

Project No: **C2-04 in the frame cooperation CEA-IFA**

Project title: **AMS analyses of concentrations of hydrogen isotopes and other elements in tiles dismantled from the Toroidal Pump Limiter at Tore Supra Tokamak.**

**CEA:** Dr. Eric Gauthier , IRFM, CEA Cadarache

**IFIN-HH :** AMS Group

**Partener I :** UPB

Duration : *3 years*

### **Scientific motivation of the experiment**

The project will use experimental method the Accelerator Mass Spectrometry (AMS) for the research of fusion facilities and for the experiments contributing to the finalising the construction of the first International Thermonuclear Reactor (ITER) in Cadarache, France.

The year for start operating is 2018, but many issues of research are still open. Tokamaks around the world, including the Tore-Supra having the longest duration for a plasma confinement, are performing experiments to resolve the last problems related to this goal. These fusion reactors employ over 100 diagnose tools for the surveillance of each experiment. Out of these, AMS has been rising to the level of supremacy for its kind, significantly contributing to the perfecting of the usage of the fusion power as a safe controlled, clean and virtually limitless energy source.

Such AMS experiments were especially performed at JET facilities that provide a unique contribution to the consolidation of the scientific basis in plasma physics and plasma engineering and to the demonstration of high performance in operational modes relevant to the objectives and configuration of ITER. Never the less, AMS was applied also to the important fusion experiments at ASDEX-Upgrade (Germany), which largely contribute together with Tore Supra (France) to the material research required for ITER. Therefore, now it would be most appropriate to apply AMS at Tore Supra.

Sensitive analyzing by AMS will be performed for the first time at Tore Supra. The particle deposition will be investigated in the depth of the protection tiles of the Toroidal Pump Limiter (TPL) and will deliver information of the transport of particles in the reaction vessel.

The main objective of this project is to study the particle accumulation in the TPL at Tore Supra.

Since this assembly is removing the most of the emitted particles during the fusion discharges the AMS analysis of concentration depth profiling of different elements would provide interesting information not only about particle transport and erosion deposition but will reveal also information about the fusion efficiency during the tokamak discharges.

We will analyze by AMS samples cut from tiles dismantled from the TPL, located in the center of the limiter. A number of 16 relevant locations around the torus will be chosen. These

samples were exposed to the plasma discharges in the Tore Supra and AMS will determine the **deuterium concentration depth profile and the deposition of other elements on the surface.**

The poloidal distribution of particle retention on the limiter will also be studied. The samples will be cut from locations on tiles situated in radial direction (4 different locations on the circumference). From each location five samples will be extracted from one end to the other of the radius.

Further on, dust from Tore Supra and JET will be measured. The collection of dust will be performed in relevant locations. The only problem of analysing dust by AMS is the possibility to press the dust in solid form. A rather complete elemental analyses of dust can be achieved.

An other important part of the project will be dedicated to the elemental deposition studies on the protection tiles. By use of AMS and of other conventional methods the element deposition on tiles from the toroidal pump limiter at Tore Supra will be determined. From different locations relevant for the particle transport in the tokamak, samples will be extracted from the dismantled tiles. A characterization of the elements deposited on the tile will be performed.

Concerning the AMS analysis of depth profiling (DP) of material concentrations, it requires standard samples that must correspond in structure with the material under investigation. Thus, the host materials should have the same atomic matrix and the calibration of standards is not always a simple task.

**In this experiment we will perform the objective from Stage I** with following steps:

- Preparation of samples for the AMS analyses, from the 9 samples cut in the TPL toroidal geometry;
- Estimative measurements of the concentration of hydrogen isotope in the samples for optimizing the standard samples concentration and experimental conditions by another methods;
- Preparation of dedicated AMS standard samples with diverse concentrations of deuterium.
- Measurements of standard samples and the 9 samples from TPL.

Final date: 15.06.2012

Expected results are: scientific report, model experiments.

### **Beam Time Request**

**We ask for 5 days of beam-time.**

The experiment will use the 7.5 MV value of the terminal voltage to determine deuterium concentration and several sequences of short time (10 min.) will use the 7.5 MV value of the terminal voltage for pilot beam ( $^{12}\text{C}$ ).

Dr. Mihaela Enachescu