DRF: Thesis SL-DRF-19-0498

RESEARCH FIELD

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

TITLE

Characterization of hydrogen pellet ablation for the fueling of thermonuclear fusion devices

ABSTRACT

Pellet injection is mandatory for the fueling of next generation devices (pellets are small pieces of Deuterium and/or Tritium ice injected at a few 100 m/s in the plasma). But reproducing the corresponding conditions is not possible in present tokamaks. Predictions are exclusively based on modelling and additional validation of the ablation/deposition codes is necessary for reliable extrapolation. Pellet injection is composed of two phases: the pellet ablation (sublimation) and the homogenization of the deposited material. If phase 2 is well validated, phase 1 is less accurately diagnosed: the density, temperature and ionization dynamics in the deposited cloud were only rarely determined, and always with significant approximations. This project aims at filling up this void. It comprises the participation (1) to the operation of a dedicated diagnostic and (2) to experimental campaigns on several machines, (3) the determination of cloudlet physical parameters. The results will be systematically compared with predictions of ablation code for improving the latter by a more accurate description of the physics involved (departure from thermodynamical equilibrium, splitting of the ablation cloud into independent cloudlets). This project is integrated in the action undertaken by the "Integrated Operation Scenario" group of the "International Tokamak Program Activity" for validating the codes that simulate the feeding of fusion machines by pellet injection, the ultimate goal being the building of a meta-model yielding the effective source as a function of the pellet injection parameters and plasma characteristics.

LOCATION

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http://www-irfm.intra.cea.fr/sppf/Phocea/Vie_des_labos/Ast/ast_groupe.php?id_groupe=514
http://www.nifs.ac.jp/en/helical/hdpprd.html

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