High Frequency Gravitational Waves - Induced Propulsion

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Abstract

It may be possible to generate high power / high frequency gravitational waves (HFGWs) by high frequency accelerated axial rotation (spin) and/or accelerated high frequency vibration of an electrically charged, possibly asymmetric structure, within the context of non-equilibrium thermodynamics, namely far-from-equilibrium physics, highly non-linear in nature.

The structure which is the HFGW generator (HFGWG), has the ability to control the accelerated modes of vibration and spin of its electrically charged surfaces, in particular the rapid rates of change of accelerated-decelerated-accelerated vibration and/or accelerated-decelerated-accelerated gyration (axial spin) of these electrified surfaces, in this manner delaying the onset of relaxation to thermodynamic equilibrium, thus generating a physical mechanism which may induce anomalous effects. Under certain conditions, involving rapid acceleration transients, it is observed that there will be exponential growth in electromagnetic energy flux with accelerating vibration. In the present paper, high power HFGWs are generated by enabling the Gertsenshtein effect, that is gravitational wave production by propagating electromagnetic radiation through strong magnetic fields.

Controlled motion of charged matter under rapid acceleration transients may enable macroscopic quantum coherence, namely possible quantum mechanical behavior of macroscopic objects. Moreover, the accelerated vibration and/or spin of charged matter may generate high power / high frequency gravitational waves which can be used in a variety of applications, such as advanced field propulsion, namely the design of a workable space drive.

Therefore, it may be feasible to propel a hybrid craft equipped with an HFGWG, by producing high frequency gravitational waves which in turn generate their own gravitational fields upon which the craft would propagate in a ‘wave-surfing’ fashion.

Introduction

On February 11, 2016 the National Science Foundation publicly announced that the Laser Interferometer Gravitational Wave Observatory (LIGO) had finally detected gravitational waves from the collision of two stellar mass black holes, thereby showing the reality of such waves and further strengthening General Relativity (GR) theory predictions [1].

Think of gravitational waves as undulations in the structure of spacetime, or to be more exact “ripples” in the curvature of the spacetime fabric. They are propagating fluctuations in gravitational fields [2], which arise due to dynamics of massive physical entities, although the source of gravitational waves may not be massive in nature as long as its motion is represented by high frequency/high energy, far from equilibrium dynamics. This fact can be observed from the stress-energy-momentum tensor expression in the GR field equations.

It is important to note that because of their physical nature (the graviton being a spin 2 particle) these waves have the capability to penetrate solid matter at high frequency (HF), moving at the speed of light. Furthermore, similar to electromagnetic waves these gravitational waves (GWs) are carriers of energy and momentum. Moreover, GWs are transverse and quadrupolar in nature (stretching and squeezing space along their propagation path), and can be produced by accelerating asymmetric masses, which denotes the far form equilibrium phenomena, their emission represents.

Electromagnetic (EM) radiation, caused by accelerating electrically charged objects, when passed through a static magnetic field (of constant magnetic flux density) gives rise to gravitational waves at the same frequency with the EM radiation. This phenomenon is known as the Gertsenshtein Effect [3].

In the language of quantum field theory, the Gertsenshtein effect can be described as the mixing of a propagating photon with a graviton, via a Yukawa-type coupling mediated by a virtual photon from the background field.

The generation of high power high frequency gravitational waves (HFGWs) is just one application of the fundamental innovative principle behind this work, namely the enablement of macroscopic quantum coherence induced by controlled motion of charged matter, subjected to rapid acceleration transients. This principle can give rise to Emergent Physical Phenomena, such as, but not limited, to Superconductivity.

Artificially generated, high energy, electromagnetic fields can interact strongly with the local Vacuum energy state, an aggregate/collective state comprised of the superposition of all fluctuations in the collective of quantum fields (including EM and gravitational fields, among others) permeating a given spacetime locality [4]. According to quantum field theory, this strong interaction between the fields is based on the mechanism of transfer of vibrational energy between the fields, further inducing local fluctuations in adjacent quantum fields which permeate that spacetime locality (these fields may or may not be electromagnetic in nature).

