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SUJET DE THÈSE 2011

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Titre du sujet de thèse : Synthetic reconstruction of diagnostic measurements in the edge plasma of tokamaks with focus on reciprocating Langmuir probes

Résumé du sujet :

Edge transport issues remain one of the main unknowns for future machines and in particular ITER. The understanding of the physical mechanisms explaining particles and heat fluxes in the outer part of the plasma are fundamental for the determination and the optimization of performances and plasma facing components life expectancy. A large database has been gathered in the last two decades about profiles and fluctuations for the density, the temperature or the velocity, relying in great majority on the use of Langmuir probes, often mounted on reciprocating devices. However, the interpretation of these measurements is not always straight-forward and often relies, for comparison with models and codes results, on questionable assumptions. The recent progress made in numerical models allows tackling the problem from the other side. Instead of interpreting experimental signals on the basis of simple models, one can use the output of transport codes to simulate the signal that one would expect to observe with such or such diagnostic. Such a method is called synthetic reconstruction.

This PhD proposal aims at developing and studying synthetic diagnostics for the edge plasma in order to be able to compare directly codes outputs with experiments. The main focus will be on Langmuir probes, especially mounted on reciprocating devices, but generalization to other edge physics diagnostics (eg, reflectometry) is also considered. One of the central questions that will be studied is that of the interpretation of probes' measurements in turbulent plasmas. Most of the existing work has been carried out in laminar plasmas and the presence of turbulence raises several questions. How do the mean values of fluctuating signals compare with the actual average profiles? How does the presence of the probe itself perturb the measurement? How to interpret measurements obtained with complex probe geometry (for example flow measurement with Gundestrup probes) in strongly fluctuating plasmas? The work will involve adapting existing models and codes to simulate the impact of a probe on the plasma as well as the signal it would produce. Specific numerical tools may also have to be developed. Results will then be compared with existing experimental data from the Tore Supra tokamak or from collaborations with other machines. The design of and participation to dedicated experiments is also expected.

Compétences souhaitées : titulaire d'un master en physique et/ou d'un diplôme d'ingénieur, connaissances en physique des plasmas et en programmation / méthodes numériques

Intitulé du master préconisé : master fusion