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INVESTIGATION OF CONDENSED MATTER FUSION

Annual Progress Report

for Period March 15, 1990 - December 1990

S.E. Jones, M. Berrondo, J.B. Czirr, D.L. Decker, K. Harrison, G.L. Jensen, E.P. Palmer, L.B. Rees, S.Taylor, H.B. Vanfleet, J.C. Wang, D.N. Bennion, J.N. Harb, W.G. Pitt, J.M. Thorne, A.N. Anderson, G. McMurtry, N. Murphy, and F.E. Goff

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Annual Progress Report
Investigation of Condensed Matter Fusion

Abstract

Work on muon-catalyzed fusion led to research on a possible ne type of fusion occurring in hydrogen isotopes embedded in metal lattices. While the nuclear-product yields observed to date are so small as to require careful further checking, rates observed over short times appear sufficiently large to suggest that significant neutrons and triton yields could be realized--if the process could be understood and controlled. During 1990, we have developed two charged-particle detection systems and three new neutron detectors. A segmented, high-efficiency neutron counter was taken into 600 m underground in a mine in Colorado for studies out of the cosmic-ray background. Significant neutron emissions were observed in this environment in both deuterium-gas-loaded metals and in electrolytic cells, confirming our earlier observations.

Introduction

Our studies of the possibility that fusion could occur in hydrogen isotopes at room temperature, with the use of catalysts other than negative muons, were first published in 1986.[1] In this early paper, we discussed the possibility that cold fusion could occur in the core of Jupiter and in highly compressed hydrogen isotopes. An experimental program to investigate the idea was initiated at Brigham Young University in April 1986 and continues to the present, under the auspices of the Advanced Energy Projects Division of the U.S. Department of Energy.

Considerable progress has been made in the nascent field in 1990, as reviewed at an international conference on "Anomalous Nuclear Effects in Deuterium/Solid Systems" held at BYU in October 1990.[2; see attached agenda] Results were presented from laboratories in the United States, Canada, Europe, China, the Soviet Union, India and Japan, many of which confirmed and extended the early BYU reports of low-level nuclear effects in deuterium/metal systems. Despite widespread skepticism [3], research continues to show a small but significant effect with diversely prepared metal-deuterium samples and with the use of improved detector systems.[4] Recent observations of energetic charged particles complement measurements of neutron emissions.[2] Papers from the workshop are now being assembled at BYU; proceedings will be published in Spring 1991 by the American Institute of Physics.

Thus, we find it appropriate to continue further intensive and collaborative investigation of the phenomenon, with objectives of increased understanding and assessment of possible applications. We are actively working with researchers at the Los Alamos National Laboratory, the Kamiokande facility in Japan, the Colorado School of Mines, the University of Hawaii, and Texas A&M (K. Wolf). In

fact, there now exists a global network of researchers who share information and ideas, as represented at the BYU workshop.

Neutron Emissions

Over the past several years, we have developed a series of neutron detectors at BYU. Our compact neutron spectrometer [4] was instrumental in identifying 2.5 MeV neutron emissions as described in our April 1989 paper in Nature [5]. It is noteworthy that 2.5 MeV neutrons from deuterided metals have been observed by other workers as well.[6,7,8,9] We have recently acquired a high-efficiency (34%) neutron counter of the type developed by Howard Menlove, a Los Alamos National Laboratory fellow. (We have the privilege of working with Dr. Menlove and his team in the study of neutron emissions from deuterided metal systems; ref. 10,11,12.) This detector was recently taken by Dr. Jones into a deep lead mine in Colorado. Neutron signals were repeatedly detected in this 600-m underground environment showing that the signals cannot be ascribed to cosmic rays. A paper on this experiment is being prepared for the Proceedings of the BYU workshop on "Investigation of Anomalous Particle Emissions in Solid/Deuterium Systems"; see attached abstract. We have also taken a portable neutron spectrometer to the Colorado School of Mines for use in conjunction with Prof. Ed Cecil's experiments showing charged-particle emissions.[13] Two other neutron detectors designed to accommodate samples in 1.6"-diameter wells and with efficiencies above 20% have been built and are operating at BYU. They utilize sophisticated waveform digitizers and have time resolutions of about 40 ns between pulses.

