In Cosmology, $c^2 = \text{const}$
Is the Measure of Inertia, Not Mass

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Abstract

It is understandable that in 1916 Einstein was unable to explain his postulate $c=\text{const}$, that in the case of the lightning and the train that moves on the railway embankment he still tacitly implied that the inertial coordinate system which is at rest has advantage over the one in motion. In serious scientific journals, there are no tries of explanations of this postulate, but it is strange that even today, at popular lectures, Einstein's explanation is taken as valid. It isn't difficult to show that his explanation is not valid; it is difficult to find the right explanation without trying to form an alternative theory. The article is dedicated to this goal. The found explanation will also serve to explain, for example, the EPR-paradox without any *"spooky action at a distance"* or *"hidden variables"* (Einstein's expressions). And this is not the only example where it can serve.

Content:

Introduction

In special theory of relativity, the mass is defined only as a rest mass, i.e. as the mass in its own coordinate system, because otherwise it is relative.

When describing physical laws all inertial coordinate systems are equal by the fact that the speed of light in the vacuum is the same in all of them, $c = $ const, and that is precisely the reason why the mass is relative: with the increase of relative speed the mass will increase as well, whereby this speed cannot be greater than the speed of light, the highest speed in the nature, $c_{max} = $ const.

The highest one, however, related to which reference point? If all the inertial coordinate systems are equal, although they are moving to each other which ever speed with, then why not those whose relative speed is $c + v$? How it happens that for light $c \pm v$ is again equal c, what was proved by De Sitter with help of astronomical measurement as early as in 1913?

This cannot be understood on macro-level, whichever mass with.

This can be understood only if the measure of inertia is not a mass, even not of infinite density and it doesn't matter how large, from which could be counted the beginning of the time and the whole universe at all—in some though absolute coordinate system—but rather if the speed of light or actually the square of the speed, $c^2 = $ const, is understood as the inertia of the whole cosmos itself.

And how? That is provided in this article.

What Einstein couldn't explain

In 1905, at the time when Einstein formulated his special theory of relativity,[1] it was not known that there were other galaxies besides the Milky Way. All the speeds in our galaxy are negligible low related to the speed of light, so that it doesn't matter related to what mass is that c_{max} to be counted. In 1917 Einstein himself wrote in his *Cosmological Considerations about the General Theory of Relativity*:[2] all the mass of the world is so large as it is, so in relation to that mass as a whole c_{max} and a coordinate system starting at its center somewhere in the center of the Galaxy. Einstein was troubled by something else: how to explain relativity of time and length. And that $c \pm v$ is again equal to c, for this he found the relativity as sufficient explanation, i.e. Lorenz transformation. So in a lecture published in 1911 under the title THEORY OF RELATIVITY[3], he presents the next thought experiment, the funny thing, as he himself considers it, but with the inevitable consequence, as he himself mentions *"When a living organism is sent for some time there and back at approximate speed of light, although for it passes only a moment, once back, it will find a new generation at the place of departure."* There and back, where he is and where his listeners are from, that coordinate system is to be understood as if it were absolute and at rest, therefore, in relation to it the time went slower in the moving system.

I don't know who and when noticed that paradox and explained it with the twins case, today known as **twin paradox**: the brother who returned, was not moving in his coordinate system (and this is still a special theory of relativity that does not take into account acceleration and gravity), so with regard to him, quite equally and symmetrically (because of this symmetry, Einstein postulated $c = const$), the brother on the Earth traveled as well, so that the returnee, on the contrary, had to find his brother not elder, but rather younger. This apparent paradox is due to the fact that Maxwell's wave equation for electromagnetic expansion of light has not considered mass, but only length and time; its coordinate beginning can be anywhere, regardless of any mass. Hence the solution of the paradox is trivial: it doesn't matter how many inertial systems are there and in parallel movement, the time will be passing in the fastest way in that one, which we choose to be moveless, because only in relation to this system all the speeds are counted as absolute while in all other systems they are relativistic added to each other. This can be shown in a consistent example with Lorenz transformations in three inertial coordinate systems A, B, and C. The only thing here is that the symmetry becomes more complex, it is not simply **AB-B**A when we by chance chose A, and then B to stay moveless, but it is rather cyclic: **ABC-B**CA-**C**AB. Etc.[4]

