ALMA WebLog Review

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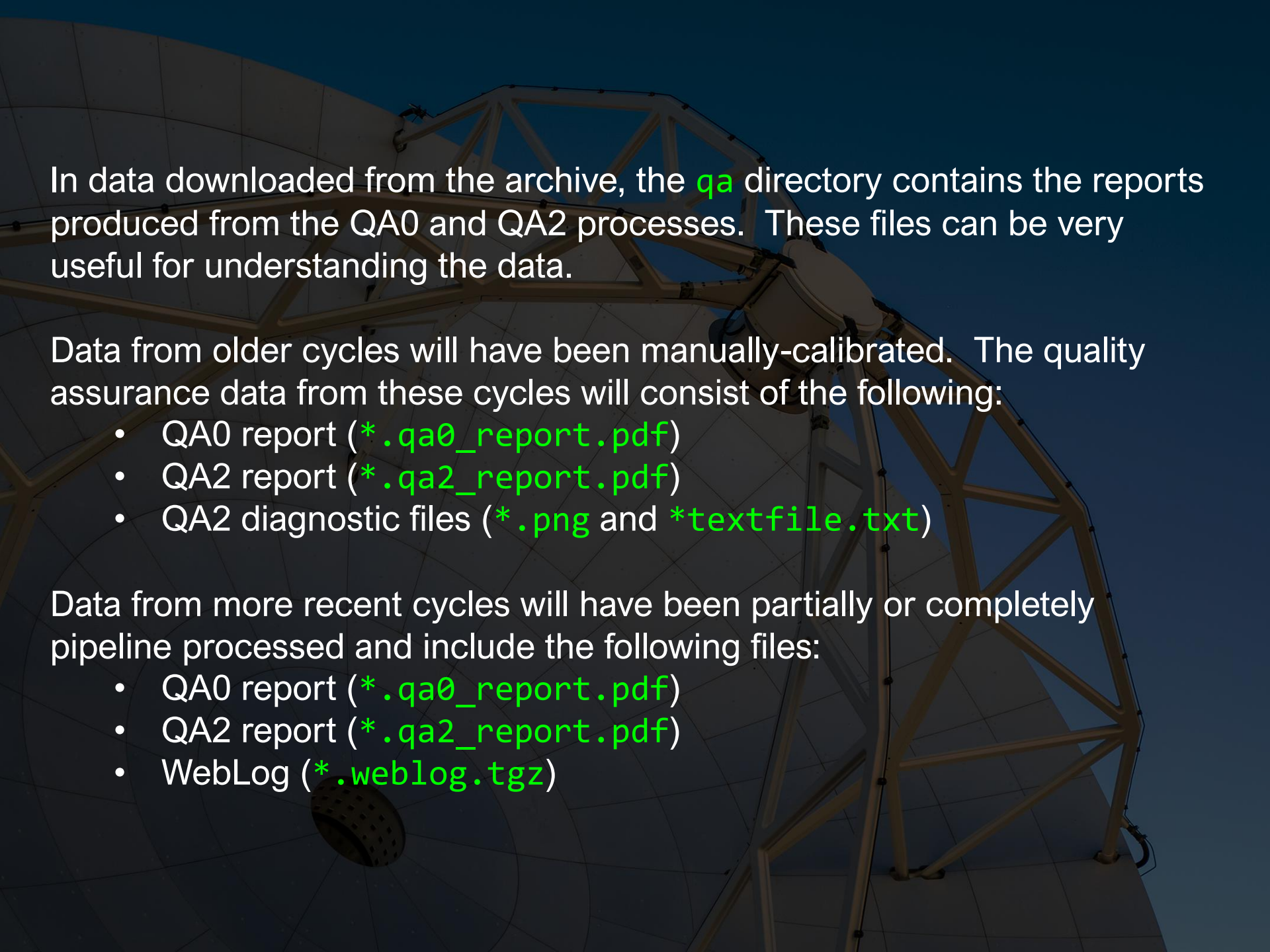
In the context of ALMA, QA stands for quality assurance. ALMA has four phases of quality assurance:

QA0 Simple quality checks performed at the observatory as soon as the data are acquired

QA1 Long-term monitoring of the performance of the observatory (not specific to any project)

QA2 A complete quality assessment performed on the data after completely calibrating and imaging the data

QA3 Re-assessment of data after they are delivered to users triggered when someone discovers a previously-unidentified problem



In data downloaded from the archive, the `qa` directory contains the reports produced from the QA0 and QA2 processes. These files can be very useful for understanding the data.

Data from older cycles will have been manually-calibrated. The quality assurance data from these cycles will consist of the following:

- QA0 report (`*.qa0_report.pdf`)
- QA2 report (`*.qa2_report.pdf`)
- QA2 diagnostic files (`*.png` and `*textfile.txt`)

Data from more recent cycles will have been partially or completely pipeline processed and include the following files:

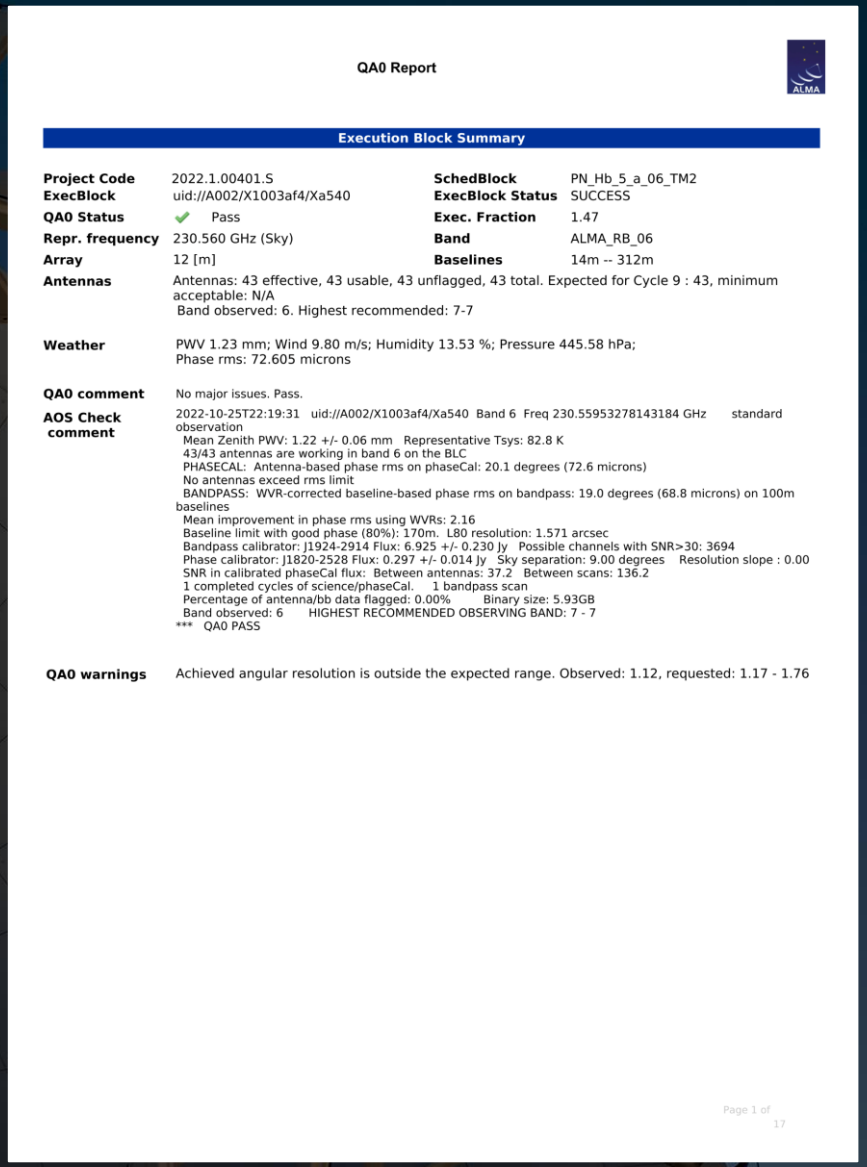
- QA0 report (`*.qa0_report.pdf`)
- QA2 report (`*.qa2_report.pdf`)
- WebLog (`*.weblog.tgz`)

The QA0 PDF provides a summary of comments from the astronomer who acquired the data. Each Execution Block (EB) will have its own report.

Versions of this document from earlier cycles contain just some simple diagnostic plots.

Versions from recent cycles contain several new sets of diagnostic plots as well as preview images.

These documents are most useful for understanding whether any problems were encountered during the observations.



QA0 Report

ALMA

Execution Block Summary

Project Code	2022.1.00401.S	**SchedBlock**	PN_Hb_5_a_06_TM2
ExecBlock	uid://A002/X1003af4/Xa540	**ExecBlock Status**	SUCCESS
QA0 Status	✔ Pass	**Exec. Fraction**	1.47
Repr. frequency	230.560 GHz (Sky)	**Band**	ALMA_RB_06
Array	12 [m]	**Baselines**	14m -- 312m

Antennas
Antennas: 43 effective, 43 usable, 43 unflagged, 43 total. Expected for Cycle 9 : 43, minimum acceptable: N/A
Band observed: 6. Highest recommended: 7-7

Weather
PWV 1.23 mm; Wind 9.80 m/s; Humidity 13.53 %; Pressure 445.58 hPa;
Phase rms: 72.605 microns

QA0 comment
No major issues. Pass.

AOS Check comment
2022-10-25T22:19:31 uid://A002/X1003af4/Xa540 Band 6 Freq 230.55953278143184 GHz standard observation
Mean Zenith PWV: 1.22 +/- 0.06 mm Representative Tsys: 82.8 K
43/43 antennas are working in band 6 on the BLC
PHASECAL: Antenna-based phase rms on phaseCal: 20.1 degrees (72.6 microns)
No antennas exceed rms limit
BANDPASS: WVR-corrected baseline-based phase rms on bandpass: 19.0 degrees (68.8 microns) on 100m baselines
Mean improvement in phase rms using WVRs: 2.16
Baseline limit with good phase (80%): 170m. L80 resolution: 1.571 arcsec
Bandpass calibrator: J1924-2914 Flux: 6.925 +/- 0.230 Jy Possible channels with SNR>30: 3694
Phase calibrator: J1820-2528 Flux: 0.297 +/- 0.014 Jy Sky separation: 9.00 degrees Resolution slope : 0.00
SNR in calibrated phaseCal flux: Between antennas: 37.2 Between scans: 136.2
1 completed cycles of science/phaseCal. 1 bandpass scan
Percentage of antenna/bb data flagged: 0.00% Binary size: 5.93GB
Band observed: 6 HIGHEST RECOMMENDED OBSERVING BAND: 7 - 7
*** QA0 PASS

QA0 warnings
Achieved angular resolution is outside the expected range. Observed: 1.12, requested: 1.17 - 1.76

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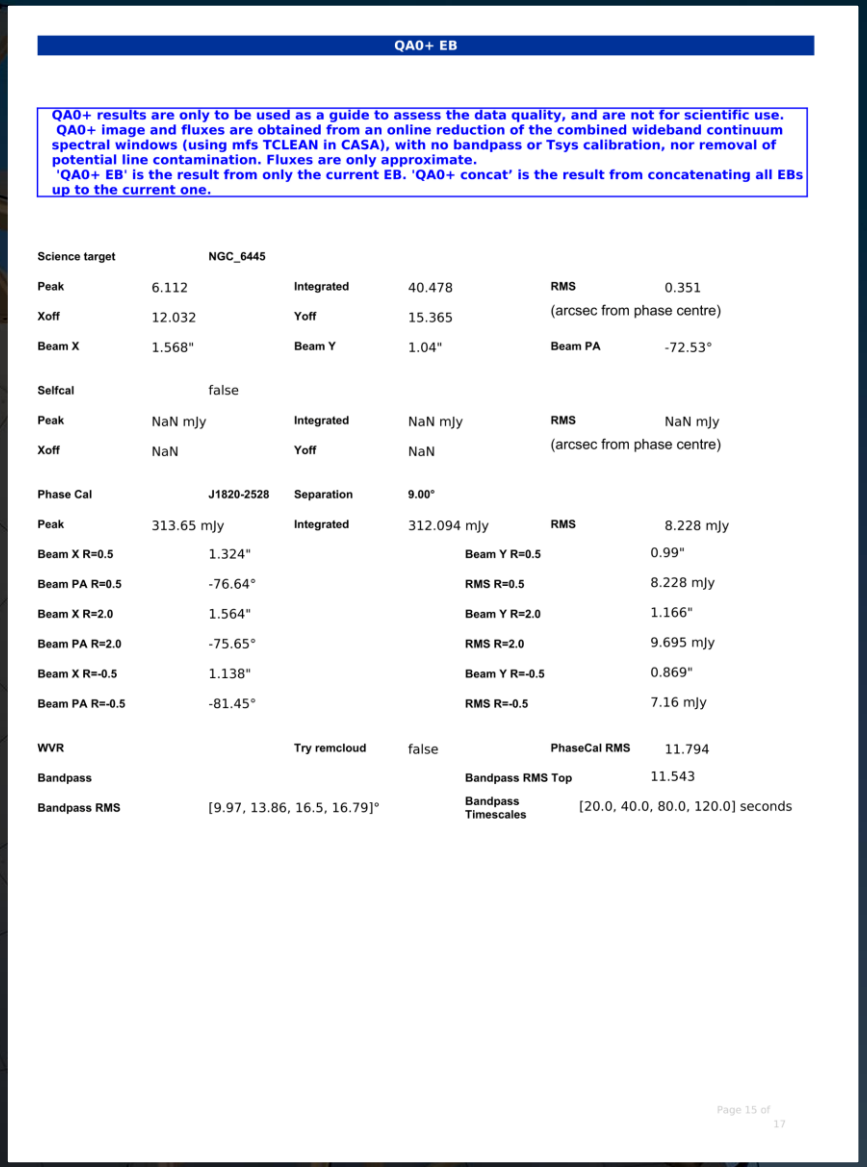
The QA0+ section shows some very quick (but very rough) images produced from the data soon after the observations were performed as well as some measurements from those images.

While these images and data are useful for providing a preliminary view of the results, they may be inaccurate compared to what is in the WebLogs.



QA0+ EB

QA0+ results are only to be used as a guide to assess the data quality, and are not for scientific use. QA0+ image and fluxes are obtained from an online reduction of the combined wideband continuum spectral windows (using mfs TCLEAN in CASA), with no bandpass or Tsys calibration, nor removal of potential line contamination. Fluxes are only approximate.
'QA0+ EB' is the result from only the current EB. 'QA0+ concat' is the result from concatenating all EBs up to the current one.

Science target	**NGC_6445**				
Peak	6.112	**Integrated**	40.478	**RMS**	0.351
Xoff	12.032	**Yoff**	15.365	(arcsec from phase centre)	
Beam X	1.568"	**Beam Y**	1.04"	**Beam PA**	-72.53°
Selfcal	false				
Peak	NaN mJy	**Integrated**	NaN mJy	**RMS**	NaN mJy
Xoff	NaN	**Yoff**	NaN	(arcsec from phase centre)	
Phase Cal	**J1820-2528**	**Separation**	**9.00°**		
Peak	313.65 mJy	**Integrated**	312.094 mJy	**RMS**	8.228 mJy
Beam X R=0.5	1.324"			**Beam Y R=0.5**	0.99"
Beam PA R=0.5	-76.64°			**RMS R=0.5**	8.228 mJy
Beam X R=2.0	1.564"			**Beam Y R=2.0**	1.166"
Beam PA R=2.0	-75.65°			**RMS R=2.0**	9.695 mJy
Beam X R=-0.5	1.138"			**Beam Y R=-0.5**	0.869"
Beam PA R=-0.5	-81.45°			**RMS R=-0.5**	7.16 mJy
WVR		**Try remcloud**	false	**PhaseCal RMS**	11.794
Bandpass				**Bandpass RMS Top**	11.543
Bandpass RMS	[9.97, 13.86, 16.5, 16.79]°			**Bandpass Timescales**	[20.0, 40.0, 80.0, 120.0] seconds

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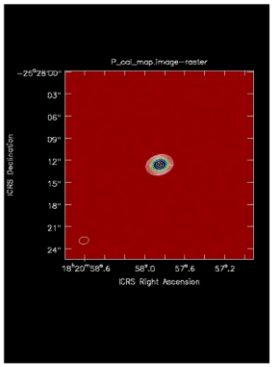
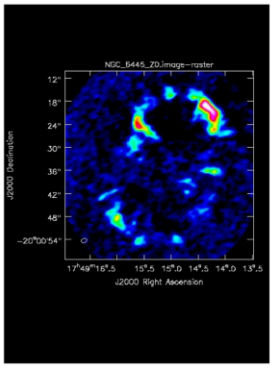
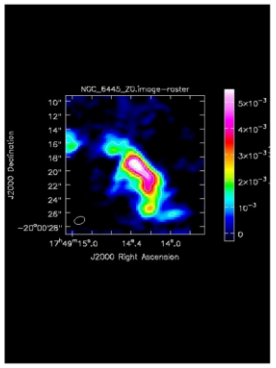
Phase Cal (left).



Target images





The QA2 PDF includes some comments on the data processing and summary information about the observations.

The last few pages of the document include standard instructions sent to all users.

The first part of the section under "Final QA2 comment" may be useful to read in case something went wrong with the observations.

QA2 Report

Project information

Name	Mapping Molecular Irradiation Tracers in Extreme Bipolar Planetary Nebulae
Code	2022.1.00401.S
PI	Joel Kastner
Organization	Chester F. Carlson Center for Imaging, Rochester Institute of Te
Co-Is	J. Alcolea, J. Bublitz, T. Forveille, P. Hily-Blant, P. Moraga Baez, M. Santander-García

ObsUnitSet information

Name	Member OUS (PN_Hb_5)
QA2 Status	Pass
Member OUS Status ID	uid://A001/X2d20/X2bb8
SchedBlock name	PN_Hb_5_a_06_TM2
SchedBlock UID	uid://A001/X2d20/X2b46
Array	TM2
Mode	Pipelineable
Band	ALMA_RB_06
Repr.Freq. (sky)	230.56 [GHz]
Spectral setup	FDM
Sources	NGC_6445, PN_Hb_5
Other SBs in this Group OUS (Member OUS Status ID in brackets):	PN_Hb_5_d_06_TM1 (uid://A001/X2d20/X2bb6)
Execution count	1.47 of 1 expected

Final QA2 comment

Calibration issues: None.

Imaging issues: None.

It is recommended that the PI carefully assess the results on the hif_findcont weblog page, and the "line-free moment 8" images on the cube imaging weblog page.

Self-calibration was not performed.

This dataset has been checked for the so-called “renormalization issue”. A detailed description about this issue, and how the renormalization process is carried out, can be found at the following link: https://help.almascience.org/kb/articles/what-are-the-amplitude-calibration-issues-caused-by-alma-s-normalization-strategy The requirement of rescaling due to any astronomical lines detected in this dataset has been evaluated and the largest peak rescaling value has been estimated to be 5.4 %, as displayed in the table in the hifa_renorm task of the delivered weblog. The effect of rescaling is a channel-dependent increase of the line flux, which is largest in the brightest channels. This is not an increase in flux-scale uncertainty, but a flux offset correction. When comparing such an offset to the nominal absolute flux accuracy, which is 5% in Bands 3, 4 & 5 and increasing to 20% in Bands 9 & 10, it is concluded that offsets up to 2% are considered negligible. Since the rescaling factor is above this threshold, this dataset has been corrected for the above issue.

QA2 was performed on the image whose channel width is the one closest to the representative bandwidth selected by the PI in ALMA OT, in the spectral window closest in frequency to the representative frequency. Both the beam size and the RMS meet the PI requested performance parameters. Therefore, this scheduling block has been deemed a QA2 PASS.

Representative Window - spw 27
- Image name: uid___A001_X2d20_X2bb8.s40_0.PN_Hb_5_sci.spw27.repBW.I.iter1.image
- Robust = 0.5
- Beam size = 1.60 x 1.15 arcsec
- RMS = 5.65 mJy/beam over an effective bandwidth 2.71 MHz

Aggregate Continuum -
- Image name: uid___A001_X2d20_X2bb8.s36_0.PN_Hb_5_sci.spw25_27_29_31.cont.I.iter1.image
- Robust = 0.5
- Beam size = 1.49 x 1.04 arcsec
- RMS = 0.33 mJy/beam over 2.51 GHz

The WebLog contains most of the useful diagnostic information from the QA2 process.

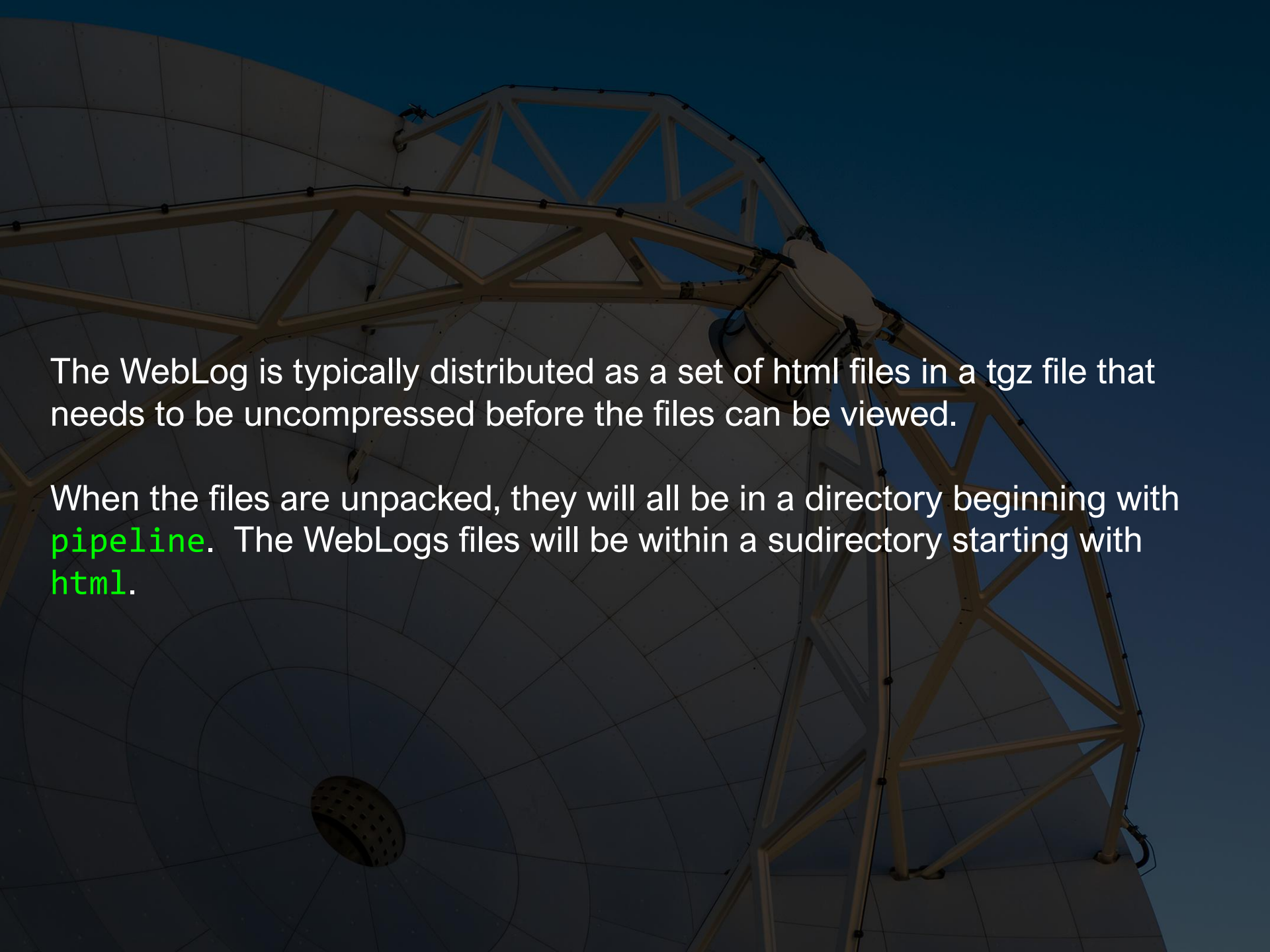
This is produced by the ALMA pipeline as the data are being calibrated and imaged.

