Electrostatic Force and Charge Structure

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In our previous report, *Electromagnetic Effects and Structure of Particles due to Special Relativity*, we proved that electromagnetic effects are due to special relativity by showing eleven significant digits of correspondence between the maximum value of rotation minus precession and the fine structure constant. We now provide the theoretical basis for the correspondence and its relationship to the previously derived electron and proton structure.

Introduction

Because relativistic length contraction occurs only in the direction of motion, and not in the transverse direction, an angle observed during motion differs from an angle observed when stationary according to[1]

$$\frac{\Delta\theta}{2\pi} = \gamma - 1 \tag{1}$$

where γ is the Lorentz factor. Angular rotation, ω, results in angular precession, ω_P, according to[1]

$$\frac{\omega_P}{\omega} = \frac{\Delta\theta}{2\pi} = \gamma - 1 \tag{2}$$

The sense of angular precession is of a secondary rotation in the opposite direction of the primary angular rotation. Angular rotation minus angular precession gives a difference angular velocity

$$\omega_d = \omega - \omega_P = \omega(2 - \gamma) \tag{3}$$

This can be thought of as effective angular velocity with regard to angular momentum and kinetic energy. Multiplying Equation 3 by radius, we can write difference velocity in terms of rotation velocity.

$$v_d = v(2 - \gamma) \tag{4}$$

Figure 1 shows difference velocity graphed from Equation 4.

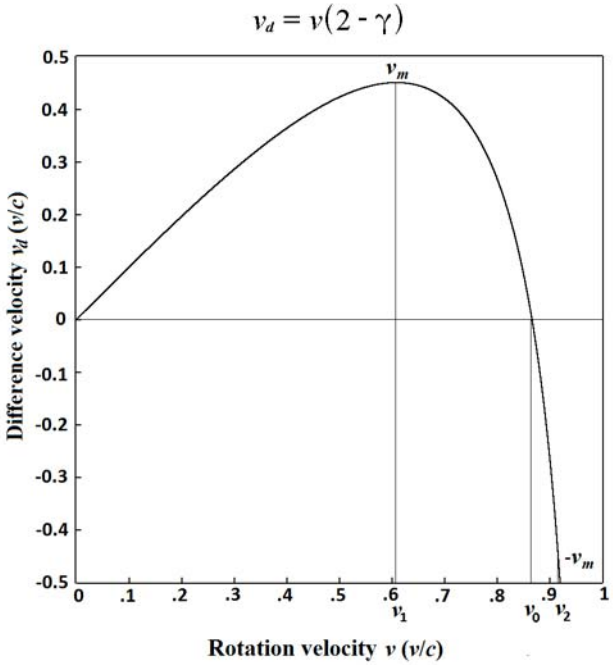


Fig 1. Difference velocity as a function of rotation velocity

When we solve for the maximum difference velocity we find

$$v_m = (2^{2/3}\text{-}1)^{3/2}\, c \;\cong 134965504.63776 \text{ m/s}, \tag{5}$$

where c is the speed of light.

Analysis

The magnitude of the electrostatic force between two charged particles separated by distance r can be written as

$$F(r) = \frac{2\pi}{r^2 c}\left(\frac{\frac{\sqrt{3}}{2}\hbar k_1}{\frac{1}{2}m_e v_m^2} + \sqrt{2}\hbar v_m k_2\right) \tag{6}$$

where

$$k_1 \equiv \text{kg m}^4/\text{s}^4 \tag{7}$$
$$k_2 \equiv \text{m/s} \tag{8}$$

and m_e is electron mass, and ħ is the reduced Planck constant. Note that k_1 and k_2 effect unit transformations, which will be described below. Constants c and v_m are exact values.

The uncertainty of the calculation is only that of the reported values of ħ and m_e. The value obtained using Equation 6 matches the value from Coulomb's law applied to two elementary charges to eleven significant digits.

The first term in parenthesis in Equation 6 is charge total angular momentum divided by the kinetic energy of electron mass rotating with difference velocity v_m, modified by a unit transformation. The second term in parenthesis in Equation 6 is photon total angular momentum multiplied by v_m, modified by a different unit transformation.

