Force and Rotation

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This paper establishes a relation between what the author defines as *Energy Moment* and electrostatic force. The charge e is defined with fundamental constants and is shown to be closely related to the energy of the particle and a rotational radius value. The standard Coulomb Law for force between charges such as an electron and a proton is shown to exist in a form different from what is customarily presented in physics. New insights into the nature of forces are gained from the new force equations.

1. Introduction

The author has derived a different Coulomb force formula. The derivation was published in a paper[1]. That derivation is repeated here for convenience.

In SRT, an increase in mass with velocity is express by the γ term in the equation $m = \gamma \times m_o$. Also the energy of m in this equation is expressed $E = mc^2$ It is customary to identify E in this latter equation as the combination of rest energy and kinetic energy. This paper examines the implication E includes a particle's potential energy as well as its kinetic energy and the additional implication of 'potential mass' in all $m = E / mc^2$.

2. Energy Storage between Two Charges

The force f_{12} between two charges can be expressed as the rate of change of energy, dE_{12}, with respect to incremental distance, dr, as:

$$f_{12} = \frac{dE_{12}}{dr} \tag{1}$$

Thus, Coulomb's Law may be considered as a simple ordinary differential equation of the first order. It's solution for two charges of magnitude e is:

$$E_{12} \;=\; \pm \mathrm{k}e^2 \int_{\infty}^{r} \frac{dr}{r^2} = \pm \frac{\mathrm{k}e^2}{r} + \mathrm{C} \tag{2}$$

where C is a constant, $k = 1/4\pi\varepsilon_o$, and r is the distance between the two charges. It is customary in conventional physics to set $C = 0$ and deal only with relative changes in E_{12} for both *like* and *unlike* charge relationships. This paper examines the implication of a different choice for C. Also, conventional physics takes the standard rest mass of an electron, m_{oe}, or positron as constant and separate from the electric field. For the energy relationship E_{ep} between *unlike* charges of charge e (say an electron and a positron), the author assumes $C_{(unlike)} = 2m_{oe}c^2$, where c is the speed of light. This assumption sets the potential mass of the electric field equal to the isolated rest masses of the two charged particles, in effect, making them "one and the same". This assumption is explored below. In addition, this assumption necessitates for *like* charge relationships of charge e (say two electrons) that $E_{ee} = 0$ as r approaches ∞, so that $C_{(like)} = 0$. This conclusion is reached with the following reason: Suppose a positive and negative charge, both being of charge e, were somehow bounded closely together and were relating to a third charge, also of charge e, at some distance. As the 'bound charges' were brought from a near infinite to a very near zero distance with respect to the third charge, the *unlike* charge relationship would lose an amount of energy equal to $2m_ec^2$ while the *like* charge relationship would gain $2m_ec^2$ of energy. This is because the 'bound charges' experiences no electrical force with the third charge at any distance and thus no change of total energy. The energies of each type of relationship (*like and unlike*) compliment each other. Projecting what the energy must be in the *like* charge relationship at near infinite distance, it is concluded that $C_{(like)} = 0$ and $E_{ee} = ke^2/r$.

Continuing the formula development for the energy of the electron-positron system, E_{ep}, and using the above assumption:

$$E_{ep} = 2m_{oe}c^2 \text{-} \frac{ke^2}{r} \tag{3}$$

The distance obtained by setting $E_{ep} = 0$ in (3) and solving for r is:

$$r = \frac{ke^2}{2m_ec^2}$$

The author defines r for this distance as R_k, and it is one-half times the commonly known electron radius, ($r_e \equiv ke^2 / m_{oe}c^2$):

$$R_k \equiv \frac{ke^2}{2m_{oe}c^2} \tag{4}$$

$R_k = 1.4089697\text{x}10^{-15}$ m after all the values are substituted in (4). Also, the author defines E_k to be C for *unlike* charge relationships:

