Scattering of Mm-Waves By Turbulent Structures in Magnetically Confined Fusion Plasmas

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Abstract

In magnetically confined fusion devices, electron cyclotron resonance heating (80-170 GHz) is characterized by a local RF-power deposition at the electron cyclotron resonance [1]. A mm-wave RF Gaussian beam is launched from a dedicated antenna and propagates through the highly turbulent scrape-off layer (SOL) at the edge of the confined plasma. Turbulence in the SOL is characterized by filamentary plasma structures, known as blobs, which may affect the mm-wave propagation and lead to less precise targeting or broadening of the absorption at the resonant layer.

The RF Module of COMSOL Multiphysics® software is used to perform a full wave simulation of the scattering of the mm-waves by blobs. This allows investigating the interaction between the mm-waves and the turbulence in the SOL. The simulation results are compared with experiments carried out in TORPEX, a simple magnetized toroidal plasma with a magnetic configuration similar to the SOL, which enables the generation of blobs and their study [2].

Reference

[1] A. Fasoli et. al., TCV heating and in-vessel upgrades for addressing DEMO physics issues, Nucl. Fusion vol. 55 (2015) 043006.

[2] I. Furno et. al., Plasma turbulence, suprathermal ion dynamics and code validation on the basic plasma physics device TORPEX, J. Plasma Physics vol. 81 (2015) , 345810301.