Does the strength of a substance increase with its speed?

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Abstract: In this paper, a paradox resulted from the mass increasing with speed is presented. In this paradox, the same system appears two conflict states. The system is stay in good order for an observer who is moving together with the system, but it is damaged for an observer who is at rest. To avoid this contradiction while leaving relativity intact, we have to introduce the assumption that the strength of a substance will increase with its speed.

Introduction

There are a lot of publications on the paradoxes from the results of the theory of relativity, such as twin, length contraction, Two Space Ships' paradoxes, etc. [1-11] Here in this paper, a new paradox is presented, which is caused by the relativistic mass.

In the theory of special relativity, the mass of an object varies with its speed as following relationship,

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

Where m_0 is rest mass, u 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.

However, from this relativistic mass definition a critical paradox comes as shown in following thought experiments. In order to resolve this contradiction while leaving relativity intact, we must introduce the assumption that the strength of an object will increase with its speed.

Thought experiments

Experement1.

In a uniform gravitational field, a spaceship is flying through in high speed. Within the spaceship, a heavy object is suspended on the ceiling by a string, as shown in Fig.1. The speed of the spaceship is u. The rest mass of the heavy object is m_0. The gravitational acceleration of the uniform gravitational field is g. The bearing pulling force of the string is the rest weight of the object, m_0g. Once the weight of the object is over m_0g, the string will break.

Now let's see what happens to the two observers, one in the spaceship (observer-inside) and the other outside the spaceship (observer-outside). For the observer-inside, the weight of the object is m_0g. So, he will see the object being suspended on the ceiling, as shown in a) of Fig.1.

However, for the observer-outside, the weight of the object is mg. Because $m > m_0$, $mg > m_0g$, the weight is over the bearing pulling force of the string. So, the observer-outside will see that the string is broken and the object is on the bottom, as shown in b) of Fig.1.

Experement2.

Similar to experiment1, the difference is that the heavy object is on a desk, instead of being suspended on ceiling by a string. The bursting strength of desktop is just m_0g. Once the weight of the object is over m_0g, the desktop will break up.

For the observer-inside, the weight of the object is m_0g. So, he will see that the object is on the desk, as shown in a) of Fig.2. However, for the observer-outside, the weight of the object is mg. Because $m > m_0$, $mg > m_0g$, the weight is over the bursting strength of desktop. So, the observer-outside will see that the desktop is broken up and the object is on the bottom, as shown in b) of Fig.2.

Experement3.

Similar to experiment1 and 2, the difference is that the heavy object is suspended on the ceiling by a spring, as shown in Fig.3.

Because the mass of the object in motion is larger than that of the object at rest, the observer-inside will see shorter spring, as shown in a) of Fig.3, but the observer-outside will see longer spring, as shown in b) of Fig.3.

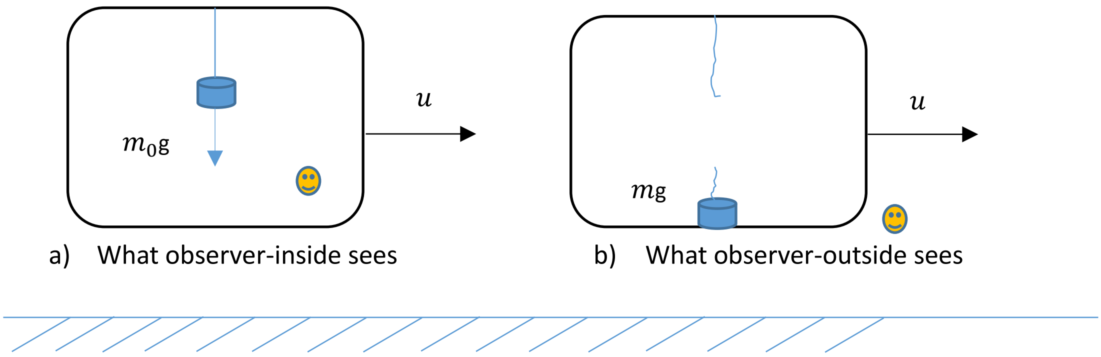

Fig.1. a spaceship is flying through a uniform gravitational field with the speed of u.

