

Title: A discussion related to the existence of the entities of Space and Time

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Abstract: Humans need the entity of Space to perceive relative positions between objects. Humans also need the entities of Space and Time to calculate values that Humans attribute to Motions, such as Velocity or Acceleration. The entities of Space and Time are also the entities that compose the four-dimensional Interwoven Space/Time entity, introduced by Einstein's General Relativity theory, which provided an explanation of the *origin* of the attraction between Massive Bodies.

However, although the notions of Space and Time, as Humans perceive these notions, do provide the significant explanation of the *origin* of the attraction between Massive Bodies, via Einstein's General Relativity theory, the notions of Space and Time, as Humans perceive these notions, are not sufficient for providing explanations to an additional similar unanswered question: what is the *origin* of the attraction or the repulsion between Electrically Charged bodies?

This paper presents the following prediction: Electric (or Magnetic) Fields are forms of Accelerations, like the Gravitational Field, which is already recognized as a form of Acceleration.

This prediction also leads to the following thesis: Changes and Movements are the result of Interactions between Energies, and the entities of Space and Time are not entities that exist.

The entities of Space and Time are notions (or entities), invented by Humans, because Humans need such notions to perceive Changes and Motions.

For some Interactions between Energies, which result in Changes or Motions, Humans can attribute, to these Interactions, attributes of Space and Time, which will assist in providing explanations to why these Changes or Motions are the result of these Energies Interactions.

However, this paper predicts, that different sets of Interactions between Energies, should be assigned *separate and independent* attributes of Space and Time, *different and independent* from the Space and the Time attributes, assigned to other sets of Interactions between Energies, to provide an explanation for the *origin* of motions which are yet unexplained, such as: what is the *origin* of the attraction or the repulsion between Electrically Charged bodies?

Because *different and independent* Space and Time attributes should be assigned to different sets of Interactions between Energies, then, Space and Time, as Humans perceive these notions, cannot

exist, because the above implies, that there should be **multiple, independent** notions of Space, and **multiple, independent** notions of Time, and not just one universal Space entity, and just one universal Time entity, as Humans perceive the Space and the Time entities.

By abandoning the conclusion that the entities of Space and Time exist, and by concluding that Changes and Motions are only the results of Interactions between Energies, the **origin** of attraction or repulsion between Electrically Charged bodies can be explained, in addition to the explanation, already provided by Einstein's General Relativity theory, relating to the **origin** of the attraction between Massive Bodies.

The prediction that the entities of Space and Time do not really exist sounds as an extraordinary, unbelievable, and out of line statement, at first. This is because, as presented above, the notions of Space and Time are crucial notions, which Humans need them, to perceive, understand and calculate Motions and Changes.

However, this paper also proposes a relatively simple experiment, which if implemented, and its results will be successful, as this paper predicts, this will either validate or disprove, what is presented in this paper.

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

The issue of Massive Bodies attraction was initially investigated by Galileo as well as Kepler, but Newton discovered the inverse-square dependance of the Gravity Force on the Distance.

Newton's measurements concluded that two spherical symmetric Massive 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 Massive Body, m_2 is the Mass magnitude of the second Massive Body and r is the distant between the center of Masses of the two Massive Bodies.

The Universal Gravitational Law presented above provides the amount and the direction of the Force that attracts these two Massive 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 Massive Bodies.

Attempts to explain the **origin** of the attraction force between Massive Bodies introduced the concept of the Gravitational Field.

The Gravitational Field concept stated that a Massive Body creates a Gravitational Field around it, which generates the force presented in the Universal Gravitational Law.

However, the concept of the Gravitational Field could not explain how any Field, including this Gravitational Field, can cause the attraction forces between bodies.

The Gravitational Field strength, which is defined as the Gravitational Force, of the Gravitational Field, in Newtons, that acts on a Mass of one Kg, is presented by the following equation (2):

$$g = G \cdot m_g / r^2$$

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

Thus, from Newton's Universal Gravitation Law, presented above, the attraction Force between a Massive Body of Gravitational Mass magnitude m_g , which generates its Gravitational Field strength g , at a distant point r in Space, from its center of Mass, and another Massive Body of Inertial Mass Magnitude m_i , at this distant point r in Space, from the center of Mass of the Massive Body m_g , is presented by:

$$F = G \cdot (m_g \cdot m_i) / r^2$$

Thus, the Universal Gravitational Law can be reformulated as:

$$F = m_i \cdot g$$

Where m_i is the Inertial Mass magnitude of the Massive Body on which the Gravitational Field strength 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 Massive Bodies by introducing the concept, that Gravitational Forces are related to the Space and the Time entities, which can be also presented as a curved Interwoven Space/Time construct, if Mass can be assumed to induce a curve into that Interwoven Space/Time construct.

