Smulsky J.J. A New Approach to Electrodynamics and to the Theory of Gravitation

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A New Approach to Electrodynamics And to the Theory of Gravity

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Abstract: The force between two charged particles depends not only upon the distance between them (Coulomb's Law), but also upon their relative velocity. A new analysis of these effects yields a force equation derived from Maxwell's Theory with implications for Special and General Relativity as well as the theory of gravity.

1. Introduction

From the beginning of the twentieth century to the present time, a critical attitude to Einstein's Theory of Relativity (TR) has persisted. The theory has been partially or fully rejected by such famous scientists as A. N. Krylov, S. I. Vavilov, A. K. Timiryazev, V. V. Mitkevich, L. Yanoshy; and professors O. D. Hvalson, N. P. Kasterin, K. N. Shaposhnikov, T. A. Lebedev, S. A. Bazilevskii, A. A. Tyapkin; and many others [1-7].

This critical attitude is not well known, because works that found fault with the Theory of Relativity were seldom published or reprinted. Two exceptions are the works of the Minsk philosopher A. K. Maneev [8] and the Chelyabinsk physicist G. D. Lomakin [9]. And there have been rare publications in foreign journals [10-12]. Recently, owing to glastnost, a number of works opposing TR have been published in USSR. These began with the publications of professors V. V. Cheshev [13] and B. I. Peshevitsky [14] and continued in popular science journals [15-16], in cooperative published booklets [17-18], and even in newspapers [19-21]. But critical works on TR have not yet appeared in mainstream scientific literature.

This paper presents a new approach in understanding of the electromagnetic and gravitational phenomena, an alternative to the Theory of Relativity. Contradictions in the Theory of Relativity are cited in references [8-21] mentioned above; but, here, these problems are given minimal attention.

The Theory of Relativity embraces such a sizable sphere of science—in such fields as physics, philosophy, mathematics and methodology—that numerous interrelationships are created which become the proof of logical analysis for its many founders and followers. Yet other specialists, not accepting the constructions and conclusions of TR, carry out critical analyses from different points of view. This paper considers both the Special Theory of Relativity (STR) and the General Theory of Relativity (GTR) by analyzing the action of one object upon another object. This approach permits us to see new sides of the issue and resolve it in a new fashion.

2. Action and its Description

Two kinds of action are considered in the Theory of Relativity: first, an electrical or electromagnetic action; and second, a gravitational action. STR deals with the first action, while GTR deals with the second. From considerations of the electrical action of a moving body, Einstein discovered STR in the year 1905.

What is an *action*? We comprehend the action of one object on another as the capacity of the first body to set in motion or change the motion of a second body. To change a body's motion means to change its speed—either its value or direction; i.e., to impart an acceleration **a**. The action on the second body is determined by the value of its acceleration, which it acquires or will acquire when the action begins. If there is no acceleration, then either there is no action or the action of the first body has been neutralized by another opposing action. For example, a stone hung on a spring is attracted by the earth, but its motion doesn't change because the spring neutralizes the earth's attraction. The spring exerts an action to oppose the action of the earth on the stone, leaving the stone at rest. The spring in this case is extended a length Δl.

Historical precendent has defined that an *action* is determined by the spring deformation Δl. Corresponding to this action is the concept of a force **F** which is determined by the deformation Δl of the spring. A standard force scale was constructed so that for any location, a force unit corresponds to the same action on a standard body. Such a standard body is maintained in Paris—a platinum-iridium cylinder of diameter and height equal to 39 mm. Under the influence of the earth's action, this standard body extends a spring over the same length Δl that corresponds to a force value of 1 kg in the MKS System. If dropped, the earth's action causes the standard body to fall with an acceleration of 9.8 m/s^2. But we describe this action as a force whose value is one kilogram or 9.8 Newtons in the SI system.

If we take n standard bodies, they extend a spring until its force is n kilograms, and we say that the earth acts on them with this force. Likewise, a single body can extend a spring by the same amount as m standard bodies. Yet the single body and standard bodies fall with the same acceleration, 9.8 m/s^2. Thus, we conclude that although the acceleration is identical, the force and *action* on various bodies are, in general, different. Specifying only a force does not fully characterize the action on a body, and it is found necessary to also specify the body's mass m defined in terms of the action on n standard bodies and a standard acceleration. Hence, it appears that the action on a mass of $m = n$ standard bodies produced by a force **F** results in an acceleration **a**

$$\mathbf{a} = \mathbf{F}/m \qquad (1)$$

Equation (1), known as Newton's second law, is correct for every action in a consistent unit system. And, as we can see, it is the result of our choice of the action characteristics and measuring units. Analogously, Newton's first and third laws are consequences of our approach. For example, as the first law states, a body moves with uniform motion in a straight line if other bodies do not act upon it—a consequence of our initial determination.

