The Relationship of Mass and Charge

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Abstract: In this paper, the two distinct properties of particle mass and charge are related, unifying equations for classical mechanics and electromagnetism that use mass and charge as variables for the electron.

Introduction

The electric universe theory studies the importance of electrical interactions from the smallest of particles to the largest galaxies in the universe, with supporting evidence that "electricity" appears to be everywhere [1,2,3,4,5]. In our recent paper *Particles of the Universe Meets the Electric Universe,* we apply the concept of wave energy to Ohm's Law to derive properties of the universe, illustrating that it indeed has electrical properties [6]. Amongst some of the properties that were derived in the paper were Coulomb's law and the electron's mass. Here in this paper, we will expand on the relationship discovered between Coulomb's law, which is the force of particles with charge, and another property of particles, which is mass.

Explaining Mass and Charge

From *Particles of the Universe Meets the Electric Universe*, an energy equation was established from Ohm's law that described the fundamental electric force. A version of the equation from that paper, Eq. 2.5, is slightly modified to use a variable charge (q) in the equation for the energy measured at a distance, where d=r. The equation becomes:

$$E = \frac{\mu_0 c^2}{4\pi} \left(\frac{qq}{r} \right) \tag{1}$$

The challenge with relating mass and charge is that they use different units, and furthermore, that neither are expressed as energy. To relate them, the units of charge (Coulombs) is addressed first. In our previous paper, we established that the units of charge can be expressed as wave amplitude, with units of distance, greatly simplifying units for equations that utilize charge as a variable. If one assumes a *substance* in the vacuum of space that has a physical property of kilograms, and moves as waves, then the following are descriptions of mass and charge:

- **Mass** is standing longitudinal wave energy (without consideration of wave speed – c^2)

- **Charge** is traveling longitudinal wave energy over distance (force)

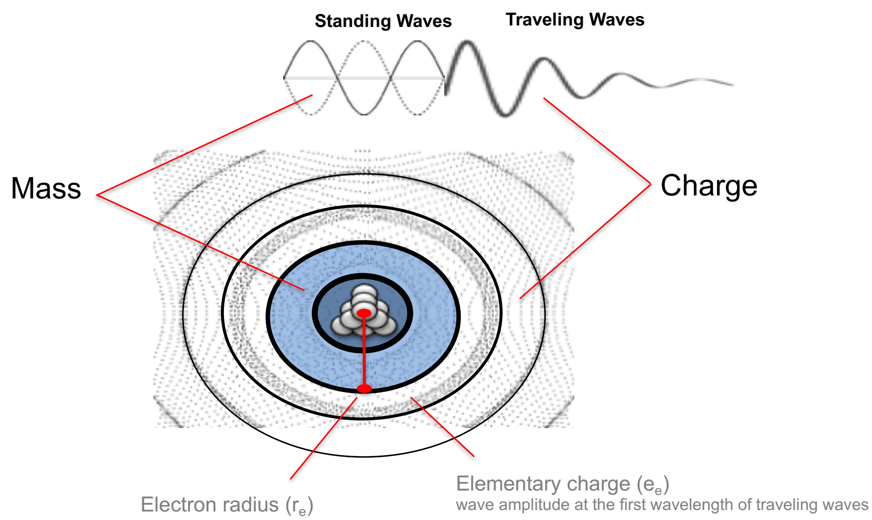

Fig. 1 – The relationship of mass and charge as waves (electron in blue)

This explanation requires something physical, as the substance filling space between particles, that is the cause of both mass and charge. It is not the purpose of this paper to debate whether this is a field, the aether, or something else. But the components of the substance will be given a name for the purpose of explaining mass and charge. The black dots in Fig. 1 will hereafter be referred to as granules to explain their motion.

In Fig. 1, the electron particle is highlighted in the center in blue. It is formed from standing waves as in-waves collide with out-waves, creating a standing wave until the perimeter which becomes the electron's radius (r_e). Beyond this radius, waves continue as traveling waves as they cannot maintain their standing wave form too far from the core as waves expand spherically and decline in wave amplitude. Granules collide and transfer energy from one to the next at all points in Fig. 1. The only difference between what is measured as the particle and what is measured as the force generated by that particle is simply the wave form.

