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The Quantum Vacuum Lepton/Photon Ratio

Dr. Carlos Calvet hyperspace@telefonica.net
Francisco Corbera no. 15, E-08360 Canet de Mar (Barcelona), Spain

Abstract: From Coulomb's Constant, the "Planck charge" (q_P) and the corresponding quantum vacuum (QV) lepton/photon ratio are calculated, the latter by dividing q_P by the Planck mass. The QV-lepton/photon ratio is very different to the analogous baryon/photon ratio that is predicted by Standard Model, demonstrating that QV and space-time are **two different entities** (e.g., that they have a *different number of dimensions*). A dimensional model for the QV that evolves from, and is supported by, the lepton/photon ratio is presented herein, together with emerging technologies.

Keywords: Coulomb's Constant, Planck charge, virtual pairs, quantum vacuum.

Introduction

That Coulomb's Constant ($C = 8.988 \times 10^9$ Nm^2/C^2) is a quantum-vacuum (QV) function, is already known, since it is a function of vacuum permittivity (ε_0) and/or permeability (μ_0). That vacuum has a permittivity and/or permeability means that it contains charges, since any charge is exposed in vacuum to a certain electrical resistance. But no "real" charges are found in empty space, thus the corresponding particles (Dirac pairs) are considered "virtual".

In a former paper [1], this author found that Newton's Gravitational Constant ($G = 6.673 \times 10^{-11}$ $m^3kg^{-1}s^{-2}$) also is a QV-function, since it can be precisely derived from Zero Point Energy (ZPE) Density Matter Equivalent ($\delta_{ZP} = 5.159 \times 10^{96}$ kg/m^3) and Planck time (t_P) according to the equation: $G = \delta^{-1}_{ZP}\ t^{-2}_P$.

In the same paper, it was demonstrated that the value of the ZPE Density Matter Equivalent found (e.g. in [2] and [3]; value of approx. 10^{97} kg/m^3) is much easier obtained, by simply dividing Planck mass (m_P) by Planck volume (third power of Planck length [l_P], being $m_P/l^3_P = 5.159 \times 10^{96}$ kg/m^3), with the corresponding energy being as "virtual" as QV-charges (i.e., it is unable to be detected directly).

Further, it is generally known that even the speed of light (c) is a QV-function, as it is the exact quotient between l_P and t_P ($c = l_P/t_P$). This fact and that the above-mentioned ZPE Density Matter Equivalent (DME) is equal to the quotient between Planck mass and Planck volume, supports the idea that Planck units are real and that they represent effectively existing physical circumstances of QV.

On the other hand, natural constants like Coulomb's Constant and Newton's Gravitational Constant are per definition absolutely real too, since they represent space parameters that influence our measurements, respectively by increasing or decreasing natural forces, in this sense, electric force ($C > 1$ Nm^2/C^2) and gravity ($G < 1$ $m^3kg^{-1}s^{-2}$).

When Max Planck derived in 1899 his natural units (l_P, t_P, m_P), he used a comparison method, whereby he took G, c, and his own constant (h), and thus assembled them according to the corresponding dimensions. In this way, he obtained a length, a time, and a mass that are as real as any natural constants, since they are the direct product of these. Even Planck frequency (ν_P

$= t_P^{-1}$) is a very real value, since it is the assumed cut-off of the QV-radiation spectrum [4] and this frequency was used in [3] to calculate the ZPE DME. In addition, in [1], it was demonstrated that the value of the ZPE DME is exactly the same, whether it is derived from ν_P or from m_P, thereby implying that the QV frequency cut-off is effectively ν_P and that both values are analogous and real.

Since ZPE is per definition the energy contained in QV, the most outstanding conclusion of the above-mentioned is that both, natural constants and Planck units, are real and provide direct evidence about the properties and composition of QV.

This paper follows the above-mentioned research lines and provides strong evidence that the QV and String Theory can be unified through a common 6-dimensonal space that allows well-known properties like particle non-locality or Bose-Einstein (B-E) condensate material waves.

Results

As demonstrated in [1], G is a function of the ZPE DME and, per extension, of the QV-energy content. Hereunder, it will be shown, how it is possible to calculate from Coulomb's Constant (C), the charge contained in QV, known as 'virtual pairs'.

Considering the units of C (Nm^2/C^2) and using the same method as Max Planck, when he developed his natural units (and per extension, the same method as used in [1]), we break down the units of C into Planck units as follows:

$$C = \frac{F\, l_P^2}{q^2} = \frac{E\, l_P}{q^2} = \frac{m_P\, c^2\, l_P}{q^2} \qquad , \qquad (1)$$

where F = a force, E = an energy, and the value "q" represents in this context per definition, the charge that is confined within a Planck volume, therefore making it legitimate to denominate this, "Planck charge" (q_P).

