FUSION facts

A Monthly Newsletter Providing Factual Reports On Cold Fusion Developments

ISSN 1051-8738 • University of Utah Research Park •

ISSN 1051-8738

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

VOLUME 5 NUMBER 8 FUSION FACTS FEBRUARY 1994

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AMENDED CALL FOR PAPERS

MINSK

International Cold Fusion and Energy Conference
May 1994

ABSTRACTS

Must be received by
15 March 1994
Papers to be received by
31 March 1994

See further information and addresses to

A. FIVE YEAR AWARD SPECIAL

March 23, 1994 is the five-year anniversary of the announcement of the discovery of the production and control of nuclear reactions in an electrochemical cell. On that date in 1989, Drs. Stanley Pons and Martin Fleischmann, against their better judgement, agreed to a press conference, called by officials of the University of Utah, to announce some of the results of "Project F."

In March, 1990, Dr. Robert L. Park, a staff person with the American Physical Society, proclaimed that the meeting was a wake being held by a few true believers to observe the last twitchings of a dying corpse. Of all of the scientific observations ever grandly bestowed to a misled public, this comment has proven to be the most ridiculous.

Obviously, Dr. Park will not be among the recipients of the annual awards given to the "Fusion Scientist of the Year" by *Fusion Facts*. In past years, this award has been given to Drs. Stanly Pons and Martin Fleischmann (January, 1990); Drs. Bor Yann Liaw and Bruce Liebert (January, 1991); Drs. Randell Mills, Robert Bush, and Robert Eagleton (January, 1992), and to Drs. Yan Kucherov, Alexander Karabut, and Irina Savvatimova (January, 1993). The press of papers from the Maui, Hawaii, ICCF-4, filled our December, 1993 and January, 1994 issues. **Therefore, March, 1994 was chosen as the award announcement month to coincide with the five years of steady progress in the development of cold fusion (and to the consternation of the pathological skeptics.)**

"Cold fusion is dead!" annually cry the pathological skeptics. "Wolf!", too often, cried the lonely shepherd boy. One was eaten by wolves, the others defused by reality. In one case, the shepherd boy was lost, in the other a world-improving discovery was abandoned by the very group that is paid to find new, renewable sources of energy. To both, we award the "Flying Pig Award"*. One for immaturity. The other for dollar-grant-threatening apoplexy induced by cold fusion.

* The "Flying Pig Award" was suggested by Dr. Edmund Storms in honor of those who believed that pigs would fly before cold fusion was real.

The vocal and perennial skeptics are now in hot water for their masterful ability to avoid the acceptance of a new science. For failure to accept reality, for studied indifference to hundreds of successful experiments, **long may they simmer!**

B. SPACE ENERGY - PEER REVIEWED

By Hal Fox

[In our quest to report on enhanced energy systems in addition to cold fusion, the following information, adapted from *New Energy News*, February, 1994, is presented. Ed.]

The way the various institutions of science are structured, it is important to work within the system to successfully introduce new scientific theories and facts. That is what Dr. Harold E. Puthoff has gently accomplished over the past few years. As shown by Moray King [1] others have been involved in this task and have contributed over 300 peer-reviewed articles to the scientific literature.

Experimental evidence precedes theory. Theories that seem to explain the experiments, the use of the theory to predict new experiments, and new experimental data normally follow new discoveries. So that scientists everywhere can have access to both new data and new theories, papers are submitted, peer-reviewed and published.

The peers (those scientists who are sufficiently well-trained in a particular discipline) help maintain the integrity of the system by correcting errors before they are published and by preventing the publication of obvious scientific nonsense. The peer-review system sometimes fails, as in the case of cold fusion. **In these cases the new truth is neither recognized nor accepted because for such new science there are few peers.**

The concept of an energetic space is a relatively new one. Originally, an ether was theorized to explain how light can travel from the sun to the earth. Later the Michelson-Morley experiments showed that light traveled at the same speed in the direction of earth's travel as perpendicular to earth's travel in its orbit around the sun. One explanation for this experimental evidence (which became dogma) was to deny the existence of an ether. Alternative explanations were ignored.

After Einstein's Special Theory of Relativity, the development and acceptance of quantum dynamics (which began to explain many heretofore unresolved mysteries of our physical universe), led to the mathematical prediction of either a real or a virtual (only a mathematical concept) energetic ether. Some of the space energy concepts date back to the work of Casimir in 1948. Casimir explained that the force that exists between two closely-spaced, conducting, parallel plates is the result of space energy pushing the plates together (from the outside) as the close spacing ruled out an interior opposing force of electromagnetic radiation for wavelengths less than half the spacing between the plates. Therefore, the closer the plates the stronger the Casimir force. Thus a possible real (not virtual) ether began to explain some factors of observed reality.

THE WORK OF DR. HAROLD E. PUTHOFF

Experimental data available to Hal Puthoff led him to believe that there was an energetic ether, and that it could be tapped. By basing his theoretical physics carefully on the previous peer-reviewed literature (some of which brought Nobel prize nominations to his older fellow scientists), Puthoff has developed a carefully constructed peer-reviewed basis for space energy. Here is the chronological history of his most important publications:

In a peer-reviewed paper published in May, 1987, Puthoff extended the concept of an energetic space to explain that the ground state of the hydrogen atom (the lowest energy level of the electron orbiting the hydrogen nucleus) was a dynamic equilibrium between the energy emitted by the orbiting electron **and energy received from "zero-point fluctuations of the background vacuum electromagnetic field."** This theory explains the paradox of how an electron can emit energy while circulating around the atomic nucleus and yet not spiral into the nucleus (a major unresolved difficulty with the Bohr model of the atom.) The highly successful equations of quantum dynamics predict an energetic space (virtual or real.) In addition to working in harmony with quantum dynamics, Puthoff accomplished something equally as clever. He cites the literature to show that stochastic electrodynamics (SED) had been used to help in solving some of the equations or expressions of quantum mechanics. In other words, Puthoff was able to use classical physical concepts to develop his mathematical proof. Specifically, for much of his work he can base his equations on Newton's laws of motion without having to start with relativistic laws of motion.

The conclusions of this important paper by Puthoff are (paraphrased by me) that the stable ground state of the hydrogen atom is a by-product of the concept of an energetic space. This paper extended the number of quantum phenomena that have yielded to classical analysis (which is understandable to more professional scientists than are the more difficult concepts of quantum dynamics.) In addition, this paper also provided deep insight into the **role of space energy in stabilizing all matter.** Puthoff states, "Finally, it is seen that a well-defined, precise quantitative argument can be made that the ground state of the hydrogen atom is defined

by a dynamic equilibrium in which collapse of the [ground] state is prevented by the presence of zero-point fluctuations of the electromagnetic field. This carries with it the attendant implication that the stability of matter itself is largely mediated by ZPF phenomena in the manner described here, a concept that transcends the usual interpretation of the role and significance of zero-point fluctuations of the vacuum electromagnetic field."

ONWARD TO GRAVITY

In March, 1988, Puthoff submitted a second article to *Physical Review* [3]. Puthoff begins by reviewing the peer-reviewed publications, especially six attempts to explain gravity. He cites a 1967 model by the famous Russian physicist, Andrey D. Sakharov (who was awarded the 1975 Nobel Prize for Peace), in which Sakharov suggests that gravitation is not a fundamental interaction at all, but rather an induced effect brought about by changes in the "quantum-fluctuation energy of the vacuum when matter is present."

Puthoff explores the model suggested by Sakharov in a straight-forward mathematical treatment using previously published results of ZPF models of van der Waals and related effects in flat (as contrasted to Einsteinian curved) space-time. Puthoff shows that the **Zitterbewegung** motion (a type of random oscillation of a particle) is related to the internal particle energy that is identified with the rest-mass energy of a particle. It is this mass that is shown to be involved in the gravitational interaction. Puthoff assumes that the gravitational and rest masses are identical and can be equated to obtain a cutoff frequency (of the ZPF) which satisfies the Sakharov condition. This cutoff frequency can be inverted (a mathematical process) to give the well-known gravitational constant. Next Puthoff considers the interaction between two masses with the assumption that the average force acts along the axis joining the two masses. Some equations later, Puthoff shows that the results can be expressed in the form of Newton's law with no adjustable parameters required **(even the Gravitational Constant has been derived.)**

In his **Discussion** section, Puthoff finds, "The fact that gravitational interaction is characterized by a unipolar [single-valued] **charge** (mass) can be traced to a **positive only** kinetic energy basis for the mass parameter." Puthoff continues, "The lack of shielding effects in gravity can also be comprehended on a rational basis. As understood here [in this paper], this is a consequence of the fact that ZPF **noise** (quantum noise) in general cannot be shielded, a factor which in other contexts sets a lower limit on the detectability of electromagnetic signals."

Finally, Puthoff notes, **"Assuming that the model is a proper representation of the gravitational attraction, the already unified aspect of the model would seem to mitigate against canonical attempts at unification of gravity as a separate force."** In my terminology: We no longer need to search for a GUT (Grand Unifying Theory), Puthoff has provided it for us by showing that gravity is a byproduct of the electromagnetic space energy!

ON TO THE SOURCE OF SPACE ENERGY

Puthoff next addresses the issue of the source of Zero-Point Energy (which is a misnomer and is better replaced by the concept of an all-pervading **space energy**.) In a paper published by *Physical Review A* in November, 1989, Puthoff explains the source of ZPE [4]. Puthoff states that Nature provides two choices for an explanation: Either ZPE exists as a boundary condition of the universe or **by the quantum-fluctuation motion of charged particles that constitute matter.**

Using "straightforward calculations", Puthoff shows with 30 equations that the spectrum of electromagnetic energy from the motion of charged particles is approximately the right value to account for the dynamic-generation process to produce the ZPE field (or space energy.) This energy-generation process as defined is of fundamental importance because this total process and energy field can explain atomic stability, gravitation, and the Casimir and van der Waals effects.

TAPPING SPACE ENERGY

The next logical question to be explored by Puthoff (aided by Daniel C. Cole of IBM) is the concept of whether the vacuum of space at zero degrees Kelvin (in other words, no thermal energy to utilize) can give up energy. In a paper published in August, 1993, the authors show that, in principle, energy can be extracted from vacuum energy (space energy) [5].

This paper concludes that, in principle, systems can be defined that can either generate heat or perform work using "vacuum" energy. The paper does not address the issue of a practical method of energy or heat extraction.

EXPLAINING INERTIA!

Inertia, we are taught, is the property of matter such that when at rest, a mass tends to remain at rest or when in motion, tends to remain in motion unless acted upon by an outside force. First recognized by Galileo (c. 1638) and more formally defined by Newton (c. 1687), **inertia has never been adequately explained, until now.** This mystery was somewhat explained by Mach (c. 1883) whose "principle" was that inertia is a function of the cosmic distribution of all matter. Now Puthoff and two friends (Bernhard Haisch of Lockheed and Alfonso Rueda of California State University at

Long Beach) have explained this centuries old mystery [6]. With a rigorous mathematical development, these authors show (using over 100 equations) that the bulk of the inertial effect comes from the very high frequency components of the zero-point electromagnetic fluctuations. Read about this historic development in the words of Dr. Harold E. Puthoff in the following paragraphs.

Inertia, Mach's Principle, and Fluctuations of the Vacuum
by Harold E. Puthoff

You are standing on a train in the station. As the train leaves the platform with a jerk, you could be thrown to the floor. What is this force that would knock you down, seemingly coming out of the nowhere?

Although oft-experienced at a mundane level, the above phenomenon, which we conveniently label as **inertia** and go on about our physics, is a subtle feature of the structure of the universe that has perplexed generations of physicists from Newton to Einstein. Since in the above example the sudden disquieting imbalance results from acceleration "relative to the fixed stars," in its most provocative form one could say that it was the **stars** that delivered the punch. This key feature was emphasized by the Austrian physicist and philosopher of science Ernst Mach, and is known as Mach's Principle. Nonetheless, the mechanism by which the stars might do this deed has eluded convincing explication - - **until now.**

Addressing this issue in a paper entitled "Inertia as a Zero-Point Lorentz Force" [6], researchers Bernhard Haisch of the Lockheed Research Laboratory in Palo Alto, California, Alfonso Rueda of California State University at Long Beach, California, and Harold Puthoff [the author] of the Institute for Advanced Studies at Austin in Texas, trace the problem of inertia and its connection to Mach's Principle to properties of the vacuum itself, specifically its zero-point fluctuations. In a sentence, although a uniformly moving body does not experience a drag force from the vacuum fluctuations (the spectrum is Lorentz-invariant), an accelerated body meets a resistance (force) proportional to the acceleration, the constant of proportionality is defined as the inertial mass m, and the results leads to Newton's Second Law, F = ma.

The vacuum fluctuations also provide the missing link with regard to Mach's Principle. Mach's Principle states that since accelerated motion would appear to be devoid of meaning in the absence of surrounding matter, the local property of inertia must **somehow be a function of the cosmic distribution of all other matter.** The link is that it is the cosmic distribution of matter, via radiation processes associated with the quantum fluctuations in that matter, that has been shown to be the source of the local vacuum field fluctuations. (See for example, Where Does the Zero-Point Energy Come From?" [7]. Thus, the quantum fluctuations of distant matter structure the local, Lorentz-invariant, vacuum-fluctuation frame of reference, and **acceleration relative to this frame results in the retarding force that we label inertia.**

The implications of this discovery are far-reaching. As an example, since inertial and gravitational masses are known empirically to be identical in magnitude, this study provides further support for a concept due originally to Sakharov, and further explored by Puthoff [3], that gravitational effects in general, and gravitational mass in particular, also derive from vacuum-fluctuation-driven phenomena. Further, light is shed on concepts as fundamental as the conservation of energy. A particle set into motion by the application of a force, for example, can be seen in terms of work being done against the vacuum fluctuations during particle acceleration which is then returned from the vacuum during the inverse deceleration process - **a new view of the concept of the transformation of kinetic energy into another form.** Again, as in the recent discoveries in cavity QED (quantum electrodynamics) wherein the restructuring of vacuum states has been shown to lead to changes in atomic parameters formerly thought to be immutable (such as spontaneous emission rates), **there is the possibility (at least in principle) that inertial and gravitation masses can also be similarly affected.**

Probably the most important aspect, however, of the discovery of the intimate connection between inertia and the vacuum fluctuations is that the number of independent physical concepts upon which the structure of modern theory is built is reduced by one, thereby **providing yet another step in our attempt to develop a coherent, unified view of the structure of the physical universe.**

[End of Dr. Puthoff's explanation.]

Perhaps more important to the readers of this article is the concept that if we can learn to modify space energy, we should be able to modify or control inertia and gravity. **Thus, this series of enormously important peer-reviewed papers (especially this last paper) provides us with a better understanding of the physics of matter and energy. This enhanced perception removes the barrier to scientific communication that has prevented the understanding and acceptance of the works of such stalwarts as dePalma, Tewari, Inomata, and Robert Adams.**

SUMMARY

Although many inventors, engineers, and scientists have been personally convinced of the reality of space energy, it has taken the dedicated and ingenious efforts of Puthoff and his colleagues to get the message into the scientific literature. By careful and brilliant theorizing, coupled with strong mathematical expertise, buttressed by a thorough knowledge of the peer-reviewed published literature, Puthoff et al. have won an important victory in search of truth and knowledge.

We will now be pleased to follow the remaining battles in the war for the acceptance of space energy. The scientists who have accepted and taught physical science, including the 90-year old denial of an energetic ether, now have a challenge to meet. They must either ignore, refute, or accept this important paper. A somewhat similar battle has been raging around the discovery of cold nuclear fusion (Pons-Fleischmann, University of Utah, March 1989 announcement.) However, in the case of space energy, there does not appear to be a well-funded, entrenched group of scientific lobbyists or any specific project that would compete with this new understanding of inertia and of space energy. **It would be a clever strategy for federal-dollar-hungry university researchers and for aerospace scientists to quickly make proposals to various government agencies on methods of influencing or controlling zero-point energy fluctuations.**

The battle for recognition of space energy has been won, the war is not over, peace has not been declared. **However, like cold fusion, this intellectual achievement cannot be purchased and shelved.**

Note: It is strongly suggested that cold fusion theorists look carefully at the effects of a **space energy** pervading a **metal crystal lattice**, and its effect on the Coulomb barrier. Julian Schwinger and Robert Bass have already partially addressed this issue. [see column → for reviews of Bass's latest work.]

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[7] Harold E. Puthoff, "Where Does the Zero-Point Energy Come From?", *New Scientist*, vol 124, p 36, 2 Dec, 1989.

C. NEWS FROM THE U.S.

CALIFORNIA - SPIN POLARIZATION ENHANCEMENT

Robert W. Bass, "Magnetic Enhancement of the Fleischmann-Pons Deuterium Fusion and Bush Cold Alkali Fusion (CAF) & LANT Processes by Spin Polarization," submitted for publication in the ICCF-4 Proceedings.

