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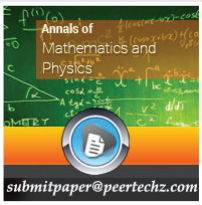

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Review Article

Generation of a substance with negative mass

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Abstract

An analysis of known experiments was carried out to determine the dependence of the mass of electrons on their speed. Errors were discovered in determining the sign of the electron mass. It is shown that at electron velocities above the critical ω = 235696.8871 *km/s* their masses are negative. The results obtained are explained on the basis of the Principle of Nonequivalence of inertial and gravitational masses since inertial mass can only be positive, and gravitational mass can only be positive or negative The purpose of this work is to show that since radioactive substances can emit electrons with negative mass at velocities above ω, they can be a source of their production.

Introduction

The possibility of the existence of matter with a negative mass (also called *negamatter*), consisting of non-particles, is described in many works [1-7]. However, no one has yet been able to obtain non-matter or detect it in nature. At the same time, an analysis of the methodology and results of a number of experiments conducted by different authors gives reason to believe that they were dealing with non-particles.

Calculations have shown [5,6] that all bodies, upon reaching a critical speed

$$\omega = \frac{c}{\sqrt{\phi}} = c\sqrt{\frac{\sqrt{5}-1}{2}} \approx 235696.8871 km / c$$

Where c = 299792458 km/s is the speed of light, $\Phi \cong 1.618033989$ is the value of the golden section, they experience a phase transition consisting of an inversion of body mass, accompanied by a change in the sign of body mass. The mass changes abruptly from positive values to the same absolute value, but negative values. This gives reason to assume that, directly, at this very speed of movement of the body, mass zeroing occurs. A similar phase transition occurs with substances at corresponding high temperatures but is different for different chemical compositions of the substance. The results obtained, although they give an idea of the behavior of particles with a negative mass under various conditions, do not yet allow us to understand the essence of a negative mass of a substance and its differences from ordinary matter with a positive mass.

The purpose of this work is to identify errors in the interpretation of the results of experiments to determine the mass of electrons and to show that in these experiments non-matter was formed and, thereby, to propose a method for obtaining negamatter.

Experiments to determine the electron mass

The first determinations of the specific charge of electrons were carried out by three methods in 1897 - 1899 by D.D. Thomson [8], but with low accuracy. Greater accuracy was achieved in 1900 - 1906. V. Kaufman [9-11]. In his experiments, he used a longitudinal electric and transverse magnetic field: a beam of cathode rays exited the lower open end of the chamber

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and fell on a fluorescent screen. A metal thread was stretched at the top of the anode, giving a narrow shadow on the light spot of the fluorescent screen. Large coils created a uniform magnetic field. The beam deflection was measured by the displacement of the shadow from the thread. The speed v_0, with which the particle entered the magnetic field was determined from the equation

$$\frac{mv_0^2}{2} = eU, \quad (1)$$

and the electron mass m was calculated using the formula [12]:

$$m = eH^2b^4 / 8z_b^2Uc^2 \quad (2)$$

Where U - difference between cathode and anode, H - magnetic field strength, z_b - the total deflection of a particle along its entire path in a magnetic field acting along a section of the path b, e = -1,60217733 · 10^{-19} coulombs (electron charge), c - speed of light. At electron velocities from 2,36 · 10^8 to 2,83 · 10^8 m/s electron mass increases from 1,23 · 10^{-30} to 2,54 · 10^{-30} kg, respectively [13,14].

From equality (2) it is clear that due to the fact that the charge of the electron is negative, the mass of the electron under the conditions of this experiment should also be negative. From work [4], if we assume that the speed of interaction is equal to the speed of light, as well as work [5,6], it follows that the mass of anybody when it reaches a speed greater than the critical one ω = 235696.8871 km/s becomes negative. And since the velocities of the electrons, the masses of which were measured by V. Kaufman, were greater than ω, they were indeed negative.

