2. TOKAMAK ISTTOK

2.1. Introduction

This project will include activities in the areas of liquid metal limiter, other operation systems and diagnostics, control and data acquisition and plasma physics studies.

2.2. Testing of the liquid metal limiter concept[1]

The following tasks are planned for 2006:

- Finalization of the Liquid Metal Limiter (LML) implementation on ISTTOK tokamak;
- Resume of the ISTTOK operation with a liquid Gallium limiter;
- Study of the influence of the LML on the ISTTOK plasma performance;
- Experimental measurements of the Gallium jet power removal capability.

2.3. Other operation systems and diagnostics

The following activities are foreseen for 2006:

- Implementation of a new gas injection system to achieve precise puffing injections of hydrogen, aiming at long operation periods. A microcontroller will regulate a piezoelectric valve analyzing the information from the pressure gauges and the plasma average density calculated in real time from the interferometer data;
- Use of the currently installed spectroscopy system on ISTTOK to analyse plasma impurities[2]. Profiles of Ga neutral density will be measured during the operation with liquid metal limiter to study its influence on the ISTTOK plasma performance;
- Implementation of a spectroscopic ion beam imaging technique. This tool will allow the inference of the magnetic field from the curvature of a singly charged particle beam moving through the field. This is a measurement of great interest for the plasma devices with highly three-dimensional (3D) magnetic field distribution. The technique utilizes the spectroscopic observation of emission from singly charged ions excited by electron impact as they pass through the plasma. On ISTTOK, this technique will be tested using a Xe^+ 22 keV injector of a heavy ion beam diagnostic;
- Test of a Retarding Field Analyzer Probe and measurement of the ion temperature edge profile;
- Test of the combined force-Mach-Langmuir probe;
- Test of a fast CCD camera for 2-D imaging of the edge plasma turbulence[3];

[1] Work in collaboration with the University of Latvia.
[2] Work in collaboration with the University of Latvia.
[3] Work in collaboration with CIEMAT.

- Upgrade of the time of flight energy analyser of the heavy ion beam diagnostic by installing channeltrons to acquire the "start" and "stop" signals, which will allow an increase of the signal to noise ratio;
- Design and construction of a Bennett RF mass spectrograph for edge plasma investigations.

2.4. Control and data acquisition

The following activities are foreseen for 2006:

- Development of a new version of the ISTTOK control software, which will allow the integration of any type of hardware, with drivers programmed in any language, through a plug and play XML based system. Remote hardware configuration and firmware upload is also a primary goal. Data storage will be based on events and timestamps;
- Implementation of a real-time plasma position control system to achieve long-time AC discharges on ISTTOK;
- Finalization of the upgrade of the ISTTOK control and data acquisition system towards a real time philosophy with event driven and time-stamp operation.

2.5. Plasma physics studies

The following studies will be carried out in 2006:

o *Study of the momentum fluxes using the combined force-Mach-Langmuir probe*[4]

The combined force-Mach-Langmuir probe will be tested and used to determine simultaneously the parallel Mach number, ion temperature and the plasma force in the parallel direction. The ion temperature will be compared with that derived from the retarding field analyzer probe data.

o *Study of the edge plasma turbulence using the fast CCD camera*[4]

Plasma turbulence is known to have complex two and three-dimensional structures which evolve in rapidly time. There are therefore clear advantages in measuring the 2 and 3D nature of these structures using fast cameras. A fast CCD camera (100 kHz) will be tested for turbulence studies in collaboration with Ciemat. Results will be compared with those obtained with other edge diagnostics as multi-pin Langmuir probe arrays.

o *Study of AC discharges*

[4] Work in collaboration with CIEMAT.

Independent real-time control systems will be implemented on the primary current, vertical field and horizontal field. ISTTOK AC operation will be carried out aiming at optimizing the tokamak discharges.

- *Studies on Reynolds stress and fluctuations*[5]

Simultaneous measurements made with emissive probes of the Reynolds stress and the fluctuation-induced radial particle flux with and without biasing will proceed. Results will be compared with those of cold probes.

[5] Work in collaboration with the University of Innsbruck and CIEMAT.