Supreme Theory of Everything: The Open Hysteresis in Place of Inverse-Square Law

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ABSTRACT

The inverse-square law (ISL) is used widely in physics, astronomy, celestial mechanics, cosmology, and other branches of sciences from the very beginning of classic physics up to date. But the development of modern physics and cosmology reveals that ISL becomes a big source of two problems. First, crucial cosmic-scale problems concerning gravity such as the accelerating expansion of the universe, the anomaly in galaxy rotation speed, the missing baryon problem, and dark matter remain unsolved. Second, Coulomb's electrostatic law, DLVO theory, Lennard-Jones 12-6 potential, and Yukawa potential were described imperfectly the nature at the scale of atoms and subatomic particles. The reasons connect to the ISL and the inverse-proportional law (IPL) consequence of which these laws will be deducted slowly from scientific and practical applications. In this paper, a possibility using the open hysteresis instead of ISL and IPL is proposed. The open hysteresis law can work from particle physics to cosmology.

Keywords: inverse-square law, inverse- proportional law, coulomb's law, dlvo theory, l-j 12-6 potential, yukawa potential, hysteresis-law in place of the inverse-square law.

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I. INTRODUCTION

In science, an inverse-square law is any scientific law stating that a specified physical quantity is inversely proportional to the square of the distance from the source of that physical quantity. The fundamental cause for this can be understood as geometric dilution corresponding to point-source radiation into three-dimensional space. It indicates the intensity of the radiation (I) decreases in proportion to the square of the change in distance (d) and is writing as follows [1]:

$$LIGHT\ INTENSITY\ (I) = \frac{1}{(DISTANCE\ (d))^2} \qquad (1)$$

Since it describes the intensity of light at different distances from a light source:

$$\frac{I_1}{I_2} = \frac{(d_2)^2}{(d_1)^2} \qquad (2)$$

Where I_1 is the initial intensity of radiation, I_2 is the final intensity, d_1 is the initial distance, d_2 is the final distance.

The base of the ISL is the inverse-proportional law (IPL). People used widely to measure speed, calculate time, keep calendars, and plan work in ancient times.

The majority of physical laws have been described based on ISL and IPL. Since IPL may be the most common law in the universe.

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Here I would like fearlessly to show the applications of ISL and IPL based on the famous physical laws of genius scientists. These laws are so popular that the question is rarely asked whether they are fit for purposes.

1. Isaac Newton (1687)

$$F = G \cdot \frac{m_1 \cdot m_2}{r^2} \qquad \leftarrow \frac{1}{r^2}$$

2. Charles-Augustin de Coulomb (1785)

$$F = k \cdot \frac{q_1 \cdot q_2}{r^2} \qquad \leftarrow \frac{1}{r^2}$$

3. Georg Simon Ohm (1827)

$$I = \frac{U}{R} \qquad \leftarrow \frac{1}{R}$$

4. Wilhelm Carl Werner Otto Fritz Franz Wien (1896)

$$\lambda_{max} = \frac{b}{T} \qquad \leftarrow \frac{1}{T} \text{ and } \frac{1}{\lambda}$$

5. Max Carl Ernst Ludwig Planck (1900)

$$B_v(v, T) = \frac{2hc^2}{\lambda^5} \cdot \frac{1}{e^{\frac{hc}{\lambda k_B T}}} \qquad \leftarrow \frac{1}{\lambda} \text{ and } \frac{1}{T}$$

6. Pierre Curie and Marie Curie (1903)

$$M = \chi \cdot H = \frac{c}{T} \cdot H \qquad \leftarrow \frac{1}{T}$$

7. Albert Einstein (1915)

$$ds^2 = -\left(1 - \frac{r_s}{r}\right)\Delta t^2 - \frac{1}{\left(1 - \frac{r_s}{r}\right)}dr^2 \leftarrow r_s = r$$

   a. Relativistic momentum:

$$p = \frac{mV}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \qquad \leftarrow v \approx c$$

   b. Time dilation:

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \qquad \leftarrow v \approx c$$

8. Louis Victor Pierre Raymond de Broglie (1929)

$$\lambda = \frac{h}{mV} \qquad \leftarrow \frac{1}{m} \text{ and } \frac{1}{V}$$

9. Edwin Powell Hubble (1929):

$$\text{Hubble constant } \rightarrow \text{ Hubble flow } \rightarrow \text{ Hubble} - \text{Lema}\hat{i}tre\ law$$

