Electric Charge, Negative Energy and Time Travel

Rodolfo A. Frino

Electronics Engineer
Degree from the National University of Mar del Plata
rodolfo_frino@yahoo.com.ar
April 2015 (v1)

Abstract

In this paper I derive the lepto-baryonic formula for the electric charge. The formula is based on the lepto-baryonic formula for the fine-structure constant that I published recently. This paper shows that the electrical charge is a function of the ratio of the mass difference between the two lightest charged leptons: the electron and the electrino; and the mass difference between the two lightest baryons: the proton and the neutron. Thus the formula for the elementary charge is a function of the mass of four elementary particles. Two of these particles (the electron and the electrino) control the sign of the electric charge. This allow us to derive the electric charge of the positron from the electric charge of the electron by interpreting the positron, as Feynman did, as an electron of negative energy travelling backward in time.

Keywords: *fine-structure constant, electromagnetic coupling constant, atomic structure constant, mass ratio, lepton, electron, electrino, neutrino, baryon, proton, neutron, Feynman diagram, NIST.*

1. Introduction

The lepto-baryonic formula (or exponential formula) for the fine-structure constant given in my previous article [1] and is defined by the expression

$$\alpha = 2^{-18\,\rho_{lepto\text{-}baryo}} \tag{1.1}$$

where the mass ratio $\rho_{lepto\text{-}baryo}$ is defined as

$$\rho_{lepto\text{-}baryo} \equiv \frac{m_e - m_l}{m_n - m_p} \tag{1.2}$$

From the previous equations we get

$$\alpha = \frac{1}{2^{18\left(\frac{m_e - m_l}{m_n - m_p}\right)}} = 2^{-18\left(\frac{m_e - m_l}{m_n - m_p}\right)} \tag{1.3}$$

The value of the fine-structure constant given by this formula is $\alpha \approx 0.007\ 297\ 352\ 57$ [2].
In the following section I shall derive the lepto-baryonic formula for the electric charge

2. Nomenclature

The following list contain the symbols used in this paper

α = fine-structure constant, electromagnetic coupling constant, atomic structure constant.
h = Planck's constant
c = speed of light in vacuum
ϵ_0 = permittivity of vacuum (also known as electric constant)
$\rho_{lepto\text{-}baryo}$ = lepto-baryonic mass ratio
e = electric charge or elementary charge
m_e = electron rest mass
m_l = electrino rest mass
m_n = neutron rest mass
m_p = proton rest mass
E_e = electron rest energy ($E_e = m_e c^2$)
E_l = electrino rest energy ($E_l = m_l c^2$)

3. Derivation of the Lepto-baryonic Formula for the Electrical Charge

The definition of the electromagnetic coupling constant is

$$\alpha = \frac{e^2}{2\epsilon_0 h c} \tag{3.1}$$

The lepto-baryonic formula for the electromagnetic coupling constant is

$$\alpha = \frac{1}{2^{18\left(\frac{m_e - m_l}{m_n - m_p}\right)}} \tag{3.2}$$

We can derive the lepto-baryonic formula for the elementary charge by eliminating α from equations (3.1) and (3.2). The result is

$$e = \frac{\pm\sqrt{2\epsilon_0 h c}}{2^{9\left(\frac{m_e - m_l}{m_n - m_p}\right)}} \tag{3.3}$$

The value this formula yields is

$$e = \pm 1.602\ 176\ 564 \times 10^{-19} C$$

The plus sign is, for example, the electrical charge of protons and positrons while the minus sign is the charge of anti-protons and electrons. The value for the electric charge given by NIST (2010) [3] is

$$e = 1.602\ 176\ 565(35) \times 10^{-19} C$$

4. Analysis

The Reason Why Electrically Charged Antiparticles Have Opposite Charge to that of Particles

I shall now consider equation (3.3) for the electron. Because the electron is a negatively charged particle we use the minus sign of equation (3.3). Thus we get

electron electric charge

$$e_{electron} = \frac{-\sqrt{2\epsilon_0 h c}}{2^{9\left(\frac{m_e - m_l}{m_n - m_p}\right)}} \tag{4.1}$$

In his lecture notes of 1961 [4] Richard Feynman interpreted negative energy as follows:

"The fundamental idea is that the "negative energy" states represent the states of electrons moving backward in time...reversing the direction of proper time s amounts to the same as reversing the sign of the charge so that the electron moving backward in time would look like a positron moving forward in time."

