Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Experiments and numerical simulations of dense-core vortex rings in a sharply stratified environment[1] RICHARD MCLAUGHLIN, ROBERTO CAMASSA, SHILPA KHATRI, KEITH MERTENS, CLAUDIO VIOTTI, University of North Carolina at Chapel Hill, Mathematics — Ambient stratification strongly influences the mixing and dispersion properties of particle dynamics. Much insight can be gained by studying the simplified setup of vortex ring dynamics. We present three dimensional direct numerical simulations of the dynamics for a vortex ring settling in sharply stratified miscible ambient fluids for two layer configurations. These simulations are compared with experiments conducted in the UNC Joint Fluids Lab. The core fluid of the vortex rings has density higher than both the top and bottom layers of the ambient fluid, and is fully miscible in both layers. This setup results in a rich parameter space which we partially present here. In particular, a critical (bifurcation) phenomenon is identified which distinguishes long-time behavior of the falling vortex ring. The ring either fully traps at the ambient density layer, or continues through the layer in its downward motion. This critical behavior is set by initial conditions (e.g., size and speed of the vortex ring, initial distance to the layer, etc.). Detailed comparisons between experiments and simulations for density, velocity, and vorticity fields will be discussed.

[1]This research is supported by NSF RTG DMS-0502266, NSF RTG DMS-0943851, NSF RAPID CBET-1045653, NSF CMG ARC-1025523, NSF DMS-1009750, and ONR DURIP N00014-09-1-0840.

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Date submitted: 03 Aug 2012 Electronic form version 1.4