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Effect of the outer laminar flow on zero-pressure-gradient turbulent boundary layers[1] YOSHINORI MIZUNO, CALLUM ATKINSON, JULIO SORIA — This study examines the effect of the invasion of the laminar flow on zero-pressure-gradient turbulent boundary layers by using direct numerical simulations, comparing with channel flows for comparable Reynolds numbers around $\delta^+ = 600$, where δ is the boundary layer thickness and $^+$ stands for normalization by a wall-unit. The turbulent/non-turbulent boundary is captured in an appropriate way, and the transitional layer, often called viscous (or laminar) superlayer, is defined. The distribution of the position of the boundary is represented well by the Gaussian distribution function of the wall-distance, and the mean and standard deviation are found to be approximately 0.9δ and 0.15δ, respectively. A clear gap in turbulence intensities is observed within this layer, and enstrophy and dissipation rate are locally enhanced by the strong shear in the turbulence-side of this layer. The thickness of the viscous superlayer is found to be in the order of the Kolmogorov's length as found in previous works, but it is also found that it becomes thinner as moving away from the wall. The enhancement of enstrophy and dissipation rate is more significant at higher positions.

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