



Exact turbulence laws in collisionless plasmas: Hybrid simulations

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An exact vectorial law for turbulence in homogeneous incompressible Hall-MHD is derived and tested in two-dimensional hybrid simulations of plasma turbulence. The simulations confirm the validity of the MHD exact law in the kinetic regime, the simulated turbulence exhibits a clear inertial range on large scales where the MHD cascade flux dominates. The simulation results also indicate that in the sub-ion range the cascade continues via the Hall term. The simulations also indicate that the total cascade rate tends to decrease at around the ion scales, especially in high-beta plasmas, likely owing to non-thermal features, likely related to collisionless ion energization, that is not retained in the Hall MHD approximation.