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Validation of diagnostics for kinetic profiles at ASDEX Upgrade using integrated data analysis

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At ASDEX Upgrade (AUG) Integrated Data Analysis (IDA) is used to infer kinetic plasma profiles like electron density by a joint analysis of several heterogeneous diagnostics. A reliable forward model for each diagnostic is essential for the probabilistic approach, linking parameter space to data space, and prediction measurements accurately. The IDA approach enables the identification of systematic differences in profiles estimated from individual diagnostics, in case the observational volumes are overlapping.

IDA at AUG determines the density profiles based on interferometry, Thomson scattering, lithium beam excitation spectroscopy, thermal helium beam, and swept O-Mode reflectometry. The results for independent diagnostics are not always in agreement, with situational differences beyond the diagnostic uncertainties. These differences can originate from numerous sources like invalid assumptions in the forward models or uncertainties in physical parameters, insufficient calibration of diagnostics or time-dependent drifts, cross-calibration of diagnostics under invalid assumptions, and others.

The most recent addition to IDA is the reflectometry system, which adds a third independent diagnostic, complementing Thomson scattering and lithium beam, for density profiles with high spatial resolution around the separatrix. Based on this addition, a study on the uncertainties and discrepancies between the three diagnostics on experimental data is presented. Understanding the limitations of diagnostics and their forward models is essential for interpretation and evaluation of experiments, especially when profiles are used as input to large modelling codes.

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