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Gyrokinetic inverse cascade in the sub-Larmor range: An analysis in the style of Fjørtoft, 1953 GABRIEL PLUNK, TOMO TATSUNO, University of Maryland, College Park — It is known that an inverse cascade of energy occurs in two-dimensional neutral fluid turbulence and also, under certain conditions, in magnetized plasma turbulence. The reason for this phenomenon in both cases is due to the existence of two quadratic invariants that are *mutually-constraining* in the sense that the spectral redistribution of one is constrained by the other. The homogeneous gyrokinetic equation has two collisionless quadratic invariants when restricted to two dimensions in position-space. In this letter, we consider the consequences of this fact for scales smaller than the thermal Larmor radius, where turbulent fluctuations exist, with equal importance, in the position and velocity space dependence of the kinetic distribution function. Using a spectral formalism for position and velocity space, we find that the gyrokinetic invariants are mutually constraining with respect to spectral redistribution of energy. We adapt the analysis of Fjørtoft (1953) to investigate the consequences of this fact. We find that inverse cascade is possible, but differs from the conventional inverse cascade of fluid turbulence in several ways. In certain scenarios, we argue that a dramatic non-local inverse cascade will occur, whereby fluctuations at scales much smaller than the Larmor radius can transfer energy directly to the Larmor scale. In the other extreme, we argue that the inverse cascade can be completely shut down.

Gabriel Plunk
University of Maryland, College Park

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