So, the action on a body is shown by its acceleration. We express and describe an action in the form of force and mass of the considered body. In the chosen system of units, the mass along with the measured force determines the object's acceleration. Hence, we form three important conclusions: First, in all interactionss, the body mass will be the same. Therefore, it is senseless to search for any divergence between gravitational and inertial mass. Such searches inevitably find measurement errors in the different kind of actions. The second conclusion is, in principle, the same, but it refers to the thesis of TR on changing the mass by speed. It follows from the determination of mass, as described above, that mass cannot change from another action or motion. Third, only that object or phenomena can have mass which can acquire acceleration as a result of another object's action. Moreover, one can measure this action in the force form. As for light, fields, energy, etc., this process is not realized, and these phenomena are not associated with a mass. This brief discussion of actions on a body has been previously considered in recent works dated from 1969 to 1972 [22-23].

3. Electromagnetic Action and Its Description

We begin a discussion of electromagnetic action with the force given by Coulomb's law on a point charge q_1 by another point charge q_2, for Gauss's system

$$\mathbf{F} = \frac{q_1 q_2 \mathbf{r}}{\varepsilon r^3} \tag{2}$$

where the force $\mathbf{F}$ on the first charge depends upon the direction and distance $\mathbf{r}$ between the two charges. Coulomb's law is an incomplete expression of the force because, if body 2 moves, the force will be different. Numerous experiments demonstrate that a motionless charged body produces an action on another charged object but has no effect upon a magnet or a conducter with current. In contrast, the experiments of Rowland, Eihenwald and Roentgen demonstrate the effect of a moving charged body upon a magnet or conductor with current. Analogously, a motionless magnet or current loop does not act upon a charged body; however, when relative motion appears, an action also appears. This phenomena is summarized by Faraday's law of electromagnetic induction. These two phenomena groups—an appearance of action on a magnet in the specific force form $\mathbf{H}$ during the charge's motion, and an appearance of action on a charge in the specific force form $\mathbf{E}$ during the magnet's motion—are described by first and second of Maxwell's laws.

$$\nabla \times \mathbf{H} = \frac{4\pi}{c}\rho \mathbf{v} + \frac{\varepsilon}{c}\frac{\partial \mathbf{E}}{\partial t} \tag{3}$$

$$\nabla \times \mathbf{E} = -\frac{\mu}{c}\frac{\partial \mathbf{H}}{\partial t} \tag{4}$$

where ρ is the charge density, ε is the permittivity, and μ is the magnetic permeability. $\mathbf{E}$ and $\mathbf{H}$ are the force per unit of charge and magneticity, respectively. The reader may note that the E and H vectors are *not* described in terms of electric and magnetic field strength.

So, by the complicated formulation of differential equations, the action of one charged body on another is described in terms of their relative motion. By combining equations (3) and (4), we can determine the action on a charged object. For example, by eliminating $\mathbf{H}$, we get D'Lambert's equation for the action of charges in relative motion.

$$\Delta \mathbf{E} - \frac{1}{{c_1}^2}\frac{\partial^2 \mathbf{E}}{\partial t^2} = \frac{4\pi}{{c_1}^2}\frac{\partial \rho \mathbf{v}}{\partial t} + \frac{4\pi}{\varepsilon}\nabla \rho \tag{5}$$

Following this equation for a point charge solution [22], we get the force of its action for a point charge in motion.

$$\mathbf{F} = \frac{q_1 q_2 (1-\beta^2)\mathbf{r}}{\varepsilon [r^2 - (\vec{\beta} \times \mathbf{r})^2]^{3/2}} \tag{6}$$

where $\vec{\beta} = \mathbf{v}/c_1$, and $c_1 = c/\sqrt{\varepsilon\mu}$ is the electromagnetic velocity or velocity of light in space with permittivity ε and permeability μ.

