Direct Measurements of Parallel Blob Extension in Diverted TCV Plasmas

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Turbulent plasma structures, called blobs, dominate the cross-field transport of heat and particles in the tokamak Scrape Off Layer (SOL), and may pose a threat to the first wall in a fusion reactor. Their dynamics perpendicular to the magnetic field has been studied extensively on a number of devices. However, there is less experimental data available on their dynamics parallel to the field, and less is known on how turbulence communicates between the outer midplane and the divertor. In this work, we use the extensive diagnostic coverage of TCV's SOL - in particular the midplane and X-point GPI systems, wall-embedded Langmuir probes and the Reciprocating Divertor Probe Array (RDPA) - to experimentally determine the parallel extent of blobs from the midplane to the divertor plates.

Guided by field line tracing, we configured the plasma geometry in attached L-mode plasmas in such a way that the midplane GPI was field-aligned to the other diagnostics. The parallel extension of the blobs is then determined by pairwise cross-correlation between the diagnostics at different locations in the SOL: far above the X-point, just above the X-point, just below the X-point and on the divertor plates. This showed that blobs extend from the midplane to below the X-point. Near the separatrix, coherence along the magnetic field seems to be disrupted as turbulence crosses the X-point, to be then re-established further out in the SOL. The results suggest that some local mechanism, such as the extreme magnetic shear that elongates the blobs, is the cause of the loss of coherence. We will here present a discussion on the consistency of these measurements, a comparison with leading blob models, and the extension of these studies to high density, detached conditions.