ALMA OT hands on session

Case study: Gas and dust in local minor merger remnants

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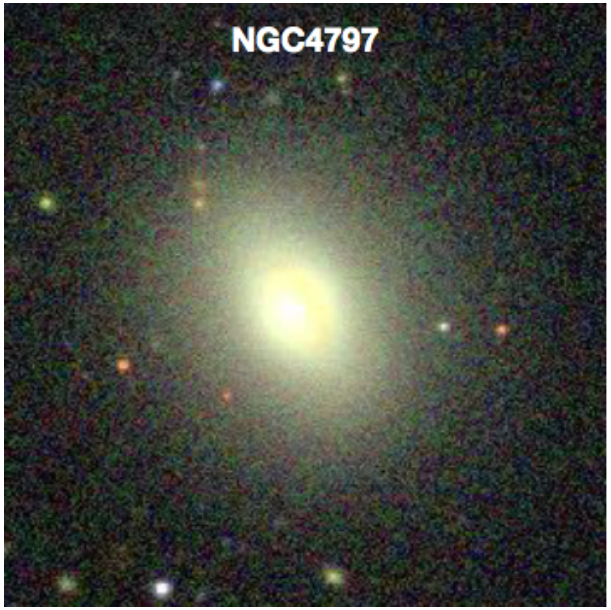
Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Very Long Baseline Array

Overview

Science case – Minor mergers are an important process in galaxy evolution. Whilst major mergers often enhance star-formation, minor mergers have been shown to suppress star-formation (Davis et al. 2015). We will use ALMA to determine the underlying physical cause of this intriguing effect.

