

ON EXTRACTING ELECTROMAGNETIC ENERGY FROM THE VACUUM

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Abstract. Generators and batteries do not furnish any of their internal energy to their external circuit, but only dissipate it internally to perform work on their own internal charges to form a source dipole. Once formed, the dipole's broken symmetry extracts observable energy from the virtual particle exchange between dipole charges and active vacuum. The extracted *observable* energy is reradiated as the energy flow through all space surrounding the external circuit. The tiny *Poynting* fraction intercepted by the surface charges enters the circuit to power it, while the huge nonintercepted *Heaviside* fraction misses the circuit and is wasted. So electrical loads are powered by energy extracted from the vacuum, not by chemical energy in the battery or shaft energy input to the generator. Any EM system may be asymmetrically regauged freely, changing the energy of the system by changing its potential. By placing the source dipole in a closed current loop with external loads and losses, half the free excitation energy then *discharged* by the circuit destroys the source dipole while half powers loads and losses. This applies Lorentz symmetrical regauging so that additional internal generator/battery energy must be made available to dissipate on the internal charges to reform the dipole. Such self-crippling EM power systems exhibit $COP < 1.0$ *a priori*. Requirements for $COP > 1.0$ EM systems are given, as are recognized examples of such processes. We also propose the ubiquitous unaccounted Heaviside energy as the "dark matter" gravitational energy long sought by astrophysicists.

Introduction

A permanent solution to the world energy problem, dramatic reduction of biospheric hydrocarbon combustion pollution, and cessation of building nuclear power plants (whose nuclear component is used only as a heater) could be readily accomplished by the scientific community. However, to solve the energy problem we must (i) update the century-old notions in electrodynamic theory of how an electrical circuit is powered, and (ii) rid the classical electrodynamics model of numerous serious foundations flaws. We summarize the problems and essential changes, based on more modern developments in particle physics and gauge theory well after the foundations of electrodynamics were set. Self-powering systems readily extracting electrical energy from the vacuum to power themselves and their loads can be quickly developed whenever the scientific community will permit their development to be funded.

What Actually Powers the External Circuit Connected to a Battery or Generator?

Contrary to conventional wisdom, neither the shaft energy introduced into a generator nor the chemical energy present in a battery is used to power the external circuit. The internal energy in a generator or battery is only dissipated to perform work upon the internal charges, to separate them and form a source dipole between the terminals, with some of the energy dissipated in other internal losses.

Once formed, the source dipole's broken symmetry [1] in the vacuum's energy flux extracts enormous *observable* EM energy — many orders of magnitude greater than the small amount of energy input to the generator or present in the battery — from the virtual particle exchange between dipole charges and active vacuum. The extracted *observable* EM energy

is reradiated as the EM energy flow through all space surrounding the external circuit [2]. This energy flow is usually referred to as the *Poynting* [3, 5] flow, but Poynting's theory [3] captured only a very tiny component of it. Heaviside captured the remaining huge component, but Lorentz [6] mathematically discarded it.

To summarize: The total energy flow in space surrounding the conductors has two components as follows:

- 1) A tiny *Poynting component* [3] of the energy flow directly along the surface of the conductors strikes the surface charges [4] and is diverged (deviated) into the conductors to power the circuit.

- 2) The huge nondiverted *Heaviside component* [3, 5] filling all space around the circuit, misses the circuit entirely and is wasted in all those circuits using only a single pass of the energy flow. The Heaviside energy flow can furnish energy to the circuit if retroreflected to again pass over the surface charges, but conventional power systems completely ignore this enormous energy source accompanying every circuit. Other methods of extracting energy from the neglected Heaviside component are discussed later.

Why Lorentz Eliminated the Heaviside Flow Component

The Heaviside component was arbitrarily discarded by H.A. Lorentz [6], who integrated the energy flow vector itself around a closed surface enclosing any volumetric element of interest. This discards any *nondiverted* (nondiverged) energy flow components, regardless of how large [7], and retains only the *diverted* (diverged) component. Effectively Lorentz arbitrarily changed the *energy flow* vector into its *diverted flow component* vector — a fundamental non sequitur. In one stroke he discarded the bothersome Heaviside component, reasoning that it was "physically insignificant" because — in single pass circuits — it does not enter the circuit and power it. This is rather like arguing that all the wind on the ocean that does not strike the sails of a single sailboat, is "physically insignificant." A moment's reflection shows that the "insignificant" remaining wind can power a large number of additional sailing vessels. A very large amount of energy can be extracted and used to do work, if that "physically insignificant" wind is intercepted by additional sails [8, 63].

If Lorentz had not arbitrarily discarded the huge Heaviside energy flow component surrounding the circuit and not contributing to its power, electrodynamicists would have been confronted with the dilemma of explaining where such an enormous flow of energy — pouring forth out of the terminals of every generator and battery — could possibly have come from. Obviously the operator does not input such enormous energy, because the Heaviside flow is often some 10^{13} times as large in magnitude [9] as is the retained Poynting flow. Neither does a battery contain such enormous chemical energy.

The Deadly Closed Current Loop Circuit

In conventional systems, a closed current loop contains the generator or battery source dipole as well as the external circuit's loads and losses. This arrangement requires that half the collected energy in the circuit must forcibly pump spent electrons in the ground return line back through the back emf of the source dipole. Specifically, for every electron passing through the voltage drop across the loads and losses in the external circuit, an electron must be forcibly rammed back up through the source dipole against the same voltage.

Forcing the spent electrons through the source dipole's back emf performs work upon the end charges of the dipole to forcibly scatter them. This destroys the dipole and cuts off its free extraction of energy from the vacuum. In a charged battery, this "back emf work" causes a partial reversal of the normal chemistry [10] of the electrolyte, which reduces the chemical energy available by the battery to re-establish the source dipole. The battery's remaining chemical energy is expended to continually restore the source dipole as it is continually

destroyed, until the chemical energy is exhausted. Then one must introduce additional energy into the battery to "recharge" it by forcing the chemistry back to its initial fully charged condition.

Electrical loads are and always have been powered by energy extracted and converted from the vacuum by the source dipole, not by shaft energy furnished to the generator or by the chemical energy in the battery. Half the Poynting energy collected in the external circuit is expended in the circuit loads and losses (forward emf direction), and half is expended against the back emf of the source dipole (in the back emf direction), destroying the dipole.

Another way of seeing this is to simply examine the scalar potential existing between the two charges of a dipole. A "scalar" potential is not really a scalar *entity*, although it has a scalar reaction cross section for reaction with a static charge. Instead, it is a harmonic set of bidirectional longitudinal EM wavepairs, as shown by E.T. Whittaker [37] in 1903. Thus any dipole has an enormous set of longitudinal EM wave energy flows into it from every point in the universe, and a corresponding enormous set of longitudinal EM wave energy flows out from it to every point in the universe. Once the source dipole is formed in the generator or battery, this energy flow exchange between source dipole and the universal active vacuum is established and ongoing, as is the broken symmetry of the dipole in that energy flux exchange with the active vacuum. At any point in the universe in that "potential" (organized bidirectional flow), a charge will interact with the flow and extract energy from it.

Present Power Systems Are Designed to Forcibly Apply Lorentz Self-Regauging

Together the two equal halves of a conventional circuit's energy dissipation constitute *forced Lorentz symmetrical self-regauging* [11] of the discharge of the excitation energy. In turn, this causes the excited system to forcibly maintain its equilibrium with its active vacuum environment *while dissipating excitation energy in the circuit loads and losses*. Classical thermodynamics with its infamous second law rigorously applies, because the system itself is diabolically designed to continuously and forcibly restore itself into equilibrium with its active vacuum environment by killing its own source dipole gusher of vacuum energy flow.

A priori the source dipole is killed faster than the load is powered, since half the circuit's excitation energy is discharged to destroy the dipole, while less than the remaining half of the circuit's excitation energy is discharged to power the load.

In a generator-powered system, continual input of energy to the generator shaft is required to continually add energy to perform work on the scattered charges, in order to restore the source dipole which the closed current loop continually destroys. Thus our present *self-crippling* vacuum-powered generator circuits/systems exhibit $COP < 1.0$ *a priori*, as do our self-crippling battery-powered circuits and systems.

We must pay for the initial energy input to the generator to establish the source dipole. *Once formed*, the dipole continuously extracts and pours out enormous observable EM energy flow from the vacuum. The typical closed current loop circuit receives only a single-pass of the energy flow, and therefore only intercepts, collects, and utilizes the very small Poynting component, simply wasting the enormous Heaviside component that misses the circuit altogether. Our present *single-pass* power systems waste some 10^{13} times as much energy as they catch and utilize. Scientists can easily do better than this if they (i) remove Lorentz's arbitrary and erroneous discarding of the Heaviside energy flow, and (ii) develop circuits and circuit functions to catch and use much of that available but *presently neglected* huge energy flow.

To summarize: The intercepted Poynting energy flow component freely "excites" the external circuit, which then will decay from its excited state and release its excitation energy back to its vacuum environment. Due to the design of the closed current loop circuit, that

decay is self-enforced to be a symmetrical regauging of the system back to a nonexcited state. In present closed current loop circuits, half the Poynting excitation energy is still used in this symmetrical decay to destroy the source dipole. The other half of the Poynting excitation energy is used to power the load and losses, so that only a part of that half is dissipated in the load. A real circuit has losses, so less energy is dissipated in the load than is dissipated to kill the dipole. Since it requires at least as much energy to *re-create* the dipole as to *destroy* it, then the energy continually dissipated in the load is less than the energy we have to continuously input to the shaft of the generator to re-create the dipole. For real systems, with such a self-defeating circuit design we cannot obtain as much work in the load as the energy we have to input to keep restoring the dipole that our circuit diabolically keeps killing. So conventional circuits exhibit $COP < 1.0$.

What We Mostly Pay the Power Company To Do

Essentially we pay the power company to engage in a giant Sumo wrestling match inside its generators and to *lose* by killing the free extraction of energy from the vacuum faster than the wrestling process powers the loads.