The calibration part of the pipeline will calibrate the following in the visibility data:

- Phase versus frequency
- Amplitude versus frequency
- Phase versus time
- Amplitude versus time

The imaging pipeline produces the following:

- Image cubes
- Continuum flux images for each spw
- Aggregate continuum image for all spws



The WebLog is typically distributed as a set of html files in a tgz file that needs to be uncompressed before the files can be viewed.

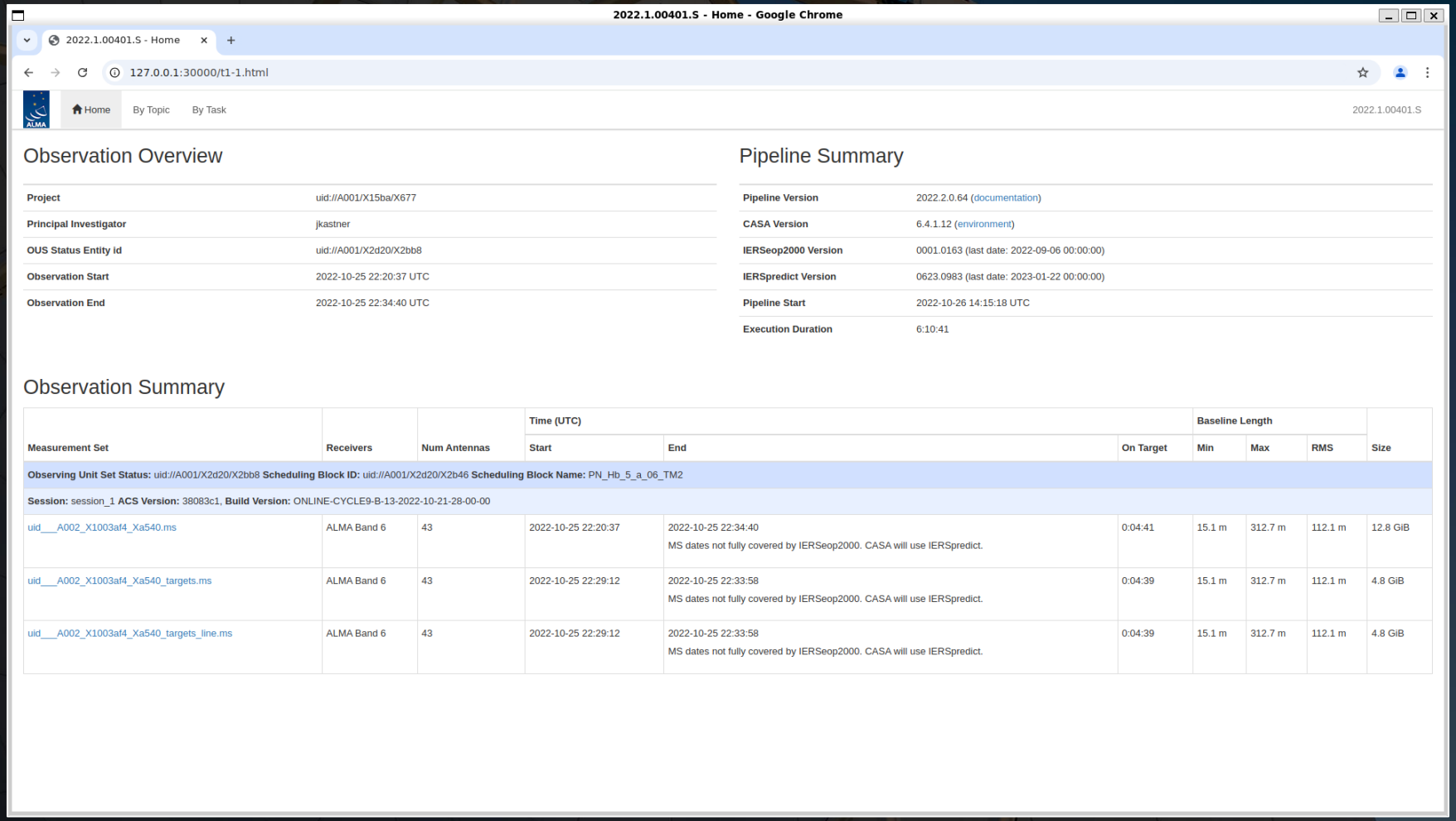
When the files are unpacked, they will all be in a directory beginning with `pipeline`. The WebLogs files will be within a sudirectory starting with `html`.

Most web browsers may not open the WebLogs correctly because of issues with their security settings.

The current recommendation is to use the following steps to open a WebLog:

1. In a terminal, go to the `pipeline*/html` directory with the WebLog.
2. Start CASA in pipeline mode using the `--pipeline` option.
3. At the CASA prompt, type `h_weblog()`.
4. Copy the url printed by this command into the address bar of a web browser.

The main index (or Home) page provides an overview of the observations. The page has three tabs at the top. The Home tab is currently displayed. Clicking on a measurement set in the bottom table leads to a page with more detailed information about those data.



Observation Overview

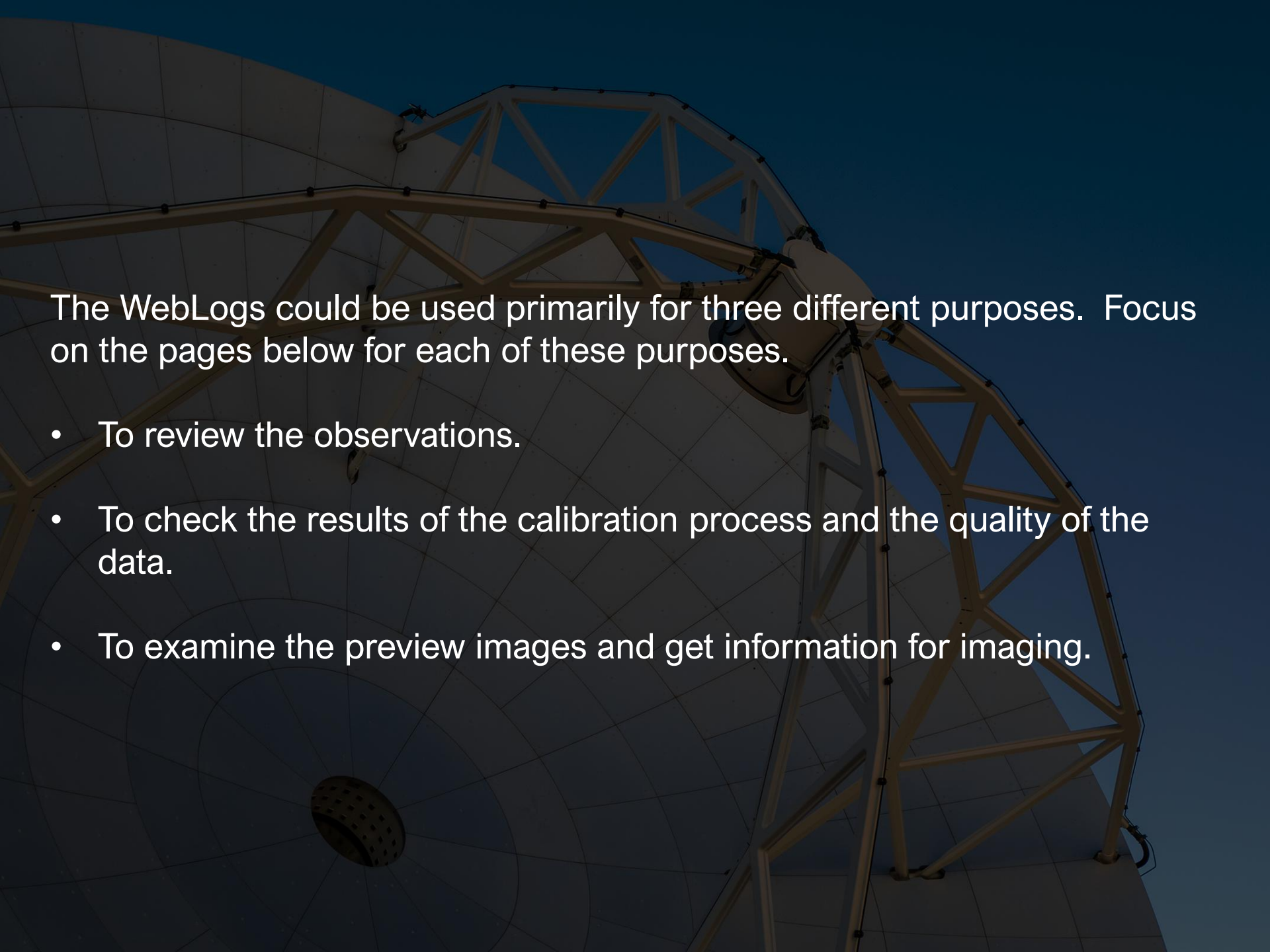
Project	uid://A001/X15ba/X677
Principal Investigator	jkastner
OUS Status Entity id	uid://A001/X2d20/X2bb8
Observation Start	2022-10-25 22:20:37 UTC
Observation End	2022-10-25 22:34:40 UTC

Pipeline Summary

Pipeline Version	2022.2.0.64 (documentation)
CASA Version	6.4.1.12 (environment)
IERSeop2000 Version	0001.0163 (last date: 2022-09-06 00:00:00)
IERSpredict Version	0623.0983 (last date: 2023-01-22 00:00:00)
Pipeline Start	2022-10-26 14:15:18 UTC
Execution Duration	6:10:41

Observation Summary

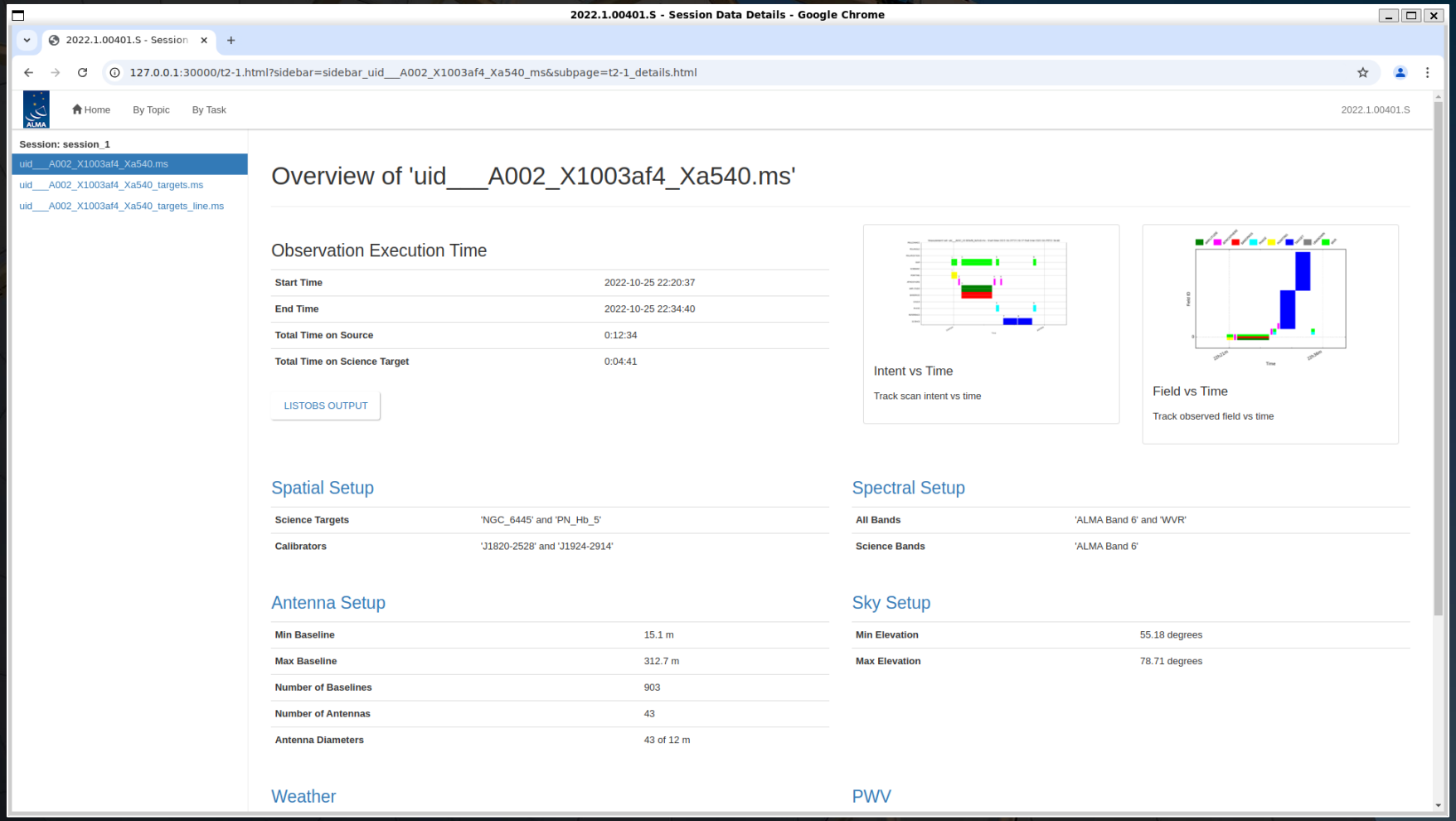
Measurement Set	Receivers	Num Antennas	Time (UTC)			Baseline Length			Size
			Start	End	On Target	Min	Max	RMS	
Observing Unit Set Status: uid://A001/X2d20/X2bb8 **Scheduling Block ID:** uid://A001/X2d20/X2b46 **Scheduling Block Name:** PN_Hb_5_a_06_TM2									
Session: session_1 **ACS Version:** 38083c1, **Build Version:** ONLINE-CYCLE9-B-13-2022-10-21-28-00-00									
uid___A002_X1003af4_Xa540.ms	ALMA Band 6	43	2022-10-25 22:20:37	2022-10-25 22:34:40 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:04:41	15.1 m	312.7 m	112.1 m	12.8 GiB
uid___A002_X1003af4_Xa540_targets.ms	ALMA Band 6	43	2022-10-25 22:29:12	2022-10-25 22:33:58 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:04:39	15.1 m	312.7 m	112.1 m	4.8 GiB
uid___A002_X1003af4_Xa540_targets_line.ms	ALMA Band 6	43	2022-10-25 22:29:12	2022-10-25 22:33:58 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:04:39	15.1 m	312.7 m	112.1 m	4.8 GiB



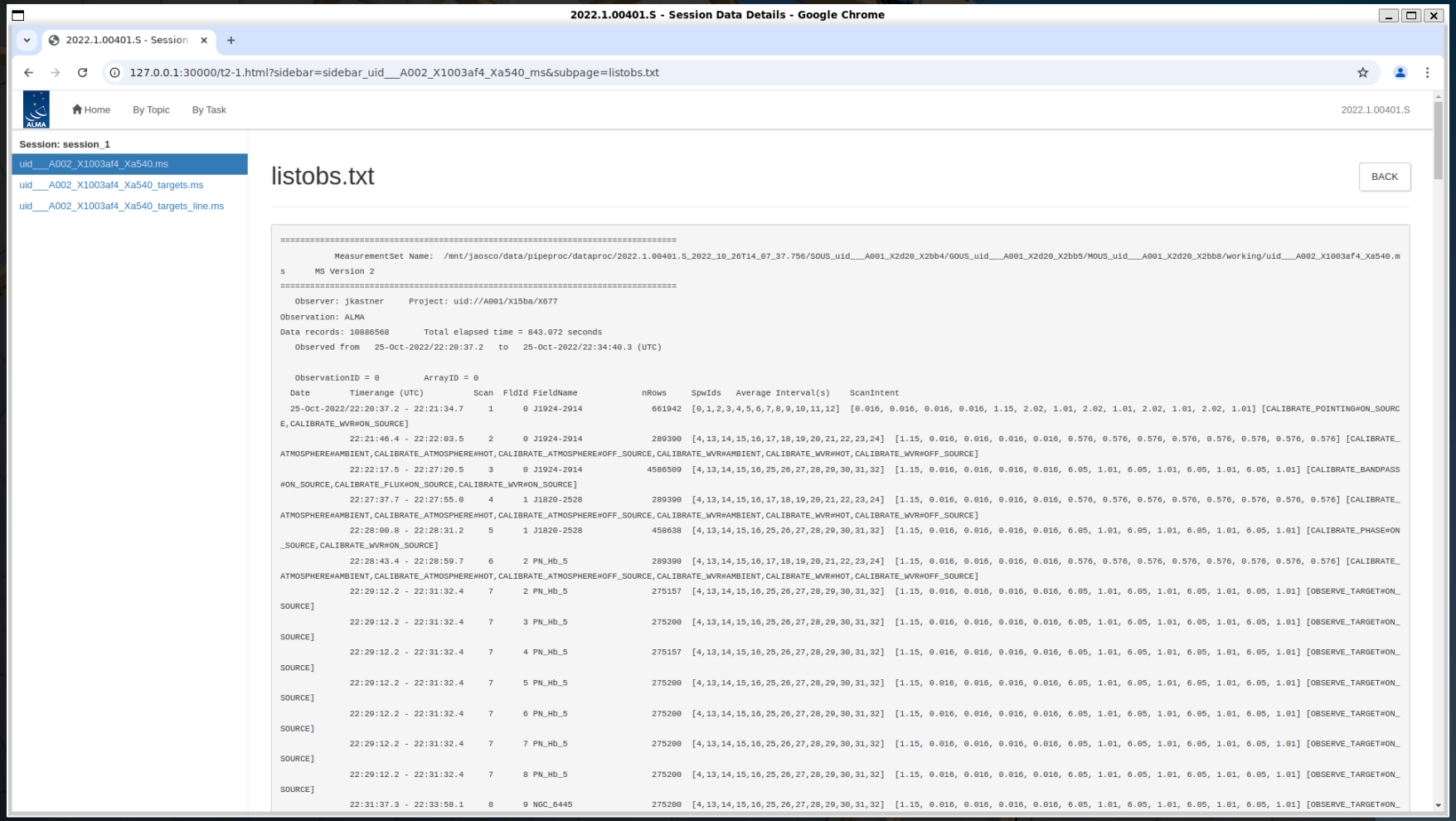
The WebLogs could be used primarily for three different purposes. Focus on the pages below for each of these purposes.

- To review the observations.
- To check the results of the calibration process and the quality of the data.
- To examine the preview images and get information for imaging.

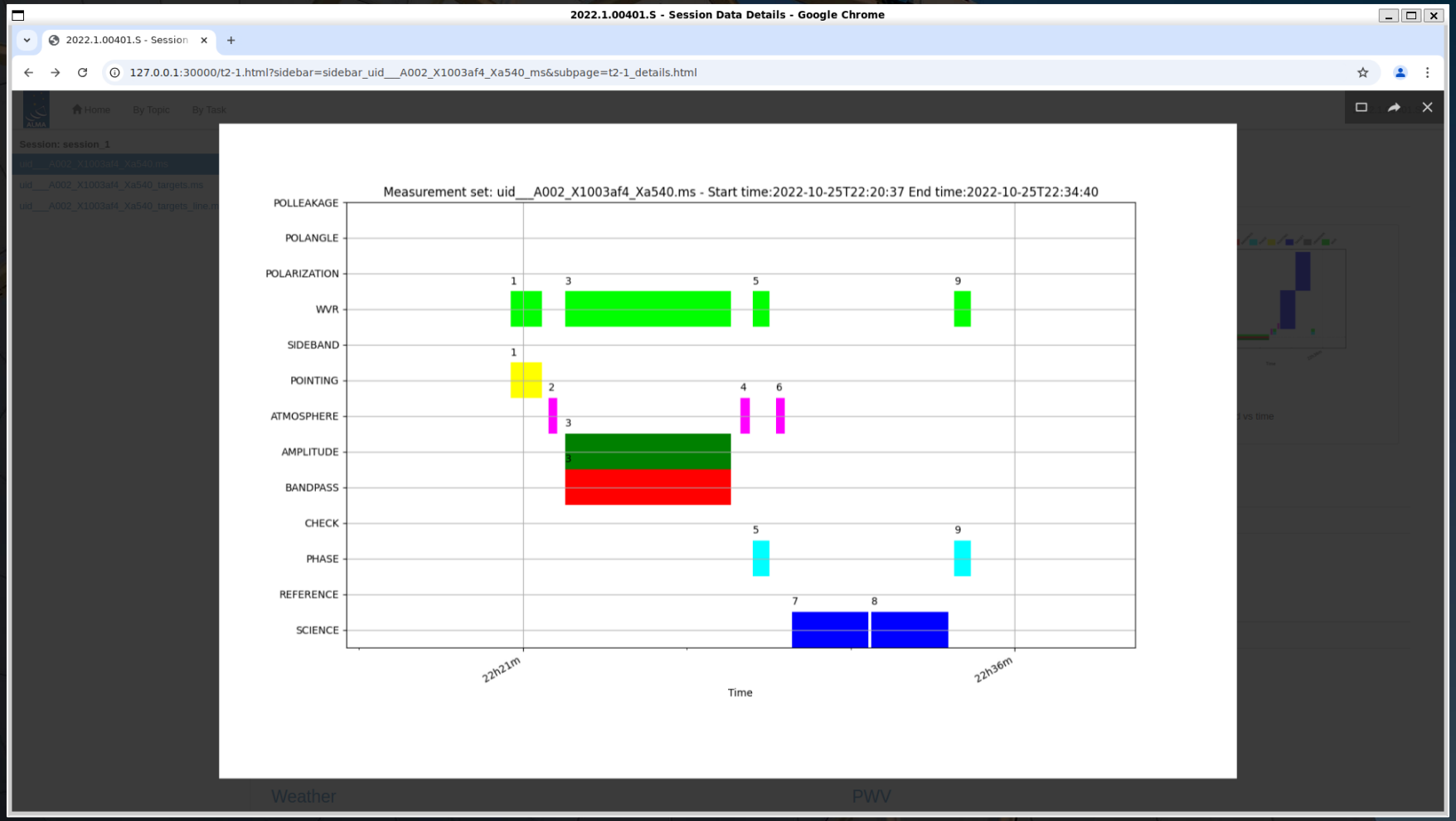
The overview page lists a lot of basic information about the observations themselves.



