Fusion technology

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EXPERIMENTAL DEVICES

NUMERICAL SIMULATIONS OF *IN SITU* NEUTRON DETECTOR CALIBRATION EXPERIMENTS ON THE TOKAMAK FUSION TEST REACTOR

L. P. Ku
H. W. Hendel
S. L. Liew
J. D. Strachan

L. P. Ku (top right) (BS, nuclear engineering, National Tsing-Hua University, Taiwan, 1970; MS, 1973, and PhD, 1976, nuclear engineering, Columbia University) is a staff member at Princeton Plasma Physics Laboratory (PPPL). He has been with the Tokamak Fusion Test Reactor (TFTR) and TFM design team since 1978 where he is responsible for nuclear radiation analysis and shielding design. His current interests include neutron physics, transport theory, fusion neutronics, and fusion reactor system analysis. **H. W. Hendel** (top left) (PhD, physics, Technical Institute Munich, Federal Republic of Germany, 1953) is a principal research physicist at the PPPL, on leave from the RCA David Sarnoff Research Center, Princeton, New Jersey. His main field of research is the study of neutron source strength on the TFTR. **S. L. Liew** (bottom right) (MS and DES, nuclear engineering, Columbia University) is a project engineer in the Engineering Analysis Division of the PPPL. His current interests include fusion neutronics and nuclear design analysis. **J. D. Strachan** (bottom left) (PhD, University of British Columbia, Canada, 1972) has been a physicist at PPPL since 1975. His research interests include confinement processes and nuclear diagnostics in fusion research, especially tokamaks.

CALIBRATION OF THE NEUTRON ACTIVATION SYSTEM ON THE FRASCATI TOKAMAK UPGRADE: COMPARISON BETWEEN MEASURED AND CALCULATED ACTIVATION RESPONSE COEFFICIENTS

Maurizio Angelone
Paola Batistoni
Marcello Martone
Mario Pillon
Massimo Rapisarda
Sofia Rollet

Maurizio Angelone (right) (Dr., physics, University of Rome, Italy, 1982) worked for the Italian Commission for Nuclear and Alternative Energy Sources (ENEA) at the Casaccia Nuclear Centre. His research was devoted to neutron dosimetry for fast reactors using the absolute radiometric technique, and he also worked on fast reactor shielding using conventional and Monte Carlo transport calculations. In 1989, he moved to the Frascati

Fusion Centre, where he is involved in neutron spectra measurements and in the construction of a neutron generator. **Paola Batistoni** (top right) (Dr., physics, University of Florence, Italy, 1982) joined ENEA in 1984 as a member of the Applied Neutronics Division at the Frascati Fusion Centre. Her research interests are in the area of neutron diagnostics for magnetically confined fusion devices and in the physics of fusion products, especially with respect to experiments exploitation, plasma simulations, alpha-particle confinement calculations, and neutron transport calculations. **Marcello Martone** (top left) (Dr., physics, University of Rome, Italy, 1957; habilitation plasma physics, University of Rome, Italy, 1969) has worked at ENEA since 1959. He was head of the Plasma Diagnostic Laboratory from 1975 to 1982 and is currently head of the Applied Neutronics Division of the fusion department. His present interests include the development and the exploitation of neutron diagnostics for magnetically confined thermonuclear plasmas. **Mario Pillon** (center right) (Dr., nuclear engineering, University of Rome, Italy, 1982) has been a member of the Applied Neutronics Division at ENEA (Frascati) since 1984. His research is in the field of neutron diagnostics and related neutron transport calculations for tokamaks. He is also working on benchmark experiments for the validation of neutron calculation applied to the fusion reactor blanket design and is responsible for the construction of a neutron source generator. **Massimo Rapisarda** (bottom left) (Dr., physics, University of Palermo, Italy, 1979) worked initially in X and gamma astronomy on the observations of the European Satellite Cos-B. Since 1983, he has been a researcher in the Applied Neutronics Division at ENEA (Frascati), working in the field of neutron diagnostics on tokamaks. His research is mainly experimental, in the fields of time-resolved neutron flux measurements and activation measurements, with applications to tokamaks. **Sofia Rollet** (bottom right) (Dr., physics, University of Torino, Italy, 1987) has worked on personal neutron dosimetry. A fellow of the Associazione per lo Sviluppo Scientifico e Tecnologico del Piemonte since 1988, she is currently a guest scientist at the Applied Neutron Division of ENEA (Frascati), working on neutron diagnostics.