It might be also added, that, because an Interwoven Space/Time construct, embeds both the Space and the Time entities in it, which implies that at each point of this curved Interwoven Space/Time construct, an Acceleration can be calculated, the understanding that the Gravitational Field is also a form of Acceleration, helped Einstein to develop this concept, of a curved

Interwoven Space/Time construct, which succeeded to explain the *origin* of the attraction between Massive Bodies.

The fact that the Gravitational Field is also a form of Acceleration, was already a well-known fact when Einstein developed his Interwoven Space/Time concept, because it can be derived directly from Newton's work.

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

$$F = m_i \cdot a$$

Where a is the Acceleration that this Massive Body of Inertial Mass magnitude m_i acquires because of the force F exerted on it.

However, the above already presented, that a Gravitational Field strength g exerted on a Massive Body of Inertial Mass magnitude m_i also results in a force F exerted on this Massive Body:

$$F = m_i \cdot g$$

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 Massive Bodies?

Einstein's General Relativity Theory explains the *origin* of the attraction force between Massive 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 Massive Body, residing in it, which is the Acceleration embedded in the point of this Interwoven Space/Time entity, where this Massive 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 Massive 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 Massive Bodies is a result of the *Way* a form of Energy (the Gravitational Field) *Interacts* with another form of Energy (Massive 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** Energies Interact with each other, is used to explain the attraction or the 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 Massive 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, assuming that the Electric Charges embedded in the Electrically Charged Bodies used in a Coulomb's Law experiment, are spread uniformly on these Electrically Charged Bodies.

As in the case related to the attraction between Massive 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 Massive 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 Massive 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 Massive 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 its own separate 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 are governed by exactly the same processes.

Unification of Gravity and Electricity is an endeavor which the Science of Physics pursues for a long time, without significant success.

Unifications in Physics are significant steps forward because such unifications provide new insights, explanations to yet unanswered questions, and new predictions.

This paper argues, that if the notions (entities) of Space and Time, will be proven to be entities that do not exist, as this paper predicts, then, the fact that the endeavors to unify the Gravitation with Electricity were based on the conclusion that the entities of Space and Time do exist as a single Space entity and a single Time entity, might be the reason, that such endeavors were not yet successful.

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 that Electric Fields are also a form of Acceleration.

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 this paper predicts that 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 addresses the following unanswered question:

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 Massive 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?

This paper predicts that Electric (or Magnetic) Fields are forms of Accelerations, like the Gravitational Field, which is already recognized as a form of Acceleration.

The prediction that Electric (or Magnetic) Fields are also forms of Acceleration resulted in another prediction: Changes and Motions are the results of how Energies Interact, and Space and Time are not entities which exist.

Space and Time are notions invented by Humans because Humans needed these notions for perceiving Changes and Motions and these notions are required to calculate values that Humans attribute to Motions such as Velocities or Accelerations.

Based on the above, the paper provides an explanation to the *origin* of the attraction or the repulsion between Electrically Charged bodies, in addition to the explanation already provided by Einstein's General Relativity theory, to the *origin* of the attraction between Massive Bodies.

This also provides a lead for a simple unification of Gravity and Electricity.

The prediction that the entities of Space and Time do not really exist sounds as an extraordinary, unbelievable, and out of line statement, at first. This is because, as presented above, the notions of Space and Time are crucial notions, which Humans need them, to perceive, understand and calculate Motions and Changes.

However, this paper also proposes a relatively simple experiment, which if implemented, and its results will be successful, as this paper predicts, this will either validate or disprove, what is presented in this paper.

This experiment is based on the conclusion that if Electric (or Magnetic) Fields are forms of Acceleration, then the Acceleration in the attraction or repulsion between two Electrically Charged bodies, under Coulomb's Law, is dependent mainly on the amount of the Electric Charge that these bodies carry and not on their Mass magnitudes, as Newton's second Law of motion states.

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, which are virtually Electrically Neutral Bodies) or Electrically Uncharged Bodies, or Forces exerted on Electrically Charged Bodies which do not originate from Electric Fields, and for Electrically Charged bodies attracted or repelled under Coulomb's Law, Newton's Second Law of motion should undergo a suitable modification.

The experiment proposed by this paper 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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