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## Inside Zero Point Energy

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### Introduction

For the first time in history, a lot of media attention is being paid to the sea of energy that pervades all of space. It just happens to be the biggest sea of energy that is known to exist and we're floating inside it. (Credit due to *The Sea of Energy* by T. Henry Moray for the idea.) Not only is it big but its energy is estimated to exceed nuclear energy densities, so even a small piece of it is worth its weight in gold. What is it? Many people are not sure what "zero point energy" (ZPE) is. Most agree that virtual particle fluctuation contributes to it and van der Waals forces don't explain everything. Does it offer a source of unlimited, free energy for homes, cars, and space travel? Depending on who we talk to, ZPE can do everything and ZPE can do nothing useful. How can the energy be converted to a usable form? What are the basic explanations of ZPE and the new discoveries, which have rocked the U.S. Patent Office, Physical Review Letters, Science, Scientific American, and the New York Times? Why is ZPE implicated in the latest confirmation of cosmological antigravity? Can the Casimir effect be a source of energy? This article is intended to give a review of the latest developments (as

well as an introduction to the topic for those who are non-specialists).

### **The Casimir Effect**

Zero point energy has been called "the ultimate quantum free lunch" (*Science*, Vol. 275, 1/10/97). During the early years of quantum mechanics, Paul Dirac theorized that the vacuum was actually filled with particles in negative energy states (*Proc. R. Soc. London A*, 126, 360, 1930) thus giving rise to the concept of the "physical vacuum" which is not empty at all. Quantum mechanics also predicted that invisible particles could become materialized for a short time and that these virtual particle appearances should exert a force that is measurable. Hendrik B. G. Casimir (*Phys. Rev.* 73, 360, 1948) not only predicted the presence of such a force but also explained why van der Waals forces dropped off unexpectedly at long range separation between atoms, predicting that force  $F=K/d^4$  where  $K=nhc/480$ . Though the Casimir effect subsequently was verified using non-conductive plates, there was always a scientific need for a verification of the Casimir force using conductive plates based on Casimir's 1948 paper. For the first time, Dr. Lamoreaux, now at the Los Alamos Labs, performed the experiment with less than one micrometer (micron) spacing between gold-plated parallel plates attached to a torsion pendulum (*Phys Rev. Ltrs.*, 78, 1, 97). In retrospect, he found it to one of the most intellectually satisfying experiments that he ever performed since the results matched the theory so closely (within 5%).

The Casimir effect has been posited as a force produced solely by activity in the vacuum. The Casimir force is also very powerful at small distances. Besides being independent of temperature, it is inversely proportional to the fourth power of the distance between the plates! Therefore, as the plates are brought closer, the virtual particles outside the plates increasingly overpower the decreasing quantity of virtual particles appearing between the plates with an exponentially increasing force. (Also notable is the fact that its frequency dependence is a third power and the force can be altered with dielectrics or resonate with narrow-band mirrors—see *Phys. Left. A* 225, 1997, 188-194.) Lamoreaux's results come as no surprise to anyone familiar with quantum electrodynamics (QED), but they serve as a material confirmation of an unusual theoretical prediction that QED predicts the

all-pervading vacuum continuously spawns particles and waves that spontaneously pop in and out of existence. Their time of existence is strictly limited by the uncertainty principle but they create some havoc while they bounce around during their brief lifespan. The churning quantum foam extends throughout the universe even filling the empty space within the atoms. A diagram showing "The Shape of Nothing" (*The New York Times* 1/21/97) is pictured to be not only subatomic but subelementary particle in size. Physical theories predict that on an infinitesimally small scale, far, far smaller than the diameter of atomic nucleus, quantum fluctuations produce a foam of erupting and collapsing, virtual particles, visualized as a topographic distortion of the fabric of space time.