EDITOR'S SUMMARY

Bass summarizes the Pons-Fleischmann discovery and the imputed production of ^{4}He by deuterium fusion; the measurement of ^{4}He by Miles et al.; and the production of large amounts of ^{4}He in a Palladium cathode by Bockris et al. He then summarizes the work of Bush and Eagleton using light water and the transmutation of alkali elements by proton (or deuteron capture). Bass, having reviewed the achievements, asks how the effect can be scaled up to higher power levels. Bass reviews some of the **resonance-related** theories of cold fusion; cites potential applications to stabilizing radioactive elements; and presents a simplified summary of the Bush LANT (Lattice Assisted Nuclear Transmutation) process. Bass then proposes and discusses the magnetic enhancement of resonance-related nuclear reactions by the use of spin polarization techniques. As is well known in the case of DT reactions in hot fusion reactors, aligning the nuclear spins of D & T increases reaction rates. Bass suggests a technique that could be expected to double the aneutronic excess heat produced by cold fusion reactors.

CALIFORNIA - MADELUNG SERIES FOR C.F.

Robert W. Bass, "A Closed-Form Expression for a Generic Madelung Series," submitted for publication in the ICCF-4 Proceedings, Hawaii.

EDITOR'S SUMMARY

If charged particles, such as deuterons, are distributed uniformly throughout a metal lattice, a combined electrostatic force is produced that can strongly affect the Coulomb force (see Dick, "Madelung Constant", in *McGraw-Hill Encyclopedia of Physics, 2nd Ed.,* page 723.) In this paper, Bass develops a one-dimensional model of a PdD lattice where the Pd/D ratio = 1. Bass then discusses the difficulty of computing the results of the slowly-converging Madelung constant. However, he presents a simplification and then carries out the calculations for 44 steps (corresponding to a line of Pd-D-Pd-D combinations of 44 pairs). This calculation, as described, attains an accuracy of 17 decimal points in 44 steps. This expression is used by Bass in other papers to show that using the concept of resonance, the probability of fusion of deuterons in a "loaded" metal lattice can approach 1.

CALIFORNIA - ANEUTRONIC CF EXPERIMENT

Robert W. Bass (Sci. Adv. Board, ENECO, Inc., Salt Lake City, UT), "Proposed Nuclear Physics Experiment to Conclusively Demonstrate & Explain Aneutronic Cold Fusion," submitted for publication in the ICCF-4 Proceedings.

AUTHOR'S ABSTRACT

The protocol of the proposed experiment makes only two plausible assumptions: (1) CONSERVATION OF BARYON NUMBER; and (2) that if three identically-prepared **deuteron beams** of mean energy E_{crit} eV are injected into three identically- prepared thin frozen samples of fully loaded beta phase $Pd{\cdot}D_{1.0}$ lattices, for **times** of duration T, 2T, 3T, then the **same percentage** of deuterons will be wasted in each case (i.e. reflected or not entrant perpendicular to a plane of the embedded D-lattice): more specifically, if a TOTAL of N_T, $2N_T$, $3N_T$ deuterons are injected in each case, then almost exactly N, 2N, 3N deuterons will enter the lattice perpendicular to a lattice plane, where N is not predicted (but $N < N_T$).

The DESIDERATUM is to demonstrate in comparison to a non-irradiated control sample the **creation** of O, N, 2N, 3N Alpha Particles from LOW ENERGY aneutronic fusion of O, 2N, 4N, 6N static-target (near zero-point energy-level) bound deuterons, at a Kinetic Energy Cost of almost exactly $O, N{\cdot}E_{crit}$ eV, $2N{\cdot}E_{crit}$ eV, $3N{\cdot}E_{crit}$ eV plus unpredicted but proportionate wasted energy (which can be measured). If the experiment is performed and for ANY low-energy (say, less than 20 eV) value of E_{crit} eV attains the stipulated desideratum, i.e. the number of Alpha Particles created is incontrovertibly *proportional* to the *beam* DOSE, then the empirical reality of Cold Fusion will have been conclusively DEMONSTRATED. However, it will not have been conclusively EXPLAINED.

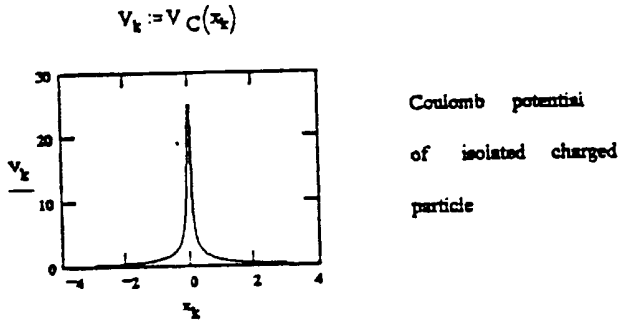
The purpose of this paper, besides advocating this novel experiment, is to present the first orthodox quantum-mechanical treatment of *low-energy penetrability* of the `Coulomb Barrier,' by *Resonant Transmission* in a deuterium lattice, which includes quantitative estimates (by the WKB approximation) of the minimum value of E_{crit} (below which N is tangibly reduced), and to prove that to a first approximation this value is about $E_{crit} = 6.3$ eV. Alternative versions of the experiment would replace the deuteron beam by a high-intensity flux of coherent monochromatic *ultraviolet* rays providing photons of energy E_{crit}, and also Fleischmann-Pons electrochemical-cell calorimetry experiments in which the voltage driving the deuteron current through the palladium cathode is set just below, just at, and just above E_{crit} eV.

CALIFORNIA - MADELUNG DEPRESSES COULOMB FORCES

Robert W. Bass (Sci. Adv. Board, ENECO, Inc., Salt Lake City, UT), " Proof That Madelung Forces Predict the Schwinger Ratio Correctly & That They Drastically Attenuate Coulomb Singularities in Lattices," manuscript of 14 pages, 7 refs, 4 figs.

AUTHOR'S ABSTRACT

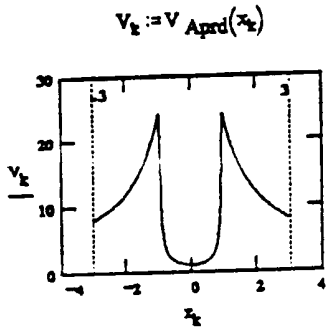
Recently I derived a simple infinite series expression for the Madelung forces on a loosely bound charged particle, assumed oscillating in a stable potential well and surrounded on both sides (in a one-dimensional approximation) by rigidly bound particles of the same sign, whose aggregate electrical charge is rendered effectively neutral by intervening oppositely charged particles. In order to check the validity of my theory, I have used it to compute the Schwinger Ratio σ for a supersaturated ("beta phase") deuteron lattice inside a palladium lattice, where the ratio is known accurately from



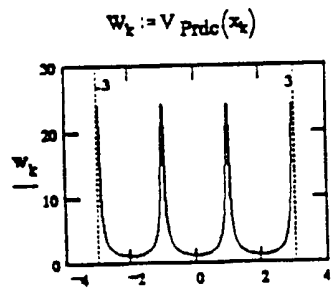
cold-fusion-relevant experimental data.

Elsewhere I have defined the Schwinger Ratio $\sigma = L/\Lambda$ as the ratio of the lattice *periodic length* L to the *mean-square oscillation amplitude* Λ of a quantized harmonic oscillator, at zero-point energy level, as an approximation to the particle's mean square vibration amplitude in the lattice at a temperature of zero Kelvins.

The theory presented below predicts $\sigma \simeq 22.3$; the measured result is $\sigma \simeq 28.2$, and this *relatively* good agreement (considering the approximation made in replacing a truly anharmonic oscillator by a harmonic oscillator) lends confidence to the theory.



Coulomb potential of adjacent but otherwise isolated charged particles



Coulomb potential of periodic lattice of charged particles

CALIFORNIA - PENETRATE COULOMB BARRIER PROOF

Robert W. Bass (Sci. Ad. Board, ENECO, Inc., Salt Lake City, UT), "Proof that Zero-point Fluctuations of Bound Deuterons in a Supersaturated Palladium Lattice Provide Sufficient Line-broadening to Permit Low-energy Resonant Penetration of the Coulomb `Barrier' to Cold Aneutronic Fusion," manuscript of 16 pages, 8 refs, 3 figs.

AUTHOR'S ABSTRACT

Between the energy levels of E = 6.26 eV and E = 140.96 eV, there are 600 Resonant Transmission levels $E_{N'}$ (N = 0,1,2,3, ... , 600), at which the quantum-mechanical probability flux intensity transmission coefficient, or transmissivity, T = 1, i.e. which assure with 100% probability that a loosely bound deuteron of that energy, between two adjacent rigidly bound deuterons, will tunnel through the Coulomb barrier of one of the adjacent deuterons (to within the range of its strong nuclear force) and remain there indefinitely. Use of the standard WKB [Wentzel-Kramers-Brillouin] approximation establishes that between E_0 = 6.26 eV and E_5 = 6.59 eV there are five such resonant lines, which have line breadths increasing from 1.8% to 7% of the difference between that line and the next higher line. At N = 88, one finds E_{88} = 13.7403 eV, and E_{89} = 13.8468 eV, and the line breadth δE_{88} = 0.077967 eV of the 88th level is 74% of the difference ΔE_{88} = 0.1065 eV between the 88th and the 89th levels. The line broadening is caused by zero-point energy fluctuations of the rigidly bound deuterons, as characterized by the Schwinger Ratio $\sigma \equiv L/\Lambda$ = 22.31, according to the Madelung potential theory presented in a companion paper.

AUTHOR'S CONCLUSION

Despite expert opinion to the contrary, "standard quantum mechanics" most assuredly does PREDICT the existence of the phenomenon of cold fusion in a PERIODIC lattice when the ratio of deuterons to palladium ions is nearly one-to-one, and when some externally applied force (e.g. a current, or a shock) is driving newly entering deuterons through the adjacent cells of the deuterium lattice. The lowest resonant energy level at which the line broadening is more than 70% of the distance to the next line is at E_{88} = 13.74 eV.

Applying a deuteron current with a driving voltage of 13.74 volts between the palladium cathode and the platinum anode should produce cold fusion. (Also, any other voltage between 6.26 eV and 6.59 eV should work almost as well.)

AUTHOR'S CONCLUDING POSTSCRIPT

The inherent limitations of the widely used but inexact WKB approximation *preclude over-reliance* upon the *precise* numerical values announced herein, but nevertheless suggest the *qualitative validity* of the *Resonant Transparency Spectrum* presented above. The present spectrum seems to be a refinement of the relatively crudely-derived but experimentally confirmed Bush TRM spectrum, because the present quantum-mechanical results predicts 600 resonances in an energy range wherein the Bush spectrum predicts only 132 resonances; also an apparently fatal objection to the concept of Resonant Transparency as used either by Bush or above is asserted by me to have been decisively rebutted. Obviously it would be highly desirable to have the present research repeated with the more exact methodology of Kim, Yoon, Zubarev & Rabinowitz in order to predict *experimentally testable results* about this spectrum with greater numerical precision. But the past successes of the WKB method suggest that the present results have, for the first time, starting with Schrodinger's equation, established the EXISTENCE of a Resonant Transparency Spectrum of energy levels of slightly excited deuterons in a frozen deuterium lattice, even at absolute zero temperature, and otherwise composed of rigidly bound deuterons which would be motionless except for zero-point fluctuations, yet according to standard quantum mechanics will find the Coulomb `barrier' to Cold Fusion to be transparent rather than opaque!

CALIFORNIA - NUMBER THEORY CONJECTURE

Robert W. Bass (Sci. Ad. Board, ENECO, Inc., Salt Lake City), "An Apparently True Conjecture in Number Theory Related to the Zeta Function," paper presented for ICCF4.

AUTHOR'S ABSTRACT

For all non-negative integers i, j define

$$\pi_{ij} = \sum_{k=1}^{+\infty} \frac{1}{k^{i+1} \cdot (k + 1/2)^{j+1}} < Z[i+j+1]$$

where *Z[m]* denotes the Riemann Zeta Function, and define

$$c_m = \sum_{k=0}^{2m} \pi_{k,2m-k} .$$

It is conjectured that $c_m \rightarrow 2$ as $m \rightarrow +\infty$.

CALIFORNIA - TRANSPARENCY OF COULOMB BARRIER

Robert W. Bass (Sci. Ad. Board, ENECO, Inc., Salt Lake City, UT), "Bi-Resonant Transparency of Quadruple Coulomb Barriers in Periodic Triple Potential Wells," paper presented for ICCF4.

AUTHOR'S ABSTRACT

Using the phase-integral method of Jeffries (1923), commonly called the WKB method for (qualitatively correct but only quantitatively approximate) solution of the wave equation, expressions are derived which would be, if exact, necessary and sufficient conditions for energy levels of a particle moving toward a triple potential well to encounter Resonant Transparency of all four Coulomb Barriers, i.e. to penetrate all four barriers with 100% probability. As a special case, a 6.3 eV deuteron trapped in a deuteron lattice (inside a $Pd{\cdot}D_{1.0}$ lattice) can readily penetrate the nearest two Coulomb barriers, to reach the vicinity of the strong nuclear force of either adjacent bound deuteron, even if it lacks the full 4.3 MeV energy proved here to be required for Resonant Transmission completely through the nuclear potential wells: so standard quantum mechanics actually PREDICTS "aneutronic cold fusion" in a (supersaturated, "beta" phase) $Pd{\cdot}D_{1.0}$ periodic palladium-deuterium lattice.

CALIFORNIA - HEAT & HELIUM

M.H. Miles (Chem. Div., Res. Dept., Naval Air Warfare Center Weapons Div., China Lake, CA, USA), B.F. Bush (SRI International, Menlo Park, CA), "Heat and Helium Measurements in Deuterated Palladium," manuscript of a paper presented at ICCF4.

AUTHORS' ABSTRACT

Metal flasks were used to collect electrolysis gas samples in Pd/D_2O + LiOD and Pd/H_2O + LiOH experiments in order to minimize effects due to helium diffusion through glass. For five control experiments yielding no excess power, the mean value for the background helium concentrations in our system was 4.4 ± 0.6 ppb or $5.1 \pm 0.7 \times 10^{13}$ ^{4}He/500 mL. For five experiments producing excess power, the measured helium concentration was higher than the background level in each case. Three different laboratories have been used for measurements of the helium concentrations in various electrolysis gas samples from our experiments during the past three years. The chance probability of obtaining these heat-helium results for a total of 27 measurements due to random errors is extremely small. Furthermore, the helium measurements from all three laboratories yield helium production rates of 10^{11}-10^{12} ^{4}He/s·W.

CALIFORNIA - SOLID-STATE FUSION

Jean-Paul Bibérian (R&D Intl., Orinda, California and Dep. Phys., Fac. Sci. De Luminy, Marseille, France), "Solid State Cold Fusion: $AlLaO_3$," presented at ICCF4.

AUTHOR'S ABSTRACT

Since the discovery of cold fusion by Fleischmann et al., most of the experimental work has been done in liquid electrolytes. However as soon as 1989, Forrat proposed a solid state reaction that could achieve better results. There are several factors that make such materials more appropriate to the development of cold fusion reactors:

1. Oxides can be heated at high temperature, so that the diffusion time of deuterium ions in the solid is increased by several orders of magnitude.

2. The sample is placed in a gas environment and not in a liquid, so that there is no problem of impurities depositing at the surface of the sample, that can stop the diffusion of deuterium.

3. The fusion reaction works better at higher temperatures. In a liquid electrolyte, it is limited by the boiling of the heavy water. In a solid electrolyte such a limitation disappears.

4. The energy transfer is better with a high temperature heat source. This is an important point for practical nuclear reactors construction.

5. The handling of a solid state cell is much easier and less dangerous than a liquid cell.

What has been proposed by Forrat, is the use of an ionic solid capable of accepting deuterium ions in the lattice. Therefore the electrolyte must have non-compensated ionic vacancies creating V centers (i.e. p-type semiconductor). Application of a voltage on two sides of the crystal creates the formation of three zones: an F zone (i.e. N-type) at the cathode, an intrinsic zone in the center, and a V zone (P-type) at the anode.

Numerous such crystals can be used, however rare aluminates are very well suited. $AlLaO_3$ proton conductivity has been extensively studied for fuel-cell applications. The structure of the intrinsic aluminum lanthanade is: $Al^{3+}La^{3+}O_3^{6-}$ and the crystal appears white.

A ceramic with 5% vacancies will be red and will have the following structure: $Al^{3+}La^{2.85+}_{0.95}O^{5.85-}_{3}$. When the ceramic is heated in a deuterium and hydrogen atmosphere, ions diffuse in a sample and vacancies are occupied by the deuterium ions, and consequently the crystal recovers its intrinsic white color. The structure of the crystal is now:

$Al^{3+}La^{2.85+}_{0.95}D^{0.15+}_{0.15}O^{6-}_{3}$.

After application of a voltage an F zone appears at the cathode with the composition: $Al^{3+}La^{2.85+}_{0.85}D^{0.20+}_{0.20}O^{6.05-}_{3}$.

