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A new technique for the investigation of the energy cascade associated with coherent structures in Kelvin-Helmholtz turbulence

Claudia Rossi (1), Enrico Camporeale (2), Francesco Califano (3), Silvio Sergio Cerri (4), Alessandro Retinò (5), Luca Sorriso-Valvo (6), and Vincenzo Carbone (1)

(1) Dip. Fisica, Università della Calabria, Ponte P. Bucci, cubo 33B, 87036 Rende, Italy (claudia.rossi@unical.it), (2) Center for Mathematics and Computer Science (CWI), Amsterdam, The Netherlands (E.Camporeale@cwi.nl), (3)) Dip. Fisica, Università di Pisa, Largo B. Pontecorvo 3, 56127, Pisa, Italy (francesco.califano@unipi.it), (4) Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany (sscerr@ipp.mpg.de), (5) LPP-CNRS/École Polytechnique/UPMC, Université Paris VI, Paris XI, 91128, Palaiseau Cedex, France (alessandro.retino@lpp.polytechnique.fr), (6) Nanotec-CNR, U.O.S. LICRYL di Cosenza, Ponte P. Bucci, Cubo 31C,I-87036 Rende, Italy (sorriso@fis.unical.it)

The dissipation of turbulent energy at small scales in space plasmas is an open and challenging problem. Coherent structures at the kinetic scales could play a fundamental role in redistributing the plasma energy thus replacing in some sense the role of collisions.
Coherent structures in the form of current sheets (CS) are associated with localized particle heating, and are generally responsible for the observed intermittent nature of plasma turbulence. Still, the contribution of such structures to the local energy spectrum shaping is not well understood. Here, for the first time, we apply a 'space-filter' technique to two-fluid plasma simulations of Kelvin-Helmholtz turbulence to obtain a local measure of the inter-scale transfer and to characterize the contribution of coherent structures to the energy spectrum. This technique, used in hydrodynamics and in Large-Eddy-Simulation communities, is applied here for the first time to space plasma turbulence. Specifically, we study in detail the current sheets forming in turbulent Kelvin-Helmholtz vortices by the Partial Variance of Increments (PVI) technique, and we discuss the correlation between the inter-scale transfer and high values of the PVI index.