Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Behavior of local dissipation scales in turbulent pipe flow[1] SEAN BAILEY, University of Kentucky, MARCUS HULTMARK, Princeton University, JOERG SCHUMACHER, TU Ilmenau, VICTOR YAKHOT, Boston University, ALEXANDER SMITS, Princeton University — Classically, dissipation of turbulence has been thought to occur around the Kolmogorov scales. However, the Kolmogorov scales are prescribed using mean dissipation rate, whereas dissipation is spatially intermittent. It therefore seems natural to instead describe dissipation using a continuum of local length scales rather than a single scale. By connecting a local dissipation scale η to the velocity increment across this scale δu_η, it is possible to derive a probability density function (PDF) of η which show how the dissipation is contained in scales larger and smaller than the Kolmogorov scale. Here we present a comparison between measured PDFs in turbulent pipe flow, the analytically derived PDF, and PDFs determined from direct numerical simulation of homogeneous isotropic turbulence. It was found that there is good general agreement between experiment, simulation and theory amongst both homogeneous and inhomogeneous turbulent flows, pointing to universality in the dissipation scales amongst different flows. It was also found that the PDFs are invariant with distance from the wall except for a region very near the wall ($y^+ < 80$), where dissipation was found to occur at increasingly larger length scales as the wall is approached.

[1]Supported by ONR and DFG.

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Date submitted: 05 Aug 2010 Electronic form version 1.4