Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Effects of mean shear and scalar initial length scale on three-scalar mixing in turbulent coaxial jets[1] CHENNING TONG, WEI LI, MENGYUAN YUAN, Clemson Univ, CAMPBELL CARTER, AFRL — We investigate three-scalar mixing in a turbulent coaxial jet, in which a center jet and an annular flow, consisting of acetone-doped air and ethylene respectively, are mixed with the co-flow air. We investigate the effects of the velocity and length scale ratios of the annular flow to the center jet. Planar laser-induced fluorescence and Rayleigh scattering are employed to image the scalars. The results show that the velocity ratio alters the relative mean shear rates in the mixing layers between the center jet and the annular flow and between the annular flow and the co-flow, modifying the scalar fields through mean-flow advection, turbulent transport, and small-scale mixing. The length scale ratio determines the degree of separation between the center jet and the co-flow. The results show that while varying the velocity ratio can alter the mixing characteristics qualitatively, varying the annulus width only has quantitative effects. The evolution of the mean scalar profiles are dominated by the mean-flow advection, while the shape of the joint probability density function is largely determined by the turbulent transport and molecular diffusion. The results in the present study have implications for understanding and modeling multiscalar mixing in turbulent reactive flows.

[1]Supported by NSF

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Date submitted: 11 Jul 2016 Electronic form version 1.4