Navigating the ALMA IF Pipeline and Its Weblog

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Outline

- Reference Material
- The CASA Pipeline(s)
  - ALMA IF Pipeline steps in “plain language” and in task language
- Weblog Overview
  - Related: QA2 Report
  - Home, By Topic, By Task
  - EB.ms Overview
- Calibration Tasks
  - Common Issues
- Imaging Tasks
- Looking Ahead

Documentation

- Main Documentation Page: https://almascience.nrao.edu/processing/science-pipeline
  - User's Guide > fantastic!
  - Reference Manual > amazing!
  - Known Issues
  - Tarball for installation
- The EU ARC Network "ALMA Weblog Inspection" talk is also a good reference: https://almascience.nrao.edu/tools/eu-arc-network/i-train
- CASA Docs: https://casadocs.readthedocs.io/en/v6.4.1/index.html

Acronyms

ALMA – Atacama Large Millimeter/submillimeter Array
ARC – ALMA Regional Center
ASDM – ALMA Science Data Model
CASA – Common Astronomy Software Applications
EB – Execution Block
FDM – Frequency Division Mode (spectral correlator mode)
IF – interferometry
MFS – multi frequency synthesis (continuum)
MS – Measurement Set
NAASC – North American ALMA Science Center
PPR – pipeline processing request
QA – Quality Assurance
SB – Scheduling Block
SD – Single Dish
(S/G/M)OUS – Science[goal]/Group/Member Observation Unit Set
spw – spectral window
TDM – Time Division Mode (continuum correlator mode)
TM1 – Twelve Meter configuration (longer baselines)
TM2 – Twelve Meter configuration (shorter baselines)
TP – Total Power
uid – unique identification number
VLA – Very Large Array

The CASA Pipelines

What is the CASA Pipeline?

- A series of high-level CASA tasks for calibrating raw data and imaging the corrected data > a “recipe”
- There are different recipes for
  - ALMA Interferometry (same for 7m and 12m arrays)
  - ALMA Single Dish (Total Power)
  - VLA PI Science
  - VLA Sky Survey
- Can be executed in pipescript.py (easy to modify) or PPR.xml (used in production) formats
- Pipeline tasks consist of heuristics and several core CASA tasks, and follow this naming convention:
  - h_<task> = generic heuristics
  - hif_<task> = heuristics for interferometry
  - hifa_<task> = heuristics for interferometry, ALMA-specific
  - hsd_<task> = heuristics for single dish (total power)
- Heuristics determine which steps are necessary and the ideal parameters to use in the core CASA tasks

Why should I care about the pipeline and its products?

- It is how your ALMA data is calibrated.
- You will need to understand the pipeline and its products for when you download data off of the archive.
- You may have to re-calibrate or re-image your data or data from the archive.

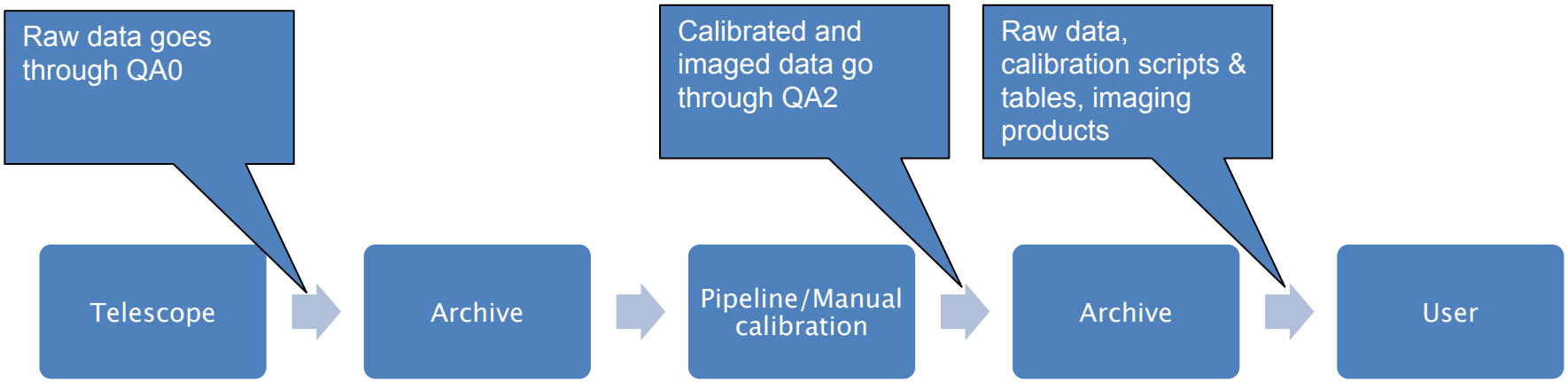
ALMA Observing Project Hierarchy

(EB or ASDM: ALMA Science Data Model)

Different data reduction paths for ALMA data

- Manually calibrated and imaged (non-standard datasets, e.g. polarization, solar observations, etc.) ~2% (NA)
- Pipeline calibrated and imaged (most standard datasets) ~98% (NA)
- Pipeline calibrated and manually imaged (e.g. PL cannot image because the data products are too large)
- Pipeline calibrated and imaged, with additional subset imaging using PL scripts (different robust, manually identified continuum)
- Pipeline calibrated and imaged, with additional manual imaging (self-calibration due to high dynamic range)
- Each MOUS is processed separately, different MOUSes may have different data reduction paths

Introduction to ALMA pipeline (PL)



What goes into an ALMA pipeline execution?

- Project

  (S/G/M)OUS – Science[goal]/Group/Member Observation Unit Set

  - SOUS
    - GOUS
      - MOUS > pipeline execution
        - » calibrated > created by running a restore
        - » calibration > cal tables
        - » log > casa_commands.log
        - » qa > qa0 report, qa2 report, weblog.tgz
        - » raw > EB1.asdm.sdm, EB2.asdm.sdm, etc
          - one or more executions of a single scheduling block
        - » script > scriptForPI.py
- Restore calibrated data
  - https://help.almascience.org/kb/articles/interferometric-calibration-and-imaging-regeneration

Introduction to ALMA pipeline (PL)

- Used to calibrate ALMA interferometric (IF) and single-dish (SD) data – has different recipes for different types of observations
- Automated calibration and imaging
- Modular calibration and imaging tasks within CASA, put together based on standard prescriptions or recipes
- Produces a WebLog – a collection of webpages with diagnostic messages, tables, figures and Quality Assurance (QA) scores
- User's guide and other useful documentation: https://almascience.nrao.edu/processing/science-pipeline

IF Calibration Steps

- System Temperature (Tsys) vs Frequency
- Antenna positions
- Water Vapor Radiometers (Phase vs Time)
- Bandpass (Phase and Amplitude vs Frequency) > per-channel instrument response
- Flux (Absolute Amplitude vs Frequency) > per spw scaling
- Gain (Phase and Amplitude vs Time) > atmosphere
- Renormalization (auto-correlation division correction)
- Various flagging throughout

IF Imaging Steps

- Continuum detection, fitting and subtraction
- Continuum flux images per spw
- Aggregate continuum image for all spws combined
- Spectral line image cubes (channel/frequency/velocity axis)

Standard interferometric calibration and imaging recipe for ALMA

```
__rethrow_casa_exceptions = True
context=h_init()
try:
   hifa_importdata(dbservice=False, vis=['uid___A002_X877e41_X452'], session=['session_1']) ## Uses flux.csv
   hifa_flagdata(pipelinemode="automatic") ## Uses *flagtemplate.txt
   hifa_fluxcalflag(pipelinemode="automatic")
   hif_rawflagchans(pipelinemode="automatic")
   hif_refant(pipelinemode="automatic")
   h_tsyscal(pipelinemode="automatic")
   hifa_tsysflag(pipelinemode="automatic")
   hifa_antpos(pipelinemode="automatic") ## Uses antennapos.csv
   hifa_wvrgcalflag(pipelinemode="automatic")
   hif_lowgainflag(pipelinemode="automatic")
   hif_setmodels(pipelinemode="automatic")
   hifa_bandpassflag(pipelinemode="automatic")
   hifa_bandpass(pipelinemode="automatic")
   hifa_spwphaseup(pipelinemode="automatic")
   hifa_gfluxscaleflag(pipelinemode="automatic")
   hifa_gfluxscale(pipelinemode="automatic")
   hifa_timegaincal(pipelinemode="automatic")
   hifa_targetflag(pipelinemode="automatic")
   hif_applycal(pipelinemode="automatic")
   hif_makeimlist(intent='PHASE,BANDPASS,AMPLITUDE')
   hif_makeimages(pipelinemode="automatic")
   hif_makeimlist(per_eb=True, intent='CHECK')
   hif_makeimages(pipelinemode="automatic")
   hifa_imageprecheck(pipelinemode="automatic")
   hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)
   hifa_renorm(pipelinemode="automatic")
   hifa_exportdata(pipelinemode="automatic")
# Start of pipeline imaging commands
   hif_mstransform(pipelinemode="automatic")
   hifa_flagtargets(pipelinemode="automatic") ## Uses *flagtargetstemplate.txt
   hif_makeimlist(specmode='mfs')      ## Uses cont.dat
   hif_findcont(pipelinemode="automatic") ## Modifies cont.dat
   hif_uvcontfit(pipelinemode="automatic") ## Uses cont.dat
   hif_uvcontsub(pipelinemode="automatic")
   hif_makeimages(pipelinemode="automatic") ## Uses cont.dat
   hif_makeimlist(specmode='cont')          ## Uses cont.dat
   hif_makeimages(pipelinemode="automatic") ## Uses cont.dat
   hif_makeimlist(specmode='cube')          ## Uses cont.dat
   hif_makeimages(pipelinemode="automatic") ## Uses cont.dat
   hif_makeimlist(specmode='repBW')         ## Uses cont.dat
   hif_makeimages(pipelinemode="automatic") ## Uses cont.dat
finally:
   h_save()
```

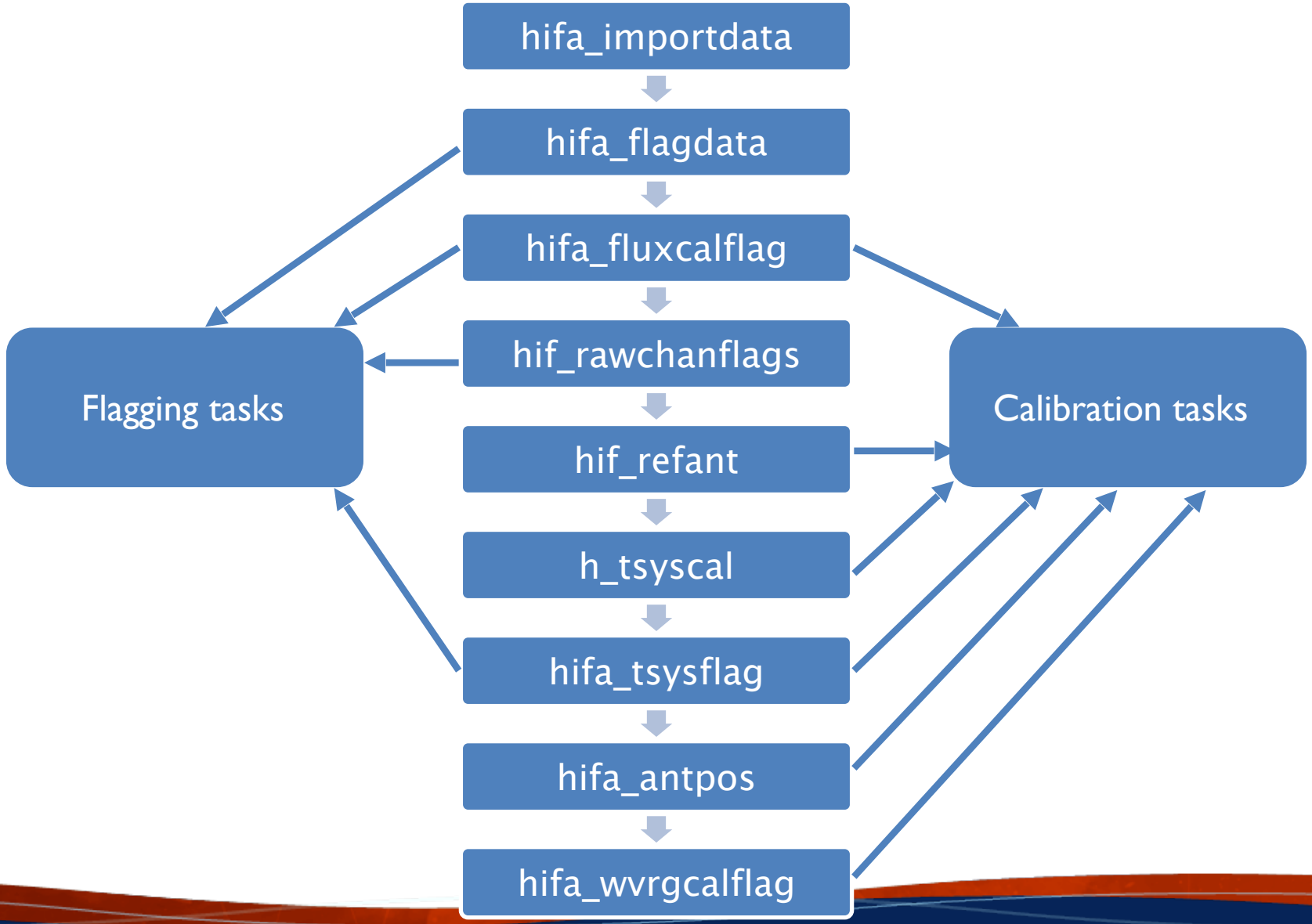
Calibration tasks; ## indicates the use of pipeline helper files