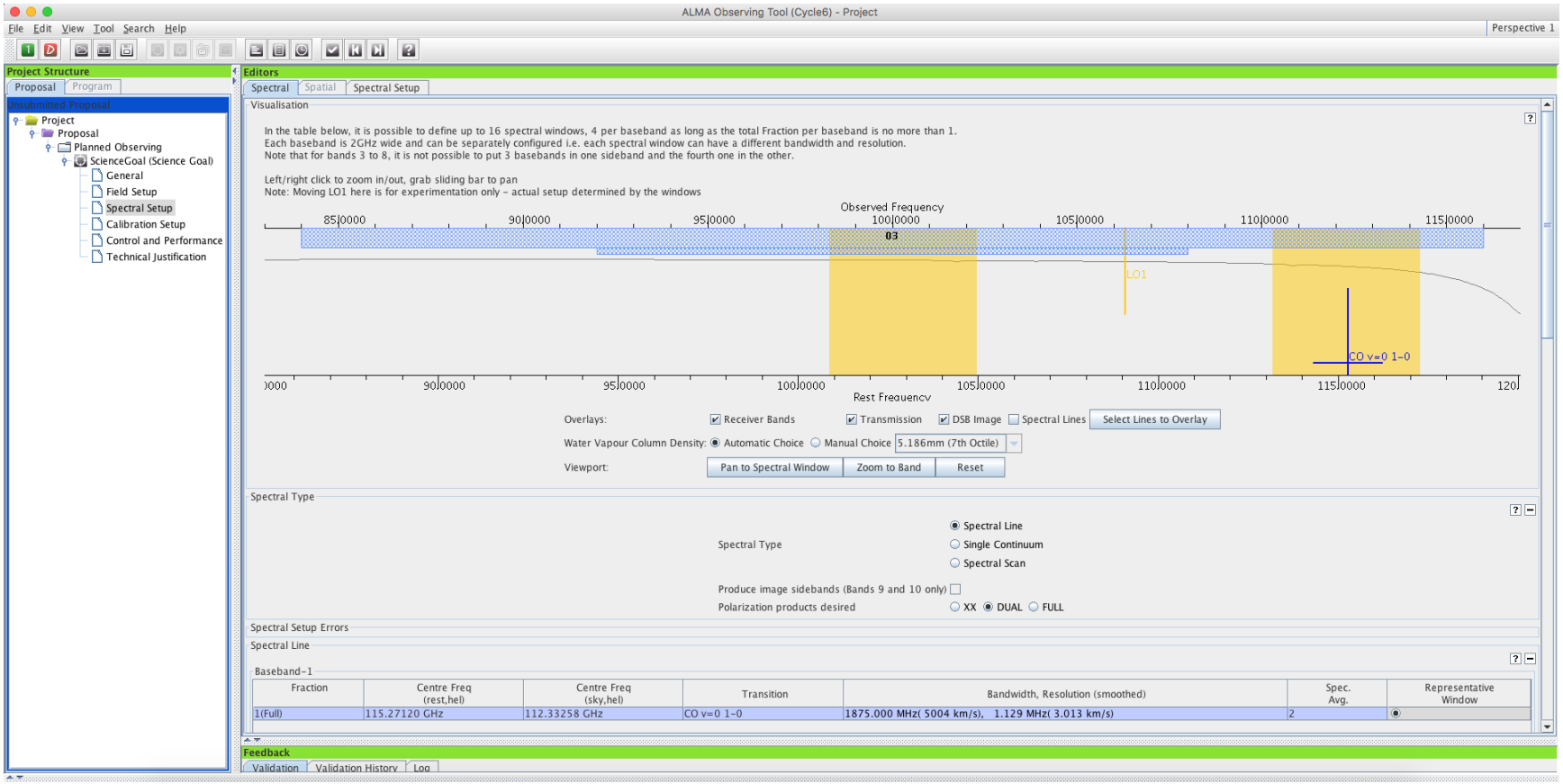


Goal – This proposal aims to study the gas velocity and distribution in a minor merger remnant (NGC 4797), to distinguish between