Tentative Additional Explanations to Why Electric Charges Attract and Repel Each Other

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Abstract:

Newton's Universal Gravitational Law (1) provided the magnitude of the Force of the attraction between massive bodies.

However, the reason what causes this attraction remained a mystery until the introduction of Einstein's General Relativity Theory (GRT) (*2*) .

GRT explained the attraction between massive bodies, but Physics does not provide yet a tested, verifiable explanation to the question: why Electric Charges attract and repel each other, despite the fact, that the Coulomb's Law Force (3) provided the magnitude of the Force of the attraction or the repulsion between Electric Charges.

Current main stream Physics does provide several theories which attempt to provide an explanation to why Electric Charges attract and repel each other, but all these theories are still in the stage of research and investigation, and none propose a feasible test or experiment to provide additional validity to its claims.

This paper proposes tentative additional explanations to the question: why Electric Charges attract and repel each other, along with a feasible proposed experiment.

Since GRT replaced the Energy embedded in Newton's Gravitation Field with Einstein's four-dimensional interwoven spacetime Field, and Newton's Universal Gravitational Force with the geometry attributed to Einstein's four-dimensional interwoven spacetime, then, similarly to GRT, this paper presents, that it might be reasonable to present, several models, which replace the Coulomb's Electric Force with additional geometries, attributed to the Energies embedded in the Electric Fields, such that, these models, might provide additional explanations to why Electric Charges attract and repel each other.

And, as already mentioned above, this paper also proposes a feasible experiment which might either provide additional validity to the models presented in this paper, or disprove them.

An explanation to why Electric Charges attract and repel each other is just one issue in a larger attempt to Unify Gravity and Electromagnetism.

Thus, the existing theories that also try to provide an explanation to why Electric Charges attract and repel each other, also propose a tentative Unification of Gravity and Electromagnetism.

Thus, if the experiment, proposed in this paper, will be implemented, and its results will be successful, this might also provide a lead, to achieve a tentative Unification between Gravity and Electromagnetism, a significant issue which is still an open subject.

1. Summary of what current mainstream Physics presents on the subject

Einstein's Relativity theories are the leading acceptable theories on the subject.

Einstein's Relativity theories assume a single four-dimensional interwoven spacetime.

That spacetime is the foundational backbone of the two most successful and experimentally verified theories in mainstream Physics: Special Relativity Theory (SRT) and General Relativity Theory (GRT) (2).

The standard confirmed view, which is the established, tested and practical realm of the current mainstream Physics, is that the universe embeds a single four-dimensional interwoven spacetime manifold, which consists of three spatial dimensions (x, y, z) and one temporal dimension (t), unified into a single geometric entity.

That model accurately predicts and describes Gravity, the orbits of planets, the bending of Light around massive bodies, time-dilation, and the propagation of Gravitational Waves, all of which have been experimentally confirmed.

Thus, for all practical macroscopic phenomena, and for the vast majority of Physics (including the Standard Model of Particle Physics which operates on this background), the Universe is treated as a single four-dimensional spacetime with a single geometry.

However, the current mainstream Physics encompasses additional highly developed, though currently unproven, theoretical frameworks on the subject.

Some of these additional theories discard the assumption of a purely four-dimensional spacetime with a single geometry in favor of higher dimensions.

For example, the Kaluza-Klein Theory (KK) (4) assumes a five-dimensional spacetime, with the fifth dimension being of the shape of a tiny circle, with a radius of 23 times the Plank length, which is of the order 10^{-33} cm.

Another example is the String Theory/M-Theory (5) which assumes ten to eleven dimensions.

Yet another example is the Brane Cosmology (e.g. Randall-Sundrum Models) (6) which assumes five+ dimensions.

However, all the above presented extra-dimensions theories are unverified, highly theoretical attempts, which remain subjects of ongoing research rather than established facts, because these theories do not propose yet a feasible experiment which might provide them extra validity.

In addition to the extra-dimensional theories which were presented above, mainstream Physics considers the Quantum Field Theory (QFT) (7) and more specifically, the Quantum Electro Dynamics (QED) (8) as the established framework for Electromagnetism.

QED explains Electromagnetism by the exchange of a Quantum Particle, the Photon.

In QED the Electric Field is not a property of geometry. It is a Quantum Field that generates and exchanges Photons. In QED the attraction and the repulsion arise from the mathematical property of the Quantum exchange process.

But, also QFT and QED are still considered as non-verified theories which are still in the stage of research and investigation, without a suggested experiment that might provide them complete validity.

2. A brief elaboration about the GRT elements related to the subject.

In GRT Gravity is not a Force, it's a geometry.

In Newtonian Physics Gravity is a Force that causes an acceleration (a=F/m).

In GRT Gravity is not treated as a Force. Instead, Mass and Energy Curve spacetime. The presence of Mass (like the Earth) wraps the four-dimensional fabric of the spacetime creating a curvature.

In GRT Gravitational Motion is Geodesic. Objects which are subjected only to Gravity (like an apple falling, before it hits the ground), are not actually accelerating in their local frame of reference, and thus, their motion is not described by GRT as an acceleration. They are simply following the "straightest possible path" (a Geodesic) through the curved spacetime.

The apparent acceleration observed for a falling apple is the result of its path being curved by the geometry of the Earth's Mass. The four-dimensional spacetime geometry, therefore, accounts for the Gravitational acceleration by transforming it from a Force into a geometric property.

In GRT accelerations are considered as deviations from the Geodesic.

Thus, GRT accounts for two distinct kinds of accelerations:

In a Gravitational acceleration a particle is following a curved worldline (Geodesic), due to the curvature of the spacetime itself.

In a non-Gravitational acceleration (for example, an apparent acceleration because of an Electromagnetic Force, or a regular normal Force) a particle is deviating from its natural Geodesic path, caused by a non-Gravitational Force, and in such a case, the acceleration is represented by the four-acceleration vector in the same four-dimensional spacetime, which measures how much the worldline deviates from the Geodesic.