Imaging tasks; ## indicates the use of pipeline helper files

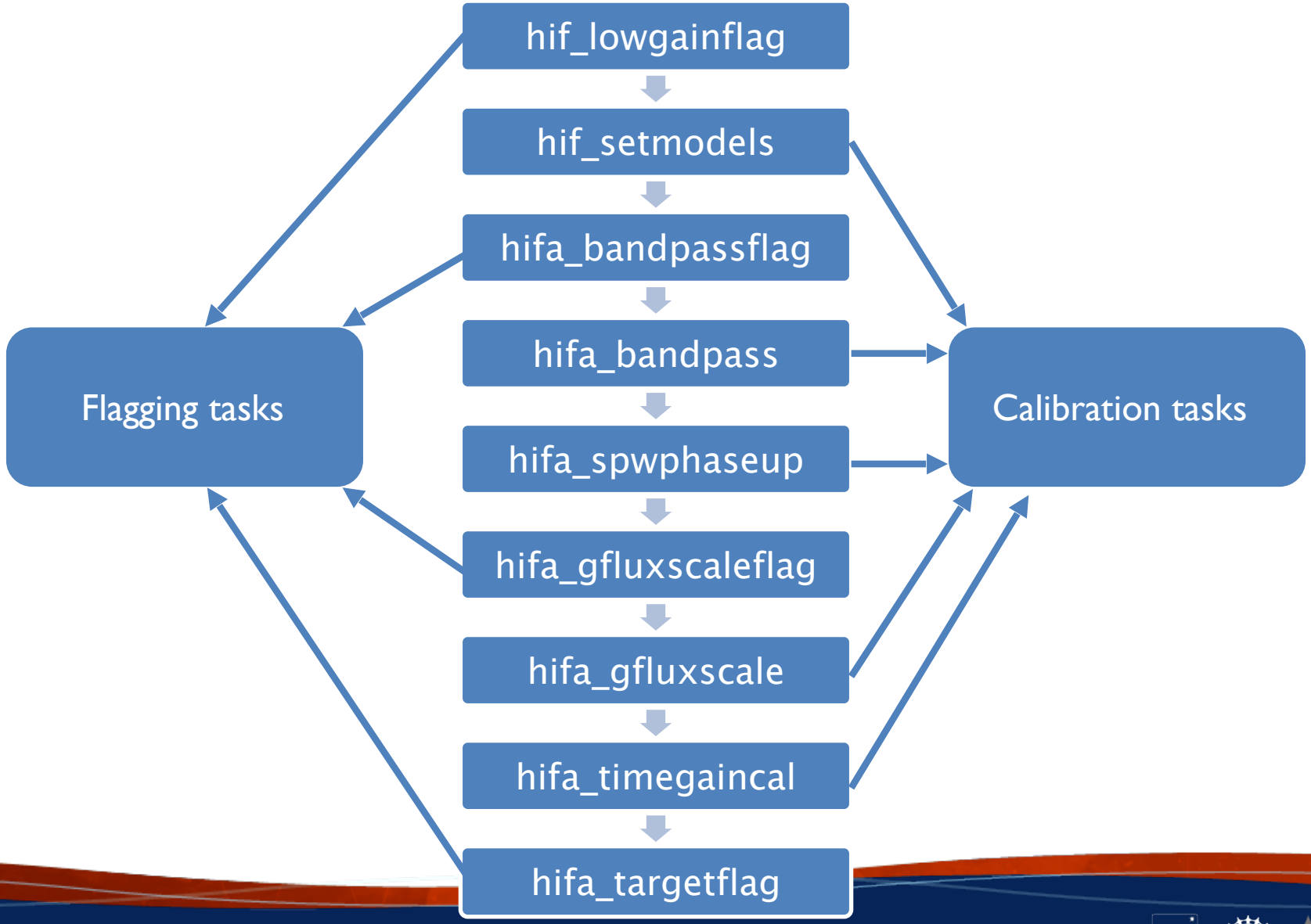
Note about pipeline tasks

- Task name examples – h_tsyscal, hif_applycal, hifa_antpos, hsd_image
- hif and hifa – interferometric tasks, hifa – ALMA, hifv - VLA
- hsd – single dish tasks
- h – common to all pipelines
- h_init – initializes pipeline, creates new pipeline context
- h_save – saves context
- h_resume – resumes specified or last context to resume pipeline run

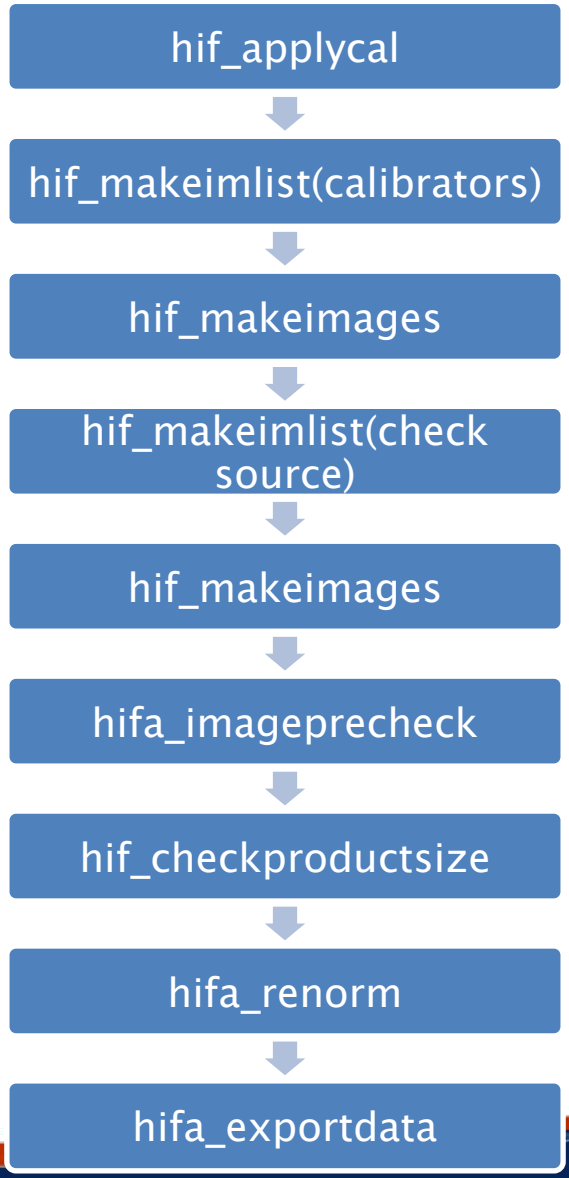
Standard calibration recipe



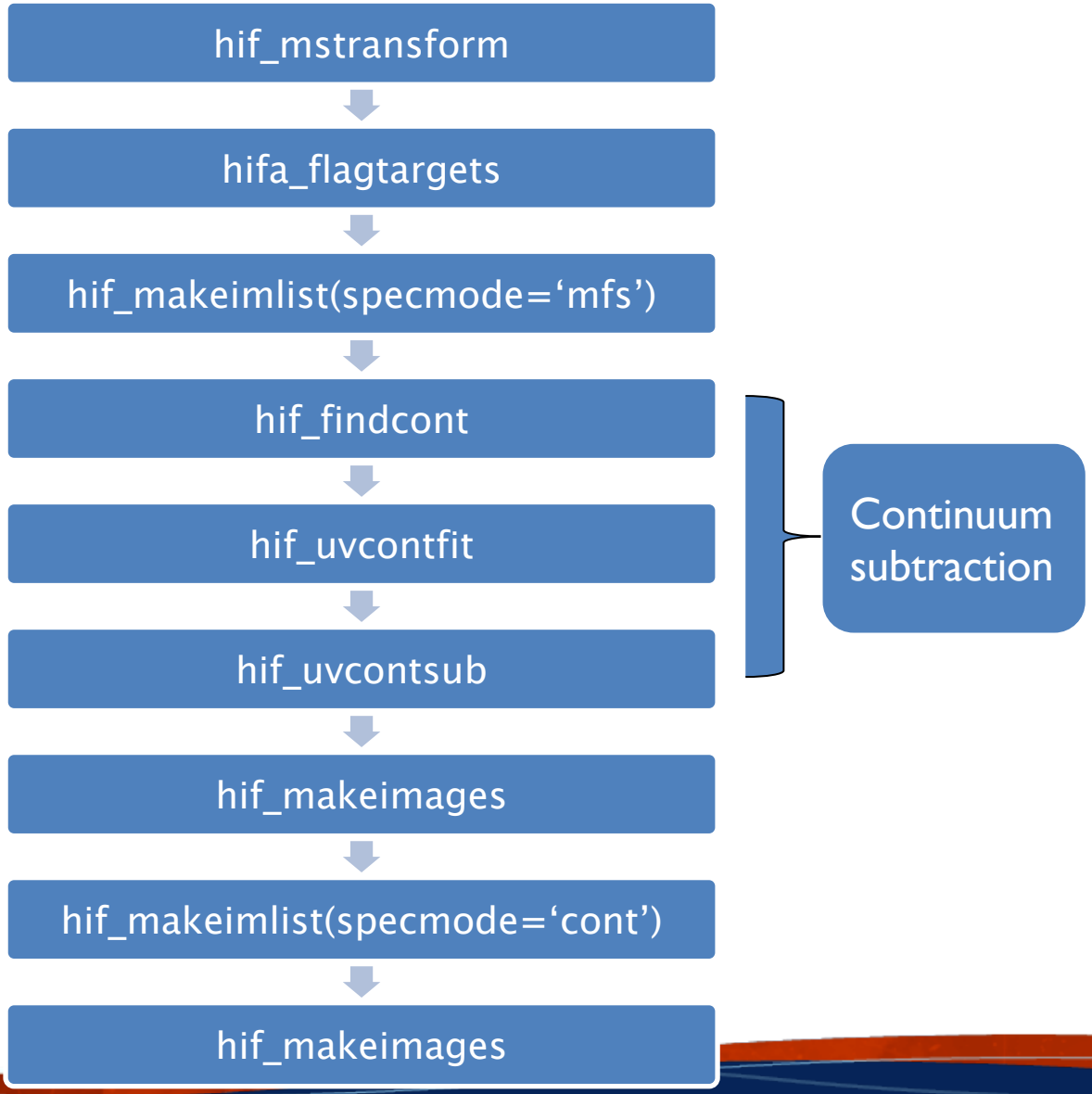
Standard calibration recipe



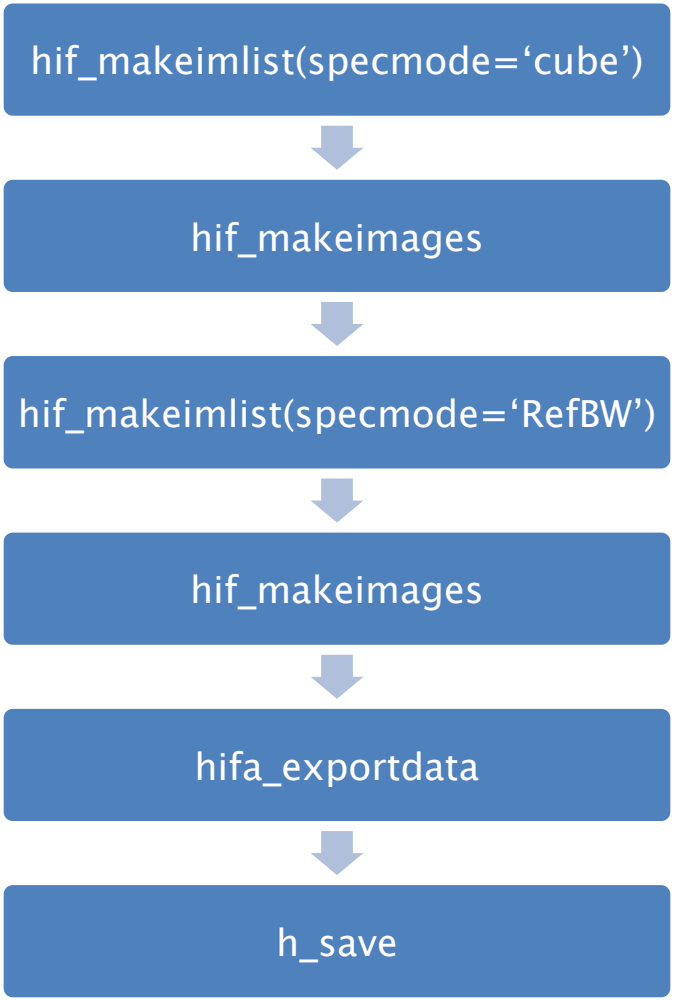
Standard calibration recipe



Standard calibration recipe



Standard calibration recipe



Cycle 9 (2022.x) IF Weblog Overview

What is a Weblog?

