Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Quantitative Measurement of Scalar Dissipation Rates in Turbulent Jets Using Planar Laser Imaging L.K. SU, Johns Hopkins University, D.B. HELMER, Stanford University, C.J. BROWNELL, United States Naval Academy — Quantitative planar measurements in turbulent jet flows of scalar quantities, such as jet fluid mass fractions, Y, are relatively common, but planar measurements of the scalar dissipation rate, $\chi \propto \nabla Y \cdot \nabla Y$, are not. A complete understanding of the scalar dissipation rate field is important to applications such as turbulent non-premixed combustion. The particular challenge facing the measurement of χ is spatial resolution. Here, using planar Rayleigh scattering to measure Y in helium-air and nonreacting acetylene-air jets, we measure χ from the near field up to ≈ 40 jet diameters, d, from the jet exit using a series of five imaging windows. With this approach, the individual windows can be sized to ensure adequate pixel resolution to measure the local χ, while the full set of data allows the measurement of the χ scaling over the entire axial range. Results indicate that the χ decay rates are slower than predicted from classical scaling arguments, and also slower than measured decay rates of kinetic energy dissipation. The data also permit assessment of the effects of spatial filtering on the measured χ, which is relevant to efforts to model χ in combustion simulations.

Lester Su
Johns Hopkins University

Date submitted: 05 Aug 2008 Electronic form version 1.4