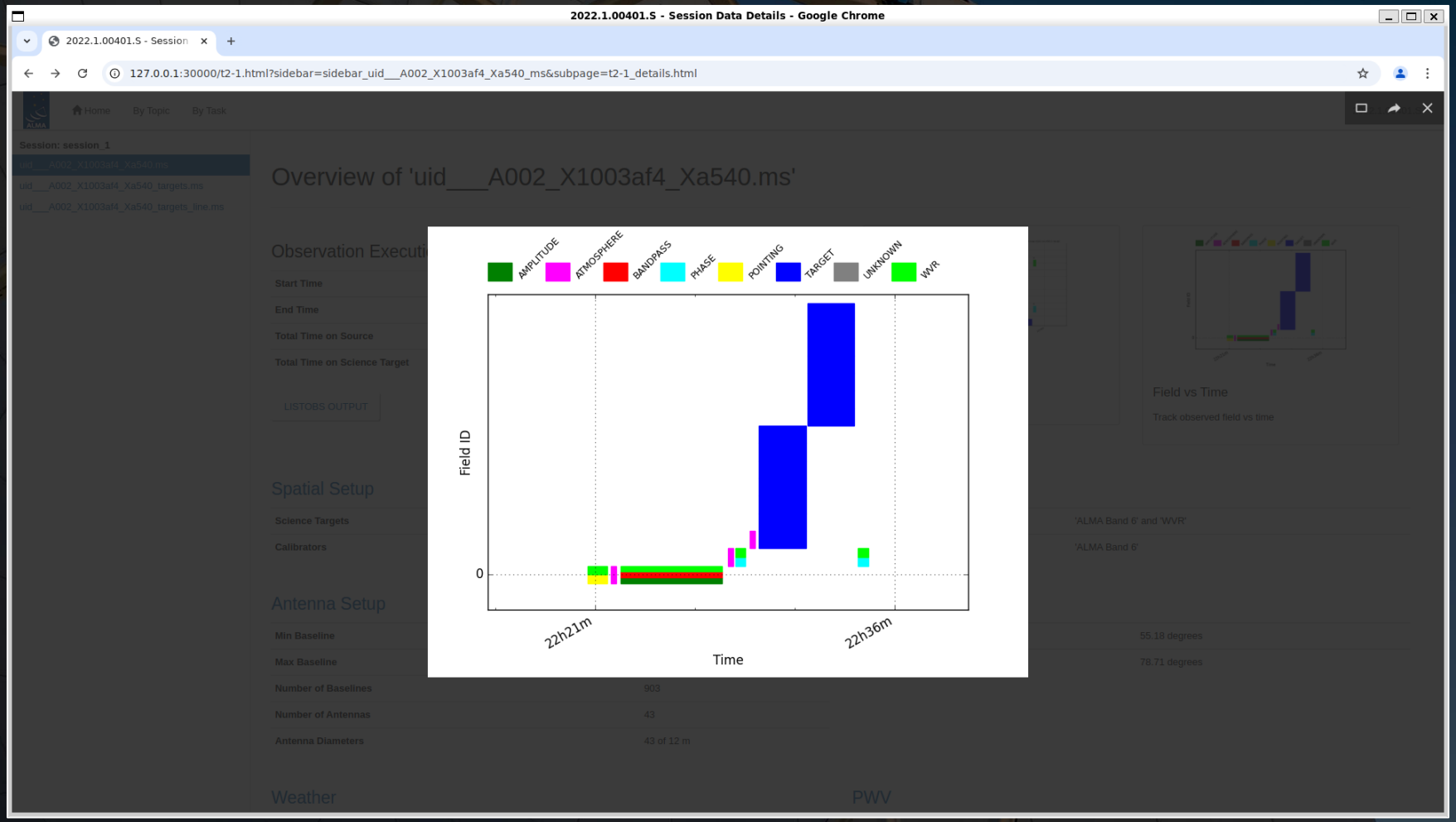
The listobs output button displays a text file with summary information about the sequence of observations, the fields, the spectral windows, and the antennas. Versions of this file can also be created using the `listobs` command in CASA.



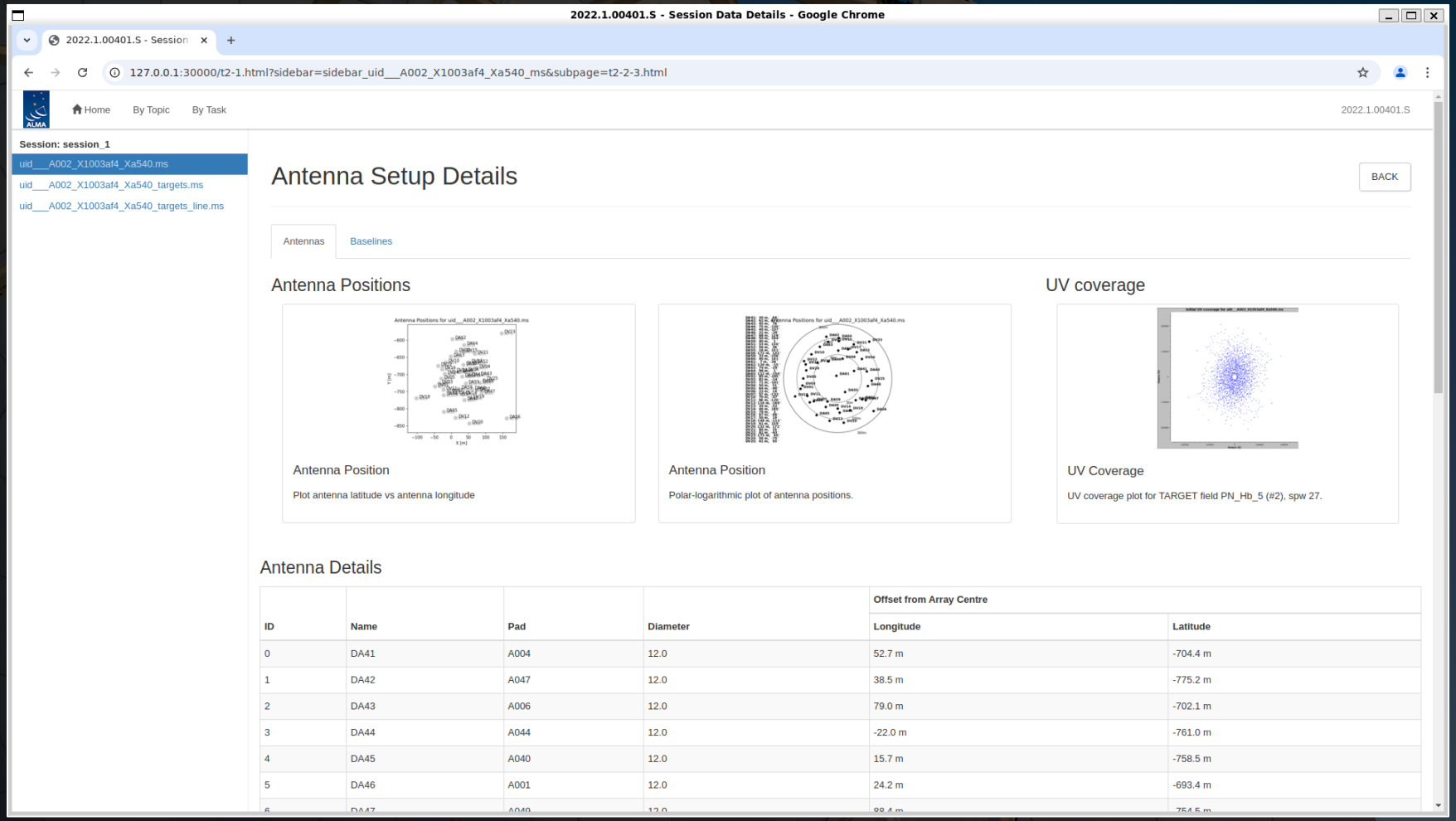
The intent versus time plot shows the sequence of the observations as well as the purpose of those observations. Some observations have multiple purposes.



The field versus time plot is similar except that the y-axis indicates the field ID. In this case, 0 is field for the bandpass calibrator, 1 is the field for the phase calibrator, and 2 is the field for the science target (Z CMa).

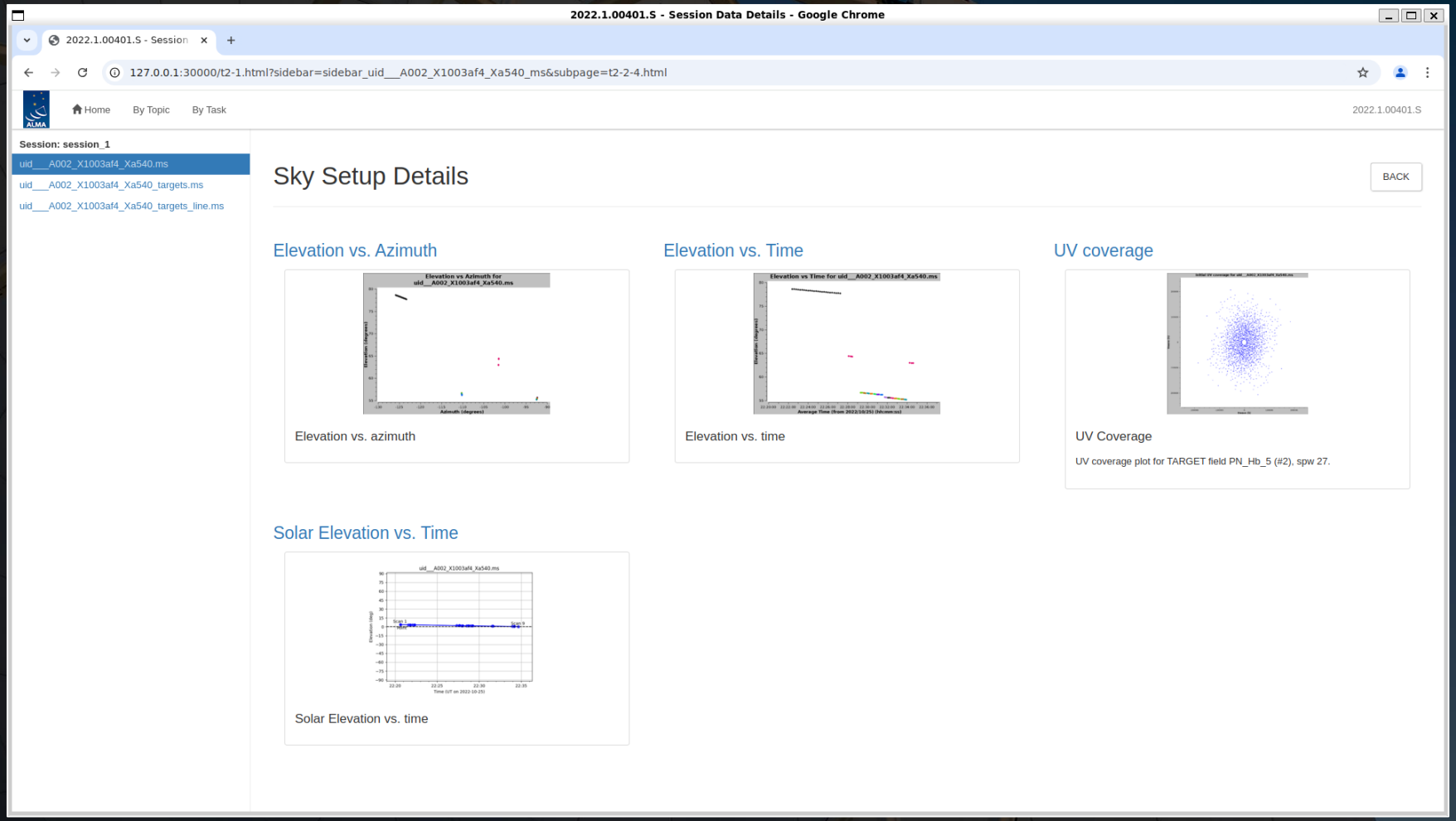


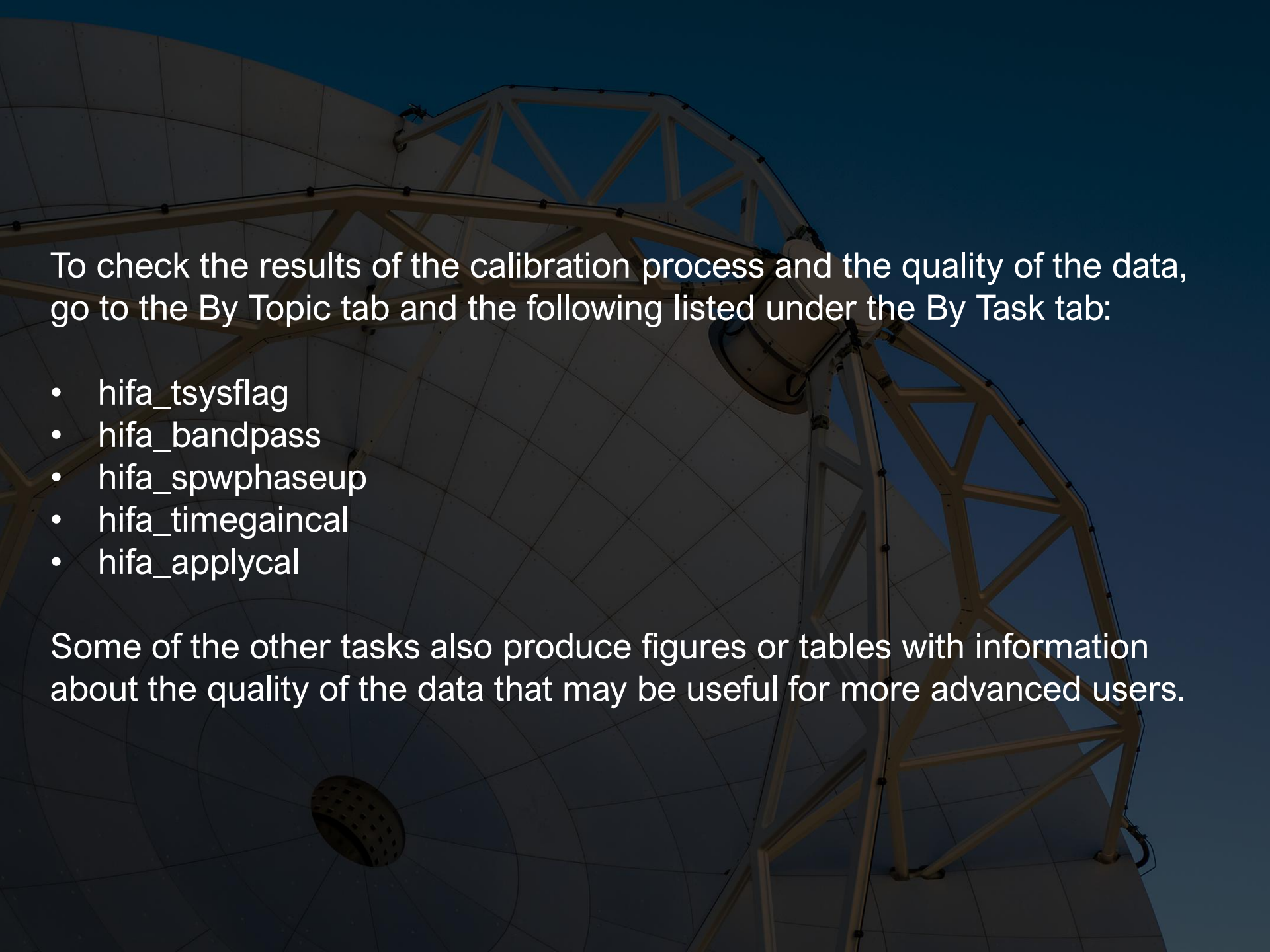
The antenna setup page shows the location of the antennas and the resulting uv coverage (which is related to the final angular resolution and maximum recoverable scale of the data).



ID	Name	Pad	Diameter	Offset from Array Centre	
				Longitude	Latitude
0	DA41	A004	12.0	52.7 m	-704.4 m
1	DA42	A047	12.0	38.5 m	-775.2 m
2	DA43	A006	12.0	79.0 m	-702.1 m
3	DA44	A044	12.0	-22.0 m	-761.0 m
4	DA45	A040	12.0	15.7 m	-758.5 m
5	DA46	A001	12.0	24.2 m	-693.4 m
6	DA47	A040	12.0	88.4 m	-754.5 m

The sky setup shows the elevation and azimuth of the fields during the observations. The beam for sources observed at low elevations (<45°) could appear elongated. Calibration problems may occur if the phase calibrator and science target are too far apart (>10°).





To check the results of the calibration process and the quality of the data, go to the By Topic tab and the following listed under the By Task tab:

- hifa_tsysflag
- hifa_bandpass
- hifa_spwphaseup
- hifa_timegaincal
- hifa_applycal

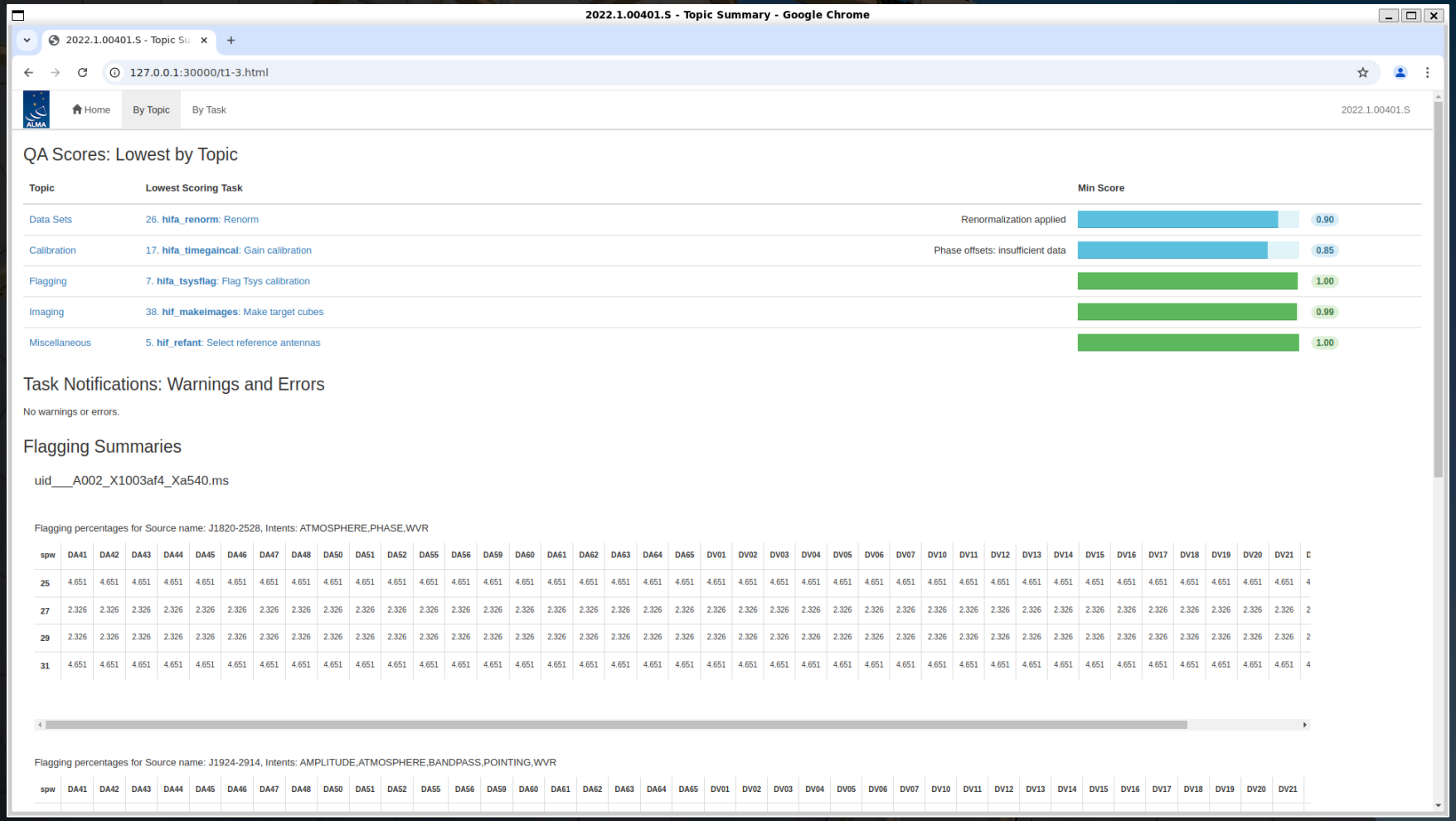
Some of the other tasks also produce figures or tables with information about the quality of the data that may be useful for more advanced users.

If any problems appear in the data and the problems are not corrected by the pipeline calibration, the flagdata command can be used in CASA to flag the data (which will indicate that the data should not be used in imaging). See the example below to flag the data for spw 27 from antenna DA59.