A collection of observational information and pipeline output (products) from calibration and imaging tasks including UV data plots, tables, spectra, masks, images, etc., organized into an html package for display in a web browser.

- produced by the pipeline as it runs > track progress!
- used to examine data quality, calibration effectiveness, and the images produced
- contains most of the diagnostic information used for QA2
  - **QA2 = Quality Assurance performed at the data reduction level.** Staff add data flags, recalibrate, or reimage as necessary, especially to achieve the PI requested noise (RMS) and angular resolution (beam size) for the representative target field, spw, and image type. Calibration and Imaging are typically performed by the pipeline, but are done manually in rare cases.

QA2 Report

- Communicates info about data reduction quality and recommendations to the PI
- For pipeline processed data, often includes remarks about the weblog
- https://almascience.nrao.edu/dataPortal/member.uid___A001_X3570_Xa3.qa2_report.pdf

Final QA2 comment

CASA version: 6.4.1.12, Pipeline version 2022.2.0.64

Reduction mode: PL calibration and imaging

Calibration issues: None

Imaging issues: None

General info:

Because of its spectral configuration, the impact on this dataset of the renormalization issue, described in the KB article described at the link below, is expected to be negligible. More details can be found at: https://help.almascience.org/kb/articles/what-errors-could-originate-from-the-correlator-spectral-normalization-and-tsys-calibration

It is recommended that the PI carefully assess the results on the hif_findcont weblog page, and in the "line-free moment 8" images on the cube imaging weblog page.
Self-calibration was not performed.

This is a continuum project, thus QA2 was performed on the Aggregate Continuum.
The RMS and beam size meet the PI requested performance parameters.
Therefore, this scheduling block has been deemed a QA2 PASS.

Aggregate Continuum -
Image name: uid___A001_X3570_Xa3.s36_0.AT2022tsd_sci.spw5_7_9_11.cont.I.iter1.image
Robust = 0.5
Beam size = 0.657 x 0.543 arcsec
RMS = 0.030 mJy/beam over 6.88 GHz

Optional Follow Along

- Download
  - https://almascience.nrao.edu/aq/
  - search MOUS uid://A001/X3570/Xa3
  - auxiliary > qa > *weblog.tgz
    - The weblog is only delivered if the data are pipeline calibrated
  - Direct link:
    https://almascience.nrao.edu/dataPortal/
    member.uid___A001_X3570_Xa3.hifa_calimage.weblog.tgz
- Extract

  tar –xvzf member.uid___A001_X3570_Xa3.hifa_calimage.weblog.tgz
- Open

  pipeline-20221025T120844/html/index.html
  - https://help.almascience.org/kb/articles/what-is-the-best-way-to-view-the-weblog
  - Firefox is the recommended browser
- Don't be confused - this presentation includes many examples from different weblogs!

Let's open it together

- Can either open it with:
  - In casa with h_weblog()
    - Cd to pipeline directory
    - $casa —pipeline
    - h_weblog()
  - Firefox
    - Launch Firefox
    - File > Open File…
    - Note that the set-up steps need to have been completed
      - Firefox settings need to be configured to view weblog (see https://almascience.eso.org/euarcdata/itrain04/weblog.pdf for screenshots).
      - In Firefox, type "about:config" in the address bar. (This may display a warning page, but click continue to exit the page.)
      - On this page, search for the "privacy.file_unique_origin" preference and set it toFalse. After this, restart Firefox for the fix to take effect.

Home Page

Observation Overview

Project	uid://A001/X3570/X50
Principal Investigator	annayqho
OUS Status Entity id	uid://A001/X3570/Xa3
Observation Start	2022-10-21 04:54:40 UTC
Observation End	2022-10-21 08:11:55 UTC

MOUS

Pipeline Summary

Click!

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	0623.0982 (last date: 2023-01-21 00:00:00)
Pipeline Start	2022-10-25 12:08:44 UTC
Execution Duration	15:36:55

Observation Summary

Measurement Set	Receivers	Num Antennas	Time (UTC) Start	Time (UTC) End	On Target	Baseline Length Min	Baseline Length Max	Baseline Length RMS	Size
Observing Unit Set Status: uid://A001/X3570/Xa3 **Scheduling Block ID:** uid://A001/X3570/X97 **Scheduling Block Name:** AT2022ts_a_08_TM1									
Session: session_1 **ACS Version:** 7e0bfbc, **Build Version:** ONLINE-CYCLE9-B-7-2022-09-23-28-00-00									
uid___A002_Xfffde1_X9b5c.ms	ALMA Band 8	43	2022-10-21 04:54:40	2022-10-21 06:05:11 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:43:37	15.1 m	368.6 m	122.3 m	21.2 GiB
uid___A002_Xfffde1_X9b5c_targets.ms	ALMA Band 8	43	2022-10-21 05:04:52	2022-10-21 06:03:35 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:43:32	15.1 m	368.6 m	122.3 m	10.4 GiB
uid___A002_Xfffde1_X9b5c_targets_line.ms	ALMA Band 8	43	2022-10-21 05:04:52	2022-10-21 06:03:35 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:43:32	15.1 m	368.6 m	122.3 m	10.4 GiB
uid___A002_Xfffde1_X9dbf.ms	ALMA Band 8	43	2022-10-21 06:06:16	2022-10-21 07:16:28 MS dates not fully covered by IERSeop2000. CASA will use IERSpredict.	0:43:36	15.1 m	368.6 m	122.3 m	21.0 GiB

Full Measurement Set

Click!

Target fields only

Continuum subtracted

Next execution...

Sessions

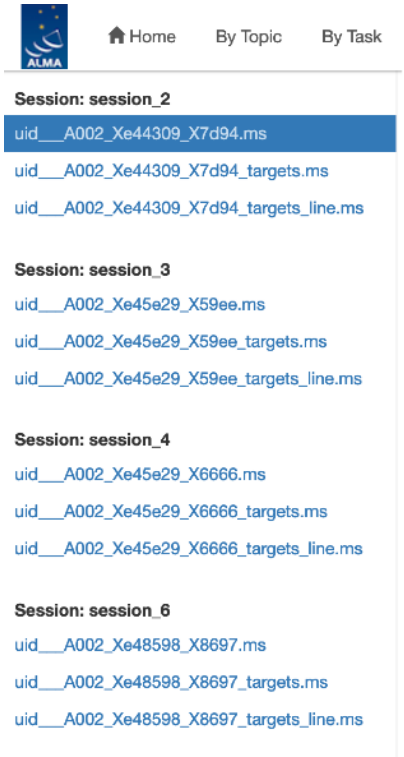
- Technical Handbook 8.7.1
- “the continuous execution of the same SB until the scientific criteria are met”
- started by the Telescope Operator interacting with the Executive subsystem
- primarily used for polarization and VLBI observations

Home page

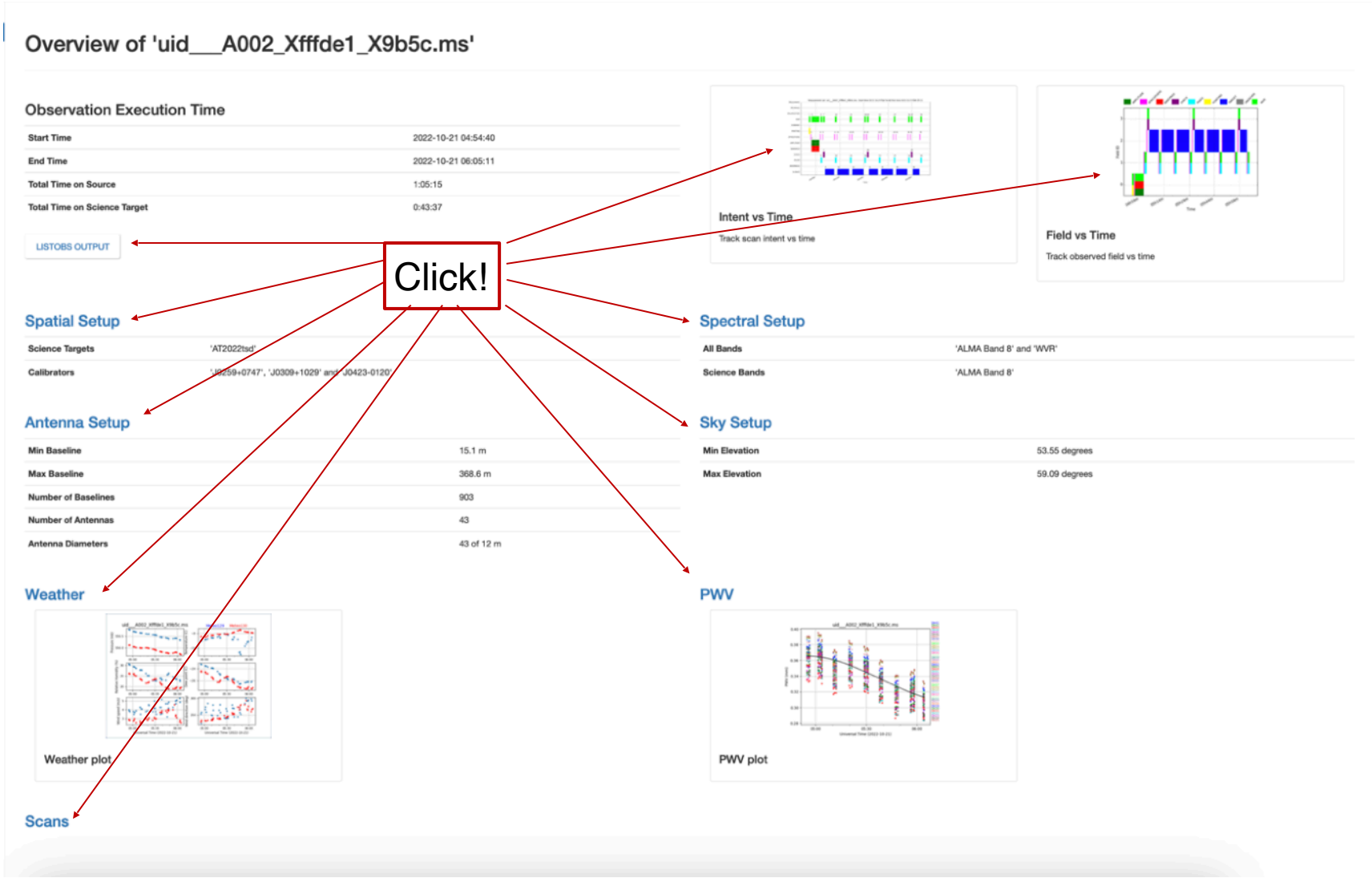
Observation Summary

Measurement Set	Receivers	Num Antennas	Time (UTC) Start	Time (UTC) End	Time (UTC) On Target	Baseline Length Min	Baseline Length Max	Baseline Length RMS	Size
Observing Unit Set Status: uid://A001/X1467/X29e **Scheduling Block ID:** uid://A001/X1467/X298 **Scheduling Block Name:** M17SW_a_07_7M									
Session: session_2 **ACS Version:** Unknown, **Build Version:** ONLINE-CYCLE7-B-137-2019-11-22-28-00-00									
uid___A002_Xe44309_X7d94.ms	ALMA Band 7	11	2019-11-28 19:30:28	2019-11-28 21:19:45	0:49:10	8.9 m	48.9 m	26.4 m	6.7 GiB
uid___A002_Xe44309_X7d94_targets.ms	ALMA Band 7	11	2019-11-28 20:05:37	2019-11-28 21:16:55	0:49:10	8.9 m	48.9 m	26.4 m	2.8 GiB
uid___A002_Xe44309_X7d94_targets_line.ms	ALMA Band 7	11	2019-11-28 20:05:37	2019-11-28 21:16:55	0:49:10	8.9 m	48.9 m	26.4 m	2.8 GiB
Scheduling Block ID: uid://A001/X1467/X298 **Scheduling Block Name:** M17SW_a_07_7M									
Session: session_3 **ACS Version:** Unknown, **Build Version:** ONLINE-CYCLE7-B-137-2019-11-22-28-00-00									
uid___A002_Xe45e29_X59ee.ms	ALMA Band 7	10	2019-11-30 16:11:27	2019-11-30 17:55:50	0:49:10	8.9 m	45.0 m	24.2 m	5.6 GiB
uid___A002_Xe45e29_X59ee_targets.ms	ALMA Band 7	10	2019-11-30 16:41:15	2019-11-30 17:52:56	0:49:10	8.9 m	45.0 m	24.2 m	2.3 GiB
uid___A002_Xe45e29_X59ee_targets_line.ms	ALMA Band 7	10	2019-11-30 16:41:15	2019-11-30 17:52:56	0:49:10	8.9 m	45.0 m	24.2 m	2.3 GiB
Scheduling Block ID: uid://A001/X1467/X298 **Scheduling Block Name:** M17SW_a_07_7M									
Session: session_4 **ACS Version:** Unknown, **Build Version:** ONLINE-CYCLE7-B-137-2019-11-22-28-00-00									
uid___A002_Xe45e29_X6666.ms	ALMA Band 7	10	2019-11-30 18:10:50	2019-11-30 19:55:21	0:49:10	8.9 m	45.0 m	24.2 m	5.6 GiB
uid___A002_Xe45e29_X6666_targets.ms	ALMA Band 7	10	2019-11-30 18:41:03	2019-11-30 19:52:31	0:49:10	8.9 m	45.0 m	24.2 m	2.3 GiB
uid___A002_Xe45e29_X6666_targets_line.ms	ALMA Band 7	10	2019-11-30 18:41:03	2019-11-30 19:52:31	0:49:10	8.9 m	45.0 m	24.2 m	2.3 GiB
Scheduling Block ID: uid://A001/X1467/X298 **Scheduling Block Name:** M17SW_a_07_7M									
Session: session_6 **ACS Version:** Unknown, **Build Version:** ONLINE-CYCLE7-B-137-2019-11-22-28-00-00									
uid___A002_Xe48598_X8697.ms	ALMA Band 7	12	2019-12-03 18:48:18	2019-12-03 20:37:40	0:49:10	8.9 m	48.9 m	26.7 m	7.7 GiB
uid___A002_Xe48598_X8697_targets.ms	ALMA Band 7	12	2019-12-03 19:23:28	2019-12-03 20:34:50	0:49:10	8.9 m	48.9 m	26.7 m	3.3 GiB
uid___A002_Xe48598_X8697_targets_line.ms	ALMA Band 7	12	2019-12-03 19:23:28	2019-12-03 20:34:50	0:49:10	8.9 m	48.9 m	26.7 m	3.3 GiB