3. Elaborations on the leading attempts to Unify Gravity and Electromagnetism

The Unification of Gravity and Electromagnetism is still a very significant unresolved issue in Physics.

The Kaluza-Klein theory (KK) (4) was one of the theories which attempted to Unify Gravity and Electromagnetism.

The KK theory proposal was to add a fifth, curled-up spatial dimension to Einstein's four-dimensional interwoven spacetime. When KK's five-dimensional geometry was solved using Einstein's equations, the equations for the four-dimensional world separated into the original four-dimensional Einstein's equations, describing Gravity, on one hand, and Maxwell's equations, describing Electromagnetism, on the other hand.

The KK theory showed that Electromagnetism could be a geometric manifestation of a higher-dimensional spacetime, where the Electric Field is a component of the Gravitational Field in the extra dimension, and the KK theory treated the Electric Field's effects as the geometry of that extra, hidden dimension.

Thus, the KK theory does provide a geometric explanation for the Electromagnetic Force and for the attraction and the repulsion between Electric Charges, by showing that it emerges from the five-dimensional Geodesic equations, which is structural similar to how GRT explains the attraction between massive bodies in Gravity.

However, the KK theory is not supported by an experiment and is not currently accepted as a complete, viable theory of Nature.

The extra dimension that KK theory suggests, of a tiny, compact fifth dimension, has not been verified yet. That extra dimension, if it exists as required by the KK theory, must have a radius on the order of Plank's length (around 10^{-33} cm). Direct verification of a dimension that small would require Energies far beyond anything attainable in current or foreseeable particle accelerators.

In addition, the KK theory is not considered a candidate in the attempts to Unify Gravity and Electromagnetism also because of the following:

The KK theory could not explain Quantum phenomena like the spin of the Electron.

And, the KK theory only proposed a Unification between Gravity and Electromagnetism, but it could not accommodate the weak and the strong Nuclear Forces, which are now fundamental parts of the accepted Standard Model of Particle Physics.

And also, the KK theory exhibits the Scalar Field, or Radion/Dilaton phenomenon, which is a phenomenon that exists in the reduction from five-dimensional to four-dimensional. That reduction produces a Scalar Field, which is a Field with no direction, unlike the Electromagnetic Potential. This Field known as Radion or Dilaton, would have long range effects that are not observed, which presents a major theoretical difficulty related to the KK theory.

In addition to the above elaborations, relating to the KK theory, the fact that the KK theory relates to Einstein's intact equations, was an important point in the parameters chosen in the attempts presented in this paper, to propose an experiment, which might provide additional

validity, to the tentative explanations, presented in this paper, to why Electric Charges attract and repel each other.

As will be presented in more details later in this paper, the proposed experiment, proposed in this paper, intends to check if the Electric Charges do also induce deformations into a four-dimensional interwoven spacetime, somewhat similarly to how massive bodies induce deformations into Einstein's four-dimensional interwoven spacetime.

And, more specifically, the proposed experiment intends to check if these deformations should be affected also from the sign (Positive or Negative) of the Electric Charge which might induce these deformations.

Since Einstein's equations does also predict that Electric Charges might affect spacetime, but only via the amount of the Energy that the Electric Charge embeds, and Einstein's equation predict that the Electric Charge's sign does not affect at all the deformations it induces into the spacetime, and since the KK theory does rely on purely intact Einstein's equations without any changes attributed to Einstein's equations, this might be a significant parameter, which the proposed experiment might utilize, in presenting if the KK theory does indeed provide a valid explanation to why the Electric Charges attract and repel each other, or, alternatively, if the proposed explanations, presented in this paper, might provide more suitable explanations, to why the Electric Charges attract and repel each other.

Apart from the KK theory, the accepted leading theory in the attempts to Unify the Gravity and the Electromagnetism is the Quantum Electro Dynamic Theory (QED) (8).

In QED the attraction or the repulsion between Electric Charges is explained as the result of the exchange of virtual photons.

In QED repulsion is explained as follows: when two like-charged particles approach, they exchange virtual photons, which transfer momentum and cause them to push apart.

In QED attraction is explained as follows: when two oppositely charges particles approach, they also exchange virtual photons, which is complex, but it effectively "pulls" the charges towards each other due to the nature of the field and the charges involved.

But, as GRT, QED does not present that the sign of the Electric Charge has an effect on Einstein's four-dimensional interwoven spacetime, and because the proposed experiment, proposed in this paper, focuses exclusively on the Gravitational Signature of the Electric Field's source (the Electric Charge), then, any measurable difference in Einstein's four-dimensional interwoven spacetime curvature between Positive and Negative Electric Charges might provide strong evidence that the Positive and the Negative Electric Fields possess unique, non-symmetric geometric properties, that violate the sign-agnostic Q^2 contribution predicted by the standard GRT/QFT framework.

4. Electric Fields, Geometry and GRT Unification: a Theoretical Analysis.

Newton's Gravitational Force can be represented as F=mg, where g is Newton's Gravitational Field Force strength, and, from Newton's Second Law, F=ma, (9) follows, that g is also acceleration.

Thus, the fact that g is also acceleration helped Einstein in developing GRT.

But, as already presented, GRT replaced the Gravitational Field by the four-dimensional interwoven spacetime, and GRT also replaced the Gravitational Force by the geometry attributed to that single four-dimensional interwoven spacetime.

However, in a scenario of two Electrically Charged bodies attracted or repelled under the Coulomb's Law Force (3), from the fact that the structure of the Coulomb's Law is identical to the structure of Newton's Universal Gravitational Law (1), follows, that these Electrically Charged bodies also accelerate (or decelerate) with an acceleration (or deceleration) which is equal to (q/m)e, if Newton's Second Law is also assumed to be valid in this scenario, where q is each body's Electric Charge magnitude, m is each body's Mass magnitude and e is the Electric Field Force strength.

