Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 14 octobre 2013

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Lieu du stage / *internship place*: NANCY ou CEA_Cadarache			

Titre du stage / *internship title*:Turbulence characterization in magnetized plasmas using reflectometry

Résumé / *summary:* *encadrants* S. Heuraux (Univ-Lorraine)-S. Hacquin (IRM_CEA Cadarache)

The characterization of the turbulence, which is found in fusion plasmas as the main vector of the anomalous transport, is a real challenge and a necessity to establish the working conditions of fusion reactors. For ITER plasmas the assumed parameters induce some question about the reliability of the reflectometry to probe the ITER plasmas. The aim of this work is to define a model able to predict for different ITER scenarios in which it is possible to use the reflectometry as an accurate tool to probe the plasma. Especially here the interest goes on the wavenumber spectrum and density fluctuations profile obtained using data coming from an ultra-fast sweep frequency reflectometer. 1D simulations have given some results, however important part of the contributions are missed concerning the role of the poloidal wavenumber contribution associated, for example, to the forward scattering or a corrugated cut-off layer lighted by a probing beam with a finite size and a given radiation pattern.
Using two-dimensional simulations, the determination of the field scattered by turbulence in a given zone of the probed plasma is one the goal of this master thesis. The study aims towards the question whether it is possible to extract local properties of the density fluctuations from global measurements and towards establishing a full transfer function between density fluctuation spectrum and/or turbulence level and the phase or/and amplitude variations. Scattering efficiency profiles have to be computed for linear and nonlinear cases of density fluctuations positioning a localized turbulence zone along the optical axis as well as on a line perpendicular to it. To find the transfer function linking the measurements to turbulence properties, the role of the radiation pattern should be perfectly understood, especially on the dependencies in terms of poloidal wavenumbers. The average values are required to do that due to the fact that there are different kinds of contributions, mirror effects able to generate interference, forward scattering able to spread to the probing beam, Bragg backscattering able to induce local amplification of the probing field. To evaluate the different contributions for a given radiation pattern, a specific choice of wavenumber spectrum of the turbulence should be done and studied as a function of different radiation patterns. The synergies if they exist should be studied in details as a function of the turbulence level. From these computations, try to answer to the following question: Is it possible to define universal transfer functions to extract the turbulence properties using an ultra-fast sweep frequency reflectometer with a given radiation pattern? Is it possible precise for kind of radiation pattern able to provide it, and in which conditions? This study has to be done in the linear regime (under Born approximation), and non-linear regime (above Born Approximation).

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : oui**

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **FUSION-DC ou CFR_CEA**

Lasers, Optique, Matière		Lumière, Matière : Mesures Extrêmes	
Plasmas : de l'espace au laboratoire	+		

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