Measurements of the relative diffusion of a passive scalar plume in sheared turbulence[1] CHRISTINA VANDERWEL, STAVROS TAVOULARIS, University of Ottawa — A neutrally buoyant aqueous solution of Rhodamine 6G fluorescent dye was injected isokinetically from a thin tube into fully developed, uniformly sheared, nearly homogeneous, turbulent flow in a water tunnel. The turbulent Reynolds number was $Re_\lambda \approx 150$. Instantaneous dye concentration variations in several planes normal to the flow were mapped by means of planar laser-induced fluorescence. Mean relative concentration maps were determined by ensemble averaging the instantaneous maps, each shifted to a common centre of mass. These maps could be fitted well by a 2D Gaussian function. The distance-neighbour function was also determined in each plane from mean planar autocorrelation maps and its shape was found to be comparable to analytical expressions by Richardson and by Batchelor. The relative plume width, defined as the standard deviation of the mean relative concentration map, was approximately equal to $1/\sqrt{2}$ times the standard deviation of the distance-neighbour function. The relative plume width remained within the inertial subrange and its streamwise growth rate was consistent with Richardson's 4/3 Law. The estimated value of Richardson's constant was roughly 0.1.

Stavros Tavoularis
University of Ottawa

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