Molecule and dust reprocessing by the reverse shock in the supernova remnant Cas A

<u>Chiara Biscaro (Basel University)</u> & Isabelle Cherchneff (Basel University)

Dust and molecules are observed in various supernovae (SNe) and their remnants, but their formation and evolution in these hostile, shocked environments are still unclear.
In some remnants, such as the 330 years-old SN remnant Cas A, the reverse shock (RS) is currently reprocessing the material formed after the SN explosion. Recently, transitions of warm CO have been detected with the Spitzer, Akari and Herschel telescopes in Cas A. In particular, CO lines were detected with Herschel in a small O-rich clump, and a high CO column density and temperature, compatible with shocked gas, were derived from line modelling (Wallström et al, in prep.). These observations thus show that a fair quantity of CO reforms after the passage of the RS.
The Cas A remnant results from the explosion of a 19 M_{sun} star as a Type IIb supernova, characterised by a low-density ejecta. We first model the SN ejecta chemistry to identify the molecules and dust clusters that form after the explosion and are reprocessed by the RS. We find that Cas A progenitor could have formed large quantities of molecules and dust only in a dense ejecta involving clumps.
We then model the impact of the RS on an oxygen-rich ejecta clump, considering various RS speeds and investigating the post-shock chemistry. We consider the destruction of molecules and dust clusters by the shock and their reformation using a chemical kinetic model. The impact of UV photons coming from the hot post-shock region on the ionization fraction of the post-shock gas is included. We also model the sputtering (thermal and non-thermal) of the dust by the RS.
We found that the reverse shock destroys the molecules and clusters present in the O-rich clump. CO reforms in the post shock gas with abundances that concur with the latest Herschel observations, confirming a post-shock origin for the submm CO lines.
We then derive a dust size distribution for the ejecta of the Cas A progenitor, and investigate the effect of different RS velocities on this dust size distribution. Our results show that only large grains can survive the RS and that small dust clusters do not efficiently reform in the shocked gas, indicating that once destroyed by the RS, the SN ejecta dust won't be able to reform in the remnant.