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EDITORIAL COMMENTS

IS KNOWLEDGE POWER?

Francis Bacon (1561-1626) said, "Knowledge itself is power." It is supposed that he would accept an extended version that would read, "The knowledge of truth is power." If that be so, then where is the power of those who refuse recognize or even endure the discussion of new truths? They are destined to have neither lasting power nor fame. Bacon also said, "There is nothing makes a man suspect much, more than to know little." Perhaps this is the problem with those who rail against such a simple event as the recent three-day **International Conference on Future Energy**, held at the Holiday Inn in Bethesda, Maryland beginning on April 29, 1999.

We recognize that Declan McCullagh was able to be at this International Conference on Future Energy. He has taught us much about the inadequacies of critics. Declan is a self-proclaimed reporter for Washington, D.C. papers. However, it is apparent from his choice of negative words in a recent email (e.g. "...garage researchers who gathered Saturday in a ramshackle Holiday Inn ...") that Declan McCullagh is not about to provide an unbiased, science-journalist's report. His science education has apparently failed to teach him that nearly all major scientific breakthroughs do not come from the ivy-covered halls of academia nor from highly-funded government laboratories.

Declan failed to mention that one of the foremost experimentalist this nation has enjoyed (Kenneth Shoulders) presented (for the first time) some exciting details about high-density charge clusters. One of the many interesting topics that Ken Shoulders briefly presented is the ability of a charge cluster to create a phase change in silicon carbide (which disassociates at 2300 degrees C) without there being any evidence of a thermal gradient in the experimental silicon-carbide layer coated onto aluminum foil. That experiment has just been replicated in Trenergy's laboratory. Could Declan McCullagh or his supporters explain that experiment by using any of his classical physics books? Not likely!

Declan failed to mention that the experiments by the famous scientist, Peter Graneau. Dr. Graneau presented a exciting paper which demonstrates energy anomalies. Declan also failed to mention the numerous papers that have been published in peer-reviewed journals by dozens of respected international scientists who have found anomalous nuclear reactions in a large variety of experiments in which some form of electrolysis or low-voltage plasmas produced elements not initially present in the experimental apparatus.

Some experimental anomalies can, of course, be explained by classical physics. The ones that cannot be explained by known physics are the ones that serve to advance science. It does not matter whether the presentations are made in a motel or at a classroom in MIT. The advancement of new science and new energy will continue regardless of those who choose to thwart their work or those who use disparaging comments about selected papers. There were many disparaging remarks made against the Wright Brothers, Edison, Goddard, etc. Now they name airfields, buildings, and parks after these "garage scientists". As Einstein observed, it takes little intelligence to criticize.

Others, who have been highly critical of new-energy meetings, have proclaimed, "This is fringe science!" It is indeed a wonderment that highly-educated men of science could achieve any advanced degrees without learning that all new-science stems from the fringes of old science. It is the pushing of the boundaries of today's knowledge that leads to the breakthrough discoveries. How can any true scientist be so naive as to condemn "fringe science?"

Perhaps we should bestow on these unbelieving and self-appointed, all-knowing critics an **Annual Order of Irrelevance.** In these conferences on new-energy, the organizers may err in allowing speakers to proclaim a hypothesis that is obviously not in agreement with what we think we know about Nature. Permission is certainly more virtuous than wholesale condemnation. It is a poor gardener who destroys the harvest to kill a weed. In attending some twenty conferences concerning new-energy topics, this author has not experienced many new-energy theories that are as wild as the Big Bang. Think of the rich ideas that Nature has disclosed to the many new-energy scientists. Which of the following new-energy discoveries should be declared invalid: High-density charge clusters? Low-energy nuclear reactions? The hydrosonic pump? The action of cavitating bubbles on deuterated palladium? The collapse

of the hydrogen atom below its ground state? Anomalous energy with water-gun experiments? Gravity-wave fluctuations? Superluminal velocity of torsion fields? The Aspden Effect? The Rowe Effect? Nuclear batteries? Low-energy transmutation?

Nature is telling us something profound, if we will but observe and study. Classical physics (after spending billions of dollars) in the study of high-energy, nuclear reactions has yet to provide a clean, abundant, energy-producing resource. By contrast, new-energy technologies have already succeeded. Today's scientists who proclaim that new-energy science should not be tolerated in a government-owned facility must stem from the same halls of science as those who have proclaimed the inadequacy of the work of Edison, Goddard, the Wright Brothers, Tesla, et al. **These critics are irrelevant. Nature is revealing her truths. The critics will die off, their opportunities for fame obscured by their inadequacy to recognize new scientific truths. We extend our sympathy to them.** Because they exhibit intellectual demise, they should all best each be treated in the words of Thomas Gray, "No farther seek his merits to disclose, Or draw his frailties from their dread abode, (There they alike in trembling hope repose), The bosom of his Father and his God." From Elegy Written in a Country Churchyard.

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COLD FUSION RESEARCH: MODELS AND POTENTIAL BENEFITS

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ABSTRACT

Observations have been made of deuteron-deuteron fusion at room temperature during low-voltage electrolytic infusion of deuterons into metallic titanium or palladium electrodes. Neutrons with an energy of approximately 2.45 meV have been clearly detected with a sensitive neutron spectrometer at a rate of 2×10^{-3} n/s which cannot be accounted for by ambient neutron background variations. The reaction has been known to yield excess (or "latent") heat, where D + D yields ^{4}He + 23.8 meV. This paper examines the latest experimental results from several international researchers and summarizes several new theories of nuclear model interactions that have been put forth to explain these intriguing results.

RESULTS

Cold fusion has been largely a study of results first and theories which follow. Since most results from solid fusion experiments do not agree with olden and contemporary nuclear theories, new theories are being generated to account for these experimental results.

One of the most important results is the discovery of neutron emissions in the form of bursts which have been observed by De Nino, Sanchez, and Gozzi (De Nino, 1989), (Sanchez, 1989), (Gozzi, 1992). Neutron spectra with a 2.45 MeV peak should be evidence of deuteron-deuteron (D + D) fusion. However, the detection of neutrons is complex and expensive, requiring a great deal of equipment and experimental expertise.

A University of Rome study showed that after imposing a constant current density of 200 mA/cm^2, the nuclear and thermal effect was first recorded after 150 hours! Then in a time interval of 22h5'54", the neutron recorder counted 80 single spikes! Before and after the event, the neutron counting rate was equal to the background level. During the entire experiment, at least 36 counts were concentrated in an unresolved group which would imply an emission of 7.2×10^5 neutrons in 4 minutes, or 3×10^3 n/s, while the electrode temperature increased to a value of 150°C (with an overall temperature change average of 100°C) (Gozzi, *et al*, 1990).

Excess tritium (T) was also detected, and this presence of nuclear by-products indicates that a nuclear reaction is taking place. Texas A & M's Department of Chemistry and the Cyclotron Center built and tested over ten cells and reported the production of tritium from heavy water (D_2O) electrolysis at a palladium (Pd) cathode, with the maximum tritium count observed in one cell as 4.9×10^6 disintegrations per minute per milliliter, showing 100 to 100,000 times more than that expected from the normal isotropic enrichment from electrolysis (Bockris, 1989a). Critics claim that if tritium is being produced at 1.008 MeV, then equally large quantities of neutrons must also be present. However, if the neutrons are not always inside the nuclear well, it is possible that the neutron is stripped away to form tritium with the other deuteron which would account for the large excess of the emission ratio of tritium over neutrons (T/N). In cold fusion electrochemical cells, tritium has been measured at levels of 10^{13} atoms per milliliter, yet actual

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T/N ratio of emission has been estimated to be about 10^8/1 (Iyengar, 1989). These ratios indicate that the reaction:

$$D + D \rightarrow T + H$$

appears to be the dominant reaction taking place in cold fusion.

Water temperatures in excess of 170°F. have also been observed (Haag, 1990).

The argument of the physics community is that the amount of heat does not correlate with the limited number of neutron emissions. ^{4}He has also be generated which can correspond to the level of heat produced. The reaction:

$$D + D \rightarrow {}^4He + \text{a beta, phonon or plasmon (at 24 MeV)}$$

has been proposed. But in many experiments far too little ^{4}He has been detected to prove that these reactions are occurring.

Opponents suggest that a chemical reaction of some type must be occurring. However, a result of excess heat anywhere from 10 to 100 W/cm^3 Pd (or about 1.0 keV/atom) has been reported in many different cells from various institutions.

Additional experiments and reports internationally also have shown Pd x-ray lines and clear evidence of nuclear transmutation events.

THE FACTORS

In a chemical reaction, only a few electron volts (eV) of energy are released per atom taking part in the reaction, and even fewer in a mechanical process. In a nuclear reaction, millions of electron Volts (meV) can be released per atom. If all the atoms in an electrolytic cell were to react, the energy release would be on the order of a thousand electron Volts (keV)/atom.

There are several approaches to cold fusion development, but the basic approach since 1989 has deviated only slightly from the original Pons and Fleischmann model using electrolysis of Lithium deuteroxide (LiOD) on palladium (Pd), where a palladium cathode is immersed in an heavy water-based electrolytic solution of 0.1 molar LiOD in 99.5% D_2O + 0.5% H_2O. The LiOD is added to make the electrolyte conductive. The palladium cathode is surrounded by a bare platinum wire helical anode. A unique property of palladium is its ability to absorb large quantities of hydrogen (or deuterium) at the cathode in an electrolysis cell.

The platinum wire anode is attached to a positive DC voltage while the palladium is charged negatively. Direct current is supplied at 3-25 Volts across each cell at currents of 10-500 mA. Specific correlations between fusion yield and voltage, current density, or surface characteristics of the metallic cathode have yet to be clearly established. The fusion reaction occurring produces excess thermal energy inside the palladium metal electrode, and raises the temperature of the water surrounding the electrode.

There are various approaches to loading the palladium, one of which incorporates the use of pulsed heating which has a clear effect on the loading speed. Many researchers consider pulsed current an important factor, along with temperature variations.

Very high pressure does not stimulate cold fusion phenomena. However, further research is examining the effects of magnetic and optical irradiation, ultrasonic waves (>10^9 Hz), and the use of pressure waves.

Also, certain foreign atoms may enhance the surface dynamics, such as vanadium, aluminum, and tin in titanium or silver in palladium. Alloys may be more efficient than pure metals.

The cathode, palladium, is a face-centered-cubic (fcc) crystal lattice with a side of about 3.89 Angstroms. If hydrogen is loaded into it, the crystal expands slightly to 4.03 Angstroms with a D-Pd ratio of 0.8. In the Pd-D lattice there are rows of deuterons along direction [110] and l is (a/2 SQRT(2) n) for coherence, *a* being the lattice constant (Vaidya, 1993).

Palladium functions as an absorber of hydrogen or deuterium ions, as well as a resistance problem to monitor the loading ratio, and also a resistive heater to raise the temperature. After electrolysis in an electrolyte containing both H and D ions, the cold-rolled palladium cathode has been shown to produce macroscopic deformations on the surface, eventually leading to craters and in some instances exhibiting faceted crystals inside the craters (Silver, 1993).

THEORIES

In 1989, Pons and Fleischmann publicly announced their results, (and also the results of others) using the term "cold fusion," and since that time many theories have been put forth to account for some or all of their results. Some researchers continue to see their results as purely fusion based, while others have come up with terms such as "new hydrogen energy," or "chemically assisted nuclear fusion" or "cold nuclear fission." The biggest conflict appears to be designing a theory in which the nuclear Coulomb barrier is overcome even at low temperatures.

In a deuterium molecule occupying octahedral sites, where the equilibrium separation between D-D is 0.74 - 0.94 Angstroms (Å), the fusion rate is exceedingly slow, about 10^{-74} per deuterium molecule per second. One of the important factors appears to be the Pd which when loaded appears to bring deuterons much closer together than they could otherwise get at ambient temperature. Although the average separation of deuterons is approximately 1.4 Å in heavily loaded palladium, the deuterons can be in equilibrium at a separation as close as 0.94 Å.

Here the interstitial lattice sites may be considered shallow potential wells allowing for high deuteron mobility and, possibly, an enhanced probability of fusion through the repulsive, proton Coulomb barrier. In actuality, the neutrons and protons are only weakly bound in deuterons and may be outside the D nuclear well a large portion of the time.

The Pons-Fleischmann Process

It was originally thought that, as the voltage is applied across the electrodes through electrolysis, the heavy water (D_2O) is split into oxygen and deuterium (Pons and Fleischmann, 1989). The deuterium atoms are absorbed into the palladium at octahedral sites on the crystal lattice while oxygen accumulates at the platinum anode. The deuterium density is greater than that of liquid hydrogen.

The fusion reaction is catalyzed by the deposition of D^+ and metal ions from the electrolyte at (and into) the negative electrode. The deuterium atom ionizes with its electrons entering the band structure of the palladium. After various times of charging (or "aging"), the palladium rod is supersaturated with deuterons, and it has a crystal lattice structure like NaCl (King, 1989). All lattice sites are occupied, and the excess free deuterons form a "protonic fluid" which can aid electrical conduction. Thus, although metals such as palladium and titanium are used to support the fusion reaction, they are not consumed in the process of solid-state fusion. Instead the fuel consumed is the deuterium in the heavy water.

The Surface Model and Three-body Collisions

John Bockris at Texas A & M also describes the "surface model" which does not consider that the fusion occurs within the electrode, but suggests that the surface of the electrode might be the site of the reaction. He suggests that these reactions occur at specific points, or protuberance on the surface of the electrode (Bockris, 1989b). Here the reaction occurs on the lattice, not within the lattice, whereby the lattice is a reservoir of deuterium providing enough raw material for the dynamic process that takes place even after the electrolysis is stopped or D_2O and LiOD is replaced by H_2O and LiOH (Glueck, 1993).

Jacques DuFour of Shell Research S.A. in France believes that when a transient electrical field is created by sparking through the gas between two dissymmetrical electrodes, the surface layer of hydrogen isotopes builds a three-body collision of two hydrogen isotopes and one electron (DuFour, 1993). The accumulation of these species in a surface layer of the electrode metal can be explained by the known properties of sparks and of hydrogen isotopes in metal, implicating the weak electronuclear force that yields products completely different from those of hot fusion, whereby a deuteron is a two-nucleon system containing weak interactions.

According to DuFour there is a whole class of nuclear fusion reactions at room temperatures, involving "three-body collisions" of two hydrogen isotopes and a neutrino, which through an indirect transition (virtual neutron states), have reactions favored by the high electron and proton concentrations existing in the metal and the high transient electrical field created by the sparks.

Very high thermal energy prevents the Coulomb forces from deviating their trajectories under conditions of hot fusion, but in metal there is a high concentration of thermal, low-energy protons and electrons at a mean distance of about 2 Å and when exposed to a transient electrical field the probability of the three-body collision increases. DuFour has estimated this collision at 10^{-12} s and 10^{-14} s, which is characteristic to the weak nuclear force.

A controversy has arisen over the need for the use of refined palladium that is relatively free of microscopic cracks in order for the "cold fusion" process to succeed. Several researchers claim that if the electrode has too many cracks it will fail to produce the excess heat and a purity of 99.9% is required. Contrary to this belief, Rainer Kühne in Germany postulates that it is the cracks within the electrode (99.8% purity) that are the trigger for cold fusion (Kühne, 1994).

The crack hypothesis claims that the absorption of hydrogen gives rise to deformations and expansion of the metal lattice and that the formation of anions (metal ions) which allow for crack formations near the surface gives rise to deuterium absorption, whereby kilo-electron-Volt deuterons rapidly lose energy by collisions allowing areas of high temperature to arise. Kühne claims that at such locations deuterid bubbles collide, giving rise to electric fields and to kilo-electron-Volt deuterons in an ongoing process during the charging of the electrolytic cell.

The Two-Step Mechanism Involving Electron Capture by a Deuteron or Lithium Atom

This model represents a coherent and semi-coherent neutron transfer with increasing phonon coupling. It appears that on the surface of the Pd, the D^+ can diffuse and combine with ingoing electrons where $2D^+ + 2e^-$ yields D_2 or the D ions can also stay on the surface and be independent of the electrons. Another theory proposed by J.C. Jackson and Budelov is that the neutron could be captured by the Pd metal nuclei and used to produce a different isotope of palladium plus a gamma photon which could cause a photodistintegration of the deuteron and could liberate a neutron. The by-products would then be heat and electrons explaining the low neutron production rate compared to the high excess heat output (Hagelstein, 1990).

Transmission Resonance

Dr. R.T. Bush of California State Polytechnic University has suggested that when a palladium lattice is fully occupied by deuterons, conditions are favorable to support laser-like actions where the deuteron-loaded lattice supports a type of resonating phenomena in which the probability of a traveling or "hopping" wave-like deuteron fusing with a target deuteron is increased significantly.

This may also be caused by the possibility of plasma oscillations of the D-shell. Also the theory that deuterons (protons) exist in deep energy wells may not be valid because the protons appear to be mobile in a similar state as classical oscillators. Bush's theoretical model accounts for the heavy water heat effect and light excess heat effect from cold fusion. It provides a unique and highly novel mechanism to sufficiently enhance tunneling through the Coulomb barrier, as well as incorporating the role of lithium in electrolytic experiments.

The transmission resonance model begins with the hypothesis:

$$D + D \text{ yields } \rightarrow {}^4He \text{ (23.8 meV)}$$

occurs for deuteron lattice configurations with nearest neighbors on either side to produce a "sideways charge polarization" with protons directly opposite neutrons. Vibration of the lattice is required for the oscillatory collisions of the nearest-neighbor deuterons to produce the tunneling. Tritium and neutrons result from the oscillatory collision of two nearest-neighbor deuterons isolated from their neighbors and thus favoring (Bush, 1994):

$$D + D \rightarrow T + p \text{ (4.03 meV)}$$

The Collapse Ground State

If one could increase w_{min} of the zero point field associated with the establishment of l_{max} this could cause the electron to spiral inward to increase its angular velocity where $w'_o = w_{min}$, where w is the frequency of absorbed radiation and w'_o is the electron angular velocity. It is believed that alkali atoms, the Li and D, or a mixture, may serve as crucial ingredients in the Casimir reflecting planes, whereby the Li-plane Casimir reflector separation corresponds directly to the Pd lattice spacing. The Casimir separation for the D-planes is twice as great (Bush, 1994).

In some experiments light water or ordinary water has been used successfully to reproduce results similar to the Pons-Fleischmann model. According to Dr. Randell Mills of Hydrocatalysis Power Corporation (Lancaster, PA), we may be viewing a catalysis process whereby the H electron is induced to undergo a transition to a lower electronic energy level than the "ground state" as defined by the usual quantum-mechanical model of the atom. Thus, stored energy in the atom is catalytically released.

It may be that the barrier to the access of the D in relationship to the tetrahedral sites is nothing but the zero-point energy of the harmonic oscillator in the *n*-direction.

The Tunneling Model

Nuclear interactions can be coherent when the difference in the phases of the wave functions of the compound nucleus states formed by overlap between the itinerant deuteron (neutron) and the lattice deuterons (nuclei) is an integral multiple of 2p (Vaidya,1993).

Tunneling has been considered a quantum mechanical phenomenon, where a particle whose energy is less than the potential energy of a barrier can overcome the barrier of electrical repulsion. Calculations by

Rabinowitz and scientists at EPRI have shown that it is possible for the effective mass of the deuterium nuclei in a solid to be sufficiently less than the mass of deuterons in free space (Rabinowitz, 1990). This can increase the tunneling coefficient by many orders of magnitude.

By replacing the electron in a hydrogen molecular ion with a more massive charged particle, the fusion rate is greatly increased. Mario Rabinowitz of EPRI likens tunneling to a classical high jumper where an extended body can clear a barrier even when its energy is less than the potential energy of the barrier, if it can communicate with and be aided by the interaction on the other side of the barrier. Tunneling would strongly favor reactions with reduced masses such as:

$$D + p \rightarrow {}^{3}He + \text{gamma}$$

According to Charles Horowitz, the electrons in metallic hydrogen can be modeled as a Fermi gas of electrons and a crystal of nuclei. Palladium is a transition metal that in its *alpha* phase has a face-centered-cubic (fcc) lattice structure and a lattice constant of 3.89 Å and a nearest-neighbor distance of 2.75 Å fcc lattices in the orthohedral sites with the highest packing fraction of 1.0 - 1.5 Å. Under normal conditions, in D_2 gas or liquid states, the separation of the deuterium nuclei is 0.74 Å. However, for muon-catalyzed fusion to occur this must be at least 0.035 Å.

A zero-point energy of approximately 0.06 eV can be assumed which leads to the first-excited state above the potential minimum near 0.1 eV. The question is: Can 0.1 - 1.0 eV deuterons penetrate the Coulomb barrier? We know that the electron screening length is shorter than the interparticle spacing reducing the width of the Coulomb barrier. However, the deuterons must be within the scale of the fusion barrier (r_0) of approximately 0.37 - 0.125 Å in order for the cold fusion rate to be near the claimed reaching states of 10^{-23} s^{-1} $deuteron^{-1}$ as seen by Jones *et al.* (Jones and Palmer,*et.al.* 1989).

According to Adam Burrows of the University of Arizona, this would first require that the deuterons (positive) and the deuteride (hybrid) exist not as atoms or molecules, but as screened positive charges with screening clouds having the required length (Burrows, 1989). However, this would still not be sufficient since cold fusion reaction rates also require the increasing of the tunneling integral by unity to increase the fusion rate. Moreover, a vacuum zero-point energy stimulated by a resonance effect that matches the palladium cathodes atomic mass may be required to create the proper tunneling potential.

A further expansion of tunneling comes when the centrifugal barrier is combined with the Coulomb barrier. Here penetration can be increased due to the resonance level between the Coulomb barrier and the centrifugal barrier.

The E-Cell Theory

According to the theory put forth by Gennady Fedorovich *et al.* of the Russian Academy of Sciences, the E-cell is a radiation defect of a crystalline lattice of a hydride which forms as a result of the capture of a thermal neutron by the nucleus of an atom where, for example:

$$^{6}Li + n \rightarrow {}^{4}He + T + 4.785 \text{ meV}$$

Here the reaction products leave the cell in 10^{-17} s which is shorter than the electron system (10^{-15}s). Hydrogen nuclei and the average density of free electrons in the central region of the E-cell exceeds 10^{24} cm^{-3} which results in a greater suppression of the Coulomb barrier. According to Fedorovich's calculation, to confine the surplus electrons in the E-cell, the pressure in the LiH crystal must be >10 - 20 Mbar, where the motion of the hydrogen nuclei form a collective movement and at some phases of the movement, the

potential energy is transformed into kinetic energy, the nuclei approaching a distance of < 0.1 Å (Fedorovich, 1993).

Jahn-Teller Symmetry Breaking and Hydrogen Energy in Gamma-PdD

Keith Johnson from MIT has proposed a chemical process which corresponds to an "internal phase change of the deuterium within the gamma-PdD lattice." He believes that the energy released is caused by the internal cyclic gamma-phase change of atomic deuterium to di-deuterium. The heat produced is "latent" in that it is produced by repeated formation of the "interstitial sublattice" of the D-D bonds between the tetrahedral interstices in gamma-Pd-D. According to Johnson, as atomic deuterium diffuses into Pd and di-deuterium diffuses out causing 9.4 eV per Pd atoms for 6.8×10^{22} Pd atoms/cm^3 (Johnson, 1994).

Due to the high symmetry coordination of a Pd atom by D atoms in four of the eight surrounding fcc-palladium tetrahedral interstitial sites, the Jahn-Teller effect is unstable leading to a central energy minimum of distorted tetrahedral symmetry and a planar "broken-symmetry" energy minimum 9.4 eV below the high symmetry at a shortened distance of 0.76 Å (almost equal to the bond distance of a free hydrogen molecule). The cycle time for recombination (4D to $2D_2$) is difficult to calculate, but it would be somewhere between 1 and 100 minutes at 9.4 eV per Pd atom per unit time. This process according to Johnson could generate heat at a rate of 17 to 1700 Watts/cm^3 Pd.

New Particle: The Iton Particle and Nattoh Model

J.F. Yang from Hunan Normal University has suggested since 1989 the possibility that a new neutral elementary particle may be forming, wherein the deuteron captures an electron and is transformed into a dineutron $^2{}_0N$; the deuteron-dineutron reaction would then account for the cold fusion. The Nattoh model proposes a reaction that involves plural hydrogen atoms and electrons where:

$$2D + 2e + D \rightarrow {}^4N + I_2 + D$$

where ^4N is a quad-neutron and I_2 is a double iton. Matsumoto (1993) has observed ring spots caused by gravity decay of single and di-neutrons upon copper plates after the cold fusion reaction. The double iton could explain warming or "Heat after Death" phenomena that occurs for up to three hours afterwards and as described by Fleischmann and Pons.

Given the D-D fusion model, further contention arises over the required kinetic energy required for a deuteron to overcome the Coulomb barrier. A deuteron in such a crystal is subject to forces from the crystal lattice, as well as the Coulomb force from another deuteron. For known D-D fusion, the deuteron must acquire more than 4×10^5 eV of kinetic energy from the electrical field. Cold fusion, low-voltage electrolytic experiments use only 10 V. The probability that a deuteron passes through the barrier is 10^{-74} per second at normal room temperature, and in cold fusion experiments it is recorded to be 10^{-20} per second.

Some research has suggested that hydrogen ignition is occurring at the air-water interface. From preliminary results obtained by Matsumoto and Hokkaido University using the Nattoh model, they predict that cold fusion can occur using ordinary water. The model is based on the hypothesis that hydrogen clusters are trapped in tiny cavities such as cracks and compress themselves to a induced hydrogen-catalyzed fusion reaction. Here cold fusion occurs when the hydrogen pressure exceeds a critical value under electrical current flow.

Matsumoto claims that a metal such as nickel which has low hydrogen permeability can be used whereby hydrogen clusters on the surface (Matsumoto, 1993).

RECENTLY PUBLISHED RESULTS

The most comprehensive and up-to-date bibliography of new research papers, articles, and patents in the cold fusion area is now available on PC disk from the Fusion Information Center (H.Fox, current). A summary is available on the internet (c.f. the reference).

Several papers, articles, patent summaries, and book summaries in these areas are also available on the internet, catalogued by subject title (P. Bailey, current).

A private meeting entitled "Low Energy Nuclear Reactions Conference" was held in College Station, Texas, on June 19, 1995, to review the latest available results of "cold fusion" and "transmutation" experiments. The meeting was organized by J.O'M. Bockris and G.H. Lin and was held in a conference room at Texas A&M University. All of the papers from that conference have only just recently been publicly published. (Bockris and Lin, Jan. 1996.) In the order listed below, eight papers were presented on "Basic Experimental Studies", four on "Theoretical Models", and five on "Innovative Approaches".

Each experimental paper presents positive and repeatable results of cold fusion and/or an atomic transmutation of elements (listed in the order as they are in the Proceedings):

EPRI: Low energy proton and deuterium reactions seen by Wolf in 1992 to produce Silver, Rhodium, and Ruthenium with excess neutrons and mild radioactivity. (T. Passell, 1995.)

Hakodate Nat. College of Tech, Japan: Production of iron isotopes with excess heat from gold and lead electrodes in electrolytic solutions. (T.Ohmori and M. Enyo, 1996.)

Scientific Industrial Assn., Russia: Glow discharge experiments with very pure Pd electrodes produce excess heat 2x-3x (2-to-3 times "over-unity") and several new elements. (A. Karabut, Y. Kucherov, I. Savvatimova, 1996.)

Portland State University: Excess heat and unexpected elements produced by electrolysis of Pd in several experiments. (S. Miguet and J. Dash, 1995.)

CalPoly University: Strontium produced from rubidium with excess heat in light water electrolysis with nickel electrodes. (R. Bush and ENECO, 1993.)

Hokkaido Univ., Japan: Excess heat 2x-to-4x and several nuclear products found in light and heavy water electrolysis cells using Pd and Ni electrodes. (R. Notoya.)

Ukrainian International Academy of Original Ideas: Various electrolysis results, including zinc turned into copper; and copper implanted into steel, with weight loss. (G. Rabzi, 1996.)

Ukrainian International Academy of Original Ideas: Formation of new elements with atomic numbers 82 through 40 via electrolysis with lead and zinc. (A. Fabrikant and M. Meyerovich, 1996.)

Purdue University: Optical Theorem explains low-energy nuclear fusion reactions and unstable product formations. (Y. Kim, 1996.)

CalPoly University: Electron Catalyzed Fusion Model fits EPRI/SRI cold fusion data and other data from Japan. (R. Bush and ENECO, 1996.)

Clustron Sciences Corp.: Nucleon Cluster Model provides explanations for cold fusion experiments and also for radioactive waste cleanup. (R. Brightsen, 1996.)

Clustron Sciences Corp.: Nucleon Cluster Model compares exactly with the Periodic Table of the Elements (discovered in 1869.) (R. Brightsen, 1996.)

Hokkaido Univ. & Hakodate Nat. College of Tech., Japan: Excess heat observed in 12 of 80 cases using powdered oxides and Pt in hot D_2 gas. (T. Mizuno, *et. al.*, and M. Enyo, 1996.)

Mt. States Mine and Smelter: Creation of helium and lithium from nitrogen gas using electromagnetic fields. (R. Kovac, 1996.)

Wireless Engineering: Creation of fluorine from water using shaped electromagnetic fields, duplicating some of the 1927 experiments of Walter Russell. (T. Grotz, 1996)

Los Alamos National Laboratory: Creation of tritium from small palladium wires and voltages. (T. Claytor, D. Jackson, and D. Tuggle, 1996.)

Burns Developments, Ltd.: Experimental evidence for the "Alpha-Extended Model of the Atom". Demonstrated removal of radioactive thorium and creation of new and lighter elements in 15 tests igniting specific mixtures of elements. (R. Monti, 1996.)

In addition, two additional conferences have been organized and held in Texas on hydrogen and cold fusion topics. The papers presented are listed on the internet and are available in proceedings (H. Fox, Summer 1996; H. Fox, Sept. 1996).

More recently published results also include: (1) A method for calibration of Pd-D_2O systems for cold fusion results (Pons and Fleischmann, 1996, in France); (2) A summary of the cold fusion results observed by Dr. Bockris and his team (Bockris, Sept.-Oct. 1996); (3) Excess energy and transmutation of elements in light water (T. Ohmori, Mar. 1997, in Japan); (4) Solid-state plasma fusion in Japan (Y. Arata, 1996); (5) Cold fusion results observed by the Dept. of the US Navy (M. Miles, Nov, 1997); (6) History of transmutation experiments and results (T. Grotz, Mar. 1997); (7) US Patent for a "System for Electrolysis" (J. Patterson and D. Cravens, Mar. 1997); (8) A large conference on several new experiments with positive results recently held in St. Petersburg, Russia, whose proceedings are available in English (A. Frolov, June 1996); and (9) A summary review of the results from the last International Cold Fusion conference (J. Rothwell, Dec. 1996) — most of these are available on the internet.

It is now conclusive that positive and repeatable results in both the "cold fusion" energy conversion area and in the "transmutation of elements" area are now being observed within the US, Europe, Russia, China, Japan, and in many other countries. Science is now undergoing a paradigm shift. Researchers are encouraged to read two papers on how researchers can promote these new technologies (H. Fox, Apr. 1997) and the challenge to each person that would like research in these areas to rapidly more forward (H. Fox, June 1997); both are on the internet.

Other theories that may explain the nuclear mechanisms that occur during these processes include: (1) High Density Charge Cluster, and (2) Long Neutron Lifetimes. Hal Puthoff at the Institute for Advanced Studies at Austin, Texas, has performed experimental research in these areas and feels that both have merit (H. Puthoff, Apr. 1997). The high density charge cluster theory was patented by Ken Shoulders in 1991 (K. Shoulders, May 1991), and has been described in several articles on the internet (H. Fox, Feb. 1997), (H. Fox, Nov. 1996), (H. Fox, Jan. 1997). Basically, the concept is that electrons will group together into large donut-shaped cluster fusion type cells, and be able to cause the nuclear reaction results that are observed. Also, if neutrons could be allowed to stray between ions within a cell's E field, then the observed transmutation results might be explained. Both theories need further research and examination.

FUTURE BENEFITS OF COLD FUSION

At the *Power-Gen '95 Americas* trade show in Anaheim, California, on December 4 & 5, 1995, Clean Energy Technologies, Inc. (CETI) of Dallas, Texas demonstrated a 1-kW cold fusion reactor. During the demonstration, between 0.1 and 1.5 Watts of electricity was input, and 450 to 1,300 Watts of heat was output. This was an increase from the ratio of 1:18x that had previously been demonstrated only a short time earlier in October 1995 at the International Conference on Cold Fusion (Rothwell, 1996).

According to Keith Johnson, if some of these theories are correct and 1 cm^3 of Pd is capable of yielding upwards of 1.7 kW of energy, this would eventually create systems of 22 kW or 30 HP in automobiles with the possibility of "water engines" electrochemically generating both heat and hydrogen for a fuel cell.

The world's oceans contain a large amount of readily extractable heavy water, sufficient to meet the global energy needs for hundreds and perhaps thousands, of years. Heavy water production facilities will be needed. One gallon out of every 7,000 gallons of ordinary water is heavy water (deuterium oxide or D_2O). The energy equivalent of a gallon of heavy water is about equal to 300,000 gallons of fuel oil. The cost of production of one gallon of heavy water is estimated at less than $1,000 or less than one cent per gallon of oil (energy equivalent).

A target range of 400% to 1000% (4x-10x) excess energy generation for a given cathode design should be a commercial target for the system. Currently, the thermal energy output of electrochemical fusion reactors is being achieved with excess of electrical energy input by a factor varying from 25% to 600% (6x). Fleischmann and Pons reported briefly achieving a factor of 100-fold thermal energy excess over electrical energy input and also have briefly achieved boiling water at 100°C (Pons and Fleischmann, 1990).

Although energy generated has been in the 10 to 100 W/cm^3 range, for commercial products such as heaters up to 100 W/cm^3 of active deuterium-absorbing metal electrode materials would be needed to allow for rapid response and short heating times.

In terms of domestic heaters where an electric or natural gas water heater can cost on an average $250-$400 U.S. dollars per year, after installation costs and capital expenditures which would hopefully be achieved at current heater prices, the average cost of heating a 5.50 kW fusion-based water heater could be as low as $50.00 per year (Haag, 1990). In addition, the low neutron radiation is highly desirable because there is only a limited amount of harmful radioactivity that could be easily shielded even for home use.

Heating tap water from 40°F to a temperature of 158°F requires an energy input of 0.26 kWh per gallon of water. The average consumption for a family of four is 80 gallons per day, requiring 20.8 kWh of energy. The height of standard residential water heater is 152 cm, a deuterium storing metal rod electrode having this height and a diameter of 1.3 cm with a heat generation rate of 50 W/cm^3 an energy output of 0.050 kWh cm^3 could be achieved with a volume of 200 cm^3 of electrode material.

Over $8 billion per year is spent on fossil fuels for heating water in the United States. This represents 4% of our total energy needs. The nuclear fusion-based water heater could save up to 90% of this cost for consumers per year.

The systems where industrials would be positively effected are: (1) water heating; (2) steam generation for sterilization; (3) water distillation; (4) air conditioning; (5) cooking; (6) heating for greenhouses; (7) heaters for chemical processing plants; (8) heaters for various transportation vehicles (trains, planes, buses, trucks); (9) heaters for snow, ice removal; and (10) heaters for swimming pools and hot tubs.

Several organizations are actively pursuing licensed commercial applications for their proven "cold fusion" technologies. Further information about these applications can be found on the Institute for New Energy web site at: www.padrak.com/ine/.

CONCLUSIONS

The challenge before us is to move forward with the expansion of worldwide teamwork, the study of Li and Ni, reverse profiles for low nuclear concentrations, and to make a closer study of several elements such as Al, Bi, Ca, Dy, Gd and Sm that are considered the reaction products of requisite existence for Cold Fusion activity.

Many of these theories although different are similar—suggesting that there may be a unifying mechanism behind the Cold Fusion phenomenon, such as zero-point energy fluctuations. Clearly the challenge beckons our full attention.

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BIOLOGICAL NUCLEAR REACTIONS: EMPIRICAL DATA DESCRIBES UNEXPLAINED SHC PHENOMENON

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ABSTRACT

In the Spring 1998 issue of *The Journal of New Energy*, Dr. Panos Pappas proposes an Equation of Life" which posits the existence of a low-energy nuclear fusion on an intracellular level. This equation, $^{11}Na_{23}$ + $^{8}O_{16}$ + Electrical Energy + ATP Energy ⇒ $^{19}K_{39}$, invokes an endothermic reaction and biological transmutation in living cells. Pappas asserts that this new equation replaces the flawed hypothesis of the so-called "sodium-potassium pump" accepted in modern biology [1]. Others, like Komaki and Kervran, have likewise posited, and demonstrated in experimental trials, the likelihood of non-radioactive biological low-energy fusion involving sodium and potassium. [2]

This assertion may be supported by recently replicated studies by Benford *et al.* which identified statistically significant decreases in extremely high-frequency electromagnetic fields, gamma rays, during alternative healing therapy sessions with a trained practitioner and multiple subjects [2,3]. One hypothesis suggests that the fluctuations may occur because of increased gamma radiation absorption or diminished intracellular radiation emission by the subject during bioenergetic treatments whereby the magnetic energy fields surrounding the healer's hands are significantly stronger than at resting levels [4].

The increased proportion of energetic gamma radiation may result in the activation of specific cellular and molecular processes that are beneficial to the organism. This presupposes an innate disposition among animal cells to use radiant energy, similar to plant photosynthesis, as an alternative energy supply via a process called "radiogenic metabolism." If correct, this additional high-energy source may participate as a significant factor in Pappas' "ATP Energy" requirement accounting for biological transmutations and other intracellular nuclear reactions.

In this paper, the author presents a tandem hypothesis that the gamma radiation enrichment under certain conditions may be responsible for not only beneficial biological nuclear effects, but also deleterious effects resulting in the heretofore unexplained phenomenon of Spontaneous Human Combustion (SHC) and it's possibly less violent counterpart toxic epidermal necrolysis (TENS).

INTRODUCTION

During the Benford *et al.* experiments [3, 4], external (between 2 and 6 inches from body) gamma radiation counts were recorded to obtain: (1) background control values, (2) resting control values (subjects in supine position), (3) no treatment baseline control values (with a person standing along side the subjects), and (4) treatment values (with Polarity therapist's hands gently placed on the subjects). "Polarity therapy" is one of several hand-mediated bioenergy therapies, which are gentle, holistic methods of treatment, applicable to many health problems and also useful in maintaining health. Central to these modalities is the concept of a life energy or "élan vital" which is in constant pulsation creating fields and energetic lines of force that permeate the body. This treatment creates an energetic "template" for the physical body.

During the initial Benford *et al.* preliminary tests involving Polarity therapists and volunteer subjects, total counts were recorded in 100-second trials separately over the subject's crown, heart, abdomen and pelvic regions using a NaI(Tl) crystal scintillator which detected gamma radiation from approximately 100 KeV to 3 MeV. Later tests involved 300-second counts over the heart and pelvic regions only.

The results demonstrated that gamma radiation levels markedly decreased during therapy sessions with 100% of subjects and at every body site tested regardless of which therapist performed the treatment. In many instances, the gamma counts fluctuated by thousands within the short time periods analyzed. T-tests were used to determine statistical significance with p-values ranging from $p = .035$ to $p < .0001$, in the 100-second trials, and $p < .0000001$ in the 300-second trials. A complete description of these studies can be found elsewhere [3,4].

The dramatic and consistent results obtained in these controlled experiments may result, in part, from the increased bioenergetic fields surrounding the hands of healers. Dr. John Zimmerman discovered large frequency-pulsing fields emanating from hands of therapeutic touch practitioners during therapy as measured by an extremely sensitive magnetometer called a SQUID (Superconducting Quantum Interference Device) [5]. Similar frequency-pulsing bioenergetic fields were later measured and quantified from the hands of meditators and practitioners of yoga and QiGong using a simple magnetometer. These fields were 1000 times greater than the strongest human bioenergy field [6] and were found to be in the same frequency range as those being tested in medical research laboratories for use in speeding the healing process of certain biological tissues [7]. This range is low energy and extremely low frequency and spans from 2 Hz to 50 Hz [7].

One participant in the Benford *et al.* alternative healing studies involved a survivor of a Spontaneous Human Combustion (SHC) event (participant KF). Simply defined, SHC is the ignition and burning of a mass independent of contact with a burning substance. Since the middle ages, over 400 cases have been documented reporting this phenomenon in human beings [8]. However, this number may be grossly under-reported due to ill-defined parameters defining such occurrences at local fire departments, mortuaries, and medical facilities.

Cases involving SHC have many features which distinguish them from routine fires:

1. The burning is never spontaneous in routine fires; there is always an ignition source present in the room near the victim.

2. In SHC, the body is normally more severely burned than one that has been trapped in a normal fire. The burns are not distributed evenly over the body, the extremities are usually untouched by fire, whereas the torso usually suffers severe burning. In many cases, the torso is completely destroyed, the bones being reduced completely to ash. In SHC the rate of total body burning is much faster than in the hottest burning crematoriums.

3. In SHC, the combustion is localized to the body. Almost no fire damage is done to other objects in the vicinity of the body excluding thermal effects to high hydrogen-containing elements such as water (dehydration), plastics (charring, dehydration) and waxes (melting). Often the victims clothes and other highly flammable items are found unscathed.

INTERVENTION

KF was tested for gamma fluctuations during a Polarity therapy session on May 8, 1998 at the Columbus Polarity Therapy Institute in Columbus, Ohio. KF was one of ten test subjects who was monitored for 100-second count gamma fluctuations during Polarity therapy, a type of healing energy practice (three test subjects on March 13th and seven on May 8th).

Two years prior to this date, in February of 1996, she experienced an explosion adjacent to her left shoulder blade which created a dark smoke that filled her kitchen. She reported feeling "something from the base of my back going up my back," [9]. Her back remained hot and red for only fifteen minutes at which time her skin returned to normal. This event had an eyewitness and was later validated by medical

physicians. At the time of the event, KF was on NorPace® for her chronic heart arrhythmia and was taking prescription-strength potassium supplements. Her height and weight were reported as 5'2" and 112 pounds at the time of the incident with her weight increasing to 120 pounds at the time of testing. She was 39 years old at the time of the incident and 41 at the time of testing [10].

