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Exponential Modeling of the Induced Field Intensity of a charged ion Relative to its Nuclear Region

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Abstract: *Charged sub atomic particles create an electric field that extends outward into the space that surrounds it. The charge alters that space, causing any other charged object that enters this space to be affected by this field. The strength of the electric field is dependent upon how charged the object creating the field is and upon the distance of separation from the charged object. Hence, an atomic physics program was adopted to investigate and model the effect of the field intensity with the force($y = 16.02x – 0.2098$; $R^2=1$), the field intensity with the charge distance($y= 14021x^{-2.134}$, $R^2 = 0.8249$) and the force with the charge distance ($y= 875.17x^{-2.134}$, $R^2= 0.8245$).*

Keywords: Electric field, electron, electric field strength, charge distance and electronic force.

1.0 INTRODUCTION

Electron is an elementary negatively charged particle with an atom. Electrons relate with the lepton subatomic generation that is typically regarded as elementary particles that exist without extra subcomponent [1]. It retains a mass that is approximately 1/1836 of the positively charged proton. The electron's quantity of mechanical properties contains an intrinsic momentum (spin) of a half-integer value expressed in Planck's constant units [1]. Being fermions, no two electrons can occupy the same quantum state, according to the Pauli exclusion principle [2]. Like all elementary particles, electrons exhibit properties of both particles and waves as they collide with other particles and diffracted like light. In experiments, the wave properties of electrons are simpler to detect than those of other particles like neutrons and protons, since electrons have a lower mass and thus a lower mass and longer de Broglie wavelength for given energy [3].It plays an essential role in numerous physical phenomena, such as electricity [1], magnetism [2], gravitational [3], chemistry [4],welding [5], thermal conductivity[6], cathode ray tubes [7], radiation therapy [8], lasers [9], gaseous ionization detectors[10] ,particle accelerators[11] and electron microscopes [12]. Interactions involving electrons with other subatomic particles are of interest in fields such as chemistry and nuclear physics [13]. The interaction of the Coulomb force between the positive protons within the atomic nuclei, and thus the negative electrons without, allows the composition and stabilities of the atoms. Ionization or differences in the proportions of negative electrons versus positive nuclei changes enhance the binding energy of an atomic system. [14] Electromagnetic fields generated from several sources will influence the trajectory of an electron in line with the Lorentz force law as electrons absorb or emit energy within the sort of photons once they are accelerated [15]. Currently, experimental devices are able of capturing individual electrons as electron plasma by the use of electromagnetic fields and can detect electron plasma in space with special telescopes. The key reason for chemical bonding and reactions is the exchange or sharing of electrons between two or more atoms. [16] The idea was first hypothesized in 1838 by the British natural philosopher Richard Laming of an indivisible sum of electrical energy to elucidate the chemical properties of atoms [17]. The Irish physicist George Johnstone Stoney has called this energy from the atomic entity 'electron" in 1891 and J. J. Thomson and his team of British physicists identified it as a particle in 1897 [18]. Electrons can also participate in nuclear reactions, such as nucleosynthesis in stars, where they are known as beta particles [19]. Through beta decay of radioactive isotopes and in high-energy collisions, electrons can be formed, as when cosmic rays touch the atmosphere [20]. The antiparticle of the electron termed the positron is like the electron except that it carries an electrical and opposite charges. Particles are annihilated when an electron collides with a positron, creating gamma-ray photons [21]. The electron charge was calculated more carefully by the American physicist Robert Millikan and Harvey Fletcher in their oil-drop experiment of 1909, the results of which were published in 1911[22],[23],[24]. This experiment used an electrical field to stop a charged droplet of oil from falling as a result of gravity. This device could measure the electrical charge from as few as 1–150 ions with a precision margin of 0.7%. Thomson's team had previously performed comparable experiments using clouds of charged water droplets produced by electrolysis, and Abram Ioffe, who obtained an equivalent independently, in 1911 [5]. However, oil drops were more stable than water drops because of their slower evaporation rate, and thus more suited to precise experimentation over longer periods [25].With the introduction of the electric field concept, it was stated that the concept arose in an attempt to elucidate the effects of distance on the forces. All charged objects induced an electric field that extends outward into the space that surrounds it [26]. The charge alters that space, causing the other charged object that enters the space to be altered by this field. The strength of the electrical field depends upon how the charged entity is able to acquire a level of energy relative to the distance from the charged object. Electric field strength is a vector quantity with both magnitude and direction [27]. The magnitude of the electric field strength is defined in terms of how it is measured [28]. The test charge within the electrical field experience an attractive or repulsive electrical force as the magnitude of the electrical field is defined by the force per charge on the test charge. If the electrical field intensity is denoted by the symbol E, then the equation is often rewritten in symbolic form as Where F is the force (Newton) exerted on the charged particle (electron) q in coulomb and distance d in meter.

