The Zero Point Field

The combined theories of kinetic theory of gasses, thermodynamics, and Maxwell's equations seemed to indicate that all of the kinetic energy of molecules should long ago have been radiated away, leaving a cold dead universe.

Quantum physicists struggled with the question of why an electron orbits around a proton, like a planet orbiting around the sun. In the atomic world, any moving electron, which carries a charge, would eventually radiate away its energy and spiral into the nucleus, causing the entire atomic structure to collapse. [1]

The hidden mechanism which prevents atomic collapse appears to be the Zero Point Field. In 1987, Hal Puthoff was able to demonstrate in a paper published by Physical Review, that the stable state of matter depends on the dynamic interchange of energy between the subatomic particles and the sustaining Zero Point Energy field. [2]

In quantum field theory, the individual particles are transient and insubstantial. The only fundamental reality is the underlying entity- the Zero Point Field itself . [3]

Interestingly, Timothy Boyer and Hal Puthoff showed that if you take into account the Zero Point Field, you don't have to depend on Bohr's Quantum Mechanical model. One can show mathematically that electrons loose and gain energy constantly from the ZPF in dynamic equilibrium, balanced at exactly the right orbit. Electrons get their energy to keep going because they are refueling by tapping into these fluctuations of empty space. Puthoff showed that fluctuations of the ZPF drive the motion of subatomic particles and that all the motion of all the particles generates the ZPF.

Timothy Boyer showed that many of the weird properties of subatomic matter which puzzled physicists and led to the formulation of strange quantum rules could easily be accounted for in classical physics, if you include the ZPF: uncertainty, wave-particle duality, the fluctuating motion of particles all had to do with interaction of the ZPF and matter.

In the 1960s, Paul Dirac showed that fluctuations in fields of material particles produces a polarization of the ZPF whereby it in turn affects the particles mass, charge, spin, or angular momentum. About the same time, Andrei Sakharov proposed that the slowing of clocks and shrinkage of lengths near the speed of light are the result of effects induced in the vacuum "due to the shielding of the ZPF by charged particles. [4]

Quantum Mechanics and the Zero Point Field are most obviously related, as they are mutually interdependent for their existence.

To quantum physicists attempting to model the electron mathematically, the vacuum, or Zero Point Field was seen as an annoyance which introduced infinities into their equations. In Paul Davies words: "The presence of infinite terms in the theory is a

warning flag that something is wrong, but if the infinities never show up in an observable quantity we can just ignore them and go ahead and compute." [5]

To their delight, physicists found that not only could these infinities be subtracted out mathematically, but the resulting theory of Quantum Electrodynamics proved highly successful. [6] This theory states that interaction between electrons is mediated by virtual photons from the quantum vacuum (ZPF). Electrons feel each other by exchanging virtual photons.

However, the very success of QED itself provided a clue to the profound importance of the Zero Point Field. This theory says that fluctuations of this Zero Point Field are really occurring and effect the structure of atoms. In 1947, Willis Lamb found that the energy levels in the hydrogen atom are not exactly where you would expect them to be based on classical physics. The mismatch is called the Lamb Shift, which is explained by QED: unless you include the effects of the virtual particles, you will not get the classically expected values. The vacuum is also manifest macroscopically, as seen in the Casimir effect, in which two thin plates placed on one another experience a net attraction. [7]

There is some controversy regarding the energy density of the Zero Point Field, or quantum vacuum. [8]

Is there a difference between zpf and qv?