Inspection reveals that equation (6) reduces to Coulomb's law for the limiting case of zero relative velocity between the two charges, i.e., when $\beta = 0$. Another limit occurs for two charges moving with relative velocity equal to the speed of light, giving a force $\mathbf{F}$ equal to zero, i.e., an action is not exerted on either body, nor are they accelerated. Indeed, using equation (6) and Newton's second law, equation (1), the acceleration of one charge relative to the other becomes

$$\frac{d^2\mathbf{r}}{dt^2} = \mu_1 \frac{\mathbf{r}(1-\beta^2)}{[\mathbf{r}^2 - (\vec{\beta} \times \mathbf{r})^2]^{3/2}} \tag{7}$$

$$\mu_1 = \frac{q_1 q_2 (m_1 + m_2)}{\varepsilon m_1 m_2} \tag{8}$$

where μ_1 is the coupling constant, and $\mu_1 < 0$ if $q_1 q_2 < 0$.

Solving equations (7) and (8), we get a trajectory equation in the form

$$\varphi = \int \frac{h\, d\mathbf{r}}{r^2 v_r} \tag{9}$$

$$v_r = c_1 \left[1 - \frac{h^2}{{c_1}^2 r^2} - \left(1 - {\beta_{ro}}^2 - \frac{h^2}{{c_1}^2 {r_o}^2} \right) \times \exp \frac{2\mu_1}{{c_1}^2} \left(\frac{1}{\sqrt{r^2 - h^2/{c_1}^2}} - \frac{1}{\sqrt{{r_o}^2 - h_2/{c_1}^2}} \right) \right]^{1/2} \tag{10}$$

where v_r is the radial velocity; $h = \mathbf{v_t} \cdot \mathbf{r_o} = \mathbf{v_{to}} \cdot \mathbf{r_o}$ is the kinetic moment of momentum; and $\mathbf{v_{to}}$, $\mathbf{v_{ro}}$ are the tangential and radial velocities on radius r_o.

Again, for two charged objects moving with relative velocity equal to the speed of light, the acceleration given by equation (7) is equal to zero and it follows from equation (10) that their velocity does not change.

4. Criticism of the Theory of Relativity

According to the Theory of Relativity, an electrical action is described as the field created by an electrical charge. For example, in general, the field of an arbitrary distribution of charge density ρ has been expressed as a differential equation known as Poisson's equation

$$\Delta \mathbf{E} = \frac{4\pi}{\varepsilon}\nabla \rho \tag{11}$$

where $q\mathbf{E}$ is the force on a charge q at any point in space, and $\mathbf{E}$ is the intensity of the electrical field at that point in space. In our opinion, a field is a mathematical term that should not be presented in the form of some medium or matter.

According to TR, application of the principle of relativity should not cause any physical change if objects move without acceleration; i.e., a physical law must be invariant, and a field should not change. Thus, interactions of the moving charges should be described by the same equation (11) as non-moving charges. It is not difficult to show that if the equation (5) for moving charges is to be replaced by an equation (4) for non-moving charges, then it is necessary to transform the parameters of the equation (5) by the assistance of equation (5) parameters. It was in this manner that Lorentz obtained his famous transformations of space and time (but only for the equation of scalar potentials φ).

Therefore, if the same expressions are to describe an interaction for both moving and non-moving cases, then it becomes necessary to express the parameters of rest in terms of the parameters of motion. This approach is assumed by recognizing the conditional nature of the transformations. But in TR the transformations are made absolute, and it is customary to consider that distance, time and other parameters really change as an object increases in velocity, i.e., the object changes from being at rest to being in motion merely by defining a moving plane of reference.

The Lorentz transformations contain a velocity of electromagnetic propagation that is equal to the velocity of light c. Since the result of a Lorentz transformation becomes meaningless as an object's velocity approaches the speed of light, advocates of TR assumed that this speed represented a physical limit. But since the Lorentz transformations only represent a mathematical method of treating the influence of relative velocity, the same limit of the object's velocity does not exist.

For these reasons, we consider that the principle of relativity and the principle that limits propagation velocity are two initial, erroneous statements of TR.

5. The Results of the New Descriptions

So, an action force of a charge onto another charge depends not only on the distance, but also on the velocity. We obtained an analagous result for the interaction of magnetic bodies and current loops. Reference [23] provides the calculations of action forces between charged plates, charged lines, currents, magnets and moving charged bodies. These expressions give the same force as the classical equations when the velocity is zero, and a force of zero as the velocity increases to the speed of light. These equations explain the results measured for the charge to mass ratio in the Kaufmann experiments. Equation (6) was derived as a general solution of the force between moving charges. This method has the advantage of predicting the correct experimental results without requiring an arbitray change in mass or the ratio of charge to mass.

