Frequency, energy and power: New perspectives in quantum physics

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The primary aim of this paper is to illustrate the universal relationship between frequency, energy and power, $E = \pm\, n.h.f$ and $P = \pm\, n.h.f^2$ for electromagnetic and gravitational waves by deriving quantum gravitational expressions for wavelength and energy from Einstein's equation for gravitational power in General Relativity. We then derive the energy and power equations from the conductance properties of a Hydrogen molecule in a (Pt-H-H-Pt) chain and demonstrate that the classical equation of power for standard electric circuits can, under certain circumstances, apply to simple molecular circuits. Finally we test the validity of Podkletnov's experimental results concerning the gravitational shielding effects observed when sample masses are placed over rotating superconducting disks in high frequency AC magnetic fields and conclude that gravitational effects due to the rotation of the disk are negligible and can be excluded. However since quantum gravitational energy has two solutions as in Dirac's relativistic wave equation, we do not rule out the possibility that anti-gravitational effects related to the superconducting state in concert with the rotating magnetic fields are responsible for this shielding effect.

Pacs Numbers: 04.60.-m, 73.23.-b, 74.20.-z

Key words: Quantum gravity, Electronic transport in mesoscopic systems,
Theories and models of superconducting state

I. INTRODUCTION

The existence of gravitational waves was predicted by Einstein as a consequence of General Relativity [1] and described as ripples in the curvature of space-time. In an analogous way that electromagnetic waves are produced by accelerated electric charge, it is argued that gravitational waves are emitted by mass in acceleration or by the sudden change in the mass of an object. However, whereas electromagnetic waves are produced by oscillating dipoles, the principal source of gravitational power is in quadrupole radiation. Yet despite the success of GR [2], gravitation has resisted quantization to date which implies that the current approaches (operator, canonical, path-integral, loop, geometrical and brane) summarized in S. Carlip's article [3] and treated in greater detail [4] by some of the world's experts are inaccurate since they have so far given unsatisfactory results. The process of renormalization in the path-integral method for example, which is a prime candidate in this regard, has severe drawbacks [5], since the lagrangian describing classical gravity, treated as a function of the metric $h_{ik} = g_{ik} - h_{ik}$ is not perturbatively renormalizable [6]. It is also probable that general relativity which needs to be modified if it is to be reconciled with quantum physics although the difficulties involved seem formidable. Consider for example, the quadrupole equation:

$$4.\pi.R^2.S = (\bar{k}/80.\pi)[\Sigma_{uv}\dddot{J}^2_{uv} - 1/3.(\Sigma\dddot{J}_{uu})^2] \qquad (1)$$

for a mechanical system which maintains perfect spherical symmetry about its axis. The principle that this system cannot emit dipolar gravitational radiation because of conservation of angular momentum appears flawless. Yet with respect to:

$$t_{41}/i = (K/64.\pi^2.R^2)[1/4.(\dddot{J}_{22} - \dddot{J}_{33})^2 + \dddot{J}_{23}] \qquad (2)$$

which represents the gravitational flux or energy density of the waves, Einstein paradoxically admits that a future quantum treatment of gravitational waves would require a modification of GR [7]. In view of this fact, the strategy we have adopted consists of quantizing Einstein's equation for gravitational power thereby deriving expressions for wavelength and energy without altering the validity of general covariance, the equivalence principle and the notion of space-time in four dimensions.

II. FREQUENCY, ENERGY AND POWER IN QUANTUM GRAVITY

A classical problem solved by Einstein [8] for example, concerns the gravitational radiation emanating from a metal bar of radius *1* m, density *7.8* g.cm^{-3} and tensile strength 3×10^9 dyne.cm^{-3} spinning perpendicular to its centre of mass axis. The mass of the bar at 4.0×10^5 kg and of length *20* m gives a moment of inertia of:

$$I = m.l^2/12 \tag{3}$$

$$I = 1.633 \times 10^7 \text{ kg.m}^2$$

With angular velocity $\omega = 28$ rad.s^{-1} the gravitational power of the waves is given by:

