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On the near-wall vortical structures at high Reynolds numbers PHILIPP SCHLATTER, RAMIS ORLU, QIANG LI, Linne FLOW Centre, KTH Mechanics, FAZLE HUSSAIN, University of Houston, DAN HENNINGSON, Linne FLOW Centre, KTH Mechanics — A recent database from direct numerical simulation (DNS) of a turbulent boundary layer (TBL) up to $Re_\theta = 4300$ has been analysed to educe the dominant flow structures in the near-wall region. In particular, the question of whether hairpin vortices are significant features of TBL is addressed. It is shown that during the initial phase of laminar-turbulent transition induced via tripping, hairpin vortices evolving from transitional vortices are numerous, and can certainly be considered as the dominant structure of the immediate post-transition stage of a boundary layer. This is in agreement with previous experiments and various low Reynolds-number simulations. At sufficient distances farther downstream from transition, the flow is dominated by a staggered array of quasi-streamwise vortices which are the same as observed in channel flow studies. It turns out that even quantitatively, no major differences between boundary layers and channels can be detected. The present results confirm that there is i) no reason why transitional hairpin vortices should persist in the fully developed turbulent region, ii) that the regeneration process does not involve hairpin vortices, and iii) that their dominant appearance as instantaneous outer structures is unlikely.

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