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Overview of EAST Experiments on the Development of High-performance Steady-State Scenario

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EAST aims to demonstrate steady-state advanced high-performance H-mode plasmas with ITER-like configuration, plasma control and heating schemes. Since 2015, EAST has been equipped with all ITER-related auxiliary heating and current drive systems. Two NBI systems injected from Co- and Ctr-current directions, have been installed on EAST and allow the flexible study of the plasma rotation effect. A flexible in-vessel RMP coil system was installed in 2014 for active MHD instability control in order to achieve long-pulse steady-state operation in the EAST tokamak. Since then, EAST has been capable of investigating ELM control with most existing methods, including RMP, pellet-pacing, SMBI, LHW and Li-pellet injection.
The exploration of fully non-inductive, high performance, upper single-null discharges with the tungsten divertor has been successfully demonstrated with upgrades of heating and current drive capabilities on EAST. A higher beta regime has been achieved with the 4.6 GHz LHCD and NBI. Experimental results show that LHWs at 4.6 GHz exhibit stronger current drive capability than at 2.45 GHz, in agreement with less pronounced parametric instability behavior with the 4.6 GHz LH wave. By means of the 4.6 GHz and 2.45 GHz LHCD systems, H-mode is obtained at relatively high density.
A stationary ELM-stable H-mode regime has been achieved in EAST with 4.6 GHz LHCD. This regime allows nearly fully non-inductive long-pulse operations, exhibiting a relatively high pedestal and good global energy confinement with H98y2 near 1.2, good impurity control, and the capability of operation at relatively high density.
Complete suppression of ELMs has been observed during the application of n = 1 and 2 RMPs on EAST. The experimental results show that the plasma response plays an important role in ELM control. Critical thresholds for the amplitude of the RMPs and the plasma rotation for this transition have been observed for the first time on EAST.
The 3D edge magnetic topology has been applied for active control of heat and particle fluxes deposited on the divertor targets in steady-state operation on EAST. The impacts of the 3D magnetic topology on the edge plasma transport and heat flux distribution have been investigated using the EMC3-EIRENE code and found to be consistent with the experimental observation of strike-line splitting.

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