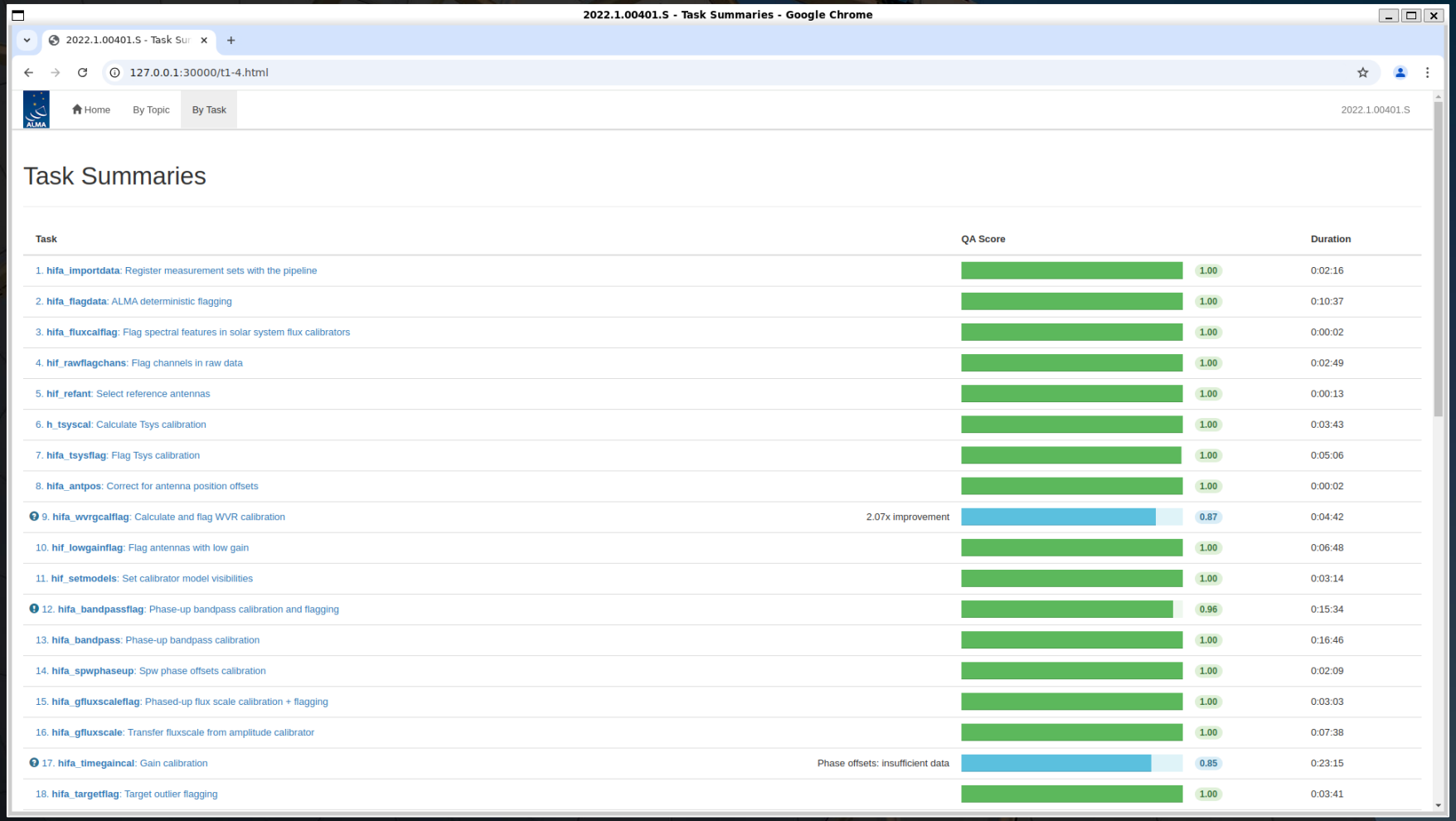
```
flagdata(vis='example.ms',
  mode='manual',
  antenna='DA59',
  spw='27',
  flagbackup=False)
```

If very severe problems are found in the WebLogs, especially problems affecting multiple antennas, it would be appropriate to submit a Helpdesk ticket to ask about the problem.

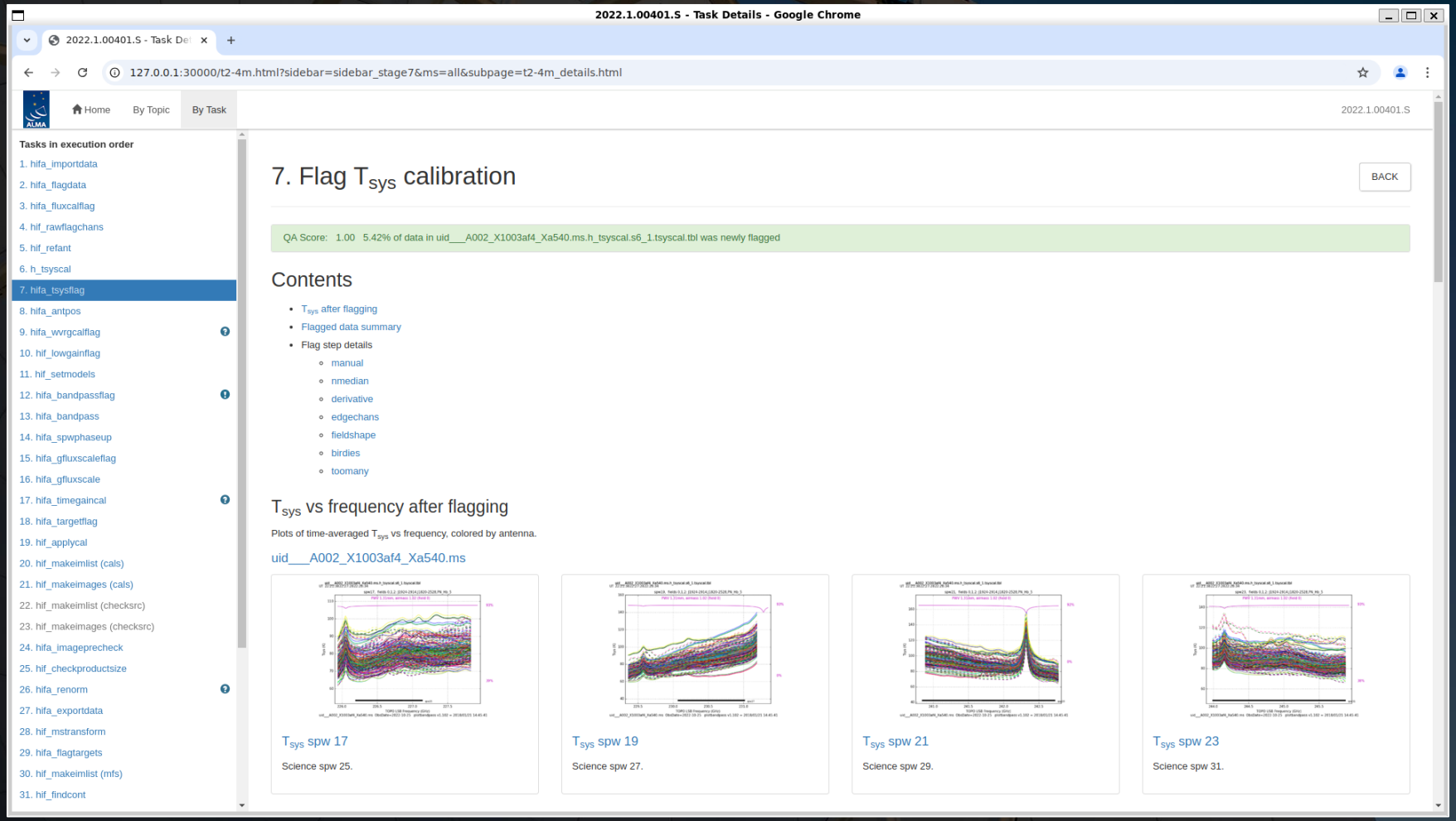
The By Topic page lists warnings that were produced by the pipeline along with grades for those warnings and tables showing the amount of data flagged for each antenna in each field. This page is more important for reviewing the quality of the data.



The By Task page lists each of the calibration and imaging steps that were applied in the pipeline. Not all of these steps need to be checked. Many of these have diagnostic information primarily used for quality assessment.



hifa_tsysflag: This step includes plots of the T_{sys} data (used to correct amplitudes) as a function of frequency. It is useful to check these plots to understand the atmospheric transmission. Spectral features in these data could potentially reappear in the final spectra of the science targets.



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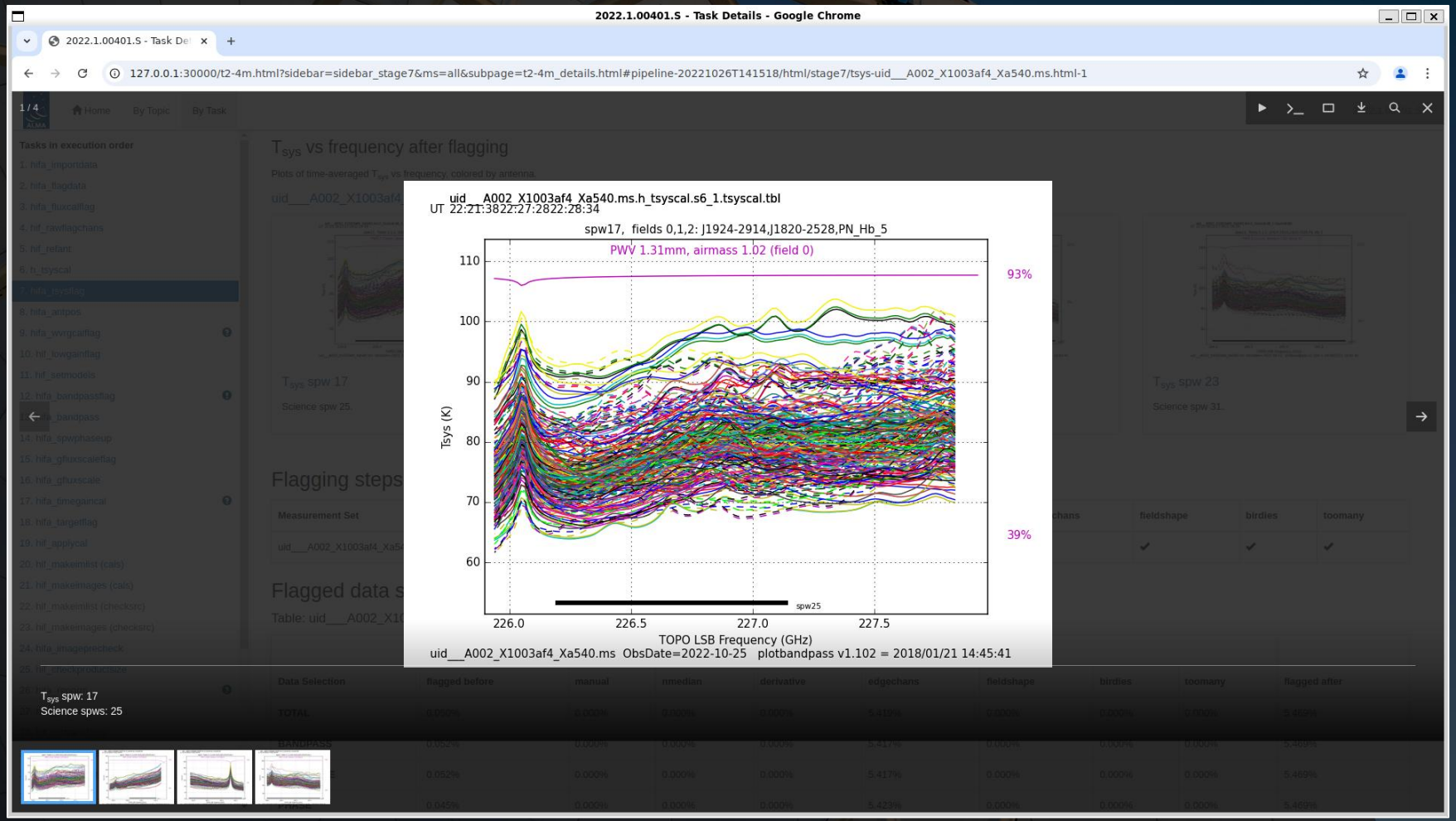
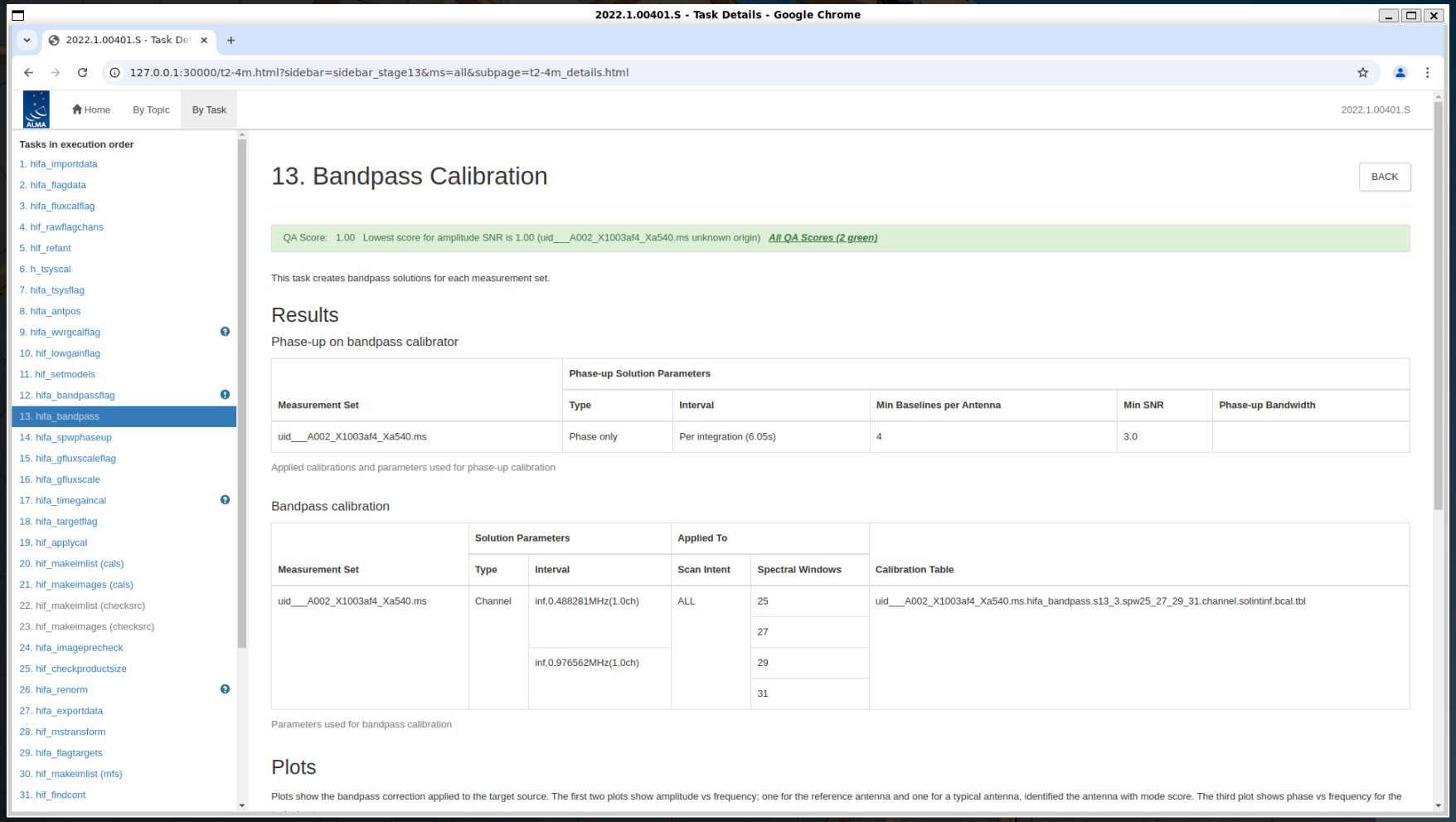
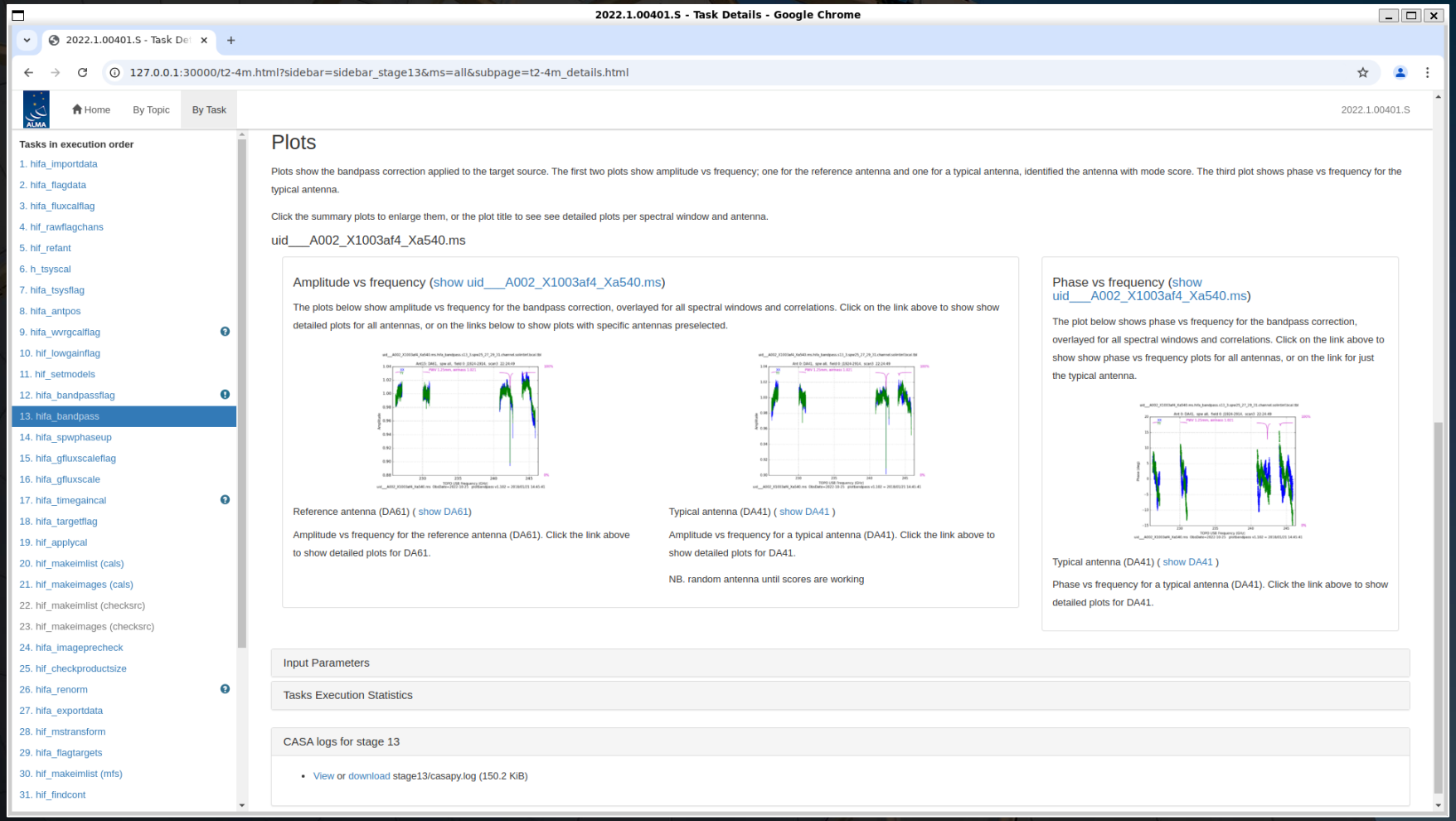


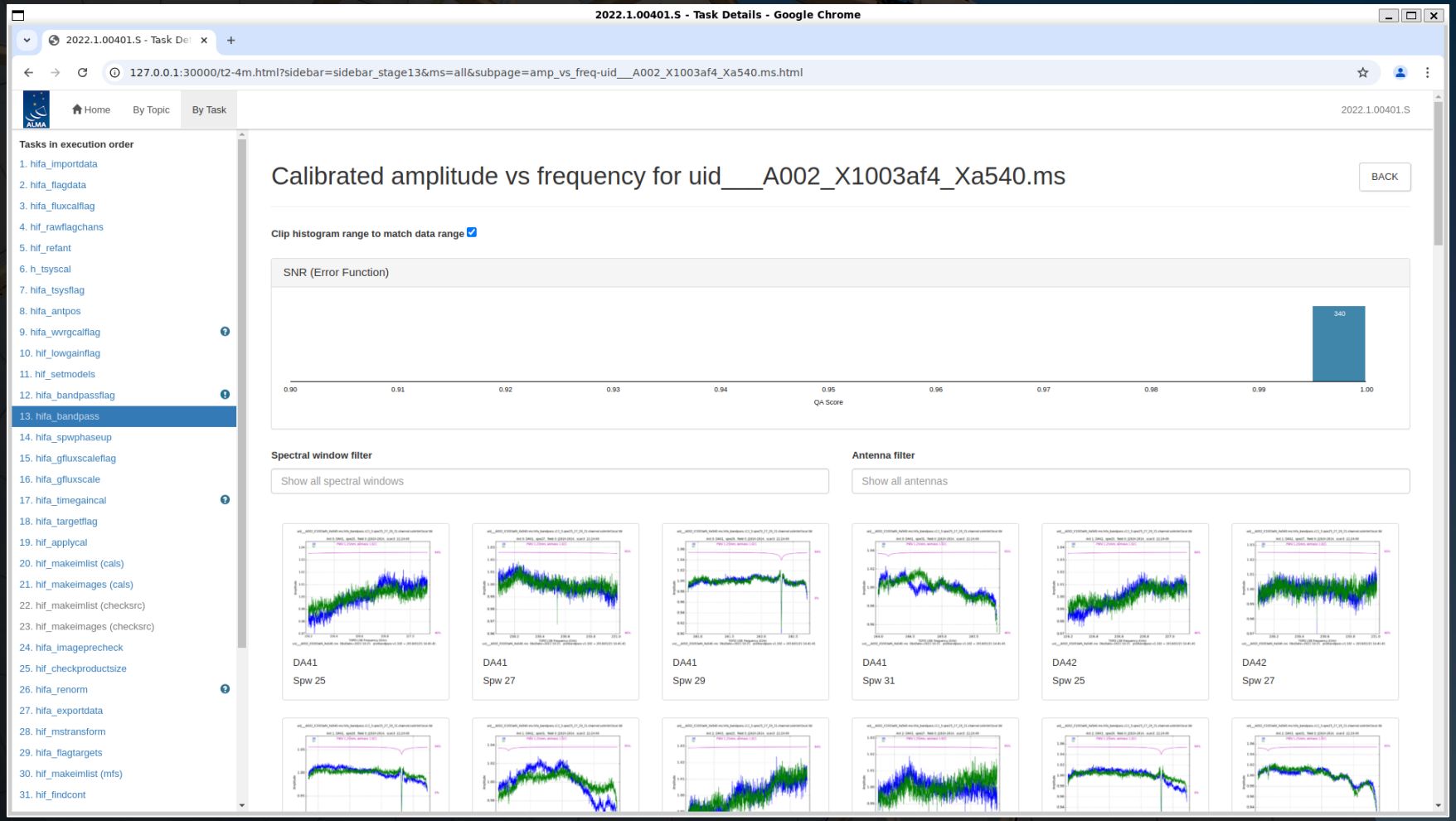
hifa_bandpass: Corrections for the phase and amplitude versus frequency are derived in this step.