ICF DRIVER TECHNOLOGY

NUMERICAL INVESTIGATIONS OF ELECTRON BEAM ENERGY DEPOSITION INTO THE GAS MEDIUM OF AN EXCIMER LASER

M. I. Avramenko
V. A. Burtsev
P. A. Ivanov
N. I. Kazachenko
V. S. Kuznetsov

M. I. Avramenko (top) [physics, Leningrad Polytechnical Institute (LPI), USSR, 1956; candidate for technical sciences, 1969] is a senior staff member of the D. V. Efremov Scientific and Research Institute of Electrophysical Apparatus (SRIEA). His primary work is in the area of charged-particle beam physics. **V. A. Burtsev** (center) (physics, LPI, USSR, 1958; candidate for physical and mathematical sciences, 1970; doctorate, 1982) is head of the pulsed fusion device physics and engineering department of the SRIEA. **P. A. Ivanov** (bottom) (electron optics engineering, Leningrad Uljanov, Lenin Electron Engineering Institute, USSR, 1980) works in the area of mathematical simulation of

electromagnetic fields. **N. I. Kazachenko** (right) (physics, Leningrad State University, USSR, 1975) is a scientific worker at the SRIEA. His present work is the simulation of charged-particle beam penetration through matter. **V. S. Kuznetsov** (left) (physics, LPI, USSR, 1956; candidate for technical sciences, 1964; doctorate, 1972) is head of the laboratory for mathematical simulation of charged-particle accelerators and laser for fusion at the SRIEA.

BLANKET ENGINEERING

REACTION RATE DISTRIBUTIONS AND RELATED DATA IN THE FUSION NEUTRON SOURCE PHASE II EXPERIMENTS: COMPARISON OF MEASURED AND CALCULATED DATA

R. T. Santoro
R. G. Alsmiller, Jr.
J. M. Barnes

R. T. Santoro (top) (MS, University of Tennessee, 1967) is a member of the Engineering Physics Division at Oak Ridge National Laboratory (ORNL). His current interests are in neutron transport and neutron interactions with matter related to fusion reactor design. He is currently involved in the neutronic investigations of reactor blanket and shield design, neutron beam injectors (NBIs), radiation streaming from penetrations, radiation effects in materials, and the analysis of integral experiments for fusion reactor shields. **R. G. Alsmiller, Jr.** (center) (PhD, University of Kansas, 1957), is leader of the Applied Physics and Fusion Reactor Analysis Group of the Engineering Physics Division at ORNL. For several years he has directed the theoretical research in this division in the areas of high-energy nuclear reactions, high-energy nuclear transport, and fusion reactor neutronics. **J. M. Barnes** (bottom) (BS, University of Arkansas, 1965) is a member of the Computer Sciences Division at ORNL. He is involved in the neutronic analysis of fusion reactor blankets and shields, NBIs, radiation effects in materials, and the analysis of integral experiments for fusion reactor shields.

PRELIMINARY ANALYSES OF SWINPC BERYLLIUM NEUTRON MULTIPLICATION INTEGRAL EXPERIMENTS

Lian-Yan Liu
Edward T. Cheng

Lian-Yan Liu (right) [BS, nuclear physics, Fudan University, People's Republic of China (PRC), 1984; MS, nuclear engineering physics, Institute of Applied Physics and Computational Mathematics (IAPCM), PRC, 1987] is currently with the IAPCM and is engaged in the fusion-fission hybrid reactor research project. His major research interests are nuclear data testing, development of neutronics software for hybrid blankets, and sensitivity analysis. **Edward T. Cheng** (left) (PhD, nuclear engineering, University of Wisconsin, 1976) is currently with TSI Research, Solana

Beach, California. His main research activities are related to fusion energy development, with emphasis on blanket and shield neutronics, radioactivity, and nuclear data.

SAFETY/ENVIRONMENTAL ASPECTS

SIMULATION OF CLEANUP OF TRITIATED WATER IN FUSION REACTOR-SIZE CONCRETE ENCLOSURES

Shigeo Numata
Yasuhiko Fujii
Makoto Okamoto

Shigeo Numata (top) (M. Eng., nuclear engineering, Kyoto University, Japan, 1984) is a researcher at the Shimizu Corporation Institute of Technology. He has worked in the areas of neutron spectroscopy and radiation shielding. His current interests are material interaction and decontamination of tritium in buildings. **Yasuhiko Fujii** (center) (Dr. Eng., nuclear engineering, Tokyo Institute of Technology, Japan, 1973) is an associate professor at the Tokyo Institute of Technology. His current interest is in the area of fusion chemistry. **Makoto Okamoto** (bottom) (Dr. Eng., nuclear engineering, Tokyo Institute of Technology, Japan, 1966) is a professor in the nuclear reactor research laboratory at Tokyo Institute of Technology.