dynamical suppression, gravitational heating and AGN/starburst feedback (van de Voort et al. 2018)

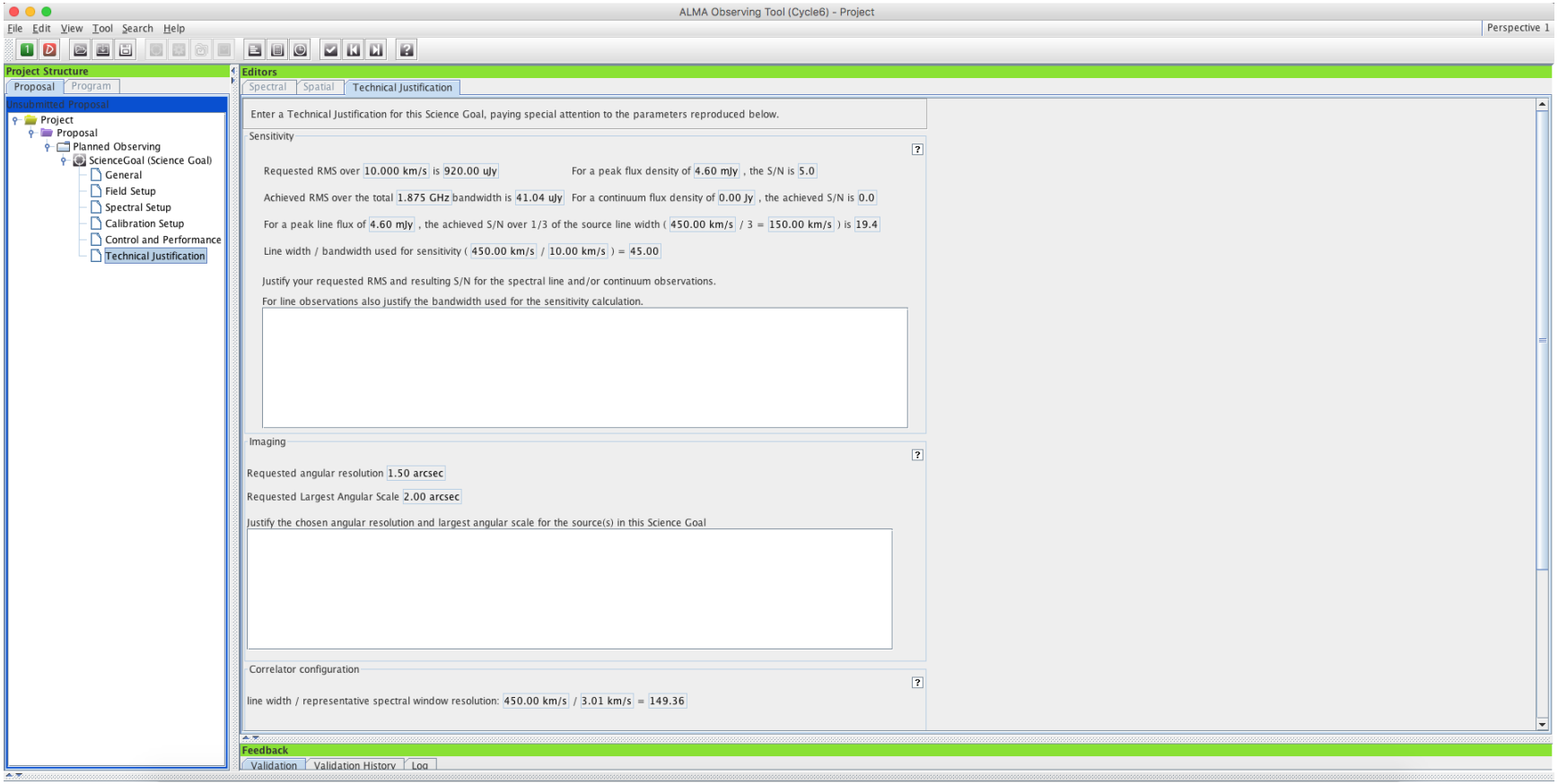
Science case 1 – mapping CO(1-0)

