Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Experimental study of scale-dependent droplet clustering in turbulence E.W. SAW, Dept. of Physics, Michigan Tech, R.A. SHAW, Michigan Tech, S. AYYALASOMAYAJULA, Cornell Univ., P.Y. CHUANG, UC Santa Cruz, A. GYLFASON, Z. WARHAFT, Cornell Univ. — To evaluate the dependence of inertial particle clustering on turbulence parameters we have investigated the spatial distribution of particles in laboratory turbulence. The experimental facility is an active-grid wind tunnel, generating approximately homogeneous, isotropic turbulence with R_λ in the range of 300 to 900. Under statistically stationary conditions droplets are injected into the flow and downstream their diameter, longitudinal speed, and time of arrival are measured at a point with a phase Doppler interferometer. The resulting particle pair correlation functions $\eta(r)$ show droplet clustering increasing with decreasing spatial scale r and with increasing Stokes number as expected from theoretical and computational work. Specifically, the particle pair correlation function $\eta(r)$ has a negative power law dependence on r for $r < 10r_k$, where r_k is the Kolmogorov microscale. Furthermore, the power-law exponent increases with the dimensionless droplet Stokes number, defined as $St = (1/18)(\rho_p/\rho)(d/r_k)^2$ for particle diameter d. These experiments at high Reynolds numbers provide a link to geophysical systems where inertial droplet clustering is thought to be of relevance, such as atmospheric clouds and the rate of rain formation.

Raymond Shaw
Michigan Tech

Date submitted: 10 Aug 2005 Electronic form version 1.4