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Turbulent Heating and Fluctuation Characteristics in Alfvenic Turbulence

WILLIAM DORLAND[1], Department of Physics, University of Maryland, College Park, MD, 20742

Alfveń waves are ubiquitous in natural and laboratory plasmas. In this talk, the main focus is on astrophysical plasmas that are turbulent, magnetized, hot and diffuse. The dynamically important characteristics of these plasmas are often well- described by magnetohydrodynamics [see *e.g.,* Ref. 1]. However, much of what we actually observe is critically affected by how much of the turbulent energy is absorbed by (highly radiative) electrons [2], the amplitude of density fluctuations [3], and the spectral indices of turbulent, Alfveńic cascades. These questions each have essentially kinetic aspects. In this talk, we present detailed simulations and analyses of of the cascade of shear Alfveń waves, to and through scales comparable to the ion Larmor radius in the direction perpendicular to the magnetic field. We demonstrate analytically and numerically that the nonlinear gyrokinetic equations, originally developed for fusion applications, are perfectly suited to these astrophysical problems. We present extensive linear and nonlinear gyrokinetic simulation results from the `GS2` code. We demonstrate accurate resolution of the damping of kinetic Alfveń waves in plasmas with beta small, large and comparable to unity, for a wide range of electron-to-ion temperature ratios, in linear and nonlinear contexts. We have used the `GS2` code to calculate the turbulent energy absorption, density fluctuation characteristics, and spectral indices for plasmas with parameters taken from hot accretion flows and from the interstellar plasma. These results will be compared with theoretical predictions [2] and to observations. Co-authors: S. C. Cowley (UCLA), G. W. Hammett (PPPL), E. Quataert and G. Howes (UC-Berkeley), and A. Scheckochihin (Cambridge)

1. S. Balbus and J. Hawley, Rev Mod Phys, Vol. 70, p. 1.
2. E. Quataert and A. Gruzinov, Ap J, Vol. 520, p. 248; E. Quataert, Ap J, Vol. 500, p. 978.
3. Y. Lithwick and P. Goldreich, Ap J, Vol. 562, p. 279.
4. P. Goldreich and Sridhar, Ap J, Vol. 438, p. 763; P. Goldreich and Sridhar, Ap J, Vol. 485, p. 680.

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