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Elementary Physics of Magnetic Field

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Abstract

Generalization of Particular Models, as Planck showed, makes it possible to identify new Invariants and construct a General Model. But this method only works if it is carried out on the basis of strictly defined Elementary Models. And for the Magnetic Field, historically, its very loose Definition based on "Descartes' gimlets" is used. Incorrect mystical "Definitions" of the Magnetic Field, in principle a relativistic effect, led to fundamental errors in Electrodynamics and the Theory of Relativity. The conducted phenomenological analysis made it possible to restore the true value of the Lorentz Force as a gradient of cylindrical Equipotentials - all-round dynamic pressure on a streamline (analogous to the gradient of spherical Equipotentials of a static Coulomb). This made it possible not to use the "imaginary forces of interaction" of Descartes's gimlets, but to return to the strict Definition of the Magnetic Force as a derivative of the Ampere Force in Classical Physics, and also to eliminate in the Description the errors of the "gimlets" prolonged from the "mysticism" of the Magnetic Field, such as Micro- and in Giga-World.

Keywords: Oscillator; Real Solution; Complex Solution; Ampere Force; Magnetic Field

Introduction

Any axiomatic theory is built on a strictly specified orthogonal frame. This applies to both particular theories and Physics in general. On the basis of a verified orthogonal reference point, Elements are built from which a Unified Consistent Description of Nature can be composed. But, unfortunately, just in Physics, which has the ability to experimentally verify selected reference points, a lot of non-strictly defined reference points are used. This is how people discovered the Magnetic Field a long time ago. And it has been actively used for a long time, from the first magnetic compass needles, to electromagnets and electric motors. But just as it was discovered as something mystical, without a clearly expressed source of "charge," this mysticism was recorded in its modern theoretical description. Hence the ongoing attempts to search/detect a magnetic charge - magneton. Hence the mysticism of the most advanced theoretical calculations and conclusions, because the errors of the "scientific definitions" of the Magnetic Field are extended into Electrodynamics and the Theory of Relativity. From here, after the completion of work on Quantization [1], a brief work on a strict Definition of the Magnetic Field, the Idea of which arose after the discovery of a misinterpretation of the Exclusiveness of the speed of light [2], resulted in a whole cycle of works [3-6], in in which an analysis was made of various aspects of the Magnetic Field, which until now had no strict scientific explanation and were very contradictory. In fact, we still did not even have a strict Definition of the Magnetic Field, but only had a bad infinity in attempts to hide the Misunderstanding of Elementary Things behind a more sublime - "quantum" Misunderstanding.

Alogisms of the Used "Definitions" of The Magnetic Field

According to the wise statement of Albert Einstein: "Some equations of Classical Physics can be rewritten in operator form," it is the Correct Classical Representations and Models that are the Basis of any physical, including Quantum, Theories. And in modern Physics, Misunderstanding of Fundamentals is often hidden behind “Definitions”, which are, to put it mildly, not strict, and more correctly, they are not Definitions at all. Thus, the description of Magnetism given in the primers, simply embellished with formulas, was driven into Descartes’ Ideas about “gimlets”, without even carrying out the necessary analysis of either the Ampere Force or the Lorentz Force. Here are several examples of similar “Definitions” of the Magnetic Field, now used in Physics textbooks.

The Magnetic Field is “defined” in a Special way through the Magnetic Moment! “The Magnetic Field can be called a Special type of matter through which interaction occurs between moving bodies or bodies with a magnetic moment.” And it is complemented by “Determination” through Magnetic Induction!“The main quantitative characteristic of the Magnetic Field is the vector of Magnetic Induction B (vector of Magnetic Field Induction).” At the same time, Magnetic Induction itself is Over-Determined through the Magnetic Field! “Magnetic Induction is a vector physical Quantity that is Force! Characteristics of the Magnetic Field, namely the Characteristics of ITS Action on moving charged particles and on bodies possessing a Magnetic Field.”

