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Test of the ITER-like RMP configurations for ELM-crash-suppression on KSTAR

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KSTAR has demonstrated a divertor heat flux broadening during edge-localized-mode (ELM)-crash-suppression using ITER-like 3-row resonant magnetic perturbation (RMP) configurations for the first time. Over the last couple of years, we have established a robust methodology to fully suppress ELM-crashes using low-n RMPs. To address the ITER relevant ELM control, a systematic exploration of various RMP configurations at lower q95 plasmas led us to accomplish RMP-driven, ELM suppression down to q95 = 3.3 [1]. As long as the mode-locking at low q95 is avoided and a quick recovery of the wall conditioning (e.g. cryo-pumping or divertor gas-puffing) is secured, the access to the targeted q95 (~ 3) for ITER is foreseen to be feasible in KSTAR. Taking full advantage of 3-row in-vessel control coils (IVCC) in KSTAR, rather than 2-rows in other devices, a series of intentionally misaligned RMP configurations have been investigated for ELM-crash-suppression. The ITER-like 3-row RMPs were found to have broadened the divertor heat flux in the vicinity of outer strike point, while the 2-row has rarely affected the near scrape-off-layer (SOL) heat flux despite a little broadened profile change in the far-SOL area [2]. Since the main focus of divertor heat flux dispersal would be the redistribution of the peaked near-SOL heat flux, such contrasting 3-D heat flux broadening must be similarly attributable to the choice of 3-rows in ITER, instead of 2-rows. Since such broadening characteristics could be completely different in partially detached plasmas in ITER [3], KSTAR has conducted an investigation of whether RMP-driven, ELM-crash-suppression would be compatible with detached plasmas. Although a fully detached plasma under RMP has not been obtained yet, we were able to greatly reduce heat flux at q95=3.8 using n=2 RMPs in high density plasmas [4].
Overall, the new lessons we have learned would be directly relevant to the successful ITER RMP research, while resolving any uncertainty associated with 3-row RMPs that could be further exploited in KSTAR.

References:
[1] Y. In et al, APS-DPP invited talk titled "Tamed Stability and Transport using Controlled Non-axisymmetric Fields in KSTAR"(2017)
[2] A. Loarte, Y. In et al, to be published (2018)
[3] R. Pitts, private communications (2018)
[4] J.W. Ahn et al, APS-DPP (2017)

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