Stationary Power-law Solutions of Weak Kinetic-Alfvénic Turbulence

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Based on nonlinear gyrokinetic theory, we proposed the wave-kinetic description of weak kinetic-Alfvénic turbulence in a low-β uniform plasma of axisymmetry, which conserves energy and parallel-momentum (generalized-helicity). We calculated the stationary power-law solutions corresponding to energy and parallel-momentum cascades using the Zakharov transformation, in both long-wavelength and short-wavelength limits, for both counter-propagating and co-propagating cases. The cascade directions of stationary solutions were identified and further verified by numerical calculations of the wave kinetic equation. Discussions about the relevance of such predictions to the imbalanced solar wind turbulence, the formation of the transition range, and cascade behaviors of helical kinetic-Alfvénic turbulence are given.

Reference: Shen K., Cheng Z. and Qiu Z., arXiv:2508.03478