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On Gyrokinetic-Fluid Model for Electromagnetic Fluctuations in Magnetized Plasmas

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The hybrid gyrokinetic-fluid model (termed as GK-E&B) [1] for simulating low- frequency electromagnetic fluctuations is revisited [2], with emphasis on the self-consistency between the gyrokinetic ordering and magnetohydrodynamic equations. It is found that, contrary to the previous results, the parallel electric field equation is a Poisson-like equation in general for the typical electromagnetic microturbulence with wavelengths of the order of the thermal ion Larmor radius. Although the GK-E&B suffers no conventional Ampere cancellation issue since it employs the gauge-free gyrokinetic equation formulated in terms of electromagnetic fields, the balance between parallel electric field and electron pressure gradient must be accurately captured. Furthermore, the ion parallel current correction is shown to be essential to the ion sound wave branch in the GK-E&B model, and the compressional component of magnetic field fluctuation should be computed from the perpendicular component of Ampere's law, instead of the Faraday's law.

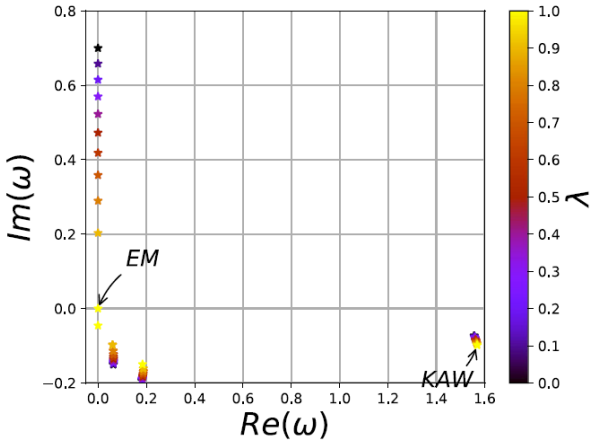

Figure 1 Neglecting the Laplacian operator in generalized Ohm's law has little effect on kinetic Alfven wave (KAW), but will destabilize the entropy mode (EM).

References

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