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Mixed mode transition in zero and adverse pressure gradient boundary layers[1] RIKHI BOSE, PAUL DURBIN, Iowa State University — Flow regimes exist where interaction of Klebanoff streaks and the Tollmien-Sclichting waves trigger transition but either mode is individually insufficient. Such interaction between orderly and bypass routes of transition is called Mixed mode transition. In zero pressure gradient boundary layers, mixed mode transition follows three routes depending upon strength of these perturbation modes. At high free-stream turbulence intensity (Tu), bypass transition is dominant and the flow is very weakly sensitive to the TS mode strength. In the presence of a strong TS mode, low Tu triggers secondary instability of the TS wave forming Λ vortices. The Λ vortices are forced response due to the weak streaks rather than resonance mechanism seen in monochromatic excitations. When both of these modes are weak, secondary instability of streaks trigger consequent breakdown to turbulent spots. Three-dimensional visualization of the perturbation fields shows toroidal $n = 0$ and helical $n = 1$ modes observed in instability of axisymmetric jets and wakes. In adverese pressure gradient boundary layers, the presence of an inflection point significantly increases the growth rate of TS mode thereby strengthening the secondary instability route and the interaction is more interesting.

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