Another implication for free energy from ZPE comes from the fact that Casimir also mentioned a three-dimensional volume effect (*Physica XIX*, 1956, 846). This has recently been used with the relativistic stress-energy tensor to analyze the quantum electromagnetic field inside any given volume. With a "relatively" simple calculation it has been shown that as the electron density increases due to gravitational compression, there is an energy creation. "The energy output produced by the Casimir effect during the creation of a neutron star turns out to be sufficient to explain nova and supernova explosions" (Sokolov, *Phys. Left. A*, 223, 1996, 163-166).

The *New Scientist* (July 1987, "Why Atoms Don't Collapse") gives an impressive endorsement of the importance of ZPE:

"There is a dynamic equilibrium in which the zero-point energy stabilizes the electron in a set ground-state orbit. It seems that the very stability of matter itself appears to depend on an underlying sea of electromagnetic zero-point energy."

### **Lamb Shift**

Another historically valid test in the verification of ZPE has been what's been called the "Lamb shift." Measured by Dr. Willis Lamb in the 1940's, it actually showed the effect of zero point fluctuations on atomic levels. The electrons are slightly shifted upwards in their atomic orbits. (The implications of the Lamb shift were never fully explained when I took

quantum mechanics except that the professor was forced to mention God as he tried to explain the "all-pervading electromagnetic field" which caused the problem.) Physicist Margaret Hawton describes the Lamb shift as "a kind of one atom Casimir Effect" (*Phys. Rev. A* 8/94) and predicts that the vacuum fluctuations of ZPE need only occur in the vicinity of atoms or atomic particles; which seems to agree with Dr. Koltick's findings cited above.

The ZPE fluctuations are fundamentally based upon the uncertainty principle, which has been predicted to be "signed into law" someday soon, since no violations have so far been found. Furthermore, the majority of physicists today attribute *spontaneous emission* and the Lamb shift entirely to ZPE (as noted in Hawton's paper). This may lead everyone to believe that though it is random, it can no longer be called "spontaneous emission" but instead should properly be labeled "stimulated emission" much like laser light is stimulated emission, even though there is a random quality to it. Textbooks on quantum theory already agree with this new interpretation:

"The smallest possible energy of the field one-half quantum per state. This suggests emission as being induced by the zero-point oscillations of the electromagnetic field; note, however, that these oscillations are twice as effective in producing emissive transitions as are real photons and are of course incapable of producing absorptive transitions." — Schiff, *Quantum Mechanics*, 3rd edition.

### **The Classical Vacuum**

One of the best educational viewpoints on ZPE has been given by Dr. Timothy Boyer, in an article entitled, "The Classical Vacuum" (*Sci. Amer.*, 8/85, p. 70). Boyer, a well-published and highly respected physicist, describes all of the features to be expected from ZPE including the frequency spectrum, even in a moving reference frame, as well as the energy and force. Boyer traces the historical "creation of the vacuum" as proceeding in stages in parallel with the historical development of ideas about the vacuum. To paraphrase, he says that in the 17th century, it was thought that a totally empty volume of space could be created by simply removing all matter and, in particular, all gases. That was our first concept of the vacuum. Just get rid of all the

gas. Late in the 19th century, it became apparent that the region still contained thermal radiation. But it seemed that the radiation might be eliminated by cooling. So the second concept of getting a real vacuum is to cool it down to zero temperature. Just go all the way to absolute zero. Then we've got a real vacuum. Right? Well, since then, both theory and experiment have shown that there is a non-thermal radiation in the vacuum and that it persists even if the temperature could be lowered to absolute zero. Therefore, it was simply called the "zero point" radiation. Further proof is evident, as Dr. Forward points out in his tutorial below, when physicists have cooled helium to within microdegrees of absolute zero and still it remains a liquid! Only ZPE can account for the source of energy is keeping helium from freezing.

Another aspect of the vacuum is that the constant virtual particle flux of the vacuum ZPE can become less virtual (short-lived) near the boundaries of bigger particles, with atomic number  $Z=137$  or higher. This is because the intense electric field gradient causes a more prodigious decay of the vacuum when the binding energy equals or exceeds the rest mass of the electron. Furthermore, if superheavy atoms are created with  $Z=173$ , the binding energy then exceeds twice the rest mass of the electron and pair production ensues with matter and anti-matter appearing out of the vacuum. The electron is driven into the nucleus and spontaneous positrons (anti-electrons) are produced constituting a true source of free energy.

