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IST contributions to the ASDEX Upgrade edge and divertor physics using microwave reflectometry

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Information of the plasma density is essential for the study and operation of magnetically confined fusion devices. Microwave reflectometry appears as an attractive diagnostics due to its high temporal and spatial resolution and its application to profile as well as fluctuation measurements.
The microwave reflectometry systems developed by IST for ASDEX Upgrade consist of: (i) multi-band frequency modulated continuous wave (FMCW) O-mode reflectometer with the unique capability of providing simultaneous profile and fluctuations measurements on the high-field side (HFS) and low-field side (LFS), making it the ideal diagnostic for poloidal asymmetry studies; (ii) fast frequency hopping O-mode reflectometer used to obtain more detailed information on density fluctuations at the LFS; and (iii) A multichannel X-mode reflectometry diagnostic recently installed to measure the edge density profile in front of the ICRF antenna.
This contribution presents an overview of the scientific results obtained on ASDEX Upgrade where the different reflectometry systems are used in a complementary way in order to address some of the key issues under investigation in this device. Experimental results will be presented on topics such as: (i) Influence of the high-field side density front on the midplane density profiles; (ii) Edge turbulence in different states of divertor detachment; (iii) Edge instabilities across the L-H transition and in H-mode; (iv) Understanding density profiles in front of the ICRH antenna; (v) Synthetic reflectometry diagnostic; and (vi) Real-time plasma position control. The experimental results obtained demonstrate that the IST reflectometry systems provide a valuable contribution to a better understanding of important physics issues such as pedestal instabilities, SOL turbulence, dynamics of the density profiles and connection between midplane and divertor conditions. Different upgrades are under development that will provide uniquely flexible diagnostics for combined profile and fluctuations measurements particularly relevant for edge instabilities and turbulence studies.

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