Public Abstract
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Title:NUMERICAL METHOD FOR SHOCK DRIVEN MULTIPHASE FLOW WITH EVAPORATING PARTICLES

Shock Driven Multiphase Instabilities (SDMI) arise in various cases in nature. This instability is involved in the shock processing of the cosmic dust produced during supernovae explosion events and by Asymptotic Giant Branch (AGB) stars. It is also involved in the study of the dynamic properties of shock induced ejecta particles in case of high energy explosives. In addition, it has applications in the study of the distribution of the solid particles (Tephra) during volcanic eruptions, mixing of air and fuel in the scramjet engines, and performance of ejector pump refrigeration cycles. To study SDMI, a numerical method for the solution of the multiphase flow with shock capturing scheme is required.

In this study, a new numerical method was developed by combining a Piecewise Parabolic Method (PPM) hydrodynamic solver for solving the gas equations with the particle equations by the Particle in Cell (PIC) technique. This method was implemented in an open source hydrodynamics code called FLASH, developed at University of Chicago, FLASH center. This method was used to perform a parametric study of SDMI in two and three dimensions.

In the simulation study of multiphase flow, particles following a distribution can be represented as particles with the median radius of distribution or even by passive particles where size is ignored. In addition, evaporation of the particles is also often ignored during such studies. A typical example is the use of passive tracer particles during simulations of the interaction of a shock wave with a gas bubble containing particles. In this study, 2D simulations focused on the effect of particle size distribution and particle evaporation effects on the evolution of a SDMI. It was found that larger size particles develop larger overall circulation than the smaller size particles. So, approximating the particle distribution with a single radius of particles would over predict the evolution of interface. Furthermore, the evaporation was also found to increase the rate of evolution of the interface. The study was further extended to 3D with very high particle resolution. The study showed the development of the secondary features during evolution, asymmetric growth of the interface, and small scale perturbations at the interface.

Further study of the SDMI with new physics for droplet collisions, droplet breakup and coalesce, and radiation under complex accelerations needs to be done to understand complicated processes like dust processing during supernovae explosions. This study lays the foundation for such advanced study by providing a numerical method for solving shock driven multiphase flow with particle evaporation and explored the effect of different multiphase parameters during the evolution of SDMI.