Investigation of momentum and particle transport induced from magnetic perturbation and RF heating in KSTAR

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1. INTRODUCTION

Momentum and particle transport studies have shown important topics for magnetic confinment fusion researches since they are essential for plasma stability and confinement physics. In 2015 and 2016 KSTAR campaigns, momentum and particle transport experiments induced from various magnetic perturbation and RF heating have been performed to investigate their impacts on the stability and confinement. An interesting result shows that a particle confinement is improved during magnetic perturbation in certain experimental conditions [1-2], which is a surprising phenomenon since externally applied magnetic perturbation usually degrades particle confinement in tokamak plasmas. In addition to the magnetic perturbation experiment, intrinsic toroidal rotation in RF heated experiments are simultaneously carried out in a long-pulse discharge. In this presentation, the experimental observations from momentum and particle transport induced from various magnetic perturbation and RF heating are discussed.

2. EXPERIMENTAL RESULTS

Figure 1 shows a temporal evolution of main plasma parameters induced from toroidal mode number n = 2 magnetic perturbation (even phasing) and 140 GHz ECH heating. In this experiment, three different experiments are simultaneously carried out in a single long-pulse discharge. The ECH injection in the ohmic and H-mode phase show a clear toroidal rotation increase in the co-current direction coincident with a sudden rotation reversal and a large rotation reduction, respectively. The larger toroidal rotation reduction is measured for higher magnetic perturbation and the rotation reduction from maximum magnetic perturbation at 16.5 s is almost compatible with ECH injection at 18.5 whereas the ion temperature behaviors are much different as shown in Fig. 2.

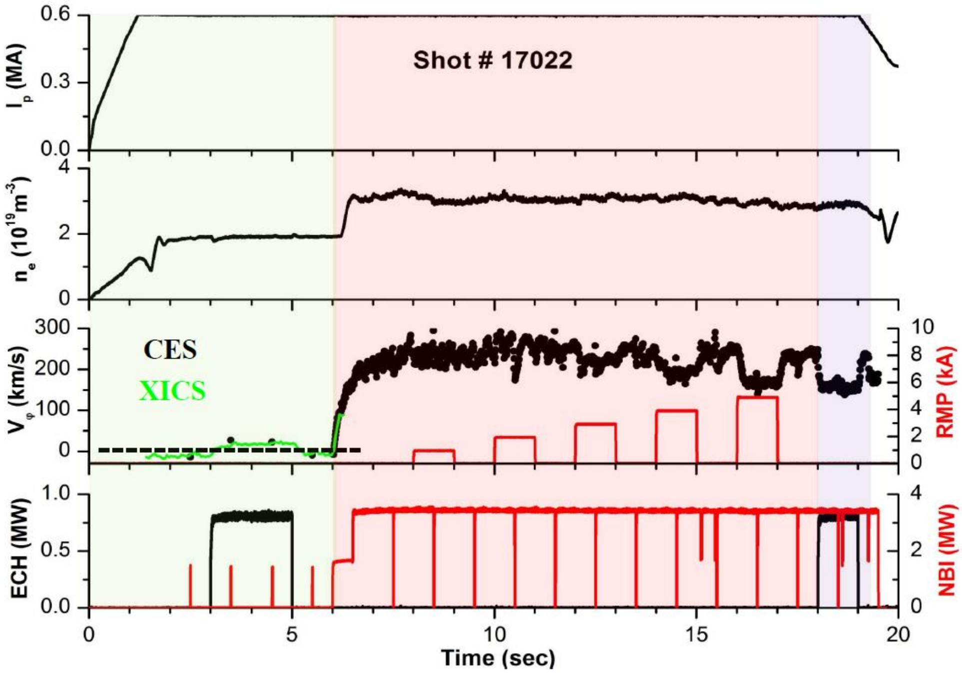

Fig. 1. Temporal evolution of main plasma parameters for shot 17022.

