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Gyrokinetic simulation and theory for kinetic ballooning mode

YUE-YAN LI, YONG XIAO, Institute for Fusion Theory and Simulation, Zhejiang Univ — The kinetic ballooning mode (KBM) plays an important role in H mode formation and edge-localized mode (ELM) physics and internal transport barrier. A thorough understanding of the linear KBM physics is crucial to understanding the nonlinear edge physics in tokamaks. The second stability regime in small shear and sufficiently large pressure gradient has been predicted by the ballooning MHD theory. In the present work, a kinetic ballooning mode is found for the second stability regime in s-alpha space. This KBM mode is characterized by a broad-spread eigenfunction in the ballooning space, and destabilized dramatically by the ion temperature gradient. Such KBM mode almost exists in the entire second stability regime. Also KBM has been found in the sufficiently small shear even with negative shear. The gyrokinetic code GTC is employed to study the KBM physics, and finds that the linear KBM growth rate and frequency are very sensitive to the equilibrium profile. The effect of parallel current and density has been investigated, and comparisons between gyrokinetic simulation and analytic theory are carried out. The results shows that parallel current response have a strong effect in stabilize KBM instability, which could have a large effect on nonlinear electromagnetic turbulent transport.

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