Investigations of turbulent structures in the TORPEX device
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Lab., Denmark — Electrostatic turbulent structures are visualized on the TOR-
PEX toroidal plasma experiment ($R = 1\text{ m}, a = 0.2\text{ m}$) using HEXTIP, an 86-tip, 
2D Langmuir probe array covering the whole poloidal section. To characterize such 
turbulence imaging data statistically, thus providing a quantitative basis for compar-
ison (theory-experiment, theory-theory, experiment-experiment), suitable observ-
ables like positions, shapes and velocities of structures must be defined. Several 
possible definitions are compared in terms of information content, discriminative 
power, robustness and computational requirements. The statistical distribution of 
these observables is experimentally measured on TORPEX as a function of control 
parameters, i.e. quantities set externally and not subject to the plasma feedback 
action. Among these, the magnetic field line pitch angle is shown to play a special 
role for the turbulence dynamics through its effect on parallel flows, important to 
oppose drift-induced charge separation. The TORPEX results thus provide a highly 
discriminative test environment for turbulence models. On the modeling side, a 
pseudo-3D variant of the two-fluid code ESEL has been developed, accounting for 
the effect of a non-zero field line pitch angle and permitting to replace formerly freely 
chosen dissipation parameters by a physical model of the parallel dynamics.

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