Fast Imaging of ELM Structure in DIII-D*

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The spatial structure of edge localized modes (ELMs) is studied using a fast camera with frame rates up to 26 kHz and spatial resolution of 256 x 256, with each pixel imaging approximately 50 mm^2 in the plasma. This fast framing camera was first used in 2005 to image the outboard midplane of DIII-D with a near-tangential view.[1] In 2006, this diagnostic was improved by replacing the zinc selenide window to allow full visible light transmission. Measurements with CIII and D_α filtered line emission show that ELMs have a helical filamentary structure with high poloidal and toroidal mode numbers that depend on plasma density. Low-density plasmas have ELM toroidal mode number n ranging from 15–30, while high density plasmas have n ranging from 20–40. Typically, the safety factor q is approximately 3 in the region of emission; thus, the inferred poloidal mode numbers $m=qn$ range from 45 to 120. During inter-ELM periods, the observed emission region is localized near the separatrix, and filaments are visible in CIII light. In the nonlinear phase of the ELM, filaments balloon radially outward at a rate of 500–1000 m/s. The filaments interact with the outboard wall in a poloidally-localized region within ±15 cm of the midplane. Poloidal profiles are taken of bright D_α emission during wall-filament interactions, and poloidal filament widths are measured in the range 2–5 cm. The results obtained from imaging will be compared with peeling-ballooning theory of ELMs. In addition, the radial width of CIII emission during resonant magnetic perturbation (RMP) ELM suppression is found to be larger than that during inter-ELM periods without RMP, presumably due to stochastic field lines.

[1]G.Y. Antar, et al., "The Spatio-Temporal Structure of Type I Edge Localized Modes by Fast Imaging on the DIII-D Tokamak," this conference.

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