New Concept of Mass

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Abstract

In contemporary physics mass is a basic property of any physical object, but there is no consistent definition of what mass is. This article formulates a new concept of mass based on the statement that space and force field are synonyms, i.e., mass is the charge of gravity.

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Introduction

Mass is one of the most fundamental concepts of physics. Understanding and calculating the masses of the is the central problem of modern physics, and is intimately connected with other fundamental problems such as the origin of *CP* violation, the mystery of the energy scales that determine the properties of the weak and the compositeness of particles, and the properties of the not-yet-discovered [1]. End of quotation. In physical science, one may distinguish conceptually between at least seven different aspects of mass, or seven physical notions that involve the concept of mass [2, 3]:

- Inertial mass is a measure of an object's resistance to acceleration when a force is applied.

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- Active gravitational mass is a measure of the strength of an object's gravitational field.
- Passive gravitational mass is a measure of the strength of an object's interaction with a gravitational field.
- Energy also has mass according to the principle of mass–energy equivalence.
- Curvature of spacetime is a relativistic manifestation of the existence of mass.
- Quantum mass manifests itself as a difference between an object's quantum frequency and its wave number.
- The Schwarzschild radius represents the ability of mass to cause curvature in space and time.

Nothing of the said notions can be used as a definition of mass.

Origin of mass

There are variants of mass generation models. They can be classified by two types: gravity-free models and models that involve gravity. No one of them can explain all properties of mass.

In high energy experiments the particle generation is closely bound to mass emergence as it is shown by Dirac equation in SI system:

$$E^2 = m^2 c^4 + p^2 c^2, \qquad (1)$$

where: E - energy,
m - mass,
p - momentum,
c - speed of light.

In Gauss unit system $c = 0$ and Dirac equation can be written as:

$$E^2 = m^2 + p^2 \quad \text{or} \quad E = \pm(m^2 + p^2)^{½} \qquad (2)$$

Therefore mass is: $m = \pm(E^2 - p^2)^{1/2}$ (3)

From equation (3) it follows that each event creates 2 masses with an opposite sign. This is confirmed by experiments: the particles are generated in pairs [3] and *vice versa* the mass disappears when a particle collides with an antiparticle. The particles convert to photon-antiphoton massless pairs with opposite energy according to equation (2). The sign of energy means that they run away in opposite directions. This agrees with observations [3] and the principle of completeness [4].

Definition of mass

Difficulties with the definition of mass arise from the presumption of General Relativity Theory that gravity is not a force but only a curvature of space. Through complementing Newton law of gravity with the assumption that space is a force field [5, 6], we obtain a new definition of mass:

Mass is the charge of gravity.

As a result, mass is the cause of gravity and that of space curvature simultaneously. The new definition of mass covers all the said notions at the beginning of the article.

Conclusions

The new theory of mass predicts that antiparticles have negative mass, i.e., anti-gravity. It follows that gravity repels antimatter. It explains baryon asymmetry in the Universe. There must be Anti-universe containing only antimatter. The ordinary Universe and Anti-universe repel each other.

References

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