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Recent advances in EAST physics experiments in support of steady-state operation for ITER and CFETR

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Significant progress in the development of plasma control mechanism and understanding the related physics for steady-state advanced high-performance H-mode plasmas have been achieved on EAST since the last IAEA FEC in 2016. First demonstration of >100 seconds time scale long-pulse steady-state scenario with a good plasma performance (H98(y2) ~ 1.1) and a good control of impurity and heat exhaust with the tungsten divertor has been successfully achieved on EAST using the pure RF power heating and current drive. The synergy effect between the ECH and two LHW systems (2.45GHz and 4.6GHz) on EAST has been investigated for enhanced current driven and improved confinement quality. ELM suppression using the n=1 and 2 RMPs has been achieved in EAST and applied for development of the long-pulse H-mode scenario. Reduction of the peak heat flux on the divertor was demonstrated either in a QSF configuration or using the active radiation feedback control. A fully non-inductive steady-state QSF plasma with a duration of 21s has been obtained with a reduced factor of 2.5 on the outer divertor target. Divertor particle and heat flux control using a low n rotating RMP field has been confirmed. Suppression of the W sputtering has been achieved by lowering the edge medium-Z impurity content (C, O, etc) and forming a mixture deposition on the surface of divertor target after the application of lithium wall conditioning. Disruption mitigation experiments have been studied on EAST with the application of the massive gas injection of helium or argon on the termination of initial stable target plasmas. A further increase in the total heating power and improvement of the plasma confinement are expected when using a 0-D model prediction for high bootstrap fraction (fbs~50%) regime. Preliminary 1.5-D simulations suggest that the on-axis ECRH will enhance the deposition of LHW power in the core region, which is beneficial to the effective core heating of the plasma. A new designed lower ITER-like tungsten divertor with active water-cooling is reported. With this upgrade, EAST will be capable to access the high-triangularity small-ELM H-mode regimes and also to perform the target plasma in an advanced X-divertor configuration with assistance from two new water-cooled internal PF coils in support of steady-state operation for ITER and CFETR.

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