Main stages of development of the special theory of relativity

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In the article an attempt is made in a brief form to present the main stages of development of the special theory of relativity.

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Given the materials presented in [1], [2] it is possible to note the main stages of development of the special theory of relativity.

I. Formation of the initial conditions for creation of the special theory of relativity

Introduces the following initial conditions:

- the space is homogeneous and isotropic,
- the time - homogeneous,
- the considered reference system – inertial,
- the principle of relativity operates,
- the postulate of invariance of the speed of light in vacuum operates.

II. The creation of relativistic kinematic (for three-dimensional space)

Based on the initial conditions of the special theory of relativity, the

relationship between the coordinates and time in inertial reference systems represented in the form of the Lorentz transformations.

From the Lorentz transformations are derived transformations of speeds and accelerations for inertial reference systems.

III. Creation of relativistic dynamic (for three-dimensional space)

To create a relativistic dynamic used the initial conditions of the special theory of relativity, relativistic kinematic, and is taken into account that:

- the law of conservation of energy of the mechanical system follows from the homogeneity of time (independence of the laws of motion of the system from the choice of the time reference point),

- the law of conservation of momentum mechanical system follows from the homogeneity space (parallel translation in the space of a mechanical system as a whole does not change mechanical properties of the system),

Relativistic dependence of momentum and kinetic energy of a material point on the speed of her movement were obtained using the law of conservation of momentum and energy in the interaction of two bodies (material points) in the inertial reference systems.

Moreover, it was assumed that the interaction of the bodies has single character and for consideration chosen moments of time before and after the interaction of bodies.

IV. Creation of relativistic kinematic and dynamic for four-dimensional space–time

In three-dimensional space in the transition from one inertial system to another using the Lorentz transformations the basic physical laws changes their views, which contradicts the principle of relativity.

To exit from the current situation was chosen path that is associated with the increasing complexity of the applied mathematical apparatus (increase in the number of unknowns and the number of equations), which consists in the fact that the consideration transferred from three-dimensional space in four-dimensional space-time.

But do not forget that four-dimensional space-time is purely geometrical concept (space may not be aware that it is four).

Four-dimensional space-time was chosen so that the transition from one inertial reference system to another is described by Lorentz transformations.

Construction of four-dimensional velocity and four-dimensional acceleration was performed with the use of own time so that in the case of low velocities is their transformation them into three-dimensional velocity and three-dimensional acceleration respectively.

Relativistic equations of motion created by the method of adjustment to answer - the introduction of four-dimensional momentum and four-dimensional force that at low speeds would have a kind of three-dimensional momentum and three-dimensional force respectively.

On the implementation of conservation laws in four-dimensional space we can say, that in case of consideration of the motion of a closed mechanical system is constantly interacting bodies (material points) in the inertial reference system:

- the total momentum (four-dimensional vector) of this closed system of bodies is not constant value in time as a consequence of the fact, that the velocity of propagation of interaction in relativistic mechanics is finite;

- the total energy (four-dimensional vector) of this closed system of bodies also is not constant due to the fact, that in the relativistic formula of energy is not include the potential energy (it is assumed that, given the potential energy the total energy of a closed system bodies will be a constant value).

V. Deadlock. The need to adjust the special theory of relativity

Unfortunately, there are some examples of closed mechanical systems of the constantly interacting bodies, which in the inertial reference system the potential energy do not change their values, obtained with the help of the special theory of relativity the total momentum and the energy of the system of this bodies still are variable values in time.

The simplest example of these systems is the closed mechanical system, consisting of two bodies, equal to the mass of the rest, connected by a thread and

rotating about a common center of mass in the inertial reference system, in which this common center of mass is stationary.

The possibility of a violation of the laws of conservation of momentum and energy of the mechanical system of bodies in the inertial reference system is in contradiction to the initial conditions of the special theory of relativity.

References

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