RESULTS

TABLE 1: 100-second Gamma Count Decreases (Background minus "Before" Therapy)
KF compared to group average (n=10)

	CROWN	HEART	ABDOM.	PELVIS	TOTAL
KF	4,336	5,796	6,292	6,346	22,770
AVG.	2,485	4,248	4,587	4,471	15,790
MINIMUM	338	2,233	2,850	2,809	
MAXIMUM	4,336	5,796	6,292	6,364	

Graphic depiction of TABLE 1

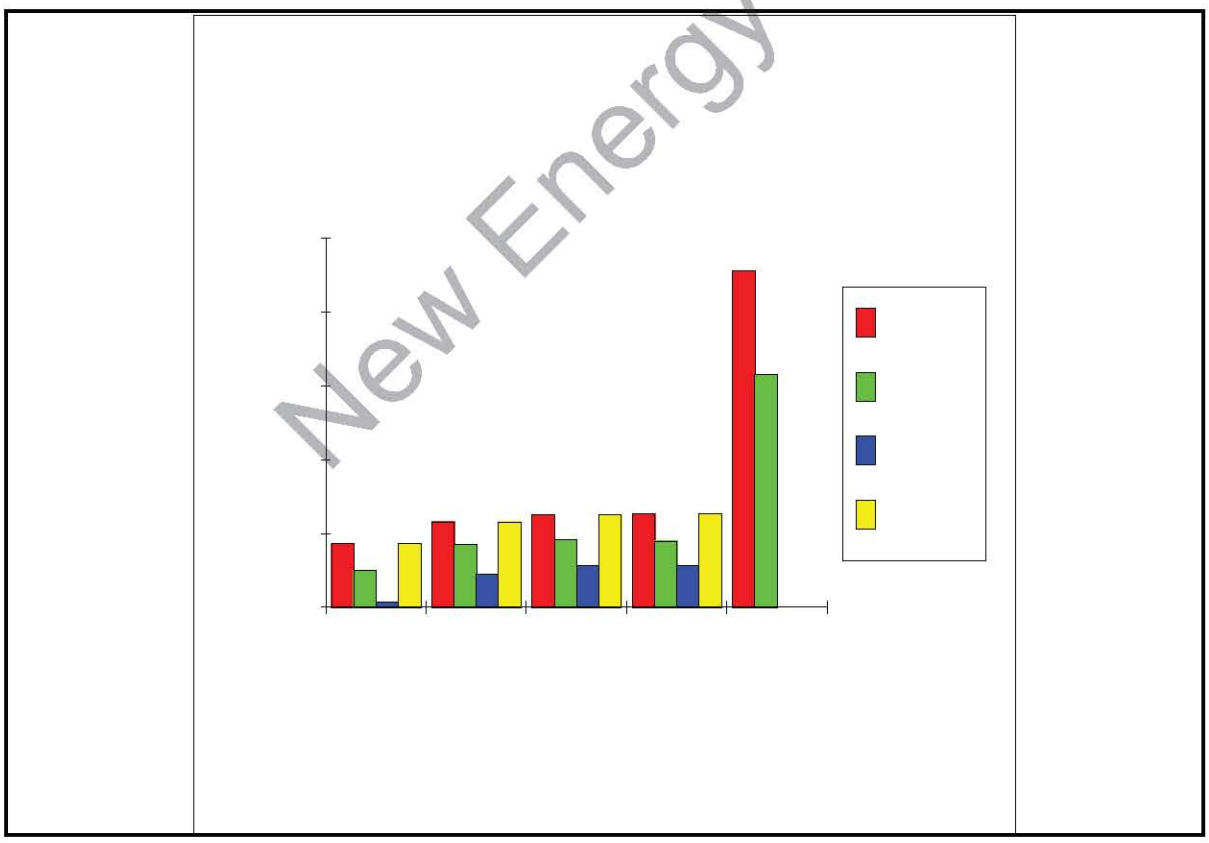
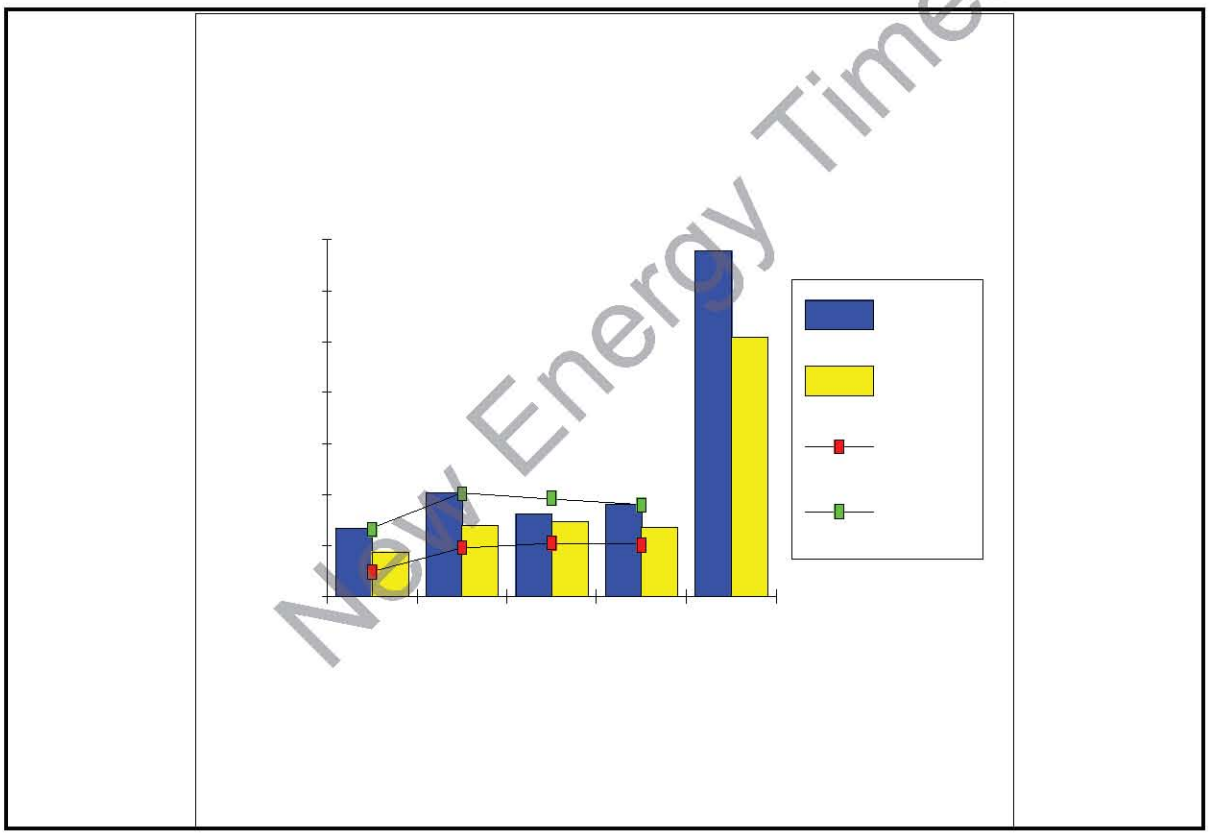


TABLE 2: 100-second Gamma Count Decreases (Background minus "During" Therapy)
KF compared to group average (n=10)

	CROWN	HEART	ABDOM.	PELVIS	TOTAL
KF	6,671	10,142	8,050	9,008	33,871
AVG.	4,358	6,912	7,335	6,781	25,385
MINIMUM	2,409	4,738	5,207	5,154	
MAXIMUM	6,671	10,142	9,560	9,008	

Graphic depiction of TABLE 2



Discussion

As is clearly seen in both Tables 1 and 2, the decreases of gamma radiation for KF as compared to the rest of the group are significantly higher and reflect the maximum levels obtained during the study save one reading (see Table 1 abdominal reading). To explain the gamma decreases observed both before and, more dramatically, during alternative healing therapy, Benford has hypothesized that an alternative fuel source of ionizing radiation is being used by cells to complement existing food supplies. This may arise from one of two mechanisms: absorption of external radiation or decreased emission of ionizing radiation from within the cells. When cells are incoherent, under stress, and/or dysfunctional, the need for these radiant energy sources increases, thus, absorption and/or hoarding of energy increases and externally-monitored gamma counts decrease.

In human cells, only forty percent of the total potential energy in glucose is transferred to ATP. The remaining sixty percent of the energy is generated in the form of heat [11]. Given this inefficient energy cycle, it is not hard to imagine the cellular need for an alternative fuel supply other than food stuffs.

By comparison, plants are able to capture the energy in sunlight and use this energy to synthesize glucose by the complex process of photosynthesis. A crucial observation is that bacteria are considered a part of the Plant Kingdom. It is believed that mitochondria, the power-producers within the human cell, were once free-dwelling prokaryotes identical to bacteria. Subsequently, mitochondria are more closely aligned to organisms from the *plant* kingdom capable of photosynthetic processing of radiant energy than the eukaryotic cells with which they now share a symbiotic relationship. The theory of free-standing mitochondrial bacteria, originally championed by Dr. Lynn Margulis, suggests that today's mitochondria are the descendants of ancient prokaryotes that established a symbiotic relationship within eukaryotic cells [12].

More recent research, by Martin and Müller, suggests that the archaebacterium host (theoretical ancestor of the mitochondria) was strictly autotropic, which means it was self-feeding. This assumption further supports the theory that primordial mitochondrial archaebacterium may have depended on the abundant ionizing radiation as a fuel source for its nutritional energy needs [13].

If mitochondria already are known to be capable of anaerobic, energy-generating processes and, like other plant organisms, can theoretically utilize radiant energy as a power source for energy production, is it not possible that this ability extends to the use of high-energy gammas to supply energy within the cell? After all, prior to an atmosphere rich in oxygen and their symbiotic relationship with the eukaryotic cells, the mitochondrial bacteria had to have some energy source that was abundant and powerful enough to provide all their energy needs. Dr. Luckey coined the term for this gamma usage within human cells as "radiogenic metabolism." [14] By Luckey's description, radiogenic metabolism is concerned with "the promotion of metabolic reactions by ionizing radiation and its products. It is hypothesized that radiogenic metabolism was involved in prephotosynthetic transformation of radiant energy into chemical energy. Metabolic adaptation to the utilization of free radicals from the radiolysis of water could be the evolutionary precursor to the use of active oxygen radicals in photosynthesis and respiration." [1]

If this theory of radiogenic metabolism is correct, in that, high-energy gamma photons are being "digested" and utilized as an ongoing energy source by human cells, then there should be some identifiable "by-product" of the metabolism. Recently published work by Dr. Fritz-Albert Popp of the International Institute of Biophysics in Germany suggests that low-energy biophotons are emitted from human beings. In a long-term study, Popp demonstrated that photon emissions from each of the skin areas tested followed the same biological rhythms but were phase-shifted between various body parts, e.g., hands versus forehead. Popp also demonstrated that normal patterns are disrupted in people suffering from various illnesses and diseases [15].

In a separate series of experiments, Popp discovered that one of the roles of biophotons involves "the growth of bacteria in their nutritional medium." [16]. Bacterial nutritional mediums emit photons as a result of routine oxidative processes such that the photon output of the medium radiates uniformly for days. However, once bacteria are introduced to the medium, the photon emission immediately decreases. Once the colonies have obtained a more highly concentrated population density, the unexplained absorbance dissipates [16].

In addition, the Benford *et al.,* gamma measurement results may indicate a type of "self regulation" by the body; whereby, only the amount of gamma needed is absorbed/stored at any given time when applied under these conditions. Also, when the cells are ineffectively processing energy, as in certain dysfunctional states such as KF's heart arrhythmia, there may be an increased influx/decreased release from the alternative gamma radiation source.

During times of cellular stress, intracellular energy requirements increase as the cell strives to maintain metabolic equilibrium. The Benford *et al.*, experiments demonstrated that, at these times, there may also be an increase in gamma absorption or decreased gamma emission to compensate for the disrupted primary energy cycle. In tissues, most of this gamma radiation is absorbed by the cell water, largely because there is more water in the body than any other molecule. The radiation causes one of the oxygen-hydrogen bonds in the water to split, leaving a single electron on hydrogen and one on oxygen, thus creating two radicals: H is a hydrogen radical (or hydrogen atom), and OH is a hydroxyl radical. The latter is the most reactive radical known to chemistry. Modern medicine has dubbed these partial molecules "free radicals." [17]

CONNECTION BETWEEN SHC AND FREE RADICALS

Free radicals have one or more unpaired electrons. Unpaired electrons make the species more attracted to a magnetic field (they are said to be paramagnetic). Of interest, is that the majority of documented SHC events have occurred during times of increased geomagnetic flux in the vicinity of the victim. This paramagnetism, in turn, gives free radicals a highly-reactive nature.

Various free radical species have been implicated in over fifty diseases [17]. This large number suggests that radicals are not uncommon but, rather, participate as a fundamental component of tissue injury in most, if not all, human diseases. Once again, a comparison can be made to those falling prey to SHC in that most are elderly and/or suffer from some physical infirmity, like KF, which might predispose them to dysfunctional cellular operations, increased gamma radiation energy needs, and, subsequently, more free radical build-up.
Free radicals are observed in oxidation reactions, combustion reactions, and many other biological reactions. A common feature of the reactions of free radicals with non-radicals is that they tend to proceed as chain reactions, where one radical begets another [17].

Such was the case for post-SHC victim, KF, whose gamma counts decreased over 10,000 from background readings (heart region) during a 100-second time period while receiving Polarity therapy, a hand-mediated energy practice that may involve stronger magnetic fields around the hands of the healers (see TABLE 2). For KF, control measurements taken prior to the therapy session also demonstrated a disproportionately elevated absorption (see Table 1) which may indicate a consistent elevated absorption of gamma radiation.

If this is the case, additional free radicals would be formed by continuous influx emission of ionizing radiation into incoherent cells or from a subsequent delay in gamma emission. KF also reported feeling "a weight lifted off her chest," following the Polarity therapy which, according to the practitioner, released energy blocks in her heart region. Under certain conditions, these energized free radicals might combust. "Theoretically, the complex organic compounds of the human body should immediately combust in the oxygen of the air (as occult magazines, such as *The Unexplained*, occasionally claim that people have done) but the spin restriction and other factors slow this down, fortunately!" [17] But what if those "other factors" changed?

The typical reaction of free radical electrons is for the unpaired electron to pair with another electron. However, this is not the only possible reaction. Unpaired electrons also seek to annihilate with positrons, their antimatter counterparts. This reaction creates two 511 KeV gamma rays which are emitted in opposite directions (a 180-degree angle). Thus, theoretically, fewer than a dozen simultaneous annihilations within a cell could provide enough energy to liberate neutrons and protons from certain atoms. But where does the elusive positron come from inside a cell?

One little known fact is that our bodies naturally contain radioactive elements. One Japanese study determined that contributions of each radionuclide to the total effective dose are potassium-40 or K40 (63%), lead-210 or Pb210 (16%), and Polonium-210 or Po210 (16%) [18]. An often ignored or unrecognized feature of K40 is that it decays to Ar-40 via emission of positrons, which is also termed EC (Electron Capture). In the Auger electron spectrum of K40 EC decay, the most notable group is the 200 ev L-Auger group with a range in water of 8 nm and an occurrence rate per 100 K40 decays of 16 (11.2%). This represents the second largest group of decay events next to beta radiation at 89 (62.2%) per 100 K40 decay events [19]. Accordingly, the localized absorbed energies cluster around the K40 decay sites with the major impacts occurring when intracellular K40 levels are highly concentrated as was the case with KF.

In comparison to Plutonium ($Pu_{238-239}$) in the air of the lungs, which produces one disintegration each 500,000 seconds, e.g., one decay per 5.8 days, K40 produces 50 disintegrations per second. This represents, in the lungs alone, 25,000,000 times more decays from K40 than plutonium equating to 483,840 positron emissions (11.2% of total K40 decays) per day [20]. These occurrences in and around intracellular free radical electrons within the water could, theoretically, produce highly energized annihilation events.

This accumulation of radioactive isotopes within the cell serves as a basic component of radiogenic metabolism and, may also, be accelerated in times of stress or disease. When accompanied by increased free-radical production, the chance for a positron - electron reaction multiplies. Similarly, documented ingestion of known radioactive materials, e.g., potassium supplements such as those taken by KF, will further increase the matter-antimatter potential and the likelihood of an intracellularly-mediated nuclear event.

Recent work by Benford and researchers at The Ohio State University on a known cellulose-based artifact from an SHC-event (book dust jacket from the George Mott case of 1986) provided compelling evidence for a biologically-induced nuclear event. The book jacket was evaluated using visual/light microscopy, Fourier Transform Infrared (IR) analysis, X-ray Photoelectron Spectroscopy (XPS), and Carbon-14 dating.

The results indicated significant visual, microscopic, atomic and molecular differences between the blackened front cover of the Mott book jacket and the unaffected back cover. Carbon-14 "aging" was noted for the Mott book jacket in comparison to the identical book jacket control sample. This compared to similar aging noted on a cotton tunic worn by a person exposed to the atom bomb at Nagasaki [21].

Diol dehydration can account for each variation observed in the IR spectrum of the blackened front cover vs. normal back cover of the Mott book dust jacket: the OH and C-O disappearance, the modified CH signal and the C=O signal appearance. (Alcohols have an OH group attached to a carbon. When the next carbon also has an OH, the molecule is called "diol" (di (2) ol (Alcohol)). At the same time, the spectrums show the carbon background, which could be formed if a thermal energy source, was applied beyond the dehydration in a fast photonic burst. A thermal-, or proton-radiation effect, can account for the carbonized organic material more easily than an acid.

One theory, that may account for all the empirical data found in the Mott case is a biologically-induced nuclear explosion. In such an intracellular nuclear reaction scenario occurring within the body of the victim, both neutron and proton radiation would be released, leaving remnant effects on the artifacts found at the post-SHC scene. This theory is capable of explaining most, if not all, of the scientific findings both on the book dust jacket and at the post-SHC scene at Mott's house.

SUMMARY

If Pappas, Komaki, and Kervran are correct, in that a nuclear fusion process drives Na-K intracellular equilibrium, then a disruption in this mechanism may contribute to further energy build-up which, if blocked as believed to be the case with KF, may incite a chain reaction among the most reactive free radicals harbored by the most dysfunctional cells. It is of interest to note that KF had been taking prescription-strength potassium supplements for several years prior to the SHC event. It is also pertinent to note that most SHC cases involve the area of greatest infirmity, or disease, and may leave healthier tissue uninvolved [8].

If, as posited, this transmutation involves higher energy reactions, e.g., matter-antimatter annihilations within the cells, then it would explain the magnitude of disruption documented in most SHC events. Various caveats need to be studied involving this type of spontaneous combustion in disease conditions which disturb the normal cellular and electron balances.

Benford has recently hypothesized a connection between SHC and a well-documented, yet rare, medical condition known as toxic epidermal necrolysis, or TENS, which includes numerous overlaps with SHC cases. Future research should focus on these phenomena and other similar conditions known to generate excessive free radicals while requiring high-doses of potassium supplementation and/or predisposing the person to hyperkalemia.

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NUCLEAR IMPLOSION

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ABSTRACT

Nuclear implosion is predicted by the spiral field theory proposed earlier by the author. The spiral field theory is based on application of novel relativistic relationships according to which both the gravitational mass and electric charge decrease with increase in velocity and become equal to zero at the velocity equal to the ultimate spiral field velocity that is only slightly greater than the velocity of light. This theory presents both the nucleus and the outer particles as assemblies of the double toroidal spiral fields located on quantum energy levels. Double helical spiral fields are created during transfer of toroidal spiral fields from higher to lower energy levels. When the energy level reduces to zero, the nuclear implosion takes place. During the nuclear implosion, the toroidal spiral fields collapse to become the inversion field rings having zero mass and zero electric charge and the entire released energy is carried out by the double helical spiral fields. The amount of energy released during the collapse of the electron-positron-based toroidal spiral fields (external nuclear implosion) is comparable with that released during nuclear fusion. Even greater amount of energy is released during the collapse of muon-based toroidal spiral fields (internal nuclear implosion) or tau-based toroidal spiral fields (subnuclear implosion).

INTRODUCTION

Spiral field theory [1-3], proposed earlier by the author, predicts the structure of an atom by employing the concept of spiral field. The theory is based on the novel relativistic relationships for the mass and electric charge according to which both the particle gravitational mass and electric charge decrease with velocity and become equal to zero when the velocity is equal to the ultimate spiral field velocity. Table 1 provides a comparison of the novel relativistic equations with those of theory of relativity.

TABLE 1 Comparison of relativistic equations for mass and electric charge.

Parameter	Theory of relativity	Spiral field theory
Gravitational mass	$m_g = \frac{m_0}{\sqrt{1-(v/c)^2}}$	$m_g = m_0\sqrt{1-(v/C)^2}$
Electric charge	$e = e_0$	$e = e_0\sqrt{1-(v/C)^2}$
Inertial mass	$m_i = \frac{m_0}{\sqrt{1-(v/c)^2}}$	$m_i = \frac{2\,m_0\sqrt{1-(v/C)^2}}{1\pm\sqrt{1-(v/C)^2}}$

where

m_o, e_o = rest mass and rest electric charge respectively
v = particle translational velocity
c = velocity of light

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C = ultimate spiral field velocity.

The spiral field theory was recently expanded to reveal close relationships between the double helical and double toroidal spiral fields [4]. The former is responsible for the existence of various forms of electromagnetic waves and the latter for the existence of elementary particles. Also, based on the spiral field theory, the author described the structures of elementary particles [5] and advanced the idea if unified field and matter [6]. The present paper, describes another phenomenon predicted by the spiral field theory, the nuclear implosion.

DOUBLE-HELICAL SPIRAL FIELD

Structure of Double Helical Spiral Field - At the core of the structure of the double helical spiral field is an **electric dipole** created by polarization of empty space. The electric dipole comprises two electrically-charged particles separated from each other by a distance $2\mathbf{r}_1$. The dipole is involved in two principal motions, translation with velocity v_{t1} and rotation with velocity $\mathbf{v}_{r1}$ (Fig. 1). Thus, each electric charge of the dipole leaves an imaginary trace in a form of a double helical spiral with the pitch $\mathbf{s}_1$.

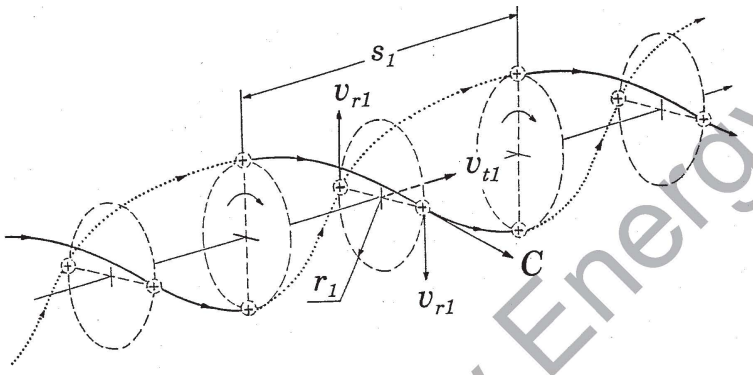

Fig. 1. Double helical spiral field. Adapted from [3].

Unlike the commonly known electric dipole with opposite electric charges, this dipole can have the electric charges of either opposite or the same signs. The sign depends on how half of the distance between the electric charges $\mathbf{r}_1$ relates to the inversion radius of the spiral field $\mathbf{r}_i$ that is given by:

$$r_i = \frac{k e_0^2}{m_0 C^2} \tag{1}$$

where

k = Coulomb constant

$\mathbf{e_o}$, $\mathbf{m_o}$ = rest electric charge and rest mass respectively of the core particles forming the electric dipole.

When $\mathbf{r_1 < r_i}$, both electric charges have the same sign, whereas when $\mathbf{r_1 > r_i}$, these charges have opposite signs.

Velocities of Double Helical Spiral Field - The geometrical sum of translational velocity v_{t1} and rotational velocity v_{r1} of the electric dipole is equal to the ultimate spiral field velocity **C**, i.e.:

$$v_{t1}^2 + v_{r1}^2 = C^2 \tag{2}$$

In terms of relative translational velocity $\boldsymbol{\beta_{t1} = v_{t1}/C}$ and relative rotational velocity $\boldsymbol{\beta_{r1} = v_{r1}/C}$, we obtain:

$$\beta_{t1}^2 + \beta_{r1}^2 = 1 \tag{3}$$

The physical meaning of Equations (1) and (2) is that electrically-charged particles of a dipole move along their helical spiral paths with ultimate spiral field velocity **C**. Thus, the dipole moving with translational velocity $\mathbf{v}_{t1}$ and rotational velocity v_{r1} is identical to a double-helical spiral field propagating along its spiral path with ultimate spiral field velocity .

Discrete Character of Double Helical Spiral Field - The ratios of translational velocity v_{t1} to rotational velocity v_{r1} of the double helical spiral field must be equal to certain discrete values which are the products of the energy levels **n** of the double helical spiral field and Universal Spiral Field Constant **U**, as given by the equation:

$$\frac{v_{t1}}{v_{r1}} = \frac{\beta_{t1}}{\beta_{r1}} = n\,U \qquad n = 0, 1, 2, \ldots\ldots \tag{4}$$

n = energy level of the double helical spiral field.
U = 1 / α = Universal Spiral Field Constant
α = Sommerfeld fine structure constant.

Equations (3) and (4) yield the following expression for relative translational and rotational velocities β_{t1} and β_{r1}:

$$\beta_{t1} = \frac{v_{t1}}{C} = \frac{n\,U}{\sqrt{(n\,U)^2 + 1}} \qquad n = 0, 1, 2, \ldots\ldots \tag{5}$$

$$\beta_{r1} = \frac{v_{r1}}{C} = \frac{1}{\sqrt{(n\,U)^2 + 1}} \qquad n = 0, 1, 2, \ldots\ldots \tag{6}$$

Principal Parameters of Double Helical Spiral Field - Table 2 shows principal parameters of double helical spiral field as a function of relative translational and rotational velocities β_{t1} and β_{r1}

TABLE 2 Principal parameters of the double-helical spiral field as a function of relative translational and rotational velocities.

Parameters	Inner field $b_1 \leq 1$	Outer field $b_1 > 1$
Relative spiral radius $b_1 = r_1 / r_i$	$\frac{1}{1 + \beta_{t1}}$	$\pm \beta_{t1}\,\beta_{r1}$
Relative electric charges e / e_0	$\pm \beta_{t1}\,\beta_{r1}$	$\pm \beta_{t1}\,\beta_{r1}$
Relative gravitational mass m_g / m_0	$\beta_{t1}\,\beta_{r1}$	$\pm \beta_{t1}\,\beta_{r1}$
Relative inertial mass m_i / m_0	$\pm \beta_{t1}\,\beta_{r1}$	$\frac{2\,\beta_{t1}\,\beta_{r1}}{1 + \beta_{t1}}$
Relative carrier frequency f_{c1} / f_{c0}	$(1 + \beta_{t1})\,\beta_{r1}$	$(1 + \beta_{t1})\,\beta_{r1}$

In Table 2, the base carrier frequency of the spiral field f_{co} is given by:

$$f_{c0} = \frac{m_0 C^3}{k \pi e_0^2} \tag{7}$$

Table 3 shows relative parameters of the double helical spiral field calculated with a use of the following constants:

$$U = 137;\ C = 2.998 \times 10^8 m/s;\ k = 8.9875 \times 10^9 Nm^2/C^2;$$

By reviewing the examples shown in Table 3, it is possible to visualize the shape of both the inner and outer double helical spiral fields.

TABLE 3 Parameters of the double-helical spiral field as a function of energy level (**n**).

n	β_{t1}	β_{r1}	b	m_g / m_0	f_{c1} / f_{c0}
∞	1.0	0	0.5	0	0
5	0.99999893	0.0014599	0.50000027	0.0014599	2.9197×10^{-3}
4	0.99999834	0.0018248	0.50000042	0.0018248	3.6496×10^{-3}
3	0.99999704	0.0024331	0.50000074	0.0024331	4.8662×10^{-3}
2	0.99999334	0.0036496	0.50000167	0.0036496	7.2992×10^{-3}
1	0.99997336	0.0072991	0.50000666	0.0072989	1.4598×10^{-2}
0	0	1.0	1.0	0	1.0
1	0.99997336	0.0072991	37539.5	0.0072989	1.9444×10^{-7}
2	0.99999334	0.0036496	150153.5	0.0036496	2.4306×10^{-8}
3	0.99999704	0.0024331	337843.5	0.0024331	7.2018×10^{-9}
4	0.99999834	0.0018248	600609.5	0.0018248	3.0383×10^{-9}
5	0.99999893	0.0014599	938451.5	0.0014599	1.5556×10^{-9}
∞	1.0	0	∞	0	0

Inner Double Helical Spiral Field - At the highest energy level **n = ∞** the spiral radius of the inner double helical spiral field $r_1 = 0.5r_i$ (Fig. 2). At this point, translational velocity $v_{t1} = C$ while rotational velocity $v_{r1} = 0$. Thus, at the highest energy level the double helical spiral field appears like two parallel straight infinitely-thin darts that move with ultimate spiral field velocity **C**. This field configuration is called the double field string. The gravitational masses and electric charges of the double field string are equal to zero.

As the energy level **n** of the inner double helical spiral field decreases, its translational velocity v_{t1} decreases too, but its rotational velocity v_{r1} becomes greater than zero. This leads to appearance of the **double helical spiral**. As long as the energy level **n ≥ 1**, the parameters of the inner double helical spiral field change very little during its transfer between any adjacent levels. Importantly, within this range of **n**, the translational velocity v_{t1} stays very dose to ultimate spiral field velocity **C**.

The situation changes completely when the energy level **n** reduces from 1 to 0. During that time, the translational velocity v_{t1} abruptly reduces to zero, while the rotational velocity v_{r1} speeds up suddenly to become equal to the ultimate spiral field velocity **C**. Simultaneously, the spiral radius r_1 becomes equal to r_i. Thus, the propagating inner double helical spiral converts into a stationary circle that is called the **inversion field ring**.

Outer Double Helical Spiral Field - At the highest energy level $n = \infty$ the outer double helical spiral field appears as two straight parallel lines that are infinitely separated from each other. At this point, translational velocity $v_{t1} = C$ while rotational velocity $v_{r1} = 0$. As the energy level **n** of the outer double helical spiral field decreases, its translational velocity v_{t1} decreases too, but its rotational velocity v_{r1} becomes greater than zero. This leads to appearance of the double helical spiral. As long as the energy level $n \geq 1$, the parameters of the outer double helical spiral field change very little during its transfer between any adjacent levels. Importantly, within this range of **n**, the translational velocity v_{t1} stays very close to ultimate spiral field velocity **C**.

The situation changes completely when the energy level **n** reduces from 1 to 0. During that time, the translational velocity v_{t1} abruptly reduces to zero, while the rotational velocity v_{r1} speeds up suddenly to become equal to the ultimate spiral field velocity **C**. Simultaneously, the spiral radius r_1 becomes equal to r_i. Thus, the propagating outer double helical spiral converts into a stationary circle that is called the inversion field ring.

Velocity of light - Based on the above analysis, it is possible to establish the relationship between the velocity of light **c** and ultimate spiral field velocity **C** by assuming that translational velocity v_{t1} is equal to velocity of light **c**. Thus, after considering Equation (5), we find that the ratio of the velocity of light **c** to the ultimate spiral field velocity **C** must be within the limits:

$$1 > \frac{c}{C} \geq \frac{U}{\sqrt{(U^2 + 1)}} = 0.99997336 \tag{8}$$

Double Toroidal Spiral Field

Polarization of the inversion field ring leads to formation of the outer and inner double toroidal spiral fields. This process may begin, for example, after a head-on collision of two double helical spiral fields having opposite vortices, clockwise (CW) and counterclockwise (CCW) as shown in Fig. 3.

Velocities of Double Toroidal Spiral Fields - The relationship between rotational velocity v_{r2} and translational velocity v_{t2} of the toroidal spiral field in respect to the ultimate spiral field velocity **C** is the same as for the double helical spiral field (Fig. 4). Therefore, the following equations are valid:

$$v_{t2}^2 + v_{r2}^2 = C^2 \tag{9}$$

$$\beta_{t2}^2 + \beta_{r2}^2 = 1 \tag{10}$$

where

$\beta_{t2} = v_{t2} / C$ = relative translational velocity of double toroidal spiral field

$\beta_{r2} = v_{r2} / C$ = relative rotational velocity of double toroidal spiral field.

Discrete Character of Double Toroidal Spiral Fields - The ratios of rotational velocity v_{r2} to translational velocity v_{t2} of the Toroidal spiral field must be equal to certain discrete values which are the products of the energy levels **n** of toroidal spiral field and Universal Spiral Field Constant **U**, as given by the equation:

$$\frac{v_{r2}}{v_{t2}} = \frac{\beta_{r2}}{\beta_{t2}} = n\,U \qquad n = 0, 1, 2, ... \tag{11}$$

where

n = energy level of toroidal spiral field.

Equations (10) and (11) yield the expression for the relative translational and rotational velocity of the toroidal spiral field β_{t2} and β_{r2} :

$$\beta_{r2} = \frac{v_{r2}}{C} = \frac{n\,U}{\sqrt{(n\,U)^2 + 1}} \qquad n = 0, 1, 2, ... \tag{12}$$

Principal Parameters of Double Toroidal Spiral Field - Table 4 shows principal parameters of inner and outer double Toroidal spiral field as a function of relative rotational velocity β_{r2}. The results of the calculations of these parameters are shown in Table 5.

According to Table 5, the relative orbital radii of the outer Toroidal spiral fields, that exist within the range of **b > 1**, are many times greater than these of the inner Toroidal spiral fields that exist within the range of **b ≤ 1**. As the orbital radius of an electron increases its relative translational velocity β_{t2} decreases. Simultaneously, both its relative electric charge e/e_0 and relative gravitational mass m_g / m_0 increase, approaching 1.0. The same changes occur with the positron when its orbital radius decreases. This phenomenon is called the **excitation of an atom.**

TABLE 4 Principal parameters of the double toroidal spiral field.

Parameters	Inner field $b \le 1$	Outer field $b > 1$
Relative spiral radius $b_2 = r_2 / r_i$	$\frac{\beta_{r2}}{1 + \beta_{r2}}$	$\frac{\beta_{r2}}{1 - \beta_{r2}}$
Relative orbital radius $b = r_0 / r_i$	$\frac{1}{1 + \beta_{r2}}$	$\frac{1}{1 - \beta_{r2}}$
Relative electric charge, e / e_0	$+ \beta_{r2}$	$- \beta_{r2}$
Relative gravitational mass, m_g / m_0	β_{r2}	β_{r2}
Relative inertial mass, m_i / m_0	$\frac{2\beta_{r2}}{1 - \beta_{r2}}$	$\frac{2\beta_{r2}}{1 + \beta_{r2}}$
Relative carrier frequency, f_{c2} / f_{c0}	$1 + \beta_{r2}$	$1 - \beta_{r2}$

Appearance of toroidal spiral field - The geometry of toroidal spiral field changes in a very peculiar way with the change in the relative orbital radius **b**. One can understand these changes by examining more carefully the relationship between the relative translational velocity β_{t2} and the relative orbital radius **b**:

$$\beta_{t2} = \frac{v_{t2}}{C} = \frac{\sqrt{2b-1}}{b} \qquad (13)$$

TABLE 5 Parameters of the inner double-toroidal spiral field as a function of energy level (**n**).

n	β_{t1}	β_{r2}	β_{r2}	m_g / m_0	f_{c2} / F_{c0}
∞	0.5	0	1.0	1.0	0
5	0.500006660	0.001460	0.9999989	0.9999995	1.99999926
4	0.500001665	0.001825	0.9999983	0.9999992	1.99999893
3	0.500000740	0.002433	0.9999970	0.9999985	1.99999834
2	0.500000416	0.003650	0.9999933	0.9999967	1.99999704
1	0.500000266	0.007299	0.9999734	0.9999867	1.99999334
0	1.0	1.0	0	0	1.0
1	37539.5	0.007299	0.9999734	0.9999867	2.6639×10^{-5}
2	150153.5	0.003650	0.9999933	0.9999967	6.6599×10^{-6}
3	337843.5	0.002433	0.9999970	0.9999985	2.9600×10^{-6}
4	600609.5	0.001825	0.9999983	0.9999992	1.6650×10^{-6}
5	938451.5	0.001450	0.9999989	0.9999995	1.0656×10^{-6}
∞	∞	0	1.0	1.0	0

After reviewing Equation (13) one may discern three distinct ranges of the relative orbital radius $b = r_0 / r_i$, real range, inverse range, and imaginary range (Fig. 5).

Real range ($r_0 / r_i > 1$): Within this range translational velocity v_{t2} increases with a decrease in the orbital radius r_0 and reaches its maximum value of $v_{t2} = C$. At this point the toroidal spiral field is reduced to a circular field, that was called above the **inversion field ring.**

Inverse range ($0.5 \le r_0 / r_i \le 1$): With- this range, the windings of the double toroidal spiral field reappear again but with the reverse vorticity. The translational velocity v_{t2} decreases with a decrease in r_0 and becomes equal to zero at $r_0 / r_i = 0.5$. At this point, the double toroidal spiral field appears as the **double field ring**. This field has a radius $r_0 = 0.5 r_i$. It is located in the plane perpendicular to the inversion field ring.

Imaginary range ($0 < r_0 / r_i < 0.5$): Within this range, the translational velocity of the positron v_{t2} is expressed by imaginary numbers and, therefore, within this range it is impossible to present the toroidal spiral field by using the conventional geometry.

The double toroidal spiral field within real range represents a negatively charged particle while, within the inverse range, it represents a positively charged particle.

Core Particles of the Spiral Fields - Three leptons can serve as the core particles of the spiral fields, the electrons **e** (positrons), muons **μ**, and tau particles **τ**. As shown in Table 5, that depending on the core

particle, the double toroidal spiral fields represent very distinct types of electromagnetic waves and particles.

Dynosphere - The inversion field ring represents a common field configuration for both the double helical and double toroidal spiral fields at their lowest energy level **n = 0**, or **zero energy level**. These field rings are assumed to fill the entire space, touching each other, or even intersecting and forming spherical bubbles. This assembly of the inversion field rings and bubbles is called the **dynosphere** (Fig. 6).

Unlike aether, that was supposed to serve as a static frame of reference for determining the displacements of moving objects, the dynosphere serves as **dynamic frame of reference** to determine the velocities of moving objects. This becomes possible due to the fact that the velocity of propagation of the spiral field along the periphery of each inversion field bubble is equal to the ultimate spiral field velocity **C**. This speed is, of course, the same for **e**-based, **μ**-based, and **τ**-based fields.

Besides performing this important function as the dynamic frame of reference, the dynosphere, when locally excited, would polarize and give birth to the double toroidal spiral fields representing the elementary particles.

TABLE 6 - Three types of Spiral Fields

Type of spiral field	Rest Mass of core particle m_0, kg	Base frequency of spiral field f_{c0}, Hz	Electromagnetic waves and particles represented by spiral field	
			Double helical spiral field	Double toroidal spiral field
e– based	9.11×10^{-31}	3.39×10^{-22}	electromagnetic waves from long waves to gamma rays; e – neutrinos	electrons and positrons inside of elementary particles and atoms
μ – based	1.88×10^{-28}	7.01×10^{-24}	μ – neutrinos	muons inside of elementary particles
τ – based	3.18×10^{-27}	1.18×10^{-26}	τ – neutrinos	tau particles subnuclear structures

Structure of Hydrogen Atom - In the hydrogen atom, the outer Toroidal spiral field represents the electron while the inner toroidal spiral field represents the positron. The electron and positron are located on the same energy levels **n**, making their electric charges equal in magnitude and opposite in sign, thus, canceling each other. These two toroidal spiral fields surrounds the neutron as shown in Fig. 7. The neutron is an assembly of inner and outer **μ**-based double Toroidal spiral fields [5].

Atomic Spectra - The double helical spiral field is emitted when the double toroidal spiral field is transferred from the higher energy level $\mathbf{n}_k$ to the lower energy level $\mathbf{n}_j$. The carrier frequency of the emitted double helical spiral field $\mathbf{f}_{kj}$ is equal to:

$$f_{kj} = \frac{1}{2U}(f_{ej} - f_{ck}) \tag{14}$$

where

f_{cj} = carrier frequency of double toroidal spiral field corresponding to energy level n_j
f_{ck} = Carrier frequency of double toroidal spiral field corresponding to energy level n_k.

Based on the fundamental equations of the spiral field theory, the carrier frequency f_{kj} given by Equation (14) can be expressed as a function of the energy levels n_k and n_j:

$$f_{kj} = \frac{f_{c0}}{2}\left(\frac{n_k}{\sqrt{1 + (Un_k)^2}} - \frac{n_j}{\sqrt{1 + (Un_j)^2}} \right) \tag{15}$$

Then, for the case when $U^2 >> 1$, Equation (15) reduces to the form:

$$f_{kj} = \frac{f_{c0}}{4U^3}\left(\frac{1}{n_j^2} - \frac{1}{n_k^2} \right) \tag{16}$$

One may compare Equation (16) with the following Rydberg's formula for the frequency of some of the spectra lines:

$$f_n = R_h c\left(\frac{1}{m^2} - \frac{1}{n^2} \right) \tag{17}$$

where
R_h = Rydberg constant, 109,678 cm^{-1}
c = velocity of light
m, n = integral numbers.

Rydberg's equation accurately predicts the atomic spectra of hydrogen atom when $m = 2$ and $n = 3, 4, 5$ and 6.

TABLE 7 Comparison of emitting frequencies f_{kj} calculated from Rydberg's formula and the formula based on spiral field theory.

n_k	n_j	Spectra lines of hydrogen atom	Emitting frequencies, f_{kj} ($n_j = 2$)		
			Rydberg's formula Equation (17)	Spiral field theory	
				Exact Equation (15)	Approx. Equation (16)
3	2	H_α	4.566755 x 10^{14}	4.575496 x 10^{14}	4.575562 x 10^{14}
4	2	H_β	6.165119 x 10^{14}	6.176931 x 10^{14}	6.177009 x 10^{14}
5	2	H_γ	6.904934 x 10^{14}	6.918169 x 10^{14}	6.918250 x 10^{14}
6	2	H_δ	7.306808 x 10^{14}	7.320818 x 10^{14}	7.320899 x 10^{14}

The reader can find for himself from Table 7 that when $U = 137$, the frequencies f_{kj} calculated from Equations (15) and (16) are very close to those calculated from Rydberg's formula (17) that is based on test data [7].

Nuclear Implosion - The external nuclear implosion of the hydrogen atom involves the transfer of the outer toroidal spiral field representing the outer electron e^- to the zero energy level. Simultaneously, the inner toroidal spiral field representing the inner positron e^+ also transfers to the zero energy level. This results in emission of gamma ray 2γ which can be in the form of either two double helical spiral fields, one clockwise and one counterclockwise, or one quadruple double helical spiral field. The reaction follows the equation:

$$ {}_1{}^1H \rightarrow {}_0{}^1n + e^+ + e^- \rightarrow {}_0{}^1n + 2\gamma \tag{18} $$

The energy Q_{kj} emitted during the transfer of the double toroidal spiral field from the energy levels n_k to n_j is equal to:

$$ Q_{kj} = \frac{k\pi e_0^2}{C}(f_{ck} - f_{cj}) \tag{19} $$

As one can see from Table 8, when $n \geq 1$, the amount of energy Q_{kj} emitted during the transfer of the double toroidal spiral field from the energy levels n_k to n_j is very small in comparison with that emitted during the nuclear implosion when the double toroidal spiral fields collapse after their transferring from the energy level $n = 1$ to $n = 0$. In the last case, the amount of the emitted energy is comparable with that released during nuclear fusion as shown in Table 9.

TABLE 8 Emitted frequencies f_{kj} and emitted energies Q_{kj} of the double helical spiral fields corresponding to the transfer of the outer double toroidal spiral field from the energy levels n_k to n_j, having the respective carrier frequencies f_{ck} and f_{cj}.

Energy levels		Carrier frequencies of double toroidal spiral field		Emitted frequency of double helical spiral field	Emitted energy of double helical spiral field
n_k	n_j	f_{ck}, Hz	f_{cj}, Hz	f_{kj}, Hz	Q_{kj}, MeV
5	4	3.610×10^{16}	5.642×10^{16}	7.412×10^{13}	3.063×10^{-7}
4	3	5.642×10^{16}	1.003×10^{17}	1.601×10^{14}	6.618×10^{-7}
3	2	1.003×10^{17}	2.257×10^{17}	4.576×10^{14}	1.891×10^{-6}
2	1	2.257×10^{17}	9.026×10^{17}	2.471×10^{15}	1.020×10^{-5}
1	0	9.026×10^{17}	3.388×10^{22}	1.237×10^{20}	0.511

The **external nuclear implosion** is associated with the collapse of the **e**-based double toroidal spiral fields while the **internal nuclear implosion** is associated with the collapse of the **μ**-based double toroidal spiral fields that form the neutrons. Since the rest mass of the muon is approximately 206 times grater than the rest mass of the electron, it is expected that the internal implosion would release much more energy than the energy released during external nuclear implosion. Even greater amount of energy would be released during the **subnuclear implosion** that is associated with the collapse of the **τ**-based toroidal spiral fields.

TABLE 9 Amount of energy released during external nuclear implosion and some nuclear fusion reactions [8].

Type of reaction	Particles involved in reaction	Energy released per reaction, MeV	Number of nucleons per reaction	Energy released per nucleon, MeV
Atomic implosion	hydrogen atom	1.022	1	1.022
Nuclear fusion	nuclei of deuterium	4.03	4	1.008
Nuclear fusion	nuclei of deuterium and tritium	17.59	5	3.518

SUMMARY

1. The nuclear implosion is predicted by the spiral field theory that is based on novel relativistic equations for both mass and electric charge. According to this theory, the spiral field is the primordial substance for both the field and matter as we know it today. The spiral field exists in three forms:
   a) **double helical spiral fields** representing all kind of electromagnetic waves, including neutrinos;
   b) **double toroidal spiral fields** representing the elementary particles and their components;
   c) **inversion field bubbles, or dynosphere** that serves as the dynamic frame of references for moving objects and also as a source for creation of double toroidal spiral fields, or elementary particles.

2. The spiral fields exist at discrete energy levels. Besides accurate prediction of the well-known discrete energy levels, ranging from $\mathbf{n} = 1$ to $\mathbf{n} \to \infty$ for electrons of hydrogen atom, the spiral field theory also predicts the existence of the discrete energy levels, ranging from $\mathbf{n} = 1$ to $\mathbf{n} \to \infty$ for positrons. Moreover, it predicts the existence of the zero energy level $\mathbf{n} = 0$ for both electrons and positrons. This may explain the mechanism of external nuclear implosion that involves the transfer of the double toroidal spiral fields representing both the electron and positron to the zero energy level.

3. During the nuclear implosion, both the outer and inner toroidal spiral fields totally collapse and transform into the field rings; the energy released during this reaction is carried out by the double helical spiral fields. The amount of energy released during the external nuclear implosion of hydrogen atom is comparable with the energy released during fusion of nuclei of deuterium.

4. The external nuclear implosions of the hydrogen atoms produce neutrons and gamma rays. These are also the products of the process that is presumed to be cold fusion. Is it possible that what we call today the cold fusion is actually the external nuclear implosion?

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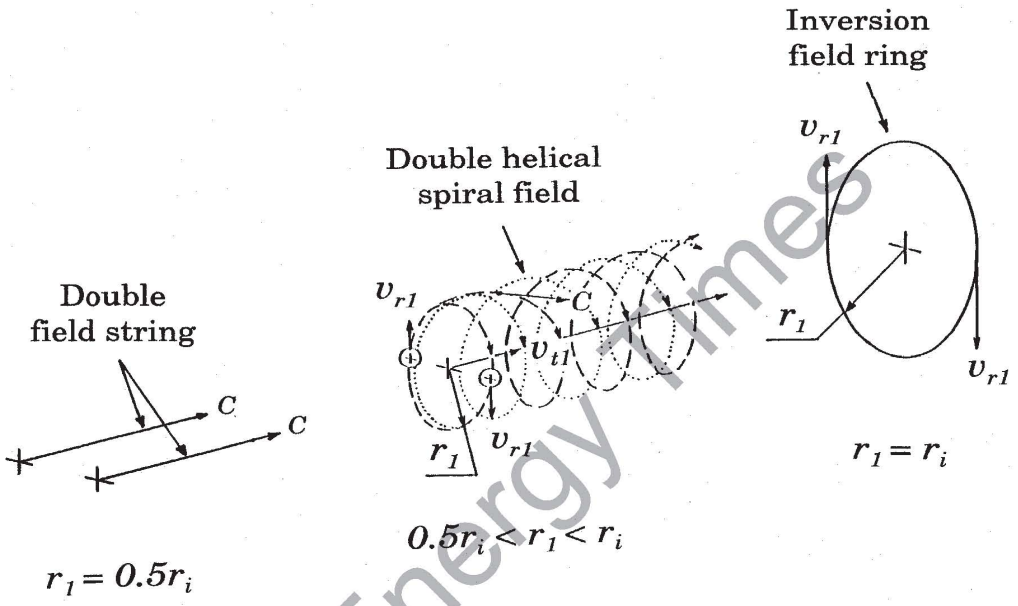

Fig. 2 Transformation of the inner double helical spiral field.

