Density profiles and fluctuations in front of the ICRF antenna on the ASDEX Upgrade using X-mode reflectometry

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A new multichannel reflectometer diagnostic (RIC) was recently installed in an ICRF antenna of ASDEX Upgrade (AUG), aiming mainly for ICRF coupling and operation studies [1]. However, this system also opens up research opportunities in the area of scrape-off layer (SOL) physics by exploring the high temporal and spatial resolution of the diagnostics and by taking advantage of the three channels installed at different poloidal locations. This reflectometry diagnostic was designed to measure density profiles up to 2×10^{19} m^{-3} in X-mode in the typical 1.5 T–2.7 T magnetic fields of AUG. The full frequency range is swept in 15 μs, generating an electron density profile every 25 μs simultaneously in 3 different poloidal positions. Besides its high sensitivity to density fluctuations, reflectometry also provides localized measurement. Therefore, taking into account its high temporal resolution, the RIC diagnostic can be potentially used to observe SOL density fluctuations. In this contribution, the capabilities of the RIC diagnostic are demonstrated in selected examples.

The SOL density profiles and fluctuations are measured in density ramp up discharges where the amplitude of the fluctuations is observed to increase with the near SOL profiles becoming flatter, which is consistent with the expected enhancement in radial transport. A good agreement between the average density profiles obtained from lithium beam, Langmuir probes, and reflectometry diagnostics is demonstrated. Statistical properties of the density fluctuations such as the standard deviation and skewness obtained from Langmuir probes and reflectometry are also compared. Fluctuations levels ranging from 40 to 60% are found, in reasonable agreement with the Langmuir probe results. Although a good agreement is found with respect to the density standard deviation, RIC measurements typically underestimate the skewness of the density fluctuations most probably due its lower temporal resolution that prevents the detection of the largest amplitude fluctuations. The dependence of the density profiles and fluctuations characteristics measured by the RIC on parameters such as plasma current, density, and magnetic configuration will be explored for L and H-mode conditions.

[1] D. Aguiam et al, Rev. Sci. Instrum. 87 11E722 2016