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Direct Measurement of Turbulent Shear[1] STEFANUS STEFANUS, STANLEY STEERS, WALTER GOLDBURG, University of Pittsburgh — Photon Correlation Spectroscopy (PCS) is used to directly measure the mean shear rate $\overline{s}$ in a turbulent soap film. A 5 mW 633 nm He-Ne laser is focused on the film at a point $\mathbf{r}$, the spot size being w =100 μm. The scattered light intensity $I(t)$ is analyzed by a correlator that measures the average, over time t, of the correlation function $G(\tau) = \langle I(t)I(t+\tau)\rangle / \langle I(t)\rangle^2 - 1$. From $G(\tau)$, one extracts the shear $\overline{s}$ averaged over w and the standard deviation of $\overline{s}$. Of special interest is the shear at points $\mathbf{r}$ near a solid boundary. The PCS measurements of $\overline{s}$ (in Hz) are compared with those obtained by laser Doppler velocimetry (LDV). The two techniques yield values of $\overline{s}$ that agree within a standard deviation. The PCS method has the advantage of compactness and rapid data collection, making it of potential use in biology and medicine. By changing the orientation of the incident and scattered beams, one can measure various components of the shear tensor. The implementation of the PCS method does not require the presence of a mean flow. It can also be applied to three-dimensional turbulence.

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