Fluctuations, turbulence and transport in the TORPEX device

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The TORPEX toroidal plasma experiment ($R = 1\,\mathrm{m}$, $a = 0.2\,\mathrm{m}$) is dedicated to study fluctuations, turbulence and transport in plasmas dimensionally similar to the tokamak edge and scrap-off layer ($B \sim 0.1\,\mathrm{T}$, $n \sim 10^{16}$–$10^{17}\,\mathrm{m}^{-3}$, $T_e \sim 5$–$8\,\mathrm{eV}$, $\rho_s/L_n \sim 10^{-2}$). Current-free discharges are produced by RF waves in the electron cyclotron frequency range. A small vertical magnetic field component is used to affect the turbulence characteristics by influencing the dynamical generation of parallel electric fields.

Time and space resolved measurements of density and floating potential are available to characterize the naturally occurring fluctuations in both Fourier and real space. For the latter, a method has been developed to identify fluctuating structures as objects in real space, measure their properties and follow them in time to assess their trajectories. The statistical distributions of the related observables provide a robust framework in which the nature of the fluctuations, the turbulence and the related transport can be characterized. The combination of Fourier-space and real-space analysis draws a complete picture of the turbulence, which appears to be generally driven by an interchange-type instability and typically shows both stochastic features and regular patterns.

Progress on the development of ESELTPX, a 3D variant of the global drift-fluid code ESEL, accounting for the TORPEX magnetic topology and boundary conditions, will be discussed. This project aims at performing full global simulations of the TORPEX device, permitting to test the underlying theoretical models against experimental results with high discriminative power.