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Population Trends of Small-Scale Spanwise Vortices in Wall Turbulence Y. WU, K.T. CHRISTENSEN, Mechanical and Industrial Engineering Dept., Univ. of Illinois at Urbana-Champaign — The population trends of prograde and retrograde (counter to the sense of the mean shear) spanwise vortex cores are studied via detailed PIV measurements in the streamwise–wall-normal plane of turbulent channel flow at $\mathrm{Re}_\tau = 566, 1184$ and 1759 and in a zero-pressure-gradient turbulent boundary layer at $\delta^+ = 1401$ and 2347. A vortex extraction algorithm is used to isolate individual small-scale spanwise vortex cores from the background turbulence and the population trends of these vortices are studied as a function of Reynolds number and wall-normal position in both flows. Substantial numbers of prograde spanwise vortices with structural signatures consistent with the heads of hairpin-like vortices are found to populate the inner boundary of the log layer. In addition, a significant number of retrograde vortices also exist, sometimes appearing as isolated structures but often forming counter-rotating vortex pairs with the remaining prograde vortices. Retrograde vortices are found to be most prominent near the outer edge of the log layer of both turbulent channel flow and the turbulent boundary layer, indicating that they may be generated locally within the log layer, advected into this region from more-distant wall-normal locations, and/or may be the byproduct of vortex merging. Of particular significance is the observation that the fractions of prograde and retrograde spanwise vortices collapse irrespective of Reynolds-number and flow in the log layer of wall turbulence.

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