Likewise, the Misunderstanding of Magnetism hides behind the Lorentz Force! Magnetic Induction is such a vector that the Lorentz Force acting from the Magnetic Field on a charge moving with speed is equal to

$$\overline{F}_L = q\cdot\overline{v}\times\mathbf{B} \Rightarrow Abs\left[\overline{F}_L\right] = q\cdot v\cdot\mathbf{B}\cdot\mathrm{Sin}\left[\alpha\right] \quad (1)$$

And it is added (for greater importance, but they hit the mark!): “Magnetic Induction IS the main Fundamental Characteristic of the Magnetic Field, similar to the vector of Electric Field Tension” (Figure. 1a).

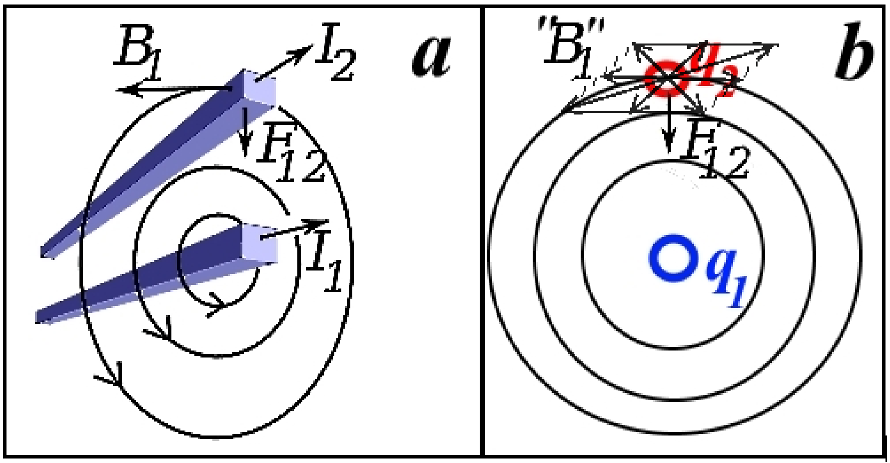

Figure 1: Comparison of the mystical definition, defined by Ampere, of the Magnetic Field Force through Magnetic Induction (a) with the definition of the Coulomb Force and the non-physicality of introducing a similar orthogonal “Induction” for it (b).

It is necessary to immediately note the senseless stretch in the comparison/comparison of Magnetic Induction and Electrical Induction. Electrical Induction is initially introduced in a completely different way - it is an Electric Field in a material, induced by an external Electric Field. Whereas the formal equation of the Magnetic Field to Magnetic Induction B in a vacuum does not in any way correspond to the direction of the Ampere Force (Figure 1a). The Ampere Force, as can be seen from, is initially orthogonal to the external Electric Field along the speed (current). The Coulomb Force between charges, perpendicular to the current line, the Magnetic Force is Collinear! And the additional Orthogonal Characteristic of the Magnetic Field, as will be shown below, arises as a consequence of the Ampere Force, as its derivative component. So in the very traditional “Definitions” of the Magnetic Field, hidden behind the scientificism is an obvious Misunderstanding of the Magnetic Field, which is only intensified by the “virtual” photons that supposedly generate it. The absence of «Descartes’ gimlets» in electrostatics saved Coulomb’s Law from «virtual» photons in the Definitions of the Electric Field. And it won’t be possible to attach “orthogonal gimlets” to the spherical equipotential at the point where the test charge is located. In contrast to the symmetry of “rotation” of cylindrical magnetic equipotentials (imaginary) (Figure 1a), introduced similarly to Magnetic, the “Induction” of the Coulomb Field would rotate all spherical equipotentials at once at all points and in all directions (Figure 1b).

Similar to the illogical “Definitions” above, in many textbooks on electromagnetism, the full force - the Lorentz Force is used as a definition of the electric and magnetic fields E and B (as its components-parameters).

At the same time, the Lorentz Force (and not, as logically should be, the Ampere Force) is presented as a simply empirical relationship:»The electromagnetic force F acting on a test charge at a given point and time is a specific function of its charge q and velocity v, which can be parameterized by exactly two vectors E and B in functional form.»

And this "definition" of the Magnetic Field as part of the general electromagnetic interaction also suffers from juggling (hypocrisy, only formulas are used instead of opaque thimble cups), because The General Interaction itself is introduced using the Magnetic Field as an independent orthogonal characteristic.