10. Werner Karl Heisenberg (1932)

$$\Delta x \geq \frac{h}{2 \cdot \Delta y} \qquad \leftarrow \Delta y \approx 0; \qquad \Delta y \geq \frac{h}{2 \cdot \Delta x} \qquad \leftarrow \Delta x$$
$$\approx 0$$

11. Erwin Rudolf Josef Alexander Schrödinger (1933)

$$i\hbar \cdot \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m} \cdot \frac{d^2 \psi}{dx^2} + U\psi \qquad \leftarrow \frac{1}{m}$$

12. Hideki Yukawa (1949)

$$V_{Yukawa}(r) = -g^2 \frac{e^{-\alpha mr}}{r} \qquad \leftarrow \frac{1}{r}$$

13. Speed and speed limit

$$V = \frac{S}{t} \left[\frac{m}{sec}\right] \qquad \leftarrow \frac{1}{t}$$

The limit of speed is the limit of time. Since $t \approx 0.000000003$ sec $= 3.33 \cdot 10^{-9}$ sec.

14. Pressure

$$P = \frac{F}{S} \qquad \leftarrow \frac{1}{S}$$

15. Propagation of sound

$$p \approx \frac{1}{r} \qquad \leftarrow \frac{1}{r}$$

$$v \approx \frac{1}{r} \qquad \leftarrow \frac{1}{r}$$

$$I = p \cdot r = \frac{1}{r^2} \qquad \leftarrow \frac{1}{r^2}$$

So forth. We can list a long series.

Do you think the above laws of nature are perfect? If so, we don't have to think or do anything. If not, what are their shortcomings and reasons? Can we solve them?

In my opinion, it is possible if we do it in the exact opposite direction, that is, from infinity to infinitesimal smallness.

II.   THE ISL AND IPL

Newton's law of universal gravitation is usually stated as that every particle attracts every other particle in the universe with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers [2].

This is a general physical law derived from empirical observations by what Isaac Newton called inductive reasoning [3].

What are the backgrounds of gravity or electromagnetic interaction that take two quantities (two masses or two charges) on the unit surface (over the square)?

The law of gravity is equal to the product of the masses divided by the square of the distance.

It looks like the weight of a body. Does it mean gravity or attraction?

Like it, the electric charges also lie over a square according to Coulomb's law.

The origin and the mathematical description of the inverse-square law are unclear. Its author maybe Isaac Newton or Robert Hooke.

It is a part of classical mechanics and was formulated in Newton's work Philosophiæ Naturalis Principia Mathematica ("the Principia"), first published on 5 July 1687. When Newton presented Book 1 of the unpublished text in April 1686 to the Royal Society, Robert Hooke claimed that Newton had obtained the inverse square law from him [3].

Above mentioned theories and formulas include the singularities by expression 1/x. This expression lurks in the shadow of ISL because we only give attention to ISL but apply mainly to the IPL.

$$y(x) = \frac{1}{x} \qquad \text{and} \qquad y1(x) = \frac{1}{x^2} \tag{3}$$
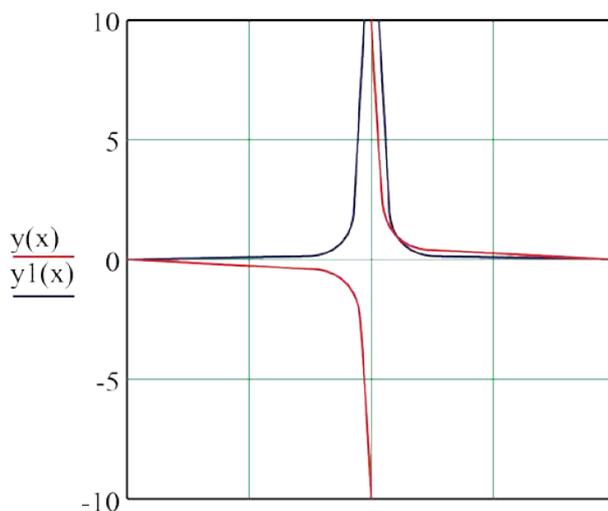

$$\frac{y(x)}{y1(x)}$$

Figure 1: Graphs of ISL and IPL

Figure 1 illustrates the graphs of the continuity to plus and minus infinity. The ISL is written by a mathematical equation, which is infinite (Equation (4) and Equation (5)) for short-range:

$$F_{gravity} = Gm_1 m_2 \cdot \lim_{r \to 0} \frac{1}{r^2} = \infty \tag{4}$$

$$F_{coulomb} = k_e q_1 q_2 \cdot \lim_{r \to 0} \frac{1}{r^2} = \infty \tag{5}$$

The results of the physical (or biological, chemical, economic, and so on) processes calculated by ISL and IPL have not any saturates. It means that the magnitudes of forces, the strength, the intensity, and so on have infinite. Since, all forces as gravity, mechanical, electromagnetic, seismic, acoustic, and thermal become infinite. Consequently, everything cannot exist in the universe. Indeed, these laws

include always somewhat imperfections and finally remained unsolved. The ISL and IPL cause trouble in science because they have a common error, which is infinite. Consequently, plus and minus values of physical parameters lose the meaning of nature.

