Demonstration of stationary heat flux control by RMP on EAST

B. Zhang, M.N. Jia, Q. Ma, Y.W. Sun, X.Z. Gong, J.P. Qian, L. Zeng, L.Y. Meng, L. Wang, J.Y. Zhang, R.R. Liang and the EAST team

Institute of Plasma Physics, Chinese Academy of Sciences, Hefei 230031, China

binzhang@ipp.ac.cn

Control of stationary heat flux (SHF) on the ITER-like tungsten(W) mono-block divertor targets due to the 3D magnetic topology induced by the resonant magnet perturbation (RMP) coils in ELM-controlled H-mode plasmas was demonstrated on EAST by the recently upgraded infra-red (IR) diagnosis. A newly developed optical technology has been implemented on the present wide-angle IR endoscope system [1] to improve the spatial resolution by a factor of two in a r = 64-pixel circular area, facilitating the observation of SHF change induced by RMPs. The self-developed 3D heat flux computation code [2] was used to calculate the SHF pattern on divertor target based on the surface temperature measured by the IR diagnosis. Both of inter-ELM SHF during the n=3 RMP ELM mitigation phase and the SHF in the n=4 RMP ELM suppression phase [3] show clear 3D structures with multiple heat flux peaks, thus expanding the plasma wetted area. The positions of the secondary strike lines are consistent with the modeling result predicted by the TOP2D code [4], as shown in figure 1. When rotating the n=3 RMP fields rigidly under \( q_{95} = 4 \) and \( P_{\text{tot}} = 3.5\text{MW} \), the inter-ELM multiple-peak SHF pattern simultaneously rotated along toroidal direction on the divertor target, with little impact on the plasma store energy. The peak heat flux was well controlled below 3.5MW/m\(^2\). It was found that both of the peak heat fluxes at the original strike zone and secondary strike line were slightly increased due to the small degradation of core confinement (\( \Delta W_{\text{dia}} = 10\text{kJ} \)) in the n=4 ELM full suppression case which was achieved for the first time with \( q_{95} \leq 3.7 \) on EAST.

Figure 1. The stationary heat flux pattern on W divertor target in rotated n=3 RMPs