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Small-scale anisotropy in turbulent boundary layers ALAIN PUMIR, Ecole Normale Superieure de Lyon, Lyon, France, HAITAO XU, Tsinghua University, Beijing, China, ERIC SIGGIA, Rockefeller University, New York City, NY. — In a channel flow, the velocity fluctuations are inhomogeneous and anisotropic. Yet, the small-scale properties of the flow are expected to behave in an isotropic manner in the very large Reynolds number limit. We consider the statistical properties of small-scale velocity fluctuations in a turbulent channel flow at moderately high Reynolds number ($\mathrm{Re}_\tau \approx 1000$), using the Johns Hopkins University turbulence database. Away from the wall ($y^+ > 200$), the skewness of the normal derivative of the streamwise velocity fluctuation is approximately constant, of order 1, while the Reynolds number based on the Taylor scale is $R_\lambda \approx 150$. This defines a small-scale anisotropy that is stronger than in turbulent homogeneous shear flows at comparable values of R_λ. In contrast the vorticity-strain correlations that characterize homogenous isotropic turbulence are nearly unchanged in channel flow even though they vary with distance from the wall with an exponent that can be inferred from the local dissipation. The statistical properties of the fluctuating velocity gradient in turbulent channel flow are therefore characterized, on one hand, by observables which are insensitive to the anisotropy, and behave as in homogeneous isotropic flows, and on the other hand by quantities which are sensitive to the anisotropy.

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