What if a violation of the 1/r2 law were observed? [4] This problem is mathematical, not physical. What we do if mathematics works wrong? If the ISL is wrong, so many laws become wrong too.

The development of modern physics and cosmology reveals that ISL becomes a big source of two problems.

A)   On cosmic scales it becomes a source to the serious problems in cosmology and modern physics:

 1. Anomalous rotation of galaxies. If the force of gravity is a lot messier than Newton and Einstein thought, then it could account for the speedy rotation of spiral galaxies without requiring dark matter. For gravity to speed up stars on a galaxy's edge, it must deviate from the "inverse-square law" — the rule that gravity decreases by the square of the distance away from something — at galactic distances [5].

Galactic rotation curves of about 1000 Galaxies [6] have provided by far the strongest evidence for the disagreement of 'dynamical' and visible mass. Assuming that all mass of a spiral galaxy is contained within its optical radius, one expects due to

$$v^2 = \frac{GM}{r} \tag{6}$$

a radial dependency $v \sim r^{-\frac{1}{2}}$ in the velocity profile of clouds that can be measured by Doppler shifts. Interestingly, up to multiples of the optical radius, practically all galaxies show rather constant ('flat') velocities than the expected Keplerian behavior. Usually, an explanation with 'dark matter' is given, though this requires a particular distribution. While the deviation is already visible within the optical radius, in the outer regions the ratios of dark and luminous matter up to 1000 are required [7]. The form of the galactic rotation curves seems to depend just on the size of the galaxy [7], [8] a fact that is hard to explain by the properties of any dark matter candidate. Many precision profiles are conflict with the standard model [9], among these the most extended velocity profile of NGC 3741 [10]. While many questions are still open [11], [12], the anomaly itself is beyond any experimental doubt (see overviews [13], [14]). There are clear hints that the morphology of galaxies is dominated by systematics we do not understand yet [15], [16].

1. *Weak gravitation.* One of the big puzzles about gravity is the fact that it is so much weaker than the other forces: it is a factor of about 10^{40} times weaker than the electrostatic and magnetic forces [17]
2. *Limit in Earth's magnetotail.* At the night side of the earth, the magnetic field is stretched far downstream to form the magnetic tail. The diameter of the tail is between 40 and 60 earth radii; its length exceeds 1000 earth radii [18].
It means that the charged particles of the earth magnetic field don't go to infinity, but more than 1000 earth radii and then come back to the earth pole. The magnetic field extensions of the stars and galaxies exceed more and more far distance, but not to infinity. The nature of everything is cyclical. In other words, everything goes and comes back to the initial point.
3. *The accelerating expansion of the universe* is the observation that the expansion of the universe is such that the velocity at which a distant galaxy is receding from the observer is continuously increasing with time [19], [20], [21]. So, the expansion of the universe has not been slowing due to gravity, as everyone thought, it has been accelerating. No one expected this, no one knew how to explain it. But something was causing it. Eventually, theorists came up with three sorts of

Supreme Theory of Everything: The Open Hysteresis in Place of Inverse-Square Law

explanations. Maybe it was a result of a long-discarded version of Einstein's theory of gravity, one that contained what was called a "cosmological constant." Maybe there was some strange kind of energy-fluid that filled space. Maybe there is something wrong with Einstein's theory of gravity and a new theory could include some kind of field that creates this cosmic acceleration. Theorists still don't know what the correct explanation is, but they have given the solution a name. It is called dark energy [22].

