

Electrostatic Structures in Space Plasmas: Studies of Two-dimensional Magnetic Bernstein-Greene-Kruskal Modes

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Electrostatic structures have been observed in many regions of space plasmas, including the auroral acceleration region. One possible description of some of these structures is relating them to Bernstein-Greene-Kruskal (BGK) modes, which are exact solutions of the Vlasov equation. While there have been approximate solutions of higher dimensional BGK modes, a three-dimensional (3D) BGK mode in a finite magnetic field has not been constructed yet. We present here new studies of 2D BGK modes in a magnetized plasma with finite magnetic field strength in order to gain insights of the ultimate 3D theory. The original method of constructing these modes was presented in [Ng, Bhattacharjee, and Skiff, *Phys. Plasmas* **13**, 055903 (2006)], which showed that these modes satisfy the exact electromagnetic Vlasov-Poisson-Ampere system. Exact solutions using a new method, as well as results on simulating these modes using Particle-in-Cell (PIC) simulations, which are important in studying the stability of these modes, will be presented.

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