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Turbulent jumps and shock-structure in shock-turbulence interactions using shock-resolving direct numerical simulations[1] CHANG-HSIN CHEN, DIEGO DONZIS, Texas AM Univ — Substantial efforts have been made to understand the canonical interaction between isotropic turbulence and a normal shock. Evidence from theories, experiments and simulations, however, has shown that the interaction is complex and that the outcome is determined not only by mean flow behavior, as suggested by early theories, but also by characteristics of turbulence fluctuations typically quantified by parameters such as the Reynolds (R_λ) and the turbulent Mach number (M_t). An important, yet unresolved, issue is the accurate determination of departures from Rankine-Hugoniot relations due to turbulent fluctuations upstream of the shock. We present an analytic study, based on the quasi-equilibrium assumption, that yield turbulent jumps that depend not only on the mean flow but also on turbulence characteristics. In particular, the focus will be on thermodynamic jumps. Our analytical results agree well with new shock-resolving simulations at a range of Reynolds and Mach numbers. In the context of these results we also present a comparison of previous theory on the dilatation at the shock with the new DNS data. This is further discussed in the context of the transition from wrinkled to broken regimes and the difficulties associated with identifying a shock for very vigorous turbulence.

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