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Mean-Velocity Profile of Turbulent Boundary Layers Approaching Separation THOMAS INDINGER, Technische Universität München, Germany, MATTHIAS H. BUSCHMANN, Technische Universität Dresden, Germany, MOHAMED GAD-EL-HAK, Virginia Commonwealth University, U.S.A. — Turbulent boundary layers approaching separation are a common flow situation in many technical applications. Numerous theoretical, experimental and numerical attempts have been made to find the proper scaling for the mean-velocity profile of this type of wall-bounded flow. However, none of these approaches seems to be completely satisfactory, and controversy still persists regarding the behavior of the mean velocity profile of turbulent boundary layers approaching separation. In this talk, we present new water-tunnel experiments of adverse-pressure-gradient turbulent boundary layers that clearly show the breakdown of the logarithmic law. Using these data and experimental results from several independent research groups, we analyze the classical scaling for ZPG TBL and the scaling by George & Castillo and Zagarola & Smits for APG TBL. Only the latter can be applied successfully for the outer region of the mean-velocity profile close to separation. It is shown that Zagarola & Smits' scaling is consistent with the classical two-layer approach, and can be applied to collapse the different data. Analyzing the Reynolds shear stress, the George & Castillo's scaling shows a reasonably good collapse of the data in the outer region.

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