Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Scalar Dissipation Length Scale Measurement[1] GUANGHUA WANG, ROBERT BARLOW, Sandia National Laboratories, NOEL CLEMENS, The University of Texas at Austin — In the current study, mixture fraction in non-reacting turbulent C2H4/air circular jet flows at Reynolds number of 4,000, 6,000, 10,000 and 15,200, measured with 1D line laser Rayleigh scattering technique, was used to determine the dissipation length scale and corresponding spatial resolution required to resolve this scale. The dissipation length scale is experimentally determined from both the measured 1D dissipation spectrum and spatial filtering. The dissipation length scale is found to be ∼6 times larger than the Batchelor scale, which is consistent with the Batchelor frequency in time series measurement and strain limited mass diffusion length scale in 2D imaging experiments. The spatial resolution to resolve this physical limiting dissipation length scale is not simply related to the Nyquist criteria and a systematic approach is proposed by considering both experimental and numerical factors. These techniques can be extended to complex turbulent flows, e.g. turbulent reacting flows, where isotropic turbulent theory may not apply. A new form of the 1D dissipation model spectrum is developed based on the dissipation structures and compared with Pope's model spectrum.

[1]This work was supported by the Division of Chemical Sciences, Geosciences and Biosciences, Office of Basic Energy Sciences, US Department of Energy.

Noel Clemens
The University of Texas at Austin

Date submitted: 07 Aug 2006 Electronic form version 1.4