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Universal scaling law for the aspect ratio of a pancake vortex in a rotating stratified medium ORIANE AUBERT, MICHAEL LE BARS, PATRICE LE GAL, IRPHE, France, PHILIP S. MARCUS, UC Berkeley — The Great Red Spot of Jupiter and the meddies in the Atlantic Ocean are the most famous and puzzling examples of long-lived pancake like anticyclones that take place in a rotating and stably stratified medium. To reproduce and study these vortices in the laboratory, we inject a volume of isodensity dyed fluid in a rotating linearly stratified layer of salt water. Due to the Coriolis force, the injected fluid rapidly forms a pancake vortex whose long term evolution is quantified using PIV measurements and image processing. Three different phases take place: a fast geostrophic adjustment, an axisymmetrization by viscous coupling with the outside and finally a very slow decrease of the motion while preserving the self-similar shape of the vortex. This last regime can be described using a simplified system of equations based on a geostrophic equilibrium, where the energy source maintaining the long-lived vortex is the density anomaly with the outside: the vortex persists as long as the density anomaly remains, maintained by internal recirculations. The non-diffusive version of the equations gives an analytical solution for the self-similar shape of the vortex and the evolution law for the aspect ratio for small Rossby numbers. These theoretical predictions are verified experimentally and also agree with published measurements for the meddies and Jupiter's Great Red Spot.

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