Influence of plasma biasing on turbulence in the torsatron TJ-K

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Plasma confinement can be strongly improved by transport barriers. First in the ASDEX tokamak, spontaneous transitions from a low-confinement (L-mode) into a high-confinement regime (H-mode) have been observed. L-H transitions are accompanied by the formation of a transport barrier at the plasma edge. $E \times B$ shear flows have been considered as a candidate for triggering the transport barrier. They are assumed to limit the radial correlation length of turbulent structures [2] and, thus, reduce radial turbulent transport. Besides spontaneous L-H transitions, improved confinement regimes can also be achieved by externally induced electric fields [3]. In the concept of plasma biasing, the plasma potential is locally modified by an inserted electrode.

In this contribution, biasing is applied to the low-temperature plasma in the torsatron TJ-K in order to investigate the mechanism of transport reduction due to shear flows. The plasma is throughout accessible for probe diagnostics and the dimensionless parameters are similar to those at the edge of fusion plasmas. Turbulent structures are detected by means of an 8×8 Langmuir probe array in order to study the shear decorrelation mechanism.

Different biasing schemes were tested to create sufficiently strong shear flows to have an impact on turbulent structures and radial transport. A clear effect was achieved with ring-like electrodes aligned on a flux surface. The plasma conditions and the fluctuations could strongly be influenced. Steepened density gradients and reduced fluctuation and transport levels were obtained when the shear was increased inside the confinement region. The direction of the poloidal propagation of turbulent structures changed from the electron-diamagnetic to the $E \times B$-drift direction when strong radial electric fields were induced. The structures were found to be distorted, but a decrease of the radial correlation length was not observed. Transport reduction can be traced to enhanced stability reflected in the cross-phase between poloidal electric field and density fluctuations and also to shortened lifetimes.

References

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