14th International Workshop on Anomalies in Hydrogen Loaded Metals

Abstracts

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Workshop Patrons

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Targosz-Sleczka Enhanced reaction rates for proton induced reactions on natural Li isotopes

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Low energy nuclear reactions are of great importance for the future development of clean, save and very efficient energy sources. Hydrogen loaded metallic structures can play here a crucial role for the advantageous conditions in which the energy can be easily produced at room temperature during nuclear fusion. At very low energies, the electron screening effect causes an exponential like enhancement of the nuclear reaction cross section measured in atomic environments compared to the bare nuclei case. This effect is theoretically well understood and experimentally observed in different fusion reactions occurring in gaseous, liquid and solid media. It could be shown that the main contribution to the screening energies describing reduction of the Coulomb barrier height results from quasi-free metallic electrons and their collective states which increase the effective electron mass. The latter effect depends not only on the environment but also on the atomic numbers of reacting nuclei.

Here, we would like to present new calculations considering the impact of electron screening effect on nuclear reaction rates for proton induced reactions on ^{6}Li and ^{7}Li isotopes in comparison with the deuteron fusion reaction rates in metallic media. These reactions are especially interesting for a low energy study because of their very high S-factors, increasing the probability of the reaction occurring at room temperature. Furthermore, the reaction products are not radioactive, making it excellent candidates for a new energy source. Nuclear reactions in natural Li will be studied next in the accelerator-driven experiments in the Centre for Experimental Physics eLBRUS at the University of Szczecin in the frame of the CleanHME project*.

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Czerski - Theory of the deuteron-deuteron nuclear reactions at very low energies*

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The phenomenon known as "cold fusion", based on the deuteron-deuteron fusion reactions taking place in metallic environments at thermal energies, offers the perspective for a cheap and clean energy source. Apart from poor reproducibility of the relevant experiments, there are still some important theoretical questions that need to be clarified in order to optimize experimental conditions for stable and high energy excess production.

Here, cross-sections of the deuteron-deuteron reactions measured in accelerator experiments at the deuteron energies of several keV on metallic and gaseous targets will be analyzed to show that both the electron screening effect and a hypothetical threshold resonance are responsible for an exponential-like enhancement of the reaction yields for lowering projectile energies. Within the proposed model, angular distributions and the branching ratio of the $^{2}H(d,n)^{3}He$ and $^{2}H(d,p)^{3}H$ reactions could be well described assuming a destructive interference among the 0^{+} threshold resonance and some highly excited resonances in the compound nucleus ^{4}He. On the other hand, the contribution resulting from the electron screening in metallic environments was estimated by comparing experimental and theoretical reaction yields which are in agreement with experimental data obtained for the gaseous target. Furthermore, a strong correlation of the experimental reaction yields with the number of crystal lattice defects in targets was observed, which can be explained by increase of the effective electron mass in the case of a small contamination of the target surface by oxygen and carbon atoms. The latter effect and the threshold resonance component increase the fusion reaction rates extrapolated down to the room temperature by many orders of magnitude additionally and clarify the heat excess production as well as the change of the branching ratios observed in room temperature experiments, offering a simple solution of the cold fusion puzzle.

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Kaczmarski - Latest accelerator-driven experiments on deuteron fusion reactions in Zr at low energies

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Electron screening effect is one of the most important factors that has to be taken into account while choosing materials for cold fusion research. Nuclear reaction rates at room temperature are enhanced by mainly quasi-free electrons lowering Coulomb barrier. Effectiveness of this process vary on the material of the target. Zr was used as the reference material to develop methodology of electron screening energy measurements because of high hydrogen stoichiometry, high stability and relatively low loading time.

Due to vast amount of materials that might display properties desired in scope of cold fusion reactions, it is of most importance to develop a method of fast estimation of the electron screening energy. A new analysis method, based on the experimental yield measurements of the $^{2}H(d,p)^{3}He$ reaction at two different deuteron energies, was established as accurate enough for this purpose using a low-energy accelerator. This enables to determine the screening energy for a given sample relatively quickly and eliminate materials that do not display promising results.

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Biberian - Direct electrical power generation with palladium and iron in a hydrogen atmosphere

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Following the pioneering work of Frank Gordon and Harper Whitehouse on Lattice Energy Conversion, I have duplicated some of their work. By electrodepositing palladium with PdBr2 on a Pd/Ag 2mm in diameter and 10cm long rod, a voltage of several hundred millivolts was generated between the Pd rod and the stainless-steel counter electrode in a hydrogen atmosphere. To increase the current, experiments were performed with palladium deposited on stainless-steel tubes 30mm in diameter and 20cm long, the counter electrode being also a stainless-steel tube 35mm in diameter and 20cm long. Preliminary studies of the voltage measured show that the polarity changes with temperature.

New experiments with iron deposition are underway and the results will be presented at the conference.

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The technology of "fusion diodes" was proposed several years ago to convert the energy of nuclear reactions taking place in condensed matter into electricity.

For 4 years, positive results have been obtained by several teams and patents filed.

The author summarizes this work and presents the results of his replication experiments.

