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Status and plan of the KSTAR program to explore the physics in steady-state high beta operation to assess the ITER and K-DEMO operations

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Achieving the steady-state operation of high-performance plasma is the most important goal that should be secured for the steady-state operation in ITER and for the design fusion reactor beyond ITER [1]. The KSTAR device has been confirmed to be a superconducting fusion device that has been very well equipped to achieve the goals according to the experimental results in the past 10 years. This is based on several unique features that are surpassing other fusion devices, which are 1) an ideal toroidal magnetic field configuration with extremely low magnetic field errors, 2) a set of control coils that can provide various mode configuration, 3) advanced 2D/3D image diagnostics with high spatial and temporal resolution, and 4) a high efficient and long-pulse capable neutral beams capable of maintaining high torque.

In the recent KSTAR joint experiment, remarkable progress has been achieved in exploring the high performance plasma discharges with performance compatible to ITER baseline (betaN ~ 2). H mode plasma discharge could be maintained for more than 1 minute and ELM suppression can be maintained perfectly for 34 seconds under similar conditions. In addition [2], exploring the scenarios comparable to we implemented a stable driving scenario in high betaN ~ betaP ~ 2.8 with limited heating power. . And several fundamental plasma physics such as MHD instabilities could be reassessed due to Utilizing the advanced diagnostic devices

The operation and research direction of the KSTAR in the future is to study various MHD instabilities that are preventing the ITER steady-state operation achievement, and to develop several new operation modes (high betaN ~4), that meets operating conditions in the demonstration fusion reactor (K-DEMO) as shown in Figure 1. In the 2018 KSTAR campaign, which is scheduled from the September in 2018, more progressed research is expected utilizing the newly installed NBI system, as shown in Figure 2, and several diagnostic systems.

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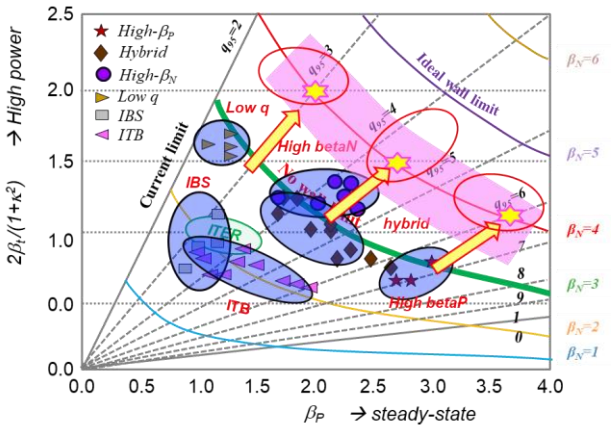

Figure 1. The representative results of the various operation modes in KSTAR toward high beta discharges. The results show that KSTAR plasma performance is very close to the ideal no-wall limits in spite of limited heating power. The purple colored area shows the planned operation area to be explored utilizing the upgraded heating systems in preparing the K-DEMO

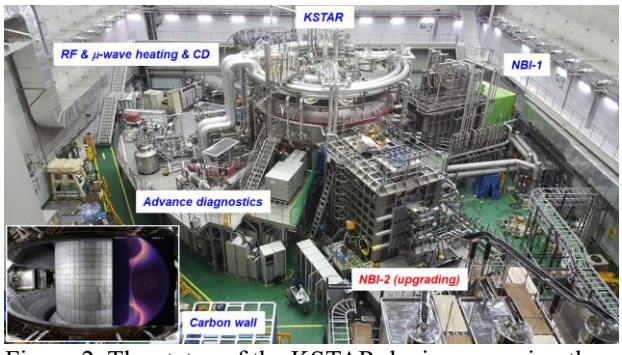

Figure 2. The status of the KSTAR device preparing the 2018 campaign with installing the second NBI system for higher beta operation

References
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