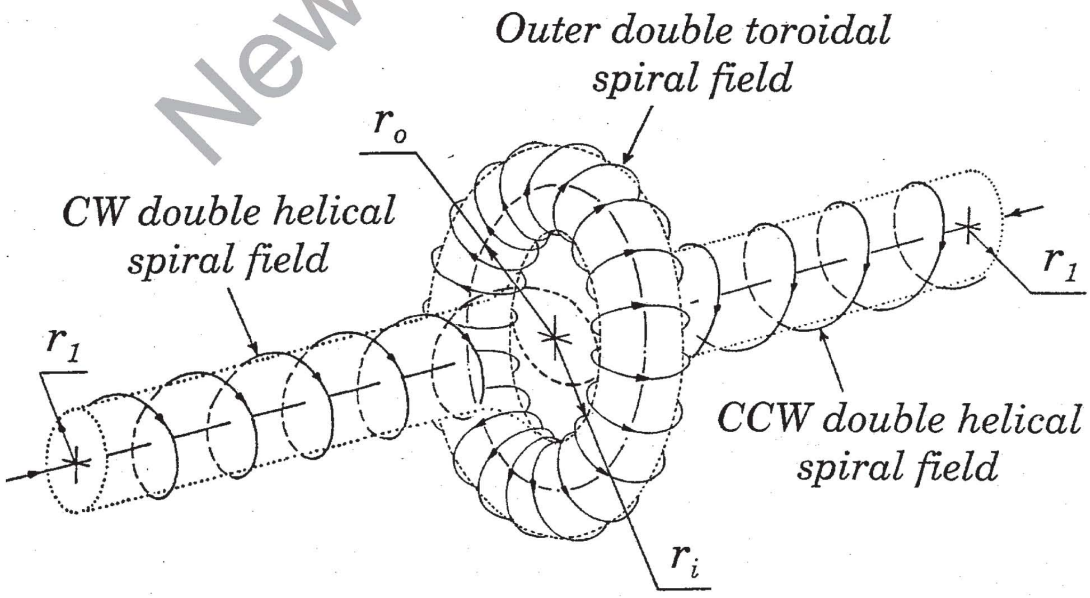

Fig. 3 Formation of the outer and inner (not shown) double toroidal spiral field after collisonof CW and CCW double helical spiral fields. Adapted from [3].

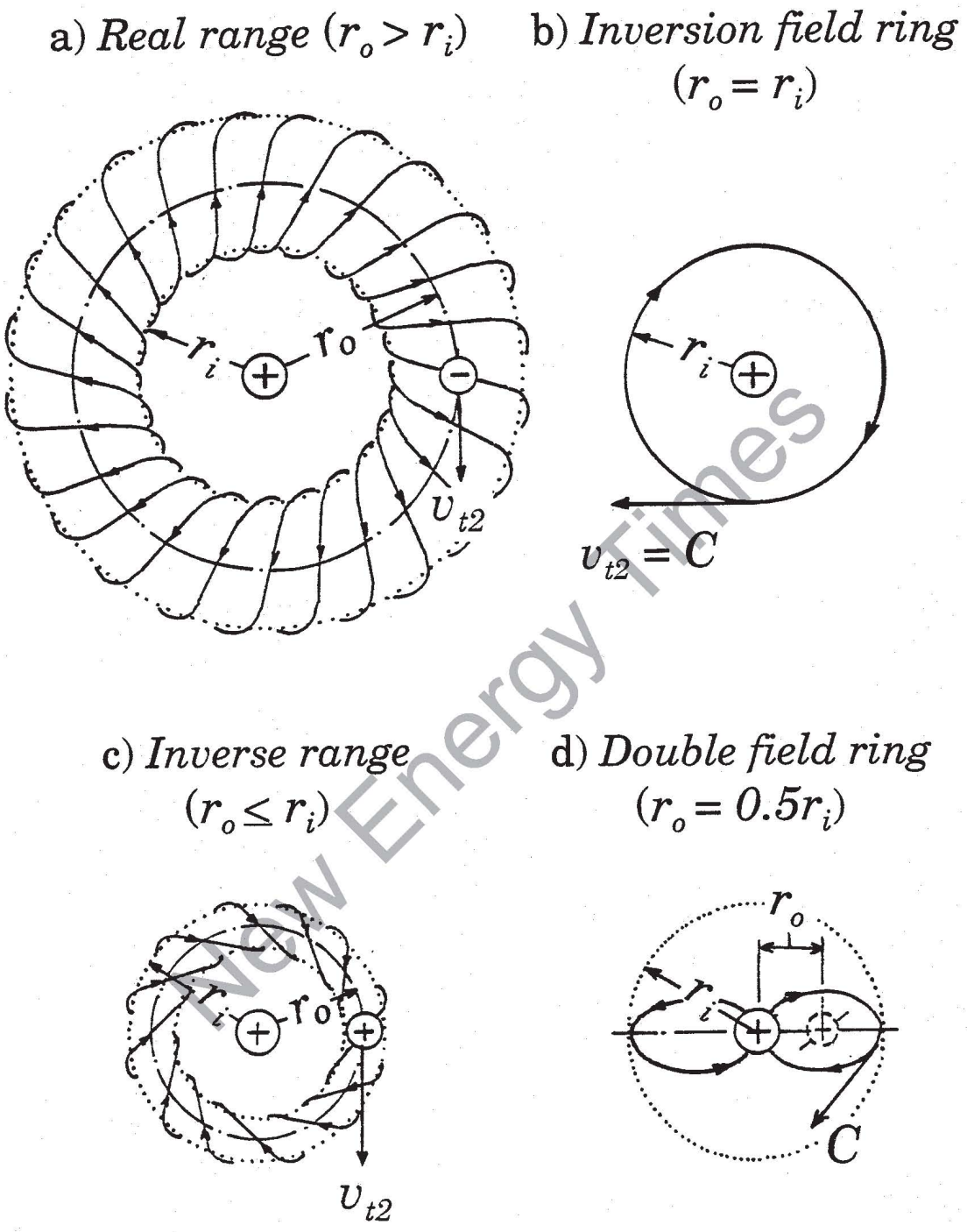

Fig. 4 Outer and inner toroidal spiral fields.

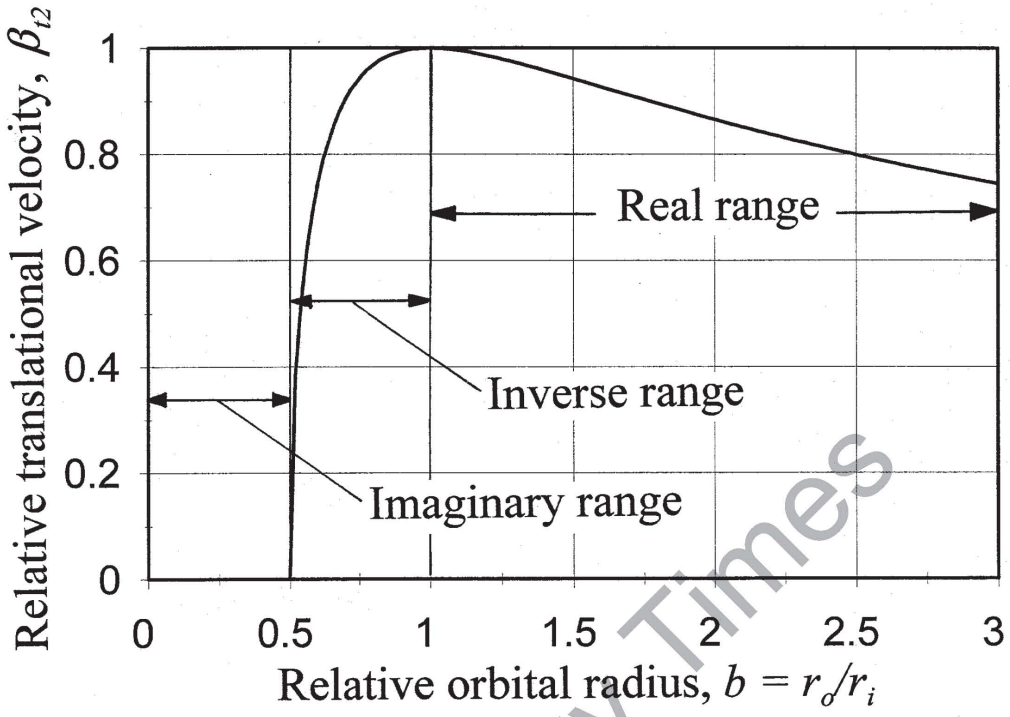

Fig. 5 Relative transnational velocity of toroidal spiral field as a function of relative orbital radius.

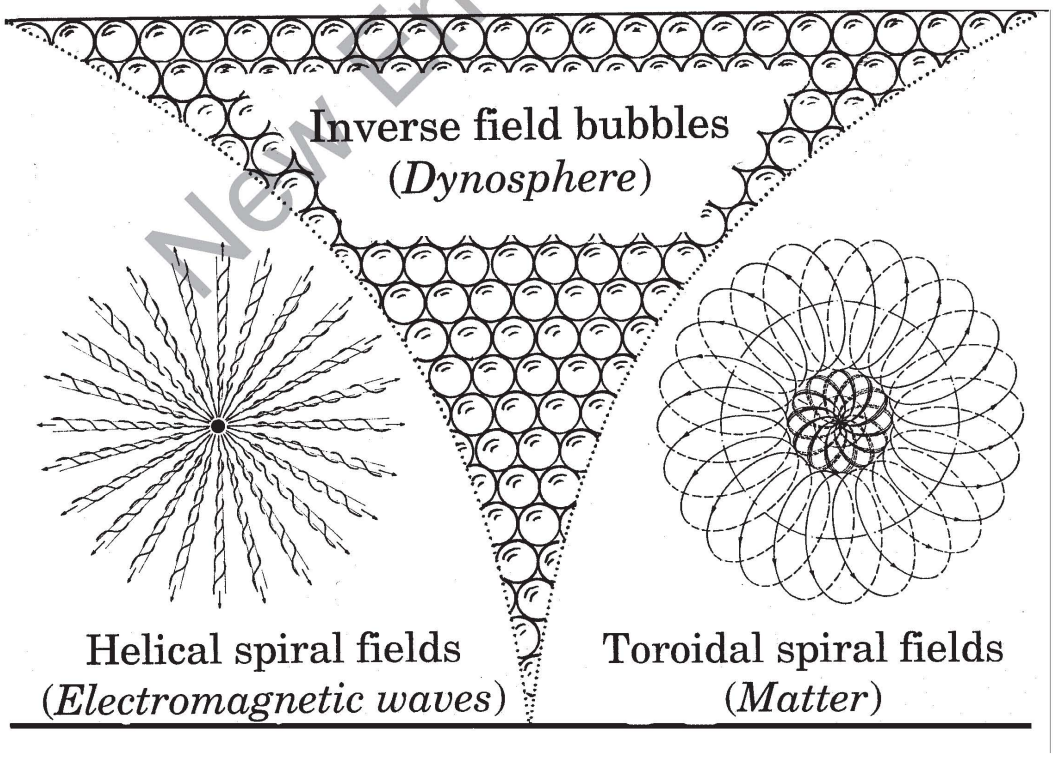

Fig. 6 Three forms of spiral field.

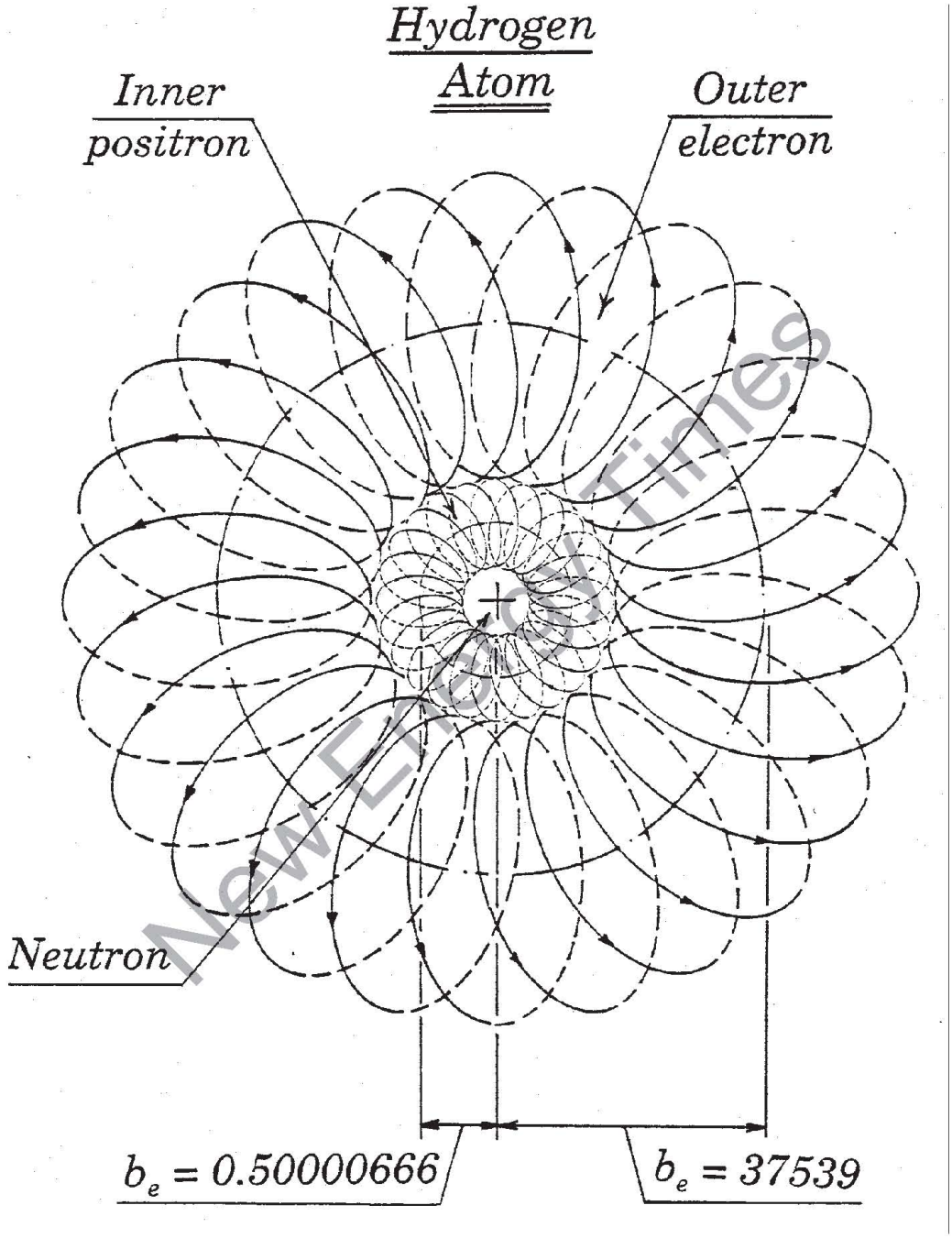

Fig. 7 Structure of hydrogen atom and proton.

EDITOR'S CHOICE

ACTION AT A DISTANCE A QUESTION OF VIEWPOINT

Josef Hasslberger [1]

ABSTRACT

A philosophical description is proposed, of the basic mechanisms of physical universe and especially of the nature of matter, that is compatible with such phenomena as instantaneous action at a distance. It is proposed that material existence in physical space is conditioned and indeed dependent upon the existence of energy patterns necessary for matter to manifest and that interactions occur not between the material manifestations but between the primary energy patterns themselves.

PHILOSOPHIES

Action at a distance would seem eminently possible if not probable, providing we integrate our purely physical picture of the universe with a concept of energies originating from a non-physical-universe source. As foreign as this may be to physics, we may need to start considering the possibility of a "spiritual ingredient" or "consciousness ingredient" in all things physical.

Eastern philosophic concepts have long held all material things to be filled with or interpenetrated by a life force (Ki, Prana). It would seem to me that our "scientific" denial of those things we are not able to measure is severely limiting our understanding and our ability to conceptualise existence in the material world. To be sure, there is a timid opening of western science to these concepts, witness books by Fritj of Capra and others, but by and large, anything that is not immediately accessible to measurement is still not welcome.

Shiuji Inomata has proposed to integrate the current scientific paradigm with a "consciousness" parameter. He outlines the necessary shift of paradigm in a paper entitled "Science of Consciousness and new scientific world view - we are in the midst of the second Copernican revolution"[1]. Inomata proposes a triangular relationship between matter, energy and a consciousness parameter designated as "Q".

In line with the work of Inomata and others, I would like to propose here a concept by which instantaneous action at a distance could be explained and I am asking the reader to forgive me if I am requiring you to stretch your imagination into an area that would seem to lay outside the province of physics. Some may even experience the ideas put forth in this paper to be a bit "unsettling" to their understanding of universe, based on the conventional scientific view.

DIMENSIONS

Our physical world is said to be three-dimensional, with reference to the basic three degrees of freedom of movement we find to exist in a right-angle-coordinated, cube-based spatial reference system as first proposed by Descartes (up-down, left-right and forward-backward, to express this in simple terms).

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Although I assent to use the word three-dimensional to indicate physical space, I have shown [2] that one could with profit describe physical space in a four-dimensional tetrahedron-based spatial reference system just by changing from 90 degree co-ordination to 60 degree co-ordination. The advantage of such a system would be an immediate orientability in physical space having to consider only four vectors, instead of six vectors (as above) of the Cartesian system.

The word three-dimensional, although in general use, is thus not an indication of any real physical properties inherent in space. It is merely a conventional way of looking at and describing space, based in Euclidean geometry. In fact, Euclid taught a progression from point (dimensionless) to line (one-dimensional) to plane (two-dimensional) and finally to space (three-dimensional). I propose that this system of geometry does not have any real physical significance and is merely an abstract way of conceptualising physical space.

We may however use Euclid's concept of the (two-dimensional) plane and it's relation to (three-dimensional) space as an analogy useful to the understanding of what follows here. As inhabitants of physical ("three-dimensional") space we would have an inherent advantage over a hypothetical inhabitant of a two-dimensional universe contained within our universe. We would in fact be able to observe, from our vantage point, any point of the plane and thus would be able to accede to any point of that universe without having to "travel it's space" like the inhabitant of the two-dimensional universe. This, to our two-dimensional friend, would be somewhat of a miracle, he would call it "instantaneous action at a distance" on our part.

In this same way, we should imagine a "four-dimensional" entity to exist, which contains within itself our "three-dimensional" universe and which has a similar advantage of being able to accede to and act at any point in our space, without having to traverse our space in the way we need to traverse space to arrive at our destination. I believe that one could call that "four-dimensional" entity hyperspace.

MOTION

In an unusually insightful manner, Gian Piero Godone [3] has proposed his "Fourth Principle of Dynamics", adding to our concepts of motion and dynamics codified in the days of Newton. The principle was first presented in Fivizzano, Italy in October 1994 and reads: "Motion of bodies through space is directly mediated, in a sequential fashion, by all those particular basic elements which permit the very existence of the bodies in the first place."

Subsequently, Godone has re-stated the principle in a more articulated way. The following is the latest (February 1998) version of Godone's Fourth Principle of Dynamics: "Any possible motion of all bodies is due directly to the natural motion of their basic elements, which by their specific sequential behavior ensure the stable existence of the bodies; such sequentiality being the consequence of constant interaction with ever new basic elements arriving in an orderly fashion from space and subsequently returning to it."

We are accustomed to consider matter as fundamentally different from space and from what might fill space. To some of us, space is empty, except for the matter it contains. Thus, to an observer within this universe it may appear that motion of material bodies is a moving of such bodies from one location to another, through basically empty space.

But if we reason with Godone, and I tend to agree with him on this count, there is really no such thing as motion in the way we imagine it, there is only an appearance of motion. Each material body consists primarily of a stable energy pattern, which is the cause of the manifestation we call matter. When in motion, the physical manifestation of the body is being successively re-constructed out of new "basic particles" each time it changes position.

An excellent analogy of this apparent motion would be our familiar TV. We see pictures in motion, but what really happens is that an electron beam lights up successive points of phosphorescent material on the inside of a glass screen, giving us the idea of a picture. By successively lighting up different sets of points, that picture on the screen seems to come to life, it seems to move.

PARTICLES OF MATTER

As Godone succinctly implies with his principle of dynamics, a very similar mechanism is at work in our physical world. Particles are actually created and constantly re-created by an energetic pattern which is maintained and sometimes animated by what I would call "life force".

Space is not empty. It is a plenum. Matter is a special state of the plenum of space. It has recently been proposed by Paul E. Rowe in an interesting series of articles printed in 'Infinite Energy' magazine [4], that space is filled by kind of a Bose-Einstein condensate of hydrogen, that is, by a close-packed matrix, a "soup" of electrons and protons.

Rowe bases this conclusion on the fact that hydrogen can be created from space under certain energetic conditions, as described in his papers. "Rowe's soup", which in practice fills all space, supplies the "basic particles" that according to Godone are necessary for matter to exist and to move.

ENERGY

We are using electric energy in our daily lives without having a firm understanding of what this energy actually is. To be sure, we have a working knowledge of how electricity behaves, we can engineer applications of it, but ask anyone to explain the basic principles behind electricity or magnetism - if you dig far enough for a basic explanation, you will get an embarrassed silence.

Thomas E. Bearden explains, in a recent article [5], that there is a great disparity between the energy that flows from a dipole and that actually captured and put to use in our electric or electronic apparatus. The energy flow from a battery or a generator is much larger; something on the order of 1013 times the amount of conventionally used energy. According to Bearden, there are some basic flaws in our way of explaining and utilizing electrodynamics. One might agree with Bearden or not, but to be sure, there are fundamental shortcomings in our theoretic understanding of energetic processes that are at the basis of what is generally called "free energy".

Torsion fields are another case in point. They are highly penetrative energies which have been demonstrated to "propagate" at superluminal velocities. Our knowledge of these fields is based largely on research done in Russia [6] by A. Akimov and G. Shipov. A recent summary of relevant research has been published by Donald Reed [7]. We are still grappling to find a mechanism that allows such speeds in physical space and are theorising "wormholes" and "time reversal".

There may however be a much simpler explanation for these phenomena, if we can take the step and open our mind's eye to the possibility that the universe does not only consist of matter and energy located in and operating through space, but that at least part of that energy is resident in and operating out of what I described as hyper space.

LIFE FORCE

I propose that all matter is created and continuously re-created by what I would call "life force". This force provides patterns of energy which "materialise" parts of the medium that fills space, coagulating it into what we perceive to be particles of matter.

There is a vast range of complexity of these particles from hydrogen to the heavy elements. There is as well a vast range of extension, from single particles to planetary and stellar masses. And there is another distinction, between what we call "dead" matter and what we call "animated" or "full-of-life" matter, such as plants, animals and human bodies.

The differences however are only quantitative, not qualitative. It is the same life force or life energy in different quantities and different degrees of mobility and individual consciousness that is responsible for the various manifestations of matter.

INTERACTIONS

Electric, magnetic, and gravitational interactions between matter are mediated by energy. Patterns of energy associated with matter are postulated as being provided by life force. Consequently, the interactions would appear to be between the energy patterns, rather than between the particles of the bodies themselves.

Life force is not part of our three-dimensional space but, residing as it were in hyperspace it is, as discussed above, one step above the dimensionaltiy of space. It is not bound to travel "through space" and thus is capable of manifesting it's effects in distant and diverse locations at the same instant. Consequently, interactions that are energy-pattern interactions are not limited by speed of light.

We thus have not only a possibility of "instantaneous action at a distance" but also of particles disappearing in one spot and reappearing in another, which agrees with recent experimental evidence. From here it is a simple step to extend the concept and include phenomena such as telepathy, telekinesis and teleportation, which so far have been relegated to the margins of science. These will, one day in the not too distant future, become normal occurrences quite within the province of scientific investigation.

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EDITOR'S NOTE:

In its early days, SCIENCE and SCIENTIFIC EXPLANATIONS disallowed any supernatural (God, devils, angels, spirits, etc.) explanations for natural phenomena. This decision (or definition) served to expand natural science.. As the borders of knowledge intersect consciousness, hyperspace, life forces, plant communication, etc., the time is coming (has come?) when there should be a redefinition of the borders between the natural and supernatural. [Hal Fox, Editor]

EDITOR'S CHOICE

DYNAMIC CASIMIR EFFECT IN AN ELECTROCHEMICAL SYSTEM

Xing-liu Jiang [1], Jin-Zhi Lei [2], Li-jun Han[1]

ABSTRACT

Studies of the behavior of the electrochemical double layer in an electrolysis cell reveals the existence of a nonstationary Casimir effect due to energy concentration at the tip or protrusions. Pitting and protrusions formed by electrochemical activity evidently provides the means for such effects. A model based on the lightning-cloud-to-land model is proposed to explain the transient process on electrode protrusions [1]. This paper strives to explain the release of excess heat of electrolysis (the so-called COLD NUCLEAR FUSION) by the dynamic Casimir effect produced by a coupling effect of gas bubble cavities with moving boundaries [2], the torsion coherence of vortex rings, and the spiral structures on the tips of electrode protrusions with zero-point energy. Nuclear active sites with highly directed beams or rays of radiation emanating from radioactive isotopes have been recorded on black & white film from the tips of electrodes by autoradiography. Considering the scale invariance of phenomena in nature, a quasar model with spiral galaxy structure and extremely high-energy cosmic rays from the center of the vortex spiral [3] is suggested to describe the generation of energetic particles which cause nuclear reactions along the crystal-lattice channels in the electrode metals.

INTRODUCTION

The behaviors of the electrochemical double layer in an electrolysis cell reveal the existence of a nonstationary Casimir effect due to energy concentration at the tip or protrusions. This paper strives to explain the release of excess heat of electrolysis (the so-called COLD NUCLEAR FUSION) by the dynamic Casimir effect produced by a coupling effect of gas bubble cavities with moving boundaries [2], the torsion coherence of vortex rings, and the spiral structures on the tips of electrode protrusions with zero-point energy.

In 1930s, quantum mechanics became accepted because it so accurately described atomic phenomena. The equations of quantum mechanics include a term that describes an ever-present, underlying energetic jitter to all phenomena whose source is from the fabric of space itself. The jitter is called zero-point fluctuations (ZPF) or zero-point energy (ZPE) since the fluctuations are not from thermal radiation, but are present even at absolute zero degrees Kelvin. The ZPE can manifest as random electromagnetic radiation with all the possible mode of propagation (frequencies, directions) in open space. Though the ZPE energy in any particular mode of any electromagnetic radiation is minute, there are so many possible modes that the ZPE summed up over all possible modes is quite enormous. But in quantum theory, this amount of energy is omitted by mean of renormalization. Ordinarily, the ZPE can't be detected for it is randomized in all frequencies and directions. In 1948, Casimir showed that there is a pull force between two perfectly conducting plates for the electromagnetic fluctuations in vacuum [5]. This effect was measured precisely by Lamoreaux in 1997 [6]. This measurement confirms the Casimir effect of ZPE. Dodonov shows that it is possible to create a photon from a vacuum due to dynamical Casimir effect in a nondegenerate cavity with vibrating boundaries. A precision measurement of the Casimir force from 0.1 to 0.9 μm has been

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carried out by U. Mohideen and A. Roy in 1998. From these research, it is possible that ZPE could be used as energy source.

EXPERIMENT DATA AND NATURAL PHENOMENA

Throughout the many experiments with excess-heat creation, it was recognized that the transient cavitation bubbles and rough surface of electrodes are essential. There are some paradigms with dynamics of gas bubbles or vortices which may related to tapping the zero-point energy in nature or at laboratory by dynamic Casimir effect or torsion coherence, for example:

*Quasar model associated with spiral galaxy structure with extremely high energy ray jet at center;

*Tornado in atmosphere;

*Ball lightning or thunder's lightning with gamma rays:

*Sonoluminesence [7,8];

*Bubble collapse can punch a hole in solid brass or steel of the ship's propeller or the turbine blade;

*Dense plasma focus with high yield rate of neutrons;

*Micropinch in vacuum spark discharge with wide band of radiation, even γ -ray;

*Pitting corrosion with electrochemical noise;

*Electrons orbiting atomic nuclei do not eventually spiral into the nucleus;

*Lots of anomalous effects in so called cold nuclear fusion experiments.

After an electrolysis experiment with light water electrolyte, highly directed ray traces were recorded by black-white film for the cathode with protrusion tips on the surface of electrode. Considering the high conductivity of electrolyte with proper solution concentration, creation of large potential drop will occur in the electrochemical double layer, i.e. high electric field more than 10^7 V/cm could appear on the localized area on the electrode surface. High density of electron flux due to localized field emission exists. A lightning-clouds-to-land model is proposed to describe the transient processes of the evolution of the electrochemical double layer. Gas bubbles with moving cavity boundary on the tips of the surface of electrode can generate resonance coupling with the zero-point energy. For high electrolysis potentials, plasma vortex filaments or rings on the tips will produce torsion coherence with the zero-point energy. High-energy beams vertical to the spiral plane has been observed. The quasar model has been proposed to interpret the nuclear reactions along the crystal channeling. Fig. 1 schematically shows the nuclear reactions along the crystal channel by micro-pinch produced beams with high energy particles which may be related to tapping the zero-point energy, and can penetrate deep into the electrode for several μms.

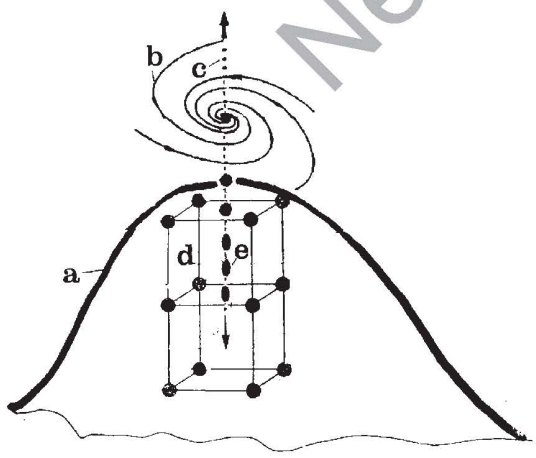

Fig. 1 Schematic presentation of a micropinch spiral by tip effect in the electrolysis cell: a) tip of the electrode; b) spiral structure of micropinch; c) electron beam; d) crystal channel; e) ion beam.

It is estimated that most of the tapped zero-point energy is released by excess heat as photons with low energy, and little of the energy appears as nuclear reactions or transmutations. Recent results by Ohmori-Mizuno experiment show that brilliant glowing pink, purple and lavender with white flashes were observed on an underwater tungsten electrode. The plasma-like discharge on the electrode often manages to disintegrate or melt tungsten underwater with only about 50 to 80 watts of power. There is also evidence for transmutation of elements. Three groups researching this technique have all gotten excess heat results with no loading time [9].

DISCUSSION

Researchers for new energy or so-called cold fusion should switch their attention from nuclear fusion reaction to the tapping the zero-point energy. Anomalous excess heat in an electric discharge system, which could be the discharge in vacuum, in gas or underwater, could be released with few nuclear reactions or without any nuclear reaction. The exist of transient cavitation bubbles and vortex filaments and rings is essential for excess heat production, no palladium electrode and heavy water is always necessary. Careful examination of the evolution of electrochemical double layer will lead to a good understanding of pitting corrosion with electrochemical noise, and further to recognize the anomalous excess heat and nuclear reactions.

There are some similarities between sonoluminescence and electrochemistry induced anomalous effects. The transient cavitation bubbles which could lead to dynamic Casimir effect to coupling of zero-point energy, exist in both cases. But magnetic self-pinch with spiral plasma structure can appear only on the tip of electrode surface, nuclear reactions take place along crystalline channels due to the effects of focusing and collimating. Heat after death was observed in the system with interface of solution and electrode surface[10]. It could be explained by vortex filaments of deuterium or hydrogen flux due to concentration difference of the interfaces of crystal grains coupling the zero-point energy and nuclear activation of transmutation nucleus. The vortical self-organization in the electric discharge system could exhibit a torsion coherence in the zero-point energy especially at the large energy densities as the vortex tightens.

ACKNOWLEDGMENTS

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MEASURING SUPERLUMINAL VELOCITY

Hal Fox [1]
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ABSTRACT

Although 66 extragalactic sources are listed where superluminal velocities appear to range from greater than **c** to 26 times **c**, such distant observations lack laboratory experimental evidence. A possible low-cost experiment is proposed to measure superluminal velocities resulting from explosions. It is hypothesized that explosions can produce torsion field changes that can be detected with the Hodowanek-Ramsay gravity fluctuation instrument. The measurement would be the time interval between the measure of the torsion field pulse and an high-frequency radio pulse. The paper cites Russian papers on superluminal velocities of torsion field fluctuations and discusses the possible impact on Einstein's second postulate.

A. INTRODUCTION

Those who believe that the progress of science is made by the acquisition and teaching of new facts, and not just by the non-critical acceptance of scientific dogma, will not reject the concept that the speed of light may not be constant nor limiting. The author likes this definition of a scientific fact: **The close agreement of a series of observations of the same phenomena.** For example, it is a scientific fact that the speed of light, as measured on earth and in nearby space, is approximately 300,000,000 meters per second. The concept that the speed of light is constant everywhere in the universe is not a scientific fact **by definition** (because no one has measured the speed of light everywhere in the universe). There is, as yet, no standard method by which the speed of light can be measured everywhere in the universe. However, it appears reasonable to hypothesize or postulate that the speed of light is the same everywhere in the universe. A postulate (Webster) is "a hypothesis advanced as an essential presupposition or premise of a train of reasoning."

The historic fact is that Einstein in his Special Theory of Relativity made an even stronger hypothesis -- that the speed of light in a vacuum is a limiting velocity. That does not make this postulate a scientific fact. True scientists do not just accept other person's hypotheses without critical review. Science does not advance by any type of democratic nor autocratic process of counting votes nor by edict. Therefore, it matters not who **believes** in any particular premise. What does matter is new experimental evidence, particularly if that evidence casts doubt on earlier accepted **beliefs, postulates, or hypotheses.** It would be an interesting history project to determine what the status of scientific measurements, thoughts, and discussions were that led to the conjecture that nothing can travel faster than the speed of light. It is assumed that in the early 1900s, no one had measured anything traveling faster than the speed of light. An important concept in science is that one replicable type of experiment demonstrating a new result is worth more than thousands of experiments that failed to discover that result. The close agreement of a series of observations of the same phenomena constitutes a scientific fact regardless of numerous preceding or following failures. A recent scientific example is the numerous failures to replicate cold nuclear fusion. The result, especially in the U.S. and England, was the condemnation of cold nuclear fusion. The scientific truth is that over 600 papers from over 200 laboratories in 30 countries have replicated or expanded the original cold fusion discoveries [1]. Although not as yet fully understood, low-

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energy nuclear reactions are a scientific fact. A similar process appears to be challenging the hypothesized concept of the limiting velocity of light.

There is more and more evidence that challenges the concept that the speed of light in a vacuum (as measured with earth and near-earth experiments) is the limiting velocity by which information can be transmitted. For example, in the paper, "Superluminal Motion Statistics and Cosmology" [2] there are 66 extragalactic sources listed in which the velocities were determined to be from greater than **c** to about 26 times **c**. In several articles about the Russian work on torsion fields, the speed of torsion-field fluctuations is stated to be at least a billion times the speed of light. For example, see reference [3].

B. THE HYPOTHESIS

Those who attended the NPA Session at the 1998 SWARM meeting heard the sounds of "gravity-wave fluctuations" as demonstrated by Bill Ramsay. This author proposes that these gravity-wave fluctuations are from the gravity component of torsion fields [3]. The author in this paper presents a hypothesis that certain types of explosions produce measurable torsion-field pulses and that these torsion-field fluctuations can be measured by the type of instrumentation demonstrated by Ramsay (the Hodowanek-Ramsay gravity-wave sensor).

In this author's twelve trips to Russia, it was apparent that there was much secret scientific work accomplished in the USSR that had no counterpart in the U.S. One such extensive series of scientific investigations (by more than 25 groups over a period of more than 20 years) was the study of torsion fields. As editor of the *Journal of New Energy*, this author has selected, edited, and published six articles on torsion fields, primarily from Russian scientists. None of these published articles explained how the measurement of the speed of torsion-field fluctuations were accomplished. Several of the articles merely stated that torsion fields travel through concrete buildings and intervening hills; that the speed is superluminal and estimated to be at least one billion times the speed of light; and that torsion fields have spin, electric, and gravity components. [3]

Another piece of experimental evidence has been provided by Paul E. Rowe [5] in which he reported on many experiments in which hydrogen was produced by explosions. This discovery was named the "Rowe Effect". The concept is that part of the energy from an explosion causes the emission of protons from the vacuum of space (also known as the Zero-Point Energy or ZPE field). It is this author's hypothesis that such production of protons from the fabric of space would also produce torsion fields.

Another factor, for the experiment proposed in this paper, came from the life-time work of Greg Hodowanek [6], joined by Bill Ramsay [7]. Hodowanek and Ramsay have developed, constructed, tested, and used special instrumentation for measuring and recording gravity-wave fluctuations. Being privy to the work of Hodowanek and Ramsay and also to the work of several Russian scientists, this author has decided that the Hodowanek-Ramsay instruments measure torsion-field fluctuations.

By combining these various experiments and published information, a relatively inexpensive experiment is proposed by which it can be determined if information can be transmitted at speeds much greater than the speed of light. The experiment is described in the following section.

C. PROPOSED EXPLOSION EXPERIMENT

It is proposed that a large explosion be used to trigger the transmission of an electromagnetic pulse having a very high rise time (as the marker to facilitate timing differences). The trigger could be the abrupt termination of continuity in an electrical circuit having a conducting wire placed adjacent to the explosion. Based on reports of Russian work with torsion fields [3] it is apparent that the torsion-field fluctuation (or the hypothesized pulse from an explosion) travels through concrete buildings and hills; that the signal

strength can be very low; and that the signal strength diminishes very slightly with distance. Based on these reports it is reasonable to try to measure torsion-field fluctuations produced by an explosion even if the measuring instrumentation is located at large distances from the source.

A preliminary experiment would be to place a torsion-field sensor in a vacuum chamber (so that acoustic noise from the explosion would not be an explanation for any observed effect) and to have the vacuum chamber well insulated or supported in a manner to eliminate or minimize any explosion produced vibration. Firecrackers could be used as the test explosions for this "calibration" or testing of the torsion-field measuring equipment.

A secondary type of experiment could be performed by suspending the torsion-field measuring device by a thread (to eliminate ground vibration) and use the firecrackers to produce the hypothesized torsion-field fluctuations. With today's modern, high-speed oscilloscopes, it would not require much distance to observe the hypothesized difference from an air-borne acoustic signal and the hypothesized torsion-field signal. The speed of sound in air is approximately 1,000 feet per second; or one foot per millisecond. The task will be to determine the pulse form (duration and wave shape) of the experimental explosion so that one can determine the distance required for an absolute difference between the acoustic pulse recording and the torsion-field recording. Assuming that the selected fire cracker had a 100 millisecond duration, then it would be useful to be 200 feet away from the explosion to separate the hypothesized torsion-field fluctuation from the acoustic wave form. This experiment will demonstrate whether there is a viable torsion-field pulse or emanation caused by the explosion. If there is a significant torsion-field pulse, then a useful next experiment would be to move the torsion-field sensor to a considerable distance to determine the extent to which the torsion-field fluctuation decreases with distance. If the Russian reports are accurate, **and if there is a torsion-field pulse produced by an explosion**, then one would hypothesize that the torsion-field pulse could be detected at relatively long distances.

If the foregoing results occur as hypothesized, then the more grand experiment is the following: It is proposed that an experimental relationship be established with the officials at the Kennecott Copper mine in the Oquirrh Mountains west of the Salt Lake Valley in Utah. The concept is to place a radio transmitter near one of the daily blast sites with a conducting loop of wire situated over the top of the blast hole. Blasting is done by drilling a vertical bore hole and filling it with an explosive slurry. The onset of the explosion would be detected by a break in the conductive wire loop. An r.f. signal (designed to produce a rapid rise-time pulse would be emitted by the transmitter. A secondary transmitter might be positioned on the top of the Oquirrh mountains. From the top of the Oquirrh mountains to the West lies the Great Salt Lake and the Great American Desert. It is believed feasible to pick up the torsion-field signal at the far edge of the Great Salt Lake (near Wendover, Utah) about 100 miles west (about 160,000 meters). An electromagnetic pulse, traveling at 300,000,000 meters per second would require about 0.53 milliseconds to travel from the blast site to Wendover. This timing is well within the capability of modern measuring equipment.

The problem that must be resolved will be the wave shape of the torsion-field pulse. If the pulse is a long, drawn-out pulse, then the resulting measurements could be in doubt. If the torsion-field pulse has a sharp rise time at the onset of the explosion, then the experiment could be successful. The plans are to make measurements of the hypothesized torsion-field emanations by recording any torsion-field fluctuations produced by the daily blasts from the copper mine **prior to going to the expense of setting up the long-distance experiments.**

D. IMPACT ON THE SECOND POSTULATE

The second postulate is explained in an article about Relativity in the 15th edition of the Encyclopaedia Britannica as follows: "Einstein realized that the key concept, on which all comparisons between differently moving observers and frames of reference depend, is the notion of universal, or absolute, simultaneity:

that is to say, the proposition that two events that appear simultaneous to any one observer will also be judged to take place at the same time by all other observers. This appears to be a straight-forward proposition, provided that knowledge of distant events can be obtained practically instantaneously. **Actually, however, there is no known method of signalling faster than by means of light or radio waves or any other electromagnetic radiation, all of which travel at the same rate, c."**

If a method can be found by which information about distance events can be exchanged or transmitted much faster than the speed of light, then all of the equations in Special Relativity, General Relativity, and all of the follow-on quantum dynamics must be re-evaluated. Depending on the notion being reduced to mathematics, c may have to be replaced by a new value. The author is not sufficiently a student of relativity, nor is it the purpose of this paper to explore all of the ramifications of the discovery that torsion-field fluctuations can carry information and appear to travel at one billion times (or more) faster than light.

The author is confident that the result of a simple experiment that would demonstrate a method of transmitting information much faster than the speed of light will cause a modest controversy in the annals of physics. Such an experimental observation, **followed by a series of observations of the same phenomena** would provide science with a much-needed, new scientific fact (at least new to most of the Western scientists.) Such a discovery should not be thought to diminish the importance of the work that Einstein did almost a century ago. The discovery of transistors did not diminish the importance of the discovery of the Edison Effect, nor the contributions of Fleming (the Fleming valve), nor of the many others that developed better and better vacuum tubes and laid the groundwork for modern electronics. Einstein will still be awarded his place in history, and scientists will modify, adapt, or eliminate some of the current dogma of physics. If the Russian work on torsion fields is correct, the scientific world is on the verge of some dramatic new advances.

It has been about 400 years since Galileo invented the telescope which opened up our knowledge of the heavens. Perhaps in the 21st century, another brilliant discovery will be made that will allow us to view the heavens from the torsion-field emanations. Then we can make great progress in cosmology by being able to view relatively recent events (by torsion fields) and compare them with the ancient events being viewed using visible light. One prediction is that other advanced intelligences in the universe are not communicating by the use of the terribly-slow electromagnetic radiation. SETI (Search for Extra-Terrestrial Intelligence) observers may be looking in the wrong spectrum.

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THE CLASSICAL/NEWTONIAN DERIVATION OF LORENTZIAN EQUATIONS FOR SOUND AND OTHER MEDIA PROCESSES

Dennis McCarthy [1]

ABSTRACT

An experimentally realizable subset of classical sound and wave equations (defined here as 'irregular') are shown to include the Lorentz Equations of the special theory of relativity. Specifically, it shall be shown that the use of open-air sound clocks to measure the relative velocity and frequency of sound waves are examples of "irregular" experiments that would completely conceal the classical, Galilean aspects of sound. Instead, the sound-clock-measured velocities and frequencies would conform to sound-based Lorentz-type equations. In conclusion, it is shown that with the single hypothesis of a physically real Lorentz-Fitzgerald contraction, the Lorentz transformations can be completely derived for any media process through classical analyses of causal mechanisms without reliance on any special characteristics of the wave or other unexplained, extraordinary principles. Theoretical comparisons are then made between the ether/media view of the Lorentz-Poincare equations and the Einstein view.