Jacques Ruer
SART VON ROHR

Hydrogen is now considered as a future major vector of energy. Hydrogen can be produced without consumption of fossil fuels by electrolysis provided the electricity is generated by green energies. The electricity might also be produced by LENR reactors. Conventional electrolysers operating at close to ambient temperature have a modest efficiency and energy is lost in the environment. They also require special catalysers made from rare metals. High temperature (HT) electrolysers have a better efficiency but require an input of HT heat to substitute a part of the electricity. This HT heat can be conveniently provided by HT LENR reactors. The coupling of HT LENR reactors and HT electrolysers makes a lot of sense in terms of efficiency and impact on the resources of rare metals. The potential benefits are reviewed.

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Egeli - Design and Operation of Lenr Reactors

George Egely

Contrary to the general belief, LENR phenomenon is much richer than generally expected.

Usually the electrochemical or hot nickel, hydrogen diffusion-based reactors are known. Most of the published test results are from this area. Even in this area there are less commonly known, smart reactor designs, like Matsumoto's flat bottom cathode, light water-based reactors, or Parkhomov's separate heater/diffusion chamber reactors. Some of these reactors are discussed.

The other major group is the dust-based, oscillating plasma reactors. In fact, this is the most important, most frequent form of LENR in nature, because all stars are driven by this method, in the dust corona of all stars. The temperature of the solar corona is over 5 million °C, while the surface of the Sun is a mere 7000 °C.

There are a number of simple reactor designs where this oscillating dusty plasma is an efficient transmutation method.

A major, third group of reactors is driven with quasi-particles, like plasmons, coupled to charge waves in conductors. However, condensed plasmoids, or “exotic vacuum objects” play also a major role. Several forgotten inventions are based on these nearly stable, nearly macroscopic objects. They are generated during spark formations.

A number of research papers address this effect, like that of Matsumoto, J. Dafour, or Adamenko et al.,

Sparks are accepted forms of quasi-particles, but the cause of their stability is unknown. It is due to the unusual concentration of electrons and positive ions why it is capable of catalyzing fusion. These charge formations hide the condensed plasmoids, the LENR catalyzing particles.

A number of interesting reactor designs are based on sparks, including the water-based cars, like Papp's engine, Horvath's engine, etc. A number of such designs will be discussed in the paper.

There may be a fourth reactor group as well based on cavitation, on collapsing, plasma generating bubbles.

The most unusual, unexpected group is the mechanical LENR machines, like Testatika, the Hyde invention, and Godin-Roschin magnetic device based on Searl's invention.

The scope of LENR is much wider than assumed, beyond the wildest dream of researchers. There is one common thread, however, all of them are based on a catalytic process one way or another.

Smith - Anomalous production of electrical energy in room temperature reactors

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Some 200 years ago Edmund Becquerel discovered a new phenomenon, the photo-voltaic effect, a discovery that led eventually to the modern solar panel. A development curve that took 150 years. Towards the end of the 19th century Heinrich Hertz and some contemporaries discovered and studied the photo-electric effect, the liberation of electrons from metal surfaces when exposed to light, and Peltier published his work on thermo-electricity.

Frank Gordon and Harper Whitehouse may have added another new chapter to this story when they discovered and developed a device they call the Lattice Energy Converter (LEC).

Many iterations of the LEC device have demonstrated the spontaneous production of voltage and current for sustained periods. The device offers unusual simplicity and remarkable replicability.

The current ‘best hypothesis’ is that a LEC converts the internal energy of gases like hydrogen or deuterium co-deposited with metals like iron, nickel, or palladium into ionizing radiation of some kind- and thus creates extractable electrical energy. Voltage and current increases with temperature, and the output is similar to that of a nuclear battery but without requiring normally radioactive components. The energy levels produced by the LEC are at present several orders of magnitude below those deemed commercially useful, but, the calculated flux of ionizing radiation necessary to match LEC output using a conventional nuclear battery would require the use of several curies of radi. But as this paper explains, this is not an accepted form of galvanism or a conventional electro-chemical effect, but something different to either.

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Experiments about interaction of deuterium gas with molybdenum specimen giving cold nuclear fusion reaction outcomes have been performed. The results are presented in this paper.

The experiments were performed in vacuum chamber in order precise measurements to be achieved and due to the relatively low concentrations of the interacting gas the amounts of the generated cold nuclear fusion products and of the generated energy (heat) were relatively low. In fact, D_2 gas in environment of H/H_2 gas in the chamber was directed to a specimen of molybdenum placed on sample holder and generations of ^3He, of ^4He and of T (tritium) was observed in all experiments as it was supported by the following facts: *i)* Mass analysis shows relatively high amount of ^3He; *ii)* Mass analysis shows relatively high amount of $^4He/D_2$ and relatively significant amount of ^4HeH that confirms relatively high amount of ^4He; and *iii)* Mass analysis shows relatively high amount of T_2H^+ ion that indicates synthesis of T. Based on the experiments it was concluded that the following cold nuclear fusion reactions have had place:

$D + D \rightarrow {}^3He$ + nuclear products* + energy (1)

$D + D \rightarrow T$ + nuclear products** + energy (2)

$D + D \rightarrow {}^4He$ + energy (3)

It must be noted that the nuclear products* in (1) are different than the nuclear products** in (2). Normally, it could be expected that the nuclear products* contains neutron and nuclear products** contains proton. However, the Authors consider that additional research must be performed in order for a right conclusion to be done.

