**Drift effects in the scrape-off layer of the W7-X stellarator**

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A key mission of the W7-X stellarator is developing the physics basis of the island divertor heat exhaust concept. The classical $\mathbf{E} \times \mathbf{B}$ and diamagnetic drifts are known to affect particle, momentum, and energy transport in the scrape-off layer (SOL) of tokamaks and stellarators, altering plasma flows and creating asymmetries between divertors. To understand how drifts affect SOL transport in the W7-X island divertor, an experiment in the 'low-iota' magnetic configuration was performed to compare plasmas with matched core parameters but opposite magnetic field directions, and therefore opposite drift transport directions [1, 2]. Parallel flow velocities of $C^{2+}$ ions in the SOL are measured with coherence imaging spectroscopy (CIS) [3], an interferometric technique that measures ion Doppler parameters with high wavelength resolution ($\lesssim 1$ pm) over a wide field of view. The measurements are interpreted with the aid of a diagnostic forward model and a 1D simple SOL model that includes the $\mathbf{E} \times \mathbf{B}$ drift. In low-density plasmas ($\bar{n}_e < 2 \times 10^{19}$ m$^{-3}$), the poloidal $\mathbf{E} \times \mathbf{B}$ drift induces a large poloidal density asymmetry within the island SOL, as measured by divertor Langmuir probes. This in turn causes the parallel flow stagnation point to shift from the position halfway between targets to the X-point in the drift direction, leading to near-unidirectional flow throughout the SOL. As density increases, the effects of the poloidal $\mathbf{E} \times \mathbf{B}$ drift decrease substantially, resulting in a smaller density asymmetry and the development of a counter-streaming flow pattern. For the entire density range probed in this experiment ($\bar{n}_e = 1.5\text{–}6 \times 10^{19}$ m$^{-3}$), the experimental observations are more consistent with the effects of the poloidal $\mathbf{E} \times \mathbf{B}$ drift than the radial $\mathbf{E} \times \mathbf{B}$ drift. Preliminary results will also be presented concerning drift effects in various other magnetic configurations and in plasmas with higher density from experiments in the currently ongoing OP2.1 campaign.

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**References**

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