B) At short interparticle distances the ISL and IPL cannot work perfectly:

1. *Coulomb's inverse-square law* is an experimental law [23] of physics that quantifies the amount of force between two stationaries, electrically charged particles. The electric force between charged bodies at rest is conventionally called electrostatic force or Coulomb force.[24] Coulomb's law was essential to the development of the theory of electromagnetism, maybe even its starting point,[23] as it made it possible to discuss the quantity of electric charge in a meaningful way.[25] The law states that the magnitude of the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them,[26]

$$|F| = k_e \cdot \frac{|q_1 q_2|}{r^2} \tag{7}$$

Here, k_e is Coulomb's constant ($k_e \approx 8.988 \times 10^9$ N·m^2·C^{-2}), [23] q_1 and q_2 are the signed magnitudes of the charges, and the scalar r is the distance between the charges.

2. *Van der Waals Interactions*

In molecular physics, the Van der Waals force is a distance-dependent interaction between atoms or molecules. Unlike ionic or covalent bonds, these attractions do not result from a chemical electronic bond; they are comparatively weak and therefore more susceptible to disturbance. The Van der Waals force quickly vanishes at longer distances between interacting molecules.

Van der Waals force plays a fundamental role in fields as diverse as supramolecular chemistry, structural biology, polymer science, nanotechnology, surface science, and condensed matter physics. It also underlies many properties of organic compounds and molecular solids, including their solubility in polar and non-polar media.

If no other force is present, the distance between atoms at which the force becomes repulsive rather than attractive as the atoms approach one another is called the Van der Waals contact distance; this phenomenon results from the mutual repulsion between the atoms' electron clouds.[27] The Van der Waals force has the same origin as the Casimir effect, which arises from quantum interactions with the zero-point field.[28]

The Van der Waals forces [29] are usually described as a combination of the London dispersion forces between "instantaneous~~ly~~ induced dipoles" [30], Debye forces between permanent dipoles and induced dipoles, and the Keesom force between permanent molecular dipoles whose rotational orientations are dynamically averaged over time.

3. *The Lennard-Jones (L-J) 12-6 potential (Nanoparticle Attraction Force)*

The common way to describe intermolecular forces is to use the so-called Lennard-Jones potential which is an expression for the interaction energy of the pair potential (r) of two molecules at a distance r:

$$W(D) = \frac{B}{r^{12}} + \frac{C}{r^6} \tag{8}$$

with the constants C and B for the attractive Van der Waals and repulsive Born repulsion, respectively. At first, the second term (Born repulsion) will be neglected [31], [32]. This law is in many respects DLVO-like interaction energy

The Lennard-Jones potential models soft repulsive and attractive interactions. Hence, the Lennard-Jones potential describes electronically neutral atoms or molecules. The potential equation accounts for the difference between attractive forces (dipole-dipole, dipole-induced dipole, and London interactions) and repulsive forces [32]. The L-J potential is arguably the most widely used pair potential in molecular simulations. It is so popular that the question is rarely asked whether it is fit for purpose. In this paper, we argue that whilst the LJ potential was designed for noble gases such as argon, it is often used for systems where it is not expected to be particularly realistic. Under those circumstances, the disadvantages of the LJ potential become relevant: most important among these is that in simulations the LJ potential is always modified such that it has a finite range. More seriously, there is by now a whole family of different potentials that are all called Lennard-Jones 12-6, and that are all different – and that may have very different macroscopic properties. [33]

$$\upsilon(r) = 4\epsilon \left[\left(\frac{\sigma}{r} \right)^{12} - \left(\frac{\sigma}{r} \right)^{6} \right]$$

Is this famous potential
ever used in simulations?

Figure 2: Lennard-Jones potential in simulations

4. *Yukawa potential.*

In particle, atomic, and condensed matter physics, a Yukawa potential (also called a screened Coulomb potential) is a potential of the form:

$$V_{Yukawa}(r) = -g^2 \frac{e^{-\alpha mr}}{r} \tag{9}$$

Where g is a magnitude scaling constant i.e. is the amplitude of potential, m is the mass of the particle, r is the radial distance to the particle, and α is another scaling constant so that $r \approx \frac{1}{\alpha m}$ is the approximate range. The potential is monotonically increasing in r and it is negative, implying the force is attractive. In the SI system, the unit of the Yukawa potential is (1/ meters) [34].
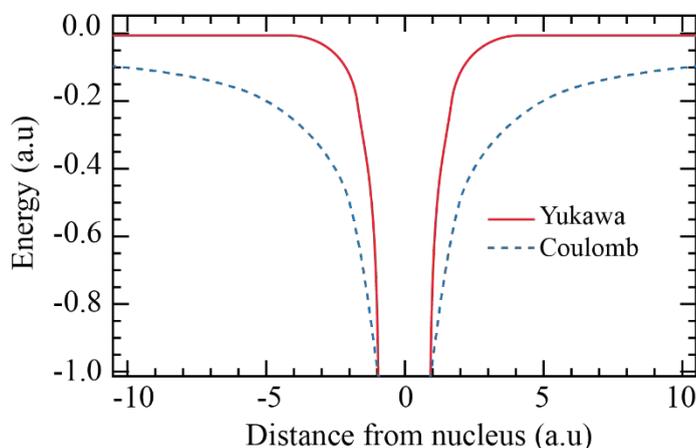

