Energy transfers between scales in fully developed magnetohydrodynamic turbulence

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The strong nonlinear couplings between different scales of a plasma flow represents one of the primary attributes of magnetohydrodynamic (MHD) turbulence. A good understanding of the energy transfers between velocity and magnetic scales is crucial for the development of adequate models. We explore the energy exchange mechanisms for fully developed MHD turbulence using direct numerical simulations. For anisotropic turbulent states, which form in the presence of an external magnetic guide field, a method of decomposing the spectral space into ring structures is presented and the energy transfers between such rings are studied.

Although all the scales of the flow are coupled together in the same manner, trough the nonlinear terms, contributions form particular scales dominate the global transfer to a given scale. To investigate this aspect of the energy fluxes, an extension of Kraichnan locality function is used.

Finally, we consider the impact of scale removal, common for Large-Eddy-Simulation modelling approaches, on charged particle transport.