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# Principles of Gravity Manipulation via the Quantum Vacuum

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**Abstract:** By expressing natural constants in terms of Planck units, we found that the Universal Gravitation Constant is the inverse of vacuum density matter-equivalent and the square of Planck time, being the former equal to Planck mass divided by Planck volume. The corresponding new equation of gravitation presented here reveals that gravitation can be manipulated via vacuum energy. Additionally, from Coulomb's constant, we can derive the "Planck charge" and the corresponding density of virtual vacuum particle pairs. A discussion of the ramifications of these findings is also presented.
**Keywords:** Gravitation, zero point energy, inertia, electrogravity, Coulomb's Constant, Planck charge, virtual pairs, quantum vacuum, event horizon.

## Introduction

In two articles [1], [2], we derived respectively the Universal Gravitation Constant (G) from Planck units and demonstrated that, spacetime and quantum vacuum (QV), are two different spaces. Newton's equation of gravitation has two components (a constant [G] and a variable mass component [$m_1m_2/d^2$]) that can be treated separately, since they are independent. As a consequence, gravitation can be considered a combined force, consisting of G (as previously demonstrated to be a QV function) and conventional 'mass attraction', the latter produced by gravity fields and/or spacetime geometry according to the corresponding theories. This principle of independence has allowed us to calculate inertia for mutually attracting and/or otherwise accelerated bodies, finding that inertia has a very high value. Its fundamental effect is probably that of marking a clear distinction between fermions (matter) and photons (light), the latter not being affected by inertia.

While "mass attraction" depends only on mutually attracting masses and their relative position or distance, G (a so-called, "non-derivable constant") can be effectively derived and is found to be the exact inverse of "vacuum mass density equivalent" ($5.156\text{x}10^{96}$ kg/m$^3$), which is come to by dividing the Planck mass by the product of Planck volume and the square of Planck time (the former having already been predicted as an approximate value, e.g. in [3]). This new equation of gravitation resulting from the substitution of G by Planck units reveals that vacuum density (analogous to Zero Point Radiation [ZPR]) affects gravity inversely. This means that, if we were able to increase ZPR, gravity would decrease and vice-versa. In fact, the very small value of G ($6.673\text{x}10^{-11}$ m$^3$kg$^{-1}$s$^{-2}$) already suggests that there is 'something' that weakens mass attraction. We found in [1] that this 'something' is ZPR).

The above findings, in combination with so-called "weak gravitation shielding experiments" ([4], [5]), reveal that gravity can be effectively manipulated via QV by using superconductor arrangements.

In our second article [2], we derived the 'Planck charge' (generally unknown or as the 'electron charge' misunderstood with a value of $1.876x10^{-18}$ C) from Coulomb's Constant (C), corresponding to the charge existing in a QV-Planck volume. By comparing the corresponding QV lepton/photon ratio with the almost equivalent baryon/photon ratio predicted for spacetime by the Standard Model, we found that the former is about 12 orders of magnitude lower, allowing it to be said that under any circumstance, spacetime and QV are two different spaces (even if we corrected somehow for the corresponding ratios, the difference would be still too large to be merely insignificant).

These findings allow us to determine that spacetime is mainly a space full of neutral matter and much light, while the QV is mainly a space full of strong radiation and some charges (virtual pairs), such that both universes are effectively incompatible and ought to exist therefore - even from a theoretical point of view - as separated spaces in the universe.

By dividing the Planck charge by the charge of the electron ($1.6022x10^{-19}$ C), we obtain an average density of 11.71 leptons per Planck volume, which per definition corresponds to the well-known virtual electron-positron pairs that create and mutually annihilate each other in vacuum. At the very moment of their mutual interaction, approximately 12 entire leptons correspond to 6 particles or strings, what is coincident with the 6 Kaluza-Klein dimensions, attributed to strings.