Figure 3: A short-range Yukawa potential in relation with Coulomb's potential [35]

From Figure 3 we see that the distance from the nucleus goes to 0, the energy also becomes infinite as Coulomb's potential (Equation (5)).

5. *The DLVO theory [36] explains that the interaction energy between the Coulomb repulsion and the Van der Waals attraction.*
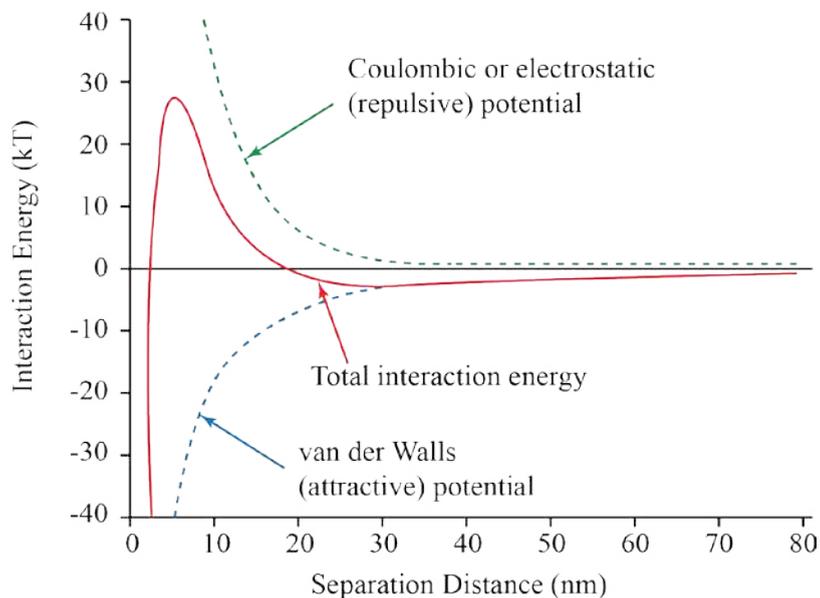

Figure 4: Schematic interaction energy versus distance profiles of DLVO

According to the DLVO theory, Coulomb's repulsion, Van der Waals attraction, and their interaction energy go to plus and minus infinities. Is it right?

6. *Modified Newtonian dynamics (MOND)* is a hypothesis that proposes a modification of Newton's laws to account for observed properties of galaxies [37]. For elliptical galaxies, galaxy groups, galaxy clusters, and larger-scale structures, the theory doesn't quite fit observations, and so it requires that extra matter — i.e., dark matter — be invoked once again. "So instead of just using an undiscovered particle to explain our observations of structures in the universe, MOND requires both an undiscovered particle and a modification to the gravitational-force law" [5].

The infinity of ISL seems also in the DLVO theory. The IPL also cannot explain the physical nature of being. Because the term "infinity" is only a mathematical trick.

Why do we Still Believe in Inverse-Square Law? [38]. Yes, it is right. This kind of a sign that we might be missing something kind of fundamental. So maybe one way to attack this problem is to go back to first principles. Nature is very simple and perfect with nothing to repair. Natural laws are only possible to comprehend. To err is human. "You've been making things unnecessarily complicated" by mathematics as said Hugh Everett (1957).

III.   OPEN HYSTERESIS INSTEAD OF INVERSE-SQUARE LAW

…The measurements suggest that the anomalous phenomena have a common origin [38]. What is a common origin? It was the ISL, particularly the IPL to date. Instead of them, open hysteresis would be more suitable.

