Predictive integrated modelling for the preparation of the advanced operation scenarios in KSTAR

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One of the mission goals of KSTAR project is to operate in the regime of long pulse (>$10\tau_R$, ~300 s) and high performance (β_N>3.0) [1,2]. In order to meet the mission and the objectives of the KSTAR tokamak, the hybrid and the advanced tokamak regime will be explored. In this way, an activity of predictive simulation study is essential to propose a practical guide before experiments are carried out. In this work, we have two purposes; one is the evaluation of the absorbed heating power and the driven current associated with KSTAR H/CD upgrade plan[3] on various plasma conditions, and the other is the feasibility study of the advanced operation scenario. We mainly consider totally 18 MW of external heating power with two H/CD systems such NBI and ECH. KSTAR NBI system will equips six beam sources manageable up to totally 12 MW. Two of them, 4 MW, will be capable to be injected to off-axis. KSTAR ECH system will equips four 105/140 GHz gyrotrons manageable up to totally 4 MW and two 170 GHz gyrotrons up to totally 2 MW. Based on the H/CD system specifications, the database applicable to design the operation scenario is built by evaluating each H/CD system on various plasma operation conditions. Secondly, the practical guide of external H/CD mix scenarios, the appropriate scheme of the combination of NBI beam lines, and the launching conditions of ECH system are suggested to achieve advanced operation regimes. Finally, the advanced operation scenarios are suggested for KSTAR. The suggested operation scenarios are simulated and extrapolated based on the existing high performance discharges operated in relatively low heating power in KSTAR. Also, the corresponding specific q profiles are also presented here to evaluate the reliability in the view of the physics based manner. The reliable results from our work could become a useful database for exploring the advanced regime of KSTAR discharges in the near future.

Reference

[1] Kwon M. et al 2011 Nucl. Fusion 51 094006, [2] Na Y-S. et al 2009 Nucl. Fusion 49 115018

[3] Wang S-J. et al 2018 KSTAR Conference (Muju, Republic of Korea)