Think of the local Vacuum energy state as the collective energy state (structure) comprised of the ground state of minimum energy (baseline fluctuations) that is the quantum vacuum, and the excited state of energy (induced fluctuations) generated by matter or any other source of energy in that spacetime locality [5]. According to quantum field theory, matter, energy, spacetime are emergent constructs which arise out of a foundational structure, the fundamental framework which is the Vacuum energy state. Matter is confined energy, bound within fields, and may be thought of as a spectrum of different vibrational (and possibly gyrational) frequencies of the Vacuum energy state. The engineering of the Vacuum metastructure (since there are multiple Vacuum structures) has been discussed from a General Relativity perspective [6], and from a quantum field theory perspective [7].

Consider that we are immersed in an ocean of energy, the Vacuum energy state, yet ordinarily we seem not to interact with it. This is because under normal circumstances (at or near equilibrium regime), the Vacuum state is homogeneous, isotropic, Lorentz invariant, in other words it is symmetric. Break this symmetry (far-from-equilibrium regime), and strong interactions with the Vacuum energy state become possible, thus affecting the manner in which the collective fields exchange energy with one another.

If we perform a “gedankenexperiment” we observe that the coupling of high frequency spin with high frequency vibration (especially for rapidly accelerated spin/vibration) of an electrically charged system (object) puts every point on the boundary of the object in a state of coherent superposition, thereby inducing a macroscopic quantum phenomenon [8].

Furthermore, as observed from the Casimir effect, the boundary conditions of a physical system affect the local Vacuum energy state (VES) of that system (comprised of zero point EM energy (QED) among other types of field energies (QCD, Higgs, etc.)) thereby affecting the system’s physical properties. Thus by manipulating/ modifying the boundary conditions of a physical system with respect to its local VES, we can alter the system’s physical properties.

With this in mind, in a recent paper [9], the author discusses the possibility of inertial (or gravitational) mass reduction using high energy electromagnetic (EM) fields, whereby high frequency accelerated vibration and /or high frequency accelerated spin of electrically charged systems (minimally charged, if so desired) can lead to local vacuum state polarization (EM energy flux values in excess of 10^{33} W/m^2 are feasible, with corresponding energy densities in excess of 10^{25} J/m^3), in this manner modifying the local spacetime lattice energy density. These systems would be strategically placed on an intergalactic craft.

The craft mass reduction effects are achieved by control, namely coherence, of the collective quantum fluctuations in the Vacuum energy state in the immediate vicinity of the aerospace vehicle/ spacecraft’s electrified outer mold skin. As a result, extreme craft speeds can be achieved.

In a nutshell, this concept relates to an EM device which induces vibratory mass / energy fluctuations within a structure, which may or may not be solid in nature, thus generated EM plasma non-liniarities may be considered.

An important realization (mathematically shown) of this aforementioned work is the fact that in an accelerated vibration and/or accelerated spin mode, the system’s EM energy flux is amplified by a factor equivalent to the product of vibrational (or spin) angular frequency and the operational time of acceleration (namely the time for which system is operated at maximum acceleration), with respect to the non-accelerated system’s EM energy flux (showing the importance of an accelerated departure far from thermodynamic equilibrium).

It is very important that the craft has the ability to control the accelerated modes of vibration and spin of the electrically charged surfaces, in particular the rapid rates of change of accelerated-decelerated-accelerated vibration and/or accelerated-decelerated-accelerated gyration (axial spin) of the electrified surfaces.

In this manner we can delay the onset of relaxation to thermodynamic equilibrium, thereby delaying maximal entropy production, thus generating a physical mechanism which may induce anomalous effects. In this case, the system’s EM energy flux is amplified by a factor equivalent to the square of the product of vibrational (or spin) angular frequency and the operational time of acceleration (time while system is at maximum acceleration), with respect to the non-accelerated system’s EM energy flux.

Going back to our subject matter at hand, a report written by the JASON group of the MITRE Corporation [10] for the Office of the Director of National Intelligence (Defense Intelligence Agency) comes to the conclusion that current means and methods of producing HFGW do not constitute a national security threat and in no shape or form can such physical entities be used for advanced propulsion or communication of any type.

