

# Celebrating 30 Years of Cold Fusion Science: The 2019 CF/LANR Colloquium at MIT

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Dr. Mitchell Swartz, Gayle Verner and their team at JET Energy, in collaboration with Dr. Peter Hagelstein of the Research Laboratory for Electronics at Massachusetts Institute of Technology (MIT), organized yet another successful Cold Fusion/Lattice Assisted Nuclear Reactions Colloquium at MIT in Cambridge, Massachusetts. The meeting was co-sponsored by JET Energy and the Anthropocene Institute.

The 2019 event began on March 23, 2019—30 years to the day since the cold fusion announcement of Stanley Pons and Martin Fleischmann at the University of Utah. The two-day colloquium—held in MIT's Stata Center for Computer, Information and Intelligence Sciences lecture room—was attended by over 100 international scientists (experimentalists and theorists), investors and interested parties. Attendance at the event was essentially free, with a \$30 donation recommended but not required.

Swartz opened the meeting with an introductory lecture, "Why CF/LANR Is Important," discussing the reasons cold fusion is compelling as a fuel or power source. Hagelstein also presented an opening lecture, "Issues in Excess Heat Experiments," overviewing the 30-year struggle in cold research (obstacles, issues) and highlighting some of the key experiments.

The program was jam-packed for a two-day meeting. We received abstracts from most of the presenters, detailing the work or ideas shared at the Colloquium. These abstracts are appended below in alphabetical order (p. 11). New and old experimental work and theories were presented. There were a few talks related to research and documentation projects, and presentations about patents and societal benefits of

clean energy.

We did not receive abstracts for some of the talks; those presenters and titles are as follows: Ruby Carat, "Update from Cold Fusion Now!"; Richard Chan, "Current State of LANR: An Intellectual Property Perspective"; Thomas Ciarlariello, "Muon Catalyzed Fusion: From Prior Art to Future Space Planes"; Konrad Czerski, "Crystal Lattice Defects and Threshold Resonance of the Deuteron-Deuteron Fusion Reactions at Room Temperature"; Jozsef Garai, "Physical Model for LANR"; Florian Metzler, "Update on MIT Phonon-nuclear Coupling Experiments"; Carl Page, "Anthropocene Institute, Clean Energy and Cold Fusion"; Vladimir Plekhanov, "Study of the Strong Nuclear Interaction via Re-normalization"; Robert Smith, Jr., "Cooling a High Temperature CF/LANR Reactor" and "Impacts on the Rate of Knowledge in LANR"

Ruby Carat of Cold Fusion Now covered the meeting (<https://coldfusionnow.org/cold-fusion-research-at-30-years-young/>) and conducted more interviews for a documentary she is preparing. (She also stepped in at the last minute to present Mel Miles' talk, "The Production of Helium in Cold Fusion Experiments.")

Carat reported on the presence of investors at the 2019 Colloquium, writing: "[W]hile CMNS experimentalists and theorists were reporting on the state of the field, their very success is riding a wave of attention and funds flowing into research. Concurrent with the increased number of patent filings in the Low Temperature Nuclear Fusion category, private capital is moving to do what federal funds wouldn't, securing sections of basic scientific research that are incrementally advancing towards usable technologies in the near- and long-term. At least four active investors were at the Colloquium getting updates on their projects." These included Michael Halem of LENRInvest, Dewey Weaver of Industrial Heat, Hideki Yoshino of Clean Planet, Inc. and Carl Page of Anthropocene Institute.

Presenters and a few attendees were treated to a fabulous dinner at Legal Sea Foods, a well-known, high-end seafood restaurant on the East Coast. Anthropocene Institute sponsored this outing, which was a grand celebration after a long Saturday of presentations. JET Energy also provided sandwich lunches each day.

We asked our attending colleagues to weigh in on the Colloquium. Some specific comments we received about the presentations are noted here, unattributed:

- "Tanzella gave what was probably the strongest presentation so far on the Brillouin experiments."
- "The systematic work performed by a large collaboration in



Colloquium organizers Gayle Verner and Mitchell Swartz

Japan, presented by Iwamura, was very good.”

- “Celani appears to have some strong new results based on the approach he talked about at the meeting, including some data taken after the meeting.”

- “Metzler’s excitation transfer experiments are interesting and useful.”

- “The works by Swartz, Hagelstein, Alexandrov and Iwamura are especially valuable.”

- “The paper by Hagelstein on the rate of radiation changing due to mechanical stresses was intriguing.”

- “It was great to see the presentation by Carl Page on his interest in the LENR field and how it fits in to his societal objectives for the Anthropocene Institute.”

- “The two presentations by Dolan and Zuppero were highlights, since I now understand better what they are thinking and asserting about a new mechanism for LENR.”

- “Swartz showed some of his results from his 327 MHz RF detection that were interesting.”

- “The presentation by Ólafsson, on the experiment of Holmlid and collaborators in Sweden, was especially interesting, particularly because it had similarities to my own work.”

- “I was particularly interested in the presentation by Fredericks.”

- “From Chan’s presentation, I learned about the recent situation on the attitude of the U.S. Patent Office for CMNS.”

Quotes received from a few presenters sum up not only the current state of the cold fusion field, but the impact and importance of the anniversary Colloquium. Francesco Celani predicted, “The field of LENR-AHE is very active and not too-far from a (limited intensity) demonstration device.” Thomas Grimshaw noted, “It was good to see so many of the ‘old guard’ still active and giving good presentations—as well as a fair amount of ‘new blood’ in the field, which it so badly needs.” David Nagel said, “Overall, the meeting was for me a celebration with colleagues for three decades of vigorous work.”

## 2019 COLLOQUIUM ABSTRACTS

**Brian Ahern, VET Corp.**

— *An Energy Miracle: Harnessing the Power of Scalar Longitudinal Waves*

Perovskite minerals support nonlinear molecular orbitals. Strontium ferrite is a strong ferromagnetic material with high electrical resistivity. These features are a prerequisite for the Longitudinal Spin Seebeck Effect (LSSE) that cools while it enables spin currents. These spin currents are amplified by resonance with longitudinal scalar waves that are ubiquitous emission from all stars. We are awash with scalar waves and the Manelas billet is an ideal antenna for converting background waves into useful battery power.

The nonlinear orbitals in the billet can be enhanced by processing grains in the sub-12 nanometer size regime. These nanoscale grains allow for energy localization. Energy localization is a nanoscale phenomenon that challenges the Second Law of Thermodynamics and permits conversion of background thermal energy. Clean electrical power, accompanied by negative hysteresis, is produced.

