

**CEA/CADARACHE**

**DIRECTION DES SCIENCES DE LA MATIÈRE (DSM)**

**INSTITUT DE RECHERCHE SUR LA FUSION PAR CONFINEMENT MAGNETIQUE (IRFM)**

CEA/Cadarache - 13108 St Paul-lez-Durance Cedex - France

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**PhD PROPOSAL 2011**

<b>Supervisor :</b>  David DOUAI	<b>e-mail :</b> david.douai@cea.fr
	<b>phone :</b> +33 442 25 62 78
	<b>secretary :</b> +33 442 25 62 25
<b>Research Team :</b> DSM/IRFM/STEP/GPAS	

**Title :** Study and optimisation of wall conditioning of the vacuum chamber of Tokamaks in the presence of a toroidal magnetic field

**Summary :**

In tokamaks, machines dedicated to the study of thermonuclear fusion by magnetic confinement (<http://www-fusion-magnetique.cea.fr/gb/index.html>), the interaction of the plasma with the inner walls of the vacuum chamber releases impurities which can affect the performance of the fusion plasma. In order to control the surface state of the vacuum vessel, and thus the fluxes of impurities between the plasma and the walls, a set of techniques is used which is called conditioning.

In today's equipments, the conditioning of vacuum chambers is generally ensured by direct current glow discharges (low temperature plasmas, neon type) in a hydrogen or helium atmosphere. These conditioning discharges are done between plasma experiments, without magnetic field. In ITER, the fact that the confinement magnetic field, generated by superconducting magnets, will be continuously maintained reduces drastically the efficiency of DC glow discharges. Several alternatives of wall conditioning are currently developed, in particular in Tore Supra: high frequencies or microwave discharges, pulsed discharges, but new investigations are needed prior to their validation as conditioning process and their application to ITER.

The subject of this thesis is the study and the modelling of methods of wall conditioning in presence of an intense magnetic field. The work will first consist in analysing the experimental data from different Tokamaks on production of impurities (oxygen, hydrocarbons) and hydrogen (and isotopes) in order to characterize and compare the different wall conditioning methods. In a second step, these discharges will be modelled taking into account the different mechanisms involved during the conditioning of the vacuum chamber. The aim is to optimise the control parameters (density, current, pressure, wall temperature,...) and to propose some technical evolutions in order to predict their relevance to ITER. Dedicated experiments of conditioning can be proposed and realised in Tore Supra.

**Skills :** Low / High temperature plasma physics, modelling, experimentation