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Progress of divertor and PWI control physics in EAST for steady-state operation in the past 10 years

L. Wang[1] for EAST Divertor and PWI Physics Group

[1]Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, China

E-mail: lwang@ipp.ac.cn

Abstract:

The tokamak divertor physics and control of plasma-wall interaction (PWI) issues are critical for next-step fusion development. In the last 10 years, EAST has made significant contributions to the basic physics understanding and developed new control means of divertor/PWI for long pulse operation of fusion devices, such as (1) steady-state heat flux control, (2) fueling particle exhaust and (3) impurity screening, which has been successfully applied in the long pulse operation to achieve the high confinement (H-mode) plasma over 100 s, by making full use of the ITER-like water-cooling tungsten divertor. Innovative achievements of the 3D divertor power deposition and the related heat flux control are made. The physics on access to H-mode detachment and radiative divertor has advanced greatly, in addition to the L-mode experimental results.

Very recently, we systematically developed the active feedback control of H-mode detachment, showing excellent compatibility with the high core-plasma performance, which has also been jointly demonstrated on DIII-D in 2019. These approaches provide important experimental information on divertor-edge-core integration for steady-state operation of future fusion devices. In the divertor physics, we have also systematically studied the particle exhaust and heat load deposition characteristics, which facilitates divertor and PWI control physics understanding. It is also found that the heat flux footprint width broadening in EAST, ~ two times the multi-machine scaling, and attributed it to the RF wave heating scheme dominated by electron heating, which provides promising experimental information for ITER, together with SOLPS and BOUT++ simulation prediction.

This talk will systematically summarize what EAST have advanced on this topic in the past 10 years and near-term plans for ITER/CFETR.

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