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Experimental study of the interaction between the horseshoe system and the vortex shedding of a wall-mounted rectangular cylinder MOUHAMMAD EL HASSAN, ROBERT MARTINUZZI, University of Calgary — The interaction between the horseshoe vortex system (HVS) and the shedding of large-scale vortical structures of a wall-mounted rectangular cylinder (height-to-width ratio h/d = 4) is investigated experimentally for both a canonical and a perturbed boundary layers (δ/h = 0.18 and 0.64, respectively). The Reynolds number is $\mathrm{Re}_d = 12000$. The 3D flow is reconstructed from uncorrelated 2D snapshots of time-resolved Particle Image Velocimetry data, using proper orthogonal decomposition, a phase-averaging technique and symmetry/antisymmetry decomposition of the flow. It is found that the dynamics of the HVS affects the topology of the vortex shedding near the wall, particularly for the thicker boundary layer. The back-flow and the zero-flow modes of the HVS have particular influence on the symmetry of the horseshoe legs and its momentum content. The orientation and the momentum content of the horseshoe legs can result in the bend of the shedding vortices towards the cylinder back wall. An interaction between the tip and the junction flows is also observed just downstream from the obstacle. A downwash mechanism and a like eruption process are evidenced for the natural boundary layer whether a strong upwash dominate the tip-junction interaction for the thicker boundary layer.

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