Abstract Submitted
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Experimental Analysis of the Diffusion of a Passive Scalar Subject to Steady Flow in a Circular Pipe[1] FRANCESCA BERNARDI, MANUCHEHR AMINIAN, University of North Carolina - Chapel Hill, SARAH BURNETT[2], Los Alamos National Laboratory, ROBERTO CAMASSA, RICHARD MCLAUGHLIN, University of North Carolina - Chapel Hill — The Taylor Pipe Flow experiment at UNC's Joint Fluids Lab was designed to be a continuation of the research on the dispersion of soluble matter through a tube conducted by G.I. Taylor in the '50s. We explore analytically, numerically and experimentally the evolution of the dispersion of a solute, focusing primarily on computing and measuring the first four moments (mean, variance, skewness and kurtosis) of solute concentration in two-dimensional channel models and three-dimensional glass pipes with circular or square cross-sections. Our experimental setup allows us to observe the effects of Poiseuille flow as either advection or diffusion dominates in different regimes and timescales set by the Taylor time scale $t_T \propto a^2/\kappa$, depending on the cross-sectional characteristic length a and the diffusion coefficient κ. We conduct experiments to illustrate these regimes, characterized by the dimensionless Péclet number, $Pe = u\,a/\kappa$, where u is the characteristic velocity. Experimentally, we take the intensity of a fluorescein-dyed portion of distilled water and find its corresponding concentration by solving an inverse problem of intensity to concentration. The experimental results validate the theoretical approach.

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