I. INTRODUCTION: PHYSICAL CAUSES VS. INHERENT TENDENCIES OR PRINCIPLES

Four centuries ago, the major theoretical debate in science pitted a theory of physical causes against a well-accepted authoritative theory based on an unexplained principle. The former, now accepted as the theory of the atmosphere, was derided at that time because it assumed the existence of a complicated, invisible material medium that surrounded the known world and served as the physical cause for pressure on barometers. Why postulate such an all encompassing invisible mechanism when the principle of the abhorrence of vacuums neatly explained the same phenomena?

Similarly, one of the more significant intellectual debates today involves a theory of physical causes involving an invisible material medium vs. an authoritative theory based on an inherent and uncaused principle. Einstein's 2nd postulate of the special theory of relativity (SR), which states that the velocity of light is constant in all inertial frames, is a preordained, unexplained, and apparently uncaused rule of the universe. (F. Muller has also recently derided the neglect of physical causes in the SR interpretation of relativistic effects. [1])

The only other well-known description of a theory that encompasses the Lorentz equations, Lorentz-Poincare aether theory (LPET) of relativity, takes a much more mechanistic approach, but that too, as originally and commonly described, relies on the postulation of an unexplained principle. This principle, known as Poincare's principle, is simply a distended principle of relativity, forbidding one from determining ones absolute motion through either empty space *or the aether*. In each theory, SR and LPET, the symmetry of the Lorentz transformations for light are entailed only because light, unlike any other known phenomenon, is allegedly graced with an unique and inherent need to maintain allegiance to their respective postulates.

The intention here is to derive the Lorentz equations for sound from Newtonian mechanics without relying on any new or inherent principle. Then it will be shown that the Lorentz equations, which follow from

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comprehensible physical analyses, in turn lead to the *apparent* validity of Einstein's 2nd postulate and Poincare's principle whenever media-based devices are used to measure media-based processes. Thus, it is argued that the principles do not cause the phenomena to correspond to the equations; it is the underlying classical, mechanical aspects of the phenomena that cause the validity of the equations and apparent validity of the principles.

II. DEFINITION AND EXAMPLES OF IRREGULAR AND REGULAR EQUATIONS

In most laboratory procedures, experimenters have to be extremely careful about environmental effects on various apparatus and measuring devices. Unfortunately, in some specific cases, the characteristics of the measuring devices are inextricably linked to the phenomenon being studied, and so it is difficult, if not impossible, to prevent the devices from physically changing during the variations of the experimental trials. This, in turn, leads to the concealment or apparent modification of the phenomenon, which, in turn, brings about the need for a new set of seemingly "non-classical" equations that include terms which account for the alteration of the measuring tools:

REGULAR EQUATIONS	IRREGULAR EQUATIONS
"Regular equations" are those idealized "classical" equations that predict the outcome of experiments in which the measuring devices remain essentially independent of and unaffected by the effect one is trying to measure.	"Irregular equations" predict the results of those "irregular" experiments in which the effect one is trying to measure varies according to causes that either directly or indirectly alter the measuring devices. Irregular equations merge the expected alterations of the measuring instruments with the ideally expected effects of the phenomenon of interest.

While most experiments are regular experiments, there are many obvious examples of irregular experiments--such as the use of metal rulers to measure the effect that the ambient temperature has on metal rods. Since the differences in temperature would alter both the rulers and the rods, the experimental results would have to be determined by an irregular equation. In the following we use a simple apostrophe with the Δ L to distinguish between its *regular* and *irregular* values.

Regular Equation for the Thermal Expansion of Rods as measured by *Ideal Rulers.*	**Irregular Equation for the Thermal Expansion of Rods as Measured by *Metal Rulers***
$\Delta L = \alpha L_0 \Delta T$ Where ΔL = the change in length of the rod ***as measured by an ideal ruler***, L_0 = the original length of the rod, α = change in temperature, and is the rod's coefficient of linear expansion.	$\Delta L' = \frac{L_0(1+\alpha\Delta T)}{LR(1+\alpha'\Delta T)} - \frac{L_0}{LR}$ Where $\Delta L'$ is the change in length of the rod ***as measured by a ruler of length LR and with a coefficient of linear expansion of α'.***

Notice in the above that if the metal of the ruler and the rod have the same coefficient of linear expansion, then $\Delta L = 0$. The effect is completely concealed. In maintaining the same vernacular, one may define such experiments in which the effect one is trying to measure is always hidden by the related alterations of measuring devices as **perfectly irregular experiments.**

III. THE IRREGULAR LORENTZ-TYPE EQUATIONS PRODUCED WHEN MOVING SOUND CLOCKS ARE USED TO MEASURE SOUND WAVES

A) Sound Clock Retardation
B) Sound-Clock Twin Paradox
C) Symmetrical Sound-Clock Relativistic Doppler Effect
D) "Mutual Time Dilation" of Sound Clocks
E) Apparent Constancy of the Speed of Sound When Measured By Sound Clocks

A) Sound Clock Retardation

Consider a sound (or any wave) clock that uses a pulse of sound (or any wave) to measure time. A single unit of time would be determined by a pulse that moves from a base to a high place and back to the base again. Thus, if the height of the clock is l and c is the velocity of the wave, then a unit of time = 2l/c.

If the clock is not enclosed and moves at some non-zero velocity V through the medium, it takes longer for the wave to move back and forth between the high place and base. The relationship between the rate of a sound clock (RC) that is at rest with respect to the atmosphere and the retarded rate of a moving clock (MC) that is aligned parallel to its motion through the atmosphere is:

$$MC = RC\,(1 - V^2 / c^2) \tag{1}$$

If the moving clock is standing so that the high place and base are perpendicular to its motion through the atmosphere, its rate is retarded in a simple Pythagorean manner. This rate relationship is expressed:

$$MC = RC\,\sqrt{1 - V^2 / c^2} \tag{2}$$

Eq. (2), of course, is the Lorentz-time factor. H. Hayden also mentioned this analogy in a '91 article of Galilean Electrodynamics. [2] It is developed in a little more detail here.

B) Sound-Clock Twin Paradox

Similar to the twin paradox, if two co-located sound clocks are stationary or are moving inertially with respect to the atmosphere , and one sound clock is accelerated and returned to the stationary sound clock, the accelerated clock will have run slow. If the traveling clock stands transverse to motion and the home clock is stationary with respect to the atmosphere, this difference in time will be governed by the Lorentz equation (2). Moreover, as shall be shown, a Doppler accounting of the sound-clock ticks by either the stationary or traveling observer during the trip reveals another Lorentzian effect that is seemingly symmetrical.

C) Sound-Clock Relativistic Doppler Effect

Imagine two sound clocks moving directly at each other, each emitting periodic sound pulses per unit of time. Since both the observer's and source's clock rate varies with velocity, the true classical Galilean effect is concealed.

	Regular Classical Galilean Doppler Effect	Irregular Equation for Sound Clocks (Adjusted for Altered f)
Source moving directly at stationary observer: (The sign of v is negative when source is receding)	(3) f (obs) = $\frac{1}{1 - v/c}$ f	(4) f(obs)' = $\frac{\sqrt{1 - v^2/c^2}}{1 - v/c} f = \sqrt{\frac{1 + v/c}{1 - v/c}} f$
Observer moving directly at stationary source: (The sign of v is negative when observer is receding.)	(5) f(obs) = (1 + v/c) f	(6) f(obs)' = $\frac{1 + v/c}{\sqrt{1 - v^2/c^2}} f = \sqrt{\frac{1 + v/c}{1 - v/c}} f$

In the above table, v = relative velocity of source and observer, f (obs) is the observed frequency, f is the frequency of the source clock when at rest in the atmosphere, and c is the velocity of the wave in the medium. The apostrophe after the f(obs)′ simply denotes an irregular equation.

Notice that the irregular equation for either situation is the same and is equivalent to the relativistic Doppler equation. The situation has become symmetrical. Neither the observer nor the source in these situations could use observations of moving clocks to determine which clock is really running slow or which clock is really moving with respect to the atmosphere.

D) "Mutual Time Dilation" of Sound Clocks

Imagine two sound clocks situated on top of a train, one on the engine and one on the caboose, and the train is moving at 1/2 the speed of sound. Comparing the train clocks to stationary sound clocks that had been synchronized along the side of the road, one notices that the train clocks are running slow. Specifically, one notices that a train clock moving between ground clock A and ground clock B exhibits less elapsed time than the difference between B time and A time.

Now, consider what would be observed from the ground frame if the train clocks are synchronized on the assumption that the speed of sound remains the same even with respect to moving trains. Assume the distance between the clocks is 343 meters and the clock on the caboose sent a signal to the engine clock at time 0. Since the train is moving at 1/2 c and the speed of sound is 343 m/s, the signal takes 2 seconds to reach the engine clock. In that time, the caboose clock has displayed an elapsed of time of 2 seconds multiplied by the retardation factor of ($\sqrt{1 - V^2/c^2}$) = 2(.866) = 1.73 seconds.

However, the engine clock is synchronized on the assumption that it only takes 1 second for the signal to move that distance. Thus, the engine clock is set at 1 second when the caboose is at 1.73 seconds--and though the two train clocks will continue to run at the same rate, the caboose clock is .73 seconds ahead of the engine clock. A ground observer with his ground sound clock who notes the time of the engine clock would see the caboose clock pass 2 seconds later--according to his ground clock. The caboose clock, on the other hand, will show a difference in time of (1.73 + .73)= 2.46 seconds as compared to the engine clock.

Thus, if both frames synchronize their sound clocks under the assumption that the speed of sound is constant, then a train clock runs slow when compared to the difference in time exhibited by two passing ground clocks, and each ground clock appears to run slow when compared to the difference in time

exhibited by two passing train clocks. This *irregular* effect, which is simply a classical consequence of skewed synchronization rituals and absolute time, has unfortunately been given the logically horrifying label "mutual time dilation."

E) Apparent Constancy of the Speed of Sound When Measured By Sound Clocks

If one were to use a sound clock to measure the speed of a wave that moves to a point in the distance and returns, again the Galilean classical equations are concealed because the speed of the wave and the rate of the clock are inextricably linked.

Regular Equation for back-and-forth Sound Velocity along a platform moving at V velocity with respect to the medium.	**Irregular Equations for back-and-forth Sound Velocity as measured by a *sound clock* that is aligned parallel to the motion of the sound wave.**
$v = c\ 1 - \frac{V^2}{c^2}$ directly into wind (7) $v = c\ \sqrt{1 - V^2/c^2}$ transverse to wind (8)	$v' = c$ (9)

Notice that for this irregular equation involving a specifically-positioned sound clock, the velocity of the medium (V) drops completely from the equation, and the velocity of the sound wave is always measured to be c no matter what the velocity of the system with respect to the atmosphere. Thus, this sound experiment becomes a *perfectly irregular experiment.*

Also, one-way speed of sound would involve the relative movement of sound clocks, and synchronization rituals would then determine the speed of sound. The standard Einstein-synchronization procedure for separated sound clocks would again demand that the measured speed of sound would be constant.

(It is important to note that the velocity of sound for back-and-forth speed of sound would be discovered to vary once a non-zero angle developed between the oscillating waves of the sound clock and the motion of the sound waves. The irregular equation for this process would be slightly more complex and is at the moment irrelevant to this discussion.)

IV. THE SOUND AND MEDIA ANALOGY FOR APPARENT LORENTZIAN MASS INCREASE

Unlike clock retardation, relativistic Doppler, and the apparent constancy of c, all of which can be explained through alterations of measuring devices, Lorentzian mass increase eludes such an analogy. However, another sound (media) based analogy for mass-increase was brought to my attention by Stephen Rado who is author of the colossal work, **Aethro-kinematics**. [3]

According to Mach's number used in aerodynamics, as the velocity of an object approaches the speed of sound, the drag increases in an amount that is greater than predicted by Newtonian laws of resistance. This is due to the compression of the fluid in front of the body, which increases in density with velocity and so increases resistance.

Additional force has to be applied to maintain the same acceleration, and this additional force is determined by Mach's number: As Rado writes:

"If the Newtonian resistance is R_0 and the combined total resistance is R, then its magnitude can be expressed in the following equation:

$$R = \frac{R_0}{\sqrt{1 - V^2/c^2}} \tag{10}$$

Where ...c is the speed of sound." [3]

This, of course, is in the same form of mass increase, with Newtonian rest mass = R_0 and total mass = R. Like objects in a fluid, as the velocity of an object increases it becomes increasingly more difficult to accelerate.

V. THE SIMPLE HYPOTHESIS OF THE LORENTZ-FITZGERALD CONTRACTION NECESSARILY LEADS TO THE LORENTZ TRANSFORMATIONS FOR MEDIA PROCESSES

The theory of a medium for electromagnetism was abandoned due to the essentially null result of the Michelson-Morley experiment, which was designed to determine the Earth's velocity through the ether. Unfortunately, the interferometer of Michelson-Morley, like all other sensible matter, is held together by internal electromagnetic interactions. So the experiment must rely on an electromagnetic-based apparatus to measure electromagnetic waves, which could make it just as an *irregular* experiment as one which relies on metal rulers to measure metal rods--or sound clocks to measure sound waves.

In trying to explain this null, H.A. Lorentz and G. Fitzgerald, working independently, each hypothesized this exact *irregular* explanation, arguing that the physical interaction of matter with the aether caused it to contract in the direction of the motion by a factor of $\sqrt{1 - V^2/c^2}$, which would cancel any noticeable variance in velocity of light in Michelson-Morley type experiments. This Pythagorean based formula for the required contraction is rather simple, based on the most fundamental of geometries, and so the contraction formula falls out of many different physical hypotheses concerning the mechanics of the aether. Lorentz, for example, was able to derive this contraction formula from his hypothesis on the spherical shape of the electron without relying on any unusual characteristics.

The Lorentz-Fitzgerald contraction, though never experimentally confirmed, is accepted by most physicists. And for the sake of theoretical analyses of the aether, such a physical effect on matter should be examined concerning media processes in general. Given the Lorentz-type equations that are shown above to occur for sound, the simple additional hypothesis of the contraction of matter in the direction of motion by a factor of $\sqrt{1 - V^2/c^2}$ necessarily leads to the Lorentz transformations for any media process.

A) Clock (oscillating media process) Retardation is always $\sqrt{1 - V^2/c^2}$ no matter its orientation.

All self-contained oscillating media processes (like sound clocks) would retard by $\sqrt{1 - V^2/c^2}$ no matter what the orientation of the system (or clock). Refer again to equations (1) and (2). And consider that while oscillating media processes retard by a factor of $(1 - V^2/c^2)$ when oscillating parallel to motion, that the clock also shrinks by a factor of $\sqrt{1 - V^2/c^2}$ in that direction:

$$\frac{(1 - V^2/c^2)}{\sqrt{1 - V^2/c^2}} = \sqrt{1 - V^2/c^2} \tag{11}$$

The retardation of atomic (electromagnetic) clocks is easily explained by this analogy, but the electro-weak force of muon decay, also known to retard, would have to be assumed to be directly affected by either the contraction or some inner oscillating process.

B) The Measured Back-and-Forth Speed of a Wave is Always Constant

This particular retardation of clocks and contraction of matter in the direction of motion necessarily leads to the apparent validity of the constancy of the speed of light as measured by media clocks and media rulers for all inertial frames no matter what the velocity of the medium or orientation of the clock. The back-and-forth waves naturally follow the same equations as the waves moving back and forth in the clocks.

C) The Derivation of Poincare's Principle and Lorentz-Poincare Symmetry

Given the contraction in the direction of motion and a standard clock retardation all the other relativistic formulas (other than mass increase) then follow and have been derived countless times in many relativity text books.

In every equation, the velocity of the medium cancels out, leaving only relative velocity between atomic clocks or between source and observer. "Mutual time dilation" as described above now becomes perfectly symmetrical, and the relativistic Doppler effect works for any velocity with respect to the medium. These consequences necessarily validate Poincare's principle for almost all experiments involving media clocks and media-contracted rulers. But again, the classical Galilean consequences are still there; they are just concealed due to the classical Galilean effects on the measuring devices. More, it must be noted that although *observations appear symmetrical*, the effects of length contraction and clock retardation *are physically absolute* and non-symmetrical. At the very least, with media processes, we *know* that time is not mutually dilating and that one of the media clocks is absolutely running faster than the other--even though the appearance of rate is symmetric. This leads to one of two possible interpretations when dealing with such experiments: the SR or LPET view. (R. Hatch also describes these differences in far greater detail in '95 issue of Galilean Electrodynamics. [4])

In the Einsteinian view, the symmetry of the Lorentz Transformation is an artifact of and maintained by the experimental ritual of "synchronizing" all clocks that are stationary in a particular reference frame by wave signals that are *assumed* to travel at speed c. This synchronization procedure is referred to as Einstein Synchronization or E-synching.

The additional hypothesis that any clock that is stationary in a frame actually keeps the absolute time of that particular frame entails that each frame has its own time, and that simultaneity as measured by these clocks is relative.

In the Lorentz-Poincare view, one prefers a local reference frame which maintains a Local Universal Time, where the speed of light is assumed to be isotropic. All clocks are then considered to be retarding due to motion with respect to this frame. This effect is not symmetrical, and once clocks are adjusted so that they maintain the same rate as clocks that are stationary with respect to this preferred frame, then the Galilean aspects of light are once again revealed.

Although not widely admitted, analyses involving the Global Positioning System utilize the Lorentz-Poincare view by preferring the ECI frame as the location where the speed of light is isotropic. The speed of light is then assumed to vary in a Galilean fashion according to frames that are in motion with respect to the ECI frame. GPS scientists also synchronize all clocks with respect to the ECI frame. [4, 5]

D) Possible Regular Experiments that will Retrieve the Galilean Aspects of Light or Determine the Local Velocity of the Aether

The easiest way to test for the regular (Galilean) equations of experiments is to avoid irregular experiments--which, of course, means using measuring devices that are not based on the media process that you are trying to measure. This is a rather simple matter with sound experiments, as electromagnetic clocks would immediately reveal the classical Galilean aspects of sound that the sound clocks had managed to obscure.

Unfortunately, this is not so easy with electromagnetism as the atomic interactions that determine the shape of rulers are electromagnetic-based, and presently our most accurate clocks are all electromagnetic. Perhaps, a cleverly constructed, very accurate gravitational clock or Pulsar timing schemes could be used in regular experiments for electromagnetism. [or could use torsion fields. Ed.]

Another possibility is to contrive an experimental set-up where two waves are classically predicted to yield two different velocities, but the alterations of the measuring devices are equal (and effectively cancel out) for the two waves. For example, if one were to circulate two waves in opposite directions completely around a rotating platform back to a source/detector on the rim of the platform, the contraction of the platform and the effect on the source/detector would be equal for both waves. Yet, Galilean Relativity predicts a difference in velocity of the two waves as determined by the detector. If such an experiment were conducted with a sound clock detector and sound waves being reflected around a merry-go-round, the Galilean aspects would *not* be concealed, and the speed of the counter-rotating sound wave would be greater than the co-rotating sound wave. Georges Sagnac, of course, conducted this experiment for light in 1913 and found the predicted Galilean anisotropy.

Interestingly, a *null* effect for a Sagnac experiment would indicate that the local rest frame of the aether was at rest with respect to the detector as it moved along the circumference of the light paths, and this would violate Poincare's principle of relativity.

VI. CONCLUSION

Given: Electromagnetism comprise many characteristics suggestive of media processes including reflection, refraction, interference, frequency, amplitude, Doppler effect, aberration, interference, Sagnac effect, Casimir effect, and zero point energy.

However, the simple discovery of seemingly non-classical Lorentzian qualities that occurred when electromagnetic processes were measured by electromagnetic-based apparatuses eventually led to the view that electromagnetism is not a media process.

Established: "Irregular" non-classical equations develop when the phenomena of study and the dynamics of the measuring instruments are linked. Specifically, measurements of sound and other media processes as gauged by sound (or media wave) clocks will conceal the classical, Galilean aspects of the media process. Instead, the sound or media process will respond to seemingly non-classical Lorentzian equations.

'**Established**: The single postulate that some media process contributes to a Lorentz-Fitzgerald contraction of matter entails the Lorentz-transformations.

Established: When one includes the hypothesis of the Lorentz-Fitzgerald contraction, the apparent validity of Poincare's principle and Einstein's constancy of the speed of a wave necessarily follow from classical media mechanics.

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NUCLEAR REALIZATION OF HADRONIC MECHANICS, I: INVARIANT REPRESENTATION OF NONPOTENTIAL NUCLEAR FORCES

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ABSTRACT

We propose, apparently for the first time, a realization of hadronic mechanics (as presented in the latest memoirs [3i, 3j, 4e]) specifically constructed for nuclear physics. A main feature is that of permitting a more realistic representation of nucleons as extended, nonspherical, and deformable charge distributions under nuclear forces with conventional, linear, local and potential-unitary terms represented with the Hamiltonian, plus novel nonlinear, nonlocal, nonpotential-nonunitary contributions due to the mutual penetration of the hyperdense nucleons, which are represented with generalized units. The latter imply a lifting of the conventional quantum formalism which reconstructs linearity, locality and unitarily on certain generalized spaces over generalized fields. We show that the emerging nuclear formalism preserves all quantum axioms and physical laws, while permitting quantitative studies of internal nonlinear, nonlocal and nonpotential effects, thus being an axiom-preserving, isotopic "completion" of quantum mechanics much along the celebrated E-P-R argument. Existing applications and verifications in particle physics, astrophysics, superconductivity and other fields are indicated, while those in nuclear physics are presented in other contributions.

INSUFFICIENCIES OF ATOMIC FORMULATIONS FOR NUCLEAR PHYSICS

We claim that relativistic quantum mechanics (RQM) is **exact** for the **atomic structure** because it represented, in an **exact** way, **all** its experimental data. By comparison, RQM provides a notoriously excellent representation of the **nuclear structure** although, on rigorous scientific grounds, RQM **cannot** be considered to be **exact** in nuclear physics because it has been unable to provide an equally **exact** representation of **all** nuclear experimental data, as emphasized in the early treatises in the field (see, e.g., the historical accounts [1a, 1b, 1c]), rather than in contemporary presentations,

For instance, RQM has permitted a good representation of total nuclear magnetic moments. Nevertheless, after three-quarters of a century of attempts and the use of all possible corrections, RQM has been unable to provide their **exact** representation because about 1% of the experimental value is still missing, for few-body nuclei, as recently established by V.V. Burov and his group [1e] at the *JINR*, while there are larger percentages missing for heavier nuclei.

In fact, for the deuteron we have the value $\mu^{Exp}_{D} = 0.857$ while quantum mechanics yields the value $\mu^{Theor}_{QM} = 0.880$ which is 2.6 % off **in excess** of the experimental value [1a]. The studies of Bondarenko et al. [1e] have indicated that, despite the use of all possible relativistic and other corrections, as well as of all allowed states, the representation via RQM still remains about 1% off. Also, the problem does not appear to be solvable via quark models because the quark orbits are too small to yield the needed deviation.

The most plausible explanation of the above occurrence was formulated by the Founding Fathers of nuclear physics in the late 1940's. For instance, in p. 31 of Ref. [1a] one can read **"It is possible that the intrinsic magnetism of a nucleon is different when it is in close proximity to another nucleon."**

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Recall that nucleons are not point-like, but have extended charge distributions within the radius of about 1 fm. Since perfectly rigid bodies do not exist in nature, the above "historical hypothesis" (as herein referred to) assumes that such distributions can be deformed under sufficient external forces. But the deformation of a charged and spinning sphere implies a necessary alteration of its intrinsic magnetic moment.

The assumption of the above "historical hypothesis" readily permits the achievement of the desired exact representation of total nuclear magnetic moments, as first shown in [1f] and, more accurately, in the adjoining note [1g].

The lack of exact character of the conventional formulation of RQM in nuclear physics can also be seen in a number of independent ways, a compelling one being that based on symmetries. Computer visualization of the Poincaré symmetry *P* (3.1) [where (3.1) represents the spacetime dimensions] indicates its capability to represent **Keplerian systems**, i.e., systems with the heaviest constituent in the center, as occurring in the atomic structure. By comparison, **nuclei do not have nuclei** and, therefore, the Poincaré symmetry must be **broken** to represent structures **without** the Keplerian center. In turn, as we shall see, the latter symmetry breaking is fully in line with the deviations from *P* (3.1) required by a quantitative treatment of the "historical hypothesis" on nuclear magnetic moments. In fact, according to the conventional Poincaré symmetry, the intrinsic magnetic moments of nucleons are perennial and immutable.

The most compelling arguments are of **dynamical** nature and they were again identified by the Founding Father of nuclear physics, although lately ignored. For instance, when dealing with the applicability of quantum mechanics to the treatment of nuclear forces, Enrico Fermi states in [1b], p. 111, "... **there are some doubts as to whether the usual concepts of geometry hold for such small region of space.**" Similar historical doubts can be found in the studies by L. Rosenfeld [1c] and others of the same period.

RQM was constructed for the characterization of action-at-a-distance, potential interactions among point-particles, as occurring in the atomic structure. By comparison, nucleons in a nuclear structure are in an average state of mutual penetration of about 10^{-3} parts of their charge distribution [2a]. But hadrons are some of the densest objects measured in laboratory until now. Their mutual penetration therefore implies a (generally small) component of the nuclear force which is: 1) of **contact** type, i.e., with zero-range, thus requiring new interactions **without** particle exchanges; 2) **nonlinear** in the wavefunctions and, possibly, their derivatives [2b], thus requiring a theory with an exact superposition principle under said nonlinearity; 3) **nonlocal**, e.g., of integral type over the volume of overlapping, thus requiring a new integro-differential topology [2c]; 4) **nonpotential**, in the sense of violating the conditions to be derivable from a potential or a Hamiltonian [2d], thus requiring new dynamical equations; and 5) of consequential **nonunitary** type as a necessary condition to exit from the equivalence class of RQM, thus requiring a new formulation.

NEED TO PRESERVE ESTABLISHED QUANTUM AXIOMS AND PHYSICAL LAWS

The baffling scenario emerging from the above comments is that, on one side, the atomic formulation of RQM does not appear to be sufficient for an exact representation of nuclear data while, on the other side, no experimental deviation has been established to date from any quantum mechanical axiom or physical law.

The fundamental assumption of this study, which is evidently necessary for physical consistency at this writing, is therefore that of assuming all conventional quantum mechanical axioms and physical laws as being **exactly** valid in nuclear physics. This eliminates *ab initio* the use of a "new mechanics", and sets the search for a "new realization" of conventional quantum axioms and physical laws.

In the next section we shall therefore study a formulation which preserves conventional physical laws such as Heisenberg's uncertainty principle, Pauli's exclusion principle, etc., while providing:

1) A representation of **extended, nonspherical and deformable shapes** of the charge distribution of nucleons, expectedly of spheroidal ellipsoidic character.
2) A representation of the **density** of the medium in which motion occurs.
3) A representation of the alteration of the intrinsic magnetic moment of nucleons.
4) A representation of nonlinear, nonlocal, nonpotential and nonunitary terms in the nuclear force, besides the conventional linear, local, potential, and unitary terms.
5) A representation of the lack of Keplerian nuclei in nuclei via a new realization of the Poincaré symmetry.

It is evident that the nonspherical and deformable characteristics are beyond any representational capability of the current formulation of RQM because the latter can only represent **perfectly spherical and perfectly rigid particles,** as necessary in order not to violate the fundamental rotational symmetry O(3).

It should be indicated that the same occurrence persists in second-quantization and related form-factors which cannot represent the main characteristics of the "historical hypothesis" under study here, the **deformability** of extended particles.

The significance of Fermi's teaching (recalled earlier) is that of focusing the attention on the limitations of the conventional atomic realization of fundamental geometries, the Euclidean and Minkowskian geometries.

Following Fermi's teaching, a main technical problem of this study is the identification of **new realizations** of the conventional Euclidean and Minkowskian geometries permitting representations 1 to 5 above while preserving conventional abstract geometric axioms. Once Fermi's teaching has been quantitatively implemented, an exact representation of total nuclear magnetic moments, as well as a number of other possible advances in nuclear physics, follow.

INAPPLICABILITY OF QUANTUM DEFORMATIONS

Our insistence on the preservation of conventional quantum axioms and physical laws can be best illustrated via the inability of the so-called **quantum deformations** to provide a consistent representation of total nuclear magnetic moments, thus confirming the need for new lines of inquiries.

The first deformations of quantum structures with brackets of the type (A, B) = pAB - qBA, where *p* and *q* are non-null parameters, A, B are Hermitean operators and AB is the usual associative product, were introduced by this author [2e] back in 1967 as part of his Ph.D. studies. Subsequently, the more general deformations with brackets (A, B) = APB - BQA, where P and Q are generally nonhermitean operators, were introduced apparently for the first time by the author [3a] in 1978. The first (*p,q*)-deformation of the SU(2) algebra was apparently submitted by the author [2f] at the meeting *Differential Geometric Methods in Mathematical Physics* held at the University of Clausthal, Germany, in 1980. Years later, Biedenharn [2g] and Macfarlane [2f] presented the quantum deformations with product (A, B) = AB - qBA which are an evident particular case of the deformations (A, B) = pAB - qBA proposed in 1967 [2e], evidently for the case p = 1, which were then followed by a number of papers so large to prohibit an outline.

Ironically, by the time Biedenharn and Macfarlane studied the q-deformations, this author had already abandoned their study as conventionally formulated (that is, on conventional Hilbert spaces over conventional fields) because of rather serious and seemingly un-resolvable problems of **physical** consistency.

To begin, the addition of one parameter q (or of two parameters p and q) is basically insufficient to reach all needed representations 1) to 5) above.

Also, (p, q)-deformations in general and q-deformations in particular, notoriously violate conventional quantum axioms (e.g., that of expectation value) and physical laws (e.g., Heisenberg's uncertainty principle). As such, they do not appear to be suitable for a physically consistent representation of total nuclear magnetic moments.

Moreover, when formulated on conventional Hilbert spaces over conventional fields, (p, q)-, q- and other deformations possess a **nonunitary time evolution**, under which we have the following physical problematic aspects (see the first sections of [3j] and [2i, 2m]):

1) Lack of invariance of the basic units of space and time, with consequential lack of unambiguous applicability of the theory to real measurements;
2) Lack of preservation of the original Hermiticity in time, with consequential lack of physically acceptable observables;
3) Lack of uniqueness and invariance of the numerical predictions, due to the lack of uniqueness and invariance of the special functions and transforms used in their elaboration;
4) Evident problematic aspects with respect to causality and probability laws;
5) Evident violation of the axioms of Einstein's special relativity (SR).

Finally, we should indicate for completeness that, even under the resolution of the above list of problematic aspects 1) through 5), (p, q)-deformations remain still unable to provide a physically consistent representation of total nuclear magnetic moments and other general problems in nuclear physics.

This author proposed the (p, q)-deformations [2e], first, under the condition of being treated with a new mathematics and, second, for the characterization of **open-nonconservative systems**, as evident from the nonconservation law $idH/dt = (p - q)HH \neq 0$. The new mathematics has recently been constructed under the name of **genomathematics** [3i], and it has been successfully applied for the resolution of problematic aspects 1) to 5) above [2n]. Despite that, (p, q)-deformations at large, and q-deformations in particular, do remain inapplicable for a physically consistent representation of total nuclear magnetic moments, trivially, because the latter require the representation of nuclei as closed-isolated.

The above comments illustrate the need for a novel formulation which, on one side, preserves the axioms of Lie's theory as a necessary condition to preserve conventional quantum axioms and physical laws (evidently including total conservation laws), while, on the other side, permits the treatment of nonunitary structures.

NUCLEAR REALIZATION OF RELATIVISTIC HADRONIC MECHANICS

In this note we introduce, apparently for the first time, a nuclear realization of a broadening of RQM known as **relativistic hadronic mechanics (RHM)**, originally submitted and studied in [3] (for independent studies see monographs [4], fdr representative papers [5] and additional references quoted therein) which apparently resolves the problematic aspects of Sects. 1 and 3, and permits quantitative and invariant studies of nuclear structures with extended, nonspherical and deformable nucleons under conventional as well as nonlinear, nonlocal and nonunitary nuclear forces. Above all, RHM permits the achievement of the desired objectives under the fundamental condition of preserving the basic axioms of the SR.

Monographs [3g, 3h] contain a presentation of RHM up to 1995. Subsequent advances in its correct mathematical structure, with particular reference to the needed new form of differential calculus, have been reached in the recent memoir [3i]. A detailed study of RHM following these mathematical advances is available in memoir [3j]. The generalized symmetry profile has been recently finalized by Kadeisvili in the

recent memoir [5q]. A detailed study of the nuclear aspects studied in this note is presented in another paper [3k].

RHM is constructed via axiom-preserving maps of the conventional atomic realization of RQM called **isotopies** [3a] here referred to **maps of any given linear, local-differential and unitary theory into its most general possible nonlinear, nonlocal-integral and nonunitary extensions which are nevertheless capable of reconstructing linearity, locality, and unitarity on certain generalized spaces called isospaces, over certain generalized fields called isofields**. The alterations characterized by RHM are called **mutations** [3a] in order to distinguish them from the "deformations" of the current literature.

The representation of physical systems via RHM requires the knowledge of **two** quantities: a conventional Hamiltonian $\mathcal{H}$ for the representation of all potential interactions; and the isotopic lifting of the conventional multiplicative unit I = diag.(1, 1, 1, 1) of RQM, into a generalized form called **isounit**, which is given by a nowhere singular, Hermitean and positive definite 4 x 4 matrix $\hat{I}$ with an unrestricted functional dependence, $\hat{I} = \hat{I}(x, \dot{x}, \psi, \partial\psi,...) = \hat{I}^\dagger$.

In its diagonal realization the isounit can be written

$$\hat{I} = \text{Diag.}\,(n_1^2, n_2^2, n_3^2, n_4^2) \times \hat{\Gamma}(x, \dot{x}, \psi, \partial\psi,...) = \hat{I}^\dagger > 0\,, \tag{1}$$

thus being ideally suited for the representational capabilities identified earlier. In fact, n_1^2, n_2^2, n_3^2 can represent the semiaxes of **extended, nonspherical and deformable shapes of nucleons**, in this diagonal case of spheroidal ellipsoidal character, under the volume preserving condition $n_1^2 \times n_2^2 \times n_3^2 = 1$; n_4^2 represents the **density of the medium in which motion occurs** (e.g., the square of the local index of refraction); and $\hat{\Gamma}$ represent all nonlinear, nonlocal and nonpotential interactions (a comprehensive study of the latter occurrence beginning at the classical level has been done in memoir [3i]).

The isotopic lifting of the basic (multiplicative) unit $I \to \hat{I} = \hat{T}^{-1}$ requires, for consistency, the corresponding lifting of the conventional associative product A x B among generic quantities A, B of RQM into the isoproduct $A \hat{x} B = A \times \hat{T} \times B$, under which $\hat{I} = \hat{T}^{-1}$ is the correct left and right unit of the new theory, $\hat{I} \hat{x} A \equiv A \hat{x} \hat{I} \equiv A$ [3a]. The **totality** of the formalism of RQM must therefore be isotopically lifted for consistency.

A realization of RHM specifically conceived for the nuclear structure to preserve conventional quantum mechanical laws, is the following. In essence, RHM can be constructed via **nonunitary transforms** of RQM. In fact, for $U \times U^\dagger \neq I$, the isounit is given by the transform $I \to \hat{I} = U \times I \times U^\dagger = \hat{I}^\dagger$; the isoproduct is given by the transform $A \times B \to U \times A \times B \times U^\dagger = \hat{A} \times \hat{T} \times \hat{B} = \hat{A} \hat{x} \hat{B}$, $\hat{A} = U \times A \times U^\dagger$, $\hat{B} = U \times B \times U^\dagger$, $\hat{T} = (U \times U^\dagger)^{-1} = \hat{I}^{-1}$; the fundamental relativistic commutation rules are subjected to the map

$$[p_\mu, x^\nu] = \delta_\mu^\nu \times I \to U \times [p_\mu, x^\nu] \times U^\dagger = [\hat{p}_\mu, \hat{x}^\nu] = \hat{p}_\mu \hat{\times} \hat{x}^\nu - \hat{x}^\nu \hat{\times} \hat{p}_\mu = -i\delta_\mu^\nu \times \hat{I} \tag{2}$$

All other aspects of RHM can be constructed with the same nonunitary transform of corresponding aspects of RQM without any known exception.

The reader should be aware that the above procedure implies:

1) The new notion of fields $\hat{F}(\hat{n}, \hat{+}, \hat{x})$ (of real $\hat{R}$ or complex numbers $\hat{C}$), called **isofields**, with **isonumbers** $\hat{n} = U \times n \times U^\dagger = n \times \hat{I}$, **isosum** $(\hat{n} \hat{+} \hat{m})\,(n + m) \times \hat{I}$, **isoproduct** $\hat{n} \hat{x} \hat{m} = (n \times m) \times \hat{I}$, additive isounit $\hat{0} = 0$, multiplicative isounit $\hat{1} = \hat{T}^{-1}$, and related isotopic operations (see [3c] for details);

2) The new **isohilbert space** $\hat{\mathcal{H}}$ with **isoinner product** and **isonormalization**

$$U \times < \phi \mid x \mid \psi > x\, U^\dagger = < \hat{\phi} \mid x\, \hat{T}\, x \mid \hat{\psi} > x\, \hat{I} \in \hat{C} \tag{3a}$$

$$< \hat{\phi} \mid = < \phi \mid x\, U^\dagger, \mid \hat{\psi} > = U x \mid \psi >; < \hat{\psi} \mid x\, \hat{T}\, x \mid \hat{\psi} > = 1; \tag{3b}$$

3) The new **isodifferential calculus** with basic rules (see Ref. [3i] for details)

$$\hat{d}\hat{x}^\mu = \hat{l}^\mu_\nu \times d\hat{x}^\nu, \ \hat{\partial} / \hat{\partial}^\mu = \hat{T}^\nu_\mu \times \partial / \partial \hat{x}^\nu, \ \hat{\partial}\, \hat{x}^\mu / \hat{\partial}\, \hat{x}^\nu = \hat{\delta}^\mu_\nu;$$

4) The new **isolinear momentum operator**, $\hat{p}_\mu \hat{\times} \mid \hat{\psi} > = -i \hat{\partial}_\mu \mid \hat{\psi} > = i \hat{T}^\nu_\mu \times \partial_\nu \mid \hat{\psi} >$;

5) New **isoeigenvalue equations** $\hat{H}\, \hat{x} \mid \hat{\psi} > = \hat{E}\ \hat{x} \mid \hat{\psi} > \equiv E x \mid \hat{\psi} >, \ E \in F, \hat{E} = E x \hat{I} \in \hat{F}$;

6) New **isoexpectation values** $\hat{<} A \hat{>} = < \hat{\psi} \mid x\, \hat{T}\, x\, A\, x\, \hat{T}\, x \mid \hat{\psi} > / < \hat{\psi} \mid x\, \hat{T}\, x \mid \hat{\psi} >$;

7) The new **Lie-Santilli isotheory** [3a, 2d, 4] based on the isoproduct

$$[A, B] = A \times B - B \times A = A \times \hat{T} \times B - B \times \hat{T} \times A$$

which does preserve Lie's axioms in isospaces over isofields;

8) The new **isominkowski space** [3b] $\hat{M} = \hat{M}(\hat{x}, \hat{\eta}, \hat{R})$ over $\hat{R}$ with isounit $\hat{I} = \hat{T}^{-1}$,
isocoordinates $\hat{x} = U x \ x x\, U^\dagger = x x \hat{I} = \{ x^\mu \} x \hat{I}$,
isometric $\hat{N}_{\mu\nu} = \hat{\eta}_{\mu\nu} x \hat{I} = \hat{T}^\alpha_\mu (\hat{x}, \hat{p}, \hat{\psi}, \partial\hat{\psi}, ...) x \eta_{\alpha\nu} x \hat{I}$, η = Diag.(1, 1, 1,-1), and isoseparation

$$(\hat{x} - \hat{y})^{\hat{2}} = (\hat{x} - \hat{y})^\mu \hat{x}\, \hat{N}_{\mu\nu} \hat{x}\, (\hat{x} - \hat{y})^\nu = [\, (x - y)^\mu \times \hat{\eta}_{\mu\nu} \times (x - y)^\nu \,] \times \hat{I} \in \hat{R}\, (\hat{n}, \hat{+}, \hat{x}) . \tag{4}$$

9) The new isotopic image $\hat{P}$ (3.1) of the Poincaré symmetry first introduced in Refs. [3b, 3d, 3f] under the name of **isopoincare symmetry** and today called the **Poincaré-Santilli isosymmetry** [4, 4e].

For all other aspects, such as the nonrelativistic and relativistic dynamical equations, we are regrettably forced for brevity to refer the interested reader to [3k], We here only recall that RHM preserves all axiomatic properties of RQM by construction. This is technically due to the reconstruction on isospaces over isofields of linearity, locality and unitarily. In particular, **isohermiticity** coincides with the conventional Hermiticity. Therefore, all quantities which are observable for RQM remain so for RHM. Also, the real eigenvalues of Hermitean operators remains real under lifting to RHM, and the same holds for other properties [3k].

It should be noted that the elaboration of the above structure with conventional and special functions and transforms leads to a host of inconsistencies which generally remain undetected by non-experts in the field. In fact, all the preceding structures have to be elaborated via the so-called **isofunctional analysis** we cannot possibly review here (see [3g] for a recent presentation).

RHM resolves the problematic aspects of quantum deformations identified in Sect. 3. For instance, all nonunitary transforms can be written in the **isounitary form** $U = \hat{U} x \hat{T}^{1/2}$, $U x U^\dagger = \hat{U} x \hat{U}^\dagger = \hat{U}^\dagger x \hat{U} = \hat{I}$. The isounit $\hat{I}$ is then the basic invariant of RHM exactly as it happens for the conventional unit I of RQM, $\hat{I} \to \hat{I}' = \hat{U} x \hat{I} x \hat{U}^\dagger \equiv \hat{I}$, $id\hat{I} / dt = [\hat{I}, \hat{H}] = \hat{I} x \hat{H} - \hat{H} x \hat{I} = \hat{H} - \hat{H} \equiv 0$; Hermiticity-observability is preserved at all times, as one can easily verify; the numerical predictions of the new theory are unique and invariant because of the uniqueness and invariance of the isospecial functions and transforms; causality and probability laws are verified in exactly the same way as that of RQM; and the theory is constructed under the fundamental condition of preserving Einstein's axioms of the special relativity in isominkowski spaces over isofields. For details on these and other aspects one may inspect ref. [3g, 3h, 3j].

The axiom-preserving character of RHM is so strong that even the maximal causal speed on isospace $\hat{M}$ remains the speed of light in vacuum c_0, and the same happens for other axioms and physical laws of the SR [3d, 3h, 3j].

Also for positive-definite isounits, all isotopic structures are locally isomorphic to the original ones, $\hat{F} \approx F$, $\hat{\mathcal{H}} \approx \mathcal{H}$, $\hat{M} \approx M$, $\hat{P}(3.1) \approx P(3.1)$, etc., and they coincide at the abstract, realization-free level by conception and construction. Therefore, RHM **is not** a new mechanics, but merely a **new realization** of the abstract axioms of RQM as desired, although the two realizations are **physically inequivalent** because connected by nonunitary transforms.

The latter properties are not mere mathematical curiosities because they imply that **the above nuclear realization of RHM preserves the physical laws of RQM**. As an example, from Eq. (2) and the isoexpectation values, one can see that the **isouncertainties** coincide with the conventional uncertainties, $\Delta p_i \times \Delta r^j \geq \frac{1}{2} \times < [p_i, r^j] > = \frac{1}{2} (\hbar = 1)$; the superposition principle is verified despite the nonlinearity of the theory because nonlinear equations $H(x,p,\psi,...) \times |\hat{\psi}> = E \times |\hat{\psi}>$ are turned into the identical forms $H(x,p,\hat{\psi},...) \times |\hat{\psi}> \equiv \tilde{H}(r,p) \times \hat{T}(x,p,\hat{\psi},...) \times |\hat{\psi}> \equiv \tilde{H} \times |\hat{\psi}> = \hat{E} \times |\hat{\psi}> = E \times |\hat{\psi}>$ which does verify the linearity condition in isospace over isofields (isolinearity); Pauli's exclusion principle is preserved because of the preservation of half-odd-integer spins and related statistics (see the adjoining note [1g])); and the same holds for other quantum mechanical laws [3j].

We should also recall that RHM is characterized by new degrees of freedom. In fact, the isominkowskian separation emerges from the new transformation of the unit $I \to \hat{I} = n^2 \times I$ called **isoselfscalarity**, for which

$$x^2 = (x^\mu \times \eta_{\mu\nu} \times x^\nu) \times I \equiv [x^\mu \times (n^{-2} \times \eta_{\mu\nu}) \times x^\nu] \times n^2 \times I = (x^\mu \times \hat{\eta}_{\mu\nu} \times x^\nu) \times \hat{I} . \quad (5)$$

In fact, a novelty of the Poincaré-Santilli isosymmetry is that of being **eleven-dimensional**, the 11-th invariance being precisely (5).

The 11-th dimensionality of the isosymmetry has permitted rather intriguing advances, such as: a novel representation of gravity via the isominkowskian geometry [3j]; the apparently first, axiomatically consistent grand unification including gravity in unified gauge theories of electroweak interactions [3m]; the applicability of the SR to varying speed of electromagnetic waves within physical media with locally varying speed $c = c_0 / n$ (where c_o is the speed in vacuum), while on $\hat{M}$ the speed remains c_0 (since it is compensated by an inverse mutation of the unit) [3b]; and other advances.

