FUSION facts

A Monthly Newsletter Providing Factual Reports On Cold Fusion Developments

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***Fusion Facts* Now Reports on Both Cold Fusion and Other Enhanced Energy Devices.**

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CONTENTS FOR MAY 1995

This issue of *Fusion Facts*
together with the April 1995 issue
contain the abstracts of the papers that have been
presented at the

Fifth International Conference on Cold Fusion

held in
Monte Carlo, Monaco
on April 9-13, 1995

A. WHO IS COMMERCIALIZING ENHANCED ENERGY SYSTEMS?

By Hal Fox, Editor

Enhanced energy devices produce more energy (of some type) than input into the device. To many scientists, this is not possible because, "That is a violation of the Law of Conservation of Energy!" That statement is true **only if there is no source for the energy obtained. Because there is an energetic ether, enhanced energy devices are merely energy transformers.** There is no violation of the Law of Conservation of Energy. Cold fusion systems are also classified as enhanced energy devices and violate only the laws of the pathological skeptics. Three writers (Julian Schwinger, Robert Bush, and Robert Bass) have suggested that cold fusion may be promoted by zero-point energy.

The good news is that there are now a few enhanced energy devices that have been developed, commercialized, and are being manufactured and marketed. As is generally true in the advancement of science, we do not, as yet, fully understand how any of these devices work. The theory of their operation has not caught up with established fact. For example, two of the devices to be commercialized produce excess heat apparently from the cavitation of water.

At the present time, we have several companies who are manufacturing and marketing enhanced energy devices or systems. At least two other companies are prepared to provide rights to a selection of intellectual property (patents issued or pending) which combined provides a variety of cold fusion and enhanced energy technologies.

New Energy News has announced the NEW ENERGY COMMERCIAL COLUMN which will print a monthly list of the names and contacts of commercial, profit-making or not-for-profit companies involved in the manufacturing and marketing of new energy systems and devices. To be listed in this column a company must be providing a product based on an enhanced energy device (including cold fusion) that has been shown to produce more power out than used as input power. Chemical combustion systems are not eligible for listing, however toys or demonstration devices based on enhanced energy technologies do qualify. These first companies are expected to be joined soon by several other companies whose technologies are based on magnetic motors/generators or on new developments in cold nuclear fusion. Here is the first listing of companies and products together with contact names and/or phone numbers:

COMPANY: PRODUCT

ENECO: Portfolio of intellectual property including over thirty patents issued or pending in cold nuclear fusion and other enhanced energy devices. Salt Lake City, Utah. Contact Fred Jaeger, Voice 801/583-2000, Fax 801/583-6245.

NOVA RESOURCES GROUP, INC.: Design and manufacture ETC (Electrolytic Thermal Cell); EG (commercial power cogeneration module); and IE (integrated electrolytic system). Denver, Colorado. Call Chip Ransford, Phone (303) 433-5582.

CETI (Clean Energy Technologies, Inc.): Developers of the Patterson Power Cell™. Dallas, Texas. Voice (214) 458-7620, FAX (214) 458-7690.

E-QUEST SCIENCES: Exploring The Micro-Fusion™ process. Seeking qualified research partners for their sonoluminescense program. Contact Russ George, FAX (415) 851-8489.

HYDRO DYNAMICS, INC.: Hydrosonic Pump, heat-producing systems using electrical input with thermal efficiencies of 110 to 125 percent. Rome, Georgia. Contact James Griggs, Voice 706/234-4111, Fax 706/234-0702.

AMERICAN COLD FUSION ENGINEERING AND SUPPLY: Information and troubleshooting for the fusion research and development industry. Sacramento, California. The president, Warren Cooley, can be reached at 916-736-0104.

UV ENHANCED ULTRASOUND: Cold Fusion Principle being used for an ultrasonic water purifier. Hong Kong. FAX (852) 2338-3057.

Note: The Fusion Information Center has been acting as an information exchange to many of these companies. We expect to augment our international service to provide contacts, information, and business opportunities to companies considering an entry into the enhanced energy market.

COMMERCIAL INFORMATION SOURCES

Fusion Facts monthly newsletter: Salt Lake City, UT 801/583-6232, also publishes Cold Fusion Impact and Cold Fusion Source Book. Plans on-line database access for later in 1995.

New Energy News monthly newsletter, edited by Hal Fox, Salt Lake City, UT 801/583-6232

Cold Fusion Times, quarterly newsletter published by Dr. Mitchell Swartz, P.O. Box 81135, Wellesley Hills, MA 02181.

Infinite Energy, planned new bi-monthly newsletter edited by Dr. Eugene Mallove, P.O. Box 2816, Concord, NH 03302-2816. Also author of **Fire from Ice**.

Fusion Technology, Journal of the American Nuclear Society publishes journal articles on cold nuclear fusion. 555 N. Kensington Ave., La Grange Park, IL 60525.

21st Century Science & Technology, P.O. Box 16285, Washington, D.C., 20041. Includes cold fusion developments.

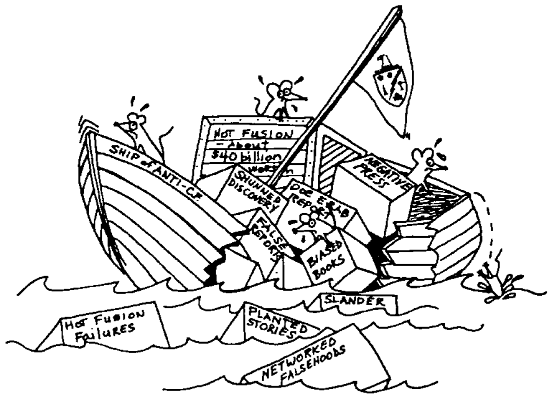
Electric Spacecraft Journal, quarterly, edited by Charles A. Yost, 73 Sunlight Drive, Leicester, NC 28748.

Space Energy Journal, edited by Jim Kettner & Don Kelly, P.O. Box 11422, Clearwater, FL 34616.

"Cold Fusion," monthly newsletter, edited by Wayne Green, 70 Route 202N, Petersborough, NH 03458.

Since 1989, this editor has been saying that cold fusion could be expected to be commercialized in two years. Now I can change my story. Cold Fusion is being commercialized. I was correct in 1993. In spite of one of the most intensive efforts in the annals of science to discredit a new technology, cold fusion has prevailed. Despite the thoroughly biased books (Bad Science, the Short Life and Weird Times of Cold Fusion; Cold Fusion, The Scientific Fiasco of the Century; and Too Hot to Handle) cold fusion is here to stay. **You may want to get copies of these three books before they are withdrawn in blushing shame or embarrassment, they will become collectors items and their authors will be targets of humorists for decades to come.**

The next problem is to get DOE's man in the patent office recycled (fired, retired, or transferred) so that the patent examiners can do an honorable job for a change. **The enormous volume of discredit currently being handled by the DOE is from its failure to follow its mission and to properly promote the development of enhanced energy systems. Now the DOE is being either downsized or disbanded**. Those responsible for the dismal lack of progress in the issuing of U.S. Patents on cold fusion may soon be faced with an intensive and embarrassing congressional investigation and possible demotions. Can you imagine that nearly 200 patents have issued internationally (with almost half of them going to Japanese inventors) **and scarcely one patent application (that has the temerity to use the phrase "cold fusion") has been issued in the United States! This lack of professionalism in the Patent Office is a national disgrace and a bureaucratic abrogation of constitutional rights."** We trust that the punishment will match the crime.



Hurry up, DOE. Your ship is sinking.

B. NEWS FROM THE U.S.

CALIFORNIA - RESONANT TRANSPARENCY

Robert W. Bass (Thousand Oaks, CA; Sci. Adv. Bd., ENECO, Inc., Salt Lake City, UT; Tech. Adv. Bd., Fusion Info. Ctr., SLC, UT), "Resonant Transparency Spectrum of Deuterium Lattices in $Pd\cdot D_{1.0}$ Cold Fusion Reactors," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #418, poster session.

AUTHOR'S ABSTRACT

A simplified grossly electrically neutral one-dimensional linear-array model of electrons and deuterons bound in a beta-phase palladium-deuterium lattice $Pd\cdot D_{1.0}$ with a periodic length L = 2.83 Å is derived. A new Coulomb/Madelung/ Fermi-Thomas potential $V_{CMFT} = V(r) \equiv V(r \pm 2L)$, $-\infty < r < \infty$ is derived to be applicable to a free deuteron formerly bound at r = 0 but considered to have been excited & now located on $-L < r < L$. Outside of this fundamental interval, deuterons are bound and averaged; electrons alternate between them; for neutrality, a Fermi-Thomas cloud of 3 electrons is included on the same interval as the unbound deuteron. The Zero Point Fluctuations (ZPF) of this deuteron have an expected rms amplitude $\Lambda = \langle r^2)^{1/2}$ measured empiricly by x-rays or neutron scattering to have the value Λ = 0. 1002 Å. The new potential V_{CMFT} is validated by correct theoretical prediction of the empirical Schwinger Ratio $\sigma = L/\Lambda = 28.24$ within one-third of one percent! Then a globally valid proof of the *Schwinger Conjecture,* which in his theory of *Nuclear Energy in an Atomic Lattice* (NEAL) he had proved only for $|r| << L$, namely that this single ratio sums up "albeit crudely" all of the forces at work in the lattice, is proved for all r specifically: the denumerable energy levels E_n and their corresponding linebreadths δE_n are functions ONLY of σ and the fundamental constants of physics and pure mathematics, where the E_n are the energies of meta-stable bound states if the periodicity is ignored, and are here the energies of *Resonant Transparency* of the *Coulomb Barrier.* For $0 \le n \le 600$, 6.28 eV = $E_0 \le E_n < E_{n+1} \le E_{600}$ = 145.6 eV, although the δE_n are not monotonic and the lowest value of n for which $\delta_n = \delta E_n/\Delta E_n, \Delta E_n = E_{n+1} - E_n$, exceeds 0.49 is at n = 88. for which E_{88} = 16.173 eV; δ_n attains its maximum δ_{mx} = 0.57 at $n \cong 150$; E_{100}= 17.691 eV; E_{200} = 32.5 eV.

A definitive "5 needles" (k = 0, 1, 2, 3, 4), k-τ seconds, τ = 1 µsec, current pulsing experiment on frozen "loaded" $Pd\text{-}D_{0.95}$ sample rods is proposed, for which the preferred pulsing voltage of 17.7 Volts corresponds to E_{100}, although more conservative is 32.5 volts (because $\delta_n \ge 0.50$ for $95 \le n \le 360$ and thus n = 200, at which δ_n = 0.55, is closer to the maximum of these [overlapping!] lines). The prescience of Schwinger's insight about the all important nature of the (empirical Schwinger Ratio) σ is demonstrated by a Quantum Resonance Triggering (QRT) proof that a particle-lattice pair is a suitable cold-fusion reactor if & only if $\sigma_{QRT} = \sigma/\pi$ is closer to an ODD than an even integer! **In five of seven separate instances of validation, this QRT™ Process Criterion (Patent Applied for in June, 1991) predicted later-measured reality before experimental confirmation.**

CALIFORNIA - QUANTUM RESONANT TRANSPARENCY

Robert W. Bass (Thousand Oaks, CA; Sci. Adv. Bd, ENECO Inc. & Tech. Adv. Bd., FIC, Inc., Salt Lake City, UT), "A Comprehensive Definitive/Predictive Theory of Cold Fusion: Quantum Resonant Transparency (QRT) of Coulomb Barriers and Lattice-Induced Nuclear Transmutations (LINT)," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #419, poster session.

AUTHOR'S ABSTRACT

The present theory could (with injustice) be called the Turner-Bush-Bass theory, if I failed to acknowledge the giants upon whose shoulders I stand (and I incorporate ideas which I first learned from F&P, and F&P jointly with Simons & Walling, as well as [early] Hagelstein, Schwinger, Parmenter

& Lamb, Chubb & Chubb, Kim et al., Rabinowitz & Worledge). This theory is now the ONLY viable CF theory:

1. It predicts the strictly empirical Schwinger Ratio to within one-third of one percent, and demonstrates why the Schwinger Ratio is "all important" to CF.

2. It is the ONLY theory which predicts that a beta-phase deuterided palladium lattice (heavy-water FP cell) will produce CF, while a similarly hydrided palladium lattice (ordinary-water FP cell) will NOT! ("Rabinowitz Acid Test")

3. It is the ONLY theory which was submitted in a patent application and a still "in press" paper in 1991 which makes 7 (SEVEN) experimentally confirmed predictions, ONLY two of which were known to me when I submitted the patent, yet then implicitly predicted that ordinary water or hydrogen gas WOULD work in nickel.

4. In a privately circulated pre-print, when F&P had only suggested up to $1kW/cm^3$, it predicted $3kW/cm^3$ before Bush & Eagleton observed that rate of Excess Enthalpy in a thin-film palladium anode plated on silver (closed FP cell).

5. It is the ONLY theory which has permitted the explicit numerical computation of the low-energy Resonant Transparency Spectrum from first principles QM in periodic solid-state lattices, updating Duane's Rule; the most important resonances cannot be found without consideration of ALL particles in the lattice, done by combining methods of Madelung & Fermi-Thomas/Molt in a periodic potential.

6. It is the ONLY theory which (via ZPF line-broadening) overcomes the formidable "Breit-Wigner Linewidth" type of objection to the Turner-Bush theory published independently by Jaendel and by Rabinowitz & Worledge, the "billion-year tunneling time," which spooked Bush into retracting his own TRM theory at ICCF-4.

7. Therefore it is the ONLY theory which garners additional experimental support by predicting the Bush Fine Structure Spectrum, or ascending multiple hill-cusped valley curve of Excess Enthalpy as function of either cell current or cell temperature, as first observed experimentally by Bush & Eagleton.

8. It early stated explicitly warnings of FP meltdowns (& Gozzi *et al.* incipient meltdowns), and is compatible with Schwinger's independently proposed theory of "chain fusion reactions" dependent upon unbroken linear lattices of barrier-well-barrier chains; thus random imperfections in the actual as opposed to ideal metallic lattice account for the unpredictable evolution in time of many experiments: and so it predicts that sporadicity, is a function of the branching ratio between phonon excitation of the host metallic lattice [FP CF heat] versus the embedded deuteron lattice [heat after death; microbomb fizzles; Pons meltdown].

9. It is compatible with Bush's ICCF-4 explanation of tritium production (low loading) versus radiationless aneutronic Excess Enthalpy by helium-4 creation (high loading), as well as Bush's generalized CAF (Cold Alkali Fusion) and LANT (Lattice Assisted Nucleon Transfer) theories, which explain the Mills type light-water and Bockris-type neo-alchemy experimental successes, plus predictions of eliminating ALL long-lived dangerous radioactive wastes (without use of neutron fluences).

10. It illuminates that what is really important is not the host lattice but the embedded deuteron lattice, therefore suggesting that solid meta-stable room-temperature-&-pressure crystalline MSD (Meta-Stable Deuterium), manufactured via Bass's patented Plasmasphere Process & patent-pending Metamatter Process (for putting fully ionized plasmas into the state of a liquid metal, prior to magnetic levitation in a refrigerated vacuum for cooling), will provide micro-pellet radiationless aneutronic cold fusion (triggered by my patent pending QRT Process).

CALIFORNIA - LIGHT WATER FUSION

Robert T. Bush, Robert Eagleton (Phys. Dept. Cal-Poly. Univ., Pomona; ENECO, Inc., Salt Lake City, UT; Proteus Processes and Technology, Inc., Denver, CO), "A Demonstrator for the Light Water Excess Heat/Effect," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 617, poster session.

AUTHORS' ABSTRACT

A demonstrator to convince critics of the reality of the light water excess heat phenomenon is being constructed. It employs closed cell calorimetry and an integrative heat design, and is based upon a theoretical model by Bush for the impurity promotion and inhibition of the excess heat effects of cold fusion. Initial data should be available by conference time.

CALIFORNIA - ELECTRON CATALYZED FUSION

R. Bush (Phy. Dept., Cal-Poly Univ., Pomona, CA and ENECO Inc., Salt Lake City, UT, & Proteus Processes and Technology Inc., Denver, Co), "The Electron Catalyzed Fusion Model (ECFM) Reconsidered with Special Emphasis upon the Production of Tritium and Neutrons," ICCF5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #416, poster session.

AUTHOR'S ABSTRACT

The ECFM ("Electron Catalyzed Fusion Model") first presented at ICCF-4 is re-examined with special reference to the production of tritium and neutrons {The model is of some interest in being the first model to fit data of McKubre et al. (SRI International/EPRI) and, independently, that of Kunimatsu et al. (IMRA), on excess power versus loading fraction}. A simplified expression is also given for the theoretical lower limit of the neutron-to-triton branching ratio, which yields a value in good agreement with that found empirically.

CALIFORNIA - IMPURITY PROMOTION & INHIBITION

R. Bush (Phys. Dept., Cal-Poly. Univ., Pomona, CA and ENECO Inc., Salt Lake City, UT, and Proteus Processes and Technology Inc., Denver, CO), "A Model for the Impurity Promotion and Inhibition of the Excess Heat Effects of Cold Fusion," ICCF5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #417, poster session.

AUTHOR'S ABSTRACT

A theoretical model describes impurity promotion and inhibition of the light water and heavy water excess heat effects of cold fusion based upon the effects upon the magnetic properties of Ni and Pd, respectively, produced by alloying with different metals. For Ni (light water case), promoters, in increasing order of efficiency, are predicted to be Cu, Zn, Al, and Sn. Inhibitors, in increasing order of efficiency, are predicted to be Co, Fe, and Mn. Ag, Au, and Cu are indicated as promoters in the case of Pd (heavy water case). Empirical evidence impacting the model will be presented.

GEORGIA - OPTIMIZATION OF COLD FUSION

Robert Indech and Ruvin Karshenboym (IPD Assoc., Norcross), "Thermodynamic Considerations in Optimizing Steady State Output in a Cold Fusion Generator," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #429, poster session.

AUTHORS' ABSTRACT

Fundamental progress has been made by many researchers in the production of excess heat from a Cold Fusion generator based upon the combination of deuterium ions within a metallic matrix. Utilizing the matrix to lower the electrostatic repulsion barrier to combination has allowed the reaction to occur at temperatures between 300°-700°K, depending upon the apparatus. It is considered that after ignition occurs, due to careful preloading of the metal, a steady state reaction will occur producing a constant excess heat.

This theoretical paper will present a model calculation for the ion impact velocity required for D-D and D-T reaction in bulk for fusion to occur. Then, utilizing ideal gas laws, the diffusion equation and Boltzmann velocity distribution, a model is presented for calculating the likelihood of steady state reaction in the unit metallic lattice cell.

Based upon the model, various methods such as use of electric fields and porous material technology to increase reaction rates will be discussed, with reference to positive results by other researchers. General guidelines for increasing reaction efficiency will be suggested.

HAWAII - ENHANCED ENERGY RESEARCH

Bertil Werjefelt (PolyTech Corp., Kaneohe, HI), Eugene F. Mallove (Cold Fusion Tech., Concord, NH), "Cold Fusion and Magnetically Derived Energy: Experimental Evidence, Mechanisms, and Thermodynamic Explanations," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #624.

AUTHORS' ABSTRACT

The substantial body of experimental evidence for cold fusion phenomena is briefly reviewed. New results are presented, which demonstrate conclusively the existence of what we have chosen to call magnetically derived energy. In completely reproducible experiments, substantially more continuous power output than input can be produced form different systems , including macroscopic versions with permanent magnets and coils of particular composition, geometry, and resonant behavior. (Patents are pending.) The scientific, technological, and social implication of energy derived form magnetism are demonstrably vast. Cold fusion effects are also approaching technological application. A possible physical explanation of the source of the excess energy of cold fusion experiments is proposed, which relies on the conventionally recognized magnetic moments of nuclear spin systems. These are referred to as "special systems" and are manifestations of well-recognized "negative absolute temperature" systems. The mechanisms of such systems have previously not been understood other than in a statistical sense, but are now explained in simple macroscopic terms. This may provide - for both magnetically derived energy and cold fusion - a valid thermodynamic explanation, which may offer a new, acceptable perspective on conventional formulations of energy conservation.

INDIANA - MODIFIED FORMULA

Yeong E. Kim (Dept. Phys., Purdue Univ., West Lafayette, IN), "New Modified Formula for Nuclear Fusion Rate in High- Density Plasma," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #404, poster session.

AUTHOR'S ABSTRACT

A new modified general formula for the high density nuclear fusion rate is presented. For given relative velocity $v = v_{ij} = |\vec{v}_i - \vec{v}_j|$ between the i*th* and j*th* particles and fusion cross section $\sigma(v_{ij})$, the fusion rate per unit volume, R_f, is expected to be proportional to $P(\vec{r}_i, \vec{v}_i; \vec{r}_j, \vec{v}_j)\, v_{ij}\sigma(v_{ij})$ where P is the probability of finding the i*th* particle at $\vec{r}_i$ with $\vec{v}_j$ and the j*th* particle at $\vec{r}_j$ with $\vec{v}_j$.

For a given one-body phase space (density) distribution, $\rho(q_l, p_l) = \rho(\vec{r}_i, m_i, \vec{v}_i)$, one possible choice for P is, suppressing m_i, $P(\vec{r}_i, \vec{v}_i; \vec{r}_j, \vec{v}_j) = \rho(\vec{r}_i, \vec{v}_i)\rho(\vec{r}_j, \vec{v}_j)$ which is valid for a collisionless ideal or low-density gas but may not be valid for a high-density gas. The separability of the phase-space distribution $\rho(\vec{r}_i, \vec{r}_i) = n(\vec{r}_i) f(\vec{v}_i)$ is assumed, where $f(\vec{v}_i) = (m_i/2\pi kT)^{3/2}\exp(-m_i v_i^2/2kT)$ is the Maxwell-Boltzmann (MB) velocity distribution for a system in thermal equilibrium. With the above assumptions, we can write R_f as

$$R_f = \frac{1}{(1+\delta_{ij})V_r^2}\int d^3r_i \int d^3r_i \int d^3v_i \int d^3v_j P(\vec{r}_i, \vec{v}_i, \vec{r}_j, \vec{v}_j) v_{ij}\sigma(v_{ij}) \qquad (1)$$
$$= \frac{1}{(1+\delta_{ij})V_r^2}\int d^3r_i \int d^3r_j \int d^3v_i \int d^3v_j\, n(\vec{r}_i) n(\vec{r}_j) f(\vec{v}_i) f(\vec{v}_j) v_{ij}\sigma(v_{ij})$$

where V_r is the system volume.

