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Real gas effects on receptivity to kinetic fluctuations[1] ANATOLI TUMIN, LUKE EDWARDS, The University of Arizona — Receptivity of high-speed boundary layers is considered within the framework of fluctuating hydrodynamics where stochastic forcing is introduced through fluctuating shear stress and heat flux stemming from kinetic fluctuations (thermal noise). The forcing generates unstable modes whose amplification downstream and may lead to transition. An example of high-enthalpy (16.53 MJ/kg) boundary layer at relatively low wall temperatures ($T_w = 1000\,\mathrm{K} - 3000\,\mathrm{K}$), free stream temperature ($T_e = 834\,\mathrm{K}$), and low pressure (0.0433 atm) is considered. Dissociation at the chosen flow parameters is still insignificant. The stability and receptivity analyses are carried out using a solver for calorically perfect gas with effective Prandtl number and specific heats ratio. The receptivity phenomenon is unchanged by the inclusion of real gas effects in the mean flow profiles. This is attributed to the fact that the mechanism for receptivity to kinetic fluctuations is localized near the upper edge of the boundary layer. Amplitudes of the generated wave packets are larger downstream in the case including real gas effects. It was found that spectra in both cases include supersonic second Mack unstable modes despite the temperature ratio $T_w/T_e > 1$.

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Anatoli Tumin
The University of Arizona

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