"Paradoxically, the vacuum near an over-critical charge is a vacuum that cannot be emptied" (*Sci. Amer.* Dec. 1979, p. 150).

Such a physics discovery vindicates the provocative name of *Infinite Energy* magazine which has provided a forum for cutting edge energy discoveries.

It is interesting to note that the above-mentioned phenomena was first labeled the "Klein paradox" when the Klein-Gordon equation mysteriously predicted the "reflection" of an electron with more energy than the incident with a simultaneous "transmission" of the particle into a negative kinetic energy state, only if the voltage barrier exceeded  $2mc^2$  or twice the particle's rest mass (Klein, *Z. Phys.* 53, 157, 1929). In retrospect, this paradox helped physicists decipher a free energy source

much as I hope the runaway solution of the Lorentz-Dirac equation will do someday.

### **Tutorial**

For those who may want more scientific detail, a tutorial and derivation of ZPE follows. (*Note: this section can be skipped with no loss of continuity.*) Dr. Hal Puthoff, in his papers, discusses the fact that the existence of the electromagnetic zero point fluctuations is a clear prediction from quantum theory resulting from quantization. Basically, quantum mechanics just simply deals with compartmentalizing energy and compartmentalizing matter. So really what we're talking about, is "quantization of matter and energy". That's all we need to presume in order to derive the existence of zero point energy! What Dr. Robert Forward does in his very interesting Phillips Laboratory Report entitled, "Mass Modification Experiment Definition Study" (#PLTR 96-3004), is to help us understand the simple harmonic oscillator basis of ZPE:

Quantum Lesson 101: we have two categories of phenomena that we're dealing with: 1) matter quantization, and therefore "matter zero point fluctuation" as well as 2) energy quantization, and therefore energy or "radiation-type" of quantization. So that's the first lesson to keep in mind.

Now, in regards to the material aspect, inside an atom, or inside matter (picture a crystal), we can actually use the equation applied to a spring, which is the standard force  $F$  equals the square root of  $k$  over the mass  $m$ . Now  $k$  normally designates the spring constant. In this case we're using it as the spring constant of the electron cloud, which is the electron cloud is acting as a spring in a crude terminology to react to the mass of the nucleus of the atom. And, of course, there is a little bit of give and take here. We have both attractive and repulsive forces that are at play, and the natural frequency of vibration is going to be quantized only if we're looking at the material part of it. So, as we derive this in the quantum mechanical viewpoint as physicists say, "the formality", (the formal approach to translating into quantum mechanics), we get the Einsteinian equation,  $E=hf$ . This relates energy to frequency in terms of Planck's constant ( $h$ )

These are very simple equations, so far, and also the next one will be as well. But what they do is describe the vibrational quanta in matter and also the radiational portion, the photons, in the vacuum. As Dr. Forward mentions in his derivation, when equations of quantum mechanics are used to determine the average energy (with a bracket on both sides of the  $E$ ) of the vibrations of the atoms, the answer is  $E = n(T) + hf/2$ . Therefore, when  $T$  goes to zero, then the number of phonons or photons that are being created also goes to zero.

Thus, even at zero temperature quantum mechanics predicts that each of the atoms will still have an average residual energy, (as we can see if we let  $n$  go to zero) of  $hf/2$ . Physicists have been grappling with this for years because there appears to be an infinite amount of energy available if  $f$  is allowed to increase without limit. Ever since Casimir predicted it and various other scientists have verified it, this simple equation is really all that is underlying the theory of the zero point field and zero point fluctuation. What's funny about it is that the one-half is there, which is a little bit deceiving. However, we have to keep in mind, as Dr. Forward points out too, that the real equation is  $E = hf$  (Rigorously, quantum field theory performs an infinite sum over eigenvalues of zero point field modes to obtain the vacuum energy—see "Absence of a zero-point ambiguity", *Phys. Left. B*, 358, 1995, 56). So, we're dealing with an amount of energy on the average that is available to only half the quanta. Another phrase called "partons" is used by Puthoff to indicate the smallest quanta of vibration oscillators: Planck oscillators that are available in a vacuum or in matter. Therefore, instead of half photons or half particles existing everywhere, we're looking at only half of the possible photons or particles really being materialized at any one time.