The mysticism of all the listed definitions of the Magnetic Field is due to the fact that the initially experimentally measured Ampere Force and its logical continuation the Lorentz Force are (re)-"determined" through an indefinite (implied) Non-Invariant relative to the Lorentz transformation quantity Magnetic Induction B, which, in essence, not determined:

$$dF_A = I \cdot dl \times \overline{\mathbf{B}} \Rightarrow \frac{dF_A}{dl} = \frac{I}{dl} \times \frac{\overline{\mathbf{B}}}{dl} \quad \Leftrightarrow \quad \overline{F_L} = q \cdot \overline{v} \times \overline{\mathbf{B}} \qquad (2)$$

Whereas the standard introduced Electrical Induction is a Consequence of the change in the external Electric Field applied to the sample by the medium. At the same time, it is already clear from Elementary (Figure 1a) that all of the listed "Definitions" of the Magnetic Field included a Confusion of the Magnetic Force with the Magnetic "Induction", which is also orthogonal to the Ampere Force. And such an introduction of "Induction" for the spherical Electric Field of Coulomb, as already noted (Figure 1b), would give it complete uncertainty in angle.

All this confusion in almost all "Definitions" of the Magnetic Field, explicitly or implicitly, is connected with the fact that Magnetic Charges were initially used, by analogy with the Electric Field. Even Coulomb himself, in the first attempt to redefine "Descartes' gimlets," constructed Coulomb's Magnetic Law, which was completely analogous to the Electrostatic and Gravitational ones. But Ampere's experimental discovery showed that the dependence of the Magnetic Force on the distance from the current-carrying conductor is of a nature that does not correspond to Coulomb's Law. Ampere's discovery is of fundamental importance, because showed the connection between the Magnetic Field and the Electric Field. But this Connection discovered by Ampere, actually a relativistic effect, was not analyzed strictly enough.

The sophistical "Definitions" used now only hide a misunderstanding of the Essence of the Magnetic Field and lead to a pile-up of formulas that do not describe many Magnetic Effects even to a first approximation requiring numerous corrections. Therefore, it is not surprising that in practice in Magnetism I use empirical classical formulas. And without a correct classical Description of Magnetism at the macroscopic level, according to Einstein's "formula" given above, there can be no talk of constructing a Quantum Theory of Magnetism. Whereas the theorists, under a far-fetched (masking a Misunderstanding of the Classics) pretext about the Quantum Nature of Magnetism, shifted the classical Description of Magnetism onto the shoulders of art critics. Thus, they buried the Understanding of Magnetism even deeper. With the same success, one could, under the pretext of the Quantum Nature of Coulomb's law, entrust art historians with Electrostatics, or continue to build "Physics" on Schrödinger's "sand", reducing all theoretical physics to the development of methods for solving the equation Due to the fact that there was no Understanding of the Magnetic Force itself, an Elementary logical mistake was made. And the macroscopic difference between the Ampere Force that determines the Magnetic Field and the Coulomb Force is Symmetry, in that the Magnetic Force acts not on a Trial Unit Charged Point, but on a Trial Line with a unit current. And all this Re-Confusion stemmed from the fact that they did not Understand how to describe the observed Asymetry, manifested in the Orthogonality of the Magnetic Force to the Electric Force, which determines the Electric Current. So Misunderstanding simply hid it behind the mathematical formula of the rotor.

Amperes Stationary Law of Force

Electrostatic Forces of current carriers in conductors, perpendicular to the current, are completely balanced by the charges of the crystal lattice. So Nature itself identified the Magnetic Field of conductors as an easily measurable characteristic orthogonal to the Electric Field. This made it possible to discover, in principle, a relativistic effect - the Ampere Force.

The Magnetic Force is initially introduced through the Suppose (and from Descartes's gimlet) "Force" rotating around the current, while from the definition of the Coulomb Force it is clear that the indicated "orbits" are simply Equipotentials, the gradient of which gives the Ampere Force! This comparison alone is enough to see that (by turning) they simply tried to express the SIGN of Power! Indeed, the qualitative difference between the Attractive Force of parallel currents and the Repulsive Force is, firstly, in the SIGN:

$$\mathrm{Sign}[F_C] = -\mathrm{Sign}[q_1]\mathrm{Sign}[q_2] \quad \Leftrightarrow \quad \mathrm{Sign}[F_M] = +\mathrm{Sign}[I_1]\mathrm{Sign}[I_2] \qquad (3)$$

And secondly, the fact is that the Ampere Force Equipotentials of a linear conductor are not spherical, as for Coulomb, but, as already noted, cylindrical (Figure 2).

