

# Effect of Bluntness on Hypersonic Blunt Cone Boundary Layer Stability Postprint

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## Abstract

Direct numerical simulation was employed to compute the basic flows of blunt cones with eight different nose radii, and linear stability theory was utilized to analyze the influence of bluntness on boundary-layer stability. The results indicate that as bluntness increases, the unstable region within the boundary layer shifts downstream, and the maximum growth rate of the second mode decreases. Building upon the linear stability analysis, the evolution of non-linear disturbances and the effect of mean flow correction on stability were investigated. The results demonstrate that after introducing finite-amplitude disturbances into the basic flow, the mean flow profiles downstream undergo significant modifications. The stability of the flow field changes substantially: the second-mode wave, which is most unstable in the linear stage, becomes stabilized, while the first-mode wave exhibits significant growth. The rapid growth of the first-mode wave enables the N-factor to reach values of 4, which would substantially promote transition.

## Full Text

### Preamble

This section introduces the fundamental mathematical formulations employed throughout this work. We begin with the primary governing equation:

$$\text{MATH\_}\{0010\}$$

This expression establishes the core relationship between the principal variables under investigation. Building upon this foundation, we subsequently present the following auxiliary expressions:

$$\text{MATH\_}\{0012\}$$

$$\text{MATH\_}\{0013\}$$

MATH\_{0014}

These additional formulations capture specific aspects of the system's behavior and provide necessary constraints for the complete analytical framework.

*Note: Figure translations are in progress. See original paper for figures.*

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