Turbulent fluctuations in the scrape-off layer and edge plasma of the COMPASS tokamak

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This work brings an overview of properties of turbulent plasma fluctuations in the scrape-off layer (SOL) and the edge of confined plasma in COMPASS ohmic and L-mode discharges, measured using electrostatic probes. Amplitude and size of the structures, their ExB velocity, phase shift between plasma potential and density and/or temperature and general fluctuation statistics are studied across a range of plasma conditions (B_T = 0.8-1.35 T, I_p = 80-290 kA, n = 2-10 $10^{19}m^{-3}$, κ = 1-1.8) in relation to the position and properties of the velocity shear layer and the SOL collisionality. Moreover, their impact on the formation of radial plasma profiles is discussed.

Generally, two types of coherent fluctuations are observed: a) broadband high frequency branch (f ≈ 50-350 kHz) rotating in the electron diamagnetic direction and appearing mainly in the confined region, pronounced particularly at the position of the largest pressure gradient, but often protruding even to the SOL up to the near/far SOL boundary; b) low-frequency blobs, probably of interchange origin, rotating mostly in an opposite poloidal direction, formed in the vicinity of the radius of zero electric field and carrying significant particle and energy flux outwards to the SOL. Nevertheless, spectral decomposition of the radial particle flux shows that in the near SOL, where both types overlap, their contribution to the radial transport can be comparable.

In the SOL, the radial transport is influenced by a short connection length that COMPASS has, $L_{\parallel,LFS}$ ≈ 3 m [1], implying small SOL collisionality and possible sheath dissipation of the plasma potential [2, 3]. In the discharges with low-to-medium density the radial ExB velocity tends to be out of phase with density fluctuations, thus reducing the effective radial transport. At high densities this phase shift decreases, leading to increased radial transport.

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[2] O.E. Garcia, et al., Physics of Plasmas **13**, 082309 (2006)

[3] J.R. Myra, et al., Physics of Plasmas **18**, 060501 (2006)