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The Equilibrium Ensemble of Three-dimensional Hall Magneto-hydrodynamics SERGIO SERVIDIO, WILLIAM MATTHAEUS, Bartol Research Institute, University of Delaware, Newark, DE 19716, VINCENZO CARBONE, Dipartimento di Fisica, Unita' di Cosenza, Ponte Pietro Bucci, Cubo 31C, 87036 Rende (CS), Italy — The nonlinear dynamics of ideal and incompressible Hall Magneto-hydrodynamics (HMHD) is investigated through classical Gibbs ensemble methods. The spectral structure of the HMHD is derived in a three dimensional periodic geometry and then compared with the MHD case. The purpose of the work is to provide a general picture of Hall MHD spectral transfers and cascades by the assumption that it follows equilibrium statistics. In the HMHD case the equilibrium ensemble is built on the conservation of three quadratic invariants, that is the total energy, the magnetic helicity, and the hybrid helicity. The latter replace the cross helicity in the one fluid case. In the HMHD equilibrium a tendency to have double cascade (inverse and direct) is observed, moreover the Alfvén effect (dynamical alignment between velocity and magnetic field) is broken at ion skin depth scales. The ensemble predictions are compared to numerical simulations with a low order truncation Galerkin spectral code.

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