After transforming the i*th* and j*th* particle coordinates into the relative and center of mass (CM) coordinates, and integrating the CM coordinates, eq. (1) reduces to $(r = |\vec{r}_i - \vec{r}_j|)$

$$R_f^{new} = \frac{n_i n_j}{(1+\delta_{ij})V_r}\int d^3r \int d^3v\; g(r) f(\vec{v}) v_0 \sigma(v_0) \qquad (2)$$

using the assumption that the pair number density $n(\vec{r}_i)n(\vec{r}_j)$ is related to the radial distribution function g(r) by $n(\vec{r}_i)n(\vec{r}_j) = n_i n_j g(r)$ with n_i and n_j representing the average number densities. g(r) is defined as the number of particles, on the average, in the volume $4\pi r^2 dr$ centered about a given particle divided by the number that would be in the same volume if the system behaved as an ideal gas [1]. g(r) can be calculated from a molecular dynamics simulation [1].

Since $\sigma(v_0)$ is experimentally measured with v_0 representing the asymptotic relative speed v_0 in the potential free region (V(r) = 0), we must use $v_0\sigma(v_0)$ instead of $v\sigma(v)$ in eq. (2), where v_0 and v are related by the total pair energy (E_0) conservation, $E_0 = \mu v_0^2/2 = \mu v^2/2 + V(r)$ with the reduced mass μ.

For a collisionless ideal gas (V(r) = 0), we have v_0 = v and g(r) = 1, and hence R_f^{new}, eq. (2), reduces to the conventional fusion rate formula: $R_f^{new} \rightarrow R_f^{conv}$, where

$$R_f^{conv} = \frac{n_i n_j}{1+\delta_{ij}}\int d^3v\; f(\vec{v}) v\sigma(v). \qquad (3)$$

Implications of the new fusion rate formula for the cold fusion, inertial confinement fusion, astrophysical problems will be discussed.

[1] J.P. Hansen and I.R. McDonald, *Theory of Simple Liquids*, Academic Press, Orlando, 1986.

INDIANA - ENHANCEMENT OF S-FACTOR

Yeong E. Kim and Alexander L. Zubarev (Dept. of Phys., Purdue Univ., West Lafayette, IN), "Anomalous Enhancement of S-Factor for Nuclear Fusion Cross-sections Involving High Z Nuclei due to Finite-range of Nuclear Potential," ICCF5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #405, poster session.

AUTHORS' ABSTRACT

We present a new derivation [1] of nuclear fusion cross-section, σ(E), at low energies for fusion reactions involving a pair of light nucleus (proton or deuteron, $Z_1 = 1$) and a heavy nucleus ($Z_2 >> 1$). Our formulation takes into account both Coulomb potential and finite-range nuclear potential on an equal footing. For a reasonable form of separable finite range nuclear potentials, we derive an explicit formula for σ(E) analytically and show an anomalous enhancement of σ(E) for deuteron + Palladium (d+Pd) fusions, $^{A}Pd(d,p)^{A+1}Pd$ and $^{A}Pd(d,t)^{A+1}Pd$, as examples.

For non--resonance reactions, it is customary to extract the S-factor, S(E), from the experimentally measured σ(E) using the following formula

$$\sigma_G(E) = \frac{S(E)}{E}\, e^{-2\pi\eta(E)} \qquad (1)$$

where $n(E) = Z_i Z_2 e^2/\hbar v$, $e^{-2\pi n(E)}$ is the Gamow factor representing the probability of bringing two charged nuclei to zero separation distance, and S(E) is assumed to be a slowly varying function of E.

For fusion reactions, such as $^{A}Pd(d,p)^{A+1}Pd$ and $^{A}Pd(d,t)^{A-1}Pd$, the Hamiltonian is given by

$$H = H_0 + V^C + V^S \qquad (2)$$

where H_0 is the kinetic energy operator, V^C is the Coulomb potential ($V^C = Z_1Z_2e^2/r = Ze^2/r$ with $Z_1 = 1$ and $Z_2 = Z$), and V^S is the strong interaction potential. We introduce T-matrix operator

$$T = V^S + V^S \frac{1}{E - H_0 - V^C} T = V^S + T \frac{1}{E - H_0 - V^C} V^S \qquad (3)$$

We note that $T \approx V^S$ if V^C (or Z) is large. Using the partial wave expansion, we can obtain the partial-wave cross-section $\sigma_l(E)$ as

$$\sigma_l(E) \approx \frac{2l+1}{kE} \int_0^\infty \psi_l^C(r) U_l(r,r') \psi_l^C(r') dr dr' \qquad (4)$$

where $E = \hbar^2k^2/2\mu$ with the reduced mass μ, $U_l(r,r') = -ImT_l(r,r')$ (optical theorem) with the *lth* partial wave contribution T_l, and ψ_l^C is the *lth* partial wave Coulomb wave function. The total cross-section $\sigma(E)$ is given by $\sigma(E) = \Sigma_l\sigma_l(E)$. We will assume $\sigma(E) \approx \sigma_0(E)$.

To estimate the S-wave cross-section, $\sigma_0(E)$, we parameterize non-local potential $U_0(r,r') = -ImT_l(r,r') \approx -ImV_0^S(r,r')$ by two parameters V_0 (strength) and $ß^{-1}$ (range) in a separable form

$$ImV_0^S(r,r') = -V_0\lambda_N \frac{e^{-\beta r}}{r}\left(\frac{e^{-\beta r'}}{r'}\right), \; (V_0 > 0) \qquad (5)$$

with the nuclear Compton wavelength $\lambda_N = \hbar/\mu c$, and use the following expression (valid for small values of E) for the S-wave Coulomb wave function $\psi_0^C(r)$

$$\psi_0^C(r) \approx e^{-\pi\eta(E)} (\pi kr)^{1/2} I_1\left(2\sqrt{\frac{r}{R_B}}\right) \qquad (6)$$

with $R_B + \hbar^2/2\mu Ze^2$. Using eqs. (5) and (6), eq. (4) reduces to

$$\sigma_0(E) = \frac{V_0\lambda_N}{kE}\left[\int_0^\infty \psi_0^C(r)\frac{e^{-\beta r}}{r}dr\right]^2 = \frac{2\pi V_0\lambda_N R_B}{E}(e^{1/\beta R_B} - 1)^2 e^{-2\pi\eta(E)} \qquad (7)$$

or

$$\sigma_0(E) = \frac{f(Z)\tilde{S}_0}{E} e^{-2\pi\eta(E)} \qquad (8)$$

where $\tilde{S}_0 = 2\pi V_0(\hbar/\mu c)\hbar^2/2\mu e^2 \approx V_0\ (0.3 \times 10^{-24} cm^2)$ and f(Z) is a Z-dependent enhancement given by $f(Z) = (e^{1/\beta R_B} - 1)^2/Z$.

To compare $\sigma_0(E)$, eq. (8), with $\sigma_G(E)$, eq. (1), we assume $S(E) = S_0$ (a constant) and denote $\sigma_G(E)$ as $\sigma_G(E) \approx S_0e^{-2\pi n(E)}/E$, and obtain the ratio $\sigma(E)/\sigma_G(E) = f(Z)\tilde{S}_0/S_0$ or $\sigma_G(E) \approx f(Z)\sigma_G(E)$ if $\tilde{S}_0 = S_0$. In the limit of zero range, $ß^{-1} \rightarrow 0$, as in the case of $\sigma_G(E)$, eq. (1), we obtain $f(Z) \approx Z^{-1}$ and $\sigma_0(E) \approx \sigma_G(E)$ if $\tilde{S}_0/Z = S_0$. However, for a reasonable non-zero value of $ß^{-1} = 10$ fm and $\mu \approx M_d$ (M_d is the deuteron rest mass), we obtain $R_B \approx 7.2$ fm/Z, and $f(Z) \approx 10^{1.2Z}/Z$.

Eq. (8) is a surprising result that the fusion cross-section for nuclei with larger values of Z is much greater than that for nuclei with smaller Z, contrary to the commonly accepted belief otherwise. The enhancement factor for $^{A}Pd(d,p)^{A+1}Pd$ and $^{A}Pd(d,t)^{A-1}Pd$, is $f(Z=46) \approx 10^{53}$ in contrast to $f(Z = 3) \approx 10^3$ for reactions such as $^6Li(d,\alpha)^4He$ (Q = 22.375 MeV). For $^{A}Pd(d,p)^{A+1}Pd$, Q values are 5.21 MeV (A = 102), 1.48 MeV (A = 104), 7.72 MeV (A = 105), 3.71 MeV (A = 106), 7.27 MeV (A = 107), 6.88 MeV (A = 108), and 3.08 MeV (A = 110). For $^{A}Pd(d,t)^{A-1}Pd$, Q values are 2.55 MeV (A = 105) and 0.32 MeV (A = 107). Based on our results, we will present possible mechanisms and scenarios for explaining the excess heat generation, anomalously large triton production and other anomalies observed in electrolysis and other cold fusion experiments.

[1] Y.E. Kim and A. L. Zubarev, Purdue Nuclear Theory Group preprint PNTG-95-1, to be submitted to *Nuovo Cimento*.

INDIANA - HIGH PARTIAL WAVE CONTRIBUTIONS

Yeong E. Kim and Alexander L. Zubarev (Dept. of Phys., Purdue Univ., West Lafayette, IN), "Importance of High Partial Wave Contributions for Nuclear Fusion Cross-sections at Extremely Low Energies," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #406, poster session.

AUTHORS' ABSTRACT

We show that high partial wave contributions are very important for estimating nuclear fusion cross-section $\sigma(E)$ at extremely low energies, and discuss implications for cold fusion phenomena. The high partial wave contribution has been neglected in previous conventional estimates of $\sigma(E)$. For non resonance reactions, it is customary to extract the S-factor, S(E), from the experimentally measured $\sigma(E)$ using the following formula

$$\sigma_G(E) = \frac{S(E)}{E} e^{-2\pi\eta(E)} \qquad (1)$$

where $n(E) = Z_1Z_2e^2/\hbar v$, $e^{-2\pi n(E)}$ is the Gamow factor representing the probability of bringing two charged nuclei to zero separation distance, and S(E) is expected to be a slowly

varying function of E. Recent results for σ(E) from laboratory beam experiments for nuclear reactions involving light nuclei at low energies (> 3 keV) show that the extracted S(E) increases toward lower energies instead of being a constant extrapolated from higher energy data, indicating the importance of the electron screening. However, recent theoretical calculations [1,2] of the electron screening effect, yield limiting values which are much smaller (by ~ 1/2) than those extracted from the experimental data for reactions $^3He(d,p)^4He$, [3,4] $^6Li(p,\alpha)^3He$, $^6Li(d,\alpha)^4He$, and $^7Li(p,\alpha)^4He$ [5]. This discrepancy between the experimental data and the theoretical estimate for the electron screening effect is not understood at present. Because of the importance of accurate cross-sections needed for cold fusion and astrophysical problems, it is very important to resolve the discrepancy. Since σ(E) at energies relevant to cold fusion phenomena (< 10 eV) and to the primordial and stellar nucleosynthesis (a few keV) cannot be measured in the laboratory, they are extracted from the laboratory measurements of σ(E) at higher energies by an extrapolation procedure based on nuclear theory. However, the energy dependence of the nuclear reaction cross-section σ(E) cannot be obtained rigorously from first principles, since the many-nucleon scattering problem cannot be solved exactly even if the nucleon-nucleon force is given. Therefore, one must rely on physically reasonable nuclear reaction models. For theoretical model estimates of σ(E), it is customary to make the partial wave expansion and use the lowest few particle wave contributions. For simplicity, we consider here the case of $Z_1 = Z_2 = 1$. We expect the high partial contribution to be larger for the case of $Z_1 > 1$ and $Z_2 > 1$.

For $^2H(d,n)^3He$ or $^2H(d,p)^3H$ reactions, the Hamiltonian is given by

$$H = H_0 + H^C + V^S \qquad (2)$$

where H_0 is the kinetic energy operator, V^C is the Coulomb potential, V^S is the strong interaction potential Let us introduce T-matrix operator

$$T = V^S + V^S \frac{1}{E - H_0 - V^C} T = V^S + T \frac{1}{E - H_0 - V^C} V^S \qquad (3)$$

Using the partial wave expansion, we can obtain the partial-wave cross-section $\sigma_l(E)$ as

$$\sigma_l(E) \approx \frac{2l+1}{kE} \int_0^\infty \psi_l^C(r) U_l(r,r') \psi_l^C(r') dr dr' \qquad (4)$$

where $E = \hbar^2 k^2/2\mu$, $U_l(r,r') = -\mathrm{Im}T_l(r,r')$ (optical theorem) with the *lth* partial wave contribution T_l, and ψ_l^C is the *lth* partial wave Coulomb wave function. The total cross-section σ(E) is given by $\sigma(E) = \Sigma_l \sigma_l(E)$.

To estimate $\sigma_l(E)$, eq. (4), we use the perturbation theory ($T_l \approx V_l^S$) with an assumption that V^S is a local potential, and write

$$U_l(r,r') \approx \delta(r - r') V_l e^{-ßr}, \qquad (5)$$

where $\mathrm{Im}V_l^S(r)$ is parameterized by V_l (strength) and $ß^{-1}$ (range), i.e., $\mathrm{Im}V_l^S(r) = V_l e^{-ßr}$. Using eqs. (4) and (5), we can write

$$\sigma_l(E) \approx (2l+1) \frac{V_l}{kE} \int_0^\infty |\psi_l^C(r)|^2 e^{-\beta r} dr \qquad (6)$$

For large *l* and small E:, we can approximate $\psi_l^C(r)$ as $\psi_l^C(r) \approx C_l(E)(kr)^{l+1}$ with $C_l(E) \approx \frac{2^l l!}{(2l+1)} e^{-\pi n(E)/2}$ [6], and reduce eq. (6) to

$$\sigma_l(E) \approx \frac{V_l}{k\beta E} \left(\frac{2^l l!}{(2l+1)!} \right)^2 (2l+2)!\,(2l+1) \left(\frac{E}{E_\beta} \right)^{l+1} e^{\pi\eta(E)} \qquad (7)$$

where $E_ß = \hbar^2 ß^2/2\mu$. To compare $\sigma_l(E)$, eq. (7), with $\sigma_G(E)$, eq. (1), we assume $S(E) = S_0$ (a constant) and denote $\sigma_G(E)$ as $\sigma_G(E) \approx S_0 e^{-2\pi n(E)}/E$, and calculate the ratio $\sigma_l(E)/\sigma_G(E)$ as

$$\frac{\sigma_l(E)}{\sigma_G(E)} \approx \frac{V_l}{k\beta S_0} \sqrt{\pi l}(2l+1) \left(\frac{E}{E_\beta} \right)^{l+1} e^{\pi\eta(E)} \qquad (8)$$

where Stirling's formula, $l! \approx \sqrt{2\pi l}\, l^l e^{-l}$, is used. Eq. (8) shows that $\sigma_l(E)/\sigma_G(E) \to \infty$ when $E \to 0$ for a given value of large *l*, indicating the importance of the high partial wave contribution at extremely low energies. We will present the numerical results for the case of 0 < E < 10 eV and large *l*.

[1] L. Bracci et al., *Nuclear Physics* A53, 316 (1990); *Physics Letters* A153, 456 (1991).

[2] T.D. Shoppa et at., *Physical Review* C48, 837 (1992).

[3] S. Engstler et at., *Physics Letters* B202, 179 (1988).

[4] G. Bluge et at., *Zeitschrift fur Physik* A333, 219 (1989).

[5] S. Engstler et at., *Physics Letters* B279, 20 (1992); *Zeitschrift fur Physik* A342, 471 (1992).

[6] Handbook of Mathematical Functions, edited by M. Abramowitz and I.A. Steguin, (1964), National Bureau of Standards.

INDIANA - ELECTRON SCREENING

Yeong E. Kim and Alexander L. Zubarev (Dept. of Phys., Purdue Univ., West Lafayette, IN), "Non-Square-Integrability of the Conventional Probability Integral and Alternative Formulation for the Electron Screening Effect for Nuclear Fusion Reactions," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #408, poster session.

AUTHORS' ABSTRACT

We show that there is a very serious difficulty associated with the conventional formula for nuclear fusion rate in the presence of electron degrees of freedom due to non-square integrability of the probability integral $|\psi_E(0)|^2$ which has been ignored in previous theoretical calculations. At low energies, fusion reaction cross-sections of charged nuclei can be written as

$$\sigma(E) = G(E)|\psi_E(0)|^2/v \qquad (1)$$

where G(E) is the so-called astrophysical factor, which embodies the nuclear aspects of the process, E and v are the collision (kinetic) energy and the relative nuclear velocity, respectively, $\psi_E(0)$ is the wave function at the origin, and the probability integral is written as

$$|\psi_E(0)|^2 = (2\pi\alpha c/v)\exp(-2\pi\alpha c/v)$$

representing the probability of bringing two charged nuclei to zero separation distance in the absence of electrons. We will consider $^3H(d,n)^4He$ reaction for simplicity and use the three-body d + e+ ^3H (*det*) initial state. The probability integral $|\psi_E(0)|^2$ in eq. (1) for this case is

$$|\psi_E(0)|^2 = \int |\psi_E(\vec{r},\vec{\rho})|^2 d^3\rho\,|_{r=0} \qquad (2)$$

where $\psi_E(\vec{r},\vec{\rho})$ is the *det* wave function with $\vec{r} = \vec{r}_d - \vec{r}_t$ and $\vec{\rho} = \vec{r}_e - (m_d\vec{r}_d + m_t\vec{r}_t)/(m_d + m_t)$. We demonstrate that the integral in eq. (2) is not square-integrable over ρ, when $\psi_E(\vec{r},\vec{\rho})$ is the exact solution of the three-body rearrangement scattering problem involving more than three bodies (five bodies, d, e^-, t, ^4He, and n for $^3H(d,n)^4He$ reaction) and more than one channel in the final state.

If $\psi_E(\vec{r},\vec{\rho})$ in eq. (2) is replaced by an approximate adiabatic representation as customarily done in previous conventional theoretical estimates, then the probability integral in eq. (2) may be square-integrable. However, the square-integrability of eq. (2) with use of an approximate solution for $\psi_E(\vec{r},\vec{\rho})$ is meaningless, if eq. (2) is proven to be not square-integrable when the exact solution for $\psi_E(\vec{r},\vec{\rho})$ is used.

For $^3H(d,n)^4He$ reaction,

$$d + (e^-,t) \rightarrow (e^-,{}^4He) + n + Q \qquad (3a)$$

$$\rightarrow e^- + {}^4He + n + Q \qquad (3b)$$

Schrodinger equation and Hamiltonian can be written as

$$(\tilde{E} - \tilde{H})|\psi\rangle = 0,\ \tilde{E} = \begin{pmatrix} E & 0 \\ 0 & E+Q \end{pmatrix},\ \tilde{H} = \begin{pmatrix} H_{\rm det} & V_{{\rm det},e^4Hen} \\ V_{e^4Hen,{\rm det}} & H_{e^4Hen} \end{pmatrix} \qquad (4)$$

with $H_{det} = T_r + T_p + V_{de} + V_{det}$ and $H_{e^4Hen} = T_{r'} + T_{p'} + V_{e^4He} + V_{e^3Hen}$. T′s are kinetic energy operators, $\vec{r} = \vec{r}_d - \vec{r}_t$, $\vec{r}' = \vec{r}_n - \vec{r}_{^4He}$, $\vec{\rho} = \vec{r}_e - (m_d\vec{r}_d + m_t\vec{r}_t)/(m_d + m_t)$, and $\vec{\rho}' = \vec{r}_e - (m_n\vec{r}_n + m_{^4He}\vec{r}_{^4He})/(m_n + m_{^4He})$. H_{det} and H_{e^4Hen} are the channel Hamiltonians for the *det* and e^4Hen channels, respectively. For $\vec{\rho} \rightarrow \infty$ and $r < b$ (b is the nuclear interaction range), eq. (4) can be written as

$$\left[E + \frac{\hbar^2}{2\mu}\frac{d^2}{d\rho^2} + \frac{\hbar^2}{2M}\frac{d^2}{dr^2} + \frac{2}{r} - V_{dt}(r)\right]\psi_{\rm det}(r,\rho) = r\rho\int d\Omega_{\vec{r}}\, d\Omega_{\vec{\rho}}\, V_{{\rm det},e^4Hen}(\vec{r},\vec{r}')\psi_{e^4Hen}(\vec{r}',\vec{\rho})\,d\vec{r}' \qquad (5)$$

From behavior of the asymptotic solution $\psi_{det}(0, p\rightarrow\infty)$ of eq. (5), we can show the non-square-integrability of eq. (2). An alternative formulation of $\sigma(E)$ which avoids the above difficulty will be given, and implications of our results for cold fusion will be discussed.

EDITOR'S COMMENTS

The above four papers by Kim et al., represent a major contribution to the understanding of nuclear reactions at low energy levels. We may now improve our understanding of the experimentally observed proton capture process in both light water cold fusion and biological nuclear processes.

MASSACHUSETTS - ELECTROMAGNETICALLY ACTIVE

Elliot B. Kennel (Space Explor. Assoc., Cedarville, OH), Peter L. Hagelstein and Louis D. Smullin (MIT, Res. Lab. of Electronics, Cambridge), "Gamma and X-Ray Measurements in Electromagnetically Active Systems," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #330, poster session.