We pay the power company to use only a "single pass" of the energy flow along its transmission lines and the consumer power circuits, and thereby to just "waste" some 10^{13} times as much available EM energy as the company allows us to "use".

Present electrical power systems simply repeat this travesty over and over, so that we are continually inputting external energy to the generator to restore the source dipole, and having to input more than we get back out as work in the load. That is why all conventional EM power systems exhibit $COP < 1.0$ *a priori*. The system is specifically designed to force itself to do precisely that, by killing itself faster than it powers its load.

Such an inane power system continually forms a marvelous extractor of vacuum energy, then turns upon itself suicidally. In an oil derrick analogy, the system continually destroys its own energy flow "well head" (source dipole) and does not capitalize upon it. That is rather like drilling an oil well, bringing in a great gusher, catching a little oil in barrels, burning half of the barreled oil to deliberately cap the well, then drilling another well beside the first one, forcibly recapping the second one, and so on.

This is what keeps those coal trains running, the fleets of oil tankers steaming, the natural gas lines flowing with gas and the oil pipe lines flowing with oil, and gasoline and diesel engines powering our transport. It keeps enormously expensive nuclear power plants being built so that their nuclear reactors can produce heat to boil water to make steam to run turbines to input shaft power to the electrical generators for the generators to restore their continually-killed source dipoles.

This insanity keeps our energy costs high, economically burdens every citizen and every nation, impoverishes many undeveloped and developing nations along with their peoples, and pollutes the planet to the limit of its tolerance and beyond. On our present course, we are embarked upon destroying our biosphere and ourselves along with it. Eerily, our scientific community ignores the terrible 135-year-old foundations errors in classical electromagnetics and assures us that this is the best that electrodynamics can do. In fact, the scientific community has not yet even recognized the problem, much less the solution. Heartbreakingly, the community itself seems adamantly bent on defending gross non sequiturs, dogma, and the status quo, rather than correcting an aged discipline so seriously flawed that it has become a scientific disgrace.

Requirements for Maxwellian EM Power Systems Exhibiting $COP > 1.0$

Along with some suggestions, the characteristics for *permissible* electrical power systems that exhibit $COP > 1.0$ are:

1) The system must be an open thermodynamic system far from equilibrium in its energetic exchange with the active vacuum. In that case classical equilibrium thermodynamics does not apply, and such a system is permitted to (i) self-order, (ii) self-oscillate or self-rotate, (iii) power itself and its loads simultaneously (the energy is just taken from the vacuum), and (iv) exhibit negentropy.

2) The external circuit's loads and losses must not be *completely* coupled into the same closed current loop with the source dipole in the generator. One suggestion is to develop and use proven *energy shuttling* in circuits. This discovery by Tesla [12] can only be seen (and designed) by electrodynamics theory embedded in an algebra of higher topology than tensors [13, 14].

3) The system must iteratively collect additional energy from the available but normally wasted enormous Heaviside energy flow component.

a) A primary way to do this is to iteratively retroreflect the nondiverted Heaviside energy flow component after each pass, reflecting it back and forth across the surface charges in the circuit's conductors, collecting additional EM energy in the circuit on each repass.

b) A second avenue is to intensively re-investigate and develop Kron's [8, 63] discovery of the "open path" for EM networks as a dual of the conventional closed path.

c) A third suggestion is to further investigate and develop (in higher topology algebra) Tesla's energy-shuttling in EM circuits as shown and improved by Barrett [13, 14].

d) A fourth suggestion is to utilize intensely scattering optically active media (ISOAM) and develop self-excitation processes in the medium. With output in the infrared region, such a process could use the excess heat to provide the heater portion of conventional power plants, allowing relatively straightforward phase-in of clean vacuum energy powering of most present major power systems. Previous experiments with such ISOAM have utilized *external* excitation of the medium and thus have $COP < 1.0$. However, *self*-excitation looms in the mechanisms being uncovered in the most recent experiments [15], which have shown positive feedback loops, trapping of light flow energy in large random walks of over 1,000 individual interactions, weak Anderson-type localization, and constructive interference of forward time and reversed time light paths. These recent experiments point toward a potential "*vacuum-energy-powered heater*." With additional research, such a heater can become self-powering by the presence of sufficient positive feedback (which will allow excess collection from the Heaviside energy flow component). We have pointed out [16] that this ISOAM process — with the self-excitation occurring spontaneously as a "kick-in" process in an exploding gas — probably accounts for the phenomena observed in the gamma ray burster. Re-ignition, afterglow, and similar effects are observed in both the gamma ray burster and also in the latest ISOAM experiments. Similar phenomena occur in x-ray bursters as well, and perhaps even in the recently confirmed gamma ray emissions from intense storm clouds.

e) A fifth suggestion is to reopen the intensive investigation of true negative resistors such as those by Kron [8, 63] and Chung [29], adding the consideration of vacuum energy interaction into the electrodynamics utilized for the investigation. Indeed, the original point-contact transistor often behaved in true negative resistor fashion, but was never understood [17]. The point-contact transistor was simply bypassed by advancing to other transistor types more easily manufactured and with less manufacturing variances.

- f) As a sixth suggestion, we point out that all semiconductor materials are also optically active materials, and that a point discharge into such materials represents a very sharp re-gauging discharge due to the increase in potential at the tip. This means that the junction involves asymmetrical self-regauging, iterative time-reversal retroreflection, increased Poynting and Heaviside energy flow components, optical scattering processes inside the junction materials, etc.
- g) As a seventh suggestion, intense sudden discharges in ionized gases are especially of interest due to the presence of optical frequency components and the involvement of iterative optical retroreflection etc. These processes seem to be involved in several investigations and inventions [18].
- h) As an eighth possibility, the present author [19] has advanced an engineerable mechanism — still proprietary at this time — for altering the rate of flow of a mass particle (or a set of them, comprising a mass) through time, including time-reversing the particle back to a previous state. The mechanism provides for exciting and discharging a charge with a *time-charge* excitation, where time-charge (time-energy) is ordinary spatial energy compressed by the factor c^2 . Hence time-charge (time-energy excitation) has equal energy density to mass. In a small time-reversal zone (TRZ) created by the process, like electrical charges attract and unlike electrical charges repel. We believe this process or a similar one may be involved in the intense clusters of like charges demonstrated by Shoulders [20] and in cold fusion reactions. The law of attraction and repulsion of charges is reversed in a TRZ, but the TRZ then decays away, providing an entirely new class of "inside-to-outside" nuclear interactions not achievable by present "outside to inside" collision physics at low spatial EM energy. As the TRZ decays, energetic changes are initiated which *start* from every point in spacetime inside the TRZ — including inside nucleons located in the zone — and move outward, interacting first with the nearly-time-reversed quarks and gluons so that quark-flipping and change of proton to neutron and vice versa become favored reactions. In the highly localized TRZ the quarks are nearly unglued anyway, so that alteration of quarks is not formidable. We have proposed novel new reactions [19] which produce most of the observed low energy transmutations of the electrolyte experiments, and also explain the anomalous phenomena experienced in the instruments for several years in electrolyte experiments at China lake. In addition to a vast new set of highly localized nuclear reactions of extremely high *time-energy* but extremely low *spatial* energy, the TRZ mechanism would seem to allow the production of true negative resistors — e.g., to be used as an external circuit bypass shunt around the source dipole in the generator, transformer, or battery. If so, once the process is developed and shown to be valid, EM circuits exhibiting COP > 1.0 will hopefully become a standard development, as will direct engineering of the atomic nucleus and nucleons in that nucleus.
- i) As a ninth mechanism, application by Kawai [21] of adroit self-switching of the magnetic path in magnetic motors results in approximately doubling the COP. Modification of an ordinary magnetic engine of COP < 0.5 will not produce COP > 1.0. However, modification of available high efficiency (COP = 0.6 to 0.8) engines to use the Kawai process does result in engines exhibiting COP = 1.2 to 1.6. Two Kawai-modified Hitachi engines were rigorously tested by Hitachi engineers and produced COP = 1.4 and COP = 1.6 respectively. The Kawai process and several other Japanese overunity systems have been blocked from further development and marketing.

- j) As a tenth suggestion, the Magnetic Wankel engine [22] should also be capable of $COP > 1.0$ and closed-loop self-powering, but apparently it has also been suppressed, as have all Japanese $COP > 1.0$ EM systems.
- k) As an eleventh suggestion, multivalued magnetic potentials arise naturally in magnetics theory, but theoreticians do all in their power to minimize or eliminate their consideration. However, if deliberately used and optimized, the multivalued magnetic potential can provide a nonconservative field, where the $\int \mathbf{F} \cdot d\mathbf{s} \neq 0$ around a rotary permanent magnet loop. In theory, this can enable a "self-powering" permanent magnet rotary engine [23].
- l) As a twelfth suggestion, certain passive nonlinear circuit components such as ferroelectric capacitors [24] have multiple nonlinear current processes ongoing inside. It is possible to utilize such components only during the time they pass the current against the applied voltage. By adroit switching, in theory one can intermittently connect and utilize such passive components as true negative resistors.
- m) As a thirteenth suggestion, DeSantis et al. [25] showed that feedback systems with a multipower open loop chain can produce $COP > 1.0$ performance. Indeed, a frequency converter using 64 transistor stages and similar sophisticated feedforward and feedback mechanisms was placed in the original Minuteman missile, then deliberately modified to stop its demonstrated $COP > 1.0$ performance. Very quietly, Westinghouse engineers then obtained several patents [26] surrounding the technology, but no further mention of it appears in the literature.
- n) As a fourteenth approach, Johnson [27] has built many novel linear and rotary motors and at least one self-powering magnetic rotary device — later stolen in a mysterious break-in at his laboratory — personally tested by the present author. Johnson uses a bidirectional "two particle" theory of magnetic flux lines which can be justified by Whittaker's earlier work showing the internal bidirectional energy flows in all potentials and fields. He also utilizes controlled spin-waves and self-initiated precise exchange forces, which are known to momentarily produce bursts of very strong forcefields [28]. His approach is to use highly nonlinear assemblies of magnets which initiate the foregoing phenomena at very precise points in the rotation cycle. In short, he seeks to produce precisely located and directed sudden magnetic forces, using self-initiated nonlinear magnetic phenomena. This is analogous to what the Wankel engine did using the Lenz law effect by sharply interrupting a weak current in a external coil. We point out that the Lenz law effect and other very abrupt field changes momentarily produce not only an amplified *Poynting* energy flow component, but also an amplified *Heaviside* energy flow component as well.
- o) As a fifteenth approach, we previously proposed a patent-pending mechanism whereby a degenerate semiconductor alloy (say, of a bit of iron in aluminum wire) is utilized for the conductors of the external circuit. By obtaining an electron relaxation time of, say, a millisecond, one can excite the circuit with potential alone, then switch away the excitation source prior to its decay. In this way, pure asymmetrical regauging is used to excite the circuit, without requiring work (except for switching, which can be made very efficient). The excited circuit then discharges in Lorentz symmetrical fashion, but all the work in the load is "free". If LE is load energy and SE is switch energy utilized, this approach yields $COP = LE \div SE$ and $COP > 1.0$ is possible.

p) We are presently working on a patent-pending, still-proprietary process whereby a permanent magnet is given a "memory" at will. By adroitly manipulating the memory, the magnetic flux from the magnet can be made to prefer and take a desired magnetic path among several available. Once one controls what the flux "prefers" and when it prefers it, obviously $COP > 1.0$ is possible.

