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Electrostatic turbulence and transport in a simple magnetized plasma[1]

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Magnetically confined plasmas are subject to gradient driven drift instabilities, causing anomalous transport. The conditions under which these instabilities grow and develop nonlinearly are investigated on the TORPEX toroidal device (R=1m, a=0.2m), taking advantage of its diagnostic accessibility and of the possibility of controlling key quantities such as the magnetic field pitch angle and the density profile. Plasmas are produced by low field side injection of microwaves (P$\leq$20kW) with f=2.45GHz, in the EC frequency range. Typical density and temperature are $n_e \leq 10^{17}m^{-3}$ and $T_e \leq 5eV$. The magnetic field is mainly toroidal ($\leq$0.1T), with a small vertical component ($\leq$2mT). In addition, an ohmic transformer can be used to drive plasma current and investigate the changes in the character of fluctuations as the magnetic flux surfaces are progressively closed. A quasi-static confinement model, verified experimentally, highlights the role of parallel flows in short circuiting drift-induced charge separation. The related confinement time and the fluctuation properties depend strongly on the vertical field, which can thus be used as a control parameter. Among the diagnostics dedicated to turbulence studies, a movable 4-tip probe measures the local dispersion relation and the profile of the fluctuation-induced flux. This flux is compared with the transport parameters inferred from the plasma response to microwave power modulation. An 86-tip probe reconstructs the temporal evolution of structures in ion saturation current or in floating potential across the plasma cross-section. The local statistical description of the turbulence can therefore be combined with 2D spatio-temporal turbulence imaging. Methods to characterize statistically the measured structures and construct quantitative observables will be discussed, along with initial comparisons with fluid codes.

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