Finding "q_P" and substituting the values of the other Planck units (all values hereunder being of the MKS metric system):

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

To convert the above q_P into the corresponding amount of leptons (where electrons and positrons = virtual pairs), we divide q_P by the charge of the electron ($1.6022x10^{-19}$ C), thus obtaining the amount of 11.71 leptons per Planck volume. These 11.71 leptons are then multiplied by the mass of the electron ($m_e = 9.1094x10^{-31}$ kg), corresponding to a *lepton mass equivalent* ($m_{q,P}$) of $1.0667x10^{-29}$ kg in a Planck volume.

Finally, since in the ZPE DME (m_P/l^3_P), m_P represents an electromagnetic (EM) radiation, by dividing $m_{q,P}$ through m_P, we obtain the QV-lepton/photon ratio:

$$\frac{m_{q,P}}{m_P} = \frac{1.0667x10^{-29}\, kg}{2.177x10^{-8}\, kg} = 4.9000x10^{-22} \qquad . \qquad (3)$$

Consequently, in QV, leptons (virtual pairs) are approximately only $4.9x10^{-20}$ % as frequent as photons (ZPE), what was already known qualitatively in vacuum research.

Conclusions and Discussion

It is generally known that in the universe, there are many more photons than fermions. The baryon/photon ratio as provided by the Standard Model is approximately 10^{-9}, although Olive, Steigman, and Skillman [5] have argued that it is approximately 10^{-10}. Since, as generally accepted, the universe must have an almost equal number of positive and negative charges in order to maintain its own stability (as known, a slightly unbalanced charge ratio would make the universe collapse), it is legitimate to compare the lepton number directly with the baryon number, since both are equivalent.

In this sense, the QV-lepton/photon ratio (3) is about *12 orders of magnitude lower* than the value of the baryon/photon ratio in the Standard Model, demonstrating that in QV, the proportion of photons with respect to matter is much higher than in space-time (there have been found no neutral particles in QV that could alter this fact). The fact that charges are much less frequent in QV than in space-time with respect to photons, demonstrates that at least in principle, the "real" universe (space-time) and the "virtual" QV are two different spaces.

Since the parameters $m_{q,P}$ and m_P used in (3) represent, respectively, leptons/gamma particles and QV-radiation, and QV-radiation has its mean approximately at the level of such gamma particles (10^{20}-10^{22} Hz is approximately the mean of the whole EM QV-spectrum up to the Planck frequency, 1.855 x 10^{43} Hz), the ratio (3) is perfectly comparable to that of the Standard Model. And even if the ratio (3) should change slightly, this would have no effect because of the enormous difference observed (about 12 orders of magnitude).

The apparently trivial question of why the QV is 'virtual', appears to be extremely important if we consider that "at the 53 GHz-frequency middle band of the COBE Differential Microwave Radiometer, the ZPF/Cosmic Microwave Background ratio would be 0.77. Even more dramatically, in the optical spectrum, eqn. 2 (EM-blackbody spectrum including ZPF) predicts, that the ZPF should be about two orders of magnitude brighter than the Sun", as argued in [6].

The generally accepted explanation of why the QV is a virtual space, is that our universe is built upon QV-energy, such that we are not able to detect it, because any detector would have to be made out of that energy. Some known visible effects produced by the QV are so-called 'van der Waal's forces', which are microscopic and act even near absolute zero (0º Kelvin); as well as adherence of crude B-E condensate, and the macroscopic Casimir force between dielectric or conducting plates [6], [7]. But even so, the main question remains, "where exactly are ZPR (vacuum radiation) and virtual pairs located?" If they were located in 4-D space-time, we should be able to detect them directly, even if we and our devices were made of such energy.

Planck units do focus this problem. In fact, a Planck mass can be considered, per definition, as a certain natural QV-mass confined within a Planck volume and allows for the calculation of a QV-mass density equivalent of about 10^{97} kg/m^3 as mentioned in [1], [2], and [3]. If we divide m_P (2.177×10^{-8} kg) by the mass of an electron (9.110×10^{-31}kg), we get the corresponding concentration of 2.390×10^{22} leptons (electrons and positrons) per V_P (Planck volume). Even in the case of much heavier or more energetic particles (baryons, gamma-particles, etc.), we always get a concentration of particles that infringes on the principle that a Planck volume cannot contain more than *one* single particle in 4-D (dimensional) space-time, since it is per definition, the smallest possible volume that can exist in space-time.

One possible solution to the above problem could be, that the QV does not only contain photons and fermions, but also other bosons, like gluons. In this sense, [8] suggested that the QV might also be the source of fields of other fundamental interactions. But so far, only EM-radiation (ZPR) has been found to exist in QV.

The above-mentioned 11.71 leptons per Planck volume (V_P) mean that, on average, there are a little less than 12 leptons per V_P, so that most frequently, the integer number of leptons in a V_P is 12. Since these 12 leptons correspond to virtual pairs that anihilate and create mutually in an endless cycle together with the corresponding gamma-particles involved (virtual pairs produce gamma-particles and visa-versa), at any time, there is an amount of 6 pairs in a V_P, which at the very moment of their mutual interaction, take a space analogous to 6 particles or strings.

