CEA/CADARACHE
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PROPOSITION DE STAGE 2013-2014

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Équipe de Recherche : IRFM/SCCP/GTTM		

Niveau du stage : MASTER INGENIEUR
Durée du stage : 3-4 mois

sujet du stage :

Titre : Development of a synthetic reflectometry diagnostic for study of plasma turbulence in fusion devices

Contexte et objectifs :
The characterisation of plasma turbulence, which is found in fusion plasmas as the main vector of anomalous transport degrading the particle confinement, is a necessity to establish and improve the working conditions of fusion reactors. Based on radar technics microwave reflectometry consists in probing the plasma with millimetre waves (typically in the 20 - 200 GHz range), the region explored depending on various parameters: the probing frequency the plasma electron density and temperature, the confining magnetic field. Reflectometry is a powerful diagnostic for the study of plasma turbulence, though the quantitative interpretation of its data remains often challenging due to the dispersion, diffraction and scattering processes together with the multidimensional effects affecting the propagation of the probing beam. Synthetic reflectometry diagnostics, which rely on numerically solving Maxwell's curl equations in the presence of plasma permittivity tensor, is then of prime interest for better understanding of the diagnostic response and enhanced interpretation of experimental data.

Nature du travail à réaliser par l'étudiant :
The main objective of the work is to study the link (transfer function) between the fluctuations of the reflectometry signal that is measured and the plasma density fluctuations which are to be characterised. Using two-dimensional “full-wave” simulations, the effects of both radial and poloïdal density fluctuations (responsible for scattering of the probing beam) will be investigated. The role of the radiation pattern of the emitting and receiving antennas on the measurement sensitivity (especially to the poloidal wavenumbers of the turbulence) will be also studied. Finally the number of samples (or measurements) required to accurately characterise the statistical properties of the plasma turbulence will have to be assessed. If time allows reflectometry simulations using density fluctuations given by gyrokinetic turbulence codes, which are particularly suitable to model the Ion Temperature Gradient (ITG) driven turbulence, will be initiated, then paving the way to realistic comparisons with experimental data.

Domaine de spécialité, compétences : Physics or applied mathematics (skills in computing - matlab, C, … required; knowledge in plasma physics will be a asset)
Prolongement possible thèse : YES