Or the example from 1916: a train and two lightning bolt simultaneously at the same distance from the passenger but from different sides, the scientific popular booklet **ABOUT SPECIAL AND GENERAL THEORY OF RELATIVITY**.[5] Einstein concludes that the passenger will spot the lightning B before the lightning A, because, observed from the railroad embankment where another observer is located, the train is indeed moving, as he said: *"to meet the light beam coming from B, and moving from the light beam coming from A."* He tentatively concludes, therefore, that the train speed and the speed of the light beam are adding to each other i.e. subtracting from each other which is opposite to the postulate $c_{max} = const$ and to all experimental measurements. Tentatively, the Earth is an absolute coordinate system, at least for this purpose.

Nowadays, electromagnetism has been studied at many technical faculties, however, it is always underlined that it is referring to electromagnetism of immobile environments. The establishment of the electromagnetism of moving environments (or moving bodies, as in 1905 Einstein wrote already in the title) by the $c = const$ postulate so that the equations are symmetric (such as Galilean transformations with plus and minus v in classical mechanics) is such a huge step forward that it is no wonder that Richard Feynman wrote in 1985 that he only describes how the Nature behaves, but that he cannot explain why it is that way, because no one can understand it.[6]

No one until now? Why?

Because at macro-level it is really not understandable. Let us have a look at three inertial coordinate systems, the fix, immobile Ox-system, and mobile O_1x' and O_2x'', it is sufficient to mark only the coordinate beginnings and x-axes:

Light →

V_1 V_2 x, x', x''

O O_1 O_2 $O_1(x_1,t)$ $O_2(x_2,t)$

t = 0
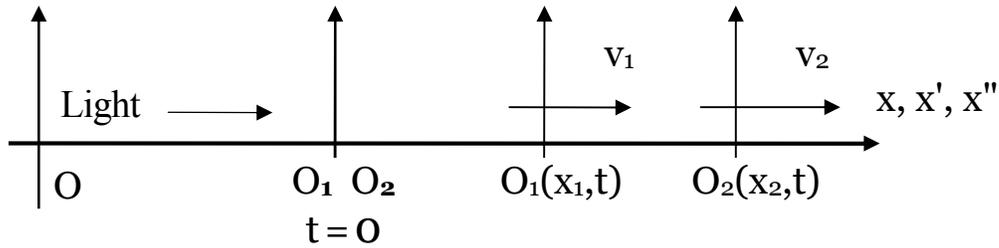
If the current light wave has been emitted from the immobile system in the positive direction of the x-axis, let us suppose that at that moment the other two systems are parallel and coincide, although they move at different speeds V_1 and V_2, their coordinate origins O_1 and O_2 are in the same place. After a while, measured from the system that emitted the light wave, the O_1 system will be at a distance of X_1, and the O_2 system, let us suppose, at a larger distance X_2. And both systems received the emitted light at the same time, because all the experiments show that Galileo's speed addition is not valid for light, but that c plus whichever v is again only c. So, the light traveled at the same speed yet it passed different distances over the same time, and all that measured in the system which emitted the light: up to X_1 and up to X_2. Elementary contradiction! And it is not a chance that the quantization of gravity has still not been solved. Relativistic theory of gravity, it is a macro-theory of general relativity, according to which the coordinate system can be linked equally to any mass, it doesn't matter how randomly it has been moved. A c = const cannot be understood at the macro-level.