In this context, the California Institute for Physics and Astrophysics mentions on its homepage that "it now appears that quantum field theory may be the low energy limit of superstring theory". String theory predicts, as generally known, that strings represent a 6-D curled microscopic space in 4-D spacetime, so that the total dimensions of a particle is 10.

Finally, the 6 particle pairs found in a V_P are surprisingly coincident with the figure of 6 curled dimensions of strings, which correspond to the interior region of elementary particles. In addition, since space-time and QV are, as shown above, two *different spaces*, the immediate conclusion is that they also have a *different number of dimensions* (since two spaces with the same number of dimensions would belong obviously to the same space). But, as seen, QV and space-time have a different overall radiation content.

Taking the model of string-theory and applying it to QV, it results that QV is a 6-D space, since in this way, each QV-V_P would have just the necessary space to contain 6 particles (strings, equivalent to 6 virtual pairs at the very moment of their mutual interaction), so that each particle (string) would be correctly placed in its own and exclusive dimension. This is in principle possible, since strings are believed to be of the Planck length and one-dimensional. In consequence, any of the strings would be included in a Planck section of the corresponding dimension.

In consequence, the universe can be understood as consisting of a macroscopic 4-D space-time, surrounded by a macroscopic 6-D QV, being both of these two spaces linked together by elementary particles, the thermal surface of the particles being 4-D and interacting mainly with space-time, while the supercold interior region of the particles is 6-D and interacts mainly with the QV, being the total number of dimensions 10, as foreseen in string theory. Because of their above-mentioned apparently complex structure, particles can be understood as small interfaces that link space-time to QV.

The above model is very simple and able to explain novel phenomena like particle entanglement (quantum non-locality) and B-E condensation. In this sense, particle entanglement is interpreted by this model as particle communication between the interior 6-D regions of two or more particles through a 6-D macroscopic QV. The time needed for this kind of communication has obviously no meaning in 4-D space-time (it happens beyond 4-D spacetime), so that it is apparently zero for human observers, thus producing the well-known properties of entangled particles (non-locality, etc.).

B-E condensation strangeness too can be explained perfectly by this model, since at condensation temperature (±0K), the 4-D kinetic of the outer thermal shell of elementary particles becomes so weak, such that the interior 6-D quantified supercold region emerges and becomes visible to space-time-observers, thus providing quantum properties to B-E-condensed matter.

Since the QV and space-time are two incompatible spaces (i.e., they cannot merge mutually due to the different radiation contents), nature has obviously provided a so-called 'event horizon' (already known from black holes), which represents the interface of contact between 4-D space-time and the 6-D QV. This interface becomes evident, for example in the *wavy nature* of B-E-condensates, since it represents a quantum property emerged from the QV that is visible for space-time observers. The very slow speed of light observed in B-E condensates is probably the effect of such an event horizon on light, such that it travels normally through the QV, but seems to 'creep', viewed from space-time.

Since B-E condensates represent an event horizon between space-time and the QV, it should be possible to send signals through the QV to distant places in almost zero human time, and to develop new related technologies. Current B-E condensates are simple atom clouds, while superfluids (supercooled helium) are still very contaminated with thermal matter. But, if we managed to produce supersolids (supercold solid matter) or perfect superfluids, as soon as the whole block of matter became a wave, this wave would represent a *macroscopic interface* to the 'other side', opposite to the *microscopic interface* that particles represent. In this case, it ought to be possible, even to step through the matter wave and send, for example, small probes to explore the 'parallel universe' on the QV-side (with the necessary technology provided).

On the other hand, *string colliders* seem to be in reach, by making collide supercold atoms mutually inside energy-free "Casimir-spaces". Since the thermal 4-D surface that surrounds particles in spacetime weakens and disappears almost completely in B/E-condensates, the amount of energy needed to make collide the free strings of the interior region of such supercold and "nacked" particles will be much less than at higher temperatures. We predict therefore that string colliders will render a *huge energy gain* in comparison to other common methods of energy production.

Summary

This model agrees with the Big-Bang theory and complements it, since the QV and the interior region of particles, which have the same number of dimensions (6), will have probably had the same creation process too. As seen, one function of the QV in our universe is that of providing gravitation through vacuum radiation [1], [2]. If the QV did not exist, there would further be no particles, since their 6-D strings could not exist in 4-D space-time, so that, although the QV does not contain matter, rather it allows for a material existence in space-time. The supercold quantified 6-D condition of the QV probably hides critical events to future exploration. Nevertheless, efforts should be made to reveal the QV-nature through supercold matter experimentation, and subsequently develop QV-technology by using the above-mentioned event horizon senario. A more detailed description of all these emerging technologies can be found in [9].

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