New Diagnostics Developments on IShTAR

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The diagnostics developed for IShTAR (Ion Cyclotron Sheath Test ARrangement) are oriented towards measurements of plasma parameters and electric fields in the vicinity of a Radio Frequency (RF) antenna in order to provide input for sheath modelling codes [1, 2]. In IShTAR the plasmas are created with a helicon antenna operated at a frequency of 11.76 MHz and with a power up to 3kW (the maximum power coupled to the plasma is around 2.7 kW). Recent improvements have been made for the density measurements in the helicon source and the main vessel. An optimised performance regime was found; by adjusting the magnetic topology the plasmas density can be increased by a factor 3 to 5, which is beneficial to the sheath studies. An additional array of RF compensated probes (Langmuir, B-dot…) has been installed to allow for a better characterization of the plasma parameters at different locations. The first results of an interferometer, installed to benchmark the electron density estimates of the Langmuir probes, will be presented.

Two approaches are followed to measure the electric fields in the plasma caused by the RF antenna sheaths. Passive optical emission spectroscopy monitors Stark effects on spectral lines with a high-resolution spectrometer [3], provided that the local electric fields are strong enough to overcome the broadening of the lines. Doppler-free saturation spectroscopy is more powerful: a laser beam depletes the ground state, eliminates the line broadening effects and makes smaller electric fields visible. However, the more complicated set-up, with a careful alignment of laser beams, makes the measurements much more challenging. After a first test on a glow discharge plasma [4], the design of the optical path and the installation of the laser at IShTAR have started; the progress will be reported.

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