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Role of fast-ion transport to sustain the high q min profile in KSTAR discharges

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Recently, a high q min scenario has been developed in KSTAR by controlling the plasma current ramp-up rate and the heating/shaping timing. An interesting finding is that a steady-state high and broad q profile has been sustained even without strong off-axis current drive scheme. Time-traces of magnetics/ECE spectrogram clearly show that Alfvenic kind activities appeared as the high/broad q profile is formed. In this study, the effect of Alfvenic modes and accompanying fast ion transport on the formation of the broad current profile is explored. Making high safety factor scenario in 2018 campaign has been succeeded with combination of different perpendicular component NB sources and all of them show similar MSE and spectrogram diagnostic patterns. Consequently, those shots are chosen as the main analysis target. The frequency of the magnetics/ECE spectrogram and the electron temperature fluctuation pattern of the ECE / ECEI were compared with the NOVA analysis to determine which series of Alfvenic modes are active. Then, the kick-model is applied to potential modes, and used to estimate how fast ion transport and beam driven currents are varied. By comparing the reconstructed current profile from the kinetic EFIT with the beam-driven current profile estimated from the kick-model, it was evaluated how much energetic particle transport affects maintaining the high q min profile. In conclusion, high and broad q profiles are obtained in the KSTAR plasma with a moderate non-inductive fraction when off-axis NBCD profile is produced from the fast-ion transport due to by Alfvenic modes. A positive aspect of Alfvenic mode driven fast ion transport in the KSTAR is the generation of favorable q-profile modification.

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