Thus, similarly to GRT, the proposed explanations, presented in this paper, to why Electric Charges attract and repel each other, present, that it might be reasonable to conclude that, the Coulomb's Force might be also replaced with a geometry, somewhat similar, but still different, from the geometry attributed to Gravity by GRT, similarly to how GRT replaced the Gravitational Force with a geometry.

Thus, the proposed theory suggests the possibility that it might be reasonable to assume, that the Electric Fields have their own geometry, somewhat different from the geometry attributed to Gravity – one for the Positive Electric Charges and one for the Negative Electric Charges – and the attraction/repulsion between Electric Charges is due to deformations of these geometries, analogous to how Mass causes attractions via spacetime curvatures in GRT.

This paper presents that there might be more than one possible geometry, which might provide a tentative explanation to why Electric Charges attract and repel each other, which implies that there might be several such explanations, as the title of this paper also manifests.

And this paper presents two of these tentative geometries, in enough general details, to present that such tentative geometries can indeed provide a reasonable explanation to why Electric Charges attract and repel each other, but this paper does not delve, at this stage, into a precise full mathematical description of each such geometry.

Thus, in the following two chapters two such possible geometries are presented.

5. An example of how a specific additional geometry can explain why Electric Charges attract and repel each other.

This chapter presents enough general details, related to a specific additional geometry, it proposes, attributed to the Electric Fields, to present, that such a proposed geometry can indeed explain, why Electric Charges attract and repel each other, but it does not delve, at this stage, into a precise full mathematical description of the proposed geometry

The proposed geometry which is attributed to the Electric Fields induced by the Positive Electric Charges will control how the Positive Electric Charges move.

The proposed geometry which is attributed to the Electric Fields induced by the Negative Electric Charges will control how the Negative Electric Charges move.

A Positive Electric Charge will wrap the proposed geometry attributed to the Electric Fields induced by the Negative Electric Charges to induce a dip in it.

That dip will attract to this Positive Electric Charge any Negative Electric Charge.

The above description is somewhat similar to how a massive body wraps the geometry attributed to Gravity to induce a dip in it which attracts to it other massive bodies.

A Positive Electric Charge will also wrap the proposed geometry attributed to the Electric Fields induced by the Positive Electric Charges to induce a hill in it.

That hill will repel from this Positive Electric Charge any other Positive Electric Charge.

A Negative Electric Charge will wrap the proposed geometry attributed to the Electric Fields induced by the Positive Electric Charges to induce a dip in it.

That dip will attract to this Negative Electric Charge any Positive Electric Charge.

The above description is somewhat similar to how a massive body wraps the geometry attributed to Gravity to induce a dip in it which attracts to it other massive bodies.

A Negative Electric Charge will also wrap the proposed geometry attributed to the Electric Fields induced by the Negative Electric Charges to induce a hill in it.

That hill will repel from this Negative Electric Charge any other Negative Electric Charge.

However, in addition to the explanation provided above, for the attraction and the repulsion between Electric Charges, the model must also comply with the apparent acceleration that appears in a scenario of an attraction or a repulsion between Electric Charges under the Coulomb's Law Force.

Because, even though, the proposed model does present, that the Electric Force is replaced by a geometry, similar to how GRT replaced the Gravitational Force by the geometry attributed to Einstein's spacetime, still GRT does comply with the apparent measured acceleration, that is detected when massive bodies attract each other, and similarly to the above, the proposed model must also comply with the apparent measured acceleration that is detected when Electric Charges attract and repel each other.

From Newton's Universal Gravitational Law follows that, the apparent measured acceleration that is detected when massive bodies attract each other, which is equal to g, is dependent only on the magnitude of the Mass embedded in the massive body that attracts to it another massive body, and the distance between these massive bodies.

However, in the GRT case it is relatively simple to devise how a massive body can induce a curvature into the spacetime which also complies with the apparent acceleration g, measured in the attraction process between this massive body and another massive body, because the magnitude of this curvature, at any point of it, depends only on the magnitude of the Mass embedded in the massive body that induced this curvature, and the specific location in this curvature.

But, in a scenario of an attraction or a repulsion between Electric Charges, the situation is more complicated.

For example, if Newton's Second Law is assumed to be applicable also in the apparent acceleration or deceleration, measured in a scenario of Electrically Charged bodies attracted or repelled under the Coulomb's Law Force, then, that apparent measured acceleration or deceleration is equal to (q/m)e, where q is each body's Electric Charge magnitude, m is each body's Mass magnitude, and e is the Electric Field strength magnitude which causes this acceleration or deceleration.

Thus, to comply with the above, the magnitudes of the curvature, induced by an Electric Charge, into a spacetime, must be also affected by the values of q, m and e, presented above in (q/m)e.

But, the q/m values, presented above, are values that depend only on the Electric Charges that are affected by the above-mentioned curvature, and the e value, presented above, is a value that depends only on the magnitude of the Charge in the Electric Charge which induced that curvature, and the location at each point of this curvature.

Thus, one possibility to present how the magnitude of a curvature, induced by an Electric Charge, into a spacetime, depends also on the above-mentioned values q, m, and e, might be the possibility, in which Electric Charges induce two forms of deformations into that spacetime.

These two forms of deformations, can be described as follows:

One such form of deformation can be a torsion, or a twist, induced by an Electric Charge, into that spacetime, whose magnitude will be proportional to the q/m value of the Electric Charge, which induces that torsion, or twist, into that spacetime, and, also, the magnitude of that torsion, or twist, will also depend on the location at each point in that torsion, or twist.

And, in the above-mentioned possibility, each Electric Charge will induce that torsion, or twist, in both geometries which were already presented above, the geometry attributed to the Energy embedded in the Electric Fields induced by the Positive Electric Charges, and geometry attributed to the Energy embedded in the Electric Fields induced by the Negative Electric Charges

And, the second form of deformation, that an Electric Charge might induce into a spacetime, would be a curvature of the shape of either the dip or the hill, which were already mentioned before.