$$P = \frac{32.G.I^2.\omega^6}{5.c^5} \tag{4}$$

$$P = 2.267 \times 10^{-29} \text{ W}$$

The wavelength of the gravitational waves emanating from the spinning bar will be given by:

$$\lambda_g = \pm \frac{(5.h.c^7)^{1/2}}{(32.G.I^2.\omega^6)^{1/2}} \tag{5}$$

$$\lambda_g = \pm 1.621 \times 10^6 \text{ m}$$

and their frequency will be given by:

$$f = c/\lambda_g \tag{6}$$

$$f = 184.943 \text{ Hz}$$

It is important to note that this frequency is not the same as the frequency of the rotation of the metal bar which at $\omega = 28$ rad.s^{-1} represents *175.929* rps but since the mass distribution of the bar is periodic with period $T = 1/2.f$ the frequency is actually *351.858* Hz. While it is true that these two quite distinct frequencies are proportional to each other, they are not synchronized with each other since the waves travel at the velocity of light and the maximum tangential velocity of the bar at $v = \omega.r = 280$ m.s^{-1} is considerably less.

To calculate the energy of the gravitational waves we use the Planck-Einstein relation $E = h.c/\lambda$ which can be expressed as:

$$E = \pm \frac{(32.G.h.I^2.\omega^6)^{1/2}}{(5.c^5)^{1/2}} \tag{7}$$

$$E = \pm 1.225 \times 10^{-31} \text{ J}$$

This equation explains that there are two solutions to quantum gravitational energy which is logical in view of the fact that the solutions $E = \pm (\rho^2.c^2 + m^2.c^4)^{1/2}$ to Dirac's relativistic wave equation $(i\gamma^{\mu}\partial\mu - m)\psi = 0$, apply to both matter and anti-matter. In other words, if ordinary matter produces gravitational energy, then for reasons of symmetry, it is probable that anti-matter produces anti-gravitational energy.

But the question of what exactly constitutes anti-gravitational energy is a difficult one to answer. When anti-matter and matter annihilate each other for example, the resulting energy is always positive and not negative. At first sight, this seems rather curious and logically if one accepts the laws of symmetry, one would reasonably expect negative energy to be created in equal amounts to positive energy. The question is why is only positive energy created and never any negative energy? It is probable that the answer has to do with interpretation and that physicists have wrongly interpreted the negative sign in Dirac's equation as negative energy. If we suppose for an instant that anti-matter is just a name to denote positive matter which is a mirror image of ordinary matter, in other words opposite charge, spin, baryon and strangeness numbers then it becomes perfectly logical that annihilation always results in positive energy, ie. positive matter + positive matter = positive energy.

Hence, in an analogous way it might be possible that anti-gravitational energy is also positive energy but such that anti-gravitational waves would differ from ordinary waves by their polarization, spin or some other hitherto unknown property since, according to standard theory, gravitons and gravitinos have different spins, $g = 2$, $\bar{g} = 3/2$. However this is problematic since the spin of particles can only be determined in the presence of strong non-uniform magnetic fields. In the absence of such a field nobody can confirm for example, that an electron is truly a spin $1/2$ particle. Moreover Podkletnov and Modanese's latest experiment (see ref [34]) which reported that their gravity impulse generator had a repulsive effect on suspended sample masses placed in vacuum flasks proportional to the mass of the samples and independent of their composition certainly seems to imply that the high-voltage discharge pulse possessed gravitational or anti-gravitational characteristics. The fact that this radiation was able to propagate through various media such as a brick wall and steel plates without any noticeable loss of energy is also particularly convincing.

