Geodesic mode spectrum modified by the energetic particles in tokamak plasmas

A.G. Elfimov

Institute of Physics, University of São Paulo, São Paulo, 05508-090 Brazil

Typically, a minority concentration of energetic ions may appear during the neutral beam (NB) and/or ion cyclotron resonance (ICR) heating in all modern tokamaks where these discharges are frequently accompanied by the Geodesic Acoustic Mode (GAM) instability that may have strong effect on plasma confinement. Presence of the energetic particles is also expected in ITER.

In the contribution, the effect of the minor concentration of the energetic bounce particles on GAM spectrum in a tokamak is analyzed by drift kinetic theory taking into the account the electron current and diamagnetic drifts. A novel method of Jacobi functions [1] is applied to solve the drift kinetic equation for the energetic particles in the limit of high bounce frequency in comparison with the GAM frequency. Using the *Q*-asymptotic of Jacobi function, the strong modification of the GAM continuum spectrum is calculated. It is shown that the energetic minority ions form the continuum minimum at the plasma core or at the NB or ICR power deposition maximum where the geodesic eigenmode may be excited [2, 3]. In this case, the electron current modeled by shifted Maxwell distribution may overcome the Landau damping threshold thus resulting in the GAM instability when the parallel electron current velocity is larger the effective parallel GAM phase velocity $Rq\omega$. The instability occurs due to its cross term of the current with the ion diamagnetic drift as it shown in Ref 3. Possible applications to tokamak experiments will be discussed.

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[3] A.G. Elfimov *et al, Physics Letters A*, **378**, 800-803 (2014)