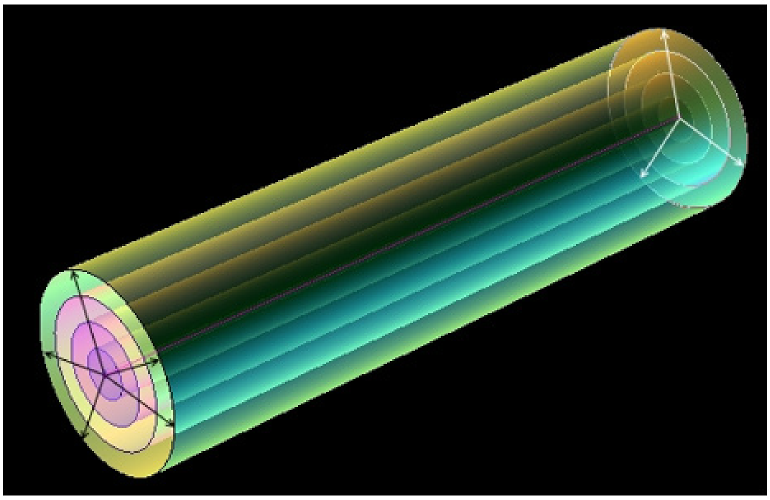

Figure 2: Equipotentials of the Magnetic Field of the current line (arrows show the orientation of the Magnetic Force, normal, of course, to the equipotentials).

And the force applied to the cylindrical Equipotentials, being the potential gradient near them, determines the pressure, which decreases in inverse proportion to the distance from the current line, in contrast to the pressure of the Coulomb field, which decreases in inverse proportion to the square of the distance from the point charge - the source of force.

So, in the used “Definitions” of the Magnetic Field, it is actually hidden that at the macroscopic level it is Ampere’s Law for a uniformly moving charge that is the same GIVEN as Coulomb’s Law for a stationary charge and, in principle, as for Coulomb’s Law at the macroscopic level is not needs knowledge of the Substructure and Magnetic Field Characteristics:

$$F_{12} = k_e \frac{|q_1||q_2|}{r_{12}^2} \quad \Leftrightarrow \quad F_{12} = \frac{\mu_0}{4\pi}\frac{2I_1 I_2}{r_{12}}\cdot L \quad (4)$$

But the symmetry of the Electric and Magnetic fields is different. If the sources of Electric Force are, ideally, charges-POINTS, which with their sign set the direction-sign of the force, then the source of Magnetic Force, ideally, are LINES of current, the direction of which-sign and set the sign of the Magnetic Force. In this case, the Measurability of the Electric Field is determined, ideally, by a point test charge, while the Measurability of the Magnetic Field is determined by a test current line of unit length.

And if the Coulomb Force, like the Electric Current, is phenomenologically a direct effect of the influence of the Electric Force on a stationary/moving test charge, then the Magnetostatic Force described by Ampere’s Law arises as a consequence of the interaction of the current with a unit parallel current

$$dF_{12} = \frac{\mu_0}{4\pi}\frac{2I_1 I_2}{r}dl \Rightarrow F_{12} = \frac{\mu_0}{4\pi}\frac{2I_1 I_2}{r}\cdot l /_{l=1, I_2=1} \to F_1 = \frac{\mu_0}{4\pi}\frac{2I_1}{r}\mathrm{Sign}[I_1]\mathrm{Sign}[I_2] \quad (5)$$

In this case, the Magnetic Force of interaction of conductors is determined by the concentration of electrons in them multiplied by their drift speed and, in accordance with the Lorentz formula for an individual electron, is determined by the Relative speed of charges in the interacting conductors. And the very existence of the Magnetic Field (Forces) is determined by the relative speed of movement of the charge Relative To The Observer. And this applies both to the charges that define the Magnetic Field under study, and to the charges of the test current. It directly follows from this that the Magnetic Field can only interact with the Magnetic Field! At the same time, for two conductors with the same direction of electron current, the Magnetic Forces have the same sign and the conductors attract each other, while the electrostatic attraction of charges of different signs correspond to Coulomb Forces of different signs!

