Plasma blobs in a basic toroidal experiment: Origin, dynamics and induced transport

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The question of plasma blobs in the tokamak Scrape-Off Layer (SOL) is one of the most active research areas in tokamak edge plasma physics, as they are believed to dominate the transport across the SOL and, from a technical point of view, lead to very high punctual loads on divertor targets that may become critical for ITER. While significant evidence for blobs has been obtained in tokamak experiments, the mechanisms leading to their ejection and propagation are still unclear. This motivates to set-up dedicated scenarios in basic plasma devices, aiming to reproduce the core-SOL transition in tokamaks to study blobs under controlled laboratory conditions.

Such experiments have recently been conducted on TORPEX, where the rf plasma production has been limited to the HFS-half of the toroidal vacuum vessel. Negligible plasma production is happening on the LFS-half, which can therefore be regarded as SOL-like. An interchange instability is present on the LFS slope of the core-plasma profile, which drives a large-amplitude drift-interchange wave propagating along the core-SOL transition. The wave crests, which can be directly visualized using the TORPEX 2D Langmuir-probe array HEXTIP, are themselves subject to instabilities. The crests elongate radially, possibly due to a wave-breaking process, and deform in the shear of the wave velocity (see I. Furno, this conference), giving rise to the ejection of blobs. Once decoupled from the wave, the blobs propagate radially and can reach the far LFS region, more than 10 cm away from the region where they are born.

A complete quantitative analysis of the properties of the blobs is presented employing a direct pattern-recognition technique, including the quantitative determination of the blob-induced transport. Preliminary results from similar experimental setups in the linear devices CSDX and LAPD are discussed.