Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Tailoring tails in Taylor dispersion: how boundaries shape chemical delivery in microfluidics: computation and theory[1] RICHARD M. MCLAUGHLIN, MANUCHEHR AMINIAN, FRANCESCA BERNARDI, ROBERTO CAMASSA, DANIEL M. HARRIS, UNC Chapel Hill, UNC JOINT FLUIDS LAB TEAM — We present the results of a combined computational and theoretical study of the dispersion of a passive scalar in laminar shear flow through rectangular and elliptical channels. We show through Monte Carlo simulation and asymptotic analysis that the cross-sectional aspect ratio sets the sign of the average skewness at long times (relative to the Taylor diffusion timescale) which describes the longitudinal asymmetry of the tracer distribution. Universally, thin channels (aspect ratio $\ll 1$) result in negative average skewness, whereas as thick channels (aspect ratio ~ 1) result in positive average skewness. Our analysis also allows us to define a "golden" aspect ratio which separates thin from thick channels, the value of which is remarkably similar for both the rectangle and the ellipse. Further, by examining the median of the cross-sectionally averaged distribution, we establish that negative skewness correlates with solutes arriving with sharp fronts followed by a tapering tail. Future directions will be discussed.

[1]Funding from NSF grant Nos.: RTG DMS-0943851, CMG ARC-1025523, DMS-1009750, and DMS-1517879.

Richard McLaughlin
UNC Chapel Hill

Date submitted: 01 Aug 2016 Electronic form version 1.4