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Kinetic Simulations of Relativistic Imbalanced Turbulence[1]

AMELIA HANKLA, Univ. Colorado, Boulder; JILA, VLADIMIR ZHDANKIN, Princeton University, GREGORY WERNER, DMITRI UZDENSKY, Univ. Colorado, Boulder; CIPS, MITCHELL BEGELMAN, JILA — Turbulent high-energy astrophysical systems often feature asymmetric mechanical energy injection, for instance Alfvén waves propagating from an accretion disk into its corona. Such systems (relativistic analogs of the solar wind) are "imbalanced": the energy fluxes parallel and anti-parallel to the large-scale magnetic field are unequal and the plasma possesses net cross-helicity. In the past, numerical studies of imbalanced turbulence have focused on the magnetohydrodynamic regime. In the present study, we investigate externally-driven imbalanced turbulence in a collisionless, ultrarelativistically hot, magnetized pair plasma using three-dimensional particle-in-cell simulations. We examine how statistical properties of the turbulence as well as kinetic aspects such as plasma heating, momentum anisotropy, and nonthermal particle acceleration depend on the degree of imbalance, and compare the results to the balanced case. We also investigate the efficiency of converting injected Poynting flux into net momentum of the plasma, and discuss subsequent implications for the launching of a disk wind. These results will better characterize properties of imbalanced turbulence in a collisionless plasma and may have ramifications for black hole accretion disk coronae, winds, and jets.

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