Study of advanced scenarios on EAST tokamak

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Steady-state long-pulse H-mode discharge [1, 2] has been obtained using RF heating and current drive with dominant electron heating on EAST tokamak. Demonstration of >100 seconds time scale long-pulse steady-state scenario with a good plasma performance (H_{98y2} ~1.1, $f_{bs} < 30\%$) and a good control of impurity and heat exhaust with the tungsten divertor has been successfully achieved on EAST using RF power heating and current drive [3]. Recently, a high β_P discharge ($\beta_P \sim 1.9$ & $\beta_N \sim 1.5$, $f_{bs} \sim 45\%$ at $q_{95} \sim 6.8$) was successfully maintained over 24s with improved hardware capabilities, demonstrating performance levels needed for China Fusion Engineering Test Reactor (CFETR) steady-state operation [4]. The observed improvement in plasma confinement is much better (H_{98y2} ~ 1.3) when compared with the RF dominant heating experiments in the EAST 2016 - 2017 experimental campaign (H_{98y2} ~ 1.1). Integrated modeling prediction suggests that high electron density would increase the plasma performance and bootstrap current fraction, which is consistent with the general experimental trend. The Shafranov shift is shown to play a role in the suppression of the electron turbulent energy transport in the high β_P RF-only discharges [5]. Besides, extensive experiments of high β_N scenario development have been carried out on EAST [6, 7]. In these high β_N scenario H-mode plasmas, the internal transport barrier (ITB) has been often observed after step-up of the NBI power with central flat q profile and it is found that the fishbone mode (m/n = 1/1) can be beneficial to sustain the central flat (q(0)~1) q profile, thus a stable ITB can be obtained. In particular, the non-inductive current fraction in the central flat (q(0)~1) q profile plasma is ~40%. Further investigation of this operation regime might be important for the development of the hybrid scenario for ITER and CFETR.

References

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