Energetic Particle-induced Geodesic Acoustic Mode

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We report a new Energetic Particle-induced Acoustic Modes (to be called EGAM) discovered [1,2] in the recent numerical simulations using the particle/MHD hybrid code M3D [3]. The new mode was found to be excited by energetic particles with free energy associated with anisotropic particle distribution function. The mode had a global radial structure peaked at the center of plasma and had a frequency inside the GAM frequency continuum. An integral differential equation is derived for EGAM including the non-perturbative effects of energetic particles. Analysis shows that energetic particles can either enhance or reduce the EGAM frequency depending on details of particle distribution such as particle energy and pitch angle distribution. In the limit of isotropic distribution and large energetic particle temperature, the energetic particle pressure reduces the GAM frequency unlike the thermal species. Furthermore, the effects of finite orbit width of the energetic particles determine the radial mode structure of the global EGAM. Details of the analytic dispersion relation for EGAM and numerical simulations will be presented.

[1] G. Y. Fu et al., the 10th IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems, paper OT6, 2007.
[2] G.Y. Fu, invited talk, the 2007 APS-DPP meeting, paper BI2.
[3] W. Park, E.V. Belova, G.Y. Fu et al., Phys. Plasmas 6, 1796 (1999)