Experimental Investigation of the Stability of a Stratified Fluid Flow Involving a Horizontal Gradient of Density[1] MARSHALL NEWMAN, MATTHEW MOORE, RICH MCLAUGHLIN, ROBERTO CAMASSA, KUAI YU, KEITH GROSE, University of North Carolina - Chapel Hill, UNC RTG FLUIDS GROUP TEAM — A vertically moving boundary in stratified fluid can create and maintain a horizontal density gradient, with greater density fluid adjacent to the moving boundary. We have designed an experiment to study the hydrodynamics of this configuration, whereby the moving boundary consists of a fishing line towed vertically through a stably stratified fluid. A shear boundary layer is observed to develop in the fluid resulting in a horizontal density gradient. We measure the size of the shear layer as a function of the speed at which the line is towed. The hydrodynamic instability of this system manifests itself as an apparent jump in this plot. Consequently, we are able to obtain a critical Reynolds number for the stability of this system. We also compare the layer size-to-speed observations with those obtained from an exact mathematical solution which approximates the geometry of the problem in the axial-symmetric case.

Matthew Moore
University of North Carolina - Chapel Hill

Date submitted: 05 Aug 2008   Electronic form version 1.4