ICRF antenna coupling in ASDEX Upgrade 3D plasmas

G. Suarez Lopez[1,2], R. Ochoukov[1], M. Willensdorfer[1], H. Zohm[1,2], D. Aguiam[3], V. Bobkov[1], M. Dunne[1], H. Faugel[1], H. Funfgelder[1], J.-M. Noterdaeme[1,4], E. Strumberger[1], W. Suttrop[1], the ASDEX Upgrade Team,[*] and the EUROfusion MST1 Team.[†]

[1] *Max Planck Institute for Plasma physics, Garching b. Munchen, Germany*

[2] *Ludwig-Maximilians-University of Munich, Munich, Germany.*

[3] *Instituto de Plasmas e Fusao Nuclear, Universidade de Lisboa, Lisboa, Portugal*

[4] *Applied Physics Department, University of Ghent, Ghent, Belgium*

The excitation of the fast branch of the ion cyclotron (IC) plasma wave by an antenna is a method for efficient energy transport to the plasma core used for ionic heating. The amount of power coupled to the plasma by the antenna is a function of the radiation impedance, which is characterized by the plasma parameters, such as plasma density, the magnetic field, and the antenna strap phasing for multiport networks.

Antenna coupling has been extensively studied under the assumption of axisymmetry in the plasma. Non-axisymmetric scenarios have become more relevant in view of the gas puff techniques used for coupling improvement and the usage of magnetic perturbations (MPs) for edge localized modes control. The application of MPs produces a plasma kink-peeling response that amplifies the vacuum field perturbation and leads to significant non-axisymmetric field-aligned displacements of the flux surfaces. These displacements create a 3D density profile in front of the IC antenna.

Dedicated discharges in the ASDEX Upgrade tokamak have been performed to study the effect of MP-induced boundary displacements on IC coupling. Different phasings between the upper and lower row of MP coils with n=2 toroidal periodicity were applied. The MP field is rotated in order to diagnose the effect of the rotating 3D profiles on the antenna performance. Strap loading resistance oscillations, coherent with the rotating density profile, of the order of $|\Delta R_L| \approx \pm 0.2\,\Omega$ have been recorded. Embedded reflectometry in one of the 3-strap antennas is used to correlate the density distribution to the observed antenna behavior. NEMEC ideal MHD modeling is performed, allowing a direct comparison of the measured loading resistance oscillations with the computed plasma deformation in the confined region.

[*]For a complete list of authors, see A. Kallenbach et al, Nucl Fus 57 (2017) 102015

[†]For a complete list of authors, see H. Meyer et al, Nucl Fus 57 (2017) 102014