And because the sign of the current also depends on the sign of the charge, then in a closed electrical circuit with branches of semiconductors of different types of conductivity, the branches will have Magnetic Forces of the same sign and will attract. But at the same time, we must immediately make a reservation that the Ampere’s Law equipotentials shown in (Figure 2) differ fundamentally from the Coulomb Equipotentials not only in symmetry. Although Ampere’s Law, in principle, has the same justification as Coulomb’s law - Dimension - inverse proportionality

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to the area of the Equipotential, which allows their Forces to be interpreted as a certain pressure, but for Coulomb it can be strictly determined by integrating the Forces Electrical Equilibrium Potential

$$\int_r^\infty \frac{1}{x^2}dx = \frac{1}{r} \quad (6)$$

And for the Magnetic Field - a cylinder around a unit length of current, the integral of the Ampere Force is divergent, since this force decreases too slowly with increasing radius. Moreover, the indefinite integral used to determine the cylindrical Magnetic Equipotentials is not equal to the difference in its values at the limits, and at the infinite limit it has no definite values at all:

$$\int \frac{1}{x}dx = \log[x];\ \int_r^\infty \frac{1}{x}dx \to \mathit{Integral\ of}\ \frac{1}{x}\ \mathit{does\ not\ converge\ on}\ \{r,\infty\} \quad (7)$$

So the conditional convergence of the Magnetic Potential can be obtained only when the degree of the denominator is only greater than one:

$$\int_r^\infty 1/x^\wedge(1+\Delta)dx \to \frac{1}{r^\Delta \Delta}, \mathrm{Re}[\Delta]>0 \quad (8)$$

Δ =0,

Δ→{0.0001,0.001,0.01,

0.03,0.1,0.5,0.8,0.9,0.99,1}

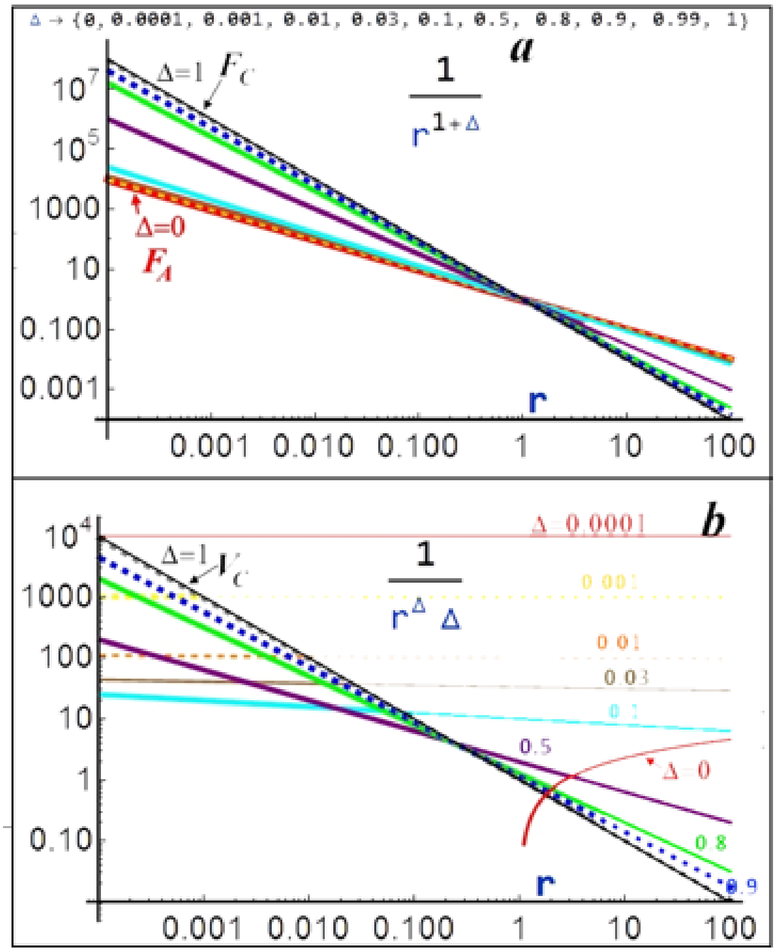

Figure 3: Relationship between the power-law spatial dependence of Force (a) with the corresponding dependence of Potential (b) the red line below shows the spatial distribution of the indefinite integral of the Ampere Force.

