§12. Multiple Eigenmode of Acoustic Mode in Collisionless Plasmas

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The origin of ZFs is the compressibility of poloidal E ×B flow. If the compression is fully compensated by a parallel return flow, it gives a zero-frequency ZF, while, if the compression mostly induces a temporal oscillation of density and only a small part is compensated by ion sound wave ISW flow, it gives the standard GAM. When the parallel flow is offered by distributed thermal velocity of particles, the GAM will be damped by the collisionless mechanism due to the coupling of the m=n=0 E×B flow to the parallel m=1/n=0 flow. However, this kinetic effect may induce multiple eigenmodes. In this work, we solve analytically the linear response of plasma to a constant electrostatic potential around a magnetic surface in large aspect ratio toroidal plasmas, and we report a series of GAM eigenmodes. Among them, there is the standard GAM, a branch of low-frequency mode, and a series of ISW-like modes.

Especially, when the parallel flow almost but not fully compensates the divergence of the E×B flow, a low but finite frequency oscillation of density is necessary to keep the continuity. This finite frequency, together with a finite frequency offered by the collisional damping of ZF, contributes to the understanding of possible finite real frequency for ZFs. The finite frequency of ZFs was observed in some experiments, and requires theoretical studies. Numerical results for the frequency and damping rate of these typical three modes are shown in Fig1.

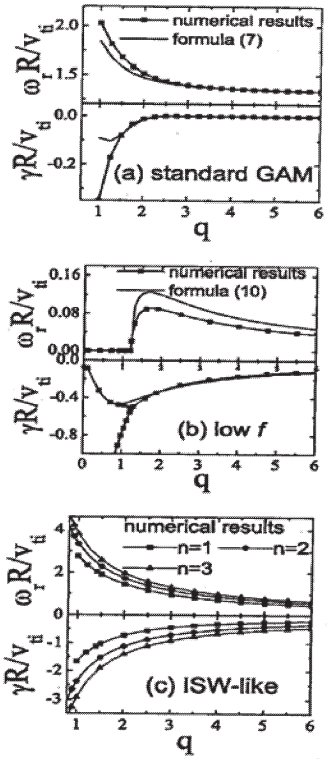

Fig.1 Eigenfrequencies of standard GAM (a), low frequency eigenmode (b) and ISW-like eigenmodes (c) as functions of q.

Reference

Zhe Gao, K.Itoh, H.Sanuki and J.Q Dong, Phys. of Plasmas **13**,100702(2006).