Contribution ID: **99** Type: **Oral**

Numerical investigations of the O-X mode conversion process in MAST Upgrade

Thursday, 23 June 2022 09:30 (20 minutes)

Electron Bernstein waves (EBWs) allow to couple energy to plasmas whose electron density exceeds the cut-off density of the injected microwave [1]. EBWs are electrostatic waves that have no high-density cut-off and are very well absorbed at the electron cyclotron resonance (ECR) and its harmonics, even at low electron temperatures (in contrast to conventional heating of O- or X-mode at harmonics of the ECR [2]). Furthermore, EBWs can very efficiently drive toroidal net currents [3], which is of particular importance in spherical tokamaks like MAST Upgrade [4], due to the necessity of non-inductive current drive in these type of devices.

The electrostatic EBWs can be coupled to injected electromagnetic waves via a two step mode conversion process: an injected O-mode couples to an X-mode at the cut-off layer, propagates then outwards and couples to EBWs in the vicinity of the upper-hybrid resonance layer. The overall efficiency of this process is strongly determined by the O-X coupling process, which itself depends on the injection angle of the O-mode with respect to the background magnetic field at the conversion layer.

In this work we present numerical studies of the O-X coupling efficiency in the MAST Upgrade geometry. Different codes have been used (2D and 3D finite-difference time-domain codes and a code using a Fourier method in the plane normal to the density gradient) to elaborate the importance of microwave beam geometry and plasma density fluctuations on conversion efficiency. Scenarios with low and high confinement have been investigated illustrating the effect of a varying density gradient length on the sensitivity of the O-X conversion efficiency against angular mismatch. High efficiencies on the order of 90 % were found making this microwave heating scheme an attractive candidate for MAST Upgrade.

References

[1] H. Laqua, Plasma Physics and Controlled Fusion 49 R1 (2007)
[2] M. Bornatici, et al., Nuclear Fusion 23 1153 (1983)
[3] J. Urban, et al., Nuclear Fusion 51 083050 (2011)
[4] J.R. Harrison, et al., Nuclear Fusion 59 112011 (2019)

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Session Classification: Wave Theory and Simulation