ICCF25

UNIWERSYTET SZCZECIŃSKI

Book of Abstracts

25th International Conference on Condensed Matter Nuclear Science

AUGUST 27—31, 2023
SZCZECIN, POLAND

ICCF25

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WELCOME WORD

The International Conference on Condensed Matter Nuclear Science has a long history dating back to 1990. The first meeting was held in Salt Lake City, USA. Since then, the location has rotated between Asia, Europe and North America. The most recent ICCF conferences were conducted in Assisi, Italy (2019) ICCF-22, Xiamen, China (2021) ICCF-23 and Mountain View, USA (2022) ICCF-24. The 25th International Conference on Condensed Matter Nuclear Science (ICCF-25) will be organized in Szczecin, Poland during August 27-31, 2023. Szczecin is the largest city of the West Pomerania region of Poland, situated on the Oder river and boasting over a thousand years of history. It is close to the German border (~150 km away from Berlin) and the Bay of Pomerania (~80 km away from the Baltic Sea). The city is abundant in green areas. Its city plan, with avenues and roundabouts, resembles that of Paris, since it was designed by the same architecture, Georges-Eugène Haussmann. The aim of the ICCF-25 is to increase cross-disciplinary discussion and exploration in the field of low-energy nuclear reactions. It will provide a great opportunity to enhance international collaboration in solid-state fusion research by presenting new scientific results, developments and applications that are needed to make the clean energy production become an everyday reality.

ICCF – 25 Committees

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COMMITTEES

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Theresa Benyo, NASA, USA
Francesco Celani, Instituto Nazionale di Fisica Nucleare, Italy
William Collis, International Society for Condensed Matter Nuclear Science, United Kingdom
Konrad Czerski, University of Szczecin, Poland
Lawrence Forsley, NASA, University of Texas, USA
Peter Hagelstein, Massachusetts Institute of Technology, USA
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Jirohta Kasagi, Tohoku University, Japan
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Agata Kowalska, Maritime University of Szczecin, Poland
Natalia Targosz-Sleczka, University of Szczecin, Poland
Mathieu Valat, University of Szczecin, Poland

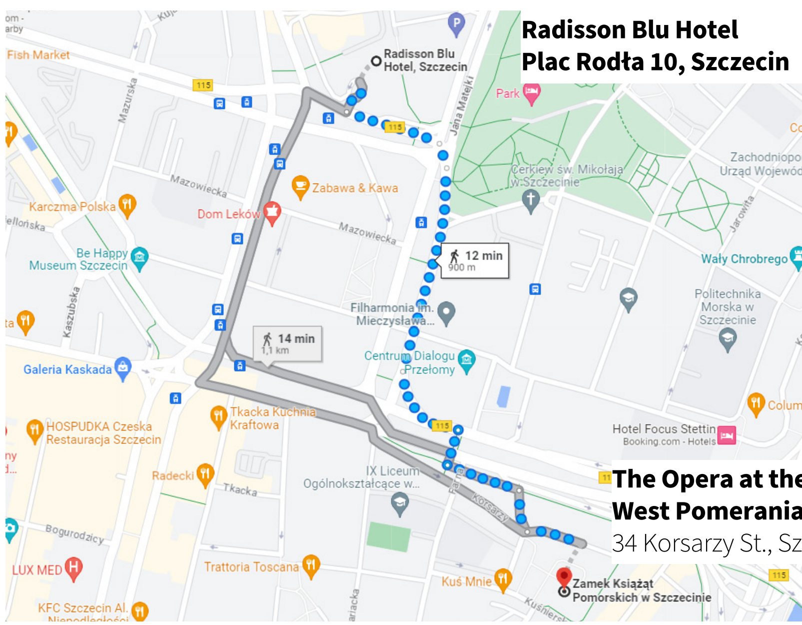
SOCIAL EVENTS

Welcome reception (free and open to all participants)
Date: Sunday, 27 August 2023 | 18.00 – 20.00
Venue: Radisson Blu Hotel, Copernicus Club, 11th floor

Szczecin walking tour
Date: Tuesday, 29 August 2023 | 18:00 - 20:00
Start: main lobby at Radisson Blu Hotel
2 hours walking tour through main tourist attractions of Szczecin

Public lecture
Date: Wednesday, 30 August 2023 | 18.30 – 20.00 (free and open to all participants)
Venue: The Opera at the Castle, Auditorium
[West Pomeranian Dukes' Castle, 34 Korsarzy St., Szczecin]

Conference Dinner
Conference dinner (admission ticket needed; please bring your conference badge to the event as it will constitute an entry permit)
Date: Wednesday, 30 August 2023 | 20.00 – 22.00
Venue: The Opera at the Castle, O. Gallery
[West Pomeranian Dukes' Castle, 34 Korsarzy St., Szczecin]



Radisson Blu Hotel
Plac Rodła 10, Szczecin

The Opera at the Castle,
West Pomeranian Dukes' Castle,
34 Korsarzy St., Szczecin

DETAILED PROGRAMME

Sunday, 27th of August

18:00—20:00	**Welcome Reception** (Copernicus Bar, Radisson Blu, 11th floor)

Monday, 28th of August

CONCERTO I+II+III, 1ST FLOOR

09:00—09:30	**Opening** Konrad Czerski (University of Szczecin, Poland)	
09:30—10:05	Jean-Paul Biberian, VEGATEC, France	*S.1.1 Excess Heat in Nano Particles Based on Hydrotalcites*
10:05—10:30	Jirohta Kasagi, Tohoku University, Japan	*S.1.2 Photon radiation calorimetry for anomalous heat generation in NiCu multilayer thin film during hydrogen gas desorption*
10:30—10:55	Melvin Miles, University of La Verne, USA	*S.1.3 Helium-4 as a Measurement of Excess Power in the Palladium-Deuterium System*
10:55—11:20	Kang Zhou, Zhejiang University, China	*S.1.4 [VIRTUAL] The role and mechanism of anomalous heat generation during earthquakes and its implications for regional geothermal resources*

Coffee Break, 11:20—11:50 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR

11:50—12:15	Francis Tanzella, Energy Research Center LLC, USA	*S.2.1 Total Calorimetry ("from the wall") in a Brillouin Reactor*
12:15—12:40	Takehito Itoh, Tohoku University, Japan	*S.2.2 [VIRTUAL] Photon Radiation Analysis for Spontaneous Heat Burst during Hydrogen Desorption from Nano-sized Metal composite*
12:40—13:05	Mitchell Swartz, JET Energy, Inc., USA	*S.2.3 [VIRTUAL] Road to High Incremental LANR Power Gain*
13:05—13:30	Dimiter Alexandrov, Lakehead University, Canada	*S.2.4 Critical Temperature Required and Experimental Proofs about Cold Nuclear Fusion Reactions in Constantan*

Lunch Break, 13:30——14:30 (Restaurant, ground floor)

CONCERTO I+II+III, 1ST FLOOR		
14:30——14:55	Shinya Narita Iwate University, Japan	*S.3.1 [VIRTUAL] Heat Measurement in Hydrogen Desorption Experiment Using Pd Foil Coated with Ni Membrane*
14:55——15:20	David Nagel George Washington University, USA	*S.3.2 Surprising Correlation between Peaks in LENR Transmutation Data and Deuteron Fusion Screening Data*
15:20——15:45	Vladimir Vysotskii Taras Shevchenko National University of Kyiv, Ukraine	*S.3.3 Stimulation of efficient low energy tritium fusion under the action of a weak undamped thermal wave on remote TiD target*
15:45——16:10	Harishyam Kumar Indian Institute of technology, Kanpur, India	*S.3.4 [VIRTUAL] Low energy nuclear fusion at second order in perturbation theory*

Coffee Break, 16:10——16:40 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR		
16:40——17:05	Florian Metzler Massachusetts Institute of Technology, USA	*S.4.1 Probing neutrons and purported fission daughter products from gas-loaded, laser-irradiated metal-hydrogen targets*
17:05——17:30	Tomotaka Kobayashi Waseda University, Japan	*S.4.2 [VIRTUAL] Anomalous temperature increases in single-component metal powder exposed to pulsed high-pressure hydrogen gas: fundamental experiments for high power focusing engine*
17:30——17:55	Francesco Celani Istituto Nazionale di Fisica Nucleare, Italy	*S.4.3 The role of electric pulse shape on the generation of AHE in surface-modified Constantan, at high temperatures and under Hydrogen or Deuterium gases*

EXTRAORDINARY GENERAL MEETING OF THE ISCMNS (Members only), 18:30——21:00 (Concerto I+II+III, 1st floor)

Tuesday, 29th of August

CONCERTO I+II+III, 1ST FLOOR		
09:00——09:35	Yasuhiro Iwamura Research Center for Electron Photon Science, Tohoku University, Japan	*S.5.1 Elemental analysis and quadrupole mass spectrometry towards the clarification of anomalous heat generation observed in Ni-based nano-multilayer metal composite and hydrogen gas*
09:35——10:00	Lawrence Forsley NASA GRC/GEC/UT Austin, USA	*S.5.2 [VIRTUAL] Plasma-induced electron screening at the Bragg Peak*
10:00——10:25	Sveinn Ólafsson Science Institute University of Iceland, Iceland	*S.5.3 Time of Flight Characterisation of Laser Accelerated Hydrogen Rydberg Matter Absorbed in Tantalum foil*
10:25——10:50	Rakesh Dubey Institute of Physics, University of Szczecin, Szczecin, Poland	*S.5.4 Electron observation benchmarking for solid-state DD fusion experiments at thermal energies*

Coffee Break, 10:50——11:20 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR		
11:20——11:45	Konrad Czerski University of Szczecin, Poland	*S.6.1 Proton induced nuclear reactions at thermal energies*
11:45——12:10	Ali Ihsan Kilic The University of Eskişehir, Faculty of Science, Department of Physics, Turkey	*S.6.2 Resonance structure in 4He showing material dependence of cross section at very low energies*
12:10——12:35	Narayan Behera Centre for Energy Research, SVYASA University, India	*S.6.3 [VIRTUAL] The quantum effects of vacuum polarization can significantly enhance the tunneling probability of deuterium nuclei to form helium nucleus in cold fusion*
12:35——13:00	Philippe Hatt Belgium	*S.6.4 Relationship Between Higgs Boson Mass And Neutron, Proton, And Electron Masses Strong Nuclear Interaction Explanation*

Lunch Break, 13:00——14:00 (Restaurant, ground floor)

CONCERTO I+II+III, 1ST FLOOR		
14:00——14:25	N. Lynn Bowen Colorado Mountain College, USA	*S.7.1 An Examination of LENR Design Improvements, Based on the Recently Gained Understanding of the LENR Mechanism*
14:25——14:50	Andrew Gillespie Texas Tech University, USA	*S.7.2 New Mass Spectrometry, Calorimetry, and Tritium Extraction Instrumentation with Applications to Lattice-Confined Fusion Experiments*
14:50——15:15	Oleksii Ivanchuk Ukraine	*S.7.3 [VIRTUAL] Detection of LENR in Spark Plugs*
15:15——15:40	Gokul Das Haridas Institute of Physics, University of Szczecin, Poland	*S.7.4 Monte Carlo Geant 4 simulation for studying the DD reactions at thermal energies*

Poster Session, 16:00——17:00 (Concerto I+II+III, 1st floor)

Szczecin walking tour,
18:00——20:00

Advisory Committee Dinner (by invitation)
20:30——22:30

Wednesday, 30th of August

CONCERTO I+II+III, 1ST FLOOR		
09:00——09:35	Peter Hagelstein Massachusetts Institute of Technology, USA	*S.8.1 Coherent nuclear dynamics for the nuclear part of LENR models*
09:35——10:00	Xingzhong Li Tsinghua University, China	*S.8.2 [VIRTUAL] A^(1/3)—Law in Nuclear Transmutation of Metal Hydrides (II)*
10:00——10:25	Daniel Szumski USA	*S.8.3 Calibration of an Electrode-Energy Partition Model Using George Miley's Published Data*
10:25——10:50	Diadon Acs LENS Forum, USA	*S.8.4 Utilizing Machine Learning Techniques for In-Depth Investigation of Low Energy Nuclear Reaction (LENR and Lattice-Assisted Nuclear Reactions (LANR)*

Coffee Break, 10:50——11:20 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR		
11:20——11:50	Tieshan Wang School of Nuclear Science and Technology, Lanzhou Univeristy, China	*S.9.1 Sub-Coulomb Barrier Light-Nuclei Fusion in Various Environments*
11:50——12:15	Natalia Targosz-Ślęczka University of Szczecin, Poland	*S.9.2 Nuclear reaction enhancements determined by means of direct and inverse kinematics in metallic environments*
12:15——12:40	Ben Barrowes USArmy CRREL, USA	*S.9.3 Morphological and Elemental Changes of Palladium Immersed in Deuterium under Laser Irradiation*
12:40——13:05	Sadie Forbes MIT, USA	*S.9.4 Low-level energetic ions from TiDx in ion beam experiments*

Lunch Break, 13:05——14:00 (Restaurant, ground floor)

CONCERTO I+II+III, 1ST FLOOR		
14:00—–14:25	Aleksandra Cvetinović JSI, Slovenia	*S.10.1 Electron Screening in Palladium*
14:25—–14:50	Bin-Juine Huang Advanced Thermal Devices (ATD), Inc., Konglin Group, Taiwan	*S.10.2 Anomalous gas emission from low-energy nuclear reaction of water*
14:50—–15:15	Yuta Toba Waseda University, Japan	*S.10.3 [VIRTUAL] Optimization of gas-jet nozzle length for increasing anomalous heat generation due to metal composite nanopowder and hydrogen gas*
15:15—–15:40	Prahlada Ramarao S-VYASA, India	*S.10.4 Exploring the Potential of Low Energy Nuclear Reactions (LENR)*

Coffee Break, 15:40—–16:10 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR		
16:10—–16:35	Anissa Bey Extreme Light Infrastructure - Nuclear Physics (ELI-NP), "Horia Hulubei" National R&D Institute for Physics and Nuclear Engineering (IFIN-HH), Romania	*S.11.1 [VIRTUAL] Towards the Commissioning of a Laser-Electron-Driven Bremsstrahlung Gamma Source for Nuclear Isomer Studies at ELI-NP*
16:35—–17:00	George Egely Egely Ltd., Hungary	*S.11.2 Test results of catalytic fusion*
17:00—–17:25	Sebastian Domoszlai Egely kft., Hungary	*S.11.3 Method for Measuring Input Power in Pulsed Electric Circuits*

Open Lecture "History of the Universe", Krzysztof Meissner
Warsaw University, Poland
18:30—–19:00 (The Auditorium, Opera at the Castel)

Open Lecture "Cold Fusion: Past and Present", Florian Metzler
Massachusetts Institute of Technology, USA
19:00—–19:30 (The Auditorium, Opera at the Castel)

Conference Dinner, 20:00—–22:00 (O. Gallery, Opera at the Castel)

Thursday, 31th of August

CONCERTO I+II+III, 1ST FLOOR		
09:00—–09:35	Theresa Benyo NASA Glenn Research Center, USA	*S.12.1 [VIRTUAL] LENR Products: Lattice Confinement Fusion (LCF), Fission, or Both?*
09:35—–10:00	Edo Kaal Stichting Structured Atom Model, Netherlands	*S.12.2 Fusion and fission in LENR experiments as the underlying mechanism through the lens of the Structured Atom Model*
10:00—–10:25	Shyam Sunder Lakesar Indian Institute of Technology Kanpur, India	*S.12.3 [VIRTUAL] Reliability of EDS when checking for transmutations*
10:25—–10:50	Vladislav Zhigalov Satbayev University, Kazakhstan	*S.12.4 The movement of solid particles on the surface forms tracks of strange radiation*

Coffee Break, 10:50—–11:20 (Foyer, 1st floor)

CONCERTO I+II+III, 1ST FLOOR		
11:20—–11:45	Steven Krivit New Energy Times	*S.13.1 A Basic Introduction to the Widom-Larsen Theory*
11:45—–12:10	Frank Gordon Inovl, Inc., USA	*S.13.2 Scaling up the Lattice Energy Converter (LEC) power output*
12:10—–12:35	Robert Christian USA	*S.13.3 Making CMNS Mainstream*
12:35—–13:00	Robert Greenyer Martin Fleischmann Memorial Project, United Kingdom	*S.13.4 Practical Applications of the Fractal Toroidal Moment*

Lunch Break, 13:00—–14:00 (Restaurant, ground floor)

CONCERTO I+II+III, 1ST FLOOR		
14:00——14:25	Thomas Grimshaw LENRGY, LLC, USA	*S.14.1 The Role of Cold Fusion in Securing the Habitability of the Earth*
14:25——14:50	Stephen Bannister University of Utah, USA	*S.14.2 On the edge of a revolution*
14:50——15:15	Jacques Ruer SFSNMC, France	*S.14.3 Energy for mankind in the next centuries - A role for LENR*

Coffee Break, 15:40——16:10 (Foyer, 1st floor)

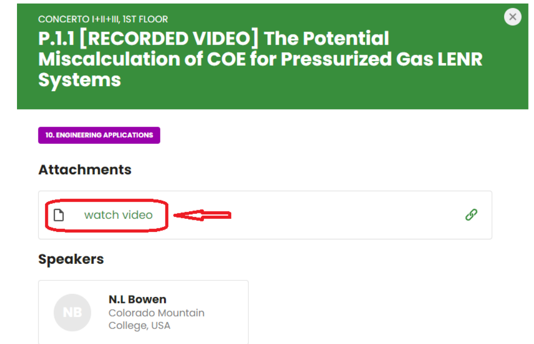
CONCERTO I+II+III, 1ST FLOOR		
16:10——16:35	Maurizio Maggiore European Commission, Brussels, Belgium	*EU support of cold fusion research and other international projects*
16:35——17:00		*Discussion and Closing ceremony*

Visiting eLBRUS Laboratory of University of Szczecin
18:00——19:00

POSTERS

IMPORTANT NOTE ON POSTER SESSIONS

There will be 1 poster session during the ICCF-25 Conference on Tuesday 29 August 2023. In this hybrid event, poster session will include onsite as well as virtual posters. All will be presented on 5-minute videos with a poster presentation together with a audio-video narration of an author. You will be able to watch this recorded poster presentation at https://iccf25.com/live-schedule at the timeslot provided for a poster session. To watch the video of a chosen poster simply click on the tile with a poster of your interest to open the file.



Onsite posters will be additionally presented at the conference venue as printed versions.

TUESDAY, 29TH AUGUST

Poster Session, 16:00——17:00 (Concerto I+II+III, 1st floor)

Poster 1	N. Lynn Bowen Colorado Mountain College, USA	*[ONSITE + RECORDED VIDEO] The Potential Miscalculation of COE for Pressurized Gas LENR Systems*
Poster 2	Mitchell Swartz JET Energy, Inc., USA	*[RECORDED VIDEO] Encoding Qubits using the Anti-Stokes Peak From a Working CF/LANR Nanomaterial System*
Poster 3	Heinz B. Winzeler Switzerland	*[ONSITE + RECORDED VIDEO] Inductively activated LENR reactor*
Poster 5	Jonah Messinger University of Cambridge and Anthropocene Institute, United Kingdom	*[ONSITE + RECORDED VIDEO] A curated website resource for LENR*
Poster 6	Gennadiy Tarassenko Caspian State University of Technology and Engineering, Kazakhstan	*[ONSITE + RECORDED VIDEO] Seismic data on cold nuclear fusion*

Poster 7	Vladimir Vysotskii Taras Shevchenko National University of Kyiv, Ukraine	*[ONSITE + RECORDED VIDEO] The use of graphene for controlled LENR in thin conductive targets by optimize low-voltage corona discharge*
Poster 8	Wiktor Parol Institute of Nuclear Physics Polish Academy of Science, Poland	*[ONSITE + RECORDED VIDEO] Beam energy distribution measurement implemented via time-of-flight method*
Poster 9	David Nagel George Washington University, USA	*[ONSITE + RECORDED VIDEO] Does ElectroMigration Enable LENR?*
Poster 10	Kimmo Pyyhtiä University of Turku, Finland	*[ONSITE + RECORDED VIDEO] Investigation of energetic particle generation in Pd/D co-deposition*
Poster 11	Hang Zhang Qiuran Lab, China	*[RECORDED VIDEO] Progress of Reproducing the Lattice Energy Converter Experiment in Qiuran Lab*
Poster 12	Jacques Ruer Sart von Rohr, France	*[ONSITE + RECORDED VIDEO] Electrical resistivity of powders at high temperature in a hydrogen atmosphere*
Poster 14	Mathieu Valat Institute of Physics, University of Szczecin, Poland	*[ONSITE + RECORDED VIDEO] New Gas-Loading System in eLBRUS-Labs: Studying Nuclear Reactions at Thermal Energies*
Poster 15	Gennadiy Tarassenko Caspian State University of Technology and Engineering, Kazakhstan	*[ONSITE + RECORDED VIDEO] Pulsed high-voltage cold fusion reactor in the Earth's crust*
Poster 16	Mateusz Kaczmarski University of Szczecin, Poland	*[ONSITE + RECORDED VIDEO] University of Szczecin accelerator system for low energy fusion reactions*
Poster 17	Annette Sobel Texas Tech University, USA	*[RECORDED VIDEO] Identifying neutron irradiation in space to mitigate bio-medical effects*
Poster 18	Nicolas Armanet i2-HMR, France	*[ONSITE + RECORDED VIDEO] Successful and unsuccessful high-pressure attempts to synthesize PdH(D)x>1.0*
Poster 19	Jonah Messinger Cavendish Laboratory of Physics, University of Cambridge, United Kingdom	*[ONSITE + RECORDED VIDEO] Developing methods for characterising elemental anomalies and quantifying isotopic ratios in out-of-equilibrium metal hydrides*
Poster 20	Wu-Shou Zhang State Key Laboratory of NBC protection for Civilian, China	*[RECORDED VIDEO] Refinement process and mechanism of nano-Cu-Ni-Zr alloy by high-energy ball milling*
Poster 21	Arayik Danghyan Exhlab, USA	*[ONSITE + RECORDED VIDEO] Hydrogen Atom and Low-Energy Nuclear Fusion (LENR)*
Poster 22	Jozsef Garai Hungary	*[ONSITE + RECORDED VIDEO] Possible Physical Explanation for Lattice Confinement Fusion*

Poster 23	Philippe Hatt Belgium	*[ONSITE + RECORDED VIDEO] Higgs Boson mass and neutron, proton masses*
Poster 24	Aleksandr Nikitin Germany	*[RECORDED VIDEO] Low-Energy Cold Fusion Chain Reaction (LENR) is a new source of carbon-free energy*
Poster 25	N.L. Bowen Colorado Mountain College, USA	*[ONSITE + RECORDED VIDEO] The Electromagnetic Considerations of the Nuclear Force Part IV: The Electromagnetic Behavior of the Nuclear Force for the Smaller Nuclides*
Poster 26	Jozsef Garai Hungary	*[ONSITE + RECORDED VIDEO] The Phase Transformation of the Electrons and the Structure of the Atoms*
Poster 27	Sveinn Ólafsson Science Institute University of Iceland, Iceland	*[ONSITE + RECORDED VIDEO] Nature of spontaneous signal and detection of radiation emitted from Hydrogen Rydberg Matter*
Poster 28	Daniel Szumski USA	*[ONSITE + RECORDED VIDEO] Calibration of an Electrode-Energy Partition Model Using George Miley's Published Data*
Poster 29	Agata Kowalska Maritime University of Szczecin, Poland	*[ONSITE + RECORDED VIDEO] Local crystal structure of deuteron implanted Zr samples relevant to LENR*
Poster 30	Ali Ihsan Kilic The University of Eskişehir, Faculty of Science, Department of Physics, Turkey	*[ONSITE + RECORDED VIDEO] Low energy nuclear reactions in the metallic mesh wires*
Poster 31	Guido Parchi FutureOn Srl, Italy	*[ONSITE + RECORDED VIDEO] Detection of high-density states of hydrogen isotopes via ion beam acceleration against catalytic targets*
Poster 32	Steven B. Krivit Publisher, New Energy Times, USA	*[ONSITE + RECORDED VIDEO] Confirmation of Anomalous-Heat Report*

OVERVIEW OF ABSTRACTS

Monday

August **28th**

Excess Heat in Nano Particles Based on Hydrotalcites

Jean-Paul Biberian1, Robert Michel1, Christophe Le Roux2, Mathieu Valat3,
Sébastien Bucher4, Arnaud Kodeck5, Jacques Ruer6, Cyril Calatrava6
1VEGATEC, France 2CNRS France, 3Institute of physics, University of Szczecin, Poland,
4LIFCO France,
5 Lakoco, Belgium, 6Sart von Rohr

Following the work presented at the ICCF24 conference (1), we have continued our work on nanoparticles of nickel-based alloys, and transition metals deposited on various substrates. The experiments are now conducted in two heat flow calorimeters capable of operating from room temperature up to 1000°C at low electrical input power, with a sensitivity of 100mW in the full temperature range. A new air-flow calorimeter (2) is now in operation which can load up to 300g of powder. The reactor is a 30 cm by 3.5 cm in diameter stainless steel tube where the powder is placed. Hydrogen is introduced on one side of the cylinder and pumped out from the other side. This enables to have a continuous flow of hydrogen which will first decarbonate the sample and reduce the metal oxides, and then will permit absorption of hydrogen inside the metal nanoparticles. To lower the necessary input power, the metal tube is heated from the outside and covered by an insulating material.

The nanomaterials are produced starting from hydrotalcites where the magnesium atoms are replaced by transition metal atoms. This unique method of manufacturing nanoparticles in a matrix made of alumina is very promising for industrial applications since it is very cheap, the main materials utilized are nickel, copper, other transition metals and aluminum. Moreover, the excess heat is obtained in a hydrogen atmosphere. A new reactor is being developed capable of using 1kg of powder so that the coefficient of performance of the system will be high, and close to a demonstrator device.

In this presentation, we will show the latest's results both positive and negative obtained by the two calorimeters. We will show that more excess heat is produced when the hydrogen is pumped out of the cell. This indicates that some active sites within the nano particles keep some hydrogen that trigger the reaction.

[1] J.P. Biberian, R. Michel, C. Le Roux, Mathieu Valat, Sébastien Bucher, Arnaud Kodeck, Bo Hoïstad, P.J.R. Söberg, J. Ruer to be published in the proceedings of the Journal of Condensed Matter Nuclear Science
[2] J. Ruer J. Condensed Matter Nucl. Sci. Vol.33 (2020) pp. 252–267.

This project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement no 951974. This work reflects only the authors view and the European Commission is not responsible for any use that may be made of the information it contains.

Photon radiation calorimetry for anomalous heat generation in NiCu multilayer thin film during hydrogen gas desorption

#J. Kasagi [1], T. Itoh [1,2], Y. Shibasaki [2], T. Takahashi [2], S. Yamauchi [2], Y. Iwamura [1]
[1] Research Center for Electron Photon Science, Tohoku University, Japan
[2] Clean Planet Inc., Japan
Email: kasagi@lns.tohoku.ac.jp

In order to investigate the anomalous heat effect (AHE) in NiCu multilayer thin film, we have been developing photon radiation calorimetry as reported in ICCF23 and ICCF24 [1]. The calorimetry is intended to obtain radiation heat flow from a metal sample producing anomalous large excess heat. Presently, three types of optical spectrometer are used to cover a wide range of wavelengths; a thermometer TMHK-CLE1350 (wavelength 3-5.5 μm) for mid-IR, an FTIR spectrometer Hamamatsu C15511 (1.5-2.5 μm) for near-IR, and a spectroscope Hamamatsu C10027 (0.3-0.9 μm) for visible light.

The current method of energy generation developed by Tohoku U. and Clean Planet Inc. is as follows [2]: H_2 or D_2 gas is occluded in a thin film sample, which consists of a multilayer NiCu film deposited on a Ni substrate. After the sample absorbs H_2 (D_2) gas, the chamber containing the sample is evacuated and at the same time the sample is heated up by a heater to about 1000K. Then, the sample starts to produce excess heat during desorption of H_2 (D_2) gas from the sample. Keeping the input power of the heater constant, we measure the excess power. Since the sample is placed in a vacuum (less than 10^{-4} Pa), most of the heat flow from the sample is thermal radiation from the sample together with its holder. Thus, the photon radiation calorimetry is best suited for reliably obtaining the heat generated from a sample placed in a vacuum.

A comparison of radiation spectra measured with the same heater input power (P_{in}) shows the heat generation visually as in Fig. 1, where the radiation intensity ratio, obtained by dividing the radiation spectrum during H_2 desorption by that before H_2 absorbed (without H_2), is plotted as a function of photon energy. It shows that the radiation during H_2 desorption exceeds that without H_2 in all energy range: this clearly indicates excess heat production in the sample due to the presence of H_2. The dashed line is the calculation by the gray-body approximation, T = 890K (emissivity = 0.15) without H_2 and 930K (0.135) with H_2.

We have quantitatively measured the excess heat power by changing the experimental conditions, such as heater input power, elapsed time after desorption, hydrogen/deuterium gas, Cu/Ni ratio and so on. In this report, we discuss the measurement method and show the results of these measurements, in detail.

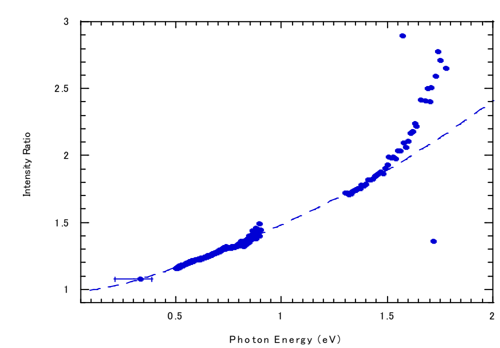


Fig. 1. Ratio of radiation intensity (during H_2 desorption / without H_2) vs photon energy, for P_{in} = 27 W.

[1] T. Itoh et.al, J. Condensed Matter Nucl. Sci. 36 (2022) 274–284
[2] Y. Iwamura, et.al., J. Condensed Matter Nucl. Sci. 33 (2020) 1–13.

