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EUROfusion Integrated Modelling (EU-IM) capabilities and selected physics applications

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Recent developments and achievements of the EUROfusion Code Development for Integrated Modelling project (WPCD, follow-up of EFDA-ITM-TF), which aims at providing a validated integrated modelling suite for the simulation and prediction of complete plasma discharges in any tokamak, are presented. WPCD develops generic complex integrated simulations, workflows, for physics applications, using the standardized EU Integrated Modelling (EU-IM) framework. The integration of codes in EU-IM workflows is besides accompanied by a thorough cross-verification and, recently, by the introduction of rigorous release procedures. Among the achievements, the European Transport Simulator (ETS), has now reached a capability equivalent to the state-of-the-art integrated modeling transport codes, including interchangeable physics modules for equilibrium (both fixed and free boundary), transport (interpretative analytical, neoclassical, anomalous), impurities (all ionization states), NTM, sawteeth, pellets, neutrals, Heating and Current Drive (HCD) sources including all the heating schemes (EC, NBI, IC, nuclear) and synergy effects. The core ETS has been released and deployed at JET, offering a leading tool for both interpretive transport analysis and predictive modelling of complex scenarios. Selected physics applications are presented, in particular ETS simulations of plasma density control in reactor-scale plasmas fueled with multiple pellets.
A MHD stability chain was developed for the analysis of equilibria from any tokamak in the EU-IM platform; it includes a pool of interoperable high-resolution equilibrium and linear MHD stability codes. Having passed a benchmark on core and global ideal kink instabilities, the chain has been released and applied to the predictive analysis of DEMO and JT60-SA scenarios and can be straightforwardly used for interpretive runs on present devices as JET and ASDEX Upgrade.
A predictive J-alpha MHD pedestal stability analysis workflow has also been developed. Routine application to sensitivity analysis of DEMO1 scenarios is performed.
Furthermore, a workflow including a turbulence code and a synthetic probe was developed and applied to investigate the turbulent transport in the edge and Scrape-Off-Layer (SOL) of ASDEX Upgrade. Finally, a prototype edge workflow integrating the interaction with PFC was demonstrated.

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