We see from Equation 2 that $\Delta\theta = 2\pi$ when $\omega = \omega_P$. The physical interpretation of this is that an angle perceived when rotating differs by 2π from the same angle perceived while stationary when the rotation angular velocity equals the precession angular velocity. This condition exists when rotation velocity equals $\sqrt{3}/2\ c$ so $\gamma = 2$. This rotation velocity is labeled v_0 in Figure 1. In other words, at rotation velocity v_0 the difference velocity is 0 because rotation minus precession equals 0, so there is no kinetic energy or angular momentum. The angular difference is the source of the 2π factor in Equation 6.

Now that we have established the significance of all of the individual components in Equation 6, we turn to the relationship between the components and the previously derived models of the physical structure and behavior of the electron and proton.

First, as a brief review of our previous report, both electron and proton consist of three mutually orthogonal rings of rotating mass. The electron rings' difference velocity remains between +/- v_m, with each ring's angular momentum S_Z = +/- ħ /2 at +/- v_m. This is shown in Figure 2.

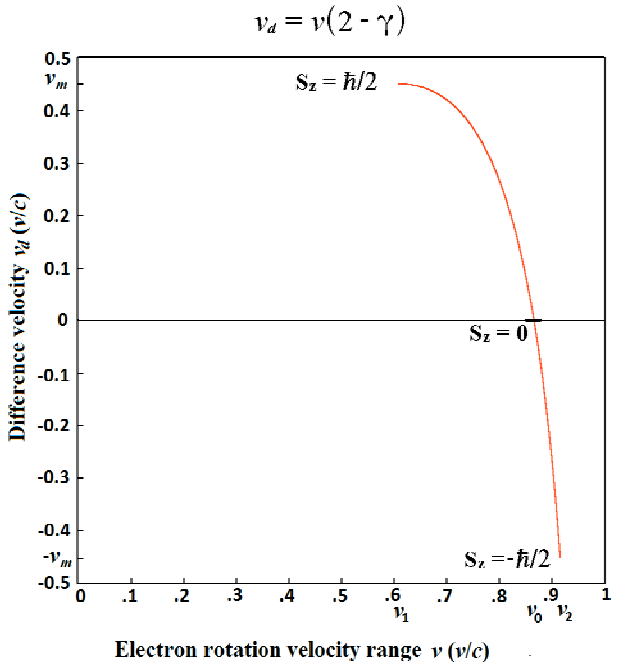


Fig 2. Electron ring difference velocity as a function of rotation velocity, with angular momentum annotated.

The proton maximum difference velocity is

$$v_{mp} = v_m \sqrt{\frac{m_e}{m_p}} \cong 3149694.18144 \text{ m/s} \tag{9}$$

where m_p is proton mass. The proton rings' difference velocity remains between +/- v_{mp}, with each ring's angular momentum S_Z = +/- ħ /2 at +/- v_{mp}. This is shown in Figure 3.

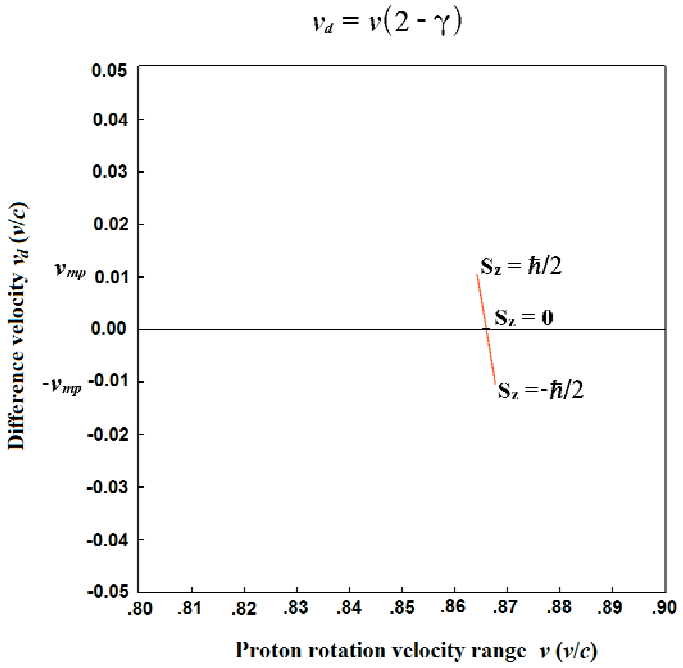


Fig 3. Proton ring difference velocity as a function of rotation velocity, with angular momentum annotated.

