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Electric potential and turbulence in OH and ECRH low-density plasmas

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New experimental observations and theoretical description of the plasma potential and radial electric field Er formation in the T-10 tokamak are presented. The potential was measured by heavy ion beam probe (HIBP) diagnostic from the plasma core to edge with high spatial (<1 cm) and temporal (1 mus) resolution, and by Langmuir probe (LP) at the edge. Low-density OH deuterium plasma (ne=1.0⊠1019 m–3, Te<1.3 keV, Ti <0.6 keV) is characterized by a negative potential up to phi(0.25)=-800 V. The potential profile is monotonically increasing towards the edge. The off-axis (rhoEC=0.5) ECRH with power PEC-off <1.7 MW (fEC=144 GHz) leads to the formation of a flat Te profile at 2 keV inside rho EC. It causes a dramatic raise of the core potential to positive values over the whole observation area, forming nearly zero Er. Extra nearly on-axis (rho=0.2) ECRH with PEC-on<0.5 MW (fEC=129 GHz) leads to a further increase of Te up to 3.3 keV, and to potential raise to phi(0.25)=+900 V forming an extended area of positive Er, from the core to the edge. Also HIBP and LP measure Geodesic Acoustic Modes (GAMs) and broadband (f <400 kHz) turbulence of the potential and density. GAMs with higher frequency satellite are dominating in potential power spectra in OH plasma, GAM amplitude increases during ECRH. Both GAM and satellite have uniform structure with constant frequencies over a wide radial extension, exhibiting the features of global eigenmodes of plasma oscillations. At the edge, a quasicoherent (QC) electrostatic mode (f~50-120 kHz) coexists with the GAM A Stochastic Low Frequency (SLF) mode with frequency <50 kHz is seen in the plasma density and potential power spectra, density poloidal coherence and cross-phase, exhibiting the poloidal rotation opposite to QC mode. Neoclassical (NC) modeling use various codes, from the simple analytical approach to the orbit code VENUS+delta f. The radial profiles and the main tendencies like potential decrease with density raise and potential raise with Te increase due to ECRH were reproduced by NC models. The turbulent dynamics in the edge plasma was described by the 4-field nonlinear two-fluid Braginskii model. The link between the potential and confinement is discussed.

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