Investigation of the turbulence characteristics and turbulent fluxes in the SOL of T-10 tokamak

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Highly anomalous particle transport in tokamak near the last closed flux surface (LCFS) leads to an essential widening of the scrape-off layer (SOL) [1]. Langmuir probe measurements of the SOL plasma parameters indicates [2] that intermittent convection rather than diffusion can define the cross-field transport. Intermittent plasma turbulence associates with formation and propagation of the coherent plasma structures (“bursts”) with high plasma density. Investigation of the turbulence characteristics and turbulent fluxes in the SOL and their correlation with core turbulence clarifies the mechanism of particle transport as well as particle balance and particle confinement in tokamak.

Characteristics of the periphery turbulence and turbulent fluxes were investigated on the T-10 tokamak by the Langmuir probes and heavy ion beam probe (HIBP) [3]. Both diagnostics measured the values and fluctuations of the density, potential and electric fields in the periphery plasma. Formation of plasma bursts is observed in the vicinity of the LCFS. The relative level of the intermittent turbulence and duration of the bursts rises with the radii beyond the LCFS. Coherent plasma structures moves in radial and poloidal direction. Radial velocity is about 1 km/s nearby LCFS and predominantly directed to the vessel wall. The velocity of the plasma poloidal rotation is 2-3 km/s and corresponds to the velocity of the poloidal $E_r \times B$ drift in value and direction. Measurements of the radial turbulent particle flux $\Gamma_r$ reveal its intermittent behavior in the SOL. The radial flux with bursts is about $1 \times 10^{18} \text{ cm}^{-2} \text{ c}^{-1}$ near the LCFS and represents the significant part of the total radial particle flux. Comparison of the Langmuir probes and HIBP measurements reveals that the radial turbulent flux is strongly inhomogeneous in poloidal direction. Spectral characteristics of the turbulence in the vicinity of the LCFS show the presence of the GAM-type oscillations of the density and potential. The frequency of the GAM oscillations (18 kHz) is close to that measured by the HIBP in the core and periphery plasma.