Similarly, when n does not depend on the integration variables, we have the new invariance of the inner product of Hilbert spaces

$$< \phi | \times | \psi > \times I \equiv < \phi | \times n^{-2} \times | \psi > \times n^2 \times I = < \phi | \times \hat{T} \times | \psi > \times \hat{I} \quad (6)$$

Virtually all applications in nuclear physics we shall study are a consequence of the above novel invariance.

Note that the new invariances (5) (6) have remained undetected during this century because they required the prior discovery of **new numbers**, those with **arbitrary units** [3c].

Intriguingly, RHM provides an explicit and concrete "operator" realization of the "hidden variables" (see, e.g., [7a]) $\lambda = \hat{T}(\hat{x}, \hat{\psi}, ...)$ via the isoeigenvalue equation

$$H \times |\psi > = H \times \lambda \times |\psi > = E \times |\psi > = (E \times \lambda^{-1}) \times \lambda \times |\hat{\psi} > = E \times |\hat{\psi} >.$$

As such, RHM is a form of "completion" of RQM much along the celebrated argument by Einstein, Podolsky, and Rosen [7b] for which von Neumann's theorem [7c], Bell's inequalities [7d] and all that do not apply owing to the underlying **nonunitary** structure (see [3h,7e] for details).

The most suggestive way for indicating the "hidden" character of RHM is given by the fact that, as one can verify, **the isoexpectation value of the isounit recovers the conventional quantum unit**, $<\hat{I}>=I$. This property should be expected from the fact that the nonlinear, nonlocal and nonpotential effects represented by RHM are **internal** and, as such, they are not directly detectable from the outside.

Similar results can be reached from the property that **the generators of the Poincare and of the Poincaré-Santilli isosymmetry coincide**, thus confirming the validity conventional axioms and physical laws, e.g., for center-of-mass trajectories. Nevertheless, RHM does admit measurable effects, as studied in the adjoint papers [1g,3k] which can at this initial stage be conceived as a mere **new form of non-Lagrangian/non-Hamiltonian renormalizations of internal characteristics via the isounit**, which is called in the literature **isorenormalizations.**

Still alternatively, the same conclusions can be reached from the property that the Poincaré-Santilli isosymmetry $\hat{P}$ (3.1) characterizes a **new class of bound states** called **closed variationally nonselfadjoint** [2d, 3a, 3d, 3f] which are precisely characterized by the **removal of the Keplerian center** thanks to **contact** nonpotential interactions. The best visualization of the conventional Poincaré symmetry is therefore that of characterizing atomic structures with Keplerian nuclei, while the novel Poincaré-Santilli isosymmetry can be visualized as characterizing nuclear structures without Keplerian nuclei.

The reader should be aware that RHM has a number of novel intriguing applications and experimental verifications in various fields. A first application in nuclear physics has been the **reconstruction of the exact isospin symmetry in nuclear physics** [3e], which is permitted by the achievement of equal proton-neutron masses in isospaces over isofields, while maintaining conventional masses under isoeigenvalue or isoexpectation values. Another application has been the study of **deformed** nuclei under the **exact** rotational symmetry. Additional applications and experimental verifications in nuclear physics, such as the first exact-numerical representation of total nuclear magnetic moments, are presented in the adjoining studies [1g, 3k].

The noninitiated reader should be aware that the reconstructions of the exact rotational and isospin symmetries are particular cases of the general property of RHM of reconstructing as exact in isospace over isofields all space-time and internal symmetries when believed to be conventionally broken. In fact, as one can see from isoinvariant (4) and studied in details by Aringazin [3j], the isominkowski space and related Poincaré-Santilli isosymmetry can represent all infinitely possible, well behaved, signature-preserving deformations of Minkowskian spacetime in the fixed frame of the observer, a property known as **direct universality**. The reconstruction of the exact Poincaré symmetry in isospace over isofield then follows from its local isomorphism with the conventional symmetry.

Hadronic mechanics has already seen various applications and experimental verifications in particle physics, nuclear physics, astrophysics, superconductivity, biology and other fields. Among them we mention:

1) the first exact-numerical fit of the experimental data on the behavior of the mean-lives of unstable hadrons with energy [5a];
2) the first nonlocal theory of the Bose-Einstein correlation [5b] which is exactly derivable from first principles without semiphenomenological approximations, and unknown parameters as in quantum models, in excellent agreement with experimental data [5c];

3) the first exact-numerical representation of total nuclear magnetic moments which is permitted by the representation of nucleons as extended charge distributions which can be deformed under nuclear conditions [1g];
4) the first quantitative-numerical representation of the synthesis of the neutron as it occurs in stars at their initiation, from protons and electrons only, which is prohibited in the absence of nonlinear, nonlocal and nonpotential interactions [5d];
5) an isotopic quark theory with conventional quantum numbers and related experimental verifications, and with the first exact confinement [identically null probability of tunnel effects for free isoquarks - not for free quarks - even in the absence of a potential barrier] [5e], in which the confinement is due to the incoherence between the interior and exterior Hilbert spaces caused by the internal nonlocal and non-potential effects, which is not evidently permitted by the current local-differential quark theories;
6) the first attractive force between the identical electrons of the Cooper pair in superconductivity in excellent agreement with experimental evidence [5f];
7) an exact-numerical representation of the large difference in cosmological redshift between certain quasars and their associated galaxies when physically connected according to gamma spectroscopic evidence [5g];
8) the first axiomatically consistent inclusion of gravity in unified gauge theories of electroweak interactions [5h];
9) a quantitative representation of the growth of sea shells [5i];
and other applications (see, e.g., representative papers [6]).

We should finally indicate that all the above applications enjoy axiomatic consistency because it is guaranteed by the preservation of the abstract axioms and physical laws of quantum mechanics. By comparison, other generalized operator theories existing in the literature, such as q-, k- and other quantum deformations, are afflicted by rather serious problems of physical consistency recalled earlier.

The role, and, therefore, the significance of the novel isomathematics at the foundation of these studies is illustrated by the fact that it avoids the above physical shortcomings precisely because of its axiom-preserving character.

It should be recalled that RHM admits a hierarchy of realizations based on a corresponding hierarchy of mathematics called **iso-, geno-and hyper-mathematics** [3i] (a readable review is also available on Page 18 of Web Site 9]), to represent physical conditions of increasing complexity, ranging from the minimal conditions of mutual overlapping of nucleons in the nuclear structure, to their maximal conditions of mutual penetration in the interior of collapsing stars.

The realization needed for nuclear physics must preserve conventional quantum laws, as presented in this note and in the adjoining Refs. [1g, 3k]. Additional, broader realizations for more complex (e.g., open and irreversible) physical conditions occur when the isounit is **non-Hermitean**, in which case the applicable mathematics is of genotopic type, or it is a **set of non-Hermitean elements**, in which case the applicable mathematics is the multi-valued hyper-mathematics [3i, 3j].

In conclusion, an important aspect we have attempted to convey in this paper is that the validity of conventional quantum axioms and physical laws, by no means can be considered as experimental evidence of necessary validity of RQM in nuclear physics, because exactly the same axioms and laws are admitted by a structurally broader theory.

CONCLUDING REMARKS

In this note we have specialized to nuclear physics the RHM formulation of the preceding studies [3g, 3h, 3i, 3j, 4e]. We have then shown that the novel formulation permits a quantitative representation of

nucleons as extended, nonspherical and deformable under linear and nonlinear, local and nonlocal, potential and nonpotential, unitary and nonunitary interactions. Conventional quantum interactions are represented with conventional Hamiltonians while all non-quantum interactions are represented with a structural generalization of the unit of quantum mechanics. We have then provided particular attention in showing that the proposed nuclear formulation preserves all quantum axioms and physical laws, thanks to its formulation in terms of the new isomathematics.

We close this note by indicating a number of possible intriguing advances in nuclear physics available to all inquisitive minds, such as:

1) Novel studies on nuclear forces. From the above results it is reasonable to expect: the initiation of a new chapter in the study of nuclear forces which consists of: the truncation of the historical process of adding potentials to the Hamiltonian, which potentials have lately reached rather excessive numbers; the re-examination of all these terms so as to identify those truly admitting of a **real, actual, potential energy** because resulting from action-at-a-distance interactions, which must be indeed represented with the Hamiltonian, and the identification of old and new terms of contact type for which the notion of potential has no mathematical or physical meaning and which can be consistently represented with the isounit, as studied on operator grounds in this paper and on analytic grounds in memoir [3i].

2) Novel studies on nuclear models. In this paper we have introduced a novel notion of nuclear constituents, the **isoparticles** (or **isonucleons**) as irreducible representations of the Poincaré-Santilli isosymmetry. It is therefore reasonable to expect the initiation of a new chapter in nuclear models. In essence, the nuclear models constructed throughout this century are based on the conventional notion of particles as irreducible representations of the Poincaré symmetry with consequential **perennial and immutable intrinsic characteristics**. In the adjoining papers [1g, 3k] we show that the use of the covering notion of isoparticle implies the alterability of certain (although not all) **intrinsic** characteristics of nucleons with consequential quantitative representation of the "historical hypothesis" recalled earlier, and achievement of the exact-numerical representation of total nuclear magnetic moments. It is therefore reasonable to expect a re-examination of existing nuclear models, as well as attempts for new models stimulated by still unexplained nuclear characteristics, e.g., the **absence of a stable singlet coupling of a proton and a neutron.**

3) Novel studies on nuclear reactions. Perhaps most importantly, a primary characteristic of the nonlinear, nonlocal and nonpotential interactions due to deep wave-overlappings is that of being **attractive** in singlet couplings (only), as theoretically and experimentally established in Refs. [3a] for the π^o structure and in Ref. [5j] for the Cooper pair in superconductivity. The latter studies have moreover established that such an attraction is so "strong" to overcome possible repulsive forces of Coulomb type, exactly as it occurs in the identical electrons of the Cooper pair, as well as in the identical protons of a nuclear structure, thus indicating as conceivable a deeper isotopic interpretation of the charge independence of the nuclear force.

As a consequence of its mathematical structure, conventional quantum mechanics has a rather limited descriptive capability for nuclear reactions, essentially restricted to those admitting of an effective linear, local and potential approximation. The nuclear realization of RHM submitted in this note can instead predict **novel nuclear reactions** which are simply unthinkable with ordinary quantum mechanics precisely because of the absence of "strongly" attractive nonlinear, nonlocal and nonunitary forces. **The initiation of a new chapter in nuclear reactions appears, therefore, conceivable.**

These possible novel reactions deserve theoretical studies and experimental verifications because, unlike other anomalous reactions, they are **fully admitted by conventional quantum axioms and physical laws**, thus having no *a priori* scientific reason for their exclusion, as studied in the adjoint papers [1g, 3k]. A comprehensive presentation with applications to new energies is in press in *Infinite Energy* [8].

All in all, we hope to have illustrated in this note the historical perspective according to which physics at large, and nuclear physics in particular, are disciplines that will never admit "final theories." No matter how effective a given theory may appear, its structural generalization is only a matter of time. This is the fate also of the isotopic theory of this note. In fact, it is already known to be merely the germ of broader genotopic and hyperstructural formulations [3i, 3j] for a deeper understanding of the ever increasing complexity of scientific knowledge.

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NUCLEAR REALIZATION OF HADRONIC MECHANICS, II: EXACT REPRESENTATION OF TOTAL NUCLEAR MAGNETIC MOMENTS AND THE PREDICTION OF THE STIMULATED NEUTRON DECAY

Ruggero Maria Santilli [1]

ABSTRACT

By using the nuclear realization of relativistic hadronic mechanics identified in preceding note [1ae], we present the apparently first, exact representation of total nuclear magnetic moments under the validity of conventional quantum axioms and physical laws. We then apply the result to the prediction that, under certain resonating or other sub-nuclear conditions, the neutron can be stimulated to decay. We review the existing preliminary experimental evidence; we indicate its implications for possible new recycling of highly radioactive nuclear waste; and propose certain experimental resolutions.

INTRODUCTION

In the preceding works [1] we have presented a nuclear realization of relativistic hadronic mechanics (RHM) which essentially permits the representation of nucleons as extended, nonspherical, and deformable charge distributions under linear and nonlinear, local and nonlocal, potential and nonpotential, as well as unitary and nonunitary nuclear forces. The new formalism is called "isotopic" in its Greek meaning of being "axiom-preserving".

The theory is essentially based on a new mathematics called **isomathematics** [1d] characterized by a structural generalization of the basic unit $I = Diag.$ (I, 1, 1, 1) of relativistic quantum mechanics (RQM) into a 4 x 4, nowhere singular, and Hermitean matrix $\hat{I}$ with an arbitrary functional dependence on local variables $\hat{I} = I(\chi, \dot{\chi}, \psi, \partial\psi, \ldots)$ called the **isounit**, with diagonal realization (hereon tacitly assumed from its Hermiticity)

$$\hat{I} = \text{Diag.}\ (n_1^2, n_2^2, n_3^2, n_4^2) \times \hat{\Gamma}\ (\chi, \dot{\chi}, \psi, \partial\psi, \ldots) = \hat{I}^\dagger > 0\ . \qquad (1)$$

RHM can therefore represent those physical characteristics which are outside any realistic hope of quantitative representation via RQM, such as:

1) The representation of extended, nonspherical and deformable shapes via the quantities n_1^2, n_2^2, n_3^2, here characterizing the semiaxes of a spheroidal ellipsoids, under the volume preserving condition $n_1^2, n_2^2, n_3^2, = 1$, with more general shapes represented by nondiagonal isounits;

2) The representation of the medium in which motion occurs via the quantity n_4^2 characterizing the square of the local **index of refraction** or equivalents, of the local density; and

3) The representation of all nonlinear, nonlocal, nonpotential, and nonunitary interactions via the multiplicative factor $\hat{\Gamma}$.

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In this way, the characterization of nuclear systems via RHM requires the knowledge of **two** quantities, the conventional Hamiltonian H representing all conventional quantities and interactions, plus the isounit, which represents all characteristics outside the representational capability of RQM.

The isotopic lifting of the basic (multiplicative) unit $I \to \hat{I} = \hat{T}^{-1}$ requires, for consistency, the corresponding lifting of **all** conventional associative products A x B among generic quantities A, B of RQM into the isoproduct $A \hat{x} B = A \times \hat{T} \times B$, under which $\hat{I} = \hat{T}^{-1}$ is the correct left and right unit of the new theory, $\hat{I} \hat{x} A \equiv A \hat{x} \hat{I} \equiv A$ [1a]. The **totality** of the formalism of RQM must therefore be isotopically lifted for consistency.

The desired nuclear realization of RHM [1a] is then given by the systematic application of a **nonunitary transform** $U \times U^\dagger \neq I$ to the totality of aspects of RQM, e.g., the isounit is given by the transform $I \to \hat{I} = U \times I \times U^\dagger = \hat{I}^\dagger$; the isoproduct is given by the transform $A \times B \to U \times A \times B \times U^\dagger = \hat{A} \times \hat{T} \times \hat{B} = \hat{A} \hat{x} \hat{B}$, $\hat{A} = U \times A \times U^\dagger$, $\hat{B} = U \times B \times U^\dagger$, $\hat{T} = (U \times U^\dagger)^{-1} = \hat{I}^{-1}$; etc.

RHM is based on the novel **isospacetime** characterized by the **isominkowski space** (first introduced by Santilli [2a] in 1983) $\hat{M} = \hat{M}(x, \hat{\eta}, \hat{R})$ with isocoordinates $\hat{x} = U \times x \times U^\dagger = x \times \hat{I} = \{x^\mu\} \times \hat{I}$, **isometric** $\hat{N}_{\mu\nu} = \hat{\eta}_{\mu\nu} \times \hat{I} = \hat{T}^\alpha_\mu(x, \hat{p}, \hat{\psi}, \partial\hat{\psi}, \ldots) \eta_{\alpha\nu} \times \hat{I}$, $\eta = \text{Diag.}(1, 1, 1, -1)$, and isoseparation on the isofield $\hat{R}$ $(n, +, \hat{\times})$ (see Ref. [1] for brevity)

$$(\hat{x} - \hat{y})^{\hat{2}} = (\hat{x} - \hat{y})^\mu \hat{\times} \hat{N}_{\mu\nu} \hat{\times} (\hat{x} - \hat{y})^\mu = [(x - y)^\mu \times \hat{\eta}_{\mu\nu} \times (x - y)^\nu] \times \hat{I} \in \hat{R} \tag{2}$$

The central notion of RHM from which all properties and results can be uniquely and unambiguously derived is the universal symmetry of the isospacetime, which is given by the **eleven dimensional** isotopes $\hat{P}$ (3.1) of the conventional Poincaré symmetry, first identified in [2] and today called the **Poincaré-Santilli isosymmetry**.

The fundamental notion of this note is therefore that of **isonucleons**, that is, nucleons realized as representations of $\hat{P}$ (3.1) under the condition of preserving quantum axioms and physical laws. As we shall see, the lifting from P (3.1) to $\hat{P}$ (3.1) implies the alteration called "mutation" of some (but not all) **intrinsic characteristics** of nucleons as conventionally treated in contemporary nuclear physics [3].

The first conventional characteristics of nucleons which can be mutated is the conventional value of their intrinsic magnetic moments when member of a nuclear structure. As we shall see in the next section, this permits an exact-numerical representation of the "historical hypothesis" [1a], with consequential exact representation of total nuclear magnetic moments under conventional laws.

The Poincaré-Santilli isosymmetry then permits the consequential prediction that the neutron can be stimulated to decay with a number of intriguing implications studied later on.

Among the characteristics which **are not** mutated by the isosymmetry $\hat{P}$ (3.1) we have the intrinsic angular momentum (spin) which, as shown in the next section, remains conventional, thus preserving Pauli's exclusion principle.

The conceptual visualization of the notion of isonucleons is therefore that in which their charge distribution is deformed by external nuclear forces without altering their intrinsic angular momentum, in full agreement with the "historical hypothesis" of Ref. [1a].

EXACT REPRESENTATION OF TOTAL NUCLEAR MAGNETIC MOMENTS.

One of the first applications and experimental verification of the nuclear realization of RHM of Refs. [1a] is the exact-numerical representation of total nuclear magnetic moments which is still lacking for RQM [1]. The representation was first achieved in ref. [3c] under a joint mutation of intrinsic magnetic moments as well as of angular momentum and spin of nucleons. In this note we present, apparently for the first time, an exact representation of nuclear magnetic moments under a mutation of intrinsic magnetic moments but conventional values of angular momentum and spin.

The equation of RHM needed for a quantitative treatment of the "historical hypothesis" is the isotopic image of Dirac's equation, called **isodirac equation**, studied in its general form in ref. [1b]. The realization needed in nuclear physics, here presented apparently for the first time, is that characterized by a nonunitary image of the conventional equation and can be written for the total 6-dimensional isounit $\hat{I}_{tot} = \hat{I}^{Orb} \times \hat{I}^{Spin}$, $\hat{I}^{Orb} \times \hat{U}^{Orb} \times I^{Orb} \times U^{Orb\dagger} = \text{Diag.}(n_1^2, n_2^2, n_3^2, n_4^2) \times \hat{\Gamma} = \text{Diag.}\, \hat{I}_{11}, \hat{I}_{22}, \hat{I}_{33}, \hat{I}_{44})$, $\hat{I}^{Spin} = U^{Spin} \times I^{Spin} \times U^{Spin\dagger}$ (see [1e] for details)

$$[\hat{N}_{\mu\nu} \hat{\times}^{Orb} \hat{\gamma}_\mu \hat{\times}^{Spin} (\hat{p}_\nu - \hat{i} \hat{\times} \hat{e} \hat{\times} \hat{A}_\nu) - \hat{i} \hat{\times} \hat{m}^2) \hat{\times}^{Orb} | \hat{\psi} > =$$
$$= [\hat{n}_{\mu\nu} \times \hat{\gamma}_\mu \times \hat{T}^{Spin} \times (\hat{p}_\nu \times \hat{T}^{Orb} - i \times e \times A_\nu) - i \times m^2) \times | \hat{\psi} > = 0 \qquad (3a)$$

$$\{\hat{\gamma}_\mu, \hat{\gamma}_\alpha\} = \hat{\gamma}_\mu \times \hat{T}^{Spin} \times \hat{\gamma}_\alpha + \hat{\gamma}_\alpha \times \hat{T}^{Spin} \times \hat{\gamma}_\mu = 2\hat{n}_{\mu\alpha} \times \hat{I}^{Spin}, \qquad (3b)$$

$$\hat{\gamma}_\mu = (\hat{T}^{Orb}_{\mu\mu})^{1/2} \times U^{Spin} \times \gamma_\mu \times U^{Spin\dagger} \times \hat{I}^{Spin} \qquad (3c)$$

where γ_μ are the conventional gamma matrices, $\hat{i} \hat{x} \hat{e} \hat{x} \hat{A}_\mu = (i \times e \times A_\mu) \times \hat{I}^{Orb}$ and the em potential A_μ is conventional, being external and long range.

As one can see, the above equation represents particles which: a) have extended and deformable ellipsoidical shapes with semiaxes n_1^2, n_2^2, n_3^2 (under the volume preserving condition $n_1^2 \times n_2^2 \times n_3^2 = 1$); b) propagating within a physical medium with index of refraction n_4 (of value generally different than 1); and c) under conventional external elm interactions (represented by A_μ plus unrestricted non-Hamiltonian internal forces (represented by $\hat{\Gamma}$) .

When a system is considered from the exterior, all nonlocal-nonpotential internal effects must evidently be averaged into constants (due to their short-range character), as it is the case for total nuclear magnetic moments. This yields a mere isorenormalization of the n_μ's into constants hereon tacitly implied.

It is easy to see that isodirac equation (3a) preserves the conventional eigenvalues of angular momentum and spin due to its very construction via nonunitary transforms of conventional equations,

$$U \times [J_\alpha, J_\beta] \times U^\dagger = [\hat{J}_\alpha \hat{,} \hat{J}_\beta] = \hat{J}_\alpha \hat{\times} \hat{J}_\beta - \hat{J}_\alpha \hat{x} \hat{J}_\beta = U \times C^k_{\alpha\beta} \times J_k \times U^\dagger = C^k_{\alpha\beta} \times \hat{J}_k,$$
$$\hat{J}_k = U \times J_k \times U^\dagger \qquad (4a)$$

$$U \times J_k \times J_k \times | \psi > = \hat{J}_k \hat{\times} \hat{J}_k \hat{\times} | \hat{\psi} > =$$
$$= U \times s \times (s + 1) \times | \psi > = s \times (s + 1) \times | \hat{\psi} > \qquad (4b)$$

$$U \times J_3 \times | \psi > = \hat{J}_s \hat{\times} | \hat{\psi} > = U \times s_3 \times | \psi > = s_3 \times | \hat{\psi} > \qquad (4c)$$

(see [1e] for details).

Jointly, the same nonunitary transforms applied to the characterization by Dirac's equation of the magnetic moment yields the desired **mutation of the intrinsic magnetic moment of nucleons**

$$\hat{\mu}_N = \mu_N \times n_3/n_4 \ , \qquad N = n \, or \, p \tag{5}$$

where μ_N is the conventional magnetic momentum in vacuum.

The application of the above formalism to the **exact** representation of total nuclear magnetic moments is straightforward. Assume to a good approximation that protons and neutrons have the same shape (n_{kn}, $= n_{kp}$) and that they move in the same medium ($n_{4n} = n_{4p}$). Then, a simple isotopy of the QM model [3a] yields the proposed **RHM model for the total nuclear magnetic moments**

$$\hat{\mu}^{Exp}_{Tot} = \sum_K (\hat{g}^L_k \times \hat{M}^3_k + \hat{g}^S_k \times \hat{S}^3_k) \tag{6a}$$

$$\hat{g}_n = g_n \, n_4/n_3 \ , \qquad \hat{g}_p = g_p \, n_4/n_3 \ , \tag{6b}$$

where $e\hbar/2m_pc_O = 1$, $g_n^s = -3.816$, $g_p^S = 5.585$, $g_n^L = 0$, $g_p^L = 1$.

As an illustration, the above model yields the following, first, **exact representation of the deuteron magnetic moment** under conventional quantum axioms and physical laws,

$$\hat{\mu}^{Tot}_{Theor} = g_p \, n_{4p}/n_{3p} + g_n n_{4n}/n_{3n} \approx (g_p + g_n) \, n_4/n_3 = \mu^{Exp}_D = 0.857 \ , \tag{7a}$$

$$n_4^2 = 1.000, \quad n_3^2 = 1.054, \quad n_1^2 = n_2^2 = (1/n_3^2)^{1/2} = 0.974. \tag{7b}$$

As one can see, μ^{Exp}_D is exactly represented by merely assuming that the charge distributions of the nucleons in the deuteron experience a small deformation of shape of about ½ %, thus confirming the validity of the "historical hypothesis".

Note that representation (7) **derives** the value $n_4 = 1$ from the experimental data, thus recovering the speed of light in vacuum as the maximal causal speed. This is due to the fact that mutual distances of the nucleons in the deuteron are relatively large for nuclear standards, while deviations from the value $n_4 = 1$ should be expected for heavier nuclei, as we hope to indicate in future works.

Note also that the mutation is of **prolate** character which implies a **decrease** of the (absolute value of the) intrinsic magnetic moment of nucleons as needed (because the representation by RQM is in excess, [3a]).

Note finally also that the representation is of **geometric** character; it is independent from any assumed nucleon constituent; and it identifies the polarization of the constituent orbits which is needed for their compliance with physical reality. Corrections due to the value $n_4 \neq 1$ for the deuteron and other corrections (e.g. the difference in shapes between protons and neutrons) are of second or higher order and will not be considered in this first study.

The application of the model by equation (6) to the exact representation of the total magnetic moment of tritium, helium and other nuclei is straightforward and will be studied in a future work.

It should be finally indicated that the mutation of the charge distribution/intrinsic magnetic moment of the nucleons **is not** a universal constant, because it depends on the local conditions, thus being generally different for different nuclei. This illustrates the need of having infinitely possible **different** isounits $\hat{I}$.

THE PREDICTION OF THE STIMULATED DECAY OF THE NEUTRON

The alterability of the intrinsic magnetic moments of the neutron has a number of predictable implications. In particular, it implies the alterability of other characteristics of the neutron, provided that, again, they are compatible with quantum axioms and physical laws. One of them is the **prediction by RHM that the meanlife of the neutron can be altered under sufficient conditions**. In fact, the derivation of the latter mutation from the former can be readily established via the Lorentz-Santilli isoboosts [2b].

In turn, the alterability of the mean life of the neutron has a number of rather intriguing conceptual, theoretical and experimental implications. In fact, the neutron is one of the largest available reservoirs of clean energy. The capability of altering its mean life implies **the prediction by RHM that the neutron can be stimulated to decay**, with consequential possibilities of new forms of energy, new means for recycling highly radioactive nuclear waste (that is, stimulating its decay in a protected environment into inert elements), conceivable new medical applications, and others.

Independently from the above prediction, experimental evidence clearly establishes that **the neutron does indeed possesses a variable mean life depending on the local physical conditions**. In fact, in certain nuclei, neutrons have a mean lives of a few seconds, in others they have the mean life of minutes, and then admit longer mean lives all the way to stability in nonradioactive nuclei. If nature has established the dependence of the mean life of the neutron from local conditions, the possibility of its stimulated decay is consequential, and its practical realization is essentially open to all inquisitive minds. [See Ed. note at end.]

Once the above scenario is understood (and admitted), the prediction is reduced to the selection of possible means capable of stimulating the decay of the neutron. In this note we study the possible **gamma stimulated neutron decay (GSND)** according to the reaction [4b]

$$\gamma + n \rightarrow p^+ + e^- + \bar{\nu} \tag{8}$$

which is already covered by patent applications. Other possibilities are predicted by RHM via the use of other "triggers", such as other incident particles or disruptions of unstable nuclear structures which are conceivable via a judicious use of the novel nonlinear, nonlocal, and nonpotential component of the nuclear force. The latter means are currently under patent coverage and they will be discussed at a later time.

As it is well known (see, e.g. [3a]), reaction (8) is fully admitted by RQM. The point is that it is predicted to have a very small cross section for all possible values of the energy of the photon $E(\gamma)$, thus having no practical significance.

RHM confirms that indeed the cross section of reaction (8) is very small for all possible values of $E(\gamma)$, **with the exception of a sharp peak in the cross section at the value** $E(\gamma) = 1.294$ MeV (corresponding to 3.129×10^{20} Hz) called **resonating frequency** (RF), with a smaller peak predicted at $E(\gamma) = 0.511$ MeV (corresponding to 1.236×10^{20} Hz) [4b].

The above prediction can be reached in a number of ways. The first is via the **isotopes of the scattering theory**, also called **nonpotential scattering theory**, or **isoscattering theory** (see Ch. 12 of [1c]). The case here is significant (the isotopy of the conventional scattering theory for reaction (8)), can be constructed by the interested reader via a step-by-step **nonunitary** transform of the conventional treatment, much along the rules of ref. [1a]. This recovers the conventional very small value of the cross section of reaction (8) for all possible values of $E(\gamma)$ except at the values of resonating frequencies.

Alternatively, one of the first applications of RHM for which it was proposed [1] has been the exact-numerical representation of the synthesis of the neutron in stars at their beginning, from protons and

electrons only [2e, 2f], as originally conceived by Rutherford [4a], and today characterized by the familiar reaction

$$p^+ + e^- \to n + \nu. \tag{9}$$

Again, the above reaction is fully admitted by RQM, although with a very small cross section at low energies, thus predicting the reaction to be possible in significant amounts only under the high energies available in the sun.

The first novelty of studies [2e, 2f] via RHM is that of recovering these results at all energies, except for a sharp peak at the threshold energy of 0.80 MeV caused by the highly attractive character of the nonlinear, nonlocal, and nonpotential interactions originating from the mutual penetration of the proton and the electron in singlet coupling. The first novelty of RHM is therefore that of predicting the possibility of synthesizing the neutrons at ordinary temperatures.

Moreover, following Fermi's teaching recalled in ref. [1a], the nonlinear, nonlocal, and nonpotential effects due to the total immersion of the electron within the hyperdense medium inside the proton imply a mutation of the interior spacetime. Since our isominkowskian spacetime is "directly universal" for the representation of all possible mutations, and the only one preserving the original Minkowskian axioms, it applies for the geometrization of the interior of the neutron. In turn, this implies a **necessary** isorenormalization of the rest energy of the constituents, as it is the case for all alterations of the conventional Minkowskian space because of the change of the value of c in the expression $E = mc^2$.

Explicit calculations done in Refs. [2e, 2f] have indicated that the total penetration of the electron within the hyperdense proton structure implies a novel non-Lagrangian isorenormalization under which the rest energy of the electron is lifted from the conventional value 0.511 MeV in vacuum to the value 1.294 MeV, which is precisely the primary resonating frequency (RF) for stimulated decay (8), the secondary RF being the conventional value 0.51 MeV of the rest energy of the electron.

The second novelty of studies [2e, 2f] is, therefore, that according to RHM, **the electron e^- does not "disappear" at the time of syntheses (9), but remains in full existence after the synthesis, although in a mutated state e^- obeying the Poincaré-Santilli isosymmetry**. This is the truly fundamental prediction from which the capability to stimulate the neutron decay is consequential. In fact, the excitation frequency for the stimulated neutron decay is in reality that for the excitation of ν the mutated electron within the neutron. At any rate, this author has experienced considerable uneasiness since his graduate studies in physics in accepting the contemporary view along weak processes that a perfectly stable and perfectly elementary particle such as the electron could possibly "disappear" at the time of synthesis (9).

Needless to say, the current representation of process (9) via weak interactions preserves its full physical value, although as an **exterior non-structural representation** of process (9). The above representation via RHM is the complementary interior structural representation. No conflict among the two complementary representations is known at this writing. A complete review is available in ref. [7].

If the predictions of the synthesis of the neutron and its stimulated decay are confirmed, their primary intended use is for conceivable new means for recycling nuclear waste. One among various possible methods is given by **bombarding the radioactive waste with a beam of photons of the needed excitation frequency and of the maximal possible intensity and coherence**. Such a beam would cause an instantaneous excess of peripheral protons in the waste nuclei with their consequential decay due to instantaneous excess of repulsive Coulomb forces. Other methods are under patenting and will be discussed in the scientific literature at some later time.

It should be stressed that this note can only address the basic **principle** of the GSND. Once experimentally established, the recycling requires evident additional technological studies on the

equipment suitable to produce the photon beam in the desired frequency, intensity and coherence, e.g., via synchrotron radiation or other mechanisms, whose study has already been initiated by Driscoll [4d] and others.

The important point is that an equipment of the above type is expected to be definitely smaller in size, weight and cost than large particle accelerators currently under study for the recycling of nuclear waste. As such, the recycling is expected to be usable by the nuclear power companies in their own plants, as well as in dumping site which may in this way become more acceptable.

A novelty of this note is that the study of recycling mechanisms is specifically restricted to the **subnuclear** level. A virtually endless number of possibilities exist for the reduction of the mean life of the waste via mechanisms of **nuclear** type. Among them we note mechanisms based on RQM, such as those by Staffer et al. [5a], Marriot et al. [5b], Barker [5c] and others, as well as new **nuclear** mechanisms indicated earlier which are predicted by RHM. The understanding is that, to maximize the efficiency, the final recycling equipment is expected to be a combination of various means of both subnuclear and nuclear character, thus based on both RQM and RHM.

We should finally mention for completeness that the GSND (8) is also under study for **light, natural, stable elements** [4b]. Intriguingly, after the imposition of all quantum mechanical axioms and physical laws, as well as of ordinary conservation laws for the energy, angular momentum, etc., there remains the possibility of stimulated transmutation in a few light, natural, stable nuclei into others of smaller atomic weight, such as [4b]

$$\gamma + \mathrm{Mo}(100, 42) \rightarrow \mathrm{Tc}(100, 43) + \textit{beta - minus - (stimulated)};$$

$$\mathrm{Tc}(100, 43) \rightarrow \mathrm{Ru}(100, 44) + \textit{beta - minus - (spontaneous)}, \qquad (10)$$

which, if confirmed, would imply the release of a considerable amount of clean energy, called **hadronic energy** to indicate its sub-nuclear origin.

One should meditate a moment on the facts that such a conceivable energy is clean in the sense that it does not release harmful radiation (because the electrons can be easily trapped to utilize their energy and the neutrinos are harmless to humans and to the environment), and it does not release harmful waste (because certain light, natural, stable elements are turned into light, natural, and stable elements of smaller atomic weight). Moreover, unlike nuclear energy, the hadronic energy would not require a heavy shield or a critical mass and, therefore, it could be realized in large or miniaturized forms.

No matter how small the chances of success, societal and scientific accountabilities warrant the studies herein suggested. After all, we should not forget that in the past century eminent scientists predicted that the best possible use of fossil oil was for the illumination of lamps in public streets.

EXPERIMENTAL VERIFICATIONS

In the author's view, the currently available experimental values of the total nuclear magnetic moments constitute direct experimental verifications of the Poincaré-Santilli isosymmetry and related nuclear realization of RHM, because they are the only known formulation providing their exact-numerical representation via a mutation of the intrinsic magnetic moments of nucleons.

We should also mention that preliminary experimental measures on the alterability of the **intrinsic** magnetic moments of nucleons were conducted from 1975 to 1979 by H. Rauch and his associates [6a-6e] via interferometric measures of the **4π spinorial symmetry** of the neutron. The best available measurements [6e] dating back to 1979 indicate about 1% deviations from 720°. But such deviation is

smaller than the error, and the measurements are therefore undefined. Similar unsettled measurements were conducted by Werner and his associates [6f] in the mid 1970's.

The above measurements are evidently important for possible new forms of recycling nuclear waste as well as for other novel possibilities. In fact, they would provide additional experimental evidence on possible deviations from the Poincaré symmetry in favor of the Poincaré-Santilli isosymmetry [2]. This is due to the fact that, if confirmed, the measurements would establish a deviation from the fundamental **spinorial** transformation law in favor of the mutated form easily derivable from the iso-Dirac equations (see Ref. [1f] for details)

$$\psi' = R(\theta)\,\psi = e^{i\gamma_1\gamma_2\hat{\theta}_3/2}\psi, \quad \hat{\theta} = \theta/n_1 n_2, \tag{11}$$

As an illustration, assume a 1% deviation from 720°. The isotopes re-construct the exact SU(2)-spin in isospace, thus requiring $\hat{\theta} = \theta/n_1 n_2 = 720^\circ$, from which we have the numerical values

$$n_1^2 = n_2^2 = 713^\circ / 720^\circ = 0.990, \; n_3^2 = 1.020, \tag{12a}$$

$$\mu / \mu = n_4 / n_3 \approx 713^\circ / 720^\circ, \; n_4 = n_3 \times 713^\circ / 714^\circ = 1.000, \tag{12b}$$

namely, our iso-Dirac equation (3) provides an **exact-numerical** representation of the 4π interferometric measurements by **deriving** the value $n_4 = 1$ occurring in vacuum, as it is the case for the set-up of the experiment (a thermal neutron beam moving in vacuum).

Note that isorepresentation (12) is not possible with RQM, and this may be a reason why such a fundamental scientific knowledge has remained unsettled since the late 1970's.

A preliminary experimental verification of the synthesis of the neutron in laboratory was done in Brazil by don Borghi's and his associates [4e]. In essence, the experimenters filled up a metal chamber with a ionized hydrogen gas at room temperature which was kept partially ionized via electric discharges. Since protons and electrons are charged, they cannot escape the metal chamber and are therefore kept in its inside. In the outside of the chamber and all around it the experimenters placed a variety of materials for various lengths of time and apparently detected their transmutation due to a neutron flux. In the absence of any other source, the only apparent source of neutrons is their synthesis in the interior of the chamber from protons and electrons according to reaction (9). Needless to say, this experiment too is preliminary and in evident need for independent verifications (see below).

Note the most important point here requiring experimental verification, which **is not** the general synthesis of the neutron (since it is established in stars), but its **synthesis at ordinary temperature**, evidently under the availability of the 0.80 MeV threshold energy. This is the occurrence which is denied by RQM, but which is predicted by RHM thanks to the highly attractive nature of nonlinear, nonlocal, and nonpotential interactions in singlet couplings [1f, 7].

A preliminary experimental verification of the stimulated decay of the neutron for the RF of 1.294 MeV has been conducted in Greece by N. Tsagas and his group [4f]. In this case, the experimenters placed a disk of Eu^{152} (which emits photons with the needed frequency of 1.3 MeV among others), next to a Mo^{100} mass and measured with a scintillator the energy of the emitted electrons. It is known that if such energy is of 1 MeV or less, the electrons are due to Coulomb scattering of the gammas with the peripheral atomic electrons. However, if the electrons have energy over 2 MeV they can only originate from stimulated transmutation (10). At this writing, the latter electrons have been measured indeed, but they cannot be definitely distinguished from the background and these measurements too need further tests.

The reader should be aware that RHM has a number of direct experimental verifications outside nuclear physics recalled in [1a].

PROPOSED EXPERIMENTS

Physics is known to be a science with an absolute standard of value, the experimental verifications. Experiments themselves have their own standard of value. The more fundamental the physical law is to be tested, the more important is the test. Yet another standard of value is the fact that preliminary experimental results can only be confirmed or denied via independent re-run and they certainty cannot be dismissed via personal theoretical beliefs one way or another.

In the preceding note and in this note we have studied three possible nuclear events, all outside the predictive capacities of RQM, the deformability of the intrinsic magnetic moments of nucleons, the synthesis of the neutron from protons and electrons only under the threshold energy of 0.80 MeV, and the simulated decay of the neutron via photons with a suitable resonating frequencies or other subnuclear triggers.

We have proved that, unlike other nuclear events, the above events verify in an exact way quantum axioms and physical laws, only realized in a way more general than the simplest possible realization provided by RQM.

We have then indicated that each of the above three predictions has already received experimental verifications, although they are preliminary at the time. Yet the reader should keep in mind that each of the three experimental verifications [4e ,4f, 6] could have **excluded** the predictions by RHM already in their preliminary runs, which has not been the case.

The above occurrences exclude any possible scientific resolution of the above three predictions via theoretical considerations alone one way or another, thus leaving no possibility other than the experimental resolution.

We therefore suggest the experimental resolution one way or the other of: the 4π interferometric measures [6], provided that it is not done in vacuum but with the thermal neutron beam passing through dense matter (otherwise no anomaly is predictable); don Borghi's experiment on the synthesis of the neutron [4e], provided that it is done near the threshold energy of 0.80 MeV (otherwise no synthesis is possible); and Tsagas experiment on its stimulated decay [4f], provided that it is done with the specific resonating frequency on an element admitting the stimulated neutron decay (otherwise no such decay is conceivable). All these tests can be re-done in their original versions or in a number of alternative versions.

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I would like to express my sincere appreciation to Yuval Nee'man of the University of Tel Aviv, Israel, for penetrating and invaluable criticisms he expressed back in 1980 at the meeting on *Differential Geometric Methods in Theoretical Physics* held at the University of Clausthal, Germany, following my presentation [3d] on the first quantum deformations of the SU(2)-spin algebra on record and its application to a representation of the 4π interferometric measurements of [6]. It should be recalled that my presentation (based on non-Lie, Lie-admissible deformations) was intended for a quantitative treatment of hadrons **under "external strong" interactions** which is still a basically open aspect as of now on both theoretical and experimental grounds. The sound objection moved by Yuval Nee'man which stimulated this work is that the setting of measurements [6] is essentially electromagnetic and, therefore, we should expect no deviation from conventional quantum laws as instead implies by quantum deformations [3d]. This note

reports my solitary scientific journey following the Clausthal meeting of 1980 to achieve the indicated representation. The unusual length of time in the solution is an indication of the complexity of the problem which eventually required the construction of the new isomathematics and related reformulation of the nuclear theories.

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EDITOR'S NOTE:

The potential for stimulating or altering the decay times of excess neutrons resulting from the fission of heavy elements may have been experimentally observed. In the use of high-density charge clusters to bombard some heavy elements, the end products (fissioned elements) are stable. Therefore, the rate at which excess neutrons decay (usually by beta emission) has apparently been accelerated. The observation of neutrons in other experiments may be related to eq. (9).

Reference: Ken Shoulders & Steve Shoulders, "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions," *J. New Energy*, vol 1, no 3, pp 111-121, Fall 1996, 7 refs, 22 figs.

EDITOR'S CHOICE

INTERACTION BETWEEN KOZYREV-DIRAC RADIATION AND RADIONUCLIDES

I.M. Shakhparonov

ABSTRACT

Contemporary physics admits the existence of a magnetic monopole in the theories of grand unification, though until recently there have been no evidences of its existence. Having applied a non-trivial approach to a search for a magnetic monopole, the author succeeded in showing that a magnetic monopole is not a rarity in nature and that it, in fact, had been long discovered by Russian scientist N. Kozyrev. In the article we mention the results of earlier published papers by the author on elucidation of the properties of the newly discovered radiation which consists in the flow of magnetic monopoles. The novel data presented bring an indication of the magnetic monopole being very similar to a neutron, on the one hand, and on the other hand, we have demonstrated a possible approach to the fission control with the use of the Kozyrev-Dirac radiation.

INTRODUCTION

In his work [1], predicting the existence of a magnetic monopole, Dirac has found that within the framework of the quantum theory, a quantized electrical charge cannot exist without a magnetic charge. Accordingly, it would mean that the amount of magnetic monopoles in the volume of substance approximates to the amount of atoms in the same volume and that the stability of the substance depends wholly on the presence of such particles in it.

On the other hand, numerous attempts directed at a search for magnetic monopoles had no success. Both experimenters and theorists repeatedly posed the question of their existence in nature. Thus, within the framework of traditional approaches, the problem cannot be solved. Among probable untraditional approaches, the most promising ones seem to be researches held by Kozyrev [2] and Lavrent'ev [3,4], et al., who staged experiments on elucidation of the essence of time. **Magnetic monopole can be viewed as a carrier of properties of time.** The choice is by no means accidental, since a stream of particles of such large mass as that of magnetic monopoles should noticeably distort the space-time metrics, thus affecting the course of cause-and-effect relations. According to the published data, both researchers at a different time came to the same conclusion about the existence of an earlier unknown factor contributing to the transmission of information with infinite velocity in vacuum.

Independently, while investigating the properties of nonoriented contours, the author came to a conclusion that there exists earlier unknown radiation capable of transmitting information with infinite velocity. The discovered radiation had a specific feature, namely, on being absorbed by the substance of the transmitter, it cooled this substance. Within current notions such property appears explicable on a presumption that, in this case, we have to do with the magnetic cooling effect. We may assume that a star, the Sun included, generates a stream of magnetic monopoles traveling with velocities considerably smaller than the velocity of light; in their turn, they distort the metrics forming gravitational waves with the velocity far greater than that of light in vacuum. Moreover, magnetic monopoles, traveling along magnetic lines of force to the center of the Earth, increase its mass and produce an essential effect on atmospheric and tectonic processes. Thus, Kozyrev and Lavrent'ev investigated natural sources of scattered radiation. The author of this report has succeeded in manufacturing a number of concentrators of the new radiation, which

ensure stable parameters in laboratory conditions. Taking into account, that the actual discoverer of the new radiation is Nicolai A. Kozyrev, and the theorist who predicted the possibility of existence of such particles was P.A.M. Dirac, the new radiation was called "Kozyrev - Dirac radiation" (KDR) [5].

