Redistribution of three-dimensional divertor footprint induced by time-varying resonant magnetic perturbations on EAST

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The application of time-varying resonant magnetic perturbations (RMPs) is recently proposed for its promising abilities of both edge localized mode (ELM) control and divertor power load control in tokamak H-mode discharges[1]. These effects are all closely related to the three-dimensional magnetic topology changes induced by magnetic perturbations, which can be studied with both experiments and numerical analyses. It needs to be examined on various devices as references for future ITER operation[2]. Recently two kinds of time-varying RMPs, the rigid rotating and up-down differential phasing RMPs, with toroidal mode number n=1 and 2 have been examined in the EAST H-mode discharges. The observed power load distributions on the divertor target are rotated synchronously with the rotating or phasing RMP fields. Numerical modelings of magnetic topology, which takes into account the plasma responses calculated by the toroidal magnetohydrodynamics code MARS-F, are carried out by the field line tracing code TOP2D. The topology modelings show that the magnetic footprint pattern has a qualitative consistency with the experimental observations[3]. The plasma response is found to play an important role in magnetic edge topology changes as well as in the ELM-control effect[4]. With different spectra by changing the up-down phase difference, it shows an amplifying or screening effect, which means it changes the field line penetration depth rather than the general footprint shape. These results show the potential of making a scheme using both rotating and phasing RMP fields with minimum current changes to achieve an even power load distribution on divertor targets while keeping a good ELM-control effect.

References

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