**Dimitar Alexandrov, Lakehead University**

— *Cold Fusion Synthesis of Helium Isotopes in Interaction of Deuterium and of Hydrogen Nuclei with Metals*

This paper is a continuation of the author’s presentation made at the ICCF21 conference. Experimental results, not presented at ICCF21, are presented here because there has been a significant amount of interesting experimental results during the recent stage of research. New artifacts confirming cold nuclear fusion synthesis of both  $^3\text{He}$  and  $^4\text{He}$  are presented. Experiments about low temperature nuclear fusion synthesis of both helium isotopes  $^3\text{He}$  and  $^4\text{He}$  in several metals have been carried out. The experiments were performed in a vacuum chamber for precise measurements to be achieved; due to the relatively low concentrations of the interacting gases, the amounts of the generated helium and released energy (heat) were relatively low. In fact,  $\text{D}_2$  gas in the environment of  $\text{H}/\text{H}_2$  gas in the chamber was directed to metal samples and generation of both  $^3\text{He}$  and  $^4\text{He}$  was observed in all experiments as it was supported by mass analysis, which shows relatively high amounts of both  $^3\text{He}$  and  $^4\text{He}$ , and by DC plasma spectroscopy showing peaks typical for both  $^3\text{He}$  and  $^4\text{He}$ .

The experiments were carried out in two modes—without plasma and with plasma containing both deuterium and hydrogen ions as in both modes there was cold fusion synthesis of both  $^3\text{He}$  and  $^4\text{He}$ . In the plasma mode the kinetic energies of both D and H ions were determined and it was found that the amounts of both  $^3\text{He}$  and  $^4\text{He}$  go up with increase of these energies. It was found that the pressures of both  $^3\text{He}$  and  $^4\text{He}$  increase with increase of the deuterium pressure. The temperature of the sample holder was measured during the experiments and cyclic dependence on the time was found, and it was found that this dependence correlates with changes in the amounts of both  $^3\text{He}$  and  $^4\text{He}$  in the time. Calculations show significant ratio (released heat):(volume of interacting D and H) and a conclusion about commercial application of the observed process was made. In some experiments external heating of the sample was performed in the range of 100-700°C for the dependence of the cold fusion synthesis on the temperature to be investigated an increase of the amounts of both  $^3\text{He}$  and  $^4\text{He}$  with increase of the temperature was found. Radiation (including gamma rays and neutrons) was measured in all experiments and no increase of the radiation above the normal background was found. The experimental results provided above are explained with an earlier developed quantum mechanical theory based on interaction of both D and H nuclei with heavy electrons that are localized in solids. The theoretical outcomes are consistent with the above experimental results. The theory is valid for all solids, however it determines that the above nuclear fusion reactions can have places only in solids having certain properties.

**Francesco Celani, INFN and ISCMNS**

**Collaborators: C. Lorenzetti, G. Vassallo, E. Purchi, S. Fiorilla, S. Cupellini, M. Nakamura, P. Boccanera, R. Burri, P. Cerreoni, A. Spallone**

— *Effects of “Super-Capuchin Knot” Geometry, and Additional Electric Fields, on Hydrogen/Deuterium*

*Absorption: Related AHE on Long and Thin Constantan Wires with Sub-micrometric Surfaces at High Temperatures*

In the framework of Low Energy Nuclear Reactions (LENR) studies focused on Anomalous Heat Effect (AHE) generation by hydrogen/deuterium interaction with proper lattices, using Constantan (since 2012; CNM, alloy of  $\text{Cu}55\text{-Ni}44\text{-Mn}1$ ) wires,

with long (up to 130 cm) and thin shapes (surfaces made sub-micrometric by proper thermal treatments), since 2015 we have developed a procedure to increase the local temperature of the wire (like a hot spot) flowing specific amounts of current, by proper knots with low diameter holes. We observed that the amount of the AHE increases when: A) increasing the number of knots (up to 50/m); B) reducing the hole diameter (down to 200  $\mu\text{m}$ ); C) reducing the wire diameter (200, 100  $\mu\text{m}$ ); D) increasing the total length of the wire; E) increasing the local wire temperature and gradients along it. Moreover, the addition of oxides of specific elements (Fe, Sr, K, Mn; multilayer structure) at the surfaces of both wires and the specific glass sheaths (where CNM is inserted) had some effects both for the “lighting-on” and overall stability of the system, for AHE production (up to some days in the best experiments). The reproducibility of the effects and the amount of AHE were, on the whole, not satisfactory enough, especially toward a practical application of the effect. In addition, the amount of AHE, although not stable over time, was significantly reduced when we moved from isoperibolic thermal measurements (intrinsically with large thermal gradients along the wire length) to flow-calorimetry (thermal gradients largely reduced).

In order to overcome such limitations we introduced, just after ICCF21, a quite innovative geometry of the wire, based on the so-called “Capuchin knot.” The first results were presented at IWAHLM13 (Greccio, Italy, October 2018). By such geometry were reconfirmed both the beneficial effects of high temperatures and local (large) thermal gradients. Anyway, because of excessive mechanical stresses during the preparation, the maximum number of turns was limited to 8 and minimal distance among the knots was about 12 cm. So, the total number of “coils” was limited to 4-5/m. Moreover, the construction of the Capuchin knot and the overall installation inside the reactor (made by a tube of tick borosilicate glass) were quite difficult and time-consuming.

Because of such considerations, we further developed the knot construction, introducing a hybrid geometry that keeps the best of Capuchin geometry while reducing the drawbacks of excessive mechanical stresses/difficulties. In addition, we had the opportunity to add both a “field” wire (insulated) and a thermometer inside the loop of the long coil. In conclusion, the number of turns is not limited any more and the assembly is extremely compact: the apparent length, starting from a wire with 180 cm of length, is just 12 cm with an outer diameter of 1 cm. Such coil, with 50 turns, is inserted inside a 10-12 mm diameter SS316 tube that is used both for mechanical support and IR reflection emitted by the wire. In such a way the local temperature of most of the wire is largely increased (in respect to a nuke wire configuration, even covered by our usual hybrid glassy sheaths, *i.e.* borosilicate glass and  $\text{SiO}_2\text{-Al}_2\text{O}_3$  fibers) reducing (factor of 4-8) the external electric power needed to reach the operating temperatures (600-800°C).