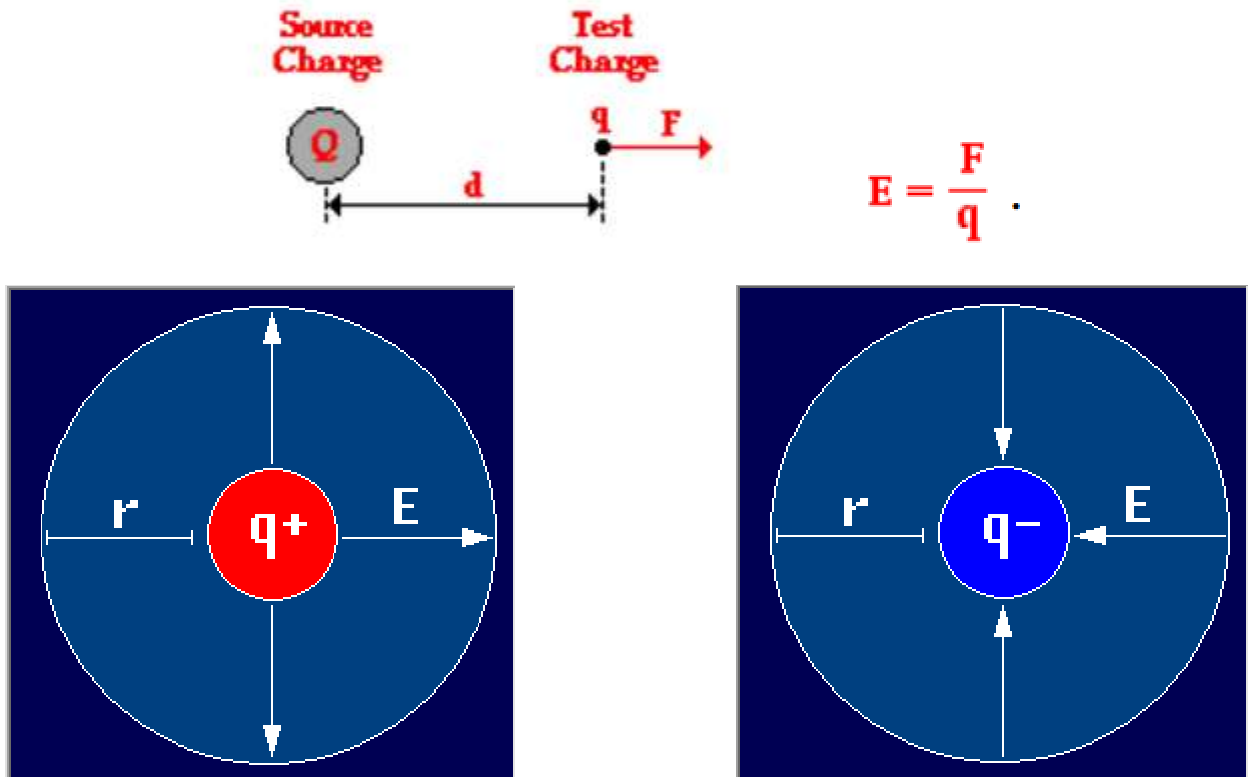

Figure1.The interface of physics version 1.3 simulation program

2.0 METHODOLOGY

Physics simulation version 1.3 program was employed with the charged ion (q^-/q^+) at 1.60 × 10^{-6} coulombs at a charged distance range (r) of 1 to 10 (× 10^{-13}) meters as inputs.

3.0 RESULTS AND DISCUSSION

Table 1.Modeled field intensity and force of an average charged ion.

