Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Stratified Flows with Vertical Layering of Density: Theoretical and Experimental Study of the Time Evolution of Flow Configurations and their Stability[1] MATTHEW MOORE, Courant Institute of Mathematical Sciences, ROBERTO CAMASSA, DAVID HENDEL, RICHARD M. MCLAUGHLIN, MARSHALL NEWMAN, University of North Carolina Chapel Hill, KUAI YU, North Carolina State University, UNC RTG FLUIDS GROUP TEAM — A vertically moving boundary in a stratified fluid can create and maintain a horizontal density gradient or vertical layering of density. Such a flow is created experimentally by towing a narrow fiber upwards through an initially stable stratification, as a layer of heavier fluid entrained by the fiber forms a vertical column. We develop a lubrication model to predict the time evolution which shows close agreement with the experiment. We perform stability analysis on a class of vertically layered shear flows and find a critical length-scale for the size of the entrained layer, below which the flow is stable and above which the flow is unstable. The bifurcation behavior is independent of the Reynolds number. Flows with unstable layer sizes have been created experimentally, however the small amplification rates prevent the instabilities from being observed.

[1]NSF RTG grant: DMS-0502266

Matthew Moore
Courant Institute of Mathematical Sciences

Date submitted: 08 Sep 2010 Electronic form version 1.4