Helium-4 as a Measurement of Excess Power in the Palladium-Deuterium System

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It was often noted in many electrochemical experiments on the Pd/D_2O system that the measurements of helium-4 also served as a check on our calorimetry. Recently, an accurate equation was derived that related the He-4 production with the excess power (P_x) and the cell current(I) as shown in Equation 1:

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

where P_x is in Watts and I is in Amps [1]. This equation can readily be rearranged to give the excess power based on the He-4 measurements in ppb.

$$P_x\ (W) = (\text{He-4})\ I / 55.91 \quad (2)$$

However, accurate He-4 measurements are required. For example, at a cell current of 0.500 A, an error of ±5.0 ppb in measurements of He-4 would result in a calorimetric error of ±45 mW, but an error of only ±0.1 ppb He-4 would give a small calorimetric error of only ±0.9 mW.

Some unknown retention of He-4 within the palladium is another significant error source, but based on many experiments, this retention was generally about 20% for our palladium cathodes used. Therefore, an approximate correction would be to simply multiply the measured helium by 1.20.

The use of He-4 as a calorimetric measurement was applied to an experiment were the He-4 measurements were accurate to ±0.1 ppb [1]. The excess power values from Eq. 2 were 0.082 W and 0.053 W for two experiments at I = 0.525 A and 0.043 W for a third experiment at I = 0.500 A. These values are reasonably close to the reported calorimetric measurements of 0.100 W, 0.050 W and 0.020 W [1]. In this example, the check provided by the He-4 measurements suggests a significant error for the 0.020 W calorimetric value, probably because of the neglected work term, $P_w = -RT\ (0.75\ I/F)$, that would add about 0.010 W (a 50% increase) to the 0.020 W calorimetric value.

Other results will be presented, including the collection of gas samples in metal flasks [1]. The Pd-B result is of special interest because the He-4 measured (4.9 ppb) is significantly less than the 13.4 ppb predicted by the calorimetric power of 0.120 W at I = 0.500 A. Perhaps boron atoms in the grain boundaries significantly slow the rate of He-4 escaping from the Pd-B electrode as previously found for the escape of deuterium.

The reasonable agreement for the excess power calculated directly from the He-4 measurements rules out any significant energy carried away from the calorimetric cells by gamma rays or neutrons. These results also show that He-4 is the dominant fusion product in the Pd/D_2O electrochemical system [1].

[1] M.H. Miles in "Cold Fusion: Advances in Condensed Matter Nuclear Science", Jean-Paul Biberian, Editor, Elsevier (2020) pp. 3-15.

The Role and Mechanism of Anomalous Heat Generation During Earthquakes and Its Implications for Regional Geothermal Resources

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For decades, the state-of-art theories and hypothesis failed to explain that, for the interior of our planet as a dissipative system, how strain and thermal energy seemingly to follow a spontaneous pattern within a relatively small region to form seismic disasters. Theory of Isostacy, normal and strike-slip force by impounding reservoir, erosion and deposition, radioactive decay of heavier elements, Earth's rotation and cooling of the Earth Core, the gravitational influence from the other celestial bodies are flawed to form a coherent stress/heat generation mechanism to successfully explain both their spatial temporal distribution and the magnitude of energy released from major intraplate tectonic earthquakes. Our qualitative approach shows that even within the same fault zones localities with abundant geothermal manifestations, including hot spring complex, geothermal gradient anomaly and locations of geothermal power plants, although may frequently bothered by small, or mild seismic events, have much less destructive earthquakes compared to spots with little geothermal resources. Changing normal force upon the crust, such as water impounding of reservoirs, only triggers, in rare occasions, earthquakes with shallower foci and less magnitude. After going over the empirical study made by Jiwen Teng, Dewei Li, Zuoxun Zeng, Jianguo Du, Guanghe Liang certain characteristics other than stress building up and rock slipping, of major earthquakes can be seen. And a reasonable heat genic mechanism is required.

With the pioneering research conducted by Song-sheng Jiang, Wei-Yin Chen, T. Mizuno, Edmund Storms, and other scholars, source cavities of these earthquakes may indicate a few possible scenarios initiating energy surge or energy increase, while depicting profiles of active environment that sustains thermal energy accumulation confined in a source cavity. In particular, the work of Song-sheng Jiang, Edmund Storms and F. J. Mayer gave rise to the postulate that deep in Earth, nuclear reaction may take place due to the formation of nuclear active environment (NAE) resulting in anomalous heat generation. And conditions for such reactions may foster similar processes to occur at shallower depth in source cavities of earthquakes: the deep fractures can serve as conduits for the transportation of species from deep Earth. An enclosed source cavity receives heat-genic substances, forming nuclear active sites generating excess heat on fluid-solid interface within the media, leading to T, P accumulation, and subsequent melting of surrounding rocks (the low velocity zone). Accordingly surge of static electricity replenished from the atmosphere and formation of electron-proton composite (tresinos) and electron clusters stored within the crust, may be correlated to the initiation of low energy nuclear reaction (LENR). Protium and Deuterium may play a role in prolonged thermal energy generation responsible for energy surge in source zone, and electromagnetic/thermal energy supply at the epicenter. Active lava flow on the Moon 2 billion years ago may indicate a similar energy generation mechanism. Finally, based on the field study in Fujian Province, southeast China, a twin relation between seismic events and geothermal energy release was proposed: Geothermal energy resource may bear great potential in understanding, diagnosing earthquake occurrence and even tempering hazardous seismic events by its conversion into a new paradigm of renewable energy.

[1] Qingxiang Z., Dewei L., Shuanggao Z., Wei C., Zhaojun Z. Geological Response Research on the Geothermal Resources and Deep High Temperature Rock Formation of Zhangzhou Basin and the Peripheries, ISBN 978-7-116-11477-7, Geology Press, Beijing(2019), pp. 173

Total Calorimetry ("from the wall") in a Brillouin Reactor

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Brillouin Energy (BEC) has continued performing calorimetry measurements on the metal (*e.g.* Ni)/ceramic/Cu coated ceramic tube (reaction tube) in a H_2 atmosphere with nanosecond pulses applied across the coatings. The Energy Research Center (ERC) has been examining and verifying BEC's calorimetry. Earlier work [1] describes the calorimetry performed on an earlier version of their reactor. Criticism has been levelled that this calorimetry examined only a small portion of the total energy deposited into the reactor. The reactor/calorimeter system has been modified such that all electrical power used to stimulate the system and all thermal power exiting the system are now measured. A block diagram of the system is shown in Figure 1.

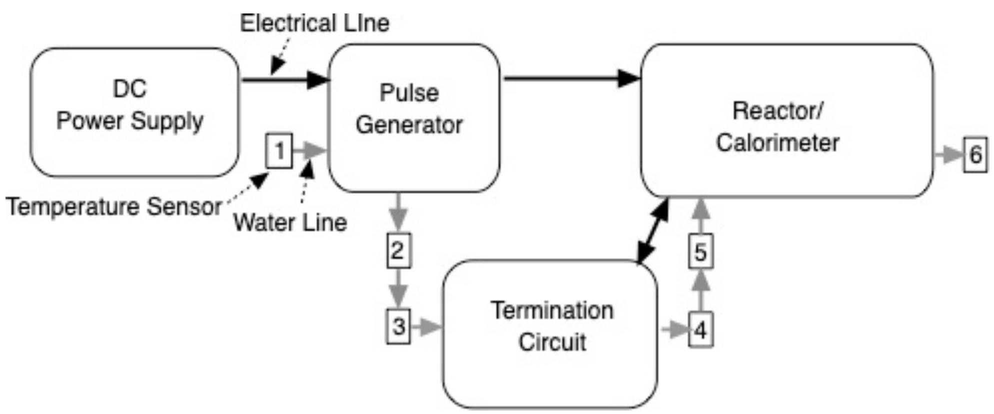

Fig. 1 Block diagram of reactor and calorimeter system

All direct current (DC) power entering the system is measured at the power supply. This DC power is converted to nanosecond (ns) pulses, in the pulse generator [2], which are then applied to one end of the cylindrical reaction tube. This tube is enclosed in a coaxial H_2-containing sheath surrounded by another coaxial water mass flow calorimeter. The other end of the reaction tube is connected to an electrical termination circuit to maximize the pulse power deposited in the reaction tube. Water mass flow calorimeters also encase both the pulse generator and termination circuits to capture the thermal losses from these components. Water flows first through the pulse generator calorimeter to keep those electrical components at near ambient temperatures. The water then flows through the termination electronics and then on to the reactor. Temperatures are measured at the inlet and outlet of each of the component calorimeters. The flow rate is measured before the inlet of the pulse generator reactor where the water is at ambient temperature. The water is then cooled to ambient using a water-air heat exchanger. Results of these measurements under various stimulation conditions will be presented.

[1] R. Godes, R. George, J. Liu and F. Tanzella, J. Condensed Matter Nucl. Sci, vol. 33 (2020) pp. 33-45.
[2] R. Godes, "Drive circuit and method for semiconductor devices", US Patent 8,624,636, 2014

Photon Radiation Analysis for Spontaneous Heat Burst during Hydrogen Desorption from Nano-sized Metal composite

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We have been conducting research on anomalous excess heat (AEH) generation phenomena using hydrogen and nano-sized metal composite. Up to the present, we have observed the AEH that cannot be explained by the chemical reaction [1,2].

The sample used in our experiments is a Cu/Ni/CaO nano-sized multilayer film, which was deposited using magnetron sputtering. We fix the two nano-sized multilayer films on both sides of a ceramic heater in a sample holder installed in the vacuum chamber (Fig 1(a)). After hydrogen absorption into the sample, we heat the samples up and keep the heater input power constant, while evacuating the chamber to release hydrogen from the samples: This induces the AEH generation. In these experiments, we often observed heat burst phenomena, in which the temperature of the heater suddenly rises [2]. Observing this phenomenon in detail is one of the ways to understand the mechanism of the AEH production. In recent experiments, we measured the heater temperature continuously together with the photon radiation emitted from the surface of the sample [3,4]. Attempted was the simultaneous detection of photon radiations when the heat burst occurred. We used FTIR spectrometer for near-IR (1.5-2.5 μm), and a spectroscope for visible light (0.3-0.9 μm), and 2 photodetectors for mid-IR (wavelength 3-5.5 μm). The two mid-infrared photodetectors are placed on both side of the heater so that the radiation from surfaces A and B can be detected simultaneously. As reported in [4], we find that the visible, near-infrared, and mid-infrared radiant intensities increase synchronously with the occurrence of heat bursts.

Fig.1(b) shows an example of heat burst phenomenon. In this experiment, 8 heat bursts were observed, and the emission of mid IR from surfaces A and B increased synchronously with the heater temperature rise. Fig.1(c) is an enlarged view of the second heat burst. There is a sharp rise in radiation at surface A, then the heater temperature increases, and finally the radiation at surface B increases. This suggests that a heat burst occurs on surface A. Furthermore, it should be noticed that the radiation at surface A drops first, several seconds before the burst, and then rapidly increases as the burst. Details of the results and analysis will be reported.

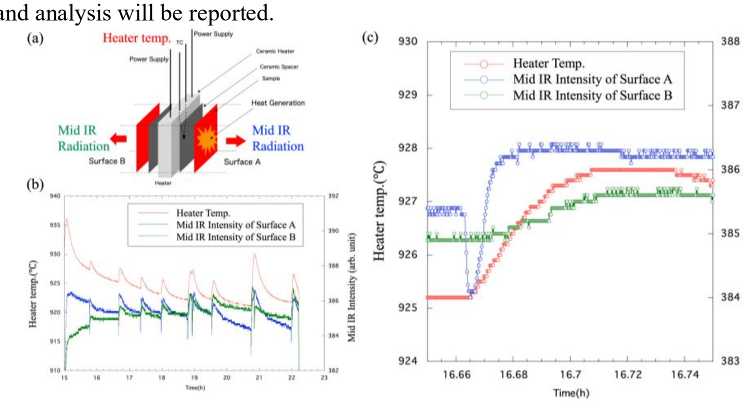

Fig. 1 (a) Schematic diagram of the experiment (b)Time evolution of Heater temperature, mid-infrared intensity (c) Enlarged view of the second heat burst

[1] T. Itoh, et.al., J. Condensed Matter Nucl. Sci. 24 (2017) 179–190.
[2] Y. Iwamura, et.al, J. Condensed Matter Nucl. Sci. 36 (2022) 285–301
[3] T. Itoh et al., Proceedings of the 21st Japan CF Research Society, JCF21, p.15-25.
[4] T. Itoh et.al, J. Condensed Matter Nucl. Sci. 36 (2022) 274–284

Road to High Incremental LANR Power Gain

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Thirty-four years of solid sterling evidence heralds that the excess heat in CF/LANR is very real - and that it results from deuterons as fuel along a nuclear path. Ultimately, however, what is of major importance is: obtaining large values of the actual, desired product. Theories have less importance. Therefore, the keys to the future are the alloy lattice, the incremental excess power gain, and the duration that the excess heat can be continued. In the past, we have shown how to successfully obtain, confirm, and measure excess heat for a number of years. Now, this report is the confirmation of very high achievable LANR incremental power gains. For over three decades, the information is always best shown as follows: first an ohmic control, then the measurement, with inclusion of the integrated energy for both input and output [Figure 1], and the background thermal power. The incremental power gain (proportional to the actual excess heat) of CF/LANR is clearly seen, with much better incremental gain than we saw with the PHUSOR®-type D_2O components in 2003 (ICCF-10 open demonstration - with gains to circa 480% [1]), and better than with NANOR®-type ZrO_2NiPdD components in 2012 (at the MIT IAP Course, then with a gain of only 12x (1200% [2]), later increased to ~80x with magnetic fields (ICCF-14 [3]).

[1] Swartz M. R., Excess Power Gain using High Impedance and Codepositional LANR Devices Monitored by Calorimetry, Heat Flow, and Paired Stirling Engines, *Proc. ICCF14* 1, 123 (2008).
[2] Swartz, M. R., G. Verner, J. Tolleson, P. Hagelstein, Dry, preloaded NANOR®-type CF/LANR components, *Current Science*, 108, 4, 595 (2015).
[3] Swartz M. R., Verner, Hagelstein, P. et al, Amplification and Restoration of Energy Gain Using Fractionated Magnetic Fields, J. Cond.Matter Nucl. Sci. 15, 66 (2015).

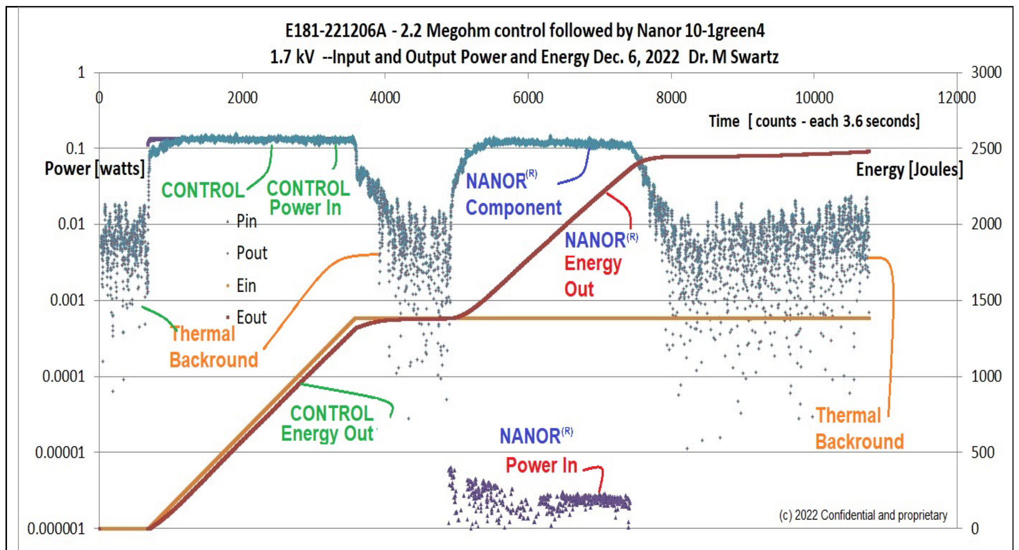

Fig. 1 Input and Output Powers and Energies - The graph shows the response of NANOR®-type Component N10-1G4, and an ohmic control, in Run E181-221206A. The ohmic control was driven prior to the LANR component. The input and output powers are read off the left hand logarithmic values. Note how many orders of magnitude the electrical input to the NANOR®-type component was below the thermal background. Yet even that tiny input has, by LANR, produced very large energies out (right axis) far in excess of the input. The horizontal axis is labelled by counts; with each being 3.6 seconds.

Critical Temperature Required and Experimental Proofs about Cold Nuclear Fusion Reactions in Constantan

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This work is a continuation of the Author's research connected with investigation of interaction of constantan with deuterium gas [1] as the approach described in [2] is applied. Specimens consisting of constantan wires coiled on alumina rods were used in the experiments at different temperatures (T's). Each specimen was placed in a gas chamber, where injection of either nitrogen (N_2) gas or deuterium (D_2) gas having 99.995% purity was performed for each experiment. Experiments about interaction of constantan with N_2 gas only and experiments about interaction of constantan with D_2 gas only as both gasses had room initial T were performed. The purpose of these experiments was that the outcomes of the interaction with D_2 to be distinguished from these with N_2. Both experiments were performed at two T's of the whole specimen measured by a pyrometer – 300^0C and 400^0C. (These T's correspond respectively to 405^0C and 524^0C as T's of the constantan wire heated by external AC current as the wire T's were determined by optical spectral measurements applied to the Stefan-Boltzmann law.) *i)* Regarding the interaction constantan – N_2 gas (Fig.1): step increase of the N_2 pressure was applied at 300^0C (405^0C of the wire) and T decrease was observed because the injected N_2 cooled the specimen. Immediately after that T = 400^0C (524^0C of the wire) of the whole specimen was established and step pressure increase followed immediately by other step pressure increase within the same pressure interval, which was followed by step pressure decrease within the same pressure interval, was applied. More or less cooling of the specimen correlating with the pressure was observed as the T's remain below 400^0C (524^0C of the wire); *ii)* Regarding the interaction constantan – D_2 gas (Fig.2): the same pressure variations at the same T's were applied like those in *i)* as similar temperature behaviour was observed at initial T = 300^0C (405^0C of the wire). However, here increase of the T above the initial T = 400^0C (524^0C of the wire) were observed in the beginning – ~420^0C (548^0C of the wire) – and after that T decrease was observed. The explanation is that cold nuclear fusion (CNF) reaction in the constantan occurred in its interaction with D_2 giving initial T increase followed by T decrease due to both gas saturation in the constantan lowering CNF reaction and cooling caused by the injected D_2 gas.

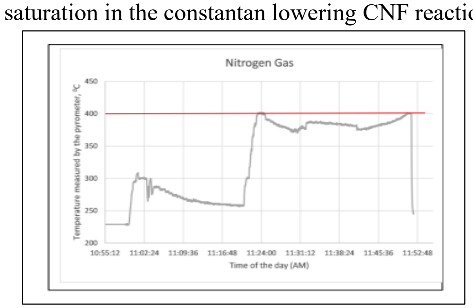

Fig. 1 Interaction constantan - nitrogen gas

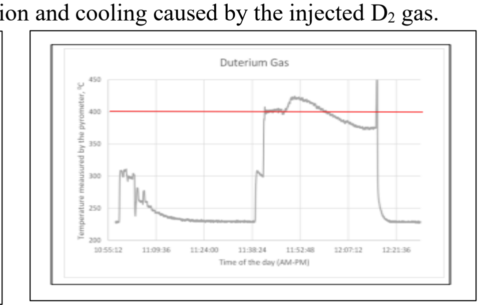

Fig. 2 Interaction constantan - deuterium gas

Other set of experiments with D_2 performed within initial T = 405^0C – 524^0C of the constantan wire show an initial T~496^0C of the wire required (critical T) that CNF reaction to be observed. These experiments obeyed the same experimental scheme described in the above case *ii)* and Fig.2.

[1] D. Alexandrov, 15th International Workshop on Anomalies in Hydrogen Loaded Metals, 25 - 29 September 2022, Assisi, Italy
[2] D. Alexandrov, International Journal of Energy Research, vol. 45, no. 8, (2021) pp. 12234-12246

Heat Measurement in Hydrogen Desorption Experiment Using Pd Foil Coated with Ni Membrane

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It has been reported that excess heat has been observed in hydrogen diffusion process with nano-sized particles or thin multilayer composite of Pd-Ni and Cu-Ni [1,2]. The phenomena observed in those studies are supposed to be related to a low energy nuclear reaction in condensed matter and it is suggested that the sample conditions such as nanostructured-metal and the complex composition might be the keys for inducing the reaction. Considering these results, we have performed a hydrogen desorption experiment using a sample of Pd foil coated with Ni membrane and investigated thermal as well as hydrogen diffusion behaviour.

In the experiment, the sample was fabricated by depositing a thin metal membrane by Ar ion beam sputtering onto one of the surfaces of the Pd foil with the size of 10 mm × 10 mm × 0.1 mm. The thickness of the membrane was ~100 nm. The fine-structured interface was formed by etching the Pd foil surface with an Ar ion beam before depositing the membrane. The fabricated samples were exposed to hydrogen gas at 5 atm for ~24 h for loading. The loading ratios were typically 0.7-0.8. After loading, the sample was placed into a chamber evacuated by a Turbo-Molecular-Pump (~10^{-4} Pa). In the chamber, the sample was heated by applying a direct current at constant power (0.6 W) to stimulate the hydrogen diffusion. The sample temperature and chamber pressure were continuously monitored for ~24 h. A thermo-couple and an infrared thermometer were used for the temperature measurement. The pressure inside the chamber was measured by an ionization gauge. The current and the bias applied to the sample were also recorded during the experiment. In addition, a camera was used to observe the sample referring to earlier report on occurring sample deformation concurrently with heat evolution in desorption experiment [3]. A schematic of the experimental setup is shown in Fig. 1

Figure 2 shows the time dependence of temperature, pressure, and power supplied to the sample in hydrogen desorption process. We observed exothermic phenomenon that continued for about 1 h with fluctuation. In addition, the pressure changed simultaneously with the temperature. This phenomenon happened with high reproducibility within a few hours after the start of the experiment. It may be suggested that the unique conditions of the sample are thought to induce specific hydrogen diffusion, which in turn causes an exothermic reaction. We have estimated the excess power from comparison with the results for unloaded sample, and obtained preliminarily up to a few hundred mW so far. We are continuing the experiments to confirm the heat evolution and to improve the accuracy of the excess heat evaluation.

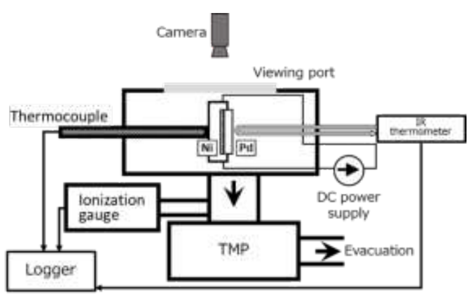

Fig. 1 Schematic of the experimental setup.

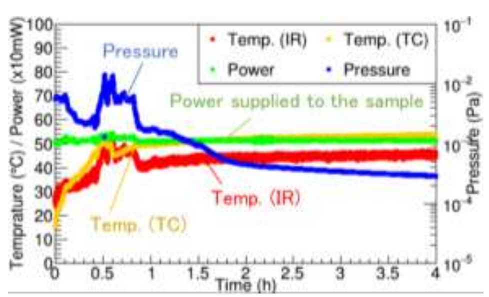

Fig. 2 Time dependence of the temperature, pressure, and voltage in hydrogen desorption

[1] A. Takahashi et al., J. Condensed Matter Nucl. Sci, 33 (2020) pp.14-32.
[2] Y. Iwamura et al., J. Condensed Matter Nucl. Sci, 36 (2022) pp.285-301.
[3] E. Yamaguchi et al., Jpn. J. Appl. Phys., 29 (1990) L666-L669.

Surprising Correlation between Peaks in LENR Transmutation Data and Deuteron Fusion Screening Data

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Over one-third of a century of research on Low Energy Nuclear Reactions (LENR) has produced a remarkable amount of experimental data. Examination of some of that data revealed an unexpected correlation between the transmutation data in Figure 1, and the screening energies from low-beam-energy deuterium fusion data in Figure 2, the peaks of which align with the transmutation data peaks.

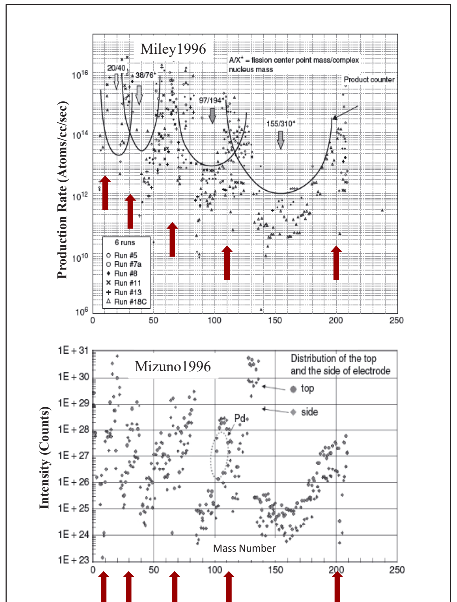

Figure 1. Transmutation data from Miley and Mizuno, both as a function of atomic mass number.

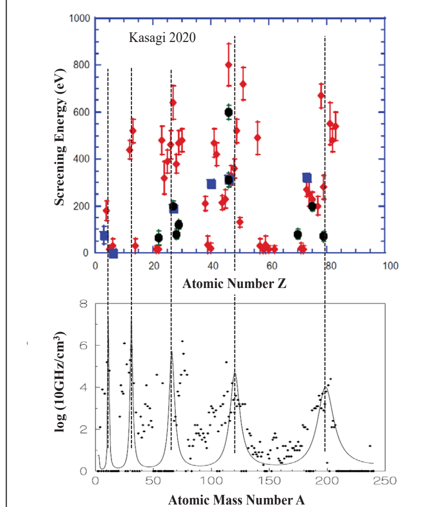

Figure 2. Compilation of D-D fusion screening potential energy data by Kasagi, compared to the Optical Potential Model of Widom and Larsen (solid line) and the transmutation data from Miley (points).

The transmutation data from Miley [1] and Mizuno [2] agree with and validate each other, both peaking at five similar values of atomic mass, as indicated by the arrows in Figure 1. Peaks occur at the same five atomic masses in an Optical Potential Model of neutron absorption by Widom and Larsen [3], as shown in Figure 2. Compilations of electron screening potentials by Czerski [4] and Kasagi [4] have peaks that align with peaks in the transmutation and theoretical data. Potential implications of the peaking of both transmutation and beam fusion data at similar values of atomic mass will be discussed.

[1] G. H. Miley and J.A. Patterson, "Nuclear transmutations in Thin-Film Nickel Coatings Undergoing Electrolysis", Journal of New Energy, vol 1 (3), pp. 5-13 (1996)
[2] T. Mizuno, T. Ohmori, and M. Enyo, "Isotopic Changes of the Reaction Products Induced by Cathodic Electrolysis in Pd", Journal of New Energy, vol. 1(3), pp. 31-45 (1996)
[3] A. Widom and L. Larsen, "Nuclear abundances in metallic hydride electrodes of electrolytic chemical cells", arXiv preprint cond-mat/0602472 (2006)
[4] K. Czerski, "Influence of Crystal Lattice Defects and the Threshold Resonance on the Deuteron-Deuteron Reaction Rates at Room Temperature", presented at ICCF-21 (2018) and J. Kasagi, "Screening Energy for Low Energy Nuclear Reactions in Condensed Matter" in J.-P. Biberian (Editor), *Cold Fusion*, Elsevier (2020)

Stimulation of efficient low energy tritium fusion under the action of a weak undamped thermal wave on remote TiD target

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In our previous cavitation experiments [1], we have investigated low energy *d+d* fusion that was stimulated by the distant action of undamped thermal wave ($\omega \approx 80\,MHz$) and led to the creation and track detector registration of fast α-particles. In the report the results of similar experiments on an alternative $d + d = H^3 + p$ fusion are discussed. In these experiments (Fig.1) we have used *TiD* targets (length - 10 mm, diameter - 7 mm, *D* saturation ~150%) that had been installed at a distance of 20 cm from the source of thermal wave and had been irradiated for 20 and 40 minutes by these waves.

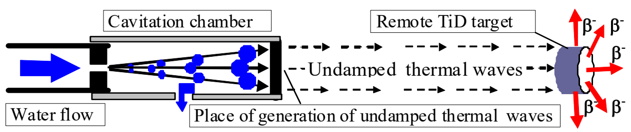

Fig.1. Setup for the generation of undamped thermal waves and stimulation of low energy $d(d,p)H^3$ fusion.

Analysis of the spatial position and activity of the created H^3 nuclei in *TiD* targets was carried out by radioluminescence method 6 months after the targets had been irradiated with a thermal wave. Fig.2 shows two radioluminograms, which are the result of *He-Ne* laser imaging (photostimulated luminescence) of latent images formed in a irradiated by β^- during H^3 decay phosphor plates.

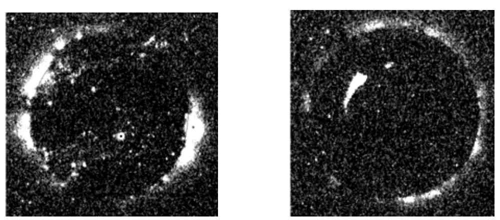

Fig.2. Radioluminograms demonstrating the spatial distribution and concentration of the synthesized H^3 in the target area adjacent to its back surface. The left and right photos correspond to irradiation for 40 and 20 minutes.

These plates were placed near back surfaces of irradiated *TiD* targets for 65 hours. The β^- activity of back surfaces were Q_{40}=163 *Bq* and Q_{20}=46 *Bq*. Calibration and restoration of the original β^- activity of tritium was carried out using the standard Amersham-Typhoon tritium test. From these data it can be concluded that the total number of H^3 nuclei synthesized in the near-surface thin layer of *TiD* targets was $\sim 1.6\times 10^{10}$ (irradiation for 40 minutes) and $\sim 4.6\times 10^9$ (irradiation for 20 minutes). The same H^3 nuclei were synthesized in the entire volume of the target. The specific mechanism of LENR stimulation by weak undamped thermal waves is associated with fast structural changes in the volume of *TiD* target, which form coherent correlated states of H^2 nuclei, leading to the generation of giant energy fluctuations $\delta E \geq 30 - 100\ keV$ of these nuclei and efficient $d(d,p)H^3$ fusion [2,3] in the target.

