

# The pseudotensor is inept because its contribution to mass is positive

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In order to increase our confidence in the practical advantages of Einstein's procedure in introducing the pseudotensor of gravitational energy and momentum  $t_{\beta}^{\alpha}$  [1 (20), 2 (87.12), 3 (59.4)], Tolman intended to demonstrate the principles for the conservation of energy. He counted up the *total* energy of a fluid sphere  $U = m$  [2 § 97, 4]. This total energy, which is conserved, according to the Einstein's idea, is the sum of the *proper* energy of the sphere and the corresponding *gravitational* energy.

$$U = \int T_4^4 \sqrt{-g} dx dy dz + \int t_4^4 \sqrt{-g} dx dy dz = m. \quad (1)$$

Equation (1) is the Tolman's formula [2 (92.1)]. Here  $g = g_{44} g_{xx} g_{yy} g_{zz}$  is the determinant of the used coordinate system  $x, y, z$ ,  $T_4^4 = \rho$  is the component of the energy-momentum tensor of the fluid, i.e. the volume density, and  $t_4^4$  is the component of the pseudotensor. Tolman successfully transformed the expression for the gravitational energy ( $p$  is pressure,  $dV_0$  is the *physical volume*) [2 (92.4), 4]:

$$\int t_4^4 \sqrt{-g} dx dy dz = -\int (T_1^1 + T_2^2 + T_3^3) \sqrt{-g} dx dy dz = \int 3p \sqrt{g_{44}} dV_0, \quad \sqrt{-g_{xx} g_{yy} g_{zz}} dx dy dz = dV_0. \quad (2)$$

As a result, now, according to Tolman and others, the total energy of a fluid sphere is counted up with the use of the Einstein's pseudo-tensor by the formula

$$U = \int \rho \sqrt{g_{44}} dV_0 + \int 3p \sqrt{g_{44}} dV_0 = m; \quad (3)$$

the first summand is the *proper* energy of the sphere; the second summand is the corresponding *gravitational* energy. This result is confirmed in [5 (105.23)].

However, in reality, Eqs (1), (3) do not represent energy! As is well known, proper mass-energy  $M$  of a body equals the integral of the volume density  $\rho$  over the *physical volume* [5, § 100]:

$$M = \int \rho dV_0 = \int \rho \sqrt{-g_{xx} g_{yy} g_{zz}} dx dy dz. \quad (4)$$

So, the factor  $\sqrt{g_{44}}$  in (1) – (3) is superfluous. Note,  $\sqrt{g_{44}} < 1$ . Using the coordinates  $r, \theta, \varphi$  of the Schwarzschild's interior solution [2 § 96] yields [6]

$$M = m + 3m^2 / (5r_1) + \dots, \quad (5)$$

where  $r_1$  is the radial coordinate of the sphere surface, and  $m$  is the parameter of the Schwarzschild's exterior solution, which is constant when the sphere collapses, under the Birkhoff's theorem. This means that, in reality, even the *proper* energy of the sphere  $M$  is greater than  $m$  of the formula (1) or (3). Landau & Lifshitz called this circumstance *the gravitational mass defect* of the body.

Let  $G$  is the *gravitational* energy. Then the conservation of the *total* energy implies:

$$M + G = m, \quad \text{i.e. } G = -3m^2 / (5r_1) - \dots < 0. \quad (6)$$

I.e. the *gravitational* energy of the sphere must be negative. But, according to (2), the Einstein's pseudotensor provides positive gravitational energy of the sphere in any case. So, the pseudotensor is **inept!** The sum (1) or (3) equals the desired  $m$  only because these formulae are senseless.  $U$ , which uses the pseudotensor, is not the total energy in any case,  $U$  is senseless [6-9].

## References

1. Einstein A. Das hamiltonisch.es Prinzip und allgemeine Relativitätstheorie. *Sitzungsber. preuss. Akad. Wiss.*, 1916, 2, 1111—1116.
2. Tolman R. C. *Relativity Thermodynamics and Cosmology* (Dover Books on Physics 2011)
3. Eddington A.S. *The mathematical theory of relativity* (Cambridge University Press, 2010)
4. Tolman R. C. *Phys. Rev.* **35**, 875 (1930)
5. Landau L. D., Lifshitz E. M. *The Classical Theory of Fields* (Pergamon, N. Y. 1975).