Although the new assembly has been in operation for only one month and the data are few, we observed: a) the AHE increases reducing the wire diameter (from 350 to 200  $\mu\text{m}$ ); B) the effects of AHE increases the absolute temperatures of the wire (tested up to 850°C); C) the field wire, inserted inside a porous quartz-alumina sheath, quite close (1-2 mm) to the CNM coil, although absorbing a very limited amount of power (<1 mA at 300V) is able to both control the amount of deuterium absorbed (by usual resistance ratio measurements) and the amount of AHE produced. Such an extremely interesting result

is obtained just by changing the values of Voltage applied and its polarity. We also started to study the time response of the system: 5-10 ms of duration, of cyclic excitation.

**Thomas J. Dolan, University of Illinois**

**Anthony C. Zuppero, Tionesta Applied Research Corporation**  
**— Isotopic Transmutation by Heavy Electron Catalysis**

The purpose is to understand nuclear transmutations have been reported, such as Ni into Fe and Zn. Injection of momentum into a crystal lattice, such as Ni, may bring some electrons near an inflection point of the band diagram, where their effective masses are raised above the rest mass  $m_0$ . A heavy electron trapped between two ions, such as Ni and H, may reduce their separation distance to a range that facilitates tunneling of the electron through the repulsive quantum kinetic energy barrier to facilitate nuclear binding, where the electron acquires most of the binding energy. This is analogous to muon catalyzed binding of protons to deuterons. If the electron energy exceeds the binding energy of a stable sub-nucleus, such as an alpha particle, then that fragment may be ejected.

Calculations based on this hypothesis yield required electron masses  $\geq 10 m_0$  and tunneling probabilities up to a few percent. The sub-nuclei emissions are consistent with the reported isotopes over a range of different observations and reactants (hydrogen, deuterium, tritium, and lithium) with lattice nuclei of nickel, titanium, palladium, cesium, tungsten and barium. The predicted isotopes appear to be consistent with experimental data.

#### **— Applications of the Model to Experimental Data**

Application of an electron catalysis model of a recent chemical physics discovery of a binding reaction to nuclear transmutation systems having the same potential energy diagram, but with nuclear potentials instead of chemical potentials, appears to be well supported by the entire set of observations associated with lattice assisted nuclear reactions (LANR). A sampling of the data is presented. Energy-releasing binding of hydrogen is predicted with about 5-10% of the nuclei in the periodic table. The observed reaction of hydrogen binding with nickel data confirms the electron catalysis model that produces zinc and copper. Similarly, the observed electron catalysis of deuterium binding with palladium produces silver.

The binding reaction releasing energy, of order 6 MeV per binding nucleon follows the chemical physics of recently discovered “Vibrationally Promoted Electron Emission” (VPEE) first published by LaRue (2011, UC Santa Barbara, Chemistry). The prompt binding due to a thermally unbound electron in a single scattering event between the binding nuclei occurs within the effective range of the binding potential, which is nuclear in this system. The 6 MeV energy in the ejected electron may, in a first reaction branch, eject with most of the binding energy, as in the chemical case. When the electron energy interacts with nucleons within the nucleus, the inverse of VPEE appears to provide the chemical physics of the observed fracturing of the nucleus into stable isotopes. The inverse, “Desorption by Multiple Electronic Transitions” (DIMET), appears to account for the observed iron and cobalt of the hydrogen nickel reaction.

Most interesting is the apparent simultaneous electron catalysis of one or more pairs of hydrogen isotopes, such as pairs of deuterium nuclei, with about 10-20% of the isotopes in the periodic table. The Iwamura reactions of two or three pairs of deuterium nuclei with cesium, strontium, barium, tungsten and several others confirmed the observed transmutation products



using VPEE. Using DIMET, the energy (sometimes exceeding 50 MeV) inside the product nuclei would release sufficient energy to form and eject alpha particle and other stable nuclei from the product nucleus. The products are always in the ground state. The fracturing of a nucleus formed by deuteron pair binding results in the original nucleus with prompt ejection of the fracture product, such as alpha particles. In DIMET chemistry, a neutral particle, a fracture product, is ejected because the energetic electron “pushes” the fracture product. The result is a neutralized alpha, with either one or two electrons attached. The expected and observed helium, a neutral alpha, without the observation of 22 MeV alpha particles, is confirmed by the presented data. This would imply helium production in an apparent catalysis, neither a fusion nor a fission reaction.

Other examples include observed production of long-lived stable nuclei that decay by weak interaction, such as electron capture and beta emitting nuclei.

Confirmation of electron catalysis binding, nuclear transmutations following the chemical physics model of VPEE and DIMET, is apparently well supported by the presented observations.

**Jeff Driscoll, ZHydrogen**

— *Randell Mills’ Grand Unified Theory of Classical Physics is Simpler to Understand than Standard Quantum Mechanics*

Randell Mills’ Grand Unified Theory of Classical Physics generates accurate equations for the atom that are far simpler than Standard Quantum Mechanics. For example, the ionization energy of one electron atoms and the emission spectrum of atomic hydrogen can be modeled with classical physics equations with a high degree of accuracy. In 1911, Niels Bohr postulated that the angular momentum of the electron is multiplied by the principal quantum number “n”. But if he had postulated that the electric force in the atom is divided by the principal quantum number “n” then it is very likely that the classical physics described by Randell Mills would have been invented instead of the confusing, inconsistent Standard Quantum Mechanics.

**L.P. Forsley, Global Energy Corporation**

**Collaborator: P.A. Mosier-Boss, U.S. Navy SPAWAR-Pacific, Retired**

— *Condensed Matter Nuclear Reactions Using Pd/D Co-Deposition in Three Acts*

The LANR/CF Colloquium at MIT on March 23, 2019 was also the 30<sup>th</sup> anniversary of the Fleischmann and Pons (FP) premature announcement at the University of Utah, subtly named “cold fusion” by the press. Since that time several thousand investigators have weighed in on the phenomena. Yet, the vast majority were unable to replicate the effect, largely because neither they nor its discoverers knew how. However, several hundred experimentalists have successfully reported effects primarily with electrolytically loaded palladium deuteride. This presentation looks at the field through the lens of the patented Pd/D co-deposition protocol (US 8,419,919) in three acts: Discovery, R&D Collaborations and “Back to the Future.”

Act One identifies what failed for many with the FP protocol, then introduces the Szpak co-deposition “defective” protocol. Act Two reviews collaborations using the protocol around the world, including 60 peer reviewed papers from 58 authors and co-authors from 11 countries. It may be neither cold nor fusion, but it’s definitely nuclear.