Experiments are underway to verify this model. A 2 mm thick sample with a surface of 1 cm^2 is heated to several hundred degrees with a tungsten filament in a deuterium atmosphere. Two gold electrodes deposited on the two sides of the sample are used for polarization. As loading of deuterium is accomplished, the temperature of the sample is recorded versus time. Fusion should show an increase of the temperature due to excess heat generated in the sample. It is hoped that if the heat generated is large enough, the tungsten heater can be switched off and the only input of energy could be the current flowing through the sample.

In a future experiment, it should be easier than in liquid electrolytes to measure the production of helium.

[For further solid-state fusion see Enyo, et al., in July 1993 of *Fusion Facts*. Ed.]

CALIFORNIA - EXCESS HEAT-PRINCIPLES

J.L. Waisman (Consultant, Irvine, CA), N.J. Kertamus (Senior Research Scientist, S. CA., Edison Co., Rosemead, CA., U.S.A.), "Excess Heat; The Macro-Principles," manuscript of a paper presented at ICCF4.

AUTHORS' ABSTRACT

This paper presents Macro-Principles which permit prediction of the Excess-Power-density developed in Pd-D crystal lattices. The principles are stated in terms of three state properties which can be measured and controlled, and other conventional thermodynamic and heat transfer properties. The 3 state properties of the lattice are composition, temperature and deuterium chemical potential.

The principles are independent of the details of the heat producing collision events. They consider (a) that the events occur in the course of collisions of a given deuterium entity with another entity in the lattice, (b) that the collisions occur as a consequence of the jumping of the hydrogen isotope from one interstitial position to another, and (c) that the jumps and collisions are triggered by the state of internal energy in the lattice.

We present previously published experimental evidence that the effect of temperature on excess heat production has the predicted trend. Simulations of the excess heat, produced by varying the 3 state properties and two heat transfer properties, are also consistent with experimental results. The simulations also explain the very large excess power density obtained during forced-to-boiling tests.

AUTHORS' CONCLUSIONS

The principles are believed to offer a plausible explanation of heat bursts, and runaway temperature accompanying excess heat produced during electrolysis. The principles predict achievable conditions which will produce excess power at commercially competitive densities. These predictions should permit a leap into practical applications.

HAWAII - MOLTEN SALTS, Ni ELECTRODE

Bor Yann Liaw and Yi Ding (Hi. Nat. En. Inst., Sch. Ocean & Earth Sci., Univ. of Hi., Honolulu), "Charging Hydrogen into Ni in Hydride-Containing Molten Salts," manuscript from paper presented at ICCF4.

AUTHORS' ABSTRACT

Elevated-temperature calorimetric measurements were performed using a cell: Al 6061 alloy | LiH (saturated), LiCl-KCl eutectic | Ni with a charging current of about 600 mA. An anomalous positive temperature excursion was observed, which was difficult to explain based on our understanding of the electrochemical reactions occurring in the cell and the associated enthalpies. The potential between the working and counter electrodes fell in two peculiar ranges: in the initial stage, 0.7-1.2 V, and in a later stage, 2.3-2.6 V -- a range of great interest -- due to its similarity to the condition of an excess heat event that we reported in the Pd-D system in which significant excess heat was measured.

IDAHO - BAND-CROSSING IN Pd ISOTOPES

Chemical Abstracts, 1 Nov. 1993

R. Aryaeinejad, J.D. Cole, R.C. Greenwood, S.S. Harrill, N.P. Lohstreter, K. Butler-Moore, S. Zhu, J.H. Hamilton (Idaho Nat. Eng. Lab., Idaho Falls), "Band crossing observed in Neutron-rich Palladium Isotopes via Spontaneous Fission of Californium-252," *Phys. Rev. C, Nucl. Phys.*, 1993, vol 48, no 2, pp 566-573.

AUTHORS' ABSTRACT

High spin excited states in neutron-rich nuclei ^{112,114,116}Pd have been investigated by measuring prompt γ rays emitted from a ^{252}Cf spontaneous fission source. Two different measurements were performed. First, γ-γ coincidence data, necessary to detect the decay schemes, were obtained by using an array of 20 Compton-suppressed Ge detectors. Second, Z identification and enhancement of a desired neutron channel were carried out using a x-n-γ multiplicity spectrometer. Ground state bands have been extended to $J\pi = 10+$ for ^{112}Pd, and $J\pi = 12+$ for ^{112}Pd and ^{116}Pd. Band crossings were observed in all three isotopes. These backbends are due to the alignment of two $g_{9/2}$ protons. The measured energy levels were also compared with predictions of the interacting boson model.

MISSISSIPPI - ATOMIC NUCLEUS

Evan Ragland (Diamondhead, MS), "An Alternate Model of the Atomic Nucleus," presented at ICCF4.

AUTHORS' ABSTRACT

The many successes of the Standard Model, and the promise it holds for development of a unified field theory, have gained such wide acceptance that other atomic models are seldom considered. Nevertheless, there are often distinct advantages to be gained from alternative viewpoints. The Alternate Model theorizes a field centered atomic model which may offer further insight into nuclear fusion mechanics.

The Standard Model constructs the atomic nucleus as a cluster or clump of protons and neutrons each of which contains three electric charges (quarks) bound together by three carriers of the nuclear strong force (gluons). The Alternate Model constructs the neutron as the complement of the hydrogen atom (an electron inside a proton); and, the nucleus as a field centered organization of protons and neutrons, each confined to a distinct shell location. The neutron's internal electric field is the nuclear strong force.

The construct builds on Rutherford's electron/proton doublet, the Mayer/Jensen Shell Model of the nucleus, and the Boscovich action of forces to develop a systematic geometry and logic for field centered nucleons at rest in stationary states with harmonious spins. The model treats the electron, proton, and the composite neutron internal field as force fields of common origin.

In his Bakerian Lecture of 1920, Ernest Rutherford advanced the concept of an electron/proton doublet as a neutral particle within the atomic nucleus. He visualized the particle as an electron in orbit about a proton within the nucleus. This is an untenable arrangement as the energy required to confine the electron to an orbit within the nucleus is greater than the binding energy of the nucleus. The Alternate Model proposes the doublet arrangement of the neutron to be an electron captured into stationary state within the proton. Again, the energy required to confine the electron is greater than the binding energy of the doublet; thus, the system must, in time (half life - 12 minutes), decay into lighter constituent elements. Most often, before decay, the neutron reacts by binding to another nucleon. This reaction can form a stable nucleus. For example, a neutron reacting with a proton to form a deuteron creates a stable nucleus with binding energy greater than the confinement energy of its constituent parts.

According to the Mayer/Jensen Shell Model, the general rules of quantum mechanics restrict nucleons to a shell arrangement of discrete states within the nucleus similar to the shell structure of atomic electrons. When the model is applied to the clump or cluster concept of the Standard Model, nucleons are envisioned as occupying discrete orbits within the nucleus. Ambiguities of this visualization clarify when the model is applied to the field centered concept of the Alternate Model. Here a set of discrete symmetrical stationary states can only be occupied by nucleons with particular energies and motions at the time of nuclear acquisition and assembly. The Pauli exclusion principle holds in the Alternate Model; i.e., no more than one proton or one nucleon can occupy a discrete energy state with the exception that a pair of protons or a pair of neutrons of opposite spin may occupy the same state.

The Alternate Model treats the electron, proton, and neutron as Boscovich point sources of field force or charge rather than as particles. While a point cannot be a real source, it can mark the origin within a real field of an extinct causative source. That real fields exist for electrons, protons, etc. about "Boscovich points" is demonstrated in terms of the equivalence of mass and energy. Plausible logic shows their powers of combination about a common origin into atomic nuclei. A symbolic flow diagram for the progression, proton field through alpha field, supported by a Boolean algebra further exemplifies field treatment of the atomic nucleus.

In summary, the Alternate Model is another way of viewing the atomic nucleus. It may be more suitable than the Standard Model for examination of low energy nuclear effects in condensed matter. In particular, it seems to better explain the absence of the neutron branch in cold fusion deuteron/deuteron reactions.

NEW JERSERY - PRINCETON HOT FUSION

Malcolm W. Browne, "Reactor Passes Point of No Return in Uphill Path to Fusion Energy," *Science Times, New York Times*, Dec 7, 1993, p B7, illus.

AP Staff, "Princeton produces large fusion reaction," *Deseret News*, December 10, 1993, p A1.

EDITOR'S SUMMARY

While the cold fusion reports from Maui (where up to 4,000 times as much power out compared to input is reported) receive little media attention, the $1.4 billion Princeton reactor achieves front page headlines by producing one-eighth the power output as input (24 million watts input, 3 million watts output for four seconds). In subsequent tests the same reactor achieved about one-third the amount of power out as input for a few seconds. The sequence of the several tests, using 5 grams of tritium (at $30,000 per gram) plus deuterium (from heavy water), lasting a few seconds per test, produced copious amount of neutrons. The reactor is now so radioactive that it will have to "cool down" for about one year before it can be dismantled. **The *New York Times* headline properly included the phrase "point of no return". We assume that this refers to the lack of return on the ten-year investment of $1.4 billion spent by Princeton.** Compare this achievement of getting only about 1/4 of the energy input returned, for a few seconds, to the achievements of cold fusion where many devices provide twice as much and more energy out compared to energy input, in a time frame of output in hours or days in some cases. Consider what a few million dollars of investment in cold fusion research has produced compared to the $20 billion spent by the U.S. over the past 20 years on hot fusion!

NEW JERSEY - 8 IN, 1 OUT

Staff (Knight-Ridder News Service), "Scientists Set Record for Fusion Power," *Salt Lake Tribune*, Friday, Dec 10, 1993, page A10.

EDITOR'S SUMMARY

Exceeding a record set in 1991, scientists at Princeton Plasma Physics Laboratory set a record by producing 3 million watts of power out for four seconds. This article fails to mention that input power was eight times as large. While relatively inexpensive cold fusion devices are producing power gains of about four to one, the hot fusion device ($25 million) "enormous metal doughnut" uses considerably more

power in than power out. Later the Princeton group achieved over five million watts out. Earlier, the hot fusioneers had been working with the d+d reaction but this experiment used half deuterium gas and half tritium gas. The d+t reaction produces intense neutron radiation. The article also reports that the 1989 report by two chemists achieving fusion resulted in initial fanfare which turned into derision and that the scientists left to pursue their work in France. "Last week", the article states, "the U. sold exclusive licensing rights to so-called cold fusion to a privately-held Utah company." Although not identified in the article, the company is ENECO, Inc. (formerly FEAT).

NEW YORK - FUSION REACTION WITH HEAVY ICE IMPACT

Y.K. Bae, R.J. Beuhler, Y.Y. Chu, G. Friedlander, and L. Friedman (Chemistry Department, Brookhaven Nat. Lab., New York), "DD Nuclear-Fusion Reactions with Small D_2O and H_2O Clusters Impacting Heavy Ice," *Physical Review A*, vol 8, no 6, Dec. 1993, pp 4461-4466, 18 refs, 6 figs, 1 table.

AUTHORS' ABSTRACT

The large DD-fusion-field enhancement reported earlier by our group (*Phys. Rev. Lett*. vol 63, pp 1292 (1989); *J. Phys. Chem*. vol 94, pp 7665 (1990)) in the bombardment of deuterated targets by large heavy-water clusters was shown by post-acceleration magnetic and electrostatic filtering to be due to small-ion impurities produced in the acceleration column. With the filtering arrangement in place, we have carefully studied DD-fusion rates with small $(D_2O)_nD^+$ and $(H_2O)_nH^+$ ions ($n \leq 10$) which produced detectable fusion rates. Formation of carbon films on the polydeuteroethylene surfaces caused the observed fusion rates to decrease rapidly with time. This problem was solved by using D_2O ice targets which are "self-cleaning." No enhancement was observed for the fusion rates of the small D_2O clusters after the oxygen knock-on corrections were made. However, the fusion yields for knock-on processes produced by $(H_2O)_nH^+$ clusters ($4 \leq n \leq 10$) showed approximately a twofold enhancement over the yields for H_3O^+ ions at the same velocity. The stopping power of clusters was measured and shown not to be responsible for this enhancement.

NEW YORK - TRANSMUTATION OF ELEMENTS

Jerry Bishop, "Alchemists' Dreams Hover Over Parley on 'Cold Fusion'," *Wall Street Journal*, Dec 10, 1993, p B5A.

EDITOR'S SUMMARY

When all nuclear reactions create new elements or new isotopes, it is strange to stress "transmutation". The article relates the elemental changes found in light water experiments where rubidium is changed into strontium and potassium into calcium. While these results can be named "proton capture", no complete explanation was presented at the Maui cold fusion conference held Dec. 6-9, 1993. More inexplicable is the Japanese report of iron being produced by electrolysis (a phenomena that has been observed in India). The article mentions that Dr. John Bockris (Texas A&M) is intrigued with the phenomena and has labeled it "low-energy nuclear change." This article fails to note the many papers reporting the measurements of other nuclear reactions with reports of the production of tritium, helium, neutrons, and isotopic changes in cold fusion cathodes. [See the Dec., 1993 and Jan., 1994 issues of *Fusion Facts* for a more complete report on the Maui conference.]

NEW YORK - 9 NEGATIVES 4 POSITIVES

Jerry Bishop (WSJ Staff Reporter), "Japanese Funds Warm a Conference of 'Cold Fusion' Die-Hards in Maui," *Wall Street Journal*, Dec 9, 1993, page B10.

EDITOR'S SUMMARY

The 300 scientists at the ICCF4 conference are labeled as "The scientifically beleaguered few". Bishop reports that "the Japanese Ministry of International Trade and Industry (MITI) is launching a major effort to find out if cold fusion is real." The goal of MITI is to confirm, demonstrate, and apply "new hydrogen energy", Bishop reports. The Japanese will cooperate with the U.S. EPRI work. Bishop reports EPRI's research director, Dr. McKubre, as saying that they are now able to consistently get excess heat if the D/Pd ratio is .95 or better. Bishop states that "nobody has [explained]...the general absence in the experiments of some kind of nuclear ash..." The article cites Fleischmann as reporting about four times as much power out as input and that the excess power is now about 150 to 170 watts, compared with much smaller amounts four years ago. "This year we're trying to get 300 to 500 watts of excess power.", Fleischmann is quoted as saying.

PENNSYLVANIA - DIHYDRINO MOLECULE

Randall L. Mills and William R. Good (HydroCatalysis Power Corp., Lancaster, Pennsylvania), and Robert M. Schaubach (Thermacore, Inc., Lancaster, Pennsylvania), "Dihydrino Molecule Identification," *Fusion Technology*, vol 25, no 1, Jan. 1994, pp 103-119, 15 refs, 12 figs, 9 tables.

AUTHORS' ABSTRACT

Three sets of heat production and "ash" identification data are presented. An exothermic reaction is reported wherein the electrons of hydrogen and deuterium atoms are stimulated to relax to quantized potential energy levels below that of the "ground state" via electrochemical reactants K^+ and K^+; Pd^{2+} and Li^+; or Pd and O_2 of redox energy resonant with the energy hole that stimulates this transition. Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode were performed. The excess output power of 41 W exceeded by a factor >8 the total input power given by the product of the electrolysis voltage and current. The product of the exothermic reaction is atoms having electrons of energy below the ground state, which are predicted to form molecules. The predicted molecules were identified by their lack of reactivity with oxygen, by separation from molecular deuterium by cryofiltration, and by mass spectroscopic analysis.

AUTHORS' CONCLUSIONS

...Further experiments are planned to demonstrate that this lower energy form of hydrogen is the product of heat-producing [electrolytic] cells. Following cryofiltration of the electrolysis gases, the dihydrino molecule is distinguished from normal molecular hydrogen by mass spectroscopy. The branching ratio to form $m/e = 1$ relative to $m/e = 2$ that is observed for the dihydrino molecule is different from the ratio that is observed for normal molecular hydrogen. Mass spectroscopy further distinguishes a sample containing dihydrino molecules from a sample containing H_2 by showing a different ion production efficiency as a function of ionization potential and a different ion production efficiency at a given ionization potential for the two samples. High-resolution mass spectroscopy shows two peaks for a mixture of H_2 and H_2*.

[See also in this issue, page 15, comments by Dr. Vigier concerning the evidence for non-nuclear excess heat. Ed.]

UTAH - QUANTUM LIMITATIONS THEORY

Kiril Chukanov (General Energy Int., Inc., West Jordan, Utah), "New Pulse Gas Loading Cold Fusion Technology," presented at ICCF4.

