Contribution ID: **569** Type: **Poster**

Comparative simulations of the plasma response to RMPs during ELM-crash mitigated and suppressed phases in KSTAR

Thursday 25 October 2018 08:30 (20 minutes)

Control of the edge localized modes (ELMs) is one of the most critical issues for a ITER and the future tokamak fusion reactors. In order to develop a *predictive* model of the access to ELM-crash suppressed states, it is essential to understand first the underlying physics mechanism of ELM-crash-suppression. This paper reports comparative simulation results for particular KSTAR experimental shot, where both of the ELM mitigated and suppressed phases were observed sequentially and separated distinctly in time with low-n resonant magnetic perturbations (RMPs) in KSTAR. We have observed that toroidal (ω_t) and ExB (ω_{ExB}) rotation frequencies are increased, while electron pressure gradient and the associated electron diamagnetic rotation frequency (ω_{*e}) reduced near the pedestal top through the transition from mitigation to suppression of ELMs. This results in a small outward shift in the zero-crossing of the electron perpendicular rotation ($\omega_{\perp e} \sim 0$) and $\omega_{\perp e}$ becomes even smaller inside the pedestal. Correspondingly, two-fluid linear plasma response modeling with the resistive MHD code M3D-C1 [1] indicates that resonant tearing response is increased significantly near the pedestal top, which is well correlated to the observed onset of ELM-crash suppression. This result is similar to the recent ECEI observation of perpendicular flow changes at the onset of ELM-crash suppression in KSTAR [2]. It remains unclear how the RMP-driven transport (with associated kinetic effects) bring out such changes to the rotation profiles and we plan to study that with XGC0 [3] and XGC1 [4] codes. Detailed results will be presented.

References:
[1] N. M. Ferraro, Phys. Plasmas **19**, 056105 (2012); [2] J. H. Lee *et al.*, APS-DPP (2017); [3] G. Y. Park *et al.*, Phys. Plasmas **17**, 102503 (2010); [4] C. S. Chang *et al.*, Phys. Plasmas **16**, 056108 (2009)

Country or International Organization

Korea, Republic of

Paper Number

TH/P5-26

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Session Classification: P5 Posters