ESAC 2017 JWST Workshop

MIRI MRS Observations of SN1987A.

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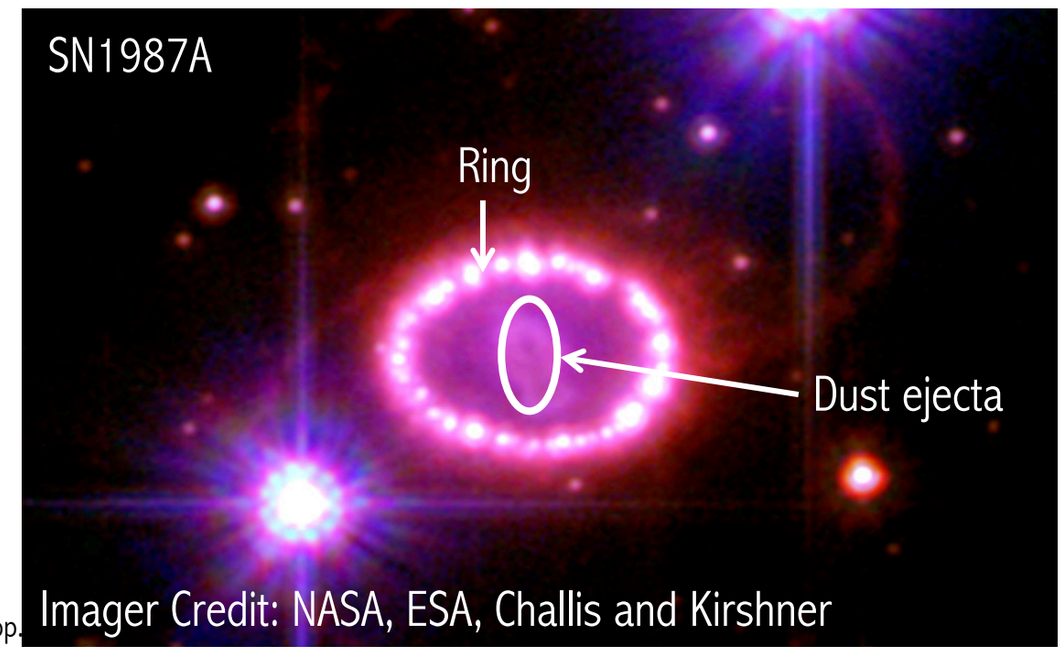
ETC hands-on Experience

Overview

•Background: SN1987A is one of the most well studied SN. It consists of a bright ring, enclosing the dust ejecta from the SNa. One challenge is to detect the ejecta without saturating the ring.

- Ring diameter ~ 1.1 arcsec, with thickness ~0.2 arcsec
- Total emitting area ~ 1.3 arcsec^2.
- With a MIRI pixel scale of 0.11 arcsec/px -> ~107 pixels
- Ejecta occupy approx. 4 pixels, i.e. just-resolved.

Goal: **Create an ETC workbook that estimates the exposure time needed to observe the SN1987A ring and eject using the MIRI Medium Resolution Spectrometer (MRS) with simultaneous imaging.**



Scenes and Sources

In the "Scene and Sources" you can create different sources and combine them to make an astronomical scene. Because the SN will completely fall into the MRS FOV, we will simulate a couple of stars to estimate the exposure time in the imager.

- Source1: The provided Spitzer integrated spectrum (5-30+ micron, sn1987a_spitzer_kendrew.txt format: first column wavelength in microns, second flux in mJy), represents the combined ring + ejecta
  Use it to create a source with the following options:
  - No renormalize
  - Extended source with flat shape (i.e. assumed uniform). Semi-minor and semi-major axis 0.638".
  - Source centred in the middle of the scene.

- Source 2: Create a point source using a stellar A0V 9500 K template. Renormalize it at 15 Abmag, Bessel K-band. This represents a star for the imaging FOV.
- Source 3: Create a point source using a stellar A1V 9500 K template. Renormalize it at 13 Abmag, Bessel K-band. This represents a star for the imaging FOV.

Scene: Create a scene with source 1, that will represent SN1987A ring+ejecta in the MRS field.
Create another with source 2 and a third one with source 3, representing stars in the ima

Calculations

MIRI MRS: Use Scene 1, and target the [NeV] line at 24.3 μm with Ch 4 - Medium (FOV 7.2x7.9" in size).

- Use FAST mode (Hint: default readout mode for the MIRI MRS is SLOW but you will find cases in which FAST is better suited, e.g. bright targets).
- In the strategy tab pick the 24.3 microns and Nod Off scene to correct for the background and thermal emission and choose aperture radius (MRS slice width). Do you think the Nod In scene would work in this case?
- Aim for SNR of about 60 in the spectral region of interest. Use 4 exposures to simulate a 4pt dither pattern.

Hint: With MIRI favour long single integrations (that do not saturate) over short multiple integrations.

Calculations

Simultaneous MIRI Imaging: Use F770W, F1000W and F2550W filters in scenes 2 and 3. Use a low background. In the strategies tab use “Imaging aperture photometry” and define an aperture radius and annulus suitable to perform photometry and background subtraction.

Hints:

- Watch for saturation and consider using subarrays if you run into issues.
- With MIRI favor long single integrations (that do not saturate) over short multiple integrations. Default readout mode for the imager is FAST.