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Low energy nuclear fusion at second order in perturbation theory

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It has been suggested that low energy nuclear fusion may arise at second order in perturbation theory. At this order there are two interactions, one of which occurs at atomic distances and the second at nuclear distance scales. We refer to the corresponding amplitudes are molecular and nuclear respectively. The first interaction creates a short lived state which get contributions from all energy eigenstates of the unperturbed Hamiltonian. The high energy states have large amplitude for tunnelling through the potential barrier and hence it is possible that the total amplitude for this process may be large.

We assume that a photon is emitted at the first vertex. The important point is that we need to sum over the intermediate states of all energies. Since the initial state has very small energy (Ei) and momentum, the molecular matrix element is appreciable only when the energy of the intermediate state (En) is such that the corresponding momentum ($\vec{P}$n)closely balances the photon momentum $\vec{P}\gamma$. One might expect that the dominant contribution to the entire amplitude would $\vec{P}n \approx \vec{P}\gamma$ with the corresponding energy En >> Ei, there by leading to a rather large amplitude. However, explicit calculations show that this fails. The problem is that here we are dealing with particles in a potential and hence the energy eigenstates are not eigenstates of momentum. Due to this the molecular matrix element does not select a unique value of $\vec{P}$n and a large range of values of Pn = $|\vec{P}n|$ contribute. Explicit calculations show that these cancel among one another leading to a very small amplitude. We investigate this process in detail by using a model potential. We find that if we assume that the process takes place in free space, then the rate is very small. However we find that in a medium, the rate can be quite large and observable.

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Probing neutrons and purported fission daughter products from gas-loaded, laser-irradiated metal-hydrogen targets

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Since 2019, the innovation agency of the US Department of Energy—ARPA-E—has engaged in an effort to review low-energy nuclear reaction (LENR) literature and to identify both the potential of this field and possible roadblocks [1]. This resulted in an assessment that LENR research appears promising but that there is a dearth of carefully documented experimentation with comprehensive characterization of experimental conditions, state-of-the-art detectors, and ample controls. ARPA-E also called for a so-called reference experiment: an experiment that unambiguously points at a nuclear origin of observed effects; that can be reproduced with some degree of reliability; and that ideally matches a theoretical hypothesis.

Our evaluation of the LENR literature led us to conclude that a specific group of experiments may represent a suitable candidate for such a reference experiment: gas-loaded and laser-irradiated palladium-deuterium and titanium-deuterium samples, which have been reported to produce energetic neutrons and/or low-Z elements such as Fe, Ni, and Cr. Here, we briefly review the ARPA-E program requirements and the group of experiments that we identified; we then provide an outline of the corresponding experimental campaign at MIT and at partner organizations. This includes a discussion of the key diagnostics employed in this campaign and of a hypothesis based on coherently-coupled nuclear fusion-fission [2-3] that could explain reported findings and serve as a basis for the refinement and advancement of such experiments.

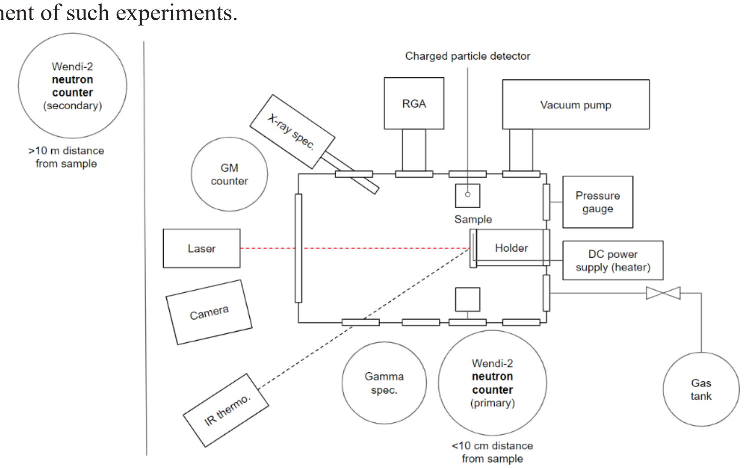

Fig. 1 Proposed experimental platform for prompt detection of LENR nuclear products.

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Anomalous temperature increases in single-component metal powder exposed to pulsed high-pressure hydrogen gas: fundamental experiments for high power focusing engine

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Miley reported anomalous heat in the electrolysis using nickel film (Miley and Patterson, J. New Energy, 1996). Recently, Arata reported anomalous heat generation in the exposure of metal powder (nickel or palladium) to hydrogen (or deuterium) gas (Arata and Zhang, J. High Temp. Soc., 2008) and Kitamura reported anomalous effects in hydrogen (or deuterium) gas absorption by mixed oxides of palladium and zirconium (Kitamura et al., Physics Letters A, 2009).

In a reaction system with a small chamber (Fig. 1), we have conducted some fundamental experiments to evaluate the anomalous heat in the hydrogen gas absorption of metal powder (especially under the rapid pressure increase). Experiments on the absorption of hydrogen gas injected with pulsed flow generated by the solenoid valve into Pd-Ni-Zr composite powder (PNZ10r, provided by Technova Inc.) show temperature increases over 50 K, in cases that under the condition of 240 °C of initial temperature and over 0.8 MPaG of the hydrogen gas pressure (Kobayashi et al., ICCF-24, 2022, Kobayashi et al., JCF23, 2023, Kobayashi et al., J. Condensed Matter Nucl. Sci., 2022). A K-type thermocouple is employed to measure temperature increases inside the composite powder.

In this report, we measure temperature increases of Cu particles by using another temperature sensor, which is of type of noncontact thermometer. As a result, we got a possibility that more temperature rise is observed. This leads to a large possibility of a focusing engine having high power beyond chemical reactions such as combustion if the new focusing engine leads to stable pressure over 5MPa (Fig2.).

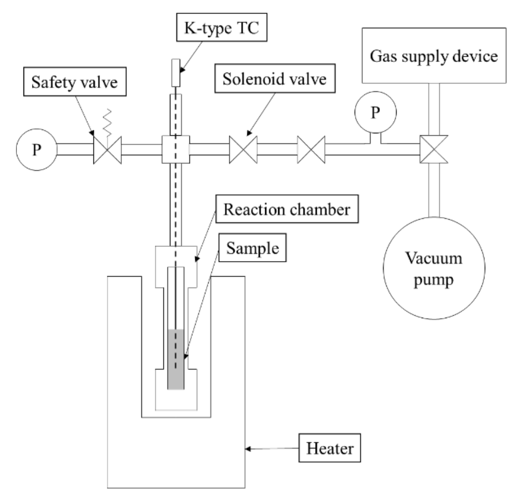

Fig. 1. Reaction system for experiments with low-pressure hydrogen gas

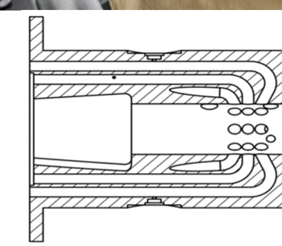

Fig. 2. Focusing compression engine

The role of electric pulse shape on the generation of AHE in surface-modified Constantan, at high temperatures and under Hydrogen or Deuterium gases

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Since 1994 we observed that negative unipolar pulsing (in respect to usual DC polarization; electrolytic environment by D_2O) had useful effects about the generation of AHE when proper materials (Pd, Pd-Y alloys) were used and the surface/bulk of active material (plates, wires) got some peculiar conditions. Anyway, the effects where (usually) modest, although of Scientific interest: mainly because the intrinsic limits of electrolytic set-up: maximum solution temperature, of the usual LiOD-D_2O, about 100 °C at 1 bar of pressure. Moreover, complexity of specific pulser (homemade; fast pulse's duration of 1-5 µs, peak current up to 200 A) hindered replications by other Researchers.

Recently, we decided to make new experiments using again pulse approach. Used the cost-effective Constantan (by us introduced since 2011 in the LENR field, price 100 times lower then Pd), long and thin wires shaped (similarly to previous Pd). Moreover, because gas environments (H_2, D_2; pure or mixed with low thermal-conductive gas Ar or Xe), we were able to operate at local wire's temperature up to 850 °C with evident advantages (Carnot limit) about excess energy (if any) recovered at the reactor's external surface (up to 350 °C, using typical thick-glass reactor; higher using SS tubes).

Moreover, we tried to use simplified circuitry for pulsing, in respect to previous one. Now we used just the 50 Hz line, properly shaped by fast/high power diodes. Moreover, because intrinsic experimental constrains (i.e., negative capacitive discharge), we never were able in the past to make comparison using positive or bipolar waves, apart the DC conditions (positive or negative) in respect to the counter electrode (reverse coaxial geometry).

Recent results and experimental set-up were, in deep, discussed at the Multidisciplinary Workshop ANV12 (Terni-Italy, 17-19 February 2023, DOI: 10.13140/RG.2.212948.17284): *we confirm the useful effects, about AHE, even just using negative pulses at 50 Hz*. As confirmation, and cross-check, we tested: positive pulses, bipolar. Both showed useful effects in respect to DC polarization but weaker in respect to negative one (AHE values, using negative shape in some specific conditions, were up to 3 times larger). Calibration was made using He, in DC, at similar pressures (1-2 bar); ancillary calibrations were made under: dynamic Vacuum, Ar, Ar-He mixtures.

Since the end of March 2023, we tried to make further simplifications: we are testing just virgin wires. I.E. without our usual surface pre-treatments: multiple oxidation-reduction cycles (to increase surface area) followed by "painting" Low Working Function materials (Ca, Sr, Ba; to increase electron emission intensity at the middle-high temperatures of 500-900 °C). Among others, we guess that the large number of emitted e^- interact with H stored at near-surface of the spongy wire. In such last experiment the spongy surface was minimized and (hopefully) it can be possible to study/separate both the effect of specific powder (made by Cu-Ni; Ca, Sr, Ba; Fe, K; anti-sintering agents) where the wire is «immersed» and possible role of Super Abundant Vacancies (bulk effect induced by electro migration effect, «reinforced» by high power pulsing procedures) by itself, as claimed by Prof. M. Staker.

We will report, apart ANV12, mainly results (by any type, unipolar positive/negative, sinusoidal wave excitation) about such over-simplified arrangements and new tests, if any.

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Tuesday

August **29th**

Elemental analysis and quadrupole mass spectrometry towards the clarification of anomalous heat generation observed in Ni-based nano-multilayer metal composite and hydrogen gas

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An innovative heat generation method induced by rapid heating of nano-structured Ni based multilayer thin film filled with hydrogen has been developed by our team. Anomalously large heat generation more than 20keV/H, which was too high to be explained by known chemical reactions. Ni-based nano-sized multilayer film was preloaded with hydrogen gas and heated rapidly to diffuse hydrogen and induced heat generation reaction. Not only steady-state anomalous heat generation, but also spontaneous heat burst phenomena were sometimes observed. Based on the observation of spontaneous heat burst, intentional heat bursts have also become possible. Even a single heat burst phenomenon cannot be explained by any known chemical reactions. Observation of the heat bursts has improved the reliability of excess heat evaluation. Samples that generated excess heat or heat bursts often show some regions of very high oxygen concentration after the experiment according to SEM-EDX and TOF-SIMS analyses [1]-[3].

In addition to further analysis of the high-concentration oxygen region, quadrupole mass spectrometer (BGM-202, ULVAC) was applied to the gases released during excess heat generation. Samples were observed under SEM/EDX (JSM-6500F, JEOL), then specific regions with common characteristics were identified in the samples that produced excess heat. These areas were selected as measure points for performing TOF-SIMS (TOF.SIMS 5, ION-TOF GmbH) analysis.

The morphological observations using SEM showed the presence of some high-concentration oxygen regions in the middle of crystal grains in a Ni substance. EDX data indicated that Ni was the major element in the surface components, whereas the regions contained higher O ratios (at% >10) than the matrices (at% <1). Furthermore, the depth profile obtained from TOF-SIMS revealed that intensity of O is also higher in the high-concentration oxygen regions.

Gas analysis was evaluated based on the peak intensity of Ar. For the samples that released excess heat, the value of mass32(O_2)/mass40(Ar) were more than 10 times higher than the value during baking before hydrogen was provided to the samples. These were anomalously large that could not be explained simply by external leakage or contamination. Moreover, this mass32/mass40 ratio was higher when the hydrogen loaded pressure to the sample was 30 kPa than when the loading pressure was 250Pa.

Experimental results up to now showed that samples with many high-concentration oxygen regions after the experiment tended to have higher oxygen concentrations in released gas and more excess heat during heat generation experiments. For samples with less excess heat, the oxygen concentration in the gas released during the experiment was lower, and the number of high-concentration oxygen regions after the experiment was smaller.

The source of this high concentration of oxygen is unknown at present. Further intensive research will be required to make clear what is happing. At ICCF25, we will also report on the relationship between the crystal grain of the samples and the high oxygen concentration regions.

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Plasma-induced electron screening at the Bragg Peak

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Over 36 years of laboratory astrophysics experiments employing accelerated hydrogen isotope beams have demonstrated the role of electron screened, enhanced nuclear reactions. The astrophysical role of weak and strong electron screening was first discussed by Saltpeter [1] in 1954 and later by Hagino and Balantekin [2] in 2002. Assenbaum, *et al*. [3], Czerski, *et al*. [4], and Schenkel, *et al.*, [5] have used accelerated deuteron beams on various metal targets and observed increased fusion rates over the expected Astrophysical, *S(E),* and Gamow Factors for bare deuteron-deuteron fusion rates. The Pines [6] calculated both electron screened direct and asymptotic enhancement factors, *f(E)* in condensed matter. Arguably, *electron screening makes LENR possible*.

We propose an enhanced electron screening effect occurs due to plasma screening as charged particles traverse condensed matter and sweep electrons with them. These electrons will be most pronounced at the Bragg Peak where the ions come to rest and have been observed with high Linear Energy Transfer (LET) particles in Solid State Nuclear Track Detectors. In fact, Pines [6] noted plasma screening equals erbium atomic electron screening.

Ziegler's SRIM/TRIM code [7] modeled the effective Bragg Peak (Fig 1) for a 6 keV deuteron beam in Pd where the ions have a range of 433 angstroms. Experimentally, this Bragg Peak model can assist in statistically knowing the nuclear reaction depth in condensed matter by the charged particle LET losses. For example, a 3 MeV proton from the D(*d,p*)^{3}He reaction in a lattice could be predicted/located using this model. Plasma screening effects haven't been previously considered in laboratory astrophysics experiments. If these effects are considered, a better understanding of when and where d-d fusion reactions occur could be accomplished.

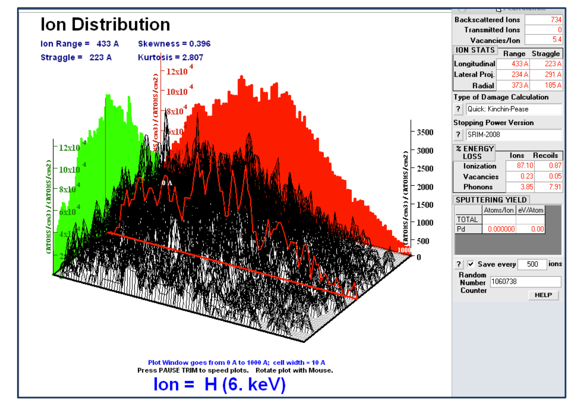

Figure 1 Bragg Peak for 6 keV D on Pd

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Time of flight characterisation of Laser accelerated Hydrogen Rydberg Matter absorbed in Tantalum foil.

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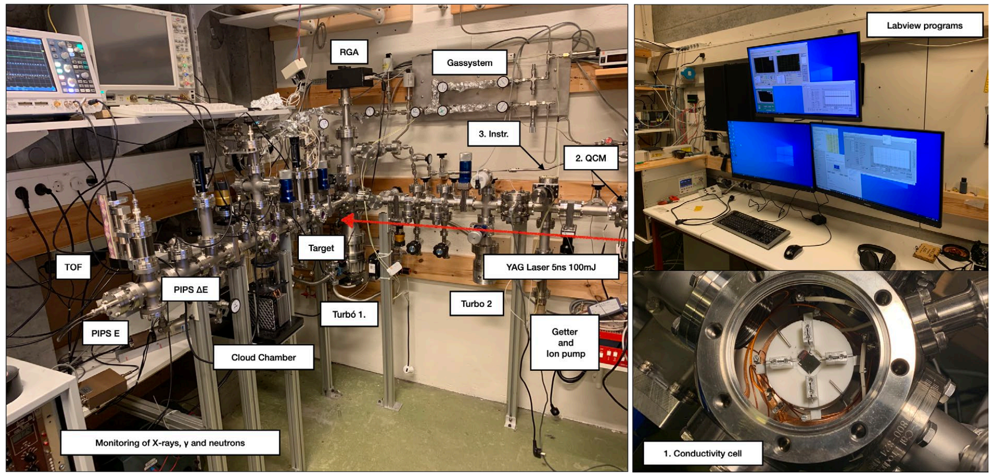

In series of papers L. Holmlid [1,2,3] has reported observation of generation of 0.1c-0.5c fast particles when metallic foils exposed to Hydrogen Rydberg matter are hit with 5ns laser excitation. In this presentation this experimental observation will be checked with improved experimental instrumentation.

The instrumentation will be described and first results of using ΔE – E PIPS detector mesasurement on the observed fast particle will be presented. The instrument can collimate the laser generated bunch of fast particles down to individual particles that are then measured in the simple ΔE – E telescopic detector system. Previous results [1] and results at University of Iceland indicate that the fast particles have positvie charge. The ΔE PIPS detector uses 300μm Silicon as detecting material. To pass such detector 16 MeV protons are needed to give signal in the later E detector. The charge sign will be also confirmed with new measurements. It is hoped that this work will settle the nature of the type of the fast particles that L. Holmlid has observed and then presented as exotic manifastation of muons and leptons but with a use of much inadequate instrumentation.

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Electron observation benchmarking for solid-state DD fusion experiments at thermal energies

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The DD fusion reactions at thermal energies should in principle proceed through the main channels: (^{3}H, p), (^{3}He, n), and (^{4}He, γ), as it is observed in high temperature plasma or accelerator experiments. However, cold fusion studies lead to the conclusion that ^{4}He productions are the strongest reaction channel, and no simultaneous gamma emission takes place [1]. This finding can be supported by observation of the DD threshold resonance with a spin and parity assignment $J= 0^+$ in the ^{2}H(d, p)^{3}H reaction carried out at deuteron energies down to 5 keV [2]. The most probable decay channel of this resonance is expected to be internal pair creation [3]. Electrons and positrons (e^-/e^+) should exhibit a continuous spectrum with energies up to 22.84 MeV [4].

Here, we would like to present the first experimental observation of this new reaction channel performed at the eLBRUS Ultra High Vacuum Accelerator Facility of the Szczecin University, Poland [5]. To reduce the natural background and systematical uncertainties, Si detectors of different thicknesses and various Al absorptions foils placed in front of the detector were applied. This experimental setup helped us to confirm $e^-/e+$ emission unambiguously. The measured energy spectra agree very well with the Geant4 simulation calculations. Furthermore, the electron-proton branching ratio determined for lowering deuteron energies down to 6 keV shows a significant increase in agreement with the threshold resonance mechanism. Based on that, the theoretical calculations predict that the e^-/e^+ channel and ^{4}He productions should dominate nuclear reaction rates at thermal energies. Therefore, future cold fusion experiments should focus not only on excess measurements but also on the detection of high energy e^-/e^+.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Proton induced nuclear reactions at thermal energies

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Gas-loading experiments performed in a low-pressure hydrogen atmosphere show a long-term heat excess production when nickel-based alloys or powders are utilized [1,2,3]. The amount of surplus energy appears to be similar whether light or heavy hydrogen is used and significantly exceeds that expected for chemical reactions. On the other hand, no nuclear reaction products could not be directly measured so far. Therefore, it is convincing to calculate cross sections of proton induced reactions at thermal energies and compare them to the deuteron-deuteron reactions which are known to be strong enough to produce significant amount of energy in both electrolysis and gas loading experiments [4]. Based on the known level structure of compound nuclei and the electron screening effect in metallic media [5], the nuclear reaction rates could be determined in the present work for a wide energy range from meV to keV. The latter will allow to predict to what extent the results of accelerator experiments carried out at higher projectile energies can help us understand the data obtained at thermal energies. Proton induced reactions on protons, deuterons and lithium natural isotopes has been recognized as the most likely candidates for commercial applications. Surprisingly, the first one, although involving weak interactions, seems to be of a comparable strength due to its small reduced mass and a possible resonance structure.

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Resonance structure in ^{4}He showing material dependence of cross section at very low energies

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In the presented contribution we will discuss the energy dependence of the branching ratio and angular distributions of different target materials in the context of nuclear reactions involving deuterons. Especially, we will focus on the ^{2}H(d,p)^{3}H and ^{2}H(d,n)^{3}He reactions and how their branching ratio and angular distributions are affected by the target material in which the reactions take place.

Previous measurements on deuteron fusion reactions in metallic targets made of Al, Zr and Ta showed similar energy dependence of the branching ratio and angular distributions as observed in gas targets [1]. However, for Sr and Li targets, a significant suppression of the neutron channel and an increase in angular anisotropy were observed at deuteron energies below 20 keV [2]. This unusual effect was attributed to resonances contribution in the d+d reactions, which were not taken into accounted in the previously used models. To address this, an alternative model based on T-matrix elements corresponding to broad ^{4}He resonance contribution was applied [3]. This approach allowed for easy inclusion of interference effects between resonances. The theoretical results were found to be in good agreement with experimental data for most materials and with multi-channel R-matrix theory. However, to explain the experimental data obtained for Sr and Li, the presence of a new 0^+ threshold resonance with a single-particle deuteron-deuteron structure and narrow width was required [4,5]. The contribution of this 0^+ resonance was found to have a significant impact on the reaction cross section, potentially reducing the observed large screening energies. These findings highlight the importance of considered resonance contribution and the role of target materials in understanding the energy dependence of branching ratio and angular distributions in nuclear reactions involving deuterons.

Further studies are needed to fully understand the underlying mechanisms and implications of these observations. The proposed subthreshold 0^+ resonance could play an important role in future energy production utilizing the d+d reactions in dense metallic environments. It could be compared to a known breakthrough in nuclear astrophysics, a different single-particle 0^+ resonance, called Hoyle resonance, which was postulated in the past to explain helium burning and ^{12}C synthesis in massive stars and experimentally confirmed a few years later.

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Theoretical and Computational Studies

The quantum effects of vacuum polarization can significantly enhance the tunnelling probability of deuterium nuclei to form helium nucleus in cold fusion

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In cold fusion experiment, electrolysis of heavy water in palladium metal lattice environment generates excess heat at room temperature. One of the proposed mechanisms is the quantum mechanical tunnelling of a particle through a potential barrier even if its total energy is lower. Hence the deuterium nuclei can pass through the Coulomb barrier and eventually fuse leading to helium nuclei and excess energy. The existence of electron deep-electron orbits in deuterium atoms in relativistic quantum mechanics has renewed interest in cold fusion possibility. In quantum field theory, the vacuum is not empty, but is filled with virtual particles such as electron and positron pairs. They can spontaneously appear and disappear. One of the effects of these virtual particles is vacuum polarization. It refers to the modification of the vacuum by the presence of an external electric field provided by the host nuclei. The electrons can move towards the deuterium nuclei and thus can create an effective screening of the Coulomb potential, reducing the strength of the Coulomb barrier. Furthermore, the virtual particles that are created in the vacuum can interact with the deuterium nuclei, leading to a modification of their effective mass and charge. So the self-energy of the deuterium nuclei is affected by their interaction with the electromagnetic field, which can be described by virtual photons. This can have the effect of shifting the energy levels of the deuterium nuclei closer to the top of the Coulomb barrier, making it easier for them to tunnel through the barrier.

To calculate the effect of vacuum polarization, the Feynman diagrams that describe the interaction between the particles and the electromagnetic field are used. Feynman diagrams are graphical representations of the perturbative expansion of the quantum field theory in terms of interaction vertices and propagators. These diagrams involve virtual photon loops that represent the creation and annihilation of virtual particle-antiparticle pairs. The contribution of these loops to the interaction energy is calculated using the rules of perturbation theory. This involves summing over all possible ways that the virtual particles can be exchanged between the real particles. To calculate the tunnelling probability, the WKB approximation is used, which involves solving the Schrödinger equation for the wave function of the deuterium nuclei in the presence of the potential energy barrier. The WKB approximation is modified to include the effect of vacuum polarization on the tunnelling. The tunnelling probability is also found by calculating the transmission probability of the Coulomb repulsion in barrier penetration model. The effect of vacuum polarization significantly enhances the tunnelling probability of deuterium nuclei to fuse to helium nuclei and release energy.

Relationship Between Higgs Boson Mass And Neutron, Proton, And Electron Masses Strong Nuclear Interaction Explanation

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The scalar Boson called Higgs Boson is the fundamental particle associated with the Higgs Field, a field that gives mass to other fundamental particles of the Standard Model such as electrons and quarks.

As the nucleon, i.e. the neutron that decays into proton, electron, and antineutrino is the only stable particle of the Standard Model it is interesting to seek for a mass relationship between the Higgs Boson and the neutron, proton, and electron.

The mechanism yielding the neutron mass from the Higgs Boson mass will be shown. It is based on an iterative “massification” and “demassification” process. This process is responsible for creating mass as well as annihilating it after a time gap, and hence for releasing baryonic mass, the mass one knows. So, baryonic mass is the result of the implementation of a bigger amount of mass which is offset by that same amount of mass, nevertheless with a time shift resulting in the “creation” of baryonic mass. The impression left is the occurrence of mass and antimass, the latter acting as negative mass.

This process is in turn yielding electromagnetism, as it will be shown. Negative electromagnetism is the occurrence of mass + antimass, positive electromagnetism that one of antimass + mass. This will be shown in discussing the weak nuclear force, when the neutron is decaying into proton, electron, and antineutrino.

The strong nuclear interaction will be longer discussed as there is a fundamental interest in that force for the understanding of LENR versus classical nuclear fusion. These two processes are based on different approaches, the one on the Higgs Boson endowing mass process, the other on the known classical solution. The process the author is interested in is based on several quantized binding energy values determined on basis of neutron and proton mass. Examples of calculating binding energy values for various nuclei will be given.

Keywords: Higgs Boson, neutron, proton, electron, dipolar magnetic moment, weak nuclear interaction, strong nuclear interaction.

An Examination of LENR Design Improvements, Based on the Recently Gained Understanding of the LENR Mechanism

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A proposed understanding of the mechanism for Low Energy Nuclear Reactors (LENR) has been recently proffered. For an LENR reactor running in steady state, when the ^{2}D to ^{2}D primary reactions occur, four child products are released: n, p, ^{3}He, and ^{3}T. These child products have a high kinetic energy. The four child products scatter with the high density ^{2}D fuel in the core, transferring their kinetic energy to the deuterons. The ^{3}T and ^{3}He also react with the ^{2}D in secondary reactions, creating four new energetic child products: n, ^{4}He, p and more ^{4}He. These four new child products also scatter with the ^{2}D fuel in the core, transferring kinetic energy to the ^{2}D. The Coulomb barrier is overcome by this transferred kinetic energy. If enough of the ^{2}D are energized, a subsequent ^{2}D to ^{2}D reaction can take place. A chain reaction occurs if more energetic deuterons are created as a result of this subsequent ^{2}D to ^{2}D reaction.

Below are 12 suggestions to improve the safety, reliability and energy output of the reactor design.

1. The core material must be able to contain a high concentration of ^{2}D. If it is a metallic core, it must be prone to fissures and crystal defects, which are necessary for creating the nuclear active environment.
2. There must be a high concentration of ^{2}D fuel loaded into the core.
3. A start-up mechanism is necessary. The lack of a start-up mechanism is speculated to be one of the causes for the problem of unreliable LENR behavior. The solution is to intentionally include a start-up mechanism within the design of the reactor. If the conditions within the core are sufficient for a chain reaction, this start-up mechanism will trigger the reactor to ignite.
4. More excess output power can be achieved with a larger core. There is a strong correlation between core volume, ^{2}D concentration, and maximum excess output power.
5. A rolled-up foil shape is an optimum shape for the LENR core material, since this shape minimizes the kinetic energy loss from the child products.
6. There should be enough space for a small amount of electrolyte water to exist between the layers of this rolled-up foil. This increases the surface area of the reactions, and it helps to moderate the energetic child neutrons as they travel between the layers of the rolled-up foil.
7. The rolled-up foil should be thin, to improve the ratio of surface area per volume of the core.
8. ^{6}Li in the electrolyte is beneficial for producing more output heat.
9. The addition of boron inside the core material is beneficial [2]. This produces more heat, as well as a stronger chain reaction. However, the addition of boron must not decrease the loading that can be obtained.
10. The addition of ^{3}T to the deuterium fuel is beneficial. An LENR reactor is much easier to ignite, simply by adding ^{3}T to the deuterium fuel. LENR need not be unnecessarily constrained by using only ^{2}D.
11. To increase heat output, a hybrid reactor design should be considered. This hybrid reactor is a fusion reactor as the inner cylinder, surrounded by a fission reactor as the outer cylinder. The outer fission reactor contains ^{6}Li and ^{10}B, which fission into ^{4}He. More heat and more ^{4}He are obtained from these reactions.
12. If a hybrid reactor is not used, then the use of lithium in the electrolyte, borosilicate glass in the set-up, and a large water bath surrounding the set-up are required to shield the neutrons.

