Abstract Submitted
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Toluene laser-induced fluorescence imaging of compressible flows in an expansion tube[1] V.A. MILLER, M. GAMBA, M.G. MUNGAL, R.K. HANSON, Stanford University, K. MOHRI, C. SCHULZ, University of Duisburg-Essen — Laser-induced fluorescence (LIF) imaging using toluene as a tracer molecule has been developed for high-speed, low-to-moderate enthalpy conditions in the Stanford 6-inch Expansion Tube. The approach is demonstrated on three canonical compressible flow configurations: (i) supersonic flow over a 20 $^\circ$ wedge, (ii) around a cylinder, and (iii) a supersonic boundary layer. Under constant-pressure conditions, toluene LIF offers unique sensitivity to temperature and can therefore be used as an accurate thermometry diagnostic for supersonic flows; on the other hand, for variable-pressure flow fields (e.g., flow around a blunt body), toluene LIF imaging is demonstrated to be an effective flow visualization tool. The three configurations selected demonstrate the diagnostic in these two capacities. For all configurations considered in the study, toluene (0.6% by volume) is seeded into a nitrogen freestream at a Mach number $\sim$ 2.2, T $\sim$ 500K, and p $\sim$ 1.5 bar. A frequency-quadrupled pulsed Nd:YAG laser is used to excite the tracer, and the resulting fluorescence is captured by an ICCD camera. Synthetic fluorescence signals from CFD solutions of each case have been computed and compare favorably to measured signals.

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