

Carbon counter-streaming flow studies of attached and detached plasmas in the Wendelstein 7-X island divertor

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The Scrape-Off Layer (SOL) of the Wendelstein 7-X (W7-X) stellarator is characterized by the presence of magnetic islands, which have been exploited for the island divertor configuration. The complex 3D magnetic topology of W7-X leads to a structure of SOL counter-streaming flows that is also 3D. This pattern, previously predicted, has been observed for the first time with a Coherence Imaging Spectroscopy (CIS) diagnostic during the last experimental campaign (OP1.2b). CIS is a camera-based interferometry diagnostic capable of measuring Doppler particle flow associated with a selected visible emission line from the plasma. The 2D measurement capability allows observation of the effects of the W7-X 3D edge geometry, supporting new physics investigations on SOL flows not possible with conventional 1D probes. Two CIS systems have been designed to monitor the same island divertor portion from nearly perpendicular directions for improved emission and flow interpretation. Thanks to a newly implemented calibration source, based on a continuous tunable laser, the intrinsic carbon impurity behavior has been investigated for different plasma conditions, e.g. density and heating power. The measured velocities vary in the range 0-35 km/s. Additionally, one of the most striking transition occurred during detachment: once this condition is achieved, the flow velocities decrease approximately by a factor 4. CIS detachment observations are compared with other diagnostics and dedicated EMC3-EIRENE simulations.