EB.ms Overview sidebar



ExecutionBlock.ms Overview



Listobs

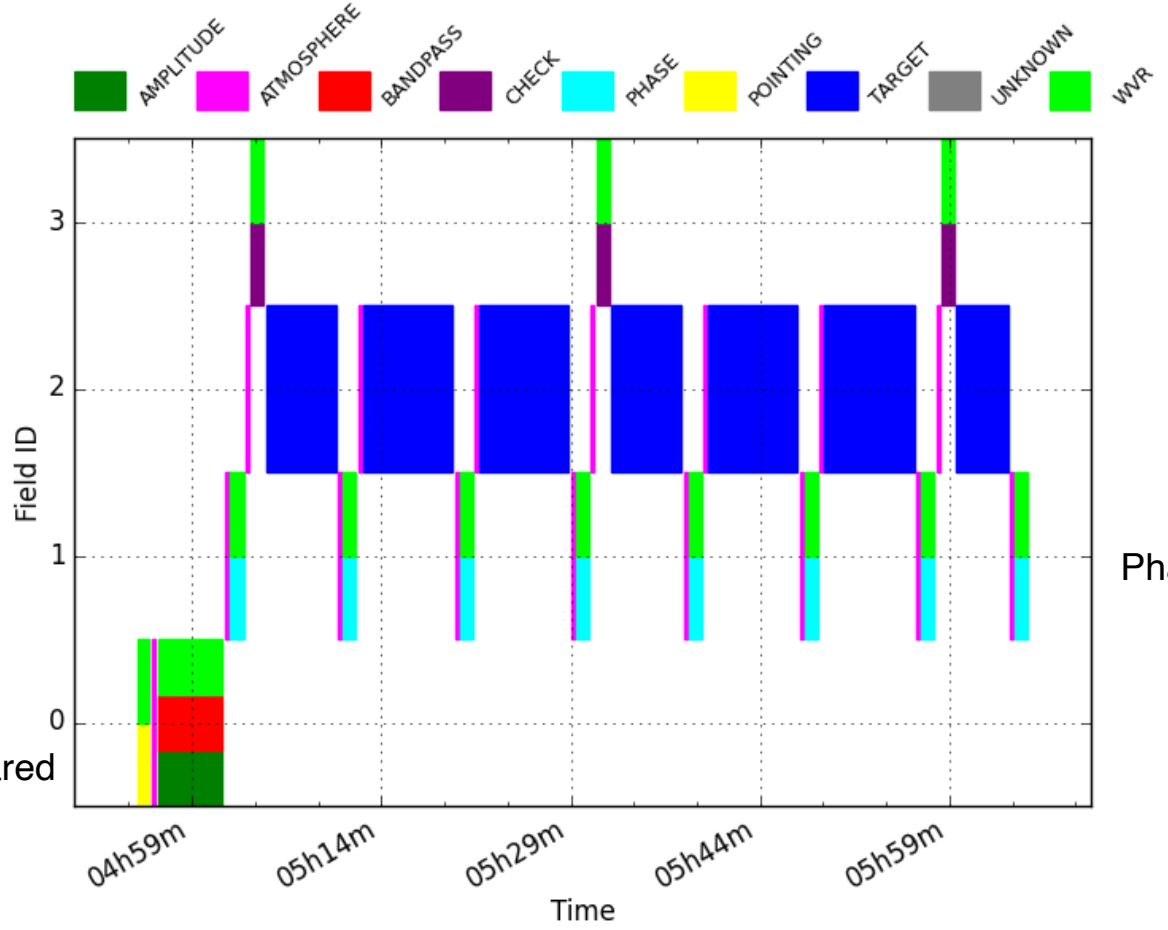
- Text file output from the casa task listobs, which contains much of the same information presented graphically in the ‘EB.ms’ overview
- Viewing recommendations:
  - open in new tab (middle click or right click the button)
  - disable line wrapping
    - firefox > about:config > plain_text.wrap_long_lines = False

```
================================================================================
           MeasurementSet Name:  /mnt/jaosco/data/pipeproc/dataproc/2022.A.00010.T_2022_10_25T10_38_24.710/SOUS_uid___A001_X3570_Xa1/GOUS_u
================================================================================
   Observer: annayqho     Project: uid://A001/X3570/X50
Observation: ALMA
Data records: 63878263       Total elapsed time = 4231.06 seconds
   Observed from   21-Oct-2022/04:54:40.9   to   21-Oct-2022/06:05:12.0 (UTC)

   ObservationID = 0         ArrayID = 0
  Date        Timerange (UTC)          Scan  FldId FieldName             nRows     SpwIds   Average Interval(s)    ScanIntent
  21-Oct-2022/04:54:40.9 - 04:55:38.7     1      0 J0423-0120            662028  [0,1,2,3,4,5,6,7,8,9,10,11,12]  [0.016, 0.016, 0.016, 0.
              04:55:51.2 - 04:56:07.7     2      0 J0423-0120            289433  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              04:56:18.8 - 05:01:22.0     3      0 J0423-0120           4964909  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:01:41.4 - 05:01:58.6     4      1 J0309+1029            289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:02:04.4 - 05:03:05.0     5      1 J0309+1029            992956  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:03:14.7 - 05:03:31.9     6      2 AT2022tsd             289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:03:40.0 - 05:04:41.4     7      3 J0259+0747            992999  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:04:51.5 - 05:10:26.9     8      2 AT2022tsd            5461430  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:10:37.1 - 05:10:53.3     9      1 J0309+1029            289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:10:58.9 - 05:11:59.6    10      1 J0309+1029            992956  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:12:09.2 - 05:12:26.4    11      2 AT2022tsd             289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:12:32.3 - 05:19:38.1    12      2 AT2022tsd            6950864  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:19:50.0 - 05:20:06.2    13      1 J0309+1029            289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:20:11.9 - 05:21:12.5    14      1 J0309+1029            992956  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:21:22.2 - 05:21:39.4    15      2 AT2022tsd             289390  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
              05:21:45.2 - 05:28:51.1    16      2 AT2022tsd            6950864  [0,1,2,3,4,5,7,9,11,13,14,15,16]  [0.016, 0.016, 0.016,
```

Intent and Field vs Time

- Intent vs Time > shows scan numbers
- Field vs Time > easy to map fields to intents



Amplitude > “Flux”

Usually,
BP and Flux are shared

Phase > “Complex Gain”

Spatial Setup: Sources

- Proper Motion and Ephemeris tables

Sources

ID	Source Name	Source Position			Proper Motion		# Pointings	Intent	Ephemeris Table (sampling interval)
		RA	Dec	Ref. Frame	X	Y			
0	J1517-2422	15:17:41.813	-024.22.19.476	ICRS			1	AMPLITUDE, ATMOSPHERE, BANDPASS, POINTING, WVR	
1	J1532-1319	15:32:45.375	-013.19.10.087	ICRS			1	ATMOSPHERE, PHASE, WVR	
2	Io	15:22:43.479	-017.16.12.502	ICRS			1	ATMOSPHERE, TARGET	EPHEM0_Io_58197.4 (10.0 minutes)

Sources in uid___A002_Xca8fbf_X5733.ms

Sources

ID	Source Name	Source Position			Proper Motion		# Pointings	Intent	Ephemeris Table (sampling interval)
		RA	Dec	Ref. Frame	X	Y			
0	J0510+1800	05:10:02.369	+018.00.41.582	ICRS			1	AMPLITUDE, ATMOSPHERE, BANDPASS, POINTING, WVR	
1	J0435+2532	04:35:34.583	+025.32.59.698	ICRS			1	PHASE, WVR	
2	J0438+3004	04:38:04.948	+030.04.45.518	ICRS			1	CHECK, WVR	
3	AA_Tau	04:34:55.428	+024.28.52.580	ICRS	5.351e-16 rad/s	-3.224e-15 rad/s	1	ATMOSPHERE, TARGET	

Sources in uid___A002_Xf287d3_X951b.ms

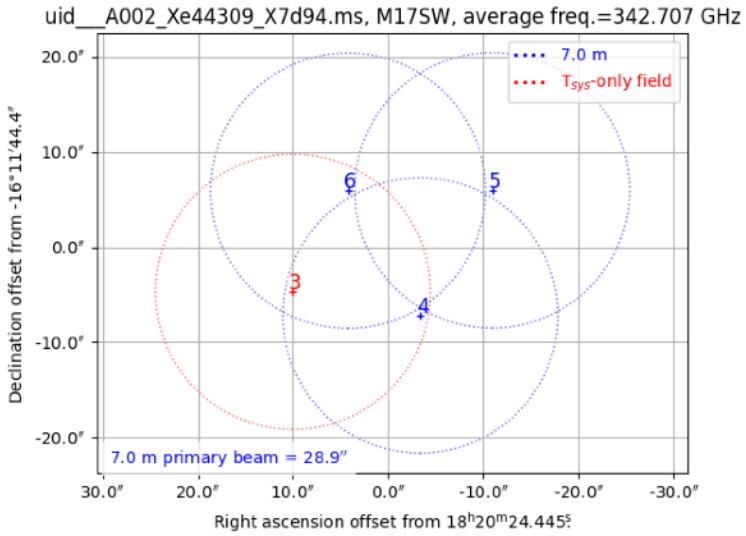
Spatial Setup: Fields

- Mosaics

Fields

Field ID	Field Name	Position			Intent	Source Reference
		RA	Dec	Ref. Frame		
0	J1924-2914	19:24:51.056	-029.14.30.121	ICRS	AMPLITUDE, ATMOSPHERE, BANDPASS, POINTING, WVR	J1924-2914 (#0)
1	J1733-1304	17:33:02.706	-013.04.49.548	ICRS	POINTING, WVR	J1733-1304 (#1)
2	J1832-2039	18:32:11.046	-020.39.48.203	ICRS	ATMOSPHERE, PHASE, WVR	J1832-2039 (#2)
3	M17SW	18:20:25.140	-016.11.49.100	ICRS	ATMOSPHERE	M17SW (#3)
4	M17SW	18:20:24.212	-016.11.51.575	ICRS	TARGET	M17SW (#3)
5	M17SW	18:20:23.689	-016.11.38.462	ICRS	TARGET	M17SW (#3)
6	M17SW	18:20:24.739	-016.11.38.492	ICRS	TARGET	M17SW (#3)

Fields in uid___A002_Xe44309_X7d94.ms



Spectral Setup

- spw and channel info, including respective spectral lines
  - TDM > continuum
  - FDM > spectral lines

