Transition to turbulence by interaction of free-stream and discrete mode perturbations[1] RIKHI BOSE, PAUL DURBIN, None — In this work based on DNS, boundary layer streaks have been induced by free-stream turbulence (FST). The FST is numerically generated following the work of Jacobs & Durbin (J. Fluid Mech., 428, 185, 2001). Modal interaction of FST induced streaks and a 2D TS wave have been noted by invoking the FST and TS wave disturbances at the inlet of the computational domain. For higher turbulence intensity of FST (3.5%), the flow undergoes bypass transition to turbulence as in Durbin & Wu (Ann. Rev. Fluid Mech., 39, 107, 2007). When low intensity FST (1%) and TS wave are specified at inlet, transition is triggered via secondary instability. Secondary instability is instigated by interaction of FST induced streaks and TS wave. The pattern of Λ structures observed in these studies is neither of H or K type transition and depends upon inlet frequency spectrum of FST. Frequencies smaller than the TS wave frequency grow and determine the instantaneous pattern of the secondary instability. The span-wise length scale of the Λ structures have approximately half the size seen in Herbert (Ann. Rev. Fluid Mech., 20, 487, 1988). The evolution of the secondary instability is spontaneous rather than forced by the inlet FST or TS wave disturbances.

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None