Thus, the above implies, that by using the above mentioned two forms of deformations, that an Electric Charge might induce into a spacetime, it might be possible to explain how a curvature induced into that spacetime, by an Electric Charge, might explain, on one hand, the attraction and the repulsion between Electric Charges, and, on the other hand, also comply with the apparent measured acceleration (or deceleration) in such a scenario, by presenting that this induced curvature is affected also by the values of q/m embedded in the Electric Charges that are affected by this curvature, and also the by the value of e, mentioned above.

The geometries presented in this chapter, imply that the geometry attributed to the Electric Fields induced by the Positive Electric Charges is separate and independent from the geometry attributed to the Electric Fields induced by the Negative Electric Charges, and both these geometries are also separate and independent from the geometry attributed to Gravity.

Because the above proposal presents three separate and independent geometries, this also implies that the above proposal assumes that the Universe might embed not just one, single four-dimensional interwoven spacetime, as GRT presents.

Instead, the above proposal presents that the Universe might embed several, separate and independent four-dimensional interwoven spacetimes, each attributed to a different form of Energy.

One such spacetime would be Einstein's four-dimensional interwoven spacetime, attributed to the Energy attributed to Gravity.

Another such spacetime would be attributed to the Energy embedded in the Electric Fields induced by the Positive Electric Charges.

And the third proposed spacetime would be attributed to the Energy embedded in the Electric Fields induced by the Negative Electric Charges.

The above description of three separate, independent geometries, and three independent spacetimes, might also imply that the spacetimes presented in this chapter, do not really exist, and are just attributes, or facets, of certain forms of Energy.

The spacetime attributed to Gravity might just be an attribute, or facet, of the Energy embedded in the Gravitational Field.

The separate spacetime attributed to the Electric Fields induced by the Positive Electric Charges might just be an attribute, or facet, of the Energy embedded in the Electric Fields induced by the Positive Electric Charges.

And the separate spacetime attributed to the Electric Fields induced by the Negative Electric Charges might just be an attribute, or facet, of the Energy embedded in the Electric Fields induced by the Negative Electric Charges.

And each of the above separate spacetimes, might only be a mathematical tool to explain the interactions performed by these Energies, which implies, that none of these separate spacetimes really exist.

The explanation why Electric Charges attract and repel each other, via the separate geometries and spacetimes presented in this chapter, has an advantage that it is a relatively simple explanation which resembles the explanation provided by GRT to why massive bodies attract each other.

But a complete Physical justification of this explanation might also be more difficult because the geometries and the spacetimes presented are presented as indeed separate and independent.

However, the above presentation, that each presented geometry is just an attribute, or a facet, of a certain form of Energy, can be considered as a gesturing towards a relational, Energy-based Ontology of Physics, which is actually touching on a deep and active philosophical question, which can be presented as follows:

Can spacetime be eliminated as an independent entity, and replaced by the idea that only Energy (or Energetic Relationships) exist, with spacetime being just a mathematical representation attached to each inertial-frame Energy?

Because nothing in the mathematics of Physics requires that spacetime be interpreted as an independently existing physical substance, then, the above proposal also echoes several existing lines of thoughts in modern Physics, such as:

1. Relationalism (Leibniz, Mach) (10): Space and Time are not things; only relations between physical objects exist.
2. Emergent spacetime (Modern Quantum Gravity) (11): Spacetime is not fundamental; it emerges from deeper physics structures like Energy, Entanglement, or Quantum States.
3. Energy-based Ontology (12), (13), (14): Some speculative works treat Energy, Action or Information as fundamental, and geometry as secondary.

Contrary to what was presented in this chapter, that the geometries and spacetimes presented in that chapter are separate and independent, in the next chapter, another tentative geometry is presented, which might also explain why Electric Charges attract and repel each other, and that geometry is fully embedded in Einstein's four-dimensional interwoven spacetime.

Thus, the geometry presented in the next chapter, or any other proposed geometry that can be presented, as a geometry that is fully embedded in Einstein's four-dimensional interwoven spacetime, might be easier to Physically justify, compared to a complete Physical justification, that might be required to the separate geometries and spacetimes, presented in this chapter.

6. Another example of how additional geometries can explain why Electric Charges attract and repel each other.

The previous chapter presented a description of three separate, independent geometries, and three separate, independent spacetimes, which might be used in a tentative explanation to why Electric Charges attract and repel each other.

In this chapter another possible description of a geometry is provided which can be used in a tentative explanation to why Electric Charges attract and repel each other.

In the tentative geometry, presented in this chapter, all the relevant geometries are not separate and independent.

Instead, the geometry attributed to the Electric Fields induced by the Positive Electric Charges, the geometry attributed to the Electric Fields induced by the Negative Electric Charges and the geometry attributed to Gravity, are all geometries which are embedded in Einstein's four-dimensional interwoven spacetime manifold.

The above implies that in this description of the Universe, the Universe still embeds just one, single four-dimensional interwoven spacetime manifold, as GRT presents, but this spacetime does not embed only one geometry, as GRT presents.

Instead, that spacetime embeds more than one geometry.

This proposal actually presents that the single spacetime actually embeds three possible, different, but not separated and not independent, geometries.

Because in this proposal, all three geometries belong to one spacetime manifold, that spacetime is what controls the movements of all particles, Uncharged Masses and Electrically Charged bodies.

In that proposal the movements of Uncharged massive bodies are still assumed to comply with what GRT presents, which implies that such movements are the results of the curvatures induced in this single spacetime by any Uncharged massive body, as GRT presents, and also, as also GRT presents, each Uncharged massive body induces a curvature in that single spacetime.

But, in this proposal also Electrically Charged bodies induce curvatures into that single spacetime, which are different from the curvatures that Uncharged massive bodies induce in that single spacetime, as GRT presents, such that these curvatures, induced by Electrically Charged bodies, are able to explain why Electric Charges attract and repel each other.

