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Spatial signatures of retrograde spanwise vortices in wall turbulence. (English)

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Summary: The spatial signatures of retrograde spanwise vortices in wall turbulence are assessed from particle-image velocimetry measurements in the streamwise–wall-normal plane of a zero-pressure-gradient turbulent boundary layer at $Re_\tau \equiv u_*\delta/\nu = 2350$. The present results suggest that a proportion of retrograde spanwise vortices have a well-defined spatial relationship with neighbouring prograde vortices. Two-point cross-correlations and conditionally averaged velocity fields given a retrograde vortex reveal that such structures are typically oriented either upstream of and below or downstream of and above a prograde core. While these pairings are consistent with the typical-eddy patterns reported by *R. E. Falco* [*Philos. Trans. R. Soc. Lond., Ser. A* 336, No. 1641, 103–129 (1991; Zbl 0731.76035)], we offer an alternative interpretation for a proportion of these retrograde/prograde pairs. In particular, the arrangement of a retrograde spanwise vortex upstream of and below a prograde core is also consistent with the spatial signature revealed if an omega-shaped hairpin structure were sliced through its shoulder region by a fixed streamwise–wall-normal measurement plane.

MSC:

76–05 Experimental work for problems pertaining to fluid mechanics

76F40 Turbulent boundary layers

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