4) The system must dissipate the excess collected energy in the circuit in the load (and in the losses) *without* dissipating the source dipole, or by dissipating the source dipole much slower than it powers the load. For a two-wire circuit, one method might be to utilize a *true* negative resistor shunt [29] in parallel with the primary source dipole but in its external circuit. In that way, some of the return current in the external circuit that is forced back up through the back emf will not pass through the source dipole, but remain in the external circuit and the bypass. With that arrangement, less than half the energy collected in the circuit is then used to destroy the dipole, and with minimal losses in the external circuit, more power can be developed in the load than is dissipated in the source dipole to destroy it. Hence such a system exhibits $COP > 1.0$.

5) For self-powering of Maxwellian $COP > 1.0$ systems once developed, clamped positive energy flow feedback from output side to input side and excess collection from the Heaviside component can be used to power a motor turning the generator shaft, with the remainder of the output dissipated in a load. We stress that no laws of physics, electrodynamics, or thermodynamics are violated, nor are Maxwell's equations violated before arbitrary Lorentz regauging. The conservation of energy law is obeyed at all times. Such an open dissipative Maxwellian system — which is what is being described — rigorously is permitted to self-power itself in that fashion, as shown by Prigogine [30] and others [31] in the study of nonlinear systems far from thermodynamic equilibrium. But following Lorentz, electrodynamicists have arbitrarily discarded all such Maxwellian systems *because it simplifies the mathematics!*

Proof of the Available But Neglected Heaviside Energy Flow Component

To prove the ubiquitous existence of the Heaviside energy flow component, and to demonstrate that it can easily be tapped, one can refer to Bohren's [32] demonstration that a resonant particle collects and emits up to 18 times as much energy as is input to it by conventional accounting (that is, in the Poynting component of the true energy input). Resonant particle absorption and emission is a $COP > 1.0$ process already proven and standard in the literature for decades; e.g., see the pioneering work by Letokhov [15]. The effect reported by Bohren was confirmed and verified, e.g., by Paul and Fischer [33]. Bohren, Paul, Fischer, and other electrodynamicists are unaware that their energy input actually included the huge unaccounted Heaviside energy flow component as well as the accounted Poynting flow defined by reaction with a *static* unit point charge.

The reason for the $COP > 1.0$ in this process is that the *resonant* particle sweeps out a greater *geometrical reaction cross section* in the total energy flow than is included in Poynting's theory for a standard *static* particle's interception. In short, it proves that the neglected Heaviside component is present and can be readily intercepted to obtain real expendable energy. We did a back-of-the-envelope calculation for the relative magnitude in a simple DC circuit of the Heaviside component compared to the Poynting component. The neglected Heaviside component for a nominal simple circuit was on the order of 10^{13} times as great in magnitude as the feeble Poynting component. A more exact calculation would be welcomed, but we could not locate such a calculation in the literature [34].

The Heaviside Energy Flow Component Was *Arbitrarily* Discarded

Practical EM power systems exhibiting $COP > 1.0$ are included in the Maxwell-Heaviside equations prior to Lorentz's symmetrical regauging [11][35], which changed the equations to a small subset of the Maxwell-Heaviside theory. Specifically, the Lorentz procedure arbitrarily discards that entire class of Maxwellian systems that are not in equilibrium with their active vacuum environment. It is precisely that discarded class of Maxwellian systems that contains all Maxwellian EM power systems exhibiting $COP > 1.0$, by functioning as open dissipative systems freely receiving and using excess energy from the active vacuum.

A Proposed Aspect of the Missing "Dark Matter" Gravitational Energy

Lorentz arbitrarily discarded the vast Heaviside energy flow component accompanying every EM *field or potential* and charge reaction — i.e., their reaction cross sections. The calculations of the fields, potentials, and energy radiations for all such reactions in the universe have grossly underestimated the actual EM energy involved, using only the reaction cross section of the field or potential to a unit point static charge. It follows that throughout the observed universe a myriad of interactions are pouring forth very large amounts of unaccounted Heaviside EM field energy flow, across the universe in all directions. Consequently, at any location in space, there exists a vast flux of these Heaviside "dark radiation" energy flow components. Indeed, the nonlinear wave and field interactions of these unaccounted dark energy flows may be taken as what is "driving" the EM vacuum fluctuation of "zero-point" energy, essentially what is included in Puthoff's cosmological feedback principle [55].

Three facts [36] are of interest: (i) The local gravitational potential from the distribution of stars perpendicular to the Galactic plane seems greater than can be provided by the masses of known types of stars, (ii) due to the decrease in luminosity to mass (or energy) in the outward direction from the center of galaxies, there must be some form of missing "dark" (non-Poynting radiant) matter (or alternatively, unaccounted and therefore "dark" energy flow) in the outer galactic regions which contributes to the gravity, and (iii) in clusters of galaxies it is known that there must be more mass (or dark energy) present than is contained in the visible (by Poynting detection) parts of galaxies.

We point out that the Heaviside component of radiation does in fact represent a "dark" form of radiated EM energy that is missed by standard detectors, is arbitrarily excluded from the EM theory, and has been completely unaccounted in astrophysics, as well as elsewhere. Certainly the EM dark energy radiation is gravitational, so one may hypothesize this as a candidate or contributor to resolving the dark matter problem. In short, the dark matter problem may arise not because of missing *matter*, but because of *unaccounted, undetected, and theoretically discarded dark radiation of Heaviside form*. As with any other hypothesis, of course, this one requires falsification or validation by future experimental and theoretical investigations.

The "Scalar" Potential Is Not a Scalar Entity, But a Multi-Vectorial, Multi-Wave Entity

There is of course a scalar potential established between the two end charges of a source dipole. Let us examine what kind of energy flows actually comprise a "scalar" potential, and whether it is a scalar entity or actually a set of multi-wave multi-vector EM energy flows.

When a "scalar" potential is set upon a transmission line, it speeds down the line at nearly light speed, revealing its vector nature. When it is set onto the middle of the transmission line, it speeds off in both directions simultaneously, revealing its *bidirectional* vector nature. In addition to this observation, there is rigorous mathematical proof as well.

In 1903 E.T. Whittaker [37] showed that the scalar potential *identically is* a harmonic set of longitudinal EM bidirectional wavepairs, where each wavepair is comprised of a coupled longitudinal EM wave and its phase conjugate replica. Hence the potential is a bidirectional, multiwave, multi-vectorial entity and an equilibrium condition in a myriad bidirectional flows of longitudinal EM wave energy. There is thus a vast, bidirectional, longitudinal electromagnetic wave "infolded electrodynamics" inside every potential and comprising it.

In 1904 Whittaker [38] showed that any EM field or wave consists of two scalar potential functions, initiating what is known as *superpotential* theory [39]. By Whittaker 1903, each of the scalar potential functions is derived from internally structured scalar potentials. Hence all EM fields, potentials, and waves may be expressed in terms of sets of more primary "interior" or "infolded" longitudinal EM waves and their impressed dynamics [40]. This is indeed a far more fundamental electrodynamics than is presently utilized, and one which provides for a vast set of new phenomenology presently unknown to conventional theorists.

There is No Such Thing As An Isolated Charge in Space

From quantum electrodynamics and particle physics, it is known that "empty space" is filled with intense virtual particle activity. An "isolated charge in space" must interact with the fleeting virtual charges that appear and disappear in accordance with the uncertainty principle of quantum mechanics. Consequently, virtual charges of opposite sign will be drawn toward the observable charge, before they disappear. The result is a formation of denser virtual charges of opposite sign, surrounding the observable charge, and a polarization of the local vacuum. We may take a tiny "piece" of the observable charge, coupled with a nearby virtual charge of opposite sign during its existence, and consider the pair to be a *dipole* in a special "composite" (coherent virtual and observable) sense. So the "unit point charge" often used in electrodynamics to interact with the fields and potentials — and erroneously "define" them as their own reaction cross sections — is not really a point charge at all but is a set of *composite dipoles*. Further, it occupies the "neighborhood of a point" rather than a point.

Each little composite dipole also has a "scalar potential" between its ends. We may decompose that potential into a harmonic set of bidirectional EM longitudinal wave (LW) pairs, where each pair consists of an outgoing LW and an incoming LW. Now, however, the incoming (convergent) LWs are virtual; i.e., comprised of organization and dynamics in the virtual flux of the vacuum.

We may repeat this analysis for each of the composite dipoles comprising the so-called "isolated observable charge".