However Feynman, like the majority of contemporary physicists, was adamant that anti-gravity could not exist. Unfortunately his conception of anti-gravity was based on the belief that since likes repel and opposites attract for electric charges, the opposite should be true for matter and anti-matter [9], in other words since matter attracts matter then anti-matter should repel matter which is not supported by experiments involving the disintegration of K_0 and $\bar{K}_0$ particles. However Feynman's argument does not take into account the individual properties of particles such as quark flavour, quark colour, strangeness, baryon number, spin, isospin, electric charge as well as gluon colour and anti-colour combinations and gluon spin which can make all the difference. This is demonstrated by the fact that charged pions $p^+ = (u\,\bar{d})$ for example, which are composed of quark/anti-quark pairs of different flavours and which can therefore not annihilate each other, decay into muons and neutrinos while neutral pions $p^\circ = (u\,\bar{u})$which have the same quark flavour, annihilate into gamma rays which is positive energy. This means that there is presently no evidence to dismiss the possibility that matter and anti-matter repel each other. On the other hand, it may be possible that when an anti-gravitational wave interacts with a gravitational wave, they simply cancel each other out to create energy if they are of equal magnitude which would manifest itself as quantum fluctuations of vacuum for example. Unfortunately without experimental detection of gravitational waves, it is difficult to define exactly what anti-gravitational waves are. Nevertheless we can now express the energy and power equations of the gravitational waves as:

$$E = \pm\, n.h.f \tag{8}$$

$$P = \pm\, n.h.f^{\,2} \tag{9}$$

Where $n = 1,2,3...$ in this case and where (9) describes the instantaneous power of the waves during the period $T = 1/f$ or more precisely, the energy of a gravitational wave at a given frequency during the time interval it takes for a single wavelength to cross a given set of coordinates, $T = \lambda\,/c$.

III. FREQUENCY, ENERGY AND POWER IN SIMPLE MOLECULAR CONDUCTANCE

In this section we prove that equation (9) also applies to electromagnetic waves but to understand how, one needs to clarify what conductance is at the macroscopic level.

At this scale, electric current has traditionally been defined as the rate at which moving electric charge crosses a given surface area which is unsatisfactory since the mean drift speeds of electrons or ions in typical metal conductors for example, are on the order of a couple of $mm.s^{-1}$. But when an electrical switch is turned on, the signal is virtually instantaneous. Hence it can be argued that electric current is really the successive absorption and emission of photons by individual electrons which constitutes the electromagnetic wave which is transmitted at relativistic speed across the electrons. This makes sense because the electric field which is defined as the force acting on a given point charge at a given set of coordinates is proportional to the drift speed of the charge carriers which is too slow to transmit this instantaneous signal. Hence only the electric and magnetic fields of the waves which are proportional to the square of the Fermi energy of the medium can satisfactorily explain this instantaneous electric current. If this is true then the Planck-Einstein relation (8) can be used to describe the energy of the waves which in turn implies that (9) can be used to calculate the instantaneous power of the waves. If (9) is absent from contemporary physics literature it is simply because the power of electromagnetic waves has traditionally been described in terms of the Poynting vector which is quite inappropriate for single wavelength calculations.

It is also probable that the mathematical emphasis in standard definitions of frequency [10] has, to some extent, hindered the development of a thorough microscopic theory of conductance. We can overcome these problems by allowing frequency to be defined as the ratio of electric current to electric charge precisely as it is described in high frequency surface acoustic wave (SAW) devices [11] and three-junction single electron pumps (SET) [12] which exhibit quantization of the current in steps of $I = e.f$ where f is the clock frequency of the gate signals:

$$f = I/e \tag{10}$$

We can now demonstrate that this simple relationship applies to the conductance properties of individual molecules which act as a bridge between electrodes when they are in a state of resonance with the electrode states near the Fermi level, leading to electron transport similar to that found in conventional metals [13]. A recent experiment in this regard [14] concerns the measurement of the conductance properties of a Hydrogen molecule in a (Pt-H-H-Pt) chain which obtained peaks in bias voltage $V = 63.5$ mV when $G_0 = 2.e^2/h$ confirming near single channel electronic transport. If the channel was a perfect conductor and had a transmission probability of $T = 1$ instead of the observed ($T = 0.97 \pm 0.01$) then the energy and power equations would be described by:

$$E = h.I/2.e \tag{11}$$

$$P = h.I^2/2.e^2 \tag{12}$$

Since the current [15] is described by $I = G.V$ and the conductance [16] is $G_0 = 2.e^2/h$ for single channel electron transport then:

$$I = 2.e^2.V/h \tag{13}$$

This is corroborated by the fact that when a dc voltage is applied across a Josephson junction it generates an ac current:

$$I = I_{max} \sin\,(\delta + 2.\pi.f) \tag{14}$$

Where δ is a constant equal to the phase at $t = 0$ and f is the frequency of the Josephson current:

$$f = 2.e.V/h \quad (15)$$

Equating (10) and (15) we obtain (13).

