Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

A generalized self-similar spectrum for decaying homogeneous and isotropic turbulence[1] PINGFAN YANG, Center for Combustion Energy, Tsinghua University, Beijing, China, ALAIN PUMIR, Ecole Normale Superieure de Lyon and CNRS, Lyon, France, HAITAO XU, Center for Combustion Energy, Tsinghua University, Beijing, China and Max Planck Institute for Dynamics Self-Organization, Goettingen, Germany — The spectrum of turbulence in dissipative and inertial range can be described by the celebrated Kolmogorov theory. However, there is no general solution of the spectrum in the large scales, especially for statistically unsteady turbulent flows. Here we propose a generalized self-similar form that contains two length-scales, the integral scale and the Kolmogorov scale, for decaying homogeneous and isotropic turbulence. With the help of the local spectral energy transfer hypothesis by Pao (Phys. Fluids, 1965), we derive and solve for the explicit form of the energy spectrum and the energy transfer function, from which the second- and third-order velocity structure functions can also be obtained. We check and verify our assumptions by direct numerical simulations (DNS), and our solutions of the velocity structure functions compare well with hot-wire measurements of high-Reynolds number wind-tunnel turbulence.

[1]Financial supports from NSFC under grant number 11672157, from the Alexander von Humboldt Foundation, and from the MPG are gratefully acknowledged.

Haitao Xu
Tsinghua Univ., and Max Planck Inst. for Dynamics Self-Organization

Date submitted: 31 Jul 2017 Electronic form version 1.4