Act Three comprises training, scaling and application.

Training consists of the development of a university STEM (Science, Technology, Engineering and Mathematics) enrichment program based upon hundreds of successful Pd/D co-deposition protocol experiments. These include ACS and APS presentations from three semesters of University of California, San Diego Chemical Engineering student teams and a lone physics student at Point Loma Nazarene University. The Trackers STEM Program™ has been undertaken with partial support from the Anthropocene Institute and Global Energy Corporation.

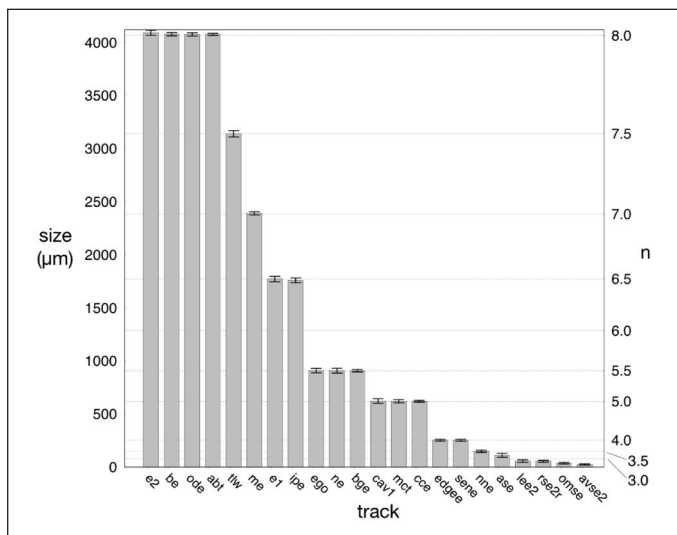
Scaling and its application to deep space power for NASA began with JWK Corporation in conjunction with the NASA Advanced Energy Conversion Project and continued through a second Global Energy Corporation Space Act Agreement with NASA. Both scaling and application revolve around the modification of a hybrid fusion-fast-fission reactor to meet NASA requirements.

The presentation concludes acknowledging colleagues, supporters and ardent voices who kept us on our toes during this 30 year journey, but especially those who labored long and now rest, including a brief video of Martin Fleischmann, in his home in Tisbury, UK. As Martin said, “Keep Going...”

**Keith Fredericks, Restframe Labs**

— *Elliptical Tracks: Evidence for Superluminal Electrons?*

In the literature of Low-Energy Nuclear Reactions (LENR), particle tracks in photographic emulsions (and other materials) associated with certain electrical discharges have been reported.<sup>1</sup> Some Russian and French researchers consider these particles to be magnetic monopoles.<sup>2-4</sup> These tracks correspond directly to tracks created with a simple uniform exposure to photons (without electrical discharges).<sup>5</sup> This simpler method of producing tracks supports a comprehensive exploration of particle track properties. Out of 750 exposures with this method, elliptical particle tracks were detected, 22 of which were compared to Bohr-Sommerfeld electron orbits. Ellipses fitted to the tracks were found to have quantized semi-major axis sizes with ratios of  $\approx n^2/a^2$  to corresponding Bohr-Sommerfeld hydrogen ellipses. This prompts inquiry relevant to magnetic monopoles due to the  $n^2/a^2$  force difference between magnetic charge and electric charge using the Schwinger quantization condition. A model



**Fredericks Figure 1.** Quantized ellipse semi-major axis sizes. Ellipses between  $n = 8$  and  $n = 3.5$  are shown to be quantized as half integer values. Ellipses less than  $n = 3.5$  are quantized by quarter integer values.

using analogy with the electron indicates that the elliptical tracks could be created by a bound magnetically charged particle with mass  $m_m = 1.45 \times 10^{-3} \text{ eV}/c^2$ , yet with superluminal velocities.<sup>6</sup> Using a modified extended relativity model,  $m_m$  becomes the relativistic mass of a superluminal electron, with  $m_0 = 5.11 \times 10^5 \text{ eV}/c^2$ , the fine structure constant becomes a mass ratio and charge quantization is the result of two states of the electron.

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#### **Thomas Grimshaw, The University of Texas at Austin — LENR Research Documentation Initiative**

When cold fusion (CF) was announced in 1989, its immense potential energy benefits were immediately recognized. The world's need for a source of cheap, clean, inexhaustible and safe energy seemed to be met indefinitely. However, CF (also referred to as Low Energy Nuclear Reactions, LENR) was rejected by mainstream science within a year or so, and it remains highly marginalized to this day. On the other hand, the phenomenon has been rigorously pursued by many investigators in several countries. The mounting evidence for the reality of LENR shows that its potential benefits may yet be realized.

Because it is a "pariah" science, LENR has attracted relatively few new investigators to the field. Many of the researchers became active in the early months and years after the 1989 announcement. Now 30 years later significant numbers of these investigators are leaving the field. The results of their many years of LENR investigation are at risk of being lost, which would be extremely unfortunate not only for the field, but also potentially for humanity.

An initiative is underway to mitigate the risk of loss of research records of long-standing LENR investigators. It is set up to collect, organize, document and archive these records. It is being performed at the Energy Institute of The University of Texas at Austin. The aim of this LENR Research Documentation Initiative (LRDI) is to help researchers make sure that their efforts are preserved and ensure that the records continue to be available for additional analysis and insights.

The LRDI began with a "pilot project" with Edmund Storms, one of the foremost investigators in the LENR field. The results of that project were reported at the 21<sup>st</sup> International Conference on Cold Fusion (ICCF-21). Additional projects have been initiated with other long-term LENR researchers, including David Nagel, Mahadeva Srinivasan, Arik El-Boher and Dennis Pease (formerly with the Sidney Kimmel Institute for Nuclear Renaissance, SKINR) and Tom Claytor and Malcolm Fowler (formerly with Los Alamos National Laboratory).

In most cases the first step is to collect publicly-available LENR-related publications, often in the Cloud. Other components of the research record normally include unpublished experiment reports, lab notebooks, experiment procedures, progress reports, hard-copy files and electronic files in current and legacy media (e.g., CDs, ZIP discs, external hard drives). The investigator retains ownership of the files and other materials in his or her possession. As appropriate, arrangements are made for long-term protection (archiving) of the LENR materials.

It may reasonably be argued that the long-term future of humankind depends on realization of an inexhaustible source of low-cost and environmentally secure energy. The LRDI seeks to maximize the prospects of LENR realization by securing and documenting the extensive record of its research since 1989.