More tutorial information on ZPE is also available in the two-hour video for which I was the technical consultant: "Free Energy: The Race to Zero Point" produced by Lightworks Audio and Video also available from Integrity Research Institute.

### **Cosmological ZPE**

Recently, ZPE was mentioned in *Science* (Vol. 282, Dec. 18, 1998, p. 2157) in an article called the "Breakthrough of the Year." Two teams of

astronomers have confirmed that distant galaxies are accelerating apart. Furthermore, 2/3 of all astronomers now acknowledge the data as valid. Thus the cosmological constant envisioned by Einstein is being reconsidered and an antigravity force being postulated. Physicists have also interpreted the force as "the evanescent particles that flicker in and out of existence in 'empty' space that gives space its springiness, shoving it apart." *Scientific American* seems to agree ("Cosmological Antigravity", January, 1999, p. 53): "The aggregate energy represented by these 'virtual' particles, like other forms of energy, could exert a gravitational force, which could be either attractive or repulsive depending on physical principles that are not yet understood." The cosmological constant represents energy inherent in space itself and coincidentally is almost exactly equal to the average density of ordinary matter in the universe (1 gm/cc), at this particular time in its evolution.

To help explain the concepts raised above, it is important to mention that a repulsive Casimir force may be experimentally obtained in the lab by utilizing a cavity built with a dielectric and a magnetic plate (see Boyer, *Phys. Rev. A*, 9, 1974, 2078 or Kupiszewska, *J. Mod. Opt* 40, 1993, 517). Thus the cosmological effects may be easier to explain than the popular journals are indicating at this time.

### **Experimental ZPE**

Since ZPE is due to virtual particle flux and high electric field gradients cause the flux to increase, it is reasonable to assume that near the surface of an electron, the ZPE virtual particle flux would be very high, like a bunch of flies buzzing around it.

*Science News* reports (2/8/97), "Since the 1930's, theorists have proposed that.. .virtual particles cloak the electron, in effect reducing the charge and electromagnetic force observed at a distance."

Therefore, for the first time, Dr. Koltick (*Phys. Rev. Ltrs.* 1/20/97) performed an experiment designed to penetrate the virtual particle cloud surrounding the electron with a particle accelerator at energies of 58 gigaelectronvolts without creating other particles. From his data, the newly obtained value of the fine structure constant is 1/128.5 instead of the smaller 1/137 that is traditionally observed for a fully screened electron. The fine structure constant equals the electron charge squared

divided by Planck's constant and the speed of light.

As to the concept of free energy from ZPE, one of the first journal articles to investigate the possibility is "The extracting of electrical energy from the vacuum by cohesion of charge foliated conductors" (*Phys. Rev. B* 30, 4, 84). Dr. Forward describes this "parking ramp" style corkscrew or spring as a ZPE battery that will tap electrical energy from the vacuum and allow charge to be stored. The spring tends to be compressed from the Casimir force but the like charge from the electrons stored will cause a repulsion force to balance the spring separation distance. It tends to compress upon dissipation and usage but expand physically with charge storage. It is similar to the multilayer mirror in the article, "The Casimir force for passive mirrors" (*Phys. Left. A*, 225, 1997, 188) or the "Casimir forces between beads on strings and membranes" (*Phys. Left. B*, 347, 1995, 56) where virtual particle exchange between the beads is analyzed. It seems that any closely spaced matter in the submicron range will invoke the Casimir force. The last article could be useful for ZPE experimentalists since the Casimir force equations provided for the N "beads" allow for them to be stuck on a membrane or freely placed, with a variable D for the spatial dimension of interest.