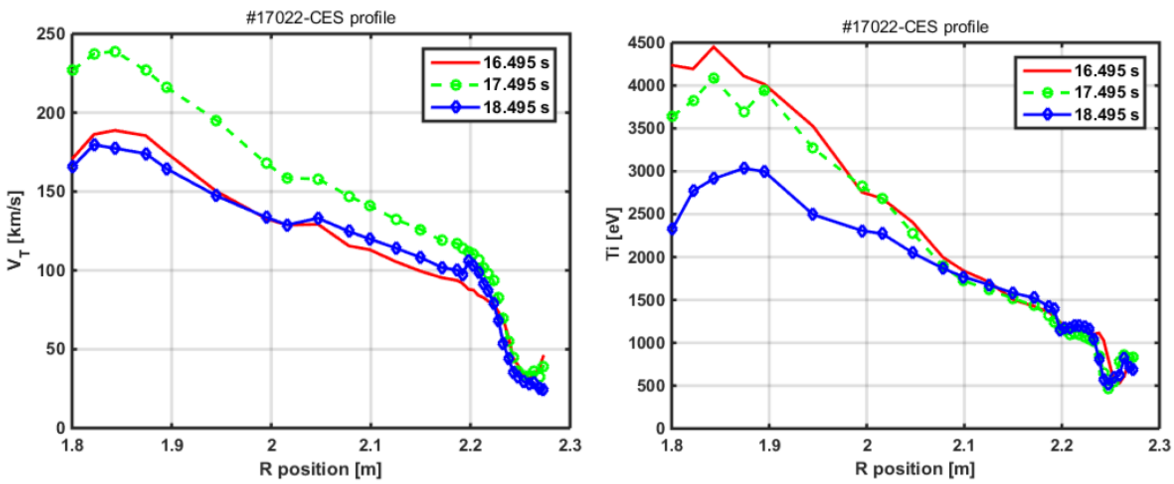

Fig. 2. Toroidal rotation (V_T) and ion temperature (Ti) profiles for shot 17022.

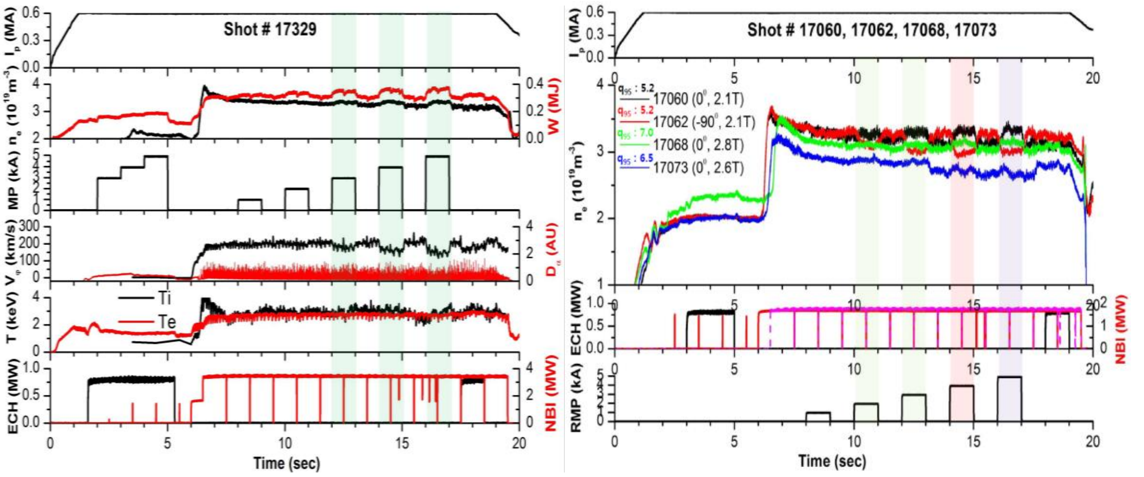

Fig. 3. Temporal evolution of shot 17329 which is reproduced for shot 17060 (left) and q_{95} dependency for the particle confinement from magnetic perturbation (right).