- Methodology – Using a single pointing, obtain a spectral line observation of the 12CO(1–0) line at 10 km/s resolution. The CO gas traces molecular hydrogen gas and will be used to map the gas velocity and distribution.
- Source – NGC 4797
- RA, Dec = 12:54:55.166, +27:24:45.55
- z= 0.0262
- Requirements – S/N=5 on the 12CO(1–0) line (rest frequency 115.271 GHz).
  - Peak line flux of 4.60 mJy/beam.
  - Desired sensitivity per pointing of 920 μJy/beam.
  - Line width = 450 km/s.
- Dual polarization products.
- Correlator setup: band 3, 1875 MHz bandwidth, 1.129 kHz (3 km/s) resolution.
- Set the bandwidth used for sensitivity to 10 km/s because we will spectrally average to this channel width during data reduction.
- Largest angular scale (LAS) = 2.0", resolution = 1.5". The LAS of the CO gas in NGC4797 is 2" because in early-type galaxies such as NGC 4797 the gas is usually found within 0.5 effective radii (Davis et al. 2013).

Science case 1 - Spectral line setup



Science case 1 - Technical case



Estimated time 1.15h

Science case 1 - continuum

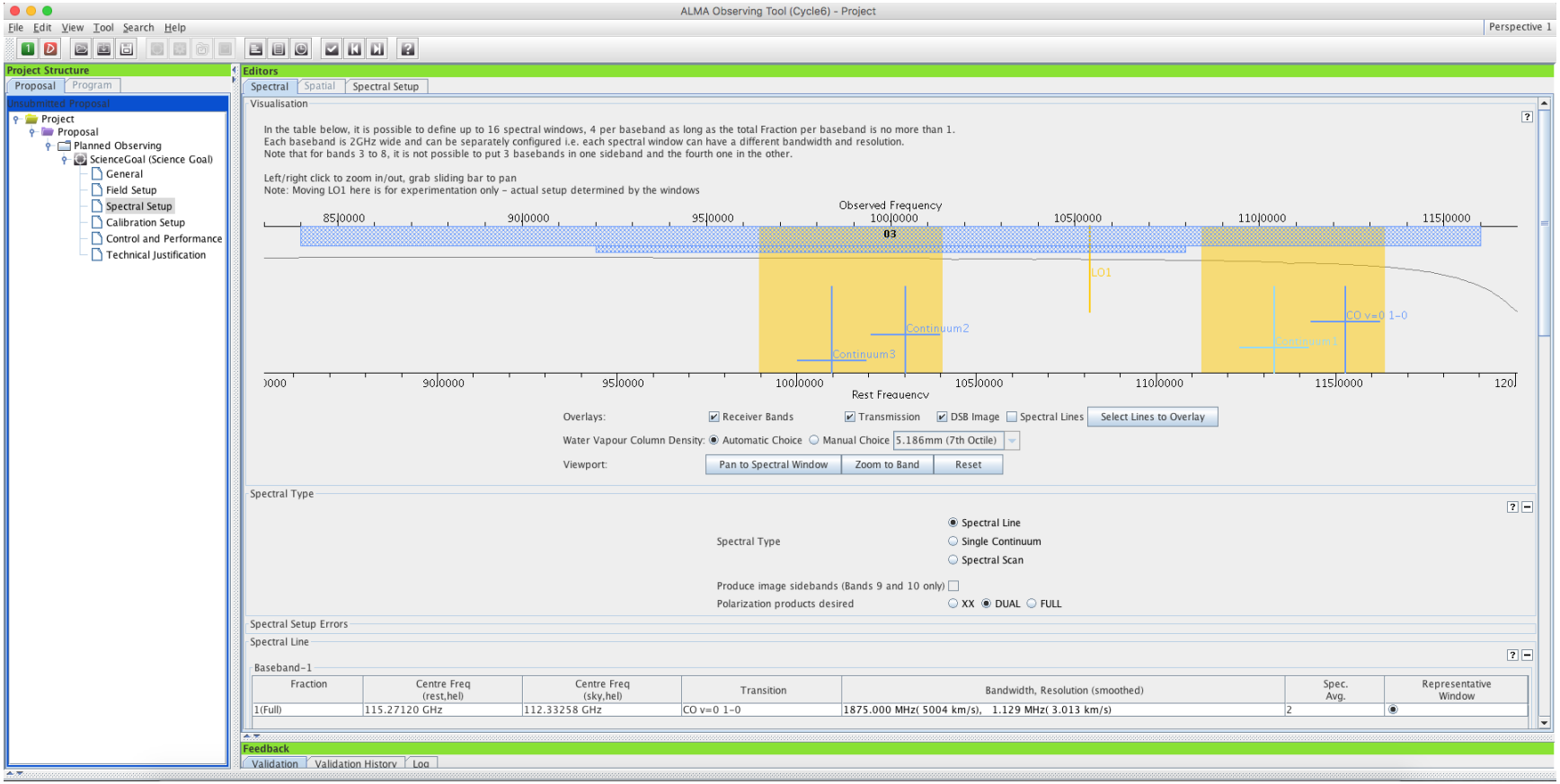
Set the peak continuum flux sensitive per synthesized beam to 0.304mJy/beam (this was estimated from fitting a modified blackbody to fluxes at shorter wavelengths).

Now add 3 spectral windows to record continuum in band 3. Use the lowest spectral resolution correlator mode, and use the full 7.5 GHz bandwidth.