Besides, we have produced a solid-state magnetic film detector, which allowed us not only to define the trajectories of the radiation carriers and to estimate their energy, but also to show that the particles transform a substance on interaction with it. A good example in this sense is the treatment of a sample of superpure block graphite. Graphite is known to feature clearly pronounced diamagnetic properties. Diamagnetic graphite can be transformed into paramagnetic one by the neutron bombardment of the sample with a total dose of 7×10^{19} neut./cm^2. [6]. This kind of treatment inevitably results in the formation of carbon radioactive isotopes. The exposure of the same carbon sample to KDR resulted in acquired paramagnetic properties but no radioactive isotopes were detected. With a knowledge of the dimensions of the sample, the time of KDR action and the parameters of the KDR concentrator, it is possible to estimate the total mass of particles per pulse which in the neutron equivalent will make 2×10^{14} neut./cm^2 x s. Whether this mass is the mass of one particle or several particles is to be found in later researches.

Until now there exist several models of interaction between a magnetic monopole and a substance. One of them assumes the magnetic monopole to be a catalyst of nucleon decay [7], and consequently can be considered to be an agent in transmutation processes. According to another model [8], a magnetic monopole appears to be a chemical element. All singularities of the magnetic monopole behavior should be well seen in a nonequilibrium (for example, radioactive) substance. This conclusion is driven at owing to a comparative ease of recording the changes in the gamma-spectrum in contrast to other methods. By virtue of the above-cited reasons in 1993 the author carried out the first experiment in this direction with ^{131}I. The experiment has shown an anomalously fast disintegration of the KDR-treated radionuclide (Fig. 1) [9]. Similar results were obtained earlier by other authors [10] in experiments with radionuclide samples in equi-potential electrostatic fields of high intensity produced with the Van de Graaff generator. However, no detailed analysis of nuclear transformations has been made. This report is the first work intended to make up for this annoying gap.

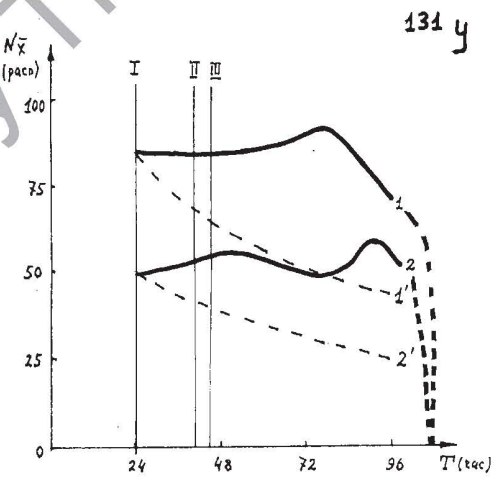

Fig. 1 Disintegration of the KDR-treated radionuclide

EXPERIMENTAL SET-UP

In theory it is known that magnetic monopole can be accelerated in the magnetic field [11]. The increase of energy can be calculated from the formula:

$$E(eV) = 300 \bullet 137/2\ HL,$$

where:

H is the magnetic field induction, G/cm, and
L is the length of solenoid, cm.

While accelerating, the magnetic monopole travels along force lines. With this property in mind, we designed and fabricated an induction accelerator. The accelerator consists of the following parts (Fig.2):

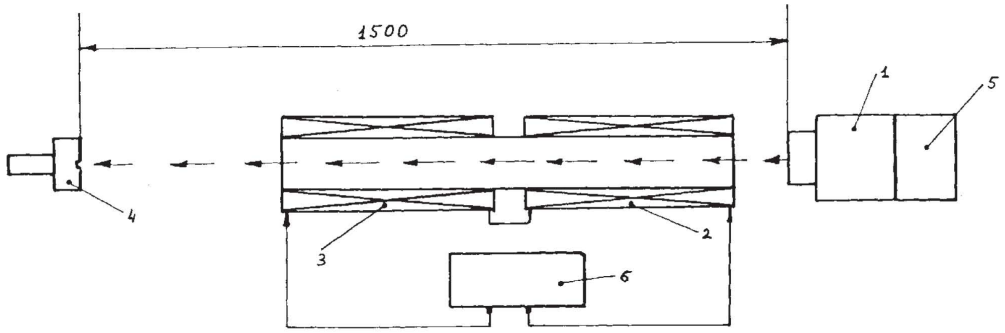

Fig. 2 Induction accelerator

1. A concentrator and a shaper of the beam of magnetic monopoles (KD-radiation);

2. The 1st accelerating section 29 cm long with induction of 628 G/cm. With the current of 10A the monopole energy should increase by ≅0.37 GeV;

3. The 2nd accelerating section 39.5 cm long with induction of ≅1000 Ge/cm. With the current of 10A the monopole energy should increase by ≅0.8 GeV

4. A target in the form of a uranium bolt M12 L22 consisting of a mixture of uranium isotopes (^{235}U, ^{236}U, ^{238}U), subjected to intensive neutron bombardment with a subsequent 5-year seasoning;

5. A power supply of the shaper. An average electrical power is 10 mW;

6. A stabilized power supply of accelerating sections 0-30 V; 0-10 A.

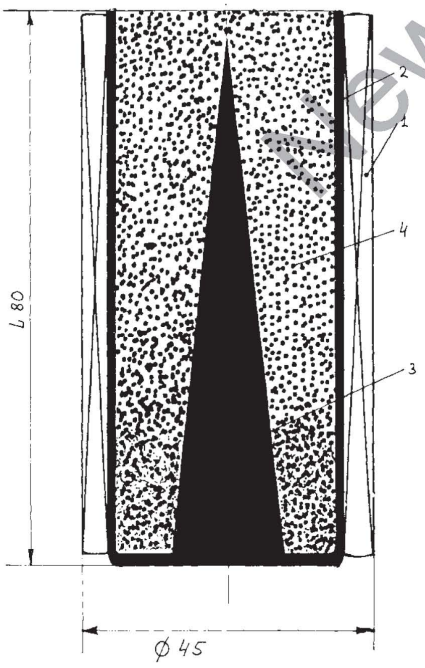

Fig. 3a KDR forming device

The acquisition and the primary analysis of gamma-spectra were carried out on installation ROUS (abbreviation of the Russian "X-ray spectrometry model installation") equipped with a semiconductor detector with the energy resolution 500 eV and the energy detection range from 50 to 2700 keV.

The KDR forming device (Fig. 3) is made of a metal glass (2) with a conic central guide (3). In the body of the glass a nonoriented superlattice (4) is formed with the total number of elements of the order of 10^{10}. Atop of the metal glass an exciting winding (1) is coiled. The distribution of the magnetic field along the length of the device is shown in Fig. 3b. Nanosecond pulses with the recurrence frequency of 20 kHz are applied to the winding.

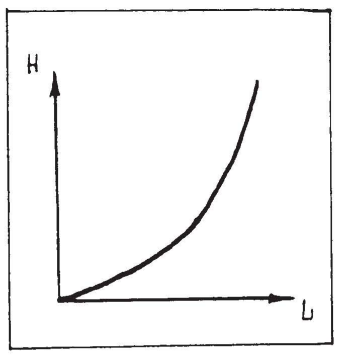

Fig. 3b Distribution of magnetic field

The experimental technique consists in the following:

The preliminary stage envisages careful warming up of the installation, a 4-hour accumulation of the initial spectrum, a spectrum

acquisition and its primary treatment. The experimental part includes a 4-hour treatment of the uranium target according to the schedule program followed by production and treatment of the spectrum. Thus, the four basic spectra were obtained: the first is the initial on; the second is the spectrum of the KDR action on the uranium target without acceleration, the third is that of the KDR action, accelerated by the first section; and the fourth is the spectrum of the KDR action, accelerated by two sections. The acquisition of one spectrum in one experiment takes in sum 9 hours (i.e. 4 hours of KDR treatment, 4 hours of spectrum production and 1 hour of its derivation and primary processing).

RESULTS

From the presented histograms of the gamma-spectrum line distribution (Fig. 4), one can see that specific reactions proceed in the uranium target under the action of magnetic monopoles. Unfortunately, because of the incompleteness of the database the gamma-spectrum was not interpreted. However, even what is already available allows us to make definite conclusions. We have paid attention to an absolutely explicit circumstance, that a merely focused KDR beam produces no effect on the gamma-spectrum of the target (histograms 1 and 2). The stable substance did not turn active under the influence of the KDR stream of our accelerator, since the holder of the uranium bolt did not become radioactive after hours of treatment. After the exposure of the target to magnetic monopoles accelerated by the first section, we may notice essential changes (histogram 3). In this mode the changes in the gamma-spectrum basically manifest themselves in the suppression of radiation of, apparently, K and L levels of radioisotopes in the target (37% of the total number of lines of the initial spectrum). Attention should be drawn to the emergence of new lines (5%) and an annihilation line of 511 keV. We attribute the origination of this line to a nucleon decay in the magnetic monopole field. Thus, in this acceleration mode the effect of radiation suppression is much more pronounced than the effect of activation. With a sufficient degree of probability it is possible to predict, that a complete suppression of nuclear reactions in the target is feasible through making use of a more powerful source of KDR and a selection of appropriate acceleration energy. Still greater acceleration of magnetic monopoles by means of an application of two solenoids connected in series brought about an abrupt change in the gamma-spectrum of the sample. Along with still greater number of suppressed lines (45%), there appeared a noticeable amount of earlier unobserved ones (41%). Thus, we see the presence of two competing processes (suppression and excitation). To our opinion, both processes are caused by the interaction of the fields of a magnetic monopole and an atom. Since KDR is

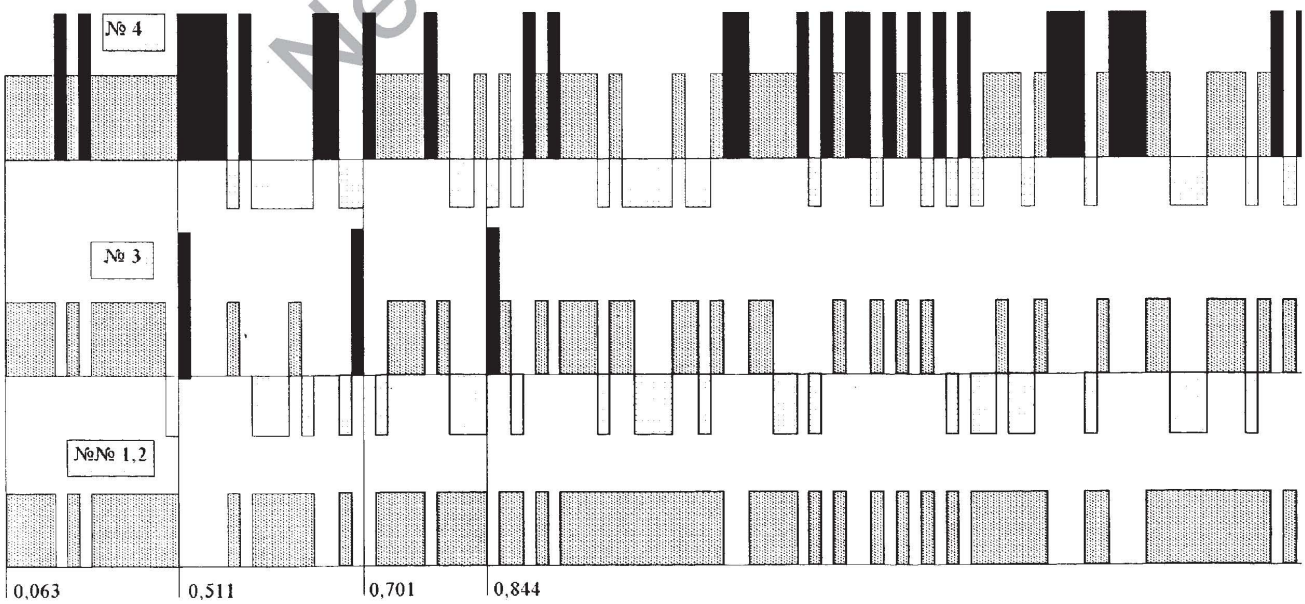

Fig. 4 Histograms of the gamma-spectrum line distribution

polychromatic, the monopoles of different energies can interact differently with nuclei. Therefore, we can assume that through modification of KDR parameters it is possible to achieve a mode of full suppression of the nuclear reaction or, on the contrary, of fast scintillation of the radioactive substance. Further steps in this direction and especially the construction of a cyclic induction accelerator of KDR will test the correctness of our prognoses. The measurements of the activity of radionuclides of the target have revealed its monotonic reduction with each next experiment. Though the activity variation is within 10% of the error, its persistent lessening gives us the right to think that this process is not accidental.

CONCLUSION

Summing up, we can stress out the following characteristic symptoms of the KDR interaction with stable and radioactive substances:

1. Neither focused nor accelerated (up to $\cong$1,17 GeV) KDR activates stable substance.
2. Focused and accelerated in the magnetic field (up to $\cong$0,37 GeV) a KDR beam basically prevents the disintegration of radionuclides.
3. A beam with the energy $\geq$ 0,37 GeV initiates a nucleon decay in the magnetic monopole field.
4. Focused and accelerated in the magnetic field (up to $\cong$1,17 GeV) a KDR beam accelerates the decay of radionuclides.

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to all workers of the Head Laboratory of Radiation Monitoring and Radiation Physics for their help in the researches and my special appreciation to Sergei Kolotukhin for his selfless labour. But for his persistence, knowledge and energy this work would have never been successfully carried out.

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BREMSSTRAHLUNG - RELATIVE ROLE IN HOT AND COLD FUSION AND IMPACT UPON POTENTIAL ISOTOPIC FUELS

Mitchell Swartz [1], Gayle Verner

ABSTRACT

Unlike hot fusion or plasma systems, bremsstrahlung radiation in cold fusion systems cannot dissipate fusion power through production of penetrating radiation. The bremsstrahlung radiant power from cold fusion differs from hot fusion in being markedly lower in intensity, with an output spectrum in the near infrared. The cold fusion bremsstrahlung power density, relative to input power, falls from 0.05 - 0.28 (hot fusion) to only 1.4 - 8.1 x 10^{-10} for cold fusion. The delivered x-ray radiation dose (at 1 meter) decreases from 3.1 x 10^{19} Grays (hot fusion) to 1.4-3.3 x 10^{-4} Grays for cold fusion. These calculations are consistent with the relative absence of apparent ionizing emissions from cold fusion systems for both nickel-light water and palladium-heavy water systems.

The energy transfer in cold fusion systems via bremsstrahlung radiation is limited by the skin depth which for palladium (9.25 x 10^{6} mhos/meter, 10^{13}-6 x10^{14} Hz) is 2.7-20.9 nanometers. One implication of the effective containment of the radiant bremstrahlung power, is its possible overlap with thermal and phonon processes. A corollary is that because of the much lower levels of bremsstrahlung power emitted, isotopic fuels of higher atomic number may be useful in cold fusion systems.

INTRODUCTION - Bremsstrahlung and Cold Fusion

There have been many suggested theories used to dismiss the extensive experimental observations of the cold fusion phenomena. Several of these purported reasons have been shown to be incorrect including the unusual and unexpected cold fusion branching ratio [1], recombination [2, 3, 4], special relativistic effects [1], and experimental issues involving sampling error, noise, and contamination [3, 4].

X-ray emissions, including bremsstrahlung [German for "braking (**brems**) radiation (**strahlung**)] emissions, have also been repeatedly cited as a theoretical reason to dismiss the extensive experimental observations of cold fusion. But this is incorrect on both logical, and quantitative, and spectral-emissive grounds. The issue is not that Bremsstrahlung emission rates from cold fusion cells are qualitatively lower than those emission rates from hot fusion plasmas, but that cold fusion reports have been dismissed by skeptics because of purported x-ray (and neutron) emissions which they claim must accompany cold fusion reactions at a level to create the purported "graduate student problem (read: survival after the experiment with negligible shielding)". This purported "miracle" of cold fusion concerning the relative absence of lethal ionizing radiation emission actually must pass a semiquantitative test. The other purported "miracle" was eliminated as a concern when the neutron emission channel was closer examined because it was shown to be ~1 MeV above the helium nucleus first excited state, and therefore unattainable at cold fusion temperatures [1] and hence, the channel is forbidden - consistent with observations. Therefore, x-ray bremsstrahlung emission – often invoked but rarely quantitatively considered – remains the only theoretical factor (other than coulomb barrier penetration and nuclear-coupling issues to the lattice) which skeptics can honestly use against cold fusion.

[1] Research supported by JET Energy Technology, Inc., Wellesley Hills, MA 02481

Furthermore, accurate measurements of very low energy x-ray emissions from both nickel light water cells [5] and palladium heavy water cells [6] indicate levels on the order of background consistent with the actual calculation reported herein (Table 1). This paper, therefore, examines bremsstrahlung and its possible role in the cold fusion phenomena more closely considering the following questions: Is there bremsstrahlung in cold fusion? How would it differ from the extensively observed Bremsstrahlung in electron beam experiments, plasma systems, and hot fusion?

Electromagnetic Radiation Emitted has Many Components

Power loss from fusion systems (P_{LOSS}) has the usual components of radiation (P_{RAD}), conduction (P_{COND}) and convection (P_{CONV}). The power loss from radiation (P_{RAD}) as usually considered in hot fusion systems consists of radiation components secondary to bremsstrahlung (P_{BREM}), cyclotron radiation (P_{CYC}) , and optical emissions (P_{OP}) [7]. These are augmented here by three additional terms, which represent the effects of conduction and convection, that is, blackbody power emission (P_{BB}), heat (enthalpy) conduction (P_{ENTH}), and the power loss which may result through the exit gas stream (P_{GAS}). In cold fusion systems these must be included.

The heat conduction in hot fusion is usually handled through its implicit incorporation in the energy confinement time. Here, it is included explicitly in equation (1) because the excess enthalpy of cold fusion is the major signal of the desired reactions where optical phonons may play a significant role in hyrided lattices and their electronic behavior [8].

$$P_{LOSS} = P_{RAD} + P_{COND} + P_{CONVECT} = P_{BREM} + P_{CYC} + P_{OP} + P_{BB} + P_{ENTH} + P_{GAS} \quad (1)$$

Significant levels of bremsstrahlung occur at hot temperatures characteristic of plasmas. Because of the energies involved, the bremsstrahlung radiation is penetrating and cannot be contained. This is important because at relativistic energies, the energy loss by bremsstrahlung may exceed that secondary to all collision interactions with matter surrounding and within the reactor. Contrast this to hot fusion systems, where the energetic ions and electrons of the plasma radiate so much ionizing (x-ray) power by bremsstrahlung that this radiation leakage challenges reactor planning because it can effectively remove so much of the produced fusion power.

Bremsstrahlung [Breaking Radiation]

There are two well-known types of bremsstrahlung - outer and inner. Outer bremsstrahlung (output spectrum shown in Fig. 1) is the release of ionizing radiant energy from highly energetic moving charged particles upon their deceleration [9,10]. This form of bremsstrahlung was first observed when it produced secondary x-radiation from fast moving electrons hitting thick metallic targets. Inner bremsstrahlung occurs in β-decay and results in the emission of photons in energy between zero and the maximum energy available for that transition. Inner bremsstrahlung, double bremsstrahlung [11-13], polarization bremsstrahlung, solar bremsstrahlung [10] and the relativistic bremsstrahlung associated with hadronic showers including solutions by the Weizsacker-Williams method of virtual quanta will not be discussed in this paper.

This paper considers the energy range of the electromagnetic radiation emitted by Bremsstrahlung, the proportion of Bremsstrahlung to other energy losses including radiant and collisional, and in the case of fusion, the ratio of Bremsstrahlung power density to fusion power density.

Outer Bremsstrahlung Emission Spectrum

Bremsstrahlung, described by a theoretical energy spectrum and angular distribution [14, 15, 16], has an observed power output spectrum (confer fig. 1) as a function of the emitted photon energy. The output

spectral curves are continuous, but also contains characteristic material-specific photon peaks (lines) superimposed. The latter occurs from the displacement of lower-lying electrons in the target and the subsequent refilling of those orbitals. Fig. 1 was obtained by spectroscopy of bremsstrahlung emission from electrons of varying electrical accelerating potential which impinged upon a thick tungsten target. The peak emission outputs increase with applied electric potential. The 'white' light emission characteristics are shown which are very close to those of bremsstrahlung. The effect of filtration (discussed below) of 1 millimeter of aluminum is also shown in Fig. 1.

Bremsstrahlung Radiation Cross Section

The energy in the bremsstrahlung output spectrum (Fig. 1) is expressed for incident beam or gendanken experiments as a cross section of photon emission with dimensions of area/unit photon energy. This enables the determination of the beam energy loss as a function of distance ($\frac{dErad}{dx}$). The radiation cross section of bremsstrahlung has been considered several ways including classical, semiclassical quantum, and the Bethe-Heitler quantum mechanical Born approximation (done in 1934). Calculations usually begin with the kinetic energy of the moving particle considered, relativistically if necessary [17-19]. The radiation cross section is

$$\chi_q(\omega) \cong \frac{16}{3}\frac{Z_M^2 e^2}{c}\left(\frac{z^2 e^2}{Mc^2}\right)^2 \left(\frac{c}{v}\right)^2 \ln\left(\frac{2\pi\lambda Mv^2}{h\omega}\right) \tag{2}$$

where the impact particle has charge ze, mass M, and velocity v, impinging upon a target material characterized by charge $Z_M e$. λ is a numerical factor, on the order of unity, used to correct for uncertainties regarding the impact parameters. It can be seen by inspection of Eq. (2) that emission of bremsstrahlung radiation is most important for low mass (m) particles impinging upon high atomic number materials (Z_M), and therefore for electrons impinging upon palladium (Z = 46) or nickel (Z = 28) would be well characterized by this equation.

For such beam experiments, the total energy loss over distance is therefore determined by the integration of the radiation cross section over all frequencies. If N is the number of fixed charges in a unit thickness, the energy loss per unit distance becomes

$$\frac{dErad}{dx} = N \int \chi_q(\omega)\, d\omega \tag{3}$$

Eq. (3) is solved by use of conversion to a new variable of integration, $x = \geq \frac{h\omega}{2\pi E}$. The radiative loss per unit distance by bremstrahlung is thus

$$\frac{dErad}{dx} \cong \frac{16}{3} N * \left(\frac{2\pi Z_M^2 e^2}{hc}\right) * \left(\frac{z^4 e^4}{Mc^2}\right) \tag{4}$$

Screening Effects for Sufficient Relativistic Energies

Screening effects due to the target atomic electrons have not been considered above, but are typically included through their relationship to the impact parameter. There is a critical energy (E_s) beyond which the impinging relativistic particles are said thereafter to have "complete" screening. The important result from screening considerations, discussed elsewhere, is that for all $E > E_s$, the bremsstrahlung radiation cross section changes and, thereafter for increasing frequencies, becomes constant. Where does this occur for the materials used in cold fusion? For beam systems where this has been experimentally confirmed, for electrons in aluminum (Z = 13) this critical energy, E_s, is about ~42 MeV, and for lead (Z =

82), the relevant relativistic energy E_s is ~23 MeV. This is characterized by

$$E_s = \left(\frac{192\,M}{Z_M^{1/3} m} \right) Mc^2 \tag{5}$$

Equation 5 was used to calculate the expected critical energy (E_s) for the hydrided materials associated with cold fusion. For electrons in palladium (Z = 46), this calculation is E_s = ~28 MeV. For nickel (Z = 28), it E_s ~33 MeV, and titanium (Z = 22), E_s ~35 MeV. The conclusion is that the bremsstrahlung screening effect is unimportant in this analysis of cold fusion systems.

Calculation of λ_{min}

By inspection, conservation of energy requires that the maximum wavelength of Bremsstrahlung emission be limited to, under non-relativistic conditions, the kinetic energy of the incident particle, and so $\frac{hc}{\lambda_{min}} \cong \frac{1}{2} Mv^2$. This has great impact upon radiation behavior. Therefore, the upper limit for photon energy emission occurs at the shortest wavelength (Angstroms) which is inversely dependent upon the voltage (V) used.

$$\lambda_{min} = \frac{hc}{eV} \cong \frac{12{,}396}{V} \tag{6}$$

The putative bremstrahlung of cold fusion differs from hot fusion due to the lower temperature. At cold fusion temperatures, circa 300 K implying equivalent energies of 1/40 electron volt, the maximum energy (minimum wavelength) output of Bremsstrahlung emission is in the near infra-red. Given this result, the most important implication is that cold fusion bremsstrahlung would have insignificant penetration of the electrode or even aqueous medium. The penetration depth, and its implications, will be calculated after first considering the relative role of bremsstrahlung radiation to all collision related energy losses.

Comparison to Collision Losses

It is important to compare the power loss by bremsstrahlung to power loss by collisions because these secondary collisions are quite numerous. This is important because each collision creates additional collision and radiation losses [16]. An impinging 1 MeV electron might undergo circa ~10,000 collision interactions before coming to "rest". The ratio of radiative energy loss to collisional loss can be written as

$$\frac{dErad}{dEcollision} = \frac{4}{3\pi} Z^2 \left(\frac{Z_M}{137} \right) \left(\frac{m}{M} \right) \left(\frac{v}{c} \right)^2 \frac{1}{\ln B_q} \tag{7}$$

B_q is impact parameter. There are several implications of this equation. The $(\frac{v}{c})^2$ term indicates that bremsstrahlung radiative loss is negligible for non-relativistic kinetic particles which are characterized by $v << c$. The $\left(\frac{m}{M} \right)$ term is consistent with the fact that the bremsstrahlung-related radiative loss results from deceleration of the incident particle (of mass *m*), whereas the remainder of the losses (collisional) involve the kinetic mass of the impacted material (mass *M*).

Bremsstrahlung Output Power Calculation

The standard calculation for plasma and hot fusion bremstrahlung requires determinations of both ion density and excitation energy. The bremsstrahlung power equation becomes

$$P_{BR} = 5.35 \times 10^{-31} f \sum_j k_j Z_j^2 * (n^2) * T_e^{1/2} \quad (8)$$

where $f = \sum_j k_j * Z$, the electron temperature is T_e (in keV), and there are n ions/cm^3, containing j nuclear species, of charge Z_j and of fraction density (sum =1) of $k_j * n$. Here Z is the nuclear charge, n_i and n_e are ion and electron densities (number of particles/cm^3) and T is the electron temperature [keV]. Table 1 compares the bremsstrahlung power density to estimated cold fusion power densities. The table shows the calculation for the applied voltage, the thermodynamic equivalent voltage for k_BT which is 1/40 eV. Also included is the maximum estimated voltage which might occur under some experimental setups under those conditions when electrical arcing is seen. This is limited by the expected dielectric breakdown of the materials.

Radiant X-ray Power

First, the **bremsstrahlung power volume** is much less at cold fusion (CF) temperatures (~300 K) than at thermonuclear temperatures. However, the determination as to whether bremsstrahlung is important for CF (as it is for thermonuclear fusion) also depends upon the ratio of bremstrahlung power to fusion power. In kinetic beam experiments as discussed above, it is also important to consider the radiant x-ray power in comparison to input electrical beam power. In the sense that cold fusion experiments also have central electrical input power distributions as the etiology of the fusion mechanism, this factor was also examined for the case of cold fusion although it may not be strictly applicable.

$$\eta = \frac{x\text{-}ray\ power}{beam\ power} = 0.0007 * Z * V \quad (9)$$

Table 1 list the results. The ratio of x-ray power to beam power falls from 0.05 - 0.28 (hot fusion, characterized by aluminum and lead targets, Table 1) to 1.4 - 8.1 x 10^{-10} for cold fusion (palladium Z = 42, and water (average Z = 8)).

Radiation Dose Delivered

This marked decrease in the exit of ionizing Bremsstrahlung radiation must be reflected in the radiation dose delivered. This can be calculated from the x-ray beam dose equation [20], here modified as the x-ray dose in Grays (at 1 meter) delivered per coulomb of electrical input.

$$D/Q = 1.50 * V_{max}^{2.8} * Z^{1/2} \quad \text{(Grays/Coulomb)} \quad (10)$$

V_{max} here is dominated by k_BT because the applied electrical field intensity, assuming homogeneous distribution over the system is insignificant by comparison. This most important result from equations 10 and 11 is the correct calculation of the derived value of the bremsstrahlung delivered dose at a distance of 1 meter for conventional fusion systems (Table 1). The radiation dose (Grays) per coulomb at 1 meter drops from ~3.1 x 10^{19} Grays (hot fusion) to 1.4-3.3 x 10^{-4} Grays for cold fusion.

Correlation with Experimental Results

This above result is consistent with experimental findings. Again there is no reason for the experimenters in cold fusion laboratories to have easily seen any ionizing radiation because, like neutrons, there are theoretical reasons for x-radiation to be absent. Some recent experiments are consistent with cold fusion (using the codepositional method) producing very low levels of ionizing energy release in the range of ~6

to 30 keV [6, 21] for Pd heavy-water systems, and on the order of background for the nickel light-water experiments [5]. The origin of these very low photoelectric ionizing emissions, if confirmed, is not clear but may be due to interactions involving the electrode material itself. Bremsstrahlung radiation (certainly in the ionizing radiation regime) has felt not to be characteristic of cold fusion experiments. We must now examine the impact of the fact that most of the Bremsstrahlung radiant power exists, in cold fusion systems, in the near-infrared.

Implications of Shift to Non-Ionizing IR Output

The shift of the cold fusion bremsstrahlung output power spectrum to non-penetrating radiant energies has great implications. The first implication of the maximum energy with cold fusion is the increase in the role of self-attenuation. As an example of how significant this effect might be, consider that small amount of even low-Z filtration produces the well-known effects of beam hardening widely used by radiologists for a century. This can be seen in Fig. 1 by comparing the filtered curves to those without that filtration. For example, when 65 keV electrons are bombarded into tungsten targets, the filtering of 1 mm aluminum alone cause all radiation below about 10 keV to drop to virtually zero.

The second implication is effective containment of the radiant bremsstrahlung power, and its overlap with thermal and phonon processes. With cold fusion, could the impact of this present serious and interesting physics because of the extremely limited skin depth? It must be true that the final boundary condition will be the Stefan-Boltzmann distribution of blackbody radiation characterizing the system. However, in this case, there is the additional, albeit small, localized input from the cold fusion bremsstrahlung radiation which may act to supplement the local phonon field.

Impact of Skin Depth

The loss of potential fusion energy through Bremsstrahlung radiation is very low for cold fusion systems because the radiation is in the near infrared and, therefore, is trapped by the skin depth effect to remain vicinal to the reactions. The infrared radiation is essentially locked into the materials, as opposed to the penetrating, uncontained, ionizing radiation of hot fusion (Table 1). The energy transfer in cold fusion through bremsstrahlung is limited by the skin depth which is relatively small. The skin depth is defined, in continuum terms, where σ is the conductivity, and μ the permeability, by

$$\delta_{skindepth} = \frac{2}{\sqrt{\omega * \mu * \sigma}} \tag{11}$$

For palladium (9.25×10^6 mhos/meter), at 1 Megahertz this is 0.066 mm, but in the infrared (10^{13} - 6×10^{14} Hz), the skin depth ranges from 2.7 to 20.9 nanometers (Table 1). This must be compared to the hot fusion bremsstrahlung which is very penetrating (Table 1) with tenth value thicknesses of lead ranging from 0.2 to 65 millimeters.

The result of equation 11, is that because of the skin depth, the energy of the bremsstrahlung radiation is trapped inside the metal, possibly in thermodynamic equilibrium, and can only exit by blackbody radiation, exit gas stream (or possibly monatomic gases, or ions, through catastrophic desorption) or further phonon conduction.

Relative Unimportance of $T^{1/2}$ Wall in Cold Fusion

The radiated power by bremsstrahlung is proportional to $T^{1/2}$ power, but for cold fusion the T is markedly lower. Fig. 2 considers equation 8 with ~5 MeV to represent the temperature of hot thermonuclear fusion. Cold fusion has an electron energy of k_B*T = ~1/40 eV at room temperature, although the plot permits

consideration of other voltages (Table 1). Equation 8 predicts, assuming it holds for such cases, results which are shown in Fig. 1, and which are presented as the relative radiated power by Bremsstrahlung for both hot and cold fusion. The relative radiated power is shown as a function of electron temperature for different atomic charge.

Fig. 2 shows the impact of the different operating temperatures in the two fusion systems. Once again, such assumptions about hot fusion do not necessarily have the same implications for cold fusion. In this case the expected bremsstrahlung power radiation factor -- even if applicable -- may be only <<1% of what is expected for hot fusion systems. Given the temperatures and the bremsstrahlung power radiation factor (eq. 8), there is a maximum ratio of ~0.002 as the temperature correction factor when the plasma bremsstrahlung power radiation equation for cold fusion systems.

Possible Secondary Effects

In summary, leakage of radiation energy within cold fusion systems by bremsstrahlung is found to be much less important by quantity than for conventional hot fusion systems. There are three things to consider. How will the energy be lost? Is there an impact of the retained energy upon the fusion reactor its component materials, or the desired reactions? Are any limitations changed in cold fusion as compared with hot fusion?

First, the bremsstrahlung power which radiates will remain trapped until either blackbody radiation or phonons carry off the energy. The Boltzmann constant 5.67×10^{-8} W/m^2 - K^4 indicates how fast (or slowly) further loss will occur by such radiative process (P_{BB}). Faster routes include, first, the phonon heat transfer routes because their rates exceed radiant heat transport rates by some six to eight orders of magnitude.

Second, some limitations do appear to be possibly changed in cold fusion as compared with hot fusion. Unlike the continuing of leakage of momentum and energy in hot fusion, in cold fusion the output spectrum of bremsstrahlung being in the near IR couples to the electrode, indicates that cold fusion Bremsstrahlung might not exactly follow the "$T^{1/2}$ power wall behavior" which limits hot fusion systems. Instead there may be further reaction with the very hydrided lattice that produced the desired fusion reactions. Other limitations involving possible changes in fuels will be discussed below.

Third, consideration of how bremsstrahlung power loss might influence cold fusion is very complicated. It is important to note that putative bremsstrahlung, produced by slowing of a putative energetic CF product particle, would only occur **after** the cold fusion reaction(s) have already occurred, and therefore removal of energy and momentum from the reactions is involved. The bremsstrahlung coupling to the local lattice may have several late effects. These might include either dampening (or accelerating) the effect and/or changing the lattice itself.

Could this infrared radiation, secondary to Bremsstrahlung, explain either the unusual cold fusion branching ratio, coupling to the lattice, or the increase in fusion rates over conventional calculations? The locked in radiant bremsstrahlung may be small in comparison to the optical phonons in the hydrided material, but it may produce further contributions that might enhance, or inhibit, the desired reactions. To the degree the cold fusion reactions, or the reactions that proceed or activate them, are extremely temperature sensitive, the spatial locking-in of the bremsstrahlung radiation might inhibit the cold fusion reactions by removing power from the local of the fusion reactions, thereby braking the desired reactions. Given the skin depth, such power loss is insignificant compared to hot fusion and does not seem likely to be sufficient to cause serious cooling in the solid.

However, more importantly, the lock-in effect means that there may be additional post-fusion contributions to the optical phonons. These lattice vibrations have coupling in the infrared, which itself is linked with molecular vibrations. Given the lattice, additional phonons would thereafter develop. To the degree that

these phonons are needed to continue further CF reactions, the cold fusion bremsstrahlung might accelerate the desired reactions. There may be theoretical reasons to believe that nuclear-to-lattice coupling of cold fusion might proceed through nonlinear phonon effects. [8] There is preliminary evidence in some of our experiments that sudden loss of heat from the cold fusion reactors might be markedly influencing the fusion reaction rate. Efforts are ongoing to determine why and to quantify the effect. Furthermore, it is known that there can be focusing of phonon, and diffusive hydride-flux energy toward those few select sites where the reaction can occur.[1,22] The contribution of cold fusion bremsstrahlung might enhance this focusing effect as well.

COULD MID-Z ELEMENTS BE FUELS?

There is a second important result and implication. For example, both the ratio of Bremsstrahlung to ionizing effects may be significant. Also, isotopic fuels of higher atomic number may be useful in cold fusion systems. As Fig. 2 shows, the Z dependence makes bremsstrahlung power loss greater than potential fusion power gain at hot fusion temperatures, except for the very few cases of low-Z elements.

However, at cold fusion temperatures, this atomic charge restriction regarding fusion may actually be less secure. Given the reported putative transmutations observed during some cold fusion experiments, this analysis also suggests that even when Bremsstrahlung power radiation might be limiting to the attainment of successful fusion systems, isotopic fuels of higher atomic number than normally considered for hot fusion may be useful in cold fusion systems. If the conditions are limiting, and the physics is the same as described by eq. (3), then the isotopic fuels could include at least second and third row elements, possibly even potassium.

SUMMARY

We have examined the role of bremsstrahlung in cold fusion systems. The critical bremsstrahlung screening frequency for electrons in palladium ~28 MeV (nickel Es ~33 MeV). Unlike hot fusion or plasma systems, by magnitude bremsstrahlung radiation in cold fusion systems does not play a dominant role. We calculate a marked shift in bremsstrahlung power density compared to beam power, from 0.05 - 0.28 (hot fusion) to 1.4 - 8.1 x 10^{-10} for cold fusion (palladium Z = 42) and water (average Z = 8). The delivered x-ray beam dose (at 1 meter) decreases as the radiation dose (Grays) per coulomb drops from 3.1 x 10^{19} Grays (hot fusion) to 1.4-3.3 x 10^{-4} Grays for cold fusion. These calculations are consistent with the relative absence of apparent ionizing emissions from cold fusion systems except for a few reports looking in the ~6 to 20 keV region.

Perhaps more importantly, the bremsstrahlung radiant power from cold fusion differs from hot fusion in that - because of the markedly lower temperature - most of the Bremsstrahlung radiant power in cold fusion systems is in the near-infrared region. The energy transfer in cold fusion systems via bremsstrahlung radiation is limited by the skin-depth which for palladium (9.25 x 10^{6} mhos/meter), in the near infrared (10^{13} - 6 x 10^{14} Hz) ranges from 2.7 to 20.9 nanometers. One implication is effective containment of the radiant bremsstrahlung power, and its overlap with thermal and phonon processes.

Therefore, both because of the skin depth and bremsstrahlung power density, any leakage of fusion power from within cold fusion systems by bremsstrahlung is found to be much less important than for any conventional plasma or hot fusion system. One corollary is the lock-in of any cold fusion bremsstrahlung may have secondary effects upon the rates of the desired fusion reactions. Furthermore, a second corollary of this analysis of cold fusion bremsstrahlung indicates that because of the much lower levels of bremsstrahlung power emitted, isotopic fuels of higher atomic numbers may be useful in cold fusion systems.

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TABLE 1 - ANALYSIS OF BREMSSTRAHLUNG IN FUSION

	Temp [deg K]	Central Density [#/m3]	Brems. Peak [Angstroms]	X-ray Power Beam Power [nondimensional]		IrradiationXray Dose (at 1 meter) [Gray = 100 rads]		Penetration Depth (TVL Pb) [meters]	Radiation Region	Energy [e*V]	Role in cold fusion
Hot Fusion	1-2x10^{8}	2-3x10^{20}	2.5x10^{-03}	0.28	lead	3.1x10^{19}		~30x10^{-3}	Pair production region	~5x10^{6}	
				0.05	aluminum			6-65x10^{-3}	Compton region	0.3-1.5 MeV	
								0.2x10^{-3}	Photoelectric region	~50 keV	
Cold Fusion	~290 -373	~5x10^{22}	0.3	1.3x10^{-3}	palladium	7.8 x 10^{13}	palladium			~40,000 (est.)	peak arcing
				2.3x10^{-4}	water (average)	3.3x10^{13}	water (average)				
			2.5x10^{+03}	1.6x10^{-7}	palladium	9.2 x 10^{+2}	palladium	~7 x 10^{-10}	skin depth	5	applied electric field
				2.8x10^{-8}	water (average)	3.8 x 10^{2}	water (average)				
			4.5x10^{+5}	8.1x10^{-10}	palladium	3.3 x 10^{-4}	palladium	0.27-2.1x10^{-8}	skin depth	0.04	thermal energy
				1.4x10^{-10}	water (average)	1.4 x 10^{-4}	water (average)				

(*) characterized by HVL
(**) secondary to skin depth

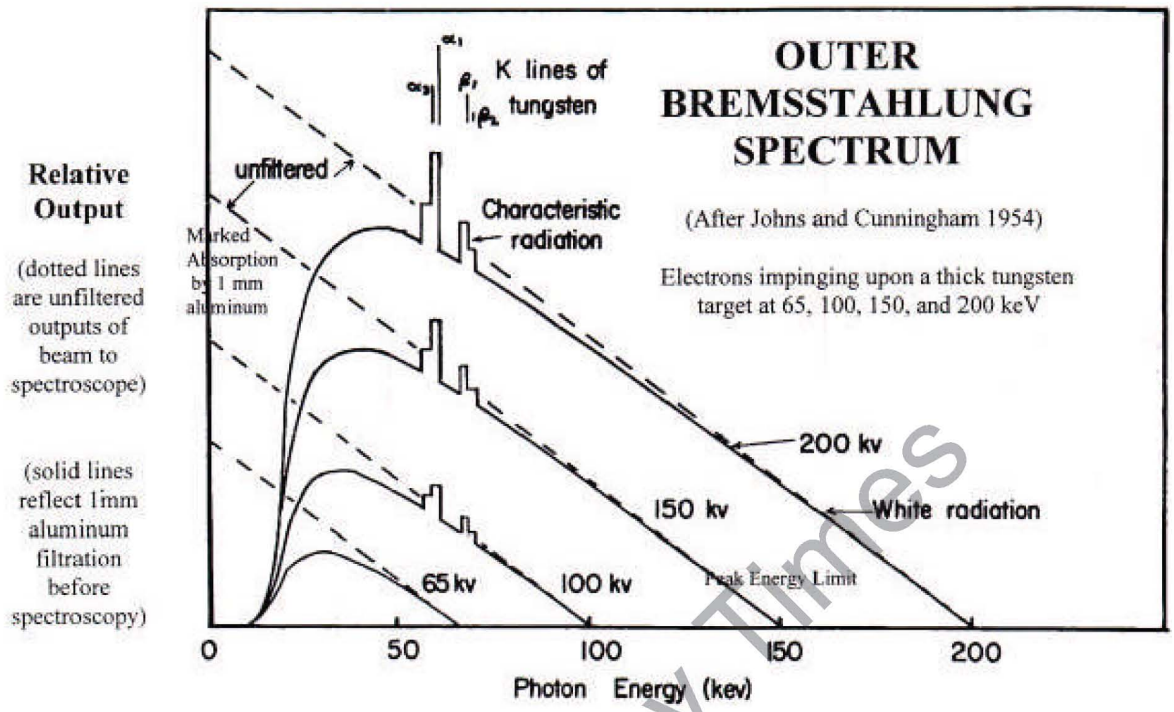

Figure 1 – Outer Bremsstrahlung Radiation Spectrum
Output bremsstahlung spectral curves which are continuous also contain characteristic material-specific photon peaks superimposed. There is not accuracy with respect to width of those characteristic peaks. Energy spectroscopy is of the bremsstrahlung emission from electrons of varying electrical accelerating potential which have impinged upon a thick tungsten target. The 'white' light radiation characteristics are shown, along with both unfiltered, and filtration using 1 millimeter of aluminum for beam hardening.

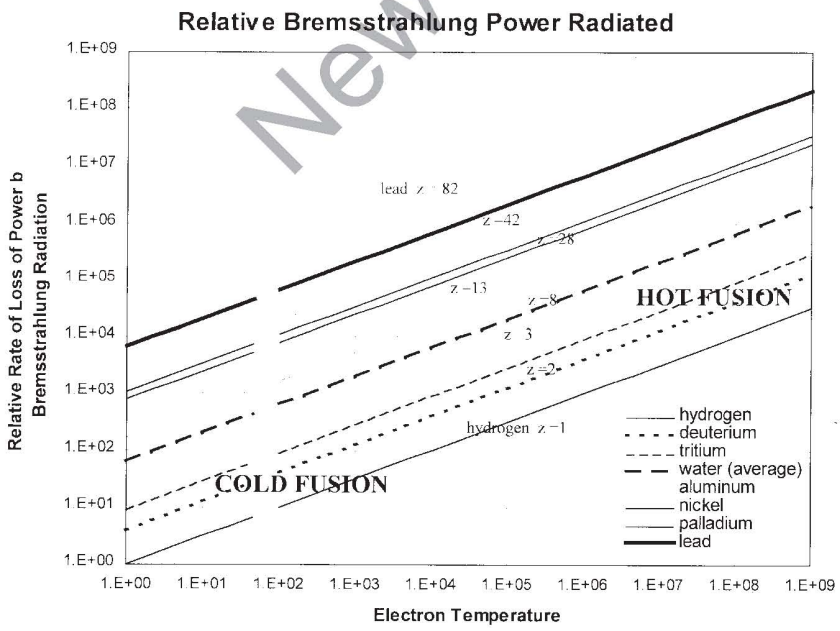

Figure 2 - Relative Bremsstrahlung Output Power Radiated
The standard calculation for plasma and hot fusion brems-strahlung is used with corrections for electron temperature, and ion and electron densities is used to attempt to compare the relative bremsstrahlung powerdensity for both hot and cold fusion. Various fuels (different atomic number as noted) are shown with the relative bremsstrahlung radiated power as a function of temperature.

