JWST Observations of SN 1987A

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SN 1987A: The Formation & Evolution of Dust in a Supernova Explosion

From Supernova to Supernova Remnant, SN 1987A, has given us a unique opportunity to study the mechanics of a supernova explosion and now to witness the birth of a supernova remnant.

We want to understand how massive stars age and explode, how their ejecta form dust and molecules, and how the blast wave from their violent explosion affects their surroundings.

Key SN1987A Results

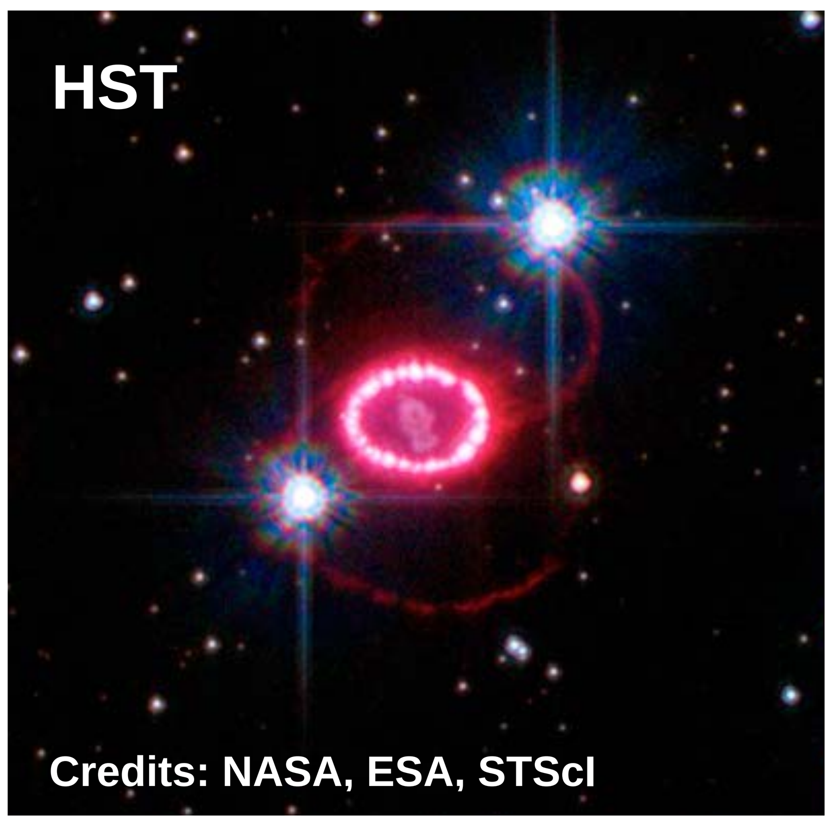
The central stellar ejecta of SN 1987A is surrounded by a ring of progenitor gas and dust that is being shocked by the blast wave of the explosion.

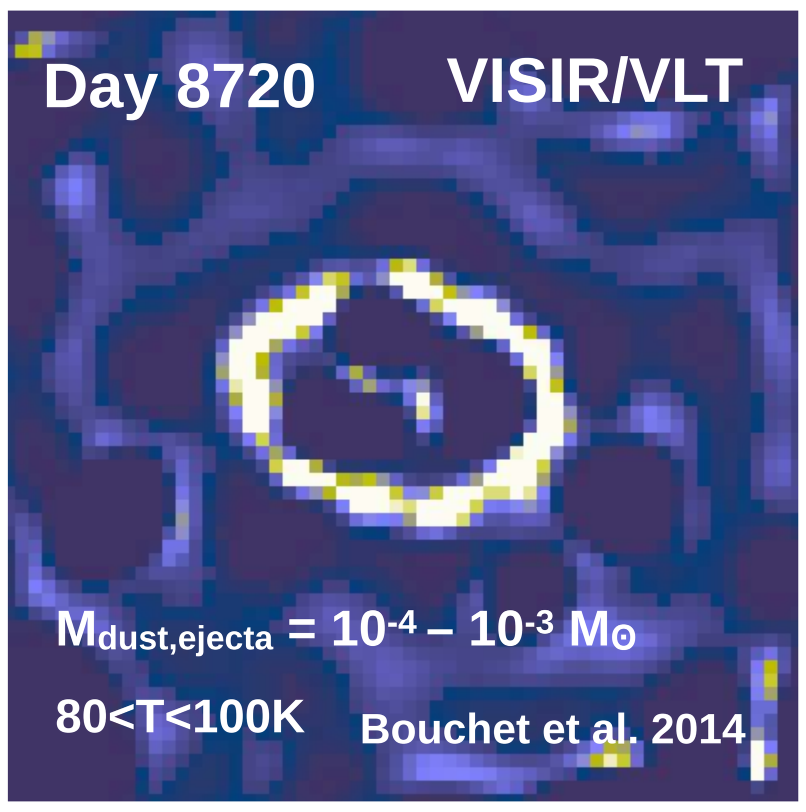
SN1987A was detected with dust ~1 year after explosion (Moseley et al. 1989; Bouchet et al. 1991; Wooden et al. 1993).