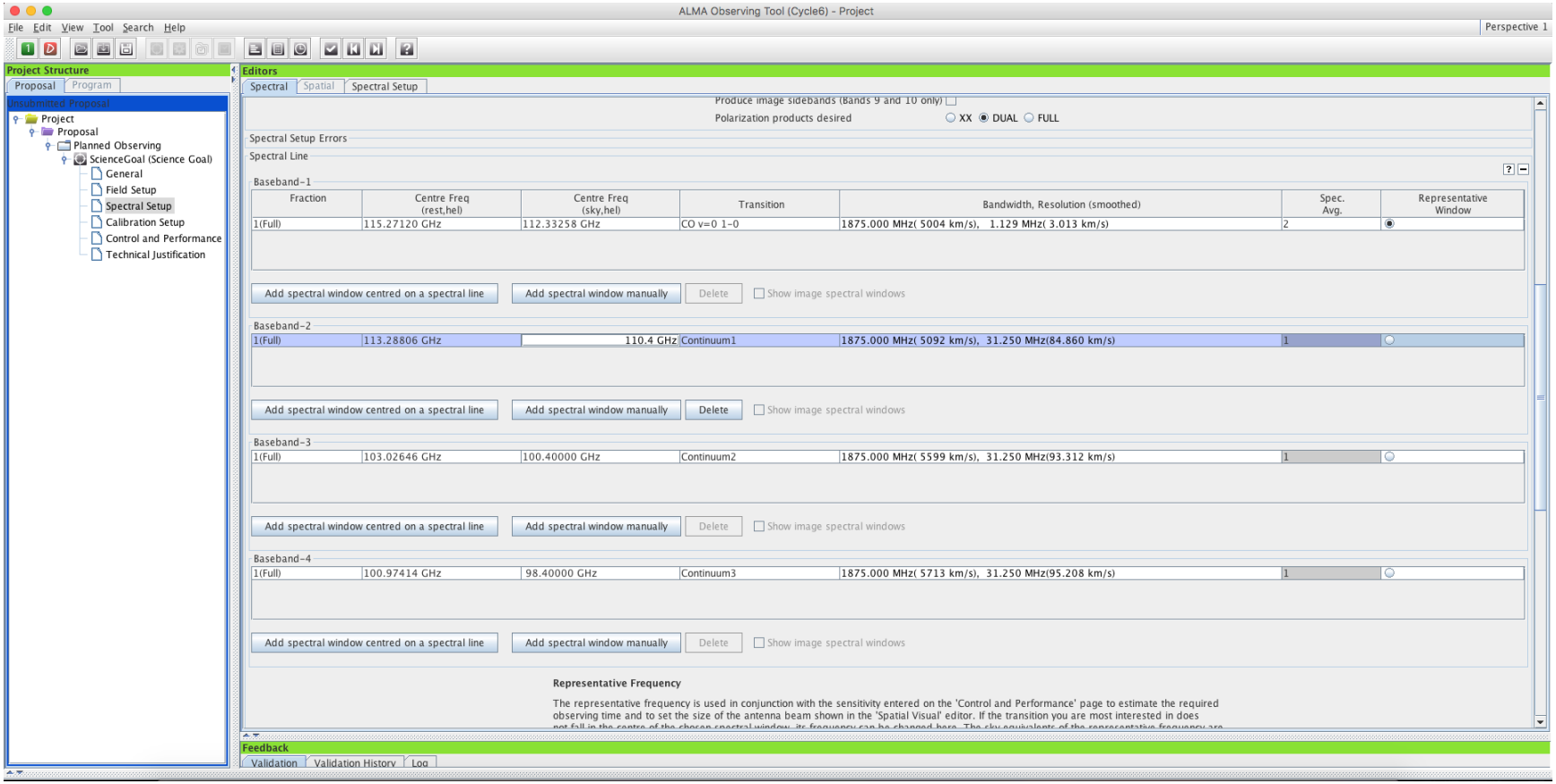
What is the continuum flux density S/N? (Hint – use the Technical Justification tab).

Change the largest angular structure to 20". What is the integration time now, and why is it longer?

