Updates on LENR all Around the World

Updates on LENR Experiments from Around the World

Christy L. Frazier

In anticipation of ICCF24 in July 2022, *Infinite Energy* reached out to over 40 experimentalists doing work in low energy nuclear reactions (LENR, or cold fusion). We asked for a short overview of recent and current experimental efforts. Preparing short summaries of work in a complex field is not an easy task, and *IE* appreciates that so many were able to respond. Not everyone was able to participate in this survey of work being done around the world—some for privileged reasons, some for personal reasons, some (like a few of our Russian colleagues) because communication to their part of the world from our part of the world has been difficult.

The *IE* viewpoint is that theory and experiment are equally important, and often go hand-in-hand. *IE* has published many theoretical and experimental papers in the field over the years, and also had special issues devoted to LENR theory (#108, #112). It is not unique to cold fusion that many experimentalists are also theorists, and vice versa, but this may be the only field where you could ask someone to name a significant experimentalist and theorist and have the same name uttered. Here we focus on experiment because it is important to highlight efforts that may not be publicized for some time; experiments are often not well-known until after a paper is published, which can often be a long period of time after results are achieved.

Presented herein are updates from numerous LENR researchers/groups, in alphabetical order by corresponding author. They represent the following eight countries: China, France, Hungary, Italy, Russia, Ukraine, United Kingdom and United States. Most of these experimentalists are presenting either talks or posters at ICCF24 (www.iccf24.org).

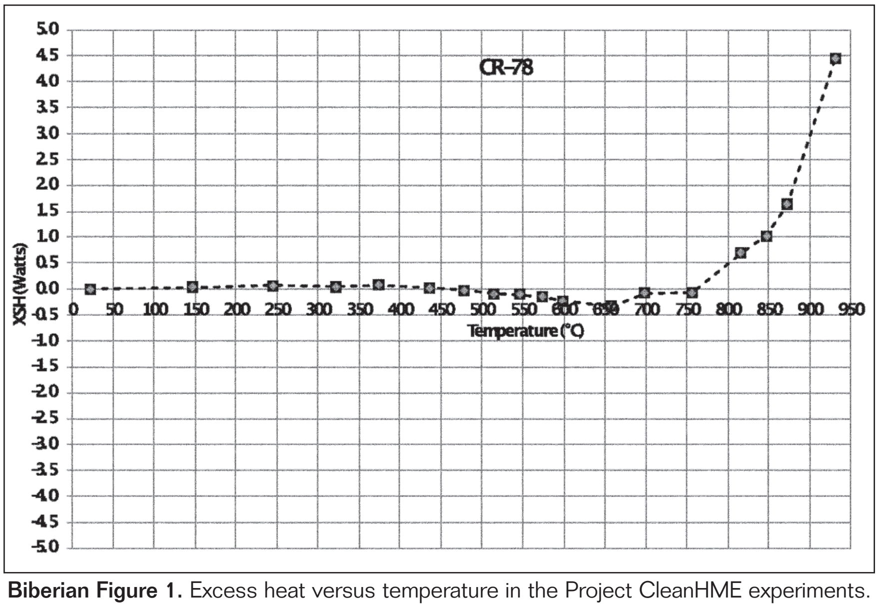
IE would like to acknowledge the advice and expertise of Dr. David Nagel, Dr. Michael McKubre and Marianne Macy in the preparation of this piece, and also thank the scientists who took the time on short notice to provide updates of their work.

Jean-Paul Biberian
Aix-Marseille University (Retired) / France

I have been working in the field of cold fusion since 1993, and during these past 29 years I made many experiments with many different techniques. I had the chance to collaborate with excellent scientists all around the world. In 2020 I edited the book *Cold Fusion: Advances in Condensed Matter Nuclear Science*, published by Elsevier. Since my retirement from the University ten years ago, I am lucky enough to have my own personal laboratory at home with excellent equipment to do calorimetry.

In the past I worked with electrochemistry, but in recent years I prefer to concentrate on gas experiments because they are both simpler and more convenient for industrial applications. At the ICCF24 conference I will present three experimental works that I am performing now.

The first one is part of the European Project CleanHME (Horizon 2020 grant agreement #951974). This collaboration has allowed me to measure excess heat in nanoparticles of nickel alloys in hydrogen at temperatures up to 940°C. This has been possible thanks to a collaboration with qualified material scientists of the CleanHME project and a precise heat flow, high temperature calorimeter of the Seebeck type. More than 5 Watts of excess heat has been measured with 20 g of powder for extended periods of time. (See Biberian Figure 1.) The experimentation is going on to confirm the results with other materials and test other conditions. This is an important achievement, because to produce



Biberian Figure 1. Excess heat versus temperature in the Project CleanHME experiments.

electricity, it is important to have a heat source as high as possible. We have shown that the heat production increases greatly with temperature. Soon we will operate at higher temperatures.

The second experimental work has been performed with my colleagues Patrick Jacquouton and Eric Marmiroli. We have developed a unique device that permits generation of a pulsed magnetic field using rotating magnets. The magnetic field is in the order of 0.5 Tesla. A quartz test tube that can be heated up to 800°C is placed in the magnetic field, and we have shown that below the Curie temperature of nickel (358°C) with nickel samples loaded with hydrogen, there is a cooling effect, and above the Curie temperature there is a heating effect. We have also shown that at room temperature there is a temperature increase of more than 40°C at a magnetic field frequency of 3 Hz. This is a very new discovery that shows that the properties of nickel loaded with hydrogen are very different than of pure nickel. We are continuing the work to understand the mechanisms as well as to increase the yield.

The third experimental work is a replication of the work of Frank Gordon and Harper Whitehouse of direct production of electricity by Lattice Energy Conversion (LEC). Recently, with Jean-Philippe Ginestet, we have produced a cell exhibiting up to 80 microwatts in air on a 1 kOhm resistive load, and with an open voltage of 640 mV. The cell is formed by a central aluminum cylinder of 12 cm in length and 3 cm in diameter; the counter electrode is a copper tube. Palladium has been deposited on the aluminum cylinder by electrodeposition. More work is under way to increase the current. The open circuit voltage is 640 mV.

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Francesco Celani *et al.*
National Institute of Nuclear Physics / Italy
Project CleanHME
C. Lorenzetti, G. Vassallo, E. Purchi, S. Fiorilla, S. Cupellini, M. Nakamura, P. Cerreoni, R. Burri, P. Boccanera, A. Spallone, E.F. Marano

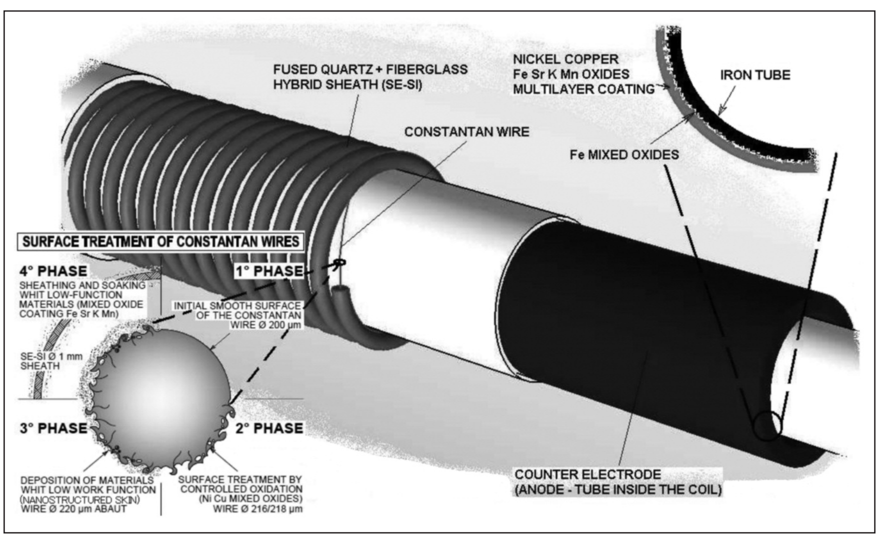
At the National Institute of Nuclear Physics, Frascati National Laboratories (INFN-LNF) in Italy, studies about cold fusion started on March 26, 1989. We found, since the beginning, that *non-equilibrium situations* are *mandatory* to get any "anomalous effect" (thermal/nuclear).