c=const can be understood only at the micro-level

And only with the help of Heisenberg's relations of uncertainty, as for example: the uncertainty of the micro-particle speed[7] multiplied with the uncertainty of its place is not equal to zero – due to Plank's constant, which is, it doesn't matter how small, larger than zero. Therefore, the location and speed of the particle cannot be accurately determined at the same time, but the more accurate is the position, the less accurate is the speed and vice versa. And that is exactly what Einstein didn't like, so he thought that Heisenberg's relations of uncertainty (1927) were not sustainable, so that there were still undiscovered variables which would, once discovered, finish with this indeterminacy and in general with the wave probability of quantum physics, for whose superposition is possible, as he said, *"ghostly remote action"* faster than light, so that he published in 1935, together with his assistants, an article that mathematically shows this effect ... [8]

On the micro-level, however, there is no contradiction because the light beam is seen as a unity of countless photons, and can be separated: one is the emitting and the spreading of light; it is one event, related to one mass. And another is the spreading and the reception of light; it is another event, related to another mass. Each of these events is what it is, but in its own coordinate system,

just according to the theory of relativity, as each has its own units of length and time. And only if the light emitting, spreading and reception is observed homocentrically in the same coordinate system, in the immobile one, although the reception is happening in another one (or third, etc.) which is mobile (which are mobile) – it will appear what on the macro-level is not understandable. Thus, $c = const$ is perfectly understandable if the fact is stated:

Not even all the photons of the same frequency from the same light source are the same; each of them will be such, so that it arrives to its receiver with the $c = const$ speed.

Of course, the question remains, how? And probably not in a way that the photon **knows** in advance in which receiver it will be caught, so that it already by emitting is transferred to the receiver's coordinate system, adjusting its speed to that receiving system?

Of course, not that way. But, once emitted, the photon no longer has a certain energy $E = h\nu$ because its frequency ν is not defined since it has lost the measure of emitting system which has defined its time, therefore the frequency, and still it **doesn't know** in which receiver it will be caught. It simply travels through the universe vacuum as **the general part of the universal inertia of the Universe**,[9] and only by the receipt into a new atom-mass it discloses exactly the energy that it has given by adjusting its frequency and speed to the units of time and length of that receiving mass. And it happens exactly according the law of the general inertia of the Universe, its Δ-contribution to the mass is exactly according the Einstein's formula $E = mc^2$, i.e.

$$c^2 = \frac{h\nu'}{\Delta m'} = \frac{h\nu''}{\Delta m''} = ... = const.$$

It turned out that the mass is not constant, and that it depends on the speed. It has been shown as well that $c^2 = const$ is the measure of inertia, not mass. **This c^2-inertia of the entire universe explains $c = const$.** And how, this is described by the uncertainty relations. At reception, the location of the photon is precisely determined; therefore, there is no uncertainty for location. Then the indefinite speed is infinite, the speed of light can be any, larger and smaller than c. It is as if the infinite snail or to the disappearance small worm, which had so far moved indefinitely, suddenly in waves climbed into the standing wave and enriched in addition to the mass of the receiver.

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It's as if the entire world is being rebuilt again with every caught photon in any atom receiver, as if every single photon from any atom is once again decayed into this infinite indefinite, the only real infinity that lasts and continues – **inertia**.   _____

Mathematically, since $v = c$ Lorenz's root is zero, in its own photon coordinate system all wave lengths are infinite, the photon as if it is suddenly everywhere, which is the property of virtuality. Only from this uncertainty $\infty \cdot 0$ it is possible to accomplish the definite length in any coordinate

system of the already materialized world, which, however, has its own length. As with any particular time from indefinable $0/0$. Because in its own photon coordinate system time does not flow, it is always zero, and only with the receiving mass and the coordinate system related to it the time is defined. In the considered case of the light flash from the O_1 system, at the beginning, it is synchronized in all three coordinate systems, $t_0 = 0$. At a later time t, measured from the broadcast system, both mobile systems capture their photons. But because of relativity, that moment no longer coincides with the corresponding moments in moving systems, but is $t > t' > t''$.

