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## EX/6-3Ra & EX/6-3Rb: ELM Mitigation by Supersonic Molecular Beam Injection: KSTAR and HL-2A Experiments and Theory; ELM Mitigation with SMBI & CJI Fuelling in HL-2A H-mode Plasmas

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

New experimental results of ELM mitigation by supersonic molecular beam injection (SMBI) are reported in HL-2A and KSTAR. The experiments show that ELM frequency increase ( $f_{\text{ELM}}^{\text{SMBI}}/f_{\text{ELM}}^0 \sim 2-3.5$ ) 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 change 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 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 broken 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.

EX/6-3Rb: ELM Mitigation with SMBI & CJI Fuelling in HL-2A H-mode Plasmas

For a tokamak fusion reactor, the mitigation of Edge Localized Mode (ELM) is likely a mandatory requirement to avoid excessive erosion of the divertor targets and yet exploit the benefits of high confinement mode operation [1]. It is reported that pellets could trigger ELM when injected in type-I ELMy H-mode and ELM pacing has been accomplished with small multi-pellets injection [2]. Resonant Magnetic Perturbation (RMP) is another effective method to ELM mitigation that full ELM suppression has been achieved on DIII-D and AUG [3, 4]. Recently, ELM amplitude decrease and frequency increase for a finite duration are observed after the Supersonic Molecular Beam Injection (SMBI) fuelling into H-mode plasmas on HL-2A. The same phenomenon is observed even more significantly after the Cluster Jet Injection (CJI) fuelling.

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