Contribution ID: **42** Type: **Oral (Plenary Session)**

Latest advances in active control of H-mode detachment and its physics on EAST for ITER/CFETR

Monday, November 4, 2019 12:50 PM (20 minutes)

Active handling of excessively high heat load and tungsten sputtering on divertor targets is of critical challenge for EAST and future fusion devices like ITER and CFETR. It is acknowledged by the fusion community that divertor detachment is the most promising means for steady state plasma-wall interaction control.

Significant progresses on the active feedback control of H-mode detachment for long-pulse high-performance operations have been made in EAST with ITER-like tungsten divertor in the last two years. A serial of methods and systematic experiments for detachment control including radiation power, particle flux roll-over, Te < 5 eV have been successfully developed, respectively. Both neon and argon impurity seeding have been demonstrated in maintaining the divertor detachment stably. More importantly, it has been observed that the core plasma performance exhibits no significant loss or even a slight increase during the stable feedback control phase, suggesting excellent divertor-edge-core plasma integration. A new periodic detached-attached dithering regime, which is of potential application for steady state operations, was clearly identified and reproduced with different target-Te values. A new detachment feedback control scheme, which combines divertor Te and radiation signals into feedback to achieve sustained detachment, has also been demonstrated successfully. It is indicated that the ExB drifts and other SOL flows play key important roles to the success of the detachment access and long pulse maintenance. The detachment density threshold exhibits a strong dependence on the divertor closure. The radiation feedback control for detachment was demonstrated in DIII-D high beta_p H-mode scenario within the joint DIII-D/EAST Task Force. Further experiments to demonstrate the latest EAST results of drift effect on detachment is scheduled in September on DIII-D in the high beta_p scenario with different divertor geometry. New advances that may arise will also be presented. These latest detachment advances and related physics understanding are of great importance to the design of CFETR divertor and the steady state operation of ITER.

This work was supported by the National Key Research and Development Program of China (No. 2017YFE0301300), the US Department of Energy (No. DE-FC02-04ER546981), the Anhui Natural Science Foundation (No. 1808085J07).

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Session Classification: Divertor Plasma Control

Track Classification: Radiative Power Exhaust