AUTHOR'S ABSTRACT

Theoretical Model: Conventional (type S. Pons - M. Fleischmann) 'Cold Fusion' can be explained using Dr. Chukanov's Quantum Limitations of Matter Theory as follows: The density of deuterium plasma in palladium's lattice is critical. In the initial phase of saturation when density of deuterium plasma is still low, the assembly of deuterium nuclei is far from the critical quantum point of transition to a new form of matter (material continuum). Higher density, however, causes deuterium ions to approach the critical point. Deuterium saturates palladium very slowly, so assembly of deuterium nuclei easily resists conversion into material continuum. To resist transition into material continuum, deuterium nuclei begin to oscillate and increase their energy as the ions approach the quantum limitation and thus violate the law of conservation of energy. The result is excess energy. This gift of energy is the unexplained excess heat in cold fusion. The Chukanov theory predicts that near the quantum boundary, the temperature of the deuterium nuclei can reach tens of millions of degrees. The result can be normal 'hot fusion' of deuterium nuclei. But such rare 'hot fusion' contributes very little towards the total energy balance of the system. In addition, the theory suggests that if light hydrogen is used, the result is heat but not fusion. This type of cold fusion is accompanied by an unusual phenomenon: chemical properties of the crystal lattice dominate the nuclear characteristics of atomic nuclei. The Law of Conservation of the hydrogen charge leads to the creation of the hydrogen form of nuclear byproducts. In addition to the formation of deuterium and tritium, it may be possible to create a fourth, super heavy isotope (heretofore unknown) form of the hydrogen ($^4H_1$ - fourtium). Another development of the cold fusion phenomena is the Chukanov's pulse gas loading technology. Mechanism of production of free energy is different. The assembly of hydrogen atoms (or nucleus) occupies some volume of the space, which is not empty space, but a special form of the matter: material continuum. Material continuum is strongly connected to the assembly of hydrogen nucleus. It can be created or destroyed using pulse gas technology. As a result free energy (positive or negative) is produced. For the first time in the history of Science we observe Anti - Energy.

Experiments: In his experiments, the author used a specially prepared alloy for cold fusion. Because of the special structure of the alloy, the cold fusion process stuns a few minutes after the beginning of saturation with hydrogen gas. In an average of nine cases out of ten, the alloy sample exploded and became a powder. The temperature of the alloy sample dropped in a fraction of a second by 10 - 15 degrees C, while the temperature of the surrounding metal objects raised at the same time by 20 - 40 degrees C. It is thought that the emission of protons takes some energy from the alloy's metal lattice. Another and much bigger part of the energy is the result of the violation of the Law of Conservation of Energy. This effect is called the "Chukanov Effect" and further replication should demonstrate the true mechanism of cold fusion phenomena. Further experimental work is expected to lead to an improved alloy that will be an improved cold fusion material for gas-loaded enhanced-energy devices. Using pulse gas technology it is possible to change (in less then 1 sec.) the temperature of the space energy active sample 80 - 90 C.

Practical Applications: General Energy International created a series of SE Generators. The two stage SE Boiler and Cooler can produce about 20 KW power. This generator possesses a special system of recycling hydrogen gas. Very soon General Energy's SE Generators will be presented for commercialization on the World Energy Market.

[Chukanov's demonstration equipment does produce temperature changes. The theory will be more believable when the experiments are replicated by others. Similar work was accomplished several years ago by scientists in the LUCH organization, Podolsk, (near Moscow), Russia. There explanation was clearly a chemical explanation. Ed.]

UTAH - REPRODUCIBLE T-GENERATION

Fritz G. Will, Krystyna Cedzynska and Denton C. Linton (National Cold Fusion Institute, Salt Lake City), "Reproducible Tritium Generation in Electrochemical Cells Employing Palladium Cathodes with High Deuterium Loading," *J. Electroanal. Chem.*, vol 360, no 1-2 (1993) pp 161-176, 55 refs, 4 figs, 2 tables.

AUTHORS' ABSTRACT

Reproducible tritium generation well above background has been observed in tightly closed D_2SO_4-containing cells in four out of four Pd wire cathodes of one type. Tritium analysis was performed before and after each experiment on the Pd, the electrolyte and the gas in the head space. No tritium generation was observed in four identical Pd cathodes in H_2SO_4 cells operated at the same time under the same conditions. A cyclic loading-unloading regime with low current densities, rather than the usual continuous constant current regime, was employed to attain D/Pd and H/Pd loadings of 1 ± 0.05

reproducibly. D/Pd loadings greater than 0.8±0.05 appear to be necessary to generate tritium. The largest amount of tritium, generated in 7 days of continuous electrolysis, was $2.1x10^{11}$ tritium atoms, compared with a background of $4x10^{9}$ tritium atoms. The concentration of tritium and its axial distribution in the Pd were determined and concentrations of up to $9x10^{10}$ atoms /g Pd were found compared with a maximum background of 5x108 atoms g^{-1}. The T/D ratio in the Pd is about 100 times larger than in the electrolyte or gas and indicated that tritium generation occurs in the Pd interior rather than at its surface. No tritium generation was observed in two other types of Pd electrodes in D_2SO_4, despite the attainment of D/Pd ratios near 1:1. Thus high D/Pd ratios appear to be a necessary but not sufficient condition for tritium generation in D_2SO_4 electrolysis.

D. NEWS FROM ABROAD

BELARUS - SYNERGETIC ACTIVATION MODEL

Veniamin Fillimonov (Inst. of Physicochemical Problems, Belarus State Univ., Minsk, Belarus), "Synergetic Activation Model: Key to Intense and Reproducible Cold Fusion," presented at ICCF4.

AUTHOR'S ABSTRACT

The main criteria of cold fusion (CF) theories validity are their ability to explain (i) reasons for irreproducibility and way to improve it, (ii) high probability of intense CF reaction, and only then preferring of aneutronic channel, tritium/neutron channels asymmetry and so on.

The synergetic activation (SA) model [1] supposes that intense CF implementation at "normal" temperatures and pressures is the sequel of self-organization processes in crystalline matter. SA model already succeeded in the analysis of fast chemical processes in solid state such as reactions initiated by shock waves (SW) in solids, detonation of solids and cryogenic reaction in freezed gas mixtures under phase transitions. The difference between above mentioned reactions and CF is rather quantitative than qualitative: due to higher activation energy of CF and lower probability of elementary event CF, implementation commonly doesn't lead to host crystal lattice destruction and therefore durable and stable process is possible in principle.

The main points of SA model are as follows:
1. The more gently sloped than exponential one distribution of atoms by energy (namely reciprocal power distribution) that caused easier overcoming potential barriers by the system is possible in self-organizing systems.

2. Such distribution is realized in spatiotemporal limits of shock or detonation waves (SW and DW correspondingly) fronts that are therefore considered as dynamical dissipative structures.

3. A self-generation of SW (DW) and self-focusing of the same that promote gathering of energy in focal zones are possible under intense heat and mass transfer in perfect crystalline solids in vicinity of phase transition or phase separation region.

Point 1 of the model shows that effective overcoming of potential barrier of nuclei repulsion may be caused not only by quantum but also by synergetic ones. Proposed power distribution of atoms by energy (see below) is seemed to be typical for strongly non-equilibrium systems in which energy dissipation and mass transfer are implemented by cooperative phenomena such as SW and/or DW.

Noted waves in solids, owing to point 2 of SA model, might be described as dynamical dissipative structures. The type of structuring is the spatial ordering of vibrational and/or electronic excitations in spatiotemporal limits of SW and/or DW front. It is the sequel of different drift velocities of noted excitations having different energies in noted fronts. Such dynamical structure is the staircase which the multistep excitations are implemented by. Resulting probability P'_n of such multistage excitation of atom having average energy E_0 up to highest energy level E_n (e.g. effective activation energy of CF process with account of quantum tunneling) is expressed (see above) by the power function:

$$P'_n = A \cdot (E_n/E_0)^{-1}, \quad \text{where } 1 > 1$$

where n is a number of intermediate steps: A is the factor that characterizes a self-organization processes intensity; 1 is determined by the structure of excitation energy levels.

Point 2 states the necessary conditions of SW (DW) self-generation and propagation in solids: (i) vicinity of phase transition or phase separation region; (ii) perfection of host crystal lattice and saving of the latter during the experimental run. There are few published papers on CF concerning definite data on the real crystal structure of host lattice. Nevertheless, analysis of such data shows certain correlation between CG intensity and reproducibility, on one hand, and conditions mentioned in point 3, on the other hand.

CHINA - HV PULSE DISCHARGE

Courtesy of Jiangtang He

Jiangtang He (Inst. High En. Phys., Academia Sinica, Beijing), "A study on Anomalous Nuclear Fusion Reaction by Using HV Pulse Discharge," presented at ICCF4.

AUTHOR'S ABSTRACT

A study on anomalous nuclear fusion reaction by using 10 KV pulsed high voltage discharge in deuterium was completed. During HV pulses no neutron signal was detected, but two peaks of gamma rays were detected. The energies of two gamma rays are at 425 keV and 870 keV respectively. It might be explained as $^{108}Pd^*$ and $^{56}Fe^*$ excited by high energy charged particles de-exciting radiations. Neither neutron signal nor gamma signal was detected in the intervals between pulses.

PRESENTATION SUMMARY

The Results are summarized as follows:

1. The spectra of both gammas and neutrons outside the period of HV pulses, detected by system B [gate B of recording system] are consistent with background spectrums recorded without HV within statistical error.
2. During HV discharging, the neutron signals are comparable with background. However, there are extra gamma rays. [Showing the net spectrum (observed minus background).] It is very clear that there exist two peaks. According to the calibration curve of system A[1], one peak is at 425±40keV, another is at 870±50keV. Because the electrodes are made of Pd, Fe, and also W, the spectrum of gamma rays might be relevant to the following nuclear de-excitation processes:
$^{108}Pd^* \rightarrow {}^{108}Pd$ + gamma (425 KeV)
$^{56}Fe^* \rightarrow {}^{56Fe}$ + gamma (854 KeV)
$^{184}W^* \rightarrow {}^{184}W$ + gamma (110 KeV)
However, the energy of the gamma originating from $^{184}W^*$ is too low to be seen against noise.

Since the HV pulse is only 10 KV, the electron/deuteron with energy of 10KeV can excite only atoms, but not nuclei. So, the high energy gamma rays could be produced only from nuclear Coulomb excitation by charged particles with high energies. The gamma yields are about 10^{-6} per 3.0 MeV proton absorbed in palladium. Our result can probably be explained by the excited Pd and Fe in the products from the reaction mode 2 [tritium branch of d+d fusion]. From the present experiment, we would conclude that in HV pulse discharging experiment we only detected the characteristic gamma rays without neutrons. It seems that the reaction rate of mode 2 is much higher than mode 1 [neutron branch of d+d fusion] in a low-energy D-D fusion in a palladium environment. Taking the acceptance [of the data for the two reaction modes] into account, from our experimental results, we can deduce: R [ratio of tritium/neutrons] is greater than 10^9. We are going to do some experiments with different electrodes.

CHINA - THERMODYNAMIC DISSIPATION

Shu-I Liu (U. of Sci. & Tech. of China, Beijing) and Qihong Shi (Chem. Dept., Shantou Univ., Guangdong), "Thermodynamic Dissipation Criteria and its Principles for Cold Nuclear Fusion," presented at ICCF4.

AUTHORS' ABSTRACT

In a period (1979-1991) a new discipline known as State-Field Theory of Thermodynamics (S-F TOT) had been established by an author of this paper. The purpose of the present paper is to give a strict treatment of the currently interesting problem of Cold Nuclear Fusion (CNF) by applying S-F TOT.

FRANCE - SCREENING & RESONANCE

Michel Rambaut (France), "One Can Account for Cold Fusion by Two Concepts: Screening by Electrons and Harmonic Oscillator Resonance," presented at ICCF4.

AUTHOR'S ABSTRACT

In a plasma, the role of electrons has been largely underestimated, in spite of the fact that the "Screening concept" was born early during the fifties. So if one considers two "fusible" nuclei, neutrons for example in a dense medium, and if one supposes that they are sufficiently close together, one has to take into account the specific nature of perturbation they impose to their environment. A potential well is created during a very short time, at the place of the two ions. Given the high velocity of electrons, in comparison with the one of the ions, a great number of environmental electrons can be trapped in this well. The creation of this well necessitates that two deuterons are approaching sufficiently close together. The trapped electrons are coming from the immediate proximity of the two approaching deuterons, causing an electron depopulation around the two deuterons. So the immediate environment becomes constituted by positive ions. This is conceivable since this trapping, which causes the crossing of their mutual coulomb barrier by the two ions, lasts a very short time, typically between 10^{-14} and 10^{-12} seconds.

The unbalance of electron charge repartition, referred often to their polarizability, increases transitionally the coulomb electrical potential at the place of the two colliding deuterons. In return this increase deepens the potential well, and could contribute to maintaining the electron cloud around the two deuterons. So nuclear fusion reactions are possible for a two deuteron low relative velocity. This model appears to be common at the same time to various kinds of deuterated plasmas: plasmas produced by collisions, plasmas made of deuterium absorbed by certain metals such as palladium, titanium, vanadium, or plasmas produced by high voltage capacitor discharges.

But given that the process is drastically different from the one occurring in a thermonuclear medium, the macroscopic fusion reaction production must be ruled by a specific production term T, different from the "usual" thermonuclear one. The results of calculations exhibit a linear relationship between Log T and Log E, with $T = (\sigma FL) / \theta$ (σ the nuclear cross section, F the transmission barrier factor, L the effective barrier width, θ the barrier crossing duration, E the deuteron energy in the mass center system of reference). The slope p of the straight line representing the linear relationship corresponds to an electron accumulated constant number n around the two colliding deuterons. This slope p is bounded by two approximative limits, $1.3 < p < 1.8$, *n* being of the order of one to two thousands for p=1.3, and rather in the range of some hundreds for p=1.8. The corresponding linear relationship can be represented by:

$$\text{Log } (T/T') = p \text{ Log } (E/E') \qquad (1)$$

But this model taking only into account the electron trapping by a potential well does not describe in what circumstances adequate deuteron collisions are occurring.

One gets a view about a specific circumstance where adequate collisions followed by electron accumulation can occur, taking into account the results of high voltage capacitor discharge into deuterated media.

In some cases the fusion reaction production, which is most frequently detected by a neutron burst, is supposed to occur by sausage instability, after injection of a sufficient amount of energy into the deuterated medium. But the most interesting experiments are

the ones where there is no excess energy when the neutron burst occurs. In this case the onset of this burst coincide with the current apex. This occurrence suggests a resonance phenomenon, which could take place, just when the current begins to decrease. Given the short current wave pattern, no collective acceleration is possible, and this resonance cannot occur at another level than at the particle level. The basic harmonic oscillator is constituted of one deuteron and of k electrons surrounding one deuteron. During the current increase, the harmonic oscillator is mildly submitted to electrodynamic forces, with a resonance frequency $\Omega = (2(kq)^2/mr^3)$ (r being the mean distance between deuterons, q the elementary charge, and m the deuteron mass). One can verify that this frequency is in the range of 10^{14} rad/s.

To simplify, one can assume a sawtooth current pattern, with a leading edge duration θ_0, and a trailing edge θ, and a Lorentz force acting on the deuteron, whose velocity is supposed v_0, at the current apex. Assuming moreover that the deuterated medium has a cylindrical shape with a radius ρ, the maximum velocity attainable by the deuteron during the harmonic oscillator resonance, in the middle between the axis and the outer part of the cylinder has the following expression, 1 being the current at the apex:

$$f = \frac{\mu_0 q v_0 I}{m\Omega^2 4\pi\rho} + \left(\frac{1}{\theta_0} + \frac{1}{\theta}\right) \qquad (2)$$

The initial electron velocity is proportional to the integral of the current square, $\int I^2\,dt$, between the onset and the apex. As this integral is proportional to current square at the apex I^2; and assuming that $\theta \ll \theta_0$, the deuteron energy is proportional to the sixth power of the apex current and inversely proportional to the square of the current decreasing duration:

$$E \approx I^6\,\theta^{-2} \qquad (3)$$

Given that, for a specific medium density, the nuclear fusion rate is proportional to T, one gets:

$$\text{Log } R'/R = p\,[6 \text{ Log } (I'/I) + 2 \text{ Log } (\theta/\theta')] \qquad (4)$$

The p value p=1.66 corresponds to the slope of Log R versus Log I, observed by J.D. Sethian et al (6). This result is also in agreement with the pure stochiastic point of view, which leads approximately to n such as $10^3 < n < 2x10^3$ electrons around two colliding deuterons:

$$R'/R = (I'/I)^{10}(\theta/\theta')^{3.3} \qquad (5)$$

In the case where there is an excess energy introduced into the deuterated medium, the deuteron energy is proportional to I^4:

$$\text{Log } R'/R = p \text{ Log } (I'/I)^4 \qquad (6)$$

One can recover the I^5 law observed in this case by J.D. Sethian et al. too, with a lower value than in the preceding case p, which would correspond to a greater number of electrons trapped by the potential well.

So the supplementary harmonic oscillator hypothesis gives a new confirmation to the trapped electron model (also called double screening model). As it has been shown in previous papers, this model is also in agreement with the cluster fusion experiments performed by R.J. Beuhler et al.