The temperature of the molybdenum specimen was initially established to be 700^0C by an electrical heater and the temperature was measured during the experiments. It was found that the temperature increases with ~20^0C as result of interaction of the deuterium gas with the specimen. The released average power on the surface of the specimen was 9.31W. The released energy was due to interaction of deuterium gas with the molybdenum specimen as interaction of nitrogen gas with the specimen in the same experimental circumstances didn't cause an energy release.

The external radiation (including gamma rays and neutrons) was measured in all experiments and no increase of the radiation above the normal background was found. Absence of increase of the radiation is due to either: *a)* The low amounts of gases used in all experiments give a radiation, which is very small and cannot be detected by the used devices; or *b)* These is no external radiation at all due to the low kinetic energies of the interacting D nuclei in solids and due to the fact that the released neutrons could be ultra-cold and they may not leave the molybdenum specimen or the chamber. However, the Authors consider that additional experiments must be carried out regarding the neutron release.

The experimental results provided above are explained with a previously developed quantum mechanical theory based on interaction of D 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 as the molybdenum is a solid satisfying these requirements and the released both helium and tritium are having higher concentrations.

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This paper will compare the predictions made by theory against experimental observations. The comparison will include expected interactions of naturally occurring stable isotopes. The concepts considered will include:-

1. Overcoming a Coulomb barrier
2. Electron capture and fusion
3. Fusion of multiple deuterons
4. Deep Dirac Levels
5. Widom Larsen heavy electrons
6. Polyneutron theory
7. Erzion theory

In addition we discuss common constraints that apply to all CMNS models. It is shown that there is no “Cold Fusion” because the expected products of Coulomb barrier penetration are not observed.

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The theoretical understanding of the LENR processes observed for years is extremely complex and requires multi-disciplinary knowledge. The processes seem to involve most of the known interactions, so it seems reasonable to start from Standard Model (SM): SM includes the most knowledge and observations in fundamental physics. In fact, we may have to go even beyond it, i.e. extend it, rather than building simplifying "home-made" theories: in any case, such theories should give at least all the results obtained by SM.

We give a brief reminder of the SM underlying modern physics, and specifically Particle Physics: Universe is made of a small number of basic constituents, "fundamental particles", governed by small number of "forces", or "fundamental interactions", involving associated "mediators". SM was developed on Quantum Mechanics (QM) basis and has been crowned with success by a lot of experimental observations satisfying theoretical predictions, thanks of constant progress of experiment techniques (large accelerators/colliders, super-computers, astrophysical observations...). However, these advances in experimental techniques have also led to emergence of phenomena unexplained by the current theory. These questions lead currently to an intense research "Beyond SM".

Here, we start from the Lagrangian Mechanics (LM), basis of mathematical formalism used in the "canonical" model of particle theory. This leads us to a short reminder of (Classical) Analytical Mechanics (AM), sometimes called Classical Dynamics [1], with the "principle" of *stationary action* and the great importance of *symmetries*. In fact, AM is a gateway to QM, next the QM extension -"2nd quantization"- is a gateway to Quantum Field Theory (QFT).

Our path is as follows:

- Lagrangian Mechanics
- Extension of Lagrangian Mechanics to Classical Field Theory.
- Introduce quantization, leading to QFT [2]: theoretical framework of SM of particles.
- Elements of particular QFTs involved in the three current fundamental interactions of particle physics: electro-magnetic, strong nuclear, weak nuclear, plus some elements on "residual" nuclear interaction, which is not a "fundamental" but a derived interaction.
- Gravitational interaction, modeled by General Relativity [3], is just touched upon as it is not yet unified with the other interactions.
- Finally a non exhaustive overview of puzzles (unexplained phenomena) in SM, as well as more or less successful attempts to solve some of them, in the current experimental research programs.

Is the *cold fusion secret* hidden in these phenomena, requiring completion/revision of some elements of the current SM ?

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Near instant transmutation of Tungsten using Ohmasa Gas

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In the 1910s Irving Langmuir observed large volumes of gas produced in his bulbs during the development of the Tungsten filament lightbulb. In the 1980s, David Hudson saw two thumb sized electrodes disappear in a flash in an electric arc furnace with the emission of radiation that damage glassware. In 1992, Mikhail Solin cited Tungsten as a prime example of a fuel for use in his awarded electric beam coherent nuclear process which he stated lead to wide transmutation and decay of nucleons. In the early 2000s, S. V. Adamenko saw transmutation of Tungsten and other metals in relativistic discharges with the production of unusual radiation. In 2006, Tadahiko Mizuno had a catastrophic event with Tungsten, calculating an energy excess of 800x and the destruction of his glassware. In the 2010s, Simon Brink used capacitor discharges and saw changes in elemental composition. In 2017, the SAFIRE team saw the disappearance in an instant of a Tungsten Langmuir probe.

In 2019, this author tested an advanced form of water gas called Ohmasa Gas in Japan. The thermal temperature of the gas was not more than 135ºC on its own and when interacting with a 2% Thorium doped Tungsten rod, it was well below 1000ºC. Despite this, the Tungsten however started to fume. In further testing, it was shown that the fuming began in seconds and this author captured the emitted particles. All of this was caught on video from multiple angles.

Both the Tungsten rod and captured particles showed transmutations exactly in line with those observed by other parties, with every sample containing Ca. Using the MFMP reaction calculator at nanosoft.co.nz, Ca is one of a pair of nuclides that is the most likely fission product of Tungsten. Moreover, patterns on the rod are similar to those observed by other researchers work such as Takaaki Matsumoto and Ken Shoulders and in other experiments by other third parties such as Alexander Parkhomov analysed by this author.