$$E_k \equiv 2m_{oe}c^2 \tag{5}$$

$E_k = 1.6374529\text{x}10^{-13}$ J after values are substituted into (5). Substituting (4) and (5) into Coulomb's Law for two charges of magnitude e:

$$f_{12} = \frac{\pm E_k R_k}{\mathrm{r}^2} \tag{6}$$

and into (3):

$$E_{ep} = E_k\left(1\text{-}\frac{R_k}{r}\right) \tag{7}$$

Our first observation of (7) is that the energy E_{ep} is positive for all $r \geq R_e$. Also, E_{ee} is positive for all r. The author defines the energy, E_{ep}, in (7) to be zero for $r < R_e$ (negative energy does not exist, except mathematically). Eq. (7) describes the stored potential energy in the electron-positron system. Dividing (7) by $2c^2$, the potential rest mass, $\mathrm{m_o}$ of one of the particles in the electron-positron system becomes:

$$m_o = m_{oe}\left(1 - \frac{R_k}{r}\right) \tag{8}$$

Eq. (8) shows that potential mass could vary as a function of r. Table 1 collects the formulae thus far. These formulae are presented first so that new constants, E_k *and* R_k, could be used in the development below for support of the potential mass variation concept and the derived force formulas.

Relationship	**Force f_{12}**	**E_{12}**	**Rest Mass Change**
like	$\frac{-E_k R_k}{r^2}$	$E_k \frac{R_k}{r}$	$m_{oe} \frac{R_k}{r}$ *
unlike ($r \geq R_e$)	$\frac{E_k R_k}{r^2}$	$E_k - E_k \frac{R_k}{r}$	$-m_{oe} \frac{R_k}{r}$ †

Table 1. Static force, energy, and rest mass formulae for relationship of two charged particles of charge e.

If the charged particle has a mass greater than m_{oe}, like a proton, then its mass is decreased according to the mass formulae in Table 1. For example, in a proton-electron relationship, the rest mass of the proton is decreased as follows:

$$m_{op} - \frac{m_{oe} R_k}{r} \tag{9}$$

These results are supported by Bohr Atom analysis in this same paper[1].

In another paper[2], the author derived formulae relating to the new Coulomb Law (6). Employing Eq. (6) and the formula for E_k for unlike charges:

$$f_{12} = \frac{E_k R_k}{r^2} = \frac{2 m_{oe} c^2 R_k}{r^2} \tag{10}$$

Rearranging (10) and inserting α, the fine structure constant:

$$f_{12} = \left(\frac{2 R_k m_e c}{\alpha}\right)(\alpha c)\left(\frac{1}{r^2}\right) = \frac{\hbar c \alpha}{r^2} \tag{11}$$

If numerical values are substituted into the constants enclosed in the first parenthesis of (11), we find it is exactly equal to Plank's constant $\hbar = h/2\pi$

$$\frac{2 R_k m_{oe} c}{\alpha} = r_{ce} m_{oe} c = r_{cp} m_{oe} c = \hbar \tag{12}$$

We note from (12) that the Compton radius, r_{ce}, of the electron is related to R_k as:

$$r_{ce} = \frac{2 R_k}{\alpha} \tag{13}$$

Substituting (12) into the right side of (11) we have:

$$f_{12} = \frac{k e_p e_e}{r^2} = \frac{\hbar c \alpha}{r^2} = \frac{r_{ce} m_{oe} c^2 \alpha}{r^2} = \frac{r_{cp} m_{op} c^2 \alpha}{r^2} = \frac{2 R_k m_{oe} c^2}{r^2} \tag{14}$$

We note that the far right side of (14) depicts Coulomb's Law as a product of a length x energy. This strongly suggests that charge is created by an **Energy Moment** of the spinning electron or spinning proton. Eq. (12) shows units of angular momentum and thus spin of the charged particle. Solving for the fundamental charge value e:

$$e = \sqrt{\frac{2 R_k m_{oe} c^2}{k}} = 1.60210 x 10^{-19} \text{ C} \tag{15}$$

We note from (15) that the basic charge e is defined in the more fundamental units of length times energy. Also, we note that since e can be represented by the proton and its Compton radius, that e is the largest of all elementary charges and is constant for all of them. The basic Coulomb's Law where q represents a charge greater than e can be represented as:

$$f_{12} = \frac{k q_1 q_2}{r^2} = \frac{n_1 n_2 R_k E_k}{r^2} \tag{16}$$

where n_1 and n_2 are the number of elementary charges in q_1 and q_2 respectively.