The vacuum or quantum fluctuation theory, also known as the cosmological constant theory is among the major contenders in accounting for "dark energy", which makes up 70% of the universe, and which is causing an acceleration in the expansion of the universe. [9] From astronomical considerations, many believe the vacuum energy density to be close to zero. However, empty space may turn out to be a writhing sea of energy. The quantum vacuum itself obeys Heisenberg's Uncertainty Principle: the smaller the distance and time the larger the uncertainty in energy. Even though space time is considered discrete at the Plank scale, (10 -33rd cm) the vacuum fluctuations in energy density are still enormous, being calculated variously as 10^{96} kilograms per cubic meter. [10] Richard Feynman, who made major contributions to QED , [11] noted that the energy in one cubic meter (variously one teaspoon) of empty space contains enough energy to boil all the oceans of the world. [12] These large vacuum fluctuations, as we have previously seen, make unification of Quantum Mechanics and gravity very difficult. Seen in this perspective, physical matter can be seen more as a froth appended to the churning sea. [13]

The Zero Point Field and Information

The existence of the Zero Point Field implies that all matter in the universe is interconnected by waves. [14]

Robert Jahn notes that current science deals not only with matter and energy, but also information. According to the Apollo astronaut Edgar Mitchell, information and energy are the stuff of the universe. "The quantum vacuum", Mitchell said, "is the holographic information mechanism that records the historical experience of matter." [15] Ervin Laszlo

contends that [16] the Zero Point Field is in fact a super dense information field which in addition to retaining a record of all events, holds the universe together and accounts for literally "everything".

How could the quantum vacuum convey the "historical experience of matter"? The German physicist Hartmut Mueller has found that pressure waves may propagate through the ZPF, and claims that the observed dimensions of atom as well as galaxies is determined by pressure waves in the ZPF. These pressure waves may superimpose, creating standing waves. These waves determine physical interactions by setting the values of the electromagnetic, gravitational, weak and strong nuclear forces. By means of resonance they amplify some vibrations and suppress others, and are thus responsible for the distribution of matter through the universe. [17]

The Russian physicists G.I. Shipov and A.E. Akimov et al proposed the "torsion wave " theory, which has been elaborated upon by European and US scientists. This theory shows how the vacuum can link physical events through space time. The torsion waves act at one billion times the speed of light. Particles that have "spin" also have a specific magnetic momentum, which is registered in the vacuum in the form of minute vortices made up of virtual bosons. Hungarian Laszlo Gazdag has argued that these vortices carry information, much the same as magnetic impulses on tape or a computer disk. These vortices interact with each other to form interference patterns that integrate the strands of information. An analog is the sea and the way waves from objects in the sea interact. The persisting wave patterns are the memory of the objects that moved in the water. [18]

It makes sense, says Ervin Laszlo, to name this ZPF information field of the universe the "A-Field", after the Indian philosophical concept of the Akashic Chronicle, the record of everything that has happened in the universe.

Laszlo arrives at his ZPF as the explanation for everything by way of a grand generalization in assuming that the ZPF is the mechanism producing the well documented property of non-locality of quantum mechanics. He then notes that living tissue, being a Bose- Einstein condensate, may be considered a quantum system. He then goes on to assume that the coherence of biological systems, the linkage of organisms to one another and the environment in evolution, and the connection of individual consciousness to a larger awareness are all due to the ZPF. Information is carried by superimposed vacuum wave interference patterns that are equivalent to holograms.

The Zero Point Field and Inertia

Gravity has remained a mystery to physicists, being billions of times weaker than the other three acknowledge forces of nature. Even Einstein, who was able to describe it thru his general theory of relativity, could not explain where it came from or how to relate it to the other fundamental forces.

Hal Puthoff, with the help of Alfonso Rueda and Bernie Haisch, collectively called HRP, demonstrated mathematically that gravitational and inertial effects were entirely consistent with zero point particle motion. Tying gravity to Zero Point energy solved a

number of problems that had troubled physicists for centuries. It answered why gravity is weak and can't be shielded (the ZPF can't be shielded). it also explained why we can have positive mass and not negative mass. [19]

The paper *The Origin of Inertia*, [20] by James F. Woodward, offers an interesting perspective on and critique of HRP's theory of inertia.
Woodward believes the cause of inertial reaction forces has been proven to be the action of gravity, as a result of the work of Dennis Sciama in the 1950s, and D.J. Raine in the 1980s. He notes however, that problems do arise when we ask how, in detail, local instantaneous inertial reaction forces are produced by distant matter in the cosmos.
He offers three alternative solutions:

1) The inertial force is propagated instantly from all distant matter in the cosmos

2) Some sort of local field (for example the ZPF) is the cause of inertia.