The elementary charge of a single electron (e_e) is the wave amplitude at the first traveling wavelength beyond the electron's radius. Amplitude is the average displacement distance from equilibrium of granules. The displacement of granules will be greater near the electron's core and decrease in amplitude at distance, as granules collide and transfer energy to more granules as it spreads spherically.

Now, because matter (measured as rest energy or mass) is formed from the same wave that has electrical properties (measured as charge), they can be related both logically and mathematically. Logically, it is simply the type of longitudinal wave: standing or traveling. A standing wave is stored energy as it has no net propagation of energy. A traveling wave, by definition, is traveling energy.

Proving the Relationship of Mass and Charge

The energy equation from Eq. 1 is used to prove the relationship between the electron's mass and its electrical property of charge by deriving Coulomb's law.

Mass

The electron's mass is the stored energy of standing waves. It is the energy equation from Eq. 1 without consideration of wave speed (c^2).

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

For a single electron, charge (q) is the elementary charge (e_e).

$$q = e_e \tag{3}$$

Eqs. 3 and 1 are substituted into Eq. 2 to solve for mass. When the distance (r) to be solved is set to the electron's radius (r_e) for the perimeter of the standing wave, it resolves to the electron's mass [7]. *μ_0 is the magnetic constant.*

$$m_e = \frac{\mu_0}{4\pi}\left(\frac{qq}{r_e}\right) = 9.109 \cdot 10^{-31} \text{ [kg]} \tag{4}$$

Charge

Although charge can be expressed as energy, it is often expressed as a force, seen in Coulomb's law for the electric force. Force is energy at a distance.

$$F = \frac{E}{r} \tag{5}$$

The Coulomb constant is the magnetic constant times wave speed squared, over 4π. Coulomb gave it the letter k.

$$k = \frac{\mu_0 c^2}{4\pi} \tag{6}$$

Substituting the Coulomb constant (Eq. 6) for the constants in the energy equation (Eq. 1), and then substituting it into the force equation (Eq. 5), yields Coulomb's law.

$$F = k\left(\frac{qq}{r^2}\right) \tag{7}$$

Conclusion

It is a simple way to express both Coulomb's law and the electron's mass from one energy equation. Logically, both mass and charge can be explained as waves. And mathematically, the electron's mass can now be expressed in terms of charge (q/e_e) and the magnetic constant (μ_0), relating the domains of mechanical and electrical by equation. Eq. 4 can be substituted into equations for the electron's mass in classical mechanics to relate it to electromagnetism.

References

1 Weimer, D. R., D. A. Gurnett, C. K. Goertz, J. D. Menietti, J. L. Burch, and M. Sugiura. "The current-voltage relationship in auroral current sheets." *Journal of Geophysical Research: Space Physics* 92, no. A1 (1987): 187-194.

2 Arnoldy, R.L., 1974. Auroral particle precipitation and Birkeland currents. *Reviews of Geophysics*, *12*(2), pp.217-231.

3 Kelley, M.C., 2009. *The Earth's ionosphere: plasma physics and electrodynamics* (Vol. 96). Academic press.

4 Alfvén, H. and Carlqvist, P., 1967. Currents in the solar atmosphere and a theory of solar flares. *Solar Physics*, *1*(2), pp.220-228.

5 Southward, A.J., 1955. Observations on the ciliary currents of the jelly-fish Aurelia aurita L. *Journal of the Marine Biological Association of the United Kingdom*, *34*(2), pp.201-216.

6 Yee, J., Gardi, L., 2019. Particles of the Universe Meets the Electric Universe. *ResearchGate*. Online: https://www.researchgate.net/publication/330737944.

7 Mohr, P., Newell, D. and Taylor, B., 2014. CODATA Recommended Values of the Fundamental Physical Constants, *Rev. Mod. Phys. 88*, 035009.