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Theoretical and Computational Studies

New Mass Spectrometry, Calorimetry, and Tritium Extraction Instrumentation with Applications to Lattice-Confined Fusion Experiments

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We present the design and implementation of new high resolution mass spectrometers, pulsed evaporative calorimeters, and tritium extraction and detection instrumentation. The high-resolution FT-ICR mass spectrometers have routinely achieved a mass resolution better than 0.0001 Da at mass-3, and can quantitatively distinguish between ^{3}He, ^{4}He, tritium, D_2, DH, DT, ^{20}Ne, ^{40}Ar, and many nuclear byproducts relevant to novel nuclear reactions [1]. In addition to excellent mass resolution, devices display excellent linearity from their noise level near 0.1 picomole (pM) to over 50 pM in ^{3}He and ^{4}He measurements, permitting the underlying nuclear process to be studied analytically. Three different open-system calorimeters, each optimized for specific measurements, are able to accurately and quantitatively isolate experiments from environmental heat fluctuations. These include a liquid nitrogen evaporative calorimeter [2], a differential, open-air Peltier calorimeter [3], and a differential vacuum calorimeter [4]. A new tritium extraction method is also presented and applied to lattice-confined fusion experiments performed in collaborative experiments between Texas Tech University and the University of Missouri Research Reactor (MURR). Tritium is detected with lower limit near one femtomole [5]. We discuss detection limits of our equipment for nuclear by-products, persistent systematic errors that have been eliminated, and discuss the potential applicability to experiments in other laboratories.

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Instrumentation

Detection of LENR in Spark Plugs

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Emission of an unknown nature, coming from LENR reactors, specifically damages the surfaces of glass, plastic and other solid objects at a distance of up to 20 cm [1,2]. Blank DVDs were chosen as an object to detect this emission, and therefore the existence of LENR. After the LENR reactor is turned off, it continues to radiate, but the intensity decreases over time [3].

In the first experiment, the DVD was kept at a distance of 5 cm from 30 broken spark plugs for a week. These spark plugs have been used in cars for years. Microscopic tracks were found on the surface of the DVD, consisting of repeated damages chains. There were no tracks on the control DVDs.

To determine the agent that causes damage to the DVDs surface, an artificial damage was caused by various mechanical methods. Identical tracks were obtained by rubbing two discs against each other covered with room dust, that had been accumulated during a week. An unknown force pressed solid microparticles of aerosol into the disk for some time with a thrust of about one gram.

In the second experiment, DVDs were placed above a running car engine, above a car electric generator, above a car battery, inside a car, below a car: near the resonator and right after the exhaust pipe. The engine was idling for three hours. In this experiment, the tracks from soot particles were traced. The particles were pressed against the disk by an unknown force and moved across the disk, leaving thin long lines of soot behind them. Tracks were found on DVDs which had been located above the engine and near the exhaust pipe, no tracks were found on other DVDs.

To retest the first experiment, 200 used spark plugs were applied to the discs but the latter showed no tracks. Then disks were coated with a thin layer of soot. On DVDs with soot, which had been laying for a week under 200 non-working spark plugs, a huge number of branching tracks were found Fig. 1. The first type is a thin lines cleared out of soot. The second one represents the sticking together tree-like branching soot structures. The third type is wide and relatively long, up to several millimeters, loose tracks. The tracks area occupies approximately 30% of the disks.

Most occurrences of an unknown force near the LENR are not reflected as damage on DVDs. The sensitivity can be increased by coating DVD with a layer that is more susceptible to deformation, for example, a thin layer of soot.

Fig. 1 Three types of tracks of strange radiation near used spark plugs

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Instrumentation

Monte Carlo Geant 4 simulation for studying the DD reactions at thermal energies

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A threshold 0^+ resonance in the compound nucleus ^{4}He at the excitation energy of about 23.85 MeV was observed several years ago [1]. It should predominantly decay by the internal pair formation [2] which has been recently measured in the DD reactions at very low energies using the UHV accelerator facility at the eLBRUS Lab, Szczecin University in Szczecin, Poland[3]. Detection of electrons/positrons with energies up to 23 MeV is very challenging because of their low stopping power values and correspondingly very long attenuation length, which competes with the experimental background.

In the present work, we will discuss the nuclear measurement technique to distinguish between the direct fusion events and indirect events arising from elastically scattered particles (e.g., proton, e-) within the target and protection foils placed in front of the detector. To study these effects, we applied Monte Carlo Geant 4 simulation and calibrated experimental set-ups with radioactive sources 204Tl, 60Co, and 241Am. The same procedure was adopted for low energy deuteron induced reactions to estimate the proton-electron branching ratio. To show the validity of the simulated results, a comparison of the simulated electron, proton particle energy spectrum with the experimentally measured one will also be presented.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Instrumentation

Poster Session

The Potential Miscalculation of COE for Pressurized Gas LENR Systems

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A potential miscalculation of the coefficient of energy, or COE, for high-pressure gas-type LENR is discussed. The mechanism for this potential miscalculation is explained, and a numeric example is given to estimate the magnitude of the effect. The importance of thermodynamics to LENR systems is emphasized.

One relatively common type of an LENR is a pressurized gas reactor, in which hydrogen gas, either ^1H or ^2D, is pressurized and placed in direct contact with a metallic core, such as palladium or nickel. Under high pressure, the gas is absorbed into the lattice of the metal with a high density, allowing possible fusion to occur. Measurements of the excess heat released by these nuclear reactions are made, and the coefficient of energy, or COE, for the system is calculated.

The parameter of COE is a measure of how much output energy is being released by the reactor, compared to the amount of input energy going into the reactor. If COE is greater than 1, this is a possible indication that nuclear reactions are occurring within the reactor. The definition of COE is shown in Eq. (1).

$$COE = E_{output}/E_{input} \quad (1)$$

Frequently, the calculations for COE for LENR experiments modify the input term such that the denominator is only the electrical input energy going into the set-up, as shown in Eq. (2).

$$COE_{erroneous} = E_{output}/E_{input\_electric} \quad (2)$$

However, using only the electrical input energy to calculate COE is a miscalculation of COE. Consider the situation wherein a quantity of gas is pumped to a high pressure into a small air tank inside the LENR system. Thermodynamics state that if a quantity of gas goes initially from a low pressure and a large volume to a higher pressure and smaller volume, then its temperature will increase, as shown in Fig. 1. This is called adiabatic heating [1], and it is a potential source of miscalculation for COE.

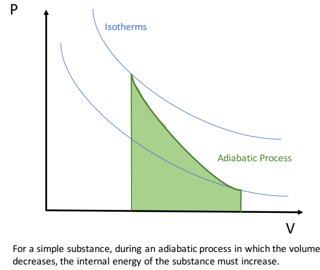

Fig. 1: Diagram of adiabatic heating

It is important for both experimental and theoretical LENR physicists to have a good working knowledge of thermodynamics. For an experimental set-up, all external energy going into the LENR set-up must be accounted for—whether it is electrical energy or other types of energy.

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Encoding Qubits using the Anti-Stokes Peak From a Working CF/LANR Nanomaterial System

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We previously reported the use of preloaded CF/LANR nanomaterial components and their anti-Stokes emissions when they were successful ([5]; Figure 1). Last month, MIT RLE researchers proposed that two slightly different frequency lasers can manipulate nuclear spin [1,2,3,4]. We use two near-frequency photons from CF/LANR anti-Stoke emissions [5,6] to coherently control polarization and optical output downstream in a Qubit system. These emissions and interactions are not picked up in the absence of incident coherent red or green irradiation. However, with either, there is an increase in emissions of photon polarized light in this three polarizer optical system. These results reveal that the anti-Stoke LANR/CF emissions from an active CF/LANR preloaded nanomaterial component can be used to influence a quantum polarization Qubit system including the construction of a NAND (not AND) gate in new type of quantum computing system with high coherence. Because the anti-Stoke LANR/CF emissions can be used to influence a quantum polarization system, they may enable new types of quantum computing systems/components.

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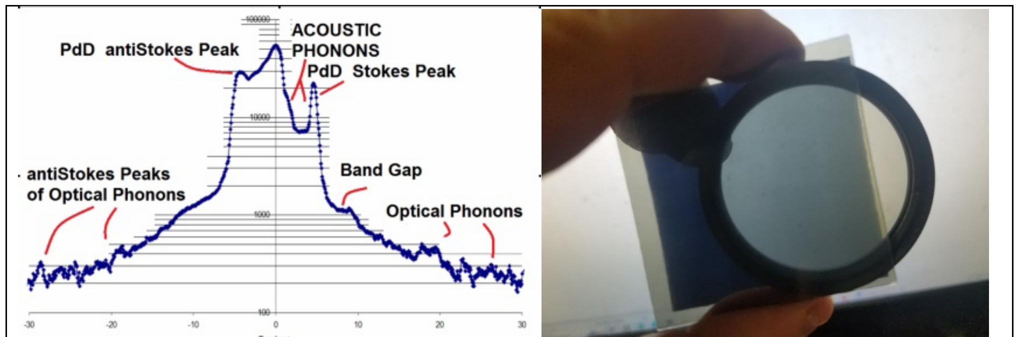

Fig. 1 (left) Log-Intensity Raman Spectrum obtained during Excess Heat Mode [desired, non-avalanche] - This logarithmic presentation of electric-driven Reflection Coherent Raman Spectroscopy of a preloaded, correctly-driven, ZrO_2PdD NANOR®-type component. Identified are the Stokes and anti-Stokes peaks of PdD, and the band gap between acoustic and optical phonons. (right) Schematic of CMORE-controlled Photon Polarization Qubit System - The triple polarizers are shown, orthogonal except for the interposed third polarizer, which can be seen to increase the downstream optical output.

Poster

Inductively activated LENR reactor

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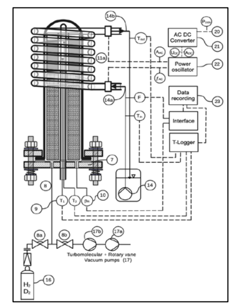
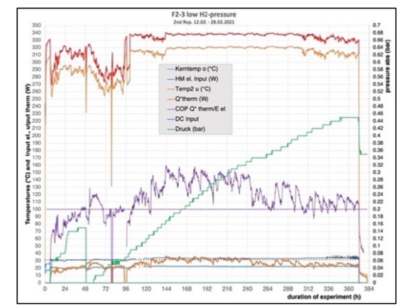
The modular LENR reactor contains a flange with feedthroughs at the lower end, which allows the exchange of reaction material. The double jacket tube of the reactor in quartz glass or ceramic material is arranged vertically and heated in the upper, dome-shaped and insulated reaction zone. The connections for hydrogen supply and vacuum, sensors for temperatures and pressure therefore are not exposed to higher temperatures. In the central tube, which at the bottom is open to the atmosphere, the thermocouples remain freely movable during the reaction so that temperature profiles can be recorded.

A coil surrounding the reactor combined with a power oscillator is used to generate an alternating magnetic field. This heats and excites the reaction material in the reactor by means of induction. The reaction material is arranged in the annular gap around the thermocouple tube. Coolant flows through the tubular induction coil so that it acts both as an inductor and as a heat exchanger for extracting heat as useful energy (Fig. 1 P&I chart, Fig. 2 reactor detail, pat. pending).

For the reaction, nickel and hydrogen were used in a first phase, based on the reaction type already discovered in 1989 by Francesco Piantelli and described in 1994 and 1998 by Focardi et al. [1]

An example is shown with 0.25 mm nickel foil. During about 1 week, the heat yield was >100% (Fig, 3 purple curve). The dependence on H_2 pressure could not yet sufficiently be confirmed. SEM/EDX analysis showed morphological changes with Carbon 5-8 m-%. in the reaction product, which were not detected in the initial material (fig. 3 and tab. 1). Reproducibility seems to depend on the material and remains an ongoing problem. The choice of the inductor configuration and the frequency range were chosen arbitrarily and hold great potential for optimization.





electr. input: 22.5W DC

Inductor-frequency: 100 kHz

Therm. output: $m^* \cdot c_p \cdot \Delta T$

Fig. 1 P&I chart Fig. 2 Induction/heat transfer coil Fig. 3 run no 3, during 360h /operating condns.

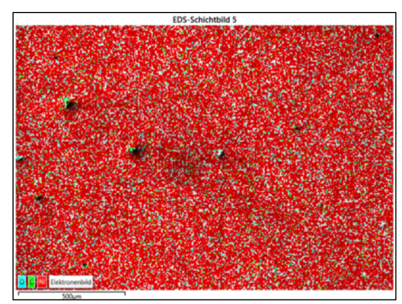


Fig. 4: SEM/EDX of reacted material

Tab. 1 EDX analyses for starting vs. reacted material

Element (m-%)	Ref 1 Bild 2	Ref 2 Bild 3	Ref 3 Bild 4		Probe1 Bild 5	Pr 2 Bild 6	Pr 3 Bild 7	2. Pr 4 Bild 9/8	2 Pr 5 B 10/9	Pr 6 B11/10
Massst.	1 mm	1 mm	1 mm		500 µm	1 mm	1 mm	1 mm	/500µm	500 µ
Ni	97.2	95.0	98.5		89.7	90.8	93.1	93	91.0	93.7
C	0	0	0		5.7	8.3	5.8	6.0	8.1	6.3
Co	1.7	3.3	2.3		3.1					
O		0.7	0.7		0.9	0.9	1.1	1.1	0.9	
Fe	0.3	0.4	0.3		0					
Cu	0.7	0.4	0.7		0.4					
Mn	0.2	0.1	0.3		0.2					
Ca	0.0	0.1	0		0.0					

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Poster

A curated website resource for LENR

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The low-energy nuclear reaction (LENR) community has, on the one hand, made quiete yet steady scientific progress over the last few decades. On the other hand, the field is still not well-regarded by the broader scientific community and sorely needs an influx of young researchers. There are many resources for curious minds to learn about the field. Certainly, there are dozens of books, hundreds of research papers—some published in widely-read journals and many in the *Journal of Condensed Matter Nuclear Science*, and several websites with curated news, science, sociological, and historical content. However, there is a dearth of websites designed specifically to be a resource to the various relevant constituencies such as curious established scientists, science journalists, investors, and students.

Our team at the Anthropocene Institute is developing a website (https://solidstatefusion.org) that intends to be a guide, catered to each of the aforementioned constituencies, to learn about LENR. One tool under development, which will be relevant for newcomers and experienced LENR researchers alike, is a depository of high quality LENR scientific research papers and presentations. The database will sort and tag content via an exhaustive list of search parameters: author, year of publication, type of research (i.e. theory, experiment, review, etc.), experimental type (reactor setup, observables, and stimulation), and sample type (metal or alloy and isotopic hydrogen reactants). Such a database will allow for quick access and discovery of relevant papers to active researchers in the field and newcomers focusing on different areas of the literature. Moreover, we seek to provide important scientific and historical context to the literature. One of the challenging aspects for new entrants to the field is the wide range of empirical results (e.g. neutron bursts, charged particle emission, excess heat, low-Z transmutations, etc.). Such a disparate set of claims can be easily confused, hard to grasp, and challenging to identify meaningful patterns. In short, solidstatefusion.org aims to be a go-to resource for those who wish to learn about LENR, potential new researchers to the field, and veteran scientists keen to stay up to date on the evolving research literature.

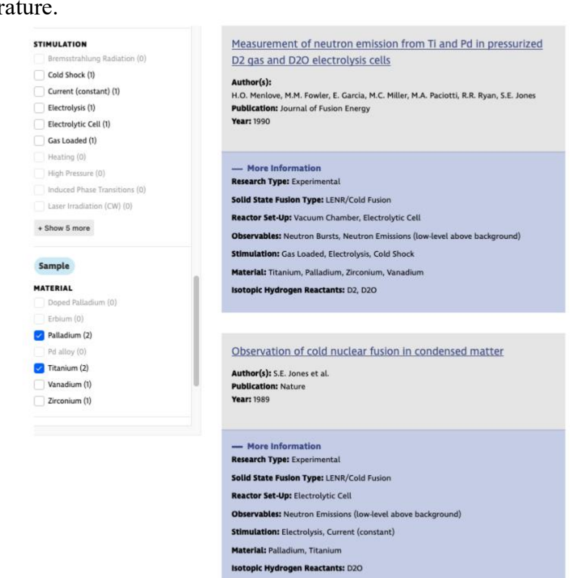

Fig. 1 Example of LENR research database tool.

Poster

Seismic Data on Cold Nuclear Fusion

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Fluid formation and formation of minerals occurs in the mantle under the action of electric explosions, where all conditions are created for the processes of cold nuclear synthesis of chemical elements and ball lightning, electromagnetic induction, catalysts and other nuclear-plasma-physico-chemical reactions. All the above-mentioned deep seismic profiles are interpreted as one common tectonic process of the evolution of the planet Earth, associated with constant mechanical convection in its bowels from the very beginning.

It has been established that all earthquakes with K>13 and a significant part of earthquakes with K>11 are preceded by sharp changes in the amplitudes of this wave at most stations, and sometimes by azimuths of the approach 15-45 days before the earthquake. The coverage area is up to 400 km. It is imperative to study the mechanisms of earthquake foci.

Tracking other geophysical fields will allow us to study the physics of the process more fully and, in general, increase the reliability of forecast estimates. The project proposes to use the magnetic component of the Earth's magnetic field (EMF) as an accompanying parameter under study, or rather, changes in the components of the full vector of the Earth's magnetic field in the range of 20 seconds. Moreover, the preliminary data obtained as a result of a retrospective analysis of the variations of the module of the full vector of the EMF are encouraging. Sufficiently stable signals corresponding to the radiated range have been identified, and the correlation of these signals with seismic ones has been noted. In this regard, it is proposed:

1. At the first stage, analyze data on existing networks of regime observations of variations of the module of the full vector of the MPZ.

2. At the second stage – to install 1-2 autonomous magnetovariation stations registering the components of the full vector of the EMF in the most seismically dangerous areas of the republic.

Aftershock activity of the Earth's crust does not affect the change in amplitudes. The sliding of geolithodynamic (scales, plates) complexes in the lithosphere leads to a rupture of their continuity, forming huge cavities (caves, karsts). In turn, they are filled with fluids migrating from subduction zones. The time of filling the cavity takes from 15 to 45 days, after which a natural electric capacitor (part of the lithosphere) is closed – an electric discharge leading to an earthquake. To predict earthquakes, it is necessary to conduct deep seismics for more than 20 seconds, which will allow calculating the time of fluid migration from the subduction zone into the cavity, from the moment of a sharp change in amplitudes according to seismological data.

These data indicate the internal terrestrial, and not induced from the surface, origin of a very strong pulse that deforms the Earth's crust in this particular area, changes the amplitude of the natural vibrations of the Earth's crust. This impulse occurs before the very manifestation of an earthquake in the scope of earthquake preparation. The most promising methods for detecting this pulse, along with studying the azimuth amplitude of the low-frequency wave approach, we consider the study of the magnetic field at this frequency, deformation and tilt-dimensional studies at several points on the polygon.

The increase in shaking on soft sediments, according to many scientists, is due to the delay of seismic waves as a result of complete contrast resistance between sediments and underlying rocks when there are lateral inhomogeneities. This delay affects not only the volume waves, but also the surface waves that develop on these inhomogeneities.

Poster

The use of graphene for controlled LENR in thin conductive targets by optimize low-voltage corona discharge

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The traditional methods of "accelerator nuclear fusion" are based on the need to use particles with high kinetic energy that interact with a remote unoriented optimal target. The efficiency of such fusion is very low (3 - 5%) due to the strong non-nuclear deceleration of moving particles upon interaction with target atomic electrons [1]. The use of channeling motion of accelerated particles in oriented crystal targets significantly reduces the rate of non-nuclear deceleration, but the probability of nuclear fusion decreases even faster. In our works [2-4], it was shown that accelerator $p + Li^7 = 2He^4$ fusion can be realized on moving protons with an optimal low velocity $v_{opt} = 2d < \omega(z) >_z$ and kinetic energy $T_{opt} = Mv_{opt}^2 / 2 \approx 500 eV$ of the longitudinal motion in the periodic interplanar Li crystal potential $V(r_\perp, z) = V(r_\perp, z \pm nd) = M\{\omega(z)\}^2 r_\perp^2 / 2$. This condition is fulli consistent with experiments [5] and it corresponds to the formation of a coherent correlated state (CCS) of the moving particle [6], which is characterized by giant fluctuations δE of its transverse energy. The complexity of such experiments is connected with the need to use optimal for fusion single crystals and monoenergetic directed proton beams.

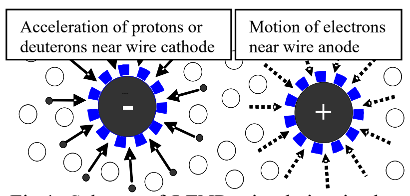

Fig.1. Scheme of LENR stimulation in the cathode during a negative corona discharge in H(D) gas near the surface of thin wires coated with single-layer graphene.

In the report a system (Fig.1) that meets all these requirements is considered: the use of low-energy moving particles; self-orientation and self-monochromatization of the particles' energy. Additionally, in the system take place self-formation of CCS and generation of giant energy fluctuations. Such a system utilizes of cathodes and anodes in the form of thin conductive wires with radius R coated with single-layer grapheme to provide a negative corona discharge mode. In this system, the main acceleration of particles (protons or deuterons) to the same optimal energy $T_{opt} \approx eU$ occurs in the radial direction in the region $\Delta r < 10R$ near the cathode wires.

As particles with the optimal energy pass through a monocrystalline graphene film in a short-range channeling regime, a CCS of these particles is formed [2]. This state is characterized by giant fluctuations $\delta E \geq 30 - 100 keV$ of their transverse kinetic energy [2-4,6]. The interaction of these particles in CCS with adjacent to the film unstructured cathode leads to effective nuclear fusion. Such corona discharge mode at a voltage of $U \approx 500\ V$ can exist (according Peek's law [7]) for a long time in hydrogen gas with concentration of $n_a \approx 10^{17} cm^{-3}$ at $R \approx 1mm$. For self-cleaning of the cathode surface, it is necessary to periodically swap the anode and cathode by changing the voltage polarity.

The efficient low-energy $d(C^{12}, \gamma)N^{14}$ fusion in deuterium gas with much higher atom concentration $n_a \geq 10^{20}\ cm^{-3}$ can be achieved in a case when the cathode and anode consists of only a large number of spatially separated single-layer conductive graphene nanotubes without any internal wires.

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Beam energy distribution measurement implemented via time-of-flight method

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High-precision experiments [1], like investigation of nuclear interaction in few body systems require a very good knowledge of the reaction conditions. For experiments using a hadronic beam, important parameters are, among others, the average kinetic energy of the particles and its blurring. Accelerators deliver beams of a given energy with the accuracy of the nominal parameters, but this accuracy is often neglected in the experimental error calculation. The difference between the requested and received beam energy is not only a contribution to the error calculus itself, but affects the credibility of such procedures as calibration, particle identification and, as it is in the case of few-body experiments, determination of the normalization factors for cross sections [1]. In addition, some of the accelerators used for scientific research are medical devices, calibrated in the scale of particle range in water, not beam energy.

The proposed method allows to perform instant and precise control measurement of beam energy distribution, which do not affects the experiment. It can play crucial role in significant reduction of contribution to both statistical and systematic effects of final measurement uncertainties, as well as enhances reliability of patient therephy or other industrial use use of beam requiring energy precision.

The method is based on the time-of-flight measurement allowing to achieve the accuracy below 0.2% for the beam energy range of 70-220 MeV. It is individually fitable to the specific beams and required precision limits.

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Does ElectroMigration Enable LENR?

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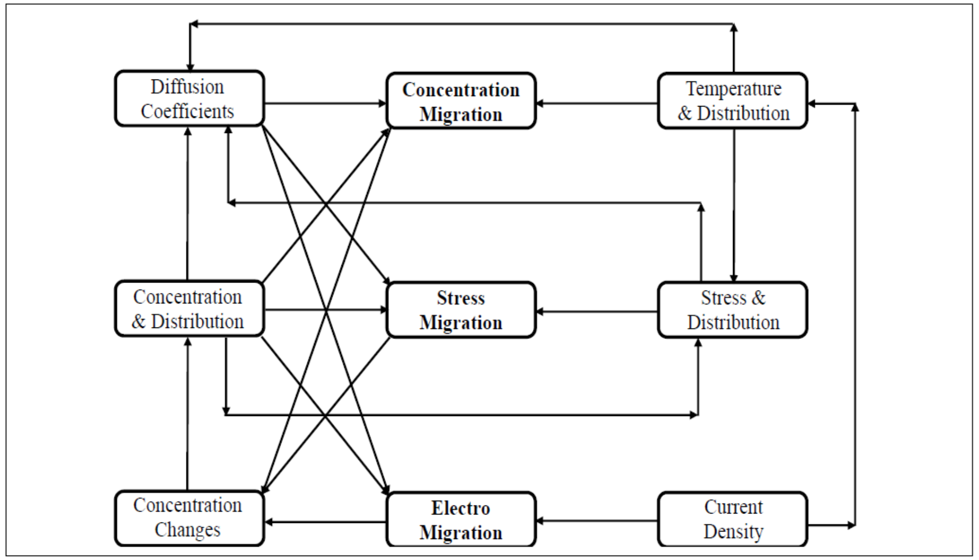
It is believed that protons and deuterons must move on and in materials in order to cause the interactions needed for low energy nuclear reactions (LENR) [1]. They move due to gradients in concentrations, stresses, and voltages. The figure indicates the complexity of motions considered to be relevant to LENR [2]. This paper reviews reports where voltages were applied to electrochemical cathodes. The resulting electromigration produced two conditions favourable to LENR, higher deuteron concentrations and deuteron fluxes.



The use of electromigration in electrochemical LENR experiments may have been responsible for significant results. The most noteworthy is reported generation of LENR power densities in excess of those in fission fuel rods [3]. Celani's group has reported to have used electromigration effectively in many experiments [4]. Despite the evident value of electromigration in causing LENR, there remain two major problems with the subject. The most basic is the mechanism, and the resulting direction of the motion of protons and deuterons within LENR cathodes. The other and related problem is the theory of the electromigration of hydrogen isotopes in materials. We will review the status and potential solutions for both problems. We also consider the use of electromigration in hot gas and plasma LENR experiments.

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Investigation of energetic particle generation in Pd/D co-deposition

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The electrochemical co-deposition of Pd/D has been a contentious issue since the late 1980s, with reports of anomalous heat and energetic particle generation. Despite extensive research during the "cold fusion boom" of the 1990s, conclusive results were not achieved, and low energy nuclear reaction was largely dismissed as pseudoscience. Nonetheless, some research has persisted to the present day, and there has been a growing interest in recent years in re-examining the topic of cold fusion as the world is increasingly in need of new sustainable energy generation technologies.

The reproducibility of cold fusion experiments, particularly those that report excess heat, remains a major challenge in the field, compounded by the lack of a suitable theoretical framework. Within the Horizon 2020 FET Proactive project HERMES, our work has focused on replicating experiments previously conducted by Mosier-Boss *et al.* [1-2] and determining the factors that impact the count of energetic particle tracks that are visible on CR-39 nuclear track detectors.

To investigate the generation of energetic particles during Pd/D co-deposition, we conducted experiments in an electrochemical cell equipped with a CR-39 nuclear track detector. By depositing palladium on an Ag wire, dendritic structures were formed and the etched CR-39 detectors were analyzed for evidence of high-energy particles once the multi-day experiments were completed. These particles break down the polymer chains of the CR-39 plastic, resulting in visible pits when etched with an alkaline solution. Our experiments explored various combinations of electroactive species ($PdCl_2$, $CuCl_2$, $PtCl_2$) and supporting electrolytes (LiCl and KCl), dissolved in either H_2O or D_2O. We also investigated the hypothesis that the pits were produced by hydrogen and oxygen recombination [3]. Finally, we analyzed the electrolyte contents before and after the experiments using ICP-MS to detect any deviations in the Pd isotope ratios from natural abundance ratios. We will present a summary of our findings in this poster.

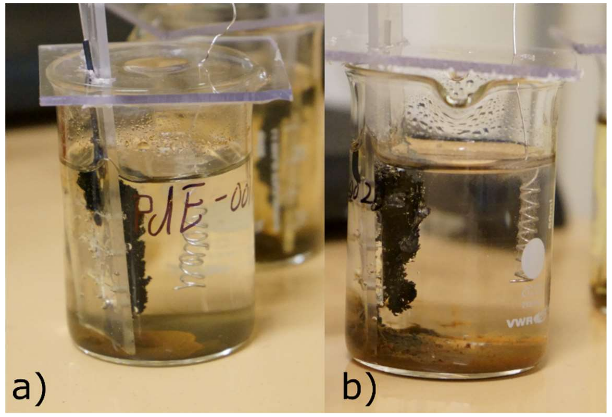

Fig. 1 Cells after electrodeposition containing PdCl2 in, a) light water, b) heavy water with coiled platinum wires as counter electrodes.

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Progress of Reproducing the Lattice Energy Converter Experiment in Qiuran Lab

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The objective of this study was to reproduce and investigate the lattice energy converter(LEC) experiment. The LEC experiment was first conducted by Frank Gordon and Harper J Whitehouse and later on reproduced by Alan Smith.In these experiments, the 0.5-3mm gap of two separated electrodes wasfilled with different types of gas such as airdeuterium and hydrogen. Electric voltage at an order of hundreds of milli-voltscould be observed between the electrodes especially when the surface of electrodes were activatedby electrolysis[Ref. 1-3].

To reproduce the LEC experiment, we adopted the titanium tube electrodes set up reported by [Ref 4], as shown in Figure 1. The gap between the inner and outer tubes was in the range of 0.5-1mm and filled by different type of gas. The tubes were activated bydifferent methods including iron plating, nickel plating, copper plating and electrolysis. A KEITHLEY 2700 voltmeter paralleling with a 1MΩ resistorwas used to measure the voltage output from the above electrodes.

The results of our experiments showed that, the LEC voltage at an order of 30-60mV was observed at 80% chance regardless which electrode activation method was used. The LEC voltage was highly correlated with the temperature of the gas between the electrodes, as shown in Figure 2.

In conclusion, we successfully reproduced the LEC experiment and observed some new phenomenons different from those reported previously.

Figure 1. Titanium tube reactor

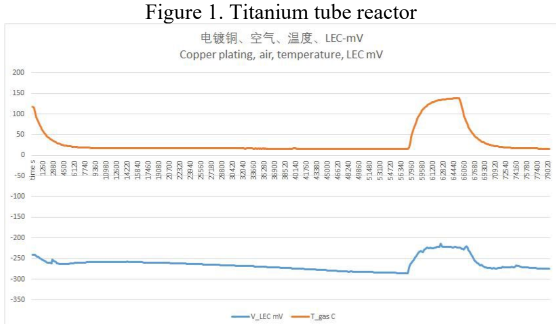

Fig. 2. Data diagram of electroplated copper-titanium pipe in air

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Poster

Electrical resistivity of powders at high temperature in a hydrogen atmosphere

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Following the work presented at the ICCF24 conference [1], we have continued our work on active materials (AM) based on nano-particles of nickel-based alloys (or transition metals) supported on amorphous alumina or silica, the AM being obtained via suitable precursors (phyllosilicates and hydrotalcites) synthesized by direct co-precipitation in water. In some cases, a coprecipitation with a LWF [1] precursor such as cerium (III) nitrate gave mixtures of the AM and cerium oxide.

