BOOK REVIEWS

Selection of books for review is based on the editor's opinions regarding possible reader interest and on the availability of the book to the editor. Occasional selections may include books on topics somewhat peripheral to the subject matter ordinarily considered acceptable.

Some Aspects of the Study of Gas-Discharge Plasma and Production of High Magnetic Fields

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Publisher	National Technical Information Service, Springfield, Virginia 22161 (TT 75-52133, DOE-tr-73, UC-20)
Pages	175
Price	$16.50
Reviewer	E. B. Hooper, Jr.

This book is a 1981 translation of papers on topics in magnetohydrodynamics (MHD) presented in 1965 at the Institute of Electromechanics Conference in the Soviet Union. Some of the work will be of interest to specialists in high pressure, low temperature discharges. The remainder of the papers, on high-field and superconducting magnets, are so out of date as to be of little significant value.

The Soviet Union has conducted extensive research into advanced methods of energy production, including MHD. The immediate goal of the MHD research is for power generation using conventional fuels. Successful achievement of economic MHD power generation would also be significant to the fusion program where it could increase the efficiency of electricity production, perhaps by use as a topping cycle.

Application of MHD to fusion (or fission) power plants requires using a closed-cycle system rather than an open cycle in which combustion products are the working fluid. In the closed cycle a working gas such as helium is heated in the power plant, seeded with ~0.1% cesium to provide ionization, and expanded through a nozzle where electrical power is generated directly in a crossed magnetic field. After recovery of the residual heat in a bottom plant, the cesium is removed and the gas recycled using a compressor.

Significant enhancement of efficiency can be achieved if the ionization level in the expanding gas is greater than the thermal equilibrium level. This can be obtained by joule heating, that is, by running a discharge through the seeded gas. Understanding high pressure arc physics is thus a critical part of closed-cycle development.

Work on gas-discharge plasmas, such as that reported here, is directed toward developing practical understanding of high (gas) pressure ionized media to permit application to power plants. Stability of the plasma has proved a major impediment to closed-cycle MHD and is consequently a major part of the studies.

The reported work accordingly concentrates primarily on discharges at atmospheric pressures, usually with a seeding of cesium or other alkali metal vapor. The results attest to the difficulty of maintaining stability in such plasmas. Experiments and analysis are presented on the bending of an arc column due to gaseous convection (V. Yu. Baranov) and on theory (A. M. Dykhne) and experiments (A. F. Vitskas et al.) on contracted plasmas. Atomic radiation plays an important role in these plasmas: Consequences for equilibrium energy balance are considered (V. M. Batenim and V. F. Chinnov) and an instability resulting from radiative energy losses analyzed (A. D. Lebedev). Breakdown measurements in flowing argon in transverse magnetic fields are described by V. S. Borodin and F. G. Rutberg. Of final interest is the description of a high pressure plasma arc, the "three-phase plasmatron" by F. G. Rutberg and B. P. Leuchenko.

Because the work is now quite old (17 years), the book is recommended only to experts interested in the very special topics described. Workers in other branches of MHD will probably not find the reports useful. The subjects and analyses are not of sufficient value to most readers to warrant purchase of the book.

E. B. (Bickford) Hooper, Jr. (BS, 1959, and PhD, 1965, physics, Massachusetts Institute of Technology) is a physicist in magnetic fusion energy at Lawrence Livermore National Laboratory. He is presently involved with the experimental plasma physics of tandem mirrors and on the physics and design of advanced tandem mirrors. He has worked on a variety of topics in plasma physics and magnetic fusion including low frequency instabilities, confinement and heating of toroidal plasmas, diagnostics, and intense negative ion beams. During the course of experimentation, he has developed numerous plasma discharges for use in studying fundamental plasma physics and for startup mechanisms for plasma in the fusion regime. He spent a postdoctoral year at the Royal Institute of Technology (Sweden), has been employed as assistant professor of applied science at Yale University, and has taught graduate physics courses at the University of California, Davis, Livermore Extension.