Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

A Comparison of Condensation Fog and Wide-Field PIV Measurements in a Mach 5 Turbulent Boundary Layer BULENT YUCEIL, NOEL CLEMENS, DAVID DOLLING, The University of Texas at Austin — Condensation fog planar laser scattering has been used to visualize the structure of supersonic turbulent shear flows. Some previous work at Princeton in a supersonic boundary layer has suggested that the scattering from CO_2 clusters closely reflects the fluctuating density field. However, the relationship between the fog scattering and the velocity field has not been established. In the current study wide-field, side-view PIV measurements of a turbulent boundary layer that develops naturally on the floor of a Mach 5 wind tunnel is performed using three 1k×1k resolution cameras. For the PIV, TiO_2 particles are seeded into the flow, but the particle images also reveal a fog of ice crystals that is formed due to isentropic cooling in the nozzle from the water vapor already present in the flow. This natural fog in the freestream evaporates and disappears in the boundary layer forming a clear demarcation of the boundary layer edge. The interface between the fog and the boundary layer seems to correlate with the instantaneous velocity contours. The measurements suggest that the structures observed with the fog technique are dynamically significant and not just artifacts of an advecting passive scalar. A similar comparison is made in the plan view to visualize the very large-scale coherent structures that have been observed in previous studies at lower Mach number.

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Date submitted: 05 Aug 2008 Electronic form version 1.4