Goodbye, the Pseudotensor!

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It is shown that the Einstein-Eddington-Tolman's concept of gravitation energy is wrong as a whole because their pseudotensor contributes a POSITIVE term to the total energy of an isolated system, and therefore this standard pseudotensor breaks the conservation law. The original result is the proving of the positiveness, which buries the Einstein-Eddington-Tolman's pseudotensor. So, no works using the pseudotensor can provide a well-defined notion of the gravitational energy no matter what conditions are considered. The Tolman's formulas are demonstrated in the paper as formulas containing arithmetic mistakes.

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A gravitational field differs from ordinary fields, electromagnetic field, gluon field, which eliminate themselves due to interference when attracting objects. A gravitational field becomes stronger when attracting objects rather than eliminates itself. The mass-energy of objects always increases in the process of attracting. In the case of an ordinary field, this increase is compensated by a decrease of the field energy for satisfaction of the conservation law. However, in the case of a gravitational attraction, we are forced to ascribe a negative energy to the gravitation field if we believe that the total energy of the system "objects + field" is conserved in the process of attracting.

For accounting this negative gravitation energy, an energy-momentum pseudotensor of gravitation field t_μ^ν was proposed [1, § 87]. An addition of the component t_4^4 of this pseudotensor to the relevant component T_4^4 of the matter energy-momentum tensor gives a formula for the total energy of an isolated system [1, (91.1), (91.3), (92.1)]:

$$U = J_4 = \int (T_4^4 + t_4^4)\sqrt{-g}\, dx^1 dx^2 dx^3 = m. \tag{1}$$

The total energy equals the sum of the proper energy of the matter and the gravitational energy, the sum to be equaled to the Schwarzschild constant m, which, by definition, determines the static field at large distances.

Tolman writes [1, § 97]: "This satisfactory result can serve to increase our confidence in the practical advantages of Einstein's procedure in introducing the pseudo-tensor densities of potential gravitational energy and momentum t_μ^ν".

An explicit expression for the component t_4^4 of the pseudotensor of the isolated system was found, in particular, in [1]. It is the sum of pressures along the three axes, i.e. it is the triple pressure in the isotropic case [1, (92.4), (97.2), (97.3), (97.5)], [2, (105,23)]:

$$U = J_4 = \int (T_4^4 - T_1^1 - T_2^2 - T_3^3)\sqrt{-g}\, dx^1 dx^2 dx^3 = \int (T_4^4 + 3p)\sqrt{-g}\, dx^1 dx^2 dx^3 = m. \tag{2}$$

However, it is strange that the pseudotensor addition is positive, whereas the addition must bring a negative contribution to the total mass-energy. It is strange, as well, that despite this positive addend to the proper energy of the matter, the sum is found to be equal the constant m, although the proper energy of the matter itself exceeds this constant [see (5) below].

The riddle is solved simply. Formulae (1), (2) are false. Density $T_4^4 + t_4^4$ must be intgrated over the proper spatial volume,

$$dV = \sqrt{-g_{11}g_{22}g_{33}}\, dx^1 dx^2 dx^3, \tag{3}$$

in order to obtain the total energy. This is pointed to, in particular, in [2, § 100]. So, given the pseudotensor, the modulus of the total energy (the invariant total energy) of the isolated system must be calculated by the formula [3, (6.9)]

$$J = \int (T_4^4 + 3p)\sqrt{-g_{11}g_{22}g_{33}}\,dx^1 dx^2 dx^3 = \int (T_4^4 + 3p)\frac{\sqrt{-g}}{\sqrt{g_{44}}}dx^1 dx^2 dx^3 \,. \qquad (4)$$

But this quantity is much more than the constant m because $g_{44} < 1$. And even energy of the matter itself is more than the constant m [3, (5.8)],

$$P = \int T_4^4 \sqrt{-g_{11}g_{22}g_{33}}\,dx^1 dx^2 dx^3 > m\,. \qquad (5)$$

This indicates the gravitational mass defect of the body [2, § 100].

  Quantities (1), (2) are obtained by the integration of the covariant component of the 4-momentum of the system element. The remained index 4 indicates this. But such an integration is meaningless because the coordinate vectorial bases, which support the vector components of the element, are different in different points of the integration domain. And a coordinate vectorial base does not exist, which supports the integral quantity J_4, in spite of the Galilean asymptotics.

  Therefore the description of "gravitational energy" by the pseudotensor is false because the pseudotensor does not fulfill its main function: to contribute a negative term to the total energy of an isolated system.

Addition (optionally)

A criticism of the energy-momentum pseudotensor of gravitation field was rejected many times.

1. The present paper was rejected by

-- GRG January 11, 2015**:**

  The author attempts to point out some apparent non-sense in the uses of the pseudo tensor. There have already been a tremendous number of works that show that under certain conditions, the pseudotensor provide a well-defined notion of the gravitational energy for an isolated system in general relativity. However, the present author appears to almost completely ignore these existence results. In addition, since all the calculations (1)—(5) and conclusions are simply quoted from the references 1—3 (with the explicit equation number or section nubmer), I cannot find that this paper would contain any its own original results. GRG should publish only an original work which contains new, interesting results for the community. For these reasons, I recommend this paper to be rejected. **Abhay Ashtekar**

  My reply was:

  In the paper "**Goodbye, the Pseudotensor!**", it is shown that Einstein-Eddington-Tolman's concept of gravitation energy is wrong as a whole because their pseudotensor contributes a POSITIVE term to the total energy of an isolated system, and therefore this standard pseudotensor breaks the conservation law. The original result is the proving of the positiveness, which buries the Einstein-Eddington-Tolman's pseudotensor. So, no works using the pseudotensor can provide a well-defined notion of the gravitational energy no matter what conditions are considered. The Tolman's formulas are demonstrated in the paper as formulas containing arithmetic mistakes.