AUTHORS' ABSTRACT

The intent of this article is to call attention to various means by which false positive signals can be observed in x-ray and gamma spectroscopy, and to show how false positives can be avoided by combining good experimental techniques with proper interpretation of statistics.

Gamma and x-ray signatures from cold fusion experiments would be extremely valuable in allowing researchers to deduce the nuclear reactants (assuming that they indeed exist) in cold fusion experiments. However, for the most part cold fusion

experiments do not emit signals which are large enough to be easily detected and distinguished from background radiation.

The detection of small signals is difficult, and errors can easily arise. Accordingly, a review is presented of proper background measurement procedures, background subtraction procedures and propagation of statistical errors.

Electromagnetic interference provides a more serious problem. This occurs when signals from the laboratory couple inductively to electronic circuits in the radiation detection and counting system. In many cases, such electromagnetic interference can be produced by plasma discharges, when the plasma oscillates at wavelengths similar to those used by radiation detector electronics.

Generally, electromagnetic interference is easily recognized as spurious, as it tends to result in a pile-up of excess counts at low energies at the multichannel analyzer (MCA). Surprisingly, however, it is sometimes possible to produce signals on an MCA which closely mimic the sharp Gaussian peak signature of a gamma radionuclide as produced by a high purity germanium detector (HPGE). Presumably this occurs when something in the laboratory oscillates at a nearly constant, pure frequency. In other cases, it is possible for electromagnetic interference to mimic the output of a sodium iodide detector, complete with low energy Compton plateau. Examples are presented of each.

Pulse experiments, plasma discharge experiments and experiments using *rf* modulation are likely to be especially susceptible to electromagnetic interference. However, it is usually possible to eliminate electromagnetic interference by electrically isolating the experiment and detector. Suggestions on how this can be accomplished and tests to verify that spurious signals have been eliminated are also presented.

The authors wonder if other researchers presenting data on gamma and x-ray emission from cold fusion experiments may have fallen prey to similar phenomena. However, it is most expressly not the intention of this paper to make the claim that all positive results are due to detector artifacts and faulty estimates of statistical significance. Rather, it is our opinion that nuclear emissions can indeed result from cold fusion experiments, and that these can be reliably observed and analyzed by following proper protocols in a difficult detection environment.

Sponsored by ENECO, Inc;, Salt Lake City, Utah

MICHIGAN - POINT CHARGE MODELS

James T. Waber (Research Prof., Phys. Dept., Mich. Tech. Univ., Houghton), "Point Charge Models Versus Condensed Matter Models in Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #412, poster session.

AUTHOR'S ABSTRACT

For the most part, theories of Cold Fusion deal with free space models and invoke the Gamow barrier or some modification thereof. This paper discusses the variety of such approaches which have been proposed but which fail to come to an acceptable explanation of the phenomena which are observed.

The one point model deals with electrochemical phenomena and with electronic transfer at the interface of the metal-inner Helmholtz layer, *à la* Bockris. However, it is dominated by point-charge thinking. The role of edge dislocations in the bulk of the solid is important.

The approach by Pons and Fleischmann depends on Wagner's methodology which in turn is based on viewing a solid as a collection of non-interacting particles immersed in a continuum, which acts as a solvent. It is a very useful model derived ultimately from the behavior of aqueous ionic solutions and has been applied very successfully to a variety of problems such as the behavior of ionic and semiconductors (in contact with a metal and to the electronic transfer through the solid). This approach, however, cannot successfully predict that various fermions such as protons, tritons, ^{3}He, or neutrons will only be minor components of the reaction products. In contrast, with a proper treatment, ^{4}He and heat will be the principal products.

The late Julian Schwinger explains why gamma rays are not observed and why Gamow penetration is not required.

The appropriate condensed matter or solid state model relies on the well-known fact that charges are not localized in a semiconductor or superconductor, but are distributed throughout the lattice and interact cooperatively, i.e. only a fraction of the reaction occurs in any one cell. This is very important and leads to the selection rule "two bosons in, two bosons out" and essentially no fermions. Another feature of the preferred treatment is that it predicts that the large energy release usually associated with the point-nuclear reactions will not be observed but it will be distributed throughout the lattice *à la* Mössbauer.

MICHIGAN - BOHR ORBITALS

James T. Waber (Research Prof., Dept. Phys., Mich. Tech. Univ., Houghton), "Concerning Deep Lying Bohr Orbitals in Atomic and Molecular Hydrogen Systems," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #413, poster session.

AUTHOR'S ABSTRACT

Vigier treats the problem of nonrelativistic energy levels in hydrogen isotopes quite incorrectly because of the short distances involved. He invokes spin-orbit interactions. Spin orbit is an approximate treatment of a proper relativistic effect. Spin-spin interaction is appropriate only when other virtual orbitals are present. But there is only one electron involved in deuterium.

Proper relativistic treatments have been known for twenty years. It is important to use the finite nuclear distribution function instead of the point nucleus since the radial dependence is the quantum number $|\kappa|$ rather than the square root γ and the charge density function $\Psi^*\Psi$ does not vanish at the origin because of the major G and minor component F. In his book, Greiner shows that the energy eigenvalue of the 1s½ is -13.606 eV for hydrogen and that the solution never drops into the negative sea even if the fine structure were to become infinite.

In Figure 6, Vigier treats an unrealistic, hypothetical situation. The exact solution for an electron in the field of two nuclear charges was developed by Teller and independently by Hylleras in 1931. The proper relativistic treatment was made by Muller and Greiner in 1975. In either case, it is a molecular wave function with the charge density distributed over space and not a point charge electron.

MICHIGAN - CONDENSED MATTER PHYSICS

James T. Waber (Research Prof., Phys. Dept., Mich. Tech. Univ., Houghton), "Concerning the Separation of Condensed Matter Physics and Nuclear Physics," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #414, poster session.

AUTHOR'S ABSTRACT

It is proper that Preparata decries the artificial separation of the two branches and that "*....the attempt to do this that is creating the major problems in the case of cold fusion."*
In this author's opinion, it is his use of plausibility or similar arguments about solid state physics that is inadequate.

His sketches of the 4d orbitals of palladium are naive even for isolated atoms. There is a continuous wave function for all r values in the free atom and a nonrelativistic node for small values. Perhaps the concentric circles represent the range of large values of charge density for that orbital. Relativistically, this disappears because of the different radial dependence of the major G and minor F components of the Dirac equation, i.e. there are no such nodes. These are important details.

The depiction of D^+, which is a bare deuteron, as a solid ball takes a bit of imagination since the operative dimension is of the order of only a few Fermis, not Ångstroms. These are important details.

More importantly, the model he invokes is really the Drude model with all of the electrons having a common frequency and he fails to distinguish the individual states of the electrons. There may indeed be displacements due to fluctuating potentials, which depend on the polarizability of the atom, but they are not symmetrical displacements of spherical shells as shown in his figure 12. He talks about the D^+ ions being *a spherical shell* and about s-d interactions, but does not use them. The references are primarily to Preparata and he does not refer to any of the modern authors of solid state theory except Anderson and then he misinterprets him.

Regrettably, the wave functions he uses do not represent the *crystal orbitals* where the l-values are mixed in the solid. Even for face-centered and body-centered forms of iron, there are significant 4d, 4p and 4f contributions to the crystal orbitals at the Wigner-Seitz boundary. The accompanying figure is taken from a self-consistent band structure calculation by Waber and Snow. The 3d orbitals do not vanish at this radius.

MICHIGAN - SPINOIDAL DECOMPOSITION

James T. Waber (Research Professor (Physics)) and Ouliiana L. Egorova-Cheesman (Chem. Engineering Michigan Tech. Univ., Houghton, Michigan), "Spinoidal Decomposition of Palladium/Palladium Deuteride and the Andreev Effect," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 512, poster session.

AUTHORS' ABSTRACT

The progressive incorporation of deuterium into palladium passes from an alpha-based solid solution to a solid solution of vacancies "dissolved" in the compound, palladium deuteride. Both solutions have the face centered cubic crystal structure but differ in their lattice parameter. However, at higher temperatures, one can traverse the composition range without a discontinuous change in the lattice parameter. These are the

conditions for the formation of a spinoidally decomposed system.

Since the alpha phase is stretched to remain coherent, dislocations will be present which reduce the regular order of the lattice. Kircheim has discussed the trapping of deuterium atoms in such edge dislocations. Yong Ki Park *et al.* has measured the trapping of deuterium in annealed and in deformed palladium using positron annihilation. The deuterium atoms with opposing spins attracts each other and hence have an influence on the formation of Cooper-paired ion band states.

The alpha form is alternatively intermixed spatially with the compound form. Thus an intimate mixture of the superconductive state with the semiconductor state is formed. Thus the model which A.E. Andreev proposed in 1964 is realized. In it, one electron from the semiconductor joins to form a Cooper pair at the superconductor interface and the resulting hole travels back to another interface and interacts there with a second Cooper pair annihilating it, but in doing so, frees a second electron to shoot across to the interface and forms a further Cooper pair. This phenomenon has apparently now been observed with indium arsenide by Kroemer *et al.* There are unusual quantized magnetic effects which have been observed on the electrical resistance but which have not been explored.

NEW MEXICO - D-D BARRIER IN DYNAMIC THEORY

Pharis E. Williams (Energetic Mat. Res. and Testing Cntr., New Mexico Tech., Socorro, NM), "The Deuteron-Deuteron Barrier of the Dynamic Theory," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #424, poster session.

AUTHOR'S ABSTRACT

There are two aspects of the model of the nucleus which come from the Dynamic Theory, which influence the deuteron-deuteron barrier. The first is that the five dimensionality of the theory produces a non-zero electrostatic potential which is (k/r) exp[-(λ,/r)] where the λ depends upon the particle. The second stems from the fact that this non-singular potential is a gauge potential. As anyone can show by using covariant differentiation in the Poisson brackets, a gauge function, which results in a gauge potential, leads to the conclusion that the Least Unit of Action must depend upon this gauge function and is not a single, universal number for all quantum mechanical states. By comparing the scattering cross-section predicted by the non-singular potential to the experimental data for protons and electrons, it may be shown that the λs must be approximately 1 Fermi and 1 x 10^{-3} Fermi respectively. This difference in the λs means that the force on the electron due to the presence of the proton goes to zero when the maximum of the proton potential is reached, while the proton will still be attracted to the electron. The dependence of the Least Unit of Action upon the gauge function then allows the proton and electron to establish an orbital within the proton, wherein the size of the proton's orbit is of the order of a few Fermi. A single proton in orbit around an electron is a neutron, but two protons in the orbit yields a deuteron. This presentation discusses this development and the resulting reduction of the deuteron-deuteron barrier when compared to the Coulombic barrier. The influence of spin alignment on the barrier energy is discussed as is the tendency of the reaction to produce He_4 instead of H_3, a neutron or He_3 plus a proton.

OHIO - RELATED OBSERVATIONS?

S.P. Faile, "Are Ying and Karabut Observations Related?" courtesy of author (journal entry).

Karabut et al., in their ICCF-5 paper (*FF*, April '95, p 26), mention that the glow discharge can produce 40-60 ns duration voltage pulses as high as 100,000 volts. Ying reports in *Ultimate Energy* (vol 1, no 1, "Cold Fusion in a Ying Cell, and Probability Enhancement by Boson Stimulation," by Nelson Ying and Charles Shults III, p 46-50.) that his cell some years ago before the use of Faraday box shielding, injured his partner several feet away from the cell where his finger was burned under his ring.

Perhaps the cells are emitting bursts of microwaves during high voltage pulses or it is a simple situation of brief high voltage pulses that cause currents to flow in ring shaped metal objects.

High electric fields could be an indication of charge separation effects such as found for electron bead or EV's that Kenneth Shoulders studied. Matsumoto also postulates various clusters and has observed tiny fireballs (*FF*, April '95, p 24).

OREGON - Pd SULFATE COATED Pt CATHODE

J. Dash, G. Nobel, M. Breiling, and E. McNasser (Phys. Dept., Portland St. Univ., Portland), "Excess Heat from a Palladium Sulfate Coated Platinum Cathode During Electrolysis in Heavy Water," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #222, poster session.

AUTHORS' ABSTRACT

Previously, we reported results obtained from electrolysis with a thin, rectangular palladium cathode and a parallel thin,

rectangular platinum anode in an electrolyte containing H_2SO_4 and either D_2O or H_2O. Drastically altered surface topography, excess heat, and localized concentrations of unexpected elements were observed. [1,2]

Recently, experiments were performed with this system, using a control cell with two platinum electrodes, in series with a similar cell containing a palladium cathode. The power output for the Pd cell was about 25% greater compared with the control cell.

In an experiment in which the palladium electrode inadvertently served as the anode, the power output again was about 25% greater than the control cell. About O.1 g of Pd dissolved and reacted with sulfate in the electrolyte to form a deposit composed of palladium, sulfur, and oxygen (most probably $PdSO_4$) on the platinum cathode. Subsequently, this experiment was repeated and similar results were obtained. Because the excess heat greatly exceeded that obtainable from the heat of formation of $PdSO_4$, it appeared that $PdSO_4$ attached to the Pt cathode might be serving the same function as a Pd cathode. This hypothesis was tested by comparing energy output from a control cell with two Pt electrodes to energy output from a cell with a Pt anode and a Pt cathode coated with $PdSO_4$. It was found that the energy output from the latter exceeded the energy output from the control by 0.1 to 0.4 watt, depending on the current density. This level of excess energy is comparable to that which we previously observed from a cell with a thin Pd cathode. [2]

[1] D.S. Silver, J. Dash and P.S. Keefe: "Surface Topography of a Palladium Cathode in Heavy Water"', *Fusion Technology*, 24, (1993) 423.

[2] J. Dash, G. Noble and D. Diman: "Surface Morphology and Microcomposition of Palladium Cathodes After Electrolysis in Acidified Light and Heavy Water: Correlation Excess Heat," Trans. Fusion Technology (ICCF4 Papers), 26, #4T, Part 2, (1994)

VIRGINIA - MANY-BODY REACTIONS

Talbot A. Chubb and Scott R. Chubb (Research Systems, Inc., Arlington, VA). "Fusion Reactions in Deuterided Palladium," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #410, poster session.

AUTHORS' ABSTRACT

In Fleischmann and Pons type experiments using palladium deuteride (PdD_x), heat release is observed when the deuterium concentration is forced to abnormally high values, i.e. at high deuterium chemical potential. As the chemical potential of D in PdD_x is made more positive by non-equilibrium chemistry or by ion implantation, the D energy is raised so that a portion of the D population is postulated to be excited into states that have a much higher "hopping rate" than the localized interstitial sites provided by normal chemistry. These excited ions see the periodic potential provided by the lattice instead of just a local trapping potential, i.e., they see many potential wells, but they are not trapped in these wells. For this excited population no single potential well, i.e. no single unit cell, is preferred, and the ions are only trapped in the crystal as a whole. For ions in the excited state each unit cell is essentially equivalent. The change in the external potential energy term in the wave equation from one that is in essence a localized potential well to one that covers the crystal as a whole can be viewed as a change in the boundary conditions that the D^+ must satisfy. The D^+ wave functions then become Bloch functions, which reflect the periodicity of the lattice and have identical amplitude distributions in each unit cell. The sharply defined energy levels of a harmonic well configuration become replaced by energy bands.

Once the D^+ ions adjust to the periodic boundary conditions, their coulombic avoidance behavior becomes reduced, provided the excited D^+ concentration $<10^{-3}$ per unit cell. At some higher concentration the excited state energy levels are raised to a point where an alternate chemical phase is favored. At lower concentration the reduction in coulombic avoidance behavior is determined by system energy minimization and depends on crystal size. The coulomb barrier essentially vanishes if the crystal volume exceeds 10^5 unit cells. There is then no conventional barrier to fusion. To be specific, when there is more than one excited D^+ in such a crystal, the set of excited D^+ ions becomes a many-body system. The exchange symmetry principle of atomic physics and chemistry applies. To a first approximation, the many-body system behaves like a quantized matter field, which means that all the excited D^+ ions within a single crystal become indistinguishable, mixed, and partitioned among all the unit cells of the crystal. The excited deuteron mass resembles a continuous fluid but one that can lose mass only in steps of 2 atomic mass units. The cold fusion reaction is $D^+\uparrow + D^+\downarrow \rightarrow {}^4He^{**}$ (arrows show nuclear spin direction), which is a direct dimerization reaction for deuterons. When fusion reactions occur, a distributed helium matter distribution forms which matches the deuteron distribution, and energy is released in 23.8-MeV steps. However, this energy release is partitioned among the N_{cell} unit cells of the crystal. When N_{cell} exceeds 10^9, the energy released per unit cell is sufficiently small that the crystal is not destroyed by the fusion events, so that periodic order is conserved during the fusion process. As a result, theory predicts no localization of the released energy and no high energy radiation. Also the "two particles in, two particles out" rule of simple binary collisions becomes replaced with the principle of conservation of proton-neutron pairs, since the

distributed reaction provides no mechanism for breaking proton-neutron pairs. Only micro-chunks of energy (=23.8 MeV/N_{cell}), in the range of .010 eV or less, are made available locally, i.e., in individual unit cells and at the crystal surface. These micro-chunks are able to excite lattice vibrations and serve to heat the separate crystals.

C. NEWS FROM ABROAD

BELARUS - NIOBIUM CATHODES

V.A. Filimonov et al. (Inst. Physicochem. Prob., Minsk), "Nuclear Emission, Excess Heat and Structure Changes under Electrolysis of Heavy Water on Niobium Cathodes," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #315, poster session.

AUTHORS' ABSTRACT

A dramatic difference in behavior of re-crystallized Nb cathodes having different contents of extended defects when using electrolysis (El) in lithium deuteroxide - heavy water was observed. Microphotographs of metallographic specimens (lappings) of such Nb samples were studied previously. The quantity of dislocations (Ds) etching holes varied from $5\text{-}10^4$ to 10^9 cm^{-2}.

Electrolysis was carried out at temperatures above 85°C. The direct current density was more than 1 amp cm^{-2}, voltage was 10 to 25 volts. Nb cathodes were coated with a palladium layer 1 μm thick. After passing current during 2.3 hours, a constant current density was established, and nuclear emission evidence was obtained using "working" Nb samples having Ds content of 5×10^4 to 10^5 cm^{-2}. A neutron detector with gas-filled proportional counters and gamma-ray detector with NaI crystal scintillator (with ^{10}B and ^{1}H n-γ converters) were used. No emission using "dummy" Nb samples having about 10^9 cm^{-2} Ds content was observed.

The cell was thermosrated at 85 to 100°C by Joule heating accompanying El together with hot water flow through a water jacket. After stopping, the latter cells with "dummy" Nb samples cooled rapidly. Those with "working" cathodes maintained almost the same temperature all day after switching off the hot water flow. Hence, the heat release was enhanced significantly when the outer heating was canceled. The estimated excess heat was about 100% as related to the Joule heat.

A deuteride phase was formed at the flat surfaces of cathodes situated in front of flat Pt anode during El. However, a smooth transfer from the deuteride phase to metal occurred on cross-sections of "working" samples operated above 85°C.

The described features of the behavior of Nb cathodes are consistent with the synergetic activation model of cold fusion (reported at ICCF-4), according to which 1) an high deuterium concentration gradient, 2) a low extended defect content and 3) operation near the top of the gas phase separation region in the metal-deuterium system are essential for CF implementation.

CANADA - RADIOACTIVE VARIATIONS

Roberto A. Monti (BURNS Developments Ltd., B.C.), "Variation of the Half-lives of Radioactive Elements," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #626, poster session.

AUTHOR'S ABSTRACT

According to the Alpha-extended model of the Atom [1] heavier elements are made from lighter elements by low energy transmutations (cold fusion).

Vice versa, lighter elements can be produced by cold fission of heavier elements: cold fusion and cold fission are complementary and reversible processes [2,3].

A series of experiments, made from February to May 1993 [4] showed that the effects of the ignition of a chemical mixture containing the radioactive elements $_{90}^{232}Th$ and $_{88}^{226}Ra$, resulted to be a variation of the half-lives of these elements: radioactivity after ignition went from 12,000 C.P.M. to background within 50 hours.

A new series of these experiments is now being repeated in a facility arranged by BURNS Developments Ltd. The new results will be presented at ICCF-5.

[1] R.A. Monti, "Cold Fusion and Cold Fission: Experimental Evidence for the Alpha-extended Model of the Atom," Proc. ICCF-2, Como, Italy, 1991.
[2] R.A. Monti, "Low Energy Transmutations," unpublished poster at ICCF-3, Nagoya, Japan, 1992.
[3] R.A. Monti, "Experiments in Cold Fusion and Cold Fission," unpublished poster at ICCF-4, Maui, Hawaii, 1993.
[4] R.A. Monti, "Transmutation of Radioactive Elements by Atomic Chemistry," private communication to J. O'M. Bockris.

CANADA - 2-DIMENSIONAL PROTON CONDUCTORS

William S. Page (Danelink & Page, Oxford Mills, Ontario), "Two-Dimensional Proton Conductors," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #432, poster session.

AUTHOR'S ABSTRACT

In direct analogy with the treatment of electrons in conventional solid state physics, it is possible to describe the quantum motion of hydrogen in hydrogen-bonded solids and many liquids as a superposition of Bloch states. The detailed structure of the periodic potential that the hydrogen nuclei encounter is the result of the overlap of electron orbitals, but because the nuclei are so much more massive than electrons, for many purposes, we can represent the interaction between hydrogen and other atoms simply in terms of a generalized "Morse" potential. Just as for electrons, however, solutions of the wave equation take the form of energy bands. This has significant implications for the mechanical, thermal and electrical properties of hydrogen-bonded material.