#### **Peter Hagelstein, Massachusetts Institute of Technology — Excitation Transfer: New Results, Some Applications**

We review phonon-mediated nuclear excitation transfer, recent results and applications. Second-order phonon-nuclear coupling is possible through local electric and magnetic fields; however, a few years ago we noticed that the relativistic boost interaction should be much stronger. Excitation transfer for electrons was proposed around 1930 for problems in biophysics. Excitation transfer is a quantum mechanical effect in which excitation is transferred from one nucleus to another through off-resonant intermediate states in which both nuclei can be excited or in the ground state. An early application was to account for low-level energetic alpha emission where the 24 MeV energy from a  $D_2/{}^4\text{He}$  transition is transferred to excite a Pd nucleus, which subsequently decays. A similar mechanism based on  $HD/{}^3\text{He}$  is proposed in connection with the experiment of Lipinski and Lipinski. Evidence for the existence of phonon-mediated excitation transfer comes from recent experiments at MIT with Co-57 on a steel plate, where the X-ray and gamma emission lines appear to respond to applied stress. Detailed calculations for the indirect coupling matrix element for E1 and M1 transitions hinderance due to destructive interference. Including loss in the model removes some of the destructive interference, but not enough to account for experiment. We recently proposed that the shift in energy levels off of resonance might reduce the destructive interference further. A calculation of the deuteron binding energy off of resonance strongly supports this notion. A similar calculation for the unbound dineutron shows that the dineutron can become bound off of resonance (by about 25 MeV), which suggests that neutron clusters with more neutrons might be bound at a comparable off-resonant energy. This motivates the proposal that the Iwamura transmutation in the case of Sr-88 might be due to the transfer of an 8-neutron cluster to make Sr-96 which subsequently decays to Mo-96. Last year we proposed a resonant version of single neutron transfer reactions; this year we are considering the possibility of off-resonant phonon-mediated neutron transfer reactions. We have identified a neutron transfer capable of producing an unstable product nucleus with an overall energy mismatch near 400 eV.

#### **Yasuhiro Iwamura, Tohoku University — Recent Advances in Heat Generation Experiments using Nano-sized Metal Composite and Hydrogen Gas at Condensed Matter Nuclear Reaction Division of Tohoku University**

Experimental results using Ni based multilayer thin films with Clean Planet Inc. and reproduction of energy burst events using

NEDO type apparatus were presented. These experimental results strongly suggest that nuclear reactions really occur in nano-sized metal composite and hydrogen gas system.

A four year extension of the Condensed Matter Nuclear Division at Tohoku University was approved. We would like to proceed toward the realization of a new energy source.

**Melvin H. Miles, Dixie State University**

— **The Production of Helium in Cold Fusion Experiments: Research at NAWCWD, China Lake, California (A New Look at the Experimental Data)**

Assuming that the main cold fusion reaction in the Pd/D<sub>2</sub>O system is  $D + D \rightarrow He-4 + 23.8465 \text{ MeV}$  (lattice), a theoretical relationship between the helium-4 production, the excess power and the cell current was recently derived. This relationship:

$$\text{He-4 (ppb)} = 55.91 (P_X/I) \quad (1)$$

gives the helium-4 amount in parts-per-billion (ppb) where the excess power ( $P_X$ ) is in Watts and the cell current ( $I$ ) is in Amps. This relationship was used to examine all previous helium-4 experiments at the China Lake, California laboratory (Naval Air Warfare Center Weapons Division, NAWCWD). The theoretical amounts of helium-4 expected in ppb are compared with each experimental result. Reasonable agreements with the assumed  $D + D$  fusion reaction and the experimental helium-4 measurements were found for most experiments. Other possible fusion reactions producing helium-4, such as  $D + Li-6 \rightarrow 2 (He-4) + 22.4 \text{ MeV}$  or  $D + B-10 \rightarrow 3 (He-4) + 17.9 \text{ MeV}$ , do not agree nearly as well with the China Lake experiments because the theoretical amounts of helium-4 predicted are much too large. The fusion energy production needs to be close to 23.85 MeV per helium-4 atom produced for agreement with the China Lake results. In fact, accurate helium-4 measurements can be used to check the China Lake calorimetric excess power using the rearrangement of Eq. 1,  $P_X = \text{He-4 (ppb)}I/55.91$ , if most of the helium-4 produced is found in the gas phase. This calculation indicated a possible calorimetric error for a small excess power measurement ( $P_X = 0.020 \text{ W}$ ) that was near the accuracy limit for the China Lake calorimeter. Based on the experimental helium-4 measurement, the correct excess power was 0.036 W for this experiment. Reported experimental values are often significantly higher than 24 MeV/He-4 because some of the helium-4 is retained in the palladium cathode. For the China Lake experiments, there was either no helium-4 production and no excess heat or both helium-4 production with excess heat in 30 out of 33 experiments. The statistical probability for this correlation resulting from random experimental errors is 1 in 750,000. The three exceptions can be explained by an unusual calorimetric error in one experiment and by the use of Pd-Ce cathodes rather than Pd in two other experiments.

In summary, the cold fusion excess power in the Pd/D<sub>2</sub>O system is correlated with helium-4 production, and the best fit with helium-4 measurements for my experiments is provided by the  $D + D \rightarrow He-4 + 23.85 \text{ MeV}$  fusion reaction.

**D.J. Nagel, The George Washington University/LENRIA Corp.**

**S.B. Katinsky, LENRIA Corporation**

**Collaborators: M.H. Miles, M.A. Imam, C. Patil, A. Modi**

— **Status of the LENRIA Experiment and Analysis Program (LEAP)**

There is sufficient published data on LENR to show that it (a) is a real physical phenomenon and (b) has major promise as a new source of clean energy. However, the data is being ignored. The challenge is to get the attention of the scientific community, U.S. and other governments, and the public in order to increase both types of activities: research to achieve understanding and commercialization to achieve exploitation. LENR could get needed attention by publication of a clear explanation of the mechanism(s), a strong demonstration, a repeat of the 1985 Fleischmann-Pons meltdown experiment, or publication of papers with solid LENR results from a few major international laboratories.

