Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Characteristics of space-time energy spectra in turbulent Shear flows TING WU, CHENGHUI GENG, SHIZHAO WANG, GUOWEI HE, Institute of Mechanics, Chinese Academy of Sciences, TURBULENCE TEAM — An energy spectrum over wavenumbers is preliminarily characterized by its mean and standard deviation. The mean is corresponding to the characteristic wavenumber at the center of mass of energy spectrum and the standard deviation corresponding to the bandwidth of energy spectrum. In the present study, we derive the exact expressions for the characteristic wavenumbers and the bandwidths of space-time energy spectra at fixed frequencies. The characteristic wavenumbers are used to calculate the phase velocities that bridge from temporal spectra to space-time spectra. The bandwidths are used to measure the well-known spectral broadening. It is shown that phase velocities alone are insufficient to determine the bandwidths of energy spectra. As a result, Taylor's frozen-flow model and Kraichnan and Tannekes' random-sweeping model predict the narrower bandwidths of energy spectra. Therefore, in addition to phase velocities, bandwidths are introduced to rescale the space-time energy spectra that are obtained from phase velocities, leading to the correct bandwidths of energy spectra. Existing data from direct numerical simulation of turbulent channel flows is used to validate this rescaling technique.

Guowei He
Institute of Mechanics, Chinese Academy of Sciences

Date submitted: 30 Jul 2016 Electronic form version 1.4