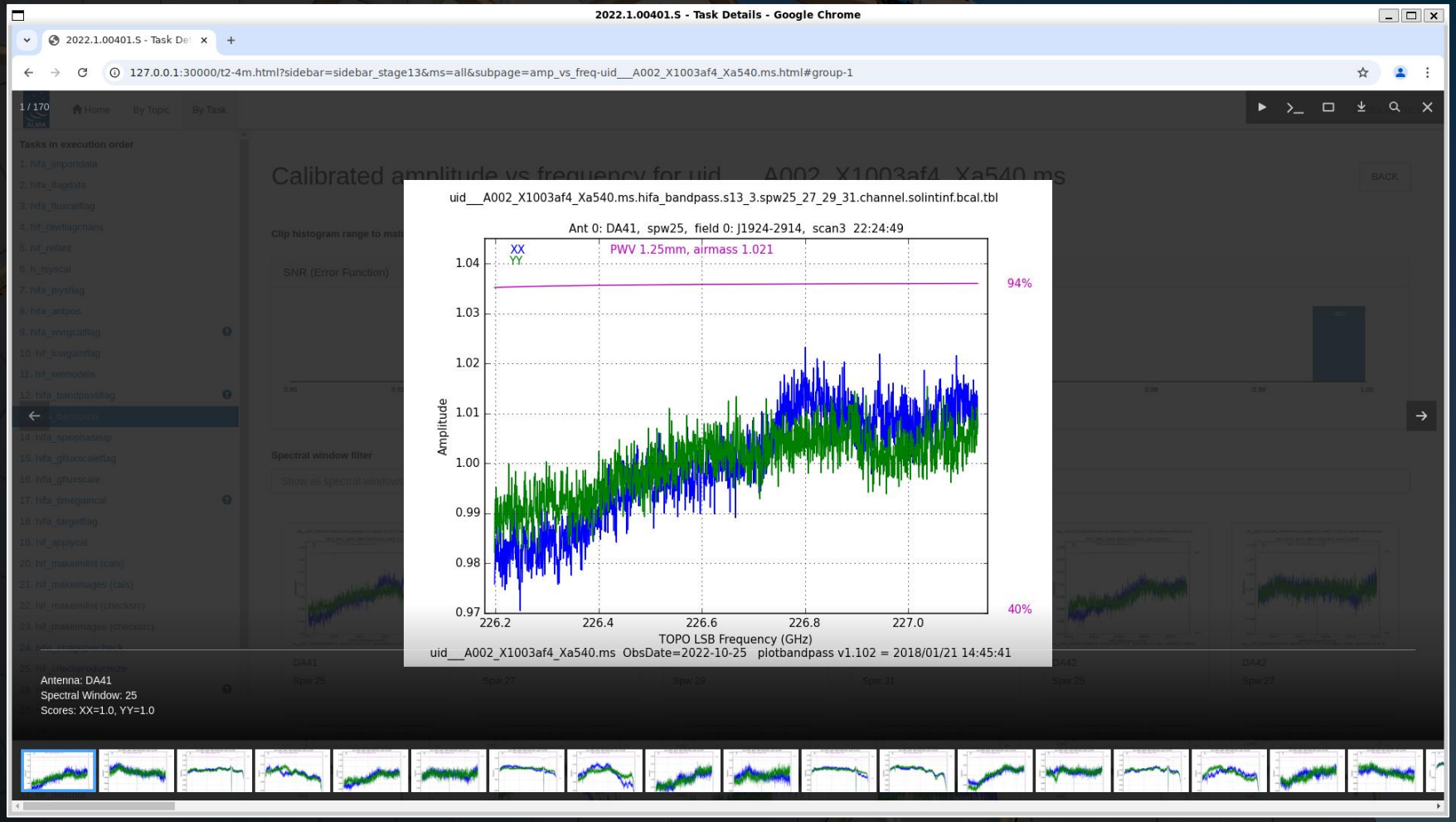
The plots of these quantities versus frequency should be smooth. Any strong spikes or dips in the data could create false spectral lines in the final image cubes.



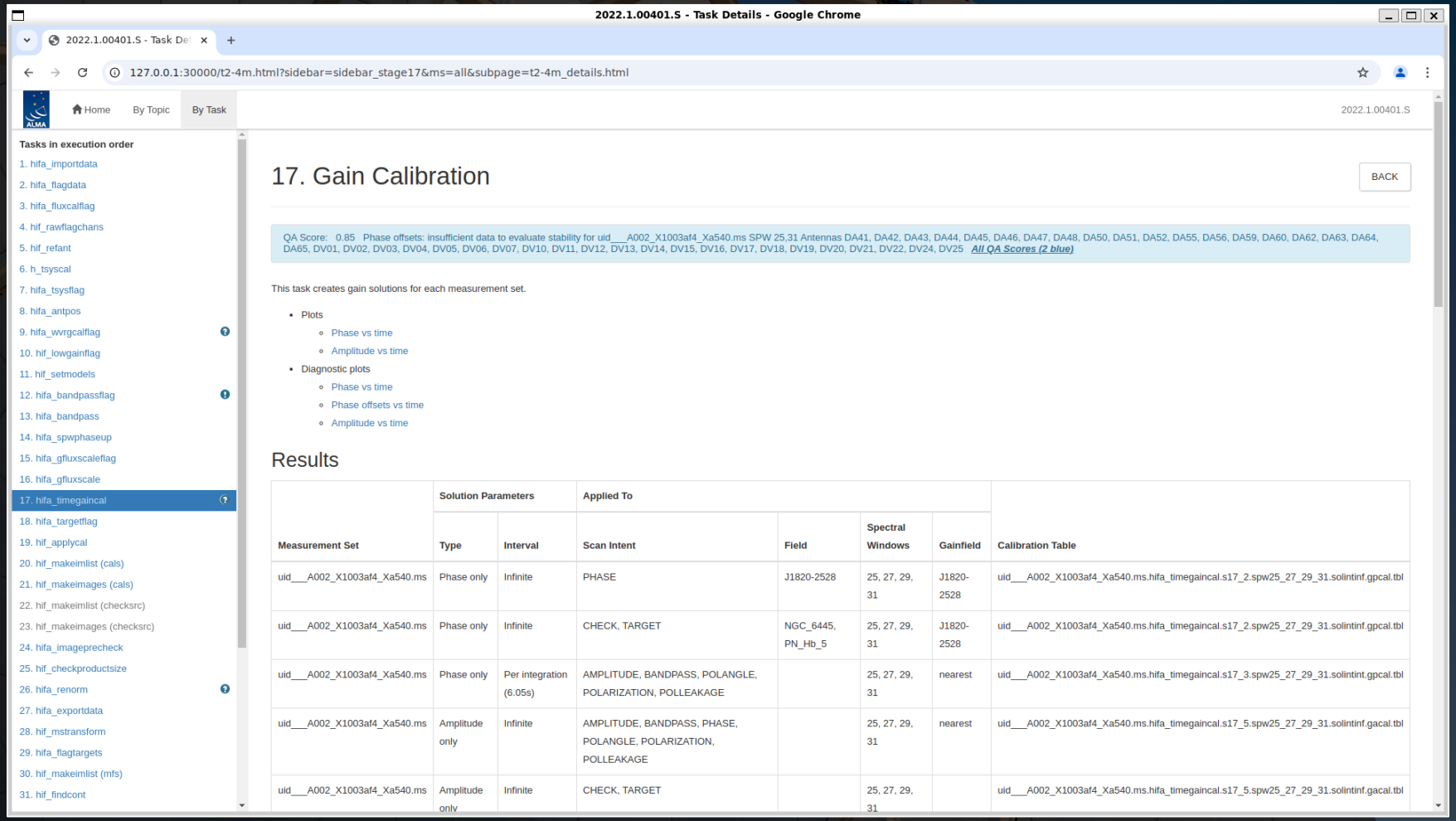
The plots of these quantities versus frequency should be smooth. Any strong spikes or dips in the data could create false spectral lines in the final image cubes.



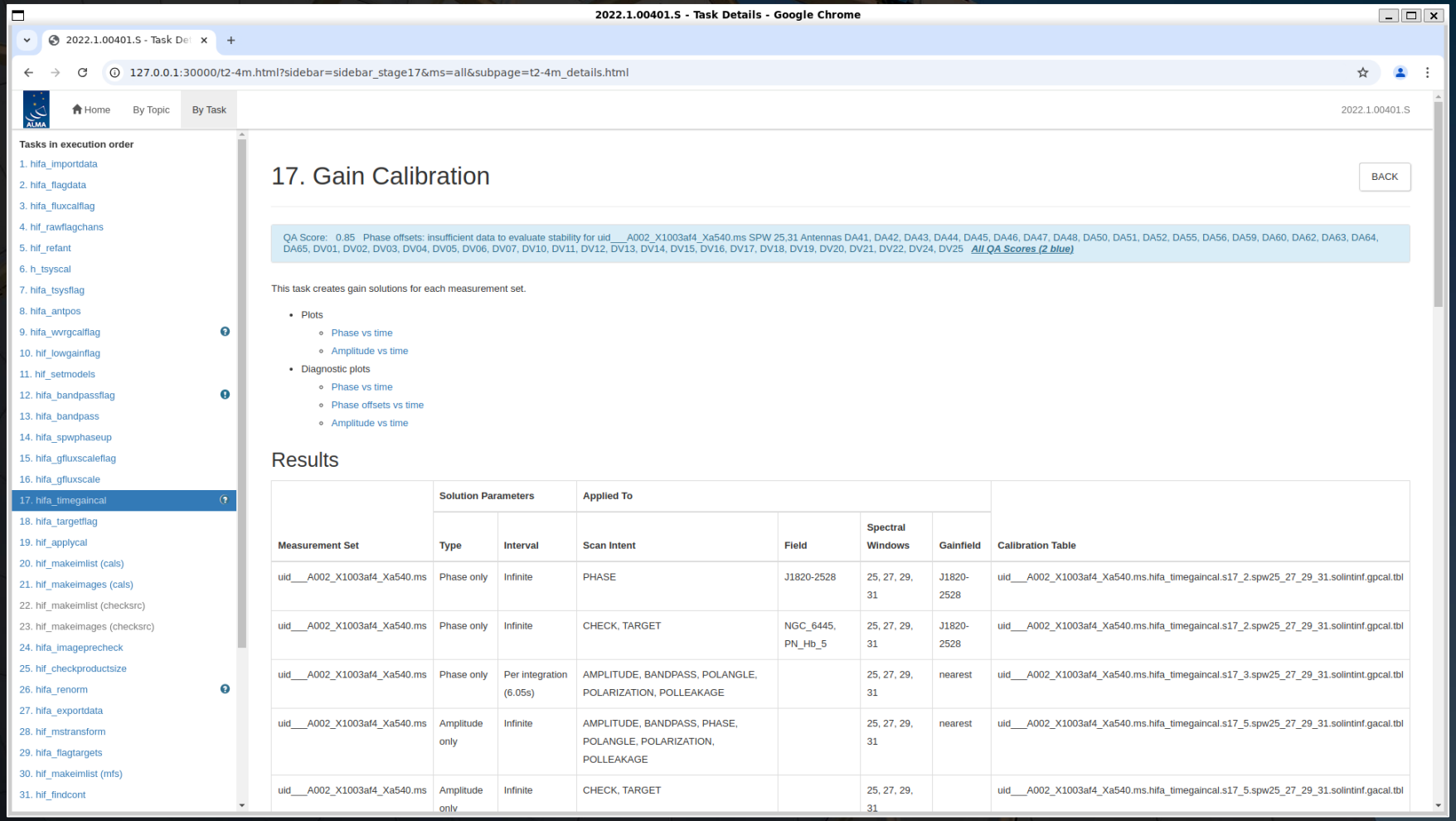
The plots of these quantities versus frequency should be smooth. Any strong spikes or dips in the data could create false spectral lines in the final image cubes.



hifa_spwphaseup: This module creates diagnostic plots of the .

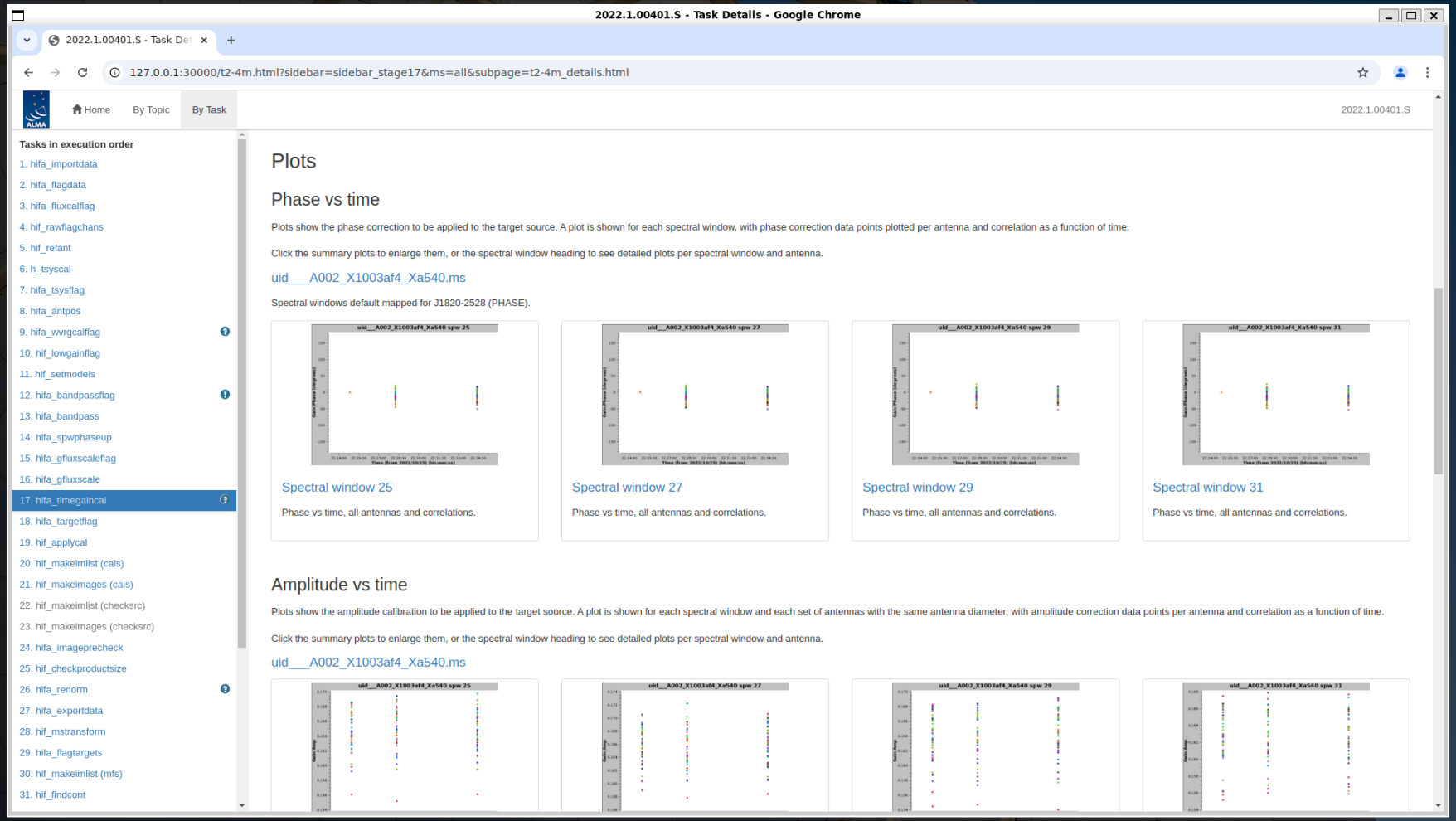


hifa_timegaincal: This module derives phase and amplitude corrections versus time. The output from this module only needs to be reviewed when problems arise with the data.

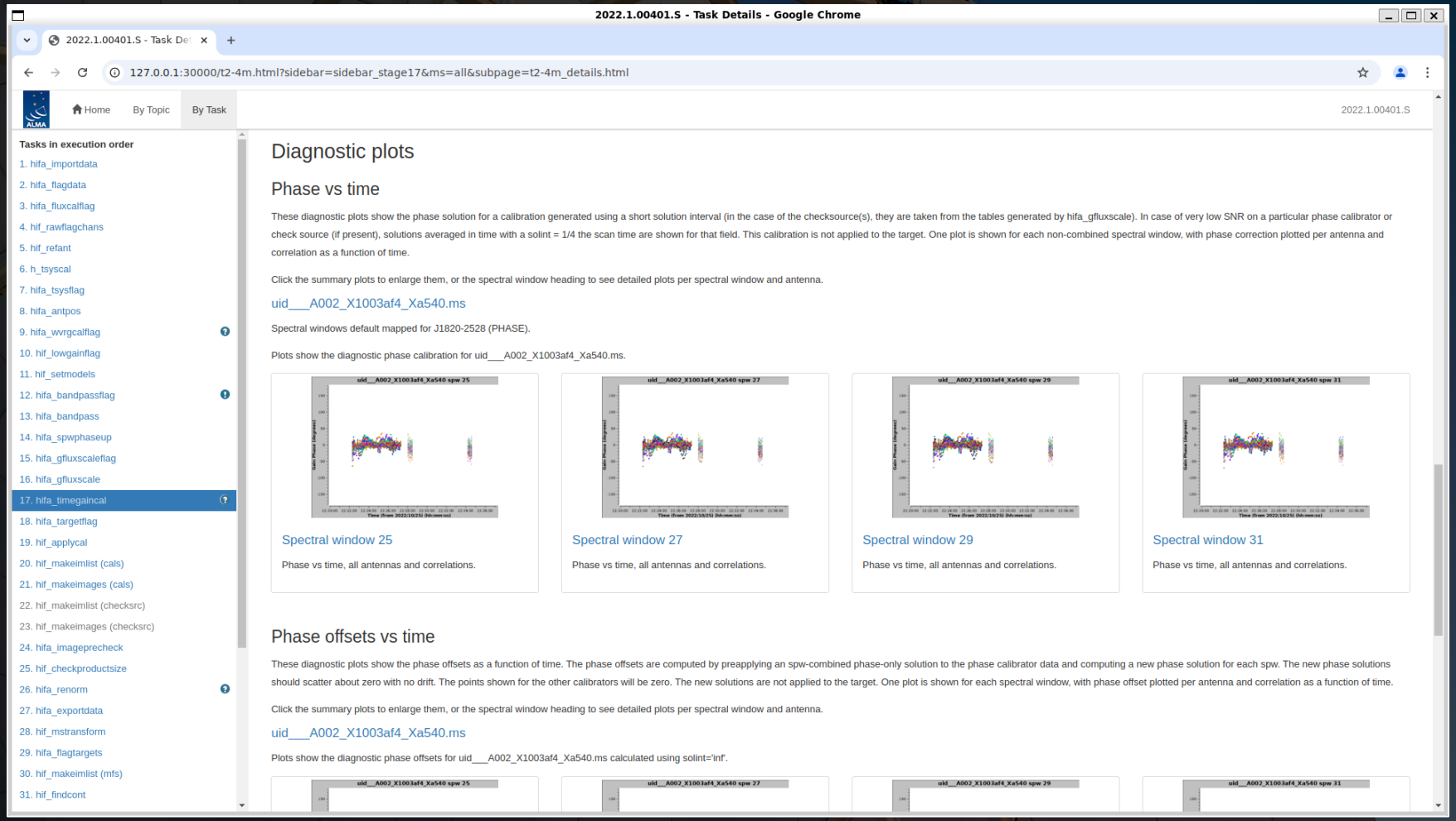


Measurement Set	Solution Parameters		Applied To				Calibration Table
	Type	Interval	Scan Intent	Field	Spectral Windows	Gainfield	
uid___A002_X1003af4_Xa540.ms	Phase only	Infinite	PHASE	J1820-2528	25, 27, 29, 31	J1820-2528	uid___A002_X1003af4_Xa540.ms.hifa_timegaincal.s17_2.spw25_27_29_31.solintinf.gpcal.tbl
uid___A002_X1003af4_Xa540.ms	Phase only	Infinite	CHECK, TARGET	NGC_6445, PN_Hb_5	25, 27, 29, 31	J1820-2528	uid___A002_X1003af4_Xa540.ms.hifa_timegaincal.s17_2.spw25_27_29_31.solintinf.gpcal.tbl
uid___A002_X1003af4_Xa540.ms	Phase only	Per integration (6.05s)	AMPLITUDE, BANDPASS, POLANGLE, POLARIZATION, POLLEAKAGE		25, 27, 29, 31	nearest	uid___A002_X1003af4_Xa540.ms.hifa_timegaincal.s17_3.spw25_27_29_31.solintint.gpcal.tbl
uid___A002_X1003af4_Xa540.ms	Amplitude only	Infinite	AMPLITUDE, BANDPASS, PHASE, POLANGLE, POLARIZATION, POLLEAKAGE		25, 27, 29, 31	nearest	uid___A002_X1003af4_Xa540.ms.hifa_timegaincal.s17_5.spw25_27_29_31.solintinf.gacal.tbl
uid___A002_X1003af4_Xa540.ms	Amplitude only	Infinite	CHECK, TARGET		25, 27, 29, 31		uid___A002_X1003af4_Xa540.ms.hifa_timegaincal.s17_5.spw25_27_29_31.solintinf.gacal.tbl

