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3D Structure and Internal Circulation of Pancake Vortices in Rotating Stratified Flows PEDRAM HASSANZADEH, PHILIP MARCUS, UC Berkeley, ORIANE AUBERT, MICHAEL LE BARS, PATRICE LE GAL, IRPHE, France — Jovian vortices, Atlantic meddies, and vortices of the protoplanetrary disks are examples of weakly-forced or unforced long-lived vortices in rotating stratified flows. Knowing the 3D structure and internal circulation of these vortices is essential in understanding their physics, which is not well-understood. For example, the aspect ratio of these vortices has been long thought to be f/N where f is the Coriolis parameter and N is the Brunt-Vaisala frequency. However, our recent theoretical and experimental study has shown that the aspect ratio in fact depends not only on f and N but also on the Rossby number and density mixing inside the vortex. The new scaling law also agrees with the available measurements of the meddies and Jupiter's Great Red Spot. High resolution 3D numerical simulations of the Navier-Stokes equation are carried out to confirm this new scaling law for a slowly (viscously) decaying anticyclonic vortex in which the Rossby number and stratification inside the vortex evolve in time. For a wide range of parameters and different distributions of density anomaly, the secondary circulations within the vortices are studied. The effect of a non-uniform background stratification is investigated, and the small cyclonic vortices that form above and below the anticyclone are studied.

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