



## Propagation Dynamics Associated with Resonant Magnetic Perturbations Field in H-mode Plasmas

W.W. Xiao<sup>1</sup>, T.E. Evans<sup>2</sup>, G.R. Tynan<sup>3</sup>, S.W. Yoon<sup>4</sup>, Y.M. Jeon<sup>4</sup>,  
W.H. Ko<sup>4</sup>, Y.U. Nam<sup>4</sup>, Y.K. Oh<sup>4</sup>

<sup>1</sup> ZJU, China, <sup>2</sup> GA, USA, <sup>3</sup> UCSD, USA, <sup>4</sup> NFRI, Korea

The resonant location of the first plasma response to periodic toroidal phase flips of a Resonant Magnetic Perturbation (RMP) [1] field is experimentally identified in the DIII-D tokamak [2]. The plasma response coincides with the  $q=3$  rational surface and electron fluid velocity null, which is consistent with simulations of the plasma response to the RMP field from resistive Magnetohydrodynamics modeling. The propagation dynamics of the RMP field into KSTAR H-mode plasmas has also been studied using an innovative experimental approach based on the application of small edge perturbations produced by a Supersonic Molecular Beam Injection (SMBI) [3]. The experimental results suggest that the RMP penetrates into the pedestal region and first excites a plasma response on the  $q=3$  rational surface, then propagate inward to the  $q=2$  rational surface with a radial averaged propagation velocity of the RMP ( $V_{\text{RMPP}}$ ) in millisecond scale. Here,  $V_{\text{RMPP}}$  is the velocity of the RMP screening field as it passes through the distance from  $q=3$  to  $q=2$  rational surfaces with a time delay. The RMP brakes the toroidal rotation ( $V_\phi$ ) on the  $q=3$  rational surface first, and the induced momentum transport by RMP is both inward

and outward from the rational surface locations. The momentum transport is accompanied by an increase in the density fluctuation. It is also found that  $V_{\text{RMPP}}$  is faster than the propagation velocity of the momentum transport. These experimental results in DIII-D and KSTAR support the current RMP physics hypothesis being used for ITER, which states: “The RMP coils are shown to induce a layer of stochastic magnetic fields near the last resonant magnetic surface, typically  $q = 3$  in the tokamak” [4]. These experimental results may exhibit an important process to improve our knowledge of related RMP propagation dynamics and the ELM control using RMP in H-mode plasmas that will be helpful for understanding how to control ELMs using the RMP coils in ITER.

### References

- [1] T.E. Evans et al., Phys. Rev. Lett. 92, 235003 (2004)
- [2] W.W. Xiao, et al., Nucl. Fusion 56 064001 (2016)
- [3] W.W. Xiao, et al., Nucl. Fusion, 52, 114027 (2012)
- [4] C. Horton and S. Benkadda, ITER Physics, Chapter 6, p 156, World Scientific publishing Co. Pet. Ltd, Singapore, (2015)