Self-Organization in Purely Viscous Non-Newtonian Turbulence

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We investigate through Direct Numerical Simulations (DNS) the statistical properties of turbulent flows in the inertial subrange for non-Newtonian power-law fluids. The structural invariance found for the vortex size distribution is achieved through a self-organized mechanism at the microscopic scale of the turbulent motion that adjusts, according to the rheological properties of the fluid, the ratio between the viscous dissipations inside and outside the vortices. Moreover, the deviations from the K41 theory of the structure functions' exponents reveal that the anomalous scaling exhibits a systematic nonuniversal behavior with respect to the rheological properties of the fluids.