Prediction of the blob generation rate at ASDEX Upgrade

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Intermittent pressure filaments (“blobs”) are observed in the scrape-off-layer (SOL) of fusion experiments in all commonly accessed operational regimes [1]. Due to a radial motion of these filaments they significantly contribute to the turbulent transport of particles and energy in the SOL, thus posing a possible threat to the first wall and plasma purity. Thanks to continuous experimental and theoretical efforts over the last years, the dynamics of single blobs is rather well understood. At present, however, there is no quantitative prediction of the generation rate of blobs, which is a prerequisite for analytical estimates of the SOL transport and wall load.

In this contribution, a phenomenological model is presented which facilitates the prediction of the blob generation rate together with the experimentally accessible detection rate: Experimental evidence from basic plasma and fusion experiments indicates that blobs are generated by turbulent fluctuations in the vicinity of the last closed flux surface on a characteristic size scale. At ASDEX Upgrade this generating instability seems to be of a drift-wave-like type [2, 3]. By evaluating the drift-wave dispersion relation for the size scale on which blob generation takes place, a characteristic generation frequency can be calculated. Experimentally, only a small fraction of these events is detected, since only high-amplitude events can clearly be distinguished from background fluctuations. This fraction of detectable blobs could be predicted from the blob-amplitude distribution function. However, since this distribution function is unknown at present, the fraction of detectable blobs is determined from experimental data.

Predictions from this model are compared to experimental detection rates and a good overall agreement is found, which is an important step towards a quantitative understanding of the blob generation process.

References