The treatment of the AM powders under hydrogen at high temperature transforms the precursors into an intimate mix of alumina or silica with nanoparticles of nickel eventually alloyed with other reducible metals. This treatment aims at conforming the powder for precise calorimetric studies by removing adsorbed water, carbonates (in the case of hydrotalcites), hydroxides and reducible oxides [3,4]. X-ray analyses showed that the transition metal oxides are fully reduced.

It is envisaged to investigate the influence of electrical currents or discharges on the occurrence of LENR. For this purpose, it is necessary to determine the electrical resistivity of the AM in relationship with the temperature. A setup made it possible to measure the DC electrical resistance of loose powders in a hydrogen atmosphere up to 700°C. In general, due to the residual humidity some current is measured at room temperature that drops to very low values above 100°C. The resistance diminishes above a given threshold temperature that depends on the type of AM.

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Poster

Pulsed high-voltage cold fusion reactor in the Earth's crust

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As a realistic alternative to designs, a high-voltage cold fusion reactor is commercially closer than ever before to reality using powerful pulsed technology. We have found a new way to produce plasma from water and petroleum hydrocarbons. To generate electricity, a reactor with a voltage of 5 kv is inserted into the stator, due to which a voltage of 1400 volts appears on the stator. The generation of electricity is associated with tectonic erosion (the millstone effect) - this process, which is constantly going on due to the difference in the velocities of geolithodynamic complexes (plates, scales) located under each other, leads to the pulverization of rocks and their differentiation by mechanical, chemical and physical processes occurring at different depths in the subduction lithosphere. The subduction lithosphere, instead of geosynclines, should be a first-order structure. This requires additional regional studies by deep seismic methods to the depth of the Moho surface, and in the subduction zone - to the depth of its immersion. Tectonic karsts and basal bundles are tectonic structural elements of sliding processes and tectonic erosion. The filling of the karst at great depths of methane leads to constant earthquakes, and the discharge is electrical discharges in the earth's crust at various depths from 5 to 450 km. Strong earthquakes form up to 5 km, leading to the destruction of the earth's crust with the formation of rifts. All this is suitable for many earthquakes in Tashkent, Turkey, which led to light effects in this area from electrical discharges in the earth's crust. Spherical nodules serve as an example of the structure of the planet Earth. Their origin is connected with the electromagnetic forces that form the rotation of fluids in reservoir formations. During rotation, the host rocks of the formation are attracted to the center and thus spherical rings (geospheres) are built up, forming spherical, cylindrical, ellipsoid, almond-shaped, etc. concretions. The rotation of fluids is possible only in the void (karst), which contradicts the "classical" understanding of the structure of the reservoir reservoir, where porosity and permeability must be present, i.e. a crystal lattice. The absence of the latter is known in coal seams coming to the surface, which are products of paleonefty. Thus, by studying the globular nodules formed in oil and gas-bearing reservoir formations and the deep seismics of the planet Earth, one can more deeply understand the structure of the planets and their formation. As a special group of natural bodies, globular nodules were isolated back in the 18th century, and they have been the object of special research for more than 300 years. But the theory of nodule formation remains undiscovered until now. Concretions in organisms (kidney stones, pearls, etc.), techno-concretions (so-called "stones in glasses", etc.) have long been established and have become the object of special research, atmospheric formations are also special concretions - hailstones, etc. Artificially, only pearls were obtained, but no one could artificially create hailstones, spherical nodules. Ego is caused by the fact that geological representations of the formation of spherical nodules were considered from the standpoint of geosynclinal theory (fixism). Oil was formed from organic matter, which was transformed into mantles due to nuclear plasma reactions and serves as a lubricant for the rotation of geospheres and radiator cooling. The rotation of the geospheres of the planet Earth leads to the subduction (movement) of the lithospheric plates under each other, where organic matter in the form of carbon is drawn into the mantle. Since oil is a dielectric, a natural electric capacitor is obtained in which an electric current accumulates due to the friction of plates, scales, geodynamic complexes, which are charged from the dynamo effect of the planet Earth itself, where the geospheres rotate from the core at a speed of 20-40 m/ sec, the mantle - 1-10 m/ year and the lithosphere itself -2-16 cm/year. It is quite natural that an electromagnetic field is formed in the form of a vortex at a distance of a basal bundle, or karst, which is why nodules on the surface can reach tens of kilometers in length and more than 3 m or more in diameter. The core is usually very soft, compared to other geospheres, which are cemented with various rocks (clay, carbonates, etc.).

Pulsed High-voltage Cold Fusion Reactor in the Earth's crust

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As a realistic alternative to projects, the high-voltage cold fusion reactor is commercially closer than ever before to reality, using powerful pulse technology. We have found a new way to produce plasma from water and petroleum hydrocarbons using helium, argon and propane. To generate electricity, a reactor with a voltage of up to 5 kV is inserted into the stator. At the same time, voltage appears on the stator from the winding attached to the iron base of the table, where the wires were closed to the iron of the table.

Electricity measurements were carried out on the stator wires when a voltage of up to 1400 volts appeared. Electricity generation is associated with tectonic erosion (the millstone effect) - this process, which is constantly continuing due to the difference in the velocities of geolithodynamic complexes (plates, scales) located under each other, leads to the crushing of rocks and their differentiation by mechanical, chemical and physical processes occurring at different depths from the subduction lithosphere.

This requires additional regional studies using methods of deep seismic exploration to the depth of the Moho surface, and in the subduction zone - to the depth of its immersion. Tectonic karsts and basal stratifications are tectonic structural elements of sliding processes and tectonic erosion. Filling the karst at great depths with methane leads to constant earthquakes, and the release leads to electrical discharges in the earth's crust at various depths from 5 to 450 km. Strong earthquakes up to 5 km deep are formed, leading to the destruction of the earth's crust with the formation of faults. All this is suitable for many earthquakes in Tashkent, Turkey, which led to light effects in the area from electrical discharges in the earth's crust.

Spherical nodules serve as an example of the structure of the planet Earth. Their origin is associated with electromagnetic forces that form the rotation of fluids in reservoir formations. During rotation, the host rocks of the formation are attracted to the center and, thus, spherical rings (geospheres) are formed, forming spherical, cylindrical, ellipsoid, almond-shaped, etc. nodules. Fluid rotation is possible only in the void (karst), which contradicts the "classical" understanding of the structure of the reservoir, where porosity and permeability must be present, that is, a crystal lattice.

The absence of the latter is known in coal seams coming to the surface, which are products of paleonefty. This is due to the fact that geological ideas about the formation of spherical nodules were considered from the standpoint of geosynclinal theory (fixism). Oil was formed from organic matter that turned into mantle as a result of nuclear plasma reactions and serves as a lubricant for rotating geospheres and cooling radiators. The rotation of the geospheres of the planet Earth leads to the subduction (displacement) of the lithospheric plates under each other, where organic matter in the form of carbon is drawn into the mantle.

Since oil is a dielectric in which electric current accumulates due to the friction of plates, scales, geodynamic complexes, which are charged from the dynamo effect of the planet Earth itself, where the geospheres rotate from the core at a speed of 20-40 m / sec, as a result in the mantle - 1-10 m / year, and in the lithosphere - 2-16 cm / year. It is quite natural that the electromagnetic field is formed in the form of a vortex at a distance of a basal beam, or karst, which is why nodules on the surface can reach tens of kilometers in length and more than 3 m or more in diameter.

University of Szczecin accelerator system for low energy fusion reactions

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Investigation of nuclear reactions at energies below 1 keV is of the highest interest for cold fusion research. However, technical difficulties resulting from very low nuclear reaction cross sections have always caused problems hard to overcome. The "eLBRUS" laboratories at the University of Szczecin are equipped with a unique accelerator system operating under ultra-high vacuum (UHV) conditions [1]. An electron cyclotron resonance (ECR) ion source delivers light ion beams with currents up to 1 mA and a long-term energy stability of about 10 eV. In the recent years, a special deceleration lens system has been installed to additionally increase beam current at the target for energies below 1 keV. Simultaneously, the maximum acceleration voltage has been set up to 26 kV. The target temperature can be changed in the range between liquid nitrogen and 1000°C. Furthermore, the Auger Spectroscopy system allows monitoring of surface contamination at the atomic cleanness level. Fast exchange of target samples is enabled due to a load lock system.

Combining UHV system with high current ECR accelerator and the energy resolution of only few eV will allow reliable measurements of low-energy fusion cross sections enhanced by the electron screening effect at energies never measured before. The most promising results are expected for the deuteron-deuteron (DD) reactions studied in different metallic environments [2], for which both branching ratios and angular distributions are planned to be determined. Especially, investigation of the internal e^+e^- pair creation [3], recently observed as the strongest decay channel of the 0^+ threshold resonance in ^{4}He [4], might contribute to solve the cold fusion puzzle.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Identifying neutron irradiation in space to mitigate bio-medical effects

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One of the primary challenges to interplanetary human travel is mitigation of radiation exposure. As fast transit with LENR driven or conventional nuclear electric (NEP) or thermal propulsion (NTP) may be imminent, time and level of radiation exposure composing ALARA (As Low as Reasonably Achievable) must be ascertained rapidly and precisely. Since acute physiological effects are difficult to detect, and chronic effects on crew health are delayed and potentially trans-generational, improved detection technologies will be game-changing and an essential element of the crew health monitoring and environmental protection toolkit. Secondary Galactic Cosmic Ray (GCR) induced neutrons are an additional hazard.

The dose equivalent Q factor, which weighs an absorbed radiation dose against its biological effect, ranges from $Q=1$ for x-rays, gamma rays and betas to $Q=5$ for thermal neutrons and $Q=10$ for fast neutrons and alpha particles. Since neutrons only have a < 11 minute half-life, they are constantly produced by fast charged particles or photons shattering atoms terrestrially, in planetary atmospheres and on planetary surfaces. Figure 1 shows the terrestrial spallation neutron spectra originating from atmospheric GCR interactions.The effect is more pronounced on Earth in aircraft and in spacecraft including the International Space Station (ISS) and soon NASA's Lunar Gateway habitat. 95% of GCR are > .5 GeV/nucleon protons and alpha particles. The Earth's magnetic field reduces GCRs reaching the Earth and the Solar magnetosphere similarly reduces them throughout the solar system. Unfortunately, Figure 2 shows the relationship between solar maxima and GCR minima within the Earth's magnetosphere and probably beyond.

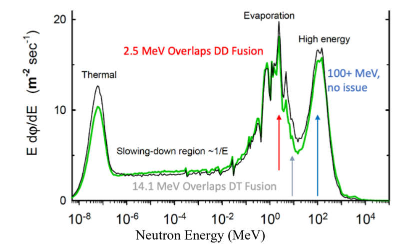

Figure 1 Cosmogenic Neutron Spectra[1]

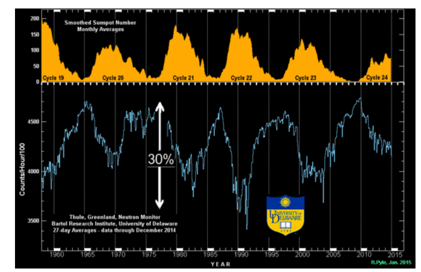

Figure 2 Sunspots vs GCR Flux [1]

Neutron diagnostics include BF_3 and ^{3}He counters, SSNTD and scintillator neutron spectrometers [2] as we have used in LENR/LCF research. However, since the Q value varies with energy, neutron spectroscopy, or at least an energy range, is necessary. Real-time measurements provide an awareness of immediate danger in space and record the heavy ion and secondary neutron doses and their current and future biological effects requiring countermeasures.[3] Once these have been characterized, mitigation strategies can be adopted ranging from spacecraft magnetic shielding against GCR to deploying regolith overburden. *Fast travel is necessary!* [4]

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Successful and unsuccessful high-pressure attempts to synthesize PdH(D)_x>1.0

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This Poster is a literature review of experimental results from independent teams and from our own investigations.

We review the successful and unsuccessful attempts using high pressure (GPa range) and temperatures from room temperature to 2000 K to synthesize superstoichiometric $PdH(D)_x$ (i.e. x > 1.0). Successes include the SAV (Super Abundant Vacancies) phases, synthesized at ~ 3 – 5 GPa and 623 – 1073 K. The evidence against superstoichiometry are X-ray diffraction data suggesting synthesis of $PdH(D)_{x=1.0}$ only (i.e. no apparent indications of phase transition). Some possible reasons for the unsuccesses are given together with some hints for future $PdH(D)_{x>1.0}$ experimental attempts using high pressures.

David J. Nagel (George Washington University, USA) and SART von Rohr (Bitschwiller-les-Thann, France) are both warmly acknowledged by N.A. for their generous financial assistance to attend this meeting.

Poster

Developing methods for characterising elemental anomalies and quantifying isotopic ratios in out-of-equilibrium metal hydrides

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Low-energy nuclear reactions (LENR) have been associated with a plethora of experimental observables, some of which are more and some less indicative of nuclear origins. Among the most compelling reported observables are nuclear transmutations, concomitant with morphological surface changes, which in some instances appear to exhibit unnatural isotopic ratios [1-3]. Motivated by our recently announced [4] ARPA-E LENR project [5], which hypothesizes quantum coherent fusion-fission reactions in out-of-equilibrium metal hydrides (Fig. 1), we identified reports of particle emission (neutrons and γ rays) [6-11] and low-Z element production (Zn, Cr, Fe, etc.) [9], [12-15]. These observables may represent, respectively, the induced asymmetric and near-symmetric disintegration of surrounding metal nuclei. It is therefore of interest to identify what possible disintegration (i.e., fission) products can result from the involved metal nuclei.

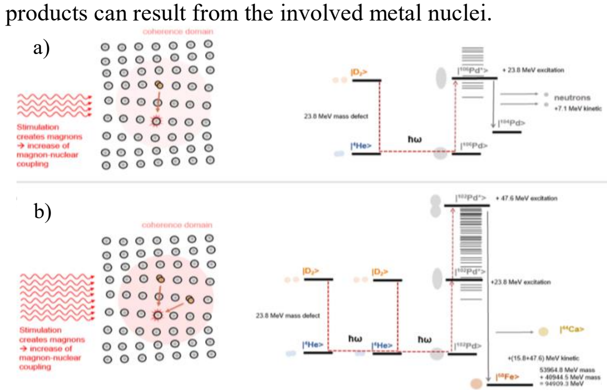

Fig. 1: Quantum coherent nonradiative energy transfer from D_2 to resonant Pd nuclei excited states inducing particle emission (a) and near-symmetric fission (b).

Additionally, we turn our focus to the development of rigorous elemental and isotopic characterization methods. We review relevant techniques such as nuclear activation analysis (NAA) and mass spectrometry (MS) approaches and best practices. Given expected nuclear ash, we detail which isotopes of interest can be measured via NAA, and which should instead be probed by MS. Finally, effort is made to avoid faulty attribution of metal hydride molecular fragments to isotopic shifts.

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Poster

Refinement process and mechanism of nano-Cu-Ni-Zr alloy by high-energy ball milling

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Cu-Ni-Zr alloy is one of materials with great potential and application prospect in Low Energy Nuclear Reaction (LENR) due to its hydrogen storage properties [1,2]. In this paper, the particle refinement process and mechanism of Cu-Ni-Zr alloy by high energy ball milling are discussed. Based on the results of scanning electron microscopy (SEM) and X-ray diffraction (XRD), the process model of particle nanocrystallization in high-energy ball milling is proposed to include four stages: welding, squeezing, fracturing and dynamic balance. The microstructure and phase composition of Cu-Ni-Zr alloy after ball milling are shown in Fig. 1. The results show that the original compositions have been transformed into alloy, the alloy has nanometer polycrystalline structure and its average grain size is 27.6 nm. Fig. 2 shows the variation of particle size in the process.

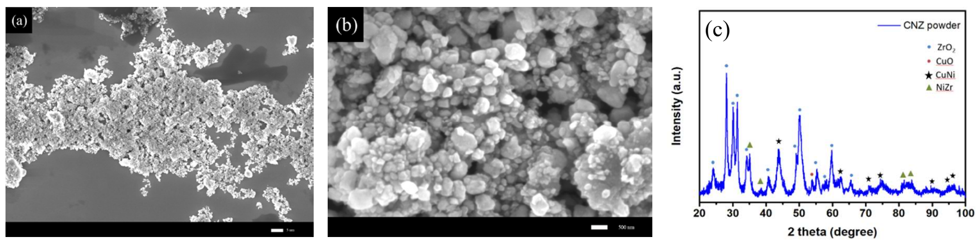

Fig. 1 (a) and (b) SEM images, and (c) XRD pattern of Cu-Ni-Zr alloy.

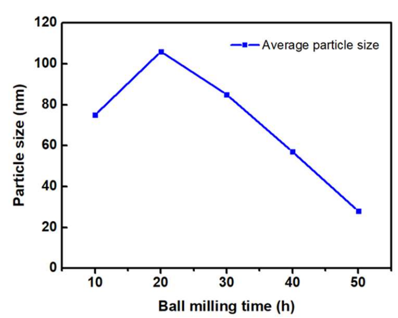

Fig. 2 Variation of particle size with ball-milling time.

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Poster

Hydrogen Atom and Low-Energy Nuclear Fusion (LENR)

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In conducting experiments on low-energy nuclear reactions (LENR), atomic hydrogen or deuterium is an important and necessary component. Therefore, identifying all the intricacies of electron behaviour in the hydrogen atom can play a decisive role in creating a LENR theory. Despite the existence of a large amount of material on this issue, it is still too early to draw a conclusion. Currently, there is no widely accepted satisfactory theory of the mechanism of anomalous energy release during LENR experiments. However, numerous hypotheses based on various physical phenomena are proposed, often quite exotic from the standpoint of ordinary logical thinking. Among the intensively discussed and popular hypotheses, a special place is occupied by the hypothesis of the existence of hydrogen atom energy states with energy below that of the so-called ground state (-13.6eV). It must be acknowledged that these hypotheses are not entirely groundless. In many experiments with hydrogen plasma [1][2], high-energy radiation in the form of gamma quanta in the range above 300 keV is observed, which is not characteristic of the hydrogen atom. Additionally, many attempts are being made by different authors to theoretically explain this phenomenon [3][4][5]. The recently created new relativistic equation M2 [6] is a unique tool for investigating the hydrogen atom and hydrogen-like ions. Solutions of the M2 equation, in addition to the usual states of the hydrogen atom in the low-energy region, also have states in the high-energy region.

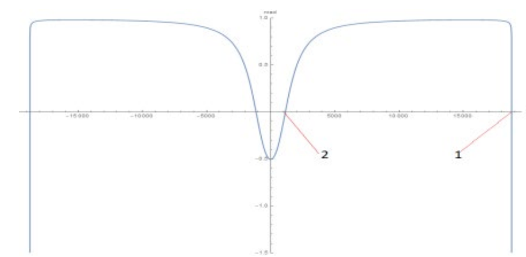

Fig. 1 Dependence of the binding energy of a hydrogen atom on the radial quantum number nrad when l=1

The given example of a graph depicting the dependence of the binding energy of the hydrogen atom on the quantum numbers clearly demonstrates the above statement. Point 1 corresponds to the low binding energy state, while point 2 corresponds to a deep, compact state with high binding energy. Solutions of the relativistic equation M2 demonstrate the theoretical possibility of the existence of compact states of the hydrogen atom with binding energies in the range of 400-500 keV. Exploring deep states of hydrogen and deuterium through experiments and theory will advance LENR research and address global energy challenges.

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Poster

Possible physical explanation for lattice confinement fusion

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A recent study, presented at ICCF-25, shows that the point charge electron when captured by the nucleus transfers to surface charge. Based on energy balance investigation it can be shown that the ionization energy is the same as the one-dimensional Casimir energy on the surface of the electron shell. If the Casimir effect is partially blocked on the surface of the electron shell, then, predictively, the energy required to remove the electron reduces proportionally. Thus, on single atom on the surface of a metal the active proportion of the surface is about 0.5, and for completely shielded atoms, inside a metal, is zero (Fig. 1). These predictions are consistent with experimental results of the photoelectric effect and the "electron sea" model of metals.

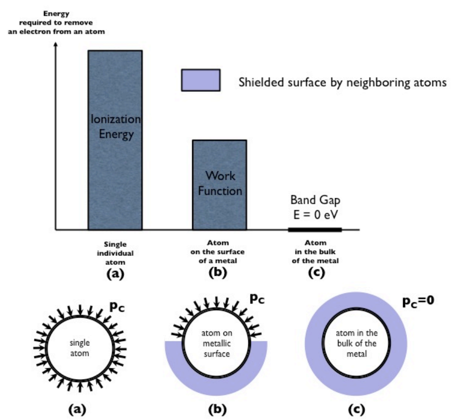

Fig. 1 The removal of the first valence electron from the surface an individual atom requires to overcome on the one-dimensional Casimir energy acting on the surface. If the surface of the atom is shielded from the Casimir effect then the energy required to remove the electron reduces proportionally. (a) free individual atom **(b)** atom on the surface of a metal **(c)** atom inside a metal

If the neighboring atoms in the lattice do not support the Casimir pressure, acting on the surface of a metal, then the electron shell of the atom under the asymmetric pressure will deform (Fig. 2).

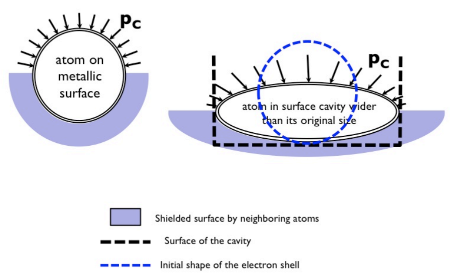

Fig. 2 The non-uniform stress on the electron shell of the atom deforms the electron shell until equilibrium is reached.

If this hypothesis is correct, then the nuclear reaction should occur in small cracks or gaps in the lattice where a Deuterium or Hydrogen molecule could be trapped. The optimum sizes of the cracks were estimated. Electrolysis, diffusion, or even stress can generate asymmetric pressure on the electron shell of the atom. Under the right conditions any of these processes might be sufficient to initiate and maintain the Lattice Confinement Fusion.

Higgs Boson Mass And Neutron, Proton Masses

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The scalar Boson called Higgs Boson is the fundamental particle associated with the Higgs Field, a field that gives mass to other fundamental particles of the Standard Model such as electrons and quarks.

As the nucleon, i.e. the neutron that decays into proton, electron, and antineutrino is the only stable particle of the Standard Model it is interesting to seek for a mass relationship between the Higgs Boson and the neutron, proton, and electron.

The mechanism yielding the neutron mass from the Higgs Boson mass will be shown. It is based on an iterative "massification" and "demassification" process. This process is responsible for creating mass as well as annihilating it after a time gap, and hence for releasing baryonic mass, the mass one knows. So, baryonic mass is the result of the implementation of a bigger amount of mass which is offset by that same amount of mass, nevertheless with a time shift resulting in the "creation" of baryonic mass. The impression left is the occurrence of mass and antimass, the latter acting as negative mass.

This process is in turn yielding electromagnetism, as it will be shown. Negative electromagnetism is the occurrence of mass + antimass, positive electromagnetism that one of antimass + mass. This will be shown in discussing the weak nuclear force, when the neutron is decaying into proton, electron, and antineutrino.

The strong nuclear interaction will be longer discussed as there is a fundamental interest in that force for the understanding of LENR versus classical nuclear fusion. These two processes are based on different approaches, the one on the Higgs Boson endowing mass process, the other on the known classical solution. The process the author is interested in is based on several quantized binding energy values determined on basis of neutron and proton mass. Examples of calculating binding energy values for various nuclei will be given.

Keywords: Higgs Boson, neutron, proton, electron, dipolar magnetic moment, weak nuclear interaction, strong nuclear interaction.

Low-Energy Cold Fusion Chain Reaction (LENR) is a new source of carbon-free energy

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The motion of matter, i.e. any change, including gravitational, electromagnetic and low-energy nuclear reactions LENR, the description of which is the task of science, can be further cognized solely on the based on a new scientific paradigm, postulating:

The primacy of the movement of our World as a way of its existence, as its absolute attribute, which is confirmed by all our experience. [1,2,3]

Our World - Cosmos, which is in constant motion-change, - the only absolutely non-local entity that unites absolutely everything: material bodies, all types of substances, incl. Bose-Einstein condensate, physical fields and ether, physical vacuum, object and subject (observer), current and conductor, "moving body" and "perpetual motion machine" with power $N=h/t_P$ (absolute invariant) in one person and singular. The non-locality of our World is confirmed, in particular, by the experiments of Alain Aspect, John Clauser and Anton Zeilinger with entangled photons and the establishment of a violation of Bell's inequalities and modern experiments.

Elementary particles, bodies and fields are the corresponding dynamical states material and energy field (MEF), and neutrino is a material-energy "displacement current", matter in the convergence-divergence process:

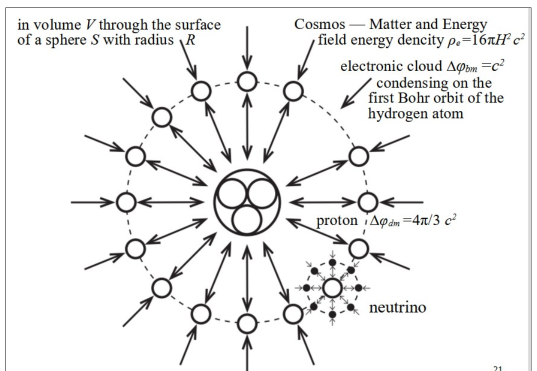

Fig.1. Convergence-divergence of matter-energy Cosmos in the hydrogen atom

In terrestrial conditions, by analogy with a natural experiment - the explosion of a supernova SN1987A, one of the real nuclear chain reactions of β-decay ($n \rightarrow p+e^-+\bar{\upsilon}_e$) along the main channel, when controlled by various methods, is feasible in the laboratory: passing hydrogen $^1H_1$ (tritium $^3H_1$, deuterium $^2H_1$, water H_2O) through $^{63}Ni_{28}$, (or ^{56}Ni) (artificial radioactive isotope of nickel, harmless to humans, serving as a source antineutrino (neutrino) and substance absorbing neutrons), at $t \sim 1200°C$:

$$\rightarrow \bar{\upsilon} + {}^{63}Ni_{28} + {}^1H \rightarrow {}^{63}Cu_{29} + e^- + \bar{\upsilon} + {}^1H + Q \rightarrow \bar{\upsilon} + p^+ + e^- \rightarrow \bar{\upsilon} + p^+ \rightarrow e^+ + n \rightarrow n \rightarrow p^+ + e^- + \bar{\upsilon} \rightarrow + {}^1H \rightarrow \quad (1)$$

where $^{63}Cu_{29}$ is a stable non-radioactive copper isotope.

With this chain reaction of LENR, along with the transmutation of the nuclei of elements and the release of the kinetic energy of the particles in the form of heat Q, it is possible to generate a high power electric current from emitted electrons, for example, using diamond semiconductors, in particular using carbon ^{14}C (beta-galvanic device, beta-voltaic generator) or others.

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Poster

The Electromagnetic Considerations of the Nuclear Force Part IV: The Electromagnetic Behavior of the Nuclear Force for the Smaller Nuclides

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This is part 4 of a series of papers on the electromagnetic considerations of the nuclear force. This model discusses the role of the electromagnetic force inside the nucleus. Previous models for the nuclear force have had only a minor inclusion of the electromagnetic forces, usually in the form of a repulsive Coulomb energy between protons. However, the quarks, which are distinct and separate within the nucleon, are the true centers of electric charges and magnetic dipole moments within a nucleon. As a result, all nucleons contain both positive and negative charges and positive and negative magnetic dipole moments. Previous models of the nuclear force have ignored the fact.

The first three papers [1, 2, 3] of this series examine how the electromagnetic behavior affects nuclear behavior. This fourth paper continues with this examination, describing how particle decay and other unexplained nuclear behaviors are caused by the electromagnetic forces within each specific nuclide. This paper explores the electromagnetic force within the nuclides—focusing on the smaller nuclides—and relating it to nuclear behavior. Each nuclide with A≤12, whether stable or unstable, is examined in its ground state, as well as in several excited states. The salient nuclear behaviors are explained.

This paper relates the standard electromagnetic principles to the structure inside a nucleus. There is nothing speculative or unrealistic about including the laws of electromagnetics within the nucleus, since the laws of electromagnetics remain unchanged, whether inside or outside the nucleus. The electromagnetic behavior of electrical charges and magnetic moments is experimentally verified and completely understood. The ideas presented in this paper are not some type of newly-invented or novel physics, but rather simply the application of standard electromagnetics to nuclear physics.

The majority of the nuclear behavior for these smaller nuclides can be explained by examining the electromagnetic forces and energies. These gained insights are extended to the patterns of behavior for the intermediate-sized nuclides. New understandings, unachieved by any previous model of the nuclear force, are revealed and explained. Over 100 questions about the nuclear behavior of the smaller nuclides are answered by this model, questions that no other model of the nuclear force can satisfactorily answer.

Using this model, a better understanding of low energy nuclear reactions (LENR) can be achieved. Numerous questions and unexplained experimental results can be understood. For example:

- The correlation between the released energy of a reaction and bond breakage.
- A better understanding of why certain isotopes have such a large thermal neutron cross section.
- Why di-neutrons and di-protons are instantly unstable.
- What is actually happening inside the nuclear structure when fusion occurs.
- What is actually happening inside the nuclear structure when fission occurs.
- Why deuterium has such a low nuclear bonding energy, and why it has no excited states.

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Poster

Phase transformation of the electrons and the structure of the atoms

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Many hundreds of experiments from well-established laboratories have reported excess heat, which is beyond the quantity explainable by chemical reaction, demonstrates that cold fusion or Lattice Confinement Fusion (LCF) is real. Accepting cold fusion as a physical reality, puts theoretical constrains on our contemporary physics. Two of them are exposed here.

