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Viscous Vertical Length Scale Selection in Stratified Fluids

Ramiro Godoy-Diana, Jean-Marc Chomaz, Paul Billant

LadHyX, CNRS-École Polytechnique, France

The evolution of pancake dipoles of different aspect ratios is studied in a stratified tank experiment. When the vertical Reynolds number is large enough, the vertical size of the dipole is shown to decrease whereas its horizontal circulation is conserved. This decrease of the dipole thickness is due to the peeling off of two boundary layers, on top and bottom of the dipole, where the fluid is slowed down by viscosity. The thickness of the dipole diminishes until a viscous length scale δ, defined by the vertical size of these boundary layers, is reached. Viscosity is therefore responsible for a fast vertical decorrelation of the flow. The mechanism that we evidence may play a significant role in the determination of the vertical length scale in strongly stratified flows.

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