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EX/P5-39: The Fine-scale Structure of the Radial Electric Field in the Scrape-Off-Layer during ICRF Heating in Alcator C-Mod

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By observing the radial structure in the poloidal dynamics of the SOL turbulence during the application of ICRF power (P_RF>0.3 MW), we find a fine-scale radial structure in the poloidal phase velocities (V_pol) of the broadband turbulence. The radial profiles are very different from typical profiles in Ohmic plasmas. Since V_pol(r) in the SOL is dominated by V_ExB, this structure implies that a fine-scale E_r profile is formed in the presence of the ICRF. This profile extends to regions well separated toroidally from the ICRF antennas (˜2 m). The |V_pol| values in the far SOL imply an Er as large as 25 kV/m. The size-scale of the structure in this radial profile is much smaller than the fast wave perpendicular wavelength (˜10 cm). The observed velocity fields are consistent with the presence of potential structures arising as a consequence of sheath rectification of the ICRF waves, and potentials as large as 350 V are implied. Such Er profiles and potentials may help to explain the increased impurity content observed with ICRF heating, as a consequence of both enhanced sputtering and enhanced transport/penetration across the SOL. This effect will be important for impurity generation and SOL transport in regions well away from the antennas. Using 2D Gas-Puff-Imaging we find that, in the ˜3 cm region outside the separatrix, the steady-state dominant propagation direction for V_pol reverses up to three times; i.e. in some configurations, V_pol(r) varies from downward (E_r>0) in the ˜1 cm outside the separatrix, and then alternates from upward (E_r<0), to downward (E_r>0), to upward (E_r<0) in the next ˜2 cm. The local maxima in radial profiles of the potential occur on the field-lines just grazing active antennas. Thus the fine scale structure is a consequence of different antennas mapping to different SOL radii at the GPI view. The dependence of the implied potentials upon launched power follows the theoretically predicted trend (˜P_RFˆ1/2). However, the potential structures are found to be significantly broadened compared to the basic theoretical expectation, having a radial width that is ˜5xd, where where the expected width, d, is the skin depth for RF waves in the C-Mod SOL. The observed radial width also exhibits a power-dependence.
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