Two characteristics of charged particles are of particular significance. Firstly, charged particles are coupled to space such that any change of particle angular momentum is accompanied by a change of angular momentum of the space adjacent to the particle. Notice that Equations 1-5 have no dependence on mass; they apply to space itself. Secondly, emitted photon energy depends on the time required for a particle's ring angular momentum to transition from maximum to 0. Consider for example an electron ring's rotation velocity, shown in Figure 2, transitioning from v_2 to v_0. Its difference velocity transitions from -v_m to 0, and its angular momentum transitions from -ħ/2 to 0. The emitted photon energy depends on the time for that change in angular momentum to occur, according to E = ΔS/ΔT. Additional details of photon emission requirements are provided in our previous work, but we emphasize here one consequence of this characteristic of particular significance to the reader first considering electron structure. Emitted photon wavelength is not directly related to charged particle dimensions.

Having reviewed some of the model of structure and behavior of electron and proton from our previous work, we move on to the relationship between the components of Equation 6. The denominator of the first tem in parenthesis in Equation 6 takes the form of kinetic energy. The kinetic energy of one of an electron's three mutually orthogonal rings when rotating at v_m is

$$E_{ke} = \frac{1}{2}\frac{m_e}{3}v_m^2 \cong 2.7655614\text{E-}15 \text{ Joules} \quad (10)$$

The kinetic energy of one of a proton's three mutually orthogonal rings when rotating at v_{mp} is

$$E_{kp} = \frac{1}{2}\frac{m_p}{3}v_{mp}^2 \cong 2.7655614\text{E-}15 \text{ Joules} \quad (11)$$

Equations 10 and 11 show that the kinetic energy of electron and proton rings is equal when they are rotating with their difference velocities each at maximum. So we see that the denominator of the first term in parenthesis of Equation 6 is the sum of the kinetic energy of all three rings of either the electron or proton. This is consistent since Equation 6 can be used to calculate the magnitude of the electrostatic force between either two electrons or two protons or one proton and one electron.

The magnitude of the first term in parenthesis in Equation 6 is equivalent to a change in total angular momentum from maximum to 0, divided by a change in kinetic energy from maximum to 0. This change occurs for both angular momentum and kinetic energy when v_d transitions from the charge's maximum to 0, resulting in the mass rotating at the velocity labeled v_0 in Figure 1.

As described in our previous report, angular momentum is conserved, so when a charge's angular momentum is decreased, the angular momentum in the space adjacent to the charge is increased. That increase in the angular momentum of space adjacent to the electron takes the form of a photon, which explains the second term in parenthesis in Equation 6.

The magnitude of the second term in parenthesis of Equation 6 is the angular momentum of a photon between two charges multiplied by v_m. The v_m factor is because the photon's maximum difference velocity is v_m with respect to charge rotation at v_0. In measuring the electrostatic force between two charged particles, there are three components as noted with Equation 6. There are the two charged particles, and a photon between the particles.

Unit modifiers k_1 and k_2 are required because force is not simply mass multiplied by acceleration. At the particle level, force has a 2π magnitude component from an angular difference due to special relativity. The asymmetrical effect of time dilation extends the conditions under which force results. Units under the SI system are not functions of velocity and angle, so the effects of particles rotating in the ranges shown in Figures 2 and 3, and the effect of a stationary photon, require unit modifiers.

Discussion

Equations 10 and 11 show that the kinetic energies of the electron and proton, when each v_d is at maximum, are equal. We now consider the maximum difference angular velocity of electron and proton.

In order to find the maximum difference angular velocity of the electron, we use the electron radius, which was derived in our previous report[2]. $R_e \cong 1.28663582937643E\text{-}12$ m. The electron maximum difference angular velocity can be written as

$$\omega_m = v_m / R_e \cong 1.048979839953E20 \quad (12)$$

In order to find the maximum difference angular velocity of the proton, we use the proton radius which was derived in our previous paper[2]. $R_p \cong 3.00262603862772E\text{-}14$ m. The electron maximum difference angular velocity can be written as

$$\omega_{mp} = v_{mp} / R_p \cong 1.048979839953E20 \quad (13)$$

Equations 12 and 13 show that the maximum difference angular velocities of electron and proton are equal.

Charge is conserved because mass with angular difference velocity in the range +/- ω_m is a particle which is always coupled to space, exhibiting the effects of charge, and it always remains in that range.