The JASON report considers relatively low EM energy fluxes, when compared with those generated by the physical mechanisms described in reference 9 (on the order of 10^{33} W/m^2, and beyond). This exceptionally high EM power intensity induces spontaneous particle pair production (avalanche), thereby ensuring complete

polarization of the local Vacuum energy state, thus resulting in modification of the local spacetime energy density. It is this possibility which may alter the aforementioned report's conclusions.

Novel Propulsion Concept

As originally observed in reference 9, for conditions of accelerated vibration or accelerated spin of an electrically charged object/system, we can write for the maximum EM energy flux (time rate of change of EM energy transfer per unit surface area):

$$S_{max} = f_G (\sigma^2 / \varepsilon_0) [(R_v \nu^2) t_{op}] \quad (1)$$

, where f_G is the charged system geometric shape factor (equal to 1 for a disc configuration), σ is the surface charge density, ε_0 is the electrical permittivity of free space, R_v is the vibration (harmonic oscillation) amplitude, ν is the angular frequency of vibration in Hertz, and similarly in the case of axial spin R_v is the effective system radius, while ν represents the angular frequency of rotation, and t_{op} is the operational time for which the electrically charged system is operated at maximum acceleration ($R_v \nu^2$) . This closed form formulation is the result of the synthesis of classical electromagnetic field theory with the physics of simple harmonic motion.

Furthermore, for the case of rapid time rates of change of accelerated vibration / spin (rapid acceleration transients) of the charged system, given that the time differential of acceleration is non-zero, we obtain:

$$S_{max} = f_G (\sigma^2 / \varepsilon_0) [(R_v \nu^3) t^2_{op}] \quad (2)$$

This is a thought provoking formulation because it shows that even with moderate vibrational / spin frequencies in a rapidly accelerating mode, the EM energy flux is greatly amplified.

Thus if the product of all the controllable parameters in equation 2 (other than the angular frequency of vibration) was of unit order, we can achieve energy flux values on the order of 10^{33} W/m^2 (endemic of the polarized Vacuum energy state) with low end microwave frequencies on the order of 10^7 Hz (inducing vibrations of a resonant cavity wall of equal or higher frequencies, depending on cavity material). This in itself may qualify as an interesting observation, showing the extensive capabilities of a high energy / high frequency electromagnetic field generator.

Furthermore if we consider adding to the equation representing simple harmonic motion an "energy/momentum-pumping" (negative damping) term (bv), endemic of system acceleration, where b is a constant and v is (dx/dt), namely the speed of a vibrating mass (m), something interesting occurs, in that it can be shown that the maximum of the total energy (E_T) of the vibrating system can be written as:

$$E_T \approx m R_v^2 \Omega^2 [\exp (2 \Omega t)] \quad (3)$$

, where Ω is the angular frequency of vibration, under the condition [(Ω = b/2m) >> Ω_0 (natural frequency of vibration)]. Since the EM energy flux is directly proportional to E_T, we observe that there will be exponential growth in energy flux with accelerating vibration, especially under the condition of rapid acceleration transients. Considering a classical Newtonian second law expression using the Lorentz (EM) force, we can relate the vibrating mass (m) with its vibrating charge (Q), in that m becomes directly proportional to the square of the ratio (Q / Ω). Coupling this relation with equation 3 yields:

$$S_{max} \approx (Q^2 / \varepsilon_0) (R_v^2 / R_s^5) \Omega [\exp (2 \Omega t)] \quad (4)$$

Equation 4 represents the maximum EM flux that can be achieved by accelerated vibration under the aforementioned condition, and applies to a spherical geometry (radius R_s) for a vibrating mass (m) of corresponding charge (Q).

Referring to the JASON report [10] we note that enabling the Gertsenshtein effect will result in the generation of a gravitational wave (out) by passing an electromagnetic wave (in) through a strong static magnetic field (these waves are of equal frequency). By combining equations 3-13 and 3-14 on page 10 of the report we obtain equation 5:

$$P_{GW(out)} = [(4\pi G / c^4) B_0^2 L^2] P_{EM(in)} \quad (5)$$

, where G is the universal gravitational constant, c is the speed of light in free space, B_0 is the magnetic flux density of the static magnetic field operating over a distance L, and $P_{GW(out)}$ is the gravitational wave power achieved from an electromagnetic wave of power $P_{EM(in)}$.

