Abstract Submitted
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Characteristics of Spatiotemporally Homogenized Boundary Layers at Atmospheric Reentry-like Conditions[1] RHYS ULERICH, ROBERT MOSER, Univ of Texas, Austin — Turbulent boundary layers approximating those found on the NASA Orion Multi-Purpose Crew Vehicle thermal protection system during atmospheric reentry from the International Space Station have been studied by direct numerical simulation using a "slow growth" spatiotemporal homogenization approach recently developed by Topalian et al. The two data sets generated were $\mathrm{Ma}_e \approx 0.9$ and 1.15 homogenized boundary layers possessing $\mathrm{Re}_\theta \approx 382$ and 531, respectively. Edge-to-wall temperature ratios were approximately 4.15 and wall blowing velocities, $v_w^+ = v_w/u_\tau$, were roughly 8×10^{-3}. The favorable pressure gradients had Pohlhausen parameters between 25 and 42. Nusselt numbers under 22 were observed. Small or negative displacement effects are evident. Near-wall vorticity fluctuations show qualitatively different profiles than observed by Spalart [J. Fluid Mech. 187 (1988)] or Guarini et al. [J. Fluid Mech. 414 (2000)] suggesting that the simulations have atypical structures perhaps as a consequence of wall blowing or the homogenization.

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