Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Stratified Vortex Rings: Visualization of the Density Evolution[1]
JASON OLSTHOORN, STUART DALZIEL, University of Cambridge — The study of vortex-ring induced stratified mixing has played a key role in understanding stratified turbulent mixing. In this study, we present an experimental investigation of the mechanical evolution and the stratification-modified three-dimensional instability of these vortex rings. Using a stereoscopic particle image velocimetry setup, we reconstruct a full, three-dimensional, time-resolved velocity field of the interaction of a vortex ring with a stratified interface. This reconstruction agrees with previous two-dimensional studies, while capturing the three-dimensional instabilities of the dynamical evolution. The stratified three-dimensional instability of a vortex ring is similar to the unstratified instability, but here the instability occurs much earlier. Through the use of numerical integration, we use the experimentally determined velocity field to simulate the kinematic evolution of the density stratification. This technique allows us to evaluate the vertical buoyancy flux throughout the vortex-ring interaction, providing a quantitative explanation for the interface sharpening observed within the experiments. Understanding the sharpening mechanism in the context of a vortex ring has direct relevance to understanding the layer formation found in stratified turbulence

[1]NSERC, EPSRC

Jason Olsthoorn
Univ of Cambridge

Date submitted: 01 Aug 2016 Electronic form version 1.4