Thus we can derive the electrical charge of the positron from formula (4.1) observing that a positron travelling forward in time is equivalent (which is denoted by the symbol $\equiv$) to electron travelling backward in time. Mathematically:

$$e_{positron\_forward} \equiv \frac{-\sqrt{2\epsilon_0 h c}}{2^{9\left(\frac{m_{e\_backward} - m_{l\_backward}}{m_n - m_p}\right)}} \tag{4.2}$$

Now let us consider the Einstein's famous equation, $E = mc^2$, which we write as follows

$$m = \frac{E}{c^2} \tag{4.3}$$

According to the above equation and considering that both the energy and the mass of a particle that travels backward in time are negative quantities, we can write the mass of the electron that travels backward in time as

$$m_{e\_backward} = -\frac{E_e}{c^2} \tag{4.3}$$

and the mass of the electrino (that would travel backward in time if the time travelling electron were to decay) as

$$m_{l\_backward} = -\frac{E_l}{c^2} \tag{4.4}$$

Because both $E_e = m_e c^2$ and $E_l = m_l c^2$ are positive quantities, the masses of the electron and the electrino (that are travelling backward in time: $m_{\text{e\_backward}}$ and $m_{\text{l\_backward}}$ respectively) are negative quantities.

When one includes the second side of equations (4.3) and (4.4) into equation (4.2) one finds the electric charge of the positron

$$e_{positron\_forward} = \frac{-\sqrt{2\epsilon_0 h c}}{2^{9\left[\frac{\frac{-E_e}{c^2}-\left(\frac{-E_l}{c^2}\right)}{m_n - m_p}\right]}} \tag{4.5}$$

Note that I have kept the signs of the two lightest baryons (the proton and the neutron) as I consider that only the electron (and the electrino, if the electron were to decay while it travels backward in time) is travelling backward in time. When we perform the following mathematical steps

$$e_{positron\_forward} = -\frac{-\sqrt{2\epsilon_0 h c}}{2^{9\left[\frac{\frac{-E_e}{c^2}-\left(\frac{-E_l}{c^2}\right)}{m_n - m_p}\right]}} = \frac{-\left(-\sqrt{2\epsilon_0 h c}\right)}{2^{9\left(\frac{\frac{E_e}{c^2}-\frac{E_l}{c^2}}{m_n - m_p}\right)}} = \frac{+\sqrt{2\epsilon_0 h c}}{2^{9\left(\frac{m_e - m_l}{m_n - m_p}\right)}} \tag{4.6}$$

we find that the positron has a positive electric charge, which, as we all know, is in agreement with the experiment.

positron electric charge

$$e_{positron\_forward} = \frac{+\sqrt{2\epsilon_0 h c}}{2^{9\left(\frac{m_e - m_l}{m_n - m_p}\right)}} \tag{4.7}$$

Note that from the point of view of an observer who were able to travel backward in time along with the time travelling electron, both the energy and the mass of the time travelling electron would be negative. However a normal observer (who travels forward in time) would measure both a positive energy and a positive mass for the positron. However, this observer will measure a positive charge for the positron as predicted by equation (4.7). The two interpretations are:

Interpretation 1: an electron travelling backward in time, and
Interpretation 2: a positron travelling forward in time.

Figure 1 and Table 1 show the two interpretations. The Feynman diagram on the left of Fig 1 (Interpretation 1) shows that when an electron, that travels backward in time, absorbs a high energy photon, can reverse its direction in time and can start travelling forward. Consequently its energy changes from negative to positive.

