Instability of a thin rotating fluid layer

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A fluid submitted to a velocity shear is in general unstable and tends to form a line of discrete vortices which is itself unstable and evolves through vortex pairing events. In 1988, Chomaz et al. have conducted a very elegant experiment to analyse this phenomenon in circular geometry and proposed a simple depth-averaged set of equations to describe it numerically. However, this model could not be justified and the comparison with the experimental results remained only qualitative.

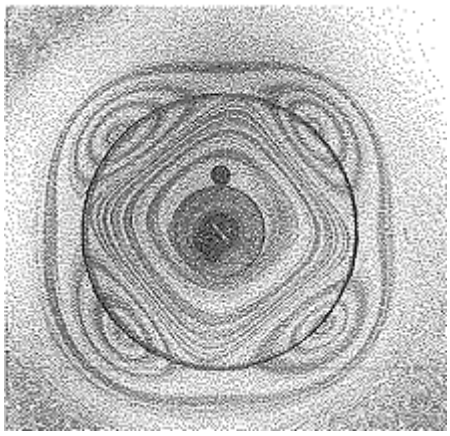

Fig. 1 Instability in a rotating flow (Chomaz et al. 1988)

The main goal of the project is use the actual computational resources to newly address this problem without this limiting hypothesis. To this end, the CFD solver COMSOL will be used. A 2-dimensions/3-components Navier-Stokes solver will be first defined to compute efficiently the base flow. Full 3D simulations will then be run and the obtained nonlinear patterns of vortices compared to the experimental results.

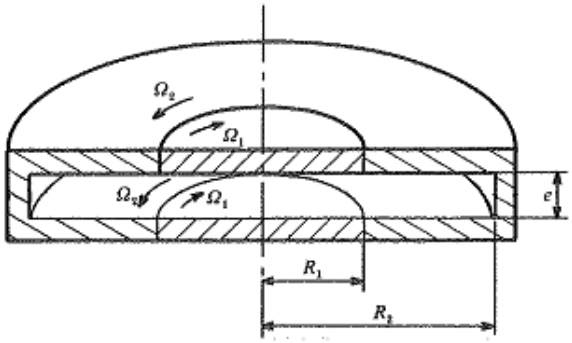

Fig. 2 Sketch of the experimental cell (Chomaz et al. 1988)

References: Chomaz, J.-M., Rabaud M., Basdevant C. and Couder Y., Investigation of a forced circular shear layer, *J. Fluid Mech*., **187**, 1988, 115-140.