Contribution ID: **403** Type: **Poster**

EX/6-3Ra: ELM Mitigation by Supersonic Molecular Beam Injection: KSTAR and HL-2A Experiments and Theory

Friday, October 12, 2012 8:30 AM (4 hours)

New experimental results of ELM mitigation by supersonic molecular beam injection (SMBI) are report in HL-2A and KSTAR. The experiments show that ELM frequency increase (f_ELM^SMBI/f_ELM^0~ 2-3.5) and an ELM amplitude decrease for a finite duration period during an SMBI influence time, tau_I. Pedestal density profiles were relaxed by SMBI and recovered gradually during tau_I. This indicates that the degradation of pedestal particle confinement. Also, a slight changes of stored energy and toroidal rotation during tau_I was observed. A change in the spectrum of edge particle flux was observed in both devices. It shows that the in low frequency region is reduced while the high frequency component increases. This suggests that SMBI inhibits the formation of large (low frequency) avalanches or transport events, while triggering more small (high frequency) avalanches. A bi-stable sandpile model reproduces features of these experiments, showing a low frequency large scale transport event is break up into high frequency small scale events by particle injection inside the pedestal. Our experimental observations show that shallow injection, just inside the pedestal foot, will be enough to mitigate ELMs, indicating that the ITER requirement for low field side pellet injection to reach the pedestal top may be overly conservative.

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Session Classification: Poster: P7

Track Classification: EXC - Magnetic Confinement Experiments: Confinement