We can now substitute (13) into (11) to obtain:

$$E = e.V \quad (16)$$

Which represents the energy bandwith across this molecular bridge in accordance with Landauer theory [17]. Hence since (16) was derived from (11) it proves that they are equivalent.

Since the platinum electrodes and the hydrogen molecule constitute a miniature electric circuit, (12) can now be derived from the following equation:

$$P = I^2.R \quad (17)$$

Since resistance is the reciprocal of conductance we can substitute $R = 1/G_0$ in (17) to obtain (12). Consequently equations (11) and (12) can now be expressed in simpler terms as:

$$E = \pm\, n.h.f \quad (8)$$

$$P = \pm\, n.h.f^{2} \quad (9)$$

Where theoretically $n = 1/2, 3/2, 5/2...$ in this particular case and $f = I/e$ which satisfies Planck's quantization condition (simple harmonic oscillator) for vibrating atoms and molecules:

$$E_n = (n + 1/2).\hbar.\omega \text{ where } n = 0,1,2,3... \quad (18)$$

Obviously n in (8) and (9) is not a constant and is influenced by several factors such as electron transmission and reflection probabilities, hybridization of molecular/metal levels [13], type of molecule being used as a conducting bridge, Coulomb charging/blockade effects [18] and conformational (shape) changes in the molecule which can affect charge distribution across the molecule [19] to name a few.

Hence the instantaneous power of electromagnetic waves is quantized by the same discrete amounts as the energy of the waves. This makes sense since we define this power precisely as we did for gravitational waves in section II, in other words as the power for the period $T = 1/f$ or more precisely, the energy of an electromagnetic wave at a given frequency during the time interval it takes for a single wavelength to cross a given set of coordinates, $T = \lambda /c$. This is a crucial point and should not be confused with the Poynting vector which describes power per surface area.

This implies that under certain circumstances the classical equation of power for standard electric circuits can also apply to simple molecular circuits. However our theoretical model assumes that [20]:

a) There is no inelastic scattering to dissipate the electrical energy gained by the electrons.
b) Landauer's original theory which applies to single metallic sub-band channels within one dimensional wires also applies to simple organic molecules.
c) The electrons are uniformely distributed in the source to drain electrodes.
d) The Fermi energy is larger than the associated thermal energy.

It is obvious for example, that for more complicated organic molecules, (9) no longer applies. Nevertheless the important point is that the same basic relationship between frequency, energy and power applies to both electromagnetic and gravitational waves in vacuum and also to this simple case of molecular conductance which increases the overall credibility of (8) and (9) in the context of gravitational waves.

IV. QUANTUM GRAVITY AT THE PLANCK SCALE

Any coherent and realistic quantum theory of gravitation should, in principle, exhibit some new mathematical insights into the nature of space-time at the Planck scale. One of the main weaknesses of current Loop Quantum gravity theories and other geometrical-based theories is their assumption that the standard laws of geometry apply at the Planck scale. Unfortunately, we can easily demonstrate that even at the molecular scale, the standard laws of geometry which deal with surface area and volume cannot be systematically applied. This is because a given surface area of electromagnetic or gravitational radiation which experiences high-frequency vibrations can, through a topological transformation, constitute volume. In geometrical calculus it is possible to introduce the notion of time by representing volume as function. If, for example, the volume of a sphere is represented by:

$f(s) = 4.\pi.r^3/3$ then $d(s)/dt = 4.\pi.r^2$

where the surface area of the sphere is a measure of the rate of change of the volume of the sphere. Similarly for a cube where its length $l = 2d$, when the volume is:

