Geodesic Acoustic Mode Driven by Energetic Particles with bump-on-tail distribution

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Energetic-particle-driven geodesic acoustic mode (EGAM) is analytically investigated by adopting the bump-on-tail distribution for energetic particles (EPs), which is created by the fact that the charge exchange time (τ_{cx}) is sufficiently shorter than the slowing down time (τ_{sl}). The equilibrium distribution of EPs is proportional to $(E^{3/2}+E_c^{3/2})^{\tau_s-1}$, where E is the kinetic energy of EPs and E_c is the critical one. For $\tau_s = 0$, the distribution is reduced to the slowing-down model.

The dispersion relation is derived in the use of gyro-kinetic equations. The ratio of critical energy E_c to the inertial energy E_0 is generally considered to be less than unit for theoretical study, while in the realistic experiments or relative simulation, the ratio can be up to 0.35, leading to remarkable effects. Similar to the slowing-down model, there are three branches of EGAM. We concentrate only on the unstable branch. Following relative simulation and experimental work, we specifically considered two cases: $\tau_{sl}/\tau_{cx} = 3.4$ and $\tau_{sl}/\tau_{cx} = 20.4$. The pitch angle is shown to significantly enhance the growth rate and meanwhile, the real frequency is dramatically decreased with increasing pitch angle. The excitation of high-frequency EGAM is found, and this is consistent with both the experiment and the simulation.

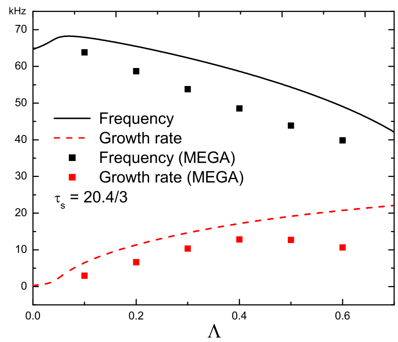

Figure 1: *The real frequency (solid curve) and growth rate (dashed one) versus the pitch angle for* $\tau_s = 20.4/3$*. The density ratio* $\varepsilon_h = 0.3$ *is adopted. The major radius* $R_0 = 3.9m$ *is used as done in the simulation [1]. In the right part, the MEGA simulation dates are cited from Fig. 10 in Ref. [1].*

References

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