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DNS of a Mach 3 and Mach 7 Turbulent Boundary Layer: Statistical Description and Scale Decomposed Physics[1] IZAAK BEEKMAN, Princeton/UMD, PINO MARTIN, University of Maryland — We analyze the statistical properties of supersonic turbulent boundary layers via spatial direct numerical simulations (SDNS). The computational domains are very large with 60 by 10 δ_{inlet} in the streamwise and spanwise directions respectively. The inflow is provided with a rescaling technique, where the recycling station is taken near the outlet, with $Re_\tau \approx 650$. We vary the nominally adiabatic wall boundary condition between a treatment that enforces a null *mean* heat transfer to the wall ($T_w = T_{recovery}, T' = 0$) and an *instantaneously* adiabatic wall with $(\partial T/\partial z)_w = 0$. The data, including spectra, are converged over $600\delta/U_\infty$ and capture the largest scales of the flow. We study broadband relations such as the strong Reynolds analogy (SRA) and Morkovin's scaling of the turbulent shear stresses in scale decomposed manner to gain insight and physical understanding for turbulence modeling.

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