Propagation of turbulent filaments in the SOL of Wendelstein 7-X

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In the Wendelstein 7-X Scrape-Off Layer (SOL), turbulent (radial) transport is assumed to play an important role for heat and particle transport to the divertor due to the generally long connection lengths of a few 100 m. The existence of large magnetic islands at the plasma edge results in a complex three-dimensional magnetic field in the SOL which can be very wide and feature flat temperature and density profiles with small temperature and density gradients. The inherent three-dimensionality make experimental investigations of turbulent transport in W7-X SOL challenging.

Here, we employ both reciprocating and divertor Langmuir probes to investigate the spatio-temporal dynamics of turbulent filaments. Probe arrays on the Multi-Purpose Manipulator (MPM) in the outer mid-plane provide turbulence characteristics such as correlation lengths, life times, and propagation velocities. Using the magnetic flexibility of W7-X and the reciprocating motion of the MPM, the role of magnetic islands for plasma turbulence can be assessed. We find that the presence of islands can significantly affect (reduce) the radial turbulent transport.

Exploiting the magnetic connection between the MPM and divertor Langmuir probes, the 3D (radial, poloidal, parallel) dynamics of filaments can be assessed by correlating the fluctuation data from both diagnostics. The role of plasma conditions (heating, density) and the effect of toroidal plasma currents on the edge magnetic topology is explored.