One: Based on contemporary physics, cold fusion and transmutations are impossible at the reported low temperatures and pressures. Thus, if someone wants to understand and explain these physical phenomena then it must go beyond the current knowledge of physics and thinking out of the box. Thus, theoretical models developed on the knowledge of contemporary physics lead to a dead end.

Two: It is well established that the probability of getting two nuclei close enough, required for LCF, is zero. Despite this theoretical constrain, LCF has been experimentally verified. The existence of LCF requires that the repulsion of the same charges/nucleus must be shielded from each other until they can get close enough for the reaction. This shielding effect can only be possible if the electrons form a surface charge halo around the nucleus. The characteristic features of the atoms support the proposed phase transformation of the electron from point charge to surface charge.

Experiments show that the laws of classical electromagnetism are valid at atomic and even at smaller scale. The consequence of applying the laws of electromagnetism to the atoms is that the non-emitting captured electron in the atom must be stationary. The stability of this captured electron can only be ensured if the point charge electron transforms to an equally distributed surface charge around the nucleus. The known features of the atoms are consistent with this phase transformation. The disturbances of the atom induce vibrations in the surface charge electron shell. The constrained size of the shell has restrictions on the wavelength, explaining the quantized nature of the momentum and the energy. The generated standing waves in the electron shell are symmetrical. This complete canceling of the fields results in no emission. Radiation is emitted only when the vibration is asymmetric. Switching from one symmetrical mode (standing wave) to another one results in emission during the transition period. Schrödinger wave equation three-dimensional and describes the vibration of a spherical shell. Thus, the surface charge electron shell of the atoms consistent with and offers a physical explanation for the wave equation.

The shielding effect of the surface charge electron shell model offers a physical reasoning of how the experimentally verified cold fusion and transmutations can occur (Fig. 1). Thus, this model should be seriously considered as a possible game changer in our understanding of Lattice Confinement Fusion.

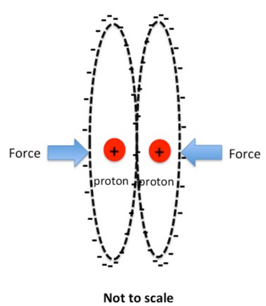

Fig. 1 Schematic figure shows the shielding effect of the surface charge electron shell atomic model for two hydrogen atoms. Acting force on the atomic surface results in the deformation of the surface charge electron shell. The two nuclei can get close to each other with no repulsion.

Nature of spontaneous signal and detection of radiation emitted from Hydrogen Rydberg Matter

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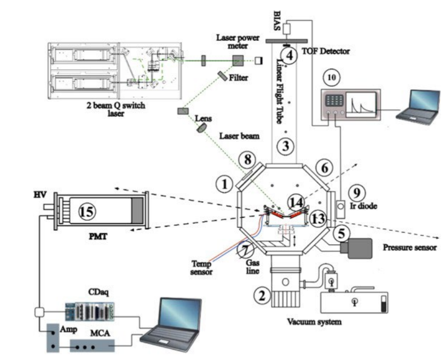

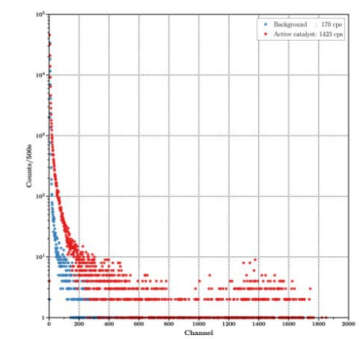

FIG. 7: Intensity of a PMT detector with aluminium foil before and after H_2 gas activation. Low active chamber gave 170 cps vs active chamber 1423 cps, 500s spectra time

In this talk/poster we report on radiation and spontaneous radiation emitted from a chamber containing Hydrogen Rydberg Matter. The experimental setup is a replication of the reactor and detection system setup reported by Prof. Leif Holmlid at Gothenburg University [1]. The results presented here were recorded randomly in our lab for over four years. The research shown in this work verifies that when Hydrogen enters an iron oxide catalyst containing potassium, the catalyst or chamber will eventually emit penetrating radiation that behaves as X-rays, and the radiation can be easily detected using several detector methods.

The emitted isotropic radiation is generated in or penetrates a 3 mm thick steel plate and several meters of air. The radiation can be detected in a simple photoelectric multiplier (PM) detector with aluminum foil covering the front end of the PM tube.

The experimental setup, how to initiate the radiation, and radiation detector construction is given. The Detector stability, time development of detector response when the chamber is activated by gas loading, and laser excitation is reported. Gamma, X-Ray sensitivity, and pulse shape are further examined to characterize the emitted radiation.

The spontaneous signal shows all indications of being x-ray in character. These observations and conclusions defy the current knowledge and understanding of Hydrogen behavior in materials and need further research by other research groups.

Keywords: Hydrogen Rydberg Matter, radiation, X-ray, Photon Electron multipliers (PMT), Dark current counts, cryogenic cooling.

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Calibration of an Electrode-Energy Partition Model Using George Miley's Published Data

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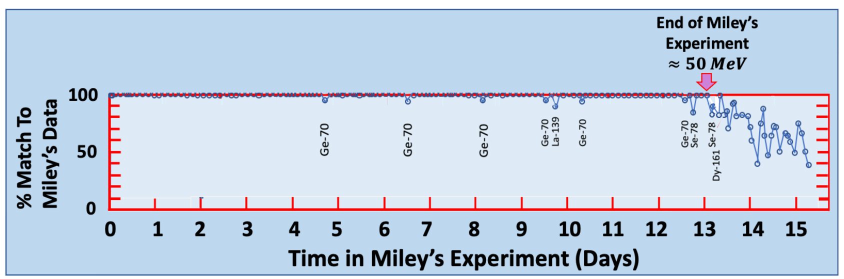
The single greatest need in cold fusion research is a scientific theory of its nuclear process. It is only at this level of understanding that nuanced insights can be brought to electrode design and developing a commercial device. In this paper I will be discussing the first calibrated model of cold fusion fundamentals. Its comparison to George Miley's published transmutation data set yields excellent agreement with model predictions of new isotopes measured in Miley's experiment. The model's excess heat calculation accurately predicts the 2-4 watts that Miley reports.

My presentation begins with a summary of the model's theory. I will discuss the source of the raw process energy, how it is accumulated to thermonuclear energy levels, and where it is stored in a room temperature nickel electrode. I want you to understand how a continually increasing, internal electrode energy, causes nuclear transmutations in the order of their increasing fusion-ignition requirement, and how unstable fusion products decay along *known* decay pathways to their final stable isotope products without gamma emissions.

The transmutation process is simulated in the Least Action Nuclear Process (LANP) modelling program. The user begins by inputting an initial electrode's isotope composition. The model then produces all of the possible nuclear reactions involving these initial isotopes plus 1-4 protons. These reactions are then arranged in order of increasing fusion-ignition energy and summarized as: 1) a four-component energy balance, 2) one or two stable isotope products, and 3) a comparison to Miley's final electrode measurements.

Note below, how the model continues to predict transmutations beyond where Miley's measurements end. There are no measurements at these electrode energies, and the % match drops away rapidly. A sampling of the first 20 of 1,262 fusion reactions and their energy components are shown.



	FUSION REACTION	FUSION PRODUCT	LANP PRODCT	RARE DECAY	RARE DECAY PRODUCT	SPONT. FISSION PRODUCT		ENERGY COMPONENTS (amu) FUSION	LANP	RARE DECAY	FISSION	TOTAL	FINAL ISOTOPES 1	2	DATA MATCH 1	2	%	
1	50Cr + 70Zn + (4)n =>	124Xe	=> 124Xe	=> B+B+	=> 124Te	=> SF => 62Ni	61Ni	0.00013	0.00000	0.00417	0.03146	0.03159	62Ni	61Ni	Y	Y	1.000	0.00
2	51V + 54Fe + (3)n =>	108In	=> 108Cd	=> B+B+	=> 108Pd	=> SF => 54Cr	54Cr	-0.00013	0.00496	0.00139	0.02503	0.02987	54Cr	54Cr	Y	Y	1.000	0.00
3	61Ni + 50Cr + (4)n =>	115Te	=> 115Sn			=> SF => 57Fe	57Fe	-0.00014	0.00746	0.00000	0.02170	0.02902	57Fe	57Fe	Y	Y	1.000	0.00
4	51V + 57Fe + (3)n =>	111In	=> 111Cd			=> SF => 55Mn	55Mn	0.00024	0.00147	0.00000	0.01613	0.01785	55Mn	55Mn	Y	Y	1.000	0.00
5	57Fe + 57Fe + (4)n =>	118Te	=> 118Sn			=> SF => 59Co	58Fe	-0.00038	0.00422	0.00000	0.02372	0.02757	59Co	58Fe	Y	Y	1.000	0.00
6	52Cr + 52Cr + (3)n =>	107Cd	=> 107Ag			=> SF => 53Cr	53Cr	0.00039	0.00097	0.00000	0.01349	0.01485	53Cr	53Cr	Y	Y	1.000	0.00
7	52Cr + 54Cr + (3)n =>	109Cd	=> 109Ag			=> SF => 54Fe	52Cr	0.00040	0.00078	0.00000	-0.00520*	0.00118	109Ag		Y		1.000	0.00
8	50Cr + 57Fe + (3)n =>	110Sn	=> 110Cd			=> SF => 55Mn	54Cr	-0.00041	0.00484	0.00000	0.01467	0.01910	55Mn	54Cr	Y	Y	1.000	0.00
9	58Ni + 54Cr + (4)n =>	116Te	=> 116Sn			=> SF => 58Ni	57Fe	0.00042	0.00562	0.00000	0.02014	0.02619	58Ni	57Fe	Y	Y	1.000	0.00
10	54Cr + 54Cr + (3)n =>	111Cd	=> 111Cd			=> SF => 55Mn	55Mn	-0.00042	0.00000	0.00000	0.01613	0.01571	55Mn	55Mn	Y	Y	1.000	0.00
11	61Ni + 53Cr + (4)n =>	118Te	=> 118Sn			=> SF => 59Co	58Fe	0.00054	0.00422	0.00000	0.02372	0.02849	59Co	58Fe	Y	Y	1.000	0.00
12	62Ni + 50Cr + (4)n =>	116Te	=> 116Sn			=> SF => 58Ni	57Fe	0.00059	0.00562	0.00000	0.02014	0.02636	58Ni	57Fe	Y	Y	1.000	1.00
13	60Ni + 50Cr + (4)n =>	114Te	=> 114Sn			=> SF => 57Fe	55Mn	-0.00060	0.00822	0.00000	0.00927	0.01688	57Fe	55Mn	Y	Y	1.000	1.00
14	51V + 70Zn + (4)n =>	125I	=> 125Te			=> SF => 62Ni	62Ni	-0.00069	0.00075	0.00000	0.03579	0.03584	62Ni	62Ni	Y	Y	1.000	1.00
15	64Ni + 52Cr + (4)n =>	120Te	=> 120Te	=> B+B+	=> 120Sn	=> SF => 60Ni	59Co	-0.00089	0.00000	0.00292	0.02681	0.02592	60Ni	59Co	Y	Y	1.000	1.00
16	54Fe + 58Fe + (4)n =>	116Te	=> 116Sn			=> SF => 58Ni	57Fe	-0.00092	0.00562	0.00000	0.02014	0.02485	58Ni	57Fe	Y	Y	1.000	1.00
17	50V + 68Zn + (4)n =>	122I	=> 122Te			=> SF => 61Ni	59Co	-0.00093	0.00400	0.00000	0.01762	0.02069	61Ni	59Co	Y	Y	1.000	1.00
18	50V + 70Zn + (4)n =>	124I	=> 124Te			=> SF => 62Ni	61Ni	0.00093	0.00284	0.00000	0.03146	0.03523	62Ni	61Ni	Y	Y	1.000	1.00
19	50V + 56Fe + (3)n =>	109In	=> 109Ag			=> SF => 54Fe	52Cr	0.00094	0.00240	0.00000	-0.00520*	0.00334	109Ag		Y		1.000	1.00
20	58Ni + 50Cr + (4)n =>	112Te	=> 112Sn	=> B+B+	=> 112Cd	=> SF => 56Fe	55Mn	-0.00096	0.01110	0.00316	0.01727	0.02740	56Fe	55Mn	Y	Y	1.000	1.00

(-)* CAN NOT OCCUR

The model is based entirely in classical physics. It is completely interactive, allowing the user to change model parameters at will. The model is available to ICCF-25 participants after my talk.

Poster

Local crystal structure of deuteron implanted Zr samples relevant to LENR

#Agata Kowalska [1], Konrad Czerski [2], Paweł Horodek[3], Krzysztof Siemek[3],
Jolanta Baranowska[4], Justyna Słowik[4], Mateusz Kaczmarski[2], Natalia Targosz-Ślęczka[2],
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LENR phenomena are known to be extremely dependent on the local crystal structure and crystal defects of the deuterated samples. Recent studies of the $^{2}H(d,p)^{3}H$ reactions in metallic targets, at projectile energies far below the Coulomb barrier, confirm a significant enhancement of cross sections due to the electron screening effect enhanced additionally by crystal lattice defects of the target material. Modification of the local crystal structure has strong influence on both hydrogen diffusion and the effective electron mass. The latter determines the strength of the local electron screening effect [1] and can change the deuteron-deuteron reaction rates at thermal energies by many orders of magnitude [2].

$^{2}H(d,p)^{3}H$ reactions are studied using the unique accelerator system with ultra-high vacuum, installed in the eLBRUS laboratory at the University of Szczecin [3]. Metal samples exposed to various conditions and energies of deuteron beams are then investigated by means of the X-ray diffraction (XRD) and positron annihilation spectroscopy (PAS) [4]. Whereas the variable energy positron beam spectroscopy revealed a very high density of crystal vacancies distributed uniformly up to the range of implanted deuterons, the positron annihilation lifetime measurement shown that they remained monovacancy type defects. Additionally applied grazing angle incidence XRD at three different incident angles ($\omega = 3^0, 5^0, 10^0$) enabled to calculate dislocation densities on different depths of the target and oxygen movement to the deeper layers of Zr imposed by irradiation. This result has been confirmed by the depth distribution of vacancies measured by PAS. Implantation of additional oxygen atoms lead to diffusion of vacancies into deeper layers of the Zr target reducing the enhancement factor of the $^{2}H(d,p)^{3}H$ reactions.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Poster

Low energy nuclear reactions in the metallic mesh wires

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In this work, we have investigated that the suggestion of a new mesh-metallic target for nuclear reactions and the possibility of producing some deuterated mesh targets using in-situ growth techniques is a novel idea which will be presented in this talk. The adjustable geometrical structure of the growth mesh structures provides the potential to change the nuclear cross-section at low energies, which could be utilized to adjust the number of neutrons and protons in the source or the energy production using d + d reactions in mesh structures in the future.

Furthermore, the role of effective electron mass in understanding the enhanced screening energy in metallic and metallic mesh environments is highlighted. The physics of low-energy nuclear reactions in metallic environments requires a new nuclear reaction theory that incorporates polarized beams and polarized electrons, as well as induced adiabatic polarization of the reacting nuclei in a crystal lattice.

The application of this new theory has been demonstrated in the case of the $d(d,p)^3T$ and $^3He(d,p)^4He$ reaction and time-dependent screening enhancement for d + d reaction at very low energies. This suggests the need for further research and development in understanding and utilizing the unique properties of mesh-metallic targets for nuclear reactions, as well as advancing the theory of nuclear reactions in metallic environments to fully exploit their potential for practical applications.

Detection of high-density states of hydrogen isotopes via ion beam acceleration against catalytic targets

#U. Abundo[1], G. De Vita[1], R. Dubey[2], F. Galli[1], D. Imperatori[1], G. Parchi[1], M. Zecchiaroli[1]
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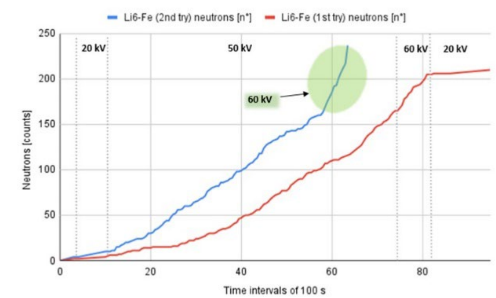
High-density states of hydrogen isotopes have been proposed by L. Holmlid as a key condition to achieve efficient LENRs [1][2][3][4][5]. Following his experiences, tests with targets made of different materials and an iron oxide-based, alkali promoted catalyzer, were carried-out.
A special particles accelerator was built to perform ions collisions against even non-conductive materials held in cathodic potential. Different materials were tested as targets in deuterium atmosphere to compare the corresponding neutron yield due to D-D fusion reactions, at the same ionization and acceleration conditions, measuring the neutron count rate with a Helium-3 proportional counter (Atomtex AT6102).

Tests with metals (W, Ti, Fe and Ir) and oxides (Fe_2O_3 and Al_2O_3-based materials) have demonstrated that metallic targets generally show higher average neutron count rates than ceramic ones. Particularly, repeated tests with an industrial potassium-promoted iron oxide catalyzer (used for dehydrogenation of ethylbenzene) revealed a neutron yield one and half (1,5) times higher than with a titanium target, the most used industrial metal for neutron gun generators.
According to the results of our experiments, the formation of high concentrations of hydrogen isotopes on the surface of suitable catalyzers can be confirmed, greater than inside the micrometric layers of metals in which hydrogen isotopes form hydrides by implantation.
A better yield in terms of neutron count rate, both respect to ceramic targets and to some metals, was achieved also with a target made of a ^6Li-doped iron oxide catalyzer *(Figure – Neutron counts at different acceleration voltages)*



The experimental investigations are supported by different simulations which allowed to do a reverse estimate of the density levels of deuterium produced during the experiments.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Confirmation of Anomalous-Heat Report

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Abstract

This study identifies, for the first time, critical calculation errors made by Nathan Lewis and his co-authors, in their study presented May 1, 1989, at the American Physical Society meeting in Baltimore, Maryland. Lewis et al. analyzed calorimetrically measured heat results in nine experiments reported by Martin Fleischmann and his co-authors. According to the Lewis et al. analysis, each of the experiments, where calculated for no recombination, showed anomalous power losses. When we used the same raw data, correct calculations indicate that each experiment showed anomalous power gains. As such, these data suggest the possibility of a new, energy-producing physical phenomenon.

Historical Perspective

On April 10, 1989, a published journal article by Martin Fleischmann, Stanley Pons, and their collaborators at the University of Utah reported evidence of anomalous heat gains in a set of heavy-water electrochemical experiments using palladium cathodes. This indicated the possibility of a new energy-producing phenomenon. [1,2]

On May 1, 1989, at the American Physical Society meeting in Baltimore, Maryland, Nathan Lewis criticized the Fleischmann et al. article and claimed that the same data indicated anomalous heat losses. Thus, according to calculations presented by Lewis et al., there was no evidence of a new energy-producing phenomenon. [3] Since then, that unpublished Lewis presentation has been used as the authoritative reference for Fleischmann et al.'s heat measurements instead of Fleischmann et al.'s own published papers. [4, 5] Lewis et al. never published their critique of the Fleischmann et al. power values in a peer-reviewed journal. The Lewis et al. paper in *Nature*, submitted after the APS meeting, discussed only the failed Caltech experiments. [6]

Introduction

We have examined the data and calculations presented by Lewis et al. We find that the raw data they used for the Fleischmann et al. experiments are accurate. However, we report here for the first time that their calculations were performed incorrectly. When calculated correctly, using the same raw data, these data confirm, rather than disprove, the anomalous-heating effect. As a result, a possible new source of energy is indicated, with a potentially vast impact on energy science, technology, and the fields of chemistry and physics.

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Wednesday

August **30th**

Coherent nuclear dynamics for the nuclear part of LENR models

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Excess heat in LENR experiments does not come about as a result of (incoherent) dd-fusion reactions, which would result in MeV neutrons and energetic ions in amounts commensurate with the energy produced. Such products are not observed in experiments, which rules out all quantum mechanically incoherent fusion and fission reactions as candidate explanations. The focus of our research has been on approaches based on coherent quantum dynamics, in which small couplings between nuclei and condensed matter degrees of freedom are greatly enhanced due to cooperative (Dicke) factors. The nuclear "reactions" important in coherent dynamics differ from the incoherent reaction pathways that we are used to (such as dd-fusion), and can be greatly accelerated due to the different scaling laws that apply.

Progress on the development of such models has long been hindered due to the lack of suitable reasonably stable excited nuclear states. A solution to this problem was presented at ICCF-24, where non-rotating nuclear molecule states were identified as candidates to support the coherent nuclear dynamics. Since then, there has been progress in model development, leading to a theoretical scenario that seems closely connected to experiment.

According to the current model, excess heat in PdD_x starts with excitation transfer from $D_2/^4He$ transitions to resonant $^4He/D_2$(compact) transitions. For the nuclear system to down-convert the large 24 MeV nuclear quantum into lower energy quanta at the eV level and below, a large number of closely spaced reasonably stable nuclear states are needed, where the average energy difference between levels is on the order of the energy quantum that can be exchanged through the coherent energy exchange process. The largest density of relevant nuclear molecule states occurs near the band head expected near 35-40 MeV in the stable Pd isotopes. It was proposed at ICCF-24 that 3rd-order generalized excitation transfer processes can be efficient at promoting excitation at multiples of the $D_2/^4He$ transition energy. A minor variation of the scheme is capable of moving excitation up to where the density of states is high if one upward transition is coupled to a downward transition to the ground state, and a downward transition to a low-lying excited nuclear molecule state.

Unfortunately, the high density of states is not sufficiently high over a large enough range of energy for the down-conversion of the large 24 MeV quantum. If sufficient nuclear excitation is promoted to near the band head, then it may be that 4th-order generalized excitation transfer processes become important. In this case, the relevant nuclear density of states is the pair density of states, and this density of states is sufficiently large so that the energy transfer required for each step can be matched to the coherent energy transfer quantum (which according to recent estimates may be near 10 keV if plasmon degrees of freedom dominate the energy exchange). When the Dicke-enhanced coupling is sufficiently strong that the 4th-order processes become important, then nuclear energy can be converted efficiently to condensed matter degrees of freedom. The analogous band head for the Ni isotopes is thought to be between 30-35 MeV, which is a good match for a 7-8x multiple of the $HD/^3He$ transition energy. This and the large multiplicity of stable isotopes are proposed as contributing factors that makes Ni efficient for excess heat production in NiH_x.

When the coupling is insufficiently strong for the excess heat path to proceed efficiently, then the nuclear molecules can tunnel decay leading to transmutation, or decay through tunnelling of low mass nuclear fragments leading to low-level nuclear emissions. In essence, transmutation is connected fundamentally to the process that makes energy in this kind of model.

An overview of the model will be given, and recent progress on model development and simulation results will be presented.

$A^{1/3}$—Law in Nuclear Transmutation of Metal Hydrides (II)

* X. Z. Li [1], C. L. Liang[1], G. S. Huang[1], S. X. Zheng[2]
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[1] Dept. of Physics, [2] Dept. of Engineering Physics, Tsinghua University, Beijing, CHINA
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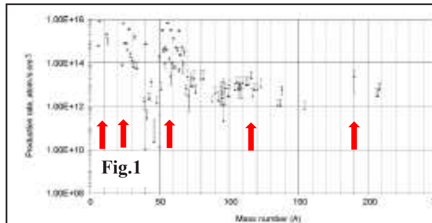

Fig.1

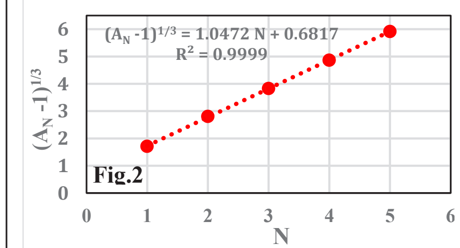

Fig.2

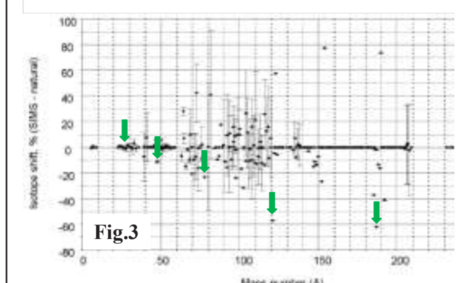

Fig.3

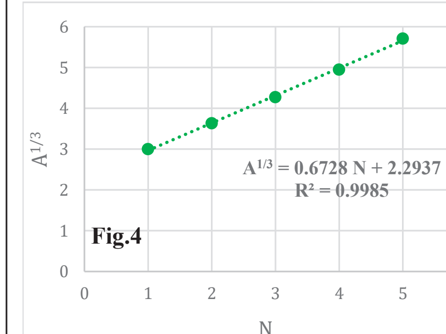

Fig.4

In addition to the temperature dependence of excess power, atomic mass (A) dependence of nuclear transmutation in metal hydride reveals again the existence of Low Energy Nuclear Resonance in lattice.

During ICCF-23 in China and ARPA-E Workshop in US, Professor Nagel showed A-dependence of nuclear transmutation in Ni-H. It turns out to be the evidence of the resonance between the wave length of the proton and the radius of the target nucleus [1]. It was found that the peak position, A_N, may be expressed by $A^{1/3}$**—Law:**

$(A_N)^{1/3} \approx$ a N+ b.(N is a positive integer).

Many thanks to Professor Miley, we are able to discuss new evidence of A-dependence in Ti-H here [2]. Fig.1 shows again 5 production peaks of the production rate (upward red arrows). Since the main reaction to produce nucleus with mass number A_N is the reaction between proton and the nucleus with mass number (A_N -1). The line $(A_N -1)^{1/3}$ versus N should be a straight line. Fig.2 shows this good agreement with the expectation ($R^2 = 1$ is for a perfect straight line).

On the other hand, 5 depletion peaks in isotope shift, A_N (downward green arrows on Fig.3), are due to the reactions between proton and nucleus with mass number A_N; hence, $(A_N)^{1/3}$ versus N should be a straight line. Fig.4 shows the expected result as well.

Ni-H is a face-centred cubic crystal (fcc), and Ti-H is a hexagonal close-packed crystal (hcp). The slopes of these straight lines for fcc and hcp are different. It may implies the importance of multiple-scattering in resonance.

Thus $A^{1/3}$ **—Law** justified the existence of Low Energy Nuclear Resonance in Condensed Matter Nuclear Science, and the importance of lattice in resonance.

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Theoretical and Computational Studies

Calibration of an Electrode-Energy Partition Model Using George Miley's Published Data

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The single greatest need in cold fusion research is a scientific theory of its nuclear process. It is only at this level of understanding that nuanced insights can be brought to electrode design and developing a commercial device. In this paper I will be discussing the first calibrated model of cold fusion fundamentals. Its comparison to George Miley's published transmutation data set yields excellent agreement with model predictions of new isotopes measured in Miley's experiment. The model's excess heat calculation accurately predicts the 2-4 watts that Miley reports.

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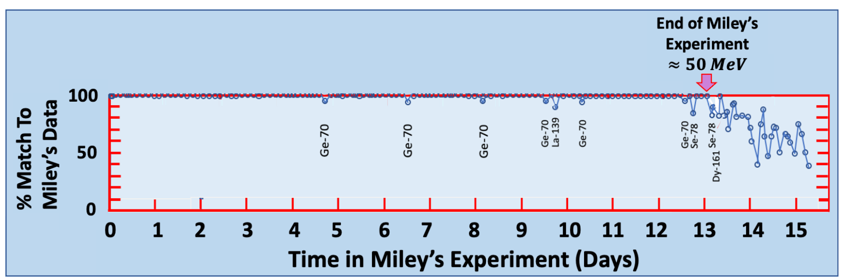
The transmutation process is simulated in the Least Action Nuclear Process (LANP) modelling program. The user begins by inputting an initial electrode's isotope composition. The model then produces all of the possible nuclear reactions involving these initial isotopes plus 1-4 protons. These reactions are then arranged in order of increasing fusion-ignition energy and summarized as: 1) a four-component energy balance, 2) one or two stable isotope products, and 3) a comparison to Miley's final electrode measurements.

Note below, how the model continues to predict transmutations beyond where Miley's measurements end. There are no measurements at these electrode energies, and the % match drops away rapidly. A sampling of the first 20 of 1,262 fusion reactions and their energy components are shown.