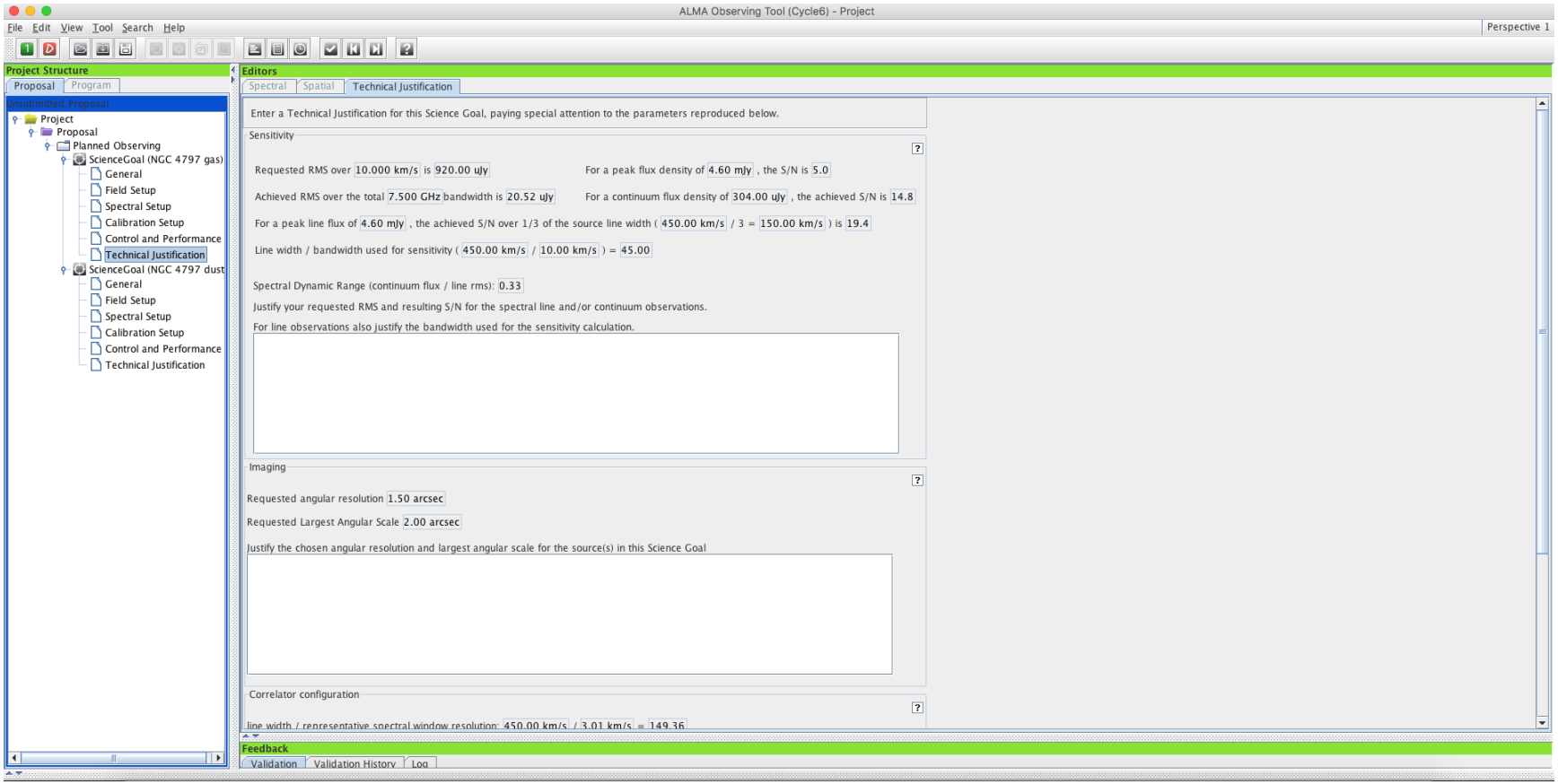
Science case 1 - continuum



Science case 1 - continuum



Science case 1 - continuum



Science case 2 – high frequency continuum

Science case – Map the dust continuum to look for extended dust emission, and to do radiative transfer modelling to reveal the sources of dust heating.

Goal – Image the dust continuum at high resolution to match the spatial resolution of existing optical data. The dust continuum will be brightest at high frequency.

Science case 2 – high frequency continuum

Methodology – Image the central region with a single pointing.

Copy the science goal and give it a new name.