FRANCE - HI TEMP SUPERCONDUCTIVITY
Courtesy of Samuel P. Faile

Michel Laguës, Xiao Ming Xie, Hassan Tebbji, Xiang Zhen Zu, Vincent Mairet, Christophe Hatterer, Cristian F. Beuran (École Sup. Phys. et Chim. Indust. de la Ville de Paris) and Catherine Deville-Cavellin (Lab. d'Electr., Univ. Paris), "Evidence Suggesting Superconductivity at 250 K in a Sequentially Deposited Cuprate Film," *Science*, vol 262, 18 Dec. 1993, pp 1850-1852, 23 refs, 3 figs.

AUTHORS' ABSTRACT

An artificial cuprate compound belonging to the BiSrCaCuO family with eight adjacent CuO_2 layers in each building block was deposited on a single crystal of $SrTiO_3$ by sequentially imposed layer epitaxy. This compound undergoes a five order of magnitude resistivity drop with an onset near 280 Kelvin and an offset at 250 Kelvin. It exhibits a diamagnetic variation of susceptibility and magnetization below 290 Kelvin. Additional observed features, such as strongly nonlinear conductivity, suggests superconductivity as a plausible explanation of the properties of this compound.

FRANCE - NEW BOHR ORBITS

Jean-Pierre Vigier (Univ. Paris VI - CNRS/URA, Paris) "New Hydrogen (Deuterium) Bohr Orbits in Quantum Chemistry and `Cold Fusion' Processes," presented at ICCF-4.

AUTHOR'S ABSTRACT

New experimental results presented at (and after) the 1992 Nagoya Conference on "cold fusion" raise an evident theoretical problem "Can one explain the "Excess Heat" observed in condensed matter containing Hydrogen and Deuterium in terms of conventional quantum and nuclear knowledge?" If one accepts (as believed by the author) that they will be confirmed (i.e. vindicate Fleischmann's and Pons' initial discovery) one should answer two theoretical questions:

A) Can one interpret (or not) the new facts within the frame of the presently known quantum and nuclear theory?

B) If not, what is the nature of the modifications of these theories suggested by these experiments?

The aim of this contribution is to present the possible following answers to A) and B):

a) The observed presence of excess heat in Hydrogen based experiments shows that this enthalpy excess is not (at least at low energy input) based on fusion processes but rather on an exotic new form of quantum chemistry associated to new "tight" Bohr orbits in Hydrogen and Deuterium. [See paper by Mills, Good, & Schaubach, page 11, this issue. Ed.]

b) If one accepts presently known fusion theory, the observed presence of "fusion ashes" in deuterium based experiments (also believed true by the author) shows that the corresponding fusion reactions (despite the fact that they are numerically many orders of magnitude too small to explain the associated excess heat) are present and 1) should be related to the new exotic chemical mechanism and to a screening mechanism in condensed matter 2) could lead, with

higher energy inputs to real fusion reactors: since fusion energy would be added to the new chemical energy.

c) As basis for the new phenomena one can add to the Coulomb Potential (utilized in Hydrogen and Deuterium) spin-spin and spin orbit interactions. Usually neglected they would manifest themselves when $\vec{L}$, $\vec{M}_1$, $\vec{M}_2$ are oriented (parallel) (due to electromagnetic interactions) when H and D are in condensed form in various types of electrodes. Indeed for two charged particles e_1, e_2 with magnetic moments $\vec{M}_1$ and $\vec{M}_2$ [we begin with the] usual quantum Schrödinger Hamiltonian.

[We can show that] this gives an effective radial potential V(r) given by:

$$V(r) = \frac{1(1+1)}{2\mu r^2} + \frac{e_1 e_1}{r} - \frac{e_1 \mu_{-2} C_e}{m_1 r^3} + \frac{e_1^2 \mu_{-2}^2}{m_1} \cdot \frac{1}{r^6}$$

which evidently implies the existence of new subground state (w.r.t. the Coulomb Potential) quantized energy states E_m corresponding to new "tight" Bohr orbits. These new Bohr orbits can be shown 1) to be circles around L_3, corresponding to an integer number m of de Broglie's wavelengths 2) to be calculable through the formula:

$$\frac{m^2 \hbar^2}{m_1 r^3} = \frac{\partial V(r)}{\partial r}$$

d) this model yields new Hydrogen (also Deuterium) energy levels (also describable in terms of "enhanced" electron masses) which 1) correspond to new resonance reactions (which generate soft X-rays) 2) to new "tight" types of molecular Hydrogen $\bar{H}_2^+$ and Deuterium $\bar{D}_2^+$ whose formation is exothermic, and 3) favor fusion when enhanced by a "screening" mechanism within specific electrodes.

e) The prediction of the apparition of this new type of molecules can be (as suggested by Mills-Good and Shaubach) by lack of reactivity with oxygen, separation from molecular deuterium by mass spectroscopic analysis.

f) The existence of predicted "cold fusion" enhanced by V(r) "screening" in this model should now be tested with high energy discharge both in plasma focus and capillary fusion experiments as presently attempted by Maric et al. at the University of Belgrade.

GERMANY - DEUTERIUM FUSION REACTIONS
Chemical Abstracts, 13 Dec. 1993

S. Lemaître, Gennant Paetz, H. Schieck (Inst. Kernphys., Univ. Koeln, Cologne), "Complete Determination of the Transition Amplitudes from a Comprehensive Data Analysis of the Fusion Reactions D(d,p)^{3}H and D(d,n)^{3}He for E_d<500 keV," *Ann. Phys.* (Leipzig), 1003, vol 2, no 6, pp 503-521, in German.

AUTHORS' ABSTRACT

All relevant low-energy transition amplitudes for the D(d,n)^{3}He and D(d,p)^{3}H reactions were detected from a fit to Legendre expansion coefficients of the available experimental data. A simple barrier penetrability model was used. Quintet S-wave transitions are found to contribute strongly thus obliterating the idea of neutron-lean polarized fusion energy production. The D+D interaction radius was detected with good accuracy for both reactions individually. The astrophysical S functions show a small S-wave enhancement and P-wave suppression of the D(d,p)^{3}H branch.

ITALY - HIGH POWER PULSING

F. Celani, A. Spallone, P. Tripodi, A. Nuvoli, A. Petrocchi, D.Di Gioacchino, M. Boutet (INFN, Lab. Nazionali di Frascati, Italy), P. Marini, V. Di Stefano (SKITEK, IRI, Pomezia, Italy), "High Power μs Pulsed Electrolysis for Large Deuterium Loading on Pd Plates," manuscript from paper presented at ICCF4.

AUTHORS' ABSTRACT

A high peak current (up to 100 A) and a very short pulse (1 μs) generator were used to perform electrolysis in D_2O-LiOD solution using a Pd sheet as a cathode and a Pt net as an anode. This high power pulse (up to 50 KW) can be rated up to 20 KHz.

Very high D/Pd values (up to about 1:1) has been reached with any cold-worked Pd sheets used. A very hard sheet (about 300 Hv) has generated an excess heat of the order of 15% for a long time (some weeks).

Some considerations about the metallurgy of electrodes are performed and an effort is made to correlate the excess heat with metallurgical parameters, over-voltage and surface resistance.

Conclusion
Independently by the metallurgy of the Pd electrodes, we developed an high pulse technique to highly charge Pd plates (D/Pd around 1:1). However, the metallurgy of the plates affects the absorption rate "shape" parameter. The over-voltage and electric resistance parameters give useful indications about the Pd plate surface status during the Deuterium absorption. An important role can play the ionic Li on the surface, in particular way when the Pd plate reaches high D/Pd values.

The excess heat occurring for some Pd plates seems dependent by the metallurgy of the electrode: a high hardness plates (doped by proper impurities) can give excess heat (around 15% in our case) for very long time (some weeks). This condition seems to be necessary but not still sufficient, because the first charging-up procedure seems to play an important role depending on the samples hardness. Moreover, observing the plates at the end of the tests, we can point-out that the excess heat occurs when there were no cracks on the plate surfaces. In other words, the peak pulse current should be limited to avoid disrupting effects to the plates.

ITALY - DEUTERIUM CHARGING

F. Cilioco, R. Felici (CNR, Ist. di Struttura della Materia, Frascati, Roma), and L. Bertalot, F. De Marco, A. De Ninno, A. La Barbera, F. Scaramuzzi, V. Violante (ENEA Frascati, Roma), "Deuterium Charging in Palladium by the Electrolysis of Heavy Water: Measurement of the Cell Parameter," presented at ICCF4.

AUTHORS' ABSTRACT

An experiment on the electrolysis of heavy water with palladium cathode is performed while measuring in real time the size of the cell parameter, with the help of an X-ray spectrograph. A first experiment permitted to evaluate the charging of deuterium in the palladium lattice up to a value of 0.82 of the D/Pd ratio (atomic). Other experiments are in the planned program, aimed to correlate the D-charging with electrolysis meaningful parameters, such as the current intensity, the use of pulsed current, the characteristics of the material. The results of these measurements will be reported.

JAPAN - FLUID PROTON THEORY
Courtesy of the author.

Note: The author provided copies of the following paper as written material pertaining to his ICCF4 presentation, "Nuclear Fusion in Condensed Materials."

Setsuo Ichimaru (Dept. of Physics, U. of Tokyo), "Cold Nuclear Fusion in Pressurized Liquid Metals," *Journal of the Physical Society of Japan*, vol 60, no 5, May 1991, pp 1437-1440, 20 refs, 1 table.

AUTHOR'S ABSTRACT

Liquid metals pressurized to a few megabars and consisting of light nuclear species such as D-H and Li-H can sustain considerable reaction rates due to electron screening and by the strong internuclear screening potentials when the temperature is raised above the onset of fluidity in hydrogen. The nuclear fusion rates may reach a power production level on the order of kW/cm^3 at a temperature and mass density of 600K(550K) and 3.9 g/cm^3 (6.8 g/cm^3) for D-H (Li-H). The detection of such a nuclear reaction at a density near 2-4 g/cm^3 will make a first laboratory demonstration for the reaction processes in supernova.

AUTHOR'S CONCLUSIONS

In conclusion, I have demonstrated through quantitative analyses that the pressurized metals of D-H and Li-H can sustain nuclear reactions at a power-producing levels if the temperatures are raised into a range where protons can behave as a fluid. In addition to its possible utility for power production, the detection of such a nuclear reaction will make the first laboratory demonstration for the elementary processes in supernova mechanisms and may lead to an examination on the validity of extrapolating the cross sections into regimes of extremely low energies on the order of 0.1 eV. Details of the theory will be published elsewhere.

JAPAN - PROTON CONDUCTORS & HEAT

Tadahiko Mizuno, *Michio Enyo, Tadashi Akimoto and Kazuhisa Azumi (Fac. of Eng., * Catalysis Research Center, Hokkaido Univ., Sapporo, Japan), "Anomalous Heat Evolution from $SrCeO_3$-Type Proton Conductors During Absorption/Desorption of Deuterium in Alternate Electric Field," manuscript of paper presented at ICCF4.

AUTHORS' ABSTRACT

The cold fusion phenomena were tested with use of proton conductor (pc) solid electrolyte plates maintained at 400~500 °C. An anomalous level of excess heat evolution of the order of 50 watt was observed during absorption and desorption cycles of deuterium-containing hydrogen gas under application of an alternate electric field.

JAPAN - BIOLOGIC TRANSMUTATION
Courtesy of the author.

Hisatoki Komaki (Biologic & Agricultural Research Inst.), "An Approach in the Probable Mechanism at the Non-Radioactive Biological Cold Fusion or So-called Kervran Effect (Part 2)," Poster presentation at ICCF4, 4 pages, 4 tables, 14 refs.

AUTHOR'S ABSTRACT

In previous papers the author, with Prof. Dr. C. Louis Kervran, suggested the probable occurrence of the biological cold fusion or the biological transmutation of elements. In order to confirm the phenomena under more controlled condition than ICCF-3, the author determined the content of potassium, magnesium, iron and calcium in the dried cells of *Aspergillus niger* IFO 4066, *Penicillium chrysogenum* IFO 4689, *Saccharomyces cerevisial* IFO 0308, *Tarulopsis utilis* IFO 0396, cultured in normal medium and media deficient in one of potassium, magnesium, iron and calcium. The experimental results led the author to conclude the probable occurrence of the non-radioactive biological transmutation of elements or the non-radioactive biological cold fusion.

EDITOR'S SUMMARY

The experiments used 200 ml of culture media, shaking the culture at 30C for 27 hours. The molds and yeasts used showed only about 1/5 to 1/10 the growth in the nutrient-deficient cultures as compared to the normal cultures. However, on the basis of per gram of dried cells, each of the dried cell samples showed evidence of having from about 1/2 to 1/6 of the normal amount of the mineral nutrient not supplied in the culture. The experimental evidence, therefore, suggests that various molds and yeasts have the capability of producing some elements missing from the cell's environment. This experimental observation has been reported previously but has been dismissed by the scientific community because the claims are not acceptable under current theories of nuclear reactions. **If the experimental evidence is correct**, then these results are further evidence of catalyzed nuclear reactions. Kervran suggested nuclear reactions in which protons, O_{16}, and C_{12} nuclei could be joined to

higher mass nuclei to produce the deficient elements in the cell's diet. Replication of Komaki's latest work is **highly recommended**. If biological mechanisms exist for proton capture by higher-mass elements, then the observed transmutation of alkali-metal elements in light-water experiments (such as reported by Bush and Eagleton) would appear more acceptable.

JAPAN - NEGENTROPY THEORY

Ryoji Takahashi (Tokyo, Japan), "Cold Fusion Explained by Negentropy Theory of Microdrop of Heavy Water," presented at ICCF4.

AUTHOR'S ABSTRACT

The cold fusion phenomena which arise in the electrolysis of the D_2O/salt system are treated in this paper as problems of the liquid state and explained by the working of the microdrop of D_2O created in the D_2 gas.

Outline of Negentropy Theory of Microdrop of Water

The properties of D_2O are similar to those of H_2O and the surface tension of D_2O is smaller than that of H_2O by 6.8%. So the negentropy theory of D_2O is regarded as represented by that of H_20 described below. The pressure P in a drop of water of radius r, in saturated moisture, is calculated as a function of temperature T by Laplace's equation,

$$P=2\gamma/r+Pv \quad (1)$$

where γ and Pv represent the surface tension and the vapor pressure. The P-T curves for r=0.5μm, 1.5μm and 3μm, and the P-r(V) curve at 0°C is illustrated. The value of dP/dT is negative for small values of r at low temperatures. The microdrop satisfying $dP/dT<O$ takes negentropy (negative entropy) for the increase in V (volume) by Maxwell's third thermodynamic relation. So when the microdrop receives a negative pressure $-\Delta P$, the normal water changes into super water and the volume increases by ΔV, by taking negentropy from the surrounding and do work $P\Delta V$. The energy balance in this action of the microdrop is given as:

$$E-T\Delta S=P\Delta V \quad (2)$$

where E, T and $-\Delta S$, represent mechanical energy which causes a negative pressure, absolute temperature and negentropy. Eq.(2) shows that the outside of the microdrop is given heat by the microdrop. Eq(2)is rewritten as

$$E=P\Delta V+T\Delta S. \quad (3)$$

Eq.(3) shows that heat is generated by forming compounds from the simpler substances included in the microdrop. It is obvious that the microdrop performs as a new type of engine and it is named here as MICRODROP ENGINE. The negentropy range of the microdrop of water in moisture is limited, but if the microdrop is placed in the relatively higher pressure of a gas than that of the vapor, the following Laplace's equation is held,

$$P=2\gamma/r+Po \quad (4)$$

where Po represents the outside pressure regarded as constant for a small change of temperature. In this case the negentropy is maintained in the wide ranges of T and r.

JAPAN - SLOW PLATINUM DIFFUSION
Chemical Abstracts, 15 Nov. 1993

Naohiko Kimizuka, Takayuki Abe, Kingo Itaya (Fac. Eng., Tohoku Univ., Sendai), "Slow Surface Diffusion of Platinum Atoms on Platinum (III)," *Denki Kagaku oyobi Kogyo Butsuri Kagaku*, 1993, vol 61, no 7, pp 796-799.

AUTHORS' ABSTRACT

The surface diffusion of Pt atoms on the Pt(III) electrode was studied by the in situ electrochemical scanning tunneling microscopy (STM). STM images of Pt(III) after successive potential cycles (say, 20, 30 and 50 cycles) were examined, and it was concluded that the disordered surface structure of Pt(III) remained unchanged upon the further application of the limited potential cycles. Oriented islands with height of 2 or 2 atomic layers were formed on the Pt(III) surface within the first 10 potential cycles, and no change of the microstructure of Pt surface was observed after the additional potential cycles. The results suggested that the slow diffusion of Pt atoms took place in pure 0.05 M H_2SO_4 solution.

