Relativity principle in coordinateless presentation

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Abstract

It is shown that the relativity principles describe properties of the space-time. They state that the space-time geometry is a monistic conception, describing by the unique space-time structure, known as the space-time interval between any two events (space-time points). Classical nonrelativistic conception of the event space contains in addition another structure, describing time interval between any two events (points).

The relativity theory has arisen in the beginning of the twentieth century as a result of negative result of measurement of the the Earth velocity with respect to the ether [1, 2]. This experiment generates a transition from the nonrelativistic physics to the relativistic physics. After numerous discussions the scientific community accept the relativity principle. *The principle of relativity means the requirement that the equations describing the laws of physics have the same form in all admissible frames of reference.* It looks as a general physical principle, which concerns the event space arrangement and dynamics of physical bodies. Besides, formulation of the relativity principle contains a reference to coordinate systems and to the laws of their transformation.

The reference to the way of description (frames of reference) looks rather strange in the formulation of a physical principle. Any physical principle is to admit a formulation, which does not contain a reference to the means of description. The fact, that such an important physical principle is not formulated in the coordinateless form, is a defect of our understanding of the relativity nature. We try to find a coordinateless formulation of the relativity principle.

Note, that in the previous formulation of Einstein the relativity principle concerns only dynamics and dynamical equations. Minkowski showed that the principle of relativity concerns also the event space (space-time). Now the principle of relativity is considered as conditioned be the space-time properties. Unfortunately, conventional description of the contemporary space-time geometry begins from introduction of a coordinate system. Coordinateless description of the space-time geometry is absent in the axiomatic conception, which is used practically in all papers. Coordinateless description of geometry exists only in the framework of the metric conception of geometry [3].

The relativity principle means essentially that space and time have equal rights. Space may transform to time and vice versa. Space and time were different entities primordially. The relativity principle declare their connection. But the difference between the space and the time was primary, whereas their connection is secondary.

It is possible another approach, when connection between the space and time is primary, whereas their difference is secondary. In this case the space-time geometry is a monistic conception, described by a unique structure: the space-time interval $\rho\left(P,Q\right)$ between any two events (points) P and Q of the event space. To divide space and time one may introduce a second space-time structure $T\left(P,Q\right)$, describing temporal interval between two events P and Q of the event space. In this case an absolute simultaneity appears. In this case we have the fortified geometry, i.e. a space-time geometry with two space-time structures. Having the two structures ρ and T, one can introduce absolute spatial distance $S\left(P,Q\right)$ between any two events (points) P and Q.

The relativity principle means, that *there is only one space-time structure* ρ *in the real space-time*. It is the coordinateless formulation of the relativity principle. Note, that such a formulation is possible, if one uses the metric conception of the space-time geometry. Tachyon gas as a dark matter[4, 5] and the induced antigravitation [6] tell in favour of the metric conception.

References

[1] A.A. Michelson, The Relative Motion of the Earth and the Luminiferous Ether, *American Journal of Science* **22**: *120–129 (1881).*

[2] A.A. Michelson, A A.Morley, E.Williams, On the Relative Motion of the Earth and the Luminiferous Ether, *American Journal of Science* **34**: *333–345, (1887).*

[3] Yu.A. Rylov, Metrical conception of the space-time geometry *Int. J. Theor, Phys.* DOI: 10.1007/s10773-014-2228-0.

[4] Yu. A. Rylov, Tachyon gas as a candidate for dark matter, *Vestnik RUDN ser. Mathematics. Informatics, Physics* (2013), iss 2 pp.159-173 (In Russian)

[5] Yu. A. Rylov, Dynamic equations for tachyon gas, *Int. J. Theor. Phys.* **52**, 133(10), 3683- 3695, (2013).

[6] Yu. A. Rylov, Induced antigravitation in the extended general relativity. *Gravitation and Cosmology, Vol.* ***18****, No. 2, pp. 107–112,(2012).*