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The European Integrated Tokamak Modelling Effort: Achievements and First Physics Results

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The achievements and first physics results are presented of the European Integrated Tokamak Modelling Task Force (EFDA ITM-TF) effort, aiming at providing a standardized platform and an integrated modelling suite of validated numerical codes, for the simulation and prediction of a complete plasma discharge in any tokamak.

The framework developed by the ITM-TF, based on a generic datastructure enclosing both simulated and experimental data, allowed for the development of sophisticated integrated simulations (workflows) for physics application. Those include the European Transport Solver (ETS), incorporating a sophisticated module for synergy effects between heating schemes, several equilibrium modules, pellets, impurities, neutrals, sawteeth and NTM modules, a variety of simple transport modules and neoclassical modules. The ETS workflows have been subject to an extensive verification and validation laying the foundations for the use of ETS for both predictive and interpretative transport simulations as well as scenario modeling on present devices and ITER.

The equilibrium reconstruction and linear MHD stability simulation chain is being applied for production runs on several devices. In particular, an analysis of the edge MHD stability of ASDEX Upgrade type-I ELMy H-mode discharges and ITER hybrid scenario was performed, revealing the stabilizing effect of an increased Shafranov shift on edge modes.

A successful benchmark among EC beam/ray-tracing codes (C3PO, GRAY, TORAY-FOM, TORBEAM, TRAVIS) has been performed in the ITM framework for an ITER case for different launching conditions from the Equatorial Launcher, showing good agreement of the computed absorbed power and driven current.

Simulations performed within the ITM infrastructure with the turbulence code GEM for a JET hybrid discharge and the comparison of the simulated anomalous fluxes with TRANSP are presented, addressing in particular, the effect of the $\mathbf{E} \times \mathbf{B}$ shear on the thermal and particle confinement. Finally, recent developments on the integration and validation of synthetic diagnostics (fusion products, mse and reflectometry) on the ITM platform are shown.