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4.8 Considerations of the q-profile control in KSTAR for advanced tokamak operation scenarios

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The q-profile control is essential for tokamaks exploring the advanced tokamak scenarios, which expected to be able to provide a possible route towards a steady-state high performance operation in a fully non-inductive current drive state. This is because the pressure and current profiles must remain optimal for the scenario during the injection of large amounts of heating and current drive. Here, essential tools for the q-profile control are the motional Stark effect (MSE) diagnostic for measuring the radial magnetic pitch angle profile and a state-of-the-art plasma control system. The pulse duration of the H-mode discharge at KSTAR has been extended year by year with improved control performance, and the experiment of ITB formation in a weakly reversed q-profile with a marginal NBI majority heating successfully demonstrated. These recent achievements are attributed to reliable profile measurement, which means that profile feedback control has become a necessary step to ensure a robust and reliable approach to advanced scenarios as the next step of research in KSTAR. In this work, we present the technical and conceptual requirements for the q-profile control according to the upgrade plan of heating and current drive systems in the coming years.

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