So any "isolated charge" in fact organizes and dynamicizes the entire vacuum potential of the universe. The simple charge imposes negentropy and organization upon the entire vacuum, all across the universe. A vast set of "energy circulations" in the form of LWs and virtual LWs is established by charge-vacuum interaction, where a set of convergent virtual LWs feeds virtual energy continuously into the "charge", and the charge organizes some of its received energy into observable LW energy radiated out to the ends of the universe.

Each of the virtual particles comprising the composite end of the dipole, e.g., will also be accompanied by an organization of much finer, localized virtual particles of opposite sign. Hence another set of even finer composite dipoles is formed, each of which can again be decomposed into finer harmonic composite bidirectional LW wave sets.

The *organization of the vacuum* process continues at ever finer levels without limit.

A single electron organizes the entire vacuum energy of the universe, to a very surprising depth and degree. The vast, ever-changing interactions of the vacuum organization and dynamics, with particle dynamics, simply stretches one's imagination. But it is real, and the total energy content affected by each "reorganization" is enormous. This is an indication of

the vast extent and dynamics of the "self-ordering" that the entire energetic vacuum performs, in response to the slightest stimulation by a charge. It also illustrates that the vacuum is a special kind of scalar potential, with internal Whittaker structuring and dynamics. To change the internal structuring of a potential requires no work, because no force is involved or translated against resistance. Virtual energy which appears and disappears need exhibit no inertia in this reordering, since the reordering occurs "between" the extinction of one virtual particle and the appearance of another. There is no "change of an ordering" in the classical sense, but only the "emergence of a new ordering." In short, in the causal domain (such as the active vacuum) prior to the invocation of the $\partial/\partial t$ observation operator, negentropy is readily and freely obtained on a massive scale.

It is therefore not surprising that the "self-organization action" of a small source dipole in a generator or battery should produce such an enormous reorganization of vacuum energy and such great negentropy as is demonstrated in the Heaviside component. It should also not be surprising that, with no available theory dealing with or even touching such matters, Lorentz simply chose to resolve the "Heaviside energy flow component" problem by eliminating it altogether. One result of the Lorentz integration of the energy flow vector around a closed surface was to eliminate all that intense negentropic self-reorganization of the local vacuum that *did not* interact immediately with the circuit. In today's terms, he effectively eliminated *vacuum energy engineering* from electrodynamics. Decades later, the vision of vacuum engineering was glimpsed by modern physicists such as Lee [41]. But vacuum engineering by electrodynamic means, though fairly straightforward and practical by extended electrodynamics, is still missing from electrodynamics by arbitrary exclusion.

Field and Potential Are Erroneously Equated As Their Own Reaction Cross Sections

As we stated, neither the scalar potential's magnitude nor the field's magnitude is calculated in conventional classical electrodynamics [42]. Instead, only the magnitude of the *static particle reaction cross section* of the potential or field is calculated at each point in space where it exists. Assuming a unit point static charge at each point in space occupied by the "scalar" potential, each of the longitudinal EM waves comprising the potential is slightly diverged around the intercepting charge. The amount of energy in the stationary divergence of all the waves around the point charge is rigorously the reaction cross section of the potential, not the magnitude of the potential itself. The small amount of water diverged from a river's flow, around a small fixed pebble on the bottom, is most certainly not the magnitude of the river itself. A tiny whirlpool in a river is not the river itself.

The magnitude of any nonzero potential is indefinite, since as much energy as one wishes can be collected from it (from its composite unceasing energy flows driven by the negentropic charged vacuum), if one uses sufficient intercepting charge q . That of course is shown by the simple equation $W = \phi q$, where W is the total energy collected by intercepting charges q from a potential (set of bidirectional longitudinal EM wave flows) having static particle reaction cross section ϕ . If the particles comprising q are resonated, W increases up to 18 times greater.

A similar situation exists in the erroneous "definition" of a field as its own static particle reaction cross section.

The very "definitions" of field and potential have been corrupted in conventional electrodynamics to only include their Poynting (intercepted and diverged) energy flow component, and to discard their enormous Heaviside (nondiverged) energy flow component. *A priori*, classical electrodynamics (CEM) does not calculate the field or the potential, but only a tiny (Poynting-based) component of each — precisely that tiny portion diverged around an arbitrarily assumed unit point static charge. CEM calculates the reaction cross section only for a stationary intercepting/diverging static particle. The actual reaction cross

section will be changed, e.g., for a resonant (nonstationary) particle, without any change in the true field or potential. The resonant particle will therefore seem to collect and output "more energy than was actually input to it", as shown by Bohren [32] and others [33]. It collects the additional energy from the neglected Heaviside energy flow component unwittingly input by the researchers but not accounted by them.

In the *topological* approach to EM fields, such as in modern gauge field theory, this problem is bypassed and does not occur. But the problem remains a serious foundations problem in orthodox electrodynamics not based on gauge field theory and topology. Thus it remains a serious problem of omission in the electrodynamics used to design and build electrical power systems.

The continued presence in electromagnetics of such major foundations non sequiturs is responsible for our present "energy crisis." A single large electrical power plant generates sufficient *Heaviside* energy flow to power all electrical loads on Earth, were it intercepted, collected, and used to power loads without destroying the source dipoles in the generators. Indeed, when the Heaviside component is considered, a single human body in its tiny double surfaces produces about 10^{15} joules per second of total energy flow! But its reaction cross section is only about 10^{-13} . Hence it intercepts, collects, and dissipates only about 100 watts — enough to light a common light bulb [43].

Open dissipative EM power systems freely receiving and using environmental energy from the ignored Heaviside component *are permitted by the Heaviside-Maxwell equations before arbitrary Lorentz regauging.*

In Classical Electrodynamics Charges are Implicitly Assumed to be Perpetual Motion Machines

In classical electromagnetics with an inert vacuum assumed, by implication the "source charge" has no external energy input. It is assumed to *create* its associated fields and potentials (and their energy), which then reach across the entire universe in all directions, changing the energy density of the entire vacuum potential of the universe. Since those fields and potentials in their entirety contain enormous energy, CEM implies that the source charge creates all that energy from nothing. This of course violates the primary maxim that energy cannot be created or destroyed. Consequently, as stated by Sen [44], "*The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics.*"

The problem is already resolved in particle physics, since the charge is a broken symmetry in its exchange with the vacuum. Hence it is an open system far from thermodynamic equilibrium in its active vacuum environment. As such, classical *equilibrium* thermodynamics does not apply to the charge. As an open dissipative system, the source charge is permitted to (i) self-order (some of its received disordered virtual energy), (ii) self-oscillate (in this case, self-spin), (iii) power itself (its spin) and its output (continuous bidirectional EM energy flows across the universe, establishing the fields and potentials), and (iv) exhibit negentropy. These capabilities follow from the well known theory of open systems far from thermodynamic equilibrium.

Even though we are using the customary terms "source" and "source charge" in this paper, there is really no such thing as a true "source". Semiz [45] states it succinctly: "*The very expression 'energy source' is actually a misnomer. As is known since the early days of thermodynamics, and formulated as the first law, energy is conserved in any physical process. Since energy cannot be created or destroyed, nothing can be an energy source, or sink. Devices we call energy sources do not create energy, they convert it from a form not suitable for our needs to a form that is suitable, a form we can do work with.*"

The source charge and the source dipole are therefore special energy converters, freely converting some of the disordered vacuum EM virtual energy they receive into observable, ordered EM energy, and outputting that ordered component as the field energy and potential energy outpouring in all directions.

So we have argued that the basic "energy source" — the charge — is not a source but a transducer. Indeed, if Yilmaz [46] is correct, then the ultimate energy sink — the black hole — may not exist as such either, once one corrects Einstein's elimination of gravitational energy as the only kind of energy not producing curvature of spacetime.

Lorentz's Demons Can Be Identified In Every Electrical Power System

In the Lorentz symmetrical regauging, it is assumed that the potential energy of the system is changed twice (in two simultaneous *asymmetrical* regaugings) in carefully selected equal and opposite fashions, so that the two new force fields also formed are equal and opposite. We point out where these two Lorentz demons are invoked in the closed current loop.

First, we pay to asymmetrically regauge the generator to produce the source dipole initially.

The external circuit is then potentialized when the source dipole extracts an enormous energy flow from the vacuum and sends it through space surrounding the conductors of the external circuit. The surface charges intercept the tiny Poynting component and diverge it into the wires, potentializing the Drude electrons and freely exciting the system with excess energy.

The excitation energy is then dissipated in two equal parts, one half in the external loads and losses and one half in the source dipole itself, against the back emf. Using a simple dc example, the E-field E_1 across the circuit loads and losses is given by $E_1 = -\nabla V$, where V is the voltage between positive and ground terminal. The E-field E_2 generated upon the electrons in the current returned through the source dipole is $E_2 = \nabla V$ which then can return the electrons from the ground side to the positive terminal through the source dipole and against its potential. Hence $E_1 = -E_2$, and the two force fields (which are Lorentz's two asymmetrical demons) are equal and opposite. This is how Lorentz symmetrical regauging of the excitation discharge is accomplished.

Those "two Lorentz asymmetric but equal and opposite regauging demons" *must appear* and *do appear* in all EM power systems designed in accord with the Lorentz-regauged Heaviside Maxwell equations, since the demons are assumed in the equations themselves. The standard closed current loop circuit guarantees that the circuit forcibly and symmetrically discharges its free excess excitation energy, in accord with Lorentz symmetrical regauging of the Maxwell-Heaviside equations.

The limitation to $COP < 1.0$ is because the second Lorentz demon (driving the current back through the back emf of the source dipole) dissipates more energy to kill the dipole and shut off any further free self-excitation, than the first Lorentz demon dissipates in the external circuit's loads. COP may be defined as *usable energy (usually load) output divided by the required energy input by the operator*. To *restore* the scattered source dipole, we have to input as much energy to the generator (and a bit more to cover the generator's own inefficiencies) as was dissipated by the second demon in *destroying* the source dipole. We get less *usable* output energy (as work in the load) than we have to input to the generator. Thus the system exhibits $COP < 1.0$.

