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Combining PIV and LDA to study 3D instabilities in rotating flows JENS SORENSEN, ROBERT MIKKELSEN, Technical University of Denmark, IGOR NAUMOV, Sibirian branch of RAS — The swirling flow between a rotating lid and a stationary cylinder is studied experimentally. The flow is governed by two parameters: The ratio of container height to disk radius, h, and the Reynolds number, Re, based on the disk angular velocity, cylinder radius and kinematic viscosity of the working liquid. For the first time the onset of three-dimensional flow behavior is measured by combining the high spatial resolution of Particle Image Velocimetry (PIV) and the temporal accuracy of Laser Doppler Anemometry (LDA). A detailed mapping of the transition scenario from steady and axisymmetric flow to unsteady and non-axisymmetric flow is investigated for h-values in the range from 1 to 3.5. The flow is characterized by the generation of azimuthal modes of different wave numbers. A range of different modes is detected and critical Reynolds numbers and associated frequencies are identified. The results are compared to previous numerical stability analyses. In most cases the measured onset of three-dimensionality is in good agreement with the numerical results and disagreements can be explained by bifurcations not accounted for by the stability analysis. For h=3.4 the experiment revealed the existence of a stable triplet that may explain the steady behavior of the k= 3 mode observed in previous computations.

Jens Sorensen
Technical University of Denmark

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