Justification Dimension is not strict for Coulomb's Law [7]. But its Local character manifests itself only on a galactic scale [8]. So it is quite correct to apply the Electric Potential on the micro- and macro-scales used in Solid State Physics. Whereas for the Magnetic Field, the spatial Magnetic Force allows us to obtain a mathematically correct spatial distribution of the "Potential" only when the degree approaches unity. But this "Potential", tending to infinity, does not physically correspond to the equilibrium Potential. Those. The Ampere Force integrated to obtain it is not static, it is dynamic - it is reactance and Magnetic "Equipotentials" correspond to the Power of emission/absorption (and propagation at the speed of light) of the Magnetic Field! Hence it follows that for the Magnetic Field, in principle, Kirchhoff's empirical rules for Flows (originally constructed for electric currents) work.

Comparative Analysis of Coulomb Force and Ampere Force

"Induction" B was not introduced out of nowhere, but in an attempt to somehow describe some additional properties of the Magnetic Field. But they called it, by analogy with Coulomb, Magnetic Permeability, very unfortunately - it, as already noted, is not at all analogous to Dielectric Permittivity. And the confusion about what is the main characteristic of the Magnetic Field: H or B, is a consequence of the fact that the direction of H was set incorrectly, in a vacuum the same as for B.

It should be immediately noted that confusion in the definition of the Magnetic Field also manifests itself at the Elementary level. That is why the equipotentials shown in (Figure 2) are often mistaken for lines of force (force lines go, naturally, perpendicular to them along the arrows indicated in (Figure 2).

Coulomb repulsion

In order to Understand where this additional characteristic of the Magnetic Field comes from, we will show what it corresponds to (and does not correspond to) in the characteristics of the Electric Field. Due to the problems with Magnetic Potential described above, we will conduct a comparative analysis of Magnetism with Electrostatics mainly by Force.

To do this, consider the repulsion forces acting on a unit test "charge" between identical charges and counter currents. For Coulomb, this force is strictly balanced between the charges, but when deviating from the axis connecting the charges, it increases to the maximum component of the buoyant force perpendicular to the axis of the force for single electric charges and, for clarity, setting the distance between the charges and the coefficient equal to unity. In this case, the Coulomb Repulsive Force between two charges of the same name acts, naturally, not only along the line connecting these charges, but, strictly symmetrically, also on a test charge of the same sign, in the perpendicular direction (Figure 4).

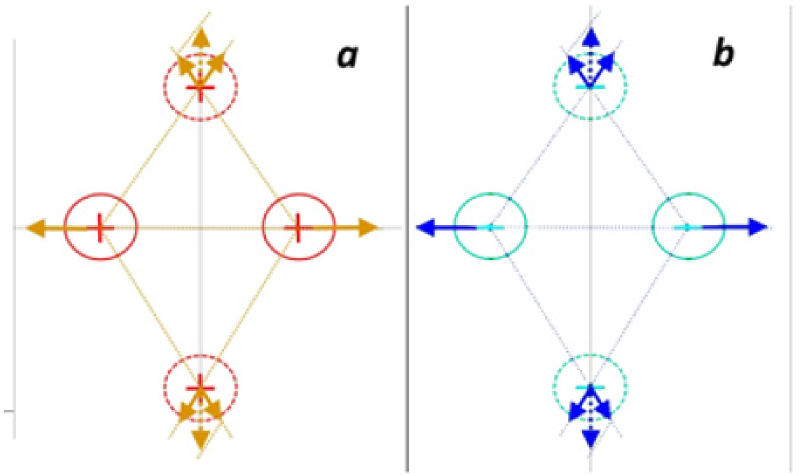

Figure 4: Repulsion of a test charge from a pair of electric charges of the same sign: a - for positive charges, b - for negative ones.

