dependency of gravitational mass on velocity is different than in the GRT. This solved the energy conservation problem.

The presented results have fatal consequences for the GRT, because unquestionably prove its incorrectness. These findings thus have a significant impact on all the theories based on the GRT such as the Big Bang and similar ridiculous models of the Universe.

The author hopes that the main stream relativists finally recognize this problem and abandon the GRT with all its ridiculous claims of existence of Black Holes, Event Horizons, and the Big Bang Universe with its accelerating expansion to infinity from nothing.

References:

[1] http://gsjournal.net/Science-Journals/Research%20Papers/View/7070

[2] http://physicsessays.org/browse-journal-2/product/904-8-jaroslav-hynecek-remarks-on-the-equivalence-of-inertial-and-gravitational-masses-and-on-the-accuracy-of-einstein-s-theory-of-gravity.html

[3] http://physicsessays.org/browse-journal-2/product/447-16-jaroslav-hynecek-new-space-time-metrics-for-symmetric-spaces.html

[4] http://physicsessays.org/browse-journal-2/product/397-17-jaroslav-hynecek-the-galileo-effect-and-the-general-relativity-theory.html

When I have submitted this paper to Physical Review D the editor has responded with the following comments:

Dear Dr. Hynecek,

Physical Review D does not publish papers on speculative alternatives to or reinterpretations of currently accepted theories unless stringent requirements are met. Papers that lie outside the mainstream of current research must justify their publication by including a clear and convincing discussion of the motivation for the new speculation, with reasons for introducing any new concepts. This discussion should be at a level of detail and precision comparable to that of the accepted theory, and should be at a level of discourse appropriate to the current state of research in the field. If the new formulation results in contradictions with the accepted theory, then there must be both a discussion of what experiments could be done to show that the conventional theory needs improvement, and an analysis showing that the new theory is consistent with all existing experiments.

Upon reading your manuscript, I conclude that your paper fails to satisfy all of these requirements. I regret to inform you that it is therefore not suitable for publication in Physical Review D.

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I think that there is no chance to win against the "mainstream accepted theory" even if it is wrong. The PC dominates even in exacts sciences, how sad. The interested readers please judge by yourselves.