

Title: A Simple Unification of Gravitation and Electricity

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Abstract: Einstein devoted many years for finding a Classical Unification of Gravity and Electricity. These attempts did not result in conclusive successful results.

This study proposes a simple unification of Gravity and Electricity by predicting that Electric Fields are also forms of Accelerations, as Gravity is already recognized as a form of Acceleration.

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There are other proposals for unifications of Gravity and Electricity, but neither also propose a simple test how to validate the proposed unification.

This study, on the other hand, does also propose a relatively simple physical experiment, which if implemented might prove, or disprove, the prediction that Electric Fields are also forms of Acceleration, which will also provide validity to the proposed unification of Gravity and Electricity, or disprove it.

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One-Sentence Summary: A proof that Electric Fields are forms of Acceleration will also provide a simple unification of Gravitation and Electricity.

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Main Text: After the publication of the General Relativity Theory, Einstein devoted many years and significant efforts, together with various numerous colleagues, to unify Gravitation and Electricity, in what is known as the quest for finding a Classical Unified Field Theory. Among Einstein's endeavors were also endeavors to employ additional dimensions such as his work with five-dimensional classical Kaluza–Klein theory (13) . However, these Einstein's endeavors did not result in conclusive successful results, as the following quotes from References (14) and (15) indicate: "Einstein, in the latter part of his career, wanted to unify the theories of general relativity and electromagnetic field into one unified theory. He wasn't able to achieve any significant success in this goal though", and "With the death of Einstein, the search for a unified theory of gravitation and electro-magnetism has apparently faded into the background". Also, a basic corner stone of electricity is Coulomb's Law, and as Ref (16) states: "Coulomb's law is not compatible with the unified theory".

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Unifications in Physics are significant steps forward because they provide deeper understanding, new insights, and new predictions.

This study proposes the prediction that Electric Fields are also forms of Acceleration, as Gravitation is already known to be also a form of Acceleration. Based on this prediction, this study proposes a simple unification between Gravitation and Electricity.

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1. Einstein's Space/Time concept explains the *Origin* of the Attraction between Masses

The issue of Mass bodies attraction was initially investigated by Newton. Newton's measurements concluded that two Mass bodies attract each other according to the Universal Gravitational Law, which is formulated as (1):

$$F = G \cdot (m_1 \cdot m_2) / r^2$$

Where G is the Gravitational Constant and is equal to $6.674 \times 10^{-11} \text{ m}^3 \cdot \text{kg}^{-1} \cdot \text{s}^{-2}$, m_1 is the Mass magnitude of the first Mass body, m_2 is the Mass magnitude of the second Mass body and r is the distant between the center of Masses of the two Mass bodies.

The Universal Gravitational Law presented above provides the amount of Force that attracts these two Mass bodies.

However, Newton could not provide a complete explanation relating to what causes this force, or what is exactly the *origin* of the attraction between Mass bodies.

Newton tried to explain the *origin* of the attraction force between Mass bodies by introducing the concept of the Gravitational Field.

Newton stated that a Mass body creates a Gravitational Field around it, which generates the force presented in the Universal Gravitational Law.

However, Newton could not explain how any Field, including his Gravitational Field, can cause the attraction forces between bodies.

Newton's Gravitational Field is presented by the following equation (2):

$$g = G \cdot (m) / r^2$$

Where g is the Gravitational Field magnitude, G is the Gravitational Constant, which was already presented above in the Universal Gravitational Law, m is the Mass magnitude of the Mass body which creates this Gravitational Field g and r is the distance between the center of Mass of this Mass body, and the point in Space, where this Gravitational Field g is measured.

Thus, the Universal Gravitational Law can be reformulated as:

$$F = m \cdot g$$

Where m is the magnitude of the Mass body on which the Gravitational Field g exerts the force F.

However, as already stated above, the notion of a Field, does not provide a complete answer to the question: how can a Field generate the Forces that it is assumed to create?

