Abstract Submitted
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A volume-filtered description of shock-particle interactions[1] GREGORY SHALLCROSS, JESSE CAPECELATRO, University of Michigan — This study presents a volume-filtered formulation and consistent numerical discretization to simulate particle-shock interactions. When a shock passes through a dense suspension of solid particles, the surrounding gas accelerates to supersonic speeds, referred to as choking. While this phenomenon is captured in fully resolved simulations of shock-particle interactions, it remains a challenge to reproduce using coarse-grained models, such as Euler-Euler and Euler-Lagrange methods. Volume filtering the viscous compressible Navier-Stokes equations reveals sub-filtered terms that require closure but are typically neglected. A-priori filtering the flow fields generated from particle-resolved direct numerical simulations is performed to evaluate the relative contributions of these unclosed terms. Results are reported for different values of filter size and particle loadings. Of particular interest is the pseudo-turbulent kinetic energy (PTKE), which appears in conservation of momentum, energy, and the equation of state. This term systematically acts to reduce the local gas-phase pressure and increase the Mach number. We present a transport equation for PTKE within a high-order Eulerian-Lagrangian framework and validate it against direct numerical simulations.

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