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How many unstable modes are in high-speed boundary layers?[1]
ALEXANDER FEDOROV, Moscow Institute of Physics and Technology, ANATOLI TUMIN, The University of Arizona — L. Mack (1969) carried out the inviscid stability analysis of high-speed boundary layers, and he found that in addition to the unstable mode having a viscous nature, there are other unstable discrete modes associated with acoustic perturbations "trapped" inside the boundary layer. In contemporary stability analysis of high-speed boundary layers at finite Reynolds numbers, two discrete modes are identified: the 1st and 2nd modes. However, at high Mach numbers and finite Reynolds numbers, the discrete spectrum of normal modes has only one eigenvalue that is meandering in the complex plane (the wave number or the frequency, depending on the stability framework) that corresponds to an unstable perturbation. In the present work, we illustrate how the synchronism and branching of discrete modes can lead to a spectrum with one or two unstable discrete normal modes. One has to be aware of this phenomenon and to keep in mind the ambiguity associated with the terminology of the "1st mode" and "2nd mode."

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