It is important to note that a simple dimensional analysis shows that there is a factor missing in equation 5 (as written in the JASON Report) equal to the inverse of the magnetic permeability of free space, namely a factor on the order of 10^6.

Omitting this fact however, we can still show that by using a high frequency / high energy electromagnetic field generator we can produce HFGW exhibiting power levels on the order of 10^{10} watts, for an input EM energy flux on the order of 10^{33} W/m^2, where B_0 is the magnetic flux density, on the order of 10^{10} Tesla which is also produced with accelerated motion of charged matter under rapid acceleration transients.

Furthermore, by using equation 3-25 in reference 10, we can show that such HFGW power levels are equivalent to 10^{35} gravitons/sec production rates.

These extremely high graviton production rates further show that if multiple high power, high frequency gravitational waves were to be focused on a particular point in a spacetime locality, they can induce a spacetime curvature singularity, namely a "highly distorted and disrupted patch of spacetime fabric" [11].

We can conceive of a spinning and or vibrating asymmetric quadra-polar configuration of a plurality of EM resonant cavities in which specially arranged microwave emitters produce the accelerated vibrations necessary to generate the HFGWs, via the Gertsenshtein effect.

From a propulsion perspective, a craft equipped with a plurality of HFGW generators (HFGWG) induces curvature singularities in its close proximity, generating a gravitational well in its flight path, thereby "rolling down" this spacetime curvature dip, in a manner analogous to surfing.

Enablement of Propulsion Concept

The coupling of high spin frequency with high vibration frequency in order to achieve gravitational field manipulation/modification via the Gertsenshtein effect will enable the design of a hybrid craft, as shown in figure 1. This hybrid aerospace/underwater craft (HAUC) configuration utilizes microwave-induced vibration within a resonant annular cavity, which features electrically charged outer mold line skin. The manner and effectiveness with which the microwave energy couples with the resonant cavity inner wall is called the cavity Q-factor. This parameter can be written as the (Energy stored / Energy lost) ratio and is in the range of 10^4 to 10^9 (and beyond), depending on whether ordinary metal (Aluminum or Copper at room temperature) or cryogenically cooled superconducting material (Yttrium Barium Copper Oxide or Niobium) is used for the resonant cavity inner wall and outside mold line skin of the aerospace vehicle.

The electrified skin of the craft can be further vibrated in an accelerated manner using imbedded lead zirconate titanate (PZT) modules (details not shown in figure 1 due to possible security classification) which would generate the strong magnetic fields necessary for the enablement of the Gertsenshtein effect (nested EM fields). If the HAUC craft has a modular electrified outer skin design, composed of an ensemble/collective of miniaturized electrically charged surfaces, independently or collectively vibrated, then the craft can be very large in size.

Consequently, the generated high energy / high frequency electromagnetic flux would induce repulsive EM energy fields while in earth's atmosphere, thereby repelling air and water molecules in the craft's flight path.

Once in orbital space, HFGW-induced gravitational field manipulation would permit swift movement of the hybrid craft, which comes in conical or lenticular triangle /delta wing configurations, beyond our Solar System. A plurality of microwave antennas (high radio frequency emitter sources) in the electromagnetic spectrum range of 300 Megahertz to 300 Gigahertz are arranged within the annular duct - resonant cavity (surrounding the crew compartment and power plant system, which would be guarded in a Faraday-type cage, against all EM radiation effects), as portrayed in figure 1.

An auxiliary conventional power plant/propulsion unit (not shown), would provide the initial hybrid vehicle thrust and electrical power generation. Furthermore, if the annular resonant cavity duct is filled with a noble gas such as Xenon, the microwave energy collision with the gas particles will induce a plasma state of matter (further augmenting the oscillatory vibrations experienced by the resonant cavity inner wall), thereby creating a highly non-linear environment (phase transitions / abrupt changes of state from gas to plasma, which induce Symmetry-breaking) which will intensify non-linear effects, thereby augmenting induced HFGW power. This will intensify the coherence of quantum vacuum fluctuations in the proximity of the outside mold line skin (electrically charged) of the aerospace vehicle, in this manner assuring a high degree of Vacuum polarization.

