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Short Communication

Reconsideration of the principle of relativity

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The applicable ranges of the principle of relativity were reconsidered. There are magnetic field forces between positive charge and negative charge in an electric doublet which is moving in a laboratory reference frame, whereas, analyzing the electric doublet with the same physical method in a reference frame which is at rest relative to the electric doublet, no magnetic field force exists between the two charges. The results obtained in the two frames are self-contradictory. Maxwell's equations maintain the form invariant under Lorentz transformation can not fully prove that electromagnetism laws satisfy requirement of the principle of relativity, because the form invariant are the same as the expression for Doppler effect.

Key words: The principle of relativity, applicable range, inertial reference frame, magnetic field force, Maxwell's equations.

INTRODUCTION

The Special Relativity has changed the space-time concepts formed since Newton's time and it was based on the principle of relativity and the constancy of the velocity of light (Einstein, 1905). In the past century, the two postulates had been accepted universally. Nevertheless, the special relativity has been challenged continuously since its establishment from both theories and experiments. In 2000, Nature journal declared an experiment result to find super-light velocity by Wang et al. (2000). Thenceforth, different laboratories in the world have successively accomplished a series of parallel test results about super-light velocity. In 2003, Wang et al. reported modified Sagnac experiments (Wang et al., 2003); it seems that the result is inconsistent with the constancy of the velocity of light. In 2007, Chongwu Guo proved that there is the crossed Doppler effect of light in Newton's space - time concepts (Guo, 2007), that is to say, a moving clock runs slow can not be thought to be "time dilation".

In the classical physics, the mechanics laws satisfy the requirement of the principle of relativity, but the electromagnetism laws do not. After establishment of the special relativity, the principle of relativity has been thought to be applicable for all physics laws, which mean that physics laws maintain wholly the form invariant in all inertial reference frames. However, it was discovered by this research that some electromagnetism laws were not thusness.

A MOVING ELECTRIC DOUBLET

In a laboratory reference frame S, we have an electric doublet. The positive charge P and negative charge N within the electric doublet lie on x, y-coordinate plane, and the coordinate values of the negative charge N are bigger than those of the positive charge P. Denote by α the angle between the direction of line segment PN and the x-axis, let the distance between the two charges be r and the electricity quantities of the two charges be q and $-q$ respectively. Suppose that the electric doublet is moving with a velocity v along the x-axis direction, according to Biot-Svart law, we get the magnetic strength at point N produced by the positive charge P.

$$B_N = \frac{\mu_0}{4\pi}\frac{q v \sin \alpha}{r^2}$$

And according to Ampere law, we have the magnetic force acting on negative charge N,

$$F_N = \frac{\mu_0}{4\pi}\frac{q^2 v^2 \sin \alpha}{r^2} \qquad 1$$

F_N directs towards the y-axis direction. With the same

method we get the magnetic force acting on the positive charge P by the negative charge N,

$$F_P = -\frac{\mu_0}{4\pi}\frac{q^2 v^2 \cos\alpha}{r^2} \quad 2$$

Where minus denote that F_P is towards the negative y-axis direction. Equations 1 and 2 indicate that the direction of the electric doublet PN will be perpendicular to the x-axis under the actions of F_N and F_P, unless the initial condition is $\alpha = 0$.

Suppose we have a reference frame S' that is moving relative to the laboratory reference frame S at the velocity v along the x-axis direction, the electric doublet is motionless from the view point of observers in the frame S'. The magnetic forces between the positive charge and negative charge are zero when computing with Biot-Svart law and Ampere law, therefore, the electric doublet PN may direct any directions in the frame S'. The result is absolutely inconsistent with that in the laboratory reference frame. Apparently, some electromagnetism laws can not satisfy the requirement of the principle of relativity.

MAXWELL'S EQUATIONS

Set up two inertial reference frame S and S'. The x-axis is coincident with the x'-axis, y-axis is parallel to y'-axis and z-axis parallel to z'-axis. The frame S' is moving at a velocity v relative to frame S in the x direction. When the origin of frame S' passes the origin of frame S, the clocks at the two origins read zero.

Transition of Maxwell's equations in going from the frame S to the frame S' by Lorentz transformation gives the equations for Lorentz transformation of the electromagnetic field:

$$E_x' = E_x$$

$$E_y' = \gamma(E_y - vB_z)$$

$$E_z' = \gamma(E_z + vB_y)$$

$$B_x' = B_x$$

$$B_y' = \gamma(B_y + vE_z/c^2)$$

$$B_z' = \gamma(B_z - vE_y/c^2)$$

Where; $\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}$, E_x, E_y and E_z are electric field strengths in the directions of x-axis, y-axis and z-axis, respectively, B_x, B_y and B_z are magnetic field strengths in the directions of x-axis, y-axis and z-axis, respectively and c is the velocity of light. In the free space, the relations between the electric field strength $\vec{E}$ and the magnetic field strength $\vec{B}$ in the electromagnetic waves are

$$\vec{E} = -c\vec{h} \times \vec{B}$$

$$\vec{B} = c\vec{h} \times \vec{E}$$

Where; $\vec{h}$ denotes the unit vector in the direction of the propagation of electromagnetic waves. Now we suppose the light source that is at rest in the frame S emits light and the light propagates in the x direction. From the above equations we get

$$E_y' = \gamma(1 - v/c)E_y$$

$$E_z' = \gamma(1 - v/c)E_z$$

$$B_y' = \gamma(1 - v/c)B_y$$

$$B_z' = \gamma(1 - v/c)B_z$$

It seems that the equations are the same as the expression of Doppler effect. Therefore, Maxwell's equations maintain the form invariant under Lorentz transformation can not fully prove that electromagnetism laws satisfy requirement of the principle of relativity.

CONCLUDING REMARKS

The principle of relativity has been widely recognized to be applicable for the electromagnetism for as long as one century. However, the researches show that some electromagnetism laws do not meet the requirement of the principle of relativity. Consequently, reconsideration of the applicable ranges of the principle of relativity will be necessary.

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