This coincidence allows the establishment of a direct link between strings and the QV as already suggested by The California Institute for Physics and Astrophysics in its homepage ("It now appears that quantum field theory may be the low energy limit of superstring theory") and suggests that the QV is the space where strings are physically located. This model would explain the effect known as 'quantum non-locality', since strings (in so-called 'entangled particles') would interact instantly via the QV in a time that is zero for spacetime observers, since the QV disposes of a different time frame than spacetime because of its different number of dimensions, and therefore QV-time has no meaning to us.

# Gravity Manipulation

As already shown in [1], vacuum mass-density equivalent can be understood, per definition, as a Planck mass existing in a Planck volume:

$$\boxed{\delta_{ZP} = \frac{m_P}{l_P^3}} = \frac{2.177x10^{-8}\,kg}{\left(1.616x10^{-35}\,m\right)^3} = \frac{2.177x10^{-8}\,kg}{4.220x10^{-105}\,m^3} = 5.159x10^{96}\,kg\,m^{-3} \quad , \qquad (1)$$

where: $\delta_{ZP}$ = vacuum mass-density equivalent, $m_P$ = Planck mass, and $l^3_P = V_P$ (Planck volume). Also see [3] for a parallel derivation.

By substituting G with the corresponding Planck units, we get:

$$\boxed{G = \frac{1}{\delta_{ZP}\, t_P^2}} \quad , \qquad (2)$$

and substituting:

$$G = \frac{1}{5.159\,x10^{96}\ kg\,m^{-3}\ (5.391\,x10^{-44}\ s)^2} = 6.670\,x10^{-11}\ m^3 kg^{-1} s^{-2} \quad , \qquad (3)$$

which is equal (to the rounded decimals) to the normal value of G (6.673x$10^{-11}$ $m^3kg^{-1}s^{-2}$) and demonstrates that G corresponds effectively to function (2), i.e., that **G is a quantum-function**.

In consequence, Newton's equation of gravitation adopts the following form by substituting G by eq. (2):

$$F = \frac{1}{\delta_{ZP}\, t_P^2} \frac{m_1 m_2}{d^2} \quad . \qquad (4)$$

In this equation, we call the above-mentioned independent right component "mass attraction" because it depends only on masses and their relative position. According to the "cause-effect principle", the left component (G) can be considered a "vacuum reaction" to gravitation, since matter is obviously the origin of any gravitation. (A similar vacuum reaction to accelerated matter is known as Davies-Unruh effect [9], [10] and demonstrates that the vacuum effectively reacts to the presence of matter. In addition, since in eq. (4), $\delta_{ZP}$ represents a vacuum mass-density equivalent, any reaction to gravitation represents a vacuum effect).

The first we observe in eq. (4) is that gravity is inversely proportional to vacuum energy ($\delta_{ZP}$). In consequence, if we manipulated vacuum energy, we would in parallel be manipulating gravity. Further, if the QV did not exist, ZPR would be zero and according to (4), the gravitational force would be infinite while the opposite would occur if ZPR was infinite (gravity would be zero). In [11], we already mentioned a herewith-related case with regard to the extreme high temperature of the solar corona (up to 2x$10^6$ °C) with respect to the photosphere or surface of the sun (only 5,500°C). Probably, the very dense solar photon stream produces "holes" in the fabric of spacetime, so that the ZPR emerges from QV and heats up the solar corona. In consequence, we predict that in the solar corona, gravity could be weaker than normal.

To understand the nature of the QV and why ZPR is able to reduce gravity, we make the following experiment of thought:

Imagine a flat universe (sheet) located in spacetime (our frame). Any spacetime radiation that crosses the sheet, will produce effects in the sheet, but will not remain there. Eventually the inhabitants of the sheet (flatlanders) will notice radiation effects, but will see no radiation. Analogous happens in our universe: vacuum radiation that crosses spacetime, produces Casimir-like effects, but cannot be seen nor detected because of its alien location.

