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Symmetries, multistability and stochastic dynamics of turbulent wakes GEORGIOS RIGAS, AIMEE MORGANS, JONATHAN MORRISON, Imperial College — The dynamics of a turbulent wake generated behind a bluff three-dimensional axisymmetric body are investigated experimentally at a diameter based Reynolds number $\sim 2 \times 10^5$. Proper orthogonal decomposition of base pressure measurements indicates that the most energetic coherent structures retain the structure of the symmetry-breaking laminar instabilities and manifest as unsteady vortex shedding with azimuthal wavenumber $m = \pm 1$. In a rotating reference frame, the wake preserves the reflectional symmetry, as observed in the laminar and transitional regimes. Due to a slow and random rotation of the symmetry plane around the axis of the body, the turbulent wake explores an infinite number of metastable states and statistical axisymmetry is recovered in the time average. A simple dynamical model, where the deterministic part describes the broken symmetries of the flow and the stochastic part accounts for the incoherent fluctuations, shows excellent agreement with the experimental results for the spatiotemporal evolution of the turbulent wake. Finally, we show how these models can be obtained directly from the governing Navier-Stokes equations.

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