Thus, the question:

what is the **origin** of the force presented by the Universal Gravitational Law? remained an unanswered question, until the introduction of Einstein's General Relativity Theory (3).

Einstein succeeded to explain the **origin** of the attraction forces between Mass bodies by concluding that Newton's Gravitational Field is a form of Acceleration. That conclusion can be derived directly from Newton's work.

Newton's Second Law of Motion (4) states, that a force F exerted on a Mass body of Mass magnitude m obeys the following equation:

$$F = m \cdot a$$

Where a is the Acceleration that this Mass body of Mass magnitude m acquires because of the force F exerted on it.

However, the above already presented, that a Gravitational Field g exerted on a Mass body of Mass magnitude m also results in a force F exerted on this Mass body:

$$F = m \cdot g$$

Thus, from the above follows that: $g = a$

Thus, the Gravitational Field must also be a form of Acceleration.

From the above, Einstein concluded that this could provide an explanation to the question: how Newton's Gravitational Field can generate the force F expressed by Newton's Universal Gravitational Law? or, in other words, what is really the **origin** of the attraction force between Mass bodies?

Einstein's General Relativity Theory explains the **origin** of the attraction force between Mass bodies using the following argumentation:

Acceleration is the second derivative of Space as related to Time:

$$a = d^2s/dt^2$$

Where s is the Space point at which the Acceleration a is measured, and t is the Time moment at which the Acceleration a is measured.

Space is a three-dimensional entity, while Time is a one-dimensional entity.

From the above Einstein concluded that if it can be assumed, that Space and Time are not independent entities, and they are always **interweaved** into a four-dimensional construct, which replaces the three-dimensional Space entity, then, this four-dimensional Interwoven Space/Time entity already embeds an Acceleration at each point of it, because the second derivative of Space in relation to Time can be calculated at each point of it, because this four-dimensional Interwoven Space/Time entity already embeds the Space **and** the Time entities at each point of it.

Thus, Einstein concluded, that if a form of this four-dimensional Interwoven Space/Time entity can be assumed to be Newton's Gravitational Field, then, this Interwoven Space/Time entity, will exert an Acceleration, on any Mass body, residing in it, which is the Acceleration embedded in the point of this Interwoven Space/Time entity, where this Mass body resides.

2. Additional Implications as related to Einstein's Space/Time notion

Einstein's four-dimensional **Interwoven Space/Time** notion does succeed to explain the **origin** of the attraction between Mass bodies, as presented in the previous chapter, above. However, that notion embeds also an important additional implication.

By stating that the Space and the Time notions are **always** interweaved into one four-dimensional entity, this also implies that the Space and the Time notions, are not independent notions, as Humans perceive such notions.

Moreover, because Einstein's four-dimensional Interwoven Space/Time notion replaces the Newton's Gravitational Field, which should be recognized as a form of Energy, then, the Space and the Time notion, are not only not independent notions, but they are also just attributes (or facets) of a form of Energy.

In a speech, in the University of Leiden on May 5th, 1920, (6), Einstein claimed that the ether should exist to provide physical properties to his Space/Time entity, which implies, that Einstein also agreed that his Space/Time Entity is a form of Energy.

Thus, Einstein's four-dimensional Interwoven Space/Time notion also implies that the Space and the Time notions are not independent notions, are just attributes (or facets) of a form of Energy, which also implies that the Space and the Time notions, as Humans perceive such notions, do not really exist.

The statement that Space and Time do not really exist sounds as an extraordinary, unbelievable, and out of line statement, at first. This is because the notions of Space and Time are crucial notions, which Humans need them, to perceive, understand and calculate Motions and Changes. However, in view of the arguments above, if Space and Time cannot be considered any longer as independent entities, and if Space and Time are just embedded in a form of Energy (the Gravitational Field), the statement that Space and Time might not really exist does not sound so detached any more.