To quantitatively establish the type of dependence of mass on speed, the accuracy of V. Kaufman's experiments was insufficient. Following Kaufman, the law of dependence of mass on speed was subjected to experimental verification by A.G. Bucherer, K. Volz, G. Neumann (compensation method of crossed electric and magnetic fields, source of electrons - radium preparation, 1909 - 1914); E. Gupka (constancy of deviations in the magnetic field of electrons of various speeds in high vacuum, the source of electrons is the photoelectric effect, 1910); F. Paschen (magnetron method and two-capacitor method, thermionic emission, 1916); C.E. Guye, S. Ratnowsky et C. Lavanchy (method of similar trajectories, electron source – induction machine, 1911 - 1921) [4,12,13,15-18]; H. Busch (focusing by a longitudinal magnetic field, thermionic emission, 1922); P.L. Kapitsa and R.A. Tricker (method using a focal monochromator, electron source – radioactive drug, 1925) [13,14]. Method of C. T. Zahn and A. H. Spees, source of electrons - radioactive drug, 1938 [13,14,19,20]; method M. M. Rogers, A.W. McReynolds, F.T. Rogers using radium preparation, 1940 [21], etc.

In the experiments of R.A. Tricker used a focal monochromator scheme for electrons proposed by P.L. Kapitsa [14] for the analysis of electron velocities. A diverging beam of rays passes through a control diaphragm D, a lens, and a movable diaphragm C. Beams with different wavelengths are focused at different points on the optical axis S_1, S_2, S_3.... Short-wave rays are focused closer to the lens, and long-wave rays are focused further from it. By moving the diaphragm, rays of any wavelength can be released from its opening. In this method, the role of a lens is played by a longitudinal magnetic field with axial symmetry, i.e. solenoid. Electrons are focused by such a lens at a distance

$$l = 2\pi mv \cos\alpha / eH \quad (3)$$

Where α is the angle of inclination of the direction of flight of the electron to the axis of the longitudinal magnetic field. The D diaphragm could be charged up to ± 5000 V and thereby speed up or slow down the electrons. Changing the electron speed by Δv shifts the focus to

$$\Delta l = 2\pi m\Delta v \cos\alpha / eH \quad (4)$$

Tricker's measurements showed that at electron speeds up to 240,000 km/s, the change in mass follows the Lorentz-Einstein formula with an accuracy of 1% - 2%. However, no change in the sign of the mass upon transition to velocities greater than ω was noted. A possible reason for this was that the speed of 240,000 km/s was only slightly higher than the critical speed. For this reason, the speed of the electrons during their flight through the installation became less than ω and the non-matter returned to the state with a positive mass, or, conversely, due to kinetic difficulties, the mass of the electrons did not have time to transition to the state of non-matter.

In the experiments of C.E. Guye, S. Ratnowsky et C. Lavanchy [4,12,13,15] electrons were exposed to a longitudinal electric field, running through a potential difference U. After leaving this field, they entered a space in which they were exposed to the transverse electric field of a flat capacitor with a potential difference on the plates V or the action of a transverse magnetic field H and then fell on the photographic plate. Their directions were chosen so that each of the fields caused the electron beam to deflect in the same direction. The novelty of the method consisted of a special way of taking into account edge effects. The final formulas used to determine the masses of electrons m_1 and m_2 moving with velocities v_1 and, v_2 respectively:

$$\frac{m_1}{m_0} = \frac{V_0 i_1^2}{V_1 i_0^2}, \quad (5)$$

$$\frac{m_2}{m_0} = \frac{V_0 i_2^2}{V_2 i_0^2}, \quad (6)$$

$$\frac{v_1}{v_0} = \frac{V_1 i_0}{V_0 i_1}, \quad (7)$$

$$\frac{v_2}{v_0} = \frac{V_2 i_0}{V_0 i_2} \quad (8)$$

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Where m_0 is the rest mass of the electron; v_0 is determined from an equation similar to (1). The values of V and the electron current I were selected such that the observed deviations from their main direction were the same. The velocities v_1 and v_2 were calculated from equations (7,8), and the electron masses m_1 and m_2 from (5,6) [15]. More than 25 measurements were made at speeds from 69,000 to 144,900 km/s and a curve was constructed for the dependence of the electron mass on its speed, which completely coincided with the corresponding Lorentz-Einstein function [4,12,15,18]. As can be seen from equations (5,6), the mass values were found through the ratio of the determined mass of the corresponding electron to the mass of the electron at rest, which was considered positive, then the masses of moving electrons also turned out to be positive. However, since the speeds of the electrons under study were less than the critical speed ω, they should be positive. At the same time, if the electron velocities were greater than ω, then the electron masses, in accordance with [4-6], should be negative, although it follows from formulas (5,6) that they are positive.