Science Windows | All Windows

Science Windows

Real ID	Virtual ID	Name	Type	Frequency (TOPO)			Bandwidth (TOPO)	Transitions	Channels (TOPO)				Correlator Axis	Band	Band Type
				Start	Centre	End			Number	Online Spec. Avg.	Frequency Width	Velocity Width			
23	23	X1139556823#ALMA_RB_07#BB_4#SW-01	TDM	333.103 GHz	334.103 GHz	335.103 GHz	2.000 GHz	cont(ID=0)	128	1	15.625 MHz	14.020 km/s	XX, YY	ALMA Band 7	TSB
25	25	X1139556823#ALMA_RB_07#BB_1#SW-01	FDM	346.484 GHz	346.543 GHz	346.602 GHz	117.188 MHz	SO_SO2_lines(ID=0)	960	2	122.070 kHz	105.602 m/s	XX, YY	ALMA Band 7	TSB
27	27	X1139556823#ALMA_RB_07#BB_1#SW-02	FDM	346.610 GHz	346.669 GHz	346.728 GHz	117.188 MHz	SO2(ID=0)	960	2	122.070 kHz	105.564 m/s	XX, YY	ALMA Band 7	TSB
29	29	X1139556823#ALMA_RB_07#BB_2#SW-01	FDM	344.269 GHz	344.328 GHz	344.387 GHz	117.188 MHz	SO(ID=0)	960	2	122.070 kHz	106.282 m/s	XX, YY	ALMA Band 7	TSB
31	31	X1139556823#ALMA_RB_07#BB_2#SW-02	FDM	344.778 GHz	344.837 GHz	344.895 GHz	117.188 MHz	KCl(ID=0)	960	2	122.070 kHz	106.125 m/s	XX, YY	ALMA Band 7	TSB
33	33	X1139556823#ALMA_RB_07#BB_3#SW-01	FDM	332.049 GHz	332.107 GHz	332.166 GHz	117.188 MHz	SO2(ID=0)	960	2	122.070 kHz	110.193 m/s	XX, YY	ALMA Band 7	TSB
35	35	X1139556823#ALMA_RB_07#BB_3#SW-02	FDM	332.492 GHz	332.521 GHz	332.551 GHz	58.594 MHz	SO2(ID=0)	480	2	122.070 kHz	110.055 m/s	XX, YY	ALMA Band 7	TSB
37	37	X1139556823#ALMA_RB_07#BB_3#SW-03	FDM	333.030 GHz	333.059 GHz	333.089 GHz	58.594 MHz	SO2(ID=0)	480	2	122.070 kHz	109.878 m/s	XX, YY	ALMA Band 7	TSB

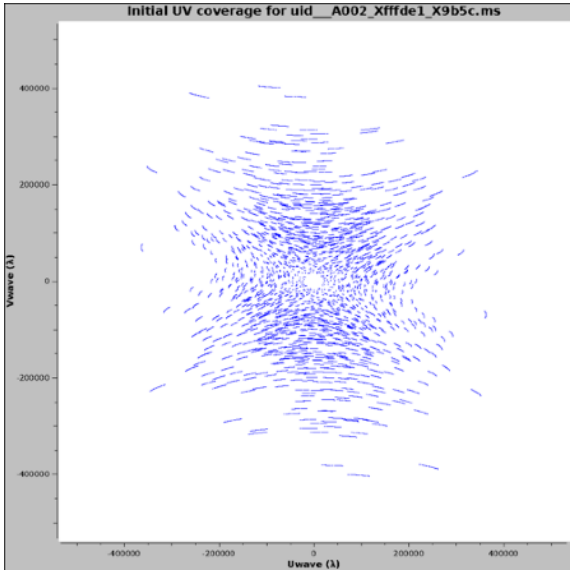
Spectral Windows with Science Intent in uid___A002_Xca8fbf_X5733.ms

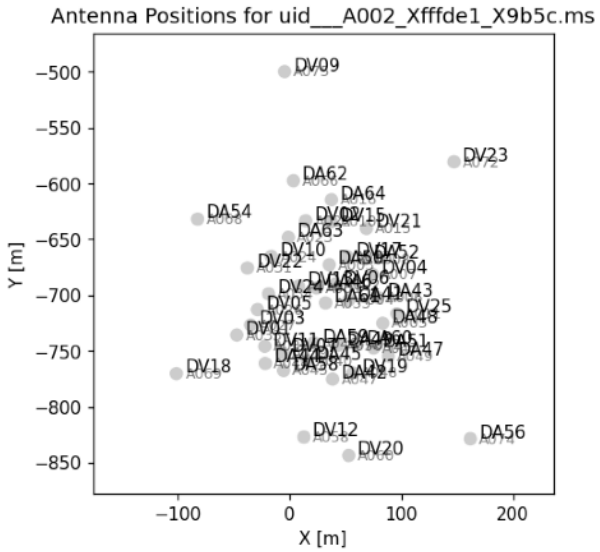
Antenna Setup

- Antennas tab
  - Configuration > Linear and Logarithmic antenna positions
  - UV Coverage for representative target and spw
  - Maps antenna ID to antenna name
- Baselines tab
  - Min and Max
  - Lists all by increasing length

Antenna Details

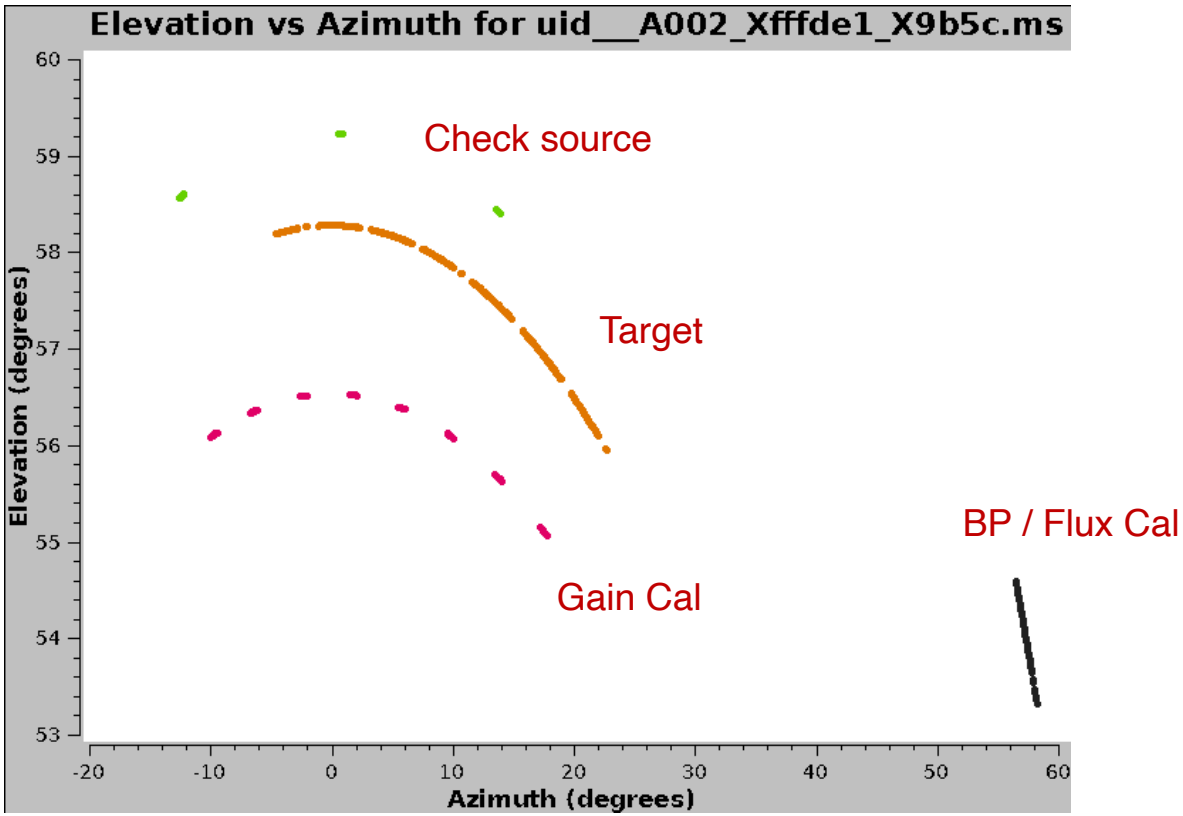
ID	Name
0	DA41
1	DA42
2	DA43
3	DA44
4	DA45
5	DA46
6	DA47
7	DA48
8	DA49





Sky Setup

- Antenna Elevation vs Azimuth and Elevation vs Time
  - 7m array starts shadowing at <50 degrees
- Solar Elevation vs Time (implications for atmosphere/phase)
- UV coverage (same plot from Antenna Setup) > will be elongated for low elevation targets



Scans

- Similar to the first table in listobs, but
  - includes duration
  - does NOT include integration time (T_int) per spw

Scan Details

BACK

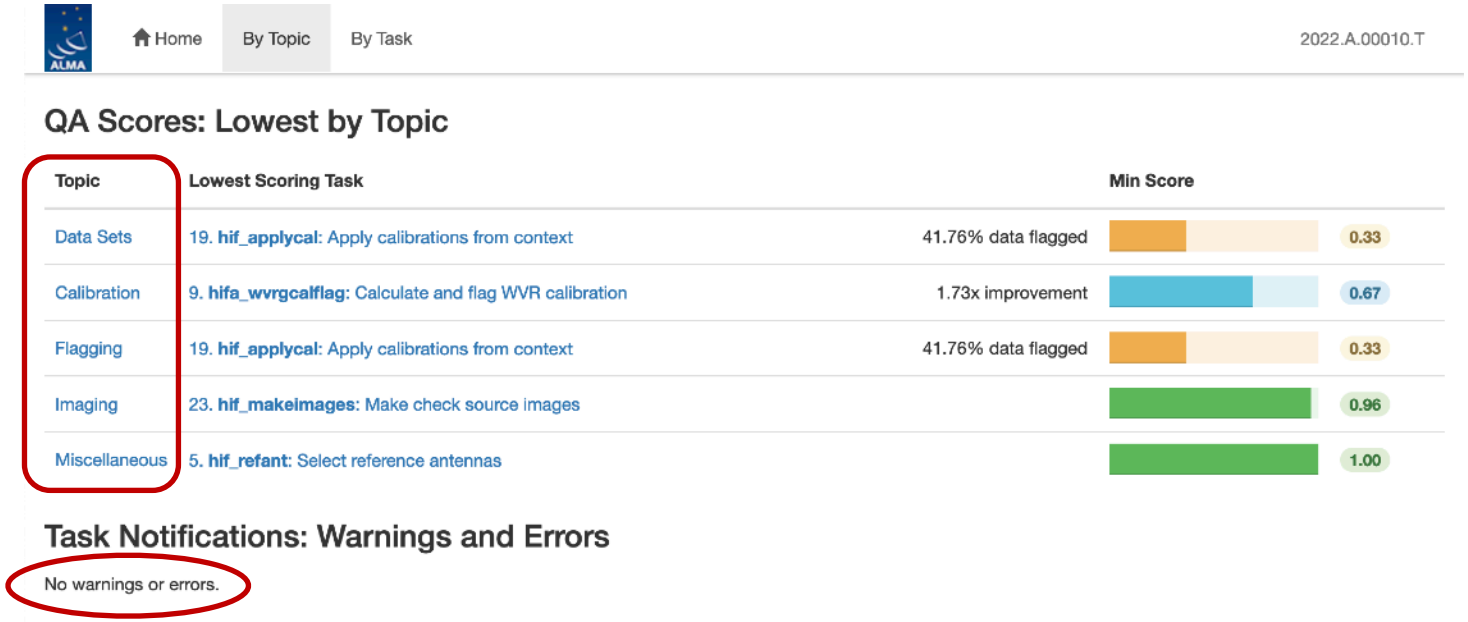
Science Scans | All Scans

All Scans

ID	Time		Duration	Spws	Fields	Intents
	Start	End				
1	2022-10-21 04:54:40	2022-10-21 04:55:38	0:00:58	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	'J0423-0120'	'POINTING' and 'WVR'
2	2022-10-21 04:55:51	2022-10-21 04:56:07	0:00:17	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'J0423-0120'	'ATMOSPHERE'
3	2022-10-21 04:56:18	2022-10-21 05:01:22	0:05:03	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'J0423-0120'	'AMPLITUDE', 'BANDPASS' and 'WVR'
4	2022-10-21 05:01:41	2022-10-21 05:01:58	0:00:17	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'J0309+1029'	'ATMOSPHERE'
5	2022-10-21 05:02:04	2022-10-21 05:03:05	0:01:01	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'J0309+1029'	'PHASE' and 'WVR'
6	2022-10-21 05:03:14	2022-10-21 05:03:31	0:00:17	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'AT2022tsd'	'ATMOSPHERE'
7	2022-10-21 05:03:40	2022-10-21 05:04:41	0:01:01	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'J0259+0747'	'CHECK' and 'WVR'
8	2022-10-21 05:04:51	2022-10-21 05:10:26	0:05:35	0, 1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 15, 16	'AT2022tsd'	'TARGET'

By Topic: QA Scores and Notifications

- Reports lowest scoring Task per Topic
- Notifications: all Warnings and Errors from the pipeline run are listed here. Click through to the individual pipeline stages for more information.



