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Twin paradox and absolute reference frame

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Abstract

New version of twin paradox that considers two twins rotating at a common circular orbit represents an extreme case of the classical version in the closed Universe model. Because of that the absolute reference frame is needed not only for a rotational movement description, but also for a forward inertial one.

1. New version of twin paradox

The paper **[Abramowicz and Bajtlik, 2009]** recently appeared in ArXiv that was dedicated to twin paradox. The authors compare the classical version of twin paradox with the case where two twins are located at a common circular orbit and have different velocities. The classical version (a forward inertial movement) of the paradox authors describe as follow:

> It is often claim that the resolution of the classical twin paradox should be the acceleration of the "traveling" twin: he must accelerate in order to turn around and meet his never accelerating brother. The twin who accelerates is *younger* at the reunion.

Further authors consider two twins orbiting with different velocities around a common center and periodically meeting. The known analysis of the situation in *the reference frame that is strongly connected with the rotating center* shows that the twin whose velocity is *more* in this frame will be *younger* at the reunion.

Let his rotating velocity be Keplerian, i.e., the such one that he freely falls to the center of rotation and remains on a stationary orbit during the infinite time (at this its kinetic energy is equal to the potential one). Then the reference frame that is hardly connected with him may be considered as inertial one, and a second twin will perform around him a complicate trajectory and have a non-zero 3-velocity and 3-acceleration. Thus, in this reference frame

> … at the reunion the accelerated twin is older than his non-accelerated brother!

This difference between forward movement and rotating one forces the authors to conclude that a time dilatation depends on velocities fraction only, not on the fact of one of twins acceleration.

However, one question appears: In what reference frame do we shall determine these two velocities – in the frame A, or in the frame B, or in another one? For a forward uniform motion in the Minkowski spacetime it is not a matter, because in this case the twins can have not more than one reunion. By the way, theoretically these two situations are not so far one from another, since the orbit's radius can be (imaginary) increased up to the perimeter of (closed) Universe.

2. Absolute reference frame

I believe, the paradox solution consists in the Newton's idea that there exists an *absolute* reference frame. This idea has well known numerous experimental witnesses, e.g., the gyroscope axes rotation. Our example with a circular orbit which occupies all

(closed) Universe[1] demonstrates that a forward motion may present an approximation only for orbital one.

Authors of another paper **[Gron and Braeck, 2009]** from Arxiv comment the work of Abramowicz and Bajtlik:

> … in the globally empty Minkowski spacetime no answer is given to the question: What determines the state of rotation of the inertial frames. We therefore suggest that the globally empty Minkowski spacetime, as well as the asymptotically empty Minkowski spacetime outside a localized mass distribution, are not satisfying models of spacetime.

In this connection they propose to add some assumption to the Minkowski spacetime model:

> The considerations above suggest that Minkowski spacetime should not be thought of as globally empty. We propose a generalized model of Minkowski space, i.e. of globally flat spacetime or the flat region of asymptotically flat spacetimes, where the space is completed by a far away cosmic massive shell with radius equal to its Schwarzschild radius, representing the cosmic mass.

In such model any object rotating relative to the cosmic shell is absolute, and its angular velocity brings the well determined contribution[2] to the "cinematic" time dilatation. If the orbit center in the considered example with two twins as such has the zero velocity relative to the immobile sky (cosmic shell), then the reference frame, which is hardly connected with this center, gives really time course description for each twin.

The well known Mach's ideas are also connected with the absolute reference frame. As the author of **[Anisovitch, 1996]** writes, Ernst Mach noted that inertial reference frame is also at rest or moves uniformely without any rotation relative to starry sky. Contrary, if a reference frame rotates or moves with some acceleration relative to the sky, it turns out to be non-inertial. In particular, while the system rotates, one can observe in it the Coriolis force and other inertia forces. Mach stated that this coincidence was not accidental, and that the reason of non-inertial motion consists in the starring environment presence (but not in an absolute reference frame existing in empy space).

3. Physical interpretation

The authors of the paper **[Gron and Braeck, 2009]** do not give any explanations of a physical meaning of above Universe's cosmic shell. I share their formulation and propose a physical interpretation that is based on the concrete Universe model, which I am developing since 1993 **[Shulman, 2009]**. In this one I suppose that our Universe represents a hypermassive black hole in some "maternal" World, and is separated from it by a corresponding event horizon. The radius of that hole is just equal to its Schwarzschild's radius. The time naturally appears inside of this black hole that is equal to its current size dividing by the velocity of time. The our Universe expansion may be explained as a consequence of the BH's rise and its event horizon increasing due to the energy and matter absorption from outside[3].

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[1] In the work **[Shulman and Raffel, 2008]** we show that the relic photons just have time to fly around all expanding Universe during 13,7 Gyr, and this leads to the real peak at the initial part of the power temperature spectrum of CMBR.

[2] Authors of **[Gron and Braeck, 2009]** call that "cosmic time effect".

[3] If the hypothesis is correct, then the Big Bang should be identified with the gravitational collapse that led to the our Universe birth. Some analysis of the event dynamics could allow us to precise details of the first time moments of its evolution.

The laws of the internal linear and angular momentum conservation must be accomplished in such model. One usually associates these laws with the space uniformity and isotropy. At the same time the mechanism of such laws action *must be necessary connected with some physical interaction* between different bodies. Just due to this one some body react to the action that is applied to another body. Thus, inertia represents a reaction of the body environment to the action applied to this body.

If the interaction radius associated with some type of inertia is small, then this type of inertia acts as local one. For example, the electrical charge of the opposite sign shade effectively one another, because of that in an electric circuit (where the inertia parameter is presents as inductance) this type's inertia is mainly localized in a small space area. Contrary, the gravitation acts at the large scale, and induced by it a space curvature manifests at each point of Universe. Because of that the usual inertia measure is just due to its gravitational mass, i.e., the gravitational interaction energy. If there where not some other bodies, then it were unusual (by definition) to talk about inertia as environment reaction.

Contrary, due to the existence of great amount of other bodies their total mass and momentum of inertia is much more than these ones of each separate body, one can talk about the averaging reaction of the global environment, i.e. about the absolute reference frame, linear and angular velocity (momentum) for a concrete body relative to the global background of the cosmic matter.

We noted above the relationship between kinetic and potential energy at the circular orbital motion. The domination of the kinetic energy leads to the time dilatation. This statement should be strongly accomplished in the absolute frame reference.

4. Real existence of the absolute reference frame

As it is known, when one measures temperature and polarization spectra of CMBR, one sees some anisotropy of this radiation. This anisotropy at each spatial point is specified by several direction and velocity. If one imagine an inertial reference frame moving to the above direction with the above velocity, then at this reference frame the anisotropy radiation disappears. Relative to any other inertial reference frame at the same point (but moving with another velocity and/or to another direction) this frame turns out to be *selected*.

Just such picture follows from the Universe model that I have proposed **[Shulman, 2007a]**. It also follows from the model that such anisotropy must be for every radiation, not only for CMBR. In the work **[Shulman, 2007b]** the approach to test empirically this idea was proposed using the observations of solar radiation spectrum at the different periods of Earth annual moving around Sun.

If this hypothesis will be validated, then probably one should correct Relativity. The time dilatation, as I believe, should be calculated at the absolute reference frame, although due to the small Earth velocity movement at this frame the correction also will be small (near anisotropy value, i.e. 0,001%).

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