In particular, water (H_2O) in solid and liquid forms can be described as a proton semiconductor [Eigen (1958), Gosar & Pintar (1964), Fletcher (1970)]. Similar to the electrons in conventional semiconductors, in pure water almost all of the hydrogen is in the "valence" band state. Each oxygen atom has two loosely bound hydrogen atoms which form hybrid hydrogen "orbitals" with four tetrahedrally coordinated neighboring oxygen atoms. Defects in this structure are classified as L-defects (empty hydrogen bonds, expressed in molecular terms as OH-) and D-defects (doubly occupied hydrogen bonds, expressed molecular terms as H_3O^+). An L-defect can also be described as a "proton hole" in the valence band, while a D-defect corresponds to a proton in a conduction band. A gap of approximately 1 eV separates the hydrogen valence band from the hydrogen conduction band. In comparison, the gap between the top of electron valence band and bottom of the electron conduction band is more the 10 eV. As a result, electrical conduction in pure water is almost entirely due to a small number of naturally occurring L/D-defect pairs created by thermally induced auto-dissociation.

Water can be doped by donor acceptor substitutional impurities. For example, ammonia (NH_3) produces D-detects which is expressed molecular terms as NH_4^+ and OH-ions, while hydrogen fluoride produces L-type defects expressed H_3O^+ and F-ions. Water with an excess of D-defects is called a D-type electrolyte (analogous to N-type electron semiconductor). Water with an excess of L-defects is called an L-type electrolyte (analogous to P-type electron semiconductor). Both L-type and D-type electrolytes are good proton conductors. L/D-type junctions produce proton current diodes with properties similar to their electron counterparts. In particular, such diodes display rectification (uni-directional current flow), high values of thermoelectric power, and may display luminescence under forward bias due to recombination of L- and D-defects. Such effects as thermo-luminescence of ice following irradiation and sono-luminescence of water may be related to L/D recombination.

By the application of a potential difference at an interface, it is possible to produce a D-type inversion layer in an L-type electrolyte, again in direct analogy to an N-channel field effect transistor (NMOS FET). Excess hydrogen is trapped in the one-dimensional quantum well which lies parallel to the electrically negative interface (z direction), but free to move in the x and y directions. Well known quantum mechanical properties [Stem (1967)] apply to this inversion layer which are due to its two-dimensional nature and the periodic potential. The hydrogen atoms move with an "effective mass" which is approximately half that of a hydrogen atom outside the lattice. Further, as for a two dimensional electron gas, the density of energy states is a constant and the Fermi energy is proportional to the hydrogen atom density. Therefore, hydrogen density in the inversion layer increases with the strength of the applied potential and the kinetic energy of the hydrogen atoms increases more rapidly than Coulomb potential energy. The net result is to enhance the probability of inelastic scattering (including fusion) of the hydrogen nuclei.

Such inversion layers may be present at the so-called double-layer at the cathode in some electrochemical cells, beneath an oxide or silicate layer on a cathode and on the surface of certain metals in hydrogen atmospheres. Two-dimensional inversion layers can also be created in several types of layered crystal structures which display high proton conductivity such as hydronium beta"-aluminate $H_2O.MgO.5Al_2O_3$ [Farrington (1978)], hydrogen uranyl phosphate HUO_2PO_4. H_2O(HUP), and sintered oxygen deficient oxides such as SrCeO.95Yb0.05O_3-alpha.

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Farrington, *Mat. Res. Bul.*, vol 13, 1978, p 763.
Fletcher, The Chemical Physics of Ice, Cambridge Univ. Press, 1970.
Gosar & Pintar, *Phys. Stat. Solidi.*, vol 4, 1964, p 675.
F. Stern, *Phys. Rev.*, vol 163, no 3, 1967, p 816.

CHINA - CHAIN REACTION THEORY

Chang Yi-Fang and Yu Chuan-Zan (Internat. Ctr. Theor. Phys., Italy and Dept. Phys., Yunnan Univ., China), "Internal Conversion Mechanism and Multistage Chain Reaction Theory of Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #422, poster session.

AUTHORS' ABSTRACT

First, the various internal conversion mechanisms of Cold Fusion are proposed. From this we derive the multistage chain reaction theory, in which the first chain reactions are $e^- + D \rightarrow 2n + v_0$, $2n + D \rightarrow {}^4H \rightarrow {}^4He + e^-$, $e^- + D \rightarrow 2n + v_e$, etc. Further, the reaction rate and power of Cold Fusion may be calculated qualitatively, in agreement with the experimental results. Finally, the three basic characteristics of Cold Fusion are discussed.

CHINA - TRITON-NEUTRON RATIO IN C.F.

Chang Yi-Fang and Yu Chuan-Zan (Internat. Ctr. Theor. Phys., Italy and Dept. Phys., Yunnan Univ., China), "Quantum Field Theory and the Triton-Neutron Ratio of Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #423, poster session.

AUTHORS' ABSTRACT

Based on the quantum field theory and the distance of two body interactions, we obtain the triton-neutron ratio $R \cong 5.32 \times 10^{-7}$ which may explain some of the experimental results of Cold Fusion.

CHINA - NEW C.F. MECHANISM PROPOSED

Yu Chuan-Zan and Chang Yi-Fang (Internat. Ctr. Theor. Phys., Italy and Dept. Phys., Yunnan Univ., China), "A New Mechanism of Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #420, poster session.

AUTHORS' ABSTRACT

In this paper, we propose a Cold Nuclear Fusion theory, which is analogous to the β^+ decay or the K-electron capture as follows: $D^+ + D^+ \rightarrow H^{4*} + e^+ + v$ or $D^+ + c^- + D^+ \rightarrow D^+ + n^2 + v \rightarrow H^{4*} + v$. The highly excited nucleus H^{4*} enhances the internal conversion pair e^+e^- (a few to emission of γ radiation because the transitions $0^+ \rightarrow 0^+$ [sic] and $2^+ \rightarrow 0^+$ are forbidden, i.e. $H^{4*} \rightarrow H^4 + me^+e^- + \gamma$,m = 0,1,2...). The neutron-rich isotope H^4 is unstable for β^--decay and neutron evaporation. The β^--decay is mainly $H^4 \rightarrow He^4 + e^- + v$. The evaporation neutrons are few in number: $H^4 \rightarrow T^3 + n$. So, the β^+-decay and the electron capture theory, i.e. the weak interaction theory is proposed as a new mechanism, in which the electron helps the deuteron to overcome the Coulomb barrier, and fusion energy is transferred as well as some electromagnetic radiation, producing H^4 as well as T, in agreement with experimental results. The key issue is to search for the β radiation and positron annihilation.

CHINA - COLD & SOLAR FUSION COMPARISON

Yu Chuan-Zan and Chang Yi-Fang (Internat. Ctr. Theor. Phys., Italy and Dept. Phys., Yunnan Univ., China), "Electroweak Interaction in Cold Fusion and Comparison of Conditions Between Cold and Solar Fusions," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #421, poster session.

AUTHORS' ABSTRACT

The experimental results of Cold Fusion are compared with the Standard Solar Model, showing the similarities of both processes. From this we can see that Cold Fusion may be produced through the weak interaction, i.e. $D^+ + D^+ \rightarrow H^{4*} + e^+ + v$ and $D^+ + e^- + D^+ \rightarrow H^{4*} + v$. Therefore, the electroweak theory may be applied, in which the long-distance electromagnetic interaction appears in Cold Fusion by the mixture of the Z°-boson and the γ-photon.

CHINA - GAMOW FACTOR REVISITED

Li Xing Zhong (Dept. Phys., Tsinghua Univ., Beijing, China, Current address: Dept. Chem., Univ. of Hawaii at Manoa, Honolulu, HI), "Revisit to Gamow Factor," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #403, poster session.

AUTHOR'S ABSTRACT

The "excess heat" phenomenon is a "slow" reaction but in resonance. The "excess heat" experiments have shown that the reaction time, τ_{xh}, is of the order of 10^4 sec. which is much longer than that of strong nuclear reaction $(\tau_N) \cdot \tau_{xh} \gg \tau_N$ means that although most parts of the deuteron wave will be absorbed after entering the strong nuclear interaction region, the weak interaction part of the deuteron wave still persists for a long period, during which the deuteron wave will have a chance to build up due to the constructive interference between the tunneling wave and the reverberating wave. The theory of "resonance tunneling via lattice confined ions" has proved that when the "slow" reaction reduces the reaction constant (λ) by a factor of Θ^{-1}, the build up enhances the wave function inside the nuclear well ($\psi(0)$) by a factor of Θ; hence, the resultant fusion reaction rate ($\Lambda = \lambda|\psi(0)|^2$) increases by a factor of Θ. The Gamow factor Θ^{-2} is replaced by a new factor Θ^{-1}.

The conventional Gamow Factor Θ^{-2} is only applicable for the nonresonance nuclear reaction, where the strong nuclear reaction absorbs the entering deuteron wave after a few reverberations. The reaction time, τ_N is of the order of 10^{-21} sec., and it indeed annihilates the possibility of resonance tunneling.

The existence of such weak interaction inside the strong nuclear interaction region was proved experimentally early in the 1960's. A recent survey showed that among 2319 nuclides, 2097 nuclides have shown the activity of the weak interaction (electron capture, $ß^{\pm}$ decay etc.). So it is not unusual to observe the "slow" reaction part of the deuteron wave in resonance. In fact the n+^{3}He inelastic cross-section has shown that the deuteron wave does exist just above its threshold. Even the newly published "Theoretical Nuclear Physics" (H. Feshbach, Wiley & Sons, Inc. (1992)) mentions the possible distorted deuteron wave function inside the nuclear force region. So the "excess heat" experiments just detected this part of the nuclear reaction by calorimetry.

This resonance "slow" reaction answers Professor Huizenga's challenge of the three miracles as well.

(1) The penetration of the Coulomb barrier is now possible due to this resonance. However, this resonance would not manifest itself in the beam-target experiment because the beam energy dispersion ($\cong$0.025eV) is much greater than the energy width of resonance level ($\cong 10^{-19}$eV).

(2) The fact that the branching ratio of (t+p) to (n+^{3}He) equals one is based on the pure strong interaction which is independent of the electrical charge. Now for the weak interaction part, which is irrelevant to the strong interaction, we are not supposed to expect the same branching ratio.

(3) The γ radiation from excited nuclei is based on electromagnetic interaction. Although it is weaker than the strong interaction by a factor of 10^{-6}, it is still too fast to be in resonance. The reaction plays the role of a damping term in the resonance phenomenon. If the driving term is very weak (e.g. for the case of a thick and high Coulomb barrier, the driving term is very weak ($\leq \Theta^{-1}$)), the damping term has to be very weak in order to have the resonance. Hence, for the γ radiation, the conventional Gamow factor Θ^{-2} applies, and we cannot see it.

The roles of palladium crystal are:

(1) Sharpening the energy level by providing confined ions, which have a discrete energy spectrum. This is totally different from that in beam-target experiments, where the energy of the incident ions distributes in a continuum.

(2) The periodical crystal structure provides the energy band for deuterons.

(3) Strong absorption of the deuterium into palladium causes the Einstein-Bose condensation, which provides enough deuteron population in the appropriate energy band. The narrow resonance level is just like a tiny crack in a brick wall. It cannot be detected *by* a screw driver (ion beam), but it can be detected by a needle (confined ion). However, a bunch of needles (ion energy band) will have much more chance to detect this tiny crack.

Predictions

(1) Grain size: Based on the "excess heat" power level, and the data from "heat after death", we anticipate that the average grain size in palladium should be around 10^{-6} cm^3, or 100 μ in dimension.

(2) Energy spectrum: Based on the critical loading ratio (D/Pd > 0.8), and the Boson nature of the deuteron, we anticipate that the energy band structure for D^+ has an energy gap of 170 meV between the ground energy band and the excited continuum.

(3) There must be helium (^{3}He or ^{4}He) inside the palladium crystal, since this is the necessary fusion product. Particularly, the helium-3 from p+d resonance might be there due to the favorable Θ.

The verification of these predictions will improve the reproducibility of "excess heat" experiments.

Conclusion: Thunder without lightning is OK

(1) In order to have resonance penetration, the damping term has to be very weak, i.e. no strong neutron radiation or γ radiation. This is just the thunder without lightning.

(2) Although it is "slow" in comparison with the strong interaction, it is still fast enough to be a practical energy source with no strong nuclear radiation.

FRANCE - WAVE-CORPUSCLE MODEL

Alexandre Laforgue (Universite de Reims), "Cold Fusion and Quantum Mechanics:- New Model of the Wave-Corpuscle," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #425, poster session.

AUTHOR'S ABSTRACT

Heat generation by fusion of two deuterons depends: (1) on the collision probability; (2) on the probability that collision is inelastic. This second probability cancels except at very high temperature (hot fusion). If the collision probability is finite, fusion does not occur. [sic]

Such hindrance takes place: (1) over the Bohr-Heisenberg potential, because the crossing of the classical trajectories is a finite set of points; (2) when deuterons belong to chemical structures which keep a finite distance between deuterons. But, if thermal fluctuation permits the dissociation of the chemical links, this hindrance is not applicable.

In order to calculate the probability of collision, we propose first to make the most general hypothesis on the walk of the corpuscle. We will consider it as a disconnected domain of points, segments of classical trajectories and segments of the Brownian motions. It is then characterized by a fractal dimension $1<D<2$, with the limiting value $D = 1$ at the Bohr-Heisenberg limit, $D = 2$ at the chemical limit. The interaction of two walks 1 and 2 exhibits the dimension $d = D_1 + D_2 - 3$. If 1 and 2 are indistinguishable deuterons

$$d = 2D - 3$$

The probability of collision is first determined by d which introduces a factor L^{2D-3} where L is a geometrical length which characterizes the reaction domain.

We have now to consider the well-known difficulties in the choice of an interpretation. In the Broglian model, the corpuscle produces the wave but the wave does not produce the corpuscle which destroys the formal reciprocity. It is more satisfying to refuse the existence of corpuscle. The propagation of a crack in the vacuum can generate a wave, but the wave can generate a fissure. In the probabilistic model it is more reasonable to restore an order for the different possible appearances of the fissure and to explain by a continuous medium model its possible discontinuities. Hence the interpretation of quantum mechanics is unified and Cold Fusion is explained as well as the heat production. A new microphysical model is proposed in a further elaboration.

Reference: A. Laforgue: *Acta Biotheoretica*, vol 40, 1992, pp 221-235, ibid. sous presse.

FRANCE - ELECTRON ACCUMULATION

Michel Rambaut (Bures-sur-Yvette), "Experimental Evidences for the Electron Accumulation Cold Fusion Model," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #622, poster session.

AUTHOR'S ABSTRACT

The electron accumulation cold fusion model has been emerging from high voltage high transitory current discharge experiments through dense condensed media containing Deuterium nuclei. It has been shown that the most probable phenomenon emerging from analysis of various experiments, and which could account of the cold fusion phenomenon, was an harmonic oscillator resonance followed shortly afterwards, that is in approximately 10^{-4} to 10^{-12} seconds, by electrons accumulation around colliding Deuterons: this collision has a probability of producing a fusion nuclear reaction [1-5]. But there are some clues for estimating that this process, firstly recognized in high transitory current, could also come out in solid state cold fusion experiments, like in Palladium and another substrata.

Moreover three experiments in general Physics have given results which are confirmations of the proposed model. Firstly this possibility of an important transitory electrons accumulation could have been appearing as unrealistic, but a more greater electron accumulation has been observed some years ago by Petr Beckmann [6].

Secondly the problem of discrepancy between the solar neutrino counting and the theoretical standard model has become recently well posed. For one decade, the experiments, performed with high volume great efficiency detectors, and minimizing the noise effects, have shown a neutrino counting deficiency of approximately thirty percents in comparison with the predictions of the standard theoretical model [7]. The problem of Gallium detector calibration has been recently solved by using an artificial neutrino radioactive chromium source [8] and it confirms the 30% unbalance. So the inner solar core temperature could be a little less than what is given by the standard model. But one could recover the solar energy constant by applying the electron accumulation model to the relatively low pressure low temperature solar plasma outside the central core, near the solar surface, mostly in the convection zone.

The third experiment, performed by J.J. Rocca et al., has consisted to perform an soft-X-ray lasing experiment using a 38 kA peak current discharge into a capillary filled with a pure Argon medium. The X-ray burst occurred shortly after the current peak [9]. The process shows some similarities with the fusion tentative experiments by high velocity high current through deuterated media. The making of an electron inversed population of the Argon inner layers is probably boosted by the harmonic oscillator resonance of the Argon ions surrounded by the free electron field.

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[2] M. Rambaut, *Physics Letters A*, vol 164, 1992, pp 155-163, 13 Apr. 1992.
[3] M. Rambaut, Frontiers of Cold Fusion, ICCF3, Nagoya, 1993, Univ. Acad. Press, Inc., pp 601-604.
[4] M. Rambaut, Proc. ICCF4, Vol 4, edited by EPRI, 1994, pp 24-1 to 24-17.
[5] M. Rambaut, "Account of Cold Fusion Screening and Harmonic Oscillator Resonance," *Fusion Tech.*, in press.

[6] Petr Beckmann, "Electron Clusters," *Galilean Electrodynamics*, vol 1, no 3, Sep/Oct. 1990, pp 55-58.
[7] P. Anselman et al., *Physics Let. B*, vol 285, 1992, pp 376 and 390.
[8] Private communication
[9] J.J. Rocca et al., *Phys. Rev. Lett.*, vol 73, no 16, 17 Oct 1994.

GERMANY - HOT SPOT MODEL OF CF

Rainer W. Kuhne and Roman E. Siode (Inst. für Astrophysik, Bonn, Germany and Inst. of Ind. Organic Chem., Warszawa-Zeran), "Hot Spot Model of Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #433, poster session.

AUTHORS' ABSTRACT

Based on "extended micro hot fusion" (EMHF) we discuss the reported kW/cm^3 heat emissions from deuterided Pd-electrodes.

Let us consider a globular hot spot whose behavior can be approximated by a stationary case. If it emits its heat preferentially as radiation, then its power output is given by the Stefan-Boltzmann law:

$$L = 4\pi R^2 \sigma \tau^4 \quad (1)$$

Stationariness means that this power output equals the power input:

$$L = pV = 4\pi R^3 p/3 \quad (2)$$

so that the input power density is:

$$p = 3\sigma\tau^4/R \quad (3)$$

If we assume that within deuterided palladium nuclear fusion occurs localized in hot spots, then we can estimate their surface temperature by the decomposition point T = 1100K of Pd-D (Pd-D does not melt but decomposes). Hence, p depends only on the bubble radius R. Numerical values are:

$$p(100)\mu m = 2 kWcm^{-3} \quad (4)$$

$$p(10)\mu m = 20 kWcm^{-3} \quad (5)$$

Let us compare this "theoretical" value with the experimental data. Srinivasan et al.[1] observed bubbles containing 10^{10} to 10^{12} tritium atoms and a tritium to deuterium atom ratio of about $1:10^4$ in their active cells. If we assume a deuterium atom density of $4*10^{22}$, then the bubble radii ranged from 9 to 40μm approximately. Since the reaction d(d,p)t releases 4.03 MeV, we obtain an energy output of 1MJ/cm^3 for these bubbles. The bubble-lifetime may be estimated to be 10 to 20 min, because Fleischmann and Pons [2,3] reported on a heat burst lasting for 11 min, and liberating over 3kW/cm^{-3}, and Karabut, et al.,[4] reported to have observed one lasting for 20 min and yielding up to 300Wcm^{-3} of electrode material. Hence, the power output of the bubbles becomes 1-2 kWcm^{-3}. However, we have to correct this result. Yamaguchi and Nishioka [5] observed the emission of tritium and helium-4 atoms with approximately a 1:1 ratio, where the reaction d(d,^{4}He) yields 23.5 MeV. Note that Miles et al.[6,7] observed the simultaneous emission of helium-4 and heat with a ratio of 10^{11} to 10^{12} atoms per Joule, i.e. the helium-producing fusion channel seems to be the dominating one for the energy production. Hence, the total energy output has to be multiplied with a factor of approximately 7, so that it becomes 7 to 14 kW/cm^3 in accordance with the "theoretical" value above.

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[2,3] M. Fleischmann & B.S. Pons: *Phys. Lett. A*, vol 176 (1993) p 118 & vol 167 (1994) p 276.
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GERMANY - MICRO HOT FUSION

Rainer W. Kuhne (Inst. für Astrophysik, Bonn, Germany), "Evidence for Micro Hot Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #434, poster session.

AUTHOR'S ABSTRACT

I argue that the "Cold Fusion" neutron emissions may be described by micro hot fusion [1-6] and review the experimental evidence.

When hydrogen is absorbed by metals, then it can form hydrid bubbles around impurities and dislocation nuclei. During their growth the bubbles deform the metal lattice and therefore build up mechanical stresses. After several hours, the mechanical stresses will have become strong enough to create cracks which propagate through the metal lattice within a few micro-seconds. Finally, crack formation results in relaxation of the lattice, so that acoustic emissions arise.

Hydrogen and palladium have different electronegativities. Therefore the surfaces of the hydrid bubbles are positively charged. If cracks occur at the boundary between bubble and weaker hydrided metal, then the crack sides will be charged, so that within the cracks of diameter 1 μm there can arise an electric field of 10^8 V/cm. Hence, on their way through the crack the protons or deuterons, respectively, can be accelerated to energies of up to 10 keV. The lighter electrons are less mobile, because they stick to the metal atoms. With a small probability such a keV deuteron can fuse with one of the non-accelerated deuterons of the other crack side. The number of these d-d fusion reactions was calculated to be 10^4 to $10^7/cm^3$ of electrode material. [1]

The following table presents the experimental evidence for this scenario.