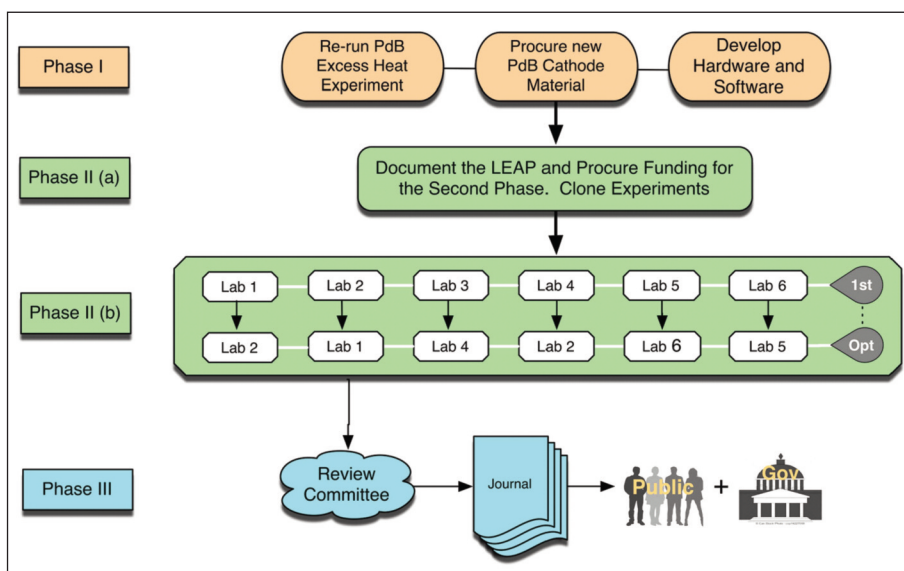
The LENRIA Experiment and Analysis Program (LEAP) is taking the last approach. The goals include: (a) perform the same LENR experiment, which has been qualified to produce excess heat, at multiple major laboratories, (b) produce reports on the conduct and results of the experiments by each laboratory and (c) coordinate simultaneous publication of the reports in a major scientific journal. These activities are summarized in Figure 1.

Phase I of the LEAP has been funded recently by the Anthropocene Institute. This presentation will describe current activities on materials, equipment and software. We have some of the Pd-B materials made over 20 years ago by one of us (Imam) at the Naval Research Laboratory. Cathodes made from those materials gave excess heat in nine of ten experiments with four different calorimeters in three laboratories in experiments by one of us (Miles). New Pd-B alloys have also been procured. A simple, transparent isoperibolic calorimeter has been designed, built and tested. LabVIEW is being use for control of experiments, and for data acquisition, analysis and display.

**Sveinn Ólafsson, University of Iceland**

— **Experimental Techniques for Studying Rydberg Matter of Hydrogen**

Among the atoms of the periodic system, hydrogen and deuterons have the lowest number of electrons and thus the



**Katinsky/Nagel Figure 1. Phases of the LENRIA Experiment and Analysis Program (LEAP).**



simplest electronic structure and are generally only found in the simplest state as chemical binding of two atoms forming H<sub>2</sub> and D<sub>2</sub> molecules. No other forms of molecular structure with higher number of atoms of H or D has been observed or predicted using simple quantum mechanical models.

In the beginning of the 21<sup>st</sup> century this picture started to be changed and questioned with the work of Leif Holmlid at Gothenburg University Sweden. He was able first to form new cluster state K7 and K19 of K atoms, and found a stable state when the K atoms were assembled in an excited Rydberg state with high n excitation number. Later he was able to find methods to do the same thing for H and D and form Rydberg matter of H7 and H19. Further research work led him to find a new transformed state he called Ultra-High-Density state (UHD) in which he observed 2.3 pm inter-proton pair distance with time of flight measurement technique. A distance result that is about 30 times shorter than H<sub>2</sub> molecule distance of 72pm.<sup>1</sup>

His work continued and has now led him to present results saying that a relative weak laser pulse when it hits the UHD phase causes part of the condensed hydrogen phase to disintegrate into subatomic particles like mesons and leptons of varying composition. Results suggest baryon number violation if they are viewed from a single particle or two-particle interaction picture. Viewed as multiparticle condensation breakup the baryon number counting or violation is experimentally hard to perform without having very advanced 4 $\pi$  detector setup.<sup>2,3</sup>

Needless to say, most of Holmlid's findings have been met with wide disbelief and simple denial using simple quantum mechanical models as a fast argumentation. Ten years after his first publication of UHD, as a first research group to try to replicate his work, we present here the first experimental confirmation of his work. Something strange is definitely going on in the experiments and it needs to be studied and checked further with more advanced methods in order to give the final conclusion: A multiparticle proton or deuteron condensate can be broken up with relative weak laser pulse into subatomic particles.

Experimental setup, conditions and pitfalls for this conclusion will be thoroughly described and discussed along with short discussion of how to avoid use of simple quantum mechanical theory to throw this experimental possibility away carelessly. Multiparticle condensate of H and D atoms needs a full quantum field theory treatment in order to describe its stability and physics and that is a rather complicated theoretical process.

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**Mitchell Swartz, JET Energy**

#### — Why CF/LANR Is Important

Simply put, fossil fuels—which now supply most of our energy needs—unfortunately create too much pollution, and negatively impact trade, producing economic upheavals and political instability. They need to be replaced, or at least significantly

reduced. In this context, we highlight why cold fusion is so very important. Given the difficulties of achieving successful hot fusion (now lagging more than half a century looking backwards, and more looking forwards), there is hope: lattice assisted nuclear reactions (LANR, cold fusion). LANR is the future clean, alternative energy production technology which will convert deuterons to helium. LANR/cold fusion, and the new and coming technologies that enable its successful use, is very important because it is the most efficient, by mass, energy production reaction, and it is clean without production of any noxious materials or radioactivity, and because this fuel is plentiful on this planet. A Rangone plot presents energy density vs. power density and the known energy production capacity of several sources, demonstrating the potential benefit of using LANR technologies. The ubiquity of the fuel is discussed. An example is a cup of coffee. Caffeine, the alkaloid dissolved in the watery coffee that gives coffee its kick, is present in each cup in a total amount of about 525 micromoles. Also, within each same cup of coffee, containing ordinary water, is about 940 micromoles of deuterons. If those deuterons were all successfully converted to helium using LANR/cold fusion then that one cup of coffee, alone, could produce, for example, either 1 watt of power for 17 years, or 100 kilowatts for 2 hours—and the result for either would still be a drinkable cup of coffee. The main point is that cold fusion is so compelling because the excess energy production is clean, and of a magnitude far beyond what is chemically available; together these factors forge an undisputed opportunity.