Moreover, the above actually indicates that what **does exist** are Energies which **Interact** with each other, and these **Interactions** cause, what Humans perceive as Motions and Changes. For example, the attraction (Motions) between Mass bodies is a result of the **Way** a form of Energy (the Gravitational Field) **Interacts** with another form of Energy (Mass bodies), which leads Humans to attribute attributes (or facets) of Space and Time to the Gravitational Field Energy. The understanding that Space and Time might not really exist, and what causes Motions and Changes are the **Ways** interactions of Energies interact with each other, is used to explain the attraction or repulsion between Electric Charges, in the next chapter of this paper, which also results in a proposal for a simple unification of Gravitation and Electricity.

3. An explanation for the Attraction or Repulsion between Electric Charges

Analogous to Newton's Universal Gravitational Law, which provides the force of attraction between Mass bodies, Coulomb's Law provides the force of the attraction or the repulsion between Electric Charges.

Coulomb's Law is presented by the following formula (5) :

$$F = K_e \cdot (q_1 \cdot q_2) / r^2$$

Where K_e represents the Coulomb's Constant and is equal to $8.99 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$, q_1 is the amount of Electric Charge in the first Electric Charge, q_2 is the amount of Electric Charge in the second Electric Charge and r is the distance between the center of Masses of the bodies that carry these two Electric Charges.

As in the case related to the attraction between Mass bodies, the *origin*, or the cause of Coulomb's Law is attributed to an Electric Field that each Electric Charge generates, which, as explained already, in relation to the attraction between Mass bodies, this cannot provide a complete explanation to the question: why Electric Charges attract or repel each other?

It should be noticed that the *structure* of the Newton's Universal Gravitational Law and the *structure* of the Coulomb's Law are identical.

Thus, the following question might be asked:

Since the *structure* of the Newton's Universal Gravitational Law and the *structure* of the Coulomb's Law are identical, why the *origin* of the attraction between Mass bodies was resolved via Einstein's General Relativity Theory, and its concept of a four-dimensional Interwoven Space/Time entity, and the *origin* of the attraction or the repulsion forces between Electric Charges, is still a mystery?

The author of this paper published an additional paper (7) which predicts that Electric (or Magnetic) Fields are also forms of Accelerations, as Newton's Gravitational Field is already recognized as a form of Acceleration.

Based on that prediction, that paper (7) explains the *origin* of the attraction or the repulsion between Electrically Charged bodies like Einstein's General Relativity explains the *origin* of the attraction between Mass bodies.

That explanation is based on the understanding, presented above, that Space and Time do not really exist.

This enabled the prediction that there are two additional *separate* four-dimensional Interwoven Space/Time entities, in addition to Einstein's four-dimensional Interwoven Space/Time entity. One of these additional four-dimensional Interwoven Space/Time entity replaces the Electric (or Magnetic) Fields generated by the Positive Electric Charges. The second of these additional four-dimensional Interwoven Space/Time entity replaces the Electric (or Magnetic) Fields generated by the Negative Electric Charges. And thus, these three separate four-dimensional Interwoven Space/Time entities are all forms of Energies, and each of these three separate four-dimensional Interwoven Space/Time entities embeds its own separate Space and Time attributes (or facets).

The paper (7) provides detailed explanations of the above, which also results in a simple unification of Gravity and Electricity, because, if the materials presented in the paper (7) will be found valid, then, Gravity and Electricity operations is governed by exactly the same processes.

4. A tentative modification to Newton's Second Law of Motion

The prediction presented above, that Electric (or Magnetic) Fields are also forms of Accelerations also implies that the acceleration between Electrically Charged bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Masses of these bodies, as Newton's Second Law of motion ($F=ma$) states.

Electrically Charged bodies always embed Electric Charge *and* Mass. However, the Coulomb's Force is much more potent than the Gravitational Force. This can be demonstrated by the following:

The Gravitational Force between two 1-kg Mass Objects that are 1 meter apart is $6.67 \cdot 10^{-11}$ (8) Newtons, while the Attraction or the Repulsion Force caused by the Coulomb's Law, between two 1 Coulomb Electrically Charged Bodies, held 1 meter apart, is $9 \cdot 10^9$ (9) Newtons. The above clearly indicates that the Coulomb's Force might be more *potent*, as compared to the Gravitational Force, by a magnitude factor of $1.35 \cdot 10^{20}$!