  I have no answer. Abhay Ashtekar answers never

-- **NJP** January 16, 2015:

  We regret to inform you that your article will not be considered for review as it does not meet our strict publication criteria. **Eberhard Bodenschatz's** Publishing Team

  My reply was:

  Is Eberhard Bodenschatz, NJP Editor, an offender?

  I explained that an intentional concealment of serious longstanding mistakes of physicists is a crime, because the physicists get pay, grants, *etc*. http://khrapko-ri.livejournal.com/14358.html https://groups.google.com/forum/#!topic/sci.physics.electromag/DXdYCaK5yqk

Now NJP Publishing Team hides a result, according to which, the concept of Einstein's pseudotensor and the huge mass of works on this topic are meaningless. The Team refuses to review the paper.

I am able to forgive Abhay Ashtekar, GRG Editor. His reviewer reviewed this paper, tried to understand the content, and could not understand it. But NJP Team hides the result consciously in order to defend illegal interests of authorities. Eberhard Bodenschatz, Editor, must be responsible for his Publishing Team.

I have no answer. Eberhard Bodenschatz answers never

2. The paper **"The energy-momentum pseudo-tensor of the gravitational field is a mistake"** http://khrapkori.wmsite.ru/ftpgetfile.php?id=114&module=files http://viXra.org/abs/1308.0151 was rejected by:

-- GRG September 01, 2013:

The paper under consideration provides an explicit example of a well-known fact, namely that the energy-momentum pseudo-tensor does not provide an invariant means for calculating the energy-mometum contribution due to the gravitational field. It is dependent on the coordinate system, or more precisely on the reference frame used. So while I believe that the paper is correct I do not think that it contributes anything new and therefore, I suggest that it be rejected. **Abhay Ashtekar**.

My reply was:

Dear Abhay Ashtekar, Sorry, Your Reviewer is not correct when he writes "that the energy-momentum pseudo-tensor does not provide an invariant means for calculating the energy-mometum contribution due to the gravitational field. It is dependent on the coordinate system, or more precisely on the reference frame used".

In reality, as is well known, the energy-momentum pseudo-tensor DOES provide an invariant means for calculating the energy-mometum contribution due to the gravitational field. It is INDEPENDENT on the coordinate system, or more precisely on the reference frame used. For example,

Tolman wrote:

"t_μ^ν is a quantity which is defined in all systems of coordinates by (87.12), and the equation is a covariant one valid in all systems of coordinates. Hence we may have no hesitation in using this very beautiful result of Einstein".

Landau & Lifshitz wrote:

"The quantities P^i (the four-momentum of field plus matter) have a completely define meaning and are independent of the choice of reference system to just the extent that is necessary on the basis of physical considerations".

Tolman wrote:

"It may be shown that the quantities J_μ are independent of any changes that we may make in the coordinate system inside the tube, provided the changed coordinate system still coincides with the original Galilean system in regions outside the tube. To see this we merely have to note that a third auxiliary coordinate system could be introduced coinciding with the common Galilean coordinate system in regions outside the tube, and coinciding inside the tube for one value of the 'time' x^4 (as given outside the tube) with the original coordinate system and at a later 'time' x^4 with the changed coordinate system. Then, since in accordance with (88.5) the values of J_μ would be independent of x^4 in all three coordinate systems, we can conclude that the values would have to be identical for the three coordinate systems".

So, I think you need to use another Reviewer.

I have no answer.

-- Classical and Quantum Gravity, September 11, 2013:

"We do not publish this type of article in any of our journals and so we are unable to consider your article further". **John Fryer, Ben Sheard, Adam Day, Martin Kitts.**

-- New Journal of Physics, September 17, 2013

"We are unable to consider the article for our journal as it has previously been rejected". **Kryssa Roycroft and Joanna Bewley.**

-- PRD, October 11, 2013

"Your manuscript only refers to work written more than sixty years ago, and ignores the considerable relevant work since then that is related to an understanding of the issues and difficulties associated with local and global concepts of energy in gravitating systems in a (necessarily) curved spacetime". **Erick J. Weinberg.**

My reply was:

Dear Erick J. Weinberg, All works written during the sixty years on this topic are founded on the first work by Einstein, Eddington, Tolman. All these works developed the Einstein's work, interpreted it or modernized it. In contrast, my paper argues that the first work is trivially invalid owing to a simple mistake, namely, a covariant component of the energy-momentum vector, instead of mass, was calculated in the work, and this component has no sense. Thus all works, which take the first work seriously, are of no interest.

An appeal against the decision was rejected without explanations.

References

1. Tolman R. C. Relativity, Thermodynamics and Cosmology (Oxford Clarendon 1969)
2. Landau L. D., Lifshitz E. M. The Classical Theory of Fields (Pergamon, N. Y. 1975).
3. Khrapko R.I. "The Truth about the Energy-Momentum Tensor and Pseudotensor". *Gravitation and Cosmology*, 20, 4 (2014), p. 264.
   http://khrapkori.wmsite.ru/ftpgetfile.php?id=132&module=files

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