6. 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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9. Khrapko. R.I. Gravitational mass defect. *XVI Russian Gravitational Conference*. Konicsberg 2017, p. 41

## **This letter was rejected by some journals**

### **GERG**

GERG-D-17-00089. The reason for rejection is the same as before.

Roy Maartens

[**Author's comment was:** "Dear Roy Maartens, you, as well as Einstein, Tolman and others, are not able to integrate if the coordinates are curvilinear. This letter shows the mistake".]

### **Journal of Mathematical Physics**

#17-0335. This paper does not contain enough new mathematical research to justify publication in JMP.

Bruno Nachtergaele

[**Author's comment was:** "Dear Bruno Nachtergaele, you, as well as Einstein, Tolman and others, are not able to integrate if the coordinates are curvilinear. This letter shows the mistake".]

### **AJP**

We have reviewed your submission (our manuscript #29483) and determined that it is not appropriate for publication in the American Journal of Physics.

David P. Jackson, Richard Price

[**Author's comment was:** "Dear David P. Jackson: You, Richard Price, Einstein, Tolman, and others cannot integrate in curvilinear coordinates".]

### **NJP**

I wrote:

"Dear Dr Ben Sheard, Jessica Thorn and Claire Fullarton, Zora Catterick and Max Paulus, Professor Barry Sanders, Dr Elena Belsole, I think you, as well as Einstein, Tolman and others, are not able to integrate if the coordinates are curvilinear. This letter shows the mistake".

But the letter was rejected just by Dr Ben Sheard, Jessica Thorn and Claire Fullarton, Zora Catterick and Max Paulus, Professor Barry Sanders, Dr Elena Belsole:

" your article NJP-106669 will not be considered for review as it does not meet our strict publication criteria".

### **Proceedings A**

RSPA-2017-0209 The author claims that the pseudo tensor in general relativity is inept, only by criticizing an old attempt of Tolman. But, in my opinion, usefulness of the pseudo tensor and its generalized one is supported by recent LIGO gravitational wave data for a two-black-hole-merging process. I do not think that the paper is appropriate for publication.

Raminder Shergill

[**Author's comment was:** "Dear Raminder Shergill, in reality, no gravitational waves are detected with the help of pseudotensors: see Misner, Thorne, Wheeler *Gravitation* §35.15. STRESS-ENERGY TENSOR FOR GRAVITATIONAL WAVES

I consider the Einstein's pseudotensor (*Sitzungsber. preuss. Akad. Wiss.*, 1916, 2, 1111). The pseudotensor was supported by Eddington, Tolman and others. This pseudotensor is a mistake. It is an obstacle to progress in theory of gravitation.

Unfortunately, your board members do not know General Relativity. E.g. they think that the coordinate  $r$  becomes time-like in the interior region of the Schwarzschild interior solution (see my appeal concerning RSPA-2016-0432 at page 5 of

<http://khrapkori.wmsite.ru/ftpgetfile.php?id=149&module=files>"]

### **Journal of Geometry and Physics**

The Journal is devoted to the publication of top-quality research papers. I feel that your your submission JGP6278 does not fit into the Journal's editorial line.

Ugo Bruzzo, Professor Editor-in-Chief

[**Author's comment was:** "Dear Ugo Bruzzo, we show that the Hamilton's principle led Einstein to a mistake. We have made Einstein's pseudotensor and a mount of corresponding works null and void!"]

### **Physical Review D**

This manuscript DD12054 repeats arguments from previously rejected submissions, including rejections that were upheld on appeals. We will therefore not consider it further.

Erick J. Weinberg

### **Foundations of Physics**

This work, FOOP-D-17-00232, is not suitable for publication in FOOP

Editor-in-Chief: Carlo Rovelli