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P1.1100 Current profile tailoring with the upgraded ECRH system at ASDEX Upgrade

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See the full abstract here:
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Adjustable current and q-profile shapes are of particular interest for the development of advanced scenarios, e.g., non-inductive tokamak operation, and for testing and refining of transport models for predictive capabilities. The current profile is tailored at ASDEX Upgrade using improved heating and current-drive actuators with an upgraded ECRH system with 8 MW for 10 s. The adjustable localised current drive capability of this flexible ECRH environment allows dedicated variations of the shape of the q-profile.
To resolve the highly-shaped current distribution an integration of all available measurement and modelling information is necessary. The equilibrium reconstruction is based on the coupling of a Grad-Shafranov (GS) solver with the current diffusion (CD) equation employing a physical coupling of neighbouring time points [1]. This coupling improves the estimated equilibrium current profile if neo-classical current diffusion can be assumed. Further ingredients are given by reliable electron and ion temperature and density profiles from an integrated data analysis approach, fast-ion pressure and driven current profiles from the RABBIT code, the electroncyclotron driven current from the TORBEAM code, bootstrap-current evaluation, all magnetic data of an extended set of poloidal-field and diamagnetic-loop measurements, internal current measurements from imaging MSE and polarimetry, and a sawtooth detection algorithm [2].
A recently developed fast reconstruction of the current distribution between plasma discharges allows for an educated and efficient scenario development. The equilibrium code IDE is parallelized using an OpenMP scheme within the Grad-Shafranov solver, within the RABBIT code of up to 8 NI-beams and within the TORBEAM code. On top of this, an MPI (Message Passing Interface)-based approach is applied for parallel calculations of the GS-solver response matrix and for parallel TORBEAM evaluations of up to 8 EC-beams for the CD-integration.
Various settings of localised counter- and co-, on-axis and off-axis current drive and heating allow for large flexibility in the q-profiles. Recent current and q-profiles obtained with the upgraded ECRH system will be presented.

[1] R. Fischer et al., Fusion Sci. Technol., 69:526-536, 2016
[2] R. Fischer et al., Nucl. Fusion, 2019, accepted

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