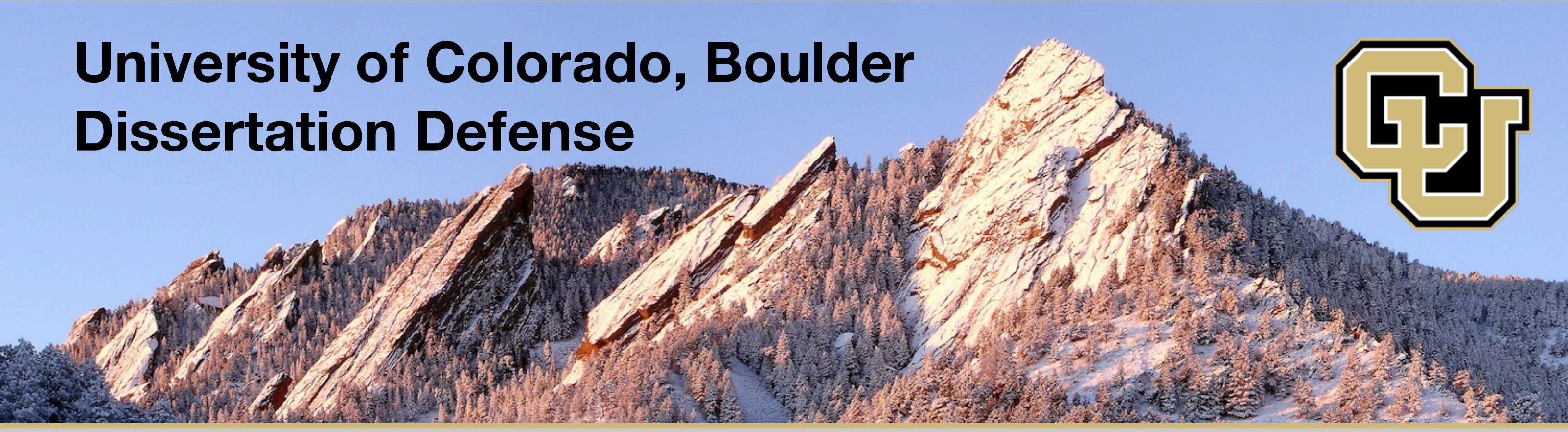

# University of Colorado, Boulder
# Dissertation Defense

Wednesday, December 6, 2017
9:00am-10:00am (refreshments at 8:45am)
UMC Room 247 (University Memorial Center)
University of Colorado, Boulder

## Direct Numerical Simulations of the Compressible Low Atwood Rayleigh-Taylor Instability

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Two fluids are considered Rayleigh-Taylor unstable when the more dense fluid is suspended above the less dense fluid in the presence of a gravitational like accelerative force. When a perturbation is applied to the interface between the two, they begin mixing as the light fluid rises and the heavy fluid drops. The extension of this to the compressible regime leads to the densities of the fluids to not be constant, but instead the molar mass is used to define the weights. At the interface, a density jump still occurs, but away from the interface the densities can vary in a variety of ways. This research investigates the effects of these density changes by imposing an initial background stratification before the initial perturbation is applied. Isothermal, isentropic, and isopycnic initial conditions are imposed for small molar mass differences and the growth of the perturbations are studied through the use of the Parallel Adaptive Wavelet Collocation Method. Strong non-linear interactions lead to the growth and destruction of complex vortical fields resulting in the initial suppression of the instability in all cases. For the isothermal case, this leads to a complete suppression at moderate to high Mach numbers, but for the isentropic and isopycnic case, this initial suppression is overcome and an increased acceleration occurs that grows with the Mach number. To further investigate these interactions, the vorticity transport equation is investigated and modified to give insights into the effects background stratification and fluctuating terms. In addition to this, a comparison is drawn to the simplified case of vortex pairs and rings propagating in the same stratifications. All of these interactions and discoveries have strong implications for understanding the physics governing engineering scenarios such as fuel capsules in inertial confinement fusion, flame front propagation in supernovae, and the mixing of fuels in some specialized burners.

**Biography:** In 2012, Scott earned his Bachelor of Science degree in Physics from Mansfield University of Pennsylvania along with minors in both Applied Mathematics and Philosophy. After a brief stint as a professional brewer, the allure of science could not be ignored anymore. In 2013, he moved to Colorado to join the Multiscale Modeling and Simulation Laboratory to pursue a doctorate in Mechanical Engineering with a focus on doing computational fluid dynamics. To do this, he began investigating the effects of compressibility and stratification on the growth of the Rayleigh-Taylor instability while using the highly innovative numerical technique known as the Adaptive Wavelet Collocation Method. Since then, he has continued to investigate the physics involved with this problem along with other compressible fluid flows all while improving the numerics involved. Through this research, he was able to collaborate with scientists at Los Alamos National Laboratory and worked there as a student researcher for three summers.