Since the QV is a 6-D space [2] that surrounds 4-D spacetime completely due to its natural superior extension, spacetime matter is completely surrounded by ZPR. If an object is moving uniformly or at rest, ZPR will be the same on any surface. But as soon as the object accelerates, a Doppler-effect takes place (see also [3] for analogous explanation), so that ZPR becomes more dense in the direction of movement and less dense behind the object. This produces a higher ZPR pressure in the opposite direction of the movement, so that an effective "vacuum reaction" takes place, with the consequence that the initial acceleration is reduced. This effect is commonly known as '**inertia**' and per definition also somehow related to the much weaker Davies-Unruh effect. This means that the vacuum reacts to acceleration by opposing ZPR-borne inertia.

In the case of static bodies, ZPR produces a homogenous radiation pressure, so that no neat vacuum reaction nor inertia takes place. But if we managed to increase ZPR, according to (4), we would induce a vacuum reaction artificially and gravitation would therefore weaken in a parallel extent. In consequence, not only the acceleration is able to produce vacuum reaction (Davies-Unruh, inertia), but also any phenomenon that affects vacuum density.

This can be understood as a vacuum reaction opposite to the existing gravitational fields. Through Newton's equation of motion, $F=m\cdot a$, any body subjected to a field of force (in this case, gravitation), is also subjected to a potential acceleration toward attracting bodies. In consequence, the vacuum reaction will produce a reaction force via ZPR pressure that is opposed to the main direction of the corresponding gravitational fields, with the final result that, even bodies in a stiff gravitational system are subjected to a neat ZPR reaction force opposite to the direction of the field (although not to inertia, since they are not accelerated. In consequence, inertia and vacuum reaction to forces differ in stiff systems and are not exactly the same).

With the above model in mind, we interpret Podkletnov's famous "weak gravitation shielding experiment" as the obvious result of QV manipulation with the aid of electromagnetic (EM) fields, produced by a spinning superconductor. In effect, it seems that the fields induced by the superconductor and/or the coils used for levitation, did increase local ZPR, probably by uploading photons from EM fields to the QV. At that point, according to eq. (4), the higher ZPR should have reduced gravity, which was effectively observed by Podkletnov [4] and later also by Li [5] and several others.

This means that, it was not the superconductor itself that affected gravity, but the resulting EM fields. Probably, a flow of photons from spacetime to the QV takes place if strong EM fields interact mutually, e.g. by making one field rotate inside another as in [4]. The resulting 'friction' between both fields could provide the necessary energy to upload photons from spacetime fields to the QV, thus increasing local ZPR and reducing gravity according to eq. (4).

This principle suggests further that ZPR is not uniform in the universe, but that there could be many local phenomena that increase or decrease vacuum energy, making therefore respectively decrease or increase the local gravity. The universe can be in this sense understood at least as a giant gravity device via the QV. The expansion of the universe could be so, at least in part, interpreted as the result of ZPR repulsion on matter. Emerging ZPR in intergalactic space could explain intergalactic voids as well as the global dispersion of the universe.

To alter ZPR, we could use any kind of device or system, able to create a photon flow from a QV to spacetime and/or vice-versa. It seems at this stage easier to weaken gravity by mutually interfering, intense spinning EM fields, or by flooding tiny spaces with large amounts of photons [11], than to increase gravity by contrary means.

Anyhow, to increase gravity, it would be necessary to extract photons from QV. This may be the way that black holes, neutron stars and other dense objects do produce or absorb some radiation of this kind. By compressing supercold matter (Bose-Einstein condensate), instead of obtaining a fusion as in a conventional hydrogen bomb, as we have already suggested in [12], it should be able to create superdense matter. Arranging this matter in devices, it should be able to download photons from the QV in order to increase local gravity. A spacecraft equipped with a combination of several of the above-mentioned technologies, should be able to navigate without the need of any propulsion, at least in the proximities of celestial objects.

All the above-mentioned are methods dedicated to alter locally Gravitational Constant, 'G'. But the right component of eq. (4), which consists of "mass attraction", is the phenomenon that, in principle, induces a vacuum reaction (left component). This means that, apart from the vacuum reaction, masses attract mutually by some sort of a ‘gravitational field’ or ‘spacetime geometry’ as predicted by quantum field theories and general relativity, respectively. Therefore, another way to alter gravity would be by manipulating such fields or geometries - a theme that is out of the scope of this paper.