Cold Fusion Phenomena Which Can Be Explained by Micro Hot Fusion

No.	Phenomenon	Explanation
1	emission of 2.5 MeV neutrons	d-d fusion
2	emission of 3.0 MeV protons	d-d fusion
3	near-surface process for Pd	crack formation near Pd-surface
4	deuterium gas emission	gas desorption by crack formation
5	neutron bursts preferentially at -100°-0°C	maximum crack growth rate at this temperature
6	acoustic emissions simultaneously with neutron & proton bursts	relaxation of metal lattice by crack formation
7	radio emissions simultaneously with proton bursts	formation of high electric electric fields within cracks
8	neutron bursts lasting for micro-seconds	time for crack-propagation
9	disappearance of neutron emission after several hours	bubble growth time 10^{-1}-10^5s, fracture time is 10^4s
10	emission of 10^4-10^7 neutrons/cm^3	calculation: ref [1]
11	heat to neutron ratio of 10^{10}	only 1 of 10^{12} of the keV-deuterons undergoes fusion reactions
12	heat emission in H_2-loaded cells	formation of bubbles, cracks and electric fields is independent of the hydrogen isotope used
13	emission of keV-electrons, positively charged keV-ions, X-rays, radio-waves and electrification from various materials and neutron emission from deuterided materials minutes after mechanical treatment	fracto-emission by formation electric fields with 10^7-10^8 V/cm and 10-100 kV
14	many non-successful experiments	poss. explanations: (4,5)

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GERMANY - MODIFIED MAXWELL EQUATIONS

Rainer W. Kuhne (Institut für Astrophysik, Bonn, Germany), "Modified Maxwell Equations," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #435, poster session.

AUTHOR'S ABSTRACT

I present arguments for a finite photon rest mass and the existence of magnetic charges. By using these ideas I modify the Maxwell equations.

More than 100 teams claim to have confirmed cold fusion. The reports include the production of high levels of tritium, helium and heat. Numerous models try to explain these reported phenomena in accordance with standard electrodynamics and quantum mechanics. However, none is completely satisfactory, yet. But in this, report I argue that electrodynamics has to be extended and the Maxwell equations to be modified.

According to quantum mechanics there exists a dualism between particle and wave. If it is valid, then the properties of both particle and wave have to be measurable. This means that both rest mass and Compton wavelength have to be measurable. The demand for a wavelength λ to be measurable is that the space in which it is measured extends at least $\lambda/2$. From big bang cosmology we know that the Hubble radius 1/H of the visible universe is finite. To be measurable the Compton wavelength of any quantum has to be less than twice this maximum radius that allows causal connection and therefore the possibility of measurement. Hence, the rest mass of the quantum has to be

$$M = 2\pi/\lambda_c \geq \pi H \sim 1 \cdot 10^{-68} kg.$$

This means that there cannot exist any quanta with zero rest mass, because otherwise their Compton wavelength would not be measurable and the dualism between particle and wave would consequently not be valid. **A finite photon rest mass means that we have to replace the Maxwell equation by the Proca equation.**

From the theory of waveguides we know that massive (quasi-particle) photons yield longitudinal components of the free electric and magnetic field. Let us consider a rectangular waveguide with extensions a and b along the x- and y-axis and an electromagnetic wave that propagates along the z-axis. Then we obtain the z-component of the H-wave,

$$B_z = B_o \cos(m\pi x/a) \cos(n\pi y/b) \exp i(\omega t - k_z z)$$

where m and n are integers. We see that H-waves have longitudinal components,

$$\underline{k} \cdot \underline{B} = k_z B_z \neq 0$$

This equation shows that the Proca theory is not complete. Insertion of the plane wave ansatz

$$\underline{B} = \underline{B}_o \exp i(\omega t - \underline{k} \cdot \underline{r})$$

into the Proca equation yields

$$i\underline{k} \cdot \underline{B} = \nabla \cdot \underline{B} = 0$$

This contradiction can be solved if we introduce magnetic charges and a magnetic four-potential. Therefore we require a second Proca equation

$$J^{\mu} = (g^{\mu\nu} (\Box + M^2) - ,\partial^{\mu} \partial^{\nu})\, a_{\nu} \qquad \text{[sic]}$$

where $J\mu$ is the magnetic four-current and a^{μ} is the magnetic four-potential that corresponds to a new gauge boson of spin 1 that I name "magnetic photon."

Expressed in three-vectors the modified Maxwell (Proca) equations read,

$$\nabla \cdot \underline{E} = \rho - M^2\phi \quad , \quad \nabla \times \underline{E} = - \underline{J} - \partial_t \underline{B} + M^2\underline{a}$$

$$\nabla \cdot \underline{B} = P - M^2\varphi , \quad \nabla \times \underline{B} = + \underline{j} - \partial_t \underline{E} - M^2\underline{A}$$

and the equations for the electric and magnetic field are,

$$\underline{E} = - \nabla \phi - \nabla \times \underline{a} - \partial_t \underline{A} \quad , \quad \underline{B} = - \nabla \varphi + \nabla \times \underline{A} - \partial_t \underline{A}.$$

HONG KONG - BIOLOGICAL EFFECTS OF CAVITATION

T.V. Prevenslik (Chem. Dept., Univ. of Hong Kong), "Biological Effects of Ultrasonic Cavitation," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 610.

AUTHOR'S ABSTRACT

The biological effects observed in the ultrasonic cavitation of water are explained without the need for postulating high bubble gas temperatures. Cavitation energy is shown to reside in the electronic state and not the thermal state of the water molecule. A temperature change does not occur because the water molecule can not respond in the time of bubble collapse. The Doppler effect is found to significantly increase the frequency of the energy trapped in the bubble before collapse and thereby produce significant collapse energetics that create the excited electronic states of the water molecule. For biological tissue in an opaque environment, the 5-10 µm blackbody thermal radiation of room temperature surroundings is found to produce 3-5 eV energetics that are capable of dissociating the water molecule and producing the chemically reactive hydroxyl radical. If the biological organisms are placed in water and irradiated with 200-800 nm UV-VIS radiation, the collapse energetics are found to be about 10 eV and are capable of exciting the very active oxygen singlet state of the water molecule. Hence, the biological effects of ultrasonic cavitation are caused by the chemical reaction of the biological organisms with the excited electronic states of the water molecule.

Preliminary verification tests on non-biological specimens of aluminum foil in water exposed to ultrasound at 20 kHz showed a significant erosion of the UV-VIS irradiated samples compared to those under ultrasonic irradiation alone. **A UV enhanced ultrasonic water purifier is being fabricated to test the destruction of E-coli and cholera bacteria in water**. The cleansing of cholera from fish tank water for Hong Kong restaurants is a high visibility application. Since boiling of water for human consumption is common in Hong Kong, but is energy inefficient compared to UV enhanced ultrasound, purifying drinking water of E-coli and cholera may be the most important application.

INDIA - "SLEFs" AND COLD FUSION

K.R. Rao and S.L. Chaplot (Solid State Phys. Div., BARC, Trombay, Bombay, India), "Short-lived Large Energy Fluctuations: Implications for the Phenomenon of Cold Fusion in Pd-D Lattices," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #426, poster session.

AUTHORS' ABSTRACT

Short-lived large energy fluctuations (SLEFs) in solids are said to be responsible for several anomalous properties in a variety of materials. This hypothesis was proposed by Khait some ten years ago to explain anomalous diffusion in solids. We report in this paper experimental verification of the hypothesis via computer experiments in Pd-D.

In the case of Pd-D lattices, our limited studies have indicated that SLEFs involving energies as large as 0.5 ev or more can be seen even in micro crystals containing hardly 400 atoms within a very short time duration of 100 ps. From these observations we surmise that larger SLEFs involving energies of the order of a few ev may be occurring in crystals of size of a few mm^3.

We comment on the relevance of these large energy fluctuations in reducing interatomic distances substantially, thereby helping to overcome coulombic barriers. Such dynamical effects arising from the phonon bath in solids like Pd-D may enhance nuclear reaction probabilities leading to "Cold Fusion".

INDIA - LOADING/UNLOADING PROTOCOL

A.B. Garg, R.K. Rout, M. Srinivasan, T.K. Sankaranarayanan, A. Shyam and L.V. Kulkarni (Neutron Phys. Div. and Chem. Engr. Div., BARC, Trombay, Bombay), "Protocol for Controlled and Rapid Loading/Unloading of H_2/D_2 Gas from Self-Heated Palladium Wires to Trigger Nuclear Events," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #309, poster session.

AUTHORS' ABSTRACT

It has now been established that during electrolysis of LiOD using Pd cathodes, a threshold loading ratio of at least 0.85 needs to be achieved before excess heat production can be expected. However, for production of neutrons and tritium (and possibly charged particles and transmutation products too), much lower D/Pd ratios, in the region of 0.4 to 0.7 appear to be adequate. This has independently been corroborated in a variety of gas loading experiments also. It is not so much the magnitude of the steady state loading ratio that is attained, but rather the creation of non-equilibrium conditions which facilitates rapid migration/transport of deuterons within the Pd lattice (as demonstrated for example in Yamaguchi's experiments) that seems to be required.

With this in view, a systematic study has been undertaken using electrically self-heated 0.125 mm dia Pd wires in H_2/D_2 atmosphere to optimize the conditions under which rapid loading/deloading of H_2 or D_2 can be achieved. The advantages of self-heated wires are: (a) any desired wire temperature can be obtained by precisely adjusting the current; (b) the instantaneous loading can be deduced from the resistance ratio which can also be independently verified by differential gas pressure measurements. It is found that the absorption rate is rapid if the wire temperature is set just below the knee of the loading ratio vs temperature curve (≅65°C for D_2 and ≅115°C for H_2), while "instantaneous" desorption is achievable by switching the current (hence wire temperature) to an appropriate high value (>130°C for D_2 and >170°C for H_2). **With this technique, loading ratios of 0.6-0.7, close to the peak region of the resistance curve, have been achieved within about 5-10 minutes, in a reproducible manner, provided the wire surface is "suitably activated" prior to commencement.** Gas pressures used in our studies to date have been < 4 bars.

Having learned to absorb/desorb D (or H) in a controlled manner in thin Pd wires and create non-equilibrium conditions, efforts are under way to detect various nuclear products such as charged particles (surface barrier detector and CR-39 SSNTDs), neutrons (annular BF_3 counter bank and bubble neutron detectors) tritium (gas flow proportional counter and liquid scintillation counting following dissolution/distillation), X-rays (photographic films and image intensifier tube with X-ray sensitive phosphor) and radioactivity (Ge-Li detector).

The overall objective of the present study is to try and devise a simple experiment which can demonstrate "on demand" the occurrence of at least one anomalous nuclear phenomenon in a deuterated Pd lattice in a reproducible/repeatable manner.

INDIA - NEUTRON OBSERVATION

A. Shyam, M. Srinivasan, T.C. Kaushik and L.V. Kulkarni (Neutron Phys. Div., BARC, Trombay, Bombay), "Observation of High Multiplicity Bursts of Neutrons During Electrolysis of Heavy Water with Palladium Cathode 308 Using the Dead Time Filtering Technique," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #308, poster session.

AUTHORS' ABSTRACT

Experiments were conducted to detect neutron bursts during the electrolysis of D_2O (LiOD) and H_2O (LiOH) using tubular palladium cathodes (area ~ 300cm^2) and nickel anode cell (Milton Roy) at low current densities (20 to 65 ma/cm^2). Data was acquired for 2 months, of which 15 days each were devoted to "control" experiments before and after the D_2O run.

The annular neutron detection system comprised of a bank of 16 BF_3 tubes embedded in a polyethylene cylindrical thermalising assembly in which an instantaneous neutron burst is temporally stretched to a few tens of μs duration. The electrolytic cell was placed at the center of this assembly. The preamplifiers and detector connections were specially designed so as to be electromagnetically and hermetically sealed. It was confirmed that the setup did not give spurious counts even under the high humidity conditions of the Bombay monsoon season. The overall neutron detection efficiency of the system was ~10% with a background of ~ 0.0494 ± 0.002 counts/s over a 15 day period.

The direct and dead-time (100 μs) filtered train of pulses was continuously counted in 5 sec intervals and the data recorded on a personal computer. The total neutron counts per day with the D_2O cell were found to be consistently about 9% above the background. A significant observation emerged from the frequency distribution of 5 sec counts which was close to Poisson in case of background but contained several large multiplicity events in presence of the H_2O and D_2O cells implying the emission of bursts of 20 to 100 neutrons in <100/μs duration from the latter.

The feature is more evident from the multiplicity distribution of the data obtained after subtracting the dead time filtered counts from the unfiltered counts. While the background counts

did not show even a single triplet or higher multiplicity count throughout the 15 day period, there were up to 6 and 7 counts in the 100 μs duration in presence of H_2O or D_2O cells. The burst events were however very few, average value being 1.7, 3.8 and 7.6 bursts per day for the cases of background, H_2O cell and D_2O cell respectively.

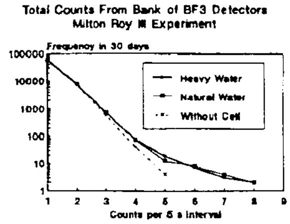

Figure 1

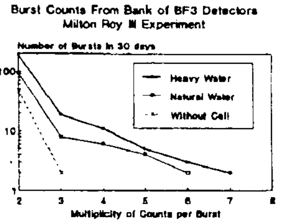

Figure 2

ITALY - NUMERICAL SIMULATION OF D_2 LOADING

F. Celani, A. Spallone, P. Tripodi, A. Petrocchi, D. Di Gioacchino, M. Boutet, M. Nakamura (INFN, Lab. Nazionali di Frascati, Italy), P. Marini, V. Di Stefano (SKITEK, IRI, Pomezia, Italy), G. Preparata, M. Verpelli (Dipt. di Fisica, Univ. di Milano, Italy), "Numerical Simulation of Deuterium Loading Profile in Palladium and Palladium Alloy Plates from Experimental Data of Absorbed Mole Rate Obtained Using μs Pulsed Electrolysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #503, poster session.

AUTHORS' ABSTRACT

A peak current (about 15 A) and very short pulses (800 ns) generator has been used to perform electrolysis in 0.3N LiOD-D_2O solution using some different pure Palladium and Palladium alloys sheets as a cathode and Platinum wire as a net-shaped anode. We have measured the absorbed moles of deuterium by metal plates. Starting from this data (as input), we performed [provided] a special purpose software to simulate the concentration profile of the deuterium absorbed in the metal sheets as a function of the sample depth and the charge flowing in the electrolytical system. In the simulation we have used experimental values of the diffusion coefficient of the deuterium in metals (α, ß, and γ phase), depending on the local concentration ratio D/M.

ITALY - DEUTERIUM CHARGING BEHAVIOR

F. Celani, A. Spallone, P. Tripodi, A. Petrocchi, D. Di Gioacchino, M. Boutet (INFN, Lab. Nazionali di Frascati, Italy), P. Marini, V. Di Stefano (SKITEK, IRI, Pomezia, Italy), M. Diociaiuti (ISS, Roma, Italy), A. Mancini (ORIM S.R.L., Macerata, Italy), "Study of Deuterium Charging Behavior in Palladium and Palladium Alloy Plates, Changing Surface Treatments, by μs Pulsed Electrolysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #504.

AUTHORS' ABSTRACT

Repetitive (5 KHz) short pulses (800 ns), provided of high peak current (15 A) have been used to perform electrolysis in a 0.3N LiOD-D_2O solution using cathodically cold worked plates (25x25x1mm) of pure Palladium (99.99%) and Palladium alloys ($Pd_{90}Ag_{10}$, $Pd_{98}(B_4C)_1(Al,Zr)_1$, $Pd_{99.9}Ce_{0.1}$). The anode was a long Platinum wire rounded as a net [sic]. Very different D/M values have been reached using the plates, which underwent three kinds of surface treatments:

1) as received with only surface cleaning by acetone and 80°C drying;
2) sequential cleaning by acetone, H_2O, HNO_3 (65%), H_2O and final degassing for 24 hours at 250°C in open air;
3) as treatment (2) with the addition of surface oxidation (PdO) by open air flame at 750°C, checking the quality of PdO by hot HNO_3 (65%).

Some studies of plates' surface, by SEM and microprobe, have been performed before and after electrolysis.

A temptative [sic] has been performed to correlate the D/M ratio to the electrode over-voltage (between pulses) and resistance (during the pulses) parameters.

ITALY - NUCLEAR REACTIONS IN CF

W.J.M.F. Collis (PCS Ltd., Italy), "Nuclear Reactions of Cold Fusion: A Systematic Study," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #623, poster session.

AUTHOR'S ABSTRACT

Despite the substantial progress made in demonstrating excess heat in Cold Fusion experiments it is still not clear what nuclear reactions, if any, are taking place. Many workers have reported small quantities of possible products including neutrons, tritium, helium isotopes and other unidentified short lived radioactive isotopes. Although no systematic pattern has emerged as to what materials are particularly suitable it has been suggested independently by various workers that reaction energy and spin conservation are important parameters.

We have created a simple database of some 2240 atomic weights and nuclear spins[7] on a personal computer. A program searches the database for possible cold fusion nuclear reactions. The common features allow novel conclusions to be made even if many of the reactions may be impossible.

The generic reactions considered are limited to 1 or two reactants and / or products:

$$p + X \rightarrow Y + Z$$

where X is one of the 278 naturally occurring nuclides and p is either protium, deuterium. Y may be an optional nuclear product such as tritium, neutron, helium isotope. For neutron transfer reactions [2,3], p or Y may be a neutron or neutron pair. Z is a product to balance the protons and neutrons. We assume that any weak interactions will be insignificant (excepting possible decay of Z).

A reaction is considered if it is exothermic. Further criteria such as spin conservation and Gamow penetration factors are used to reduce some possibilities further.

The study discusses the difficulties in producing neutrons and tritium in light water experiments. It also suggests possible materials for testing neutron transfer theories.

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ITALY - LOW HEAT ENERGY CONVERSION

Maurizio Vignati (ISPESL, Rome, Italy), "Transformation from Heat of Low Temperature Sources into Work; Fundamentals for a Maximum of Efficiency," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #625, poster session.

AUTHOR'S ABSTRACT

The problem of converting the heat produced by cold fusion into work, meets with a classical limit consisting in the second principle of thermodynamics, because the heat produced within electrolytic cells is released to the heavy water, and remains at a low thermal degree. However, this paper draws attention to the existence of ideal thermodynamic cycles the efficiency of which is considerably higher than the efficiency attained by the corresponding Carnot cycle which takes place between the same temperatures. In addition to this, it can be shown that combinations of these cycles can attain even higher efficiencies. The existence of these more efficient cycles is deduced making use of data on real fluids - data accurately selected, organized and published by appropriate Institutes in various nations. A milestone in this field is the publication entitled "Thermodynamic Properties of Argon from the Triple Point to 300 K at Pressures to 1000 atm" (1969) by Gosman et al., publication of the National Bureau of Standards (now National Institute of Standards and Technology). A more recent work (1988) is the publication entitled "New International Skeleton Tables for the Thermodynamic Properties of Ordinary Water Substance," by H. Sato, published in the *Journal of Physical and Chemical Reference* data - 17 N. 4, 1439-1539. And many other thermodynamic properties of different fluids are also published in this review. Most of these papers propose a mathematical model of the fluid under study. It is possible, therefore, to enclose these mathematical models as subroutines into interactive programs which are able to calculate the efficiency of ideal cycles and combinations of ideal cycles using the same fluid. Owing to the characteristics of these cycles and combinations of cycles, and being also possible to put them into practice, they could be taken into consideration for projects aiming at the transformation into work of the heat produced by cold fusion or other heat sources at low temperature.

ITALY - SEARCH FOR NUCLEAR "ASH"

M. Alessio*, A. Asmone*, M. Corradi*, F. Croce°, F Ferrarotto*, S. Improta*, B. Stella°°, F.F. Kayumov**, B.N. Lomonosov**, D.I. Minasyan**, V.A. Tsarev**, F. Celani+, A. Spallone+ and P. Tripodi+ (*INFN Roma 1 and Dept. Phys. & (°)Chem., "La Sapienza" Univ., and (°°)III Rome Univ., Roma, Italy and **P.N. Lebedev Phys. Inst., Russ. Acad. Sci., Moscow,; Dept. Phys. - III Univ. Roma, Italy & +Lab. Naz. INFN, Roma), "An Electrolytic Pd-D Experiment for the Search of Protons, α's, Light Nuclei, Tritium, Neutrons, Gamma Rays and Thermal Effects in a Pulsed High Current Electrolysis," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #303, poster session.

AUTHORS' ABSTRACT

In a previous electrolytic experiment (with a Pd cathode, previously degassed, in a D_2O-LiOD solution) using the FERMI apparatus at the Gran Sasso Laboratories, we monitored both the solution and the recombined gas twice a day for tritium content.

The tritium excess we found (only in coincidence with the deuterium loading of the cathode) could have been due (though this is unlikely) to a previous contamination of the Pd sample. By observing 3 MeV protons in coincidence, one could be sure that the reaction involved was dd → pT.

A special electrolytic cell has been designed to allow the detection, in the interior of the FERMI apparatus, of 3 MeV protons (and other charged hadronic particles) and to monitor in coincidence deuterium loading as well as thermal effects.

A pulsed current generator for high currents has been specifically designed to reach high loading ratios. A severe constraint is that the wanted charged particles should reach the detector but atomic deuterium (at high pressure inside Pd) should not exit. We have envisaged some treatments to reduce the degassing of the Pd cathode during the experiment (monitored on line).

The new experiment is currently active at the Gran Sasso Laboratories, and results will be presented at the time of the conference.

ITALY - NEUTRONS IN COLD FUSION

Lino Daddi (Academia Navale, Italy), "Neutrons in Cold Fusion Experiments," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #334, poster session.

AUTHOR'S ABSTRACT

This report constitutes a review of the most convincing observations of neutrons in the experiments of cold fusion, beginning with the first tests of 1989 conducted by Pons/Fleischmann, Jones and Scaramuzzi.

The poor and irregular production has constituted the essential characteristic (maintained as well in significant follow-on experiments) so much so that researchers have been persuaded to disregard neutron measurements in order to concentrate their efforts on calorimetric measurements and the determination of tritium and helium.