The use of several neutron detectors of different types is important to our effort to examine different facets of the phenomenon (such as neutrons emitted in short bursts, or emitted randomly) and for data surety. We are also able to share resources with other researchers to expedite the search for higher-yielding samples.

Charged Particle Detection

Since the inception of the current DOE grant, we have developed charged-particle detectors of two different types. The first is a silicon surface barrier detector of the type used previously in muon-catalyzed fusion experiments. [14,15] This detector permits good energy resolution and exhibits low background count rates. The second detector incorporates a 6-mil plastic scintillator glued onto a glass scintillator which is in turn glued onto the face of a 5" photomultiplier tube. This "phoswich"-type of detector permits discrimination of particle types, depending on particle energies. Moreover, we are able to scan a large amount of deuterided metal foil at one time, an order of magnitude more than achievable with the smaller surface barrier detector, for example. The signals are fed into a fast waveform digitizer to permit

separation of plastic and glass pulses, rejection of noise, and timing of pulses. We have recently observed several apparent episodes of charged particle production, with particles of large energy (possibly 3 MeV protons or 5 MeV tritons or 9 MeV alphas, we cannot yet distinguish which) appearing at a rate two orders above the background rate for about one hour in each case. A significant fraction of the pulses appear to be correlated with a preceding smaller pulse with a characteristic time separation of $\simeq$ 600 ns. We are endeavoring to understand such phenomena in conjunction with colleagues at the Colorado School of Mines and the Naval Research Laboratory who have evidence for anomalous charged-particle production, obtained using surface barrier detectors.[2,13]

Tritium Detection

We have searched for tritium using a Beckmann-II Scintillation Counter with Aquasol as the scintillation cocktail. We have also used a lithium-drifted silicon detector to search for tritium-generated X-rays in deuterided titanium samples (as suggested by Bhabha-Institute researchers [16]). This approach continues at a low level, but it is subject to false readings due to tritium contamination. We feel that the energetic particle investigations outlined above are far better for identifying and probing nuclear processes occurring in metal/deuterium systems.

Theory

A small but dedicated effort is directed toward development of models of possible nuclear processes in metal lattices bearing hydrogen isotopes. The objective of these investigations is to increase understanding of the observations and to guide efforts to increase reaction yields. For example, the titanium lattice changes from hexagonal close packing to body-centered cubic as the phase changes from alpha to beta. Changes in Ti/H phase can be effected by temperature variations, which are in turn implicated in neutron emission observations. [10,11,12] We are exploring the notion that moving phase boundaries are important as reaction sites, perhaps due to shock compression of deuterons embedded in the lattice. Various studies suggest that fusion rates of deuterons in a lattice under static conditions are far too small to measure at present [see ref. 17]. Under the direction of Dr. Berrondo, a computational model is under development of the structure of deuterium in metals using electron-density dependent (non-additive) potentials. Computer simulation of non-equilibrium phenomena involving deuterium in metals--in particular, formation of cracks and phase transitions--is underway.

Our experience in muon-catalyzed fusion research has shown that close interaction of experimentalists and theorists leads to rapid progress in understanding, and we are continuing this interactive approach.

Search for geological nuclear fusion

Laboratory observations of nuclear reactions in deuterium/condensed matter systems suggest that similar reactions could occur in the interiors of planets such as Jupiter and Earth [5,18]. Observations of excess helium-3, an important fusion-reaction product have been recorded in volcanic emission and rocks at various active plate-tectonic settings. In particular, hotspot volcanoes which tap deeper portions of the mantle emit the largest amounts of helium-3. To date, the most widely held explanation for this excess is the primordial nature of the mantle plumes which supply the upwelling magmas.[19] We hypothesize that this helium-3 excess could be due, at least in part, to deuteron-deuteron or proton-deuteron fusion in the Earth's mantle or core.