Different weblog with Warnings

By Topic: Flagging Summaries

- Flagging percentages are reported per EB, Source, Antenna, and Spw after all calibration steps are complete. Some flagging (<20%) is expected across all targets. 7m data is more affected by shadowing, so may have a higher flagging rate.

uid___A002_Xfffde1_X9b5c.ms

Science target has low flagging for this EB

Flagging percentages for Source name: AT2022tsd, Intents: ATMOSPHERE,TARGET

spw	DA41	DA42	DA43	DA44	DA45	DA46	DA47	DA48	DA49	DA50	DA51	DA52	DA54	DA56	DA58	DA59	DA60	DA61	DA62	DA63	DA64
5	17.869	17.869	17.929	17.869	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869
7	17.869	17.869	17.929	17.869	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869
9	17.869	17.869	17.929	17.869	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869
11	17.869	17.869	17.929	17.869	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869	17.864	17.869	17.869	17.869	17.869	17.869

Scroll ↓

uid___A002_Xfffde1_Xa024.ms

Scroll →

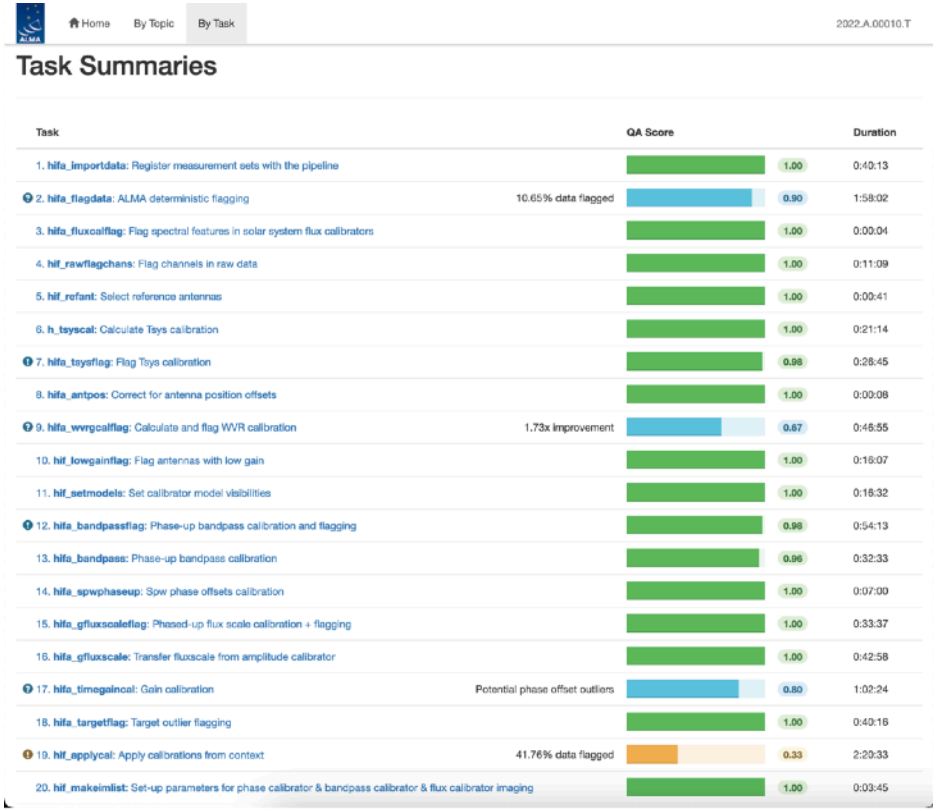
Much higher flagging in this EB!

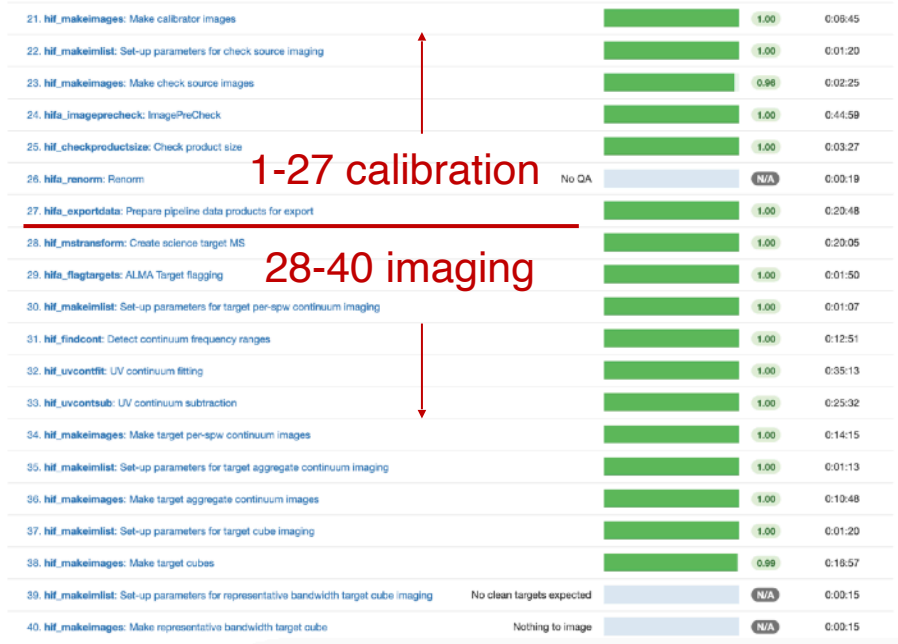
Flagging percentages for Source name: AT2022tsd, Intents: ATMOSPHERE,TARGET

spw	DA41	DA42	DA43	DA44	DA45	DA46	DA47	DA48	DA49	DA50	DA51	DA52	DA54	DA56	DA58	DA59	DA60	DA61	DA62	DA63	DA64
5	56.027	56.027	56.027	56.027	56.027	56.027	100.000	56.027	56.027	56.027	89.252	56.027	56.027	56.027	56.027	56.027	72.363	100.000	72.363	72.363	72.363
7	56.457	56.457	56.457	56.457	56.457	56.457	100.000	56.457	56.457	56.457	90.020	56.457	56.457	56.457	56.457	71.596	71.596	100.000	71.596	71.596	71.596
9	57.224	57.224	57.224	57.224	57.224	57.224	100.000	57.224	57.224	57.224	90.020	57.224	57.224	57.224	57.224	72.363	72.363	100.000	72.363	72.363	72.363
11	56.457	56.457	56.457	56.457	56.457	56.457	100.000	56.457	56.457	56.457	90.020	56.457	56.457	56.457	56.457	71.596	71.596	100.000	71.596	71.596	71.596

By Task: task list

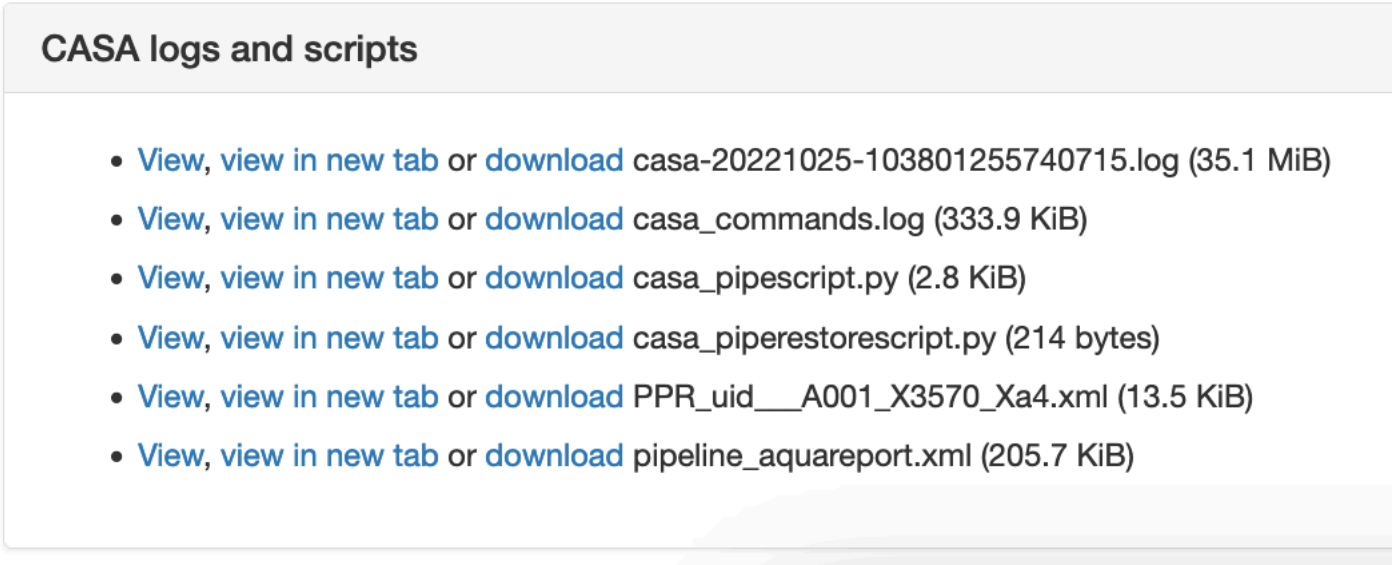
- This page lists each pipeline task/stage. Not all need to be checked. QA Score and run times are reported for each.
- Encircled symbols (? ! X) indicate there are informative QA messages or important notifications on that task page





By Task: CASA logs and scripts

- Hidden near the bottom, but these can be very useful!
- This is the overall CASA log and is very large!
  - CASA logs for individual tasks are also at the bottom of each task page



Calibration tasks and common issues

hifa_importdata

- Raw data (ASDM format) are read into CASA (MS format).
- Calibrator and Check Source fluxes are imported from the calibrator catalogue.
  - If you have concerns about flux accuracies, contact your local ARC via the helpdesk.
- Flux (aka Amplitude) cals should have a monitor point within +/-14 days. Negative means the calibrator was monitored AFTER the execution.
- Representative Target, Spw, and BW for Sensitivity are listed at the bottom.

Measurement Set	Field	Intents	SpW	Flux Density				Spix	Age Of Nearest Monitor Point (days)
				I	Q	U	V		
uid___A002_Xfffde1_X9b5c.ms	J0423-0120 (#0)	AMPLITUDE, BANDPASS	5	2.536 Jy	0.000 Jy	0.000 Jy	0.000 Jy	-0.565	0
			7	2.530 Jy					
			9	2.494 Jy					
			11	2.487 Jy					
	J0309+1029 (#1)	PHASE	5	433.540 mJy				-0.623	181.0

Measurement Set	Representative Source				
	Name	Representative Frequency	Bandwidth for Sensitivity	Spw Id	Chanwidth
uid___A002_Xfffde1_X9b5c.ms	AT2022tsd	412.00000GHz	7.50000GHz	11	15.62500MHz

hifa_flagdata

- Flagging statistics (before any calibration)
- Shadowing likely explains the high target flagging for the 3rd EB we saw in By Topic (after calibration)
- System flags recorded in the ASDM, aka “online flags,” are read into *flagonline.txt
- Manual flags added for recalibration are in *flagtemplate.txt

	Online Flags		Flagging Template	
Measurement Set	File	Number of Statements	File	Number of Statements
uid___A002_Xfffde1_X9b5c.ms	uid___A002_Xfffde1_X9b5c.flagonline.txt	6460	uid___A002_Xfffde1_X9b5c.flagtemplate.txt	0
uid___A002_Xfffde1_X9dbf.ms	uid___A002_Xfffde1_X9dbf.flagonline.txt	6060	uid___A002_Xfffde1_X9dbf.flagtemplate.txt	0
uid___A002_Xfffde1_Xa024.ms	uid___A002_Xfffde1_Xa024.flagonline.txt	5099	uid___A002_Xfffde1_Xa024.flagtemplate.txt	0

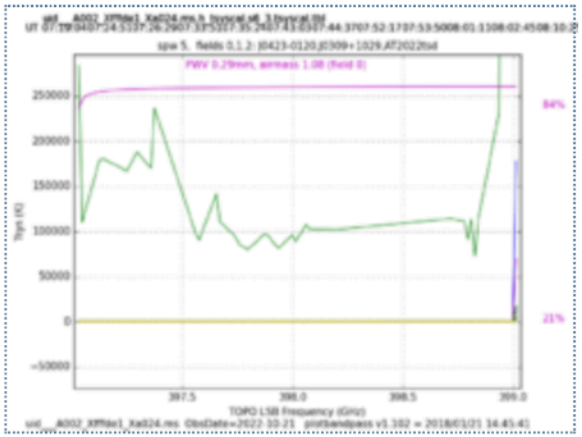
Data Selection (by intent)	Before Task	Unwanted Intents	QA0	QA2	Online Flags	Flagging Template	Partial Polarization	Autocorrelations	Shadowed Antennas	Edge Channels	Low Transmission	Total	_X9b5c.ms	_X9dbf.ms	_Xa024.ms
All Data	0.224%	15.816%	0.000%	0.000%	0.064%	0.000%	0.043%	3.656%	3.042%	4.534%	0.000%	27.379%	24.643%	24.613%	34.557%
Science Spectral Windows	0.232%	16.297%	0.000%	0.000%	0.040%	0.000%	0.045%	3.796%	3.085%	4.781%	0.000%	28.278%	25.510%	25.477%	35.540%
Flux	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	4.352%	0.000%	5.625%	0.000%	9.978%	9.978%	9.978%	9.978%
Bandpass	0.000%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	4.352%	0.000%	5.625%	0.000%	9.978%	9.978%	9.978%	9.978%
Check	0.002%	0.000%	0.000%	0.000%	0.101%	0.000%	0.000%	4.351%	4.764%	5.337%	0.000%	14.554%	10.063%	12.794%	23.931%
Phase	0.149%	0.000%	0.000%	0.000%	0.185%	0.000%	0.000%	4.346%	5.372%	5.287%	0.000%	15.338%	10.128%	13.625%	24.569%
Target (science spws)	0.097%	0.000%	0.000%	0.000%	0.064%	0.000%	0.071%	4.351%	3.676%	5.391%	0.000%	13.649%	10.009%	10.301%	23.040%
uid___A002_Xfffde1_X9b5c.ms	0.118%	16.131%	0.000%	0.000%	0.039%	0.000%	0.000%	3.645%	0.000%	4.710%	0.000%	24.643%			
uid___A002_Xfffde1_X9dbf.ms	0.108%	15.329%	0.000%	0.000%	0.034%	0.000%	0.000%	3.680%	0.751%	4.711%	0.000%	24.613%			
uid___A002_Xfffde1_Xa024.ms	0.513%	16.037%	0.000%	0.000%	0.135%	0.000%	0.155%	3.639%	10.003%	4.075%	0.000%	34.557%			

h_tsyscal and hifa_tsysflag

- Atmospheric features are plotted in magenta and should not be flagged.
- Bonus exercise: click any blue link to open sub-plots which can be filtered by EB, spw, and antenna. Can you find the problem that the pipeline flagged?

