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Perturbation evolution in high-speed flat plate boundary layers: Non-equilibrium pressure-velocity interaction effects BAJRANG SHARMA, SHARATH GIRIMAJI, Texas AM University — In fluid flows, velocity-pressure interactions undergo a marked change with increasing Mach number. In incompressible flows, pressure and velocity fields are always in equilibrium as the former is completely determined in terms of the latter via the Poisson equation. In high speed flows, pressure evolves independently as a thermodynamic variable. As a result, at high Mach numbers, out-of-equilibrium velocity-pressure interactions can significantly affect various flow phenomena. In this work, we use linear stability theory (LST) and direct numerical simulations (DNS) to establish the non-equilibrium effects on perturbation growth in high-speed flat plate boundary layers. DNS of temporally evolving flat plate boundary layers subjected to various initial perturbations are examined in the range Ma= 0.12 - 6. It is demonstrated that non-equilibrium velocity-pressure interactions significantly modify the behaviour from the baseline equilibrium case. The underlying physics is explored and the observed behaviour is explained. The effect of the observed linear behaviour on the subsequent non-linear evolution and the ultimate breakdown to turbulence is discussed.

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