Experiment by C. T. Zahn and A. H. Spees

The best results confirming the Lorentz-Einstein formula for the dependence of the electron mass on its speed and, importantly, over the entire speed range, with an accuracy of 1%, were obtained in 1938 by C. T. Zahn and A. H. and Spees [13,14,19,20]. This deserves special consideration. The device they developed consists of an electron source and two diaphragms with narrow slits S_1 and S_2.

The source of the electrons was a radioactive drug that emits electrons in all directions at different speeds, from zero to close to the speed of light. Diaphragms S_1 and S_2 allow only a narrow beam of these particles to pass into the condenser. Electrical voltage is applied to the capacitor plates. There are magnet poles on both sides of the capacitor. Thus, an electric field strength of E and a magnetic field of strength H are created in this capacitor. Having flown through the capacitor, electrons fall on another diaphragm S_3, and those that manage to fly through it reach a counter that registers these electrons. The whole device works in such a way that the source emits electrons, the capacitor and magnet sort them and pass on those that satisfy certain conditions, and the counter counts them.

All this happens as follows: an electron flying along the axis of a capacitor with a speed v is acted upon by a magnetic field directed perpendicular to the trajectory of the electron moving horizontally! This field acts on the electron with the Lorentz force

$$F_1 = evH, \tag{9}$$

directed vertically. The Lorentz force bends the trajectory of the electron, forcing it to move in a circle of radius R, relative to the direction of its horizontal speed, it is centripetal and, thereby, is attracted to the center of this circle. Force (9) has a negative sign due to the fact that the electron charge included in the formula (9) is negative. At the same time, the same electron is acted upon by an electric field, also directed vertically, but in the opposite direction. The electric field acts with force

$$F_2 = eE. \tag{10}$$

If any of these forces is greater than the other, then the electron is deflected up or down, collides with the capacitor plate, and leaves further play. Only those electrons pass through the gap of the capacitor for which both of these forces are equal in magnitude and opposite in direction $F_1 = -F_2$, i.e.

$$evH = -eE \tag{11}$$

Meanwhile, this condition is satisfied only for those electrons whose speed, as follows from (11), is exactly equal to

$$v = -\frac{E}{H} \tag{12}$$

This means that the capacitor works as a *speed filter*, and by setting certain values of the electric and magnetic field strengths, you can pass through it electrons that have only a certain speed, and, consequently, a very certain mass. The same device allows you to determine the mass of electrons. As already mentioned, the magnetic field creates a force (9) acting on the electron and directed perpendicular to the trajectory of the electron, which bends this trajectory and forces the electron to move along a circular arc of radius R. This force is counteracted by the quasi-elastic force F_3 of the moving electron against Lorentz force (sometimes mistakenly called centrifugal force):

$$F_3 = mv^2 / R \tag{13}$$

Since this force is directed against force (9), then $F_1 = -F_3$. Thus, from the equality of these forces we have:

$$\frac{mv^2}{R} = -evH, \tag{14}$$

and taking into account (12) we get

$$m = +eRH^2 / E \tag{15}$$

The mass m used in equalities (13-15) is the inertial mass m_i. Since $e = -1{,}60217733 \cdot 10^{-19}$, the value of the electron mass under the experimental conditions turns out to be negative. This means that electrons with negative mass were emitted from the radioactive drug, regardless of their speed.

The principle of non-equivalence of inertial and gravitational masses

Mass is included in Newton's gravitational dynamics as inertial mass m_i, which determines the resistance to the movement of a body, and as gravitational mass m_g, which determines the force of influence of bodies between themselves, which manifests itself in the active m_a or passive m_p form.

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Einstein's Principle of Equivalence (EPE) asserts the equality of these masses [1,22]:

$$m_i = m_g = m_a = m_p \quad (16)$$

This principle is local in nature [23]. In [1], the results of works where small differences in the absolute values of these masses are substantiated are discussed.

O.N. Repchenko [7] proposed the Field Principle of Equivalence (FPE):

1. Inertial and gravitational masses are fundamentally different physical characteristics of objects. m_i characterizes the magnitude of the change in the speed of an object under the influence of external forces, and m_g is the intensity of the object's participation in gravitational interaction.

2. The main contribution to m_i comes from the interaction with the gravitational field of the Universe - global interaction. In places where other interactions are small in comparison with it, an effect is observed that the inertial mass of a body is proportional to its gravitational charge

3. The proportionality coefficient k increases when approaching strongly gravitating objects.

4. $k = 1$ in the surrounding space is ensured by introducing a gravitational constant. This creates the appearance of equality (16).

