ENS Fusion technology

SPECIAL SECTION AUTHORS — MARCH 1985

PLASMA HEATING AND CURRENT DRIVE

OVERVIEW OF RADIO-FREQUENCY HEATING AND CURRENT DRIVE IN TOKAMAKS

Patrick L. Colestock

Patrick L. Colestock [BS, electrical engineering, Michigan State University, 1970; MS, electrical engineering, 1971, and mathematics, 1973, University of Michigan (UM); PhD, plasma physics, UM, 1975] was a research associate with Rensselaer Polytechnic Institute at the Oak Ridge National Laboratory from 1976 to 1977. In 1977, he joined the Princeton Plasma Physics Laboratory (PPPL) where he worked on ion cyclotron range of frequency heating in tokamaks. From 1982 to 1983, he was a senior scientist with McDonnell-Douglas Corporation where he worked on the development of radio-frequency (rf) heating methods for fusion. In 1983, he rejoined the PPPL where he is working on rf heating and current drive applications in tokamaks.

ELECTRON CYCLOTRON RESONANCE HEATING: PRINCIPLES, ENGINEERING, AND EXPERIMENTS

Z. X. Zhang
C. X. Chen

Z. X. Zhang (top) (BS, Nan-Kai University, China, 1964; graduate study, spectroscopy, Institute of Physics, Academia Sinica, 1967) worked at the Institute of Physics from 1968 to 1980 performing experimental studies at theta pinch and tokamak machines, particularly in the areas of plasma feedback control, diagnostics, and high-voltage engineering. From 1981 to 1983 he worked in Garching at Stellarator W VII-A in the field of electron cyclotron resonance heating as an Alexander Humboldt stipendiary. **C. X. Chen** (graduate, Moscow State University, 1958) is a research professor at the Plasma Physics Laboratory, Institute of Physics, Academia Sinica. Since 1959 he has worked at Academia Sinica and initiated and organized research activities in several important fields, such as statistical physics, solid lasers, and organic conductors. Since 1965 he has been active in research in the Chinese fusion program. Between 1971 and 1974 his group succeeded in building and operating the first tokamak in China, CT-6. He has served as vice-president of the All-China Nuclear Fusion and High-Temperature Plasma Society since 1980.

LOWER HYBRID HEATING AND CURRENT-DRIVE: EXPERIMENTAL RESULTS VERSUS THEORETICAL EXPECTATIONS

Jean-Georges Wégrowe

Jean-Georges Wégrowe (Ing. ESE, Paris, 1960; Docteur-Ingenieur, Paris, 1963) has been employed by the European Community since 1965 at the Max-Planck Institut für Plasmaphysik near Munich, Federal Republic of Germany. He has been in charge of a common French-German Tokamak/Stellarator project (WEGA 1972-1981) devoted to the study of radio-frequency plasma heating. This experiment was run at the Commissariat à l'Energie Atomique at Grenoble, France. He is currently a member of the NET team, which he joined at its creation in 1983.

ELECTRON CYCLOTRON RESONANCE HEATING EXPERIMENTS IN THE WENDELSTEIN VII-A STELLARATOR

V. Erckmann
G. Janzen
W. Kasparek
G. Müller
P. G. Schüller
K. Schwörer
M. Thumm
R. Wilhelm
W VII-A Team

Photographs and biographies are not available.

COUPLING TO FAST WAVES NEAR THE LOWER HYBRID FREQUENCY

R. McWilliams
Y. Mok

R. McWilliams (top) (BS, physics, University of California, Irvine; PhD, plasma physics, Princeton University, 1980) is a member of the physics faculty at the University of California, Irvine. His research interests revolve around experimental plasma physics work in radio-frequency current drive, cross-field transport, and laboratory simulation of the magnetosphere. **Y. Mok** (BA, physics and mathematics, University of California, Berkeley; PhD, plasma physics, University of Maryland, 1978) is a native of Hong Kong. He joined the University of California, Irvine in 1979. His research interests include plasma/radiation interaction, astrophysics, magnetic reconnection and energy transport in the solar atmosphere, and solar flare phenomenon.

