Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

The effect of viscosity gradients on the stability of the turbulent round jet RYAN KEEDY, JAMES RILEY, ALBERTO ALISEDA, University of Washington — The effect of viscosity differences between the ambient and injected fluids on a high Reynolds number round jet is poorly understood and has been largely ignored in stability analyses of this canonical shear flow. When viscosity gradients are present at the mixing interface between the two fluids, the jet behavior can be significantly affected. A new set of linear stability equations, which account for differences in jet and ambient viscosities, have been developed to study the growth of spatial disturbances. The equations are shown to reproduce results found in the literature for constant viscosity. Eigenvalue analysis is carried out to evaluate the predicted growth rates and unstable wavelengths as a function of the dominant variables: frequency, momentum thickness, etc. Experimental results obtained in a high Reynolds number (10^5) round jet facility, with a submerged jet issuing vertically in a large, essentially unconfined water tank were compared with the parametric study of the linear stability analysis results. Jet viscosity in our experiments was modified by altering the viscosity of the miscible injected fluid over a range of the viscosity ratio, $\mu_{jet}/\mu_{ambient} > 1$ (by adding glycerol) and $\mu_{jet}/\mu_{ambient} < 1$ (by raising the temperature).

Ryan Keedy
University of Washington

Date submitted: 02 Aug 2013 Electronic form version 1.4