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Self-similarity of the large-scale motions in turbulent pipe flow[1]
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Townsend's attached eddy hypothesis assumes the existence of a set of energetic and geometrically self-similar eddies in the logarithmic layer in wall-bounded turbulent flows. These eddies can be completely scaled with the distance from their center to the wall. We performed stereo PIV measurements together with a proper orthogonal decomposition (POD) analysis, to address the self-similarity of the energetic motions, or eddies, in fully-developed turbulent pipe flow. The resulting modes/eddies, extracted at $Re_\tau = 2460$, show a self-similar behavior for eddies with wall-normal length scales spanning a decade. This single length scale provides a complete description of the cross-sectional shape of the self-similar eddies.

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