Experimental study of fluid flows in a precessing cylindrical annulus

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The flow inside a precessing fluid cavity has been given particular attention since the end of the 19th century in geophysical and industrial context. The present study aims at shedding light on the underlying mechanisms by which the flow inside a precessing annular channel transits from laminar to multiple scale complex structures. We address this problem experimentally using a Ultrasonic Doppler Velocimetry to diagnose the fluid velocity. At low precession rates, the flow can be described as a superimposition of forced inertial modes. Above a critical value of the precession rate, the forced mode couples with two free inertial modes, leading to the classical growth and collapse of triadic resonances. Using the Bayesian parameter estimation, we precisely extract the wavenumber, frequency, growth rate and amplitude of each mode involved in the instability. In some cases, we observe two pairs of free modes in triadic resonance with the forced mode that coexist. The selection of free modes depends on viscous effect and frequency detuning effect. The amplitude of the forced mode is constant during the growth phase and collapse phase which indicates that the free modes draw energy from the background rotation instead of the forced mode.