Quantum indefiniteness is an essential characteristic of the Nature, that's what experiments after Einstein showed. That is why there is no absolute causality, as Einstein hoped – *"God does not play dice",* this is his famous saying in a dispute with Bohr. Therefore, the general relativity theory as well, the linking of a coordinate system to a randomly moving mass, does not exhaust the significance of relativity. Only when the coordinate system binds to photons, which, as they have no mass, can be not only randomly moving but also with infinite speeds and accelerations, when the boundary between the virtual and the real is lost, it is becoming clear not only that the explanation of the EPR-paradox is in the coordinate system related to entangled photons,[10,9] but also the following fact:

Relativity is the basic moving power of the entire Universe, **symmetry** is the basic law, and all is **inertia**.[11, 12,13,14]

References and notes

[1]   Albert Einstein: Zur Elektrodynamik bewegter Körper. ANNALEN DER PHYSIK UND CHEMIE, 17, Seite 891 – 921 (1905)

[2]   Albert Einstein: Kosmologische Betrachtungen zur allgemeinen Relativitätstheorie. Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften (Berlin), Seite 142 – 152 (1917)

[3]   Albert Einstein: Die Relativitäts-Theorie. Vortrag gehalten in der Sitzung der Zürcher Naturforschenden Gesellschaft um 16. Januar 1911. Vierteljahrsschrift der Naturforschenden Gesellschaft. Zürich. 1911.

[4]   Mike Bernhardt: Zum Zwillingsparadoxon in der Speziellen Relativitäts-theorie, März 2005
http://docplayer.org/28057077-Zum-zwillingsparadoxon-in-der-speziellen-relativitaetstheorie.html
Interestingly, the article has been removed from the link below
http://www.mpe.mpg.de/~bernhardt/zwillingsparadoxon.pdf
Moreover, the following explanation can be found after discussion at PHYSIK, DISKUSSION, TATSACHEN, IDEEN

12.11.2015, 15:40

Hallo,

Ich habe ein paar Probleme beim Verständnis der Relativitätstheorie im Rahmen des Zwillingsparadoxon. Demnach ist bei der Ankunft des vereisten Zwillings, der auf der Erde verbliebene älter. Das Paradoxon besteht darin, dass man davon ausgehen könnte, dass die Zeitdilatation (wie in der SRT üblich) wechselseitig symmetrisch ist und somit der jeweils andere Zwilling älter sein müsste, was keinen Sinn ergibt. Nun habe ich zwei verschiedene Erklärungen gefunden, zum einen mit drei verschiedenen Bezugssystemen und ohne Beschleunigung und zum anderen mit Beschleunigungen. Mir sind nun ein paar Sachen nicht klar:

1, Warum ist dieses Problem nicht mehr symmetrisch, ich könnte doch auch stets das Raumschiff-System fixieren und die Erde ändert dann das Bezugssystem?

2, Warum kann ich die Beschleunigung ignorieren, wenn ich drei Bezugssysteme betrachte?

3, Wie ergibt sich die Zeitdilatation bei einer Beschleunigten Bewegung, reicht hier noch die SRT aus?

4, Ich habe nun auch des öfteren gelesen, dass für beschleunigte Systeme die ART zu wählen wäre, gilt dies dann nicht nur für das Vorhandensein von Gravitation? Falls nein, wie sieht die Metrik für ein beschleunigtes Bezugssystem in der flachen Minkowski Raumzeit aus?

Vielen Dank für eure Hilfe

It is interesting as well that the same article by Mike Georg Bernhardt can be found on the following link:

http://docplayer.org/73001920-Zum-zwillingsparadoxon-in-der-speziellen-relativitaetstheorie.html

With the same date of 5 October 2017 on the link too:

http://www.thaleskreis.de/materialien/zwillingsparadoxon.pdf

Now, however, with the following questions:

1, Beschreibt das Zwillingsparadoxon tatsächlich eine logische Inkonsistenz in der Relativitätstheorie? **2,** Wie kann dieser scheinbare Widerspruch aufgelöst werden? **3,** Wo liegt der Denkfehler der zum Zwillingsparadoxon führt? **4,** Braucht man zur Erklärung des Problems die Allgemeine Relativitätstheorie?

