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Overview of the KSTAR research progress and future plan toward ITER and K-DEMO

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The KSTAR research efforts have been focused on expansion of the KSTAR operating space for ITER and K-DEMO[1], validation of critical physics and search of new physics. The operating regimes are high bp (up to ~2.8) non-inductive long pulse up to ~8s, high bN up to ~ 4.3, and k of ~2.16 and a long H-mode discharge over a minute. An improved underlying physics of resonant and non-resonant magnetic perturbation (RMP and NRMP) with the IVCC coils resulted in a long pulse edge localized mode (ELM)-crash suppressed H-mode discharge (~34s).[2] The ELM-crash suppression dependence on critical physical parameters, such as q95, d, and M was extensively investigated. Identification of the role of turbulence induced by RMPs in suppression of the ELMs identified the turbulence flow ($\omega_{\perp}(\perp e)$) physics during the RMP ramp up and down periods.[3] The study of L/H transition threshold power (Pth) dependence on the non-axisymmetric field found that the Pth is significantly affected by RMPs while NRMP components had no influence on Pth.[4] New physics of interaction between the macroscopic fluctuation (2/1 island) and micro turbulences [5] and validation of q0 issue in sawtooth instability has been explored.[6] Also the misaligned RMP configurations are used to test the divertor heat flux dispersal. [6] A major upgrade plan in KSTAR will be initiated in ~2021 for stable higher beta long pulse operation. Emphasis will be placed on a new actively cooled tungsten divertor possibly with new first wall materials and current drive (LHCD/Helicon). For the search of metal wall materials in the KSTAR upgrade plan, test of specially designed castellated tungsten block tiles of various shapes,[7] impurity transport physics experiments via injection of trace Ar and Kr gases and tungsten dust were performed. *This work is supported by the KSTAR research project funded by Korea Ministry of Science, ICT and Future Planning.

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