The novelty of eq. (4) is that it demonstrates that quantum gravity is not really subjected to any kind of constant, but that it is the result of the balance between gravitational attraction and vacuum repulsion on spacetime objects subjected to ZPR. Nature has probably provided this apparently complex system to allow a more stable universe that is not subject to unbiased and/or infinite field intensities and/or accelerations [1]. A universe without a QV component would probably be a very chaotic place if it had ever existed at all.

Following an analogous method as once Max Planck did when he derived Planck units from natural constants, and expressing Coulomb’s Constant (C = 8.988x10$^9$ Nm$^2$/C$^2$) in term of Planck units, in [2] we found the charge contained in a Planck volume (Planck charge):

$$q_P = \left( \frac{m_P\, c^2\, l_P}{C} \right)^{1/2} = \left( \frac{2.177x10^{-8}\, kg \left(2.998x10^{8}\, ms^{-1}\right)^2 1.616x10^{-35}\, m}{8.988x10^{9}\, Nm^2 C^{-2}} \right)^{1/2} = 1.876x10^{-18}\, C \quad . (5)$$

This charge, divided by the charge of the electron (1.6022x10$^{-19}$ C), renders the amount of 11.71 leptons per Planck volume, corresponding to well-known virtual electron-positron pairs.

Since Coulomb’s Constant is a function of vacuum permittivity ($\varepsilon_0$) and/or permeability ($\mu_0$), Planck charge can be interpreted as the charge of virtual pairs existing in vacuum. In consequence, any vacuum Planck volume contains 11.71 virtual leptons. Because 11.71 is a mean value, there can be 10, 11, 12, 13 etc. leptons at any time in a Planck volume, with 12 being the closest integer value.

These 12 leptons would correspond to 6 virtual pairs. It is known that any pair mutually annihilates and produces a gamma particle pair, which again mutually annihilate and renders an electron-positron pair in an almost immediate and endless sequence inside a confined space. At the very moment of their mutual interaction, 12 leptons/gamma particles fuse and represent the volume of 6 particles/strings. Since any string is considered to be one-dimensional and of the Planck length, 6 strings would fill up the space corresponding to a 6 dimensional Planck volume.

Since the above-mentioned 6 virtual pairs are contained in a Planck volume that according to Coulomb’s Constant is a vacuum, it results that quantum vacuum is a **6-dimensional space**. (In fact, 6 one-dimensional strings concentrated in one spot have, per definition, the extension of a 6-dimensional Planck volume).

In [2], we also showed that, by comparing the fermion/photon ratio of spacetime and QV, it results that the QV contains 12 orders of magnitude more photons than spacetime. This enormous difference between these principally infinite macroscopic spaces, together with the above 6 dimensions that are found to exist in a QV, demonstrate that the QV and spacetime are different spaces, i.e. that they are not the same space.

Further, it is generally known from string theory that particles consist of 10-dimensional strings. These 10 dimensions correspond to 4 outside spacetime dimensions (the outer shell of the corresponding particle) and 6 curled dimensions inside string environment that are supposed to be a relic of the Big Bang, so that the original 10 dimensional particle that exploded at the beginning of the universe rendered a large amount of smaller particles that carry inside curled 6-dimensional (Kaluza-Klein) universes, each about the Planck size.

The 6 dimensions attributed to string environment coincide exactly with the number of 6 dimensions we found to exist in the QV. In consequence, the QV can be considered the medium in which strings are located, such that any Kaluza-Klein universe that surrounds a particular string would be connected to the QV through a path to the 'other side' that is not directly accessible through spacetime under normal conditions.

On the other hand, it is generally known that entangled particles do display a so-called 'non-locality'. That is the ability of particles like bosons to get synchronized at very large distances and is interpreted as the immediate interchange of information in a time that is zero for spacetime observers (see [13] for additional explanation).