$f(c) = (2.d)^3 = 8.d^3$ then $d(c)/dt = 24.d^2$

where the derivative of the function represents the rate of change of the volume of the cube, or its surface area. However for a conical black hole whose height is equal to its radius and whose volume is changing at the same rate in both height and radius, we are faced with a contradictory interpretation of reality. If the volume $(A_b \times h)/3$ is represented by:

$f(c) = \pi.r^3/3$ then $d(c)/dt = \pi.r^2$

This is a two-dimensional surface area which represents the rate of change of the volume of the cone. However this does not coincide with the entire surface area of a static cone which is its base area, $\pi.r^2$ plus its lateral surface area, $(2^{1/2}.\pi.r^2)$ in this particular case, ie: $(2^{1/2} + 1)\pi.r^2$. How is this possible? since $4 \times \pi.r^3/3$ is indeed the volume of a sphere and $4 \times \pi.r^2$ is the surface area of this sphere. The implication is that the rate of change of the volume of a cone when its height is equal to its radius cannot be interpreted independently of the rate of change of the volume of the sphere! But the situation is even more complicated than this. If we now consider the surface area of this circle, $\pi.r^2$ and make it rotate uniformely about its central axis (diameter) at the unrealistic angular velocity of $\omega_P = 1/t_P = 1.855\ 09(4\ 35) \times 10^{43}$ rad.s^{-1}, in other words, the reciprocal of the Planck time, then it is probable that this surface area will now represent the volume of the sphere! One can even question the validity of the mathematical equation for the surface area of a circle. Is it correct? As surprising as it may seem, the answer to this question is not at all clear because it does not take into account the law of special relativity. We can easily prove that the mathematical equation for the surface area of a circle is in fact $2.\pi.r^2$ because in mathematics any circle can be observed from either its top or its bottom so it really depends on the position of the observer. The proof is rather simple. Consider the following equations for the surface areas of a cone and a cylinder where r is the radius and h is the height:

Cone (base & lateral) $= \pi.r^2 + \pi.r.(r^2 + h)^{1/2}$ (19)

Cylinder $= 2.\pi.r^2 + 2.\pi.r.h$ (20)

When their respective heights $h = 0$, we obtain a single circle for each equation but the surface areas of both the cone and the cylinder become $2.\pi.r^2$ not $\pi.r^2$. It is highly unlikely that this is a coincidence, rather it implies that certain modifications in geometry need to be made.

The question is how does this relate to the wavelength of the gravitational waves at Planck`s scale? The answer depends entirely on the geometry of a black hole at this scale. As it happens, if one employs the moment of inertia of a cone for a black hole at Planck`s scale where:

$I_P = 3.m_P.l_P^2/10$ (21)

and where Planck mass $m_P = 2.176\ 7(12\ 7) \times 10^{-8}$ kg, Planck length $l_P = 1.616\ 04(965) \times 10^{-35}$ m and Planck angular velocity $\omega_P = 1.855\ 09(4\ 35) \times 10^{43}$ rad.s^{-1} one obtains the following wavelength after substitution in (5):

$$\lambda_{gP} = \frac{(5.h.c^7)^{1/2}}{(32.G.l_P{}^2.\omega_P{}^6)^{1/2}}$$

$$\lambda_{gP} = 5.337\ 4(44\ 8) \times 10^{-35}\ \text{m}$$

This wavelength divided by the Planck length gives the following dimensionless number:

$$\lambda_{gP} / l_P = 3.302\ 7(727\ 5)$$

Ideally this number should be $(13^{1/2} + 3)/2$ but we are unfortunately limited by the number of significant figures in its derivation. This number is third in a series of irrational numbers described by the following function where $\pm x$ is an integer $(0,1,2,3\ldots)$:

$$f(\pm x) = \frac{2}{\{(x^2 + 4)^{1/2} + x\}} \qquad \text{where } \pm x = f(x)^{-1} - f(x) \tag{22}$$

such that:

$f(\pm 0) = 1$ or its reciprocal 1
$f(\pm 1) = 1.618\ 033\ 989$ or its reciprocal $0.618\ 033\ 989$
$f(\pm 2) = 2.414\ 213\ 562$ or its reciprocal $0.414\ 213\ 562$
$f(\pm 3) = 3.302\ 775\ 637$ or its reciprocal $0.302\ 775\ 637$ etc.

