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DNS investigation of late-stage transition in hypersonic channel flow ZHIMIN XIE, SHARATH GIRIMAJI, Texas A&M University — We perform direct numerical simulations (DNS) of normal-mode evolution in hypersonic channel flows to investigate late-stage transition physics. A well-validated compressible flow solver based on Gas-Kinetic Method (GKM) is used in the computations. In this temporal DNS, periodic boundary condition is employed in the streamwise direction and wall conditions at the normal boundaries. The DNS code is first validated against analytical transition (Orr-Sommerfeld) results in the incompressible flow regime. In the compressible regime, the code is validated against homogeneous shear flow rapid distortion theory (RDT) data. Direct numerical simulation of normal modes in laminar channel flow at very high Mach number shows that the evolution exhibits a three-stage behavior similar to that observed in many hypersonic boundary layer experiments and RDT of homogeneous shear flow. The physics associated with each transition stage is investigated in great detail and a physical picture of late-stage transition is proposed.

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