



# Reynolds-number dependence of streamwise velocity variance in wall-bounded turbulent flows

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**摘要:** We propose a model for the streamwise velocity variance in wall-bounded turbulent flows. It hypothesises that the wall-parallel motions of the attached eddies induce internal turbulent boundary layers. The streamwise momentum balance in both outer and inner layers of the internal boundary layers is analysed to obtain the model equations. A logarithmic variance profile is obtained above the (outer) peak. The peak value of the variance scaled using the square of the friction velocity has a logarithmic dependence on the ratio of the wall-normal length (thickness) of the flow to the thickness of the internal boundary layer induced by the largest attached eddies, the latter having a dependence on the friction Reynolds number in the form of a Lambert W function. Both the peak value and the length scale ratio are therefore predicted to be unbounded at asymptotically large Reynolds numbers. The model agrees with the data from the Princeton Superpipe well. %The location of the peak scales with  $\delta_o$ , and therefore moves deeper into the log layer as the Reynolds number increases. The model also predicts that the streamwise velocity fluctuations induced by the attached eddies near the viscous layer scale with the friction velocity; therefore, the contribution from the attached eddies to the scaled velocity variance there remains finite at asymptotically large Reynolds numbers. The finite contribution combined with the recent results of Chen and Sreenivasan (2021) indicates that the viscous scaled inner peak is bounded. A double logarithmic variance profile between the viscous layer and the outer peak location is predicted.

**报告人简介:** Dr. Chenning Tong received his BE and ME from BIAA in 1983 and 1986 respectively, and his Ph.D. from Cornell University in 1995. He was a Research Associate at Penn State University from 1995-1999. He then joined Clemson University in 1999 and is a Professor in Mechanical Engineering. His research interests are in the broad areas of turbulence, including turbulent boundary layers, atmospheric turbulence, Rayleigh-Benard convection, turbulent mixing, turbulent combustion, and small-scale turbulence. His current research includes both theoretical and experimental investigations.

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