In a wider context each of the resulting numbers from this function satisfies the following sequential polynomial equations:

When	$x = \pm 1$	$x^3 - 0.x^2 + x = 0$	and	$x^3 + 0.x^2 - x = 0$
	$x = \pm 1.618\ 033\ 989$	$x^3 - 1.x^2 + x = 0$	and	$x^3 + 1.x^2 - x = 0$
	$x = \pm 2.414\ 213\ 562$	$x^3 - 2.x^2 + x = 0$	and	$x^3 + 2.x^2 - x = 0$
	$x = \pm 3.302\ 775\ 637$	$x^3 - 3.x^2 + x = 0$	and	$x^3 + 3.x^2 - x = 0$
	$x = (\pm 1.618\ 033\ 989)^3$	$x^3 - 4.x^2 + x = 0$	and	$x^3 + 4.x^2 - x = 0$ etc.

An interesting aspect of this sequence is that the numbers which represent x are self-repeating as the sequence progresses but only as odd-numbered exponentials. We know that the first two numbers in this sequence are represented frequently in geometry and that they play a special role in determining the proportions of volume, surface-area and angle both within and between various shapes that exist in two or three dimensions.

It might be possible that the irrational number $3.302\ 775\ 637$ and its reciprocal also have applications in this sense although to the best of our knowledge this remains unknown at present.

V. GRAVITATIONAL SHIELDING EFFECTS IN ROTATING SUPERCONDUCTING DISKS

This phenomenon first observed by Podkletnov and Nieminen [21] in 1992 and subsequently by Torr and Li [22] amongst others, reported sample-mass weight-loss of *0.05% to 0.3%* at temperatures below *77* K using a single-phase bulk superconducting $YBa_2Cu_3O_{7-x}$ ceramic disk in AC electromagnetic fields ranging in frequency from *50* to *106* MHz. However it has been difficult to verify this shielding effect because early experimental results were not only contradictory but were also subject to certain flaws in experimental design [23]. The situation has also been exacerbated by the inconclusive theoretical explanations offered to date [24,25] some of which seem to be conflictual [26,27].

This weight-loss phenomenon has also been observed in rapidly spinning gyroscopes [28,29] for example and has been theoretically explained within the context of the law of conservation of angular momentum [30] although the exact cause and effect relationship remains unclear. In Podkletnov's second article [31] we can nevertheless determine the extent to which the increase in the rotation speed of the disk is responsible for the reported sample-mass weight-loss which varied from *0.17%* at *4 000* rpm to *0.23%* at *5 000* rpm at a constant frequency of *2* MHz by calculating the respective quantum gravitational energy and power of the waves emitted by the disk at these two rotation speeds.

The moment of inertia of the disk is given by:

$$I = (1/2).m.r^2 \quad (23)$$

If, for simplicity's sake we assume an approximate disk mass of *1* kg where $r = 13.75$ cm and thickness $h = 1$ cm then:

$I = 9.453\,1 \times 10^{-3}$ kg.m^2

At *4000* rpm the angular velocity $\omega = 418.879\,0$ rad.s^{-1}

Hence from (5), (7) and (4) the respective wavelength, energy and power of the waves will be:

$\lambda_g = 8.364\,2 \times 10^{11}$ m
$E_g = 2.374\,9 \times 10^{-37}$ J
$P = 8.512\,4 \times 10^{-41}$ W

At *5000* rpm the angular velocity $\omega = 523.598\,8$ rad.s^{-1} hence:

$\lambda_g = 4.282\,4 \times 10^{11}$ m
$E_g = 4.638\,6 \times 10^{-37}$ J
$P = 3.247\,2 \times 10^{-40}$ W

