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Turbulent energy transfer in bidimensional numerical models of plasma

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Structured, highly variable and virtually collision-free. Space plasma is an unique laboratory for studying the transfer of energy in a highly turbulent environment. This turbulent medium plays an important role in various aspects of the Solar--Wind generation, particles acceleration and heating, and even in the propagation of cosmic rays. Moreover, the Solar Wind continuous expansion develops a strong turbulent character, which evolves towards a state that resembles the well-known hydrodynamic turbulence (Bruno and Carbone). This turbulence is then dissipated from magnetohydrodynamic (MHD) through kinetic scales by different -not yet well understood-mechanisms. In the MHD approach, Kolmogorov-like behaviour is supported by power-law spectra and intermittency measured in observations of magnetic and velocity fluctuations. In this regime, the intermittent cross-scale energy transfer has been extensively described by the Politano--Pouquet (global) law, which is based on conservation laws of the MHD invariants, and was recently expanded to take into account the physics at the bottom of the inertial (or Hall) range, e.g. (Ferrand et al., 2019). Following the 'Turbulence Dissipation Challenge', we study the properties of the turbulent energy transfer using three different bi-dimensional numerical models of space plasma. The models, Hall-MHD (HMHD), Landau Fluid (LF) and Hybrid Vlasov-Maxwell (HVM), were ran in collisionless-plasma conditions, with an out-of-plane ambient magnetic field, and with magnetic diffusivity carefully calibrated in the fluid models. As each model has its own range of validity, it allows us to explore a long-enough range of scales at a period of maximal turbulence activity. Here, we estimate the local and global scaling properties of different energy channels using a, recently introduced, proxy of the local turbulent energy transfer (LET) rate (Sorriso-Valvo et al., 2018). This study provides information on the structure of the energy fluxes

that transfers (and dissipates) most of the energy at small scales throughout the turbulent cascade.