#### — Aqueous CF/LANR Systems Have Two Electrically-Driven Modes

We demonstrate that perhaps the most important difficulty to overcome for success in LANR/CF is the recognition that there are actually two different electrically-driven modes for these systems. Expanding on what was presented at ICCF21 with dry preloaded NANOR-type CF/LANR systems, here data from several runs reveals that a working high power XSH LANR/CF aqueous system has two electrically driven states, but that only one electrically-driven state is active, making the desired excess heat. The other state ("mode") is a colossal waste of time and energy. We demonstrated this multiple ways, using calorimetry, gas monitoring and dual beam coherent anti-Stokes CMORE [Coherent Multiwavelength Optical Reflection Electric-driven] spectroscopy.

The most important implications are as follows: First, these two states explain why some CF/LANR systems fail to create "excess heat." Only the more difficult-to-obtain pathway leads to the desired, sought-after excess heat; and knowledge of that has led to excess out powers as high as ~70 watts. Second, understanding the existence of these two electrically-driven states is consistent with the Optimal Operating Point (OOP) technology, and together they open the door wide to more reproducible systems.

#### — Cold Fusion Progression Over 30 Years: The Development of Active Preloaded Nanomaterials

Almost ten years of development of these active, dry preloaded, NANOR®-type components are summarized. They are two terminal components, cylindrical shaped like an electrical resistor, but with an active core of 30 to 200 milligrams ZrO<sub>2</sub>-PdD nanostructured material. The NANOR® components are smaller than 2 centimeters length, and with milligrams of active LANR mate-

rial. They are driven by a DC voltage from a few to 1000 volts. Although small in size, the LANR excess power density is more than 19,500 watts/kilogram of nanostructured material. This is enormous, and given that the carbon footprint is zero, these may well be the future of LANR.

The early Series 3 units reproducibly displayed low level excess heat, and by the Series 5 and 6 hyper-loaded units, their incremental power gain (~1200%) were used to help teach the MIT IAP class on CF/LANR. Since then, these and other NANOR®-type DC-voltage driven components have enabled the way to higher instantaneous power gain (8000%, with some approaching 1000x input power for some smaller units), and to higher total energy gain (two watts excess power). These controllable CF/LANR units are the proverbial “lab rats” of this field and have enabled research studies of imaging (by CR39), emissions, reproducibility (linearity and time invariance), anti-Stokes studies, and the impact of applied magnetic fields (as presented at ICCF17 through ICCF21).

Most importantly, as with the aqueous CF/LANR systems, there are two different electrically-driven states beyond “off”: “on-” (not active, no excess heat), and “on+” (active, with excess heat). These are revealed by CMORE spectroscopy.

Successful cold fusion is heralded by a large increase in the anti-Stokes to Stokes (aS/S) ratio, and the generated anti-Stokes peak for the desired and excess heat-producing state is very different from the avalanche-generated many anti-Stokes peaks.

The ability to discriminate active CF components from inactive ones has been invaluable, and has even led to several discoveries.

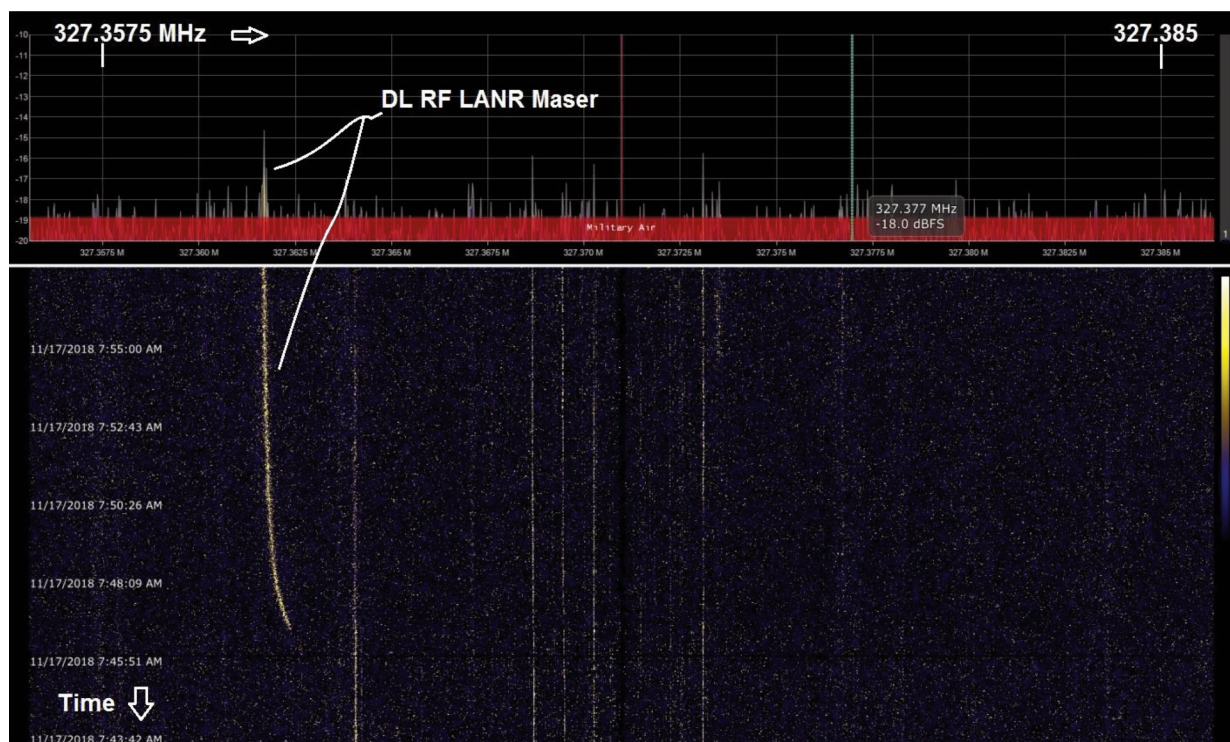
#### — $\text{ZrO}_2\text{PdD}$ 327.37 MHz Deuterium-Line Maser Heralds a FCC Active Site

This is the latest discovery using OOP-control of CF/LANR components, and this work links CF/LANR R&D with the tools and methods of the science of radioastronomy. Radiofrequency

radioastronomers study the universe by measuring radiofrequency emissions from several GHz to the far infrared. The hydrogen hyperfine line (H-Line, or HL) emission at 1.4 GHz and the 327 MHz hyperfine line of the deuterium (D-Line, or DL) radically changed astronomy by making objects—unseen by conventional optical telescopes—become visible, and by even enabling the determination of some of the galactic distributions and concentrations of H and D. Together, the H-L and D-L have provided understanding of the matter distribution through the known universe, providing information from post-Big Bang times just after recombination through reionization to the present.