We now have to calculate the energy of the gravitational waves of the earth and compare them to these figures. The approximate rotational inertia of the earth (excluding oblateness and tidal factors) is given by:

$$I = (2/5).m.r^2 \quad (24)$$

$I = 9.721\,4 \times 10^{37}$ kg.m^2

Where the angular velocity [32] $\omega = 7.292\,115 \times 10^{-5}$ rad.s^{-1}

The respective wavelength, energy and power of the waves will be:

$\lambda_g = 1.541\,6 \times 10^{-8}$ m
$E_g = 1.288\,6 \times 10^{-17}$ J
$P = 0.250\,6$ W

Based upon these preliminary results, we can ascertain that:

$E_g\,(5\,000$ rpm$) - E_g\,(4\,000$ rpm$)\,/\,E_g\,(Earth) = 1.756\,7 \times 10^{-20}$

We can therefore conclude that wether or not there is superposition or destructive interference between the gravitational waves emanating from the earth and those emanating from the disk, the increase in the gravitational energy resulting from an increase in the rotation speed of the disk is therefore negligible and any weight-loss measured in the various sample-masses attributed to this must be excluded.

This is confirmed by the sensitivity of the Dupont balance used in the experiment which being on the order of 10^{-6} g would not be capable of detecting sample-weight variations resulting from an increase in the gravitational energy of the superconducting disk.

Another experiment conducted by NASA and the University of Alabama [33] found that the shielding effect, if detectable in principle, is even smaller than that reported by Podkletnov with the maximum contribution to a change in the measured gravitation of a static YBCO superconductor in a constant DC magnetic field as less than 2×10^{-8} of the gravitational acceleration of the earth. However more recent experiments by Podkletnov and Modanese [34] have confirmed that alternating current or short pulses ($10^{-5} \times 10^{-4}$ s) of high voltage discharge ($100 - 500$ kV) are necessary for the effect to occur.

Hence in Podkletnov's second experiment [31], the increase in the measured weight-loss from *0.22%* at *3.1* MHz to *0.32%* at *3.6* MHz at a constant rotation speed of *4 300* rpm, clearly indicates that other factors related to the superconducting state and to the external high-frequency magnetic field are overwhelmingly responsible for the weight loss observed in the various sample masses.

VI. CONCLUSIONS

We have shown how it was possible to quantize Einstein's equation for gravitational power in General Relativity which gives coherent results for the wavelength and energy of gravitational waves and in the process revealed that this energy has two solutions like Dirac's relativistic wave equation.
The fact that the fine structure constant also has two solutions in this respect $\alpha = \pm (r_e / a_0)^{1/2}$ adds further credence to this argument because it represents the coupling constant of the electromagnetic force which implies that for every force there exists an anti-force which is equal in magnitude. We then illustrated that quantum gravitational energy and power were related in a simple way to the frequency of the waves which could be applied to simple cases of molecular conductance where electronic transport is similar to that found in conventional metals and where the power is:

$$P = E.f \tag{25}$$

Substituting $E = e.V$ and $f = I/e$ in (22) we obtain:

$$P = I.V \tag{26}$$

Which is equivalent to $P = I^2.R$ in classical electric circuits. Finally we discovered that Podkletnov's hypothesis concerning the gravitational shielding effects of sample masses placed over rotating superconducting disks in high frequency magnetic fields could not be attributed to the variation in the rate of rotation of the disk.

However if it can be confirmed that this effect is caused by a specific temperature-frequency correlation at the superconducting state then it will almost certainly require a revision of BCS theory for low T_{-c} superconductors which already has difficulties explaining the Cooper pairing of electrons in high T_{-c} superconductors [35]. This is because the wave function describing the superconducting state in BCS theory is an approximative description of reality for the following reason.