DIVERTOR SYSTEMS

TEST PARTICLE CALCULATIONS FOR THE TEXAS EXPERIMENTAL TOKAMAK WITH RESONANT MAGNETIC FIELDS

Alan J. Wootton
Steven C. McCool
Shaobai Zheng

Alan J. Wootton (top) (BSc, physics, 1969, and PhD, experimental plasma physics, 1972, London University, United Kingdom) has been director of the Texas Experimental Tokamak (TEXT) and assistant director of experimental programs at the Fusion Research Center at the University of Texas–Austin since 1984. Currently, his main research interest includes the study of all aspects of plasma physics. **Steven C. McCool** (bottom) (BSc, physics, University of Illinois, 1974; PhD, physics, University of Texas–Austin, 1982) is engaged in research on TEXT at the University of Texas–Austin. His current interests include the study of low-Z pellet injection and the effects of magnetic perturbations on plasma transport. **Shaobai Zheng** (photo not available) [Degree, Beijing University, People's Republic of China (PRC), 1962; PhD, Institute of Physics, PRC, 1966] is a research professor at Beijing University and has vast experience in the construction and operation of the first tokamak in the PRC.

FUSION PRODUCT MOMENTUM TRANSFER TO INERTIALLY CONFINED PLASMA

David L. Galbraith
Terry Kammash

David L. Galbraith (top) [BS, engineering physics, Cornell University, 1957; MS, 1959, and PhD, 1977, nuclear engineering, University of Michigan (UM)] is currently an assistant research scientist at UM. His areas of interest include theoretical analysis of fusion reactors and computer programming. **Terry Kammash** (BS, aeronautical engineering, Pennsylvania State University, 1952; PhD, nuclear engineering, UM, 1958) served as a consultant on controlled fusion research at Lawrence Livermore National Laboratory, Argonne National Laboratory, Oak Ridge National Laboratory, and Battelle Pacific Northwest Laboratories.

A MODEL FOR THE EDGE PLASMA NEAR A POLOIDAL DIVERTOR

William L. Barr

William L. Barr (PhD, physics, University of California–Berkeley, 1957) is a member of the advanced mirror systems (fusion) group at Lawrence Livermore National Laboratory, where he is currently analyzing end plasma and direct energy recovery for the Mirror Advanced Reactor Study. He has developed and tested plasma direct energy converters for mirror end loss plasma and beam direct converters for the ions from neutral beam injectors.

AN EXTENSION OF THE THEORY FOR NEUTRAL-BEAM-DRIVEN CURRENTS IN TOKAMAKS

W. M. Stacey, Jr.
John Mandrekas

W. M. Stacey, Jr. (top) [BS, physics, 1959, and MS, nuclear science, 1963, Georgia Institute of Technology (GIT); PhD, nuclear engineering, Massachusetts Institute of Technology, 1966], is Callaway Professor of Nuclear Engineering at GIT and serves as senior U.S. participant to the International Atomic Energy Agency International Tokamak Reactor Workshop. **John Mandrekas** (Dipl., mechanical and electrical engineering, National Technical University of Athens, Greece, 1979; MS, 1984, and PhD, 1987, nuclear engineering, University of Illinois) is a research scientist at the Fusion Research Center, GIT. His current research interests include neutral beam current drive and impurity transport in tokamaks, stability and burn control of fusion reactors, and theoretical plasma physics.

THERMONUCLEAR IGNITION IN THE NEXT-GENERATION TOKAMAKS

Jean Johner

Jean Johner (Ecole Centrale des Arts et Manufactures de Paris, France, 1973; doctorate, Université de Paris-Sud, France, 1980) has been a member of the Theory Section of the Département de Recherches sur la Fusion Contrôlée of the Commissariat à l'Energie Atomique since 1973. He has been in charge of the thermal energy confinement time studies for Tore-Supra since 1989. His interests include theory, microinstabilities and transport in tokamaks, cyclotronic and bremsstrahlung radiation in plasmas, and ignition criteria from empirical energy confinement scaling laws.

