Power balance analysis of high-parameter long-pulse H-mode on EAST

Y. Wang[1], K. Hanada[1], H. Liu[2], X. Gao[2]

[1] *Research Institute for Applied Mechanics, Kyushu University, Kasuga 816-8580, Japan*

[2] *Institute of Plasma Physics, Chinese Academy of Science, Hefei, Anhui 230031, China*

Achieving steady state operation (SSO) is a critical objective for future magnetic fusion devices. Excessive power and particle load on the plasma facing components (PFCs) will induce plasma wall interactions (PWI), thereby hindering the maintenance of the plasma. To ensure the safe and efficient operation of future fusion power plants, it is imperative to thoroughly understand and manage the power balance within the device during SSO.

Experimental Advanced Superconducting Tokamak (EAST) is a medium-sized, fully superconducting tokamak featuring all-metal PFCs, comprehensive auxiliary heating systems, and active water-cooling systems. It enables high-power injection and long-pulse steady-state plasma operation, making it an excellent platform for SSO research for future fusion power plants.

As notable examples on EAST, a 403 s long-pulse high-confinement H-mode plasma operation was successfully conducted in 2023 (discharge #122254), and a 1056 s improved confinement plasma operation with Super I-mode was achieved in 2021 (discharge #106915). The power balance of these two discharges has been analysed. Approximately 90% of the injected power can be measured mainly with the calorimetric method, which calculate the heat load on specific PFC based on the temperature increase and flow rate of the cooling water passing through it. The main PFCs of EAST are illustrated in figure 1, and the heat load comparison between discharge #122254 and #106915 are presented in figure 2, demonstrating a significant difference of heat load distribution between H mode and I mode.

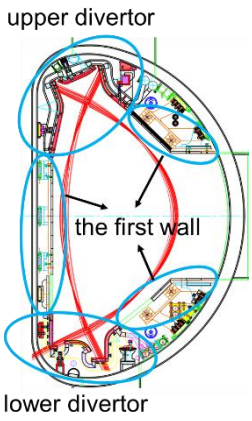

Figure 1. Schematic diagram of EAST's main PFCs in poloidal view.

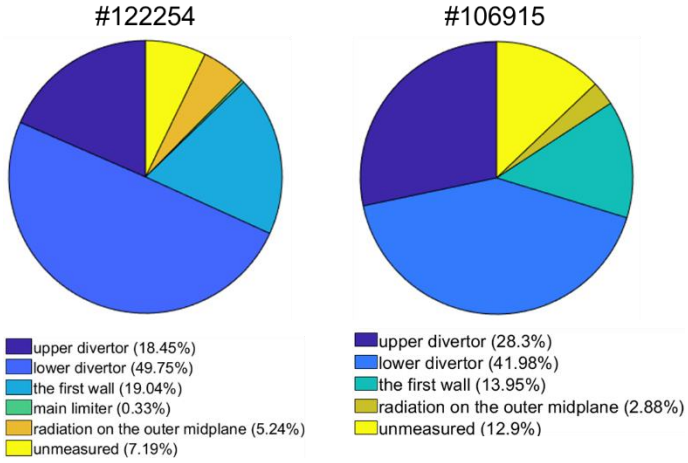

Figure 2. Heat load comparison between discharge #122254 and #106915.