Effects of the Second Harmonic and Plasma Shaping on the Geodesic Acoustic Mode

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Recent experimental work have suggested that the Geodesic Acoustic Mode (GAM) is related to the L-H transition and transport barriers. GAMs are axisymmetric poloidal $\vec{E} \times \vec{B}$ flows with finite frequencies ($\propto C_s/R$) coupled to up-down-antisymmetric pressure perturbations, which provides a restoring force of the oscillation. The experimental results indicate a periodic modulation of flow and turbulence level with the characteristic limit cycle oscillation at the GAM frequency. In simulations, it was observed that GAMs are only somewhat less effective than the residual zonal flow in providing the non-linear saturation. The ion temperature gradient (ITG) mode driven by a combination of ion temperature gradients and field line curvature effects is a likely candidate for driving ion scale turbulence and transport. The generation of large scale modes such as zonal flows and GAMs by ITG modes is here realized through the Wave Kinetic Equation (WKE) analysis that is based on the coupling of the micro-scale turbulence with the GAM through the WKE under the assumptions that there is a large separation of scales in space and time [1]. In particular, it was found in Ref [2], that the damping rates of the GAM are significantly influenced by coupling to higher m-modes. In the present work the effects of the second harmonics of the density and temperature perturbations are investigated on the linear GAM frequency and non-linear generation of the GAM, using a fluid model [3]. We show that the second harmonics contribute to the frequency with higher order terms in ε_n similar to what was discovered in Ref [4]. In addition, effects of plasma shaping will be taken into account [5].

References

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