3. The Centrifugal Force of the Electron in the Bohr Atom

The centrifugal force f_{cf} of a rotating mass m moving at velocity v at radius r_o is customarily expressed as follows:

$$f_{cf} = \frac{m v^2}{r_o} \tag{17}$$

This force may also be expressed in terms similar to the Coulomb force:

$$f_{cf} = \frac{m v^2}{r_o} = \frac{m v^2}{r_o^2} \times r_o \tag{18}$$

We note the force equation in (18) is similar to the Coulomb force equation in (14) in that the force is proportional to the product of a length times energy, the energy in (18) being kinetic energy.

4. Discussion of Eq (14) and Eq. (18)

The far right side of Eq. (14) depicts the Coulomb force as being an energy-moment force, i.e. as having length x energy as the generator of force. Also, the far right side of Eq. (18) depicts the energy-moment as the generator of the centrifugal force. So what can we say about these two forces and the similarity of the two equations?

Coulomb force: The far right side of Eq. (14) was derived, Eq. (1) thru Eq. (6), independent of the right rotational side of the Bohr Atom balance equation. Therefore, we can conclude from this analysis that the electrostatic force of a charge is strongly related to the spin or rotation of the electron or the proton. Also, the middle equations of (14), representing the Coulomb force, were derived from the rotational right side of the Bohr Atom balance equation. Because the mass of the proton is 1836 times the mass of the electron and the masses appear in both of these equations, one can logically conclude that the de-Broglie relation limits the maximum charge of a rotating particle to e. This strongly places the existence of super charged particles and super forces into question.

Centrifugal force: We can recognize that the energy of rotating masses combined with a length factor is the cause of centrifugal force. The centrifugal force acts differently than the Coulomb force in that it creates internal tension on a rotating body while the Coulomb force creates tension between two rotating bodies, yet both forces possess the characteristic of energy mo-

* Increase in quantity from the mass it starts with at large r.

† Decrease in quantity from the mass it starts with at large r.

ment. Also, the energy-moment of Eq. (18) implies the centrifugal force is local and not dependent on the far away planets and stars.

Eq. (14) and Eq. (18) suggest a force may exist between two rotating mechanical discs. This would be analogous to a spinning proton and a spinning electron creating an attractive force between them selves. A rotating mechanical disc possesses the characteristics of energy-moment. If two rotating mechanical discs were placed side by side, then the question is whether there would be a generated force between the rotating discs that is in addition to the gravitational attraction of their masses. An experiment could possibly answer this question.

5. Conclusion

1. This analysis relates spin of the electron or the proton to the cause of electrostatic charge.
2. The energy-moment of a rotating body is central to creating force.
3. The de-Broglie equation sets an upper maximum limit, e, a single charged particle can possess.
4. The analysis involving Eq. (1) thru Eq. (9) shows that the energy of the rest mass of the electron is the energy of the electric field of the electron.
5. The derived equations provide alternate ways of viewing Coulombs Law.

References

[1] James Keele, "Unifying Mass Changes of Charged Particles and Potential Energy Changes", Galilean Electrodynamics 15, No. 4, p.62 (July/August 2004).

[2] James Keele, "Unified 'No Field' Theory and the Bohr Atom", Journal of New Energy, Vol. 7, No. 3, Fall 2003 p. 45-50, (Proceedings of National Philosophy Alliance International Conference, June 9-13, 2003).