A paradox of relativistic mass increase with speed

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Abstract

In a previous paper of the author's, a paradox resulted from the relativistic mass increase with speed was presented and analyzed. To avoid this contradiction while leaving relativity intact, the assumption that the strength of a substance will increase with its speed was introduced. Here in this article, one more paradox of relativistic mass increase with speed is presented which is conflict with the principle of relativity. There are no solutions for this contradiction.

Keywords: Paradox of relativity; Relativistic mass

1. Introduction

In a previous paper of the author's, a paradox resulted from the relativistic mass increase with speed was presented and analyzed. [1] To avoid this contradiction while leaving relativity intact, the assumption that the strength of a substance will increase with its speed was introduced. In this article, one more paradox of relativistic mass is presented and there is no solution for this contradiction.

In the theory of special relativity, the mass of an object increases with its speed as following relationship, [2]

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}} = m_0\gamma$$

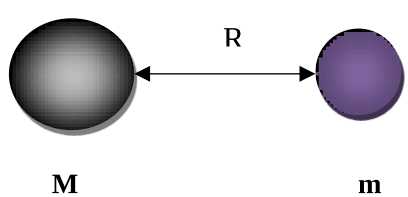
$$\gamma = \frac{1}{\sqrt{1-v^2/c^2}}$$

Where m_0 is rest mass; v is the speed of the object; and c is the speed of light in a vacuum.

According to the equivalence principle of the general relativity, the inertial mass is identical to the gravitational mass. This is a fundamental principle of general relativity.

From the definition of the relativistic mass above, a paradox comes in the following thought experiment,

2. Thought experiment



In the figure above, there are two objects in the space with rest mass **M** and **m**. In the frame where both the objects are at rest, the universal gravitation between the two objects is

$$F = \mathrm{g}\frac{M\mathrm{m}}{R^2}$$

Where, g is gravitational constant.

If we observe the system in a reference frame which is moving at the speed of v perpendicularly to the connection line of the two objects, the universal gravitation will be

$$F = \mathrm{g}\frac{M\gamma \mathrm{m}\gamma}{R^2} = \mathrm{g}\frac{M\mathrm{m}\gamma^2}{R^2}$$

Now, if the reference frame is moving at the same speed of v, but parallel to the connection line of the two objects, the distance of the two objects will decrease due to Lorentz contraction effect, so the distance changes from R to R' .

$$R' = R/\gamma$$

Thus, the universal gravitation between the two objects will be

$$F = \mathrm{g}\frac{M\gamma \mathrm{m}\gamma}{R'^2} = \mathrm{g}\frac{M\mathrm{m}\gamma^2}{R^2/\gamma^2} = \mathrm{g}\frac{M\mathrm{m}}{R^2}$$

3. Discussion

From the analysis above we conclude: based on the relativistic mass definition, the universal gravitation between the two objects will vary with the different inertia reference frames. It varies not only with the speed of the inertia frame, but also with the moving direction of the frames. This obviously conflicts with the principle of relativity.

References

[1] *Yang, Yannan, "Does the Strength of a Substance Increase with Its Speed?* ", **viXra:1612.0052** *2016-12-07*

[2] *Feynman, R, Leighton, R. and Sands, M. The Feynman Lectures on Physics: The New Millennium Edition, Volume1 (chaper15, 16, 17). ©1963, 2006, 2010 by California Institute of Technology. Simplified Chinese translation copyright © 2013 by Shanghai Scientific & Technology Publishers.*