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On a possible mechanism for the generation of cyclonic vortices regime in a precessing cylindrical container WALEED MOUHALI, ECE Paris NanoLab, THIERRY LEHNER, Luth Observatoire Paris Meudon, ATER COLLABORATION — We report experimental observations obtained by particle image velocimetry of the behavior of a flow driven by rotation and precession in a cylindrical container. This study is motivated by dynamo effect and geophysics applications. Precessional motion forces inertial waves whose amplitude are predicted by a linear inviscid theory. But, various flow regimes are identified experimentally according to the value of the control parameter ε the precession rate : the ratio of the precession frequency Ω_{P} to the rotation frequency Ω_{R} ($\varepsilon = \frac{\Omega_P}{\Omega_R}$). When ε is increased from small values, after a linear regime, we have observed a differential rotation followed by the apparition of four permanent cyclonic vortices as a consequence of instability (eruption of jets from the lateral edges of the cylinder). We propose a mechanism for this instability based on a precedent study : we have proved that the nonlinear mode coupling of two inertial waves of azimuthal wave number $m = 0$ and $m = 1$ (mode forced by the precession) in the inviscid regime creates differential rotation also observed experimentally at small ε. The profile of the azimuthal mean velocity and the corresponding axial mean vorticity both show an inflexion point in their radial profile. We show that when the control parameter ε is increased from low values, the forced mode $m = 1$ can become instable in this induced differential rotation. It could be responsible for the observed instability and for the cyclones formation within the volume after a subsequent Kelvin-Helmholtz type instability.

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