JAPAN - BOSON CLUMPING

Ken-ichi Tsuchiya (Dept. Elec. Eng., Tokyo Nat. Col. of Tech., Hachioji, Tokyo), Kazutoshi Ohashi (Fac. Eng., Tamagawa Univ., Machida, Tokyo), and Mitsuru Fukuchi (Dept. Instrumentation Eng., Fac. of Sci.& Tech., Keio Univ., Yokohama) "Mechanism of Cold Nuclear Fusion II," presented at ICCF4.

AUTHORS' ABSTRACT

Regarding deuterons as identical bosons, Bush et al. calculated the power density generated from cold nuclear fusion by using the concept of symmetry force which describes the tendency of bosons to clump. In our previous work, we also calculated the power density with assuming that two forces are effective to deuterons. One is attractive symmetry force, which increases tendency of deuteron to clump, and the other is d-d repulsive force, which decreases it.

In this work, we treat N-deuteron problem by using Lipkin's description in second quantization. In this model, creation and annihilation operators $a^{\uparrow}$ and a for proton and neutron anticommute with one another, and bound two-particle system in a state with center of mass momentum $2\hbar k$ is considered. Then deuteron creation operator $D^{\uparrow}$ is defined by

$$D^{\uparrow}_{2k} = \sum_q g_q a^{\uparrow}_{(k+q)\uparrow} a^{\uparrow}_{(k-q)\downarrow} \quad (1)$$

where g_q is the Fourier transform of the wave function for relative motion. The annihilation operator is then given by the Hermitian conjugate of eq.(1). The N-deuteron wave function Ψ_N is defined as

$$\psi_N = \prod_i \frac{(D^{\uparrow}_{2k_i})^{n_i}}{(n_i!)^{1/2}} |0> \qquad (2)$$

where |0> means the vacuum state and n_i means the occupied number of state i , which satisfies $\sum_i n_i = N$.

The commutation relation between deuteron creation and annihilation operators is given by

$$\left[D_{2k'}, D^{\uparrow}_{2k}\right] = \delta_{k'k} - \Delta_{k'k} \qquad (3)$$

where extra term $\Delta_{k'k}$ is written as

$$\Delta_{k'k} = \sum_q g_q (g_{k'-k+q} a^{\dagger}_{(2k-k'-q)\downarrow} a_{(k'-q)\downarrow} + g_{k'-k-q} a^{\dagger}_{(2k-k'+q)\uparrow} a_{(k'+q)\uparrow}). \quad (4)$$

Since $\Delta_{k'k}$ is proportional to the small quantity g_q, we can neglect it for small N systems. However, it should not be neglected for large N systems. This means that we cannot regard deuterons as bose particles when cluster size N is large. Therefore, extra term $\Delta_{k'k}$ has a role to reduce the tendency of deuterons to clump. In our previous work, we discussed cold fusion catalyzed by deuteron clusters in Pd. But we did not know how to estimate the most probable cluster size N. In this work, it is given by using Lipkin's description in second quantization.

JAPAN - DEUTERON WAVES

Norio Yabuuchi (High Sci. Res. Lab., Tsu City, Mie-ku, Japan), "Wave of Deuterons and Cold Fusion," presented at ICCF4.

AUTHOR'S ABSTRACT

When blocked cracks approximately O.1μm in size are formed in solid metals with an occluded hydrogen atom property, a wave of deuterons within the crack brings about the following two phenomena.

1. With electrons, electron wave characteristics are readily observed to be exhibited, and a tunnel phenomenon accompanied by the development of strong wave motions occurs as with an experiment conducted by Hitachi, Ltd..

2. In the case of gold atoms, quite a number of these atoms shift toward a O.1 micron layer of magnesium substrate and collect to form a thin line along the location of the layer (similar to an experiment conducted by Advantest Laboratory).

Analyzing the two above phenomena, a reaction occurs between cracks within solids that appear as large lattice defects and deuterium atoms which exist as impurities within the Pd crystalline metal structure. During this reaction, large quantities of deuterium atoms shift into the cracks of the solid. Because D changes easily to d deuterons when vibrational energy is applied, these deuterons are not subject to the restrictions of the exclusion law since they exist as Bose particles. Many d deuterons exist densely in cracks which appear as large lattice defects. The liquefied d then facilitates superfluidity and superconductivity. In fact, the burst appearing with neutrons and the burst phenomenon of superfluid He II resemble each other.

From the standpoint of a O.1 μm space, because deuterons are larger than electrons, they cause intense wave motions to occur in the form of deuteron waves within minute spatial widths of n ● O.1 μm. Accordingly, this situation has the effect of extending the collision cross section by wave r and bringing about the tunnel phenomena; both important conditions for nuclear fusion.

Next, the effect of quantum confinement is conceivable within the minute spatial width of a micro-unit and has been studied by N. Margolus at MIT and M.L. Steigerwald et al. of AT&T Bell Laboratories. Applying Heisenberg's theory of uncertainty using the relationship $\Delta x \Delta p \geq h$, if elementary particles are confined within a narrow space $\Delta x \rightarrow O$, momentum approaches infinity $\Delta p \rightarrow \infty$.

Therefore, when a large number of d exists within a O.1 μm x n space, Δp approaches infinity, $\Delta p \rightarrow \infty$, because the space for d movement becomes extremely small.

This means that the formula $\int mv dv = \frac{1}{2} mv^2 + C \quad (1)$ holds true. From the standpoint of $1/2\ mv^2 = h\nu$, and since kinetic energy increases, oscillation frequency of the wave of deuterons, which exist as Bose particles, becomes greater and motion velocity v increases. Because aluminum has the characteristic of tightly confining d, surrounding the cracks with aluminum can be used as a technique for bringing about a strong confining effects.

According to M. Born's theory, originator of the probabilistic wave, particles penetrate walls with a probability given by $|\psi|^2$, however, according to the law of Geiger-Nuttall, penetration probability of fast particles is greater than that of slow particles. Therefore, cold nuclear fusion will originate within a minute space if the velocity of d particles, contained within a d wave which does not easily collapse, is increased by taking advantage of the effects brought about by quantum confinement, extension of collision cross sections and the tunnel effect. In addition to this, if a tsunami of soliton in the deuteron field is caused by switching an electrolytic current on and off, nuclear fusion occurs at double and triple the normal rate. As shown in paper, soliton occurs sufficiently even in plasma when brought about using the shock of ionic sonic waves.

[This paper appears to be an important addition to our understanding of some of the possible mechanisms for deuteron fusion in a metal lattice. Ed.]

JAPAN - HEAT AND HELIUM CORRELATION
Chemical Abstracts, 27 Dec. 1993

Eiichi Yamaguchi and Takashi Nishioka (Basic Res. Lab., NTT, Musashino), "Helium-4 Production and Its Correlation with Heat Evolution," *Oyo Butsuri*, 1993, vol 62, no 7, pp 712-714, 8 refs, in Japanese.

AUTHORS' ABSTRACT

Using the author's "in vacuo" method with a heterostructure of deuterated Pd(Pd-D) at low temperatures <300°, the authors have detected in situ ^4He production. The real-time observation has been performed by high-resolution quadropole mass spectroscopy (0.001 amu at 4 amu). The signal attributable to ^4He production appeared when the samples exhibited a sudden increase in temperature. The system of H-loaded Pd (PH-H) heterostructure, on the other hand, produced no ^4He. A new class of nuclear fusion occurred in condensed matter.

NORWAY - PLATINUM ELECTROCHEMISTRY
Chemical Abstracts, 13 Dec. 1993

M.M. Jaksic, B. Johansen, R. Tunold (Lab. Ind. Electrochem., Univ. Trondheim, Norway), "Electrochemical Behavior of Platinum in Alkaline and Acidic Solutions of Heavy and Regular Water," *Int. J. Hydrogen Energy*, 1993, vol 18, no 10, pp 817-37.

AUTHORS' ABSTRACT

The behavior of Pt as an electrode for H (protium and D) and O evolution in both alkaline and acidic, heavy and regular H_2O solutions was studied primarily by cyclic voltammetry. The main features, such as adsorption and underpotential deposition of H (both protium and D), as well as the specific charge capacity for monolayer oxide growth with successive increase in O content (preceding H and O evolution, respectively, with characteristic desorption peaks), were more or less marked in both electrolytes. Some distinctly different behavior, however, was observed, revealing that heavy and regular H_2O behave almost as different solvent ambients. The H evolution reaction (HER) particularly in alkaline D_2O occurs at substantially more negative potential, while O evolution becomes shifted to considerably more positive potential values. H absorption, besides adsorption, of both protium and D, was marked clearly by the continuously growing charge capacity of the diffusional desorption peak, whose extent depends on the evolving rate and contact time of H evolution and distinctly exceed both 1-to-one H to Pt (H/Pt or D/Pt) atom coverage on the exposed electrode surface, and relative to the corresponding reversible adsorption wave charge are for its underpotential deposition. The H oxidation peak immediately following its desorption (in particular from acidic D_2O) also was clearly marked on voltammograms. A distinct merging and melding together of 2 initial D reversible desorption peaks into the diffusional desorption peak in acidic D_2O was discernibly scanned, too. Oxide formation usually starts at more anodic potential together with D oxidation and, specifically in acidic media, proceeds vigorously with higher and continuously growing rates and merging together with evolving molecular O, while the prevailing O evolution thereby becomes shifted to more positive potential values. These features reveal that, owing to its distinctly different steric factor, D_2O (in particular in acidic media) behaves as a stronger oxidizing agent than regular H_2O. Some discernible properties of the interplay between H and O on the Pt electrode in both electrolytes along the potential axis were clearly marked and pointed out. The Rowland of EDTA effect on the potentiodynamic features of Pt also was scanned and displayed.

POLAND - NUCLEAR SYNTHESIS REACTIONS

Roman E. Sioda (Inst. of Industrial Organic Chem., Poland), "A Mechanistic Model of Cold Fusion Based on Hot Spot Hypothesis: Spatial Constraints to Nuclear Synthesis Reactions in Electrochemically-induced Cold Fusion," presented at ICCF4.

AUTHOR'S ABSTRACT

Since the famous announcements of Fleischmann, Pons and Hawkins and of Jones et al. many papers had been published to explain these unexpected discoveries. The work in this direction is highly satisfying, because of its interdisciplinary nature, and possible energetic rewards, if the original findings are confirmed. However, the mechanism of this process is still under discussion, which explains its complicated and equivocal nature.

The purpose of the present communication is to point out some new mechanistic aspects of the process. It seems that the role of electrolysis is simply that of a means of loading deuterium into the material of the metallic electrode, such as of palladium or titanium, which can absorb large quantities of deuterium gas in the volume of the metals. The absorption of the deuterium causes a change of the structure of the lattice of the metals, which leads to mechanical and electrical stresses (charge separation and generation of potential). These stresses can cause a breakdown of a limited number of deuterium atoms, and to initiate the evolution of neutrons. The process takes place basically at the surface of the metals. Some of the neutrons are reabsorbed in the metals, while others leave the metals. Those absorbed in the metals can lead to a chain reaction, in which further deuterium atoms are destroyed by participating in several possible routes of a fusion reaction. The process is basically unstationary, and its commencement and end depend on energetic and spatial aspects of the metal surface, which are highly variable.

However, there is a spatial aspect, which tends to favor the process. As the "liquid fuel" of the reaction, i.e. deuterium, is contained in the rigid crystal lattice of heavy metal atoms, there is a tendency for the energy of an initial reaction to be contained locally, which can lead to easier excitation of further deuterium atoms, allowing them to fuse, and to release high amounts of energy in further fusion reactions, resulting in a chain and explosive-type reaction, like in dynamite. Parts of the released energy can be transferred by the electronic plasma of the metal lattice to other parts of the metal, exciting the process there too. It can be especially dangerous if the initial fusion process develops deep inside the block of a metal loaded with deuterium, as a strong explosion can take place, which had been virtually described.

There are two aspects of the present short communication, which seems to be novel in respect to what had bean published so far: 1. The influence of the rigid and heavy lattice of the metal on localizing the high energy release of an initial fusion reaction, and 2. the resulting chain character of the fusion reaction in this micro-volume. Eventually, the metal lattice becomes destroyed locally, and the chain reaction has to subside, or to transfer to another micro-volume of metal, loaded with deuterium, and still having a rigid lattice structure. The feasibility of the fusion reaction depends also locally on the concentration of deuterium atoms in the metal lattice, and hence on

the experimental conditions of deuterium loading into the electrode, such as the duration in time and the applied current density.

POLAND - NEGATIVE NEUTRON SEARCH
Chemical Abstracts, 27 Dec. 1993

Lech Lason, Marian Przytula, Ryszard Wojtkiewicz, Janusz Baczynski, and Jaroslaw Bauer (Inst. Phys., Univ. Lodz, Poland), "Search for Neutrons from Cold Fusion of Deuterium Absorbed in Palladium," *Acta Univ. Lodz, Folia Phys.*, 1992, vol 16, pp 3-12.

AUTHORS' ABSTRACT

Experimental studies were performed on detection of neutron emission from a Pd sample saturated with gaseous D_2 at room temperature and pressure <1 atm. No continuous emission of neutrons with a rate >500 $s^{-1/2}$/sqrt for time interval $t \geq 3s$ or a burst emission with number of emitted neutrons 5.10^5 neutrons/burst was observed.

ROMANIA - CASE OF SCIPIOLOGY
Courtesy of the author

Peter Glück, "Cold Fusion: A Case of Scipiology," unpublished manuscript, 3 pages. Handed out at ICCF4.

EDITOR'S REVIEW

This paper was not a part of the conference but was handed out to some of the attendees. The paper defines "Scipiology" as the science of converting disasters to triumphs. The word, coined by Peter Glück is derived from Scipea Africanus, the great Roman general who converted disaster into triumph during the Punic war by crossing the Mediterranean and attacking Carthage while Hannibal was busy fighting the Roman army. Glück states, "...lack of reproducibility has plagued this emergent scientific field from the very start ... I...have decided to solve at least one of these problems, ... to make cold fusion reproducible." Further he observes, "Lack of reproducibility has to be the most important source of information revealing to us what actually happens in these systems." (See *Fusion Facts*, vol 3, no 1, July 1991, page 1.)

RUSSIA - COULOMB SCREENING

Gennady V. Fedorovich (Rus. Acad. Sci., Theor. Prob. Dept., Moscow), "Screening of the Coulomb Potential in a Nondegenerate Hydrogen Isotope Gas," *Fusion Technology*, vol 25, no 1, Jan. 1994, pp 120-123, 21 refs, 3 figs.

AUTHOR'S ABSTRACT

To explain the mechanism of deuterium reactions in palladium and titanium (cold fusion), a model of an exotic deuterium plasma with possibly short nuclear distances due to thermal motion was considered. The screening parameter is increased by lowering the ion temperature. This is the usual feature of the screening phenomenon in plasma. Fully ionized gases of high density and low temperature are never possible outside the lattice. Hence, the growth of the screening parameter can be significant only for the hydrogen isotopes in the metal lattice.

RUSSIA - FUSION AT FERROELECTRIC PHASE
Chemical Abstracts, 15 Nov. 1993

V.B. Kalnin (Inst. Fiz. Khim., Russia), "Feasibility of Cold Nuclear Fusion at the Ferroelectric Phase-transfer Point in Potassium Dideuterium Phosphate," *Neorg. Mater.*, vol 29, no 5, 1993, pp 656-658, in Russian.

AUTHOR'S ABSTRACT

On the basis of crystallochemical concepts, a new object for cold fusion, is proposed namely KD_2PO_4, in which for the first time the reproducible effect of generating cold nuclear fusion products (esp. neutrons) is detected, stimulated by a ferroelectric phase transition (promoted by thermal cycling near T_c). In this compound, the contribution of the phase transition is unquestionably much higher than in classical cases (metal deuterides), where the randomness in the distribution of D atoms in the lattices is manifested to a significantly higher degree than in KD_2PO_4.

RUSSIA - ISOTOPIC CHANGES IN C.F.

Yu.N. Bazhutov, B. Kuznetsov, Yu. Chertov ("Erzion" Center, Moscow, Russia), "Isotopic and Chemical Compositions Changes in Cold Fusion Experiments in the Erzion Model," presented at ICCF4.

AUTHORS' ABSTRACT

An explanation is given of isotopic and chemical composition changes by the Erzion Model which took place in cold fusion experiments. (Rolison and O'Grady, Bush, Romodanov, et al.) It is demonstrated that nuclear transmutation is an important quality of the Erzion Model. Some more sensitive methods of nuclear transmutation process analysis in traditional cold fusion experiments are suggested. The phenomenon investigated in the framework of Erzion Model became, not cold nuclear fusion, but cold nuclear transmutation.

RUSSIA - ERZION-NUCLEAR TRANSMUTATIONS

Yu.N.Bazhutov ("Erzion" Center, Moscow, Russia), "Possible Exhibition of the Erzion - Nuclear Transmutation in Astrophysics," presented at ICCF4.

