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Direct numerical simulations of premixed autoignition in compressible uniformly-sheared turbulence COLIN TOWERY, RYAN DARRAGH, University of Colorado Boulder, ALEXEI POLUDNENKO, Texas AM University, PETER HAMLINGTON, University of Colorado Boulder — High-speed combustion systems, such as scramjet engines, operate at high temperatures and pressures, extremely short combustor residence times, very high rates of shear stress, and intense turbulent mixing. As a result, the reacting flow can be premixed and have highly-compressible turbulence fluctuations. We investigate the effects of compressible turbulence on the ignition delay time, heat-release-rate (HRR) intermittency, and mode of autoignition of premixed Hydrogen-air fuel in uniformly-sheared turbulence using new three-dimensional direct numerical simulations with a multi-step chemistry mechanism. We analyze autoignition in both the Eulerian and Lagrangian reference frames at eight different turbulence Mach numbers, Ma_t, spanning the quasi-isentropic, linear thermodynamic, and nonlinear compressibility regimes, with eddy shocklets appearing in the nonlinear regime. Results are compared to our previous study of premixed autoignition in isotropic turbulence at the same Ma_t and with a single-step reaction mechanism. This previous study found large decreases in delay times and large increases in HRR intermittency between the linear and nonlinear compressibility regimes and that detonation waves could form in both regimes.

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