This paper proposes that the transmutation is initiated by the production of coherent matter structures likely derived from Ohmasa Gas components and principally the OH- radical. This may also account for historical observations by Langmuir, Mizuno and Matsumoto etc.

Ohmasa Gas was also tested with other metals and alloys and produced similar extraordinary transmutations and behaviours. This supports the claimed remediation of radionuclides by Yull Brown in 1980s/1990s. Since Ohmasa Gas can be stored in steel tanks for over a decade and used at will, it would appear to be a path to instant LENR ergo “LENR in a Can”

Collis - Exotic Neutral Particles as a comprehensive explanation for CMNS

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This paper explains anomalies in hydrogen loaded metals in terms of catalytic neutron transfer by Exotic Neutral Particles (ENPs) by making radical innovations to the models of Bazhutov and Fisher, simplifying their assumptions while simultaneously improving the match with observation. It is shown how penetrating radiation is rarely produced and evidence is offered showing new interpretations of $Q/^{4}He$, tritium and neutrons. Excess heat production without penetrating radiation is explained in the Ni/H, Ti/D, Pd/D, Li_2SO_4. Conversely observed radiation from Cl and Rb is explained.

Keywords: Empirical observations, Heat–He correlation, Exotic Neutral Particles

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Mastromatteo - Neutron emission activation in hydrogenated palladium samples

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In numerous experiments with palladium samples in a hydrogen atmosphere it was possible to observe spontaneous episodes of short duration (bursts) of neutron emission. In some cases it has been possible to stimulate this emission by subjecting the sample to a rapid increase in temperature to cause a desorption of hydrogen and coincidentally observe the signal from the neutron detector placed near the reactor containing the sample. (Fig. 1).

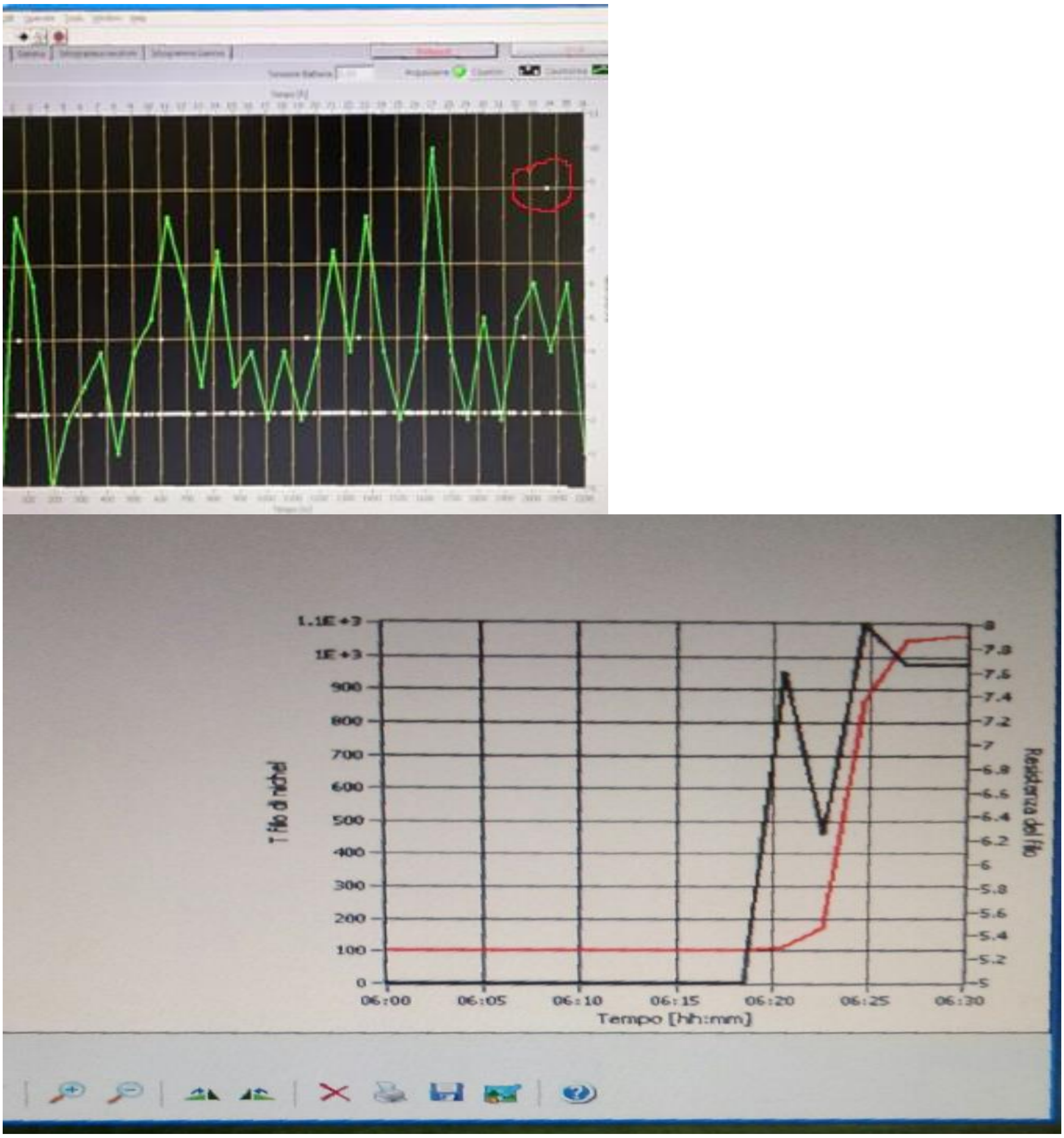

Figure. 1 neutron burst: event probability 1.25×10^{-5}

Celani - First results on wave form and frequency dependence of AHE stimulations of coaxially-coiled constantan wires, under H_2 gas, by High Power-Voltage pulses at High Temperatures.