Further, the circuit killed its own dipole during the Lorentz excitation discharge. It is incapable of *self*-excitation again, since it also killed the local Heaviside energetic reorganization of the vacuum from which its Poynting excitation energy must be intercepted. So we must again pay to restore the source dipole, so that it again reorganizes its own local

Heaviside vacuum and extracts additional Poynting energy from that reorganized vacuum's energy flow.

This *self-crippling design* of two fighting Lorentz excitation discharge demons in all our power systems keeps all the coal trains moving, the fleets of oil tankers steaming, the natural gas being burned, the nuclear fuel rods being consumed, etc. It also keeps up the vast production of CO, CO₂ and other hydrocarbon combustion byproducts, as well as nuclear waste byproducts and their as yet unresolved storage problem. Even the storage problem for the CO₂ is now of epic proportion, and the planned injection of CO₂ in vast amounts underneath the bottom of the sea is a recipe for future global disaster. The huge combustion of hydrocarbons contributes to global warming and the remarkably accelerated melting of the polar icecaps, and in general seriously pollutes the biosphere, affecting and slowly strangling many living species.

AIAS Contributions To a New Electrodynamics

The Alpha Foundation's Institute for Advanced Study (AIAS) is a novel organization directed by Dr. Myron W. Evans, a noted scientist who has nearly 600 papers in the refereed literature. Other noted scientists such as Dr. Lehnert of the Alfvén Laboratory in Sweden and Dr. Vigier in the Laboratoire de Gravitation et Cosmologie Relativistes, Université Pierre et Marie Curie, Paris, France constitute the Fellows of the AIAS. A major effort has been underway by AIAS theorists (and a few other scientists as well) to extend electrodynamics into a non-Abelian electrodynamics in O(3) symmetry using gauge field theory [47]. Numerous failings of the present U(1) electrodynamics have been pointed out by the AIAS in a series of papers published in the literature and others presently in the referee process. Some 70 AIAS extended electrodynamics papers are presently carried on a controlled Department of Energy (DOE) website for reference by DOE scientists. The papers are being published in journals as rapidly as possible.

In a recent AIAS group paper [48] on the stress energy momentum tensor, it is shown that the Poynting vector in the received view is identically zero: *reductio ad absurdum* [49]. In the new method, based on equating ϕ with A , the Poynting flow in vacuo is unlimited, simply because the A_μ drawn from the vacuum defines the Lehnert charge current density in the vacuum. A new paper in this area of vacuum energy, treating the subject in greater depth, has just been completed [50]. The results appear direct from local gauge invariance. In the new method, it is only assumed that there is an A present in the internal gauge space, and that A can be subjected in vacuo to a local gauge transform.

Thus the vacuum is indeed a very active medium, filled with many kinds of real EM energy currents, and these energy currents may and do interact with EM circuits in such a manner that the circuits extract usable EM energy from the vacuum. As we have argued, conventional circuits receive *all* their EM energy from the vacuum interaction with the source dipole and not from the generator or battery. As is slowly being developed and published, there is a rigorous theoretical basis for extracting and using electrical energy directly from the vacuum. We also recognize the enormous contributions made by other advanced theorists outside the AIAS such as Barrett [13-14, 51], Cornille [52], Ziolkowski [53], Letokhov [15], Cole [54] and Puthoff [54, 55] as well as many others. We also specifically recognize inventors including Mills [56], Shoulders [20], Patterson [57], Lawandy [58], Mead and Nachamkin [59], Sweet [60] (now deceased), Mandel'shtam et al. [62], Bedini, and many others.

Conclusion

There are many foundations non sequiturs in classical electrodynamics that are sorely in need of correction; we have pointed out only a few. The present energy crisis has occurred

largely as a result of continuing to perpetuate these major flaws in electrodynamics theory, and continuing to build our electrical power systems in accord with the flawed theory.

Most electrodynamicists hold the opinion that extracting usable electrical energy from the vacuum is extraordinarily difficult. In fact it is a very simple thing to do and has always been done by our power systems anyway. Just collect some charge (a composite dipole) or form a dipole, and the "scalar" potential between its end charges represents an organized, enormous, bidirectional flow of EM energy, established over the entire vacuum. Energy flows outward from the dipole to every point in the universe, and from every point in the universe energy converges back to the dipole, as shown by Whittaker [37] nearly a century ago. Since the beginning, every electrical load has been powered by energy extracted directly from the vacuum, and not by the heat produced from all the hydrocarbons burned and nuclear fuel rods consumed, or by the energy from the hydroturbines and waterwheels turned by dams across streams, or by windmill-powered generators, or by solar cells, etc.

The problem is in *collecting and using* the enormous energy easily extracted from the vacuum, not in simply producing the direct Heaviside EM energy flows. In short, the problem is how to obtain much more Poynting energy from the easily available and enormous Heaviside energy. One can build a "vacuum energy extractor" for less than a dollar. Simply place a charged capacitor (or electret) upon a permanent magnet, so that the E-field of the capacitor is at right angles to the \mathbf{H} -field of the magnet, and the energy flow from the magnet (a function of $\mathbf{E} \times \mathbf{H}$) is maximized [61]. The system will extract energy from the vacuum and steadily output it indefinitely as a Heaviside energy flow. It does, however, sharply focus attention on the real problem of *how to collect and use some of the energy from the balanced vacuum energy circulations set up by the system between the local vacuum and the distant, nonlocal vacuum*. Again, the problem is how to convert Heaviside energy flow to Poynting energy flow.

Once the vacuum energy transducer (generator's source dipole) is in place, it is another matter to intercept, collect, and use the "modified local vacuum circulation energy" pouring from the transducer to power loads, and to do so without destroying the source dipole created in the collecting generator. Unfortunately our power scientists and engineers have been focusing upon the wrong end of the problem.

This is one of the great ironies in the history of science: All the hydrocarbons ever burned, all the steam turbines that ever turned the shaft of a generator, all the rivers ever dammed, all the nuclear fuel rods ever consumed, all the windmills and waterwheels, all the solar cells, and all the chemistry in all the batteries ever produced, have not directly delivered a single watt into the external circuit's load. All that incredible fuel consumption and energy extracted from the environment has only been used to continually restore the source dipole that our own closed current loop circuits are deliberately designed to destroy faster than we restore them.

We strongly urge the rapid, high priority development of permissible $\text{COP} > 1.0$ EM power systems which violate the Lorentz symmetrical regauging condition in their discharge of free excitation energy received from the vacuum via the source dipole. We will gladly contribute our own findings to the effort, including citing $\text{COP} > 1.0$ power systems [62] and negative resistors [8] [63] [29] produced by known scientists and documented in the literature, but usually suppressed by fierce scientific resistance to any dramatic change in U(1) electrodynamics and the Lorentz condition.

It is known in particle physics that there can be no symmetry of a mass system without the incorporation of the active vacuum interaction, yet this too is missing from classical electrodynamics. Symmetry implies nonobservables, and asymmetry implies observables. So every observable mass system, being asymmetrical *a priori*, must be accompanied by nonobservables interacting with it, else it can have no symmetry (or equilibrium). Yet

classical electrodynamics continues to assume equilibrium and symmetry in observable systems without incorporating the active vacuum. Everywhere we examine classical electrodynamics, we find non sequiturs of first magnitude. This alone should be a compelling reason for the scientific community to assign the highest priority, ample funding, and the best theoreticians to the sorely-needed revision of electrodynamics from the foundations level up.

With vigorous and refocused attention by the scientific community to a more proper development of the electrodynamics of energy systems and circuits, self-powering COP > 1.0 electrical power systems fueled by vacuum energy can be developed and deployed in rather straightforward manner. The problem is nowhere near as complex as hot fusion or developing a large new accelerator. The cost of one large hydrocarbon-burning powerplant will allow the development to be done. The energy crisis can be solved forever. The present enormous pollution of the Earth's environment by hydrocarbon combustion and nuclear wastes can be dramatically lowered. Global warming can be slowed and eventually even reversed.

Our children, the biosphere, and the slowly strangling species on Earth will benefit enormously from that sorely needed scientific effort. We desperately need to *do it*, and we need to *do it now*.

REFERENCES

1. E.g., see T. D. Lee, Particle Physics and Introduction to Field Theory, Harwood, New York, 1981, p. 184. The broken symmetry of a dipole in its vacuum flux exchange has been known in particle physics for more than 40 years. In classical electrodynamics (CEM) the active vacuum and its exchange are omitted altogether, even though experimentally established for many years. The asymmetry between positive and negative charges was discovered in 1957. As Lee states, "*Since non-observables imply symmetry, these discoveries of asymmetry must imply observables.*" There can be no symmetry of any *observable* system anyway, unless the vacuum interaction is included. Further, by the definition of broken symmetry, the proven asymmetry of the source dipole in the vacuum flux *must* extract and output observable energy.
2. See John D. Kraus, Electromagnetics, Fourth Edn., McGraw-Hill, New York, 1992. Figure 12-60, a and b, p. 578 shows the huge energy flow filling all space around the conductors, in a single pass circuit. Almost all of the energy flow misses the circuit entirely, is not diverged into the circuit to power it, and is just "wasted."
3. Poynting and Heaviside independently discovered the flow of energy through space. See J.H. Poynting, "On the transfer of energy in the electromagnetic field," Philosophical Transactions of the Royal Society of London, Vol. 175, Part II, 1885, p. 343-361; Oliver Heaviside, "Electromagnetic Induction and Its Propagation," The Electrician, 1885, 1886, 1887, and later; Electrical Papers, Vol. 2, 1887, p. 94, 405, 514; "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. Lond., 183A, 1893, p. 423-480. Poynting erroneously considered only that energy flow component entering the circuit, and completely missed the huge additional component shown by Heaviside that missed the circuit. Hence Poynting got the direction of the energy flow in error by essentially 90°, and was later corrected by Heaviside. In this paper we call the neglected nondiverged component of energy flow the *Heaviside* component.
4. Arguably the most influential Western electrodynamics text for 25 years has been J.D. Jackson, Classical Electrodynamics, Second Edition, Wiley, New York, 1975, which

hardly addresses circuits at all. On page 237, following Lorentz, Jackson disposes of the huge nondiverted component of the energy flow in space around a circuit, that misses the circuit entirely and is wasted, with these words: "...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences." Since one properly adds only *like entities*, what is really true is that the energy flow component represented by Poynting's vector is defined as the divergence of a more general energy flow vector. Therefore, since the Poynting component is just the divergent fraction of this overall flow, the Poynting component can be (and is) accompanied by an *unaccounted* energy flow that has zero divergence. Since the divergence of the curl of any field is zero, Poynting's flow component is not a divergence from any flow component represented by the curl of a field. However, Jackson errs in implying that a zero-divergence energy flow present in one very general type of circuit can have no physical consequences. If we change the circuit so that part of the former "inconsequential" flow is now intercepted and diverged into the circuit, then additional real energy will be collected by the modified circuit from the former Heaviside energy flow component and it will perform additional useful work. Bohren's experiment (cited) clearly shows this. Twenty-one years later Jackson pointed out the decisive role played by the surface charges in the circuit; see J. D. Jackson, "Surface charges on circuit wires and resistors play three roles," *American Journal of Physics*, 64(7), July 1996, p. 855-870. But still he has not included the ignored Heaviside energy flow component, including in the third edition of his renowned text.

