ELMs Triggered from Deuterium Pellets Injected into DIII-D and Extrapolation to ITER*

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Deuterium pellet injection has been used in experiments on the DIII-D tokamak to investigate fueling and the triggering of edge localized modes (ELMs) in reactor relevant plasma regimes. ELMs have been observed to be triggered from fueling pellets injected from all locations and under all H-mode operating scenarios in DIII-D. Pellets injected into plasmas with ELMs suppressed by a resonant magnetic perturbation are also observed to trigger one or more ELM like events, but at reduced amplitude compared to non-RMP suppression. Attempts to raise the operating density with pellet fueling in RMP has thus far led to infrequent ELMs at moderate density and to a return to an ELMing H-mode state at higher density. Experimental details of the pellet triggering of ELMs on DIII-D have shown that the ELMs are triggered before the fueling pellets reach the top of the H-mode pedestal implying that very small shallow penetrating pellets are sufficient to trigger ELMs.

The penetration of pellets injected into DIII-D plasmas has been modeled using the PELLET ablation code [1] using the neutral gas shielding model [2] and agrees well with the measured depth from the lifetime of the D_α emission and fast framing camera studies. Pellets as small as 1 mm are predicted to penetrate deep enough to trigger ELMs on DIII-D. A device known as a pellet dropper has been installed on DIII-D and is now operational for ELM pacing studies. This dropper is designed to introduce 1 mm size cylindrical pellets using gravity as the accelerator so that their speed is only ~10 m/s. Pellet penetration results from the dropper will be presented and the scaling of the penetration and resulting ELM behavior extrapolated for ITER. The pellet dropper can operate at rates up to 50 Hz and its capability to pace small ELMs in otherwise large 10 Hz ELMing conditions will be presented.

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