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Dynamic Phase Alignment in Inertial Alfven Turbulence[1] LUCIO MILANESE, NUNO LOUREIRO, Massachusetts Institute of Technology, MAXIMILIAN DASCHNER, ETH Zurich and Massachusetts Institute of Technology, STANISLAV BOLDYREV, University of Wisconsin-Madison — In weakly-collisional plasma environments with sufficiently low electron beta, Alfvénic turbulence transforms into inertial Alfvénic turbulence at scales below the electron skin-depth, $k_\perp d_e > 1$. We argue that, in inertial Alfvénic turbulence, both energy and generalized kinetic helicity exhibit direct cascades. We demonstrate that the two cascades are compatible due to the existence of a strong scale-dependence of the phase alignment angle between velocity and magnetic field fluctuations, with the phase alignment angle scaling as $\cos\alpha_k \propto k_\perp^{-1}$. As a result of the dual direct cascade, the generalized-helicity spectrum scales as $\propto k_\perp^{-5/3}$, implying progressive balancing of the turbulence as the cascade proceeds to smaller scales in the $k_\perp d_e \gg 1$ range. Our results may be applicable to a variety of geophysical, space, and astrophysical environments, including the Earth's magnetosheath and ionosphere, solar corona, non-relativistic pair plasmas, as well as to strongly rotating non-ionized fluids.

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