"We review recent experimental tests of the gravitational inverse-square law and the wide variety of theoretical considerations that suggest the law may break down in experimentally accessible regions." [4]

We compare the modulations of the open hysteresis and ISL. The comparison indicates the open hysteresis can be used in place of ISL (Figure 5).
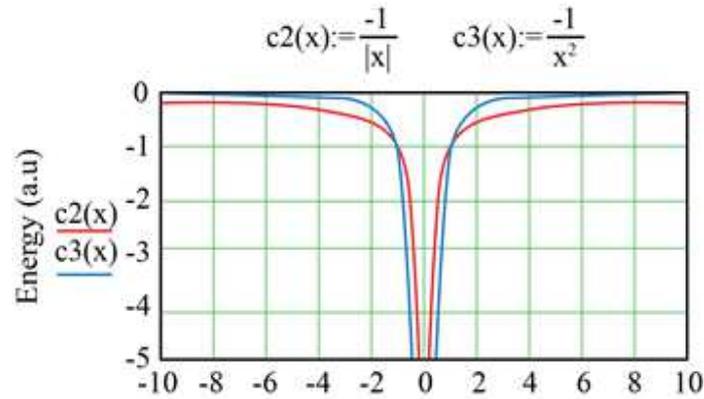

$$c2(x) := \frac{-1}{|x|} \qquad c3(x) := \frac{-1}{x^2}$$

Figure 5: Distance from the nucleus (a.u.)

The c3(x) is the base of the Coulomb interaction (blue) and c2(x) is the base of the open hysteresis (red). The base of the open hysteresis indicates the only accuracy, but the result of which goes to infinite.
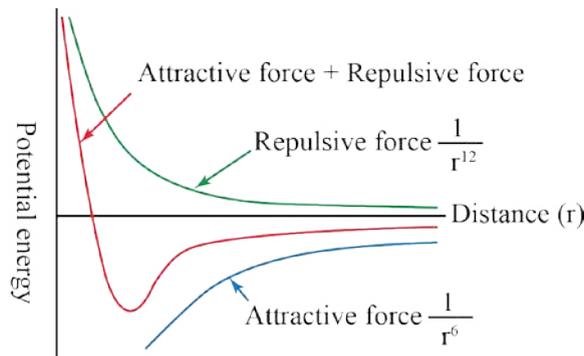

Figure 6: The potential energy between the Coulomb repulsion and Van der Waals attraction by the inverse-square law [39]

Figure 6 is calculated by the Lennard-Jones potential, the potential energy of which flies exponentially to infinity. It must be limited by interaction energy. For this reason, I show the change of the picture of the interaction of the electric charges in Figure 7b.
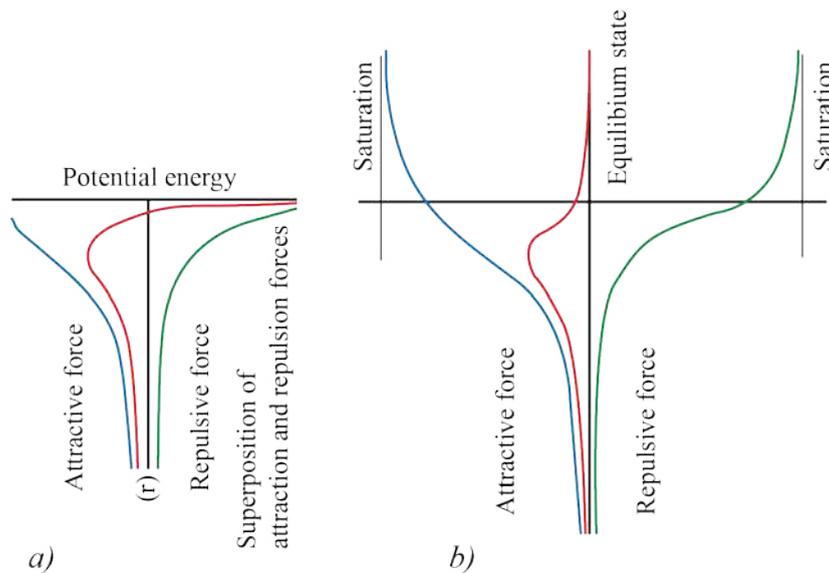
Figure 7: Interaction of the electrical charges

a) Superposition of potential energy (yellow curve), b) Open hysteresis

(Note: Distance and relative sizes are shown not to scale)

Opposite charges attract and like charges repel because doing so lowers their potential energy (energy of interaction). Energy is a force exerted through a distance ($E = Fr$). Consequently, the potential energy of two charged particles separated by a distance r. ΔE, which is referred to as the energy of interaction, is the potential energy of the two particles separated by a distance r relative to their potential energy when they are separated by an infinite distance (i.e., not interacting).

