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Boundary-layer transition over aerodynamically-significant rotating bodies STEPHEN GARRETT, ZAHIR HUSSAIN, ALISTAIR BARROW, PAUL TOWERS, University of Leicester — For practical reasons rotating-disk flow has served as the foremost model problem for studying transition in fully 3D incompressible boundary layers for over six decades and has a huge body of associated literature. However, continuing developments in spinning projectiles and aeroengines has led to the need to understand the onset of transition over rotating cones and spheroids as objects in their own right. Although numerous experimental observations have been published, these geometries received only little theoretical attention prior to 2002 when Garrett and co-workers commenced their work. In this paper we give a comparative study of the instability characteristics of the flows over these distinct geometries, discussing their similarities and differences with each other and the rotating-disk paradigm. The rotating-cone flow in particular is found to demonstrate significantly different characteristics as the half-angle is reduced below 40degs. This observation has led to the hypothesis and ultimate identification of an alternative instability mode which is expected to dominate for slender cones. Theoretical studies using numerical and asymptotic techniques are discussed. Comparisons are made to existing experimental data, and in many cases excellent agreement is observed for measurable properties. Where close agreement is not seen, we discuss possible reasons why.

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