7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

M3D-K simulations of instabilities excited by energetic particles in KSTAR

Lulu Zhang[1], Guoyong Fu[1], Hogun Jhang[2]
[1] Institute for Fusion Theory and Simulation, Zhejiang University
[2] Korea Institute of Fusion Energy
e-mail (speaker): 11936021@zju.edu.cn

.

Low-frequency fishbone and high-frequency chirping modes were observed in the KSTAR experiment after tangential NBI heating was turned on. Driven by these experimental phenomena, we utilize the kinetic-MHD hybrid code M3D-K[1,2] to carry out simulations of beam ion-driven modes using the parameters of the KSTAR experiment. The low-frequency fishbone in the early phase of the discharge is confirmed by the simulations with the calculated frequency consistent with the experimental measurement. Nonlinear simulation results show that the low-frequency fishbone jumps to a high-frequency BAE-like mode.

For the later phase of the discharge, simulation results show that high-frequency BAE modes are excited with initial frequencies similar to the measured values. In the nonlinear stage, the simulations show frequency chirping followed by frequency jumping due to the nonlinear evolution of beam ion distribution. Finally, the effects of toroidal rotation have also been investigated. Results show that mode structures of the beam-driven BAEs do not change much. The effect of toroidal rotation is mainly stabilizing. The details of simulation results and analysis will be presented.

References

[1] Parker S.E. *et al*, Phys. Fluid B, 5 (1993) 77-86
[2] G. Y. Fu et al, Physics of Plasma 13, 052517 (2006)