The energy change is negative (the energy decreases) as r decreases when q_1 and q_2 have opposite signs, therefore particles of opposite charge lower their energy as they get closer. Systems strive to lower their energy, so particles of opposite signs are attracted. However, the energy change is positive (the energy increases) when q_1 and q_2 have the same sign, which means that the energy of two particles of the same sign increases as they get closer. Consequently, particles of the same charge move apart to lower their energy; i.e., particles of like charge are repelled [40].

The total energy of a system is the sum of the attracting and repelling forces. The exchange interaction forces the spins of electrons to align either parallel (ferromagnetic exchange interaction) or antiparallel (antiferromagnetic exchange interaction). The origin of the exchange interaction is the spin-dependent Coulomb interaction. There are three contributions to exchange interaction between localized electrons: 1) spin-dependent electron-electron Coulomb repulsion at a short distance (antiferromagnetic); (2) spin-dependent electron-nuclear Coulomb attraction (ferromagnetic); 3) spin-dependent electron-electron Coulomb repulsion at a longer distance (ferromagnetic) [41].

The exchange interaction of quantum mechanics is the superposition of two forces (Figure 7a and Figure 7b). The interaction of two forces is described by the open hysteresis in Supreme Theory of Everything [42], [43] (Figure 7b). In other words, the equilibrium state originates from the superposition of both energy states.

In any case, the attractive and repulsive forces have saturation limits of potential energy and the system strives for their equilibrium state (Figure 7).
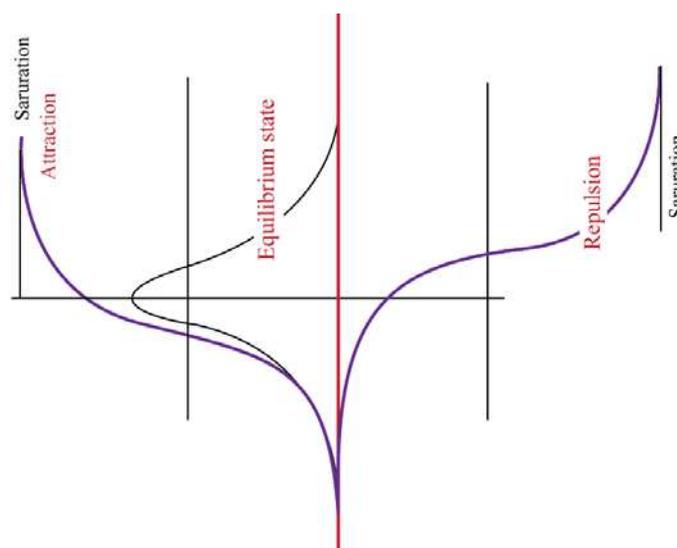
Figure 8: The open hysteresis [44] instead of "inverse-square law" shown in Figure 6.

As shown in Figure 8, everything has a limit of v saturation. For instance, the abovementioned Earth's magnetotail comes back into the north pole after traveling more than 8 million kilometers. Nothing blocks the continuous outflow of the magnetotail, but it comes back. So, its reason lies in the expression the answer is "infinity" of calculation results by ISL.

IV.   THE FIRST ATTEMPT TO DETERMINE ELECTROSTATIC INTERACTIONS BY OPEN HYSTERESIS

We need to understand that open hysteresis gives the general picture of anything that looks like the ISL and IPL. In other words, it is independent of physical, chemical, biological, and other factors. Since the open hysteresis is valid not only in electromagnetism but everything else. All the forces blend harmonically with everything.

To avoid the difficulties of ISL we need to use open hysteresis. The problem becomes more and more quantum mechanical. To do this I think presently to show interactions of electrical charges (Figure 9).

The K border is the equilibrium boundary of electromagnetic forces and separates two different mediums (Figure 9).
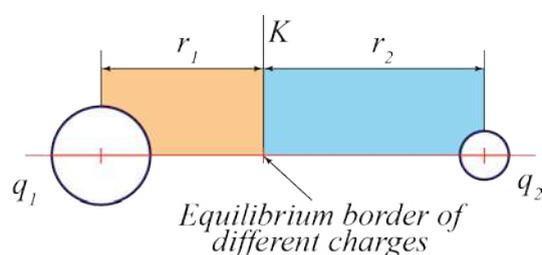