Since the ground-breaking work on the "one-atom micromaser" (*Phys. Left. A*, 217, 1996, 219), such concepts as "virtual photon tunnel effect" and "virtual photon quantum noise" are being explored. Further work is also suggested by the finding that "pressing zero point energy out of a spatial region can be used to temporarily increase the Casimir force" (Weigert, *Phys. Left. A*, 214, 1996, 215). This article describes the process of squeezing energy states in quantized electromagnetic fields to distribute the uncertainty over position and momentum at will. In fact, a future job market may be opening for the quantum mechanic or the vacuum engineer with such precision in ZPE emerging.

Dr. Forward subscribes to the classical notion that there is no known limit to the electromagnetic wavelength or frequency in the vacuum. What we see from Dr. Puthoff's approach to this is that he supports the majority view of a cutoff, which is based on Sakharov's work. The cutoff frequency (perhaps considering  $hf=mc^2$ ) is called the Planck frequency which is around  $10^{43}$  Hertz. This opposes what we see as far as Moray

King (in the book, *Tapping the Zero Point Energy*) and Dr. Forward saying that there is an infinite amount of energy available. In a later section we will see that Dr. Puthoff's theory derives gravity, inertia, heat, and also electricity directly from ZPE considerations. In Dr. Forward's paper, he suggests using micro-fabricated sandwiches of ultrafine metal dielectric layers. He also points out that ZPE seems to have a definite potential as an energy source.

Another possible experiment for ZPE is the "Casimir Effect at Macroscopic Distances" (*Phys. Rev. A* 48,1,93) which proposes observing the Casimir force at a distance of a few centimeters using confocal optical resonators within the sensitivity of laboratory instruments.

To summarize, the experimental evidence for the existence of ZPE is:

- 1) the Casimir Effect, 2) the Lamb shift, 3) Van der Waal's forces, 4) diamagnetism, 5) spontaneous emission, 6) microdegree liquid Helium, 7) quantum noise and most recently, 8) cosmological antigravity.
- Awaiting experimental verification is that inertia and gravity are also proof of ZPE.

### **The First ZPE Patent**

History was made on 12-31-96 when for the first time ever, ZPE was the subject of U. S. patent (#5,590,031). Dr. Frank Mead, from Edwards AFB, has designed receivers to be spherical collectors of zero point radiation with hemisphere reflectors of beat frequencies. He states that:

"zero point electromagnetic radiation energy which may potentially be used to power interplanetary craft as well as provide for society's other needs has remained unharnessed.">

Proposing to convert zero point electromagnetic radiation to electrical energy, Dr. Mead grapples with the high frequencies that may extend up to around  $10^{40}$  Hertz. (To gain a perspective, gigahertz radar is only  $10^{10}$  Hz or so. Visible light is about  $10^{14}$  Hertz and gamma rays reach into the 20th power, where the wavelength smaller than an atom) With

slightly different sized receivers, the system produces a *beat frequency*. A difference frequency is produced with the rest of the circuitry amplifying that lower "step down frequency". For example, if 1 part in a million accuracy was achieved in making the microspheres, then the subtraction of two  $10^{20}$  Hz signals would yield a  $10^{14}$  Hz beat frequency. However, I have recommended to Dr. Mead a real step down frequency involving "frequency division" which would mean less accuracy is required in the machining of the hardware and a bigger difference in the frequency output. The important part of his design is that the physical apparatus itself, whether a conductor or dielectric, is responding to the frequencies that it resonates with ZPE. Similar to the passive mirror article cited above, Mead realizes that the physical design of the conductor will determine resonant characteristics. If using large spheres, then it would resonate with very long, low energy frequencies. However, he points out, if this is miniaturized (nanolithography, down to submicron levels), then as the frequency cubed ( $f^3$ ) dependence goes up very fast, the energy density is much higher. The implications are that not only can it be made as a solid state device, but the smaller you make it, the better it is. In fact, Mead has confided that he is interested in working with single particles like protons or neutrons that may be slightly different by parts per trillion for example. This raises the question of what type of antenna would be appropriate for such an atomic resonator. So there's a lot of potential for this invention, and I think we're going to see other follow-up patents.

