Master M2

« Physique des Plasmas et de la Fusion »

Proposition de stage (5 à 6 mois à partir de mi-mars) **: oui**
Proposition de thèse : oui éventuellement

Date de la proposition : 10/2022

Ne pas dépasser une page / Do not exceed one page

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Nom du Laboratoire / *laboratory name*:
Code d'identification : UMR 7648 Organisme / *Institution* : CNRS Ecole Polytechnique

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Lieu du stage ou de la thèse / *internship or PhD place*: LPP –Ecole Polytechnique, // IPP Garching//EPFL

Titre du stage / Turbulence in Quiescent High Confinement regimes in tokamak plasmas, and its role in improving power exhaust

Résumé /

Plasma turbulence plays a crucial role in the performance of future fusion devices. Turbulence transport determines the typical size of the hot confined plasma expected to sustain fusion reactions. Turbulence control has been achieved in the edge of tokamak plasma in High confinement regime (Low to High confinement bifurcation).

High performance regimes (H-mode) are reached through the spontaneous formation of a transport barrier resulting from the shear-flow suppression of turbulence. The steep edge density and temperature gradients allow for large pedestal top temperature and density, thought to be necessary for ITER to achieve its fusion power targets. However these significant gradients drive instabilities such as edge localized modes (ELMs) – which appear as repetitive collapses of the edge pressure profile that may release unacceptable heat loads on the machine walls. Between ELMs, temperature and density profiles build up again on different time scales, raising the question of which transport mechanisms determine the profile evolution. Furthermore, when the plasma density is high and the plasma shaping of the confining magnetic field is strong (high triangularity), the ELM cycle disappears, a Quasi Continuous ExHaust regime is obtained, i.e. high frequency small ELMs replace large type I ELMs. This regime is associated with a change in turbulence characteristics and MHD properties close to the separatrix, with repetitive filaments occurring at frequency ranging 30-80 kHz [Wolfrum2012, HennequinEPS2017/EFTSOMP2019, Griener NME2020]. This activity is expected to affect the transport and pedestal shape. It also changes SOL transport resulting in broadened heat load on the divertor, that could be beneficial for plasma facing components.

The focus of the project research will be on the identification of the fluctuations and their role in setting the edge profiles, which is a key ingredient to global plasma performance and the capability to manage the high heat fluxes towards the machine walls. Experiments will be conducted on large European Tokamaks (WEST at Cadarache, TCV at EPFL, Switzerland). They will make use of different fluctuation measurement techniques among them Doppler back-scattering which has been developed and implemented on these tokamaks by the LPP team. These experiments will enlarge the basis for comparison to models and simulations, trying to disentangle the different mechanisms of transport regulation across the pedestal.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* ? **: Oui**
Rémunération du stage/ *financial support for the internship* ***: OUI***
Financement de thèse envisagé / *financial support for the PhD* **: EDIPP, CNRS/CEA …**
Type de stage et/ou de thèse (expérience/théorie/simulations) : thèse pluridisciplinaire