Gas and Dust Layers
from Cas A’s Explosive Nucleosynthesis

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We have developed a new picture of the structure of Cas A’s explosion using 5-40 micron images and spectra from the Spitzer Space Telescope [1, 2, 3]. In this picture, two spherical shocks (forward and reverse) were initially set up by the outer layers of the explosion. Then, as the aspherical deeper layers encounter the reverse shock, they become visible across the electromagnetic spectrum, with different layers visible in different directions. In the infrared, we see the gas lines of Ar, Ne, O, Si, S, and Fe at different locations, along with higher ionization states of the same elements visible in the optical and X-ray parts of the spectrum. These different nucleosynthesis layers appear to have formed characteristic forms of dust, the deep layers producing dust rich in silicates, while dust from the upper layers is dominated by $\text{Al}_2\text{O}_3$ and carbon grains. In addition, we see circumstellar dust heated by its encounter with the forward shock. We estimate the total dust mass formed in the explosion to be at least 0.02 M$_\odot$. Rough extrapolations of these measurements to SNe in high redshift galaxies may be able to account for the lower limit of their observed dust masses.

References