

## Regimes of solutions of an axisymmetric flow in a cylindrical tank with a rotating bottom

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Non-axisymmetric flows are often observed even in axisymmetric environments in the terrestrial and planetary atmospheres. Such a non-axisymmetry is realized in a simple laboratory experiment using a cylindrical container which is filled with water driven by a rapidly-rotating disk at the bottom. We have been reported on the results of the experiments. When we investigate the mechanism of these phenomena, the solution of the axisymmetric flow realized under this condition is necessary, and we reported last year the expression of the analytical solution obtained using boundary layer theories.

We investigated the features of this analytical solution precisely and extracted some features related to its stability. Applying the solution to the situation with water free surface, we can classify the realized axisymmetric flow into three regimes: (i) Cases where all part of the bottom disk is covered with water and it is divided into inner rigid-body rotation region and outer region with constant angular momentum (ii) Cases where the water exposes the center part of the bottom disk air and the water is divided into inner rigid-body rotation region and outer region with constant angular momentum, and (iii) Cases where the water exposes the center part of the bottom disk air and all the water keeps constant angular momentum. Applying the analytical solution, we elucidated the parameter dependence of the transition between these regimes. Each regime has different characteristic waves, which affects crucially the stability of the flow.

Moreover, in the boundary layer along the side wall, transverse velocity distribution has a jet like structure, which forms negative vorticity gradient region. It is also an important factor which may cause critical layer instability.

Keywords: rotating flow, symmetry breaking, boundary layer, axisymmetric flow, stability