AUTHOR'S ABSTRACT

There exist great kinds of anomalous astrophysical phenomena which can not be explained in the framework of traditional theoretical

models. Erzion - nuclear transmutation, if it really exists, can explain some of them such as:

1. Davis effect - considerably lower Solar neutron flux.
2. Greatly exceeding that of the Jupiter radiation.
3. Cygnus-X3 problem - big flux of neutral high energy particles from local cosmic space sources.
4. Catastrophic reducing of Li, Be, B content in the chemical elements abundance curve of Solar and Earth matter.

RUSSIA - ERZION MODEL & STABLE ISOTOPES

Yu.N. Bazhutov, V.P. Koretskiy, A.B. Kuznetsov ("Erzion" Center, Moscow, Russia), "Burning Away of Radioactive Isotopes and Production of Some Stable Isotopes in the Erzion Model," presented at ICCF4.

AUTHORS' ABSTRACT

The possibility of Isotopes transmutation in nuclear reactors radioactive wastes are analyzed within the framework of the Erzion Model. The conditions for the majority of long-lived isotopes Tc-99, I-l29, Cs-137 et al. must become stable or short-lived (tens of hours) were defined. Generation of gold from mercury is one of the most attractive projects of the stable elements production. Furthermore, some projects of the great practical significance can be implemented. For example, the alloying of semiconductor (silicon - by phosphorus, germanium - by arsenium).

RUSSIA - NUCLEAR TRANSMUTATION OPTIMIZATION

Yu.N. Bazhutov, U.P. Koretskiy, M.Y. Minakov*, A.N. Cheltsov, Yu.P. Chertov ("Erzion" Ctr., Moscow, *Rus. Sci. Ctr., "Kurchatov Inst.", Moscow), "The Possible Ways of Cold Nuclear Transmutation Optimization in the Context of the Erzion Model," presented at ICCF4.

AUTHORS' ABSTRACT

The matter enrichment methods by the catalysts for the cold nuclear transmutation are discussed. The required degree of enrichment based on the spectroscopy methods sensitivity and the catalysts concentration expectancy must be more than 10^4 times. This degree may be achieved using the high- speed gas centrifuges. It places a constraint on the enriched matter: matter must have high vapor pressure, thermal and thermodynamic resistant and must have not more than one isotope impurity of another elements. The possibility of the matter production with the help of high-speed centrifuges was examined and the resolution or the enrichment problem for isotopes Ni-64. Mo-100, Te-130, Xe-136, W-186, Os-192 was demonstrated.

RUSSIA - C.F. FERROELECTRICS

G.V. Fedorovich (Theor. Prob. Dept., Rus. Acad. of Sci., Moscow), "Ferroelectrics for Cold Fusion," presented at ICCF4.

AUTHOR'S ABSTRACT

Numerous experiments have claimed evidence for the D+D fusion reaction in deuterium trapped in Pd and Ti. The successful experiments were made with LiD crystals, a chalk sample impregnated with D_2O, high-temperature superconductors, KDP-ferroelectrical crystal and deuterium-loaded tungsten bronze D_xWO_3. The presence of a fusion neutron signal was consistently reproduced, although the fusion rates observed so far are small and out of control. Active searches for more effective catalyst of the D+D nuclear fusion are hampered by lack of some "key idea," which can guide the way for this search. The purpose of the report is the determination of parameters of crystals that are "optimal" for enhancement of the D+D fusion rate. The basis for recommendations is the model of a deuteron acceleration in ferroelectrical crystals.

We suppose that the ferroelectrical crystal consists of a sequence of layers of electrical dipoles P, which are spaced apart ($P \cong d^3P_s$, where P_s is the spontaneous polarization). A deuteron moves along the domain axis. It crosses sequential layers of dipoles. The oscillations of atoms forming dipoles bring to the variations of the dipole moments with respect to the average value $\langle P \rangle$. We assume that the dominating oscillation p (t) = p cos (wt) exists in the crystal. It can be connected with the crystal polarization reversal. In this case the relative value of the oscillation amplitude $q = p/\langle P \rangle$ can be as much as 0.3 - 0.6

The mechanism of the deuteron acceleration is the combination of the two radically different mechanisms of acceleration: when the deuteron energy T is small ($T < T_0 \equiv 4\pi e P_s d$), the stochastic acceleration takes place, this mechanism is similar to the Fermi acceleration. In the region $T > T_0$ the deuteron energy increases (if particles enter into this region with the appropriate phase) at the expense of the resonance acceleration in the field of the dominating oscillation. The latter process is described by the equation

$$\overline{M/2} \cdot dT/dt = (q \cdot T_0^2/2 \cdot d) \cdot \cos(\omega t) / \left| \sqrt{T} - \sqrt{T - T_0} \right| + \sqrt{T} \cdot F(T)$$

where M is the deuteron mass, F is the frictional force stipulated by the dielectric losses of the energy of the electric field initiated in a crystalline media by a moving deuteron:

$$F_d = \left(e^2/\pi \cdot V^2\right) \cdot \int_0^{\infty} \omega \cdot d\omega \int_{\xi}^{\infty} d\mathbf{X} / \left(\mathbf{X}^2 + 1\right)$$

where $\xi = \varepsilon'/\varepsilon''$ (ε' and ε'' are real and imaginary parts of a dielectric constant). For slow-moving particles in low-loss dielectrics $F \simeq \Lambda \cdot V$, where V is the deuteron velocity, $\Lambda \equiv \gamma \cdot e^2 \cdot \Omega \cdot V_a^{-3}$, $\Omega^2 \equiv 4\pi e^2 N/\boldsymbol{M}$, γ is the frictional constant, V_a is the velocity of acoustics waves in the crystal. The integral of the Eq. (1) has the form:

$$T = \mathrm{Max}\{T\} \cdot \cos^2 \left| \omega (t - t^*) \right| + \tau (t - t_0) \qquad (2)$$

In this relation it is designated: $\mathrm{Max}\{T\} \simeq 2 \cdot \pi \cdot V_a^6 \cdot M \cdot \boldsymbol{M} \cdot P_2^2/\tau^2 \cdot e^4 \cdot N$. The second term in sum (2) is the exponentially damped contribution of the initial condition.

To make a quantitative estimate of the maximal energy, we consider the deuteron acceleration in KDP ferroelectrical crystal as an example. The spontaneous polarization is $P_s = 1.5 \times 10^4$ CGSE. The

scale of the energy is $T_0 = 6.3x10^{-12}$ erg =3.7 eV. We assume $V_a = 10^5$cm/s, $\gamma = 10^{13}s^{-1}$. According to the Eq. (2), the maximal energy of accelerated deuteron ≃ 1 eV. This value is of no interest to "cold fusion," but we may choose the ferroelectrics with more suitable characteristics. The value of γ can be as small as $10^{-10}s^{-1}$ (e.g.in $PbTiO_3$). Some ferroelectrics (e.g. $LiNbO_3$) have the spontaneous polarization $P_s \simeq 10^6$ CGSE. For these ferroelectrics the value of Max{T} is 40 eV (in $PbTiO_3$) or 1.4 keV (in $LiNbO_3$). The latter values are of real interest to "cold fusion" in crystals.

Some perovskite-type compounds with non-stoichiometric composition show considerable promise as the possible "pretenders" to play the role of "optimal" crystal for cold nuclear fusion. The structure of certain tetragonal tungsten bronzes such as A_xWO_3, where A is an element of I group, was described in terms of "tunnel"-type lattices, which are common to a number of compounds. The tungsten trioxide WO_3 is the extreme case of this type ferroelectrics.

The tunnel-type lattice makes itself evident in the great electrical conductivity. Solid ionic crystals with low electrical resistance are known as the "superionic" crystals. The H_xWO_3 crystals have such properties. Compounds of this type have turned out to be interesting from the viewpoint of cold fusion so that it may be worth devoting some space to them.

RUSSIA - VORTICAL DISKS
Chemical Abstracts, 13 Dec. 1993

V.G. Kartavenko (Ob'ed. Inst. Yad. Issled., Dubna, Russia), "Vortical 'disks' of Nuclear Matter," *Yad. Fiz.*, 1993, vol 56, no 8, pp 38-43, in Russian.

AUTHOR'S ABSTRACT

Basic equations for the vortical disks of nuclear matter have been derived in the framework of nuclear hydrodynamics. The disk shape evolution is analogous to the propagation of a nonlinear dispersion wave in the plane. A qualitative analysis of the main features of the disk states has been made. The connection between the disk stability problem and multifragmentation process is pointed out.

RUSSIA - FERROELECTRIC PHASE TRANSITION
Chemical Abstracts, 27 Dec. 1993

A.G. Lipson, D.M. Sakov, E.I. Saunin, V.B Kalinin, M.A. Kolobov, B.V. Deryagin, A.A. Khodyakov (Inst. Fiz. Khim., Russ. Akad. Nauk., Russia), "Cold Nuclear Fusion Induced by the Ferroelectric Phase Transition in Potassium Deuterium Phosphate (KD_2PO_4) Single Crystals," *Zh. Eksp. Teor. Fiz.*, 1993, vol 103, no 6, pp 2142-2153, in Russian.

AUTHORS' ABSTRACT

A reproducible radiation of neutrons and tritium being the products of cold fusion with thermocycling ferroelectric KD_2PO_4 (DKPD) single crystals near the Curie point (T_c = 222 K) is observed. In experiment a significant asymmetry of the cold fusion product yield in the neutron (n) and tritium (T) channels ($n/T \sim 10^{-7}$) is recorded. By means of thermodepolarization it is shown that the neutron emission occurs in the temperature range being the same as for the switching of crystal domain walls. The cold fusion phenomenon in DKDP crystals is associated with the nonzero probability of simultaneous deuteron population of two neighbor D-positrons in the near-surface region of a crystal during the ferroelectric phase transition and with the possibility of displacing deuterons by significant distances to 3.5Å in high electricity fields.

RUSSIA - DOES HEAT NEED FUSION EXPLANATION?
Chemical Abstracts, 10 Jan. 1994

A.G. Lipson, B.V. Deryagin, B.F. Lyakhov, D.M. Sakov (Inst. Fiz. Khim., Russ. Akad. Nauk., Moscow), "Does the Anomalous Heat Production in the Palladium-Deuterium (Hydrogen) System Need the 'Cold Fusion' Hypothesis to Understand It?" *Dokl. Akad. Nauk*, 1993, vol 331, no 1, pp 39-42 (Phys.), in Russian.

AUTHORS' ABSTRACT

The introduction of the concept of "cold nuclear fusion" to explain the anomalous thermal effects in the Pd-D(H) is not necessary, because there exists the possibility of an interpretation from the position of "aat." fusion, i.e. disintegration of a quasi-metallic H phase. To confirm the conclusions concerning the formation of such a H state in Pd, further studies are needed.

RUSSIA - MECHANISMS OF C.N.F.

Lev. G. Sapogin (Dept. of Phys., Tech. Univ. [MADI], Moscow), "II. On the Mechanisms of Cold Nuclear Fusion," presented at ICCF4.

AUTHOR'S ABSTRACT

Let us try to observe from these positions the epoch making experiments of Fleischmann and Pons, the Jones' group and others. Not going into well known details this may be summed up briefly: the cold nuclear fusion exists but nobody knows why. The number of various fantastic mechanisms for the explanation of that phenomenon increases, but only few believe them. Let us give some estimation of these experiments. The minimum classical distance Xclas, at which deuteron nucleus may approach each other, equals Xclas=l4(A)/E(eV).

The deuteron nucleus size is about 4E-12 cm, the nuclear force range is 4E-13 cm (deuteron is very friable). The solutions of equation (3) for initial conditions Xo=952296.33 (1A);Fo=1.570796327 and Fo=1.57 are given. It is shown that nuclear reactions with such initial conditions can occur with the energy more than 1eV. If the phase Fo approximates pi/2 the energy value may decrease hundreds of times. One shouldn't think that the phase precipice phenomenon causes the nuclear reaction in the wide range of the precipice. It may be likely that with the Coulomb's repulsion reduction at the same time there takes place the strong interaction of value decrease but nobody knows the way it happens.

Besides, sometimes the particle arrives at turning point Xmin having grown sufficiently "thin." Will it be able to take part in a full scale nuclear reaction or will it pass through rapidly as an electron does in S-atom state? But there exist the narrow ranges of the phase, where particle charge increases rapidly and the particle accelerates after stopping. The charge may amount to maximum value in the nuclear force action range. Apparently, narrow phase range is responsible for the cold nuclear fusion. These data are necessary when working out the new types of nuclear reactors.

Interaction D-D takes place in three channels (energy in MeV):

D + D == T (1.01) + p (3.03) (1 channel)
D + D == He (0.82) + n (2.45) (2 channel)
D + D == He + gamma (5.5) (3 channel)

All of them are exothermic, have no threshold (now it is clear why) and are taking place for very small relative energies. For example in D molecule the balance distance between atoms 0.74A, the combination rate is very slow-1E-64s-1. But for distance 0.1A this value is sufficient for cold fusion explanation according to the classical theory.

The rate of reaction ratio for tritium and neutron channels is close to unit by the classical theory, but in numerous cold fusion experiments this ratio equals approximately 1E9 with a high reproduction. Let us explain the reason for that phenomenon. For small velocity in phase precipice the nuclear forces of attraction act on nucleons and the electrostatic forces of repulsion act on protons. Under the action of this moment of the forces, the deuteron has time for turni ng so that the neutron parts of deuterons turn out looking at each other. A nuclear force saturation arises at the approach of neutrons. So the proton connection grows weak and because of the electrostatic repulsion one of them leaves the nuclear system. It is like the Oppenheimer-Philips effect. It is easy to estimate that for E>10 keV deuterons have no time for turning, hence 2nd and 3rd channels of reaction can be realized.

The increase of the neutron channel may be due to secondary neutrons birth in reaction T + D = He+n (14.1 MeV). In rich deuteron conditions most part of the emerged tritons transform into neutrons by this reaction, that has cross-section 5 barn for E + 70 KeV. According to the estimations the number of such secondary neutrons to the unit triton equal $7.9x10^{-12}$; $1.7x10^{9}$; $2.7x10^{-6}$; 20 and 100 KeV accordingly. So predominance $T/n = 10^{6}$ may be expected in those reactions, where triton emerges with the energy E < 40 keV.

It's worth mentioning that there is a possibility of explaining one of the nuclear physics anomaly, the existence which they pretend not to notice. For nucleon energy 1 MeV, $v=10^{9}$ cm/s, $R_{nuclear}=10^{-12}$ cm, t=R/v=1E-21s the time range of nuclear disintegration is a great deal anomalic - 1E-14s. Apparently for the strong interaction the phase precipice mechanism is working also, i.e. the nucleon is very slowly crawling into the nuclear system.

Is it possible that the considerated Vendée and Austerlitz of the eq. (3) will collide with Waterloo in the Bohr-Sommerfeld problem and other cases, moreover taking into consideration my reasonable ignoring the mass? What happened with the mass under the changing of the wave function phase? I can't give a precise answer. It has been assumed implicitly that the mass is either constant or specific charge which depends on the phase.

An application of the eq.(3), which was done for D-D interaction ad hoc doesn't result in failure of Bohr-Sommerfeld and scattering models. The states with L>O correspond to the electron trajectory similar to some beautiful flowers of the buttercup sort. All results remind one very much of the radial wave function, divided by spheric harmonics and can be used for good amusement at the computer for long nights. If one observes the problem about the electron passing through the proton (S-state), that such orbits early had been excluded in the classic Bohr-Sommerfeld model is absurd. Apparently in atomic physics there are some situations when all the above said will not work. It doesn't mean the UQT failure, but it means the eq.3 roughness solely. Anyone can say, "if it is not the truth, it is a good invention." I would be very much surprised if God has ignored the beautiful chance of using the phrase. If all that was said above is true it means that the resolving of the nuclear fusion problem is to be dealt with in quite a different way. By the way, I theoretically predicted the cold nuclear fusion already in 1983 and all that was said above is the development of my old ideas. But the problem of nuclear fusion is the theme of further investigations.

RUSSIA - NEUTRONS IN PROTON CONDUCTORS

A.L. Samgin, A.N. Baraboshkin, I.V. Murigin, S.A. Tsvetkov, V.S. Andreev, and S.V. Vakarin (Inst. High-Temp. Elec., Rus. Acad. Sci., Ekaterinburg), "The Influence of Conductivity on Neutron Generation Process in Proton Conducting Solid Electrolytes," manuscript of paper presented at ICCF4.

AUTHORS' ABSTRACT

It is mentioned that the nature and the mechanism of conductivity and the existence of multilayered structures with different conductivity types in solids appears to be the additional critical conditions of abnormally increased rate of nuclear-electron reactions in solid-state deuterium system.

AUTHORS' CONCLUSIONS

Our experiments have shown the main condition of a neutron emission is an existence of ion (proton) conductivity in cerate channels. Appearance of an electron conductivity with reduction of ceramic resulted by neutron emission cessation. Obviously, the nature and mechanism of conductivity and the existence of multilayered heterostructures with different conductivity type are an additional critical condition of essential increasing speed and the intensity of electron-nuclei reactions in solid state/deuterium systems.

