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Elastic Energy Transfer in Turbulence of Dilute Polymer Solution[1] HENG-DONG XI, EBERHARD BODENSCHATZ, HAITAO XU, Max-Planck Institute for Dynamics and Self-Organization — We present an experimental study of the energy transfer in the bulk of a turbulent flow with small amount long-chain polymer additives. By varying the Reynolds numbers R_λ, Wissenberg number Wi and polymer concentration ϕ. We test quantitively the elastic theory proposed by de Gennes and Tabor (Europhys. Lett., 1986; Physica A, 1986). The rate of energy transfer by polymer elasticity as inferred from the theory is consistent with that measured from the second order Eulerian structure functions. The unknown parameter n in the theory, which represents the flow topology of the stretching field, is found to be nearly 1. Based on energy transfer rate balance, We propose an elastic length scale, r_ϵ, which describes the effect of polymer elasticity on turbulence energy cascade and captures the scale dependence of the elastic energy transfer rate.

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