For velocities of objects approaching the speed of light, our solutions give physical forces that become zero. In this case, the action force on a particle becomes zero, but the physical characteristics of length, time and mass of the object are independent of velocity and remain unchanged.

The solutions of the new approach permit widespread application; in contrast to the approximate solutions of TR, the new approach provides an exact solution for electrodynamics. Various equations of the new electrodynamics permit detailed and exact solutions of complicated interactions. References [22,23] present explanations of electrodynamic phenomena in terms of the new approach, including such well-known effects as the Doppler shift and aberration of light. Furthermore, as professors N. Kasterin and K. Shaposhnikov showed in 1919 [7], predictions of TR are not in accord with results of the Buherer experiment. The solution from the new electrodynamics, however, gives the correct results.

The awareness that electromagnetic forces depend upon speed and the proper application of well-established laws of electricity and magnetism bring critiical issues of modern physics to a conclusion. Thus, force calculations that depend upon velocity do not, in fact, obey the law of conservation of the sum of kinetic and potential energy. Consider the following example: for a particle in motion radially, where $h = 0$ in equation (10),

$$v^2 = {v_r}^2 = {c_1}^2 - ({c_1}^2 - {v_o}^2)\exp\frac{\pm 2q_1U}{m_1{c_1}^2} \qquad (12)$$

where U is the difference of potential or voltage a particle with charge q_1 and mass m_1 acquires by acceleration of its velocity from v_0 to v_1. In this example where the directions of v_0 and the action are opposite, the plus sign is used. As shown in reference [23], equation (12) is correct for an influencing charged body of any shape. In an accelerator, accelerated electrons can be described by equation (12) where U represents the potential difference sum of all passed accelerating electrons. As may be seen by inspection of equation (12), an electron speed cannot be more than c_1, even as the accelerating potential $U \to \infty$; i.e., the maximum electron kinetic energy will be $T = mc^2/2 = 0.54$ MeV, though the potential energy when $U = 10^9$ volts will be 1 GeV. Hence it is seen that assigning an electron the relativity energy of, say, 1 GeV differs considerably from it's kinetic energy. Accounting of this fact in studies of elementary particle and nuclear physics could bring about new fundamental results. We should also point out that other laws of conservation for forces that depend upon velocity have been derived and provided [23].

So, the prediction of energy by TR is different from the correct and valid energy of a particle This important result should receive great attention and experimental investigation.

The absolutization of the moving frame and relativity principle, wherein physical changes of length, mass and time are said to actually occur, brings physicists to many insuperable problems—for example, the ether with its imagined properties. Such issues are better resolved by the principle of action. When a physical system is insulated from all actions, then it is impossible to determine its movement by these actions. If it is not insulated, then its movement may be determined. For example, in the case of a train with curtained windows, moving uniformly without any awareness of the carriage tossing or rumbling of the wheels, we have no sense of movement. But let light enter the windows from an outside object, and we can then determine the speed of the train to any accuracy. Returning to the ether, this is why it is necessary to first determine any properties of the ether that may insulate us from actions, and only then to measure the earth's motion with respect to the ether.

Without the assumed limitation on speed imposed by TR assumptions in the Lorentz transformation, one can find examples of motions that exceed the speed of light—especially as there are superlight movements everywhere in nature. For example, if two sources separated by a distance of 600 meters each emit particles that approach each other, each particle traveling with speed equal to 299000 km/s, then in 1 microsecond each of them have traveled 299 meters, and they will meet. Relative to each other, the closing velocity of the particles is 598000 km/s, a velocity that is almost double the speed of light. Furthermore, it is possible to exceed the velocity of light not only for relative motions, but also in the laboratory [23]. In 1973, we filed an application that proposed a method to demonstrate approaching superlight particles [24].

6. Theory of Gravity and the General Theory of Relativity

The General Theory of Relativity (GTR) is based on the idea that velocity has a maximum limit. The theory's founders reasoned that if gravity actually existed, then its effects (action) could not propagate faster than some limited velocity, assumed to be the speed of light. The thesis of GTR has no greater substantiation than these assumptions. Prior estimates placed no such limit on the gravitational field. Laplace (1787) in his work *An Exposition of the World System* came to a conclusion based on analysis of the moon's movement that if the propagation of gravity is finite, then it is considerably greater than the velocity of light.

