Full-wave modeling of the O-X mode conversion in the Pegasus Toroidal Experiment

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Electron Bernstein waves (EBW) provide a method for heating and current drive in overdense plasmas. Due to their electrostatic nature, they must be excited via mode conversion processes such as the O-X-B mode conversion. Its overall efficiency depends strongly on the efficiency of the O-X conversion which is dependent on the injection angle of the microwave with respect to the background magnetic field. This angle is a function of the density profile in the conversion region. The Pegasus Toroidal Experiment is a spherical tokamak for which EBW heating is considered at 2.45 GHz. Due to the long vacuum wavelength (12.2 cm) as compared to the density gradient length (a few cm), the geometric optics assumption is not valid in the mode conversion region, nor is it adequate to describe the propagation of the O- and X-mode. Therefore, the 2D full-wave code IPF-FDMC [1] is used to model the O-X conversion in Pegasus as function of the injection angle and the density profile. High efficiencies of up to 80 % can be achieved with broad angular windows that are due to the steep density profiles. Furthermore, the conversion efficiency is found to be resilient to vertical plasma displacements of ±10cm.

[1] A. Köhn et al., PPCF **50**, 085018 (2008).