5 DEPARTMENT OF PLASMA PHYSICS AND TECHNOLOGY

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Overview

The activities of the Department in 2007 continued previous studies in the following fields of plasma physics, controlled nuclear fusion and plasma technology of surface engineering:

- Studies of physical phenomena in pulsed discharges in the Plasma–Focus (PF) and RPI–IBIS facilities;
- Development of selected methods for high-temperature plasma diagnostics;
- Research on plasma technologies;
- Selected problems of plasma theory and computational modelling.

As for the experimental studies particular attention was paid to the analysis of the correlation of X-ray pulses with pulsed electron beams and other corpuscular emissions from different Plasma-Focus (PF) facilities. A collisional–radiative model, taking into account the Stark effect and strong electric fields in the so called "hot–spot" regions of a pinch, was applied in those analyses. The main aim of these studies was to identify the physical phenomena responsible for the emission during the PF–type discharges. The emitted protons were also measured with nuclear track detectors. The measurements made it possible to obtain images of the regions, where the D–D fusion reactions occurred, as well as to determine the angular distribution of the emitted protons. Pulsed plasma streams were also investigated by means of time–resolved optical spectroscopy and corpuscular diagnostics.

In a frame of the EURATOM program, efforts were devoted to the development of diagnostic methods for tokamak–type facilities. Such studies include the design and construction of the 4–channel Cherenkov–type detection system for the TORE–SUPRA tokamak at CEA–Cadarache. In the meantime in order to collect some experience a new measuring head was especially prepared for experiments within small facilities. Other fusion–oriented efforts are connected with the application of the solid–state nuclear track detectors for investigation of protons from tokamak plasma and high–energy beams emitted from laser produced plasmas. Also the new materials for neutron activation measurements were tested within the JET tokamak at Culham.

A field of research activity was related to plasma technology. Efforts were undertaken to improve the ultra-high vacuum (UHV) deposition of thin superconducting layers, e.g. pure niobium film on the surface of copper resonant cavities. Structural, mechanical and superconducting properties of niobium–coated samples were investigated. The UHV arc technique was also applied for the deposition of pure lead layers as photo–cathodes of electron injectors. In the field of surface engineering, applications of pulsed plasma stream interaction with solid materials were studied.

Various physical phenomena within dense magnetized plasma were analysed theoretically, e.g. filamentation processes of a pinch column. Computational studies of plasma dynamics in the coaxial IPD accelerator also were continued.

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