Observation of coherent structures in MAST plasmas using BES

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Experiments have shown that the edge and scrape-off-layer plasma transport exhibits intermittent behaviour, with plasma fluctuations characterised by both positive and negative bursts [1]. Positive high-amplitude events are usually referred to as blobs and negative ones as holes, and have thus far mostly been observed as SOL filaments or fluctuations just inside the last closed flux-surface. The formation and properties of the observed coherent structures is still an active area of the research.

It has been shown that in plasmas close to the marginal stability threshold the perpendicular flow shear suppress small-amplitude plasma fluctuations but a sufficiently large initial perturbation can grow and transition into broadband turbulence [2]. The previous analysis has shown that the plasma turbulence on MAST is marginally unstable [2-4], and an indication of the existence of two-component turbulence consisting of rare relatively large longer-lived eddies and numerous small-scale weak fluctuations has been obtained [5].

The present work is focused on studying long-lived structures in MAST plasmas, deep in the confined region, at $r/a = 0.8 - 0.9$ using the Beam Emission Spectroscopy diagnostic [6]. The PDFs of the considered density fluctuation fields have non-Gaussian shapes with negative skewness. Extraction of high amplitude events was performed using wavelet transforms and the conditional averaging technique. Large-scale structures are characterised by correlation times up to two-fold higher than those of the ambient turbulence and close to zero tilt angles of the spatial correlation function. The importance of the non-linear interaction between long-lived vortices and sheared poloidal flows in the plasma turbulence dynamics has been addressed.

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[1] D. A. D'Ippolito, et al. Phys. of Plasmas 18, 060501 (2011)
[2] F. van Wyk et al, PPCF 59, 114003 (2017)
[3] Field, A. R. et al, PPCF 56 025012 (2014)
[4] Y.-C. Ghim et al, NF 54 042003 (2014)
[5] M.F.J. Fox et al, PPCF 59, 034002 (2017)
[6] A. R. Field et al. Rev. Sci. Instrum. 83, 013508 (2012)

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