Recently, experiments based on particular techniques and on superficial effects have demonstrated the possibility of realizing ever increasing neutron production (up to 10^5 neutrons per second) and for times long enough that the use of activation detectors is feasible. In other experiments, transmutations have apparently been obtained, perhaps due to neutronic reactions of nuclei initially present as impurities in the absorbing solid of the deuterium.

JAPAN - DOUBLE STRUCTURE Pd CATHODES

Y. Arata and Y.C. Zhong (Univ. of Osaka, Japan), "The `Latticequake Model' of the Double Structure Palladium Cathodes," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #602, poster session.

AUTHORS' ABSTRACT

The authors have proposed a new "Model" which can reasonably explain the existence of Cold Fusion Reaction and also verify the generation of tremendous excess energy in the DS-cathode, which is fifty thousand times higher than chemical reaction energy. The new model is named the "Latticequake Model."

JAPAN - NUCLEAR PROCESSES

Hideo Kozima and Seiji Watanabe (Dept. of Phys., Fac. of Science, Shizuoka Univ.), "Nuclear Processes in Trapped Neutron Catalyzed Model for Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #427, poster session.

AUTHORS' ABSTRACT

To explain the complicated experimental results obtained in Cold Fusion experiments, a theoretical model had been proposed based on the assumption of effective trapping of neutrons in solids occluding deuterium and/or hydrogen.

The trapped neutron leads to fusion reactions with a deuteron or proton in the sample and the reaction products give rise to excess heat, fusion products, successive fusion reactions.

In the present work, results are given of detailed calculations of the fusion probability of a triton generated in n-d fusion with a deuteron, fusion probability of a deuteron accelerated by t-d elastic collision with another deuteron. Many neutrons are generated in successive reactions of d-d fusion initiated by a trapped neutron, sufficient to explain experimentally observed excess heat, neutron bursts and tritium anomaly in optimum situations. The results confirm the preliminary estimations used in the former work presented in ICCF-4.

JAPAN - CHARCOAL CATHODE

Ryoji Takahashi (Univ. of Tokyo, Japan), "Synthesis of Substance and Generation of Heat in Charcoal Cathode in Electrolysis of H_2O and D_2O Using Various Alkalihydrooxides," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #619, poster session.

AUTHOR'S ABSTRACT

This experiment was done to verify the presented model of cold fusion at the last meeting [1]. It is well known that charcoal absorbs and releases gas and water in large amount by its own clearance network structure built biologically, suggesting that it includes various sizes of micro-channels favorable for the production of micro-drops. Moreover, the charcoal carburized at high temperatures possesses high electrical conductivity so its cathodic use for the electrolysis could be possible.

I. Synthesis of substance in the cathode

The specimen was prepared from the twig charcoal by sawing cross sectionally for various lots,forms and sizes. The ash element was removed by immersing the specimen in HCl for about three days and the acid was removed from the specimen by washing in hot water many times. The electrode applied was a piece of solder wire, Pb-Sn alloy, pushed into the drilled hole. The side surface of the specimen was coated with Araldite resin to maintain the mechanical strength and to diminish the waste current which does not contribute to the electrolysis in the micro-channel. The specimen was dipped partially into the electrolyte containing 0.25N of a Alkalihydrooxide, i.e. LiOH, NaOH, KOH, RbOH and CsOH. The electrolysis was done in a cell containing 50-80 cc of the liquid under the electrical input power less than about 4 watt. From the early stage of the experiment for NaOH, it was found that the electrolyte was often colored with dark brown in several hours. As there was no substance responsible for the colorization other than charcoal, Araldite was not yet used at the stage, it was supposed that some new substance is created in the cathode. To assure this idea a heating experiment was done for the sliced and powdered charcoal respectively in 0.25N NaOH-water solution at about 90°C for 4 hours. As a result the former produced slight colorization of dark brown, but the latter did not at all. This experiment shows that the colorization is not due to the extraction of substance from the charcoal but due to the structure-dependent synthesis action in the charcoal. This phenomenon was studied by standardizing the method as shown above.

II. Generation of heat in the cathode

According to the micro-drop theory, heat is generated in compensation for the synthesis. Actually, a small temperature rise was detected for the specimen which provided the colorization. The temperature rise ΔT is given by,

$$\Delta T = Tc - Tw, \quad (1)$$

where Tc and Tw show the temperatures in the cathode and the electrolyte respectively. The measurement of Tc and Tw was carried out by using two sets of thermistor thermometer of the same type, the one probe was inserted into the cathode through a drilled hole and the other probe was set in the middle of the liquid. By applying a constant voltage, Tc and Tw were measured as functions of time, and it was found that ΔT is almost constant as long as the electrolysis produces the colorization.

The measurement of the excess heat generation by using the charcoal cathode was carried out. No excess heat was observed for H_2O even in the case when strong colorization took place. However,the excess heat was observed for the electrolyte including 50%, 75% and 100% of D_2O.

[1] R. Takahashi, "Cold Fusion Explained by Negentropy Theory of Micro-drop of Heavy Water," Proc. of ICCF4, vol 4, p 29-1.

JAPAN - SIMULTANEOUS MEASUREMENT

Yoshiyuki Asaoka, Tadeshi Ichiji, Tomonari Fujita and Tetsuo Matsumara (CRIEPI (Cent. Research Inst. of Elec. Power Ind., Tokyo), "Simultaneous Measurement Device of Heat and Neutrons of Heavy Water Electrolysis with Palladium Cathode," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #219, poster session.

AUTHORS' ABSTRACT

We have developed a demonstration device of cold fusion phenomena. The feature of the apparatus is precise calorimetry and simultaneous measurement of excess heat, neutron and gamma-ray from the electrolysis cell. Several electrolyses, each of which was continued for about 1,000 hours, have been conducted with the device. The characterization of the device and the preliminary results of the heat, neutron and gamma-ray measurements are presented.

The galvanostatic electrolysis of D_2O-LiOD solution with Pd cathode-Pt anode has been carried out in the closed cell with recombination catalyst. Palladium cathode materials obtained from Tanaka Kikinzoku Kogyo (TKK) were cut to a sheet of 12mm x 12mm x 1mm or a rod of 3mmϕ x 15mm. Platinum anode for the sheet-shaped cathode was a wire rolled round the cathode as in the device of Takahashi et al; the anode for the rod-shaped cathode was a mesh. The volume of electrolysis cell, which includes cathode, anode, resistance heater, thermocouple, about 70 cm^3 electrolyte, 1 M LiOD-D_2O, and recombination catalyst is about 140 cm^3.

For precise excess power measurement, flow calorimetry was adopted. The obtained accuracy for the excess power

measurement of the system was ±0.2W at up to 10W of applied power.

The electrolysis cell was set in the shielding which consisted of polyethylene, cadmium and low background iron. Neutron emission was detected by an NE-213 recoil proton counter and a ^{3}He proportional detector. Gamma-ray emission was measured with the Ge(Li) semiconductor detector. The apparatus is able to monitor background neutron count rate simultaneously with another ^{3}He detector set outside the shielding, measuring one hour spectrum of detectors continuously for two weeks, identify the energy of neutrons and gamma rays and to discriminate signal from noise. Background count rate decreased about 30% for ^{3}He proportional counter, about 35% for NE-213 recoil proton counter, and about 65% for Fe(Li) semiconductor detector with shielding.

For these in-situ measurements of heat, neutron, gamma-ray and out of pile [sic] tritium measurement with liquid scintillation counter, no remarkable abnormal phenomena, as excess heat or higher neutron count rate than background have been observed at the present time. One of the reasons for these results is considered to be that the deuterium loading ratio in palladium cathode, which seems one of the most important factors for excess heat, was not so high. We are measuring the deuterium loading ratio using the inner pressure of the electrolysis cell and the electroconductivity of the palladium cathode.

The results of loading ratio measurement and the future plan of the experiment will also be presented at the conference.

JAPAN - HEAT & NUCLEAR PRODUCTS DETECTION

Shigeru Isagawa, Yukio Kanda and Takenori Suzuki (Nat. Lab. for High Energy Phys., Tokyo), "Heat Production and Trial to Detect Nuclear Products from Palladium-Deuterium Electrolysis Cells," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #220, poster session.

AUTHORS' ABSTRACT

A heat burst as claimed before [1] was clearly observed for the first time in our series of open type electrolysis experiments using Pd/0.1M LiOD/Pt in a constant temperature bath kept at 20°C. A new cell was designed and prepared whose heat insulation was reinforced by the use of silver mirror together with super insulation muffler. Palladium sample used was 2 mmϕ x 7.05 mm, the mass and the surface area of which are 0.227 g and 0.435 cm respectively. After a precharging period of 28 days, the current density was increased from 35 mA/mm^2 to 920 mA/mm^2. Under the constant current conditions, the cell voltage and the cell temperature were increased gradually and all of a sudden sharply increased to boiling [2]. Due to the voltage limitation of the power supply, the current was lowered and boiling stopped all of a sudden again owing to some unknown delicate factors. It was just during the calm period about 6 hours after the first boiling that the enormous heat release was observed. The temperature of the cell of about 100 ml in volume increased by 7.5 K (from 83.4°C to 90.9°C) in 13 minutes. The cell voltage showed a dip correspondingly. The excess heat can be estimated to be 6.8 W, about 110% with respect to the input electric power. The palladium cathode seemed to be a heat source, although the mechanism of the heat generation is still uncertain. Boiling occurred 3 times, the last episode continuing for about 16 hours, in the former period violent but in the prolonged later period rather gentle; the cell was driven almost to dryness. No *heat after death* [3] was observed in this case. During the whole period of this run, the heat burst phenomenon took place only once. No increase of neutron emission as observed before [4] has been detected. The measurements of nuclear products like neutron, tritium, γ and He^4 as well as low energy characteristic X-rays [5] are being continued and/or being prepared now. These results will be reported in detail at the Conference.

[1] M. Fleischmann, S. Pons and M. Hawkins, *J. Electroanal. Chem.*, 261 (1989) 301,263 (1989) 187.
[2] M. Fleischmann and S. Pons, *Phys. Lett.* A176 (1993) 118.
[3] S. Pons and M. Fleischmann, Proceedings of the 4th International Conference on Cold Fusion, C2.12, 1994.
[4] S. Isagawa, Y. Kanda and T. Suzuki, Frontiers of Cold Fusion, Ed. H. Ikegami, (Proceedings of the 3rd International Conference on Cold Fusion), Universal Academic Press, Tokyo (1993) 477.
[5] D.B. Buchler, L.D. Hansen, S.E. Jones and L.B. Rees, *ibid.* (1993) 245.

JAPAN - CHARACTERISTIC EMISSIONS

Yasuhiro Iwamura, Nobuaki Gotoh, Takehiko Itoh and Ichiro Toyoda (Adv. Techn. Res. Ctr., Mitsubishi Heavy Ind., Ltd., Yokohama), "Characteristic X-ray and Neutron Emissions from Electrochemically Deuterated Palladium," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #312, poster session.

AUTHORS' ABSTRACT

Characteristic x-ray and neutron emissions have been observed during electrochemical loading of deuterium into palladium metal. It shows anomalous and unexpected phenomena occur in deuterium-palladium system as shown in our previous paper and the others on cold fusion.

Palladium rods (ϕ3X20mm) were heated and melted in the air by a portable propane burner and cooled down quickly to room temperature (~ 298K)in pure water. After pre-loading (D/Pd ~ 0.66) in deuterium gas, we set the deuterated palladium sample in a closed type of electrochemical cell with 1 M LiOD-D_2O solution. The electrochemical cell consists of a cathode of palladium rod, an anode of platinum mesh, a recombiner and a cooling pipe for measuring excess heat generation. The excess heat was evaluated by the difference between input and output temperature of the water that passed through the cooling pipe. Neutron counting was performed by a He-3 detector with a polyethylene modulator. A NaI scintillation counter was used for both x-ray counting and spectroscopy. All cells and measurement systems are located in a clean-room where temperature and humidity are always kept constant.

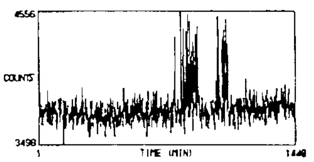

Fig.1 Time evolution of X-ray counts

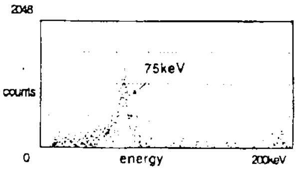

Fig. 2 X-ray energy spectrum

Fig. 1 shows an experimental result on x-ray counting. This data was acquired one week after the beginning of the experiment. Total number of x-ray counts increases twice as shown in the figure. The first peak lasts for about 2 hours and the second an hour. In addition, we observed neutron and the other x-ray emissions from this sample. Fig. 2 shows a result of x-ray spectroscopy for the counting data in Fig. 1. In this figure, we subtract background x-ray data from foreground. A clear peak can be seen around at the energy of 75keV, which corresponds to K-α characteristic x-ray of Pb. Although we cannot identify where these Pb atoms come from (contamination or generation), we can say that anomalous nuclear reactions must occur in the electrochemical cells at room temperature.

JAPAN - ERD ANALYSIS OF H ISOTOPES

Akira Kitamura, Takakaru Saitoh, Hiroshi Itoh and Yuichi Furuyama (Dept. of Nucl. Engr., Kobe), "*In Situ* ERD Analysis of Hydrogen Isotopes During Deuterium Implantation into Metals," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #329, poster session.

AUTHORS' ABSTRACT

One of the most important issues for the investigation of the mechanism is identification of reaction products and their energy. Since no nuclear reaction occurs without a charge particle as one of the reaction products, detection of the charged particles has a critical importance for the research.

One of the key factors for the appearance of excess heat has been found to be concentration of n_D of D atoms in Pd. In view of the somewhat transient nature of the anomalous phenomena, it is very important to know space- and time-dependent $n_D(x,t)$ in relation to appearance of reaction products. Moreover, it is desirable to make the analysis of n_D *in situ,* taking account of the easily movable nature of hydrogen isotopes in metals.

In this paper are described the construction of a D ion implantation/irradiation system equipped with an accelerator analysis system and the first report on the *in situ* measurement.

Effectiveness of *insitu* ERD analyses during deuterium ion implantation of Pd and Ti is demonstrated. Flux dependence of D(d,p)t reaction yield during the implantation is interpreted in terms of a temperature dependence of deuterium concentration measured with the ERD method. Simultaneous measurements of the reaction products with the recoil particles have also been made to clarify the spectra except for some unidentified peaks.

JAPAN - SPARKING DISCHARGES IN WATER

Takaaki Matsumoto (Dept. Nucl. Engr., Hokkaido Univ., Sapporo), "Cold Fusion Experiments by Sparking Discharges in Water," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #331, poster session.

AUTHOR'S ABSTRACT

Cold fusion experiments associated with microsparks were performed by discharge in ordinary water mixed with 1.5 Mil/ℓ potassium carbonate. An high current density of DC was employed with thin wire electrodes (0.5-2.0 mmϕ). Palladium, nickel, titanium, iron, cadmium and tungsten were used for the electrodes. When the voltage increased above about 40 V, many microsparks appeared on the surface of the electrode and simultaneously extraordinary phenomena were observed. The following was examined:

a. A microtelescope-VTR system recorded microsparks which sometimes have a ring structure and exploded.
b. The I/V curve showed a strong nonlinearity associated with the microsparks.
c. Extraordinary radiations were measured with a CsI scintillation detector.
d. Extraordinary traces recorded on nuclear emulsions showed tiny ball-lightning phenomena.
e. Microscopic ring-like products which were caught on an electrode showed the magnetization and decayed to a regular hexagonal plate.

f. Extraordinary traces suggesting the production of the prototype of micro-bacteria were found on nuclear emulsions.
g. Explanations would be given by the Nattoh model (1).

[1] T. Matsumoto: "Mechanisms of Cold Fusion: Comprehensive Explanations by the Nattoh Model," Submitted to *Fusion Technology*, March (1993).

JAPAN - CORRELATION OF HEAT & NEUTRONS

Hiroaki Ogawa, Yuri Yoshinaga and Makoto Okamoto (Res. Lab.- Nucl. Reactors, Tokyo Inst. of Tech., Tokyo), "Correlation of Excess Heat and Neutron Emission in Pd-Li-D Electrolysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #218, poster session.

AUTHORS' ABSTRACT

To clarify the conditions for reproducible nuclear reactions in condensed materials, we have monitored the excess heat generation and the neutron emission using Pd cathodes whose initial properties were well characterized. The size of the electrodes was 25mm(ℓ) x 10mm(w) x 1mm(t), the electrolyte was 1 M LiOD (or LiOH), and the pulse mode electrolysis used 3 hours of high current and 3 hours of low current density.

In the present work, the electric resistance and the hardness of Pd electrodes have been examined as the key factors for the nuclear reaction in the Pd electrodes initiated by the pulse mode electrolysis. The generation of the excess heat has been monitored by three thermocouples immersed in the electrolyte and the emission of neutrons has been detected by a large NE213 liquid scintillation detector. The excess neutron emission has been evaluated by the comparison of the neutron emission intensity between the background run with light water and the foreground run with heavy water.

In the two background runs, using Pd electrodes with high/low electric resistance and high/low hardness, we have found no nuclear effects as reported previously. From the two foreground runs with heavy water, the run using Pd of low electric resistance and low hardness gave clear excess heat generation and the excess neutron emission.

We will present the details of the above experiments and discuss the correlation of the two nuclear effects.

JAPAN - EFFECT OF BORON IN COLD FUSION

K. Ota, K. Yamaki, N. Tanabe, H. Yoshitake and N. Kamiya (Dept. Energy Engr., Fac. Engr., Yokohama Univ.), "Effect of Boron on Heat Production in Heavy Water Electrolysis Using Palladium Cathodes," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #221, poster session.

AUTHORS' ABSTRACT

The excess heat production in heavy water electrolysis has been reported by Fleischmann and some other research groups. In these studies, specific Pd cathodes have been used and the composition, mechanical treatment and heat treatment of the cathode are considered to be important for the reproduction of the experiments. In this paper the electrolysis with B-added Pd cathodes has been studied by measuring the heat balance; the influence of the additive on the excess heat generation will be discussed.

The heat balance measurement was carried out in an acrylic cell having a catalyst for the recombination of deuterium and oxygen. The flow calorimetric technique was applied; cold water flowing in the copper tube surrounding the cell picked up the generated power. The heat balance is represented by the ratio of the detected power to the input power. The electrolysis was operated in 1 M LiOD heavy water solution at a constant power (usually 5 W). The net error in the system was estimated to be 3%. Palladium including impurity levels of boron were provided by Tanaka Kikinzoku Co. and IMRA Materials.

Table 1 shows the results of the heat balance of the heavy water electrolysis. A small excess was observed in four runs out of five. No excess heat was observed using Pd of lowest B concentration (Run 25). Among these specimens, some of the excess heat was observed in the steady state (Runs 23, 31 and 33) from the beginning of the electrolysis. The effect of the concentration of B is not clear at this stage. Since the extent of the excess is very close to the error limit, we are now constructing more effective insulating walls for precise heat measurements.

Table 1. Heat Balance of Heavy Water Electrolyses with B-added Pd Cathodes

Run	Palladium Sample	Win(W)	C.D. (mA/cm^2)	Heat Balance max(%)	Heat Balance Av.(%)
23	B 267ppm TNK	5	750-300	107	103
25	B 127ppm TNK	5	850-440	99	97
29	B 500ppm IM	5	750-360	104	101
31	B 267ppm TNK	5	710-540	103	100
33	B 500ppm IM	5	740-660	104	103

JAPAN - PRECISE CALORIMETRY DEVELOPMENT

Noboru Oyama and Hiroshi Hirasawa (Dept. Appl. Chem., Fac. of Tech., Tokyo Univ. of Agr. and Tech., Tokyo), "Development of Precise Calorimetry for Electrolysis in a Closed Cell System," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #217, poster session.

AUTHORS' ABSTRACT

We have studied the calorimetry of the D_2O electrolysis in a closed cell system, in which D_2 and O_2 are recombined on a catalyst in the gas phase of the cell. The closed cell system is much more precise than the open cell system, in which heat generation through the recombination of D_2 and O_2, the heat uptake through vaporization of D_2O and heat loss through gas phase are very difficult to evaluate. However, our calorimeter (model MM 5111, Tokyo Riko, Japan) has not been precise enough because the heat detector was at the bottom of the cell, although heat is generated not only in the liquid phase but also on the catalyst in the gas phase.

Two further heat detectors have therefore been placed on the side of the electrolytic cell. The cap of the cell has been changed from teflon to teflon-coated stainless steel. Further, the electrolytic cell has been immersed completely in liquid paraffin. Before the reconstruction of the calorimeter a maximum of 20% of the heat generated in the gas phase was not detected. However, the reconstructed calorimeter can detect at least 98-99% of the heat generated in the gas phase.

Furthermore, a conductivity meter has been connected to a palladium cathode for the in situ measurement of the deuterium loading ratio. The correlation between the conductivity and the loading ratio was calibrated from the mass measurement of the palladium cathode. Thus, the deuterium loading ratio (D/Pd = 0 - 0.8) as well as the heat balance can be measured in the course of D_2O electrolysis.

JAPAN - STUDIES ON ICARUS 1

Toshiya Saito (New Hydrogen Energy Lab., Inst. Appl. Energy, Sapporo), Hideo Ikegami (Nat. Inst. Fusion Sci., Nagoya), "Studies on Fleischmann-Pons Calorimetry with ICARUS 1," ICCF-5-, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 216, poster session.

AUTHORS' ABSTRACT

Studies are made on the Fleischmann-Pons calorimetry with ICARUS 1 system, the installation of which in the New Hydrogen Energy (NHE) Laboratory was supported by S. Pons.