Tritium, another important nuclear product, is a relatively short-lived radioisotope ($t_{1/2}$ = 12.43 years) that decays by beta emission to helium-3. In principle, unequivocal detection of tritium in deep volcanic emissions would (unlike stable helium-3) demonstrate that nuclear fusion is occurring in the Earth's interior. Moreover, its detection would also shed light on the amounts of such reactions, their locations in the Earth, and on mantle plume upwelling rates. There is some evidence that tritium has indeed emanated from the Kilauea volcano in Hawaii.[18]

The goal of this research effort is to evaluate the presence of naturally occurring tritium in volcanic emissions or deep wells, tritium that is unequivocally coming from the Earth's interior. We are working with geophysicists at the University of Hawaii and the Los Alamos National Laboratory in these studies. Studies of tritium at Mt. St. Helens by Dr. Fraser Goff of LANL (under the subject grant) have disclosed a tritium anomaly, with tritium evidently correlated with magmatic water. His work was reviewed at the recent BYU workshop. Dr. Goff is working with Prof. Gary McMurtry of the University of Hawaii on studies of possible tritium emissions from Hawaiian volcanoes.

Conclusion

Work on muon-catalyzed fusion at BYU led to research on a possible new type of fusion occurring in hydrogen isotopes embedded in metal lattices. While the nuclear-product yields observed to date are so small as to require careful further checking, rates observed over short times appear sufficiently large to suggest that significant neutrons and triton yields could be realized--if the process could be understood and controlled. Experiments conducted in 1990 in a deep mine rule out cosmic-ray explanations for the observed neutron signals. The goal of the research is to scrutinize what appears to be an unexpected nuclear phenomenon and then to assess possible applications. An evaluation of means to enhance reaction yields will be based on data obtained in the laboratory and in the field, guided by the theoretical models developed as part of the research program.

Summary of 1990 publications (attached)

1. S.E. Jones, E.P. Palmer, J.B. Czirr, D.L. Decker, G.L. Jensen, J.M. Thorne, S.F. Taylor, J. Rafelski, "Anomalous Nuclear Reactions in Condensed Matter: Recent Results and Open Questions," J. Fusion Energy 9: 199-209 (1990).

2. H.O. Menlove, M.M. Fowler, E. Garcia, M.C. Miller, M.A. Paciotti, R.R. Ryan, S.E. Jones, "Measurement of Neutron Emission from Ti and Pd in Pressurized D_2 Gas and D_2O Electrolysis Cells, Journal of Fusion Energy 9: 495-506 (1990).

3. S.E. Jones, "Anomalous Neutron Emission from Metal-Deuterium System," Proceedings of An International Symposium on Muon Catalyzed Fusion, p. 97-102, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

4. J.D. Davies, G.J. Pyle, G.T.A. Squier, A. Bertin, M. Bruschi, M. Piccinini, A. Vitale, A. Zoccoli, S.E. Jones, B. Alper, V.R. Bom, C.W.E. Van Eijk, H. de Haan, D.H. Craston, C.P. Jones, D.E. Williams, A.N. Anderson, G.H. Eaton, "Search for 2.5 MeV Neutrons from D20 Electrolytic Cells Stimulated by High-Intensity Muons and Pions," Il Nuovo Cimento 103A(1): 155-162 (1990).

5. A. Bertin, M. Bruschi, M. Capponi, S. DeCastro, U. Marconi, C Moroni, M. Piccinini, N. Semprini-Cesari, A. Trombini, A. Vitale and A. Zoccoli, S.E. Jones, J.B. Czirr, G.L. Jensen, E.P. Palmer, "On the Criteria Followed in the Gran Sasso Measurement on Cold Nuclear Fusion," Proceedings of An International Symposium on Muon Catalyzed Fusion, p. 114-117, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

6. John N. Harb, William G. Pitt, H. Dennis Tolley, "Statistical Analysis of Neutron Burst Size and Rate During Electrolysis of LiOD Solutions," accepted to Journal of Fusion Technology.

