Abstract Submitted for the DFD07 Meeting of The American Physical Society

Rotating fluid cylinder submitted to a weak precession<sup>1</sup> CHRISTOPHE ELOY, PATRICE MEUNIER, ROMAIN LAGRANGE, IRPHE, FRANCOIS NADAL, CEA CESTA, IRPHE, MARSEILLE, FRANCE TEAM, CEA CESTA, FRANCE TEAM — We address experimentally and theoretically the flow inside a rotating cylinder subject to a weak precession. PIV measurements have revealed the instantaneous structure of the flow and confirmed that it is a sum of Kelvin modes forced by the precession. A linear inviscid approach predicts that the amplitude of a Kelvin mode diverges when its natural frequency resonates with the precession frequency. In this case a viscous and weakly nonlinear theory has been developed to predict correctly the finite mode amplitude. This theory has been compared to the experimental results and shows a good quantitative agreement. For low Reynolds numbers, the mode amplitude is shown to scale as the square root of the Reynolds number. When the Reynolds number is increased, the amplitude saturates at a value which scales as the precession angle power one third. A geostrophic (axisymmetric) mode is also forced as it has been observed and measured in the experiments. These results allow to fully characterize the flow inside a precessing cylinder in all regimes as long as there is no instability.

<sup>1</sup>This study was funded by the contract CEA-CNRS 004746.

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Date submitted: 17 Jul 2007

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