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The effect of a solid boundary on homogeneous isotropic turbulence: an experimental investigation BLAIR JOHNSON, EDWIN COWEN, Cornell University — An experimental study is performed to investigate the turbulent boundary layer at a smooth solid boundary in the absence of mean shear. Driven by a spatio-temporally varying randomly actuated synthetic jet array suspended above an enclosed water tank, high Reynolds number horizontally homogeneous isotropic turbulence is generated with negligible mean flow. Acoustic Doppler velocimetry and particle image velocimetry measurement techniques are used to characterize the near-boundary flow with statistical metrics such as turbulence intensities, turbulent kinetic energy, temporal and spatial spectra, and integral length scales. We compare various methods of computing dissipation rates and evaluate the assumptions of isotropy that are typically invoked. Furthermore, we consider Eulerian frequency spectra to improve dissipation estimates from single-point velocity measurements. Our investigations examine the effect of altering jet firing parameters on the integral length scale and resulting turbulent structures. We conclude with thoughts on the use of the dissipation rate to parameterize the bed stress in the absence of mean shear where traditional friction velocity methods struggle to fully capture the local stresses and energy present in turbulence.

Blair Johnson
Cornell University

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