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Wind tunnel measurements of scale-by-scale energy transfer, dissipation, advection and production/transport in equilibrium and nonequilibrium decaying turbulence[1] PEDRO VALENTE, CHRISTOS VASSILICOS, Imperial College London — The cornerstone assumption that $C_\epsilon \equiv \epsilon L/u^3 \approx constant$ was found to breakdown in certain nonequilibrium regions of decaying grid-generated turbulence with wide power-law near -5/3 spectra where the behaviour of C_ϵ is, instead, very close to $C_\epsilon \sim Re_L^{-1}$ (Valente & Vassilicos, 2012 [Phys. Rev. Lett. 108, 214503]). We investigate nonequilibrium turbulence by measuring with two cross wire anemometers the downstream evolution of the scale-by-scale energy transfer, dissipation, advection, production and transport in the lee of a square-mesh grid and compare with a region of equilibrium turbulence. For the nonequilibrium case it is shown that the production and transport terms are negligible for scales smaller than about a third of L. For both cases it is shown that the peak of the scale-by-scale energy transfer scales as u^3/L which is the expected behaviour for equilibrium turbulence. However, for the nonequilibrium case this implies an imbalance between the energy transfer to the small scales and the dissipation. This imbalance is reflected on the small-scale advection which becomes larger in proportion to the maximum energy transfer as the turbulence decays whereas it stays proportionally constant in the equilibrium case.

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Pedro Valente
Imperial College London

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