5. The presence of fields of a non-gravitational nature leads to a violation of proportionality between two types of masses and provides the possibility of independent measurement of these properties of objects, as well as experimental detection of deviations from equality (16).

When trying, as a first approximation, to apply FPE in practice, we are forced to be guided by the same equality (16). What EPE and FPE have in common is that they do not notice the possibility of mass having a negative sign. Therefore, the formal application of these principles to determine the nature of the interaction of non-matter gives the same results, namely, non-particles repel each other, and particles of different signs move in the same direction one after another [1,5,22-24].

The question arises: how can the results of experiments to determine the dependence of the electron mass on its speed be explained from the point of view of these equivalence principles? If electrons of positive mass were emitted from the source, this means that they increase, since there was no accelerating field in the device. And since the electron mass, in accordance with (15), turned out to be negative, it follows that their speed was, in fact, greater than ω. If we assume that the electrons escaping from the source had a negative mass. In this case, formula (15) shows that the mass of the filtered electrons was positive, not negative. The revealed paradox within the framework of EPE and FPE cannot be explained.

The works [22,25] proposed the New Equivalence Principle (NPE), which allows for the existence of non-matter and determines a more plausible nature of the interaction of negamatter:

$$|m_i| = |m_a| = |m_p| \quad (17)$$

In accordance with the NPE, negaparticles are attracted to each other and repelled from particles with positive mass. An absurd conclusion is obtained if we apply NPE to the results of the experiments of C. T. Zahn and A. H. Spees. Simple substitution $|m_i|$ instead of m_i in equality (15) shows that the body mass module can take negative values:

$$|m_i| \neq eRH^2 / E \quad (18)$$

which contradicts the concept of a module.

The results of these experiments can be explained if, instead of the principles of equivalence, the *Principle of Nonequivalence* (PN) is applied:

1. The material body has an inertial mass m_i and gravitational mass $m_g = m_a = m_p$.

2. m_i determines the amount of matter in the body, and m_g the amount of gravitational charge of the body of the corresponding sign. The concepts of "amount of matter" and "amount of gravitational charge" are currently insufficiently defined and require clarification of their physical essence.

3. Since the amount of matter in a body can be either zero or positive, then the inertial mass can also be either zero or positive $m_i \geq 0$.

4. The gravitational charge can be either positive or negative $0 \geq m_g \geq 0$.

5. Characteristics 3 and 4 follow PN: $m_i \neq m_g$.

In quantitative terms, there is a proportionality between inertial and gravitational masses

$$m_i = k|m_g|, \quad (19)$$

and in the adopted system of measures $k = 1$.

It is easy to see that the behavior of non-particles when interacting with each other and particles of positive mass will be the same as in the case of the action of NPE. The fundamental difference between PN and NPE is that in the case of NPE, the inertial mass can be either positive or negative, and the rules of NPE are such that when determining the behavior of non-particles, their characteristics are taken modulo so that the absolute values turn out to be equal to negative numbers (18). It is precisely this circumstance that makes NPE unsuitable for explaining the experiments under discussion. In the case of PN, the inertial mass cannot in principle be negative, from

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which it follows that on the right side of equality (15) there is a gravitational mass.

$$m_g = +eRH^2 / E \quad (20)$$

and the device of C. T. Zahn and A. H. Spees responded not to the inertial mass, but to the gravitational mass of the body, which quantitatively, by virtue of (19), is equal in absolute value to the inertial mass. As a result, equality (15) should be written:

$$m_i = |m_g| = |eRH^2 / E| \quad (21)$$

Equality (21) also says that regardless of the sign of the mass of the electrons escaping from the source, the sign of the mass of the electrons passing through the device is determined by their speed: if the speed of the electrons was greater than the critical one, then they had a negative mass, and if less, then positive mass.

Conclusion

As a result of the analysis of well-known experiments to determine the dependence of the electron mass on their speed, performed back in the last century, errors were discovered in determining the sign of the electron mass. It is shown that at electron velocities above the critical $\omega = 235696.8871\ km/s$ their masses become negative. It is concluded that inertial mass determines the quantitative content of matter in the body and therefore can only be positive, and gravitational mass characterizes the amount of gravitational charge in the body and therefore can be both positive and negative. Therefore, they cannot be equivalent. The Principle of Non-Equivalence of Inertial and Gravitational Masses is proposed, which explains the results of these experiments. Since radioactive substances can emit electrons with negative mass at velocities higher than ω, such substances can be used to produce non-particles.

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