As to understanding and concepts behind ZPE, Frank Mead calls it "zero point electromagnetic radiation energy." Dr. Lamoreaux wants to refer to it as "a flux of virtual particles", because the particles that react and create some of this energy are popping out of the vacuum and going back in. So, that's another viewpoint. And of course *The New York Times* simply calls it "quantum foam". But the important part about it, from Dr. Robert Forward's excellent paper, is that "the quantum mechanical zero point oscillations are real."

### **ZPE and Sonoluminescence**

Does sonoluminescence tap ZPE? This question is based upon the experimental results of ultrasound cavitation in water which emit light and extreme heat. "The Chemical Effects of Ultrasound" (*Sci. Amer.*,

2/89) explains how the bubbles 100 microns in diameter can implode violently creating temperatures of 5,500 degrees Celsius, or about the temperature of the sun's surface!

Physicist Seth Putterman from UCLA explains in "An Expanding Knowledge of a Tiny Bubble's Burst" (*Washington Post*, 8/5/96) that there is enough energy in the 1 mile per second shock wave to tear electrons off of the vapor atoms in the water (ionizing them) and heat them to light-emitting levels. Apparently, the presence of argon dissolved in the water is a crucial ingredient for the visible/ultraviolet light to glow brightly. Critical to the understanding of the nature of this light spectrum however, is whether it matches the known spectra of ionized gases. Dr. Claudia Eberlein in her pioneering paper "Sonoluminescence and QED" (*Phys. Rev. Lett.*, 76, 3, 842, 10/96) describes her conclusion that only the ZPE spectrum matches the light emission spectrum of sonoluminescence, which therefore must be a ZPE phenomena.

This helps explain products such as Grigg's Hydrosonic Pump, whose water glows blue when in cavitation mode, that consistently has been measuring an over-unity performance of excess energy output (*Inter. Symp. on New Energy*, Denver, 1996 & U.S. Patent #5,188,090).

The *Post* article, also discusses the possibility of the heat being sufficient for cold fusion as it reviews the movie "Chain Reaction" featuring Keanu Reeves. (This movie is highly recommended because it is the first movie ever made to actually mention the words "free energy.") The movie, which also was featured as a cover story of *Infinite Energy* magazine, shows the demonstration of a cold fusion cell and the concept behind the frequencies and the power availability that makes it threatening. What I find memorable is Morgan Freeman who acts as the banker's representative, a veritable archetype of J. P. Morgan resurrected. When he talks about the concept of free energy, he says, "that's a noble concept, but it would cause the collapse of the world's economies..." This reminds us of how the utilities have a vested interest in energy consumption.

Sonoluminescence and cavitation create the necessary shock waves to access zero point energy but some scientists claim that 100 times more

heat is needed to create fusion. However, some cold fusion scientists who use "high pressure" cold fusion say that they have achieved that requirement. In fact, the January 1997 issue of *IEEE Spectrum* cites UCLA physicist Robert Hiller's calculation that the black body equivalent of the sonoluminescence radiation corresponds to a temperature of 100,000 degrees Kelvin. The Yam article from *Scientific American* (12/97) continues the work of the late Noble prize winner Julian Schwinger and states,

"Basically the surface of the bubble is supposed to act as the Casimir force plates; as the bubble shrinks, it starts to exclude the bigger modes of the vacuum energy, which is converted to light."

Scientists at UCLA have recently measured the length of time that sonoluminescence flashes persist. Barber and Putterman discovered that they only exist for 50 picoseconds or shorter, which is too brief for the light to be produced by some atomic process (*IEEE Spectrum* 1/97). Atomic processes, in comparison, emit light for at least several tenths of a nanosecond which leads many to appreciate Eberlein's proposal that ZPE is the source of the radiation.