5. Heaviside realized both the diverged (intercepted) and nondiverged (nonintercepted) components of the energy flow associated with a circuit, corrected Poynting on the direction, and obliquely pointed out that the amount diverged into the circuit (the Poynting component) was tiny compared to the amount not diverged (which we have chosen to call the *Heaviside component*). See Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94. We quote as follows: :
"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire... . Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire."

6. See H.A. Lorentz, *Vorlesungen über Theoretische Physik an der Universität Leiden*, Vol. V, *Die Maxwellsche Theorie* (1900-1902), Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding a volumetric element.

7. Consequently electrodynamicists caution against interpreting the Poynting vector as the true energy flow vector, pointing out that any nondivergent (flow) vector can be added to it — not realizing they are simply stating that an indefinite amount of nondivergent energy flow may be (and is) present in the erroneously discarded Heaviside component. In other words, any amount of nondiverged energy flow can be present in addition to their accounting because they deliberately fail to calculate or account for that component — present and available for every circuit.

8. It appears that the availability of this Heaviside energy component surrounding any portion of the circuit may be the long sought secret to Gabriel Kron's "open path" that enabled him to produce a true negative resistor in the 1930s, as the chief scientist for General Electric on the U.S. Navy contract for the Network Analyzer at Stanford University. Kron was never permitted to release how he made his negative resistor, but did state that, when placed in the Network Analyzer, the generator could be disconnected because the negative resistor would power the circuit. Since a negative resistor converges surrounding energy and diverges it into the circuit, it appears that Kron's negative resistor gathered energy from the Heaviside component of energy flow as an "open path" flow of energy — connecting together the local vicinities of any two separated circuit components — that had been discarded by previous electrodynamicists following Lorentz. Hence Kron referred to it as the "open path." Particularly see Gabriel Kron, "The frustrating search for a geometrical model of electrodynamic networks," circa 1962. We quote: "...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between any set of two nodes. (Previously — following Maxwell — engineers tied all of their open-paths to a single datum point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents..." "A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search."

9. The Heaviside component represents a huge region of dynamic organization of the vacuum energy. There is no limit to such vacuum organization. It may surprise or even shock the reader that in general relativity there are really no *conservation of energy laws* as we know them, as was pointed out by Hilbert shortly after Einstein published his general theory. In D. Hilbert, Gottingen Nachrichten, Vol. 4, 1917, p. 21 Hilbert wrote: "*I assert... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations... corresponding to the energy equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity.*" Commenting on Hilbert's remarkable assessment, A.A. Logunov and Yu. M. Loskutov in their "Nonuniqueness of the predictions of the general theory of relativity," Sov. J. Part. Nucl., 18(3), May-June 1987, p. 179 made the following statement: "*Unfortunately, this remark of Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are in principle impossible.*" In simple language, the reason is as follows: The organization of the vacuum represents a change to the "primal cause" or "primal energy." Organization of energy without the involvement of mass effects does not require work, because force is not involved and work ultimately involves the translation of a resisting mass. So one can organize the "potential for doing work" without having to perform work in doing so. This is in fact what "re-gauging" actually involves. Any local region of the vacuum is after all an open system far from equilibrium with the surrounding rest of the vacuum. So that local region can exhibit (i) self-ordering, (ii) self-oscillation, self-spinning, etc.; and (iii) negentropy. To use this principle in practice, the trick is to "tickle" the local vacuum into performing the exact type of reordering and self-structuring that one wishes. One does this by adroitly changing the *effect* side of the observation process, thereby altering the *causative* side as well; a discussion of this process is well-beyond the extent of this document. In mechanics and electrodynamics the interaction of the effect back upon the cause has been erroneously omitted, but it is present in general relativity since curvature of spacetime (cause) acts on mass-energy (effect) to change it, and a change in mass-energy (effect) interacts back

upon spacetime curvature (cause) to change it accordingly. A logical mess exists in electrodynamics, where the effect has been rather universally confused with the cause, and there exists not a single text or paper illustrating how the EM wave exists in spacetime. All illustrations continue to show the E-H planar (X-Y) wave in 3-space, which is an effect existing after the interaction with charge. What exists in spacetime before interaction must be Et-Ht, since observation itself is a d/dt operator imposed upon LLLT and producing LLL. The integration of E-H along z does not add the missing time dimension, hence merely represents a "spatial composite" of many X-Y slices. Consideration of the Et-Ht "impulse" or causal wave in spacetime prior to the interaction with matter, particularly in phase conjugation pairs, leads to many very interesting new phenomena, but that is beyond the scope of this paper.

10. The pertinent battery chemistry is well known; e.g., see David Linden, Editor in Chief, *Handbook of Batteries*, Second Edition, McGraw Hill, New York, 1995; see also Colin A. Vincent and Bruno Scrosati, *Modern Batteries: An Introduction to Electrochemical Power Sources*, Second Edition, Wiley, New York, 1997.

11. J.D. Jackson, *Classical Electrodynamics*, 2nd Ed., 1975. The application of Lorentz symmetrical regauging is shown on p. 219-220, with the erroneous statement on p. 220 that the resulting set of equations is equivalent in all respects to the Maxwell equations.

12. In several of his patented circuits, as analyzed and rigorously shown by Barrett.

13. When examined in a higher topology electrodynamics, Nikola Tesla's patented circuits do demonstrate this very functioning. For proof, see T.W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," *Annales de la Fondation Louis de Broglie*, 16(1), 1991, p. 23-41.

14. Barrett later improved this mechanism for use in communication systems and patented it. See T.W. Barrett, "Active Signalling (sic) Systems," U.S. Patent No. 5,486,833, Jan. 23, 1996; "Oscillator-Shuttle-Circuit (OSC) Networks for Conditioning Energy in Higher-Order Symmetry Algebraic Topological Forms and RF Phase Conjugation," U.S. Patent No. 5,493,691. Feb. 20, 1996.

15. For the early discovery, see V.S. Letokhov, "Generation of light by a scattering medium with negative resonance absorption," *Zh. Eksp. Teor. Fiz.*, Vol. 53, 1967, p. 1442; *Soviet Physics JETP*, Vol. 26, 1968, p. 835-839; "Laser Maxwell's Demon," *Contemporary Physics*, 36(4), 1995, p. 235-243. For initiating experiments with external excitation of the medium, see N.M. Lawandy *et al.*, "Laser action in strongly scattering media," *Nature*, 368(6470), Mar. 31, 1994, p. 436-438. See also D.S. Wiersma, M.P. van Albada, and A. Lagendijk, *Nature*, Vol. 373, 1995, p. 103. For new effects, see D.S. Wiersma and Ad. Lagendijk, "Light diffusion with gain and random lasers," *Physical Review E*, 54(4), 1996, p. 4256-4265; D.S. Wiersma, Meint. P. van Albada, Bart A. van Tiggelen, and Ad Lagendijk, "Experimental Evidence for Recurring Multiple Scattering Events of Light in Disordered Media," *Physical Review Letters*, 74(21), 1995, p. 4193-4196; D.S. Wiersma, M.P. Van Albada, and A. Lagendijk, *Physical Review Letters*, Vol. 75, 1995, p. 1739; D.S. Wiersma *et al.*, *Nature*, Vol. 390, 1997, p. 671-673; F. Sheffold *et al.*, *Nature*, Vol. 398, 1999, p. 206; J. Gomez Rivas *et al.*, *Europhysics Letters*, 48(1), 1999, p. 22-28; Gijs van Soest, Makoto Tomita, and Ad Lagendijk, "Amplifying volume in scattering media," *Optics Letters*, 24(5), 1999, p. 306-308; A. Kirchner, K. Busch and C. M. Soukoulis, *Physical Review B*, Vol. 57,

1998, p. 277. An excellent overview is in Diederik Wiersma and Ad Lagendijk, "Laser Action in Very White Paint," *Physics World*, Jan. 1997, p. 33-37.

16. M.W. Evans et al., *Classical Electrodynamics Without the Lorentz Condition: Extracting Energy from the Vacuum*, *Physica Scripta*, 2000 (in publication).

17. William B. Burford III and H. Grey Verner, *Semiconductor Junctions and Devices*, McGraw-Hill, New York, 1965, p. 281-291. Quoting p. 281 on point-contact transistors: *"...the theory underlying their function is imperfectly understood even after almost a century... although the very nature of these units limits them to small power capabilities, the concept of small-signal behavior, in the sense of the term when applied to junction devices, is meaningless, since there is no region of operation wherein equilibrium or theoretical performance is observed. Point-contact devices may therefore be described as sharply nonlinear under all operating conditions."* Our comment is that point-contact transistors can easily be developed into true negative resistors enabling COP > 1.0 circuits.