	FUSION REACTION			FUSION PRODUCT	LANP PRODCT	RARE DECAY	RARE DECAY PRODUCT	SPONT. FISSION	PRODUCT		ENERGY COMPONENTS (amu) (-)* CAN NOT OCCUR FUSION	LANP	RARE DECAY	FISSION	TOTAL	FINAL ISOTOPES 1	2	DATA MATCH 1	2	%	
1	50Cr	+ 70Zn	+ (4)n =>	124Xe	=> 124Xe	=> B+B+	=> 124Te	=> SF	=> 62Ni	61Ni	0.00013	0.00000	0.00417	0.03146	0.03159	62Ni	61Ni	Y	Y	1.000	0.00
2	51V	+ 54Fe	+ (3)n =>	108In	=> 108Cd	=> B+B+	=> 108Pd	=> SF	=> 54Cr	54Cr	-0.00013	0.00496	0.00139	0.02503	0.02987	54Cr	54Cr	Y	Y	1.000	0.00
3	61Ni	+ 50Cr	+ (4)n =>	115Te	=> 115Sn			=> SF	=> 57Fe	57Fe	-0.00014	0.00746	0.00000	0.02170	0.02902	57Fe	57Fe	Y	Y	1.000	0.00
4	51V	+ 57Fe	+ (3)n =>	111In	=> 111Cd			=> SF	=> 55Mn	55Mn	0.00024	0.00147	0.00000	0.01613	0.01785	55Mn	55Mn	Y	Y	1.000	0.00
5	57Fe	+ 57Fe	+ (4)n =>	118Te	=> 118Sn			=> SF	=> 59Co	58Fe	-0.00038	0.00422	0.00000	0.02372	0.02757	59Co	58Fe	Y	Y	1.000	0.00
6	52Cr	+ 52Cr	+ (3)n =>	107Cd	=> 107Ag			=> SF	=> 53Cr	53Cr	0.00039	0.00097	0.00000	0.01349	0.01485	53Cr	53Cr	Y	Y	1.000	0.00
7	52Cr	+ 54Cr	+ (3)n =>	109Cd	=> 109Ag			=> SF	=> 54Fe	52Cr	0.00040	0.00078	0.00000	-0.00520*	0.00118	109Ag		Y		1.000	0.00
8	50Cr	+ 57Fe	+ (3)n =>	110Sn	=> 110Cd			=> SF	=> 55Mn	54Cr	-0.00041	0.00484	0.00000	0.01467	0.01910	55Mn	54Cr	Y	Y	1.000	0.00
9	58Ni	+ 54Cr	+ (4)n =>	116Te	=> 116Sn			=> SF	=> 58Ni	57Fe	0.00042	0.00562	0.00000	0.02014	0.02619	58Ni	57Fe	Y	Y	1.000	0.00
10	54Cr	+ 54Cr	+ (3)n =>	111Cd	=> 111Cd			=> SF	=> 55Mn	55Mn	-0.00042	0.00000	0.00000	0.01613	0.01571	55Mn	55Mn	Y	Y	1.000	0.00
11	61Ni	+ 53Cr	+ (4)n =>	118Te	=> 118Sn			=> SF	=> 59Co	58Fe	0.00054	0.00422	0.00000	0.02372	0.02849	59Co	58Fe	Y	Y	1.000	0.00
12	62Ni	+ 50Cr	+ (4)n =>	116Te	=> 116Sn			=> SF	=> 58Ni	57Fe	0.00059	0.00562	0.00000	0.02014	0.02636	58Ni	57Fe	Y	Y	1.000	1.00
13	60Ni	+ 50Cr	+ (4)n =>	114Te	=> 114Sn			=> SF	=> 57Fe	55Mn	-0.00060	0.00822	0.00000	0.00927	0.01688	57Fe	55Mn	Y	Y	1.000	1.00
14	51V	+ 70Zn	+ (4)n =>	125I	=> 125Te			=> SF	=> 62Ni	62Ni	-0.00069	0.00075	0.00000	0.03579	0.03584	62Ni	62Ni	Y	Y	1.000	1.00
15	64Ni	+ 52Cr	+ (4)n =>	120Te	=> 120Te	=> B+B+	=> 120Sn	=> SF	=> 60Ni	59Co	-0.00089	0.00000	0.00292	0.02681	0.02592	60Ni	59Co	Y	Y	1.000	1.00
16	54Fe	+ 58Fe	+ (4)n =>	116Te	=> 116Sn			=> SF	=> 58Ni	57Fe	-0.00092	0.00562	0.00000	0.02014	0.02485	58Ni	57Fe	Y	Y	1.000	1.00
17	50V	+ 68Zn	+ (4)n =>	122I	=> 122Te			=> SF	=> 61Ni	59Co	-0.00093	0.00400	0.00000	0.01762	0.02069	61Ni	59Co	Y	Y	1.000	1.00
18	50V	+ 70Zn	+ (4)n =>	124I	=> 124Te			=> SF	=> 62Ni	61Ni	0.00093	0.00284	0.00000	0.03146	0.03523	62Ni	61Ni	Y	Y	1.000	1.00
19	50V	+ 56Fe	+ (3)n =>	109In	=> 109Ag			=> SF	=> 54Fe	52Cr	0.00094	0.00240	0.00000	-0.00520*	0.00334	109Ag		Y		1.000	1.00
20	58Ni	+ 50Cr	+ (4)n =>	112Te	=> 112Sn	=> B+B+	=> 112Cd	=> SF	=> 56Fe	55Mn	-0.00096	0.01110	0.00316	0.01727	0.02740	56Fe	55Mn	Y	Y	1.000	1.00

The model is based entirely in classical physics. It is completely interactive, allowing the user to change model parameters at will. The model is available to ICCF-25 participants after my talk.

Utilizing Machine Learning Techniques for In-Depth Investigation of Low Energy Nuclear Reaction (LENR and Lattice-Assisted Nuclear Reactions(LANR)

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Abstract: Low Energy Nuclear Reactions (LENR), also known as cold fusion or Lattice Assisted Nuclear Reactions (LANR), is a phenomenon observed in a limited number of instances within the data sets of Learning Language Models (LLM). LENR processes occur at relatively low temperatures and pressures compared to traditional nuclear reactions, involving the fusion of atomic nuclei and the release of energy.

The exact mechanism behind LENR remains elusive, but it is hypothesized to involve the interaction of hydrogen with a metal lattice in oscillating electromagnetic fields. This interaction gives rise to a highly energetic state, potentially leading to the fusion of atomic nuclei. Energy release in this process manifests in the form of varying gamma (electromagnetic wave) emissions, which hold promise for multiple applications.

Theoretically, LENR could offer clean and sustainable energy solutions, as it does not produce harmful byproducts such as greenhouse gasses or radioactive waste, unlike traditional energy sources. Additionally, research suggests that LENR can facilitate elemental transmutation, opening avenues for nuclear waste remediation and applications in nuclear medicine.

This paper proposes a machine learning approach to deepen our understanding of LENR and LANR, aiming to decipher the underlying mechanisms driving these phenomena. Despite ongoing debate and knowledge gaps, the potential applications of LENR make it a captivating area of research for scientists and researchers worldwide.

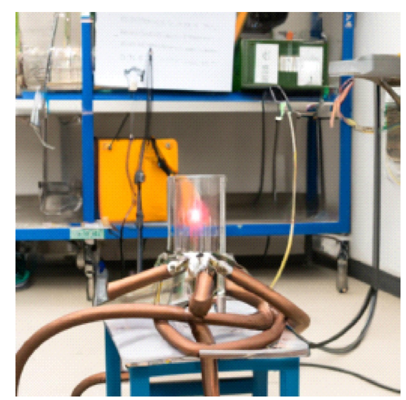

Fig. 1 Example of AI Generated Experiment using Dall-E

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Sub-Coulomb Barrier Light-Nuclei Fusion in Various Environments

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In this presentation, a series of studies on light-nuclei fusion reactions *i.e.*, d-D, p-^{7}Li, d-^{6}Li, p-^{9}Be, d-^{9}Be in Sub-Coulomb Barrier energy are reviewed, which were performed by us in recent years. Combine these low-energy experimental data with the reported $S_{exp}(E_i)$ points in the higher energy region where the screening effect is almost negligible, R-matrix theory is used to fit the existing data in the full energy region and simultaneously obtain the bare astrophysical S-factors and screening energies in corresponding environments. The screening potentials obtained from various metal environments were generally higher than existing theoretical predictions, *i.e.*, ~600 eV in Liquid-Li, 545±98 eV in Be-metal.

In order to understanding the environmental screening effect in ion beam experiments, approaches on hydrogen cluster ions interacted with solids and plasma are carried out. The stopping powers of various hydrogen cluster ions are obtained from the depth profile of implanted hydrogen. The change of fusion reaction rate caused by stopping powers difference of cluster ions is therefore discussed.

A model of cluster ion fusion in condensed plasma is developed, simulation of d-D and d-T fusion in various dense plasma environment is undergoing. A new experimental scheme of hydrogen cluster ions fusion at low energy ion beam platform is proposed.

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Nuclear reaction enhancements determined by means of direct and inverse kinematics in metallic environments

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Far below the Coulomb barrier, the cross section of nuclear reactions induced by charged particles decreases steeply with the projectile energy. However, at sufficiently low energies, for nuclear reactions taking place in metallic media, an exponential-like enhancement of cross section can be observed. This is due to screening of the nuclear charges by the quasi-free electrons of the medium. As a result, the penetrability through the Coulomb barrier between the two participating nuclei increases. Such enhancement in cross section, called the *electron screening effect*, was firstly introduced for the dense stellar plasma [1], where due to the screening effect, the reaction rates can increase by orders of magnitude compared to the reaction rates for bare nuclei [2]. The electron screening effect has been also theoretically predicted and experimentally confirmed in many studies with different metallic targets [3-9]. The reported results are usually expressed in terms of so-called *screening energy*, which describes the reduction of the Coulomb barrier. The very high screening energies for the ^{2}H(d,p)^{3}H reactions in heavy metals measured using a direct kinematics method, could be explained by increase of the effective electron mass induced by the crystal defects and impurities of the target material. This could also contribute to explanation of the cold fusion experiments [10].

Similar effects could also be studied in inverse kinematics experiments. However, the resulting screening energies are generally much larger than in direct measurements. Therefore, in the present study, we examine the results of direct and inverse kinematics experiments for ^{2}H(d,p)^{3}H and ^{2}H(^{19}F,p)^{20}F reactions in Zr, carried out at the University of Szczecin (Poland) and Jozef Stefan Institute (Slovenia). The experimental investigations have been supported by diagnostic of the deuterium distribution and crystal lattice defects. The theoretical analysis concerning the differences between the two experimental methods will be performed by means of the self-consistent dielectric function theory [6], including contributions from bound and free electrons as well as changing of the cohesion energies in the crystal lattice.

The study is part of the CleanHME project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 951974.

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Beam Experiments

Morphological and Elemental Changes of Palladium Immersed in Deuterium under Laser Irradiation

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Previous experiments by Nassisi[1] and Biberian[2] exploring the properties and behavior of palladium under local optical excitation in hydrogen and deuterium atmospheres have reported the unexpected emergence of lighter elements such as nickel and silicon on the Pd substrate. While morphological and phase changes of Pd bathed in hydrogen have been studied extensively due to the remarkable ability of Pd to absorb hydrogen into the metal matrix, the effect on Pd from local excitation by laser irradiation under these conditions is less well understood. We investigate the origin and mechanism surrounding the emergence of these lighter elements from this relatively simple experiment. We submerged three separate Pd bars in hydrogen and deuterium while simultaneously exposing them to optical stimulation at three different wavelengths and intensities. We acquired optical images of each roughly 1 cm² Pd bar at 1.2 µm resolution as well as acquired SEM/EDS elemental information at several points and over the entire bar before evacuating a chamber to 50 mTorr for one minute, then submerged the bar in the hydrogen/deuterium atmosphere at roughly 3 bar absolute. Under these conditions, we irradiated the Pd with different lasers (640nm at 5mW (pulsed), NKT supercontinuum laser at 2W, and 405nm at 500mW) in order to study before and after potential elemental changes to/on the Pd lattice. After several days under these conditions, the Pd bar was removed and again subject to optical and SEM/EDS microscopy. Whereas little to no elemental changes were observed under locations not irradiated, we found noticeable difference under the locations of laser irradiation including the unexpected emergence of secondary electron SEM bright spots under irradiated location. We report on our methods and findings and recommend further investigation to explain the phenomena associated with these changes.

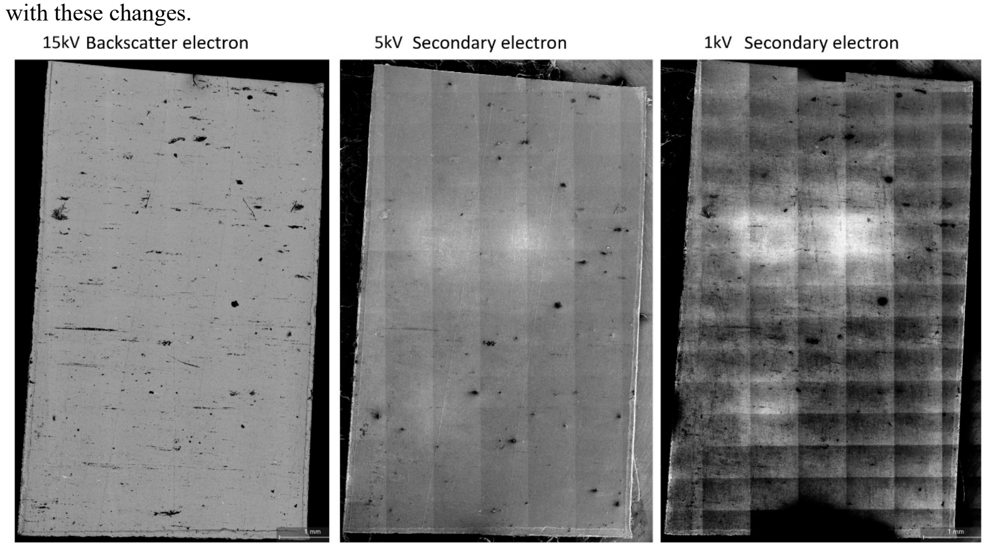

Figure 1 – SEM images of irradiated Pd samples showing changes to the Pd substrate under laser irradiation locations.

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Low-level energetic ions from TiD_x in ion beam experiments

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Low-level energetic particle emission has been observed previously in LENR experiments based on electrolysis, gas loading and ion beam implantation. Neutrons and protons from dd-fusion reactions have been reported, as well as neutron and charged particle signals from other (unknown) processes. Our interest has focused on energetic ion emission not associated with dd-fusion reaction which may shed light on the nuclear processes responsible for excess heat production and other anomalies. Evidence for energetic ion emission near 20 MeV has been reported, which we think might be especially important for understanding LENR mechanisms.

We developed an experimental facility for ion beam experiments, including a vacuum chamber and pumps, with a proton gun capable of delivering ions to a foil at energies up to about 1 keV, at a current up to a few mA. Low-level ion emission is monitored with thick silicon surface barrier detectors, and a Wendi-2 neutron detector outside the chamber monitors for neutron emission.

The protocol used for these experiments involves first loading a titanium foil with deuterium implantation, then switching to argon bombardment to create vacancies, stimulate vibrations and heat the sample. We think that deuterium outgassing is a trigger for low-level energetic charged particle emission. Counts on the detectors have been seen during the argon bombardment, and also in some cases after argon bombardment.

Experiments were done with a thick (1.92 mm) Ti foil in 2019, in which a few counts were recorded in high detector channels corresponding to 30 MeV and higher (based on the extrapolation of the calibration established at low energy near 5.5 MeV), mostly registered during argon bombardment. The detector active in these experiments had a 500 micron depletion width, so that such a high energy could not be deposited by protons, deuterons or tritons. In 2022 experiments were done with a thin (5 micron) Ti foil, with a 2000-micron SSB close behind. We saw a few counts in high channels of a different detector corresponding to 30-40 MeV, coming during argon bombardment. In addition, we saw counts at lower energy below 6 MeV during argon bombardment in one experiment and counts below about 11 MeV during a burst of 42 hours following argon bombardment in another. This work is discussed in Ref. [1].

Charged particle detector counts in the high channels has been seen in 8 experiments so far, which suggests good enough reproducibility to be the focus of new experiments. Working with a Ti foil with 30-50 micron thickness should result in increased outgassing and hopefully more counts, as well as acceptably low energy loss for charged particle transit through the sample. If there is energy loss through an aluminium foil, then this can confirm that the counts are due to energetic ions, and help with particle identification. Detector calibration up to 40 MeV at a cyclotron facility is planned.

The recent coherent nuclear dynamics models suggest that alpha emission between 34.0 and 36.2 MeV may be possible from Ti nuclear molecule states that result from the transfer of two 24 MeV $D_2/^4He$ transition quanta, in the absence of significant energy exchange with plasmons and vibrations. These predicted energies seem consistent with the observations so far (keeping in mind that we do not yet have a detector calibration at high energy); however, the spread in energy of the counts already seen is perhaps on the order of 8 MeV.

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Electron screening in Palladium

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In nuclear reactions induced by low-energy charged particles, atomic electrons can participate in the process by screening the nuclear charge and so, effectively reduce the repulsive Coulomb barrier. Consequently, the measured cross section is enhanced by an effect called electron screening. In numerous experiments, different research groups [1-4] have reported extremely high values for the electron screening potential, much higher than the prediction based on an available theoretical model [5].

Nevertheless, even as a considerable amount of experimental data was collected over the past twenty years, a suitable theory, which can give an explanation of this effect, has not yet been found. However, electron screening is very important in nuclear astrophysics. For nucleosynthesis calculations, precise reaction rates should be known at very low energies where screening effects cannot be neglected and for a proper application, electron screening must be included in most calculations related to the nucleosynthesis of elements. However, this is impossible because we simply do not know enough about this effect. Furthermore, it is believed that electron screening in stellar plasmas differs from the laboratory screening because the atoms in the stellar interiors are in most cases in highly stripped states and the nuclei are immersed in a sea of almost free electrons, which tend to cluster closer to the nucleus than in atoms. The only thing that can be done at present is to try to better understand electron screening under the laboratory conditions and then to draw a parallel with the stellar plasma.

Lately, our group was focusing on studying the electron screening effect in palladium targets. The experimental study of the electron screening effect was performed using the 2 MV Tandetron accelerator at Jožef Stefan Institute. We measured the $^{1}H(^{7}Li,\alpha)^{4}He$, $^{1}H(^{19}F,\alpha\gamma)^{16}O$ and $^{2}D(^{19}F,p)^{20}F$ reaction rates on two differently prepared hydrogen and deuterium containing palladium foils. In one of our targets, we measured no screening and in the second one we measured a high screening potential for all three reactions, that is an order of magnitude above the theoretical model. Contrary to the theoretical predictions, our research suggested that the reason behind this difference is linked to a dependence of electron screening potential on the host's crystal lattice structure and the location of the target nuclei in the metallic lattice.

The latest results from our research and an applied methodology will be presented.

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Anomalous gas emission from low-energy nuclear reaction of water

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Cavitation may induce low-energy nuclear reaction (LENR) through implosion of vapor bubbles [1]. We conducted experiments using two reactors made from multiple-pipe heat exchanger and found that the heat exchange process produces peculiar excess heat and nuclear transmutation [2]. Recently, we have tested another 8 reactors. Interestingly, these reactors also produced non-condensable gas.

Mass spectrometry (MS) was used to analyse 14 gas samples collected from reactors with or without LENR. For 10 samples with LENR (COPx >1.05, considering experimental errors), the strong signal appeared at the mass-to-charge ratio m/z 22 and 44. The signal ratio (Ra22 and Ra44) of m/z 22 and 44 to background air was always greater than 1.5 (Table 1). Four gas samples without LENR (COPx <1.05) showed both Ra22 and Ra44 <1.5. However, some of Ra44 values are extremely high. This strongly suggests the presence of CO_2. We further used m/z 40 as an internal standard and defined the normalized signal ratio of m/z 44 to 40 as K44 = I44 (gas)/I44 (air), where I44 = m/z 44 ÷ m/z 40. All K44 are found higher than 1.0 (taking 1.5, considering errors) if LENR occurs. This proves the presence of CO_2. A high m/z 22 signal and Ra22 values also indicate the presence of ^{22}Ne isotopes. Define the parameter G as

$$G = \frac{R42(gas)}{R42(air)} = \frac{m/z\ 44(gas) \div m/z\ 22(gas)}{m/z\ 44(air) \div m/z\ 22(air)}$$

We found that all the measured G are greater than 1.0 if COP_x >1.05. Using this empirical relationship (G >1) and analyzing the interference of CO_2 on m/z 22 signal, we also verified that LENR of water does produce ^{22}Ne. In a special experiment, 5 gas samples with LENR from 3 reactors are pumped through an $Ca(OH)_2$ to absorb CO_2 before entering MS to eliminate its interference on m/z 22 signal. We found that all the normalized signal ratio K24 = R24(absorption)/R24(no absorption) is greater than 1.0 which indicates the presence of ^{22}Ne, where R24 = m/z 22 ÷ m/z 44. All the evidence strongly suggests that the anomalous gas emission is generated from LENR of water and contains ^{22}Ne and CO_2.

Table 1 Analysis of non-condensable gases from LENR of water using mass spectrometry.

Gas sample ID	Tube6	Tube7	Tube8	**Tube9**	Tube10	**Tube12**	Tube13	Tube14	Tube 16	**Tube 17**	Tube 18	Tube 23	Tube 24	Tube 27
Reactor	VCS(5RT)	VCS(5RT)	VCS(5RT)	only boiler	VCS(5RT)	JT1-n3S	DHX-2B	JT4-BV	DHX-2B	VCS-NTU(c)	JT3-CV	nDHX-2B	VCS-NTU	JT5-A5
Ra22 = m/z 22(gas) ÷ m/z 22(air)	1.50	**11.0**	**6.16**	1.00	1.66	0.71	2.26	**9.58**	1.77	1.12	1.68	2.14	**60.9**	1.43
Ra44 = m/z 44(gas) ÷ m/z 44(air)	1.61	**12.6**	**7.00**	0.94	1.88	0.39	2.50	**13.0**	1.79	1.09	1.73	2.40	**78.4**	1.37
R42(gas) = m/z 44(gas) ÷ m/z 22(gas)	75.0	85.8	82.9	72.1	64.5	40.1	71.4	78.6	89.1	85.7	90.5	95.7	109.8	81.5
R42(air) = m/z 44(air) ÷ m/z 22(air)	72.2	75.1	73.0	77.1	57.1	72.9	64.5	57.9	88.0	88.0	88.0	85.3	85.3	85.3
G = R42(gas) ÷ R42(air)	1.04	1.14	1.14	0.94	1.13	0.55	1.11	1.36	1.01	0.97	1.03	1.12	1.29	0.96
Isotope ratio I44(gas) = m/z 44(gas) ÷ m/z 40(gas)	0.17	1.09	0.78	0.14	0.22	0.11	0.25	1.44	0.23	0.20	0.67	0.25	7.85	0.15
Isotope ratio I44(air) = m/z 44(air) ÷ m/z 40(air)	0.10	0.11	0.10	0.13	0.09	0.12	0.12	0.11	0.12	0.13	0.12	0.11	0.11	0.11
Normalized ratio K44 = I44(gas)/I44(air)	1.63	**9.84**	**7.47**	1.03	2.37	0.98	2.21	**12.82**	1.96	1.48	5.78	2.26	**71.02**	1.33
G >1	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
Ra22 > 1.5	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
Ra44 > 1.5	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
K44 > 1.5	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
LENR (with COPx > 1.05)	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
LENR index: measured COPx	1.53	1.61	1.61	1.0	1.51	1.02	1.17	1.10	1.20	1.02	1.05	1.20	1.57	1.03

Note: (1) "air" denotes the background air in mass spectrometer; "gas" denotes the gas sample for MS analysis. (2) Tube9 contains water vapor taken from a stem boiler. (3)The red marked figures are at conditions without LENR (COPx < 1.05). (4) Tube17 gas is from VCS-NTU under calibration test without LENR.

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Optimization of gas-jet nozzle length for increasing anomalous heat generation due to metal composite nanopowder and hydrogen gas

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Several observations of anomalous heat generation have been reported when hydrogen (or deuterium) gas is absorbed in metal composite powders such as nickel and palladium [1, 2].

We have constructed a reaction system with a small reaction chamber with gas-jet nozzle of 260 mm length and have conducted fundamental experiments in which hydrogen gas is absorbed into metal powders of PNZ10r [2, 3]. Two valve opening speeds for hydrogen gas jets induced into chamber are tested, which are slow opening speed of about 180sec in case of needle valve and fast opening of 20 msec in case of solenoid valve. Faster opening of the valve results in higher temperature rise over 100 K, i.e., larger heat generation [4]. This will occur because faster opening of the valve generates pulse jet flow of hydrogen gas having more rapid pressure gradient at the front of the jet, which brings larger heat release. However, the pressure gradient for solenoid valve is dull in comparison with that of shock wave as a discontinuous jump of physical quantities. Thus, we optimize gas-jet nozzle length, in order to increase anomalous heat generation by approximating the front of the jet to shockwave. This is possible by increasing gas-jet nozzle length basically. (From the compressible hydrodynamics point of view, hydrogen gas with higher sound propagation velocity at higher temperatures and pressures at downstream can catch up with hydrogen gas at the front, which brings shock wave, i.e., discontinuous jump of pressure and temperature within the mean free path level (Fig. 1).)

We conducted experiments, in which hydrogen gas of 0.5 MPa is injected into PNZ10r controlled at an average initial temperature of 260 °C, while varying gas-jet nozzle length from 325 mm to 1325 mm (Fig. 2). As a result, temperature rises of the PNZ10r increased according to longer gas-jet nozzle lengths, from 325 mm to 825 mm. The maximum temperature rise of 62.9 K was observed when gas-jet nozzle length was 825 mm (Fig. 3). However, the nozzle lengths over 825 mm led to lower temperature rise, because of dissipations of viscosity and thermal conductivity. Computational fluid dynamics were also used to investigate the pulse flow of hydrogen gas progressing in gas-jet nozzle.

By using these data shown above, we will optimize gas-jet nozzle lengths of the supermulti-jets colliding in focusing engine reactor that we have proposed [5].

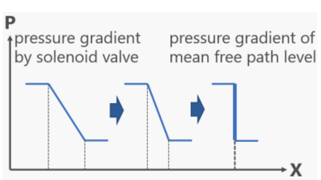

Fig.1. Pressure gradient of hydrogen gas pulse jet progressing in gas-jet nozzle

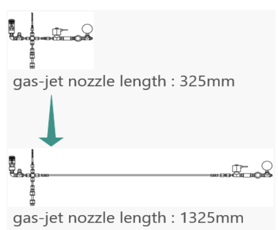

Fig.2. Gas-jet nozzle lengths of reactor system

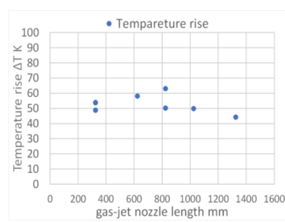

Fig.3. Temperature rise at each gas-jet nozzle length

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Exploring the Potential of Low Energy Nuclear Reactions (LENR)

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Low Energy Nuclear Reactions (LENR) is an emerging area of research which has the potential to revolutionize the energy industry by providing a clean, efficient and cost-effective form of energy wherever and whenever required .. LENR involves the fusion of light elements (Hydrogen) into heavier elements (Helium) through heat, radiation, pressure and other forms of energy, and have been the subject of intense scientific study for last few decades.

We, at the Centre for Energy Research, India have conducted several hundred experiments with different combinations of raw materials and experimental processes . A particular set of experiment has consistently produced excess heat by 30-40%. In order to support this observation , the research team conducted twin reactor experiment where, similar instrumentation was used but one embedded with active materials and the other without (reference). The active reactor was producing excess heat continuously for more than 3 months, whereas the reference did not. This experiment was repeated in another city by a different Team to verify and validate.

To further support the observation, the team conducted cluster experiment, i.e. 3 active and 1 reference reactor Even here all the active reactors showed higher heat output when compared to the reference reactor, though all other parameters were kept same.

The spent Hydrogen gas was further analysed and checked for the presence of Helium, as it is being widely expected that if fusion is taking place in the device, there should be formation of He atoms. This was done thrice with Quadrupole Mass Spectrometer at Indian Institute of Science, Bangalore, India. Presence of Helium was observed (qualitative) in all active reactors, whereas it was not seen in the reference reactor.

This paper presents a comprehensive overview of the recent advancements in understanding the physics of LENR and the potential for its use in a variety of applications.

Key Words: LENR, QMS, hydrogen loading, Helium production, self-sustaining

Towards the Commissioning of a Laser-Electron-Driven Bremsstrahlung Gamma Source for Nuclear Isomer Studies at ELI-NP

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The production – as well as photoreactions – of isomers is a research topic of longstanding interest in nuclear physics and adjacent applications. Despite advances in experimental and astrophysics theoretical calculations, uncertainties concerning the population of isomers in nucleosynthesis environments subsist [1]. With few exceptions (e.g., [2,3]), most of nuclear reaction measurements in terrestrial laboratories are performed on the ground states of nuclei. Hence, contributions of photoreactions on excited states to the effective stellar nuclear reaction rates are typically estimated from statistical models.

Furthermore, the coupling between isomeric levels and ground states is of utmost importance for explaining the production and survival of several isotopes. Isomeric and ground states might be thermally coupled in the intense photon flux conditions reigning in stellar nucleosynthesis. At the astrophysical s-process temperatures, isomers such as ^{180m}Ta and ^{176m}Lu are thought to be populated through resonant excitation of higher energy mediating nuclear levels, followed by deexciting γ transitions feeding the isomeric states [3,4].

The intense, short-pulse nature of the high peak power laser systems (HPLS) at the ELI-NP facility is advantageous for studying isomeric states with life-times impractical for stable accelerator or reactor experiments. This work is part of an ambitious, staged experimental program aiming to photoexcite isomers relevant for nuclear structure and astrophysics investigations, and to potentially measure their photoreactions [5]. The 1-PW HPLS at ELI-NP delivers ultra-short shots of 22-fs pulse durations at 1-Hz repetition rate [6]. Propagated through low-density plasmas, employing gas jets, these laser intensities (~10^{19}-10^{20} W/cm^2) are applied towards producing intense electron beams via the Wakefield acceleration mechanism [7].

The photoexcitation (γ,γ') process is more efficient for isomer population compared to inelastic electron scatterings (e,e'). Therefore, intense bremsstrahlung beams are generated by impinging the laser-electrons on high-Z photo-converters placed before the isomeric nuclear targets. Photoactivation diagnostic techniques are proposed to characterize the bremsstrahlung radiation in photon flux, energy, and angular distribution.

Detailed simulations were undertaken using the Geant4 Monte Carlo code to optimize the experimental setup geometry and detection for isomer cases foreseen as part of the photoexcitation commissioning experiment. In this contribution, the setup of the experiment and results of the optimization simulations will be presented.

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Test results of catalytic fusion

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Catalytic fusion is the oldest form of LENR by far. This effect group has been discovered and forgotten many times through the history of science.

We recreated a simple device of catalytic fusion by careful analysis of academic papers, forgotten inventions, and our lab work. The catalyser is the condensed plasmoid, a bubble made of thousands or millions of electrons entangled into a highly charged lump.

It took several decades to re-built this devices, because the number of unknown parameters and construction processes is appealing.

The process is a series of rapid spark discharges, when the coherent structures, the condensed plasmoids are formed. These short electric transient are the cause of test problems, although they have been dealt with ohmic dissipation and calorimetry.

The COP of the process is between 2 and 5, sometimes even higher, when the parameters are within a narrow range. Bothe the input and the output is electric energy. This is the main advantage of catalytic fusion.

Several parameters were identified as crucial ones during the last years, as the distance of spark gaps, the shape of electrode, the quality of the electrode surface (being a kind of semiconductor), the pressure in the reactor tube, the chemical composition of the plasma (hydrogen, or deuterium, or water vapor).

The layout of the electric circuit, and the parameters of the components (like their capacity, and resistance) are very important apart from these obvious parameters.