#### **Dr. Harold Puthoff's ZPE**

Dr. Harold Puthoff is a physicist who has continued to develop Dr. Andrei Sakharov's theories of gravity and inertia. What he has achieved, which is now causing shock waves even at NASA, is that gravity has now been theoretically proven to relate directly to ZPE. Thus, a very fascinating new theoretical imagery is presented. For example, Dr. Puthoff, in his paper, "Gravity as a Zero Point Fluctuation Force", (*Phys. Rev.* 3/89) points out that gravitational mass and its associated gravitational effects are shown to derive in a self-consistent way from electromagnetic zero point induced particle motion (in other words, ZPE). "Zitterbewegung" or particle jittering may also be the result of that zero point fluctuations. Puthoff believes that it constitutes an already unified field. He refers to the Gravitation text by Meisner, Thorne and Wheeler, often used in graduate courses on general relativity. There are basically six approaches to gravitation that are outlined in that book. The one that Dr. Puthoff emphasizes is specifically the one that Sakharov developed. In the paper, "Gravity as a zero-point-fluctuation force" (*Phys. Rev. A*

39,5,1993), he points out that Dr. Sakharov regards gravitation as not a fundamental interaction at all, but an induced effect that's brought about by changes in the vacuum when matter is present. The fascinating part about this is that the mass is shown to correspond to the kinetic energy, the zero point induced internal particle jittering, while the force of gravity is a long range effect. Low frequency, long range forces are now associated with van der Waal's forces. (Van der Waal's forces are seen in colloids and various other liquids weakly interacting.) In Puthoffs theory, gravity is related directly to zero point fields, by the low frequency end of the zero point radiation spectrum.

When we consider ZPE as having a third order dependence on frequency, it reminds me of the Hutchison effect, (see *Intro. to 'Free Energy: The Race to Zero Point'*, report published by Integrity Res. Inst.) which also has been shown to be a 3rd derivative (3rd order) effect. The Hutchison effect is used to explain an object (conducting or non-conducting) which repels gravity under the influence of high voltage AC-modulated DC fields, with the object continually and uniformly increasing its acceleration. Scientists have never seen that happen before except in the third order Lorentz-Dirac equation treating radiation reaction which may help explain the Hutchison effect. Forces in nature tends to create a constant acceleration. (due to  $F=ma$ ) The third order effect predicted by the equation of motion in Puthoffs paper is directly related to zero point energy and also yields an insight into the Hutchison effect. It is also worth noting that the "Free Energy: The Race to Zero Point" video shows the evaluation of the Hutchison effect by the U. S. military, who promptly classified the report.

### **Inertia is a ZPE Effect**

The Lorentz force is used to describe Faraday's law, for example, when we have a charged particle moving in a perpendicular magnetic field and use the right hand rule to describe where the magnetic field is going to force that particle to go. In this example, the electric field, magnetic field, and the force are all perpendicular to each other. The Lorentz Force now has been proven by Puthoff in his derivation in *Physical Review A* (49, 2, 94), to be directly responsible to what he calls the "electromagnetic resistance arising from the known spectral distortion of the zero point field in an accelerated frame."

Physicists often hear that Einstein was very interested in Mach's principle. Ernst Mach was a philosopher more than a scientist and developed the concept that we could only understand inertia if we have some unmoving reference frame. He chose the distant stars as the reference frame. This has been interpreted, not only by Einstein, but others since then to actually explain the principle of inertia, since the distant stars can be regarded as a relatively stable reference frame in the universe from our perspective. Puthoff states, "The ZPF could thus serve as the Machian cosmic reference frame... and the interesting point is that the bulk of the contribution to the effect, in this case the inertial mass, comes from the very-high-frequency components of the ZPF." He then demonstrates a causal and quantifiable basis for Mach's principle and explains that the magnetic component of the Lorentz force arises in ZPE and matter interactions.