EDITOR'S COMMENTS

Since their excellent work on bronze crystals (presented at ICCF-3) this group, with funding from ENECO, has generalized and extended knowledge concerning the types of materials in which nuclear reactions, in simple experiments, can be expected to occur. This paper, together with other papers on proton conductors, is strongly recommended for those who desire to further their understanding of nuclear reaction systems.

RUSSIA - A NEW USE OF PHASE

Lev G. Sapogin (Dept. Phys., Tech. Univ. (MADI), Moscow), "Deuteron Interaction in Unitary Quantum Theory," presented ICCF4.

AUTHOR'S ABSTRACT

A unitary quantum theory (UQT) with a new perspective on the problem of article interaction was developed in the author's papers. According to this theory any elementary particle is a condensed bunch of some unitary field travelling in a packet of partial waves. Dispersion and a nonlinear nature of the process spreads the wave packet periodically across space and assembles it; the envelope of the process happens to coincide with the de Broglie wave. The formalism of the theory amounts to a relativistically invariant system of 32 non-linear integral-differential equations from which follows strictly mathematically from the theory.

We can solve this problem by coming at it from the other side though for this purpose we must sacrifice part of the ideology of the UQT -- to refrain from dividing particles (wave packets). In general we can do this if the energies are low when the interactions are elastic though there are exceptions. I will demonstrate that despite the roughness of this approach the results are outstanding.

The concepts of the UQT and the solution of some of its equations (the value of the electrical charge and also the fine-structure constant are found which are in very good agreement with the experiment) may lead to the point of view that the charge of a moving particle is oscillating with its de Broglie wave frequency. In other words, in all macro experiments the effective value of a charge is measured and the oscillations aren't noticeable.

Let's consider two charged particles (deuterons) moving along X axis towards each other. Let's choose the origin of the reference frame in the center of one of the particles (charge Q). Let the second particle approach with a velocity -Vo from the point with coordinate X_O. If opposite beams collide, we can come to the given system introducing the normalized mass. It is able that if the sign of the charge is the same, these particles will approach at the distance of X_{CLAS}, where the velocity is equal to zero and then they will begin to accelerate themselves. According to Coulomb's law:

$$Xclas = \frac{2QqXo}{2Qq + m\,XoVo^2} \qquad (1)$$

If the charge q oscillates with its de Broglie wave frequency the in Gauss's system will be

$$m\ddot{X} = \frac{2Qq\cos^2(m\dot{X}^2\,t/2h - m\dot{X}X/h + Fo)}{X^2} \qquad (2)$$

The factor 2 accounts approximately the effective value of the charge q. In a natural system of coordinates m=1, h=1, c=1. The quantity F_{O-} is the initial phase. Then we obtain an equation of the type
Which, despite its apparent simplicity of the initial premises, can plunge any mathematician into a deep despair.

$$\ddot{X} = \frac{k}{X^2}\cos^2\left(\frac{\dot{X}^2}{2}t - X\dot{X} + Fo\right), \quad \text{where} \quad k = 2Qq \qquad (3)$$

To clarify the physical situation this equation (3) was solved by a computer with given initial conditions (chosen for the comfort of quick counting) X_O=10 and different values of the initial phase F_O (0..pi) and velocity. It was found that the laws of conservation of a momentum is only approximately fulfilled in case X_0V_0<pi. In the case of a reflected particle at the distance X_0, its velocity wasn't equal V_0, but was varying about it at 20-30%. As it has been expected, the effect of particle breaking and accelerating takes place at the moment when the charge is large. On the other hand, at the last stage of breaking (for some value of the phase F_0) a magnificent process begins. The velocity and charge are too small; thus it results in small value of the repulsive force. This small charge doesn't change for a long time because of the phase being constant, since no forces act on the particle (obviously on what is left of it).

This value phenomenon occurs within some range of the phase only and it might be conveniently called "the phase precipice." The relative depth of the precipice equals to $X_{CLAS}/X_{MIN} = 10^{-6}$ to 10^{-9} and it depends on initial conditions of the particle charge and energy very faintly. Under small energies (0.01-1 eV) the precipice is exclusively narrow (10^{-10} to 10^{-8}) and its value is difficult to compute digitally.

Energy and momentum conservation laws generally are not observed for an individual particle as there emerge relations of uncertainty type. The regularities observed in passing through potential barrier are similar to quantum-mechanical predictions. But in quantum mechanics particle passage probability is proportional to its squared wave function modulus and is entirely independent of the phase. It would only be fair to ask why some particles reflect from the barrier while some others pass through it. My model answers the question, because the probability of a particle passing through the barrier is dependent on the particle phase. If the phase is such that the charge is small, the particle will fly through the barrier without "noticing" it.

Now the quantum mechanics may be slightly kicked notwithstanding its attractiveness. **I've never understood why God has not used the phase in any way in his quantum Universe, though he hasn't ever been noticed making any surpluses before. At least now it is obvious that the phase might be used like that, but nobody ever guessed it.** [Bold emphasis by Editor.]

UKRAINE - dd-FUSION IN BOILING ELECTROLYTE

V.I. Vysotskii (Radiophys. Dept., Shevchenko Kiev Univ., Kiev, Ukraine), R.N. Kuz'min (Phys. Dept., Moscow State Univ., Moscow, Russia), "On the Possibility of Non-barrier dd-Fusion in Volume of Boiling D^2O During Electrolysis," presented at ICCF-4.

AUTHORS' ABSTRACT

Previously we have shown that non-barrier dd-fusion reaction (with eliminated Coulomb barrier) can be achieved during the forming of

short-lived (fluctuational) Fermi-condensate of N_1=10...20 deuterium atoms in microholes of optimal size $R_0 \approx$4...7A in crystals. The strict requirement posed upon the size of microholes ($\Delta R_0/R_0 \leq 0.1$) produces difficulties on the fusion observation and optimization because:

(a) there is not enough microholes of required size R_0 in the crystal:
(b) the exact value of R_0 is hardly calculable;
(c) there is no possibility of controlled creation of required size microholes and of self-adjustment $R \rightarrow R_0$.

In our opinion the problem of controlled non-barrier fusion can be solved using electrolysis in volume of boiling D_2O in closed space at defined temperature T, electric current and external pressure p_0. Let's explain the idea.

The process of boiling is accompanied by multiple formation of micro-bubbles in D_2O where bubbles containing both D_2O molecules have formed due to electrolysis and later neutralized deuterons. In accordance with Laplace law the micro-bubbles with critical radius of $R_\alpha = 2\sigma/(p_1 - p_0 + \rho gz)$ are in equilibrium and stable. Here σ is surface tension quotient, $p_1 = p_0 \exp(2\sigma/R_\alpha n_0 k_B T)$, where p_1 - pressure inside the bubble, p_0 - average liquid pressure, ρgz - hydrostatic pressure.

At certain externally controlled pressure p_0 it is possible to provide the condition $R_\alpha \approx R_0$. Thus the same condition requirements can be satisfied in the micro-bubble as were stated before for the crystal, provided the required quantity N of deuterium atoms gets into the bubble.

The frequency of bubble birth:
$I = 10^{31} \exp(-W/k_B T) cm^{-3} s^{-1}$ is described by Former-Zeldovich-Kagan theory, where $W = {}^4/_3 \pi R_\alpha{}^2 \sigma$ is bubble formation threshold. After the bubble appeared the deuterium atoms diffuse into it. The lifetime equilibrium bubble with $R_\alpha \approx R_0$ can reach $\Delta t \approx 10^{-3}$s. During this time $N \approx j_0 4\pi R^2{}_0 \Delta t$ atoms of deuterium get into the bubble.

With current density $j_0 \approx 0.5$ A/cm^2 we have N≈50...100, which according to [previous research] is enough for the forming of short-lived Fermi-condensate of $N_1 \approx$ 10...20 atoms with probability f [citing previous papers] for the realization of fusion.

In case of small difference between R_α and R_0 a self-adjustment $R \rightarrow R_0$ takes place due to unavoidable (after Δt) changes (either increasing or decreasing) of bubble radius.

The general expression for concentration of optimal micro-bubbles with fluctuational Fermi-condensate of D formed in them is $n \approx I f \Delta t$.

The quantities $I \sim \exp(-\frac{W}{k_B T})$, $\sigma \sim 1n(\frac{T}{T_\alpha})$ and $f \sim T - \frac{3N_1}{2} \exp(-\frac{A}{k_B T})$, that define n, have different temperature dependencies. The maximum of fusion velocity in the volume unit of boiling D_2O

$\Lambda = Cn(N_1 - 1)/(4\pi R_0{}^3/3)$, where $C = 2 \cdot 10^{-10} cm^3 s^{-1}$ is a constant of dd-fusion, is achieved at optimal temperature $T_{opt} \approx \frac{\pi \sigma R^2}{k_B N_1} + \frac{2\hbar^2}{k_B M R^2} (N_1 \pi)^{2/3} (3/2)^{7/3}$, which at $R_0 \approx$ 4...7A equals $T_{opt} \approx$ 500...700 °K. It corresponds to overheated liquid under high pressure p_0. No experiments at such temperature were performed yet.

According to estimates, optimization of T and p_0 could raise the velocity of dd-fusion in the volume of electrolyte D_2O up to $\Lambda \approx 10^3 ... 10^6$ cm^{-3}s^{-1}, which in case of big quantities of D_2O can become an alternative to hot fusion.

[Copy of paper was difficult to read. We may have made some errors in deciphering. Ed.]

UKRAINE - FUSION BY NOBLE GAS BOMBARDMENT

Victor F. Zelensky, Victor F. Rybalko, Galina D. Tolstoulutskaya, Sergej V. Pistryak, Igor E. Kopanets and Alexander N. Morozov (Karkov Inst. of Phys. and Tech., Ukraine), "Initiation of Nuclear Fusion Reactions in Metal-Deuterium and Metal-Deuterium + Tritium Systems by Bombardment with Noble Gas Ions," *Fusion Technology*, vol 25, no 1, Jan. 1994, pp 95-102, 16 refs, 11 figs.

AUTHORS' ABSTRACT

An experimental study confirms the possibility of initiating nuclear fusion reactions in metal-deuterium targets by bombarding them with ions that are not the reagents of the fusion reaction, in particular, with noble gas ions. The yields of (d,d) and (d,t) reactions were determined as functions of energy (0.4 to 3.2 MeV) and mass of incident ions (He^+, Ne^+, Ar^+, Kr^+, and Xe^+). It is shown that at ion energies of approximately 0.1 to 1 MeV, the yields of these reactions are rather high (10^{-10} to 10^{-7} event/ion), and they can be increased by raising the incident ion energy, by an appropriate choice of the target. Practical applications of the effect are discussed.

AUTHORS' CONCLUSIONS

These studies have demonstrated that the bombardment of targets containing heavy hydrogen isotopes by ions that do not participate directly in nuclear reactions stimulates nuclear fusion reactions to occur in the targets. At ion energies of approximately 0.1 to 1 MeV, the reaction yields are relatively high (10^{-10} to 10^{-7} events per ion) and may be increased by raising the incident ion energy, by an appropriate choice of the target, etc. In view of this, the effect can be used for some practical applications.

EDITOR'S COMMENTS

This well documented report on an extensive amount of experimental work is additional evidence of extensive nuclear reactions that can be produced and controlled in metal lattice systems loaded with hydrogen isotopes. The authors have also suggested several practical applications for this type of system as follows:
1. Methods for determining the concentration of heavy hydrogen isotopes;
2. Point sources for controlled neutron flux;
3. With appropriate software, the study of cross sections of nuclear reactions; and
4. The possible use in developing thermal power sources.

E. SHORT ARTICLES BY OUR READERS

NOTES FROM THE U.S. PATENT OFFICE

By Stephen Roen, Patent Attorney

As of this date, no U.S. Patent has been issued on any cold fusion application.

The U.S. Patent Office is refusing to issue any of the one hundred plus pending cold fusion patent applications. In a recent U.S. Patent Office Board of Appeals decision (Ex Parte Dash), the Board of Appeals upheld the Patent examiner's rejection of a cold fusion patent application for lack of enablement; that is on inoperativeness.

The Appeals Board based its decision on evidence that the experiments of other "careful researchers" in the field were unable to demonstrate neither excess heat nor traditional nuclear by-products of fusion reactions. The Board also based its decision on evidence that demonstrated the relative ease with which erroneous results could be achieved by failing to observe "strict experimental design controls." As a result, the Board held that the burden of proof shifted to the inventor, which required that he produce evidence to overcome the Examiner's position. This would then require that the inventor submit "sufficient substantiating evidence of operability."

The only evidence provided by the inventor to support a claim of a fusion reaction was an increased scintillation count rate. The court further noted that there was no other effort by the inventor to confirm the existence of a nuclear reaction. In essence, the Board held that the inventor's experimental design to evidence a fusion reaction was inadequate. It also mentioned that there were problems and difficulties associated with such experiments and indicated that a Bosch et al. article (*Journal of Fusion Energy*, vol 9, no 2, 6/90) set forth the problems in some detail.

Concerning the inventor's claim of 25% excess heat, the Board took note of the lack of any description of the laboratory means and methods used to measure this parameter, both in the patent application and in any evidence submitted by the inventor after this question was raised by the examiner. This comment, of course, applies equally as well to the claim of the fusion reaction.

The Board also sustained the rejection of the inventor's claims on the basis of various prior art publications, pointing out that if the inventor proved that his invention was operative, he would also be indirectly proving that the experiments disclosed in the prior art were also operative.

Several of the comments of the Board of Appeals concerning these issues are worth quoting in full as follows:

It is not seen wherein the specification discloses any particular structure, etc., which is unique to fusion system operative whereas the systems disclosed in the above reference "numerous teaching by skilled artisans," were not operative.

There is no adequate description of the parameters of an operative embodiment of the invention, including exact composition of the electrolyte, composition, size and dimensions of the electrodes, the current strength, voltage, etc.

F. MEETINGS AND MISCELLANEOUS

MINSK COLD FUSION CONFERENCE - MAY 1994 AMENDED CALL FOR PAPERS

A bilingual, international conference on cold nuclear fusion and affiliated energy systems will be held in Minsk, Republic of Belarus during the last week of May, 1994. Papers accepted will be published in English and Russian editions of proceedings that will be provided to attendees at the start of the conference. Presentations of the papers can then concentrate on the latest developments and the answering of questions. The proceedings are expected to provide a tutorial overview of the new science of cold nuclear fusion for a multi-disciplinary audience and provide the latest experimental and theoretical findings.

Russian language papers should be sent to:

Dr. Filimonov V.A.
14 Leningrad St., Research Inst. of
Physical and Chemical Problems
Minsk - 80, 220080
Belarus.

Abstracts due by March 15. Papers in English may be submitted to Hal Fox, P.O. Box 58639, Salt Lake City, UT 84158. Notification of acceptance will be sent by Mar. 31, 1994. Papers must be received by APRIL 15, 1994.

$250 Conference attendance includes room and meals. Authors of accepted papers must include the check for the conference when submitting the paper. Page costs for pages in excess of 6 (including figures) will be $100 per page. A total of about 70 papers will be selected and published in the proceedings. Translation costs, if handled by the organizing committee staff, will be $20 per page. Authors are urged to submit their papers in both English and Russian. Words on figures may be in English.

Institute for New Energy's
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The Institute for New Energy will sponsor an International Symposium on New Energy to be held in the Denver Hilton South in Denver, Colorado on **Thursday, May 12, 1994 through Sunday, May 15,** 1994. Fees: Registration before April 1, $150; Registration between April 1 and May 1, $175; Registration after May 1, $200; Workshops $20 each, and Banquet $25. Checks should be made payable to the **Institute for New Energy** and sent c/o *New Energy News*, to P.O. Box 58639, Salt Lake City, UT 84158.

Expected Speakers: Robert Adams - Adams Motor/Generator; Harold Aspden - Ferromagnetics; Bruce Cathie - Harmonics; Bruce dePalma - "N" machine; Shiuji Inomata - "N" machine; Stefan Marinov - Perpetuum Mobile; Harold Puthoff - Zero Point Energy; Prof. John Searl - Anti-Gravity*; Paramahamsa Tewari - Space Power Generator; Dennis Weaver - Ecology/ Economics. * Invited

Some of the speakers will present concurrent workshops on the evenings of May 12, 13 & 14, from 6:30 to 9:30 p.m. The Banquet will be held Sunday at noon.

Subjects to be presented at the conference will include all types of **New Energy** topics such as those covered in each issue of *New Energy News.* Specifically, papers are solicited covering both theory and practice of energy producing devices and systems such as cold nuclear fusion, rotating N-Machines, Solid-State energy systems, Magnetic over-unity machines, Tapping Space Energy (Zero-Point Energy), gravity control techniques, energetic transmutations (nuclear reactions), and other new energy research.

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