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Gyrokinetic Statistical Absolute Equlibrium and Turbulence[1]
G.W. HAMMETT, Princeton Plasma Physics Laboratory, JIAN-ZHOU ZHU, Univ. of Maryland — A paradigm based on the absolute equilibrium of Galerkin-truncated inviscid systems to aid in understanding turbulence [T.-D. Lee, "On some statistical properties of hydrodynamical and magnetohydrodynamical fields," Q. Appl. Math. 10, 69 (1952)] is taken to study gyrokinetic plasma turbulence. We keep a finite set of Fourier modes of the collisionless gyrokinetic equations and calculate the equilibrium statistics. A new feature is that the integrations over the distributions are functional integrals because of the extra dependence on velocity in gyrokinetics. For the case of two space and one velocity dimension with N velocity grid points (where $N+1$ quadratic invariants are conserved), we find the negative temperature states, corresponding to condensation of the generalized energy into the lowest modes. This indicates a generic feature of inverse energy cascade. Comparisons are made with some classical results, such as those of Charney-Hasegawa-Mima. There is a universal shape for statistical equilibrium of gyrokinetics in three space and two velocity dimensions with one conserved quantity. Possible physical relevance to turbulence, such as zonal flows and a critical balance hypothesis are also discussed.

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Greg Hammett
Princeton Plasma Physics Laboratory

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