Plasma filament dynamics in different toroidal magnetic configurations

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Filaments detaching from the edge of tokamak plasmas are well known. They are generated by pressure driven instability and driven outward by polarization due to the magnetic field curvature and gradient. Similar structures are also commonly observed in the edge and island divertor of the Wendelstein 7-X stellarator. Given the complex 3D geometry of the device and long connection length to the divertors considerable differences are expected in the filament dynamics. Local measurements are insufficient, therefore a multi-diagnostic approach is adopted: local measurement by an alkali Beam Emission Spectroscopy (BES) diagnostic and toroidally distributed information from 10 video cameras.

Indeed long-range correlations are seen all around the machine indicating that filaments are non-local and thus a quasi-2D treatment is inappropriate both in measurement and theory. In the LFS edge region filaments propagate outward similarly to tokamaks. As they cross the island separatrix their movement appears to be more complex. Filaments appear to extend to more than one toroidal turn and appear on the outboard side of the island as well where the polarisation electric field, and thus the radial drift is likely reversed.

Filament activity is affected by edge plasma conditions where in some cases periodic oscillations resembling the I-phase in tokamaks appear. The talk presents analysis of these structures in different stellarator magnetic configurations and their role in edge and island transport. These observations are compared to comparable data from alkali and heating BES data on various tokamak experiments (EAST, KSTAR, COMPASS) where in some cases 2D BES measurements are also available in the SOL and edge.