Thus, in that proposal, a curvature that an Electric Charge will induce in that single spacetime is described as follows:

In GRT each Uncharged massive body induces a curvature in the spacetime which is a function of the magnitude of its Mass.

However, in order to present how a curvature, induced by an Electric Charge, in that single spacetime, will be able to attract and also repel other Electrically Charged bodies, this curvature must be a function of a blend of bodies that are around that Electrically Charge body, and not only a function of its Electric Charge magnitude.

And, in order to present how a curvature, induced by an Electric Charge in that single spacetime, will be able to attract and also repel other Electrically Charged bodies, each Electric Charge must also induce two forms of deformations into that single spacetime.

These two forms of deformations, presented above, can be described as follows:

Similarly to the two forms of deformations which were already presented in the model described, in the previous chapter, the two forms of deformations presented in the model, presented in this chapter, are also a torsion, or twist, and a curvature.

And, each Electric Charge is assumed to induce the above mentioned, two forms of deformations into Einstein's four-dimensional interwoven spacetime, with one important change, as compared to the deformation described, in the previous chapter.

That important change is described as follows:

Even though, the torsion, or the twist, that each Electric Charge induces into the spacetime, is still proportional to the value of q/m embedded in that Electric Charge, the direction of the torsion, or twist, that a Positive Electric Charge induces, in the spacetime, is opposite, to the direction of the torsion, or twist, that a Negative Electric Charge induces, in the spacetime.

For example, if a Positive Electric Charge induces a clockwise torsion or twist, in the spacetime, then, a Negative Electric Charge induces a counterclockwise torsion, or twist, in the spacetime.

And, similarly to the model presented in the previous chapter, in addition to the above-described torsion, or twist, that an Electric Charge induces, in the spacetime, an Electric Charge also induces a curvature, which will be either a dip or a hill.

In order to present how a curvature, induced by an Electric Charge in the spacetime, will be able to attract and also repel other Electrically Charged bodies, the curvature that this Electric Charge induces, would be dip or a hill which depends on the following:

If the net torsion, or twist, in the vicinity of this Electric Charge, induced by all other Electric Charges, is in the direction opposite to the direction that this Electric Charge induces, in this spacetime, then, this Electric Charge will induce a curvature of a dip, in this spacetime.

And that dip will attract other Electric Charges to this Electric Charge.

Instead, if the net torsion, or twist, in the vicinity of this Electric Charge, induced by all other Electric Charges, is in the same direction that this Electric Charge induces, in this spacetime, then, this Electric Charge will induce a curvature of a hill, in this spacetime.

And that hill will repel other Electric Charges from this Electric Charge.

Thus, the deformations presented in the model presented in this chapter, are indeed similar to the deformations presented in the model presented in the previous chapter.

But, by using the above mentioned two forms of deformations, with the additional important change in the torsion, or the twist deformation, which was already presented above, this enabled the possibility to explain, on one hand, the attraction and the repulsion between Electric Charges, and, on the other hand, the model also complies with the apparent measured acceleration (or

deceleration) in such a scenario, by presenting that the induced curvature is affected also by the values of q/m embedded in the Electric Charges that are affected by this curvature, and also the by the value of e, mentioned above.

Thus, as is apparent from what was presented in this chapter, the model proposed in this chapter, is, on one hand, very similar to the model proposed in the previous chapter, and, on the other hand, all the geometries are still fully embedded in Einstein's spacetime, which might help in a simpler physical justification of the model.

Also, because all the geometries, proposed in the model proposed in this chapter, are still embedded in Einstein's four-dimensional interwoven spacetime manifold, all these geometries are not completely separate, and can communicate, and all these geometries can be geometries which obey the invariance of the spacetime interval (25).

7. A proposed experiment which might provide validity to the proposed explanations to why Electric Charges attract and repel each other

In GRT, all forms of Energy (including the Electrostatic Energy stored in Electrically Charged objects) contribute to the curvature of Einstein's four-dimensional interwoven spacetime via the Stress-Energy Tensor ($T_{\mu\nu}$). This curvature results in Gravitational Time Dilation, such that clocks run slower near massive or energetic objects.

Standard QFT/GRT contribution of the Electromagnetic Field's Energy density to spacetime curvature depends only on the magnitude of the Electric Charge (Q^2) and the Energy density of the Field. It is independent on the sign (Positive or Negative).

Thus, the proposed experiment focuses exclusively on the Gravitational Signature of the Electric Field's source (the Electric Charge), and the proposed experiment is designed to detect any measurable difference in Einstein's four-dimensional interwoven spacetime curvature between Positive and Negative Electric Charges, which affect that Einstein's four-dimensional interwoven spacetime curvature.

If Positive and Negative Electric Charges would induce distinct geometries, as proposed in this paper, these distinct geometries might couple to the spacetime metric (g) differently, potentially violating the sign-agnostic Q^2 dependance seen in the standard Stress-Energy Tensor. This would lead to a measurable difference in the Gravitational Time-Dilation based on the sign of a large Electric Charge.

Thus, strong evidence that the Positive and the Negative Electric Fields possess unique, non-symmetric geometric Properties, that violate the sign-agnostic Q^2 contribution predicted by the standard GRT/QFT framework, may help in providing additional validity to the explanations presented in this paper to why Electric Charges attract and repel each other.

And also, strong evidence that the Positive and the Negative Electric Fields possess unique, non-symmetric geometric Properties, that violate the sign-agnostic Q^2 contribution predicted by the standard unifies GRT/QFT framework, may indicate that some modification, might be also required, to the standard GRT/QFT framework.

And, because KK does rely on purely intact Einstein's equations without any changes attributed to Einstein's equations, this might also help in presenting that KK might not be the theory that provides a valid explanation to why the Electric Charges attract and repel each other.

As presented above, differences in the curvatures induced in Einstein's four-dimensional interwoven spacetime should be manifested also in differences in the Time-Dilations that such differences in Einstein's four-dimensional interwoven spacetime would create.