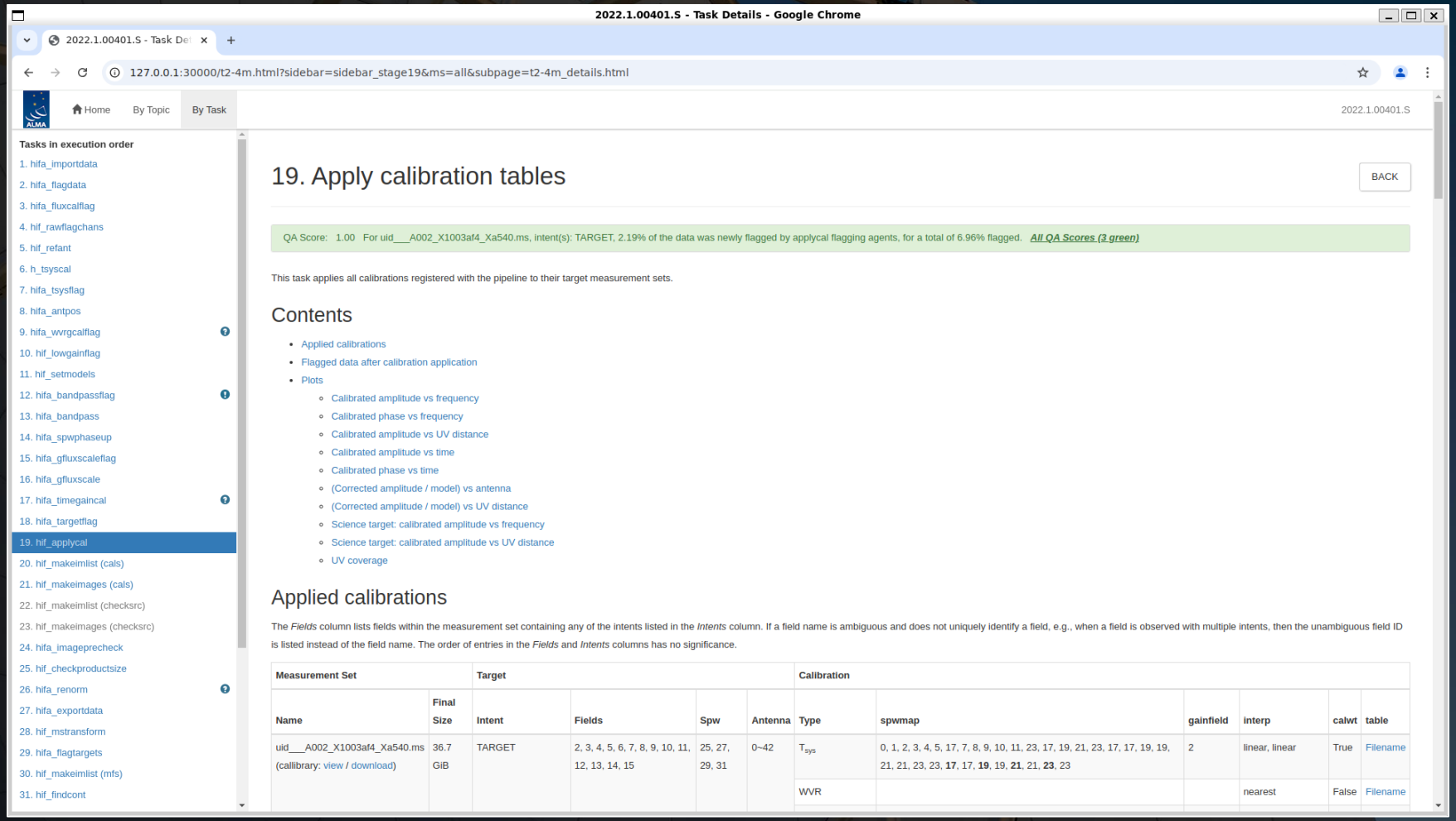
hifa_timegaincal: This module derives phase and amplitude corrections versus time. The output from this module only needs to be reviewed when problems arise with the data.



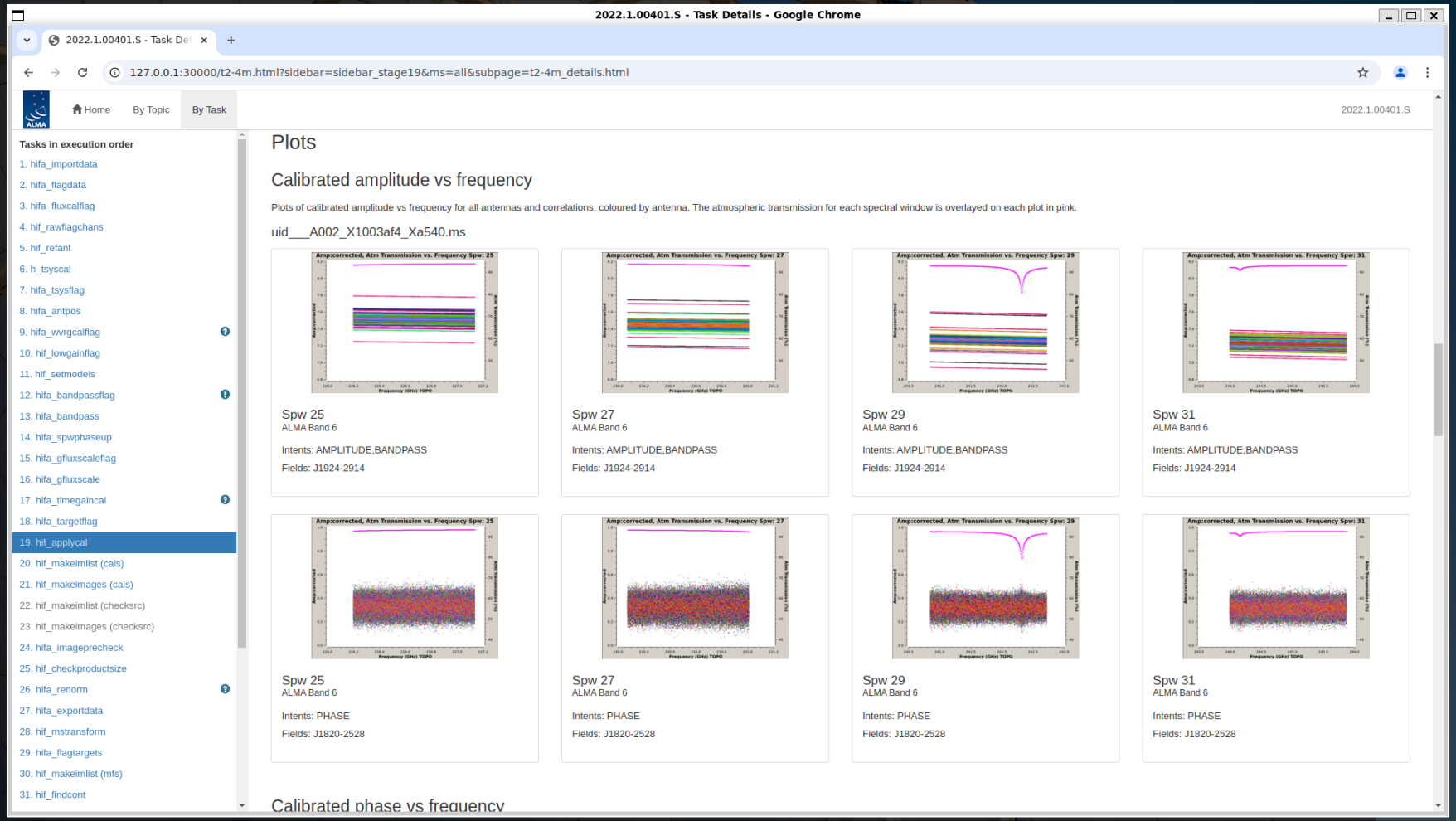
hifa_timegaincal: This module derives phase and amplitude corrections versus time. The output from this module only needs to be reviewed when problems arise with the data.



hifa_applycal: This step applies the calibration tables and created plots of the phases and amplitudes afterwards. Most of the output from this module only needs to be reviewed when problems arise with the data.



hifa_applycal: This step applies the calibration tables and created plots of the phases and amplitudes afterwards. Most of the output from this module only needs to be reviewed when problems arise with the data.



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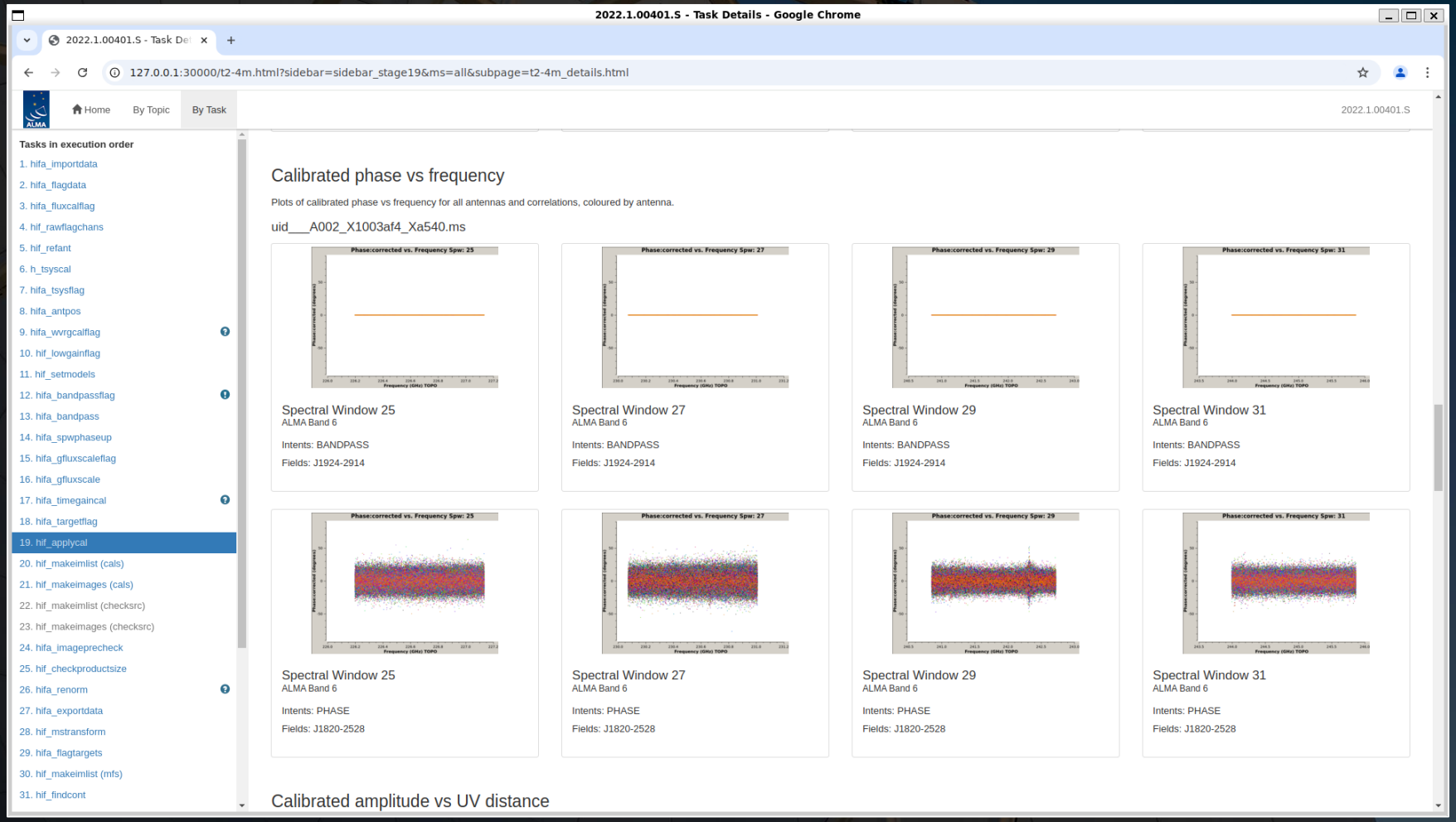

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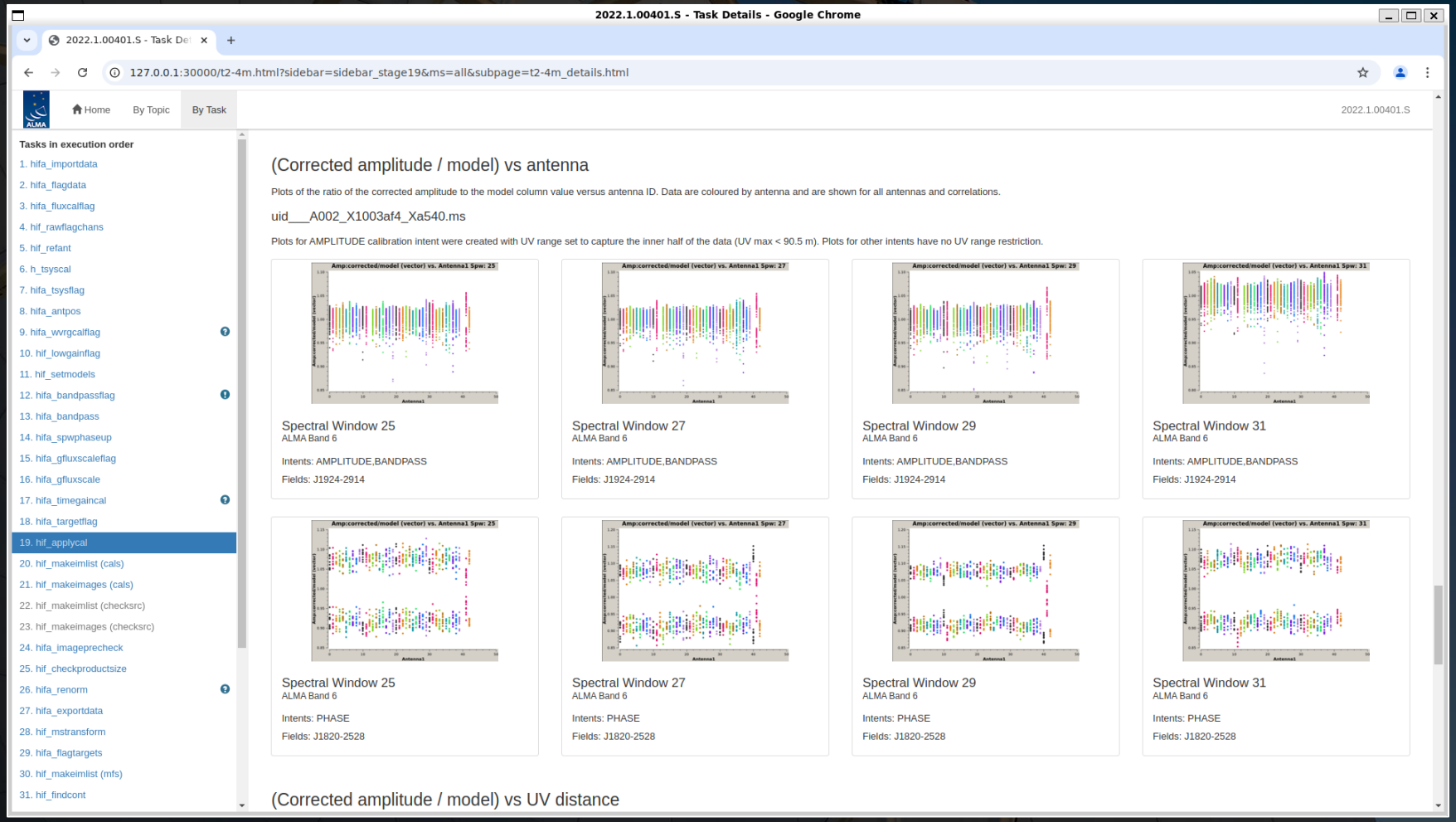
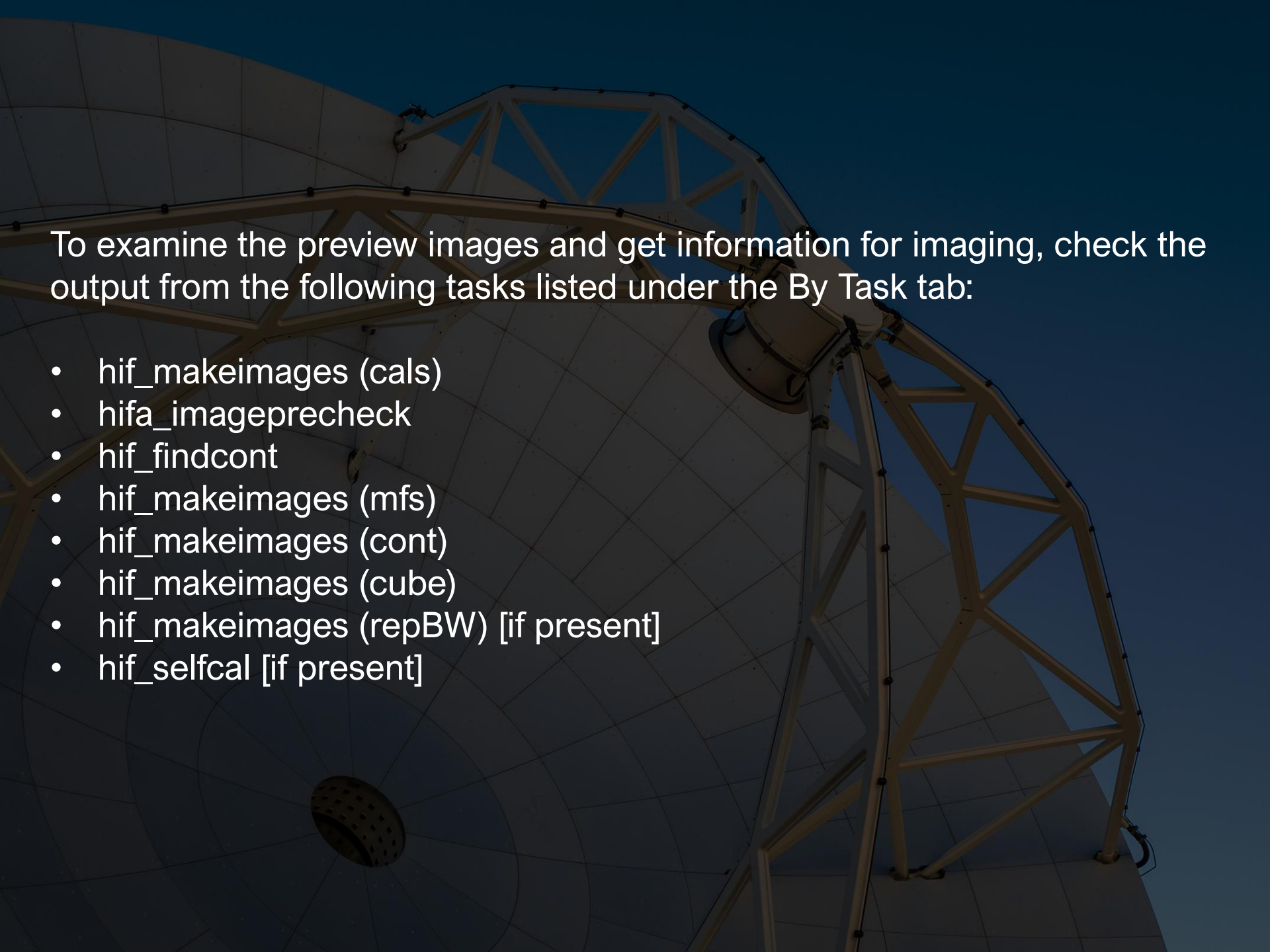
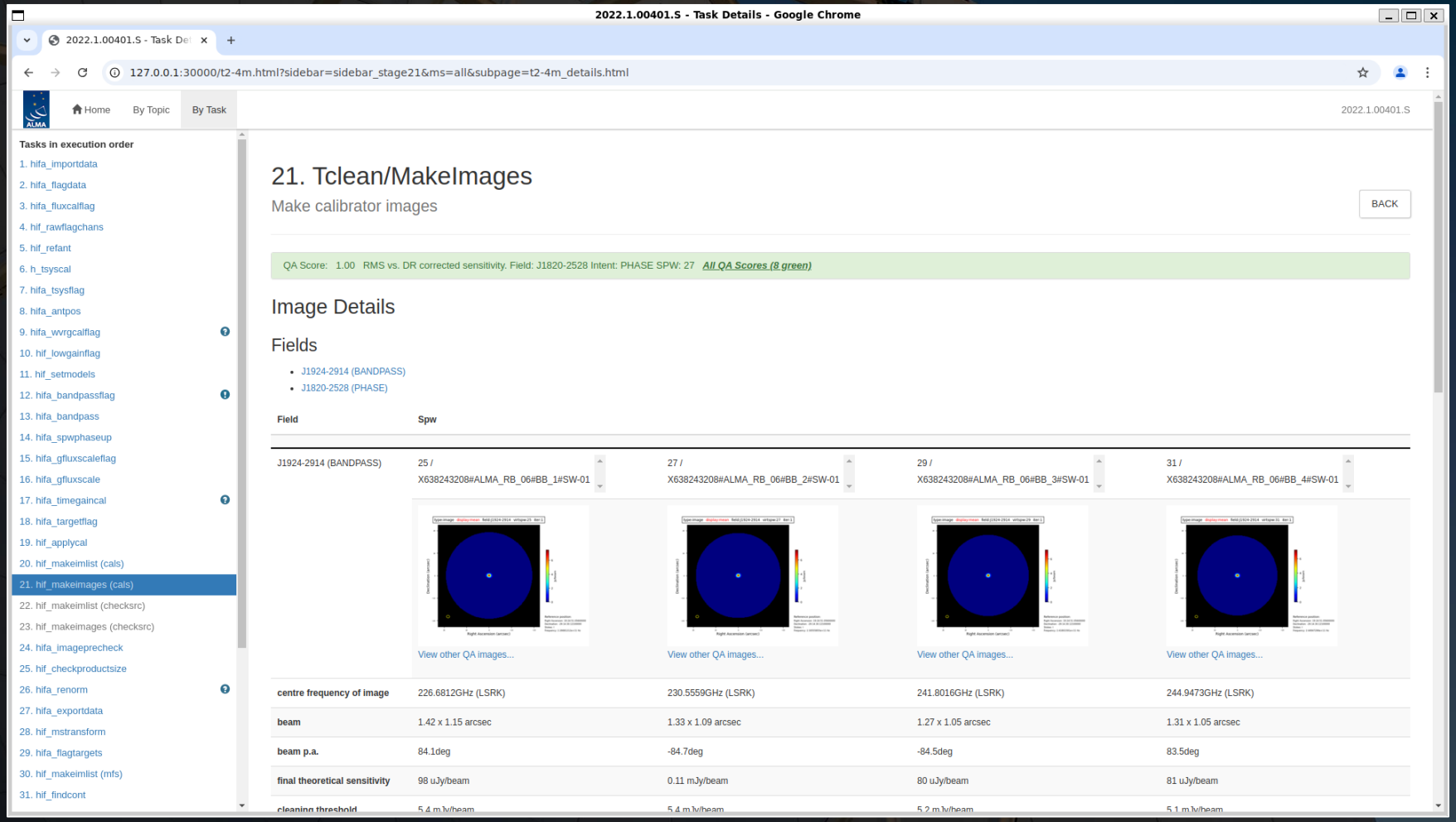




To examine the preview images and get information for imaging, check the output from the following tasks listed under the By Task tab:

- hif_makeimages (cals)
- hifa_imageprecheck
- hif_findcont
- hif_makeimages (mfs)
- hif_makeimages (cont)
- hif_makeimages (cube)
- hif_makeimages (repBW) [if present]
- hif_selfcal [if present]

hif_makeimages (cals): When this is first called, it makes continuum images of each calibrator in each spw for quality assessment. The images of the phase calibrator (which is near the science targets) are useful to look at to understand the beam size and shape.