BEAM PROFILE CONTROLLER IN A NEUTRAL BEAM SYSTEM

Shigeru Tanaka
Yoshihiro Ohara
Shin Yamamoto

Shigeru Tanaka (top) (PhD, instrumentation engineering, Keio University, Japan, 1983) is a senior scientist in the Department of Thermonuclear Fusion Research (DTFR) at the Japan Atomic Energy Research Institute (JAERI). He has worked on the development of ion sources and the neutral beam injector (NBI) for the JT-60 for ~10 years. He is now engaged in the design of an NBI as well as development of plasma-facing components for next-generation tokamaks. **Yoshihiro Ohara** (center) (PhD, nuclear engineering, University of Tokyo, Japan, 1979) works on the development and design of a negative ion source and an NBI for next-generation tokamaks as a senior scientist in the DTFR at JAERI. **Shin Yamamoto** (bottom) (PhD, physics, Kyoto University, Japan, 1979) is a principal scientist on the Fusion Experimental Reactor Team at JAERI. He is now engaged in the design and development of diagnostics system for the next-generation tokamaks as well as tokamak physics.

COLD FUSION

ON NUCLEAR REACTIONS IN DEFECTS

John K. Dienes

John K. Dienes (BA, mathematics, Pomona College, 1950; MS, 1958, and PhD, 1961, mechanical engineering, California Institute of Technology) is a specialist in applied mechanics at Los Alamos National Laboratory. His theoretical background includes basic work in solid and fluid mechanics, random processes, and biomechanics. More recently, his work has involved studies of fracture mechanics, the theory of fragmentation, weapons design, and weapons effects using both finite difference and analytic methods. He is currently developing a unified theory of deformation that accounts for both brittle and ductile behavior through a wide range of pressure, temperature, strain, and strain rate. His professional interests include continuum mechanics, especially the theory of anisotropic media, material instabilities and failure, the behavior of defects, solution of applied problems, the formulation of new methods, and more precise descriptions of the foundations.

ELECTROPIONICS AND FUSION

John P. Kenny

John P. Kenny (PhD, theoretical physics, Clemson University, 1968) is professor of physics and astronomy at Bradley University, Peoria, Illinois.

NUCLEAR ENERGY RELEASE IN METALS

Frederick J. Mayer
John R. Reitz

Frederick J. Mayer (top) (PhD, plasma physics, Case Institute of Technology, 1968) is president of Mayer Applied Research, Inc. (MARI), a research company based in Ann Arbor, Michigan. Before founding MARI, he directed fusion experiments, plasma diagnostics, and advanced research at KMS Fusion. Mayer currently consults on applying physics to industry with companies as well as with national laboratories in the areas of inertial and magnetic fusion, plasma physics, and nuclear physics. **John R. Reitz** (PhD, theoretical physics, University of Chicago, 1949) was a member of the Theoretical Division, Los Alamos Scientific Laboratory, from 1949 to 1953. He was a faculty member at Case Institute of Technology (now Case-Western Reserve University) from 1954 to 1965 and was appointed professor of physics in 1960. In 1965 he became manager of the physics department research staff at the Ford Motor Company where he remained until his retirement in 1987. He is currently a consulant in physics.

SURFACE REACTION MECHANISM FOR DEUTERIUM-DEUTERIUM FUSION WITH A GAS/SOLID-STATE FUSION DEVICE

Yeong E. Kim

Yeong E. Kim (PhD, University of California-Berkeley, 1963) was employed at Bell Laboratories from 1963 to 1965. From 1965 to 1967, he was a postdoctoral fellow at Oak Ridge National Laboratory. Since 1967, he has been professor of physics at Purdue University. He was a member of the National Science Foundation review panel for the Stanford Physics Accelerator and has been a consultant for Los Alamos National Laboratory since 1974. His interests are in theoretical nuclear physics, gravitational theory, theoretical geophysics, and nuclear fusion.

MICROSCOPIC OBSERVATIONS OF PALLADIUM USED FOR COLD FUSION

Takaaki Matsumoto

Takaaki Matsumoto (MS, nuclear engineering, Kyoto University, Japan, 1966) studied neutron and nuclear reactor physics at the Kyoto University Research Reactor Institute from 1966 to 1973. Since 1973 he has been with Hokkaido University as an associate professor of nuclear engineering. His interests include nuclear transmutation of radioactive wastes and nuclear alchemy.