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Global simulations of plasma turbulence in laboratory plasmas

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The Global Braginskii Solver (GBS) code has been developed in the last few years to simulate plasma turbulence in laboratory plasmas [1]. By solving the drift-reduced Braginkii equation in magnetic configurations of increasing complexity, from linear devices to the Simple Magnetized Toroidal (SMT) configuration, GBS performs non-linear self-consistent global three-dimensional simulations of the plasma dynamics, as the result of the interplay among the plasma source, the turbulent transport, and the plasma losses at the vessel. This gradual approach has allowed gaining a deep understanding of the turbulence dynamics, by identifying the instabilities responsible for driving plasma turbulence and to estimate the turbulence saturation amplitude. In particular, simulation results have pointed out the need of global simulations to correctly represent the dynamics of laboratory plasmas, as well as the importance of not separating fluctuations and equilibrium quantities. A code validation development project has been conducted side by side with the GBS development [2]. Such validation project has lead to the establishment of a rigorous methodology to carry out experiment-simulation comparison, and has allowed quantifying precisely the level of agreement between the GBS results and the experimental data from the TORPEX experiment at CRPP.

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[2] P. Ricci et al, Phys. Plasmas 16, 055703 (2009); P. Ricci et al., Phys. Plasmas 18, 032109 (2011).