Abstract Submitted
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Comparison of a simulated velocity profile of a turbulent boundary layer with measurements obtained by Femtosecond Laser Electronic Excitation Tagging (FLEET)[1] MATTHEW NEW-TOLLEY, YIBIN ZHANG, MIKHAIL SHNEIDER, RICHARD MILES, Princeton University — Accurate velocimetry measurements of turbulent flows are essential for improving our understanding of turbulent phenomena and validating numerical approaches. Femtosecond Laser Electronic Excitation Tagging (FLEET) is an unseeded molecular tagging method for velocimetry measurements in flows which contain nitrogen. A femtosecond laser pulse is used to ionize and dissociate nitrogen molecules within its focal zone. The decaying plasma fluoresces in the visible and infrared spectrum over a period of microseconds which allows the displacement of the tagged region to be photographed to determine velocity. This study compares the experimental and numerical advection of the tagged region in a turbulent boundary layer generated by a supersonic flow over a flat plate. The tagged region in the simulation is approximated as an infinitely thin cylinder while the flow field is generated using the steady state boundary layer equations with an algebraic turbulence model. This approximation is justified by previous computational analyses, using an unsteady three-dimensional Navier-Stokes solver, which indicate that the radial perturbations of the tagged region are negligible compared to its translation.

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