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Organization and dynamics of the large-scale motions of turbulent Rayleigh-Bénard Convection in a cylindrical domain with a moderate aspect ratio.[1] YULIA PEET, Arizona State University, PHILIP SAKIEVICH, Sandia National Labs, RONALD ADRIAN, Arizona State University — At high Rayleigh numbers in moderate aspect-ratio cylindrical domains turbulent Rayleigh-Béenard convection (RBC) exhibits coherent large-scale motions that organize themselves into a collection of three-dimensional "roll cells". The current study presents a relatively long, on the order of 3000 free fall time units (or 100 eddy turnovers), Direct Numerical Simulation of the RBC in a cylindrical domain with a 6.3 aspect ratio and the Rayleigh number of $9.6\text{x}10^7$. The study shows that the spatial organization of the roll cells in the investigated domain can be well described by the azimuthal Fourier modes. A hub-and-spoke mode-3 pattern first emerges and dominates the flow for the first 20 eddy turnovers, which then transitions into a mode-2 pattern that persists for the remainder of the simulations. A spatial inhomogeneity of the observed mode-3 and mode-2 structures is investigated. A conclusion follows that the cylindrical geometry constraint applies a "squeezing" effect to the large-scale structures, which forces them to align with a strong azimuthal periodicity.

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