5. DEPARTMENT OF PLASMA PHYSICS AND TECHNOLOGY

Head of Department: Prof. Marek Sadowski
phone: 7798678
e-mail: p05msa@cx1.cyf.gov.pl

Overviev

In 1996 the main activities of Department P-V (until December 1996 known as the Department of Thermonuclear Research) were concentrated on 5 topics:

1. Selected problems of plasma theory,
2. Studies of phenomena within high-current plasma concentrators,
3. Development of plasma diagnostic methods,
4. Studies in the field of fusion technology,
5. Research on new plasma-ion technologies.

Theoretical studies mainly concerned elementary processes occurring within a plasma, and particularly those within near-electrode regions of microwave discharges as well as those within near-wall layers (SOL) of tokamaks. We also developed computational packages for parameter identification and modelling of physical phenomena in pulse plasma coaxial accelerators. Some theoretical studies, e.g. the modelling of a cathode sheath in a magnetron sputtering device, were performed within the frame of a scientific collaboration with the Institut für Plasmaforschung at Stuttgart University, Germany.

Experimental studies were concentrated on the generation of a dense magnetized plasma in different high-current PF (Plasma Focus) facilities and small Z-Pinch devices. We carried out investigations of X-rays, relativistic electron beams (REBs), accelerated primary ions, and fast products of fusion reactions for deuterium discharges. Some experimental studies of high-temperature plasma were performed within the framework of the scientific collaboration with the Institute of Plasma Physics and Laser Microfusion in Warsaw, the Czech Technical University in Prague, the INFIP and IFAS Laboratories in Argentina, and the Institute of Plasma Physics in Kharkov, Ukraine.

Research on plasma diagnostics comprised the development of methods and equipment for studies of X-ray emission, pulsed electron beams, and fast ions, by means of classical and new techniques, e.g., using special Čerenkov-type detectors of electrons and solid-state nuclear track detectors (SSNTDs) of ions. New diagnostic techniques were developed within the frame of the collaboration with the Kurchatov Institute in Moscow, Russia, and the INFIP at the Buenos Aires University, Argentina.

Studies in the field of fusion technology concerned the design, construction, and testing of different high-voltage pulse generators. Those generators were used as pulsed power supply systems as well as simulation devices for studies of electromagnetic compatibility. We also developed special opto-electronic systems for control and data transmission. Research on high-voltage surge generators was supported by contracts with industrial laboratories (Institute of Energetics, APENA, and ELTEST).

Research on plasma-ion technology concentrated on the generation of pulsed high-power plasma-ion streams and their applications for the surface modification of different materials (semiconductors, pure metals and alloys). The material engineering studies were carried out in close collaboration with our P-IX Department and other domestic and foreign research centers, e.g. the Institute of Plasma Physics in Kharkov, Ukraine, and the Institute of Physics Ch.A.S. in Beijing, China. These studies are described in a separate chapter of this Annual Report.

The most important achievements of Department P-V in 1996 can be summarized as follows:

1. The development of a new model for the description of dynamic phenomena in a coaxial plasma accelerator and the adaptation of a conducting fluid model for the analysis of magnetron-type discharges.
2. Experimental investigations of correlations between the formation of hot-spots within a pinch column and the emission of X-ray pulses and fast e-beams, and in particular the empirical demonstration of X-ray polarization.
3. Detailed calibration measurements of different nuclear track ion detectors and the development of new Čerenkov-type electron detectors equipped with radiators made of diamond or rutil in order to decrease the energy threshold level down to about 50 keV.

Achievements in the field of plasma-ion technologies are described in another chapter prepared together with Department P-IX.