High Frequency ELM Pacing by Pellet Injection on DIII-D and Implications for ITER*

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Pellet pacing of edge localized modes (ELMs) by triggering small rapid ELMs with pellet injection, has been proposed as a method to prevent large ELMs that can erode the ITER plasma facing components [1]. D_2 pellet injection has been used on the DIII-D tokamak to successfully demonstrate for the first time the pacing of ELMs at a 10x higher rate with a much smaller size than natural ELMs . This demonstration was made by injecting slow (<200 m/s) 1.3 mm diameter pellets at 60 Hz from the low field side in an ITER shaped plasma with a low natural ELM frequency of 5 Hz, $q_{95} = 3.5$, $\beta_N = 1.8$, and normalized energy confinement factor $H_{98} = 1.1$; the input power was only slightly above the H-mode threshold. The non-pellet similar discharges have ELM energy losses up to 50 kJ ($\sim$8% of total stored energy), while the case with pellets was able to demonstrate 60 Hz ELMs with an average per ELM energy loss less than 5 kJ (<1% of the total). Total divertor heat flux from the ELMs is reduced by more than a factor of 10 as measured by a fast IR camera. Central accumulation of Ni is significantly reduced by the 60 Hz pellets. No significant increase in density or decrease in energy confinement was observed with the pellets.

A new injection line on the low field side near the divertor that mimics the injection geometry planned for ITER is used for these recent experiments. Experimental details from the pellet ablation and magnetic loop signals shows that the ELMs are triggered before the pellets reach the top of the H-mode pressure pedestal, implying that even smaller shallow penetrating pellets would be sufficient to trigger ELMs. Fast camera images of the pellets entering the plasma from the low field side indicate a local triggering phenomenon. The implications of these results for pellet ELM pacing on ITER will be discussed.

References

[1] P.T. Lang *et al.*, Nucl. Fusion **44**, 665 (2004).

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