Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

On the Effects of Viscosity and Nonlinearity on Baroclinic Critical Layers MENG WANG, CHUNG-HSIANG JIANG, UC Berkeley, PEDRAM HASSANZADEH, Harvard University, PHILIP MARCUS, UC Berkeley — A new family of baroclinic critical layers in rotating, stably-stratified flows plays a significant role in de-stabilizing shear flows and, in particular, is important in star formation in Keplerian disks (Marcus et al. PRL, 2013). These critical layers are characterized by singularities in their vertical velocities. To understand the critical layers, especially their thicknesses, and to help design future lab experiments that contain these layers, we use matched asymptotic expansions to obtain analytical solutions of the viscous flow in and around the baroclinic critical layers. To verify our solutions and to study the effect of nonlinearity, we also numerically simulate the critical layers produced by tilted vortices in strongly stratified fluids (no rotation, no imposed shear other than that induced by the vortex itself). This problem has been previously studied by Boulanger et al. (2008 JFM) and provides a framework to explore the physics of baroclinic critical layers before adding the complexity of rotation and strong shear.

Meng Wang
UC Berkeley

Date submitted: 31 Jul 2013 Electronic form version 1.4