Reduction of ELM Intensity on DIII-D by On-demand Triggering With High Frequency Pellet Injection and Implications for ITER*

L.R. Baylor, Oak Ridge National Laboratory

Deuterium pellet injection was used on the DIII-D tokamak to successfully demonstrate for the first time the on-demand triggering of ELMs at a 10x higher rate, and with much smaller intensity, than natural edge localized modes (ELMs). The triggering of small ELMs by high frequency pellet injection has been proposed as a method to prevent large ELMs that can erode the ITER plasma facing components [1]. The demonstration was made by injecting slow (<200 m/s) 1.3 mm diameter deuterium pellets at 60 Hz from the low field side in an ITER similar plasma with 5 Hz natural ELM frequency. The input power was only slightly above the H-mode threshold. Similar non-pellet discharges had ELM energy losses up to 55 kJ (~8% of total stored energy), while the case with pellets demonstrated ELMs with an average energy loss less than 3 kJ (<1% of the total). Total divertor ELM heat flux was reduced by more than a factor of 10. Central accumulation of Ni was significantly reduced in the pellet triggered ELM case. No significant increase in density or decrease in energy confinement was observed. Stability analysis of these discharges shows that the pedestal parameters are approaching the peeling unstable region just before a natural ELM crash. In the rapid pellet small ELM case, the pedestal conditions are well within the stable region with a narrower pedestal width observed. This narrower width is consistent with a picture in which the pellets are triggering the ELMs before the width expands to the critical ELM width. Nonlinear MHD simulations of the pellet ELM triggering show destabilization of ballooning modes by a local pressure perturbation. The implications of these results for pellet ELM pacing in ITER will be discussed.

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

*Supported by the US DOE under DE-AC05-00OR22725, DE-FC02-04ER54698, DE-AC52-07NA27344 & DE-FG02-07ER54917.