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Simulations on the transient heat fluxes for the RF wave heating H-mode on EAST

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The 6-field 2-fluid module in the open source software BOUT++ framework [1] has been successfully used to understand the ELMs and edge turbulence on EAST tokamak [2]. The simulations of the transient heat flux for the characteristic EAST H-mode scenario within RF heating will be reported in this paper. The inverse proportional trend of the multi-machine scaling of the SOL width is well reproduced by the BOUT++ simulations [3]. The transient heat flux is induced by the edge coherent turbulence and ELMs. The coherent mode at the pedestal region has been simulated with the similar frequency and wavenumbers with the experiments [3], as well as the fluctuation level of the electrostatic potential, electron pressure and density perturbations [4]. However, the simulated SOL width is only half of the EAST measurements. A modeled helical current filament (HCF) in SOL, which is assumed to be generated by low-hybrid waves, is added as the force-free form into the 6-field 2-fluid module of BOUT++. The results show that the HCF with the toroidal mode number 5 is able to increase the SOL width by ~25%, and the peak parallel heat flux towards divertor target is decreased by ~32%. The broadening of the particle flux by HCF clearly shows the secondary striate filaments on divertor target, which is similar to the splitting of the strike point observed by the divertor probes. The Ion-Cyclotron wave has been found to be effective to suppress ELMs without any decreasing to stored energy and edge profiles. The simulations reveals that the key factor for this effect is the strong flow shear in SOL region, not the pedestal region. The strong flow shear, which may be generated by the radio-frequency sheath by ICW antenna, is able to decrease the ELM size by one order of magnitude.

References

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