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ELM filament structure in the National Spherical Torus Experiment[1]

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The large pressure gradients near the edge of tokamak experiments during H-mode operation are predicted to drive periodic instabilities known as Edge Localized Modes (ELM). Numerical simulations have identified peeling modes and/or ballooning modes as the candidate instabilities, giving rise to filaments that burst radially outward across flux surfaces during the non-linear growth phase [1]. Fast-frame visible imaging, as well as other diagnostics, are used in NSTX to study the evolution and characteristics of the post-ELM filaments. SOL structures evolve from a perturbation of the edge topology that within 30-40 μs develops into strong "primary" filaments that propagate both radially and poloidally/toroidally, although long lived precursors are sometimes observed. These filaments are then followed by an increased level of edge turbulence (and blobs) momentarily resembling that observed during L-mode phases. The later blob filaments are clearly distinct from the initial primary ELM structures, with the early filaments being much denser (approx. pedestal densities), larger in cross-field dimensions (up to 5 cm), and moving at higher radial velocities (up to 7 km/s) than the later, "secondary" blob filaments. The edge turbulence subsides to H-mode levels within 1 ms. The correlation between filament size and speed is qualitatively consistent with analytic theory under the high collisionality regime [2]. These observations are consistent with the idea that the ELMs cause a temporary break down of the transport barrier, allowing a transient increase in turbulence close to L-mode levels. [1] P. B. Snyder, H. R. Wilson and X. Q. Xu, Phys. Plasmas **12**, 056115 (2005). [2] J. R. Myra, D. A. D'Ippolito, et al., Phys. Plasmas **13**, 092509 (2006).

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