TABLE OF SYMBOLS

B_q	Interaction parameter
c	speed of light [m/sec]
D	Dose delivered (Gray) at 1 meter from point of interest in beam
$dE_{rad}/dE_{collision}$	Relative loss of Energy to bremsstrahlung radiation to collisional losses for a beam [nondimensional]
dE_{rad}/dx	Energy loss per unit distance for a beam [joules/m]
e	electronic charge [coulombs]
h	Plancks constant
M	Target mass [kg/m^3]
m	Impinging particle mass [kg/m^3]
N	Number of fixed charges per unit thickness for a beam
n	number of ions [#/cm3]
P_{BR}	Heat loss from bremsstrahlung radiation [watts]
P_{CYC}	Heat loss from cyclotron radiation [watts]
P_{ENTH}	Heat loss from heat conduction [watts]
P_{OP}	Heat loss from optical radiation [watts]
P_{OTHER}	Heat loss from other routes [watts] (e.g. electrolysis gas stream)
P_{RAD}	Heat loss from all radiation components [watts]
T_e	electron temperature [degrees K]
v	velocity [m/sec]
V	applied voltage [volts]

Z	atomic number
ze	Charge on impact particle
Ze	Charge characterizing target material

Greek Symbols

χ_q	radiation cross section
ω	angular frequency [1/sec]
μ	magnetic permeability
η	x-ray power/beam power [nondimensional]
λ	correction for impact parameter [nondimensional]
$\delta_{skin\ depth}$	skin depth [meters]
λ_{min}	Minimum wavelength in the bremssstahlung output spectrum [meters]
σ	electrical conductivity [mho/m]

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EDITOR'S CHOICE

CREATION OF GALACTIC MATTER, AND DYNAMICS OF COSMIC BODIES THROUGH SPATIAL VELOCITY- FIELD

Paramhamsa Tewari [2]

ABSTRACT

The medium of space surrounding the cosmic bodies is in continuity with each particle of matter constituting these bodies, and rotates as a vortex that imparts angular momentum to them, thus causing their axial rotation (excluding those that do not rotate axially). The orbital motion of the bodies is also caused by the motion of the medium of space; this conclusion was reached in the recent article "On Planetary Motion caused by Solar Space Vortex" [1]. Supposing that a certain volume of space does not contain any field like a gravity field or electromagnetic field, then, this volume will be defined by the contemporary physics as an empty extension of void-ness or nothing-ness. However, contrary to this modern concept on the basic nature of space, the postulates of Space Vortex Theory (SVT) [2], assign the medium of space with non-material properties like, zero-viscosity, incompressibility, continuity, and massless-ness. The other postulate is that the space can flow at any speed up to a maximum speed of light; and it is this property that is utilized as a physical process for the creation of the fundamental particle of matter, identified in SVT as electron. (The present physics of elementary particles does not recognize the electron as the only fundamental particle. Whereas, as per SVT, if any stable particle with mass and charge less than those of electron is ever found, then all the conclusions of SVT are to be taken as incorrect). The structure of the electron is shown (Fig. 1 and Fig. 2) as a space-vortex with a central spherical-void, which does not possess within it any energy field. Basic equations on the properties of mass and charge (exhibited by electrons) are derived from the vortex-structure of electron (Fig. 1), wherein it is seen that the dimensions for the electron's mass and charge, in CGS unit, are cm^4/s and cm^3/s respectively. The other new relationship is : gram = 7.8×10^6 cm^4/s.

In the article referred above [1], the gravity fields of the Sun and planets have been computed from the velocity-field due to space-circulation around these bodies and the result, in case of the Earth, compared with the experimental value of the free-fall acceleration (gravitational field) on the Earth's surface. This procedure is independent of the Newton's equation for gravitational attraction, in which from the known value of the Earth's gravity field, and the experimental result of the gravitational constant, the mass of the Earth is derived. The result on the gravity field of the Sun, calculated in that article [1], is exactly the same as if it were calculated by Newton's equation. The following analysis shows the genesis of Newton's formulation of the gravitational equation, revealing the fact as to why the values of the gravity fields of the Sun and planets, with both the above mentioned methods, are so close; and an alternate approach to theoretically determine the gravitational constant and the masses of the cosmic bodies. The forces ascribed here for the orbital stability of the planets are different from those postulated in the Newtonian celestial mechanics. It is also shown that the cosmic matter for the galaxy is created at the center of the Galaxy.

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Kepler's third Law and Newton's Equation on Gravitational attraction

For a planet of mass m, describing an uniform circular motion around the Sun of mass M_s , and moving with speed v at a distance r from the center of the Sun, the outward centrifugal force, as per present physics, is assumed to balance the inward gravitational force *as per Newton's equation*

$$m v^2/r = G m M_s / r^2. \quad (1)$$

where G is the gravitational constant.

In the above equation, Newton , believing in the inertness of space (in his scientific works only), assumed that the concept of the *centrifugal acceleration,* v^2/r, then proposed by Huygens, is applicable in terrestrial as well as cosmic space and, therefore, in order to oppose the *outward centrifugal force*, $m v^2/r$, that he *supposed* to be acting on the orbiting cosmic bodies like the moons and the planets, he postulated the existence of an *inward gravitational force* by introducing two unknowns, namely, G and mass M_s in Eq.1, that can also be written as

$$v^2/r = G M_s / r^2. \quad (2)$$

If T is the period of revolution of the above planet around the Sun, then by Kepler's third Law,

$$r^3 \propto T^2 \propto (2 \pi r/v)^2,$$

Or

$$v^2 r \propto 4 \pi^2 = k_s, \quad (3)$$

where k_s is a constant.

Taking square root on both the sides of Eq.3

$$v \sqrt{r} = \sqrt{k_s} \quad (4)$$

Substituting the values of r and v pertaining to the orbit of the planet Mercury in the above equation

$$47.9 \times 10^5 \text{ cm/s } \sqrt{57.9 \times 10^{11} \text{ cm}} = 11.52 \times 10^{12} \text{ cm}^{3/2}/\text{s} = \sqrt{k_s},$$

from which

$$k_s = 1.327 \times 10^{26} \text{ cm}^3/\text{s}^2. \quad (5)$$

Newton's equation on gravitation is obtained by dividing both the sides of Eq.3 by r^2:

$$v^2/r = k_s / r^2. \quad (6)$$

Comparison of Eq.2 with Eq.6 shows that the quantity "GM_S" in Eq. 2 is in place of "k_S" of Eq. 6. This can be checked by using the presently accepted values of G and the solar mass M_S , and getting the product as follows:

$$G M_S = (6.67 \times 10^{-8} \text{ cm}^3/\text{s}^2 \text{ g}) \, 1.99 \times 10^{33} \text{ g} = 1.327 \times 10^{26} \text{ cm}^3/\text{s}^2, \quad (7)$$

which is the same as the value of k_S obtained in (5), thereby, showing that the quantity "GM_S" appearing in Newton's equation (Eq.1) on gravitational attraction is derived from the Kepler's Law and, therefore, *contrary to the current belief, it is the Kepler's Law that is to be taken more fundamental than the Newton's Law of gravitation, which is presently considered to provide proof to the Kepler's law.* It is also seen here that if the value of the gravitational constant G is different for reasons brought out later in this paper, the solar mass M_S will undergo proportionate change, because the quantity "GM_s" has been equated with the constant "k_S" determined from the solar space vortex (Eq.5). Further, it has also been shown [1] that the

planets are carried in their orbits by the velocity- field of the solar space- vortex, and have no relative motion with respect to their surrounding space. Hence under such a condition, on these planets (planets with axial rotation discussed in the earlier article[1]), **the centrifugal acceleration is neither produced nor can act**. Hence, in Eq.2, the relationship "GM_s / r^2" can not be equated with the nonexistent outward acceleration " v^2 / r ". It was pointed out [1] that in orbital motion, it is the electrical repulsive force, produced due to axial rotation, that operates between the Sun and the planets rather than the Newtonian (gravitational) force of attraction,

$$F = G\, mM_s / r^2. \qquad (8)$$

The force that opposes the electrical repulsive force and achieves orbital stability of the planets is discussed further in this article.

MASS OF PLANETS

After determining the gravitational constant [1798] and making an assumption that the *acceleration of free-fall of bodies* "a" is itself the *gravitational field* "g" on account of the attraction by the earth, its mass was computed. Since it is shown [1] that the acceleration "a" of the freely-falling bodies is due to the radial inward pressure created by the circulating space around the Earth. Whether "a" can be substituted for "g" to determine the mass of the Earth with the use of Newton's equation

$$g = G\, M/ R^2 \qquad (9)$$

needs to be ascertained.

Alternatively, the mass of the Earth can be calculated (roughly as a guide) from the data available on the constitution of the Earth-crust and its volume; and also accurately by determining the radial inward force (Fig. 3) that opposes the outward electrical repulsive force on the planet in the orbit. It is the former method that is first presented below.

The Earth's radius, $R_e = 6.371 \times 10^8$ cm, and the volume of Earth is $V = 1.082 \times 10^{27}$ cm ^{3}. The average radius of atoms [3] is 1.8×10^{-8} cm, which is the value obtained considering the closest spacing that atoms can have. The number of atoms (calculated from the above figures) that the Earth has is: $N = 4.43 \times 10^{49}$. The Earth's crust is composed of : Oxygen 49.13 %, Silicon 26 %, Aluminum 7.45 %, Iron 4.2 %, Calcium 3.25 %, Sodium 2.4 %, Potassium 2.35 %,Magnesium 2.35 %, Hydrogen 1 %, and others 1.87 %. With these percentages of the elements and their known masses in terms of the multiples of the hydrogen atomic-mass, and supposing that the whole of the Earth is similarly constituted, Earth's mass is found as: $Me = 2 \times 10^{24}$ kg, whereas the presently accepted value is: 5.98×10^{24} kg.

Through the other alternative, the mass of the Earth is calculated as follows. In Fig. 3, the superposition of the velocity fields of the two vortices, namely, the solar space-vortex and the Earth's space-vortex, is shown. Though there is no relative motion between the Earth and the surrounding space, yet the pressure from space, proportional to the inward acceleration-field produced by the above velocity fields, acts on the Earth; just as a body, static on the Earth's surface, is subjected to space pressure [1]. The velocity field on the farther side of the Earth is increased, whereas, on the side nearer to the Sun has decreased, due to which, the acceleration-field "a" acts inward on the Earth along the orbital radius r, and is given by

$$a = (29.8 \times 10^5 \text{ cm/s} + 7.8 \times 10^5 \text{ cm/s})^2 / r = (1.413 \times 10^{13} \text{ cm}^2 / \text{s}^2) / r. \qquad (10)$$

The inward force F on the Earth, due to the above acceleration and in opposition to the electrical repulsive force (Fig. 2) is

$$F = M_e \times a = M_e\, (1.413 \times 10^{13} \text{ cm}^2/\text{s}^2) / r. \qquad (11)$$

The electric force of repulsion between the Sun and Earth was calculated [1] with the following equation

$$F_e = (c / 4\pi)\, Q_s\, Q_e / r^2, \quad (12)$$

where , $c / 4\pi$, is Coulomb's Constant [2], and Q_e, Q_s are the electric charges of the Earth and Sun respectively.

The electric charge is produced [1] on the surface of the cosmic bodies due to their axial rotation (similar to electron), and is given by

$$Q = (\pi / 4)\, 4\pi R^2 c(v / c) = (\pi/4)\, 4\pi R^2 v \quad (13)$$

where R is the radius and v is the tangential velocity of rotation of the surface; v is also the tangential velocity of space on the surface due to which the cosmic bodies are axially rotated.

Substituting the values of R and v for the Earth in (13), the electric charge of the Earth is calculated as

$$Q_e = (\pi / 4)\, 4\pi (6.37 \times 10^8 \text{ cm})^2 (0.464 \times 10^5 \text{ cm/s}) = 1.85 \times 10^{23} \text{ cm}^3/\text{s}. \quad (14)$$

Since, as shown in earlier work [2], in CGS system of units, cm^3/s = CGSE, substituting the same in (14),

$$Q_e = 1.85 \times 10^{23} \text{ CGSE}. \quad (15)$$

Similarly, by substituting the values of the radius of the Sun, Rs =6.96×10^{10} cm, and the tangential velocity of its surface, $v_s = 1.945 \times 10^5$ cm/ s , in (13), the electrical charge of the Sun is calculated as

$$Qs = 0.928 \times 10^{28} \text{ CGSE} \quad (16)$$

which is very close to the accepted value [3] of 10^{28} esu. Since the axial rotations of both the Earth and Sun are in the same direction, their electrical charges will be similar and this will produce repulsive force between them just as it is in the case of interaction between two electrons (Fig. 4).

Substituting the values of Qe and Qs from (15) and (16) respectively in (12), the electric force of repulsion between the Sun and Earth is:

$$F_e = 1.822 \times 10^{34} (\text{cm}^4 / \text{s})\, \text{cm} / \text{s}^2. \quad (17)$$

Substituting, $\text{cm}^4/\text{s} = \text{g} / 7.8 \times 10^6$, in (17) above

$$F_e = 2.33 \times 10^{27} \text{ dyne}. \quad (18)$$

The Earth is in equilibrium in the orbit due to the equality and opposition of the forces F (Eq.11) and F_e (Eq.18). Therefore

$$M_e (1.413 \times 10^{13} \text{ cm}^2/\text{s}^2) / r = 2.33 \times 10^{27} \text{ dyne}. \quad (19)$$

Substituting the value, $r = 150 \times 10^{11}$ cm in (19) above

$$Me = 2.473 \times 10^{24} \text{ kg}, \quad (20)$$

whereas, mass of the Earth calculated earlier on the basis of the presence of the elements found in the Earth crust is : 2×10^{24} kg. The masses of the other planets, computed on similar lines as that of the earth, are shown in Table -1).It is most certain that the electric forces of repulsion from the Sun, Jupiter and Neptune, acting on Uranus, have tilted the planet such that its axis is inclined with respect to the

planetary plane by almost a right angle. It is therefore that the velocity field due to axial rotation of this planet has not been taken into account for the calculation of the inward force that opposes the electrical repulsion, though in case of the Earth (Eq.10) and other planets, the resultant of the velocity fields (due to axial as well as orbital rotations) have been considered.

The difficulty in computing the masses of other planets, that is, Mercury and Venus, lies in the fact that these planets do not have axial rotations and, hence, they can not have electric charge ; consequently, there is no electric repulsion from the Sun. Similar problem exists with the Moon also. The forces that maintain the orbital stability of these cosmic bodies are discussed later in this article.

Gravitational Constant

The gravitational potential of electron (Fig. 5) is shown [2] to be an energized state of the medium of space following the instant of creation of electron with its associated spherical void. The creation of the spherical void due to the limiting speed of space- circulation leading to the breakdown of space, and the radial movement of space- points up to a length equal to the void- radius, is shown. The compressive spherical-front follows the void's creation (Fig. 5) and produces gravitational potential (in the medium of space) that exists permanently till the existence of the electron [1,2]. Since space is opened up to the radius of the void, the gravitational field on the space-void interface will be directly proportional to the void-radius. Because all universal matter is constituted of electrons, in case of the Earth too,

$$g \propto R \tag{21}$$

where R is the Earth's radius.

The cosmic bodies, unlike the electron, do not consist of a single spherical void. On the other hand, many electrons assembled as nuclei, atoms and molecules, with different densities form these bodies. Therefore,

$$g \propto d \tag{22}$$

where d is the density of the Earth. From (21) and (22)

$$g \propto R\, d. \tag{23}$$

Similarly, the gravity field of the Moon

$$g_m \propto R_m d_m \tag{24}$$

where g_m, d_m and R_m are the gravity field, density and radius of the Moon respectively. From (23) and (24), and assuming that the same constant of proportionality exists in Eq.23 and Eq.24,

$$g / g_m = R\, d / R_m d_m.$$

Or

$$g_m = g R_m d_m / R\, d. \tag{25}$$

Substituting the presently accepted values of d_m, R_m, R, g and d in (25)

$$g_m = (9.81 \text{ m / s}^2 \;\; 1740 \text{ km} \;\; 3.34 \text{ g / cm}^3) / 6400 \text{ km} \;\; 5.52 \text{ g / cm}^3.$$

From above, $g_m = 0.164$ m /s,^{2} whereas, the presently accepted value is 0.167 m /s ^{2}. With this procedure , the gravity fields, also for the planets, Mercury and Venus (that do not have space circulation around them) come out close to the accepted values, 3.81 m/s ^{2} (3.78 m/s ^{2}), 8.78 m/s ^{2}(8.6 m/s^2) respectively, where the quantities within the brackets are the presently accepted figures.

With the above results, the validity of Eq.23 gets established. Now, since in Eq.23, the density of the Earth is

$$d = M_e / \text{volume of earth} = M_e / (4\pi / 3)\, R^3,$$

substituting this in (23)

$$g \propto Me\, R / (4\pi /3)\, R^3 = G\, Me / (4\pi /3)\, R^2, \quad (26)$$

where G is the gravitational constant. Eq.26 expresses the force that Earth exerts on unit- mass on its surface and, quantitatively, leads to a general relationship for the force between any two masses M and m, distant R from each other:

$$F = G\, M\, m / (4\pi / 3)\, R^2. \quad (27)$$

Except for the quantity $(4\pi/3)$ appearing in the denominator, Eq.27 is similar to Eq.8 from Newton. If Eq.27 is used to determine G in Cavendish experiment, the value found will be

$$G = (4\pi /3)\, 6.67 \times 10^{-11}\ m^3 / kg\ s^2. \quad (28)$$

It is thus concluded that the presently accepted value of G is $4\pi/3$ times smaller than the actual value. The formula for G is derived also from the first principles from the space-vortex structure of electron as follows.

During the process of creation (Fig. 5) of the electron's spherical void, the fluid –space is forced out at limiting speed c along the radii from a definite volume of space, leaving there a dynamically stable *hole* or *void*, and this process of *creation of the fundamental matter* takes place in a time duration of r_e/c. The space-points at the space-void interface, at the time when the break-down of the vacuum (space) starts, are pushed along the radii from the preceding points located towards the center (within a sphere of radius r_e) due to which a compressive spherical front of radial length r_e is created and transmitted outwards at speed c. Consider a spherical space- surface of radius r concentric with the void through which a volume V of space, equal to the void-volume, will flow out due to the fact that the medium of space has been postulated to be

$$\text{Volume of space displaced in unit time} = V/ (r_e /c), \quad (29)$$

and the velocity of displacement is

$$v = V/(r_e/c)\ (4\pi\, r^2) = m_e / 4\, \pi\, r^2\, r_e, \quad (30)$$

where , $m_e = V\, c$ from the mass-equation of electron (Fig. 1).

The space- points at the spherical space surface considered will interact with the spherical-front for a time duration of r_e /c , and their radial displacement will be

$$r = (m_e /4\pi\, r^2\, r_e)\ (r_e /c) = (1/4\pi\, c)\ (m_e / r^2), \quad (31)$$

which is defined to be proportional to the gravitational field of electron at a distance r from electron center. Thus, gravity field of electron is expressed as

$$g_e = (k_f /4\pi\, c)\, m_e / r^2 = G_e\, m_e / r^2 \quad (32)$$

where, k_f = 1/(unit time)², introduced to obtain appropriate dimensions for the gravity field, and G_e is the gravitational constant for electron. At the space-void interface of electron, r is equal to r_e and, since, m_e is directly proportional to r_e^3, *G_e is inversely proportional to the radius of the void.*

Cavendish performed experiment with lead- balls, which have nuclei heavier than proton by about 207 times, that is, the mass of the lead- nucleus, $m_n = 207(1.67 \times 10^{-24})$ g. Since, gram=7.8×10^6 cm^4 / s, $m_n = (3.457 \times 10^{-22}) \times (7.8 \times 10^6 \text{cm}^4/\text{s}) = 2.69 \times 10^{-15} \text{cm}^4/\text{s}$. If r_n is the radius of the lead nucleus, and considering the fact that the nuclei are the assemblies of closely packed electrons [2], applying mass-equation to determine the radius,

$$(4\pi / 3)\, r_n^3\, c = 2.69 \times 10^{-15} \text{ cm}^4 / \text{s},$$

from which

$$r_n^3 = [\, 2.69 \times 10^{-15} / (4\pi/3)\, 3 \times 10^{10}]\text{cm}^3$$

or

$$r_n = 2.8 \times 10^{-9} \text{ cm}. \qquad (33)$$

From (32), gravitational field of electron

$$G_e = k_f / 4\pi c. \qquad (34)$$

It was also shown earlier that the gravitational constant for electron is inversely proportional to its radius. Therefore, the gravitational constant for the lead atom is:

$$G = G_e\, r_n / r_e = (1/4\pi.\, 3 \times 10^{10})\ (1/\text{s}^2)\ (4 \times 10^{-11} / 2.8 \times 10^{-9}) = 3.79 \times 10^{-14} / \text{cm s}. \qquad (36)$$

The gravitational constant as per (28) is:

$$G = (4\pi/3)\, 6.67 \times 10^{-8}\ (1/ 7.8 \times 10^6 \text{ cm}^4 / \text{s})\ (\text{cm}^3/\text{s}^2) = 3.58 \times 10^{-14} / \text{cm s}. \qquad (37)$$

The closeness of the quantities in Eq.36 and Eq.37 reveals that, as concluded from (28), G should be multiplied by $4\pi/3$ to obtain its actual value.

The gravitational constant for matter in atomic state is not an universal constant and varies from atom to atom. For the fundamental particle electron, the gravitational constant in CGS unit is $1/ (4\pi c)$ s². The constitution of the Sun and the planets is widely different in terms of the atoms constituting them. Hence, use of G to determine the mass of the cosmic bodies can be only an approximate procedure. Also, with the higher value of G derived above, masses of the Sun, planets and satellites will be proportionately smaller. The free-fall acceleration on the Sun's surface, and also on the surface of the planets that possess axial rotations, determined from the space-circulation around these bodies, will ,however, remain the same. The gravity fields of the Moon, Mercury and Venus obtained from Eq.9 will not undergo change because the increased value of G is accompanied by the decreased mass in the same proportion. Further, these cosmic bodies, without space circulation around them, do possess gravity field due to void-content in the nuclei of the atoms constituting them. The conclusion drawn from this effect is that the *free-fall acceleration is identical with the gravity field as believed today.*

Density of Earth

The mass of the Earth with the new value of G determined above, and the known value of g is

$$M_e = [1/(4\,\pi/3)\, 6.67 \times 10^{-11}\,]\ (9.81)\ (6.400 \times 10^6)^2 = 1.44 \times 10^{24} \text{ kg}, \qquad (38)$$

which is 4.15 times smaller than the currently accepted mass. Also, mass of the Earth calculated as per (20) considering its orbital stability is: 2.473×10^{24} kg, which is 2.42 times smaller than the accepted figure

of 5.98 x 10^{24} kg. Taking an average of the above two values, it is most likely that the Earth is lighter at least by 3.3 times than its present mass and, therefore, its accepted average density of 5.5 g /cm^3 should not exceed 1.67 g /cm , which is also close to the average density of the Earth's crust.

Orbital Forces on Moon, Mercury and Venus

In Fig. 6, the Moon, shown in the space-vortex of the Earth, is subjected to an inward acceleration, v_m^2/ r, produced due to the velocity-field of the space-vortex and, therefore, a central force, $M_m\ v_m^2/r$, acts on it inward towards the Earth's center. As the tangential velocity of the space-vortex carries the Moon in the orbit, the centrally inward force will deviate its path towards the Earth, thereby giving rise to relative motion between the Moon and the space medium, which should lead to the creation of an *outward centrifugal force*, $M_m\ v_m^2/ r$, opposing the deviating force and, thus, provide a *restraining action* that maintains the course of the orbit. Similar situation exists for the orbital stability of Mercury and Venus, and all such cosmic bodies that do not possess axial rotation. Further, absence of the space-circulation around these bodies, will result in the depletion or even non-existence of the atmospheric belts on their surfaces. Also, planets without axial rotation can not possess satellites in the absence of the space- circulation to move the move the satellites.

Creation of Matter at Centers of large Planets

It was shown in the earlier paper [1] that at the center of the Sun, there exists a cylindrical hole along the axis of rotation of about three kilometer diameter, where matter in the form of electrons initially, and the hydrogen/helium atoms in the succeeding stages, is created. It is shown below that matter is also being created at the centers of the larger planets.

Consider the motion of the Moon around the Earth at an orbital speed of 1017 m/s. It was stated [1] that as per Kepler's third law, the orbital motion of the planets and the satellites falls in inverse proportion to the square root of their distances from their primaries. Therefore, for the earth-moon system

$$v_m = 1/\sqrt{r} = k/\sqrt{r} \qquad (39)$$

where, v_m is the orbital speed of the Moon, r is its distance from the Earth, and k is a constant. Substituting the values in the above equation

$$k = 1017 \text{ m/s} \times \sqrt{3.82 \times 10^8\, m} = 1.987 \times 10^7 \text{ m}^{3/2} \text{ /s.} \qquad (40)$$

With the above value of k, and substituting r = 6.37 x 10^6 m in (39), the tangential velocity of space in the equatorial plane and in close vicinity of the Earth's surface is:

$$v = (1.987 \times 10^7 / \sqrt{6.37 \times 10^6\, m}) \text{ m/s} = 7.8 \times 10^3 \text{ m/s.} \qquad (41)$$

It was explained in the earlier paper [1] that the circulation of space around the Earth at 7.8km /s, calculated above, will be in the regions of the ionosphere, and is reduced to about half a kilometer per second due to atmospheric belt, thus rotating the earth at this speed. It is imagined that prior to the existence of the Earth's matter (dispersed from the Sun), a vortex of space with its center coinciding with the Earth's center existed. The distance from this center, where the speed of circulation of space reaches speed of light, is calculated from (39) by substituting v_m = 3 x 10^8 m / s; it is found that at a distance of 0.004m from the center, the speed of space-circulation reaches the speed of light, thus, satisfying the condition for the creation of matter. Calculations similar to the above indicate that for the planets, Jupiter, Saturn and Neptune, radial distances from their centers, where the speed of space- circulation reaches light's speed, are 1.38 m, 0.4m, and 0.74m respectively. It is therefore concluded that the centers of the

larger planets possess material creation zones, and this could possibly be the reason for the volcanic eruptions on the surface of these planets, including the Earth.

Creation of Universal Matter in Galaxies

The solar system , at a distance of 2.62×10^{22} cm from the center of our Galaxy, revolves at a speed of 220 km / s around it. Assuming that similar to the solar system, in the galactic vortex also, space-circulation falls inversely as the square root of the distance

$$v \propto 1/\sqrt{r} = k_g / \sqrt{r} \tag{42}$$

where v is the orbital velocity of the sun, k_g is a constant, and r is the distance from the galactic center. Substituting the values given above

$$k_g = 220 \times 10^5 \text{cm / s} \sqrt{2.62 \times 10^{22}\ cm} = 3.56 \times 10^{18} \text{ cm / s.} \tag{43}$$

From (42) and (43), the distance R_g from the center of Galaxy at which the speed of space-circulation reaches the speed of light is:

$$R_g = (3.56 \times 10^{18} / 3 \times 10^{10})^2 \text{ m} = 1.408 \times 10^{16} \text{ cm,} \tag{44}$$

which is about two hundred thousand times more than the radius of the Sun.

The conclusion is that within a sphere of radius 203000 times larger than the Sun's radius, the Galaxy possesses a creation zone, where matter starting from the electrons is being continuously created. With high- speed violent motion of the particles at speed approaching light-speed, the electrons will magnetically attract and electrically repel, thus assembling neutrons, protons and hydrogen atoms; that will pour out of the *creation zone* continuously at speeds close to the light speed. There will also be such electrons that will possess spin opposite to their neighbors, thus behaving as positrons, and leading to the annihilation and consequent emission of intense gamma radiation. The matter of Galaxy is created within the central core of the Galaxy and also within the stars. Therefore, all those galactic centers, that are pushing out jets of hydrogen and gamma radiation, are in the active zones of the universe creating continuously matter, and thereby increasing the mass of the Galaxies, stars and their planets.

Orbital Radii of the Planets

In Eq.10, it is seen that the velocity-field that produces inward acceleration (and consequently inward central force) on the earth, is the resultant field obtained by the superposition of the fields of the Earth's space-vortex as well as the Sun's space-vortex ; and if this velocity-field is denoted by v_0, then Eq.11 becomes

$$F = M_e \times v_0^2 / r. \tag{45}$$

Equating (12) with (45), as was done in (19),

$$(c / 4\pi)\, Q_s Q_e / r^2 = M_e\, v_0^2 / r,$$

and from above

$$r \propto Q_e / M_e\, v_0^2, \tag{46}$$

since Q_s is constant for all the planets.

It is seen from (46) that the orbital radius for a planet (with axial rotation) is directly proportional to its electric charge and inversely proportional to the mass; it is also inversely proportional to the square of the

resultant velocity-field which, as defined above, is greater than the orbital speed of the planet. From Newton's equation (Eq.1), however, the expression for the orbital radius is:

$$r \propto 1 / v^2, \tag{47}$$

which, unlike Eq.46, shows that the orbital radius is independent of the mass of the planets. Therefore, as per present celestial mechanics, Jupiter can occupy Mercury's orbit, however, such is not the case that follows from (46).

Conclusion

The mass of the Earth is more than three times less than its presently accepted mass, making the present hypothesis of the presence of heavy elements in its interior unnecessary.

Kepler's equations and the astronomical measurements on axial rotations and the radii of the sun and planets, are sufficient to derive the free-fall accelerations on these bodies without involving, for these calculations, either mass or the gravitational constant; thereby showing the non applicability of Newton's equation in celestial mechanics for those *planets that possess electrical-charge due to axial rotation*, and are repelled by the Sun. The cosmic bodies in orbital motion are carried by the velocity-fields of their respective vortices. Motion of the comets involves relative motion with respect to the medium of space, and therefore, their orbits will be regulated by the gravitational and the centrifugal forces as in Newtonian mechanics in addition to the interaction with the velocity-field of the solar space-vortex.

New experiments for the gravitational attraction between the spherical balls made of heavy as well as light elements, with varying in- between distances and masses, need to be performed to find the value of G, and formulate afresh the formula for gravitational attraction based on these experimental results.

The phenomenon of creation of cosmic matter is the process of conversion of the spatial velocity-field (space-motion) into fundamental particles of matter (electrons), and such a creation which is presently on in our galaxy, should also be the universal phenomenon around the region of the universe in which this Galaxy exists. Therefore, the mass of the Sun and the planets should be constantly increasing despite the continuous emission of light by the Sun.

Table-1 **Some Dynamical Characteristics of Solar System**

	Earth	Mars	Jupiter	Saturn	Neptune	Uranus	Pluto	Sun
Space-circulation around the planet, v_s, (km / s)	7.8	3.72	41.8	24.9	16.5	15.18		436.7
Radius (km)	6400	3395	71500	60000	24750	25900	1700	6.96×10^5
$v_s \sqrt{R} = k$ ($m^{3/2}/s$)	1.987×10^7	6.8×10^6	3.53×10^8	1.93×10^8	8.2×10^7	7.7×10^7		11.52×10^9
Free-fall Acceleration v_s^2 / R (m / s^2)	9.55 (9.78)	4.07 (3.72)	24.5 (22.9)	10.4 (9.05)	11.02 (11.0)	8.9 (7.77)		274 (274)
Surface tangential velocity (km / s)	0.466	0.239	12.7	10.23	2.73	0.16	0.013	1.945
Electrical charge on surface (CGSE)	1.85×10^{23}	2.72×10^{22}	6.4×10^{26}	3.63×10^{26}	1.648×10^{25}	1.05×10^{24}	5.5×10^{20}	0.928×10^{28}
Mass (kg)	2.47×10^{24}	4.71×10^{23}	8.34×10^{26}	6.47×10^{26}	2.3×10^{25}	2.4×10^{25}	1.26×10^{22}	4.75×10^{29}

Note. The ratios of the mass of the planets with the new mass of the Earth are: Mars - 0.19 (0.107); Jupiter-337 (318); Saturn-261 (95.1); Neptune-9.3 (17.2); Uranus-9.7 (14.5); Pluto-0.005 (0.002), where the figures within the brackets are the presently accepted values.

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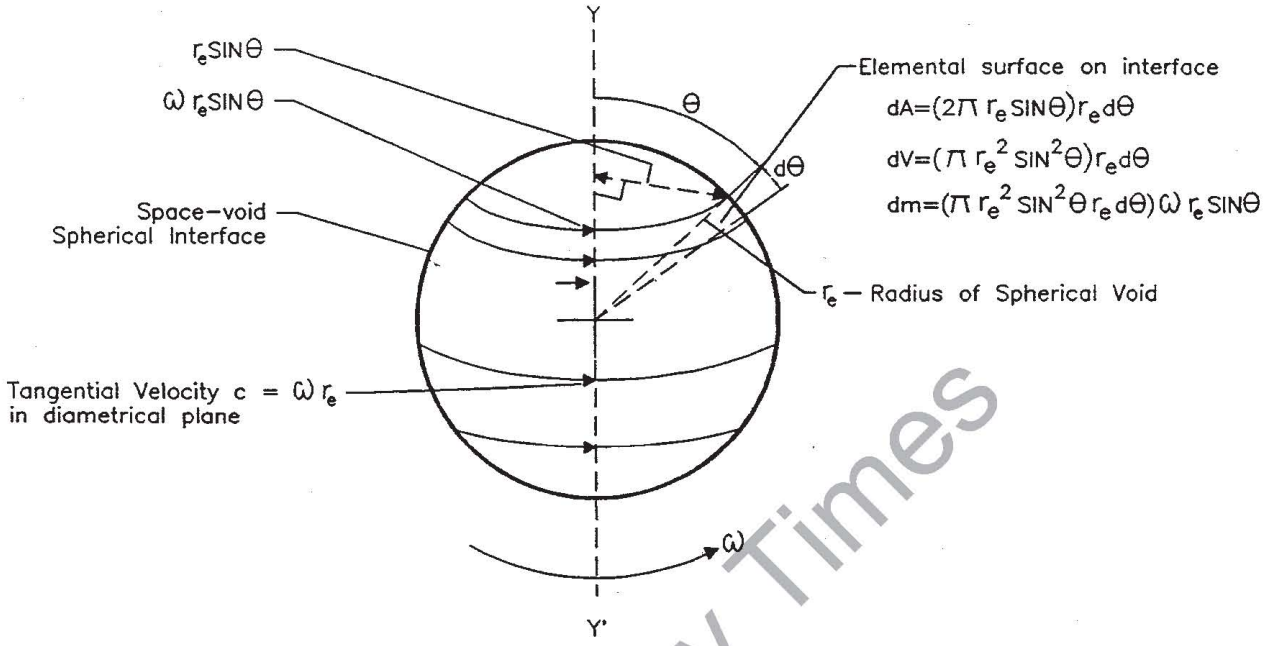


Universal Constant ω: Angular Velocity of Interface Around Y–Y' & equal to c/r_e

c : Speed of Light in absolute vacuum

q_e : Electronic charge
m_e : Electron's mass

L : Angular momentum of electron

Space : Non–viscous, mobile, continuous, incompressible

Void : Fieldless, spherical hole in space

Radius of spherical void $r_e \simeq 4\times10^{-11}$ cm

$$q_e = {}_0\int^{\Pi} dA\,\omega r_e \text{SIN}\Theta = (\Pi/4)(4\Pi r_e^2 c)$$

$$m_e = {}_0\int^{\Pi} dV\,\omega r_e \text{SIN}\Theta = (4\Pi/3) r_e^3 c$$

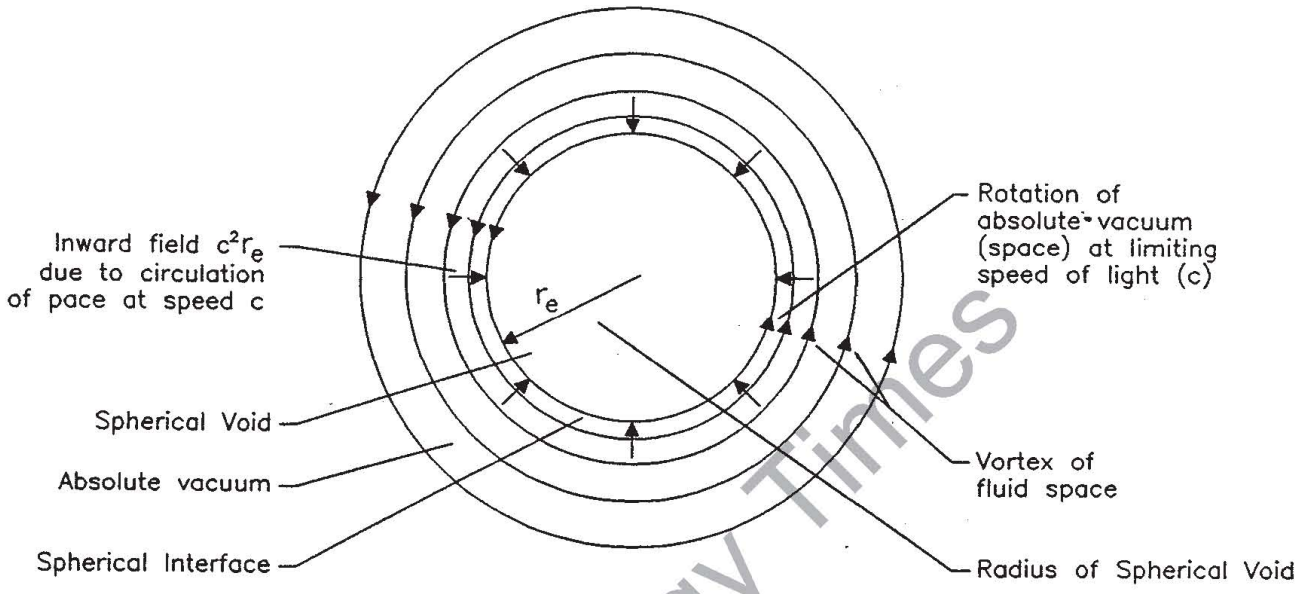
$$L = {}_0\int^{\Pi} dm(\omega r_e \text{SIN}\Theta\, r_e \text{SIN}\Theta = (4/5) m_e r_e c$$

Gram = 7.8×10^6 Cm^4/s

Unit charge (CGSE) = Cm^3/s

Generation of Mass, Charge & Angular Momentum of Electron from Absolute Vacuum

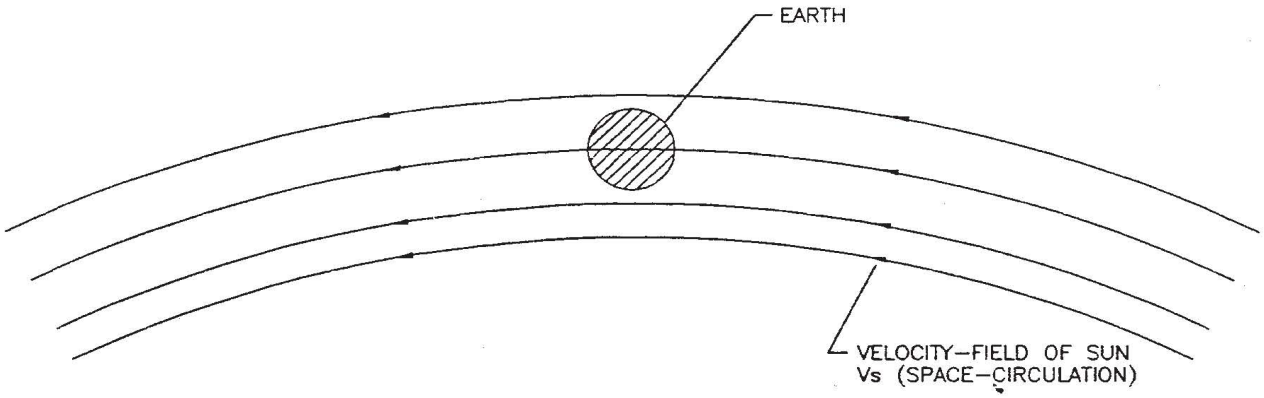
Fig.–1



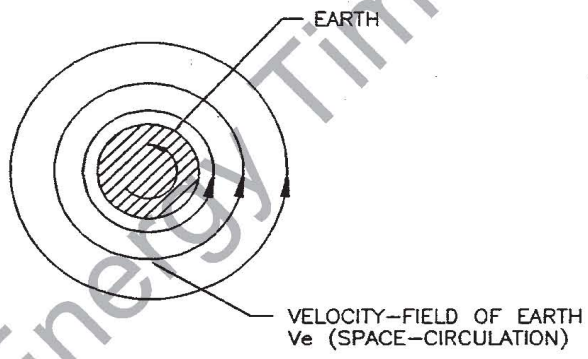
Absolute vacuum possesses non–material properties of incom–pressibility, zero–viscosity, continuity & mass–lessness of an ideal fluid; fieldless & energyless spherical–void is created due to limiting rotation & breakdown of absolute vacuum.

Space Vortex in Electron Structure

Fig.–2



(a)



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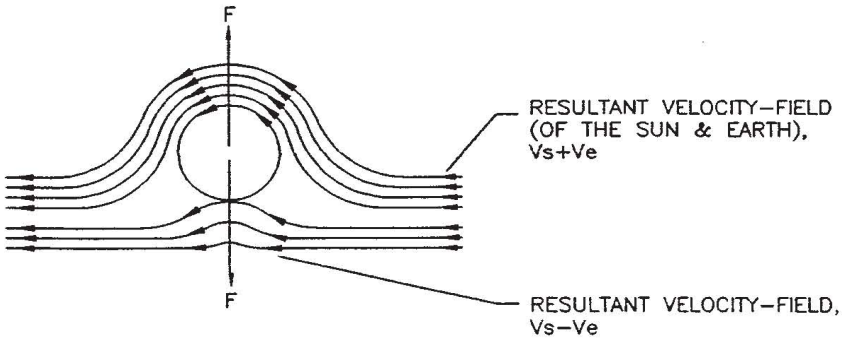
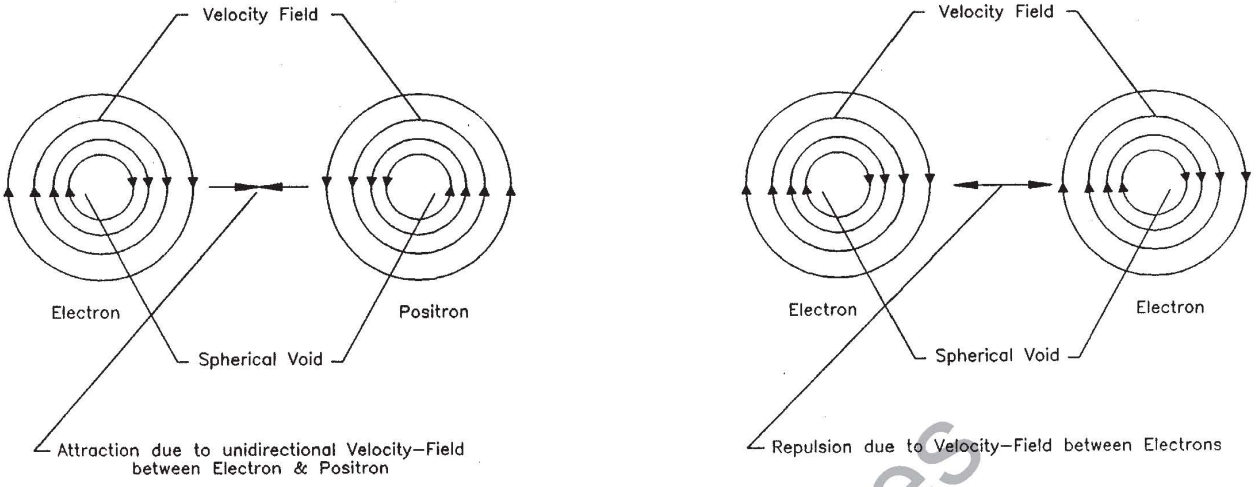


(c)

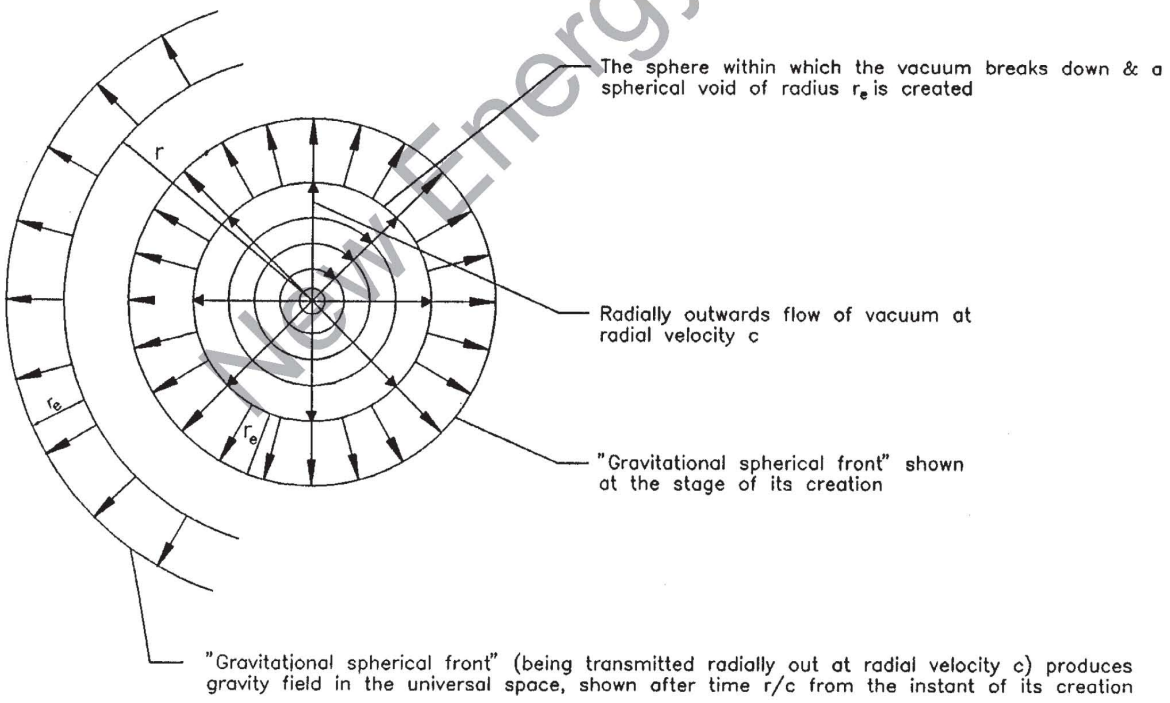
ELECTRICAL FORCE ON EARTH

Fig.–3



Attractive & Repulsive Forces due to Velocity Fields

Fig.–4



Creation of Electron

Fig.–5

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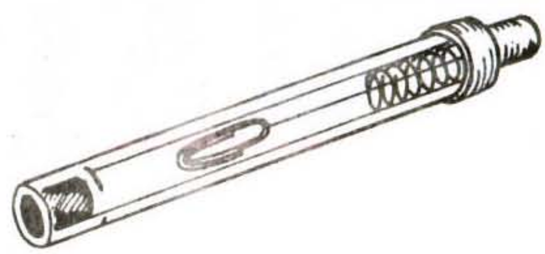

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NUCLEAR REACTIONS

Alfonso Rueda (Dept. Elec. Engr. & Dep. Phys., CA State Univ., Long Beach, CA), Bernhard Haisch (Solar & Astrophys. Lab., Lockheed Martin, Palo Alto, CA & Max-Planck-Institut für Extraterrestrische Physik, Germany), **Inertia as Reaction of the Vacuum to Accelerated Motion,** *Phys. Letters A*, vol 240 (1998) pp 115-126.

