Edge turbulence characteristics and blob dynamics following the compact toroid injection (CTI) investigated with fast visible imaging in QUEST

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Abstract

In this experiment, plasma current is driven by 8.2 GHz ECCD at electron density n_e of $\sim 10^{17}$ m^{-3} in the spherical tokamak QUEST. A compact toroid (CT) of high density is injected at 4.0 s from a radial port on the mid-plane during plasma current (I_p) flat top at $\sim$-12kA. Sudden drop in I_p (to -7 kA) is followed by a quiet phase of few ms. Thereafter, strong edge turbulence is observed at the I_p recovery phase. Helical perturbations and subsequent blob ejection is observed. Tangential fast visible imaging diagnostic [1,2] is used for the observations at a temporal resolution of 20 kHz and a spatial resolution of 3.6 mm on the tangency plane.

Time series of images is shown in figure 1. Evolution of coherent convective structures following CTI can be seen in the image sequence. In 1(a) the plasma edge is relatively quiet. Thereafter the helical perturbations grow (1(b-h)) and a huge blob is ejected. At the end, formation of another consecutive blob can be seen (1(i-j)). Figure 2 a(i-iii) shows the intensity fluctuations at three radial locations i.e., inside the last closed flux surface (LCFS), density gradient at the edge and the far scrape off layer (SOL) region at the low field side. Large intermittent positive bursts can be seen at the far SOL. They correspond to the blob propagation in that region. Probability density function (PDF) at the gradient region shows (fig. 2b) a significant shift from the Gaussian statistics. Parabolic relation ($k = As^2 + C$) is also observed between higher order moments (skewness s and kurtosis k) of spatio-temporal fluctuations on the entire R-Z plane. Thus turbulence statistics and blob dynamics at the plasma edge following CTI will be presented.

[1] Santanu Banerjee et al., IEEE Transactions on Plasma Science, **39** (2011) 3006.
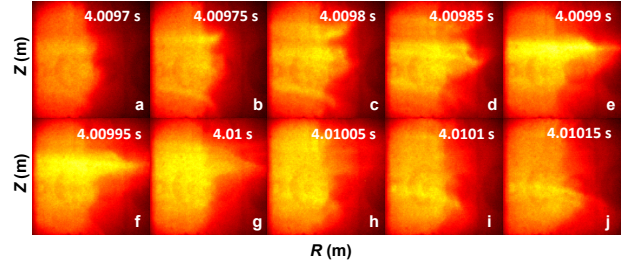[2] Santanu Banerjee et al., Rev. Sci, Instum, **83** (2012) 10E524.

Figure 1: Time series of a blob event is shown in false color. Images run from left to right and top to bottom and the consecutive images are 50 μs apart.
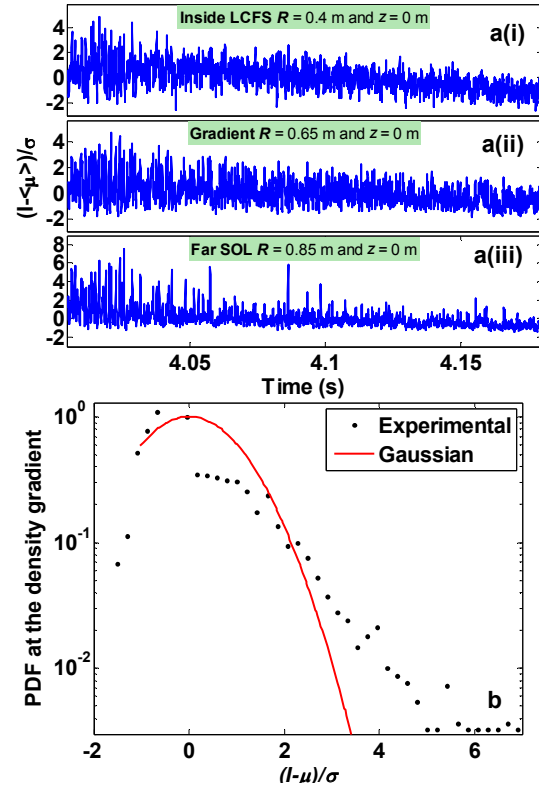

Figure 2: a(i-iii): Intensity fluctuations at three radial locations; b: Normalized PDF and the corresponding Gaussian at the density gradient.