Before flagging – 250,000 K, yikes!

uid___A002_Xfffde1_Xa024.ms

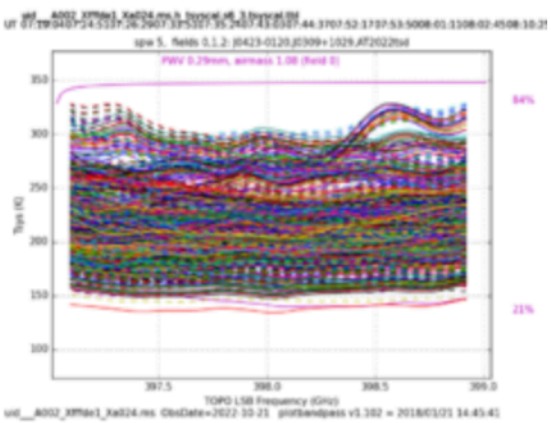


T_{sys} spw 5 ← Click!

Science spw 5.

After pipeline flagging – whew!

uid___A002_Xfffde1_Xa024.ms



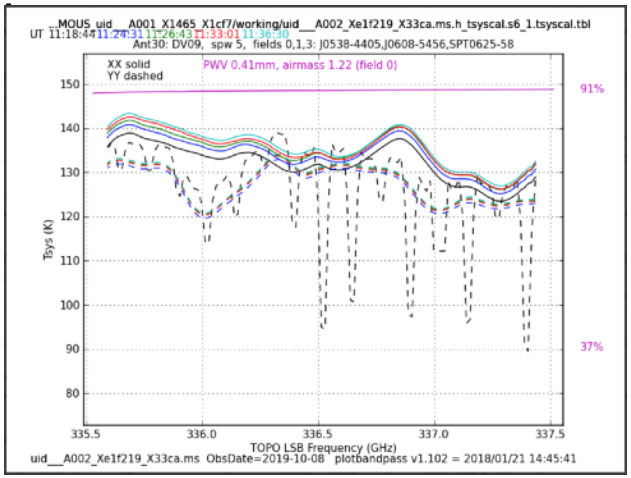
T_{sys} spw 5

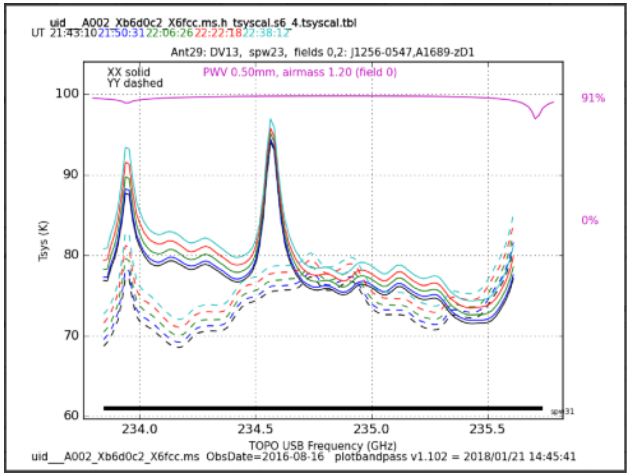
Science spw 5.

Other Common T_{sys} Issues

- Some of these require flagging. Additional inspection of the calibrated data is required.

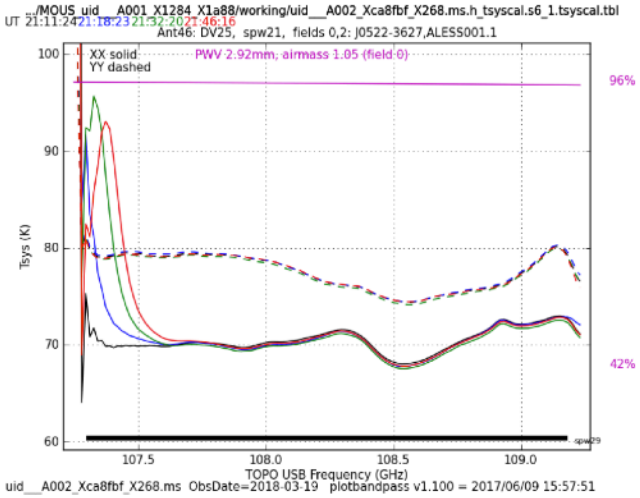
Bad data at a certain time

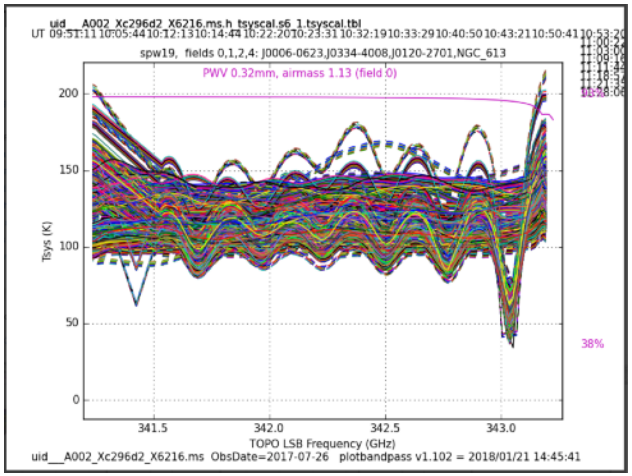




Contamination ?

Edge channels

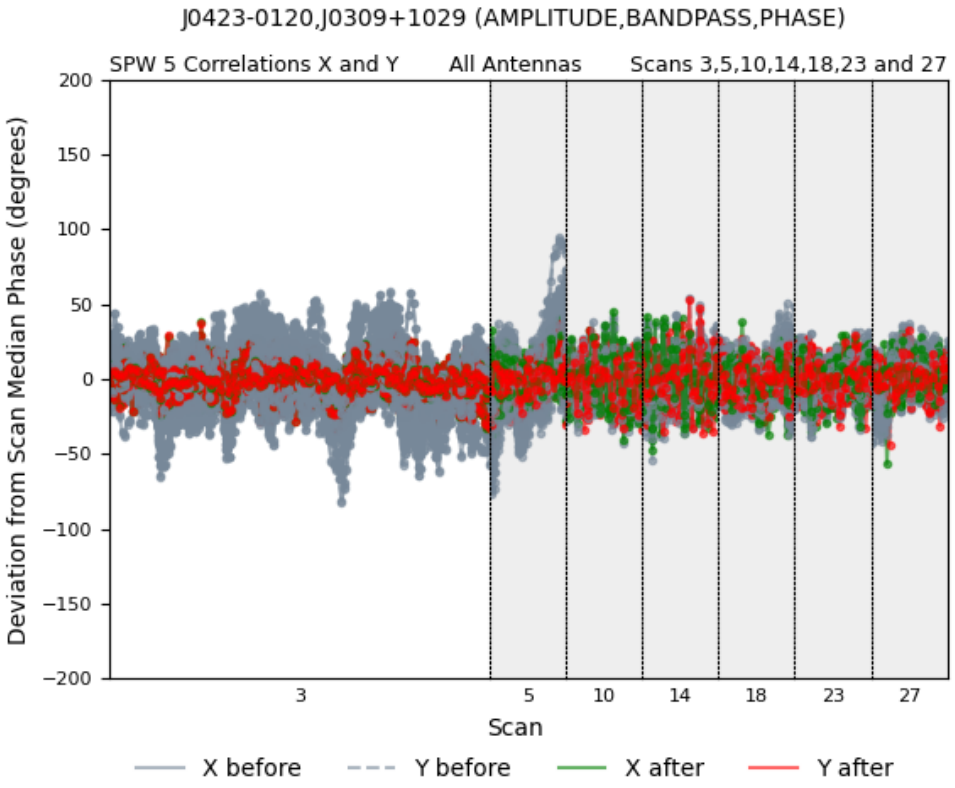




"Vampire teeth" correlator issue

hifa_wvrgcalflag

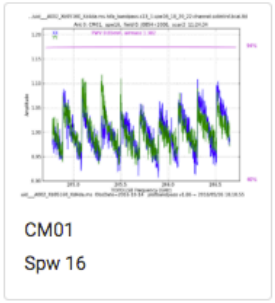
- Pipeline evaluates how much WVR corrections improve and decides whether or not apply the solutions moving forward
- gray = without WVR corrections
- green = XX after corrections
- red = YY after corrections

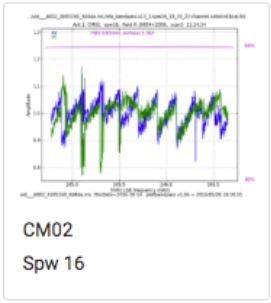


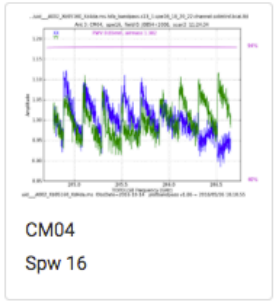
hifa_bandpass

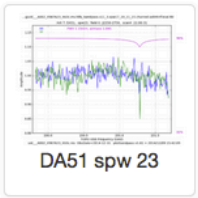
- Amplitude and Phase vs Frequency BP calibration
- The main page shows plots for the reference antenna, but examining subplots is necessary
- Recommended to filter by spw and scroll through for anomalies

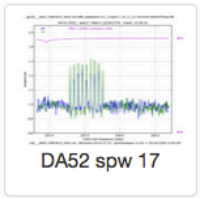
Common Issues in BP Amp

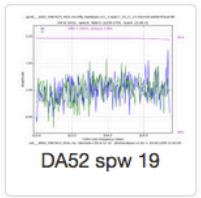

CM01
Spw 16

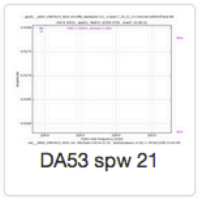

CM02
Spw 16

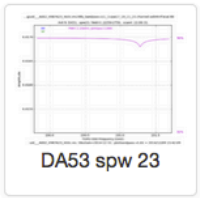

CM04
Spw 16

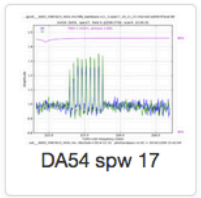

DA51 spw 23

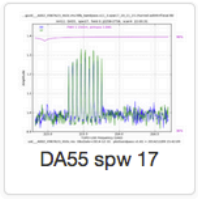

DA52 spw 17

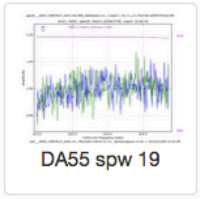

DA52 spw 19

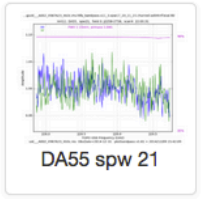

DA53 spw 21

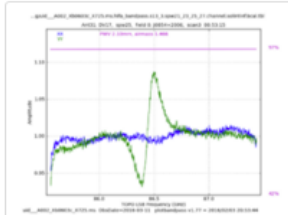

DA53 spw 23

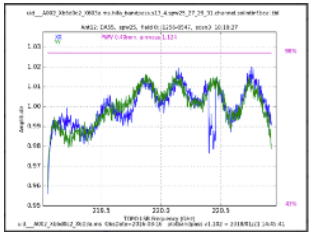

DA54 spw 17

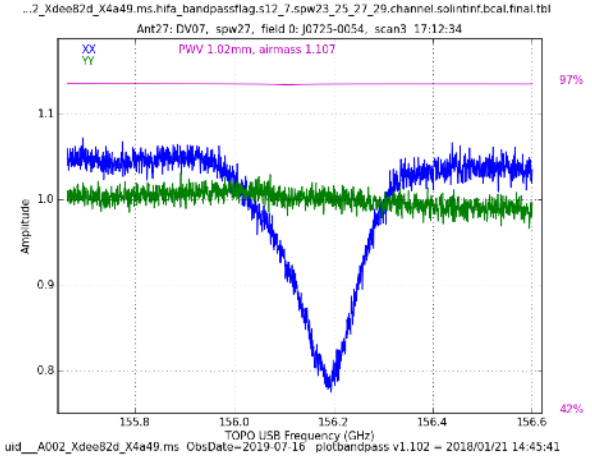

DA55 spw 17


DA55 spw 19

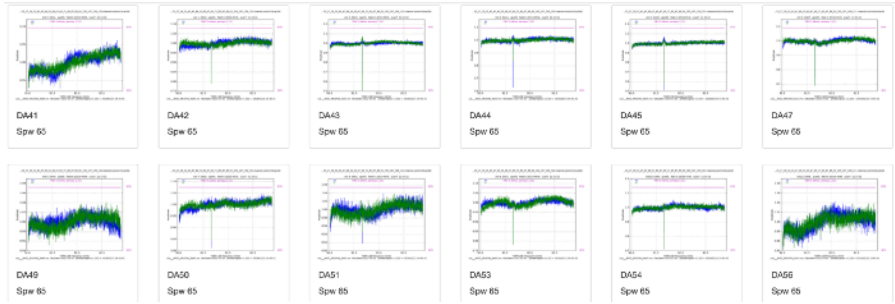

DA55 spw 21


uid___A002_Xb0603c_X725.ms
DV17
Spw 25





Check for wide features >15% in amp, then look in applycal to see if data is noisy at this freq.