18. E.g., the anomalous quenching of the Hall effect generates a negative resistance effect. The Hall voltage across a narrow current-carrying channel in the presence of a perpendicular magnetic field B behaves anomalously around $B=0$. The Hall resistance fluctuates about zero and is "quenched", then rises to a plateau at higher fields, then recovers and exhibits normal behavior beyond that region. Also see Paulo N. Correa and Alexandra N. Correa, "Electrochemical Transduction of Plasma Pulses," U.S. Patent No. 5,416,391, May 16, 1995; patent no 5,449,989, "Energy Conversion System," Sept. 12, 1995; and related patent no. 5,502,354, Mar. 26, 1996. See also cited patents by Mills and by Shoulders.

19. T.E. Bearden, "Formation and Use of Time-Reversal Zones, EM Wave Transduction, Time-Density (Scalar) EM Excitation and Decay, and Spacetime Curvature Engines to Alter Matter and Convert Time Into Energy," Invention Disclosure Document #446522, Oct. 26, 1998. While this paper is proprietary, some overall details have been given in T.E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," *Explore*, 8(6), 1998, p. 7-16; and in T.E. Bearden, "Toward a Practical Unified Field Theory and a Deep Experimental Example," presented at the INE Symposium, University of Utah, Aug. 14-15, 1998.

20. Kenneth R. Shoulders, "Energy Conversion Using High Charge Density," U.S. Patent # 5,018,180, May 21, 1991. See also Shoulders' patents 5,054,046 (1991); 5,054,047 (1991); 5,123,039 (1992), and 5,148,461 (1992). See also Ken Shoulders and Steve Shoulders, "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions," *Journal of New Energy*, 1(3), Fall 1996, p. 111-121. A proposed theory is given by Shang-Xian Jin and Hal Fox, "Characteristics of High-Density Charge Clusters: A Theoretical Model," *Journal of New Energy*, 1(4), Winter 1996, p. 5-20.

21. Teruo Kawai, "Motive Power Generating Device," U.S. Patent No. 5,436,518, Jul. 25, 1995.

22. For details, see T.E. Bearden, "The Master Principle of EM Overunity and the Japanese Overunity Engines," *Infinite Energy*, 1(5&6), Nov. 1995-Feb. 1996, p. 38-55; "The Master Principle of Overunity and the Japanese Overunity Engines: A New Pearl Harbor?," *The Virtual Times*, Internet Node www.hsv.com, January 1996.

23. T.E. Bearden, "Use of Regauging and Multivalued Potentials to Achieve Overunity EM Engines: Concepts and Specific Engine Examples," *Proceedings of the International*

Scientific Conference "New Ideas in Natural Sciences," St. Petersburg, Russia, June 17-22, 1996; Part I: Problems of Modern Physics, 1996, p. 277-297.

24. E.g., see phenomena detailed in Martin Diestelhorst; Horst Beige, and Ralph-Peter Kapsch, "Parametric small signal amplification near pitchfork bifurcations," *Ferroelectrics*, Vol. 172, 1995, p. 419-423. In particular, multivalued conjugate reflectivities may become involved in some ferroelectric capacitors; see S. Itoh *et al.*, "Simulational and experimental studies on anomalous reflectivity of phase conjugate wave." *Ferroelectrics*, Vol. 170, 1995, p. 209-217.

25. Romano M. DeSantis *et al.*, "On the Analysis of Feedback Systems With a Multipower Open Loop Chain," Oct. 1973, AD 773188, available through the U.S. National Technical Information System.

26. J. H. Andreatta, "High Power Switching Amplifier Wherein Energy is Transferred to a Tuned Circuit During Both Half Cycles," U.S. Patent No. 3,239,771, Mar. 8, 1966; Tom L. Dennis, Jr., "Highly Efficient Semiconductor Switching Amplifier," U.S. Patent No. 3,239,772, Mar. 8, 1966; Heber J. Morrison, "Square Wave Driven Power Amplifier," U.S. Patent No. 3,815,030, June 4, 1974.

27. Howard R. Johnson, "Permanent Magnet Motor." U.S. Patent No. 4,151,431, Apr. 24, 1979. See also Johnson's U.S. Patents 4,877,983, Oct. 31, 1989 and 5,402,021, Mar. 28, 1995.

28. For an exposition of exchange forces and exchange energy, see B. D. Cullity, *Introduction to Magnetic Materials*, Addison-Wesley, Reading, MA, 1972; A.G. Gurevich and G.A. Melkov, *Magnetization Oscillations and Waves*, CRC Press, 1996; Victor S. L'vov, *Wave Turbulence Under Parametric Excitation: Applications to Magnets*, Springer-Verlag, Berlin, 1994. See also V.S. L'vov and L.A. Prozorova, "Spin Waves Above the Threshold of Parametric Excitation," in A.S. Borovik-Romanov and S.K. Sinha, Eds., *Spin Waves and Magnetic Excitations*, North-Holland, Amsterdam, 1988.

29. Negative resistor candidates for such a shunt may arise from point-contact transistors and from the work of Chung *et al.* See Shoukai Wang and D.D.L. Chung, "Apparent negative electrical resistance in carbon fiber composites," *Composites, Part B*, Vol. 30, 1999, p. 579-590. Chung *et al.* found that the carbon fiber composite can be produced as either a negative resistance or a positive resistance, by controlling the production process.

30. Ilya Prigogine, *From Being to Becoming: Time and Complexity in the Physical Sciences*, W.H. Freeman and Company, San Francisco, 1980. In 1977, Russian-born Belgian chemist Ilya Prigogine received the Nobel Prize for chemistry for contributions to nonequilibrium thermodynamics, especially the theory of dissipative structures.

31. E.g., see L. Brillouin, "Life, thermodynamics, and cybernetics," *Am. Sci.* Vol. 37, 1949, p. 554-568; G. Nicolis and I. Prigogine, *Exploring Complexity*, Piper, Munich, 1987.

32. Craig F. Bohren, "How can a particle absorb more than the light incident on it?" *American Journal of Physics*, 51(4), Apr. 1983, p. 323-327. The resonant particle simply sweeps out a greater geometrical area intercepting an incident energy flow than does a static particle. Hence the Bohren resonant particle intercepts not only the Poynting energy flow component (the one intercepted by the static particle), but also part of the neglected Heaviside component that does not interact with the *static* particle. In short, Bohren's work

conclusively proves the existence of the Heaviside component of energy flow, and also clearly demonstrates an open dissipative EM system process exhibiting $COP > 1.0$.

33. H. Paul and R. Fischer, "Comment on 'How can a particle absorb more than the light incident on it?'," *American Journal of Physics*, 51(4), Apr. 1983, p. 327.

34. In a private AIAS correspondence, Dr. Myron Evans, Director of the Alpha Foundation's Institute for Advanced Study (AIAS), has rigorously shown a variety of EM energy components in the vacuum topology which can and do interact with electromagnetic circuits. He has shown that these energy currents enter into integral interactions where the constant of integration does capture the Heaviside component. This work will be published in *Contemporary Optics and Electrodynamics*, 3 volumes, Wylie, 2001 (in preparation).

35. Effectively Ludwig Valentin Lorenz first symmetrically regauged the Heaviside-Maxwell equations in Lorenz, "On the identity of the vibrations of light with electrical currents," *Philosophical Magazine*, Vol. 34, 1867, p. 287-301, not long after Maxwell's seminal 1864 oral presentation of his paper, "A dynamical theory of the electromagnetic field," published in *Philosophical Transactions of the Royal Society of London*, Vol. 155, 1865. When the prestigious H.A. Lorentz later adopted the symmetrical regauging because it provided simpler equations that were easier to solve, electrodynamicists adopted it quickly. No one seemed to notice that physically this constituted the arbitrary and total discard of all Heaviside-Maxwell systems not in thermodynamic equilibrium with their active vacuum. Even Jackson, 2nd Edition, *ibid.* erroneously states that the Lorentz-regauged equations are the same in every respect.

36. E.g., see Malcolm Longair, "The New Astrophysics," in Paul Davies, Ed., *The New Physics*, Cambridge University Press, New York, 1989 — specifically "Dark matter in galaxies and clusters of galaxies," p. 163.

37. E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," *Mathematische Annalen*, Vol. 57, 1903, p. 333-355. In addition to Whittaker's sum set of waves comprising the "scalar" potential, Ziolkowski added the product set. See Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," *Journal of Mathematical Physics*, 26(4), April 1985, p. 861-863.

38. E.T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," *Proc. Lond. Math. Soc., Series 2*, Vol. 1, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.

39. An overview of much of superpotential theory is given by Melba Phillips, "Classical Electrodynamics," in *Principles of Electrodynamics and Relativity*, Vol. IV of *Encyclopedia of Physics*, edited by S. Flugge, Springer-Verlag, 1962.

40. One might appropriate the Russian name "information content of the field" for this more fundamental interior EM, from which all other EM is made. The "infolded" electrodynamics is largely ignored in the Western scientific community, which heretofore has erroneously equated "information content of the field" as mere spectral analysis. In so doing, it has dismissed an engineerable unified field theory of great power.

41. T. D. Lee, 1981, *ibid.*, p. 380-381. On p. 383 Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge and polarization structuring) is not utilized. Lee indicates the possibility of using vacuum engineering in "Chapter 25: Outlook: Possibility of Vacuum Engineering," *ibid.*, p. 824-828.