5   Albert Einstein: Über die spezielle und die allgemeine Relativitätstheorie, 1916.

6   Richard P. Feynman: QED: The Strange Theory of Light and Matter, 1985.

7   Although the photon in its own coordinate system does not have mass, in the collision with the

electron, for example, it has got an impulse $p = mc \neq 0$, so strictly speaking, this is the uncertainty of the impulse $\Delta p = m\Delta c + c\Delta m$. But since the uncertainty of growing mass is not infinitely large, it is obvious that this must be the uncertainty of velocity Δc.

8 **E**instein, **P**odolsky, **R**osen: Can Quantum-Mechanical Description of Physical Reality Be Considered Complete? PHYSIAL REVIEW, 1935. Volume 47

The problem exposed in this article is known as EPR-paradox.

9 Milan D. Nešić: The Big Bang and its Internal Logic: The Universe as Relative Zero, http://vixra.org/abs/1811.0497, the article written according to the book by the same author: UNIVERZUM KAO RELATIVNA NULA, Kako to da svet postoji? 2014, Beograd, ISBN 978-86- 903845-8-7

10 Alain Aspect: Bell's inequality test more ideal than ever: The experimental violation of Bell's inequalities confirms that a pair of entangled photons separated by hundreds of meters must be considered a single non-separable object, it is impossible to assign local physical reality to each photon. NATURE, 1999, 398

And exactly this experimental result points to the appropriateness of linking the coordinate system also to massless particles. In the coordinate system of quantum energy of entangled photons, namely, neither the length nor the time is defined; it is virtual one until the collision with our already materialized world. Only one measurement and one result are realized in the collision, and not *one measurement and two results*, as Einstein ironically stated. Thus, mutual spacing $2d$ or mutual velocity $2v$. And not $+d$ and $-d$ or $+v$ and $-v$ in the coordinate system in advance homocentrically assumed where we are.

11 From Lagrange's formulation of the principle of least action until the work of Emmy Noether, it is historically even clearer that the conservation laws, i.e. **inertia** originate from **symmetry**. But that **relativity** is the fundamental driving force of the whole universe becomes only seen when the coordinate system of the quantum of virtual energy is taken for describing the vacuum universe, such one as people have it long known: it is homogeneous, isotropic and with relative zero as an arbitrary beginning anywhere in our already embodied world.

In that way, back in 1924, Bose started from homogeneity and isotropy, from the translational and spherical symmetry of the photon impulse, $\pm p$ and $p_x^2 + p_y^2 + p_z^2 = p^2$, seen from our world in which can be said: "*Let the radiation be enclosed in the volume V and let its total energy be E*" — all the way from that ideal photon gas, further onto deriving Planck's law of the radiation of the black body. But in a yet unrealized world without mass, there is no definite metric, no bordered volume. There is only a world of virtual photons, and relativity—equality of all possible photons with mutual difference of virtual wavelength. It is necessary to go from that form of the Planck's law of radiation—

from the bell-shaped diagram of virtual energy with wavelengths from virtual zero to virtual infinity. With such an arbitrary multitude of photons of all undefined directions, speeds and accelerations—the multitude we designate temperature in the already realized world—accidentally "where" but necessarily "somewhere" happens BANG—it comes to collision! The plus and minus masses began to emerge. The bell-shaped **E,λ**-diagram[12] of virtual energy and relative wavelengths gets all merged along its vertical coordinate and passed through **0,∞-singularity.** The current world of micro-mass, particles of chaotic movements, was created, with speeds from zero to infinite. Is it exactly to infinity; is it exactly of chaotic movement?

In the year 1860, Maxwell published his law of the distribution of velocity in the thermal motion of micro-particles. He also went from the homogeneity of the vacuum space, from the translational symmetry, back and forth, thus v^2. He also went from isotropy, from spherical symmetry: the probability of a possible particle velocity in the direction of any coordinate axis is independent of its total speed. The only function satisfying the condition that the total probability is equal to the sum of the independent probabilities of the individual components is exponential. It was, not accidentally, the same bell-shaped diagram[13] similar to that of Bose 64 years later.