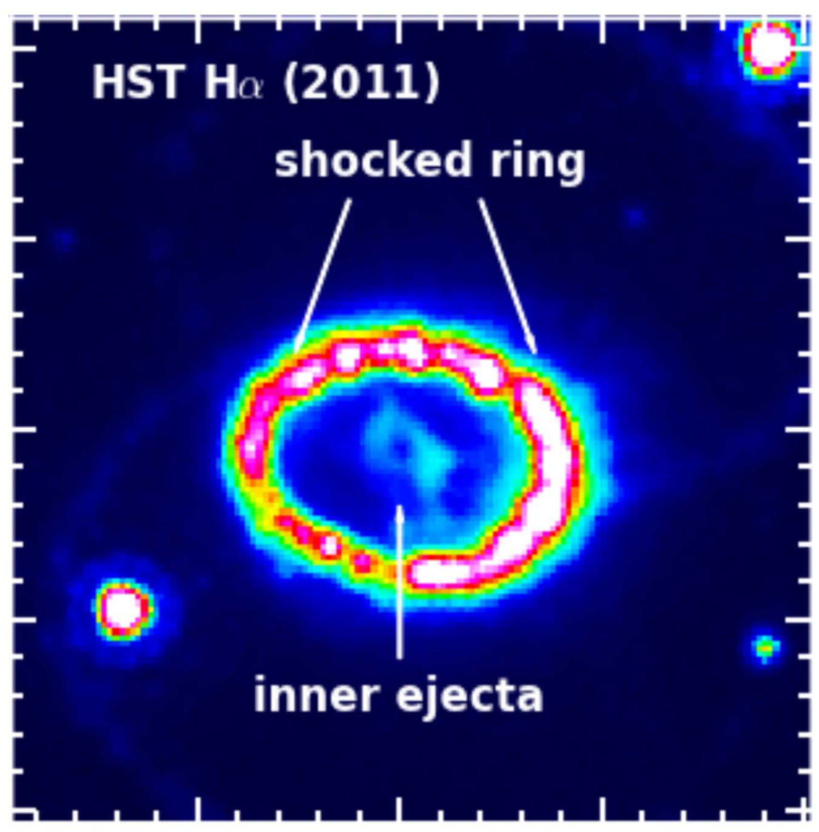
Spitzer detected warm dust in the equatorial ring which formed prior to the explosion. As shock waves impacted pre-existing dust grains, they heated up (Arendt et al. 2016).

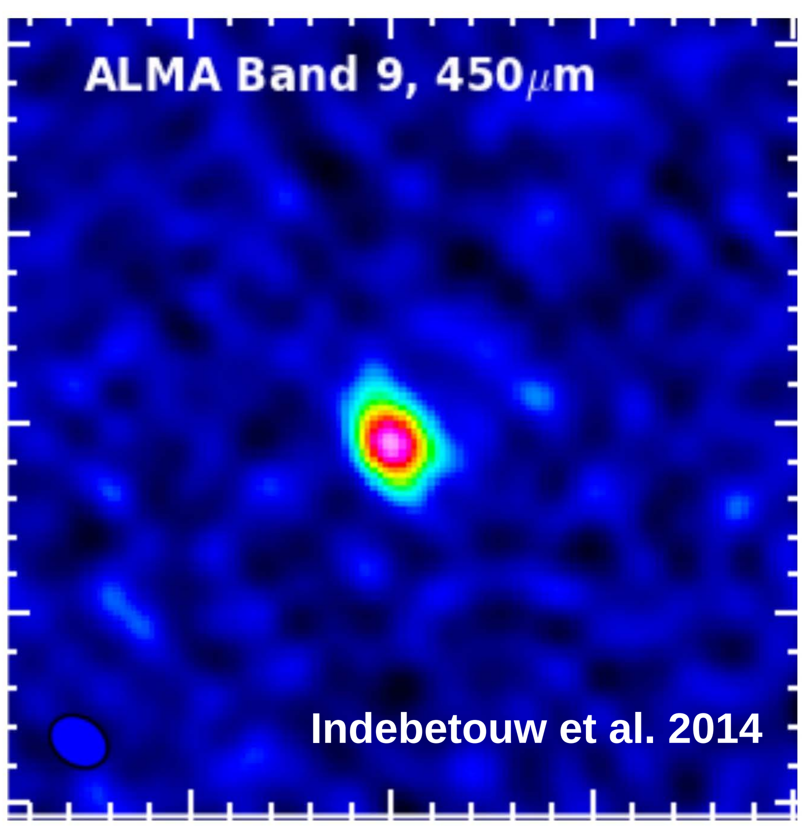
Herschel detected 0.4-0.7 M_{sun} of cold dust that formed after the explosion, made from the gas ejected by the supernova itself (Matsuura et al. 2011).

