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Influences of non-axisymmetric field on H-mode power threshold and pedestal rotation in KSTAR

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Significant reduction of H-mode power threshold (P_th) has been identified in KSTAR. Such a favorable finding is attributable to low intrinsic error field [1] and toroidal field ripple[2], which has been corroborated by high pedestal rotation. According to a preliminary comparison, KSTAR has at least 10% lower Pth during L to H-mode transition than DIII-D which have similar size but with different error-field and with n=3 non-axisymmetric fields[3].
Since KSTAR has been diagnosed with an order of magnitude lower intrinsic error field (<δB/B_0>_m/n=2/1 ˜ 1x10ˆ-5 [1]) compared with the DIII-D at the low background and toroidal field ripple (δTF=0.05% [2]), it allows us to rigorously control non-axisymmetric field without intrinsic error field impacts. In particular, we are keen on the influences of non-axisymmetric fields on pedestal transport, which may regulate pedestal profiles to stay below the thresholds for the peeling-ballooning instabilities. A systematic study has been in progress to clarify the underlying physical mechanisms of ELM suppression/mitigation by non-axisymmetric fields. At the same time, since the L-H power threshold is known to be greatly affected by non-axisymmetric fields, a systematic scan has been conducted with the most influence non-axisymmetric component, n=1 in KSTAR.
Despite various differences between DIII-D and KSTAR, both studies suggest the reduction of ⊠B has a linear dependence on Pth. Considering that P_th is very important to determine the power requirements for future devices and that further reduction of P_th is also feasible in terms of various plasma parameters.
Non-axisymmetric fields reduced the both pedestal of toroidal rotation and ion temperature [4]. Overall, lower level of intrinsic error field and toroidal field ripple in KSTAR is attributable to higher pedestal rotation, leading to the increase of radial electric field near the separatrix.
The ongoing 3D transport study focusses on H-mode threshold power and pedestal transport with controlled non-axisymmetric fields. Based on the preliminary investigation, we are cautiously predicting that the lowest Pth would be found from the lowest intrinsic error field device.
[1] Y. In et al, Nucl. Fusion 55 043004 (2015); [2] S.W. Yoon et al, IAEA-FEC (2014); [3] P. Gohil, et. al., Nucl. Fusion 51 103020 (2011); [4] W.H. Ko, et. al., Nucl. Fusion 55 083013 (2015)

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Primary author: Dr KO, Won Ha (Korea, Republic of)

Co-authors: Dr KIM, H.S. (National Fusion Research Institute); Prof. PARK, Hyeon K. (UNIST); Dr LEE, Hyungho (National Fusion Research Institute); Dr LEE, J.H. (National Fusion Research Institute); Dr SEOL, JaeChun

(National Fusion Research Institute); Dr IDA, Katsumi (National Institute for Fusion Science); Dr YOON, Si-Woo (National Fusion Research Institute); Dr IN, Yongkyoon (National Fusion Research Institute); Dr JEON, YoungMu (National Fusion Research Institute)

Presenter: Dr KO, Won Ha (Korea, Republic of)

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