Conclusion

In our model charged particles consist of three mutually orthogonal rings of rotating mass. The difference angular velocity for both electron and proton remains between +/- ω_m, while the difference velocity ranges are shown in Figures 2 and 3. The equation for the magnitude of electrostatic force between two charged particles is written in terms of the structure and behavior of our model in Equation 6, and the result of Equation 6 exactly matches the result of applying Coulomb's law to two elementary charges.

We have proven that charge structure and electrostatic force are due to special relativity. With a direct interpretation of the physical meaning of previously known Equation 2, and with a simple extension, we arrived at Equation 4 and its graph in Figure 1. The maximum value and the zero crossing of the difference velocity graphed in Figure 1 lead to every component of Equation 6, which results in an 11 significant digit correspondence with the experimentally established electrostatic force.

The components of Equation 6 have clear and concise meaning within the structural model, and the relationship between the components is reasonable only within the structural model. The inner consistency of the components of Equation 6, their direct

correspondence to each other and the model, and 11 significant digits of correspondence to experimental results is the strongest confirmation of the theoretical basis of any physical law of which the author is aware. The number of assumptions is few. The special relativistic effect of precession is well established. The exact match between the theoretical model, the equation based on it, and the measured value of electrostatic force all assure us that the electron and proton have the structure and behavior described in the model.

The development of Equation 6 is confirmation of our previous work in *Electromagnetic Effects and Structure of Particles due to Special Relativity*. The models of particle structure and their rotational behavior explain the origin of charge, conservation of charge, and its effects. The model clearly explains electron and proton per axis and total angular momentum, photon emission, spin, spin-flip, difference between electron and proton spin-flip, why there are no magnetic monopoles, how the neutron has magnetic moment though it has no charge, the negative edge of the neutron, the Larmor formula for radiated power, and many other characteristics. The current model without extension or modification explains anti-matter by orientation and counter rotation. Anti-matter may be described more fully in a future work, but it is easily understood from considering the third graph in Appendix A. The very simple and straightforward model described in our previous work and supported theoretically herein, appears capable of explaining most particle physics, material physics, and chemistry.

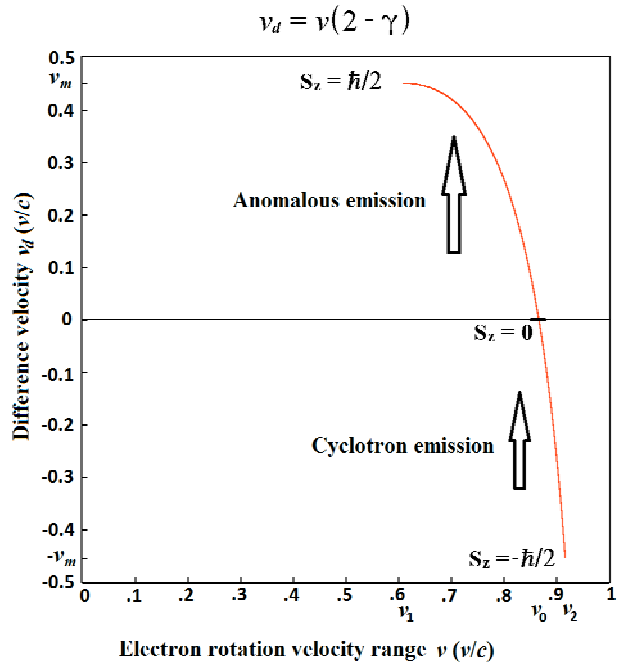
The discovery of electron structure and knowledge of charged particle structure and behavior in general will lead to advances in practically every area of physics. However, that the electron is now known to have structure and has been proven not to be a point particle has broad implications for previous research. Physics research that was based on the concept of the electron as a point particle can now be seen to have a very limited domain of validity.