42. We stress that this error does not appear in the electrodynamics work of Dr. Evans and the AIAS theoreticians. In that work a gauge field theoretic approach is used, and the field results directly from the topology, not from confusing the nonreacted field (the cause) in space with its reaction cross section upon a unit point static charge (i.e., with the reacted effect) as has been done in classical electrodynamics theory.
43. However, the neglected Heaviside energy flow component is *real EM energy* and therefore gravitational. Considering the vast number of interactions in the cosmos and the neglect of their Heaviside energy flow components, we propose that this enormous, unaccounted, ubiquitous energy probably accounts for the missing "dark matter" or "dark energy" of the universe, so ardently sought by the astrophysicists.
44. D.K. Sen, *Fields and/or Particles*, Academic Press, London and New York, 1968, p. viii.
45. Ibrahim Semiz, "Black hole as the ultimate energy source," *American Journal of Physics*, 63(2), Feb. 1995, p. 151.
46. Hüseyin Yilmaz, "New approach to relativity and gravitation," *Annals of Physics*, Vol. 81, 1973, p. 179-200; *Annals of Physics (NY)*, Vol. 101, 1976, p. 413-432; *Il Nuovo Cimento*, Vol. 107B, 1992, p. 941; Carroll O. Alley, Per Kennett Aschan, and Hüseyin Yilmaz, preprint gr-qc/9506082 in the LANL archive, 30 June, 1995. Criticisms are given by Charles W. Misner, preprint gr-qc/9504050 in the LANL archive, 28 April 1995 and by F.I. Cooperstock and D.N. Vollick, *Il Nuovo Cimento*, Vol. 111B, 1996, p. 265.
47. E.g., see M.W. Evans *et al.*, AIAS group paper, "A General Theory of Non-Abelian Electrodynamics," *Foundations of Physics Letters*, 12(3), June 1999, p. 251-265. See particularly M.W. Evans, "O(3) Electrodynamics," a review of 250 pages in M.W. Evans (ed.), *Contemporary Optics and Electrodynamics*, a special topical issue of I. Prigogine and S.A. Rice (series eds.), *Advances in Chemical Physics*, Wiley, New York, 2001, in preparation, vol. 114(2).
48. M.W. Evans *et al.*, AIAS group paper, "Inconsistencies of the U(1) Theory of Electrodynamics: Stress Energy Momentum Tensor," *Foundations of Physics Letters*, 12(2), Apr. 1999, p. 187-192.
49. M.W. Evans, AIAS correspondence.
50. M.W. Evans *et al.*, "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," to be placed on the DOE website. It has also been submitted to a leading journal.
51. T.W. Barrett and D. M Grimes, [Eds.], *Advanced Electromagnetism: Foundations, Theory, & Applications*, World Scientific, Singapore, 1995. See particularly T.W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in A. Lakhtakia, (ed.), *Essays on the Formal Aspects of Electromagnetic Theory*, World Scientific Publishing, River Edge, NJ, 1993, p. 6-86.
52. Patrick Cornille, "Inhomogeneous waves and Maxwell's equations," Chapter 4 in *Essays on the formal Aspects of Electromagnetic Theory*, Ed. A. Lakhtakia, World Scientific, 1993, p. 138-182. Quoting, p. 168: "*The calculation concerning the electromagnetic conservation laws given in most textbooks, for example in Jackson [Classical Electromagnetics, 2nd Edition, John Wiley, New York, 1975, p. 239] is not correct, as noted by Selak [Astrophys. Space Sci., Vol. 158, 1989, p. 159] et al., because it is not permissible to substitute a*

convective time derivative for an Eulerian time derivative even when we have a constant volume of integration."

53. E.g., Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," *Journal of Mathematical Physics*, 26(4), April 1985, p. 861-863; — "Localized Transmission of Electromagnetic Energy," *Physical Review A*, Vol. 39, 1989, p. 2005, — and Michael K. Tippett, "Collective effect in an electron plasma system catalyzed by a localized electromagnetic wave," *Physical Review A*, 43(6), Mar. 15, 1991, p. 3066-3072.

54. Daniel C. Cole and Harold E. Puthoff, "Extracting Energy and Heat from the Vacuum," *Physical Review E*, 48(2), Aug. 1993, p. 1562-1565.

55. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," *Physical Review A*, 40(9), Nov. 1, 1989, p. 4857-4862.

56. Randell Lee Mills et al., "Lower-Energy Hydrogen Methods and Structures," U.S. Patent 6,024,935, Feb. 15, 2000 with 499 claims recognized. Randell Lee Mills, "Energy/Matter Conversion Methods and Structures," Australian Patent No. 668678, Nov. 20, 1991. See also Art Rosenblum, "Randall L. Mills — New Energy and the Cosmic Hydrino Sea," *Infinite Energy*, 3(17), Dec. 1997-Jan. 1998, p. 21-34.; Eugene Mallove, "Dr. Randall Mills and the power of BlackLight," *Infinite Energy*, 2(12), Jan.-Feb. 1997, p. 21, 35, 41.

57. James Patterson, "System for Electrolysis of Liquid Electrolyte," U.S. Patent No. 5,372,688, Dec. 13, 1994. See also U.S. Patent Nos. 5,318,675; 5,607,563; 5,036,031; and 4,943,355.

58. Nabil M. Lawandy, "Optical Gain Medium Having Doped Nanocrystals of Semiconductors and Also Optical Scatterers," U.S. Patent No. 5,434,878, July 18, 1995. Lawandy's epochal experiment is described in Nabil M. Lawandy, et al., "Laser action in strongly scattering media," *Nature*, 368(6470), Mar. 31, 1994, p. 436-438.

59. Franklin B. Mead and Jack Nachamkin, "System for Converting Electromagnetic Radiation Energy to Electrical Energy," U.S. Patent No. 5,590,031, Dec. 31, 1996.

60. Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," *Proceedings of the 26th Intersociety Energy Conversion Engineering Conference (IECEC '91)*, Boston, Massachusetts, 1991, p. 370-375. Sweet's solid state vacuum triode used specially conditioned barium ferrite magnetics whose H-field was in self-oscillation. The device produced a $COP = 1.2 \times 10^6$, outputting some 500 watts for an input of only 33 milliwatts. Sweet never revealed his complete ELF self-oscillation conditioning procedure for the magnets. However, in ferromagnets, self-oscillations of (i) magnetization, (ii) spin-waves above spin-wave instability threshold, and (iii) magnons are known at frequencies from about 1 kHz to 1 MHz. For an entry into this technical area with detailed reference citations, see A.G. Gurevich and G.A. Melkov, *Magnetization Oscillations and Waves*, CRC Press, 1996, p. 279. See particularly Victor S. L'vov, *Wave Turbulence Under Parametric Excitation: Applications to Magnets*, Springer-Verlag, Berlin, 1994, p. 214-218, 226-234, 281-289.

61. For that matter, the charged capacitor and the magnet are dipoles. Individually, each extracts and outputs enormous energy flow from the local vacuum, continuously pouring out the extracted energy toward the ends of the universe and thus establishing its fields and potentials by altering the entire ambient vacuum potential of the universe.

62. E.g., see L Mandelstam. [L.I. Mendel'shtam], N. Papalexi, A. Andronov, S. Chaikin and A. Witt, "Report on Recent Research on Nonlinear Oscillations," Translation of "Expose Des Recherches Recentes Sur Les Oscillations Non Lineaires," Technical Physics of the USSR, Leningrad, Vol. 2, 1935, p. 81-134. NASA Translation Doc. TTF-12,678, Nov. 1969. In the 1930s Russian scientists at the University of Moscow and supporting agencies developed and tested parametric oscillator generators exhibiting $COP > 1.0$. The theory, results, pictures, etc. are in both the Russian and French literature, with many references cited in this particular translation. Apparently the work was never resurrected after WW II. Other pertinent references are Mandelstam, L.I.; and N.D. Papaleksi., "On the parametric excitation of electric oscillations," Zhurnal Tekhnicheskoy Fiziki, 4(1), 1934, p. 5-29; Mandelstam, L. and N. Papalexi, "On resonance phenomena with frequency distribution," Z.f. Phys., No. 72, 1931, p. 223; — "Concerning asynchronous excitation of oscillations," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934, p. TBD; — "Concerning asynchronous excitation of oscillations," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934; — "Concerning nonstationary processes occurring in the case of resonance phenomena of the second class," Zhurnal Tekhnicheskoi Fiziki, 4(1), 1934. See also A. Andronov, "The limiting cycles of Poincare and the theory of self-maintained oscillations," Comptes-Rendus, Vol. 189, 1929, p. 559. See also A. Andronov and A. Witt, , "On the mathematical theory of self-excitations," Comptes-Rendus, Vol. 190, 1930, p. 256; — "On the mathematical theory of self-excitation systems with two degrees of freedom," Zhurnal Tekhnicheskioi Fiziki, 4(1), 1934; — "Discontinuous periodic movements and theory of multivibrators of Abraham and Bloch," Bull. De l'Acad. Ed Sc. De l'URSS, vol. 189, 1930. See also S. Chaikin, "Continuous and 'discontinuous' oscillations," Zhurnal Prikladnoi Fiziki, Vol. 7, 1930, p. 6; — and A. Witt, , "Drift in a case of small amplitudes," Zhurnal Tekhnicheskoi Fiziki, 1(5), 1931, p. 428; — and N. Kaidanowski, "Mechanical relaxation oscillations," Zhurnal Tekhnicheskoi Fiziki, Vol. 3, 1933, p. 1.

63. E.g., a true negative resistor appears to have been developed by the renowned Gabriel Kron, who was never permitted to reveal its construction or specifically reveal its development. For an oblique statement of his negative resistor success, see Gabriel Kron, "Numerical solution of ordinary and partial differential equations by means of equivalent circuits," Journal of Applied Physics, Vol. 16, Mar. 1945a, p. 173. Quoting: "*When only positive and negative real numbers exist, it is customary to replace a positive resistance by an inductance and a negative resistance by a capacitor (since none or only a few negative resistances exist on practical network analyzers).*" Apparently Kron was required to insert the words "none or" in that statement. See also Gabriel Kron, "Electric circuit models of the Schrödinger equation," Phys. Rev. 67(1-2), Jan. 1 and 15, 1945, p. 39. We quote: "*Although negative resistances are available for use with a network analyzer,...*". Here the introductory clause states in rather certain terms that negative resistors were available for use on the network analyzer, and Kron slipped this one through the censors. It may be of interest that Kron was a mentor of Sweet, who was his protégé. Sweet worked for the same company, but not on the Network Analyzer project. However, he almost certainly knew the secret of Kron's "open path" discovery and his negative resistor.