5. DEPARTMENT OF PLASMA PHYSICS AND TECHNOLOGY

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In 1997, theoretical studies mainly concerned the verification of physical models on the basis of experimental data, an analysis of plasma behaviour within regions close to electrode surfaces during quasi-continuous discharges induced by microwaves (collaboration with the IPF at the Stuttgart University), as well as modelling of a discharge development within coaxial plasma injectors (collaboration with the Warsaw Technical University). Another direction of theoretical studies concerned elementary processes of importance for plasma research, and in particular those taking into consideration the role of spin within a classical model of proton - hydrogen atom collisions.

Experimental studies comprised measurements of pulsed electron beams and effects of the polarization of X-rays emitted from Plasma Focus (PF) facilities (collaboration with the Kurchatov Institute in Moscow), research on emission characteristics of different PF devices (collaboration with the IFAS at the University of Tandil, Argentina), as well as measurements of pulsed electron and ion-beams emitted from various devices of the PF and Z-Pinch type (collaboration with the IPP-NSC in Kharkov and the INFIP in Buenos Aires). An important direction of experimental studies concerned X-ray and ion measurements at a large PF-1000 facility (collaboration with the IPPLM in Warsaw).

In the field of plasma diagnostics, efforts were devoted to an analysis of the results obtained from time-resolved measurements of nitrogen ions and deuterons within PF-type devices (collaboration with the INFIP and IFAS). Within a frame of diagnostics, a substantial achievement was also the design and construction of a new measuring equipment for studies of plasma dynamics and X-ray emissions (collaboration with the Kurchatov Institute and MFTI in Moscow). Particular attention was also paid to studies connected with the calibration of various solid-state nuclear track detectors (NTDs), particularly modern plastic detectors of the CR-39, PM-355, and PM-500 type.

Studies in the field of fusion technology concerned the design and construction of a special pulse generator for the simulation of electromagnetic interference, as well as other efforts connected with research on electromagnetic compatibility of electronic and electrotechnical devices. Research on new types of HV pulse generators were carried out partially under contracts with industrial laboratories (the Institute of Energetics, APENA, and ELTEST). In order to modernize experimental facilities the IONOTRON-SW device was equipped with new electrodes made of pure aluminum, which were used to perform expositions of samples made of different materials (collaboration with the IPP-NSC in Kharkov and the Institute of Physics, Chinese Academy of Sciences, in Beijing).

In the field of new plasma-ion technologies a team from Dept. P-V and Dept. P-IX performed numerous experiments on the doping of aluminium plates with molybdenum ions and on the treatment of ceramic targets with pulsed streams of titanium-nitrogen or hydrogen plasmas. Results of those experiments (elaborated in cooperation with the INChT in Warsaw and the FZR in Rossendorf) are presented in another chapter prepared together with Dept. P-IX. A separate task, realized only by Dept. P-V, concerned the construction and laboratory tests of a high-current source of nitrogen ions. From other efforts of Dept. P-V, one should mention the design, assembling, and testing of a special plasma injector (ISEX), designed especially for active experiments in space (collaboration with the Space Research Centre, PAS, in Warsaw). A substantial result was also the mastering of a new technological method for the deposition of Ti or TiN layers by the means of a modified plasma gun (realized in a frame of a KBN grant).

The most important achievements of Dept. P-V can be formulated as follows:

1. Experimental confirmation of the polarization of X-rays from PF discharges (discovered in 1996) and the demonstration that there is a distinct correlation between this effect and the generation of pulsed electron beams.

2. Detailed elaboration of the calibration measurements performed for different nuclear track detectors (NTDs) exposed to protons, deuterons, helium-, nitrogen- and oxygen-ions (several papers), as well as the performance of new calibration measurements of NTDs exposed to fast (14.9 MeV) neutrons (in the cooperation with the Dept. P-I and Dept. P-IV).

3. Design and construction of new HV-pulse generators as well as the elaboration of an extended documentation of systems for the simulation of electromagnetic interferences.

4. Investigation of new plasma-ion technologies applicable to material engineering (in collaboration with the Dept. P-IX, IPP-NSC in Kharkov, and IP-ChAS in Beijing).