It was proposed by Haisch, Reuda and Puthoff that the inertia of matter could be interpreted at least in part as a reaction force originating in We may also derive some reason for hope from the circumstances of several actual inventions being of such a nature, that scarcely any one could have formed a conjecture about them previous to their discovery, but would rather have ridiculed them as impossible. For men are wont to guess about new subjects from those they are already acquainted with, and the hasty and vitiated fancies they have thence formed: than which there cannot be a more fallacious ode of reasoning.

Sir Francis Bacon, quoted from The Man Who Saw Through Time, reviewed in Infinite Energy. interactions between the electromagnetic zero-point field (ZPF) and the elementary charged constituents (quarks and electrons) of matter. Within the limited context of that analysis, it appeared that Newton's equation of motion (f = ma) could be inferred from Maxwell's equations as applied to ZPF, i.e., the stochastic electrodynamics (SED) version of the quantum vacuum. We report on a new approach which avoids the ad hoc particle-field interaction model (Planck oscillator) of that analysis, as well as its concomitant formulation complexity. Instead, it is shown that a non-zero ZPE momentum flux arises naturally in accelerating coordinate frames from the standard relativistic transformations of electromagnetic fields. Scattering of this ZPF momentum flux by an object will yield a reaction force that may be interpreted as a contribution to the object's inertia. This new formulation is properly covariant yielding the relativistic equation of motion: F = dp /dτ. Our approach is related by the principle of equivalence to Sakharov's conjecture of a connection between Einstein action and the vacuum. If correct, this concept would substitute for Mach's principle and imply that no further mass-giving Higgs-type fields may be required to explain the inertia of material objects, although extensions to include the zero-point fields of the other fundamental interactions may be necessary for a complete theory of inertia.

Mitchell R. Swartz (JET Energy Technol., Inc., Wellesley Hills, MA), **Patterns of Failure in Cold Fusion Experiments**, Proc. IECEC-98, in production.

Although reproducible cold fusion experiments continue to be difficult to achieve, analyses of these experiments offer preliminary suggestions on improving yields and reliability. Patterns of failure of cold fusion experiments can be divided into physical issues such as sample activity, loading achieved, ambient noise power, paradigm used, and possible material degradation.

M. G. Olayo, G. J. Cruz, L. Balderas, L. Melendez, A. Chavez, R. Valencia, E. Chavez, A. Flores, R. Lopez (Dept. Fisica, Inst. Nacional de Investigaciones Nucleares, D.F. Mexico), **Absorption of Deuterium in Titanium Plates Induced by Electric Discharges**, *International Journal of Hydrogen Energy*, vol 23, 1998, pp 885-890.

In this work, the absorption of deuterium in titanium plates induced by electric discharges is studied. The objective was to measure the amount of deuterium that is absorbed in the titanium structure under the influence of an electric discharge. The ionization and the free radicals produced by the electric field act as a promoter to the absorption mechanism. Thus, the absorption can be enhanced by the use of an electric discharge. The results indicated that there was a rapid desorption of deuterium at the beginning of the discharge, followed by an additional absorption to levels higher than those before the discharge. The additional absorption of deuterium was about 20% of the initial absorption. When the titanium was completely saturated with the gas, no additional absorption occurred through the electric discharges. As a result of the absorption conditions of deuterium in the titanium structure, anomalous mission of neutrons was recorded as tracks in a CR39 type plastic solid state nuclear-track detector.

Adrian Serban and Sing Lee (Nanyang Techno. Univ., Nat. Inst. Edu., **The Effect of High Axial Sheath Velocity on Neutron Yield in Plasma Focus**, *Fusion Technology*,

vol 35, no 1, Jan. 1999, pp 54-60, 20 refs, 6 figs, 3 tables.

To study the effect of higher axial sheath velocities on neutron production, the geometry of the inner electrode (anode) of a 3-kJ Mather-type plasma focus device was modified. Double-stage stepped-anode configurations were testedwith a speed-enhanced region long enough for a significant increase in speed but not long enough to allow the development of force-field flow-field separation at the end of the axial phase. Peak axial speeds up to 15 cm/μs were achieved without modifying the deuterium filling pressure and charging voltage. The neutron and soft X-ray productions were found to be dependent on sheath velocity. A new scaling law for the nonbeam component of the neutron yield was proposed.

L. Meléndez, E. Chávez, R. López, G.J. Cruz, M.G. Olayo, A. Chávez, M. Balcázar (Inst. Nacional de Investigaciones Nucleares, Plasma Phys. Lab., Mexico, e-mail: lml@nuclear.inin.mx), **Titanium Deuteration with Neutron Emission through Electrical Discharges**, *Fusion Technology*, vol 35, no 1, Jan.1999, pp 71-77, 16 refs, 7 figs.

To search for the absorption of deuterium gas in titanium plates and the neutron emission from this process, electrical discharges between two titanium electrodes in a deuterium atmosphere have been performed. During the discharges, a temperature > 300° C on the surface of the electrodes was measured. A typical characteristic of the phenomenon observed was the deuteration of the electrodes. pressure reduction was notorious when the chamber was previously cooled with liquid air. Deuterium absorption seemed to be present in all experiments whether or not liquid air was added on the deuteration chamber. Sheets of CR^{39} plastic detectors, a Bonner sphere, and a fission chamber were used to look for neutron emission.

Peter Graneau (Ctr. Electromag. Res., NE Univ., Boston, MA), Neal Graneau (Dep. Engr. Sci., Oxford Univ., UK), George Hathaway (Hathaway Consult. Serv., Toronto, Ontario, Canada), **Solar-Energy Liberation from Water by Electric Arcs**. *J. Plasma Physics*, vol 60, part 4, 1998, pp 775-786, 11 refs, 6 figs. 1 table.

This paper reports progress in an experimental investigation, started in the late Hathaway laboratory in 1994, dealing with the liberation of intermolecular bond energy from ordinary water by means of an arc discharge. Photographic evidence of fog generation and explosion during the arcing period is included. A new for accelerator is described and a table of results of the kinetic energies of fog jots is provided. A renewable water energy cycle is outlined. The fog kinetic energy has been found to be greater than the difference between the capacitor input energy and the heat losses. Given energy conservation, the only external energy input that can account for the fog kinetic energy is solar heat from the atmosphere.

Qingfu Zang, Fusen Liu, Yue Sun, Licai Cheng, Xeifeng Zhou, Xanmen Cheng (Inst. Atomic Mol. Sci. High Temp., High Pressure, Sichuan Union Univ., Chengdu, Peop. Rep. China), **Experimental study on the "excess heat" for a deuteron absorbed in a titanium lattice**, *Yuanzi Yu Fenzi Wuli Xuebao*, vol 15, no 2, pp 210-214 (Chinese) 1998.

The accuracy of the calorimeter of an open electrolysis system is very important in detecting "excess heat" from cold fusion. Considering the nature of evaporation of D_2O and the difficulty of measuring the excess potential, the equation of the calorimeter is solved by using a differential method. The electrolysis experiments were carried out with this open electrolysis system. The results of the experiments are the same as those of a theoretical calculation with the equation of the calorimeter, and the "excess heat" is 1.6-6.9 ± 0.3 W.

Vittorio Violante, Amalia Torre, Giuseppe Dattoli (Div. Fusione, Centro Ricerche Frascati, Rome, Italy), **Lattice ion trap: classical and quantum description of a possible collision mechanism for deuterons in metal lattices,** *Fusion Technol.*, vol 34, no 2, pp 156-162, 1998.

The dynamics of deuterons inside a palladium lattice around tetrahedral sites at high deuterium concentration is studied by using both a classical description and a quantum mechanical representation, and the results are compared. The classical representation takes advantage of the similarity between the electrodynamic confinement of charged particles stored in a quadrupolar radio-frequency trap and the palladium lattice. The quantum mechanical description of the dynamics of a charged particle interacting with another charged particle within a lattice radio-frequency trap is carried out by solving the time-dependent Schrodinger equation with a numerical procedure. Both descriptions produce an interaction effect between the deuterons inside the metal lattice.

Mikio Fukuhara, (Toshiba Tungaloy, Tech. Res. Lab., Kitakase, Saiwai-ku, Kawasaki, Japan), **Possible dynamic interaction of deuterons between tetrahedral and octahedral interstices of palladium lattice at cryogenic temperatures,** *Fusion Technol.*, vol 34, no 2, pp 151-155, 1998.

The dynamic interaction observed at cryogenic temperatures in PdDx(x <1) lattices is interpreted to be the result of interstitial solute deuterons jumping from the tetragonal sites to the octahedral one along the [111] directions and electrostatic attraction due to the charge transfer in the chains; i.e., an alternating tetrahedral-octahedral site arrays with the help of the electron-phonon charge-density wave coupling. The generation of heat may be associated with the collective electrons derived from the palladium atoms and neutral pions between deuterons.

Lali G. Chatterjee, (Cumberland Univ., Lebanon, TN, USA), **Electrolysis in thin-film nickel coatings: mimicking supernova physics?** *Fusion Technol.*, vol 34, no 2, pp 147-150, 1998.

Physics similar to the r-process mechanism of forming heavy elements in core-collapse in core-collapse supernovas is invoked to explain the recent observation of nuclear transmutations in thin-film nickel coatings during electrolysis. Electrolysis could catalyze weak interactions of the electron capture type in thin films, resulting in an enhanced rate for the weak capture of electrons by protons to form real or virtual neutrons. These could subsequently be absorbed by the nuclei in the metal, and the neutrinos created to satisfy conservation laws would escape detection. The neutron-rich nuclei could stabilize by various beta decay channels similar to the r-process, and this model could explain the obsd. transmuted elements as well as the absence of radiation.

Thomas V. Prevenslik, (Discovery Bay, Hong Kong), **Sonoluminescence: fusion at ambient temperature?** *Fusion Technol.*, vol 34, no 2, pp 128-136, 1998.

Sonoluminescence (SL) may be explained by the Planck theory of SL, which treats the bubbles as miniature collapsing IRasers have a resonant frequency that always increases as the bubble collapses. Microwaves are created at frequencies proportional to the collapse velocity while optical waves in standing resonance with the characteristic dimension of the IRaser cavity are absorbed by the bubble wall molecules. The microwaves are absorbed at ambient temperature and accumulate to visible-UV photon levels through the rotation quantum state of the bubble wall molecules.
In the Planck theory of SL, the collapse shape in multiple-bubble SL (MBSL) is treated as a pancake, whereas in single-bubble SL (SBSL) the collapse shape is treated as spherical. High bubble gas temperatures are unlikely in MBSL because the bubble gases in a pancake collapse are squeezed radially outward in almost constant volume at ambient temperature. However, SL spectra in MBSL are found to be far more intense than SBSL, yet the SBSL collapse shape is spherical. Because a bubble gas temperature increase is unlikely in MBSL, and because MBSL is more intense than SBSL, it is concluded that a temp. increase in an SBSL collapse is also unlikely, even though the collapse is spherical. Hence, the prospects for hot fusion in a spherical SBSL collapse are not encouraging. However, a limited number of SL-induced fusion events in D_2O may be possible in MBSL and SBSL as the bubble walls approach the spacing between D_2O molecules in the liquid state. On average, reactions between the D's on colliding D_2O bubble wall molecules do not occur as the Planck energy is limited to ~1.3 keV, but some fusion events with a Planck energy >10 keV are not impossible.

D. Gozzi, F. Cellucci, P. L. Cignini, G. Gigli, M. Tomellini, E. Cisbani, S. Frullani, G. M. Urciuoli (Dep. Chem., Univ. di Roma La Sapienza, Rome, Italy), **X-ray, heat excess and ^{4}He in the D/Pd system.** [Erratum to document cited in CA128:146611], *J. Electroanal. Chem.*, vol 452, no 2, pp 251-271, 1998.

The energy balance between heat excess and ^{4}He in the gas phase has been found to be reasonably satisfied even if the low levels of ^{4}He do not give the necessary confidence to state definitely that we are dealing with the fusion of deuterons to give ^{4}He. In the melted cathode, the data of which are reported, no ^{4}He was found at the achieved sensitivity. X-ray film, positioned at 50 mm from the cell, roughly gave the image of the cathode through spots. Extended considerations have been made to explain this evidence on the basis of the bundle nature of the cathode. From these considerations, the energy of the radiation and the total energy associated to it have been estimated as 89 keV and 12 kJ, respectively. This value is ~ 0.5% of the energy measured by calorimetry in the same interval of time. The highest values of energy and excess power are 8.3 MJ and 10 W, respectively.

Lin Chen, Xu Qiu, Shengyi Song (Inst. Fluid Phys., CAEP, Chengdu, Peop. Rep. China), **Experimental search for excess heat under high pulsed current at palladium,** *Qiangjiguang Yu Lizishu*, vol 10, no 2, pp 312-314 (Chinese) 1998.

The discharges of Pd wire in D_2O under high pulsed current were studied experimentally. Neither neutrons nor excess heat were observed in lab. According to the experimental results, it is not impossible that neutrons and or excess heat may be observed under suitable conditions.

David Moon, Chuck Bennett (Minneapolis, USA), **The nucleo-electric effect**, *Elem. Energy (Cold Fusion)*, issue 26, pp 33-34, 1998

A device is proposed to harvest energy from a cold fusion type cell.

H. Kozima, M. Fujii, M. Ohta, K. Kaki, (Dep. Phys., Fac. of Sci,, Shizuoka Univ,, Japan), **TNCF analysis of excess heat data in Pd/D/Li system,** *Elem. Energy (Cold Fusion)*, issue 23, pp 49-53, 1997.

Data of careful calorimetric measurements of excess heat from Pd wire cathodes in D_2O + LiOD electrolytic solution obtained by Ota et al. were analyzed using the TNCF model. A consistent explanation of the data was obtained with the arbitrary parameter in the model - the density nn of the trapped neutron - of $10^9 \sim 10^{10}$ cm^{-3}.

H. Kozima, H. Kudoh, M. Ohta, K. Kaki (Dep. Phys., Shizuoka Univ., Japan), **TNCF analysis of tritium generation from ceramics in glow discharge with D_2 gas**, *Elem. Energy (Cold Fusion)*, issue 23, pp 42-45, 1997.

Experimental results of tritium measurements in a discharge system with ceramics cathodes by Romodanov et al. were analyzed with the TNCF model. A consistent interpretation of the whole results is given. The adjustable parameter in the model nn, the density of the trapped neutron, was detected as nn ~ 10^5 cm^{-3} in the experiments where tritium was measured.

H. Kozima, K. Arai, M. Ohta, K. Khaki (Dep. Phys., Fac. of Science, Shizuoka Univ., Japan), **TNCF analysis of neutron emission from TiD film excited by an electric current,** *Elem. Energy (Cold Fusion)*, issue 23, pp 36-39, 1997.

Exptl. data of neutron measurement obtained in TiDx (x ~ 1.5) film were analyzed using the TNCF model. An apparent difficulty in interpretation of the data, detection of neutrons above background level but inconsistent between 2 kinds of detectors, was resolved by the model and the arbitrary parameter in the model - the density nn of the trapped neutron - was determined as ~ 5.4 x 10^{11} cm^{-3} in the case of neutron emission of 102/s obsered by 1 of 2 detectors.

H. Kozima, K. Yoshimoto, M. Ohta, K. Kaki, (Dep. Phys.. Fac. Sci., Shizuoka Univ., Japan), **TNCF analysis of tritium and excess heat generation in a Pd/D/Li system**, Elem. Energy (Cold Fusion), issue. 23, pp 24-27, 1997.

Exptl. results of the T and the excess heat measurements in Pd/D/Li system conducted by Storms et al. were analyzed using the TNCF model. A consistent interpretation of the results, including time evolution of the excess heat generation, is demonstrated. The adjustable parameter in the model – the density of the trapped neutron was determined as nn ~ 10^7 and nn_{max} ~10^{10} cm^{-3} in the experiments where T and excess heat were measured (the max. value = 7 W).

Hideo Kozima, Mitsutaka Fujii, Masayuki Ohta, Kaori Kaki (Shizuoka Univ.,, Japan), **Jones' neutron data explained using the TNCF model. A short note**, *Elem. Energy (Cold Fusion)*, issue 24, pp 60-64, 1997.

The first data of neutron detection in the cold fusion phenomenon by Jones et al. in 1989 and the following null result by the same group in a low background environment in 1993 were analyzed using the TNCF model, proposed by us. It is possible to interpret the both experimental results consistently with a value ~ 10^{11} cm^{-3} of the adjustable parameter nn in the model, the density of the trapped neutrons supplied from the ambient background neutrons. The value of nn is in the range of values detectedd earlier in various materials used in the cold fusion research with positive results.

Hideo Kozima, Masayuki Ohta, Masahiro Nomura, Katsuhiko Hiroe (Shizuoka Univ, Japan), **Using a thin Pd wire cathode for excess heat generation**, *Elem. Energy (Cold Fusion)*, issue 24, pp 57-59, 1997.

Experimental data on the excess heat generation in thin and long PdD/Li cathodes obtained by Celani et al. were analyzed using the TNCF model. A quantity measurement of the amount of the excess heat generated in the cathodes was used to determine the single adjustable parameter nn, the density of the trapped thermal neutrons, the max. value of which was determined as 1.0 x 10^{12} cm^{-3}.

TNCF analysis of excess heat, tritium and helium-4 generation in a Pd/D/Li system, H. Kozima, M. Ohta, K. Kaki, (Dep. Phys., Fac. Sci., Shizuoka Univ., Japan). *Elem. Energy (Cold Fusion)*, issue 24, pp51-56, 1997.

Experimental results of measurement of the excess heat, tritium and ^{4}He in Pd/D/Li electrolysis system were analyzed with the TNCF model. The remarkable result of the simultaneous observation of these quantities, which are decisive evidences of the nuclear reactions in solids, was interpreted consistently with one adjustable parameter of the model with a value nn ~ 10^{10} cm^{-3}.

Rex L. Matlock, Frank E. Collins, Gary R. Boucher, (Louisiana St. Univ., Shreveport, LA), **Anomalous tritium found in the recombined off-gasses during electrolysis using single crystal cathodes**, *Elem. Energy (Cold Fusion)*, issue 26, pp 28-32,1998.

Palladium and nickel single crystals were used as the cathodes in two sep. expts. during electrolysis of D_2O/T_2O. The concn. of tritium found in the recombined off-gasses was significantly larger than expected based on a electrolytic sepn. factor of two. The concn. of tritium in the cell was consistent with a sepn. factor of two based on a math. model of the process. The excess tritium in the recombined off-gasses was found to occur at 20°C and 40°C in the case of the palladium and nickel electrodes resp. Other investigations by the authors using non-single crystal electrodes have not revealed excess tritium.

H. Kozima, K. Arai, M. Fujii, (Dep. Phys., Shizuoka Univ., Japan), **Analysis of tritium and heat generation in an Ni/H/K system by Notoya, et al.,** *Elem. Energy (Cold Fusion)*, issue 26, pp 20-26, 1998.

Experimental data of tritium and excess heat generation from an electrolytic system of porous Ni electrodes, potassium carbonate and light water obtained by Notoya, et al. are analyzed using the TNCF model. The data are consistently explained using the model, with the adjustable

parameter nn of 1.2 x 10^9 cm^{-3} for the tritium data. This value gives an expected excess heat of 0.26 J/s (= 1.6 x 10^{12} MeV/s), assuming the decay consists of 40K in the surface layer, largely shortened to ~ 1 d from 1.3 x 10^9 yr in the free state, compared with the experimental value 0.88 J/s (= 5.5 x 10^{12} MeV/s) described in the paper. The accordance of two values by a factor 3.4 for the excess heat is very good in the range of a usual discrepancy of a factor 3 ~ 5 obtained in our previous analyses and shows the ability to give a consistent explanation of the cold fusion phenomenon.

David Moon (Minneapolis, MN), **Excess heat versus transmutations**, *Elem. Energy (Cold Fusion)*, issue 26, pp 12-19, 1998.

Excess heat generation vs. transmutations in cold fusion is discussed. The conditions affecting the ratio of excess heat generation vs. transmutations are considered.

H. Kozima, M. Fujii, M. Ohta, K. Arai, (Dep. Phys., Fac. Sci., Shizuoka Univ., Japan), **Neutron energy spectrum measured by Bressani et al. analyzed using the TNCF model**, *Elem. Energy (Cold Fusion)*, issue 25, pp 51-56, 1998.

The energy spectra of neutrons in the cold fusion phenomenon measured by Bressani et al. in a Ti/D gas loading system were analyzed using the TNCF model proposed by us. The data are interpreted consistently with the value of the adjustable parameter nn, the density of the trapped neutron in the model supposed to be supplied from the ambient neutron, of a value 105 ~ 10^6 cm^{-3}. The value of nn is in the smallest range of values determined hitherto in more than 40 various materials used in the cold fusion research where positive results were obtained. A possible cause of the small value of the parameter nn is discussed, taking into consideration the characteristics of the sample.

H. Kozima, H. Kudoh, K. Yoshimoto, (Dep. Phys., Shizuoka Univ., Japan), **Nuclear transmutation by fission in cold fusion experiments analyzed using the TNCF model**, *Elem. Energy (Cold Fusion)*, issue 25, pp 34-38, 1998.

Experimental data of the excess heat generation and the nuclear transmutation obtained in gas-loading Pd/D and Pd/H systems were analyzed using the TNCF model. An apparent difficulty in interpretation of the data, showing generation of zinc in palladium wire loaded with protium, is solved by the model. The arbitrary parameter in the model – the density nn of the trapped neutrons – was detected as 1.6 x 10^{12} (Pd/D) and 9.9 x 10^8 (Pd/H) cm^{-3}, which are in the range of values determined in previous works analyzing more than 40 experimental data of the cold fusion phenomenon.

Hideo Kozima, (Dep. Phys., Fac. Sci., Shizuoka Univ., Japan), **Cold fusion phenomenon and the prospects of solid state nuclear physics**, *Elem. Energy*, issue 25?

A review is presented of K. Hushimi's commemorative lectures on the cold fusion phenomenon and the prospects of solid state nuclear physics. 5 Refs.

C.L. Crespo, R.F.C. Carvalhal, C.A.C. Sequeira (Dept. Chem. Engineering, Inst. Superior Tecnico, Lisbon, Portugal), **Electrochemically induced cold fusion and environment**, *Spec. Publ. - R. Soc. Chem.*, vol 217 (Chemistry, Energy and the Environment), pp 363-377, 1998.

A review with 56 refs.

Lee D. Hansen, Steven E. Jones, David S. Shelton (Dept. Phys. & Chem., Brigham Young Univ., Provo, UT), **A response to hydrogen + oxygen recombination and related heat generation in undivided electrolysis cells**, *J. Electroanal. Chem.*, vol 447, no 1-2, pp 225-226, 1998.

A conclusion was obtained that faradaic efficiency must be accurately determined and calorimetric accuracy must be demonstrated while the cell is producing excess heat still stands if compelling evidence is to be obtained.

T.V. Prevenslik (Hong Kong, Peop. Rep. China), **Sonoluminescence: an IRaser creating cold fusion neutrons?**, *Nucl. Sci. Tech.*, vol 7, no 3, pp 157-160, 1996.

Sonoluminescence can be explained by treating the bubbles as IRasers with standing waves in resonance with the bubble dimensions. Since the IRaser resonant radiation is required to satisfy wave boundary conditions, the water molecules lining the bubble walls undergo a continuous population inversion as the bubble collapses. By stimulated processes, the Planck energy accumulates as the KbT energy of radiation photons is pumped from the surroundings through the rotational state of the water molecule. Bubble collapse occurs almost isothermally with the high IR absorptivity of the water molecule permitting the Planck energy to accumulate to 2~6 eV only to be released by VIS-UV photon emission because of the low absorptivity of water at VIS-UV frequencies. As the IRaser cavity dimensions collapse to the spacing between water molecules at liquid density, soft X-rays at about 2 keV are predicted. But, this is less than 10 keV necessary for cold fusion so that no neutrons is directly expected yet. Therefore, it is suggested that UV laser enhancement is used to accumulate further bubble collapse energy.

V.V. Yaminsky, B.W. Ninham, R.M. Pashley, (Dept. App. Math. Res. Sch. Phys. Sci. and Engr. Inst. of Adv. Studies and Chem., the Faculties,

Australian Nat. Univ., Canberra, Australia), **Interaction between Surfaces of Fused Silica in Water. Evidence of Cold Fusion and Effects of Cold Plasma Treatment**, *Langmuir*, vol 14, vo 12, pp 3223-3235, 1998.

Silica colloids and silica glass surfaces have often been used as "model" systems to study coagulation, rheology, contact angles, and surface forces. But the silica-water interface is highly changeable and reactive. It has stubbornly refused to conform to theoretical models of an ideal hydrophilic substrate. In this study we show why this is and demonstrate some of the diverse properties of this surface. Surfaces of fused quartz swell under water to form layers of silica gel. We report here on how this well-known effect shows up in surface force measurements. Peculiar effects occur already at normal pH.

Over a period of time after the surfaces are immersed in water, identical interaction patterns occur on approach and on separation. The double-layer repulsion extends from large distances down to the contact. Interaction hysteresis develops later. Adhesion and other specific interactions, particularly at short range, develop with time. The evolution that extends for hours and days is variable in its manifestations from experiment to experiment. Precise conditions of solidification from the melt, and aspects of the thermal history of the glass transition during preparation of vitreous silica samples, can be factors in this variability. Surface degradation by formation of silica gel layers on contact with water can be enhanced by cold plasma treatment and by UV radiation. Pull-off forces increase with increasing contact time. They also show a memory of conditions of previous contacts. Electrolytes enhance the adhesion. Complicated polycondensation equilibrium, influenced by nonspecific and specific ion effects, pH, nonionic solutes, and temperature distinguish the chemistry of silicic acid. All are involved in the interaction.

These curious, history-dependent, surface forces were first reported half a century ago. They were attributed by Malkina and Derjaguin to "water structure". The effects that led later to contentious and disputed notions of hydration forces can be manifest as an "extra" repulsion or an "extra" attraction. They are here related to surface gelation. These surface force observations have distinct parallels in thixotropy and other peculiarities of "anomalous" coagulation and rheological behavior of concentrated and diluted dispersions of colloid silica in water.

The effect of "cold fusion" between macroscopic surfaces of pure silica in pure water is here studied at room temperature with a new interfacial gauge force measuring technique. This spontaneous welding due to the presence of water can be hindered by stray contact shear, which interferes with observation by colloid probe and surface force techniques. The peculiar properties of the silica-water interface are discussed in connection with earlier experimental work that led to theoretical notions of polywater and non-DLVO forces.

Steven E. Jones, Lee D. Hansen, David S. Shelton (Dept. Chem., Brigham Young University, Provo, UT), **An Assessment of Claims of Excess Heat in Cold Fusion Calorimetry**, *J. Phys. Chem. B*, vol 102, no 18, pp 3647 (English) 1998 American Chemical Society.

The response from Miles at al. (*J. Phys. Chem. B*, 1998, 102) failed to adequately address either of major conclusions of our paper criticizing their work. The "anomalous" radiation and ^{4}He observed by them are artifacts. Calorimetric errors can account for the "excess heat" claimed by them.

Melvin H. Miles (Chem. & Mats. Branch Res. & Tech. Div., Naval Air Warfare Ctr., Weapons Div., China Lake, CA), **Reply to "An Assessment of Claims of Excess Heat in Cold Fusion Calorimetry**, *J. Phys. Chem. B*, vol 102, no 18, pp 3648, 1998.

The author cannot find any experimental errors that explain our radiation and ^{4}He measurements pointed out by Jones at al. (*J. Phys. Chem., 1998*). $H_2(D_2)$ recombination with O_2 must be ruled out as an experimental explanation for excess heat.

Melvin H. Miles (Chem. & Matls. Branch Res. & Tech. Div., Naval Air Warfare Ctr., Weapons Div., China Lake, CA), **Reply to "Examination of Claims of Miles et al. in Pons-Fleischmann-Type Cold Fusion Experiments"**, *J. Phys. Chem. B*, vol 102, no 18, pp 3642-3646, 1998.

The major allegations by Miles et al. (*J. Phys. Chem.* 1995, 99, 6966) have been explained and discussed previously. We proved that faradaic efficiencies ~ 100% cannot account for our reports of excess heat. Excess enthalpy for the Pd/D_2O system generally involves high current density >100 mA/cm^2, there fore their report of low faradaic efficiencies using current density of only 1-2 mA/cm^2 is not applicable to our cold fusion experiments. There is compelling evidence that the anomalous excess heat is associated with He-4 production.

Hideo Kozima, Kaori Khaki, Masayuki Ohta (Dept. Physics, Fac. Science, Shizuoka Univ., Japan), **Anomalous phenomenon in solids described by the TNCF model**, *Fusion Technol.*, vol 33, no 1, pp 52-62, 1998.

More than 25 typical experimental data sets of the cold fusion phenomenon have been analyzed phenomenologically by the TNCF (trapped neutron catalyzed fusion) model based on an assumption of the quasi-stable existence of the thermal neutrons in solids with special characteristics, giving a consistent explanation of the whole data set. The densities of the assumed thermal neutron in solids have been detected in the analyses from various experimental data and were in a range of 10^3 to 10^{12} cm^{-3}. The

success of the analyses verifies the validity of the assumption of the trapped thermal neutron. Physical bases of the model were speculated, facilitating the quasi-stable existence of the thermal neutron in the crystal, thereby satisfying definite conditions.

D. Gozzi, F. Cellucci, P.L. Cignini, G. Gigli, M. Tomellini, E. Cisbani, S. Frullani, G.M. Urciuoli (P. le Aldo Moro 5, Dept. Chem., Univ. di Roma La Sapienza, Roma, Italy), **X-ray, heat excess and ^{4}He in the D/Pd system**, *J. Electroanal. Chem.*, vol 435, no 1-2, pp 113-136,1997.

The energy balance between heat excess and ^{4}He in the gas phase is reasonably satisfied even if the low levels of ^{4}He do not give the necessary confidence to state definitely that the authors are dealing with the fusion of deuterons to give ^{4}He. In the melted cathode, the data of which are reported, no ^{4}He was found at the achieved sensitivity. X-ray film, positioned at 50 mm from the cell, roughly gave the image of the cathode through spots. Extended considerations were made to explain this evidence from the bundle nature of the cathode. From these considerations, the energy of the radiation and the total energy associated to it were estimated, as 89 keV and 12 kJ, respectively. This value is ~ 0.5% of the energy measured by calorimetry in the same interval of time. The highest values of energy and excess power are 8.3 MJ and 10 W, respectively.

V.D. Dougar Jabon, G.V. Fedorovich, N.V. Samsonenko (Escuela de Fisica, Univ. Industrial de Santander, Colombia), **Catalytically induced D-D fusion in ferroelectrics**, *Braz. J. Phys.*, vol 27, no 4, pp 515-521, 1997.

A model of deuteron acceleration in ferroelectric crystals under the process of domain polarization reversal is proposed. Experimental verification of the model with $LiTaO_3$ crystals saturated with deuterium was fulfilled. In the 75 kV/cm a.c. field the neutron emission attributed to D-D fusion is two order magnitude higher the Jones level.

ZERO POINT ENERGY RESEARCH

Chung-In Um, Jae-Rok Kahng, Thomas F. George, **Ground-state properties of two-dimensional ^{3}He-^{4}He mixtures: energetics and structures**, (Dep. Phys., Coll. Sci., Korea Univ., Seoul, S. Korea), *J. Low Temp. Phys.*, vol 112, no 5/6, pp 399-417, 1998.

Using a variational Jastrow wave function extended to include a three-body correlation function and a hypernetted chain (HNC) and Fermi hypernetted chain (FHNC) scheme with contribution from elementary diagrams, we analyze ground-state energies and structural properties of two-dimensional ^{3}He-^{4}He mixtures. The mixtures are in equilibrium at lower density compared to a pure ^{4}He system because of the large zero-point energy and statistical correlations due to the fermionic nature of ^{3}He. We evaluate the lowering of ground-state energies as a function of the impurity concentration and total density of mixtures. Comparing the results with boson ^{3}He-^{4}He mixtures, we evaluate the energy shifts coming from the statistics and analyze the enthalpy to study the miscibility and mobility of each component of the mixture.

Catherine Dekerckheer, Olivier Dahlem, Jacques Reisse (Laboratoire de Chim. Org. E.P., Univ. Libre de Bruxelles, Belg.), **On the frequency and isotope effect in sonochemistry**. [Erratum to document cited in CA127:247776], *Ultrason. Sonochem.*, vol 5, no 1, p 39, 1998

On page 208, the sentence "The authors interpreted their results on the basis of the zero-point energy difference between H_2O and D_2O[22] and were able to estimate a reaction temperature by making the assumption that the temperature is the same in H_2O and D_2O, i.e. that the cavitation phenomenon is the same in the two liquids," must be replaced by "Working on a mixture of H_2O and D_2O, the authors interpreted their results on the basis of the zero-point energy difference between H_2O and D_2O [22] and were able to estimate a reaction temperature."

Nicola Manini, Erio Tosatti (E.S.R.F., B.P. 220, Grenoble, Fr.), **Exact zero-point energy shift in the e–(nE), t–(nH) many-modes dynamic Jahn-Teller systems at strong coupling**, *Phys. Rev. B: Condens. Matter Mats. Phys.*, vol 58, no 2, pp 782-790, 1998.

We find the exact semiclassical (strong coupling) zero-point energy shifts applicable to the e–(nE) and t–(nH) dynamic Jahn-Teller problems, for an arbitrary number n of discrete vibrational modes simultaneously coupled to one single electronic level. We also obtain an analysis formula for the frequency of the resulting normal modes, which has an attractive and apparently general Slater-Koster form. The limits of validity of this approach are assessed by comparison with O'Brien's previous effective-mode approach, and with accurate numerical diagonalizations. Numerical values obtained for t–(nH) with n=8 and coupling constants. appropriate to C60- are used for this purpose, and are discussed in the context of fullerene.

Zai-wan Zhu, Jun-jie Li, (Dep. Phys., Yanbian Univ., Yanji, Peop. Rep. China), **Ground state structure of the metallic hydrogen**, *Chin. Phys. Lett.*, vol 15, no 5, pp 362-363 1998.

By using the Heine-Abarencov pseudopotential method with mono-parameter rc, the expression for ground state energy e(rc), pressure P(tc), and bulk modulus B(ts) of metallic hydrogen (fcc, bcc, and hcp structures) are derived. Based on Gibbs free energy function criterion, the calculation shows that cold metallic hydrogen lattice (T = 0K) belongs to hcp structure.

M. E Zhitomirsky, T. Nikuni, (Dep. Phys., Univ. Toronto, ON, Can.), **Two-dimensional Heisenberg antiferromagnet in strong magnetic fields,** *Physica B* (Amsterdam), volume date 1997, pp241-243, pp573-575,1998.

The authors calculate magnetization and magnon dispersion for a spin-1/2 Heisenberg square lattice antiferromagnet at T = 0 in magnetic fields up to the saturation field in the framework of spin-wave theory. Magnetic field generally suppresses zero-point fluctuations, which leads to upward curvature of the magnetization curve at low fields and logarithmic singularity close to the saturation.

New quantum effects appear due to noncollinearity of the spin structure. They consist of coupling between 1- and two-magnon spectrum and affect strongly dispersion of excitations at finite fields.

PATENTS

WO 9849689; "Method and device to obtain heat energy;" Alexandre Nikolaevitch Lichtchouk, Evgeny Yurievich Mourishev (Savic Trust Reg., Vaduz, Liechtenstein); Issued: 5 Nov 1998, 20 pp. App: 28 Apr 1997.

The invention relates to a field of energetic, to the methods and devices for obtaining and conversion of heat and other types of energy. This device and method may be effectively used in the autonomic power devices in various ranges of capacities. A method to obtain heat energy includes fusion reaction with preliminary prepn. of the working medium. According to the invention, the preparation of the working medium is carried out via hydrodynamic macrostructuring; after that, microstructuring of the medium molecules of near and far row is carried out as well as excitation of the electronic levels of the working medium via external effects. Then nuclear fusion is accomplished by the phase conversion in the structured working medium. The hydrodynamic medium macrostructuring may be made by configurators with the corresponding collection of their shape and dimensions. A device to obtain heat energy contains the working chamber, inputting elements for the working medium, outputting elements for fusion reaction products and electrodes. According to the invention, the device has the configurators providing stable regular resonance structuring of the medium. The working chamber is made with an expanding canal. The chamber inlet is connected with the configurator outlet. The device contains at least 3 pairs of electrodes. At least one pair of electrodes is placed in the configurator , at least one pair of electrodes is located at the inlet of the working chamber and at least one pair of electrodes is located in the working chamber. The heat collector may be connected with the outlet of working chamber. The configurators may be made in the shape of a pyramid.

WO 9849688; Device to obtain heat energy, working medium and electrodes to be used in this device, material for working medium and electrodes, and method to obtain this material; Alexandre Nikolaevitch Lichtchouk, Evgeny Yurievich Mourishev (Savic Trust Reg., Vaduz, Liechtenstein); issue 5 Nov 1998, 36 pp. App: 28 Apr 1997.

The invention relates to a branch of energetics, to the methods of obtaining and conversion of heat and other types of energy by way of nuclear fusion. A device to obtain heat energy contains a working chamber, elements to input the working medium, elements to output the fusion reaction products and electrodes. According to the invention the device has a block of medium structuring and contains at least one pair of electrodes thereby at least one electrode of this pair is located in the working chamber. A material for the working medium and electrodes include at least one 1st metal absorbing H isotopes and at least one 2nd metal. According to the invention at least one 2nd metal forms a solid solution with at least one 1st metal. The 1st metal may be, for example, Ti, and the 2nd metal may be the metal selected from the group including ferrum, Co, Cr, Ni, Cu, Zr, Ce. A method to obtain the working medium and electrodes includes the deformation of the metal alloy. According to the invention, under the deformation, the structuring of the alloy is being carried out, the alloy including at least one 1st metal absorbing H isotopes and at least one 2nd metal forming the solid solution with at least one 1st metal carrying out shearing strain along the crystal planes of sliding at the temps. higher than the phase change of the alloy in a solid state, but lower than the temperature of a liquid phase creation.

DE 19641471; "Energy production by nuclear reactions;" Heinrich Hora (Germany); issued 16 Apr 1998, 2 pp (German).

A method of generating nuclear energy comprises concentrating high levels of H or its isotopes in natural Th, and fission or internal conversion of Th into Pa-233. The concentration of H isotopes in Th surface can be carried out by contacting

the Th with an organic polymer or a metal with high H solubility such as Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Mn, Cr, Ti, Zr, Hf, V, Nb, Ta, Lanthanides, as well as actinides. The reaction can be controlled by variation of concentration of H or temperature of Th.

JP 10039096; "Manufacture of positron-emitting isotopes by an electrolytic system using cold fusion reaction;" Reiko Notoya (Japan); issued 13 Feb 1998; Heisei, 4 pp. (Japanese).

The isotopes, useful as positron sources for positron annihilation, are manufactured by using electrolytic cold fusion chain reaction system (claimed in JP07-174878) from M(A + 1), M(A + 2) and rarely M(A + 3) to M(A), from M(A - 1, Z - 1) to M(A, Z), from M(A - 1, Z) to M(A, Z), from M(A, Z + 1) to M(A, Z), or from M(A + 1, Z + 1) to M(A, Z) (A = mass no.; Z = at. no.). The source substances of the above method are manufactured by the same electrolytic system as the above. The electrolytic condition is precisely controlled to give isotopes efficiently.

WO 9743768; "Coproduction of energy and helium from deuterium;" Leslie C. Case (USA); Issued 20 Nov 1997, 17 pp; App.: 12 May 1997; Pri.: 10 May 1996.

Energy can be reliably produced by contacting D, in the gaseous state, with a particularly active metallic catalyst, at an elevated temperature. The product of this process is ^{4}He. Thus, the reaction appears to be D + D « 4He + 24 MeV. Only some fraction of metallic hydrogenation catalysts are active in this process, and it was not possible to predict in advance which candidate catalysts will be active, so a simple screening test was devised to identify the specifically active catalysts. The most promising catalysts for this process may be certain types of supported Pt-group metals (PGM). Pd appears to be a favored metal, although Pt, and possibly other PGMs are also active. It is envisioned that the procedure can be scaled up to produce commercial-scale energy by running steam tubes through the catalyst bed, and removing the heat produced as steam.

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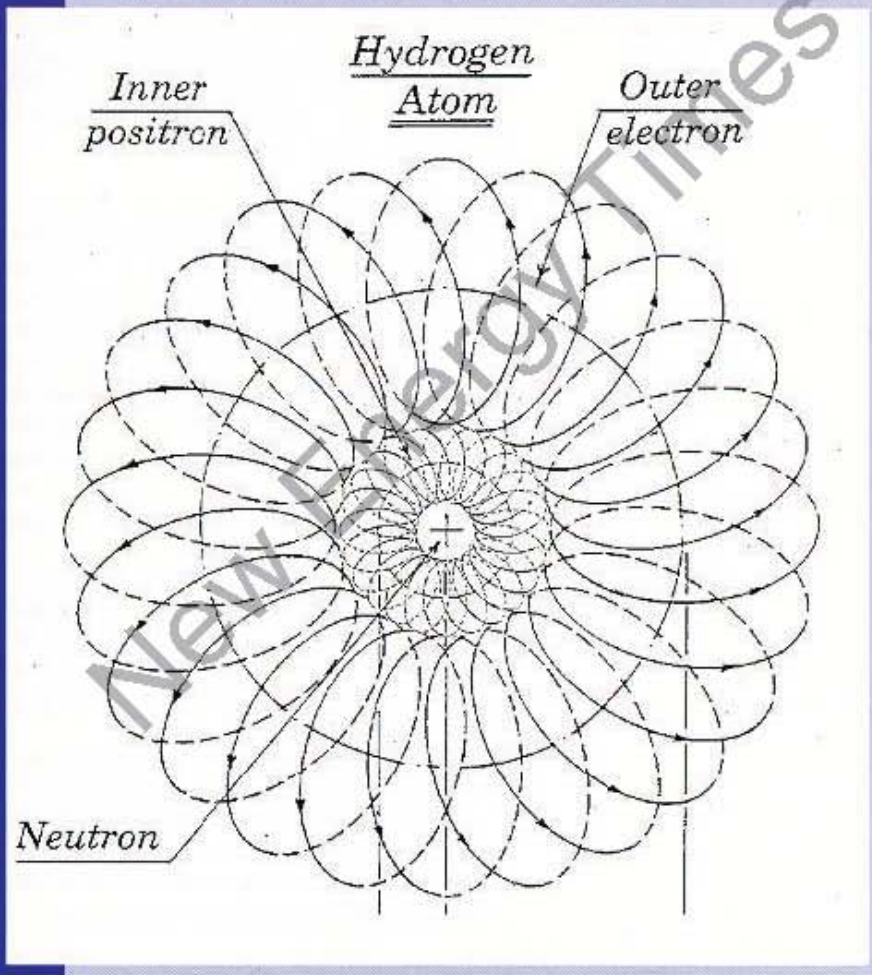

Ginzberg - Structure of Hydrogen Atom and Proton

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