Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Wall Asymptotics in Compressible Turbulent Channels AKANKSHA BARANWAL, DIEGO DONZIS, RODNEY BOWERSOX, Texas A&M University — The asymptotic behavior of Reynolds stresses close to walls is important from fundamental as well as modeling perspectives. While scaling laws are well known in incompressible flows, the transition from incompressible to compressible scaling and the limiting behavior for the latter are largely unknown. Using a large well-resolved DNS database of turbulent channel flow, we investigate the effects of compressibility on the near-wall, asymptotic region of turbulent stresses. In particular, we vary the Mach number (M) at a constant Reynolds number to assess compressibility effects. We observe that the near-wall behavior for compressible turbulent flow is different from the corresponding incompressible flow even if the mean density variations are considered and semi-local scalings are used. For flow near the incompressible regimes, the near-wall asymptotic behavior follows theoretical behavior. When M increases, the wall normal stress components show a gradual decrease in the slope due to increased dilatation effects. Our database reaches high enough M to exhibit an asymptotic behavior that can also be explained theoretically. We also observe that the slope of Reynolds stresses undergoes a transition with respect to the wall-normal direction which is studied in detail.

Akanksha Baranwal
Texas A&M University

Date submitted: 10 Aug 2020 Electronic form version 1.4