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In the **LENR-AHE** (Low Energy Nuclear Reactions-Anomalous Heat Effect) project the importance of "***stimulation***" of AHE effects, particularly procedures as simple as possible, are appreciated. Since 2011 we have focused on a specific (old, since 1890) Cu-Ni alloy, named Constantan ($Cu_{55}Ni_{44}Mn_1$), that has the peculiarity of "providing" quite large energy (up to 3 eV) for the dissociation of Hydrogen (and/or Deuterium) from molecular to atomic state (the starting point for any kind of reactions in the LENR field). In comparison Palladium (Pd), the most largely material used, can provide energy of only 0.424 eV. In addition, the cost of Constantan is several thousand times cheaper than Pd (recently 70 €/g): important attributes for any commercial application of the AHE. At the current time, the AHE are quite difficult to be induced and/or reproduced by a third part; moreover, the long-term stability remains an unsolved problem.

Since 2019 we assembled the Constantan, in the shape of long (up to 2 m) and thin (diameters 100-350 μm) wires, as a coil that encircles an inner Fe tube, used as counter-electrode. Geometry overall similar to (niche) both electrolytic systems and/or (old) vacuum tube diodes: ***coaxial*** type. The Constantan wire surfaces are coated, multiple depositions, by mixture of Low Work Function (LWF, i.e. SrO, K) and magnetic Fe_xO_y materials, deposited at sub-micrometric thickness (simple chemical-physical procedures).

In 2019 (ICCF22, air-flow calorimetry) we observed that applying a mild AC excitation (+-600 V, sinusoidal 50 Hz, low current) among the electrodes, covered by thin and partially porous glassy sheaths (holes <100 μm), under proper gas (pure H_2 and/or mixed with Ar, Xe) and low pressures (<100 mbar), it was possible to induce AHE and sustain the useful effects, once started. The effects were larger increasing temperatures (>600 °C) and lowering the pressures (down to few mbar). Such observations were consistent with both LWF materials (active at high temperatures, according to Richardson's formula, i.e. electron emission) and low pressures, where are possible also Paschen/DBD effects (at proper pressure-distance intervals) about gas discharge, with possible surfaces re-activation due to HV transversal pulses. In such conditions H_2 **flux,** in-out from the surface, seemed to be the most important macroscopic parameter to get AHE.

In 2021 (ICCF23), we moved to very high power (up to 10 kV*A/g; minus polarity), short duration (10 μs), few kHz, fast rise and fall time (range between 100 ns and few μs), longitudinal pulses (i.e. along the thin wire coiled). We used a simple "dissipation" calorimeter, i.e. thermometry, where we were able to make only relative measurements in respect to specific reference conditions that we imposed to produce zero AHE. This was necessary because short time scale needed for useful results (<0.5 h) compared to long (6 h) equilibrium time of our flow calorimeter. Our aim was to induce also, *controlled and in-phase*, **Paschen/DBD** regimes by proper unipolar high voltages (over +1000 V) short time pulses with extremely fast rise time (100 ns range), i.e. ***transversal excitation***. To achieve such additional behaviour the pulses were "self-generated", internally to the coil, at the end of main power pulse (typical duration 10 μs, current I tens of A) and, after proper shaping, connected to the Fe counter electrode. We used the fact that the coil is intrinsically inductive with wire surface coated by several layers of magnetic materials (Fe_xO_y) and also the core is a magnetic material (Fe). The voltage generates is: $V=L*dI/dt$ and "used" the fast rise-time (<100 ns) opening of the main switch (SiC technology). At the moment we were not able to exploit all the several possibilities of the system, among others. Richardson and Paschen/DBD regimes, because uncontrolled excessive current during Paschen regime that catastrophically destroyed the thin wires, i.e. local hot-spot problematics.

Recently, by chance, we observed that even the shape of the pulse (i.e. duration, repetition rate) had effects on the values of AHE. The "zero" references were made in DC conditions. We were able to make just one full test, by H_2 at 5 bar. Observed that AHE increased increasing the frequency (1→10 kHz) and reducing the pulse width (10→2.5 μs). The **effects were larger than expected considering just skin effect** (dependence as square-root of frequency). Other tests are in progress: changed gas type (Ar-H_2 mixtures,) to increase internal temperatures; improved the performances of the system coil-pulser, to explore new HF effects, if any.