Thus, the proposed experiment chose to utilize Atomic Clocks, to measure such differences in Time-Dilations, if they appear, in the experiment.

That choice, to use Atomic Clocks, is similar to the choice that the famous Hafele-Keating (15) made, to use Atomic Clocks, to provide validity to Einstein's Time-Dilation predictions.

In the Hafele-Keating experiment, cesium-beam Atomic Clocks were used to test if there are differences in these Atomic Clocks readings, between Atomic Clocks which were mounted on commercial jet flights, and identical Atomic Clocks which remained on the ground.

This experiment validated that such differences indeed occurred and these differences coincided with the differences that Einstein's SRT and GRT predicted, which provided testable evidence that Einstein's Time-Dilations predictions were indeed correct.

Thus, the proposed experiment, proposed in this paper, also chose to propose to use Atomic Clocks, to detect differences in Time-Dilations that might appear in the experiment.

8. The setup of the proposed experiment

Components:

1. A test Mass A, which is a sphere of highly conductive material, such as gold, which is charged to a maximum, extremely controlled, stable and very large positive voltage (+V).
2. A test Mass B, which is an identical sphere of highly conductive material, such as gold, which is charged to an equivalent, extremely controlled, stable and very large negative voltage (-V). The Mass magnitudes of the test Mass A and test Mass B should be nearly identical. Also, the total Electromagnetic Energy E_{EM} of test Mass A and test Mass B should be nearly identical.
3. A Reference Clock (C_R), which is a highly sensitive Atomic Clock, placed far from the Test masses. This clock will measure the true time flow.
4. A Test Clock A (C_A), which is an identical Atomic Clock, placed at a fixed very small distance (d) from Test Mass A. This clock will measure the time flow near the Positive Electric Charge.
5. A Test Clock B (C_B), which is an identical Atomic Clock, placed at a fixed very small distance (d) from Test Mass B. This clock will measure the time flow near the Negative Electric Charge.

Procedure:

1. Establishing Baseline:
   With both Test Mass A and B neutral (V=0), the experiment will start with a measurement of the time rate differences between C_R, C_A and C_B. This will account for any inherent clock or local environmental errors (R_0), which should be indistinguishable.
2. Applying Electric Charge:
   At this stage of the experiment, Test Mass A will be Electrically Charged to +V, and Test Mass B will be Electrically Charged to -V.
3. Measuring the Time-Dilations:
   At this stage of the experiment, the experiment will perform a simultaneously measurement of the time rates of C_A and C_B relative to the distant reference C_R.
4. Analyzing the differences in the Time-Dilations:
   At this stage of the experiment, the experiment will perform a calculation of the differences, ΔR, in the Time-Dilations between the two test clocks, where R_A will be the Time-Dilation measured between C_A and C_R, R_B will be the Time-Dilation measured between C_B and C_R, and the differences ΔR in the Time-Dilations, would be $\Delta R = R_A - R_B$.

Testable Prediction:

1. Standard GRT prediction:
   Since the Energy of the Electric Field E_{EM} depends on the square of the magnitude of the Electric Charge (Q^2), and the Masses are identical, then, from GRT follows that R_A and R_B are both expected not to be equal to zero, and the Gravitational Time-Dilation experienced by C_A and C_B, R_A and R_B, should be equal. Therefore, ΔR should be nearly zero.
2. Prediction if the geometric proposal predicted in the paper applies:
   If the Positive and the Negative Electric Charges geometries, presented in the paper, couple differently to the main spacetime metrics, the resulting local curvature (and thus, the Time-Dilation) will differ based on the Electric Charge sign. Therefore, ΔR would not be nearly zero.

This Experiment is crucial and will provide significant important results, in whatever results that it will provide.

As already presented before in this paper, this experiment focuses exclusively on the Gravitational Signature of the Electric Field's source (the Electric Charge).

If the results of the experiment will be a ΔR which is indeed nearly zero, because such an experiment was not executed yet, that result will provide additional validity to the standard GRT/QFT framework, in their sign-agnostic Q^2 contribution, an issue which was not tested yet.

And, if the results of the experiment will be a ΔR which is indeed nearly zero, by providing additional validity to QFT, in an issue which was not tested yet, this might also help in the endeavors to Unify between Classical and Quantum Physics, via QFT.

But, any measurable differences in the spacetime curvature (which will be manifested in measurable differences in the Time-Dilations), between the Positively Electrically Charged Mass and the Negatively Electrically Charged Mass, would provide strong evidence that the Positive and the Negative Electric Fields possess unique, non-symmetric geometric properties that violate the sign-agnostic Q^2 contribution predicted by the standard GRT/QFT framework.

9. Elaboration on suggested future work

Because GRT is the accepted, tested and intensively verified theory on the subject that is presented in this paper, and because what was presented in this paper, might require some modifications to GRT, if the proposed experiment will result in an indication that ΔR is not nearly zero, which will imply that the sign-agnostic Q^2 contribution, predicted by the standard GRT/QFT framework will require some modifications, then, the most important future work, should be an implementation of the experiment proposed, in this paper, or an alternative suitable experiment, which might provide some additional validity, to what was presented in this paper.

If an alternative experiment will be implemented, and it will indeed provide some additional validity to what is presented in this paper, or the experiment proposed in this paper will be implemented, and it will indeed result in ΔR which will not be nearly zero, which will indeed also provide some extra validity, to what is presented, in this paper, then, a more detailed mathematical framework should be prepared, for what might be seen, as the most promising proposal, presented in this paper, for explaining why Electric Charges attract and repel each other.

However, the detailed mathematical framework prepared should still be prepared such, that it might be possible to reconcile it with GRT, apart from the modifications, that will be required to implement in GRT, to comply with the experiment result that the sign-agnostic Q^2 contribution, predicted by the standard GRT/QFT framework, will require some modifications.