7. S.E. Jones, J.B. Czirr, D.L. Decker, G.L. Jensen, E.P. Palmer, "Response to Queries Regarding Observation of Cold Nuclear Fusion in Condensed Matter," Proceedings of An International Symposium on Muon Catalyzed Fusion, p. 111-113, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

8. S.E. Jones, D.L. Decker, D.H. Tolley, Correspondence on "Observation of Cold Nuclear Fusion in Condensed Matter" Nature 343: 704 (1990).

9. B. Alper, A.N. Anderson, A. Bertin, V.R. Bom, M. Bruschi, J.D. Davies, G.H. Eaton, C.W.E. van Eijk, J.B.A. England, H. de Haan, S.E. Jones, J. Metcalf, M.A. Paciotti, M. Piccinini, G.J. Pyler, G.T.A. Squier, A. Vitale, A. Zoccoli, "A novel method to determine the initial sticking in dt-fusion," Proceedings of An International Symposium on Muon Catalyzed Fusion, p. 35-37, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

10. Steven E. Jones, Alan N. Anderson, "Review of Muon Catalyzed Fusion and New LAMPF Results," Proceedings of An International Symposium on Muon Catalyzed Fusion, p. 13-22, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

11. S.E. Jones, Investigation of Anomalous Particle Emissions in Solid/Deuterium Systems, Abstract for Workshop on Anomalous Nuclear Effects in Deuterium/Solid Systems, 22-24 October, Brigham Young University, Provo, Utah.

REFERENCES

1. C.D. Van Siclen and S.E. Jones, "Piezonuclear Fusion in Isotopic Hydrogen Molecules," Journal of Physics G. Nucl. Phys. 12: 213-2212 (1986).

2. International Progress Review on "Anomalous Nuclear Effects in Deuterium/Solid Systems," Brigham Young University, 22-24 October 1990. Proceedings to be published by American Institute of Physics.

3. Pool, Robert, "Cold Fusion: Only the Grin Remains," Science 250: 754 (1990).

4. Czirr, J. Bart and Gary L. Jensen, "High Efficiency Neutron Spectrometers and Detectors," Bull. Amer. Phys. Soc. 35(8): 1673 (1990).

5. S.E. Jones, E.P. Palmer, J.B. Czirr, D.L. Decker, G.L. Jensen, J.M. Thorne, and S.F. Taylor & J. Rafelski, "Observation of Cold Nuclear Fusion in Condensed Matter," Nature 338: 737-740 (1989).

6. A. Bertin, M. Bruschi, M. Capponi, S. DeCastro, U. Marconi, C. Moroni, M. Piccinini, N. Semprini-Cesari, A. Trombini, A. Vitale, A. Zoccoli, S.E. Jones, J.B. Czirr, G.L. Jensen and E.P. Palmer, "Experimental evidence of cold nuclear fusion in a measurement under the Gran Sasso Massif," Il Nuovo Cimento 101: 997-1006 (1989).

7. Wolf, K. L., "Neutron Emission and the Tritium Content Associated with Deuterium Loaded Palladium and Titanium Metals," Proceedings of the Workshop on Cold Fusion Phenomena, Santa Fe, NM, May 23-25, 1989.

8. Takahashi, Akito, et al, "Emission of 2.45 MeV and High Energy Neutrons from a D2O-Pd Cell under Biased-Pulse Electrolysis," submitted to J. Nucl. Science and Technology, 1990.