#### **Newton's Law is a ZPE Effect**

Another theoretical breakthrough by Puthoff is the derivation of Newton's Law ( $F=ma$ ) from ZPE electrodynamics. It appears to be related to the known distortion of the zero point spectrum in an accelerated reference frame. We therefore have an understanding as to why force and acceleration should be related, or even for that matter, what is mass. Puthoff explains that the resistance to acceleration defines the inertia of matter and it appears to be an electromagnetic resistance. To summarize: the inertia effect is a distortion at high frequencies whereas, the gravity effect has been shown to be low frequency effect, according to the Puthoff theory.

It is important to mention that Drs. Rueda and Haisch have also contributed to this field by proposing to have found an explicit origin for the reaction force of Newton's second law ( $F=ma$ ), which has traditionally been attributed to inertia. Their article (*Physics Letters A* 240, 1998, II 5-126) proves that the acceleration-dependent scattering of ZPE radiation, which the accelerated object is force to move through, interacts with standard electrodynamics to cause a Lorentz force on the object. Their work cites Puthoff and is supported by a NASA contract.

The distortion of the ZPE field under acceleration is the cause of inertia that we feel from the bound electrons in our body reacting to the

sudden change of direction, according to Puthoff. Perhaps there are ways to prevent that interaction. Maybe there are some ways that we can actually turn on a dime, accelerate really quickly and also take off on a space drive. This is what Arthur C. Clarke believes constitutes a space drive in his new book, *3001, The Final Odyssey*. He specifically cites Dr. Puthoff's theory with the idea that it is written in the 3001 era, looking back 1000 years as to what was most breakthrough news in making the space drive possible. Arthur C. Clarke pointed out years ago that "the earth is the cradle of civilization but mankind cannot live in the cradle forever!"

### **ZPE Critical Acclaim**

Certainly such an impressive theoretical achievement as Puthoff's cannot go unnoticed. Philip Yam, in "Exploiting Zero-Point Energy" (*Scientific American*, 12/97) addresses the issue critically. He admits that, "Energy in the vacuum...is very much real." Yam also explains, "Specifically, zero-point energy emerges from Heisenberg's uncertainty principle, which limits the accuracy of measurements... Residual energy must therefore exist in empty space... And given the equivalence of mass and energy... the vacuum energy must be able to create particles. They flash briefly into existence and expire within an interval dictated by the uncertainty principle." He then goes on to dryly summarize the Casimir effect and Puthoff's research with a demand for proof of principle.

Dr. Marc Millis of NASA's new Breakthrough Propulsion Physics Research Program has also addressed the above "emerging technology" in several articles in the past year, including his "Challenge to Create the Space Drive" (*J. Prop. & Power*, V. 13, No. 5, 1997, p.577). There his search for asymmetrical modifiers leads him to consider the "Remaining Research" of the ZPE field (which he calls the ZPF) "because of its high-energy density". Dr. Millis states, "Electromagnetism is also suggested as a target phenomenon for space drive research because of the ZPF. The ZPF is an electromagnetic phenomenon. Discovering any way to react asymmetrically with the ZPF would likely create a space drive." Further on he concludes, ". . .these theories provide new, alternative approaches to search for breakthrough propulsion physics." Perhaps we can start a new trend by blaming everything on ZPE (pronounced

“zippy”)! For an interesting theoretical physics paper on zero point energy, download from <http://xxx.lanl.gov/abs/hep-th/9901011> .

Lastly, Dr. John Bahcall from the Inst. for Adv. Study at Princeton (where Einstein worked) says, “We are all quantum fluctuations. That’s the origin of all of us and of everything in the universe.”

#### **The Author**

**Mr. Thomas Valone** has degrees in electrical engineering and physics and is a professional engineer. He is presently the President of the Integrity Research Institute in Washington, DC providing technical consultation for engineering and law firms, authors, videos. Clients include Lightworks AV, Alternative Energy Institute, Starburst Foundation, The Magnetizer Group, Saladoff and Associates, ELF International, Sachs-Freeman Associates, AquaQueen, Newline Investments. Services provided: Electrical product design/development, engineering testing, expert testimony and opinion, magnetic field measurement & shielding, circuit design. He is the Editor of the *Future Energy* newsletter and has 3 books and 50 articles in print covering a broad range of engineering and energy issues.