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Direct Numerical Simulations of Sound-Orifice-Boundary Layer Interaction QI ZHANG, DANIEL BODONY, University of Illinois at Urbana Champaign — We report on a series of direct numerical simulations (DNS) of the interaction of a monochromatic incident acoustic field with a cavity-backed circular orifice in the presence of laminar and turbulent boundary layers of freestream Mach number 0.5 and momentum thickness Reynolds number 2,300, with application to acoustic liners. The simulations show that the addition of the orifice increases the drag and can induce laminar-to-turbulent transition at sufficiently high acoustic levels. Furthermore, the sound-orifice-boundary layer system support three distinct timescales whose spatial distributions change with the phase of the incident sound. Details of the near-orifice interaction are studied to create a model of the orifice discharge coefficient that is part of a time-domain, nonlinear reduced-order model (ROM) for the liner impedance. Comparisons between the ROM-predicted and DNS-measured near-orifice flow and acoustic impedance are given.

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