9. A. Bertin, M. Bruschi, M. Capponi, S. DeCastro, U. Marconi, C. Moroni, M. Piccinini, N. Semprini-Cesari, A. Trombini, A. Vitale, A. Zoccoli, S.E. Jones, J.B. Czirr, G.L. Jensen and E.P. Palmer, "First Experimental Results at the Gran Sasso Laboratory on Cold Nuclear Fusion in Titanium Electrodes," J. Fusion Energy 9 (1990). (in press)

10. H.O. Menlove, M.M. Fowler, E. Garcia, A. Mayer, M.C. Miller, R.R. Ryan, and S.E. Jones, "Measurement of Neutron Emission from Ti and Pd in Pressurized D_2 and D_2O Electrolysis Cells," J. Fusion Energy 9 (1990). (in press).

11. S.E. Jones, "Anomalous Neutron Emission from Metal-Deuterium System," Proceedings of An International Symposium on Muon Catalyzed Fusion, p.97-102, Keble College, Oxford, Rutherford Lab. Publication RAL-90-022, May 1990.

12. H.O. Menlove, M.M. Fowler, E. Garcia, A. Mayer, M.C. Miller, R.R. Ryan, and S.E. Jones, "Update on the Measurement of Neutron Emission from Ti Samples in Pressurized D_2 Gas," Proceedings of NSF/EPRI workshop (Oct. 1989).

13. E. Cecil, et al, Proceedings Sante Fe Workshop on Cold Fusion Phenomena, J. Fusion Energy 9 (November 1990).

14. M.A. Paciotti, S.E. Jones et al., "First Direct Measurement of alpha-muon Sticking in dt-muon catalyzed fusion," Muon Catalyzed Fusion 1988 (S.E. Jones, J. Rafelski, H.J. Monkhorst editors), AIP #181 (1989).

15. J. Davies, J.B.A. England, G.J. Pyle, G.T.A. Squier, F. D. Brooks, W.A. Cilliers, A. Bertin, M. Bruschi, M. Piccinini, A. Vitale and A. Zoccoli, S.E. Jones, V.R. Bom, C.W.E. van Eijk, H. de Haan, A.N. Anderson, M.A. Paciotti, G.H. Eaton, B. Alper, "A Direct Measurement of the Alpha-Muon Sticking Coefficient in Muon-Catalyzed d-t Fusion," J. Phys. G: Nucl. Part. Phys. 16: 1529-1537 (1990).

16. Iyengar, P.K., Cold Fusion Results in Barc Experiments, Fifth International Conference on Emerging Nuclear Energy Systems, Karlsruhe, Federal Republic of Germany, July 3-6, 1989.

17. Leggett, A.J., and G. Baym, "Exact Upper Bound on Barrier Penetration Probabilities in Many-Body Systems: Application to 'Cold Fusion'," Phys. Rev. L 63(2): 191-194 (1989).

18. S.E. Jones, et al., "Anomalous Nuclear Reactions in Condensed Matter: Recent Results and Open Questions," Proceedings Sante Fe Workshop on Cold Fusion Phenomena, J. Fusion Energy 9: 199-209 (November 1990).

19. Craig, H. and J.E. Lupton, The Sea, v. 7 (ed., Emiliani, C.) Ch. 11 (Wiley, New York, 1981).

ANOMALOUS NUCLEAR EFFECTS IN DEUTERIUM/SOLID SYSTEMS
An International Progress Review
Sponsored by the Electric Power Research Institute,
U.S. Department of Energy and Brigham Young University
22-24 October 1990

Brigham Young University
BYU Conference Center, Auditorium
Provo, Utah 84602

SUNDAY 7:00 p.m. - 9:00 p.m. Informal Reception, Excelsior Hotel Executive Board Room, 101 West 100 North, Provo.