So I got the Electric Force perpendicular to the line connecting like charges:

$$F_{\Sigma}^{C} = k_e \frac{|q_1||q_2|}{(r_{12})^2} - k_e \frac{|q_1||q_2|}{(r_{12}+a)^2} \Rightarrow F_{\perp}^{C} = 2\frac{1}{(1/2)^2 + r^2} \bullet \frac{z}{\sqrt{(1/2)^2 + r^2}} \qquad (9)$$

This buoyant Electric Force, perpendicular to the line connecting like charges, gives a strictly symmetrical distribution of Equipotentials (Figure 4) and tends at infinity to repulsion from two charges.

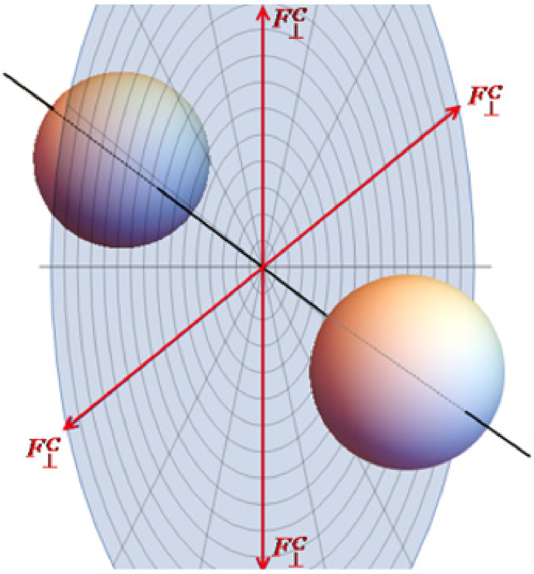

Figure 5: Spatial circular distribution of the Electrical Pushing Force in a plane between like charges.

In accordance with formula 9, the Electric Repulsion Force passes through a maximum and decreases symmetrically in all directions along the radius, asymptotically approaching the repulsive force of two charges at infinity (Figure 6).

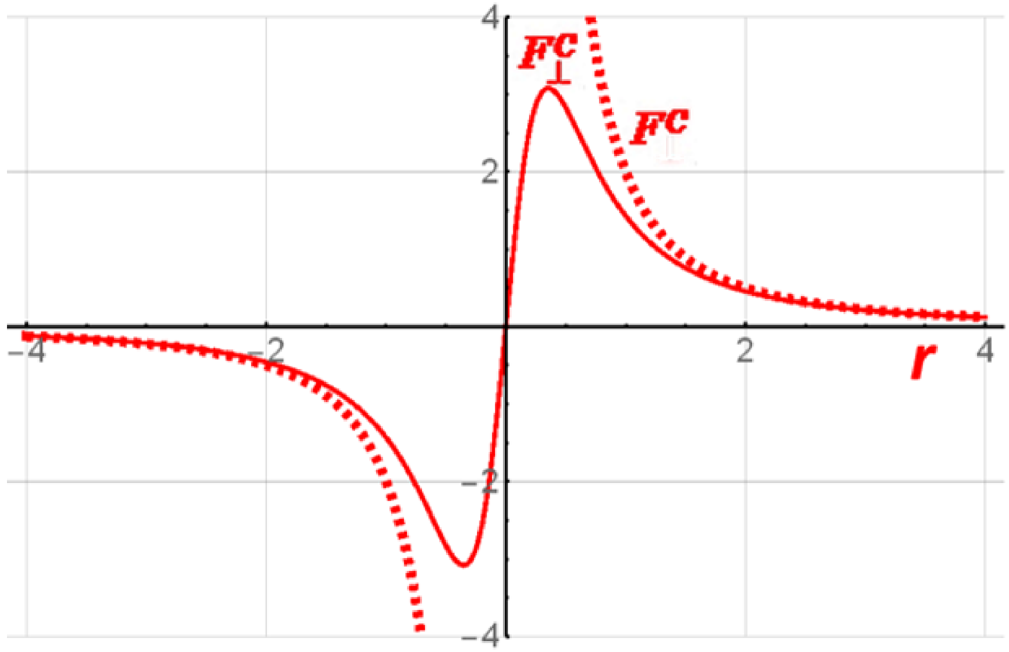

Figure 6: Radial distribution of the buoyant Coulomb Force in a plane between like charges.

Acknowledgement

None.

Conflict of Interest

None.

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