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Recent EUROfusion Achievements in Support to Computationally Demanding Multi-scale Fusion Physics Simulations and Integrated Modelling

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Integrated Modelling (IM) of present experiments and future tokamak-reactor requires numerical tools which can describe spatially small-scale and large-scale phenomena as well as dynamically fast transient events and relatively slow plasma evolution within a reasonably fast computational time. The progress in the optimisation and speed-up of the EU first-principle codes and in the development of a basis for their integration into a centrally maintained suite of IM tools achieved by the EUROfusion High Level Support Team (HLST) and Core Programming Team (CPT) is presented here. An overview of the physics phenomena which can be addressed in various areas (core turbulence and magnetic reconnection, collisional transport in non-axisymmetric devices, edge and SOL physics, heating and current drive, pedestal physics, MHD and disruptions, reflectometry simulations) using the improved numerical tools is given. The optimisation of physics codes performed by HLST allowed one to achieve six-fold speed-up of SOLPS-ITER simulations due to OpenMP parallelisation of the B2 part of SOLPS; to investigate kinetic effects in SOL region using the realistic 3D geometry implemented in BIT2/BIT3; to perform the reflectometry simulations (REFMULX/REFMULF) for ASDEX Upgrade or JET much more accurately and to preview with more reality the behaviour of reflectometry in ITER or DEMO; to resolve realistic wall structures enabling the simulation of the precise current patterns required for the prediction of asymmetric forces during disruption events (JOREK-STARWALL). The CPT development activities in support to integrated modelling including a support to local deployment of the IM infrastructure and experimental data access, to the management of releases for sophisticated IM workflows involving a large number of components and to the performance optimization of complex IM workflows are summarised.

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