Direct measurements of mm-wave beam scattering by field-aligned blobs in magnetically-confined plasmas

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In magnetically confined fusion devices, the use of EM radiations ranges from plasma diagnostics to plasma heating, current drive and core confinement preservation. For large tokamaks such as ITER, numerical simulations and analytical studies suggest that, in the presence of plasma edge turbulence, the path length of the beam will be long enough to significantly broaden the EC-beam, which could lead to a loss of current drive efficiency and possibly prevents tearing modes stabilization at the expected power levels [1, 2].

We report first direct measurements of millimeter wave (mmw) beam scattering by plasma turbulence. The experiments are carried out in the basic plasma physics device TORPEX and the Tokamak à Configuration Variable (TCV) . The two devices are equipped with an extensive set of diagnostics, which provide an ideal environment to diagnose plasma turbulence and associated structures, such as blobs. A mmw-beam is injected from the top of the device and the power is measured at the bottom. We show that the measured plasma density fluctuations are the cause of fluctuations of the transmitted mmw-power. Conditional sampling is used to identify the effect of measured density structures. On TORPEX, electron density fluctuations are measured using an in-situ array of Langmuir probes. A full-wave model based on COMSOL multiphysics is presented and compared to experiments [3]. Using the SOL turbulence simulations from the GBS turbulence code, comparison between the scattering effect on the mmw-beam using both COMSOL Multiphysics and the WKBeam code [2] are in progress in TCV. The results of the two codes as well as comparison with the experiments are discussed.

References

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