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Intermediate scaling for streamwise mean velocity and variance in a turbulent boundary layer[1] SOURABH DIWAN, Indian Institute of Science, Bangalore, JONATHAN MORRISON, Imperial College London — In this work, we use an intermediate length scale (y_m^+) proportional to the square root of friction Reynolds number and an associated velocity scale (u_m) to scale the streamwise mean velocity and variance in the intermediate region of a turbulent boundary layer (TBL; Diwan and Morrison TSFP-11, 2019). Towards this we make use of the high-Reynolds-number TBL data available in the literature. The mean velocity is plotted in defect formulation, i.e., $U - U(y_m)/u_m$. The intermediate-scaled mean velocity and variance exhibit Reynolds-number invariance over a certain region around y/y_m =1. This implies existence of a Reynolds-number independent log law in terms of the intermediate variables for the mean velocity and variance. The classical "Karman constant" and "Townsend-Perry constant" are expressed in terms of the log-law constants obtained from the intermediate scaling and their dependence on Reynolds number examined. The present work suggests a three-layer asymptotic structure for the TBL, with each layer governed by distinct length and velocity scales, which results in two overlap layers (Afzal, Ing.-Arch. 1982). We discuss the relevance of the power/log law behavior of the mean velocity in the overlap layers, based on the ratio of the velocity scales of the adjacent layers. .

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