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Extraction of nonequilibrium -7/3 energy spectrum in experimental measurement turbulence data KIYOSI HORIUTI, Tokyo Institute of Technology, Japan, YUICHI MASUDA, Tokyo Institute of Technology — A perturbation expansion for the energy spectrum about a base Kolmogorov $k^{-\frac{5}{3}}$ steady state yields an additional $-7/3$ power component which is induced by the fluctuation of the dissipation rate ε and represents a nonequilibrium state. DNS study revealed actual existence of $-7/3$ spectrum in homogeneous shear flow at $Re_\lambda \approx 150$ (*Phys. Fluids* **23**, 035107 (2011)). In this study, an attempt is made to extract the same spectrum in the data measured using the hot wire anemometer in the experiment of the driving mixing layer, in which nearly constant mean shear is established ($Re_\lambda \approx 468$, Y. Tsuji (2008)). The time series data are converted to the spatially evolving data employing the Taylor's hypothesis and ε is obtained. To be in accordance with the statistical theory, the variations of ε in the time scale comparable to the integral length scale are considered. Nonequilibrium component is extracted applying a conditional sampling on $d\varepsilon/dt$, and it is shown that the deviation from the base $-5/3$ spectrum fits the $-7/3$ power slope. The temporal development of the spectrum is divided into two regimes, Phases 1 and 2. Large energy contained in the low- wavenumber range in Phase 1 is cascaded to the small scales in Phase 2. This energy transfer is accomplished by the reversal in the sign of -7/3 power component. These results agree well with the DNS.

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