Thus, if Electric (or Magnetic) Fields are also forms of Accelerations, the acceleration between Electrically Charged bodies, attracted to, or repelled from each other, because of Coulomb's Law, should be dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Masses of these bodies, as Newton's Second Law of motion states, which also implies that Newton's Second Law of motion should undergo a suitable modification, as is described in the paper (7) .

5. An Experiment for Validating or Disproving the proposed Unification

The paper (7) also suggest a physical experiment that might prove or disprove the prediction that the acceleration between Electrically Charged bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Masses of these bodies, as Newton's Second Law of motion ($F=ma$) states.

That experiment suggests letting two Electrically Charged bodies, at a specific distant L apart, being attracted to each other under Coulomb's Law.

In the first phase of the experiment the bodies should be of equal Mass magnitudes, embedding equal amounts of Electric Charges, each of a different polarity, to enable the attraction between the bodies under the Coulomb's Force. The experiment should measure the time it takes for these bodies to collide.

Then, the experiment is repeated with two additional Electrically Charged bodies with the same amount of Electric Charge but with a much bigger Mass magnitude (for example, twice the Mass magnitude that the Electrically Charged bodies had in the first phase of the experiment).

Newton's Second Law of motion predicts that the time to collision, in that second phase of the experiment, would be different (bigger), because the Forces exerted on the bodies will be the same, as in the first phase of the experiment, because the Electric Charges are the same in both phases of the experiment, but the Masses of the bodies are bigger in the second phase of the experiment, which will result in a smaller acceleration.

This paper, on the other hand, predicts that the time to collision in both phases of the experiment would be virtually the same, because the acceleration between Electrically Charged bodies, attracted to, or repelled from each other under the Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Masses of these bodies, as Newton's Second Law of motion ($F=ma$) states.

If the experiment will prove that the time to collision will be virtually the same, in both phases of the experiment, this will provide validity to what is presented in this paper.

6. Summary and Conclusions

This paper assumes that Newton's Second Law of motion was never checked to see if it complies with the acceleration in scenarios of attraction or repulsion between Electrically Charged bodies.

Instead, this paper assumes that Newton developed his Second Law of motion based on the trajectories existing in the Solar System (10) , (11) , (12) . Newton used these trajectories to prove that his laws are valid, by showing that his laws of motion forecasted these trajectories. Thus, this paper predicts that Newton's Second Law of motion is valid only for very massive bodies (such as planets) or uncharged bodies, and for Electrically Charged bodies Newton's Second Law of motion should undergo a suitable modification.

That prediction is based on another prediction that Electric (or Magnetic) Fields are also forms of Acceleration, as the Newton's Gravitational Field is already recognized as a form of Acceleration.

The prediction that Electric (or Magnetic) Fields are also forms of Acceleration, was used by the author of this paper, to explain the *origin* of the attraction or the repulsion between Electrically Charged bodies (which is still a mystery today) like Einstein's General Relativity explains the *origin* of the attraction between Mass bodies.

This also provides a simple unification of Gravity and Electricity.

However, the prediction that Electric (or Magnetic) Fields are also forms of Acceleration also implies that the acceleration between Electrically Charged bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on the Masses of these bodies, as Newton's Second Law of motion ($F=ma$) states.

This paper also proposes a physical experiment to validate (or disprove) the prediction that the acceleration between Electrically Charged bodies, attracted to, or repelled from each other, because of Coulomb's Law, is dependent mainly on the amount of Electric Charge that these bodies carry and not on the Masses of these bodies.

This experiment is relatively simple to implement, but still requires means and funds which are beyond the reach of the author of this paper, thus, the author of this paper hopes, that this paper will bring about the execution of this experiment, and, hopefully, the validation of what is presented in this paper.

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