Following the efforts to find simple procedures to activate the specific material we developed (since 2011, based on surface-modified Constantan, shape of long-thin wires, Joule heating), we are able to produce measurable values of the anomalous heat effect (AHE). We conducted new specific tests to investigate isotopic effects as well. According to our results interpretation, the main origin of the AHE seems reconfirmed and is in agreement with the initial (some since 1989) results of researchers in the U.S., Japan and Italy.

Present work originated because we would like to reconfirm the procedures we discussed in depth during a talk at the ANV8 Workshop (December 2021, Italy), and in follow-up discussions with the LENR community. Several questions were raised, specifically about its *effective reproducibility*, *i.e.* restarting from the beginning with the wire and its treatments. Moreover, we added new experiments related to the study of isotopic effects (by H_2, D_2), if any, in respect to the amount of AHE.

The geometry of the reactor's core is almost the same as that we have developed since 2019: an "inverse coaxial coil." (See Celani Figure 1.) Energy balance (at several fixed input powers, step like) were made by thermometry (possibility of much faster measurements in respect to usual flow-calorimetry) using, as references, experiments made under He gas at the beginning of the tests, with similar pressures (>0.5 bar) of the active gases (H_2, D_2). For energy balance we considered useful the temperatures (by K-type thermocouple, SS shielded) measured at the external wall of the glass reactor: surface covered by several layers of thermal-conducting thick Al foil with side toward ambient painted with a high emissivity (>90%), high temperature (800°C) black compound. The maximum temperatures were: internal 900°C, external 380°C. Maximum power applied was >150 W. Wire's weight is 0.45 g.

We reconfirm that the simple procedure of DC Joule heating at high power (100-150 W) and long times (50-150 h) was effective in activating a virgin Constantan coil with the thin wire's surfaces properly treated (mainly by Low Work Function materials). Again, we found that the AHE measured, during the cooling cycles from the highest power, depends on the time previously spent by the reactor's core at the highest powers. We found that there is a sort of "positive memory effect" (in respect to AHE), lasting usually 10-20 h. Moreover, the AHE increases when the numbers of cycling (high→low→high power) are increased.



Celani Figure 1. Schematic of the reactor: inverse coaxial geometry.

We found, also, that increasing the wire resistance by proper "aging" treatments increased the amount of AHE. We speculated that it could be related to an increased surface area, spongy like the wire that allows, among other things, easier income↔outcome of active gases, *i.e.* flux. We measured that D_2 gas (latest experiment) and got larger values of AHE (9 W) in respect to H_2 (5 W), at input power of 130 W.

AHE are related to the voltage drop along the wire (larger is better): possible candidates are electromigration, NEMCA, "Preparata" effects. We observed such behavior since

1995 in using long-thin Pd wires. Obviously, our speciality of high-peak-power pulsing (HPPP) procedure (at proper duty cycles) is the most promising to increase both the AHE and overall COP of the system, toward practical applications. On the whole, the flux of gas (*i.e.* forced non-equilibrium) from the surface and/or along the bulk of the wire seems to be the origin of AHE. Such observation was pioneered by G. Fralick (NASA-USA); A. Takahashi (Osaka Univ.-Japan); Y. Iwamura, (MHI-Japan); our group (Italy).

We think that the Super Abundant Vacancies (SAV) condition is a co-factor to get AHE in wires (M.R. Staker, Loyola Univ.-U.S.). SAV, as also pointed out by Staker, can be obtained/increased by our HPPP procedures.

In conclusion, low-cost Constantan seems to behave like expensive Pd.

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Dennis Cravens
Independent Consultant / United States

I continue to work with and for Industrial Heat. I am presently investigating and refining the "LT" that Dennis Letts and I presented at ICCF21 (2019, Fort Collins, Colorado). At that time, the gas discharge method resulted in 7-10 W of excess heat under specific conditions. We have been working on various geometries, gas mixtures, electrical stimulation and materials to increase that level. However, the "electrical overhead cost" from the high voltage supplies and heating has prevented reaching a self-sustaining system, although we have increased the absolute levels of excess.

Due to health issues that have limited my oxygen levels, I am in the process of moving my lab from my previous 9000-foot elevation in Cloudcroft, New Mexico down to Alamogordo. My age requires me to choose my time judicially, so instead of pure science to prove cold fusion/LENR or elucidate its mechanism, I am focusing on proof-of-concepts and applications.

My extremely optimistic personal project is to produce a net electrical producing device based on hot gas and specialized powders, as was discussed in *IE* #111 (2013), where I was able to sustain heat production for over five days at the National Instruments Week convention. True, that was only about 0.3 W of excess, but it was a start motivated by Charles Entenmann's request for a bare bones demonstration. Since then, I have successfully had devices covered with TEGs that gave electrical output for multiple months when totally submerged in a hot (80°C) constant temperature bath. It should be noted that such devices do not require input power to the active component but only an elevated environment temperature. Present devices are initially brought to an elevated working temperature by heating a cartridge inside a Dewar containing the active materials and then turned off once the working temperature is reached. The LENR-produced heat is then extracted via large Cu-Te rod to TEGs without need for external input power. It takes some unique designs to remove the heat enough to be used by the TEGs without lowering the temperature of the active sites too much. The relative sizes and thermal conductivities of the components are critical. It should be noted that the cold side is kept constant by CPU style fan cooling, which uses 3-5 W of power with the current systems. The goal is to produce a net of 20 W electrical without externally supplied power.

The methodology is based on "brute force" of using a very large sample of specialized material for heat generation. It assumes heat available for conversion by the TEGs is produced proportionally to the sample mass and inversely to the surface area divided by the insulation R values (Dewar and Aerogel insulation) and temperature difference. The key that makes this possible is that the reaction rate has a positive temperature coefficient that appears to be exponential and is linear with size of the sample used. You want a hot reactive site and only take a portion of the thermal energy produced. If too much heat is removed the system will cool, reduce heat production and come to a stop.

Some will no doubt laugh and say this is a bridge too far. However, with the achievement of 20 W of net electrical energy it will be possible to trickle charge storage batteries over a month (*i.e.* 14 kWhr) to allow for a light car to run a few miles at a car show or parade. I am on schedule for a New Mexico car show in November to present such a car. This is not by any stretch of imagination a commercial level of output, but within the projected range of what I can now achieve. It will just be a proof-of-concept item, not a prototype. If successful, it just might stir up a little popular PR.

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Fabrice David
Independent Consultant / France

According to Thierry Dauxois and Volodymir Dubinko, the Boltzmann equation which links the energy of the particles to the temperature would be valid in gases and in most crystalline solids, but in some quasicrystalline solids, the thermal energy would be concentrated in certain places, called "Breathers." It is certain that these "Breathers" will have applications in the field of energy conversion. I believe that respecting the principles of thermodynamics requires that there are also areas where thermal energy is depleted. I call these areas "Freezers."

