Inertial particle clustering in turbulence: A comparison of experimental results with theory\(^1\) E.W. SAW, R.A. SHAW, Department of Physics, Michigan Technological University, S. AYYALASOMAYAJULA, Z. WARHAFT, Mechanical & Aerospace Engineering, Cornell University — In order to test the validity of recent theoretical and computational (DNS) predictions on inertial particle clustering in turbulence, we have investigated the spatial distribution of particles (water droplets) in high-$R_{\lambda}$ laboratory turbulence. The experimental facility is an active-grid wind tunnel, generating nearly homogeneous and isotropic turbulence with maximum $R_{\lambda} \approx 10^3$. Droplets are sprayed into the flow and downstream their diameter, longitudinal speed, and arrival time are recorded with a phase Doppler interferometer. We calculate pair correlation functions $\eta(r)$ conditioned on droplet diameter $d$, to show how the scale-dependence of clustering changes with Stokes number $(St = (1/18)(\rho_d/\rho)(d/r_k)^2$, where $r_k$ is the Kolmogorov microscale, and $\rho_d$ and $\rho$ are the droplet and air mass densities, respectively). We then compare the scale dependence of the pair correlation functions with various power law relations suggested from previous theoretical work, all of which have the form $\eta(r) \propto (r/r_k)^{-f(St)}$.

\(^1\)Supported by the U.S. National Science Foundation.