3) When you push on an object a gravitational disturbance goes propagating off into the past and future. In the past and future the disturbance makes the distant matter in the universe wiggle. The wiggling stuff out there makes up the currents that cause disturbances to propagate from the past or the future back to the object in the present. They all arrive from the past and future just in time to produce the inertial reaction force you feel.

After finding fault with alternative 1), he then argues for option 3) over option 2):
Woodward argues that the vacuum (ZPF) energy cannot be large enough to produce the inertial effects HRP report.
He then argues that the inertial mass of the proton relative to the neutron predicted by the ZPF theory of inertia is not quite right; giving a value of 1.56 rather than a value of slightly less than 1.

In defense of alternative 3) he notes that the wave equations describing the propagation of radiation have two equally valid types of solutions: ones that propagate forward in time, called "retarded", and ones that propagate backward in time, called "advanced".
[They are called advanced waves because their "effects" in the past occur in advance of their "causes" in the future.]

He notes that P.A.M. Dirac used advanced waves in an epochal study of the nature of electrons in the 1930s, and R.P. Feynman and J.A. Wheeler elaborated their "absorber" theory of electrodynamics in the 1940s on the basis of advanced waves. Electromagnetic radiation reaction (the reaction force on a source produced when radiation is launched) is neatly accounted for in terms of a combination of "retarded" waves (normal waves propagating forward in time) and advanced waves.

He also notes that Peter Milonni [in The Quantum Vacuum (Academic, 1993)] has shown that the zero point fluctuation processes can equally well be regarded as due to radiation reaction. Since radiation reaction can be viewed as a Wheeler-Feynman "absorber"

interaction with the distant matter in the universe in the far future, it seems that vacuum fluctuation schemes are really no different.

[1] Lynn McTaggart The Field p. 24f.

[2] The Field p. 24, also note 14 p.230: Physical Review D 1987, 35: 3266-70

[3] The field p 23 Fritjof tao of physics.

[4] Laszlo, *Science and the Akashic Field: An Integral Theory of Everything*: Inner Traditions, 2004 p. 47f

[5] Paul Davies *Superforce* p. 109 f. also The Field p. 109
[6] Paul Davies *Superforce* p. 111 f.
[7] Filippenko lecture 87

[8] http://math.ucr.edu/home/baez/vacuum.html

[9] Filippenko lecture 86 and 87.
[10] Filippenko lecture 89. See also http://math.ucr.edu/home/baez/vacuum.html
[11] The application of quantum mechanics to fields rather than single particles, resulting in what are known as quantum field theories, began in 1927. Early contributors included Dirac, Wolfgang Pauli, Weisskopf, and Jordan. This line of research culminated in the 1940s in the quantum electrodynamics (QED) of Richard Feynman, Freeman Dyson, Julian Schwinger, and Sin-Itiro Tomonaga, for which Feynman, Schwinger and Tomonaga received the 1965 Nobel Prize in Physics. QED, a quantum theory of electrons, positrons, and the electromagnetic field, was the first satisfactory quantum description of a physical field and of the creation and annihilation of quantum particles.
http://en.wikipedia.org/wiki/Quantum_electrodynamics

[12] [The Field p. 23 f.]

[13] [???? the field???]

[14] The field p. 24f.
[15] Laszlo p. 51

[16] Ervin Laszlo, *Science and the Akashic Field: An Integral Theory of Everything*: Inner Traditions, 2004

[17] Laszlo p. 49.

[18] Laszlo p. 51

[19] Lynn McTaggart The Field p. 25

[20] http://physics.fullerton.edu/~jimw/general/inertia/index.htm