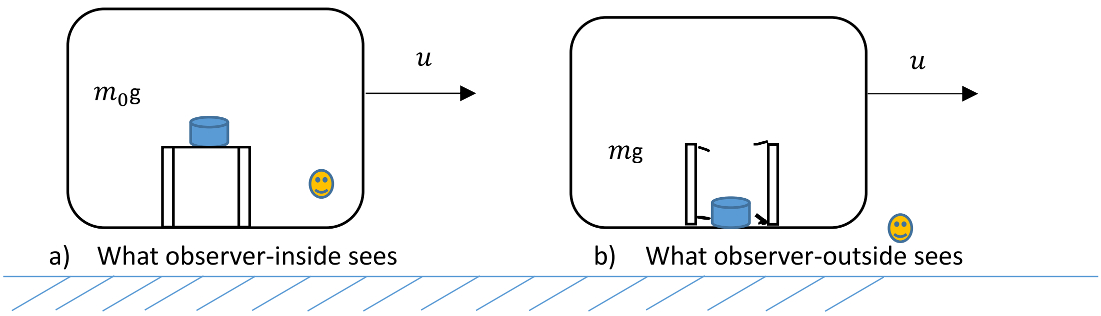

Fig.2. a spaceship is flying through a uniform gravitational field with the speed of u.

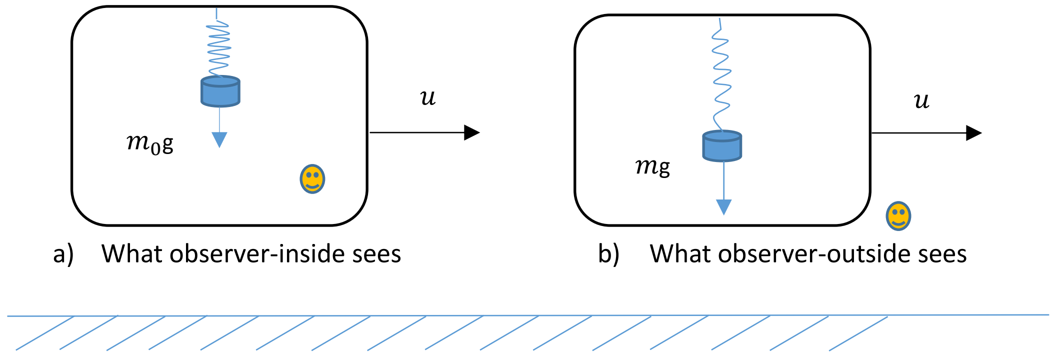

Fig.3. a spaceship is flying through a uniform gravitational field with the speed of u.

Discussion and resolution

From the three thought experiments above, the paradox of relativistic mass is well stated. During the argument process, the premise is clearly right and the derivation procedure is logically.

Even if not considering the equivalence principle of the general relativity, the paradox still exists. For the three thought experiments above, if the spaceship is replaced with an elevator in an inertial frame without gravitational field and the rising acceleration of the elevator is g, the exact same results as those of in a uniform gravitational field will be obtained, too.

Now we are faced with how to resolve the paradox. It seems that there are only two choices for us, either discard the theory of relativity or introduce another assumption while leaving relativity intact. The assumption is that that the strength of an object will increase with its speed. It looks involves all aspects of the strength of an object, such as tensile strength, bursting strength, etc. For example in thought experiment1, it involves the tensile strength (Rm) of a string. In order to keep the string from breaking, the tensile strength of the string should increase with speed as following relationship,

$$Rm = \frac{Rm_0}{\sqrt{1 - u^2/c^2}}$$

Where Rm_0 is the rest tensile strength and Rm is the moving tensile strength.

In thought experiment2, it involves the bursting strength (*Bs*) of the desktop. To keep the desktop from breaking up, the bursting strength should increase with speed as,

$$Bs = \frac{Bs_0}{\sqrt{1 - u^2/c^2}}$$

Where Bs_0 is the rest bursting strength and *Bs* is the moving strength.

In thought experiment3, it involves the elasticity coefficient (k) of the spring. It should increase with speed as,

$$k = \frac{k_0}{\sqrt{1 - u^2/c^2}}$$

Where k_0 is the rest elasticity coefficient and k is the moving elasticity coefficient.

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