Charge(q) (× 10^{-16})(coulombs)	Charge distance(r) (× 10^{-13}) (m)	Field Intensity (×10^{-9})(V/m)	Force(×10^{-22}) N
1.60	1	14418.00	900.00
	2	3604.50	225.00

	3	1602.00	100.00
	4	901.13	56.30
	5	576.72	36.00
	6	40.05	2.50
	7	294.25	18.40
	8	225.28	14.10
	9	178.00	11.10
	10	144.18	9.00

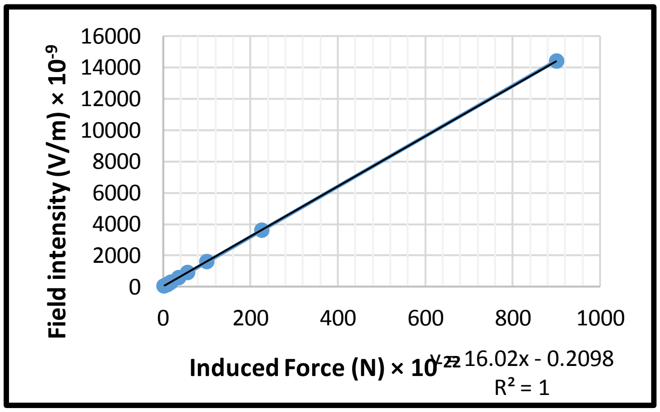

Figure 2. Induced Field intensity against the force of charged ion distance

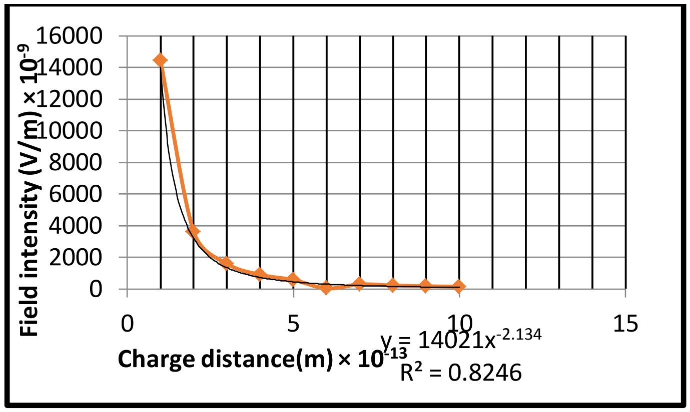

Figure 3. Induced Field intensity against the charged ion

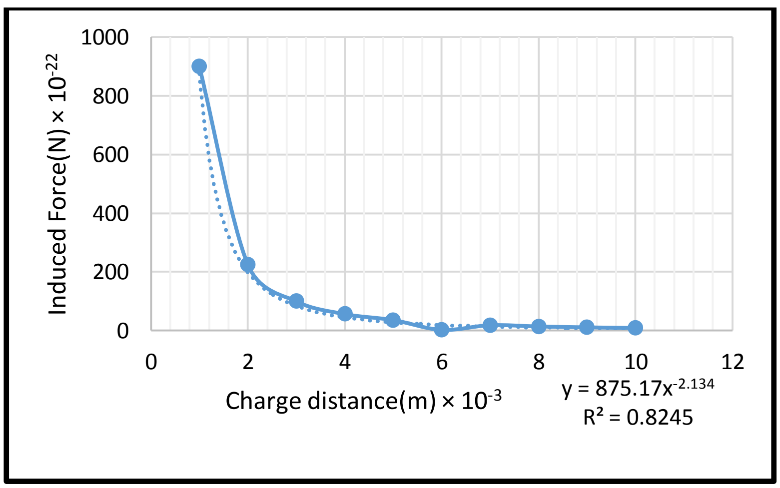

Figure 4. Induced force against the charge ion distance

The induced field intensities were interacted with the generated force in newton with a linear model of y = 16.02x – 0.2098 at correlation (R^2) of 1 (Figure 2); and against the charge distance (r) with y= $14021x^{-2.134}$ at R^2 of 0.8249 (Figure 3). Similarly, the induced force against the charge distance exhibited y= $875.17x^{-2.134}$ at 0.8245 regression coefficient.

4.0 CONCLUSION

In principle, two charged ions are fundamental. As the source and the test charges, they are fundamental in the induction of force around the test charge with respect to its distance. It takes two in the world of electronics to attract or to repel. Therefore, the electric field induced strength theory presented the two quantities of charge described in it. Since there are two charges involved, it will be interpreted to basically apply two opposite charges at the same or different magnitudes when calculating the electric field power. The symbol q in the equation is the sum of charge on the test charge while the field strength is illustrated in terms of measurement with the test charge. The generated electric field intensity is not the function of the magnitude of the charge on the test charge but the charge distance in between.

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