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Helical mode breakdown in transitional boundary layers[1] RIKHI BOSE, PAUL DURBIN, Iowa State Univ — Results of direct numerical simulation of transition to turbulence in adverse pressure gradient boundary layers beneath free-stream turbulence will be presented. Instability waves are excited spontaneously and may be identified when intensity of free-stream turbulence (Tu) is sufficiently low. At very low $Tu \sim 0.1\%$, secondary instability of the TS waves and at high $Tu > 2\%$, conventional bypass mechanisms trigger turbulent spot formation. At low $Tu \sim 1\%$ transition proceeds through formation of helical modes. Helical structures as in $n = 1$ instability modes of axisymmetric wakes and jets are clearly identifiable in visualizations of isosurfaces of stream-wise perturbation velocity. Helical modes also trigger transition at same level of Tu in zero pressure gradient boundary layers as well, provided that the inlet disturbances include a low amplitude time-periodic unstable TS wave. This indicates that these secondary instability modes might arise due to interaction of Klebanoff streaks and instability waves. Characteristically, the helical modes are inner instability modes.

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