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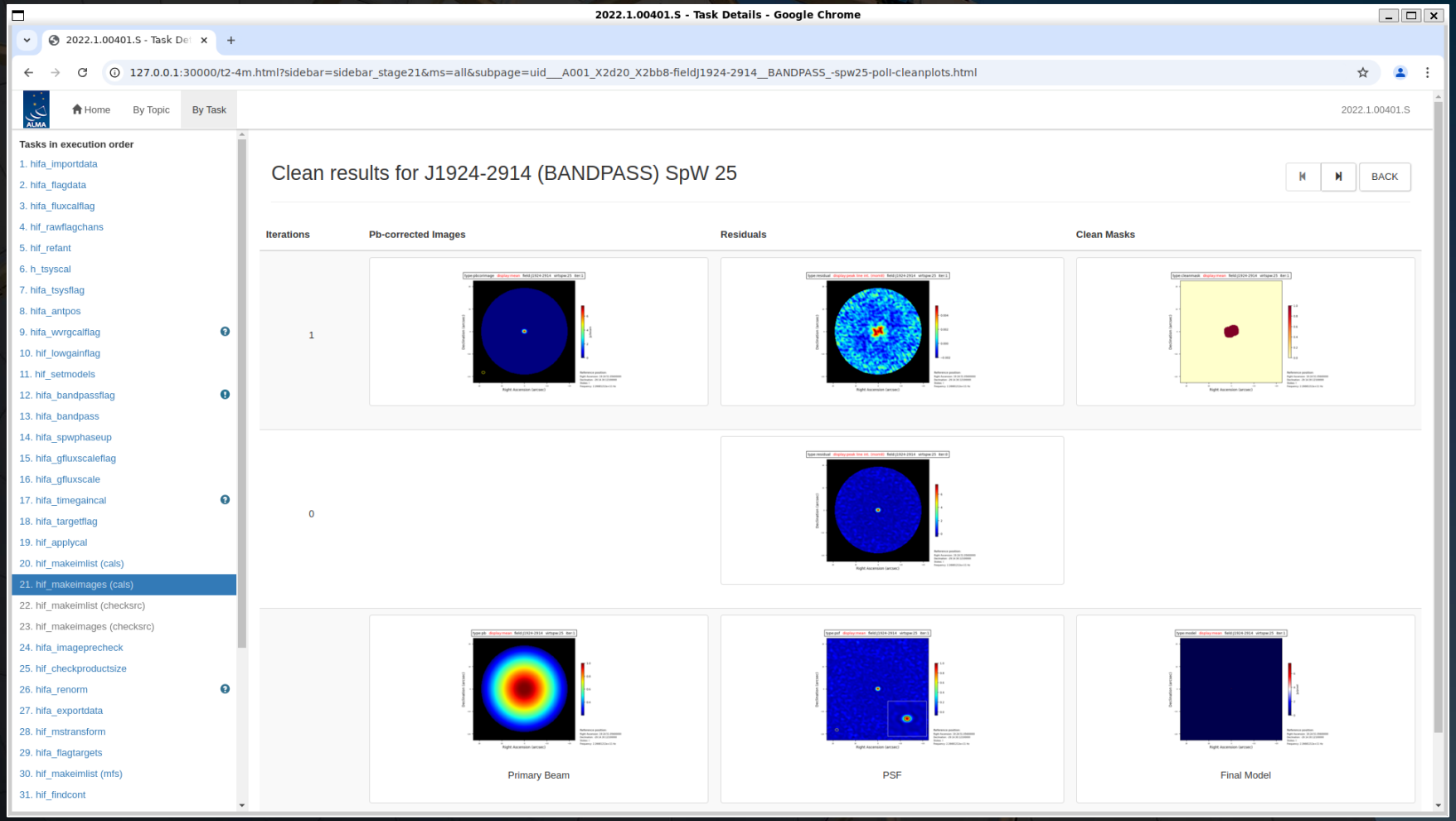
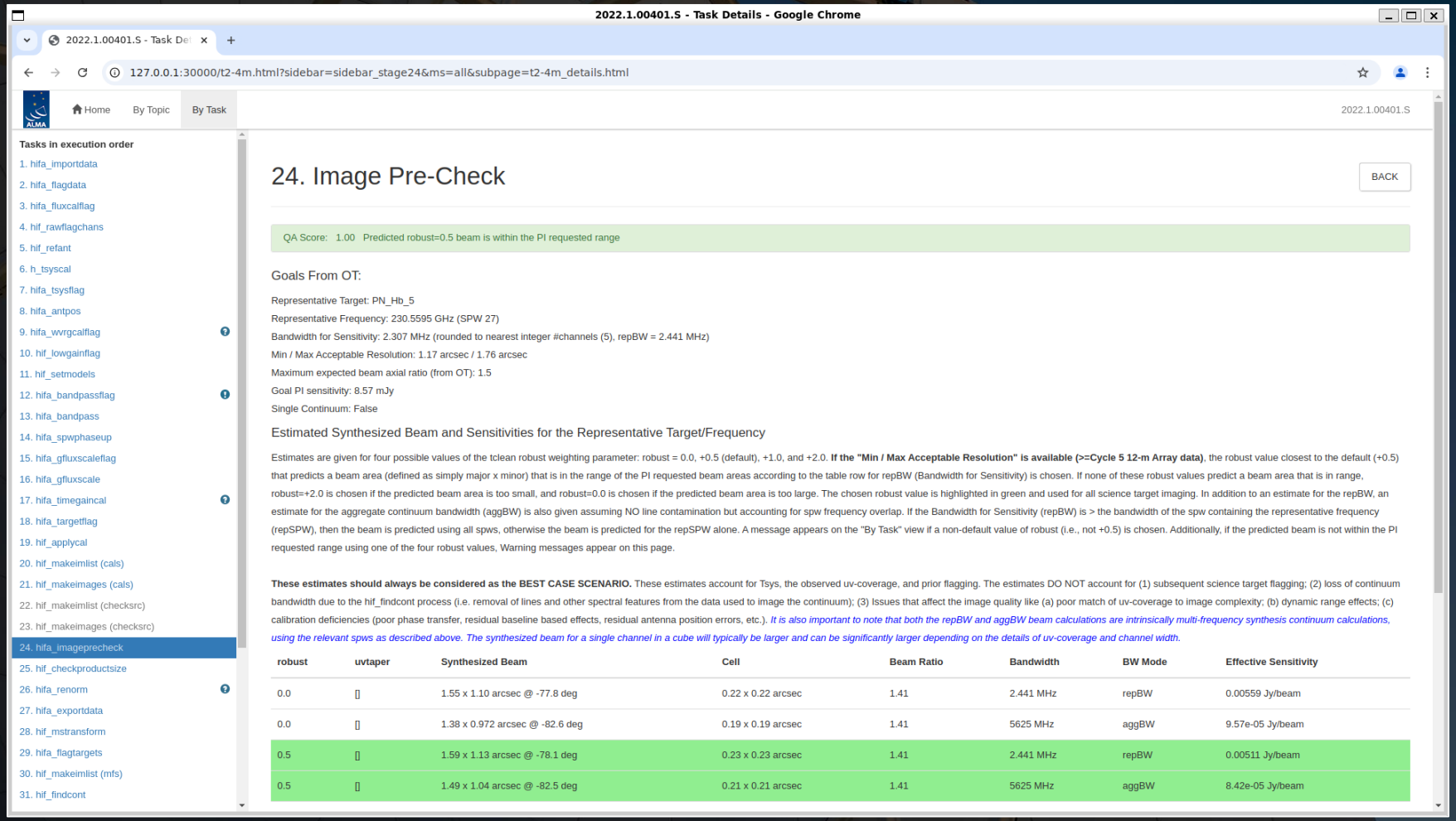
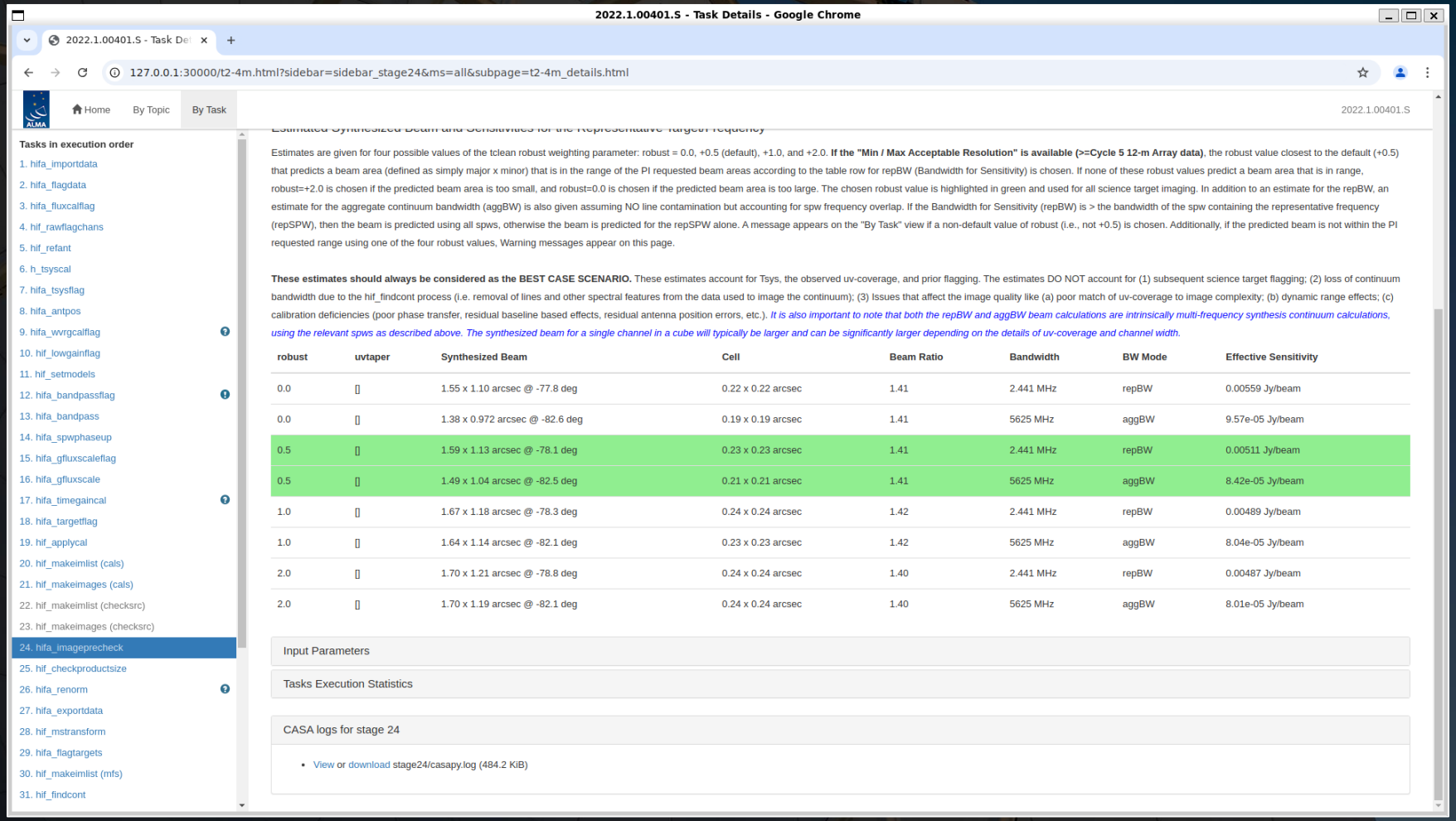


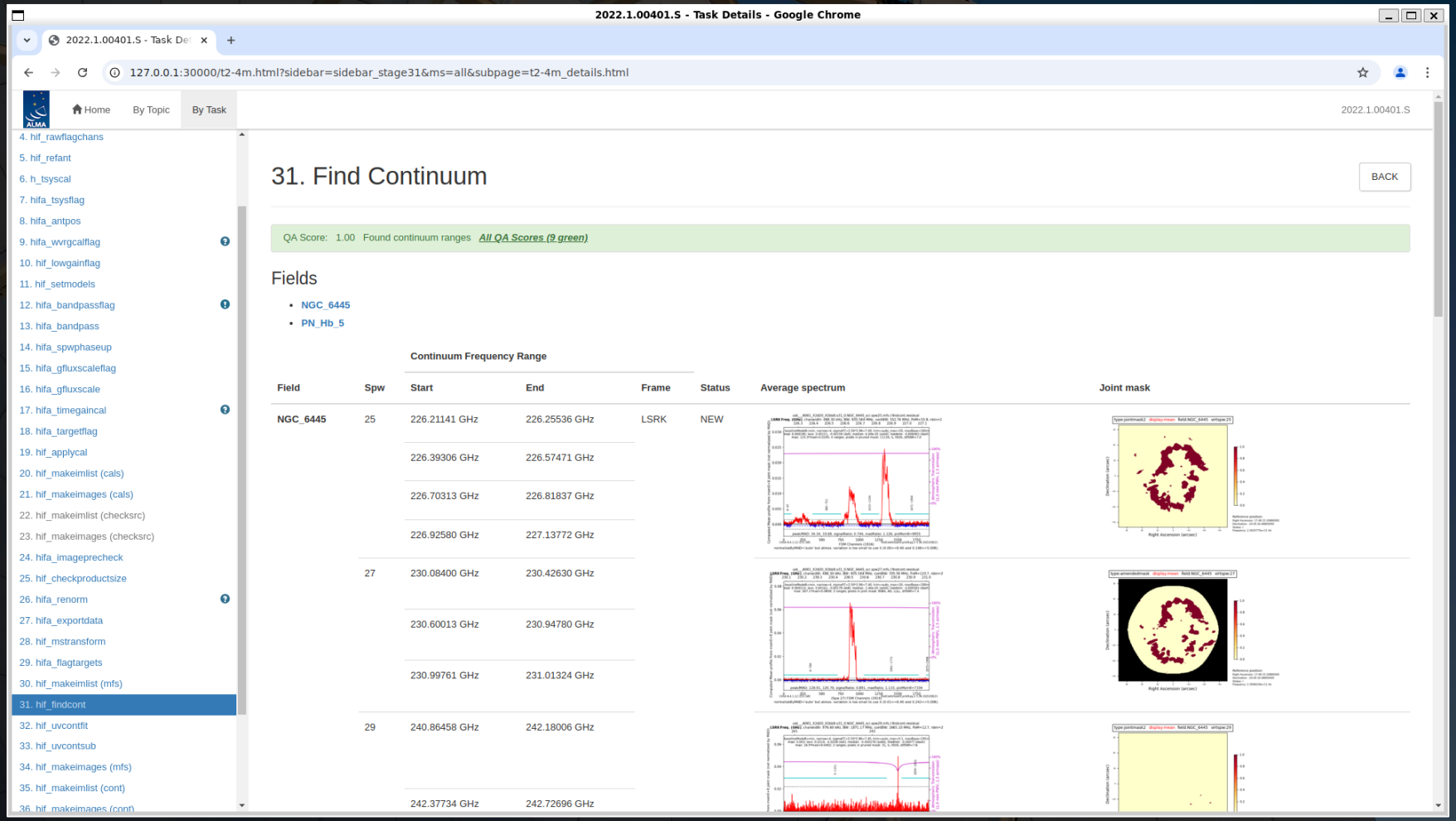
hifa_imageprecheck: This module estimates beam sizes using different robust factors for imaging, which is useful to refer to when re-imaging the data. The row in green is selected for subsequent imaging steps.



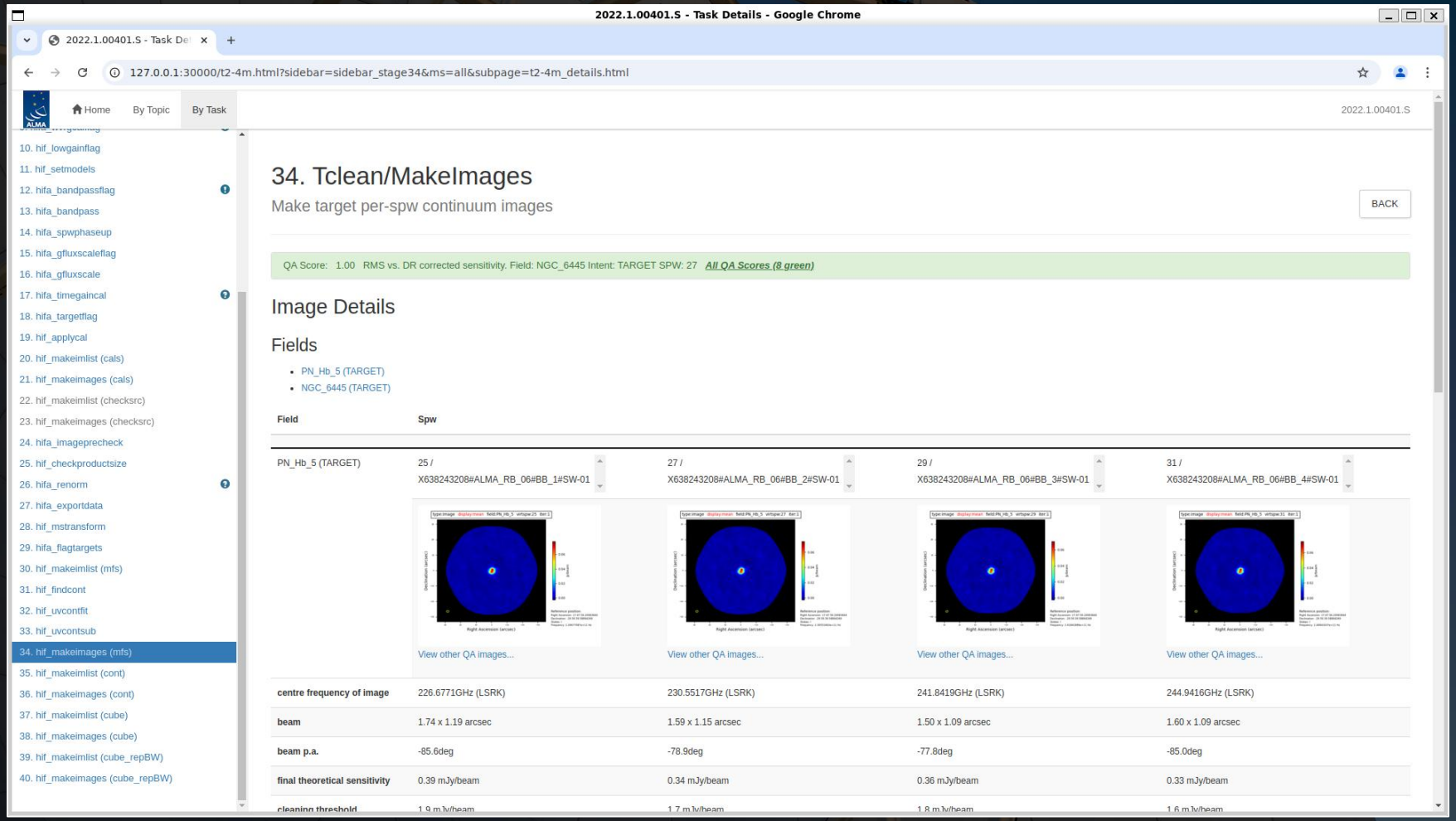
hifa_imageprecheck: This module estimates beam sizes using different robust factors for imaging, which is useful to refer to when re-imaging the data. The row in green is selected for subsequent imaging steps.



