First results from the thermal Helium beam diagnostic at ASDEX Upgrade

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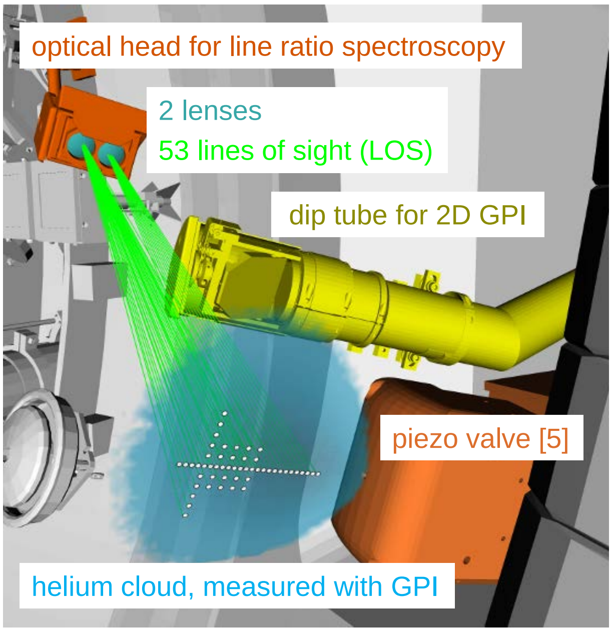
Line ratio spectroscopy on thermal Helium is a diagnostic method allowing the determination of electron density and electron temperature simultaneously [1,2,3,4]. The line ratio of two singlet transitions is mainly dependent on density, while the ratio of a singlet and a triplet transition is dominantly dependent on electron temperature. Evaluable signal of He I line radiation can only be collected in plasmas restricted to certain combinations of density and temperature. At the low end of both quantities the signal is too weak due to the low excitation rate and towards higher electron densities and temperatures the neutral Helium density is strongly attenuated. Such a diagnostic has recently been implemented at the tokamak ASDEX Upgrade. It is very well suited to investigate the plasma edge, with the measurable radial region from the far scrape-off layer (SOL) to the near SOL and in low density cases even across the separatrix into the confined region.



A piezo valve [5], mounted at the vessel wall very close to the plasma is used to inject neutral helium into the plasma. As shown in the figure, the lines of sight, optimised for radial resolution (~ 4 mm), cover a radial range of 8 cm in the plasma edge region, with additional ones for poloidally resolved measurements. The line resolved emission intensities of four He I lines are measured simultaneously with a newly developed 32 channel polychromator system, based on dichroic mirrors, small band interference filters and linear array photomultiplier tubes. With a data acquisition rate of 900 kHz this diagnostic provides not only a good spatial but also an excellent temporal resolution.

The capabilities of the diagnostic are demonstrated in selected examples. The characteristics of electron density and temperature profiles in the near and far SOL are measured across regime transitions, such as I-phase to H-mode or L-mode to I-mode. The effect of a regime transition can be seen across the whole SOL from the separatrix to the wall. Because of the high spatial and temporal resolution not only changes in profiles can be determined but also the propagation velocity of fast transient events such as bursts and blobs can be measured.

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