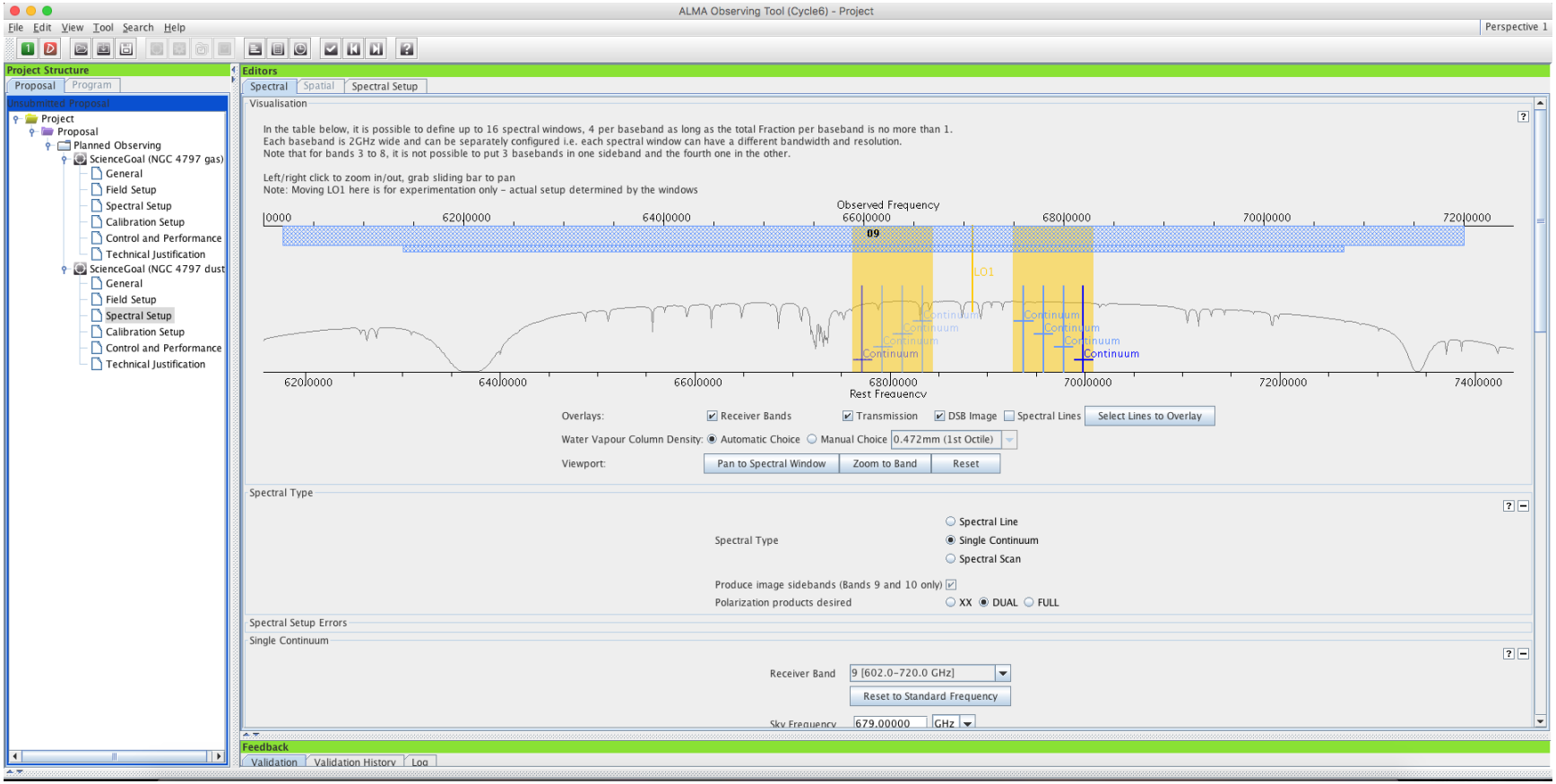
Change the spectral setup to observe continuum in band 9. Note the mirror images of the spectral windows.

Set the peak continuum flux to 0.89 mJy/beam and the peak line flux to zero.

Set the desired angular resolution to 0.6" and the largest angular scale to 2.0".

What is the desired sensitivity needed to reach a S/N of 5 for the continuum? (Hint, the integration time is 8.8 hours).

Science case 2 – high frequency continuum



Science case 2 – make a mosaic

- We want to make a map of the dust a larger region than one pointing.

- In field setup, change to a rectangular field and make a 7"x7" mosaic. Use Nyquist spacing (the default) between the pointings. This is the spacing of samples on the sky needed to get good imaging of large-scale low surface brightness emission. Use the spatial image tool to help you visualize the pointing positions.

- How long is the integration time now?

Science case 2 – make a mosaic