Sheath modelling for IShTAR ICRF antenna

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Plasma heating with Ion Cyclotron Range of Frequency (ICRF) waves is one of the crucial systems of hot plasma devices. It is important to not only increase the effectivity of such a system, but to avoid destructive effects on plasma and plasma facing components. Among those effects it is known that in the proximity of the antenna limiters increased DC potentials are formed, causing particle and heat loads to rise significantly during the ICRF system operation. A study of the relevant sheath physics is performed on a dedicated linear device IShTAR [1] in conditions similar to the tokamak SOL.

A combined experimental-numerical method is used to obtain the DC plasma potentials in the SOL plasma near the limiters of the IShTAR ICRF antenna. The experimental part consists of 3D magnetic field mapping in a broad region in front of the antenna. An array of B-dot probes on a movable manipulator is used to measure components of the RF magnetic field. The resulting experimental field map is compared to calculations performed in COMSOL software to validate the accuracy of the model.

The COMSOL model includes precise geometrical representation of the experimental device. The parallel electric field in the region in front of the antenna between the antenna limiters, which is hard to be measured experimentally, is calculated in the COMSOL model. The plasma is simulated as a material with numerically assigned cold dielectric tensor. Fast and slow components of the wave are decoupled and studied separately.

SSWICH-SW [2] is used as a final step of the procedure to obtain the rectified potentials on the limiters from the input parallel electric field from the COMSOL IShTAR model. A density profile in the SOL region is measured in the argon plasma discharge on IShTAR. The calculated DC potential can be compared to experimental measurements and can be studied for different plasma parameters and ICRF antenna regimes.

[1] K. Crombé et al., 26th IAEA Fusion Energy Conference (2016)

[2] L. Colas et al., Phys. Plasmas **19,** 092505 (2012)