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ABSTRACT

TeraHertz phonons are produced in solids and fluids by mechanical instabilities at the nano-scale (fracture and cavitation). They present a frequency that is close to the resonance frequency of the atomic lattices and an energy that is close to that of thermal neutrons. A series of fracture experiments on natural rocks and the systematic monitoring of seismic events have demonstrated that TeraHertz phonons are able to induce fission reactions on medium-weight elements (in particular, iron and calcium) with neutron and/or alpha particle emissions. The same phenomenon appears to have occurred in several different situations and to explain puzzles related to the history of our planet, like the primordial carbon pollution (and correlated iron depletion) or the ocean formation (and correlated calcium depletion), as well as scientific mysteries, like the so-called cold fusion or the correct radio-carbon dating of organic materials. Very important applications to earthquake precursors, climate change, and energy production are likely to develop in the next future.

Regarding cold fusion, despite the great amount of experimental results, the comprehension of these phenomena still remains unsatisfactory. On the other hand, as reported by most of the articles devoted to cold fusion, one of the principal features is the appearance of micro-cracks on the electrode surfaces after the experiment. A mechanical explanation is proposed as a consequence of hydrogen embrittlement of the electrodes during electrolysis. Electrolytic tests were conducted using Pd and Ni electrodes. Relevant compositional changes and the appearance of ligther elements previously absent were observed. The most relevant process emerging from the experiments is the primary fission of palladium (decrement of 30%) into iron and calcium. Then, secondary fissions appear in turn producing oxygen atoms, alpha particles, and neutrons. The chemical composition changes were confirmed by four repetitions of the same experiment. An extensive evaluation of the heat generation was carried out showing a positive energy balance in correspondence to the major neutron emission peaks.

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And their possible role in making 'Strange Radiation' tracks

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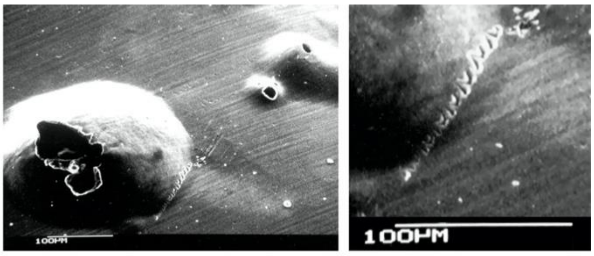
In collaboration with experimentalists in Europe and North America, a series of repeatable observations, video recorded in some cases from multiple angles, appear to show beams that would account for all of the historical structures and behaviours that have been seen indelibly marked onto witness materials in LENR reactors since at least 1992, when they were first noted (not named) in Mikhail Solin's awarded coherent matter based nuclear reactor patent.

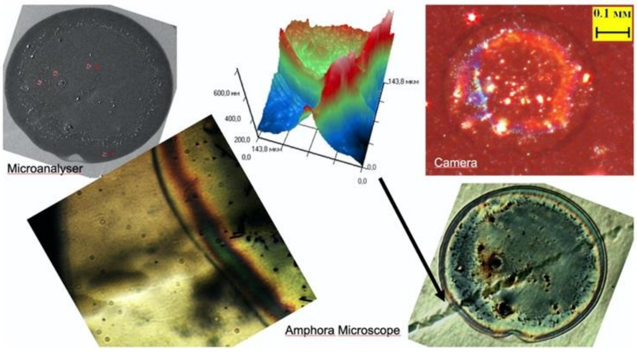
Given the name 'Strange Radiation' by Leonid Urutskoev at the turn of the millennia, they exhibit a wide array of forms, often periodic with an ability to remove large volumes of material as well as split, orbit and change direction in an instant. A comparison of historically observed structures and behaviours will be shown against video recordings, made using consumer phone cameras, of what appears to be coherent matter travelling wave beams, generated in a simple and affordable plasma discharge chamber built largely from scrap metals and electrical apparatus.

EXAMPLE 1 – Produced beam vs Ken Shoulder's witness mark on Aluminium foil (on SiC)



In the above scanning electron microscope image from "**EVO PROPULSION BASIS**" by Ken Shoulders, we can see domes made in an aluminium coating by momentum transfer between EVOs that have travelled first through a thickness of Silicon Carbide. The holes are where the EVO and the entrained atoms burst through. Unnoticed by Ken Shoulders (AFAIK) is a classic "Strange Radiation" track, the form of which could be created by a structure moving in a similar fashion to that seen in the VEGA experiment above.

EXAMPLE 2 – Produced beam vs Dmitry Baranov witness mark on Gold foil (on SiO2)



A **gold plated silicon wafer** witness material showing a similar kind of 'Strange Radiation' track recorded following a bismuth sulphate solution exposure to an electric field. Experiments by the **Russian LENR researcher Dmitry Baranov**

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In our previous works we dramatically improved the accuracy of so called "local relations" (relying on local masses) first pioneered some 50 years ago[1]. From these, global formulas were developed noticing that the best local relations appeared to satisfy a high order differential equation of this form:-

$$\frac{\partial^{p+q} M}{\partial Z^p \partial N^q} = b(-1)^{N+Z} \quad \textit{for some arbitrary constant } b \qquad (1)$$

The right hand side is any two valued odd / even function. p and q are set to 3.

Which has the general solution:-

$$M(N,Z) = f_1(Z) + \ldots + N^{q-1} f_q(Z) + g_1(N) + \ldots + Z^{p-1} g_p(N) + k(-1)^{N+Z} \qquad (2)$$

where f(Z), g(N) are arbitrary functions of their integer arguments, and k is a constant parameter, all determined by least squares regression.