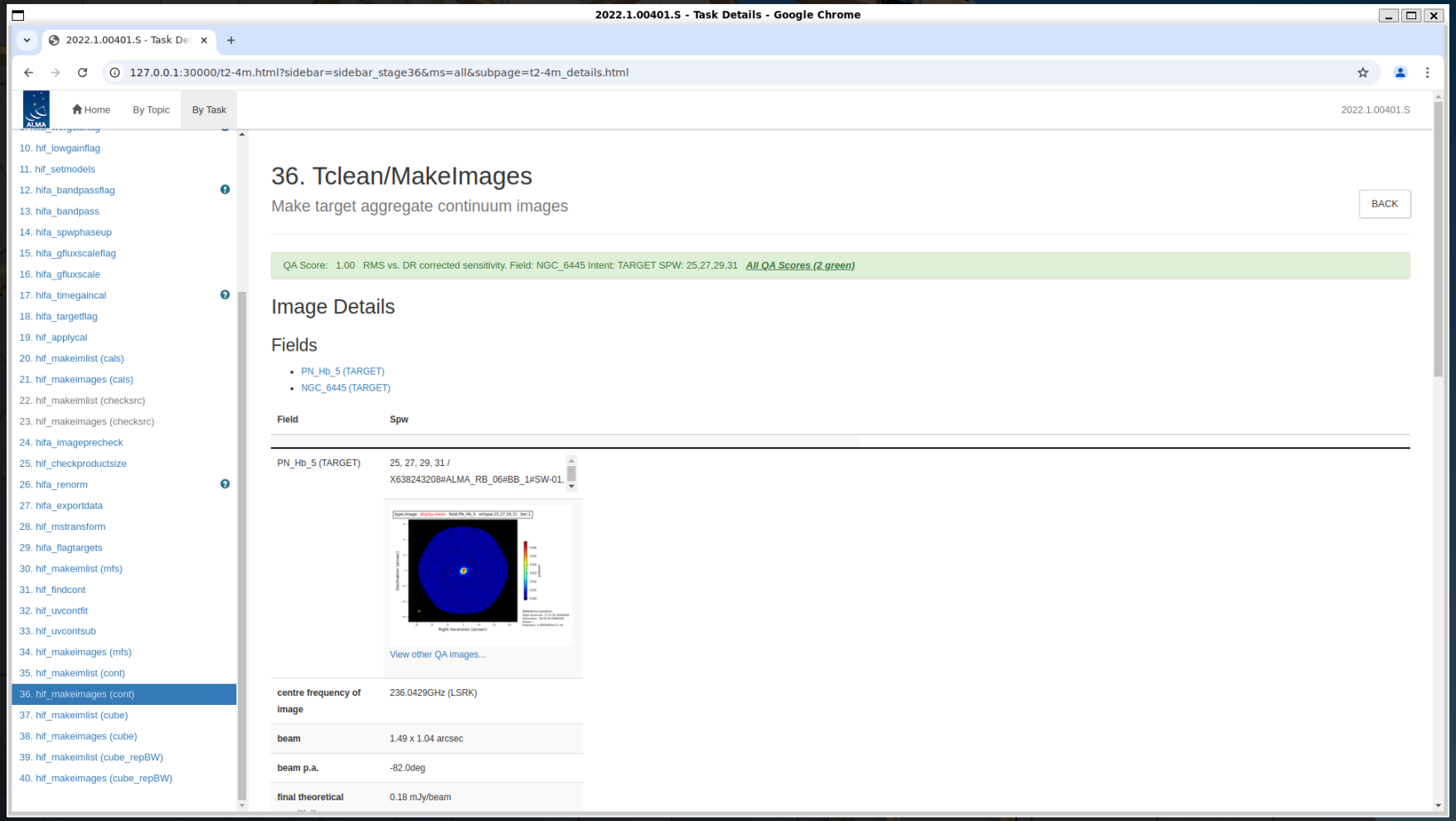
hif_findcont: This is where the pipeline creates initial image cubes and identifies continuum channels (although the identification is not always optimal). This is useful as a first look at the spectra, although re-imaging the data may be much more effective for identifying spectral lines.



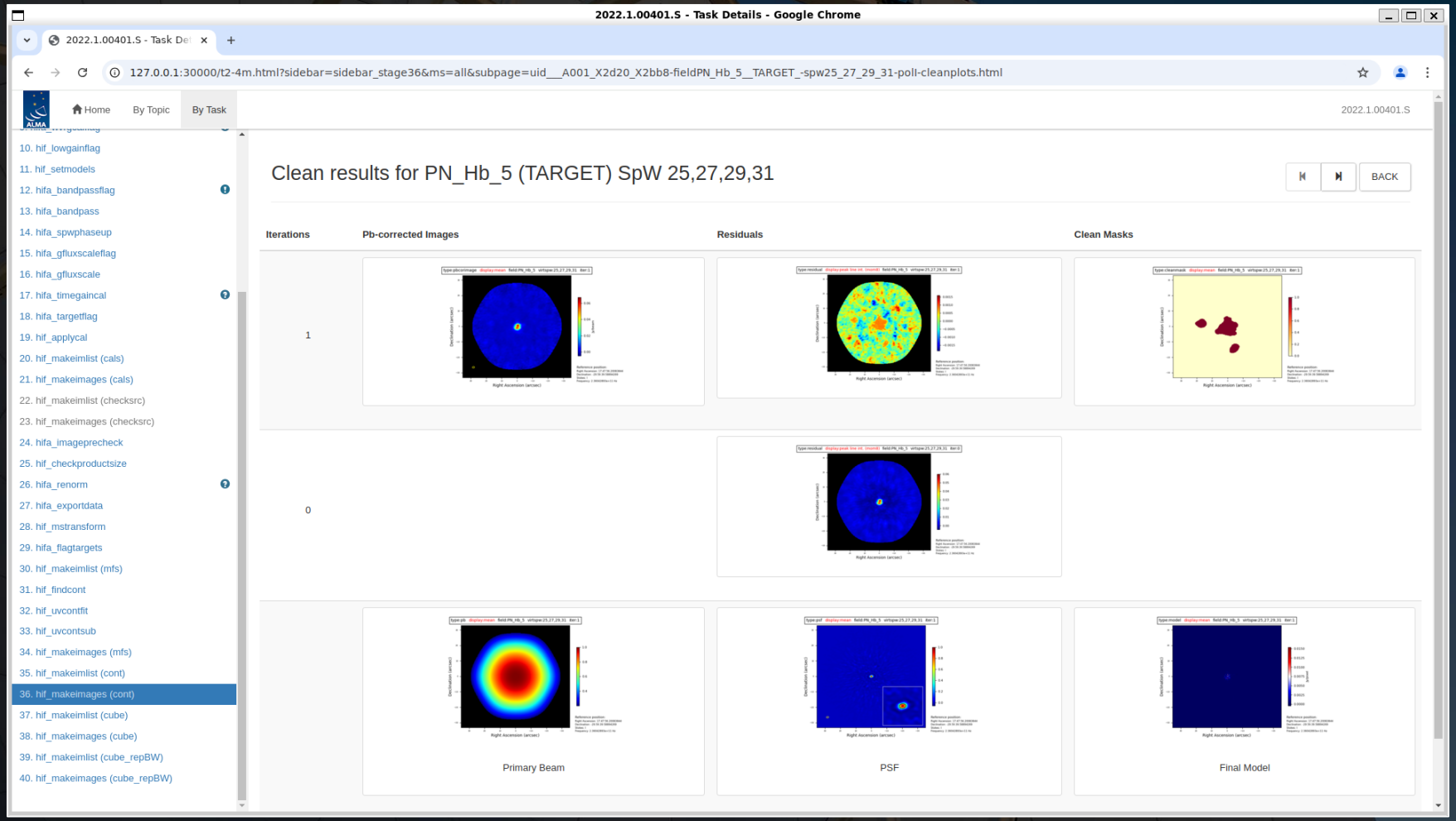
hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



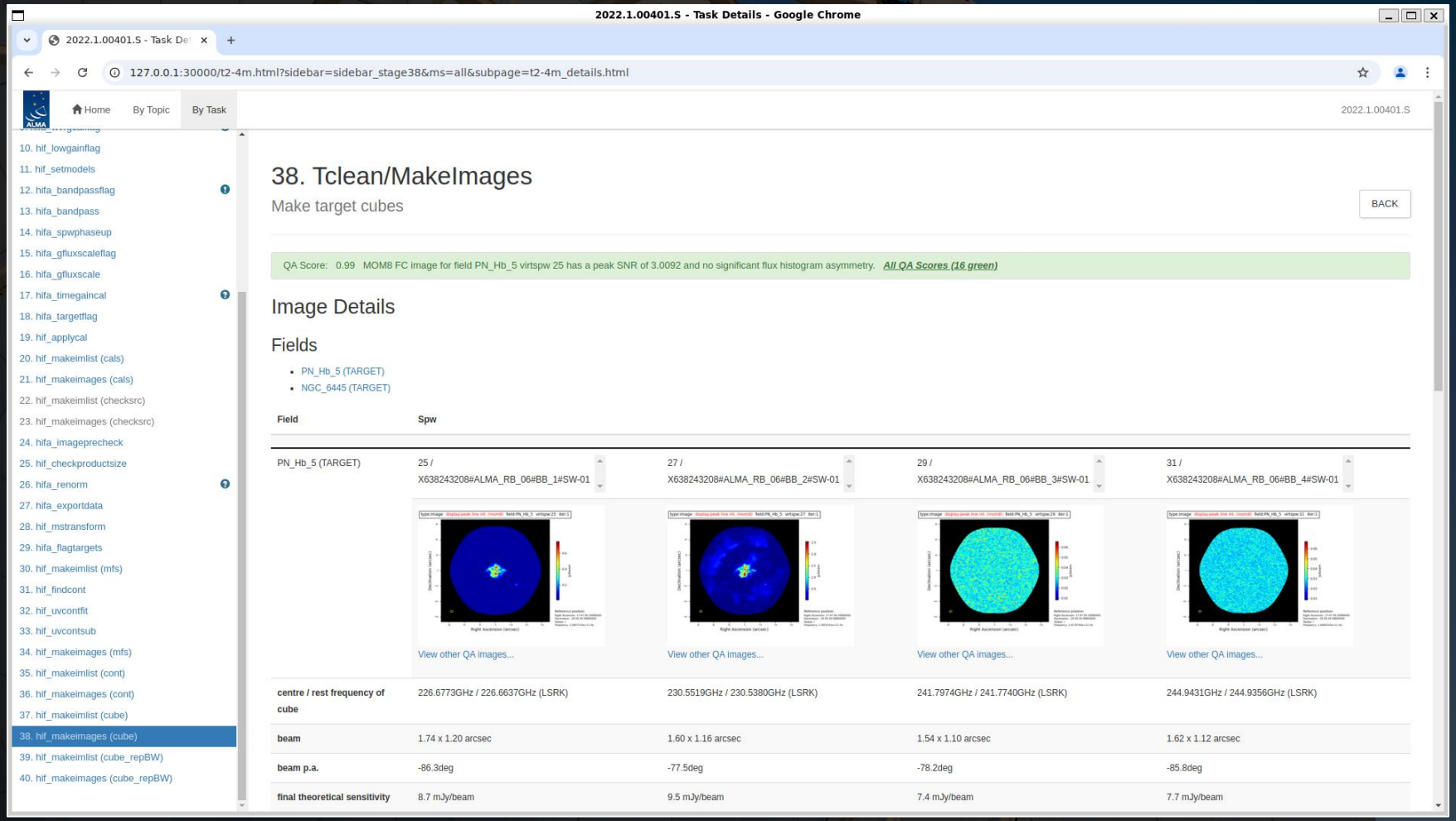
hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



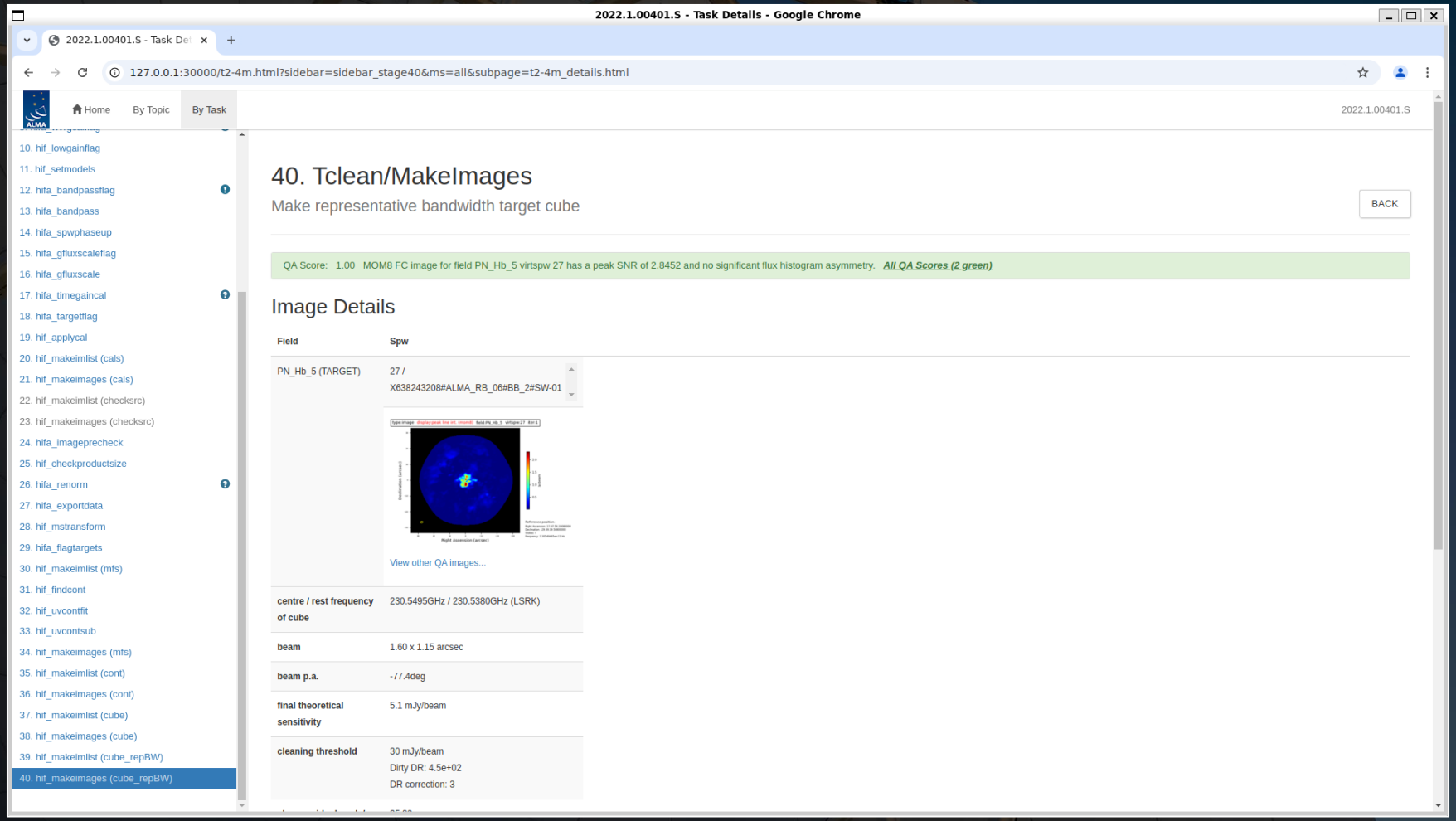
hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



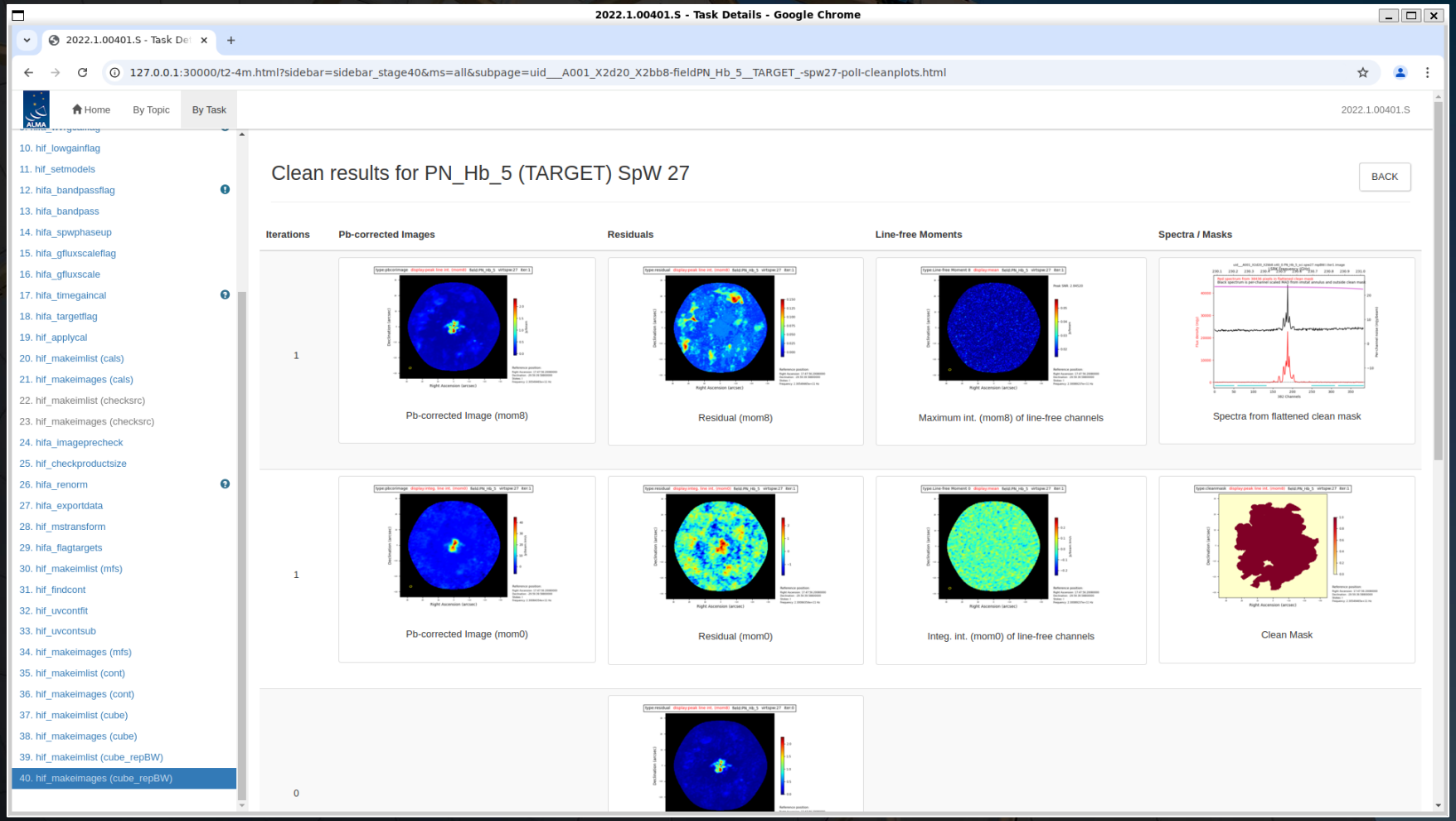
hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



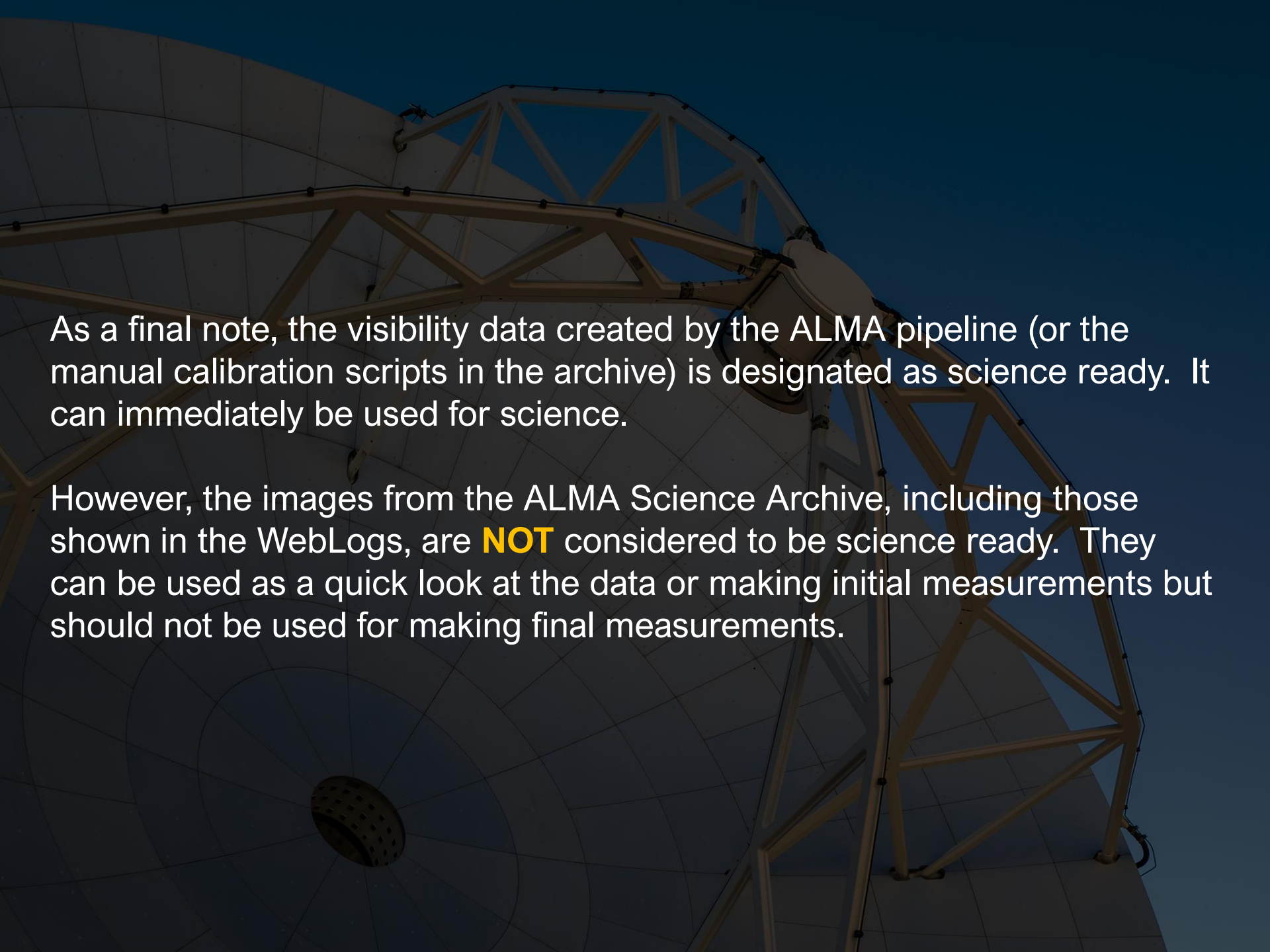
hif_makeimages: Several steps near the end of the pipeline (for multiple different types of output images) have this name. These pages are useful for seeing an overview of the imaging results, particularly with regards to information like beam sizes and noise levels.



hif_selfcal: Data acquired from Cycle 10 onwards will contain several steps that perform self-calibration (but we have no examples we can show yet).

This task will examine whether it is possible to improve the S/N of the data using self-calibration. This will be indicated by metrics in a table in the output. This is good to check to determine whether self-calibration could be useful when manually calibrating a dataset.

If the S/N is improved, several additional hif_makeimages steps after hif_selfcal will contain additional images created using self-calibration.



As a final note, the visibility data created by the ALMA pipeline (or the manual calibration scripts in the archive) is designated as science ready. It can immediately be used for science.

However, the images from the ALMA Science Archive, including those shown in the WebLogs, are **NOT** considered to be science ready. They can be used as a quick look at the data or making initial measurements but should not be used for making final measurements.