

## FUNDAMENTAL ADVANCES IN COMPRESSIBLE MULTIPHASE FLOWS - SHOCK-PARTICLE INTERACTION TO EXPLOSIVE DISPERSAL

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**Abstract.** We will look at the problem of explosive dispersal of particles and ask the question what will it take to perform predictive simulations of this complex physics from first principles.

Compressible flow resulting from an explosive release of energy is a classic problem. During and after the second world war, due to interest in better understanding nuclear explosions, this problem attracted some of the best scientists of that time - G.I. Taylor, von Neumann, Hans Bethe, and L.I. Sedov. The presence of particles, as in a hybrid multiphase explosive or dispersal of casing/liner, fragments greatly complicates the problem.

The interaction of between the gas and the particulate field is significantly complicated due to (a) the highly unsteady nature of the problem, (b) interaction of compressible flow features such as shocks and contacts with the particles, (c) high Reynolds number, (d) compressibility effects of high Mach number, (e) particle-particle interaction at large volume fractions, (f) random particle size, shape and distribution, and (g) instability and flow turbulence. Despite these complexities, in our present approach, due to lack of fundamental understanding, we are forced to rely upon standard drag and heat transfer relations that are developed for much simpler conditions.

The talk will present a rational approach that builds upon rigorous theoretical results to develop advanced momentum and energy coupling models that incorporates all the above discussed complexities in a systematic way. This leads to a hierarchical approach that spans from the microscale (order of few particles), to mesoscale (order of millions of particles), to macro or system scale of practical interest. A key aspect of this modeling and simulation approach is rigorous validation of the coupling model at every stage of the hierarchy against high quality experimental results.