For p=q=3 some 800 parameters would have to be determined (compared with some 2279 observations of experimentally measured atomic masses). In this paper we explore how the number of parameters can be substantially reduced and accuracy of the mass predictions improved. The better RMS errors in the predictions are about 104 keV with 551 parameters.

A major utility of estimating accurate atomic masses is in the simulation of highly neutron rich isotopes in supernova explosions. The described method is suitable for this purpose. The approach can be directly applied to neutron (and proton, alpha) separation energies.

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The case for new elements

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The Structured Atom Model is founded on the intuitive notion, supported by observations, that the atomic nucleus should have structural properties. It is a visual tool that permits understanding of nuclear physics at a detailed level without having to master difficult mathematics. Starting from a few simple assumptions, for example the neutron not being fundamental at the same level as the proton, but a proton-electron combination, we discovered many properties of the nucleus as well as several organizational principles that nature appears to use for constructing the elements. SAM is connected to observation because during its development at every step we checked whether the element configuration that would result was congruent with observed data such as isotope stability and abundance, oxidation state, etc.

In this process we saw a new periodic table of the elements (PTE) come into existence that raises new issues as to the completeness and limits of the current PTE. We have created a new numbering system for the elements which in turn opens space in the periodic table for new elements that nature has skipped over or that we have not found yet. However, those new elements that nature skipped could possibly be created artificially. Most of them will be unstable though.

We will go through our reasoning for the new numbering system and look at the consequences. Among others, this scheme provides an explanation for the double beta decay, why elements have sometimes large steps in number of nucleons between them, and even the neutron/proton ratio of all the elements.

Similarities between binding energy values of chemical elements.

Example of Palladium and Silver

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Several authors predict that α particle structures are present in atomic nuclei. Convincing arguments of such structures are provided by systematics of the binding energy of the even-even nuclei with equal number of protons and neutrons. So, it is to see if this is the case for any nucleus. A first point to consider is the binding energy (EB) of an α particle and its relationship with the binding energies of Deuterium, Tritium and Helium-3. A second point is to see if these EB values play a role in the EB of any nucleus. In other terms, could one determine the EB value of any nucleus on hand of those of α particle, Deuterium, Tritium and Helium-3?

To do so it is to compare as many nuclides as possible. The present study takes the cases of several isotopes of Palladium and Silver in order to look for similarities between them.

The study of the binding energy values of the chemical elements aims at understanding the mechanisms of transmutation and hence the possibility of cold fusion.

The author tries to organize the atomic nucleus in a way similar to Pauling's model of nuclear structure, with some clusters within the nucleus Pauling called Spherons. The sub-nuclei taken into consideration by the author are the α particles and four types of bonds, determined in the following way:

- Deuterium-like bond, called NP with value 2.2246 MeV, linking a neutron of one α particle with a proton of a second α particle, or a neutron or proton outside an α particle to that α particle.
- Tritium-like bond, called NNP with value 8.4818 MeV, linking three nucleons of three different α particles, or one or two nucleons outside an α particle to one or two α particles.
- Helium -3 like bond, called NPP with value 7.718 MeV, having a similar function as NNP.
- A dineutron bond, called NN with value 4.9365 MeV, linking two neutrons not being located within the same α particle. This bond value is deduced from the α particle binding energy.

Keywords: α particle, dineutron (NN), deuterium (NP), tritium (NNP), ^{3}He (NPP).

Guokas - Modeling LENR Chemical Environments by Computational Chemistry

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There have been many studies of experiments with hydrogen or deuterium in metals reporting anomalous reactions, described as LENR. Understanding and optimization of the effect could be improved if testable hypotheses could be found that can account for the many remarkable anomalies. Here chemical conditions associated with the anomalies are modeled using standard ab initio computational chemistry software, so validity of the calculation method is transparent and replicable. We share what has been learned about application of computational chemistry to conditions in LENR environments.

Celani - Clear and simple evidence of correlations among Open Voltage values and AHE in Constantan wires, DC operations under H_2 gas, after long time conditioning at 70 and 100 W of input power.

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In the framework of AHE stimulation in Costantan-H_2 gas system at high temperatures and mild pressure, we compared the values of Anomalous Heat Effects (AHE), if any, after keeping the core of the reactor now operating at INFN-LNF, under long time (36 hours) DC pre-operations at 2 different values of input powers: 70 W and 100 W.

The core is our "standard" geometrical configuration of wire, coaxially coiled with Fe counter electrode: diameter 200 μm, length 158 cm. More details published in several papers, since ICCF22 Conference (September 2019).

Given the wire diameter, geometrical construction of the reactor and its core, gas (H_2) and its pressure (4.8 bar at RT), the measured temperatures of inner core are respectively about 404 °C (at 70 W) and 504 °C (at 100 W) for the "*reference*" measurements at the beginning of the 3 experiments. The current density J flowing inside the wire are respectively 5063 and 6000 A/cm^2.

The wire's surface, according to our standard procedures, is covered by several layers (sub-micrometric thickness) of Low Work Function (LWF) materials (mainly Sr, K) added by Fe and Mn. The wires are put inside "hybrid" Glass-Alumina/Quartz sheaths, impregnated by LWF materials, mainly for electrical insulation purposes.