MONDAY Talks ≤ 20 minutes each, up to 5 minutes for questions

Morning 8:15 a.m.- 12:00 p.m.
Welcome: J. Bevan Ott, Associate Academic Vice President, Brigham Young University

Neutron Measurements: W. Meyerhof, K. Nagamine, Chairs

H. Menlove "Reproducible Neutron Emission Measurements From Ti Metal in Pressurized D_2 Gas" (Los Alamos)
M. Paciotti "Sample Preparation for Reproducible Neutron Bursts" (Los Alamos)
J.B. Czirr "High-Efficiency Neutron and Charged Particle Spectrometers and Detectors" (BYU)
S.E. Jones "Investigation of Anomalous Particle Emissions in Solid/Deuterium Systems" (BYU)
K. Wolf Neutron emission studies (Texas A & M Univ.) (12 minutes)

(15 min. break)

F. Scaramuzzi "Emission of Neutron Bursts from a Titanium -Deuterium Gas System in A High-Efficiency Low-Background Experimental Setup" (Frascati-Italy)
R. Zhu "Experimental Study on Anomalous Neutron Production in Deuterium/Solid System" (Inst. Atomic Energy-China)
W. Meyerhof "Statistical Analysis of A 'Cold Fusion' Experiment" (Stanford Univ.)
A. Takahashi "Neutron Spectra from D_2O-Pd Cells with Pulse Electrolysis" (Osaka Univ, Japan)

LUNCH 12:00 p.m. (The Morris cafeteria is 200 m South of Conference Center)

Afternoon 1:15 p.m.
Charged Particle Detection: J. Ziegler, E. Cecil - Chairs

E. Cecil "Observation of Charged Particle Bursts from Deuterium Loaded Ti Thin Foils" (Colorado School of Mines)
G. Chambers "Search for Energetic Charged Particle Reaction Products During Deuterium Charging of Metal Lattices" (Naval Research Lab.)

R. Taniguchi "High Sensitivity Measurement of Charged Particle Emission with use of the Pulsed Electrolysis Method" and "Relation between Charged Particle Emission Induced Current Pulse Noise on the Electrolysis Electrode" and (Advanced Research Lab. - JAPAN)

E. Lopez "Search for Charged-Particle d-d Fusion Products in an Encapsulated Pd Thin Film"(San Francisco Univ.)

X.Z. Li "The Precursor of "Cold Fusion" Phenomenon in Deuterium/Solid Systems" (Tsinghua Univ.-China)

(15 minute break)

Afternoon, approximately 3:25 p.m.

Tritium Measurements: F. Scaramuzzi, G. Miley - Chairs

M. Srinivasan BARC results (BARC-India)

K. Wolf "On the Observation of Tritium from the Electrolysis of Heavy Water" and "A Search for Charged-Particle Emission from Deuterated Titanium Alloys"(Texas A & M Univ.)

E. Storms "The Effect of Hydriding on the Physical Structure of Palladium and on the Release of Contained Tritium" (Los Alamos)

K. Cedzynska "Tritium Analysis of Palladium Samples" (NCFI-Univ. of Utah)

T. Claytor Tritium generation in Pd-Si systems; Gas and liquid analysis facilities for detection of tritium (Los Alamos)

C. Chien "Tritium Production by Electrolysis of D_2O" (Inst. Nuclear Energy Research-China)

O. Matsumoto "Tritium production process" (Aoyama Gakuin Univ. -Japan)

G. Miley Experiment: plasma focus for implantation (U. Illinois)

DINNER 6:30 p.m.(Buffet at Conference Center, Room 2260, no charge)

Evening 7:45 p.m. - 9:15 p.m.

Geophysical Considerations: F. Goff, E.P. Palmer - Chairs

P. Palmer "Cold Nuclear Fusion in the Earth" (BYU)

F. Goff "The Tritium Content of "Magmatic" Water Emitted from the Post-1980 Lava Dome, Mount St. Helens Volcano, Washington" (Los Alamos)

P. Britton "Preliminary Data from the Hamilton Shear Zone Project" (Reiss Foundation, MA)

G. McMurtry "Investigations of Tritium in Hotspot Volcanic Emissions as Evidence of Natural Cold Fusion Reactions in the Earth" (Univ. of Hawaii)

Vans leave for hotels at 9:30 p.m. from parking lot West of auditorium.