To overcome the Coulomb barrier of the nuclei, 300 Kelvins do not change much. The explanation is not in brute force, but in quantum effects. If the real temperature of the atoms located in these "Freezers" is sufficiently low (about 300 Kelvin below the temperature of the other atoms of the solid) then quantum effects can appear, in particular the Bose-Einstein condensate (BEC). But it would be a BEC inside solid matter. A helium nucleus cannot keep the 24 MeV energy produced by nuclear fusion without immediately fissioning into a proton and a triton or a neutron and a helium-3 nucleus. On the other hand, a BEC of several thousand atoms can handle this energy without a problem. So, the explanation of solid-state fusion is not simple.

How do we explain the many observations of solid-state fusion with light hydrogen? Isn't the hydrogen nucleus a fermion? It must be admitted that the light hydrogen nuclei which are fermions can associate two-by-two to form "composite bosons." The formation of a BEC would thus explain the extraordinary ability of hydrogen to diffuse in palladium. If the hydrogen nuclei associate in opposite spin pairs, then it must be possible to destroy the BEC state, which we call a "diafluid state" with the help of a strong magnetic field. The results of such experiments will be discussed at ICCF24.

Whatever the theoretical explanation for solid-state fusion, if we want to use it practically, we need to find a way to directly convert the fusion energy into electricity. It is not possible to do as with ITER and other "demo" reactors and use a "steampunk" era turbine system to convert heat into energy like in a Wild West locomotive.

Luckily, before being converted into heat through the "down-conversion" of Hagelstein, the fusion energy of 24 MeV per nucleus is converted into energy in the electron volt range. An energy of a few electron volts can excite electrons in a lattice. If this excitation takes place near a metal/semiconductor junction (a semiconductor diode) the same thing happens as in a solar cell: the electrons and holes created by the energy are separated and the electrons flow through the external circuit. The result is the same for solar energy or solid-state fusion energy: usable electrical current. No moving parts, no wear, no vibrations, no heat to be evacuated by radiators, no radiation. The experimental results are very encouraging. Several experimenters have successfully ignited light-emitting diodes using solid-state fusion diodes. But will the fragile junction resist in the long term, constantly subjected to fusion energy? Isn't this a chemical artifact? These are questions that remain unanswered.

I am now working on fusion diodes made of many sandwiches of special organic semiconductor paper of my own coated with a thin foil of palladium on one side and thin foil of gold on the other side. It is possible to fill the diodes with hydrogen. (I have no gaseous deuterium now in my lab.)

There are also other ways to make a fusion diode, such as work done by BioSearch and INOVL [presented in this article]. I am doing work related to these types of solid-state fusion diodes.

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George Egely
Egely Ltd. / Hungary

I have spent my life working in R&D in the nuclear industry. Currently I am working in the field of direct electricity production, the subject of my video talk at ICCF24. That talk is the summary of more than 50 years in nuclear science.

The first half of my career was spent in academic R&D, in fission-related conventional work. As such, I was awarded a research fellowship by the International Atomic Energy Agency (IAEA) in Vienna at the end of the 1970s. I was the first Eastern European to be allowed to work legally in a U.S. national lab (Brookhaven National Laboratory) on the safety of nuclear power plants.

I have learned three important facts:

1. We are unable to simulate the two-phase flow during a nuclear accident due to turbulence.
2. Actually, pressurized water reactors are very expensive. There are other, more economic options for fission reactors. However, they do not produce plutonium, thus they are useless for military applications.
3. There are other, mysterious inventions that are much better.

I found a book by T.H. Moray in a Detroit cellar; this book, *The Sea of Energy in Which the Earth Floats*, has puzzled me ever since. The captivating book excited and depressed me at the same time. Is this effect real? Why don't I have a clue about its inner physics? The book challenged me in every aspect: in science, in engineering and in morality. Do I have to serve the Russian military machine by making plutonium, and radioactive waste, for the next thousand+ years?

I was soon after chased from our Nuclear Energy Research Lab in Hungary for heresy—being openly dissatisfied by the fission-related work.

I got into LENR research after the Pons and Fleischmann announcement, as an unpaid group leader in a private lab. However, one technical failure followed the next for decades.

It took more than 30 years to figure out the fundamentals of direct energy production. It is a very strange, extremely counterintuitive multi-step process. While there will be joy at the end of the road, in the present LENR researchers are often faced with nightmares in the night and slaps in the face in the day.

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Robert Godes
Brillouin Energy Corp. / United States

The following are a summary of points that together provide independently verified, definitive scientific evidence that Brillouin Energy can control LENR heat production and nuclear effects in its test reactors:

1. Brillouin Energy has evidence of heat production beyond any chemical means:

A) The Brillouin Milestone Technical Progress Highlights[1] shows data from a series of experiments employing precision calorimetry.

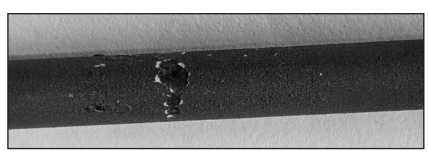
B) These tests provide evidence of heat production with no known chemical reactions between the materials in the reactor that could account for the heat produced.

C) This data resulted from an 18-month campaign run on a single catalyst rod focusing on continually refining the drive signal to maximize power output.

D) Upon removing the catalyst rod from the reactor, it appeared unchanged, with no signs of degradation.

2. Brillouin has independent evidence of nuclear effects consistent with the accumulation of neutrons. The only source of such neutrons is the reaction driven by our control system. The basis for this is a series of related independent expert tests and the reports that resulted from those tests:

A) The Brillouin Cerium Lab Test Report 2020[1] contains further evidence of nuclear reactions. The results found on page 4 of this report[1] stem from the metal missing in Godes Photo 1 (also the last photo of an online album[2]), showing a significant reduction in the most abundant isotope of nickel. In contrast, the heaviest isotope increased by 125%. (This was the result of running an active catalyst rod for an extended period of time in an inert gas instead of hydrogen. The nickel analyzed by Cerium Lab was taken from where you can see the unmelted dielectric in



Godes Photo 1. The black glassy material in the middle of the trough is the melted dielectric.

the photo. The smooth black material where the nickel is missing shows melted dielectric. The temperatures are significant, as the melting point of the dielectric is above the melting point of nickel but below the boiling point of nickel at 2913°C.)

B) The combination of Brillouin 3rd Party Test Results and Analysis,[1] the Tanzella ERC Challenge Test Report[1] and the Cerium lab test of the rod, which produced the Cerium Report,[1] provide definitive scientific evidence of LENR heat production and Brillouin's ability to control it.

C) The change in isotopic ratios indicates an accumulation of neutrons in the system. On this scale, the only apparent neutron source is the reaction driven by Brillouin's reactor control system.

D) The experiment was conducted by a Ph.D. nuclear physicist and engineer on behalf of a private equity firm, which was performing due diligence on Brillouin Energy's technology. The physicist/engineer's background included several executive-level positions at GE-Hitachi's Nuclear Energy Division. The experiment conducted by this due diligence expert was run on a different catalyst rod than the Milestone Highlights 2019[1] experiments and replaced the hydrogen fuel with helium and argon. After running Brillouin's HHT reactor in inert gas for more than a month, the documented nuclear event occurred, causing the center of the catalyst rod to vaporize. By depriving the catalyst of hydrogen, it was possible to get the system to run away. This runaway event generated *no* hazardous radiation and only caused the reactor to shut down. Brillouin Helium vs. Hydrogen: Why the COP Goes Up[1] explains why this happened, consistent with the recorded measurements.