Figure 9: The two charges in equilibrium

The distance between electrons has possible to determine by the ratio:

$$q_1 r_1 = q_2 r_2 \tag{10}$$

$$\frac{r_1}{r_2} = \frac{q_2}{q_1} \tag{11}$$

In case that r_1 and r_2 are little, we can use $\sin r \approx r$

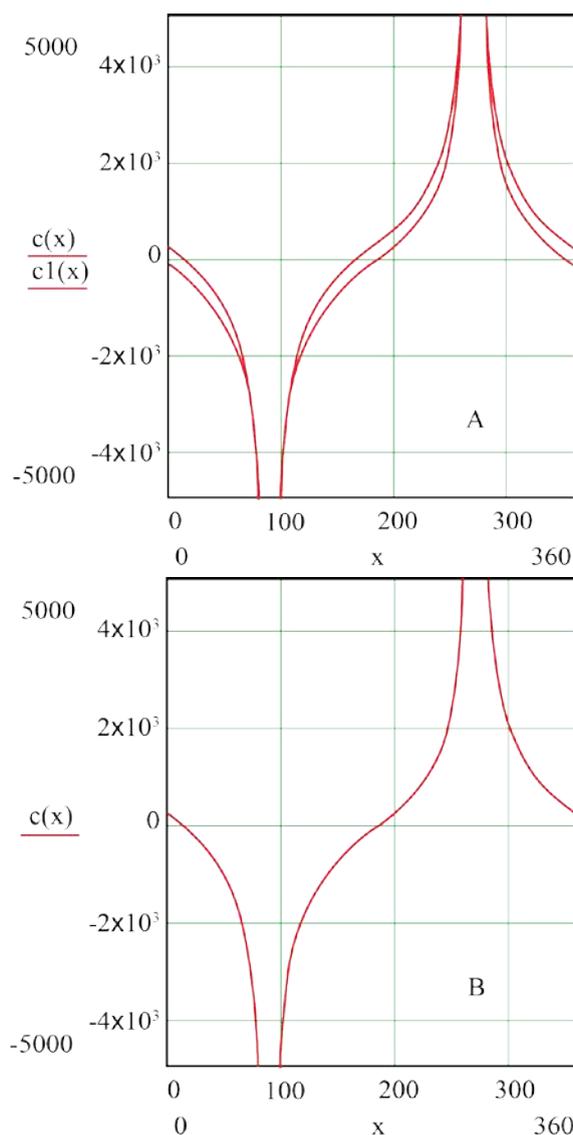$$\frac{\sin r_1}{\sin r_2} = \frac{q_2}{q_1} \tag{12}$$

It is Snell's law, which gives the hysteresis formula:

$$F_e = Q \cdot \frac{sin(r_1 - r_2)}{|cos(r_2)|} \tag{13}$$

Where r_1 is the influence radius of q_1 electric charge, r_2 is the radius of q_2.

$$Q = Q(q_1, q_2), \text{ which needs to determine by experiments}$$

The interaction force between the electric charges is displayed by Figure 10.

Figure 10: The hysteresis of the electric interaction of charges
(For simplicity $Y = 1000$ and $r_1 = 10$)
(Note: Distance and relative sizes are shown not to scale)

In Figure 10 A is the closed hysteresis and B is the open hysteresis. So, I would like to ask that excuse me because it is my first attempt to use open hysteresis in electromagnetism. I truly appreciate your critical review, comments, feedback, and questions.

The theory is valid only as long as it is not disproved by experiments. However, 'the great tragedy of science – the slaying of a beautiful hypothesis by an ugly fact.' - Thomas H. Huxley. And 'No theory should fit all data, because some data are surely wrong' [38].

If we use the open hysteresis in a general application, the vertical axis shows the force, intensity, magnitude, and the horizontal axis shows the repeated processes such as distance and period (Figure 10).

I imagine that if we use the open hysteresis instead of ISL, it may make big progress in science because the open hysteresis has a memory that causes the output value to depend on the history of the input [45], [46]. It also has periodicity, saturation and it also works in all scales.

V. CONCLUSION

1. The inverse square law can work neither on a cosmic scale nor on the subatomic scale. A lot of physical laws have been described based on the ISL,which has generated a large discrepancy between the results of theory and observation.
2. When the variable (r) of the inverse-square law and inverse-proportional formula goes to 0, the results become infinite. All the potential energy as van der Waals attraction potential, Coulombic repulsion potential, and their interaction have limits or saturations. Everything has a saturation. Nothing continues to infinity.
3. Instead of the ISL and IPL, the applications of open hysteresis are more suitable in practice due to open hysteresis having periodicity, saturation, and memory and it works in all scales.
4. The open hysteresis describes the general picture of the geometrical entity of everything that looks like the ISL and IPL. It is independent of physical, chemical, biological, and other factors. Since the open hysteresis is valid not only in electromagnetism but everything else.

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