A unit of ICARUS 1 consists of three, identical, FleischmannPons type electrolytic cells, immersed in a thermostatic bath. As has been rather well recognized, their calorimetry relies upon a heat balance equation, where the difference between enthalpy inputs and losses raises an issue of our greatest concern.

The basic equation carries two unknowns: the heat capacity and the effective heat transfer coefficient (k'_R), which can be experimentally determined in each cell from an electrolyte temperature response to a heat pulse input. Once these two quantities are determined to balance the enthalpy inputs and outputs, changes of k'_R thereafter may relate to changes in enthalpy generation in the cell. This is one principle employed by Fleischmann and Pons for their calorimetry where the key lies in k'_R.

With the ICARUS 1 system at NHE, detailed studies have been made on the effective heat transfer coefficient (k'_R); its reliability and precision in detecting any enthalpy generation, its stability during a longtime electrolytic operation, and its use for the evaluation of excess heat generation.

JAPAN - D_2 RELEASE PROCESS IN VACUUM

K. Shikano, H. Shinojima and H. Kanbe (NTT Basic Res. Lab., Nippon Tel. & Tel. Corp., Kanagawa), "D_2 Release Process from Deuterated Palladium in a Vacuum," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #332, poster session.

AUTHORS' ABSTRACT

Nuclear products of d-d reactions, such as ^4He, and an increased temperature have been observed when D_2 is released from deuterated palladium in the vacuum method [1]. To make these phenomena more reproducible and to make the reaction clear, we studied in detail the change in surface temperature and electrical resistance during the release of D_2 from deuterated palladium in a vacuum.

Samples were 30 x 30 x 1 mm Pd plates. They were slightly etched by aqua regla before being loaded with D_2 gas in a chamber at room temperature or an elevated temperature. The loading ratio (D/Pd) was 0.60-0.65, and one side of each deuterated plate was coated with a metal film (Au or Ag) and the other side was coated with manganese oxide. The sample was then placed in a vacuum chamber and heated by injecting currents while the chamber was evacuated by a turbo-molecular pump. Sample temperature, electrical resistance, and D_2 pressure were measured by thermocouples, the four-point probe method, and a vacuum gauge.

When current started to flow, the resistance decreased and the D_2 pressure initially increased briefly and then gradually decreased. The temperature changes, however, were of three types. In one, the temperature increased exponentially with time and reached at a constant value determined by the balance between Joule heating and heat dissipation. In another, the temperature rose above the balanced temperature after staying at a low value for several hours, and the pressure simultaneously fell. This variation is similar to that reported before. The third type consisted of temperature peaks not correlated with changes in pressure. After these experiments, almost all samples were found to be bent. We cannot explain these temperature variations, but are now investigating the materials including the palladium and coatings, and the correlation between the temperature changes and the nuclear products.

[1] E. Yamaguchi et al., Proceedings of the Third International Conference on Cold Fusion, 1992, Nagoya, p 179.

JAPAN - LOW ENERGY D ION BOMBARDMENT

Hiroyuki Shinojima, Takashi Nishioka, Kouji Shikano, and Hiroshi Kanbe, (NTT Basic Res. Lab., Kanagawa), "Studies of d-d Reactions in Deuterated Palladium by using Low-Energy Deuterium Ion Bombardments," April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #333, poster session.

AUTHORS' ABSTRACT

Helium 4 has been observed in a deuterated palladium as a product of nuclear fusion [1], even though the dominant d+d reactions are conventionally thought to be d+d → ^{3}He(0.82MeV) + n(2.45 MeV) and d+d → t(1.01 MeV) + p(3.02 MeV). The production of ^{4}He, however, shows that the d+d reaction in a solid state may differ from the conventional reactions in a deuterium gas.

We try to bombard a deuterated palladium plate with deuterium ions having energies from 20 to 50 keV in order to evaluate the cross sections and the branching ratio as a function of the deuteron energy. One side of the deuterated palladium plate is coated with MnO_x and another side is coated with Au. The beam currents of D^+ and D_2+ are respectively about 10 μA and 20μA. ^{3}He, protons, and tritium are detected by Si-SSDs (solid states devices), and neutrons are detected by an NE213 liquid scintillator and a ^{3}He neutron detector (Aloka Ltd: TPS-451S). We also use a high-resolution quadruple mass spectrometer system, including a cold trap for background deuterium gas, in order to detect ^{4}He. The amount of ^{4}He that can be detected is estimated to be as little as 1/50,000 of the deuterium gas emitted from the deuterated palladium plate

From the amount of neutrons and protons measured in preliminary experiments, we calculate that the cross section of the d+d reactions decreases from 3 x 10^{-2} b at the deuteron energy of 25 MeV in the center-of-mass system to 3 x 10^{-4} b at 10 KeV, while the branching ratio between the cross section of d(d,n)^{3}He and that of d(d,p)t remains constant at 50% in this energy range. The results so far indicate that the d+d reaction with deuterons in this energy range can be extrapolated from the theoretical results for deuterons with higher (MeV) energies. The new nuclear phenomena observed in the solid state [2,3], however, remain to be studied. We are continuing to investigate d+d reaction in the solid state by high sensitive detectors so we can using deuterons with even lower energies (±10 KeV).

[1] E. Yamaguchi and T. Nishioka, Frontiers of Cold Fusion (Universal Academy Press), (1993) 179.

[2] J. Kasagi, K. Ishii, M. Hirano, and K. Yoshihara, Frontiers of Cold Fusion (Universal Academy Press), (1993) 209.

[3] S. Ichimaru, *Rev. Mod. Phys.* 65(1993) 255.

JAPAN - FUSION IN SOLID Pd/D_2 GAS

Nobuhiko Wada (Dept. Phys., Fac. Sci., Nagoya Univ.), "Nuclear Fusion in Solid Pd/D_2 Gas," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #335, poster session.

AUTHOR'S ABSTRACT

Spontaneous emission of neutron bursts with temperature rise are detected from rods, foils or shavings of palladium by means of simple exposure to D_2 gas in a closed glass bulb. The process of cold working applied to the palladium in the respective production processes of the samples is one of the important factors to attain reproducible results. Silicon coating of the sample surface by means of vacuum evaporation or sputtering is effective to promote emission bursts of neutrons. Enclosure of the experimental system by polyethylene plates of over 10 cm. thickness is also a necessary condition for realization of the burst emission.

The emitted neutrons are simultaneously detected by a couple of conventional neutron H^3-surveymeters and a bare BF_3-counter. Appearance times of neutron bursts are detected by the former and the energy spectrum of the emitted neutrons by the latter. The excess amounts of neutrons of 2.45 MeV and large amounts of thermal neutron emissions are detected together with a small temperature rise of the sample when the neutron burst emissions occur. Absorption of D_2 gas by the

sample over a long time interval is observed from the time variation of the gas pressure.

RUSSIA - COMPARE HEAT & NUCLEAR PRODUCTS

Yu.M. Aliev, N.I. Starkov, V.A. Tsarev (Lebedev Phys. Inst., Russ. Acad. Sci., Moscow), "A Correlation Between Heat and Nuclear Products in Cold Fusion Experiments," ICCF5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #415, poster session.

AUTHORS' ABSTRACT

A model is presented which can explain both heat effects and nuclear products in Cold Fusion experiments. The correlations between heat and products are rather indirect and variable depending on experimental conditions.

The fundamental assumption which has some experimental and theoretical justifications [1,2] is a transition of PdDx into semi-metallic state at high loading ratio X > 1, which can be created locally in some domains, presumably near the surface. This leads to some specific effects: negative differential conductivity, domains with high electric field gradient, creation of micro-pinches etc. An high electric field can accelerate deuterons and initiate nuclear reactions, whereas other effects could manifest themselves as an excessive heat burst.

1. V.A. Tsarev: *Uspechi Phisycheskich Nauk* (Sov. Journ.), 160, (1990), 1.
2. L. Sun, D. Tomanek: *Phys. Rev. Lett.*, 63, (1989), 59.

RUSSIA - GLOW DISCHARGE & HEAT

A.B. Karabut*, Ya.R. Kucherov*, and I.B. Savvatimova (Sci. Ind. Assoc., "Luch", Moscow Region), "Excess Heat Measurements in Glow Discharge Using Flow Calorimeter," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #319, poster session.

AUTHORS' ABSTRACT

The experimental results of heat and electric power measurements in glow discharge are presented. Excess heat was registered using a continuous flow calorimeter that confirmed the previous results [1] obtained with a dynamic calorimeter.

The three parts of the discharge device - cathode, anode and quartz discharge chamber - were cooled separately. The cooling water flow and temperature rise of coolant were measured for each part.

The experiments were conducted with various power supplies providing direct current, 50 Hz pulsing current, 1KHz pulsing current with 3-10 μs pulses. The additional source of high density ion flux was also used.

Palladium cathodes and composite cathodes, made of ceramic proton-conducting solid electrolytes, were used.

Along with the excess heat, neutron and gamma emission and radioactivity of cathodes after the experiments were also registered.

1. A.B. Karabut, Ya.R. Kucherov. I.B. Savvatimova, "Nuclear Product Ratio for Glow Discharge in Deuterium": *Physics Letters A.* 170 (1992) 265.

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RUSSIA - CATHODE RADIATION INVESTIGATION

A.G. Kalandarishvili, V.A. Koryukin and V.P. Obrezumov (RRC, Kurchatov Institute, Moscow), "Investigation of a Radiation from the Palladium Cathode Treated in the Deuterium Glow Discharge," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #304, poster session.

AUTHORS' ABSTRACT

The glow discharge was ignited in the hydrogen and deuterium atmosphere at pressures from 5 to 30 torr in the diode with the cooled emitter of palladium or its alloys. The electrodes were first subjected to thermal treatment in high vacuum according to a specific procedure. Prior to and after the existence of a stable discharge in deuterium and hydrogen, the gamma quanta flux was measured in a wide range of energies. The analysis of the thus recorded data showed that when palladium had been treated in deuterium, the gamma quanta and neutron flux exceeded its average level only slightly as compared to the data recorded in hydrogen.

After having been treated in deuterium, the electrode samples along with the controls were analyzed for the presence of an induced radiation. For this analysis there were used radiography, gas-flow proportional counter, gamma-spectrometry and liquid scintillator. In some cases radiation was recorded that was continuously maintained for 4-5 months, whose nature can be related to formation and decomposition of tritium in the emitter. For individual samples there was recorded gamma-radiation of higher energy, whose physical character is being studied now.

The radiography examination demonstrated a significant nonuniformity of the film blackening over the surface at

fluence about 10^7 cm^{-2}, which points to a nonuniformity of the deuterium charged into palladium and, as a possible consequence, to the cold fusion reaction occurring at charging ratios below 0.9.

RUSSIA - CATHODE RADIOACTIVITY

I.B. Savvatimova and A.B. Karabut (Sci. Ind. Assoc., "Luch," Moscow Region), "Radioactivity of the Cathode Samples After Glow Discharge," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #317, poster session.

AUTHORS' ABSTRACT

We have detected the residual radioactivity of foils (Pd, Ag, Nb and other materials) after irradiation in a glow discharge. The samples were irradiated with proton, deuteron and argon and xenon ions of low energy. We consider that the main activity is beta emission from the samples after the experiments [1]. Samples were placed in contact with X-ray films; a semi-quantitative method relying on the measurement of the degree of blackening of the films using a micro-photometer was used. We have made an estimate of the beta activity of the samples. The X-ray film was calibrated using a tritium beta source with activity 4.1-10^9 βs^{-1} (Ti implanted). The characteristic curve from this film was obtained in a vacuum chamber. High energy radiation was compared with ^{90}Sr radiation (Eβ = 546 keV). Within 10^{-3}s after termination of the discharge, the second X-ray exposure corresponds to an equivalent dose of (1.5-4.5) x 10^{10} β/cm^{-2} from ^{90}Sr. Activity of the isotope having high energy radiation is estimated to correspond to a ^{90}Sr activity of ($\cong$2.5 x 10^4 β $cm^{-2}s^{-1}$).

We have stated previously that there were at least two isotopes emitting energy in different regions: the first at < 20 keV and the second at (0.1-0.5) MeV. [2]

We note now that activity was not observed for ion irradiated zones when using compound cathode samples (assembled from 2-7 foils of different materials) and using an high ion density. The increase of the activity of the irradiated surface (in comparison to non-irradiated surface) was within a factor 2-10. The high energy radiation was only observed in the second layer of the X-ray film; the isotopes emitting this high energy radiation were detected after only 2-4 hours of irradiation.

For cathode materials other than Pd (viz Ag, Nb, Ti ....), the activity was reduced by a factor of 10-100 for equivalent experimental conditions. The activity of Ag, Nb and Ti was in the range 10^2-10^4 $cm^{-2}s^{-1}$. That of Pd foils maintained under Ag, Nb (and other materials) was in the range 10^5-10^6 $cm^{-2}s^{-1}$.

We have not detected activity of Ag cathodes after irradiation with deuterium ions and have investigated the activity of Pd cathodes when using Ar or Xe ions under otherwise equal experimental conditions. We have therefore detected radiative emission via the blackening of X-ray films which was not due to the formation of tritium nor due to the interaction of H, D or T with these films.

We have to note the following major results:

- increase of the sample radioactivity during the first hours after the experiment and a subsequent decrease;
- presence of radioactive nuclei on the cathode emitting energy in the range of a few to hundreds of keV;
- radioactivity of the samples after irradiation with Ar or Xe ions.

We therefore propose that we have observed chains of radioactive nuclear decays. The implication is that we are observing a more general phenomenon than the reactions in the system Pd-D (transient nuclear processes during and after irradiation with low energy ions).

[1] I. Savvatimova, Ya. Kucherov and A. Karabut, "Cathode Material Change after Deuterium Glow Discharge Experiments," *Transactions of Fusion Technology,* V.26:1994, pp. 389-394, Fourth International Conference on Cold Fusion, Dec. 6-9, 1993, Hawaii.

[2] A. Karabut, Ya. Kucherov, I. Savvatimova, "Nuclear Product Ratio for Glow Discharge in Deuterium," *Physics Letters A*, 170, 1992, 265-272.

[3] A. Karabut, Ya. Kucherov, I. Savvatimova, "Possible Nuclear Reactions Mechanisms at Glow Discharge in Deuterium," Proc. of the Third International Conference on Cold Fusion, Nagoya, Japan, October 21-25, 1992, pp. 165-168.

Sponsored by ENECO, Inc., Salt Lake City, Utah 84108

RUSSIA - GLOW DISCHARGE & NUCLEAR REACTION

I.B. Savvatimova and A.B. Karabut (Sci. Ind. Assoc., "Luch", Moscow Region), "Nuclear Reaction Products Registration on the Cathode After Glow Discharge," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #318, poster session.

AUTHORS' ABSTRACT

We have noted previously the increase of impurities in Pd cathodes (of 99.99% purity) after glow discharge in deuterium. [1]

We have now observed the changes of a number of impurity elements on Pd cathodes (of 99.9% purity) after proton, proton-deuteron and deuteron-ion irradiation for equal glow discharge conditions.

We have determined the contents of species of mass 107 and 109 on the surface (the first ≅ 10 micron layer) and the next layer (also ≅ 10 microns) as well as of the lower non-irradiated sample using spark mass-spectrometry. The sensitivity of this method is 10^{-7} atom % for masses in the range 1-10 and >5 x 10^{-6} atom % for masses >100.

We have found that the content of species of mass 107 and 109 increases at the surface by a factor of up to 250 for the highest current density of deuterium ions. In the second layer (depth 10-20 microns) this increase was only up to 10 times.

No changes of the contents of species of mass 107 and 109 were observed at the highest density of proton irradiation.

The contents of species of mass 107 and 109 for lower current densities increased by a factor of 130-135 for deuteron, a factor of 45-50 for proton and a factor of 15-19 for proton-deuteron irradiation. The increases of these masses in the second layer were factors of ≅ 5, 4.5 and 3 for the D, H and H-D environments.

We have not observed any appreciable change of the natural isotopic ratios of Pd (using SIMS), nor presence of isotopes of mass 111 and 112. The formation of species of mass 107 and 109 must therefore be due to the PdH and PdD environment at the cathode. An increase of species of mass 110 by 10-65% and a small decrease of species of mass 105 was observed.

For the maximum increase of species of mass 107 and 109 we also observed maximum augmentation of other masses. Increase of species of mass 10 and 11 by a factor 4-20 and of mass 13 by a factor 10, of mass 90 and 91 by a factor 4-17, of mass 79 and 81 by a factor 6-20.

There is a change of the natural isotopic abundance of species of mass 109 and 107 as detected by SIMS. We have only obtained mass 109 for 4 samples (3 different positions in each case) for different conditions of the glow discharge. We can explain this only by the formation of species of mass 109 and a change of the isotopic ratio of Ag. The main change took place in the near surface layer (<1 micron).

The total quantity of the main nuclide impurities was 10^{17} atoms in the irradiated zone. If we consider that the energy of the suggested nuclear reactions (fusion-fission) is 3-10 MeV [2], the observed quantity of impurities corresponds to an heat output of 10^4-10^5 J [3]. In this case, the total dose of the gamma-emission was 10^7-10^8 per experiment. This means that the outcome of most of the nuclear reactions was the formation of stable nucleates.

[1] I. Savvatimova, Ya. Kucherov and A. Karabut, "Cathode Material Change after Deuterium Glow Discharge Experiments," *Transactions of Fusion Technology,* V.26:1994, pp. 389-394, Fourth International Conference on Cold Fusion, Dec. 6-9, 1993, Hawaii.

[2] A. Karabut, Ya. Kucherov, I. Savvatimova, "Possible Nuclear Reactions Mechanisms at Glow Discharge in Deuterium," Proc. of the Third International Conference on Cold Fusion, Nagoya, Japan, October 21-25, 1992, pp. 165-168.

[3] A. Karabut, Ya. Kucherov, I. Savvatimova, "Nuclear Product Ratio for Glow Discharge in Deuterium," *Physics Letters A*, 170, 1992, 265-272.

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RUSSIA - ANOMALOUS EFFECTS

A.L. Samgin, O.V. Finodeyev*, S.A. Tsvetkov, V.S. Andreyev, V.A. Khokhlov, E.S. Filatov, I.V. Murigin, V.P. Gorelov and S.V. Vakarin (Inst. High Temp. Electrochem., Ural Br. Russ. Acad. Sci. and *ENECO, Inc., Salt Lake City, UT), "Cold Fusion and Anomalous Effects in Deuterium Conductors during Non-Stationary High-Temperature Electrolysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #316.

AUTHORS' ABSTRACT

This work was performed in conjunction with researches begun in 1989 and presented in ICCF-3 and ICCF-4. The objective of these investigations is the possibility of "cold fusion" reactions in solid-state perovskite-type proton conductors based on $SrCeO_3$-type ceramics.

The following investigations were performed within this research program:

- search for synthesized ceramics of an optimum composition;
- development of the porous metal-ceramic-porous metal sandwiches with Pd- as well as Pt-electrodes;

- search for reliable evidences of nuclear reactions and nuclear products;
- calorimetry;
- investigation of possible channels of deuteron transactions within ceramic matter;
- phase and structure transformation of the ceramic samples imposed in static as well as variable electrical fields, thermo-cycling and variations of the ambient pressure of deuterium or hydrogen.

Interim results of the investigations are defined as follows:

- certain conditions for electrolysis of a proton conductive ceramic are required for repeatable anomalous effects;
- neutron bursts in excess of background were observed in a few instances;
- preliminary calorimetric results evidenced anomalous thermal effects. These effects cannot be explained by neutron radiation and correlate satisfactorily with specific temperatures of the samples in the regions of 350°C, 500°C and 650°C.

X-ray structural analysis of the samples shows phase and crystal lattice transformation of the solid electrolytes in a deuterium atmosphere. It was discovered that the samples which demonstrated significant thermal effects contained two phases - strontium cerate and cerium dioxide. Generally, the ceramic tablets were covered with cracks after thermal cycling.

Replication of the experiments in a hydrogen atmosphere indicated that thermal effects are lower as compared to a deuterium atmosphere. Also, the behavior of the ceramic samples depends on the composition, technology of processing, and ambient conditions.

RUSSIA - DEUTERATED FERROELECTRICS

V.S. Gorelik, C.M. Guro, V.A. Tsarev (Lebedev Physical Inst., Russian Academy of Science, Moscow, Russia), "On Effectiveness of Nuclear Reaction Initiation Due to Polarization of Deuterated Ferroelectrics," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 618, poster session.

AUTHORS' ABSTRACT

The first suggestion to use strong electric field in ferroelectrics for initiation of nuclear reactions has been given in [1]. It was recently experimentally realized by Russian group using ferroelectric reversal polarization by means of thermal cycling near $T_c = 222$ K [2] or by alternative electric field [3]. They observed weak neutron radiation ≈ 1.5-2 times the background. Using more correct model for interpretation of their data, we suggest a set of conditions which could increase few orders of magnitude the rate of nuclear reactions.

The conditions include temperature, the shape and duration of electric impulse and selective deuteron heating by laser IR radiation.

[1] P.N. Golubnichii et al., *Sov. Phys Doklady*, 1989, v. 307, p 99.
[2] A.G. Lipson et al., *JETP*, 1993, v. 103, p 2142.
[3] B.V. Deryagin et al., *Sov. Phys. Doklady*, 1994, v. 334, p 291.

RUSSIA - γ-RADIATION IN KD_2PO_4 CRYSTALS

A.G. Lipson, I.I. Bardyshev and D.M. Sakov (Inst. of Physical Chem. of the Russian Academy of Sciences, Moscow, Russia), "High-energy γ-emission in KD_2PO_4 Single Crystals upon the Ferroelectric-phase Transition: Possible Observation of the First Exited State of He^4 Nucleus Decay," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #612, poster session.

