

# A tentative modification to Newton's second law of motion

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## Abstract

Einstein's General Relativity Theory provided an explanation for the *source* of the attraction between Massive Bodies, which was unexplained, even though Newton's Universal Gravitational Law provided the magnitude of the attraction force and the direction of this force between two Massive Bodies.

Einstein's General Relativity Theory used the observation that Newton's Gravitational Field is also a form of *acceleration*, and it used this observation to introduce Einstein's Interwoven Space/Time notion, which explained the *source* of the attraction between Massive Bodies.

However, the *source* of the attraction or the repulsion between Electrically Charged bodies is still a mystery today, even though the structures of Newton's Universal Gravitational Law, and Coulomb's Law, are identical.

This paper provides the prediction that Electric (or Magnetic) Fields are also forms of *acceleration*. Based on this prediction, a paper published by the author of this paper, expands Einstein's General Relativity Theory to include Electrically Charged Bodies in addition to Massive Bodies, which also provides an explanation to the *source* of the attraction or the repulsion between Electrically Charged bodies.

However, the prediction that Electric (or Magnetic) Fields are also forms of *acceleration* also implies that the acceleration between two Electrically Charged bodies, attracted to, or repelled from each other, according to Coulomb's Law, is mainly dependent on the magnitudes of the Electric Charges that these bodies carry and not on the magnitudes of the Mass that these bodies embed, as Newton's Second Law of Motion predicts.

Thus, if the prediction, that Electric (or Magnetic) Fields are also forms of acceleration will be found correct, Newton's Second Law of Motion would require a suitable modification.

This paper also proposes a physical experiment which might prove (or disprove) the prediction provided by this paper, that Electric (or Magnetic) Fields are also forms of acceleration, which might prove (or disprove) what is presented in this paper.

## Introduction

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):

5 
$$F = G \cdot (m_1 \cdot m_2) / r^2$$

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.

10 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.

15 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.

20 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):

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

25 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.

30 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 is Space, from the center of Mass of the Massive Body  $m_g$ , is presented by:

35 
$$F = G \cdot (m_g \cdot m_i) / r^2$$

Thus, the Universal Gravitational Law can be reformulated as:

40 
$$F = m_i \cdot g$$

Where  $m_i$  is the Inertial Mass magnitude of the Massive Body on which the Gravitational Field strength g exerts the force F.

45 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 derivated 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.

### **Additional implications as related to Einstein's Interwoven 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.

### **An explanation for the origin of the attraction or the repulsion between Electrically Charged bodies**

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 Electrically Charged Bodies that carry these two Electric Charges, assuming that the Electric Charges

embedded in the Electrically Charged Bodies presented in Coulomb's Law, are uniformly distributed 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 Time attributes (or facets).

### **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) .

### **An experiment for validating or disproving what was presented in this paper**

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.

### **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, 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.

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 Massive Bodies.

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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