

# Blob structures and density shoulder formation in Alcator C-Mod

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Fluctuations in the boundary region of the Alcator C-Mod device are investigated with mirror Langmuir probe and gas puff imaging measurements in a series of experiments with a scan in core plasma density [1]. This reveals the familiar broadening and flattening of the radial electron density profile in the scrape-off layer. Time delay estimation and conditional averaging methods are applied to deduce blob sizes and velocities at various radial positions within the boundary region. In discharges characterized by low density, the dynamics of blobs manifest in the far scrape-off layer, exhibiting radial velocities reaching up to 500 m/s. As the core plasma density approaches the empirical discharge density limit, blob dynamics come to dominate the entire scrape-off layer, extending even inside the last closed magnetic flux surface with radial velocities exceeding 1 km/s. The fluctuations measured at any given location within the gas puff imaging field-of-view display pronounced intermittency in the region primarily governed by blob structures. Both the radial profiles and the fluctuations are in excellent agreement with a stochastic model describing the blobs as a super-position of uncorrelated pulses moving radially outwards, predicting a particle density profile e-folding length given by the product of the radial blob velocity and the parallel loss time [2]. With increasing core plasma density, the blobs move faster, the average particle density in the far scrape-off layer increases and the fluctuations become more intermittent, resulting in enhanced plasma interactions with plasma-facing components. Similar fluctuation statistics are shown to apply to H-mode plasmas in Alcator C-Mod.

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## References

[1] R. Kube *et al.*, Journal of Plasma Physics **86**, 905860519 (2020)

[2] O.E. Garcia *et al.*, Physics of Plasmas **23**, 052308 (2016); J.M. Losada *et al.*, *ibid* **30**, 042518 (2023)