3. Brillouin Energy has an earlier result demonstrating definitive independent evidence of LENR from our WET™ reactor work, where our reactor produced tritium. See Brillouin Claytor Tritium Test Results Final 2-27-15.[1]

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1. See this document online to get direct links to all reports: tinyurl.com/4766ruvn Or, scan the QR code to access the file.

2. https://photos.app.goo.gl/RTNPLArtoYjAQVpw6

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Frank Gordon and Harper Whitehouse
INOVL, Inc. / United States

Multiple Lattice Energy Conversion (LEC) devices and configurations have experimentally demonstrated the ability to self-initiate and self-sustain the production of a voltage and current through an external load impedance without the use of naturally radioactive materials. These results have been reported by the authors[1] and replicated by independent researchers.[2-6] A video[7] shows that a voltmeter and a resistance substitution box are all that is required to observe and measure LEC output, which for this test produced several hundred nanowatts of power per square centimeter of working electrode surface area.

While the ability to self-initiate and self-sustain the production of a voltage and current through a load is a significant innovation, the output must be scaled up by six orders of magnitude to produce a few watts, and by nine orders of magnitude to produce a few kilowatts. Based on a review of the literature and an analysis of experimental results, five focus areas have been identified to scale up the LEC output, including:

1. Improved metallurgy to increase the production of ionizing radiation;
2. Increased gas density (initial pressure) to increase gas ionization;
3. Improved LEC cell configurations to increase gaseous ion harvesting efficiency;
4. Elevated temperatures leading to increased power output;
5. Increased electrode surface area.

For each of the five focus areas, additional experiments and analysis are required to:

a. Identify the source and type of ionizing radiation emitted from the working electrode;
b. Identify the role that the counter electrode may play in ionizing the gas;
c. Identify gases and mixtures that optimize the production of ions;
d. Analyze the gas ion physics within the cell, which is a fourth-order nonlinear differential equation.

References

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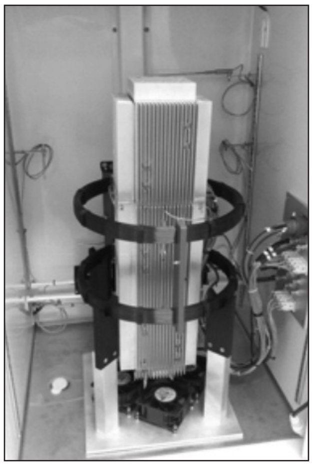
Dennis Letts
Lettslab / United States

I formed Lettslab in Austin, Texas in 1990 to study what was then known as cold fusion. Experiments began in July 1992, after studying the early papers for two years. My 1992 experiments used RF and external magnetic fields to trigger unexpected temperature increases in electrochemical cells at 82 MHz, 365 MHz and 533 MHz. Experiments in 2000 demonstrated that a single red laser would also trigger temperature increases in LiOD electrochemical cells at specific wavelengths (frequencies). In 2007, experiments demonstrated that dual red lasers tuned to provide subtractive beat frequencies of 8, 15 and 20 THz would also trigger unexpected temperature gains in LiOD electrochemical cells. The maximum excess power produced in electrochemical cells was about 4 watts with an input power of 16 watts. Lettslab constructed and tested 767 electrochemical cells with an average of ten individual tests per cell. More than 7,000 individual electrochemical experiments were run from 1992 to 2015. I have enjoyed collaborations with Bockris, Storms, Miles, McKubre, Cravens and Hagelstein.

In 2015, I joined Industrial Heat (IH) as a contract researcher and constructed a gas-plasma system to study possible low energy nuclear reactions (LENR). (See Letts Photo 1.) With the support of IH, I was able to increase the experimental capabilities of Lettslab and am currently using glow discharge methods to search for high-performance metal catalysts. I have increased the excess power gain from 4 watts to a maximum of 20 watts using nickel alloys with deuterium gas. Various RF triggers are also being studied, ranging from acoustic to 1 GHz. Since 2015, I have produced 60 reactor-catalyst configurations. Approximately 600 individual glow discharge experiments have been conducted in the seven years since joining IH. The collaboration has been positive and productive.



Letts Photo 1. Reactor core inside enclosure.

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George Miley, Erik Ziehm and Ben Peecher
Dept. of Nuclear, Plasma and Radiological Engineering
University of Illinois / United States

In addition to the continued study of the role of clusters in Low Energy Nuclear Reactions (LENR), our work has focused on the following two projects:

1. Experimental Investigations of LENR in DC Glow Discharges
Recent work addressed the possibility of LENR in a deuterium DC glow discharge with palladium electrodes. The discharge simultaneously implants deuterons into the cathode and causes crystalline deformations, which act as trapping sites for mobile interstitial deuterons. We hypothesize that bound clusters of deuterons are necessary for LENR. A Solid-State Nuclear Track Detector (SSNTD), called CR-39, was used as the technique to investigate the emission of energetic charged particles from the electrodes. A new analysis technique was developed to allow rapid scanning of large CR-39 surfaces, which amassed considerably more data than prior studies. After plasma-electrode interaction, tracks in the CR-39 detectors consistently corresponded to 138 ± 21 keV alpha particles emitted from the palladium electrodes. The track densities for deuterium discharges were often ~100 times above controls with hydrogen and helium. The production of energetic alpha particles with no source of helium or a means to accelerate the ions to such high energies indicate a nuclear reaction occurred. From trajectory estimates based on track geometry, it was concluded the reactions originated at the Pd electrodes and are not attributed to cosmic rays or atmospheric radioisotopes.

Before all tests, a deleting etch was performed for one hour at 80±5°C in 60% methanol and 40% 6.25 M NaOH, removing the first 150±10 μm of material and any background tracks and surface defects. After each test, the track etch procedure was one hour at 98±1°C in 6.25 M NaOH, removing 34±4 μm of material.

Six different methods for CR-39 analysis determined that the characteristics of most tracks correspond to alpha particles emitted in the 100 keV range from the electrodes. The first technique involved creating a response curve for the dependence of track diameters on incident alpha energy using an Am-241 source and an air gap for energy attenuation. Second, track diameters were measured after five progressive etchings and compared to those from the alpha source. Third, track depths were measured using a 3D confocal laser microscope and compared to alpha source tracks. Fourth, layers of gold were deposited on the CR-39 to determine if the energy loss of the track producing particle was consistent with ~100 keV alphas. Fifth, the detectors were placed at two locations from the electrodes, 5 and 10 cm, to see if the energy attenuation through the gas was consistent with the transmission of ~100 keV alphas. Lastly, the 3D microscope was used again to estimate the trajectories of the incident particles. All results were consistent with ~100 keV alpha particles emitted from the electrodes.

In summary, extensive CR-39 track detector experiments established the production of low energy alphas (~100 keV) in a plasma discharge with deuterium ions bombarding a palladium cathode. Current work is focused on implementing complementary radiation detection methods, such as a NaI (Tl) detector for gammas and a semiconductor charged particle detector to support the CR-39 results.

2. Experimental Studies of LENR from Pressurized Nanoparticles
This project focuses on crystal defects in metal hydride particles as potential fusion reaction sites. Our unique material processing method results in a high density of these defects in each set of particles. The objective is to tightly pack hydrogen or deuterium atoms into these defects, with the tight boundary condition of the particles making them more likely to pass the Coulomb barrier. We work primarily with alloys of palladium, zirconium and nickel, though some upcoming tests will include copper.

