The influence of magnetic field geometry on blob structure and dynamics in TJ-K

Stephen Garland¹, Golo Fuchert², Mirko Ramisch¹, Thomas Hirth¹,³

¹Institute of Interfacial Process Engineering and Plasma Technology IGVP, University of Stuttgart, 70569 Stuttgart Germany
²Max Planck Institute for Plasma Physics IPP, 17491 Greifswald, Germany
³Karlsruhe Institute of Technology KIT, 76131 Karlsruhe, Germany

Corresponding author: Name: Stephen Garland Email: garland@igvp.uni-stuttgart.de

Filament-like pressure perturbations, elongated along the magnetic field lines (often referred to as blobs), are commonly observed to propagate in the radial and poloidal directions in the scrape-off layer (SOL) of magnetically confined fusion plasmas [1]. They can significantly contribute to SOL heat and particle transport and pose a risk to plasma facing components, as well as play a role in neutral particle recycling. For this reason, a deeper understanding of the dynamics and structure of blobs, and the influence of magnetic field geometry, is important.

For this contribution the influence of geodesic curvature on poloidal blob motion and the role of magnetic shear on 3D blob structure have been studied. To this end, Langmuir probe measurements have been carried out in the stellarator TJ-K. Blob structures were detected from measurements in a poloidal cross section using the conditional averaging technique, and the centres of mass (CoMs) of blob cross-sections were calculated. By tracking the blob CoMs over time the poloidal blob velocity could be determined. Poloidal velocities were calculated according to an analytical model [2,3,4,5], expressing blob poloidal velocity in terms of the geodesic magnetic field curvature, and compared to experimental data. Good agreement between the model and experiment was found for a range of ion masses when the background ExB flow speed was also taken into account, confirming the contribution of geodesic curvature to poloidal blob dynamics. In addition, information on the 3D structure of blob filaments was obtained from probe measurements in two toroidally separated poloidal cross sections. The measurements were conditionally averaged using a common reference probe, resulting in the average blob shape at both toroidal locations simultaneously. It was found from these measurements that blob filaments are aligned to a flux tube close to the last closed flux surface, however as they propagate further into the SOL, they do not deform due to the magnetic shear, but retain their original form.