Abstract Submitted
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A Laboratory Study of Vortical Structures in Rotating Convection Plumes[1] HAO FU, SHIWEI SUN, YUAN WANG, BOWEN ZHOU, None, THERMAL TURBULENCE RESEARCH TEAM[2] — A laboratory study of the columnar vortex structure in rotating Rayleigh-Bénard convection is conducted. A rectangular water tank is uniformly heated from below and cooled from above, with $Ra = (6.35 \pm 0.77) \times 10^7$, $Ta = 9.84 \times 10^7$, Pr = 7.34. The columnar vortices are vertically aligned and quasi steady. Two 2D PIV systems were used to measure velocity field. One system performs horizontal scans at 9 different heights every 13.6s, covering 62% of the total depth. The other system scans vertically to obtain the vertical velocity profile. The measured vertical vorticity profiles of most vortices are quasi-linear with height while the vertical velocities are nearly uniform with only a small curvature. A simple model to deduce vertical velocity profile from vertical vorticity profile is proposed. Under quasi-steady and axisymmetric conditions, a "vortex core" assumption is introduced to simplify vertical vorticity equation. A linear ODE about vertical velocity is obtained whenever a vertical vorticity profile is given and solved with experimental data as input. The result is approximately in agreement with the measurement.

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