Figure 3 shows q_{95} dependency for the particle confinement from magnetic perturbation. The q_{95} shown in Fig. 3 is changed by adjusting the toroidal magnetic field with keeping constant plasma current of 0.6 MA.

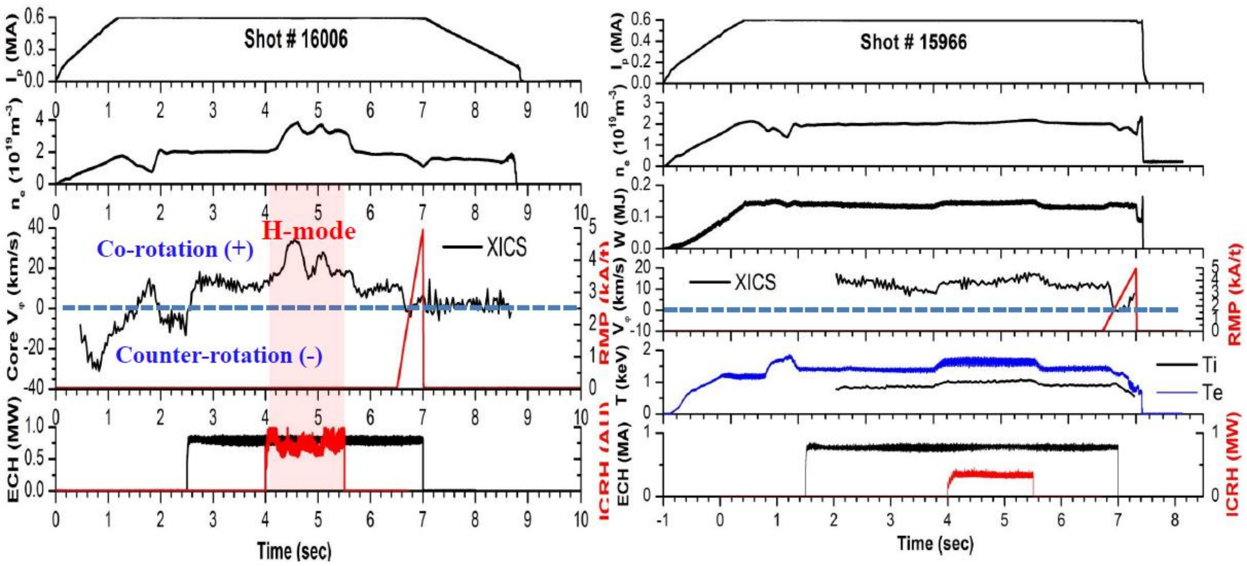

Fig. 4. Time traces of main plasma parameters during RF heating.

Figure 4 shows a temporal evolution of main plasma parameters during RF heating. The XICS [3] for the toroidal rotation and ion temperature measurements is calibrated with a stagnant mode-locking event induced from the optimum resonant magnetic perturbation. As noted before, 140 GHz ECH induces a strong co-current rotation and drives a toroidal rotation reversal and ICRF heating at about 4.0 s during ECH phase induces the ion/electron temperature increase and toroidal rotation increase in the co-current rotation direction in both L- and H-mode. The toroidal rotation increase due to ICRF heating assisted H-mode is much larger than that of the L-mode so that intrinsic rotation studies from ICRF heating during H-mode transition should be carefully investigated.

3. SUMMARY

The experimental observations from the momentum and particle transport induced from n= 1 and 2 magnetic perturbation and RF heating are discussed to investigate their impacts on the stability and confinement. In addition to the magnetic perturbation experiment, intrinsic toroidal rotation in ECH and ICRF heated experiments is simultaneously carried out.

ACKNOWLEDGEMENTS

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