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Stability of axisymmetric boundary layers: Effects of transverse curvature VINOD NARAYANAN, Dept. of Mechanical Engineering, University of California, Santa Barbara, RAMA GOVINDARAJAN, Engineering Mechanics Unit, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India — We investigate the stability of laminar boundary layer on an axisymmetric cylinder steadily translating through a fluid in a direction parallel to its axis. The aim is to study the effects of transverse curvature on instability and transition. Squire's theorem does not apply and non-axisymmetric modes are found to be unstable at the lowest Reynolds number. In an extension of Rayleigh's and Fjortoft's theorem to axisymmetric boundary layers, the present case is shown to be inviscidly stable. The helical (n=1) mode is unstable over a significant axial extent of the cylinder, but is stable for curvatures above some critical value. Higher non-axisymmetric modes are linearly unstable only for very small range of curvatures. Here the curvature is defined as the ratio of momentum thickness to the body radius. Overall there is a stabilizing effect due to transverse curvature. A secondary instability analysis of the flow shows that secondary modes remain unstable at curvatures for which the linear modes are stable. However there is a maximum curvature, above which all disturbances decay. It is found that the most unstable secondary modes are always subharmonic and those whose azimuthal wavenumbers (m+ and m-) are related to that of the linear mode (n) by m+=2n and m-=-n.

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