Boundary condition influence on instabilities in a low Reynolds free surface rotating flow

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- Fixed cylindrical cavity of radius R
- Rotating disc at the bottom
- Filled with a height h of water or water/glycerol mixture

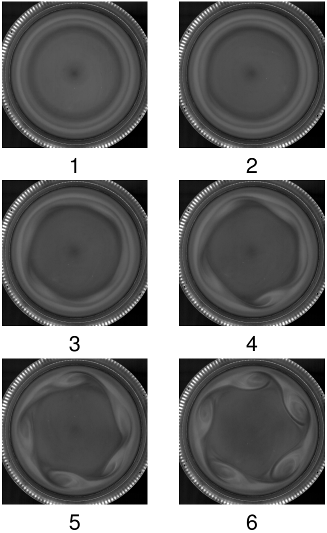
  $\Rightarrow$ Aspect ratio $G = \frac{h}{R}$
- Free surface at the top
- Low rotation speed Ω

  $\Rightarrow$ Small Reynolds number

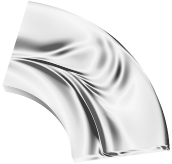
  $Re = \frac{h^2\Omega}{\nu}$

  $\Rightarrow$ Small Froude number

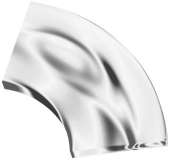
  $Fr = \frac{R\Omega^2}{g} \ll 1$



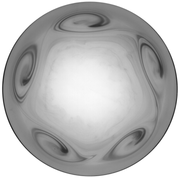
$h = 10$mm, $\Omega = 8$rpm, water + Kalliroscope, $Re = 84$ ($> Re_{c_{XP}}$).



Free Surface, 1st branch



New boundary condition, 2nd branch



Experimental Result

⇒ Huge discrepancies on critical Reynolds number

⇒ “Free surface” is maybe too ideal to modelize the experimental boundary condition at the top.

- New α weighted Robin condition :

  $0 = \alpha * V_{r_{surf}} + (1 - \alpha) * \omega_{surf}$

  ⇒ Highlighting a new instable branch

  ⇒ Qualitatively much more satisfying numerical visualizations

  ⇒ Numerical critical Reynolds number divided by two

Thanks for your attention.

For any question, remark or discussion, come meet me near this poster ⇒