Spectroscopic Diagnostic of Tungsten at ASDEX Upgrade

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ASDEX Upgrade (AUG) is pursuing a program on W plasma facing components since the beginning of the ninetieth. After preparatory experiments on W components as well as first spectroscopic investigations for the diagnostics of W sources and transport, a divertor with W coated graphite PFCs was installed in 1995 and successfully run for one campaign until 1996. Besides important results on the W behaviour in a divertor tokamak, it became clear, that carbon erosion in the main chamber had a strong impact on the overall impurity content and the deposition in the divertor. Therefore, it was decided that on the way to all W PFCs to start converting the main chamber PFCs first and then successively implement W limiters and finally the W divertor. This transition started in 1999 and was completed in 2006/07.

From the first investigations to the routine operation of an all W device, spectroscopy was a key tool to characterize the source and the transport of W. In the early years of W operation information on atomic data, both on the ionisation equilibrium as well and the excited states and transition was scarce but over the years a lot of spectroscopic information has been accumulated in AUG and many investigations on dedicated devices were triggered which complemented excellently the spectroscopic data.

The investigations in AUG concentrated on the transitions which are accessibly by the available diagnostic hardware. This means that the influx measurements were restricted to the visible range and here mainly concentrated on the 400.8 nm WI line. Whereas this excludes dedicated spectroscopic investigations on prompt redeposition, it allows a very high spatial coverage of all W sources in the main chamber as well as the in the divertor. Operating with high transmission spectrometers allows in parallel high temporal resolution as well as reliable identification of background contributions. Similar to the influx measurements, the emphasis of the measurements of the W content was also put on the routine applicability and best use of scarce diagnostic resources. This led to a focus on the monitoring of the 4.5-7 nm region in the VUV complemented by X-ray measurements in the range of 0.5 – 0.8 nm. This allowed sensitively measuring W concentrations in a broad temperature range (~0.8 – 5 keV) thereby covering a large fraction of the plasma radius in most AUG discharges and providing a sensitive measure for the evolution of the W density profiles.

This contribution will give an overview on the spectroscopic investigations for the deduction of W influx and density and highlight their applications to AUG plasma discharges.