In radioastronomy, DL and HL observations have greatly improved human understanding of the extent and interactions of galaxies, both now and back to a few hundred thousand years after the Big Bang. In that light, we have discovered that active CF/LANR systems, both aqueous and nanomaterial, emit very narrow bandwidth radiofrequency (RF) emission peaks at 327.37 MHz, in the Deuteron-Line (DL; 327.348 MHz) region. The high Q [ $> 1.2 \times 10^6$ ] and Zeeman response indicate maser action herald the fact that this is maser activity, and we built a resonant cavity to hold NANOR-type components, and two of them became masers when they were in their excess heat-producing modes. The maser action is actually seen by the bright curved line in Figure 4-2.

The active CF/LANR device is a  $\text{ZrO}_2\text{PdD}$  Nanor®-type component, operated carefully below avalanche voltage. In Figure 4-2, there are two regions. In both, the frequency increases from left to right. The top, upper portion is a graph which shows RF intensity peaks as a function of frequency (horizontal) at a single moment in time, in a single sweep. The relative intensity, in db, is shown on the left hand side. On the bottom, each peak appears as a dot on a line for each one moment in time, and time increases from top to bottom, as in a waterfall, after which the display type is named. The timestamp is on the left hand side. This is an integrated graph over a fraction of an hour. The



Swartz Figure 4-2. Software Defined Radio (SDR) identification of the first CF/LANR D-Line maser emission.



DL RF CF/LANR maser emission line is indicated in both portions of the display.

The coherent RF emission shown in Figure 4-2 occurred immediately after electrical drive (1.2 volts) (bottom left), and was followed by a short term exponential-like drift of the frequency to a slightly lower, more stabilized, monochromatic frequency. The other lines are from a variety of signals commonly observable, mainly military and cosmic.

Under some conditions, a superhyperfine structure of these RF emissions appear. A nearest neighbor resonance analysis appears to herald that the active CF/LANR reactions occur in a lattice palladium face center cubic (Pd FCC) vacancy. The CF/LANR reactions in nickel are more complex, and features a range of, possibly new, structures. The superhyperfine sidebands may soon help in better understanding what is going on in Pd and Ni lattices, including what changes have occurred near where the desired reactions take place.

**Francis Tanzella, Energy Research Center LLC**

**Collaborators: Robert Godes & Robert George, Brillouin Energy Corp.**

— **Advanced Isoperibolic Calorimetry in Brillouin's Reactor**

Brillouin Energy and Energy Research Center LLC have continued the calorimetry measurements on the Ni/ceramic/Cu coatings in a H<sub>2</sub> atmosphere performed earlier at SRI International. These sample tubes have been stimulated using nanosecond pulses applied between the Ni and Cu coatings. The reactive tubes (previously referred to as cores) have been described earlier.<sup>1</sup> We have been testing new electrical stimulation boards that have produced power and energy output in excess of that reported last year. In addition, we have recently incorporated new calorimetric methods allowing us to determine the power gain relative to actual wall power.

As presented earlier,<sup>2</sup> fast pulses of several hundred volts and tens of nanoseconds long cause the majority of the current to follow the "skin-effect" principle and concentrate at the Ni-ceramic interface before returning through the bulk of the Cu. The stimulation methods used previously have allowed us to determine the power produced by the core relative to the accurately measured power input directly to the tube. Recent advances in reducing the electrical losses in the supporting electronics have allowed us to increase the power input to the tubes by approximately an order of magnitude. Hence, a higher per-

centage of wall power is input into the tube. Figure 1 compares the increased power presently imparted to the reactor tube to that imparted in 2018.

We have been using a sophisticated model of the calorimeter with at least ten coefficients to calculate the power reaching five temperature sensors during simultaneous continuous ramps of both heater and pulse powers. We are now attempting to correlate the input heater power and high-rise-time pulse power using a thermocouple radially centered inside the reactor tube. In addition, we have removed the termination resistor used to measure the pulse current, which now allows almost all of the pulse power input to either remain in or be reflected back into the tube. Recent advances in transistor technology have also allowed us to minimize the power lost by the switching transistors.

Not all of these improvements have been finalized at this point. However, we are confident that these improvements will yield coefficients of performance (COP) significantly greater than 1.0 relative to wall power. Our most recent results will be presented.

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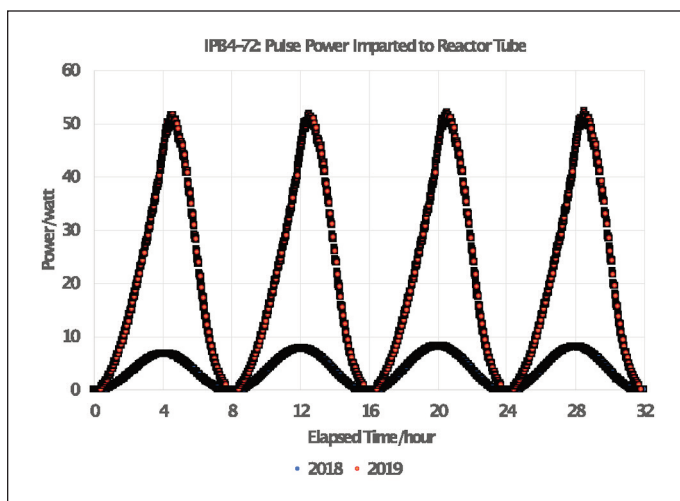
**John Wallace, Casting Analysis Corp.**

— **Einstein Was Right**

The incompleteness of quantum mechanics shown by the EPR paper of 1936 needed to be resolved before an accurate strong force potential could be derived, which is essential for understanding fusion. Studies of the relativistic longitudinal relativistic spin wave in iron provided the first experimental confirmation of the corrections needed in quantum mechanics.<sup>1</sup> These were later confirmed when applied to computing the absolute 1S hydrogen ground state level, neutrino state function as applied to the apparent loss of solar neutrinos, and their refraction by the earth as well as explaining quantum refraction in optical materials.<sup>2</sup> The resultant equations for quantum mechanics yielded the two families of particles (boson and fermion), inertia, weak and EM charge, strong force and gravity. From this a nuclear potential could be derived that is different from the Yukawa potential and is used to describe the bonding of deuterium.

References:

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2. <http://vixra.org/pdf/1809.0582v2.pdf>



Tanzella Figure 1. Pulse power increase over the past year.

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