Our reactor is designed to isolate the particles from all sources of heat except those we can measure accurately. Then, tracking the temperature of the particles with a thermocouple probe, we compare the temperature of the system to the temperature we'd expect to see based on control experiments. In the event of a significant or consistent excess heat, since the reactor is isolated from outside sources of heat, we can attribute the difference to an LENR reaction inside the reactor.

We've obtained some promising results pressurizing with deuterium at various temperatures, particularly in the 500° to 600°C range, but any excess heat is relatively low. More recently we've been trying to trigger the LENR reaction with various catalyzing mechanisms. Current experiments use a powerful electric pulse generator developed by Dr. Mark Snoswell that can create nanosecond-long kilovolt bursts. We bury an electrode connected to this generator in the particles and look for any excess heat events it might trigger. Results are still forthcoming.

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David Nagel and M. Ashraf Imam
LENR Energy and Spectroscopy Laboratory
George Washington University / United States

We have had the on-campus LENR Energy and Spectroscopy Laboratory since 2015. It is distinguished by having three types of electrochemical experiments and many kinds of spectroscopic diagnostics, with four current research programs.

The electrochemical experiments include:

1. Loading of protons onto a nickel tube using a Biologic SP-300 power supply and data logger with thermometry for heat measurements.
2. Loading deuterons into Pd-B alloys using dual open calorimeters in a constant temperature water bath powered by a Keysight E36300 triple-supply and monitored with PT-104 four-channel RTD temperature sensors, both under LabVIEW control.
3. Loading deuterons into Pd in a sealed differential calorimeter with recombiners, with thermoelectric devices for both establishing a constant temperature reference and measuring heat flow under LabVIEW control.

In addition to the calorimeters already noted, we have both visible and thermal imagers, and the following types of spectroscopies:

Measured	Range	Company	Model
Radio Frequencies	1 Hz - 4.4 GHz	Signal Hound	USB-SA44B
IR-Visible-UV	220 - 1100 nm	StellarNet	BLK-CXR-SR
X- and Gamma-Ray	2 - 200 keV	AmpTek	X123 CdTe
Acoustic	10 Hz - 100 kHz	Stanford Research	SR-560 LNA
Impedance	1 Hz - 1 MHz	BioLogic	SP-300
Electrical Noise	1 Hz - 100 kHz	National Instruments	MyDAQ

Radio frequencies can be picked up from LENR experiments with either coils or capacitors. Spectroscopy in and around the visible region is done with a commercial spectrometer that has a fiber optic waveguide input. The X-ray and gamma-ray spectroscopy can be done on cathodes before and after electrochemical runs. The Acoustic Spectroscopy is accomplished with either simple microphones or piezoelectric transducers capacitively coupled into a Low Noise Amplifier (LNA). The Electrical Impedance Spectroscopy of electrochemical cells is measured with the sophisticated commercial BioLogic SP-300 unit.

Electrical Noise Spectroscopy has only recently been brought to bear on LENR research. Various mechanisms lead to noise on top of (as part of) all electrical signals. They include atomic vibrations (Thermal Noise), the fact that electrons are discrete units (Shot Noise), variations in resistance (Flicker or 1/Frequency Noise) and fluctuations in the number of carriers in semiconductors (Generation and Recombination Noise). The key fact is that the levels of the various noise sources provide information on the motion of carriers in materials, devices and experiments, including those that seek to produce LENR. There are multiple kinds of noise in LENR experiments, including both the input stimuli and the output signals, as well as the measured LENR power. Initial measurements and estimates indicate that it might be possible to detect the occurrence of LENR at levels of 1% or less of the minimum detectable limits of calorimeters.

The four current research programs include the following:

1. An effort to reproduce the excess heat results obtained by Miles[1] using Pd-B alloys prepared by one of us (MAI) at the Naval Research Laboratory.
2. An effort to reproduce the excess heat results in a palladium experiment with electromigration, as reported by Staker.[2]
3. A study of the composition and structure of Pd co-deposited in light and heavy water with two scientists at the Naval Research Laboratory: Steven Bennett (Wavelength Dispersive X-ray Fluorescence) and Syed Qadri (X-Ray Diffraction).
4. A study with A. Mehrabian to determine the value of electrical noise measurements for detection and quantification of LENR at levels below what calorimeters can measure.

We also have use of diverse software capabilities. Besides LabVIEW, we sometimes use COMSOL to simulate the electrical and thermal behavior of LENR experiments. MatLab and Python codes are also available.

Our LENR Energy and Spectroscopy Laboratory is backed up by various facilities at the George Washington University, notably the Nanofabrication and Imaging Center.[3] It has Scanning Electron Microscopes and Energy Dispersive X-Ray Analysis capabilities.

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Irina Savvatimova *et al.*
National Research Nuclear University MEPhI
(Moscow Engineering Physics Institute) / Russia
S.F. Timashev, S.S. Poteshin, N.I. Kargin, A.A. Sysoev, S.M. Ryndya

The possibility of initiated decay of impurity elements in a nonequilibrium low-energy deuterium gas discharge has been established.

A set of studies using the mass spectrometry method (ICP-MS-LA-ICP-MS) showed the possibility of the formation of tungsten (W) from platinum (Pt) and lead (Pb) impurities in palladium (Pd) cathodes and the formation of W in a Pb cathode.

The amount of impurity elements Pt and Pb in the Pd

Savvatimova Table 1. Change in the content of W, Pt, and Pb in Pd after irradiation in D glow discharge plasma (40 hours; ICP MS). Ratio of normalized intensities (cps) of tungsten, platinum and lead isotopes before/after experiments in deuterium glow discharge plasma.

No. measurements	Pd	W			Pt			Pb		
	106	183	184	186	194	195	196	206	207	208
1	1.00	0.0018	0.0019	0.0021	28.72	25.46	27.9	302	396.6	311.6
2	1.00	0.0049	0.0036	0.0048	15.42	14.58	14.58	117.5	130.6	132.3
3	0.99	0.0034	0.0033	0.0035	16.72	11.43	16.67	47.73	23.14	41.51
4	1.00	0.0032	0.0023	0.0022	11.84	11.80	12.55	33.23	27.48	23.76
5	1.00	0.0023	0.0032	0.0048	6.08	6.12	5.35	16.92	10.10	15.14
6	1.00	0.0014	0.0011	0.0020	9.80	9.70	9.71	10.31	15.92	12.84
7	0.99	0.0038	0.0024	0.0038	7.17	7.23	7.12	11.84	13.35	13.33
8	1.01	0.0010	0.0037	0.0026	4.79	5.19	4.98	8.49	6.29	9.24
9	1.00	0.0025	0.0022	0.0027	8.83	9.15	9.72	7.95	7.19	7.54
10	1.01	0.0026	0.0021	0.0021	8.06	7.61	7.59	8.56	4.03	6.78
11	1.00	0.0039	0.0023	0.0034	3.65	3.37	3.66	5.41	3.73	8.29
12	1.01	0.0011	0.0017	0.0016	8.11	8.42	8.31	4.92	3.41	7.03
Average	1.00	0.0027	0.0025	0.0030	10.76	10.01	10.69	47.92	53.49	49.12

cathodes decreased with the duration of the experiments 40-200 hours, and the formation of W was observed. W was also formed in the Pb cathode.

In Pd, the amount of Pt impurity decreased by 30%, and Pb disappeared almost completely.

The intensity of registered pulses per second of W isotopes increased after treatment of Pd in deuterium plasma by a factor of 5-20. The amount of W in Pb increased from thousandths of a percent in the original sample to tenths of a percent after treatment in deuterium plasma, and in some cases even up to 2%. These changes are shown in Savvatimova Table 1.

