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Multi-point correlation functions of a passive scalar field in a turbulent boundary layer D.R. WEBSTER, R.J. MILLER, Georgia Tech — Multi-point correlation functions are used to analyze a fluctuating passive scalar field that develops downstream of an iso-kinetic point release of a high Schmidt number dye into the inertial layer of a fully developed open channel turbulent boundary layer. Instantaneous images of the field are captured using planar laser-induced fluorescence (PLIF). The spatial structure is fully resolved by ensuring that the laser sheet thickness and camera pixel spacing are on the order of the Batchelor length scale. Data are collected for a range of Reynolds numbers ($60 < \quad R\&e_\lambda \quad < 120$) and injection length scales (2.2 mm $< \quad d \quad <$ 9.4 mm). The fields are evaluated by determining the scaling properties, extracting geometric relationships, and examining the small-scale structures. Two-point correlation functions are used to quantify the integral length scale, which is subsequently used to scale the spacing of the multi-point correlation functions. Multi-point correlators probe the scalar field for the presence of spatial structures and simultaneously retain scaling property information. The results of this research are expected to aid in predicting the mixing and transport of the turbulent passive scalar field.

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