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
Visitez notre site Web : http://www-fusion-magnetique.cea.fr

PROPOSITION DE STAGE 2012-2013

Nom du Responsable du Stage : Annika EKEDAHL	**e-mail :**	annika.ekedahl@cea.fr
	téléphone :	04 42 25 63 32
	secrétariat :	04 42 25 62 22
Équipe de Recherche : IRFM/SCCP/GCHF		

Niveau du stage :	MASTER
Durée du stage :	6 months (or more)

Sujet du stage :

Titre : Modelling of Lower Hybrid power deposition and current drive efficiency in tokamak plasmas

Contexte et objectifs :
The goal of magnetic fusion research is to demonstrate the scientific and technological feasibility of fusion power as a means to provide a clean energy source for future generations. To achieve this, very hot plasma with temperature exceeding 100 million degrees must be generated and sustained for long durations. For long pulse operation in a tokamak, additional heating and current drive are required. One of the most efficient methods to generate non-inductive current drive is by using Lower Hybrid (LH) waves. The Tore Supra tokamak, located at CEA/Cadarache, is a world leader in this field, with two 3.7 GHz LH antennas able to inject 7 MW in continuous wave (CW) mode into the plasma and thus sustain long plasma discharges. For ITER, a 20 MW LH system at 5 GHz is proposed, aiming at extending plasma duration and assisting in improving its performance and stability.

Tore Supra has an extensive data base of experiments with high injected LH power (several MW) and large fractions of the plasma current driven by the LH waves. The experimental results are modelled with a set of codes that describes the physical process, starting from the wave spectrum launched by the LH antennas, then modelling the propagation and absorption of the LH waves in the plasma and finally reconstructing the emission from the fast electrons that are created in the process, to be compared to the experimentally measured emission as validation. In this project is proposed to focus on the role of the details of the LH antenna spectrum on the efficiency of the current drive.

Nature du travail à réaliser par l'étudiant :
Analyze the experimental data of current drive efficiency in Tore Supra for specific cases where the full current is driven by the LH waves. This includes analyzing data from a fast electron bremsstrahlung diagnostic, which yields the energy distribution and profile of the fast electrons.

Analyze the coupling of the LH antennas and how this influences the launched wave spectrum. Produce wave spectra, using either the linear coupling code ALOHA or the non-linear full-wave code PICCOLO-2D.

Perform the simulations, using the ray-tracing code and 3D Fokker-Planck code. These codes need the detailed wave spectra from the LH antennas as input, as produced either by ALOHA or PICCOLO-2D.

Validate the modelling results against the experimental data from the fast electron bremsstrahlung emission and against the experimental value of the current drive efficiency.

Domaine de spécialité, compétences : Plasma physics

Prolongement possible thèse : NON