AUTHORS' ABSTRACT

Earlier [1] it was shown that upon the transition through the Curie point in KD_2PO_4 (DKDP) single crystals the emission of neutrons and tritium production have place. Now the possibility of high-energy γ-quanta emission in DKDP single crystals upon the ferroelectric phase transition has been studied [2]. Using the set up on the basis of semiconductor (pure Ge) low-background γ-detector GEM-20180-P (EG & G ORTEC) with dimensions 50.7 x 64.4 mm and energy resolution FWHM = 1.73 KeV (1.33 MeV - band for Co^{60}) the spectrum of γ-emission in the energy interval 3.0-8.5 MeV generated by DKDP single crystals in the vicinity of T_C has been investigated. The maximum of γ-emission with energy position $E = 4.1 \pm 0.3$ MeV and width $T = 0.6 \pm 0.3$ MeV has been obtained that registered only in the temperature interval corresponding to ferroelectric phase transition of DKDP (212-22K) and is not produced out of this temperature region. It was experimentally shown that the maximum at 4.1 MeV can't be connected with decay of radioactive nucleus existed in the environment as well as can't be explained by γ-emission from non-elastic scattering of background neutrons. Therefore the deduction was done, that this maximum might be experimental evidence for decay of the first exited state of He^4 compound nucleus to be induced by the multiphonon processes in DKDP single crystals upon the ferroelectric transition.

[1] A.G. Lipson, D.M. Sakov, E.I. Saunin et al., *JETP*, vol 76, no 6, 1993, p 1070-1076.

[2] A.G. Lipson, I.I. Baryshev, D.M. Sakov, *J. Tech. Phys. Lett.*, (in Russian), vol 20, no 23, 1994, pp 53-59.

RUSSIA - TRITIUM GENERATION

V.A. Romodanov, V.I. Savin (SSRI SPA LUTCH, Moscow, Russia), V.A. Alekseev, V.I. Vasilev, Yu.F. Ryzhkov, S.V. Rylov, V.M. Strunnikov (TRINITI, Moscow, Russia), Ya.B. Skuratnik (SRPCI, Russia), "The Tritium Generation in Dependence On Material of Target for Interaction of Plasma Flux Dense with Metal Surface," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 620, poster session.

AUTHORS' ABSTRACT

The results obtained in works [1-3] permitted us to give the recommendation on main parameters of the low energy plasma interaction with condensed media to achieve the energy output of the nuclear reactions in condensed media (NRCM) equaled the energy input to all the system. One of the essential parameters which influenced the intensity of NRCM is a current density, and so further research of the plasma devices with various discharge self-compressed types of pinches have prospects. In this work we have presented results of researches on intensity of NRCM (determined tritium output) for device with using Z-pinch effect, primarily intended for thermonuclear researches.

We have received the high intensity of NRCM in device on base Z-pinch and have achieved the tritium generation rate to 10E15 at/s. Figure 1 in the paper shows the principal possibility to reach the energy balance in NRCM with tritium generation. Analysis of these results permits to affirm that the energy output NRCM equaled the energy input can be achieved in years 1996-1997.

We discuss the effectiveness of different targets in comparing with the prophecy in work [2]. It is possible to achieve the mechanisms of nuclear reaction and perspective to develop NRCM using the basic system of a plasma-target.

[1] V. Romodanov, V. Savin, Ya. Skuratnik, V. Elksnin, Proc. ICCF4, TR-104188-V3, vol 3, 1994, pp 15 (1-15).
[2] V. Romodanov, V. Savin, Ya. Skuratnik, S. Korneev, *Ibid.* vol 3, pp 22 (1-13).
[3] V. Romodanov, V. Savin, Ya. Skuratnik, A. Glagolev, *Ibid.*, vol 4, pp 40 (1-15).

RUSSIA - ENERGY BALANCE

V.A. Romodanov, V.I. Savin (SSRI SPA LUTCH, Moscow, Russia), Ya.B. Skuratnik (SRPCI, Russia), "The Demands to System Plasma-target for Obtaining a Balance Energy from Nuclear Reactions in Condensed Media," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #621, poster session.

AUTHORS' ABSTRACT

The obtaining of excess heat by nuclear reactions in condensed media (NRCM), as shown in [1-3], is else prospect. Although it may be near. The obtaining of nuclear heat determined by the rate of tritium production requires enough high energies of the deuterium ion bombardments, very big current density, special target materials, its temperature and pressure of plasma-producing gas [3].

To obtain nuclear heat by NCRM equal to external energy input is to select the optimum parameters of plasma-target interaction, which nobody has found. The reason for this is difficult in realization to a condition which we discovered, and have no wide understanding of exclusive importance to present a direction for NRCM.

In this work extrapolation of current density values carried out to the value required to obtain nuclear energy from NRCM equaled to external energy input. It was discussed the range of discharge parameters which is needed for the realization. It is shown, that for obtaining a balance energy the minimum current density of ions deuterium on target from niobium must be about 10E6 A/cm2, that excepts possibility to use stationary discharges. There is an estimate of pulse duration for using a pulse discharge and make examine for difficulty achievement of required conditions for interaction plasma with target materials.

[1] V. Romodanov, V. Savin, Ya. Skuratnik, V. Elksnin, Proc. ICCF4, TR-104188-V3, vol 3, 1994, pp 15 (1-15).
[2] V. Romodanov, V. Savin, Ya. Skuratnik, S. Korneev, *Ibid.* vol 3, pp 22 (1-13).
[3] V. Romodanov, V. Savin, Ya. Skuratnik, A. Glagolev, *Ibid.*, vol 4, pp 40 (1-15).

RUSSIA - TRITIUM & HARD EMISSIONS

R.A. Stukan (Inst. Chem. Phys., Russ. Acad. Sci., Moscow), "The Effect of Tritium on Hard Emission Generation During the Electrolysis of Heavy Water," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #313, poster session.

AUTHOR'S ABSTRACT

The electrolysis of heavy water on a Pd-cathode has been studied in the presence of tritium. It was found that the presence of tritium in the system led to sharp increase (nearly tenfold) of hard emission generation (mostly neutrons) in comparison with the experiments without tritium [1]. The tritium experiments showed full reproducibility. The hard emission generation in experiments with tritium was explained by the reaction of cold nuclear fusion $T + D \rightarrow He + n$.

[1] R.A. Stukan, Yu.M. Rumyantsev, A.V. Shishkov, *High Energy Chem.*, vol 27, no 6, 1993, p 65.

SPAIN - MEASURING LOADING RATIO

M. Alguero, J.F. Fernandez, F. Cuevas and C. Sanchez (Dpto. Fisica de Materiales,. Facultad de Ciencias. Universidad Autonoma, Madrid, Spain), "An Experimental Method to Measure the Rate of H(D)-absorption by a Pd Cathode During the Electrolysis of an Aqueous Solution: Advantages and Disadvantages," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #509.

AUTHORS' ABSTRACT

The time needed to accumulate a given over pressure ΔP, in a closed electrolytic cell of volume V, at temperature T, with a non H(D)-absorbing cathode, due to $H_2(D_2)$ and O_2 evolution is fixed by the electrolytic intensity in absence of other sources or sinks of gases. The increase of this time when the non H(D)-absorbing cathode, Pt, is replaced by a Pd one is a direct measure of the amount of H(D) introduced in the Pd sample in that time. An experimental set up based on the measure of this time has been built up in our laboratory. An electrovalve is opened and closed once the pressure is reached defining a cyclic operating mode. Times data acquisition is accomplished with a PC on line.

A desiccator, $CaCl_2$, is placed to minimize the effect of the H_2O vapor. ΔP is defined using a U-shaped manometer made of Pyrex filled with a conductor liquid. Two Pt wires are placed above the liquid level at a height h in the open arm of the manometer, proportional to ΔP, so once ΔP is reached, the two wires contact the liquid closing a circuit that opens the electrovalve and sends a signal to the PC. Both H_2O and Hg has been tested as conductor liquids. The electrolytic cell is immersed in a thermostatic bath.

Electrolysis has been accomplished with a Pt cathode and the sequence of times has been recorded. The times, τ, are not all equal but they fitted very well to an expression with 6 parameters of the form $\tau = at + b - ce^{-dt} + fe^{-gt}$, where t is the electrolysis time. The linear increase is due to the water electrolyzed and lost by evaporation, while the two exponential terms, associated with two initial transients, are related to absorption and release of different gases by the electrolyte. A good description of these effects is needed to evaluate, in a correct way, the H(D) absorbed by a Pd cathode in a loading experiment, so a number of electrolysis have been accomplished with a Pt cathode changing the variables of the experimental set up: Electrolytic intensity, temperature, ΔP, volume of electrolyte and the time that the electrovalve remains opened. The dependence of the 6 parameters on the experimental variables allow us to understand the nature of the transients and to avoid mistakes in the evaluation of the H(D) absorbed by Pd cathodes. These problems are, probably, present in loading experiments of other researchers in which the amount of H(D) introduced in the cathode is calculated from the measured of the gases evolved during electrolysis.

The communication does not only deal with the phenomena that must be taken into account in the experimental setup described and other similar, but also discuss the advantages and disadvantages against other methods used in CF research.

SPAIN - GROWING IODIDE TRITIUM FILMS FOR CF

F. Cuevas, J.F. Fernandez, M. Alguero and C. Sanchez (Dpto. Fisica de Materiales, Madrid, Spain), "An Experimental System to Grow Iodide Titanium Films for `Cold Fusion' Experiments," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 511, poster session.

AUTHORS' ABSTRACT

Most of the experimental work done in relation to "Cold Fusion" experiments have been carried out without paying much attention on the physicochemical properties of the metal matrix as they were usually run with commercial samples. Purity and structural properties of the matrix sample have a strong effect on its hydrogenation/deuteration behavior [1,2]. For example, gaseous impurities can reduce the maximum hydrogen uptake and can also influence the mobility of the hydrogen atoms, and the presence of metallic impurities alters significantly the phase diagram features of the metal-hydrogen system under study. Therefore, we think that the lack of reproducibility in "cold fusion" experiments could be related to some non controlled characteristic of the metal matrix as it was evidenced by the dependence of reported results on the commercial batch production number [3].

In this context, an experimental system has been built to grow very pure titanium films to be tested in "Cold Fusion" experiments. This system is based on the "Iodide process" and provides, besides metal of high purity, a good control over the structural properties of the films as their growth temperature, deposition rate and cooling rate after deposition can be fixed at will. An intensive study has been done about the growth parameters and "Cold Fusion" experiments are now in course. A detailed description of the experimental growth process and first results in cold fusion experiments will be presented at the Conference.

[1] G. Alefeld and L. Volkl, "Hydrogen in Metals II. Application-Oriented Properties," *Topics in Applied Physics*, vol

29, Springer Verlag (Berlin, Heidelberg, New York), (1978), pp 305-328.
[2] Y. Fukai "The Metal-Hydrogen System, Basic Bulk Properties," Springer Verlag (Berlin, Heidelberg), (1993), pp 43-68.
[3] H. Ikegami, Ed. "Frontiers of Cold Fusion," Proc. ICCF3, 1992, Nagoya, Japan, Universal Academy Press,(1993), pp 21-30 and 79-105.

RUSSIA - COLD FUSION QUESTIONS

V.N. Pavlovich (Inst. Nucl. Res., Nat. Acad. Sci. Ukraine, Kijiv), "Cold Fusion: General Consideration," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #428, poster session.

AUTHOR'S ABSTRACT

In order to explain the possibility of cold fusion in conditions of saturation of heavy metals by deuterium, it is necessary to answer two main questions:

1. In what way two deuterons draw together up to distances of the order of $l \cong 10^{-10}$ cm?

2. What is the mechanism of the reaction of two deuterons?

The qualitative answer to the second question is, probably, clear. Following the drawing together to a distance of the order of l, a nucleon (proton or neutron) of one of the deuterons can tunnel through the barrier which divides two deuterons with a sufficient probability for macroscopic observations. In spite of this, the probability of neutron tunneling is by several orders larger than that of a proton or deuteron because the neutron does not need to overcome the Coulomb barrier. The numerical value of tunneling sufficiently depends on the accepted deuteron model.

The answer to the first question is more complex. Usually, the equilibrium distance between the hydrogen atoms in a metal lattice is of the order of 10^{-8} cm. There are several mechanisms of deuteron acceleration which can lead to a decrease of this distance. But, in my opinion, such mechanisms are hardly probable.

There is also the possibility of deuteron charge screening by the inner shell electrons of metal atoms. The radius of the first Bohr orbit for these electrons is of the order of l, therefore the deuterons, which penetrate into the metal atom electronic shells, can draw together to the necessary tunneling distances. The calculation of such a system energy (metal atom + two atoms of deuterium), presented to this conference by Karasevskii, demonstrates the possibility of closing in of two deuterons into the metal electronic shells. However, that semiclassical calculation is not applicable just at the distances of the order of l, and therefore it needs to be performed more exactly.

The question about the penetration of deuterium atoms into the metal electronic shells is still open. For such a penetration, the deuterium atom must overcome the potential barrier. The value of this barrier is unknown, but the existence of this barrier and possibility of its penetration determine the possibility of the observation of the cold fusion effect at macroscopic rates.

YUGOSLAVIA - X-RAY EMISSIONS

R. Antanasijevic, D.J. Konjevic, Z. Maric, D. Sevic and A. Zaric (Inst. of Physics, Belgrade, Yugoslavia), "Study of X-Rays Emitted From Deuterium Plasma Focus Device," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #328, poster session.

AUTHORS' ABSTRACT

Measurement and analysis of X-rays emitted from a plasma focus device has been conducted. A capacitor bank was charged up to 20 kV, giving a peak current up to 400 kA. Deuterium pressure inside the chamber was varied between 1 to 5 mB. Detection and analysis of X-rays was achieved using roentgenographic method with Al-foils of varying thickness. Soft X-rays (λ > nm) were detected. Maximal neutron yield was about 10^8/pulse.

D. LETTERS FROM READERS

LETTER FROM BRUNO STELLA

After a long silence, I come with fresh news.

Two years ago, on behalf of Rome 3 University, I organized the "4th Workshop on the Status of Cold Fusion in Italy," held at Siena the last weekend of March this year. I now send you the program of the workshop and later I will send the abstracts of the reports.

The workshop has been very successful. I will edit the proceedings in English after Easter. They can be ordered at the cost of $60.

Nine experiments are running at present in Italy, plus 3 or 4 theory groups. All reported at the workshop and most of the reports will not be presented at Monte Carlo, Monaco.

Piantelli and collaborators have made three contributions. The loading of nickel is now reproducible (seen also by Prof. Stremmenos in Bologna) and some nuclear effects have been observed. I will be more precise next time.

The announcement of a "Reproducible cold fusion" has been made yesterday in Bologna by S. Focardi, accompanied by a celebration with a concert with Yehudi Menuhin playing the "Messiah" by Handel, at Bologna University. The results are presented at my workshop.

LETTER FROM INDIA

A conclusion mentioned in articles by Chuan-Zan Yu, Yi Fang Chang in their articles mentioned on page 12-13 of *Fusion Facts* March '95, is reflected in my experimental work mentioned in article "Heavy Atom Water Synthesis System" by C.S. Upadhyay (paper presented at 78th Indian Science Congress on 6-1-91). A mass spectrum due to strong curvature focusing in electrostatic fields in aqueous media as explained in the article, is shown in the enclosed figure.

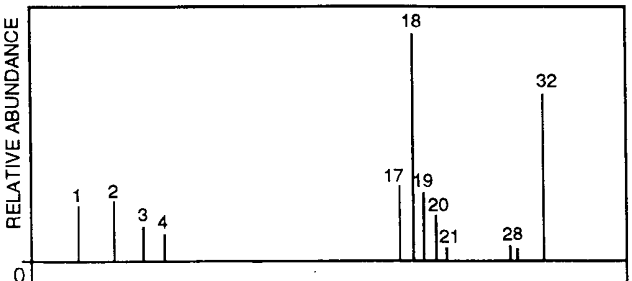

Fig. MASS SPECTRUM (Spin Electrolysed sample)

The mass line 4 may represent a deuterium molecule or Quartetium (Fourth) Hydrogen Isotope. How to distinguish between the two is a problem. This cold fusion takes place because of Multivalued Branch Point Electron Optics. The fields obey S.A. Shelkunoff symmetrical Maxwell equations. An Electron Optical Analysis combined with basic meson theory should reveal that a positive meson with four times (approximately Joule constant) proton mass will be maximum mass proton. This seems to be the simplest explanation of this cold nuclear fusion from engineering approach.

The analysis involves the application of strong electrostatic forces with negative resistance field. Probably a better understanding of Force Mechanism in cold fusion may appear with large consistent experiments and instrumentation with better mass spectroscopes. Presently total armory of "Cold Nuclear Fusion New Energy Technology" is within the framework of Electrostatic Electron Optics. This is enough for Bulk Engineering Application. The author explained such views about possibility of cold fusion in 1979 before Institution of Engineers, Rajasthan State Centre, Jaipur, India.

It will be good if *Fusion Facts* publishes full articles, now because the subject of cold fusion has come in existence and is developing fast for Bulk Engineering Application.

With Best Regards

Dr. C.S. Upadhyay
P.I., U.G.C. Project
Elect. Engr. Dept., M.R. Engr. College, Jaipur

Note: A quarterly journal is now being planned. Our readers are asked to voice their opinions about a new journal. **It would be peer-reviewed, however, the name of the reviewer and the reviewer's comments would be supplied to the author(s).** --Editor

E. EDITORIAL

SWITZERLAND - COLD FUSION, MORRISON VERSION

Paper courtesy of Jed Rothwell

EDITOR'S COMMENTS

Douglas R.O. Morrison, "Cold Fusion Update No. 10," April 1995, 12 pages, available from the author e-mail, drom@vxcern.cern.ch; or morrison@vxprix.cern.ch.

It is amazing to attend the same 5th International Cold Fusion Conference and compare favorable reports with Dr. Morrison's reports. It is scarcely believable that we attended the same conference. Some examples: Morrison states, "There were relatively few new scientific papers claiming positive effects, and some stating that earlier effects could not be confirmed, e.g. Bressani." There were 190 papers listed in the Book of Abstracts provided to attendees. Under the heading of "New Developments/New Systems" there were six oral presentations and many poster papers. Under the heading "Calorimetry and Excess Power" there were 11 oral presentations and 20 poster papers.

Morrison writes about "...controlling invitations..." *Fusion Facts* and many other publications had been advertising both "call for papers" and conference notices for several months. Morrison states, "In 1989 there were many funding sources for cold fusion, but they have mainly dried up..." Morrison does not claim to be one of the persons that has been diligently involved in doing his best to dry up funds for cold fusion. At one conference, this editor told Dr. Morrison, "You have done more to destroy cold fusion than anyone else." Morrison gleefully replied, "Can I quote you on that?" This editor replied, "Yes, but you won't want to see it on your tombstone!"

Morrison cites the implication that EPRI's source of funds for the support of cold fusion has stopped. He fails to announce that the MITI's New Hydrogen Energy Agency has agreed to fund McKubre's work. Morrison states, "For the first time, the presence of media representatives was not announced." This editor (representing *Fusion Facts & New Energy News)* introduced Carol White, George Miley, Wayne Green, and Eugene Mallove to the audience and the audience applauded them for their media efforts to report on the growing new science of cold fusion.

Morrison states, "The theory sessions were hilarious. There are many theories of cold fusion which are inconsistent with one another..." Students of science know that a multitude of theories are often proposed for fundamental new discoveries. The many theories demonstrate the intense interest in and the willingness to help advance this new science. Morrison states, "It would have been good if someone had presented a compilation of the experimental results, all of the experimental results, not just the positive ones." Many good scientists would say that just one reproducible positive result outweighs all negative results. One paper (Fox & Swartz) cited over 600 positive results and showed their geographical distribution (none from CERN nor Switzerland). *Fusion Facts* has a six-year old policy of not dwelling on the negative papers **because most of them demonstrate a lack of understanding of the protocols required to have successful experiments and therefore will serve (eventually) only as an embarrassment to the authors.** Examples are the published studies of the famous negative papers from MIT, Harwell, and Cal Tech, all of which showed either deliberate or inadvertent errors in data reporting--all three had achieved excess heat in their experiments **even though the experimenters were not adequately skilled in electrochemistry or had insufficient information about the heavy water/palladium/lithium systems.**

Morrison states, "The lack of any single clear reliable result that all respected, plus the lack of any agreed theory, meant that it was not clear what path a True Believer should pursue." Ignore the "True Believer," this was a scientific, not a religious, conference. **However, Morrison hit a true note: "...any single clear reliable result that <u>all</u> respected..."** In the foyer outside the meeting rooms, the Patterson Power Cell™ was demonstrated each day of the conference from early to late. During that time period, this demonstration cold fusion reactor produced from 200% to 1000% excess heat. Attendees could read the instruments, record the data, and calculate the amount of excess heat. Dr. Cravens even took a cell apart, showed it to an attendee, and replaced the cell and **it still provided excess thermal heat!** So how was Morrison correct? Because some of the scientists who have been working with the heavy-water/palladium/lithium systems have a hard time dealing with the light water/nickel/alkali-metal electrolyte systems. Therefor not **<u>all</u>** respected the biggest highlight of the conference. Morrison's report of the demonstration is as follows: "In preparing this note, came across a brochure for CETI, the company that is promoting the Patterson power cell being displayed in operation at ICCF-5."

Dr. Douglas O.M. Morrison is intelligent, witty, well-read, and can delightfully discuss a wide range of in-depth scientific problems, experiments, and achievements. As the commercialization of cold fusion continues and the task of limiting the funding of cold fusion is moot, then we trust that Dr. Morrison will be as energetic in promoting new science as he has been in "correcting" the cold fusion experts.

A history note: "The last gasp of a dying corpse," was a comment made by an official of the American Physical Society concerning ICCF-1 which was held in Salt Lake City, Utah in 1990. ICCF-6 will be held in 1996 in Sapporo, Japan. Dr. Morrison, you are invited. This editor plans to be there with you among the working demonstrations of cold nuclear fusion. It will be interesting to read your report.

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