Based on the results of 12 measurements, Table 1 shows a decrease in the content of Pt by ~10 times and Pb by ~50 times and an increase was found in the content of W by ~370 times in Pd after D plasma.

Comparison of the intensity of the pulse registration (rate of count per second) of W isotopes in the original Pb and after D plasma demonstrates an increase in the intensity of the count of W isotopes by an order of magnitude during the real time of the analysis (~1000 sec). A possible mechanism of initiated decay has been proposed.[1]

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Alan Smith
Net Zero Scientific Ltd. / United Kingdom

Net Zero Scientific Ltd. (NZS) is a privately owned UK research laboratory working mainly in the field of envirochemistry. We seek out, study and develop the greenest possible methods of manufacturing important industrial chemicals from otherwise neglected resources. For example, we work on the recovery and utilization of metals from waste either as metals, or as useful metallic compounds like alumina or magnetite. Zero Waste, and Net Zero, are important aspects of resource conservation, and for protecting the environment. We work on "difficult" solid wastes, including metal dust from coating processes, machine turnings and incinerator ashes. The right chemistry can turn these unloved materials into hydrogen and valuable chemicals for other uses, including vehicle batteries and display screens. This is the "day job" and we take it seriously. Research itself is relatively cheap of course; you might need only a laptop, a library and a fertile imagination to come up with good ideas, but the testing and development of concepts into realities is hard and costly in terms of labor, materials and machinery. Currently we are building a chemical hydrogen reactor at an early stage, You can see more about this work at www.netzerochem.com.

We are fortunate in having funders with more vision than most, and this has enabled us to provide practical support in terms of ideas, replication efforts, methods, lab-space and materials to other independent researchers working on cold fusion/LENR, including Russ George, who spent almost 18 months sharing the lab with us. This author has the honor of being an admin at LENR-Forum.com, which has helped NZS to develop many contacts in the cold fusion field.

Our most recent LENR collaboration/replication has been with Frank Gordon and Harper Whitehouse, inventors and developers of the Lattice Energy Converter (LEC), an intriguing device which produces electrical energy but is nothing like any standard kind of battery. In its most basic form a LEC is not difficult to construct and test; in fact we found it "worryingly reliable" and spent a long time checking for artefacts—which we did not find. Ruby Carat of Cold Fusion Now and I arranged a panel discussion about the LEC, which is available online.[1]

Some aspects of the LEC will be familiar to those who have followed cold fusion research carried out by Stan Szpak and others at the U.S. Naval Research Center, in that it exploits the use of co-deposition of metal and a hydrogen isotope onto the cathode of a wet cell, though the finished article is a dry cell containing only two electrodes and gases. Instead of using exotic materials like palladium and heavy water, you can build a working LEC using nothing more exotic than a piece of brass plate about 3x1" for a working cathode, some soft iron wire to make the plating anode, deionized water and some muriatic acid for the electrolyte (from Harbor Freight). You will also need a suitable container for a plating tank and a DC power supply—an old phone charger might do. To check for results from the carefully dried working electrode you need a multimeter capable of reading very low voltages and currents—but even low cost meters can be good enough to see results. A video made by Dr. Gordon[2] very clearly shows the LEC and its behaviors under various conditions of load and there is more detailed replication info at LENR-Forum.com.

Over the last three months, pressure to work on conventional chemistry projects (they keep the lights on) has been intense, so LEC research is proceeding very slowly and in more speculative directions. Frankly, the LEC is a mystery: something is ionizing the gas inside the devices, and the ions with associated charge are self-organizing as they migrate to the anode and cathode, creating a modest electrical output. This "something" could be radiation, but if so it has proved impossible to detect it in our lab, but others with (for example) a very sensitive cryo-cooled gamma spec might have more success. X-ray film placed near the working electrode certainly shows some darkening, suggestive of energetic emissions.

Current LEC research in our lab focuses on candidate materials for more energetic working electrodes, using non-eutectic alloys of samarium, selenium, cobalt, zinc and tin. When the reliability and reproducibility of the LEC and the persistent nature of its electrical output is further developed and tuned so that it creates more than milliwatts, we will have something very new and very special.

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Mitchell Swartz
JET Energy and Nanortech, Inc. / United States

Our goal continues to be maintaining excellence in conducting our studies in the cold fusion field using increasing numbers of synchronous controls and checking all calorimeters, including their ability to detect a square wave ("waveform reconstruction"). We also continue developing and improving the robustness of our aqueous PHUSOR®-type systems (now MOAC) and the dry, preloaded CF/LANR NANOR®-type systems. Fortunately, their presence has led to new diagnostics that prove that they really deliver excess heat, when they are in their active driven mode. These "lab rat" lattice assisted nuclear reactions (LANR) components have enabled even further theoretical advancements from these blazing, sometimes pulsing technologies. The following are some of our ongoing efforts.

PHUSOR®-type Components Now MOAC (JET Energy)

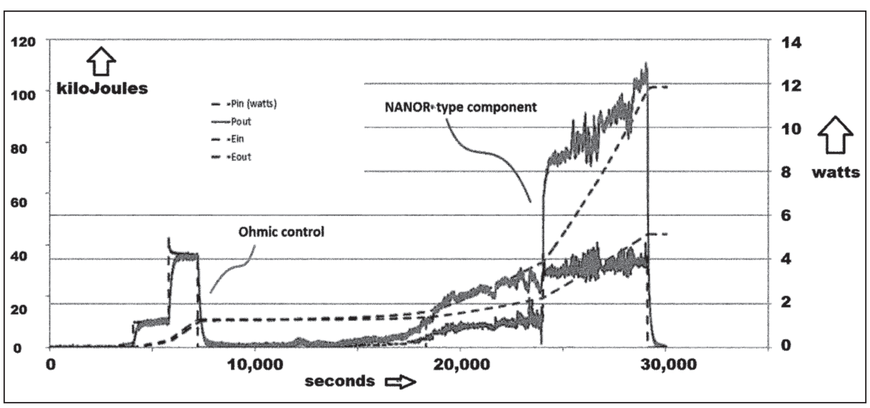
Continuing to upgrade the PHUSOR®-type line, we are revamping the LANR electrolytic cell known as the MOAC ("Mother of all Cathodes"). It has a 3 liter capacity, with a cathode of 2.14 kilograms made from #46 hard drawn smooth nickel wire with an area of circa 240,000 cm^2. The anode has five folded platinized sheets of titanium with a total area of ~3,200 cm^2, for a surface area ratio of cathode to anode of 75:1. The upgrade will be to heavy water when we acquire sufficient funding.

Toroidal Breathing Mode Driven Synchronous Behavior Makes the Coulomb Barrier Moot (JET Energy)

Understanding the theoretical bases of successful LANR has expanded and uncovered that it is synchronization of vacancy-loaded deuterons which enables successful LANR mass-energy transfer. We learned how important it was when we discovered that successfully driven lattice assisted nuclear reaction components emit unique very narrow-bandwidth hyperfine radiofrequency (RF) signals near the deuterium line (DL; ~327.37 mHz) along with informative sidebands and novel pulsations. Their incredibly high Q heralded a large inverted population. Some of the pulsations appear coupled with periods of minutes; and when synchronized, may enable mass-energy transfer. In Ni and Pd vacancy-loaded deuterons are identical bosons, and thus can interact and interchange. This analysis requires equivariant bifurcation theory. Mathematically, synchronization of the local deuteron oscillators in FCC vacancies smoothly proceeds to the "double Hopf bifurcation" driven by the applied electric field intensity. Of the many possible states which follow, only three solutions—especially the "toroidal breather mode" (TBM)—enable exchange of energy between the coupled oscillators. These important RF-detected LANR couplings, like those of the Huygens' clocks, interact in-phase with spatiotemporal symmetry. It is proposed that in LANR they combine. Most importantly, the TBM solution is the way by which interacting vacancy-loaded deuterons in highly loaded Group VIII alloys make moot and circumvent the need for surmounting the "Coulomb barrier."