The following presents some possibilities to achieve the above:

1. Introducing new Tensors in GRT:
   Introducing an additional tensor field E, representing the Electric geometry, alongside the metric tensor g, representing Gravity. The Stress-Energy tensor would now include terms dependent on E, allowing the Electric Field to affect spacetime and vice versa. In this case, the Universe will still embed one four-dimensional spacetime, but with more than one Geometry.
2. Proposing an additional Higher-Dimension Model:
   Instead of separate geometries, that is one of the models presented in this paper, the four-dimensional spacetime would be a slice of a larger manifold (e.g. five-dimensional or higher). Gravity would be the curvature of the main four-dimensional, and the Electric Field would be the curvature induced by the extra dimensions.
   However, because the experiment proposed in this paper would indicate that the sign-agnostic Q^2 contribution, predicted by the standard GRT/QFT framework will require some modifications, then, GRT would also require some modifications, and because KK is based on intact Einstein's equations, then, this Higher-Dimensional proposal should be

different from KK, and also take into account, the disadvantages of KK, that were already presented before, in this paper.

3. Using Torsion-Based Theories:
   The models presented in this paper, already used Torsion or Twist, as additional deformations induced by the Electric Fields in the spacetime. And, some theories of Gravity, like Einstein-Cartan theory (16), also introduced Torsion, which could theoretically be linked to fundamental particles' properties, like spin or Electric Charge, providing a geometric home for these Fields.
   Thus, if modifications will be needed to the models presented in this paper, which already use Torsion or Twist, then, influenced by, for example, what is proposed by the Einstein-Cartan theory, a tentative change to what is presented in this paper, might present that the Electric Fields will not be related to curvatures or bending induced into the spacetime, but only to Torsions or Twists, if such a modification, in the models presented in this paper, might be best reconciled, with GRT.

10. Elaboration on a tentative Technological implication

This chapter focuses on one possible Technological implication, if the proposed theory will be validated, even though there might be additional Technological implications, if the proposed theory will be validated.

This possible Technological implication is related to the issue of Propellant less Propulsion.

Traditional rockets work on Newton's Third Law: to go forward, one must throw something (propellant) backwards.

A propellant less drive seeks to bypass this interaction directly with the geometry of spacetime or vacuum fluctuations to create motion.

While highly speculative and currently sitting on the edge of "fringe science", there are several theoretical frameworks and experimental attempts to achieve this:

1. The Alcubierre Drive (Wrap Drive) (17).
   Instead of moving through space, the device would contract spacetime in front of it and expand spacetime behind it.
   The result of the above would be, that the craft sits in a "wrap bubble" of flat space while the geometry of the field moves around it.
   However, the above is found to requires "Negative Energy Density" (or exotic matter) to function, which has not been proven to exist in the quantities needed.
2. Mach Effect Thrusters (MET) (18).
   Based on Mach's Principle (the idea that local inertia is influenced by large-scale distribution of matter in the Universe), researcher James Woodward (19) proposed that the Mass of an object fluctuates when it is accelerated while simultaneously changing its Inertial Energy.
   Thus, by vibrating a piezoelectric stack at specific frequencies, one could theoretically create a small, steady thrust, without exhausting any fuel.

Nasa's Innovative Advanced Concepts (NIAC) program has funded research into this, (often called the MEGA drive), though results remain controversial and the thrust detected is extremely tiny.

3. Gravitational Wave Propulsion.
   Since GRT predicts that accelerating Masses create Gravitational Waves, which are ripples in the geometric Field, some theories have looked into whether "high frequency Gravitational Waves" could be generated to push a craft.
   However, the geometry required to generate a ripple strong enough to move a macroscopic object is currently far beyond our Technological capabilities.

Because the theoretical frameworks and experimental attempts to achieve a propellant less drive are based on attempts to use and manipulate the spacetime geometry attributed by GRT to Gravity, and because this paper presents the possibility that the Electric Fields might also be replaced with their own geometries, then, it might be reasonable to assume, that using and manipulating the geometries which this paper attributes to the Electric Fields, might also result in a possibility to achieve a propellant less drive.

However, Electromagnetism is significantly more potent than Gravity. This can be also concluded from the following:

The Gravitational Force between two 1-kg Mass Objects that are 1 meter apart is $6.67 \cdot 10^{-11}$ Newtons (*20*), 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 $9 \cdot 10^{9}$ Newtons (*21*). 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, the above might imply that the probability to achieve a propellant less drive, by attempts to use and manipulate also the geometries that this paper attributes to the Electric Fields, might be higher, as compared to the results presented above, which attempted to achieve a propellant less drive, by using and manipulating only the geometry attributed to Gravity.

Attempts in the endeavors to overcome Gravity, which are attempts that might be related to attempts to achieve a propellant less drive, are Nikola Tesla's endeavors to overcome Gravity. Nikola Tesla (22) is recognized for incredible contributions to Technology and Science, in the field of Electromagnetism. Without his work, our nowadays technology would be considerably worse.

As already presented in the references (22), (23), "without the genius of Tesla we could not have: Radio, Television, AC Electricity, Tesla coil, fluorescent lighting, Neon lighting, Radio control devices, X-Rays, Radar, Microwaves, and dozens of other amazing inventions. Quite an impressive list".

Among his works was his work on Anti-Gravity which he addressed as: The dynamic theory of Gravity.

There are references on the web (23) about Tesla's work relating to Anti-Gravity. From these references one might conclude that Tesla worked on the issue of finding Anti-Gravity solutions,

and might have found, technological means to overcome Gravity. However, Tesla did not accept Einstein's Relativity Theories, as viable theories.

Because Einstein's Relativity Theories have been already accepted, by the science of Physics, as viable theories, based on many observations, this paper concludes that Tesla was wrong, in relation to his attitude to Einstein's Theories.

However, it seems that his Anti-Gravity work embedded elements which might resemble what is presented in this paper, mainly because his Anti-Gravity work was based on Electromagnetism.

