Studies of RF-induced intrinsic rotations at EAST

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Plasma intrinsic rotations play a pivotal role in ensuring stability and enhancing confinement in future fusion devices. The effective suppression of Resistive Wall Mode (RWM) instabilities, particularly in devices with low external momentum injection, necessitates generation of sufficient plasma rotations. Intrinsic rotations also have strong correlations with transport barriers, since **E**×**B** shear flows can induce large residual stress to drive rotations, and these rotations can feedback the electric field via radial force balance. However, the direction of RF-induced rotations can be remarkably sensitive to specific plasma parameters, which may impede the successful control of plasma rotations in future devices [1].

Bifurcated rotational responses to Ion Cyclotron Range of Frequencies (ICRF) have been observed at the Experimental Advanced Superconducting Tokamak (EAST) facility [2]. Following the application of ICRFs at MW-power level, notable increase of approximately 20 km/s in co-current rotation has been observed in multiple experiments. Furthermore, it has been noted that the magnitude and direction of these rotation increments can undergo significant alterations with only small variations in plasma densities.

Earlier investigations have also illustrated that alterations in the prevailing turbulence types, specifically the transition from Ion Temperature Gradient (ITG) to Trapped Electron Mode (TEM), can influence the direction of intrinsic torque [3]. In order to demonstrate the connections between bifurcations in Ion Cyclotron Range of Frequencies (ICRF)-induced momentum fluxes and the changes in the dominant ITG/TEM, a series of experiments have been carried out, accompanied with efforts using quasilinear gyrokinetic simulations to verify these relationships. Additionally, this study presents comparisons of turbulence and other effects, including fast ion orbit loss, which may potentially account for the observed bifurcated momentum fluxes. This work is supported by the National Science Foundation of China (12175278) and National Key Research and Development Program of China (2019YFE03040000).

References

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