And nowadays, we know about the experiments[14] that generate thousands of electron-positron pairs, they generate mass from colliding laser-beam with only one electron as catalyst.
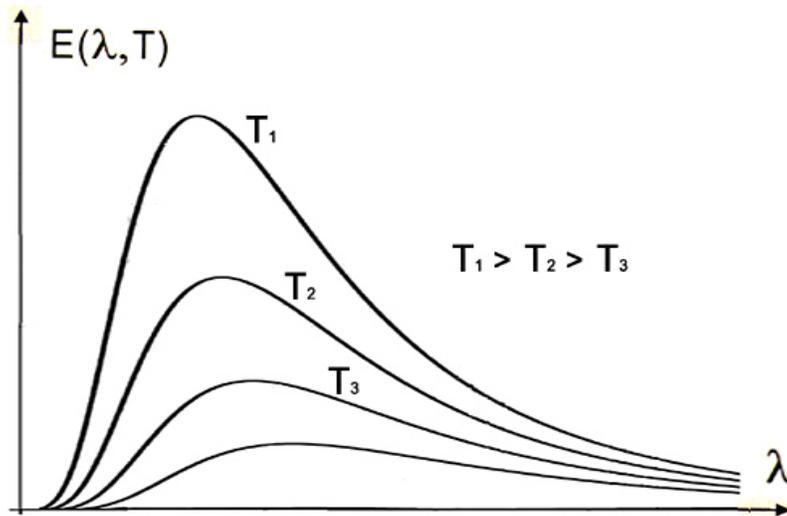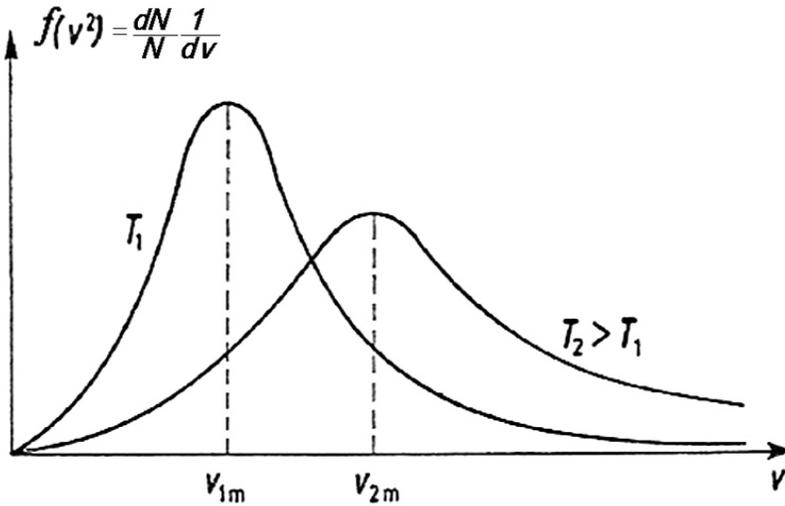
And so on.

[12]

Diagram of the bulk density of the radiation of the black body
depending on the wavelength of radiation

$$E(\lambda,T) = \frac{8\pi hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1}$$

9

13

Maxwell-Boltzmann's distribution of the velocity of micro-particles
in the absence of a gravitational influence

$$f(v^2) = 4\pi \left(\frac{m}{2\pi kT} \right)^{\frac{3}{2}} v^2 \, e^{-\frac{mv^2}{2kT}}$$

14

In September 2010, this experimental result was published in the journal "**PHYSICAL REVIEW LETTERS**": "**Pair Creation and QED Strong Pulsed Laser Fields Interacting with Electron Beams**" – accompanied by the explanation of how one single electron can make thousands of particles by a laser. Certain calculations show that it takes perhaps only twenty times the density of laser power, so that the creation of the same on thousands of particles with mass can be possible from the collision of two laser jets without any electron as a catalyst.