However, most documentation of Tesla's work on Anti-Gravity is not available to the public because it is marked as classified by the USA authorities and kept out of reach, as the following quote indicates (24):

"While researching Tesla's statements, Lyne discovered that more complete statements concerning these discoveries could only be gleaned from scattered and sparse sources, because Tesla's papers are concealed in government vaults for national security reasons. When Lyne specifically asked for these papers at the National Security Research Center (*now the Robert J. Oppenheimer Research Center*) in 1979, he was denied access because they were still classified."

If the suggested experiment in this paper, might turn successful, this might steer a technology endeavor to understand how to overcome Gravity, and possibly implementing propulsion means which embed anti-Gravity abilities, means that might overcome Gravity.

Tesla's work might have solved some (or maybe most) of the theoretical and technological obstacles relating to Anti-Gravity, but since Tesla's work is kept out of public reach by the USA authorities, the assumptions presented in this paper, if found viable, might help, a new endeavor to achieve new achievements in this field.

11. Summary and Conclusions

Before Einstein's General Relativity was introduced, Gravity was presented as an Energy Field, and the attraction between massive bodies was attributed to an attraction Force.

Einstein's General Relativity replaced the accepted understandings about Gravity, presented above, with a model of Gravity which presents spacetime as the geometric relationship among events, and this enabled Einstein to provide an explanation to what causes the attraction between massive bodies.

Thus, the geometry attributed by Einstein's GRT to Gravity succeeded to explain why Masses attract each other, but Einstein's GRT cannot be used in attempts to explain the origin of movements caused by additional specific Forces, such as the Coulomb's force which provides the magnitude of the attraction or the repulsion Force between Electric Charges.

Actually, Physics does not provide yet a tested, verifiable explanation to the question: why Electric Charges attract and repel each other, despite the fact, that the Coulomb's Law Force provided the magnitude of the Force of the attraction or the repulsion between Electric Charges.

Current main stream Physics does provide several theories which attempt to provide an explanation to why Electric Charges attract and repel each other, but all these theories are still in the stage of research and investigation, and none propose a feasible test or experiment to provide additional validity to its claims.

This paper proposes tentative additional explanations to the question: why Electric Charges attract and repel each other, along with a feasible proposed experiment, which if implemented, and its results will be successful, might provide additional validity to some of the proposed explanations, presented in this paper, to why Electric Charges attract and repel each other.

This paper presents the assumption, that similarly to GRT, which replaced Newton's Gravitational Force with the geometry of spacetime, attributed to Gravity, the Forces which are attributed to the attraction and repulsion between Electric Charges, might be replaced with geometries attributed to the Energies embedded in the Electric Fields, and this can provide explanations to why Electric Charges attract and repel each other.

This paper presents two such possible geometries, by presenting enough general details, to present that such geometries can indeed provide explanations to why Electric Charges attract and repel each other.

One of the proposed geometries, presented in this paper, presents geometries which are separate and independent from each other, and also separate and independent from the geometry that GRT attributes to Gravity, and each such geometry is attributed to a separate form of Energy, the Energy embedded in Gravity, or the Energy embedded in the Electric Fields induced by the Positive Electric Charges, or the Energy embedded in the Electric Fields induced by the Negative Electric Charges, which implies that all these geometries should be attributed also to separate and independent spacetimes, contrary to the conclusion presented by GRT, that the Universe embeds just one, single spacetime which embeds just one, single geometry.

However, the above can be also considered as a gesturing towards a relational, Energy-based Ontology of Physics, which is actually touching on a deep and active philosophical question, which can be presented as follows:

Can spacetime be eliminated as an independent entity, and replaced by the idea that only Energy (or Energetic Relationships) exist, with spacetime being just a mathematical representation attached to each inertial-frame Energy?

Because nothing in the mathematics of Physics requires that spacetime be interpreted as an independently existing physical substance, then, the above proposal also echoes several existing lines of thoughts in modern Physics, which this paper also briefly mentions.

A second proposed geometry, presented in this paper, presented still different geometries, attributed to Gravity and the Electric Fields, but all these geometries are presented as embedded in Einstein's four-dimensional interwoven spacetime.

Thus, this second presented geometry implies that the Universe indeed embeds just one single spacetime but contrary to GRT, this spacetime does not embed just one, single geometry, instead it embeds several geometries.

Also, because all these geometries, are still embedded in Einstein's four-dimensional interwoven spacetime manifold, all these geometries are not completely separate, and can communicate, and all these geometries can be geometries which obey the invariance of the spacetime interval.

As already presented above, this paper proposes also an experiment.

The experiment is designed to check if a curvature induced into a spacetime by the geometries proposed in this paper is affected not only by the amount of Energy embedded in the Electric Charge which induces this curvature, as GRT concludes, instead, the experiment is designed to check if a curvature induced into a spacetime as proposed in this paper, is affected also by the sign, positive or negative, of the Electric Charge which induces this curvature.

And, because induced curvatures in a spacetime cause also time-dilations which are affected by the characters attributed to this curvature, such as its form or magnitude, the proposed experiment is designed to check the above, by checking if a positive Electric Charge will induce a curvature which will cause a different time-dilation, different from the time-dilation caused by a curvature induced by a Negative Electric Charge.

Thus, any measurable differences in a spacetime curvature (which will be manifested in measurable differences in the Time-Dilations), induced by a Positive Charge or a Negative Charge, would provide strong evidence that the Positive and the Negative Electric Fields possess unique, non-symmetric geometric properties that violate the sign-agnostic Q^2 contribution predicted by the standard GRT/QFT framework, and might support the assumption, presented in this paper, that additional geometries, attributed to the Energies embedded in the Electric Fields, might provide explanations to why Electric Charges attract and repel each other.

This paper also elaborates on one possible Technological implication, if the theory presented in this paper, will be validated, via the experiment, presented in this paper. That Technology relates to attempts to achieve propellant less propulsions.

And, as also mentioned before in this paper, if the theory presented in this paper, will be validated, this might also provide a lead to Unify Gravity and Electromagnetism, a significant issue which is still an open subject.

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