Radial structure of vorticity in the plasma boundary of tokamak plasmas

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The first experimental measurement of vorticity and vorticity flux divergence in a fusion device is presented. This is an important achievement since vorticity plays a key role in the transport of energy and particles in plasmas and fluids. The measurements were performed in the plasma edge of the small tokamak ISTTOK, with an array of Langmuir probes, specifically designed for the purpose, allowing for the first time a direct comparison with theoretical models.

Plasma profiles and turbulence have been investigated using the probe head, located on the equatorial plane of the device. It consists of two parallel arrays of Langmuir probes separated by $\Delta r \sim 3$ mm allowing the simultaneous investigation of the radial structure of fluctuations on vorticity, Reynolds stress and turbulence in the plasma boundary region. Measurements were taken at different radial positions, both in the edge ($r < a_{limiter}$) and in the scrape-off layer ($r > a_{limiter}$) on a shot by shot basis.

The experimental results presented show that the vorticity flux divergence amplifies the shear flow in the tokamak plasma edge region. Self-similarity in the probability distribution function of several parameters, including vorticity and vorticity flux, is also observed in ISTTOK and indicate that there is no morphological change in the coherent structures in the plasma boundary region and that momentum flux is regulated by blobs.