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Nonlinear transition of divertor heat fluxes distribution during n=4 RMP suppressed ELM in EAST

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Nonlinear transition of stationary heat fluxes deposition on original and splitting strike lines on the divertor target during transition of type-I edge localized mode (ELM) mitigation to suppression using n=4 RMP has been observed, as shown in figure1. The peak temperature value on the divertor heat flux profile is changed from the original strike line to the splitting strike line during this process. The nonlinear transition of ELM mitigation to suppression with n=1 RMP has been proved with magnetic diagnose plasma response [1]. The observation provides a new perspective to understand the key physics in achieving ELM suppression.

Simulation of divertor magnetic footprints using magnetic field lines tracing code TOP2D has shown similar patterns with plasma response calculated by linear fluid code MARS-F [2]. However, to gain a further understanding, EMC3-EIRENE combined with a quasi-linear code MARS-Q are used to study the influence of nonlinear plasma response effects on the edge plasma transport in the EAST standard configuration. The modeling results show a similar time-dependent evolution as the divertor temperature observed by the infra-red camera system. These results indicate that RMP penetration into deeper plasma region may play an important role in achieving ELM suppression, with the edge magnetic topology playing a key role in reforming the edge plasma profiles and resulting in the non-linear transition of divertor heat fluxes deposition between original and splitting strike lines. Previous modeling with EMC3-Eirene for ITER shows that the heat load onto the splitting strike lines could be still significant although detachment has been achieved on the original strike lines with gas puffing during RMP application [3]. Thus, understanding the non-linear transition of divertor heat flux splitting and the physical mechanism of this process is important for the further exploration of optimizing the divertor power exhaust scheme, such as the integration of RMP ELM suppression and gas puffing or impurity seeding for future ITER application.

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References

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Figure 1 The time evolution of plasma parameters and divertor surface temperature

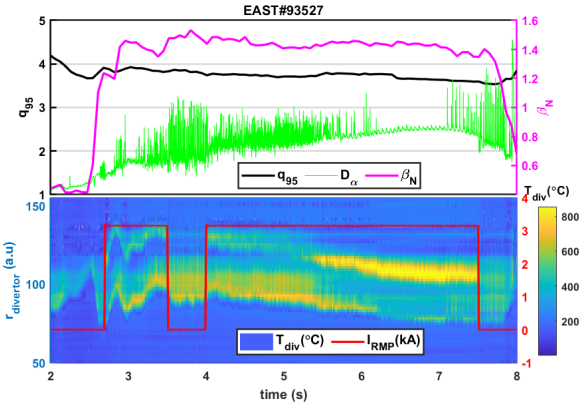

Figure 1. Time trace of EAST #93527