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A numerical study of unsteady heat-transfer between fluid and solid particles in shocked particle-laden flows PRATIK DAS, Univ of Iowa, OISHIK SEN, The University of Iowa, GUSTAAF JACOBS, San Diego State University, H.S. UDAYKUMAR, The University of Iowa — Shock-particle interaction is a commonly observed phenomenon in many natural and engineering processes, such as, volcanic eruptions, nozzle of solid propellant rockets, explosions, pneumatic conveyance of particles etc. Shock interaction with particle is inherently unsteady in nature. The unsteady momentum and heat-transfer between and the particle and the fluid phase significantly contribute to the overall acceleration and heating of the particle immersed in the fluid. In the current work, the unsteady heat transfer between the particles and fluid in shock-particle interactions is studied through particle resolved direct numerical simulations. Resolved simulations of shock-particle interactions are performed using a Cartesian grid based sharp interface framework. The solid-fluid interfaces are represented using level-sets. A heat-flux conserving boundary condition in conjunction with no-slip boundary condition is enforced at the immersed solid-fluid interfaces using a modified ghost fluid method. The current method is validated against similarity solution of compressible boundary layer over a heated flat-plate. Resolved simulations of shock-particle interaction are performed to quantify the unsteady heat transfer rate between the particles and the fluid.

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