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Hybrid simulation of fishbone instabilities in the EAST tokamak

WEI SHEN, Institute of Plasma Physics, Chinese Academy of Sciences, GUOYONG FU, Zhejiang University;Princeton Plasma Physics Laboratory, FENG WANG, Dalian University of Technology, LIQING XU, GUOQIANG LI, CHENGYUE LIU, Institute of Plasma Physics, Chinese Academy of Sciences, EAST TEAM — Hybrid simulations with the global kinetic- MHD code M3D-K[1,2] have been carried out to investigate the linear stability and nonlinear dynamics of beam-driven fishbone in EAST experiment. Linear simulations show that a low frequency fishbone instability is excited at experimental value of beam ion pressure. The mode is mainly driven by low energy beam ions via precessional resonance. The results are consistent with the experimental measurement with respect to mode frequency and mode structure. When the beam ion pressure is increased to exceed a critical value, the low frequency mode transits to a BAE with much higher frequency. Nonlinear simulations show that the frequency of the low frequency fishbone chirps up and down with corresponding hole-clump structures in phase space, consistent with the Berk-Breizman theory. In addition to the low frequency mode, the high frequency BAE is excited during the nonlinear evolution. For the transient case of beam pressure fraction where the low and high frequency modes are simultaneously excited in the linear phase, only one dominant mode appears in the nonlinear phase with frequency jumps up and down during nonlinear evolution. [1] Park W. et al 1999 Phys. Plasmas 6 1796 [2] Fu G.Y. et al 2006 Phys. Plasmas 13 052517

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