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TH/P4-14: Progressive Steps towards Global Validated Simulation of Edge Plasma Turbulence

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Simulations of edge turbulence are particularly challenging due to the presence of large amplitude fluctuations and to the coupling of equilibrium and fluctuating scales. While validating edge simulations is necessary to assess the accuracy of our understanding, difficulties in experimental diagnostics and the lack of a precise validation methodology have, to date, severely limited the process. The Global Braginskii Solver (GBS) code has been developed to simulate plasma turbulence in edge-relevant conditions [1]. We have initially studied relatively simple configurations of increasing complexity, linear magnetic configurations and the Simple Magnetized Torus. GBS has now reached the capabilities of performing non-linear self-consistent global three-dimensional simulations of the plasma dynamics in the Scrape-Off Layer (SOL). By solving the drift-reduced Braginskii equations, the code evolves self-consistently the plasma flux from the core, turbulent transport, and the plasma losses to the limiter plates. This gradual approach has allowed gaining a deep understanding of turbulence, from identifying the driving instabilities to estimating the turbulence saturation amplitude. In particular, we point out the need of global simulations to correctly represent the SOL dynamics, simultaneously describing both fluctuating and equilibrium quantities. A code validation development project has been conducted side by side with the GBS development [2]. A methodology to carry out experiment-simulation comparison had been established and applied to quantify the level of agreement between the GBS the TORPEX experiment. This work is supported by the Swiss National Science Foundation.

[1] P. Ricci et al., Phys. Rev. Lett. 100, 225002 (2008); P. Ricci and B. N. Rogers, Phys. Rev. Lett. 104, 145001 (2010); B. N. Rogers and P. Ricci, Phys. Rev. Lett. 104, 225002 (2010).
[2] P. Ricci et al, Phys. Plasmas 16, 055703 (2009); P. Ricci et al., Phys. Plasmas 18, 032109 (2011).

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