ELM filaments in the scrape-off layer of the National Spherical Torus Experiment

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The post-ELM filaments in the scrape-off layer (SOL) of the National Spherical Torus Experiment (NSTX) are studied using the Gas Puff Imaging (GPI) diagnostic [1] as well other diagnostics. ELMs are routinely seen during H-mode operation in NSTX. These have been characterized as large-sized Type I, medium-sized Type III, and small-sized Type V ELMs [2]. This paper will report on the field-aligned filaments observed in the SOL after the onset of all 3 ELM types. Similar filaments have been also observed in other experiments [3-4].

In NSTX the 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. These filaments are then followed by an increased level of edge turbulence (and blobs [5]) resembling, momentarily, that observed during L-mode phases. The later blob filaments are clearly distinct from the initial primary ELM structures, with the early filaments (those within the first 40 μs after onset) being much denser, larger in cross-field dimensions, and moving at higher radial velocities (up to 7 km/s) than the later, "secondary" blob filaments which have typical radial velocities of ~1 km/s. The density of the primary filaments can reach values typical for the top of the pedestal and are more prevalent in Type III ELMs than in Type I ELMs. For the case of Type V ELMs [6], the primary filaments are long lived structures that do not detach from the edge. The secondary filaments and edge turbulence subside to H-mode levels within 1 ms.

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