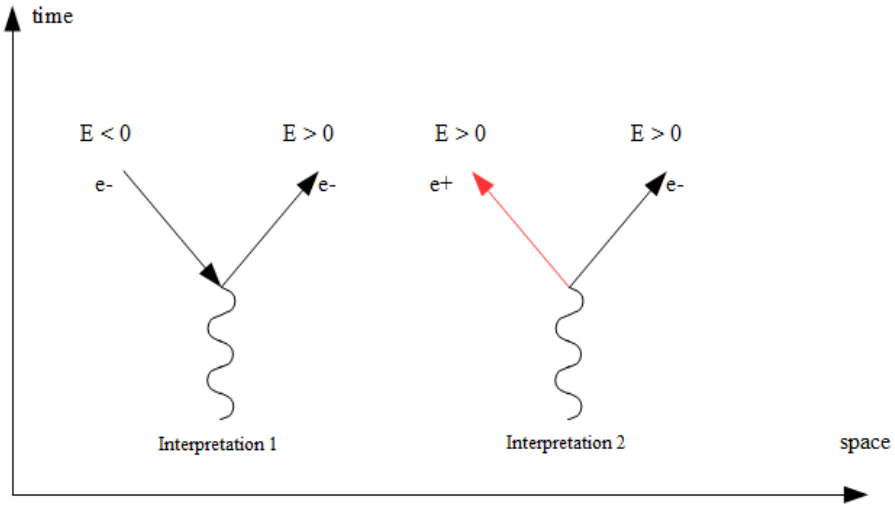

Fig 1: *The two interpretations of a positron-electron pair creation. Because we are unable to travel backward in time, we see an electron, e-, with negative energy (and negative charge) as a positron, e+, travelling forward in time (red arrow).*

Interpretation 1 should be considered the most important one since it means that there are only particles travelling either forward or backward in time. Thus, strictly speaking, antiparticles are an illusion created by the forward direction of time. So particles are able to do things we cannot do. The table allows us to compare, side by side, the parameters (mass, energy and electric charge) of a particle under both interpretations.

Parameter/ Property	Interpretation 1 Electron travelling backward in time (Preferred interpretation)	Interpretation 2 Positron travelling forward in time (Standard interpretation)
Mass	Negative $m_{\text{e\_backward}} = -m_e = -\frac{E_e}{c^2}$ $m_{\text{e\_backward}} < 0$	Positive $m_{\text{e}} = \frac{E_e}{c^2}$ $m_e > 0$
Energy	Negative $E_{\text{e\_backward}} = -m_e c^2$ $E_{\text{e\_backward}} < 0$	Positive $E_e = m_e c^2$ $E_e > 0$
Electric charge	Negative $-e$	Positive $+e$

Table 1: *Two equivalent interpretations:* ***Interpretation 1)*** *the parameters for the electron travelling backward in time; and* ***Interpretation 2)*** *the same parameters for a positron travelling forward in time.*

5. Conclusions

Antimatter has been shrouded in mystery ever since Carl Anderson discovered the positron in 1932. But this investigation confirms the Wheeler-Feynman's interpretation: that antimatter is just matter travelling backward in time. We have to keep in mind that, even if we measure positive masses (and therefore positive energies) for positrons, the physical reality is that annihilation cannot be explained with only one type of energy. One could ask: Why two particles with the same type of energy would annihilate? The answer is that antimatter is an illusion and the only way of explaining annihilation is to consider antiparticles as particles with negative energy travelling backward in time. Then one can ask: What is negative energy? The partial answer is that negative energy is a type of energy that allow particles, in the broad sense, to annihilate each other. But we should also ask: Do we know what energy is? No, we don't because it is primordial. One big difference is psychological. We are familiar with the concept of positive energy but, on the contrary, we are quite unfamiliar with its negative counterpart. We can summarize this point by saying:

> Reversing the direction of time a particle travels is equivalent to reversing its energy.
> It seems nature cannot reverse one without reversing the other.

Formula (3.3) predicts that the electrical charge of leptons depends on the mass of the two lightest charged leptons (the electrino and the electron) and the two lightest baryons (the proton and the neutron). In other words, the elementary charge is the result of a quantum-inertial effect or, equivalently, a quantum-gravitational effect (this is so because of the Einstein's principle of equivalence between inertial and gravitational mass). This is a surprising result that the Standard Model was, so far, unable to predict. It is without question that the interpretation Feynman laid out back in 1961 have profoundly changed the way we view particle physics and the universe.

REFERENCES

[1] R. A. Frino, *Exponential Formula for the Fine Structure Constant*, vixra.org: viXra 1502.0143, (2015).

[2] R. A. Frino, *On the Electrino Mass*, vixra.org: viXra 1503.0009, (2015).

[3] NIST, *Fundamental Physical Constants—Extensive Listing*, retrieved from: http://physics.nist.gov/constants, (2010)

[4] R. Feynman, *Quantum Electrodynamics*, Benjamin Inc. Publishers, p. 68, (1961).