The sequence of operations is ***very simple***, as following:

a) Make vacuum to the system, applying some current to get an internal core temperature of 400-500 °C, allowing also some H_2 previously stored inside the system/core, to be evacuated.

b) After cooling to RT, add H_2 at proper pressure (4.8 bar) and clean the system by 2 cycles of H_2→Vacuum→H_2. In the mean-time, wait several tens of minutes, at high temperatures (about 500 °C) to allow possible water (produced because H_2 recombined with O_2) to be fully evacuated during vacuum regime.

c) After refilling H_2 at RT, apply, quickly, the largest power compatible with the system under full safety conditions: e.g. 110 W, current about 1.98 A (J=6300 A/cm$^{2)}$; inner core temperature (in our geometrical configurations) reached 533 °C.

d) Wait for thermal stabilization (about 20 m in our system) at high power. Because longer equilibrium time for the first measurement (starting from RT), we waited 60 m to get reliable data and note several cross-reference aspects. Anyway, in the first test, after 30 m from the beginning, the temperatures, both internal and external, were stable.

e) Once thermal equilibrium was reached, note all the proper conditions and **ABRUPTLY** disconnect the DC power supply. Measure, ***immediately*** (<1 s), the spontaneous voltage, called **Open Circuit** (OC), at the ends of the Constant wire (one side grounded): mV range. This is the ***control/correlation parameter*** in such specific test

f) Give again power reducing the intensity, steps of 10 W, up to the minimum of 10 W. For each step wait 30 m to get full equilibrium. Moreover, lowest measurements are made also at 5 W and 0 W, as references. Collect all the intermediate values, after waiting at least 30 m for thermal stabilization. Such are the reference points, to be used as ZERO AHE, for the supposed active regimes in the next steps. In short, we forced the first set of measurements to be the ZERO of the system, even if some AHE could happen.

g) Apply high power, e.g. **70 W for long time** (36 hours).
h) Repeat the procedure of e), increasing, as first measurement, to maximum reference values (i.e. 110)
i) Repeat the procedure of g) applying **100 W**.

Results: it was clear observed that the AHE values are related to the OC values, moreover inter-related related to values of high powers pre-treatments. Both values increased when the “conditioning time at high power” was the largest. Measured over 6 W of AHE, in steady conditions.

We note that there is a general increasing of the temperature, due to the conditioning procedure, both internal (the core) and external, used as main control parameter. As a consequence, even if the procedure is very simple, i.e. only thermometry (because the need to perform several measurements in limited amounts of time), the probability of wrong results is unlike.

Such effect clearly showed that the Constantan-H_2 system has some “memory effect” about “conditioning” of the wire in the whole, i.e. bulk and surface. The effect seems to last several hours.

We guess that the return to steady-state conditions, after some out-of-equilibrium forced situation, is the most probable source of AHE, i.e. the ***flux*** of H_2 stored into the inner lattice and/or at the sub-micrometric locations at the surface. Moreover, we can’t exclude that the previous, very long time (weeks) treatments at very high peak power, up to 10 kV*A /g of Constantan used in these tests, facilitated the absorption of H_2 even not under so extreme situations.

The effect of “conditioning” by high power is similar to what we observed in previous experiments after pulsed (few microseconds durations, several kHz of repetition rate) high power conditions (current density up to 35 kA/cm^2) for shorter times (typically 30 minutes), as presented also at ICCF23.

In the present procedure the main advantage is an extremely simple experimental set-up, easy to be reproduced from other Scientists involved in the LENR-AHE field. Moreover, the AHE evaluation in DC conditions is easier understood/evaluated in respect to our more complex calculations under pulsed conditions. Anyway, with pulsed conditions we can reach values of AHE larger in respect to DC polarization.

David J. Nagel

Branching ratios for nuclear reactions are significant for understanding their physics. They might also be practically useful. The relatively simple deuteron-deuteron fusion reaction has been heavily studied both before and after the 1989 beginning of the global study of LENR. The branching ratios for that reaction are very different for the high-energy (hot) fusion and low-energy (LENR) versions of deuteron fusion. The former are well known, but the latter are little known, even after one-third of a century of attention. This paper reviews the status of the study of branching ratios for LENR involving deuteron fusion and other nuclear reactions. The results of the review for deuterium fusion are highly incomplete and unsatisfactory. Potential analytical, experimental and theoretical studies to determine the branching ratios for LENR are suggested.

Grimshaw - Mitigating the Loss of Irreplaceable LENR Research Records

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An initiative is underway to document the records of cold fusion researchers while the information is still available. Now more than 30 years after the 1989 LENR announcement, many of these investigators are leaving the field. Projects under the LENR Research Documentation Initiative (LRDI) generally begin with a site visit where information is collected and interviews are conducted. Provision is made for securing the records, and a project report is prepared. More than 20 projects including over 25 participants and collaborators have been performed. The LRDI includes a major outreach effort to ensure participation and promote the overall standing of cold fusion. Future plans for the initiative call for additional participants and more in depth coverage of research documented in previous projects. An integrated LRDI report including summaries of the individual projects is underway. Documentation of the large body of research is essential both for the LENR field and for humankind generally. Capturing the records enhances the prospects of the field by demonstrating the large amount of the information and the credibility of the researchers. The future of humanity depends on developing an inexhaustible supply of clean and inexpensive energy like cold fusion.

Keywords: LENR Research, Research Documentation, Cold Fusion Records