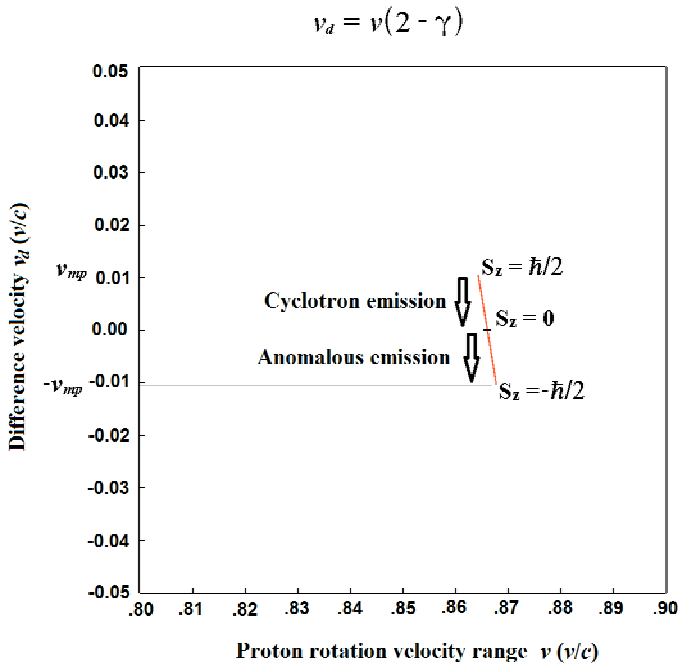
References

1) Smoot, G. F. (1998, February) Physics 139 Relativity Thomas Precession. Retrieved from https://jila.colorado.edu/arey/sites/default/files/files/seven(1).pdf

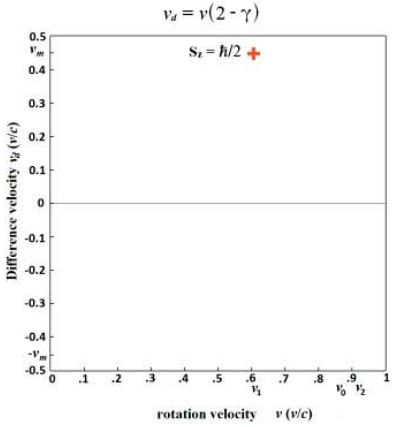
2) Guynn P. L., viXra [v3] 2017-06-12 15:13:52, 'Electromagnetic Effects and Structure of Particles due to Special Relativity', p.7

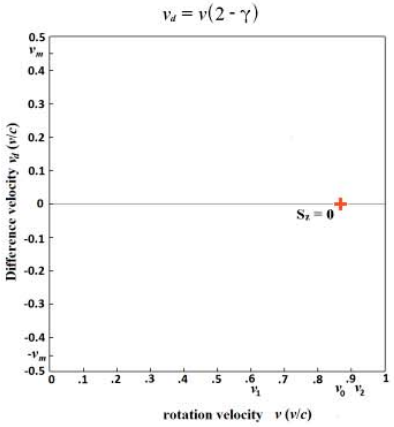
Appendix A

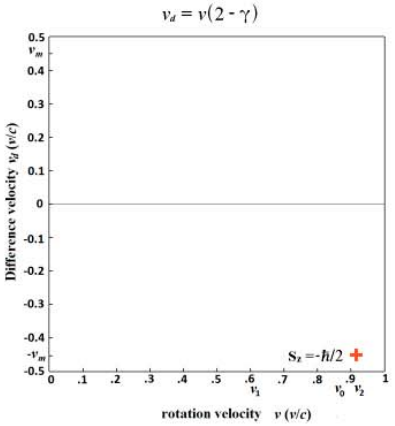

$v_d = v(2 - \gamma)$
v_m
$S_z = \hbar/2$
Anomalous emission
$S_z = 0$
Cyclotron emission
$S_z = -\hbar/2$
$-v_m$
Difference velocity v_d (v/c)
v_1
v_0 v_2
Electron rotation velocity range v (v/c)


$v_d = v(2 - \gamma)$
v_{mp}
$S_z = \hbar/2$
Cyclotron emission
$S_z = 0$
Anomalous emission
$S_z = -\hbar/2$
$-v_{mp}$
Difference velocity v_d (v/c)
Proton rotation velocity range v (v/c)

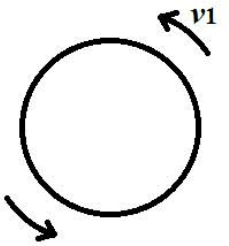
Electron rotation with difference velocity max, min, and zero

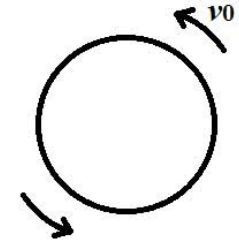


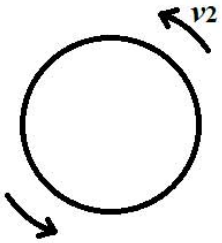




One loop top view







One loop side view, showing angular momentum