ALMA resolved the cold dust — it is located in the ejecta (Indebetouw et al. 2014).









Observing Strategy

MIRI - F560W, F1000W, F1800W and F2550W imaging using the bright sky sub array

MIRI - Medium Resolution Spectroscopy 5- 28 microns with simultaneous imaging with one filter, F1000W

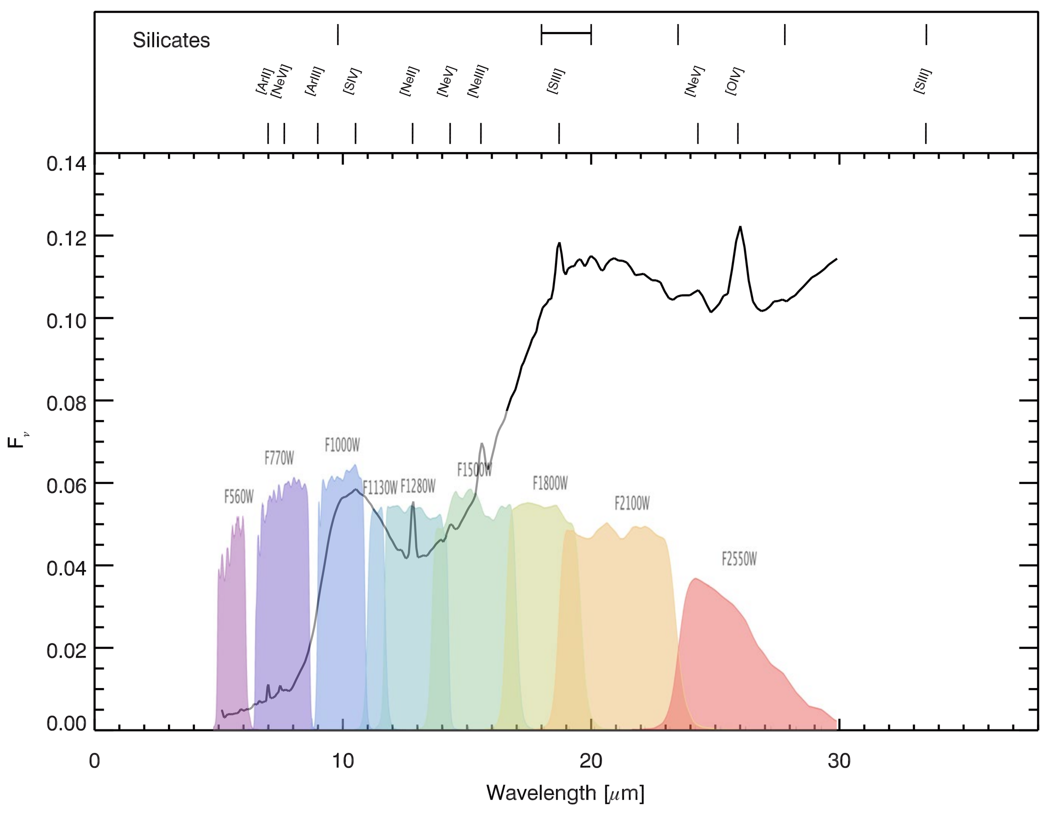
NIRSpec IFU observations will use the medium resolution grisms: G140M/F100LP, G235M/F170LP, G395M/F290LP

JWST MIRI imaging, MRS spectroscopy and NIRSpec IFU spectroscopy will provide key emission line diagnostics and dust feature and continuum measurements of SN 1987A.

A large quantity (0.4-0.7 M_{sun}) of dust in the stellar ejecta has an unknown composition and our MIRI observations will provide the first constraints through the imaging and MRS spectroscopy.

Both the MIRI MRS and NIRSpec IFU spectroscopy will measure key shocked line diagnostics that will constrain the shock physics as well as the elemental abundances in both the ring and the stellar ejecta.

The environment of SN1987A has significant star formation, which will be studied using parallel fields when SN 1987A is the prime target.



Spitzer IRS spectra of the equatorial ring, with MIRI imaging filters superimposed. (Jones 2017a,b).

Science Goals

1. Study the interaction of the blast wave with the equatorial ring.
2. Determine the nature of the ring's hot dust component.
3. Search for mid-IR emission from the 0.5 M_{sun} of ejecta dust that was discovered at far-IR wavelengths by *Herschel*.
4. Study the evolution of the dust and molecules in the ejecta.
5. Look for a remnant neutron star.
6. Survey the environment adjacent to SN1987A which has significant star formation (30 Doradus) using parallel fields.

References

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