TUESDAY

Morning 8:00 a.m. - 12:15 p.m.
Talks: 20 minutes including questions
Theory: J. Rafelski, V. Belyaev - Chairs

G. Preparata Fractofusion revisited (NCFI-U.of Utah)
M. Jandel "Pressure Enhanced Fusion Rates in Lattice Channels" (Royal Inst. of Technology-Sweden)
Y. Kim "A Surface Fusion Mechanism and Optimal Conditions
M.Rabinowitz for Deuterium Fusion with Gas/Solid-State Fusion Devices" (Purdue Univ.)
"Neutron Bursts from High Voltage Discharge Between Palladium Electrodes in D_2 Gas"
"Hysteresis Effect and Fusion Burst Phenomena in Electrolysis and Gas/Solid-State Fusion Experiments"
"The Efimov Effect and the Anomalous Branching Ratio for Deuterium Fusion Reactions"
"Cluster-Transport Impact Fusion"
"The Effect of Electron Screening and Velocity distribution on Proton-Deuterium Fusion Rates in Physical Processes" (two papers)
W. Zakowicz "Low Energy Nuclear Resonance and Cold Fusion" (Univ. of Arizona)
M. Gajda "Astrophysical Limits on Low Energy Fusion" (Univ. of Arizona)

(15 minute break)

V. Belyaev Theoretical Studies (USSR Academy of Sciences)
M. Danos Theory of neutron transfer fusion (Nat. Inst. of Standards & Technology)
G. Shaw "Fluctuations and Nonreproducibility in Cold Fusion
(L. Fonda) from Free Quark Catalysis" (Univ. of Calif. Irvine)
X. Jiang Theory of Micropinch (Langhorn Univ.-China)
M. Gryzinski "Molecular Nature of Cold Fusion in Condensed Matter" (Inst. for Nuclear Studies-Poland)
J. Rafelski "Theoretical Prospects for CCF: Conventional Cold Fusion" (Univ. of Arizona)

GROUP PHOTOGRAPH - MEET ON OUTSIDE STAIRS NORTH OF AUDITORIUM IMMEDIATELY AFTER MORNING SESSION

LUNCH 12:15 p.m.

Afternoon 1:15 p.m.
Talks $\leq$ 20 minutes each, up to 5 minutes for questions
Neutrons: K. Wolf, A. Vitale - Chairs

V. Tsarev Experimental results on neutrons, protons, & theoretical model, geophysical (Lebedev Phys.Inst.)
F. Celani Measurements in the Gran Sasso Laboratory (INFN-Italy)
R. Anderson "Neutron Measurements in Search of Cold Fusion" (Los Alamos)

J. Granada "Neutron Measurement on ($Pd-D_2O$) electrolytic cells under pulsed current conditions" (Centro Atomico Bariloche-Argentina)

J. Jorne "Neutron Emission from Palladium Deuteride Under Supercritical Conditions" (Univ. of Rochester)

D. Gozzi "Neutron and Tritium Evidences in the Electrolytic Reduction of Deuterium on Pd Electrodes" (Univ. La Sapienza-Italy)

(15 minute break)

A. Bertin A Novel Apparatus to Search for Electrolytically Induced CF-Neutral Products in the Gran Sasso Lab (U. Bologna-Italy)

A. Lipson or V.Kuznetsov Generation of neutrons in mechanical effect on the metal-deuterium system, Observation of neutron in ultrasonic cavitation in deuterium-containing media (USSR Academy of Sciences)

E.Yamaguchi "Nuclear Fusion Induced by the Controlled Out-Transport of Deuterium in Palladium" (NTT Res. Lab-Japan)

A.C. Klein "Anomalous Heat Output from Pd Cathodes Without Detectable Nuclear Products" (Oregon State Univ.)

