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On Benchmarking of Simulations of Particle Transport in ITER

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We report present status and main results of the ITPA IOS Topical Group activity on the benchmarking of simulations of the core particle transport in ITER baseline ELMy H-mode scenario with the integrated codes which are presently used for the ITER scenario simulations. The ITPA IOS group is pursuing particle transport as an important component of integrated modelling, because the simulations have shown that dynamics of the particle transport plays a key role in the possibility to access and sustain the H-mode and stable burn conditions and to provide controllable shut-down of DT discharge in ITER. Optimisation of the fuelling scenario for ITER requires sufficiently accurate numerical solvers with appropriate description of particle sources, sinks, boundary conditions and integration in the codes for simulations of self-consistent plasma evolutions. Core particle transport is being studied in the frame of code benchmarking within the ITPA IOS group with various integrated modelling codes used for the ITER scenario simulations. The purpose of the benchmark is to verify agreement among various integrated modelling codes by approximating closely the expected scenario on ITER and to predict ITER plasmas more accurately based on knowledge accumulated from the benchmark so to address the critical issues of ITER. It includes comparison of the particle transport solvers, description of the sources and sinks, as well as its implementation in the integrated codes. As a first step, the benchmark is carried out with identical prescribed particle sources, sinks, transport coefficients and boundary conditions for one time slice in the flattop H-mode phase to compare and understand differences among the codes. As a next step, we pursue a series of sensitivity studies and model expansions and improvements. Finally, the impact of particle transport on ITER fusion performance is discussed in time evolution simulations. The results of our benchmarking can be used for the choice of the level of approximation of the particle transport description necessary and sufficient for simulations of the ITER and DEMO scenarios.

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