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Experimental studies on advanced operation scenarios in KSTAR

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The KSTAR (Korea Superconducting Tokamak Advanced Research) tokamak aims at successful production of steady-state high-beta tokamak plasmas by utilizing fully superconducting magnets and a state-of-the-art plasma control system. To do this, we are developing advanced operation scenarios for KSTAR that can contribute to the next step of tokamak research. Steady-state operation, high performance of the plasma and finding alternative solutions are the main interest in the research area.

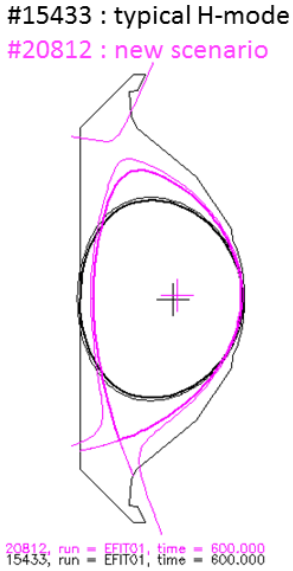

Figure 1 Plasma shape at 0.6 s. The old one (typical- H-mode) in black is limited circular during Ip ramp-up. Result in very peaked current profile, preventing any practical control of target current profiles. However, the new scenario in pink can be shaped at 0.5s at low plasma current, and it allow us to access a wide range of target current profiles. Larger bore enabled earlier so we could inject the 2nd neutral beam, and this can increase absorption of the beam.

We have made significant progress in developing plasma shape control early in the plasma startup. Modifications to the relaxed Ohmic current profile have been found to result in significant improvements in energy confinement. The initial current profile of the tokamak plasma is formed during the current increase at the start of the discharge, and current diffusion to the center of the plasma is slowed by the external Heating and Current Drive (H&CD) systems.

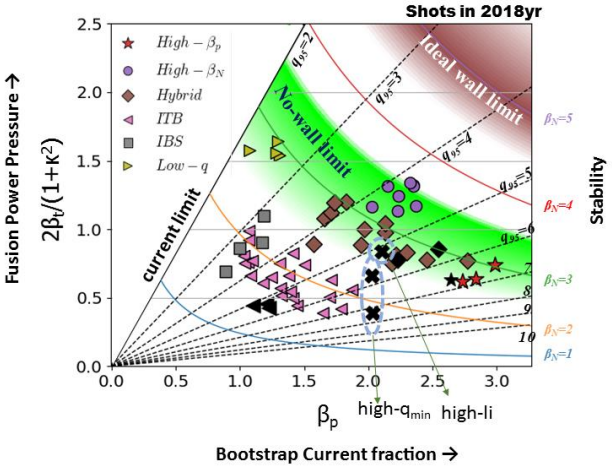

Figure 2 Performances in various operating scenarios in KSTAR. This is a plot of fusion power pressure versus bootstrap current fraction. Focused scenarios are being explored in a wide variety of physics areas in KSTAR.

The KSTAR uses the neutral beam injection (NBI) as a majority of H&CD. Effective use of the H&CD with instrumented plasma control and shaping parameters became a key to access to the advanced operation scenarios such as high βp, high li, high qmin, hybrid, ITB and low q.

In this work, we present the recent progress of experimental studies on advanced operation scenarios in KSTAR.

References

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