Abstract Submitted
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Phase Analysis of Disturbances within Transitional Shock Boundary Layer Interactions.[1] JAMES THREADGILL, JESSE LITTLE, University of Arizona — Two-dimensional laminar/transitional Shock Boundary Layer Interactions (SBLIs) have been investigated to assess the influence of Reynolds number and interaction strength, and to probe unsteadiness mechanisms. SBLIs are induced by various ramps ($15^\circ < \theta < 28^\circ$) mounted to a flat plate in Mach 4 flow ($\mathrm{Re}/L = 4.6\times10^6\ \mathrm{m}^{-1}$) at various locations ($1.2\times10^5 < \mathrm{Re}_x < 2.5\times10^5$). Oil-flow visualization and high-speed schlieren (50 kHz) have been employed to characterize the flow. The naturally laminar incoming boundary layer experiences significant separation within the SBLI ($24 < L/\delta_0 < 40$). Strong SBLIs with high Reynolds numbers initiate transition within the elongated separated shear layer, promoting unsteadiness. Low-frequency separation shock motion is observed, similar to strong turbulent SBLIs ($\mathrm{St}_L \approx 0.03$). This motion is incoherent with all upstream features, supporting claims of a downstream mechanism driving SBLI unsteadiness. Phase analysis shows that the reattachment shock motion precedes the shear layer which precedes the separation shock motion. In addition, an upstream propagating convective density disturbance was identified within the separated flow ($u \approx$ -0.2u_∞) which directly influences subsequent motion of the separation shock. These observations provide vital input when characterizing complex turbulent unsteady SBLI mechanisms.

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