Experimental investigations of turbulent transport asymmetries and 3D structure of edge turbulence

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From theoretical investigations it is well known that turbulence and turbulent transport in magnetically confined plasmas depend on details of the magnetic configuration such as field curvature and magnetic shear. As an example, turbulence simulations carried out in tokamak geometry show a strong high/low-field asymmetry. But even such a clear prediction has not yet been confirmed experimentally although it has important consequences with respect to confinement optimization and estimations of heat load on plasma facing components. The present work focuses on experiments which aim at a poloidal and toroidal resolution of turbulent transport. To this end, the turbulence characteristics and turbulent transport is measured on 128 positions located on a magnetic surface in regions where the local shear, geodesic and normal curvature are different. The experiments have been carried out on the stellarator TJ-K which is operated with a low-temperature plasma with fusion-relevant dimensionless parameters. Density and potential fluctuations are measured using two multi- Langmuir-probe arrays on two poloidal circumferences. The variations of the fluctuation amplitudes, the density-potential cross phases and the turbulent transport are correlated with the local magnetic parameters as calculated with a field-line-tracing code. With both probe arrays a strong influence of magnetic curvature on the turbulent transport is observed. Statistical data analyses of the measured density and potential fluctuations combined with a field-line tracing code reveal the 3D structure of edge turbulence. Perpendicular and parallel dynamics of elongated structures are obtained by cross-correlation analyses. Propagation velocities and correlation lengths are compared with basic drift-wave turbulence theory. The results point to an influence of the magnetic field geometry on correlation lengths.