If we take a dice for example and throw it once, we have been taught that the probability of throwing a given number is *1/6* which is in fact only true for an isolated event in a strict mathematical context. When this axiom is applied to real events it is no longer valid because it contradicts two fundamental principles in the universe which are closely related to the principle of conservation of energy which state:

a) An event or physical process never occurs independently of another one

b) Nothing exists independently of something else

To illustrate the point if we hypothetically ask *N* number of people to each throw a dice simultaneously, it is generally accepted that within this single trial, each person relative to himself will have a *1/6* chance of obtaining a predetermined number between one and six. However relative to an outside observer and considered collectively as a group, at least one person will have a greater than *1/6* chance of throwing a predetermined number between one and six as *N* gets arbitrarily large and when $N \to \infty$, at least one person will have a *6/6* chance to do so. Of course we cannot know beforehand which person this will be but it demonstrates that the probability of obtaining a given outcome does not entirely depend on the six faces of a dice. It also depends on relativity, the exact location of a given trial in a sequence of successive trials, and chaos theory which has not yet been incorporated into probability theory.

By the same token, when for example Schrödinger's equation explains that we have a *0.677* chance of finding an electron beyond the Bohr radius in the ground state energy of Hydrogen, the postulate is only *100%* true when the number of trials, that is the number of times the same experiment is undertaken, is equal to infinity which is of course impossible. As a consequence, it may be possible that Cooper pairs, $q = 2.e$ are constituted of three anti-u quarks each of a different colour (QCD) as research conducted on the electron in the context of the Hall effect [36] strongly suggests that the electron charge is actually composed of three sub-electric charges, *e/3*. Cooper pairs would therefore be anti-baryons with spin *3/2* if all three quarks are aligned in the same direction or spin *1/2* if one of the quarks is aligned in the opposite direction to the other two and they would obey the Pauli exclusion principle. In such a scenario the Meissner-Ochsenfeld effect would have to be reinterpreted as either the repulsion or cancellation of magnetic and electric fields inside the superconducting disk by the presence of anti-magnetic and anti-electric fields produced by anti-electric currents.

Evidence to support this hypothesis comes from the multiple sign changes observed in the mixed state for type II cuprates such as $YBa_2Cu_3O_{7-d}$ [37], $Bi_2Sr_2CaCu_2O_{8+d}$ [38] or $Nd_{1.85}Ce_{0.15}CuO_{4-y}$ [39] for example, which is unique in that it has a negative Hall anomaly in the normal state. The fact that multiple sign reversals have also been detected in the most anisotropic materials such as Bismuth, Thalium and Mercury compounds [40,41] and in metallic alloys such as Niobium [42] and Vanadium [43] in which they were first discovered would seem to confirm the universal nature of this anomaly in all superconductors. Furthermore a recent article by Aoki *et al.* [44] infers that the attractive interactions binding the electrons in the Cooper pairs of $PrOs_4Sb_{12}$ are mediated by magnetic moment fluctuations, specifically a spin triplet (odd parity) in the excited state which seems to corroborate the color force hypothesis.

This is also the case for Uge_2 [45] for which the pairing mechanism has been explained in terms of a magnetic spin triplet as opposed to phonon-lattice interactions. Moreover, K.B. Bohnen *et al.* [46] have recently confirmed that electron-phonon coupling is not an important contribution to superconductivity in high-T_c materials using the Eliashberg function α^2F which gave an electron-phonon coupling figure of $\lambda = 0.2$ contradicting earlier approximations.

However even if this hypothesis is correct, it does not in itself provide a full explanation of the mechanism involved by which electromagnetic radiation is transformed into what appears to be either gravitational or anti-gravitational radiation. Under normal circumstances, the colour force is so strong that quark/anti-quark pair production energy is reached before quarks can be separated but it may be possible that gluonic bonds are significantly weakened by the low temperatures coupled with the intense electromagnetic radiation which would allow the transformation of quarks into anti-quarks through some sort of spontaneous broken symmetry.

This is a reasonable assumption since gluons change the colours of quarks and anti-quarks while the W bosons change their flavours, however this would require the existence of a new boson with a mass of around *15* GeV which has not been detected to date.

In conclusion, the fact that despite several international projects currently underway to detect gravitational waves such as VIRGO, TAMA300, GEO600 and LIGO and that none have yet detected gravitational waves in the most abundant expected frequency range [49], *0-100* Hz would tend to support the possibility that they are searching in the wrong frequency bandwith.

VII . REFERENCES

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