From the viewpoint of GTR, with the gravitational field in propagation with the speed of light, equation (6) describes how a physical body moves in the force of a central field generated from another point by a body of mass m_2

$$\mu_1 = -G/(m_1 + m_2) \tag{13}$$

where G is the gravitational constant.

In GTR, the gravitational field equation is solved approximately by way of expansion, retaining terms in c whose order is no higher than c^2. Then retaining the same terms in equation (10) and substituting in equation (9) yields, according to TR, the equation of motion for the symmytrical, central force field of gravity:

$$\varphi = \int \frac{h\,dr}{r^2\sqrt{c_1{}^2 + v_0{}^2 - (c_1{}^2 + h^2/r^2)(1 - r_g/r)}} \tag{14}$$

where $r_g = -2\mu_1/c_1{}^2$ is the gravitational radius.

Equation (14) and similar results explain the General Theory of Relativity and the effects of GTR: the rotations of planets' perihelion, deflections of star light by a gravitational mass, and the existence of gravitational waves. According to GTR, a star may become so dense that its is smaller gravitational radius r_g limit retards light and slows its velocity to produce a "black hole." But as there are no reasons to consider that gravity propagates at the speed of light, then also there are no reasons to take seriously these GTR effects.

Many false claims are made by the Theory of Relativity, in areas such as the search for gravity waves, manipulations with black holes and various models of the universe, and a number of theories in microcosm physics. It is claimed that common sense (which is determined historically and by man's lifetime experiences) cannot be a criterion of truth. The breach of common sense and logic in many so-called "paradoxes" of TR is accepted by many scientists as an integral part of modern theories. Here it seems appropriate to add yet one more paradox to the TR logical "paradoxes" which one could term the "negation of negation paradox."

As we have noticed, the GTR equations for a gravitational field have been solved only approximately, and when an object's velocity is close to the speed of light, the equations are incorrect. Really, the gravitational action of a gravitational field propagating with the speed of light cannot make physical changes to an object whose speed is c. This is why a beam of star light can neither diverge nor retard from the presence of a nearby mass and gravity field. The new electrodynamics, with exact equations (9) and (10), does not predict such divergence or velocity retardation. But GTR extends classical mechanics and Newton's theory of gravity to claim that light beams bend and slow down. Classical mechanics argues that the gravitational attraction star with radius r_g prevents its light from escaping and "black holes" are the result of this effect. Suggesting this effect, GTR negated classical mechanics, the latter explaining it, negating the GTR. This is a negation negation paradox.

7. Conclusion

The present Theory of Relativity is a construction based on assumptions and hypotheses. The current task of science is to analyze this structure and remove the unfounded assumptions and hypotheses. In this spirit, the present paper has offered an alternative to TR, though we wish to encourage additional research and analysis of fundamental laws of physics.

The new approach to electrodynamics is based on the following general postulates:

1. Length, time and mass are determined in comparison to the standard bodies and processes. These terms are unique, unchangeable and inherent properties that are quantified in relation to the standard bodies.
2. The electromagnetic force of action between two bodies depends upon the distance and the speed between them.
3. The principle of relativity incorrectly states the actions between bodies, if they depend upon velocity.
4. The speed of bodies does not have a limit.
5. There are no reasons to make the propagation of gravitational effects equal to the speed of light.

The history of mechanics and mathematics in the last two centuries has been devoted to the generalization of results and methods, with heavy doses of abstractions added to explain physical phenomena. The motions and interactions of objects can be described in terms of force, mass and acceleration which can be measured [23]. With the introduction of the concepts of energy, Hamiltonian functions, fields, and distortions of force space, the original empirically derived laws have become formulated in more abstract terms In this process of increasing abstraction, the original fundamental concepts have become obscured and confused. Many modern physicists have adopted the notion that such abstract concepts are reality, and that measured values of the physical world are just supporting correlaries of these conceptions. The process of apprehending reality takes place, for many modern scientists, in the sphere of high level abstractions. To this breed of scientists, the proof of the abstractions is a logical, internal consistency of the theory. The only scientists able to escape this faulty methodological cycle are those who realize that nature is primary and that our methods of describing it must take a secondary role.

Despite this gloomy assessment of past failures of the methods of science, we think that physics stands at the threshold of revolutionary changes. The logic of common sense will triumph, mysticism will disappear from the conceptions of time and space, and we expect classical mechanics will take its prescribed place. Philosophy and methodology will be delivered from their far fetched claims, and science will give us a knowledge that is as simple and clear as the four operations of arithematic.

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