Preloaded, Dry NANOR®-type Components (Nanortech, Inc.)

Our current working set of preloaded, dry NANOR®-type components deliver excess power outputs in the range of ~12.1 Watts when driven with an input power of 4 Watts. We will continue ramping up both delivered power and effective useful incremental power gain.



Swartz Figure 1. Shown is the input electrical power to an ohmic control and then the Nanor®-type component 7-24, and the resultant output thermal power from both as a function of time. The input and output integrated energies are shown as dashed lines. The power outputs was ~12.1 Watts when driven with 4 Watts.

Continued Diagnostic Studies (Nanortech, Inc.)
We have expanded our antiStokes and radiofrequency deuterium-line studies with Impedance Spectroscopy. Soon to be reported at ICCF24 are new diagnostics that can distinguish potentially active ZrO_2PdNiD NANOR®-type components. These studies have uncovered highly distinguishable, possibly significant complex dielectric signatures and possible synchronized interactions between the loaded deuterons in vacancies prior to the desired *de novo* helium production. Impedance (dielectric) spectroscopy is an important nondestructive evaluation tool to evaluate LANR activity, material responses, breakdown and avalanche behavior, and quenching, including as a function of frequency. Calorimetry (with ohmic controls and time integration), coherent antiStokes spectroscopy and deuterium line RF spectroscopy remain the most superior methods to selectively, specifically, and semi-quantitatively detect active LANR/LENR/CF systems.

Better Understanding of Electrical Avalanches (Nanortech, Inc.)
Another advancement we have made involves a better understanding of the electrical avalanches that limit the excess heat in dry preloaded ZrO_2PdNiD NANOR®-type components. The use of dry preloaded ZrO_2PdNiD nanostructured materials in NANOR®-type components demonstrated the presence of unwanted Zener-type avalanche behavior during successful over-driven LANR. This potential unwanted Zener-type avalanche behavior immediately ends the excess heat as the component returns to prosaic V*I power dissipation. In light of what we have shown about Optimal Operating Point operations (as far back as ICCF10, including the open demonstration at MIT for three days), this will be presented at ICCF24 as "Deuteron Momentum and the Umweg (detour) Factor Limit Successful CF/LANR." This paper further examines these critical electron breakdown processes. Deuteron momentum and scattering are most important because they initiate, and then limit the success of, CF/LANR activity. It will be shown how the umweg (detour) factor, which also equals the ratio of actual drift velocities of deuterons in a material, limits excess heat in LANR nanomaterials and nanostructures because both the actual, and drift, velocities increase proportional to the applied E-field. In fact, this is what is seen.

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Vladimir Vysotskii[a] and Alla Kornilova[b]
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The hypothesis about the possibility of nuclear transmutation of chemical elements in biological systems is one of the most mysterious phenomenon in natural history and has been frequently discussed during the last decades.

The series of works of Louis Kervran holds a special place in the chronology of transmutation of chemical elements and isotopes in biological objects. He conducted several interesting experiments in which the change in the chemical composition of the element of various biological objects was recorded. A shortcoming of his research was the lack of analysis of isotope changes.

Kervran called the process of transformation of elements in biological systems "biological transmutation"(BT). In our opinion, there are no reasons to consider this process as BT and separate it from the general physical concept of transmutation as a process of isotope transformation controlled by the laws of physics in a special dynamical environmental.

From 1993-2000 we studied, observed and reported the processes of transmutation of stable isotopes Mn^{55}, Na^{23}, P^{31} in growing "one-line" microbiological cultures like *E.Coli* in nuclear reactions $Mn^{55} + d^2 = Fe^{57}$, $Na^{23} + P^{31} = Fe^{54}$. These isotopes were added to the liquid medium in which the microorganism grew. The effectiveness (rate) $\lambda_{Fe^{57};Fe^{54}} \approx 10^{-8}$ sec^{-1} of these reactions, and many references to the authors' work, can be requested from: vivysotskii@gmail.com

The physical mechanism for such reactions stimulation is associated with the generation of giant energy fluctuations during the formation of quantum mechanical coherent correlated states of interacting particles, which are localized in non-stationary potential nano-wells in growing bio-objects.

Other experiments investigated the transmutation action of special syntrophic microbiological associates that include very great numbers of different "one-line" cultures. The state of complete symbiosis of such associations results in the possibility of maximal adaptation of the microorganisms' association to any external conditions change. For such biosystems, the efficiency of transmutation has increased by 50-100 times up to $\lambda_{Fe^{57};Fe^{54}} \approx 10^{-6}$ sec^{-1}. Similar results were obtained for the case of transmutation of heavy stable isotopes in the $Cs^{133} + p = Ba^{134}$ reaction.

The next cycle of our research was associated with the transmutation of radioactive isotopes into stable ones using the same biotechnology. In our initial experiments (2005-2010), we achieved a decrease in the concentration (equivalent to acceleration of natural decay from 30 years to 310 days) in the aquatic environment of a very dangerous radioactive reactor Cs^{137} isotope due to $Cs^{137} + p = Ba^{138}$ reaction.

Recently, we have greatly optimized the technology of the biotransmutation process. Recent experiments (2015-2020) provide a much greater efficiency of radioactive Cs^{137} isotope transmutation in the same reaction: it was accelerated in comparison with spontaneous decay from 30 years to 15-20 days. Recently, we have been conducting similar experiments to deactivate another very dangerous radioactive reactor Sr^{90} isotope. These and subsequent experiments were carried out with the participation of our colleague Sergey Gaydamaka. These results are very important for the accelerated deactivation of millions of tons of radioactive water at various nuclear power plants (including Fukushima NPP).

Among our recent experiments, one can note the first discovered and studied (2019-2021) reaction of transmutation of Ca and Ti isotopes with the formation of Mo in the presence of natural microorganisms that are part of oral saliva. This $Ti^{46} + Ca^{48} = Mo^{94}$ reaction, which can occur in the human oral cavity on the surface of Ti, implants its border with the surface of the tooth and leads to its destruction, which is very often observed in practical dentistry.

It was shown in our works (2014-2016) that the "standard" heat conduction equations of classical thermodynamics are incorrect in the analysis of very fast thermal processes. This is due to the fact that these equations do not take into account the final (non-zero) local thermal relaxation time in the material propagation medium. In these equations, the process of heat transfer is considered as a transition between very small model cells, each of which is always in equilibrium state. If this assumption is corrected, then the solution of the exact equations of thermodynamics leads to the possibility of the existence of undamped thermal (temperature) waves that can be generated and propagated over long distances only at certain frequencies $\omega_n = (n + 1)\pi/\tau$ (τ - local relaxation time, n = 0,1,2,...). For air, the minimum frequency of such waves depends on pressure and temperature and lies in the interval 75-85 MHz. We have carried out many experiments on the generation of such waves in air during cavitation of a water jet in a closed chamber. The pulses generated during cavitation formed very short shock waves in the volume of the outlet wall of the cavitation chamber, which generated very short thermal pulses at the outer boundary of this wall. The action of these pulses leads to at least two important processes.

