Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Resolving turbulence in hypersonic flows using PIV OWEN WILLIAMS, Princeton University, TUE NGUYEN, Nanyang Technological University, ALEXANDER J. SMITS, Princeton University, Monash University — Measuring turbulence in hypersonic flow using PIV is made difficult by high dynamic range requirements and low flow density, which leads to stringent particle sizing requirements to avoid filtering the turbulent signal. Particle frequency response is usually measured using a strong shock and conventionally taken to be representative of the entire flow. A particle dynamics model is used to demonstrate how measured frequency responses depend on shock strength in hypersonic flow, due to changes in particle drag associated with finite inertia, compressibility and slip. A method is presented to extrapolate freestream shock responses to other positions in the flow with disturbance levels comparable to turbulent motions. This method leads to estimates of the variation in frequency response and Stokes number; highlighting regions of the flow which might suffer from filtering. We will demonstrate practical improvements to particle response and the resulting change in turbulent filtering.

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Date submitted: 02 Aug 2013 Electronic form version 1.4