Therefore it may be possible to envision a hybrid craft which due to the physical mechanisms enabled with HFGW generators (HFGWG) can function as a submersible craft capable of extreme underwater speeds (lack of water-skin friction) and enhanced stealth capabilities (non-linear scattering of RF and sonar signals). This hybrid craft would move with great ease through the air - space - water mediums, by being enclosed in a Vacuum plasma shield, due to the coupled effects of EM field-induced air/water particles repulsion and local Vacuum energy state polarization.

Potential HFGWG Applications

The implications of colliding/focusing HFGWs generated by rapidly accelerated vibration/spin of electrically charged systems can be used in applications of advanced field propulsion as well as the extreme disruption of a planetary body (if so desired) since it can be shown that the energy level (gain in potential energy) capable of annihilating a planet such as the Earth is on the order of 10^{32} Joules (possibly achieved with the concept at hand, considering $E_{annihil} = (3/5)\ (GM_P^2 / R_P)$; where $E_{annihil}$ is the gravitational binding energy, the other variables being defined by Newton's law of universal gravitation). Imagine a plurality of HFGWG devices (a minimum of four modules), aligned around the planetoid along a planar axis (at the four cardinal points).

The emitted HFGWs would impinge on each other in such a manner as to severely disrupt the vacuum energy state at a spacetime locality denoting a point of impact (collision of gravitons with gravitons). At this disruption point, energy may be amplified to such a high degree as to generate a spacetime curvature singularity, leading to total destruction of the planetoid (asteroid).

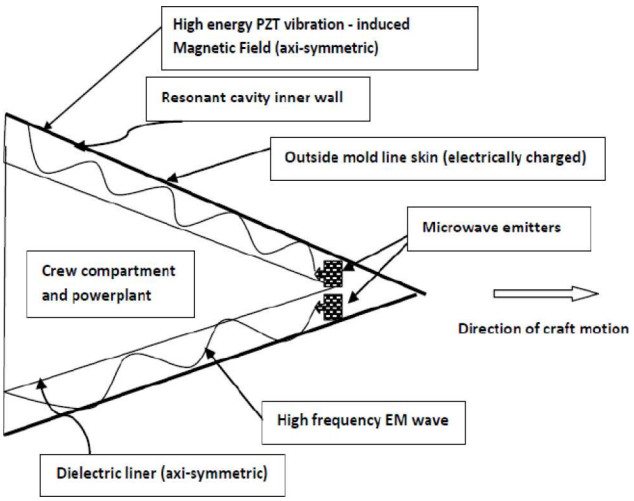

Figure 1. HFGWG - equipped craft configuration (cross-sectional view)

Moreover, considering that gravitons are spin 2 particles, hence they will not couple with the fermions / electrons (spin ½) of solid 'ordinary' matter (thus passing right through), we can devise new methods of communication through solid objects, as discussed in reference 11.

Nuclear fusion may also be engineered using the concept at hand, given the extremely high plasma densities and temperatures, as well as the high energy confinement times which can be achieved with the generation of ultra-high electromagnetic field intensities.

Conclusions

Perhaps, there is a simpler way of explaining the utilization of the HFGWG device as a propulsion unit; if we consider that this device is capable of concentrating a vast amount of energy in a relatively small space, thus locally de-stiffening / ripping / tearing the spacetime structure, thus permitting motion through the "void" within the vacuum.

As long as the device is on (and operated at high levels of accelerated vibration/spin), the HFGWG-equipped craft is capable of extreme speeds.

In parallel, if we think of the Universe as a superfluid, we may be able to say that the HFGWG device has the capability of inducing a local phase transition from a turbulent regime to a laminar regime, thus allowing for "smooth sailing" of a hybrid craft through the specially conditioned vacuum of Space (a vacuum that has undergone macroscopic quantum coherence, locally, around the craft). As a result, the craft experiences "suction" into the conditioned vacuum.

As an afterthought in regard to macroscopic quantum coherence, the controlled motion of charged matter under rapid acceleration transients may lead to room temperature superconductivity. There are three parameters which control superconductivity, namely temperature, current density and externally applied magnetic field strength. These three parameters have one thing in common, namely the motion of electric charges (electrons).

Since this motion can be strongly controlled by accelerated vibration and/or accelerated spin of charged matter (possibly inhomogeneous) under condition of rapid acceleration transients, it may possibly lead to room temperature superconductivity.

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