Hydrodynamic Simulations in Supernova Remnants: Dust destruction by reverse shocks

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Abstract:
Observations have shown that high amounts of dust are present in galaxies even less than a billion years after the Big Bang. As this timescale is far too short for dust enrichment by evolved AGB stars, dust grains are assumed to be produced in the ejecta of core collapse supernovae where the dust is condensed to (sub-) micrometre sized particles. However, due to interactions with the circumstellar and interstellar medium, reverse shocks will traverse the ejecta which could potentially destroy large amounts of the newly formed dust material. Gas-grain interactions (drag, sputtering, charging) as well as grain-grain collisions (vaporisation, shattering, sticking) lead to a reconfiguration of the spatial and total grain size distribution in the remnant. Consequently, these effects provide an important contribution to the dust destruction rate and need to be investigated intensively.

In order to determine survival rates and the resulting grain size distributions, we performed spatially highly resolved hydrodynamical simulations using the code AstroBEAR to simulate a shock interacting with clumpy supernova ejecta. For the analysis of the dust destruction, we utilized the velocity, density and temperature field given by the hydrodynamical simulation to evaluate dust grain trajectories, distances and relative velocities of certain dust grains. In our talk we will present two different approaches (internal and external of AstroBEAR) of considering dust in these simulations and give an overview of the different dust destruction processes. We will outline first results for the dust destruction rate in the supernova remnant Cas A.