# Experimental studies of edge shear layer in the proximity of density limit on the J-TEXT tokamak

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High plasma density is favorable for fusion reactors as the fusion power is proportional to the square of density. High density operation is considered as the scenario baseline for ITER[1] and DEMO[2]. While the density limit imposes constraints on the attainable maximum density for current-generation tokamak operations[3]. The Greenwald empirical scaling[4] shows that, the maximum line-averaged density is like to scales as current density, $n_G$=Ip/(π a2). Discharges with deep fuelling demonstrates that the Greenwald density can be considerably exceeded with the centrally elevated density profile[5]. So the underlying physical mechanism of density limit might lie behind the plasma edge. Recent reseaches indicate that, the collapse of edge shear layer may lead to the cooling of edge and therefore the onset of subsequent radiation losses, current shrinking and MHD instabilities that limit the density in Ohmic and L-mode discharges[6,7]. The limiting initial edge density for shear layer collapse is derived based on neoclassical screening and drift wave-zonal flow dynamics, and shown to scale favorably with plasma current. But direct experimental validation on tokamak plasmas is still incomplete.

In this paper, we present the recent experimental studies of edge shear layer in the proximity of density limit on the J-TEXT tokamak in a limiter configuration with a major radius of 1.05m and a minor radius of 0.255m. As density approaches $n_G$, ExB shear flow collapses (Figure 1(c)). It can be explained by the reduced energy transfer strength from turbulence to zonal flow, which is characterized by the dimensionless ratio of Reynolds power to internal power (Figure 1(d)). Figure 2(a-b) show the power spectra of floating potential and ion saturation current in r~24.3 cm, respectively. Ion saturation current fluctuations reflects the density fluctuations. Low-frequency avalanche-like features in density fluctuations are found as density increases. This leads to the enhanced turbulent particle flux with low frequencies, as shown by Figure 2(c), which may cause the enhanced convective heat flux and edge cooling (Figure 1(b)). More relevant work is going on and will be focusing on the edge shear layer dynamics related to plasma current scaling.

## References

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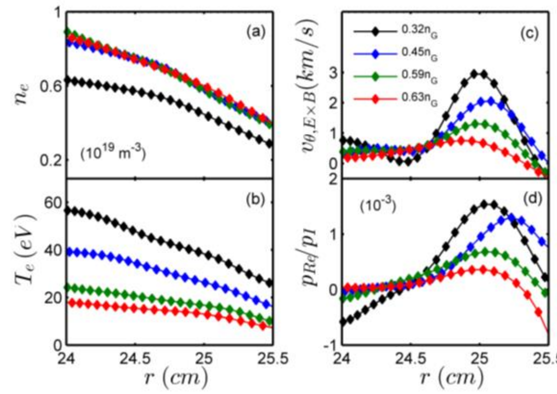


**Figure 1**. Collapse of edge shear layer and energy transfer from turbulence to zonal flow.

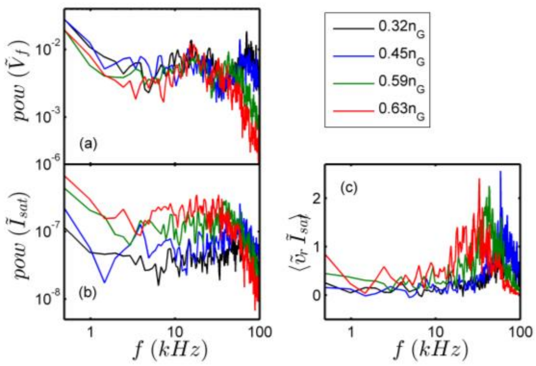


**Figure 2**. Low frequency avalanche-like features in density fluctuations