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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⊠n was extensively investigated. Identification of the role of turbulence induced by RMPs in suppression of the ELMs identified the turbulence flow (ω_(⊥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.
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References:
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[2] Y. In et al., NF 55, 043004 (2015)
[3] J. Lee et al., PRL, 117 (7), 075001 (2016), J. Lee et al., ibid (2018)
[4] W.H. Ko et al., APS bulletin (2017)
[5] J.M. Kwon et al., ibid (2018), M.J. Choi et al., NF 57, 126058 (2017)
[6] Y. In et al., ibid (2018)
[7] S.H. Hong et al., ibid (2018)

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Primary author: Prof. PARK, HYEON KEO (UNIST)

Co-authors: Dr LOARTE, Alberto (ITER IO); Dr CHANG, Choongseock (PPPL); HUMPHREYS, Dave (GA); Dr MUELLER, Dennis (PPPL); Prof. YUN, Gunsu (POSTECH); Dr PARK, Hyungho (NFRI); Dr LEE, Jaehyun (NFRI); Dr KIM, Jayhyun (NFRI); Dr CHUNG, Jinil (NFRI); Dr KO, Jinseok (NFRI); Dr KWAK, Jonggu (NFRI); Dr PARK, Jongkyu (PPPL); Dr KWON, Jsemin (NFRI); Dr AHN, Junwook (ORNL); Dr LEE, K.C. (NFRI); Dr CHOI, Minjun (NFRI); Dr PITTS, Richard (ITER IO); Dr HAHN, Sanghee (NFRI); Dr YOON, Siwoo (NFRI); Dr SABBAGH, Steve (Columbia); Dr HONG, Sukho (NFRI); Dr KO, Wonha (NFRI); Dr CHOE, Wonho (KAIST); Dr LEE, Woochang (NFRI); Dr CHU, Yong (NFRI); Prof. IN, Yonggyun (UNIST); Dr OH, Yongkuk (NFRI); Dr PARK, Yongseok (Columbia); Dr JEON, Youngmu (NFRI); Dr WANG, sunjong (NFRI); Dr NAM, yongun (nfri)

Presenter: Prof. PARK, HYEON KEO (UNIST)

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