Abstract Submitted
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A thin-walled Taylor column surrounding a bathtub vortex in rotating tank.[1] CHIN-CHOU CHU, KUAN-RUEI LAI, YIN-CHUNG CHEN, CHIEN-CHENG CHANG, Institute of Applied Mechanics, National Taiwan University, VORTEX DYNAMICS TEAM — Numerical simulations and laboratory experiments were jointly conducted to investigate a bathtub vortex under the influence of a protruding cylinder in a rotating tank. The flow pattern depends on Rossby number ($Ro = U/fR$), Ekman number ($Ek = \nu/fR^2$), and height ratio, h/H, where R is the radius of the cylinder, f the Coriolis parameter, ν the kinematic viscosity of the fluid, h the vertical length of the cylinder and H the height of the tank. Steady-state solutions obtained by numerically solving the Navier-Stokes equations in the rotating frame are shown to have good agreements with flow visualizations measurements. The bathtub vortex exhibits an interesting two-celled structure with an inner Ekman pumping and an outer up-drafting motion. The two regions of up-drafting motion are separated by a notable finite-thickness structure, identified as thin-walled Taylor column. The Taylor column sets a barrier to the fluid flow that flows into the inner region only through the narrow gaps, one above the Taylor column and one beneath it. Moreover, the dependence of thickness and height of the thin-walled Taylor column on angular velocity ratio of cylinder to background rotation (ω/Ω), ranging from -8/3 to 8/3 are also discussed.

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