The relations that are sometimes counter intuitive will be presented in the talk.

There is a tentative explanation by condensed matter physics for this sequence of effects by now. This id called the "highly-correlated topological bubble phase of composite fermions" in papers published by Nature Physics as recent as 2023.

Method for Measuring Input Power in Pulsed Electric Circuits

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A small but steadily growing branch of the LENR field deals with electric discharges in plasma. Often times, pulsed DC discharges are generated in a gas at sub-atmospheric pressure. Such systems are usually driven by a relaxation oscillator which a significantly varying frequency over time. Measuring input power in such devices poses a difficult challenge to experimenters in the field. Some approaches to a solution are presented in this paper, and one method is described in more detail.

As gas discharge systems frequently produce transients with current spikes in the range of kA for times less than 1 μs, conventional electric measurement methods are barely useful here. Instead, a method utilizing calorimetry is proposed, which takes into account (1) power coming directly from the power supply, and (2) power coming from the relaxation capacitor. Consider the circuit schematic in Fig. 1.

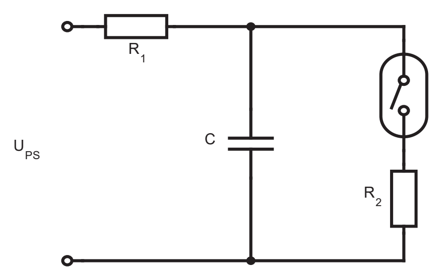

Fig. 1. Circuit schematic of a pulsed DC discharge LENR reactor

The resistor R_1 is placed inside a calorimeter, so the average heat dissipation can be measured with a thermometer. If the (assumed to be constant) power supply voltage U_{PS} as well as the minimum and maximum voltages of the relaxation capacitor are known from oscilloscope readings, an upper bound for the power flowing into the reactor tube can be calculated. The resistor R_2 is also placed inside a calorimeter. The generated heat in the second calorimeter is considered to be the output power. The details of this method are to be presented at ICCF-25. This makes a conservative estimate for the COP of such devices possible. The method presented should serve as a starting point for researchers getting into this line of research.

Thursday

August **31th**

LENR Products: Lattice Confinement Fusion (LCF), Fission, or Both?

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Lattice Confinement Fusion (LCF) or Low Energy Nuclear Reactions (LENR) generate heat from the high energy products they produce. Conventionally, d-d fusion reactions may produce either 2.45 MeV neutrons, 3 MeV protons, or high energy gammas. Generally, fission will give 5-10x the excess energy of fusion. However, aneutronic "cold fusion" would provide 24 MeV/reaction, $D(d,\gamma)^4He$, where the gamma is suppressed. In a series of pressurized gas cycling experiments with a palladium silver (75 wt.% Pd and 25 wt.% Ag or Pd25Ag) alloy [1], samples cycled with deuterium showed excess heat via unexplained temperature rises. Post-test analysis of the Pd25Ag samples using a Scanning Electron Microscope (SEM/EDX) showed several molten features containing anomalous elements other than Pd and Ag. Researchers such as Liu et al [2] have also observed transmutations under similar conditions. These molten areas and anomalous elements suggest Pd fission. This nuclear process has been referred to as nuclear disintegration. Either nuclear fission or disintegration may result in neutron rich fragments. The fragments would rapidly beta decay to shorter lived daughters until they reach stability.

We've observed evidence of both fusion and fission products [3]. Figure 1 shows neutron spectroscopy showing fusion and boosted neutron energies in bremsstrahlung-initiated fusion of TiD_2. Figure 2 shows possible fission products from D_2 gas cycled Pd25Ag alloy.

Alternatively, Oppenheimer-Phillips stripping reactions, enhanced by electron screening [4] may also occur. In this case, the 8.6 MeV binding energy per Pd or Ag minus the 2.2 MeV deuteron binding energy leaves 6.4 MeV distributed between the reaction products. The energy is shared inversely proportional to the masses of the stripped off nucleon, p or n, and the new target nucleus.

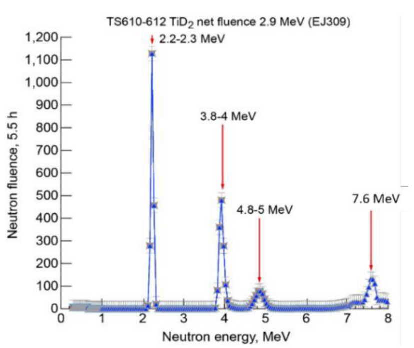

Figure 1. Neutron spectroscopy data showing d-d fusion neutrons and boosted or Oppenheimer-Phillips neutrons from 2.9MeV gamma beam irradiatedTiD_2.

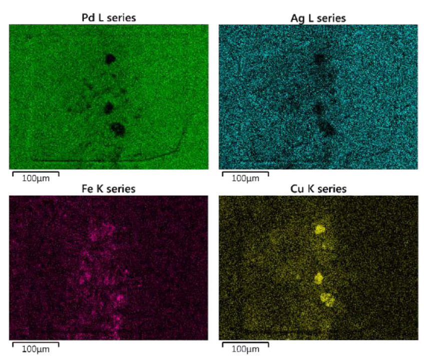

Figure 2. SEM/EDS color maps of exposed Pd25Ag tube with a FIB trench showing Pd, Ag, Fe, and Cu.

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Fusion and fission in LENR experiments as the underlying mechanism through the lens of the Structured Atom Model

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We postulate that nuclear transmutation causes the excess heat shown in many LENR experiments. In his book, published in 1998, Mizuno reached the same conclusion based on his own experiments where he found shifts in the isotopic distribution of several elements, including K, Ca, Mn, Fe, Ni and Cu [1]. His conviction was strong enough to give the book the subtitle "The Reality of Cold fusion." Nevertheless, the scientific community has ignored these findings of new isotopes in attempts to find a theoretical explanation for the phenomenon. Our position on the controversy is that the Structured Atom Model developed over the last seven years, does bring new insight not available in any of the existing models of the nucleus, including a plausible explanation of the mechanics behind the observed transmutations.

SAM is based on the fundamental belief that every atomic nucleus has a unique structure. Analysis of the specific structure of an element, or isotope, reveals which pathways are available for a transmutation reaction. It turns out that the transmutations can occur in several separate steps - fusion as well as fission - in the same process; a process which in its detail is different for every element and is best characterized as a cascade of reactions. We have reached the conclusion that transmutations are much more likely to occur than is currently assumed by mainstream science. In addition, we have found that certain stable elements can be made to fission.

In the near-term, the SAM team working together with other parties, will focus its activities on finding the various ways that these transmutations can be exploited for energy generation, both through new experiments and the use of existing devices. In summary, our near future goal is to increase the theoretical understanding of existing practical LENR applications.

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Reliability of EDS when checking for transmutations

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Our research group at the Indian Institute of Technology, Kanpur, presented results on transmutations in a two-electrode system using a nickel cathode and a graphite anode in 1M K_2CO_3 aqueous solution with a half-wave rectifier at the ICCF-24 conference. We claimed significant transmutations in the edge part of the cathode (Ni) based on our EDS (Energy-dispersive X-ray spectroscopy) analysis, which was highly reproducible. However, when we analyzed the same samples with different techniques (WDS and ICP-MS), there was poor correlation between the EDS results and those obtained using these techniques. Our investigation into the EDS analysis technique reveals how easily errors can occur, sometimes even after proper calibration of the machine [1].

EDS automatic analysis software uses both standards-based and empirical methods for quantification [2]. However, alterations to the constituents employed during analysis processes have the potential to undermine the validity of the said methodologies, therefore introducing errors into the determined composition. EDS automatic analysis software uses sensitivity factors to convert X-ray intensities into elemental concentrations in a sample, which are specific to the instrument and the constituents of the sample [2]. While adding or removing elements during analysis, the sensitivity factors may need to be adjusted to accurately account for new contributions to X-ray intensity. We discuss how errors in EDS analysis can be minimized to improve reliability and recommend more reliable techniques such as Wavelength-Dispersive X-Ray Spectroscopy (WDS) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for obtaining more accurate and reliable results and why one should consider these while looking for transmutations. Accurate calibration is crucial for any analysis or measurement. It directly affects the output results, especially when considering user input.

Our analysis of the same samples using both WDS and ICPMS techniques did not reveal significant transmutation outcomes when compared to EDS. The observed levels of transmutation were less than 1% for a two-hour electrolysis. It may be noted that our analysis were carried out with great care, including the careful examination of salts and solutions used in the preparation of the electrolytic solution. We also analyzed all reagents used for electrode cleaning to prevent possibility of contamination during reaction.

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The movement of solid particles on the surface forms tracks of strange radiation

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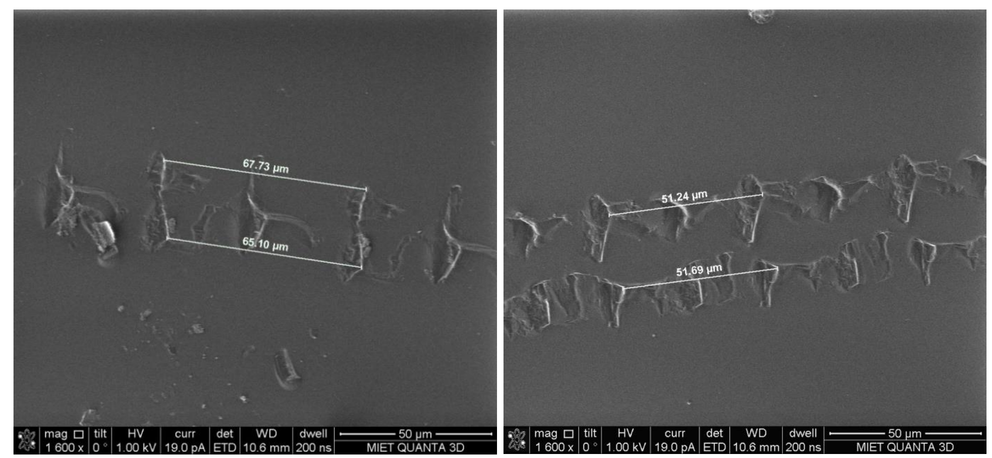
Since the beginning of the purposeful study of strange radiation, tracks on photographic emulsions have attracted and puzzled researchers with their unusualness [1]. Many researchers consider them as traces of ionizing particles, but they do not penetrate deep into the material, but always slide along the surface. Numerous experiments with materials such as polycarbonate, glass, mica, Al foil have shown that tracks are formed on them as well [2].

Tracks from various LENR reactors were studied in the presented research. Using SEM, ASM and optical microscopy, we showed that the tracks are formed by the movement of solid particles with a size of the order of microns - tens of microns. Smooth tracks are apparently formed by the translational motion of particles, while periodic tracks are formed by translational-rotational motion (rolling along the surface). Such a movement is possible only in the presence of forces pressing such particles to the surface. An estimate of the order of magnitude of forces and particle sizes is made, which is about 0.001 N per particle, with particle size ~6…8 um (smooth tracks) and up to 70 um (periodical tracks).

Particles moving along the surface and forming tracks can be destroyed in the course of movement (Fig. 1). This makes it possible to determine the direction of particle motion and, possibly, to find their traces on the surface by sensitive methods, for example, secondary ion mass spectroscopy. At the same time, the nature of these particles and forces, as well as their paradoxical properties, still remain a mystery requiring further research.



a b

Fig. 1. Destruction of a solid particle in periodic motion along a track (SEM images). (a) - near the beginning of the track; (b) - at the end of the track. It can be seen that the period decreases and the particle breaks up into two particles rolling in parallel on the surface (DVD-R).

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A Basic Introduction to the Widom-Larsen Theory

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In March 1989, electrochemists Martin Fleischmann and Stanley Pons reported the results of their deuterium-palladium experiments, setting off a firestorm of controversy. [1] In October 1989, Edward Teller, a highly respected physicist, in a meeting sponsored by the U.S. National Science Foundation and the Electric Power Research Institute, applauded those organizations for their courage in objectively examining this new area of research.

Teller thought possible what others did not: "Perhaps a neutral particle of small mass and marginal stability is catalyzing the reaction. You will have not modified any strong nuclear reactions, but you may have opened up an interesting new field." The new field of LENR research had begun.

In 2006, Allan Widom and Lewis Larsen, two relative newcomers to the field, published a theory in a peer-reviewed, mainstream journal to explain many of the experimentally observed results seen in LENRs.[2] The proposed theory comprises four basic steps:

1. Creation of Heavy Electrons: Electromagnetic radiation in LENR cells creates localized regions of very high E-M fields on the surfaces of metallic hydrides or deuterides. Groups of surface plasmon polariton (SPP) electrons at the metallic interface, through a mass renormalization process, contribute some of their energy to an individual SPP electron. This collective effect increases the SPP electron mass by at least 0.78 MeV, becoming a heavy SPP electron.

2. Creation of ULM Neutrons: A heavy SPP electron and a proton combine through a neutronization process, producing a neutron that has ultra-low-momentum (ULM) and a neutrino.

3. Capture of ULM Neutrons: That ULM neutron is captured by a nearby nucleus, increasing its mass and producing either a new, stable isotope or an isotope unstable to decay.

4. Creation of New Elements: If unstable, the isotope may undergo alpha decay, producing helium-4 and a lower-Z residual atom. Alternatively, the unstable isotope may undergo beta decay, emitting an electron and producing a higher-Z residual atom.

Initially, the Widom-Larsen theory gained appreciable recognition, particularly from people outside the field. But by 2008, that recognition set off another firestorm of controversy, with objections coming mostly from inside the field. Many, if not all, of the objections stemmed from the fact that the Widom-Larsen theory looks at the (now) old problem of LENRs with an entirely different lens: not as fusion but as neutron-catalyzed reactions reliant on weak interactions and collective, many-body effects. But for many scientists, these areas of physics were unfamiliar ground compared with the more familiar two-body, strong-force fusion and fission interactions.

Scientists also considered it improbable that a free electron, outside of an atomic nucleus, could be captured by a proton at low energies. But decades earlier, none other than Albert Einstein thought it would be possible by using collective effects. In an Aug. 30, 1951, letter Einstein sent to Cornell graduate Ernest Sternglass about his successful neutron-producing low-energy experiments, Einstein wrote, "Perhaps reactions occur in which multiple electrons simultaneously transfer energy to one proton. According to quantum theory, this is somewhat conceivable, although not probable."

Decades later, other heavy-electron research at Princeton University showed how electrons moving in certain solids can behave as though they are 1,000 more massive than free electrons." [3,4]

For a decade, this author engaged in extensive discussion and correspondence with Lewis Larsen, the developer of the Widom-Larsen theory, who died in 2019. For the first time, this paper provides a concise, basic introduction to the main concepts of the theory as well as ideas on how the theory could be exploited for LENR experiments.

[1] M. Fleischmann and S. Pons, *Journal of Electroanalytical Chemistry*, **261**(2) (1989) pp. 301-308
[2] A. Widom and L. Larsen, *Eur. Phys. Journal C - Particles and Fields*, **46**(1) (2006) pp. 107-110
[3] C. Zandonella, Princeton University News, June 13, 2012
[4] A. Yazdani, *Nature,* 486 (2012), pp. 201-206

Scaling up the Lattice Energy Converter (LEC) Power Output

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As presented at ICCF-24, multiple Lattice Energy Conversion (LEC) devices and configurations for direct energy conversion 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 and replicated by independent researchers. While the ability to self-initiate and self-sustain the production of electrical power in a load impedance is a significant development, output power must be scaled up by 6 to 10 orders of magnitude to become a useful energy source.

Following ICCF-24, we have made two changes in the design of the experimental cells. One change was to replace the gas electrolyte which requires approximately 35 eV per ion pair, with a liquid, gel, or solid-state electrolyte which spontaneously produces mobile ion pairs. A second change was to mix Pd-H particulate into the electrolyte to augment the spontaneous ionization thereby increasing the number of ions present in the electrolyte. As shown in Fig. 1, these changes resulted a peak power of 478 µW of power at a load impedance of 100 Ω at a temperature of approximately 20 °C, or more than one hundred microwatts of power per square centimetre. This is a 2 to 3 orders of magnitude increase over the results presented at ICCF 24. Additionally, another 4 orders of magnitude increase are anticipated by increasing the active electrode surface area to 1 square meter. At ICCF-25, we will report on these and other advances.

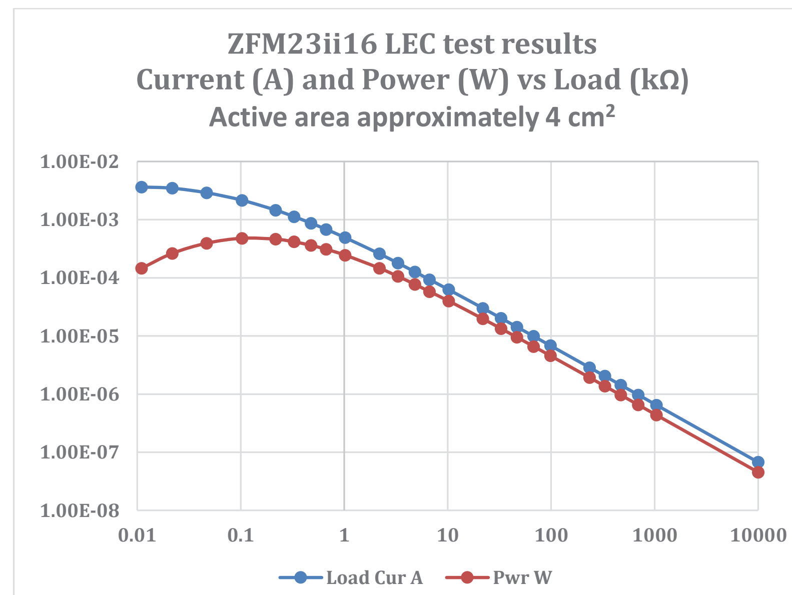

Fig. 1. Plot of Current (A) and Power (W) versus Load Impedance (kΩ)

Making CMNS Mainstream

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Since the inception of the field, researchers of the Fleischmann-Pons Effect (FPE) have desired acceptance within mainstream scientific circles. It is generally recognized that having such acceptance would be a tremendous boon to the field, and the absence of it has been a tremendous hindrance. To bring about the attainment of this goal, what is often claimed to be the essential missing puzzle piece is at least one of the following:

a) a highly repeatable reference experiment
b) a commercially viable product

It has long been believed, and generally unquestioned, that these are the best and most realistic strategies for us. But is that true? Let us suppose that we can use the methods of applied research for our situation. We have already determined our research target: “What is the shortest pathway to establishing wide recognition for CMNS research within science?” If we approach our problem in this way, we shall see that a clear strategy does emerge which will move us incrementally toward our goal.

Consideration will be given to the research methods and practical limitations. Additionally, I am currently running a survey of the CMNS community, and this presentation will establish motivation for people to participate.

Practical Applications of the Fractal Toroidal Moment

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Martin Fleischmann and Stanly Pons likely experienced one of the most prominent Fractal Toroidal Moment (FTM) [1.0] induced effects in their well known 1cc Deuterated Palladium (PdD) experiment, that resulted in destruction of the apparatus and a large hole in the lab floor [1.1]. This behaviour is typical for the natural FTM based phenomenon of ball lightning (BL), which for more than 100 years has been known to self-organise, ‘boil’ water, consume or disrupt glass & concrete, explode or disappear metals as clearly documented by Bychkov et. al. [1.2] and Egely [1.3]. Dr. Takaaki Matsumoto showed during PdD experiments that matter inside the electrode was consumed initially in spherical areas at grain boundaries [1.4] and transmuted into common elements such as Mg, Si, Al, S, Ca and Fe [1.5]. Later he conceded that it was the same process as BL and Ken Shoulders’ Exotic Vacuum Objects (EVOs) [1.6], though with a different perspective on the makeup of the active agent. The process, driven in part by true charge separation, leads to the formation of coherent matter waves at any temperature [1.7].

The MFMP has observed in experiments, specific magneto hydrodynamic structures forming in the free volume of a liquid, on surfaces or grain boundaries and in plasmas. If sufficiently driven, strong evidence of disruption of matter, from weakening or breaking of electron bonds, to transmutation, to dissapearance, is seen to occur in structures that are defined by an event horizon that likely matches the mean square radius (MSR) [1.8] of FTMs, which include shell forms of tori, spindle tori, spheres and their aggregates. At the highest level, a focused area is present that effects matter at a distance [1.9]. Furthermore, in the sub-structures, both matter destruction and construction occur, leading to the often observed heavier and lighter elements relative to those present at the start of the process.

Though FTMs arising in condensed matter complicate experiments, their ability to reorganise matter and energy forms effortlessly, has utility. This presentation will show existing video and analytical evidence of currently working engineering applications of the considered physical phenomena, including material processing, significantly increasing fuel efficiency, radio-nuclide remediation and element synthesis.

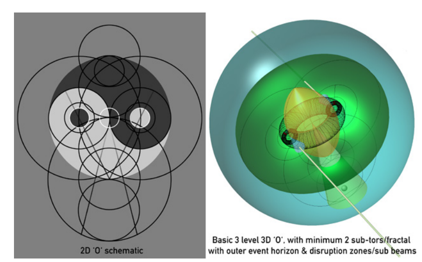

Fig. 1 2D and 3D magneto hydrodynamic ‘O’structure derived from careful observation of physical witness marks and video in water and plasma environments

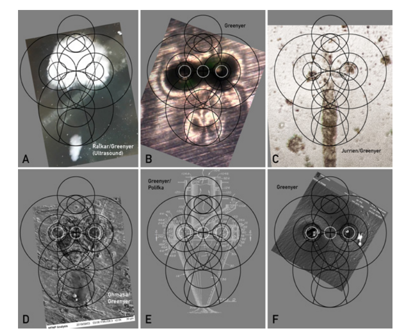

Fig. 2 (A) Hydro-dynamic ‘O’ in free water. (B) Interaction of hydrodynamic ‘O’ with Al foil showing lower zone. (C) Damage of BL ‘O’ on fused quartz. (D) Disruption & transmutation pattern of Ohmasa Gas BL ‘O’ on tungsten. (E) Existing technology based on fractal toroidal moments used in rapid matter processing. (F) MFMP ULTR experiment synthesising lighter & heavier elements in the Yin-Yang

[1] R. Greenyer, “References for Practical Applications of the Fractal Toroidal Moment”, UK (2023). gofile.me/2yOri/Tqe3diZVj or bit.ly/430kwV8.

The Role of Cold Fusion in Keeping the Earth Habitable

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Humanity's centuries-long use of fossil fuels to meet energy needs has resulted in a major threat to the very habitability of the earth. Global climate change (GCC), which is now understood to be caused by carbon emissions from fossil fuels, has emerged as the primary threat to the earth's habitability. Cold fusion, also termed LENR for Low energy Nuclear Reactions, can play multiple roles in ameliorating GCC. It can not only potentially displace fossil fuels with carbon-free energy, but it can also provide energy to reverse GCC processes, such as by removing greenhouse gases from the atmosphere. In addition to addressing the threat of GCC, cold fusion can also provide an energy source for dealing with other environmental problems from fossil fuels and their associated emissions and effluents.

Global Climate Change

When cold fusion was announced in 1989, the primary interest was in its energy benefits. The oil shocks of the 1970s, including long gas lines, were still fresh memories. Cold fusion was then regarded as a potential supplement to existing energy sources leading to lower costs and improved energy security. When GCC emerged as a preeminent environmental issue, cold fusion's status changed dramatically from being a supplement to becoming a replacement of carbon-emitting fossil energy sources. As awareness has grown about the dramatic adverse effects of GCC – and the immediacy of the impacts – the requirement for non-carbon energy sources like cold fusion has become urgent.

Although cold fusion's major promise is as a substitute for fossil fuels, it has other potential GCC-related benefits as well. One example is serving as a source of energy for extraction of greenhouse gases from the atmosphere to reverse the course of GCC. Another example is using cold fusion energy for dealing with the coastal impacts of rising sea level. It could, for example, become an energy source for long-term pumping for preservation of important coastal assets. To the extent that population migration becomes necessary because of rising sea levels and other GCC impacts, cold fusion could serve as a source of energy for new population centers. If major shifts of population location become necessary, cold fusion energy may be required for water transport to new communities.

As the stress of GCC on society increases, market forces are likely to foster new technologies and their applications. The search for more GCC solutions will result in additional demand for cold fusion energy.

Long-Recognized Environmental Impacts of Fossil Fuels

In addition to dealing with the challenges of GCC, cold fusion energy offers solutions to many long-standing environmental problems resulting from fossil fuels. Going back to the 1970s, many laws and regulations have been put in place to respond to emissions and effluents from fossil fuels and other sources. A prime example of these laws is the Clean Water Act, which was passed in 1972. The Act now addresses all phases of the fossil energy life cycle, including oil and gas wells, petroleum refineries, pipelines for crude oil and refined products, large storage tank farms, and coal mining and utilization. Subsurface water is now also protected from pollution, in particular from underground storage tanks at gas stations and other fuel outlets. Cold fusion energy will have many applications in cleaning up legacy problems (e.g., pumping polluted water for treatment and powering treatment facilities) as well as protecting the environment in the future.

Water pollution is just one of many environmental problems of fossil fuels that can be addressed with cold fusion energy. Other examples of laws and associated regulations designed to protect the environment from fossil fuels and other pollution sources are the Clean Air Act, Solid Waste Act, Safe Drinking Water Act, the Superfund (for cleaning up legacy hazardous waste sites), surface mining control and reclamation, and deep-well injection of liquid wastes. Cold fusion, particularly in dispersed energy configurations, will be essential in the future for providing energy to comply with these laws and their associated regulations.

On the edge of a revolution

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In this paper, I will continue to document the impending revolution in energy sources with new foci on how large it can be and how soon it can happen, and the large implications resulting from the transformation. These research extensions are based on history and designed to help jump-start a significantly higher level of funding. Halting global warming is only the first step in the revolution.

The people at this conference are on the leading edge of what will be the largest energy revolution in the history of mankind.

The last big energy revolution was the Industrial Revolution, shifting from wood power to coal power, still very much chemical combustion. This was triggered by approximately a 2X difference between wood and coal prices starting in about 1600.

Your work produces price differences, I call them ``Rothwell Cheap," that range from 20X to 600X cheaper than any existing source. And in my studied opinion, much, much cheaper.

Your revolution will be to start an entirely new energy regime — field energy — as the primary energy source replacing chemical combustion.

On the whiteboard in my campus office, I have had one phrase for the last half-decade: electricity will be the primary energy source. I continue to believe this will be true. This community increasingly tries to replicate and scale the relevant technologies. My work highlights and supports the urgency of this community's work to accomplish this goal.

I will also present a plan to help increase our scientific credibility to leverage its correlation with funding to accelerate your progress.

Energy for Mankind for the next centuries – A role for LENR

Jacques Ruer
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Email: jsr.ruer@orange.fr - 2 impasse des bolets Saint Germain en Laye

The abundance of fossil energy in the past century was the driving force of a remarkable development on many levels. Today the climate change invites a transition of energy supplies.

The question arises what will be the sources of primary energies in the future. The present options are discussed from the viewpoint of the availability and sustainability for the next centuries. The main macroeconomics elaborated by the UN and other international organisations are considered as the basis in terms of world population, economic development and energy demand.

Considering that fossil fuels will ultimately be phased out the future sources of primary energies will be renewables (mainly wind and solar), nuclear fission, and nuclear fusion. The different sources are examined in terms of:

- Availability in the long term linked to the terrestrial limits or the space required
- Sustainability of the mineral resources for the exploitation. Influence of the acceptable cost on the accessible reserves, possibility and incitation of recycling
- Distribution to final users, conversion of the primary energy into final energy, energy storage, hydrogen economy
- Environmental impact local, deported, global
- Social acceptance linked to the local and deported pollution, noise
- Geopolitical consequences dependence on energy source countries, sensitivity on prices, control of routes, conflicts due to contradictory problems

All options present their own merits and drawbacks that are discussed.

Should LENR reactors be introduced on a large scale the landscape could be markedly modified:

- If they consume hydrogen or deuterium the resource will not be a limiting factor even in the long term and is available everywhere. The conclusion is different if the LENR reactors consume rare metals that cannot be recycled
- They are inherently safe and do not produce emissions or dangerous wastes
- They can produce heat for direct use or electrical power. The unit size will be small compared to existing power stations
- They can be installed close to the final users so that the distribution infrastructure can be limited. The power can be controlled at will to follow the demand
- The local environmental impact is limited by the small unit sizes.
- The acceptance will necessitate a social license to be developed progressively via demonstration, communication and education.

LIST OF EXHIBITORS

Anthropocene Institute

Anthropocene Institute comprises scientists, engineers, science communicators, marketers, thought leaders, and advocates—all pulling together toward a common goal: make Earth abundant for all and sustainable for decades to come. By 2030, we will have solved the climate disruption dilemma, not through hand-wringing and austerity, but by knowing the facts and investing in and advancing the right science and technology. We have the power, the knowledge, the tools, and the resources to make Earth a brighter, healthier, endlessly diverse, and plentiful planet — but we have to move faster. Anthropocene Institute helps by fostering science, influencing policy, backing technology, educating people, and promoting sustainable, clean energy.

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https://anthropoceneinstitute.com/

Dual Fluid

Dual Fluid is creating an entirely new type of nuclear reactor that provides emission-free electricity and hydrogen, reduces today's energy costs, and uses nuclear waste as fuel.Dual Fluid differs from other new nuclear concepts by its high efficiency: the nuclear fuel is utilized up to a hundred times better than in today's light water reactors. The operating temperature of 1000° C enables new heat applications. The Dual Fluid operating principle, based on different fluids for fuel and cooling, is described in scientific publications and protected by patents. Dual Fluid Energy Inc. was incorporated as a public company in Vancouver, Canada, in January 2021 to bring the Dual Fluid technology to serial production status. The prototype of a Dual Fluid reactor is to be launched within this decade.

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Free Wi-FI internet connection is available at the venue. No password required.

Registration opening hours
Sunday, 27 August 2023, 15.30 – 19.30
Monday, 28 August 2023, 08.00 – 17.00
Tuesday, 29 August 2023, 08.00 – 17.00
Wednesday, 30 August 2023, 08.00 – 17.00
Thursday, 31 August 2023, 08.00 – 17.00

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