On the variable nature of the electric charge of subatomic particles

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December 5, 2023

Abstract

In this paper, we propose a variable modeling for the electric charge of subatomic particles, postulating that the charge of some subatomic particle with charge is dependent on its relativistic speed, with the speed of light as the main inertial reference frame, and can be calculated with the formula

$$q_s = \frac{1}{c^2 \cdot \gamma}$$

where c is the speed of light in vacuum, and

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

is the Lorentz factor, where we have that v_s is the speed of the subatomic particle in the inertial reference frame where the charge is measured. This variable modeling provides a solid explanation of the quantization of electric charge, and opens a new path of research in quantum physics.

1 Introduction

The idea that subatomic particles with charge possess an intrinsic constant charge is one of the fundamental pillars of modern physics, supported by a large number of observations and experiments dating back to the end of the 19th century. However, in this article, we propose to reconsider this notion and hypothesize that the constant electric charge as an intrinsic property of the subatomic particle is an unproven assumption rather than a demonstrated fact.

The history of physics has been closely linked to the discovery and understanding of subatomic particles and their properties. The observation of electrical and magnetic interactions, as well as the development of Maxwell's electromagnetic theory in the mid-19th century, laid the foundation for the concept of subatomic particless with electric charge. Millikan's oil drop experiment [1], performed in 1909, provided an accurate measurement of the elementary electric charge of the electron and contributed to the consolidation of the notion of the subatomic particles with charge.

However, it is important to note that these experiments were performed under conditions in which the subatomic particles were in the same inertial reference frame (Earth). No direct experiment has been carried out that conclusively demonstrates that the inertial reference frame where the subatomic particle is has no impact on its electric charge.

The main proposal of this article is to present a theory that questions the existence of the intrinsic constant electric charge of subatomic particles, and suggests that this charge could be a consequence of its motion at relativistic velocities. This is consistent with the Balloon expansion model recently proposed by Waugh [2], according to which every observer (or every frame of reference) is moving with a velocity c in one single direction (the real time/universal time direction) irrespective of its location or velocity in the 3D Field-Particle HyperSheet.

2 Main Postulates

Our main postulate states that the charge of the subatomic particle is dependent on its relativistic speed, with the speed of light as the main inertial reference frame. Concretely, we postulate that the charge of the subatomic particle is non-constant, and can be calculated with the following formula:

$$q_s = \frac{1}{c^2 \cdot \gamma} \tag{1}$$

Where c is the speed of light in vacuum, and $\gamma = \frac{1}{\sqrt{1-\frac{v_s^2}{c^2}}}$ is the Lorentz factor. Here, v_s is the speed of the subatomic particle in the inertial reference frame where the charge is measured, which is approximately equal to the speed of expansion of the universe (c) adjusted by the local inertial reference frame.

This formula is a consequence from the following fundamental relationship that we postulate:

$$q_s = \frac{m_s}{E_s} \tag{2}$$

Where m_s is the relativistic mass of the subatomic particle, and E_s is the relativistic kinetic energy of the subatomic particle. Note that we can calculate the relativistic mass of the subatomic particle with the speed of light as the main inertial reference frame as $m_s = m_0 \cdot \gamma$, where m_0 is the mass of the subatomic particle at rest, and we can calculate the relativistic kinetic energy of the subatomic particle as $E_s = m_s \cdot c^2 \cdot \gamma$. As a result, we get that

$$q_s = \frac{m_s}{E_s} = \frac{m_s}{m_s \cdot c^2 \cdot \gamma} = \frac{1}{c^2 \cdot \gamma} \tag{3}$$

We can check that this formula is consistent with the charge $q_s = 1,6021766 \times 10^{-19}$ that has been measured through various experiments performed on Earth. The most accurate measurements of the speed of light in vacuum is $c = 299.792.458$ m/s. We can approximate v_s taking into account that the Earth has a translation movement of approximately $v_t = 29.800$ m/s around the Sun, so we have that the approximate speed of the subatomic particle in the local inertial reference frame on an experiment performed in the Earth would be of $v_s = c - v_t = 299.762.658$ m/s.

As a result, using (1), we get that

$$q_s = \frac{1}{c^2 \cdot \gamma} = 1.5687747 \times 10^{-19} \tag{4}$$

Note that the difference with the measured charge $1,6021766 \times 10^{-19}$ could be due to a variety of facts that should have been incorporated to derive correctly v_s, such as the obliquity of the elliptic of the Earth, the local curvature of the 3D Field-Particle HyperSheet relative to the center of expansion of the universe, the possibility that the speed of expansion of the universe is locally slightly lesser than c, or even the local velocity of the electrons inside the atoms where their charge is measured ... Any tiny variation on v_s or c could make the formula yield the experimentally measured charge of subatomic particles with charge, as the difference adjusting v_s just with the translation velocity of Earth is of approximately 2.08%.

2.1 Corollary: the quantization of electric charge

Quantization of electric charge is a fundamental concept in physics that describes the phenomenon of the electric charge being quantized, meaning that it can only exist in discrete multiples of a certain value. The concept was first introduced by Robert Millikan in 1909 [1], who discovered that the charge on an electron was quantized in units of the elementary charge, e.

Our postulates provide a solid explanation of the quantization of the electric charge, as from (1) it is inmediately deduced that electric charge does not depend on the size of the subatomic particle, but on the local inertial reference frame, and thus it can not be divided by ”splitting” them.

2.2 Corollary: Massless particles can not have electric charge

As (1) is derived from (2), we have that, if the mass at rest m_0 of some subatomic particle is zero, then it can not have any electric charge.

3 Final Remarks

Note that our postulates need to be checked performing some experiment where the components of the local inertial reference frame change. For instance, the postulate predicts that the charge of some subatomic particle measured in outer space in some vehicle moving slow could be significantly lesser than the charge of that subatomic particle measured in Earth. As an example, plugging $v_s = 299.792.000$, for some inertial reference frame very close to the speed of light in vacuum, would yield $q_s = 1.94528 \times 10^{-20}$, a charge which would be approximately $12,14\%$ of the currently assumed constant charge of the subatomic particles with charge.

Performing such an experiment to confirm our postulate is beyond of our current financial and operational capabilities, so we shall wait to some measure of the charge of subatomic particles to be performed under some different local inertial reference frame to confirm our postulates.

References

[1] R. Millikan. The isolation of an ion, a precision measurement of its charge, and the correction of stokes's law. *Science. 32 (822): 436–448*, 1910.

[2] S. Waugh. Unified physics and cosmology: the theory of everything. *SSRN: https://ssrn.com/abstract=4211207*, 2022.