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Patterns between Two Rotating Disks

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FIG. 1.

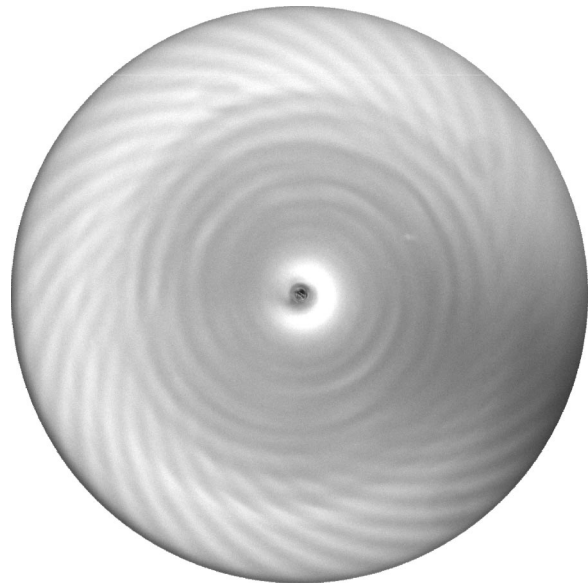


FIG. 2.

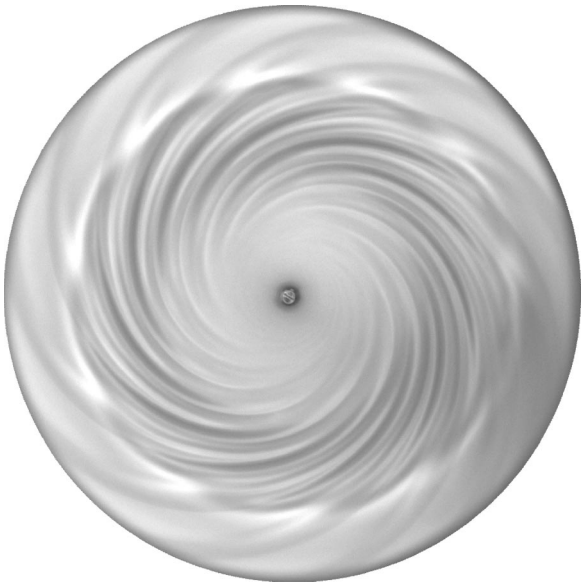


FIG. 3.

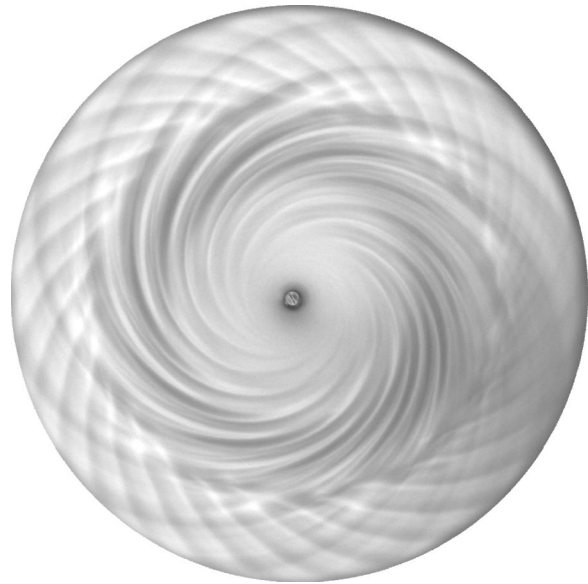


FIG. 4.

Patterns between Two Rotating Disks

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These pictures show the instabilities of the flow between two rotating disks enclosed by a cylinder. The disks, 28 cm in diameter, are 7 mm apart. The fluid is a mixture of water and glycerol, seeded with anisotropic flakes to allow visualization. The Reynolds number (built with the gap thickness) ranges typically from 10 to 200 for these pictures. When the disks rotate in the same direction, or in low counter-rotation, we first observe circles¹ (Fig. 1) propagating towards the

center. Increasing the disk velocities, we see a spiral pattern (Fig. 2), rotating in the direction of the disks (here clockwise). These two patterns are due to boundary layer instabilities. When the disks rotate in opposite direction, another spiral pattern slowly appears (Fig. 3), which fills the whole gap.² This new pattern arises through a super-critical bifurcation. Increasing the Reynolds number, the two spiral patterns can coexist (Fig. 4).

¹G. Gauthier, P. Gondret, and M. Rabaud, "Axisymmetric propagating vortices in the flow between a stationary and a rotating disk enclosed by a cylinder," *J. Fluid Mech.* **386**, 105 (1999).

²G. Gauthier, P. Gondret, F. Moisy, and M. Rabaud, "Instabilities in the flow between co- and counter-rotating disks," *J. Fluid Mech.* (under consideration for publication).