The first one is associated with the ionization and excitation of atoms on the outer surface, which leads to generation of X-ray radiation in the space near this surface. The other process is associated with the generation of the undamped temperature waves in air.

The action of these waves on a remote target leads to the generation of shock waves in its volume, which stimulate the formation of coherent correlated states of impurity particles (in particular, deuterium nuclei in the TiD target) during structural and topological processes in the target lattice and the subsequent generation of very large energy fluctuations. This process leads to generation of alpha-particles in effective LENRs $d + d = He^3 + n$, He^4.

We have shown for the first time that the presence of an additional thick metal screen in the path of thermal wave propagation does not worsen the LENR process in distant targets. Such a screen effectively converts the initial thermal undamped wave into an acoustic shock wave, and then into a secondary undamped thermal wave. Such a mechanism makes it possible to implement an effective LENR in a closed distant chamber using a source of undamped thermal waves.

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John Wallace[a] and Michael Wallace[b]
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LENR is essentially a nuclear problem of trying to understand nuclear binding. An understanding of nuclear binding has not progressed much since the end of World War II because of experimental difficulties and misleading theories that evolved from quantum electrodynamics, which was a flawed approach of making small corrections to the results of the Schrödinger and Dirac equations. The basic flaws in theory were a fixation on point particles that ensured relativity was not properly integrated into quantum mechanics coupled with explaining bosons with the Klein-Gordon equation that does not satisfy energy conservation. These mistakes led to a plethora of models: electro-weak theory, Standard Model of particles, QCD, gauge theories, super symmetry and string theories that did not aid in understanding basic nuclear processes. These models evolved trying to explain high energy experiments while ignoring low energy processes. They failed because the form of quantum mechanics they incorporated was not on a firm foundation with either relativity or energy conservation.[1]

The general bound state problem is not simple[2] nor easy to investigate in the nucleus. In following up Mitch Swartz's work on monitoring RF fields during LENR, we acquired some equipment to do this work with deuterium. While learning how to use the software defined receivers we checked hydrogen properties at higher frequencies and made an interesting discovery about bound atomic hydrogen. Normally atomic hydrogen is nearly a completely transparent and inert medium, however, we were surprised to detect the very improbable triplet to singlet transitions in bands with little difficulty when we tuned our receiver to look for sharp emission in the 1400 MHz region, a region where transmissions are prohibited. There is a natural source of protons that are driven into our atmosphere by solar radiation and these will bond to water vapor, forming H_3O^+ and other more complex arrangements.[3] These signals raised a number of questions, the first being why should a bound proton be an extremely active radiation source? It was like having a hydrogen atom welded to a high gain antenna that activated the normally glacial magnetic triplet to singlet transition. In its bound molecular states the essential atomic behavior of the hydrogen was not well disguised; it retained its essential character much like the nucleons in the nucleus, while altering its energy slightly to complete its bonding. The change in local electron density shows up in a small downward shift in the transition frequency from 1420.4 MHz to 1380-1420 MHz with many thousand possible rotational and vibrational states now available to the bound hydrogen atom.

The bonding mechanism was simple polarization producing a dipole moment that made the bound state very active in absorbing and emitting low frequency radiation and populating the now available rotational and vibrational states. These states were pumped from a strong source, presumably the triplet to singlet transition of the ground state from the vast amount of water vapor in the atmosphere at approximately 1399.997 MHz. By making a weakly interacting state a strongly interacting state by polarization, such a process may be repeated in the nucleus. Neutrons have both a positive and negative charge distribution with a net zero charge.[1] This is a very different form of polarization compared to what happens to atomic hydrogen[4] driven by the screening fields acting radially on the neutrons during the fusion process. This degree of freedom has not been properly explored.

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Hang Zhang and Si Chen
Qiuran Lab / China

Qiuran Lab is a private independent lab founded by Hang

Zhang in 2015, in Xi'an City, Shaan Xi Province, China. The mission of Qiuran Lab is to investigate and ultimately commercialize the excess heat or other phenomena which may be related to cold fusion or condensed matter nuclear reaction.

Hang Zhang serves as the lab chief and principle experimental scientist, while Dr. Si Chen serves as a data analyst and scientific writer.

At Qiuran Lab, we first developed a reaction vessel and a calorimetric system, which consists of multiple calorimeters, including: thermometric, air-flow, circulating water and Seebeck. Later on we employed the reaction vessel and calorimetric system to measure the excess heat of a sequence of experiments, such as nickel powder and lithium-aluminium hydride reaction, nickel-gadolinium alloy and lithium-aluminium hydride reaction, glow discharge of hydrogen-loading metal, and D_2/H_2 reacting with different targets including palladium coated nickel mesh, palladium-nickel alloy, electrified nickel wire, copper-nickel-zirconium alloy, copper-nickel-zirconium-palladium alloy and so on.

This work was presented at the ICCF20 satellite meeting in 2016 (oral presentation), ICCF21 in 2018 (poster presentation), ICCF22 in 2019 (oral presentation) and ICCF23 in 2021 (oral presentation). We also submitted the abstract of our latest of work, "Excess Heat in a $D_2(H_2)$-Ni(Pd) Reaction System with Multiple Oxidation of the Ni-Pd Alloy Powder," to ICCF24.

Qiuran Lab is one of the few labs in China which is actively involved in research and international communications in the field of cold fusion.

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Wu-Shou Zhang
Institute of Chemistry (CAS) / China

Excess heat produced in a Pd-D_2O electrolytic cell was the most prominent phenomenon of cold fusion first announced by Fleischmann and Pons in 1989.[1] After that, many researchers reported excess heat in open and closed Pd-D_2O electrolytic cells with different calorimetry.[2-6] However, there is no complete recipe which can be followed to produce obvious excess heat by a third party group even now. This recipe has been our goal for decades. Some key points we obtained are described here.

The first factor that we found is the temperature increment during electrolysis must be high enough.[7] This means that the most important parameter for a Pd-D system is neither loading ratio of D to Pd as emphasized before[2-4] nor the temperature itself as focused on in recent years.

Another important factor is the pretreatment of Pd cathode before electrolysis.[8,9] We found if a Pd sample is cathodically electrolyzed in D_2SO_4 heavy water solution in open cell for enough time, the solution is dry and temperature is high enough, the Pd cathode will produce excess heat in subsequent electrolysis. This method can improve the reproducibility prominently.

Melvin H. Miles observed clear excess heat in open D_2O electrolytic cells using Pd-B rod cathode and isoperibolic calorimetry.[5] In recent years, we tried to repeat excess heat with Seebeck calorimetry using the cathode provided by Miles. A reflux open-electrolytic cell was designed. The merit of the cell is that the evaporation power of D_2O, P_{vapor}, is a small constant during electrolysis (P_{vapor} = 0.00979I at 25°C) and the calorimetry is more simplified than before.[6] A Pd-B alloy rod (ϕ4.71 mm × 2 cm) was used as cathode. Clear excess heat was observed recently after 18 runs of D_2O electrolysis (0.17 to 0.75 A, 828.5 h totally) over one year. It seems that this Pd-B cathode also needs an activation procedure for production of excess heat.

We found some key factors controlling the production of excess heat in a Pd-D_2O electrolytic system. I am confident that a complete recipe to reproduce excess heat can be accomplished in the near future.

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This experimental update will appear on the *Infinite Energy* website in early August, with full color versions of figures and photos used herein and additional figures and photos by more of the participants, which we did not have space for here. Watch www.infinite-energy.com.