Electric Potential Cells at the Diverted Tokamak Separatrix*

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Detailed measurements by probes and Thomson scattering reveal unexpected electric potential and electron pressure (p_e) hills near the divertor X–point in DIII–D tokamak L–mode plasmas. The potential hill drives $\mathbf{E}\times\mathbf{B}_T$ circulation of plasma about the X–point, thereby exchanging particles, energy and momentum across the separatrix (B_T is toroidal magnetic field). The corresponding cross-separatrix transport can be large. This "potential cell" appears to be absent in ELMing and ELM-free H–mode plasmas, indicating the absence of strong X–point circulation. The measured private region convection quantitatively confirms the prediction by the UEDGE numerical code with plasma drifts included. This private $\mathbf{E}\times\mathbf{B}_T$ flow is the main cause of the well-known B_T direction sensitivity of divertor plasmas. New UEDGE modeling shows evidence of additional drift-driven pressure and potential variation poloidally around the separatrix. Potential cells in UEDGE appear to be a consequence of ion ∇B drift and parallel (to **B**) viscous stress, which cause poloidal density gradients to build-up and corresponding potential gradients to arise. We speculate that separatrix potential cells might be a major mechanism of L–mode edge transport and their suppression an important feature of H–mode.

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