Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

The Lagrangian nature of turbulent energy cascade[1] MINPING WAN, SHIYI CHEN, CHARLES MENEVEAU, ZUOLI XIAO, Johns Hopkins University (Mechanical Engineering), GREGORY EYINK, Johns Hopkins University (Applied Mathematics & Statistics) — We study the spatial and temporal evolution of energy flux at different scales using direct numerical simulations of isotropic turbulence. We compute the correlation coefficient at different times, between energy dissipation and local energy fluxes across inertial-range scales, in both Eulerian and Lagrangian frames. For the latter, we use a backward particle-tracking method. The Eulerian correlation coefficients decay monotonically, backward in time. However, the Lagrangian correlation coefficients between flux at adjacent scales peak after a certain time delay, which scales as the local turnover time. This result provides strong evidence of the Lagrangian nature of turbulent energy cascade. We present results on similar correlations in the two-dimensional inverse energy cascade range, and discuss the differences with three- dimensional forward energy cascade.

[1]Supported in part by NSF grant #ASE-0428325

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Date submitted: 01 Sep 2005 Electronic form version 1.4