J.Montgomery "Correlated Nuclear and Thermal Measurements in D/Pd and H/Pd Systems" (Weber State College)

F. Fernandez (C. Sanchez) "Nuclear Effects in Electrolytically Deuterated Ti and Pd" (U. Autonoma de Madrid-Spain)

Y. Totsuka Kamioka experiments (Univ. Toyko-Japan) (12 minutes)

Evening: Banquet at Sundance Resort, Provo Canyon. Must purchase ticket by 9:00 a.m. Monday, Oct.22, 1990.
Buses depart at 6:15 p.m. from Conference Center, return at 9:00 p.m.
Speaker: Prof. Gary McMurtry, Hawaiian Institute of Geophysics, Univ. of Hawaii, "Chasing Anomalous Tritium Around Hotspot Volcanoes: The Ups and Downs of an Unequivocal Answer."

WEDNESDAY Papers allotted 20 minutes including questions

Morning 8:00 a.m.
Theory: Y. Kim, E. Tabet* - Chairs

P. Hagelstein "Coherent Fusion Reaction Mechanisms" (Res. Lab of Electronics, MIT)

E. Tabet "Developments of a Dynamical Model for Cold Fusion in Deuterated Palladium" (INFN-Italy)

P. Handel "Influence of Surface Tension, Nucleation Centers, and Electron Effective Mass on the Achievable Level of Electrolytic Deuterium Loading" (U. Missouri)

S.R. Chubb "Lattice Induced Nuclear Chemistry" (Research Systems)

M. Berrondo "Molecular Dynamics of Deuterium in Palladium Lattices" (BYU)

R. Bush "Production of Tritium, Neutrons, and Heat Based upon the Transmission Resonance Model (TRM) for Cold Fusion" (Cal. State Polytechnic Univ.)

(15 minute break)

G. Cerofolini "$(D^{+}+D^{+})2e^{-}$ Binuclear Atoms as Activated Precursors in Cold and Warm Fusion" (EniChem-Italy)
H. Takahashi "The Role of Coherency on D-D Fusion Reaction in PdDx" (Brookhaven Nat. Lab.)
T. Matsumoto "Progresses of NATTOH Model and New Particles Emitted during Cold Fusion" (Hokkaido U.-Japan)
V. Vysotskii (Kuz'min) "The theory of nonthreshold cold fusion in solids" (Kiev State Univ.-USSR)
M. Baldo* (INFN-Italy)
J. Cohen* Theoretical considerations (Los Alamos)

LUNCH 11:30 a.m.

Afternoon 12:45 - 5:00

<u>General Papers:</u> Nate Hoffman, H. Ikegami - Chairs

H. Ikegami Recent results of time-correlated signals from neutron detectors (Nat.Inst.Fusion Sci.-Japan)
F. Iazzi Neutrons detected using TOF (U. of Tolino-Italy)
N. Hawkins "Investigations of Mechanisms and Occurrence of Meteorologically Triggered Cold Fusion at the Chinese Academy of Sciences"(ChineseAcad.Sci-China)
E. Kuzmann "Investigation on Possibility of Cold Nuclear Fusion in Fe-Zr Amorphous Alloy" (Eotvos Univ.-Budapest)
S. Barrowes "Attempt to Confirm the X-ray Radiography Results Reported by S.Szpak et al." (NCFI - U of Utah)
N. Jevtic "The Change in the Isotope Ratio and a Spectroscopic Analysis of the Gas from Gas Load Experiments" (Stefan Institute-Yugoslavia)
D. Seeliger* "Evidence for the Production of DD-Fusion Neutrons During Electrolytic Infusion of Deuterons into a Palladium Cylinder" (U. Dresden-Germany)
F. Mayer* Neutron and tritium production (Ann Arbor, MI)
J.S.C. McKee "Neutron Emission from Low Energy Deuteron Injection of Deuteron-Implanted Metal Foils (Pd, Ti and In)" (U. of Manitoba-Canada)

(15 minute break)

<u>Discussion:</u> H. Menlove, M. Srinivasan - Chairs

D. Worledge (EPRI) - Summary of Conference

Contact Dr. Menlove to arrange to give a 5-minute presentation, which may be followed by short discussion.

Wed. after session, approx. 5:00 p.m.: Tour of BYU Labs

*Not yet confirmed

END

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