NONLINEAR ION HEATING IN LOWER HYBRID CURRENT DRIVE

Vincent S. Chan
Chuan Sheng Liu

Vincent S. Chan (top) (PhD, plasma physics, University of Wisconsin-Madison, 1975) is associated with GA Technologies, Inc., where he is now manager, Plasma Heating Branch, Department of Theoretical Science. His research interests include wave heating of tokamaks at the cyclotron and lower hybrid (LH) frequencies, transport induced by auxiliary heating, and modification of magnetohydrodynamic activities by waves. He has recently worked on the nonlinear theory of LH current drive at low densities, stabilization of tearing modes using electron cyclotron heating, and impurity transport in ion cyclotron resonance heating. **Chuan Sheng Liu** (PhD, physics, University of California-Berkeley, 1968) has been manager of the Department of Theoretical Science at GA Technologies, Inc. since 1981, and a professor of physics at the University of Maryland since 1975, where he helped build one of the largest plasma theory groups in the country. His research contributions include the theories of

parametric instabilities in laser/plasma interactions, solitons in plasma, runaway electron dynamics, and nonclassical transport processes in tokamaks. Before joining the University of Maryland, Dr. Liu was invited by Professor Marshall Rosenbluth to be a long-term member at the Institute for Advanced Studies at Princeton University, where they collaborated on the theories of wave transport in tokamaks and parametric instabilities.

NONLINEAR GENERATION OF WAVES AT LINEAR RESONANCES

J. L. Sperling

J. L. Sperling (PhD, plasma physics, Princeton University, 1975) is a principal scientist in the Fusion Division at JAYCOR and has contributed to the development of radio-frequency heating techniques in tokamaks and bumpy tori. He was formerly associated with the fusion group at General Atomic.

EXCITATION OF ION CYCLOTRON RESONANCE FREQUENCY WAVES IN TOKAMAKS BY WAVEGUIDE LAUNCHER

Kimitaka Itoh
Sanae-Inoue Itoh
Atsushi Fukuyama

Kimitaka Itoh (top) [BS, 1974; MS, 1976; and PhD, 1979, physics, University of Tokyo (UT)] is a research physicist in the Plasma Theory Laboratory of Japan Atomic Energy Research Institute. He has worked on the theory of instabilities and transport of magnetic confinement plasmas. **Sanae-Inoue Itoh** (center) (BS, 1974; MS, 1976; and PhD, 1979, physics, UT) has been on the faculty of Institute for Fusion Theory of Hiroshima University since 1979 and became an assistant professor in 1983. She has worked on magnetic confinement theory. Her current interest involves the thermodynamical approach for confined plasmas. **Atsushi Fukuyama** (bottom) [BS, electronics, 1974; MS, 1976; and PhD, 1981, Kyoto University) has been a research associate in the Department of Electronics at Okayama University since 1977. He has been involved in the theoretical and numerical analysis of radio-frequency heating and the associated transport in fusion plasmas.

RAY TRACING IN THE COMPACT TORUS

E. C. Morse
Z. Mikic

E. C. Morse (top) (BS and PhD, University of Illinois) is presently an assistant professor of nuclear engineering at the University of California at Berkeley. **Z. Mikic** is currently completing his graduate studies in the Department of Nuclear Engineering, at the University of California, Berkeley. His PhD thesis investigates the effect of finite ion Larmor radius on the stability of compact toroidal plasmas for fusion applications.

NEUTRON EMISSION BY PLASMA CAVITONS

NATURE OF RESONANCES LEADING TO HIGH-PRESSURE CAVITONS

Richard T. Schneider
Peter H. Handel

Richard T. Schneider (right) (PhD, physics, University of Stuttgart, 1961) is a professor of nuclear engineering sciences at the University of Florida. His research interests include plasma spectroscopy. In the past he has worked on optical properties of uranium vapor, thermodynamic properties of UF_6, and on the

development of the nuclear pumped laser. **Peter H. Handel** (right) (MS, atomic and theoretical physics, Bucharest; PhD, solid-state theory, Bucharest, 1965) was a scientist at the Institute of Physics of the Romanian Academy (1960-1967), a scientist at the Max V. Laue–Paul Langevin Institute-Munich (1967-1969), and has been a professor of physics at the University of Missouri–St. Louis since 1969. He is best known for the quantum theory of $1/f$ noise (1975) and for the infrared divergence effect of $1/f$ fluctuations in physical cross sections and process rates. He is also known for his polarization-catastrophe theory of atmospheric electricity (1981) and many other contributions to solid-state, plasma, and noise theory.