DRF: Thesis SL-DRF-19-0553

RESEARCH FIELD

Plasma physics and laser-matter interactions / Corpuscular physics and outer space

TITLE

Experimental characterization of the waves - plasma edge interaction during high frequency heating experiment on the WEST tokamak

ABSTRACT

A controlled fusion reactor of the tokamak type requires non-inductive current source for a continuous operation. In order to prepare this ultimate phase, the ITER tokamak will address scenarios where 50% of the plasma current is generated by non-inductive external sources provided by particles and waves injection systems. Among the high frequency waves, the lower hybrid range of frequency (LHRF) waves allow a peripheral power deposition required to shape the current profile beneficial for the energy confinement.

Before reaching the hot dense confined plasma, the wave has to channel through a relatively cold plasma where non-linear interaction between the wave and the plasma may lead to a modification of the wave spectrum launched by the antenna. It results a decrease of the current drive efficiency expressed in ampere of driven current per injected watt.

Wave scattering on density fluctuations but also parametric decay of the launched wave are possible mechanisms. These mechanisms will be studied experimentally on the WEST tokamak in particular from a set of Langmuir probes embedded in the LHRF antenna.

In particular, waves with a wave number along the magnetic field could play a major role when LH wave is launched. Modelling of the LH wave propagation in a turbulent scrape-off layer showed that this type of instability can broaden the LH wave spectrum and reduces the current drive efficiency.

The works aims at establishing a possible causality between wave –plasma interaction measured at the plasma edge and the propagation/absorption of the wave in the plasma core diagnosed by different techniques (magnetic measurements, measurement of the Bremsstrahlung, measurement of the electron cyclotron emission…)

This work will be carried out in collaboration with the physics department of the American University of Beirut (Lebanon) and the Southwestern Institute of Physics de Chengdu (China). The collaborators of these institutes will support the student in particular for the physics of turbulence in fusion plasmas.

LOCATION

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