With our model of strings that are surrounded by a 6-dimensional QV, particle non-locality can be easily understood as the ability of elementary particles to interact through the QV. As previously mentioned, each particle can be understood as consisting of an outer 4-dimensional shell (spacetime side) and an inner 6-dimensional string (QV side). While the outer shell would be responsible, e.g. for conventional photon interchange via spacetime, the inner shell would be responsible for mutual 'communication' that is known to exist in entangled particles. Since communication in 6-dimensional QV happens in a time frame beyond 4-dimensional spacetime, any QV interaction happens in a time that has no meaning for spacetime observers (i.e., the time needed by two entangled particles to interact results to be zero for us and for all of our spacetime devices).

As a result, our universe can be understood as consisting of two different spaces (spacetime and QV) linked together by elementary particles, such that the outer shell of any particle corresponds to the well known 4-dimensional particle, while the inner side is built up by a string surrounded by a local portion of the 6-dimensional QV. Generally speaking, any particle can be considered as being a small window to the QV.

## Discussion

In the past, there has been no possibility to fuse these tiny windows in order to create a window that is large enough to be used, e.g. as a path to the 'other side', but the recent discovering of so-called "Bose-Einstein condensation" (BEC) makes it now possible. In fact, at a temperature of only one-billionth degree Kelvin, atoms turn into matter waves and acquire quantum properties. This means that BEC atoms behave like bosons and that they are able to overlap and to produce a single wave made out of all the small waves that constitute the corresponding atoms.

By fusing supercold atoms into a matter wave, what we would really be doing is eliminating the outer 4-dimensional shell of elementary particles, thus allowing the 6-dimensional QV to **emerge** and provide quantum properties to the wave, which are per definition usually confined inside the QV. By fusing a large amount of particles into one single wave, all Kaluza-Klein universes of the corresponding strings would also fuse, building a path to the QV, which could theoretically be enlarged with awesome potential. One possible use would be transportation through the great expanses of space.

A matter wave can be further understood as the "event horizon" of the border between spacetime and QV, resembling the event horizon of a black hole to some degree. In this sense, a matter wave (in opposition to a light wave) acts as a large window or path between spacetime and the QV. (Light can be understood as consisting of strings that are *not connected* to the QV and just simply "ride" upon spacetime fabrics. This 'simple' difference would mark the fundamental difference between matter and energy).

Theoretically, in order for a large BEC window to be used as a path for devices or probes to explore the other side, we ought to be able to create a BEC that is large enough for this purpose. Currently the BEC is very fragile and consists only of a diluted cloud of dispersed atoms. A technically useful BEC-window should consist of a large dense mass of BEC that is condensed solid matter, large enough, to provide sufficient space and dynamism for transportation through it. To achieve such a goal, we must improve the current techniques that allow creation of BEC (i.e., magnetic traps, laser light spotting, etc.) and use more powerful ones, such as matter blocks submerged in a circuit filled with a superfluid (e.g., He-4). Even if superfluids are not perfect BECs, a counter-flow of such fluids will produce a constant energy loss in matter blocks submerged in that flow, eventually until the BEC-temperature. In consequence, even with relatively simple technologies, it might be possible to produce large blocks of BEC, by just using the right technique.

Despite any difficulty that could exist in producing the above-mentioned technology, we are confident that they are in reach within the following 25 years or even earlier if these ideas are explored expeditiously.

# Conclusion

Such ideas have been criticized about not using relativistic approaches to the corresponding equations presented. But this criticism is senseless because at the Planck level, there is **no relativity**. Max Planck derived his fundamental units directly from natural constants without using any relativistic approaches. Natural constants also provide information about the QV directly. In this sense, the speed of light is the exact value of Planck length divided by Planck time and vacuum energy corresponds exactly to Planck mass divided by Planck volume. Relativity probably takes place somewhere between the Planck world and normal level. But neither the Planck level nor the cosmological level seem to be subjected to any sort of relativity – they are fundamental and so are such concepts.

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