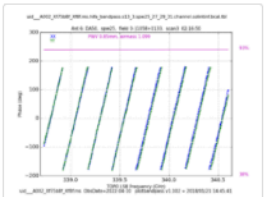
WVR leakages may be found at specific known frequencies. Usually these are calibrated out and do not need flagging.

Common Issues in BP Phase

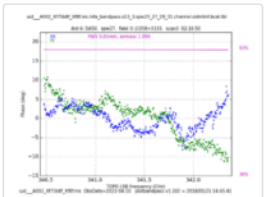
13. Bandpass Calibration

Task notifications

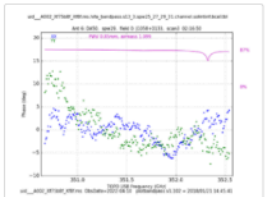
QA Lowest score for phase derivative is 0.03 (uid___A002_Xf75b8f_Xf8f.ms DA50 spw 25 YY)



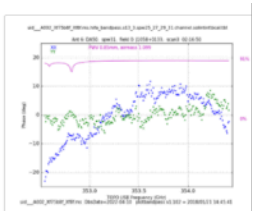
uid___A002_Xf75b8f_Xf8f.ms
DA50
Spw 25



uid___A002_Xf75b8f_Xf8f.ms
DA50
Spw 27



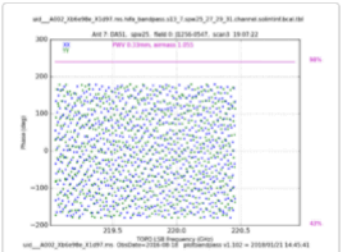
uid___A002_Xf75b8f_Xf8f.ms
DA50
Spw 29



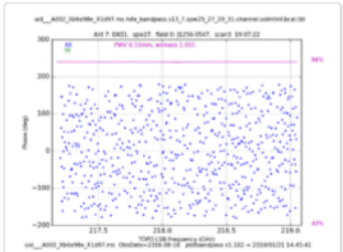
uid___A002_Xf75b8f_Xf8f.ms
DA50
Spw 31

Task notifications

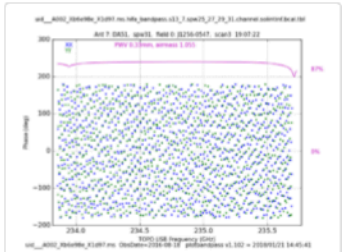
QA Lowest score for phase derivative is 0.03 (uid___A002_Xb6e98e_X1d97.ms DA51 spw 31 XX)



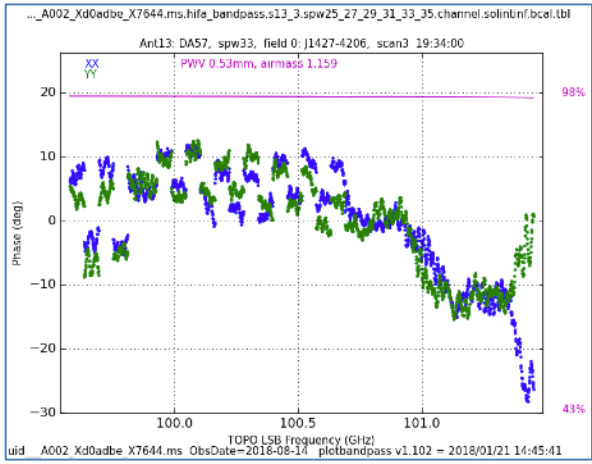
uid___A002_Xb6e98e_X1d97.ms
DA51
Spw 25



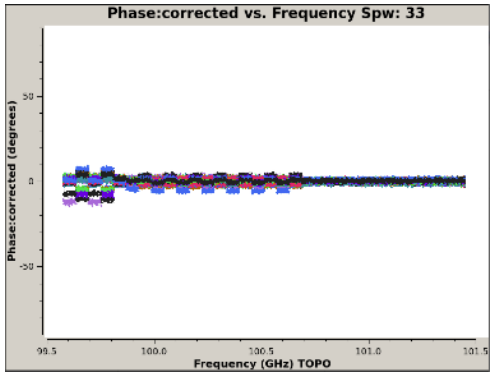
uid___A002_Xb6e98e_X1d97.ms
DA51
Spw 27



uid___A002_Xb6e98e_X1d97.ms
DA51
Spw 31

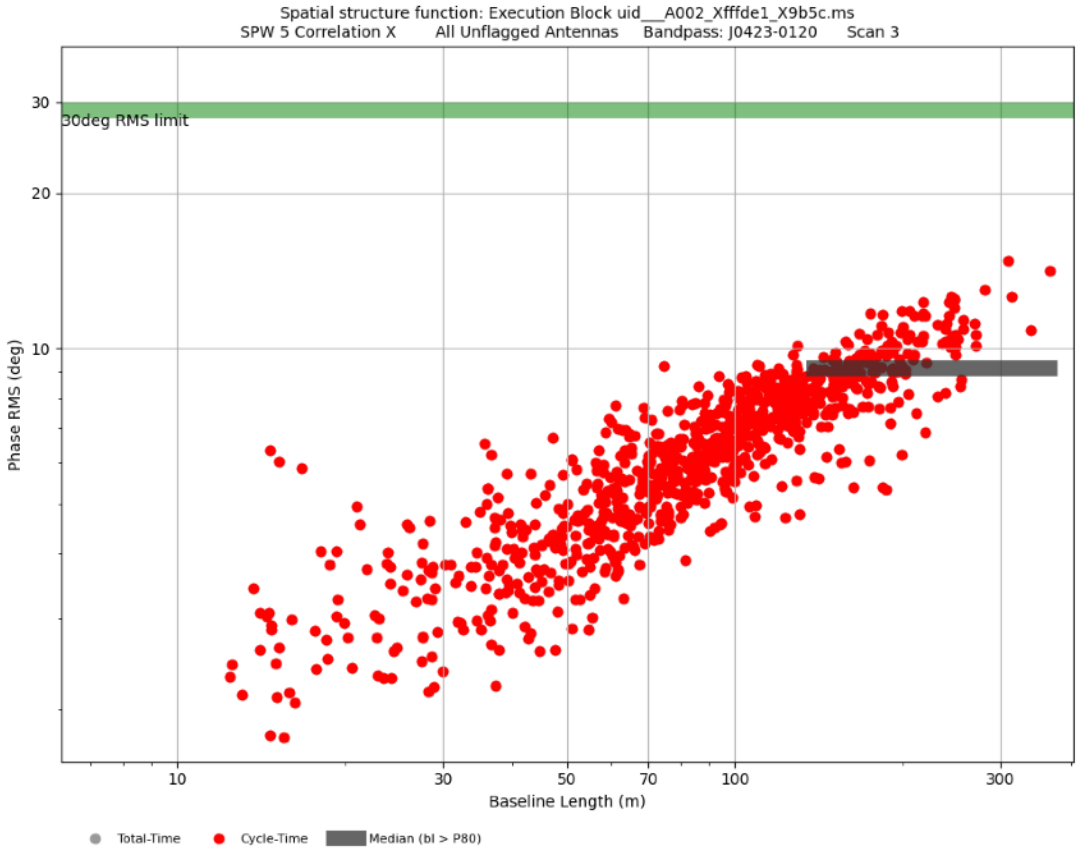


"Platforming" is a known correlator issue. Data is unrecoverable and should be flagged. The applycal plot is shown below.



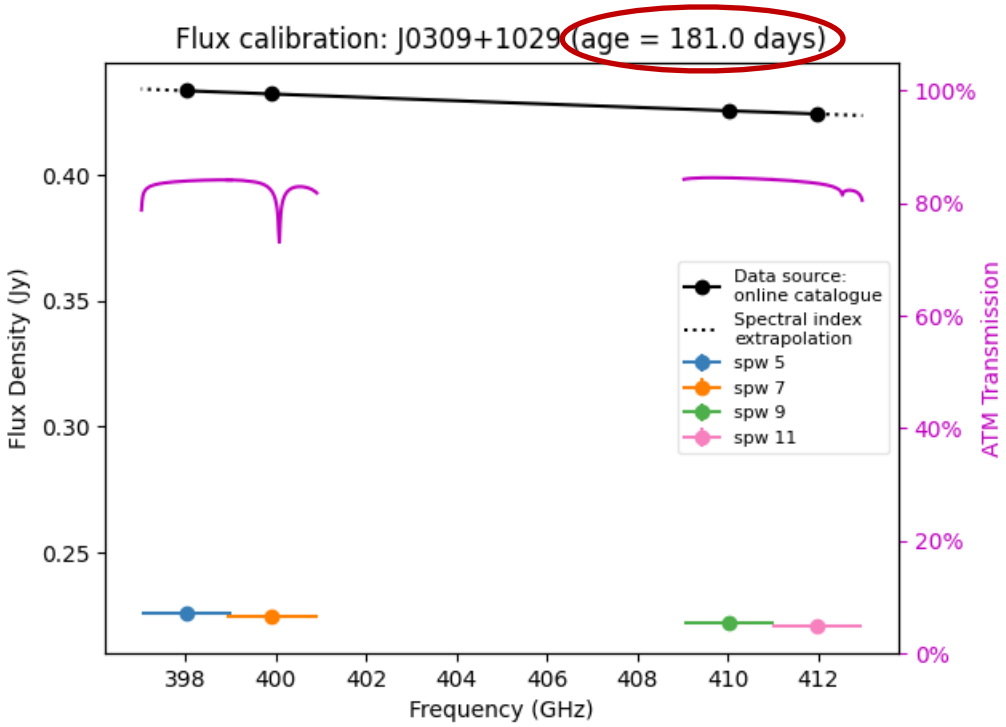
hifa_spwphaseup

- Plots are ideally within 30 deg phase RMS and follow a trend. Outlying blobs may be bad antennas. Our weblog looks great.



hifa_gfluxscale

- Flux is bootstrapped from the flux calibrator to other calibrators, which are compared to the online source catalogue.
- Some catalogue values are old but the spectral index (slope) should remain consistent.
- Note the two different Y axes that are plotted together vs Frequency



hifa_timegaincal

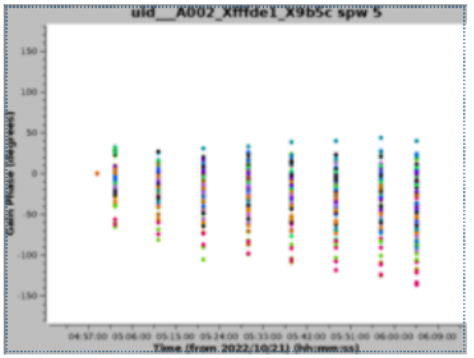
- Complex Gain (Amp and Phase) vs Time calibration
- These plots are calibration tables (aka corrections/solutions), not the corrected data, so sometimes outliers mean the calibration is doing its job and might not need flagging!
- This task shows solutions that will be applied, as well as diagnostic solutions that will NOT be applied.

- Plots
  - Phase vs time
  - Amplitude vs time
- Diagnostic plots
  - Phase vs time
  - Phase offsets vs time
  - Amplitude vs time

As usual, click to view per EB/spw/antenna if you need to identify outliers

uid___A002_Xfffde1_X9b5c.ms

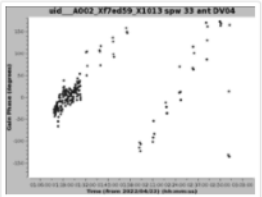
Spectral windows default mapped for J0309+1029 (PHASE).



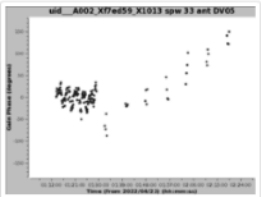
Spectral window 5

Phase vs time, all antennas and correlations.

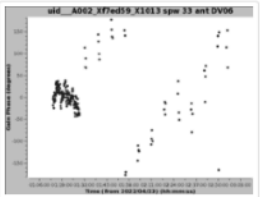
Typical Issues with timegaincal



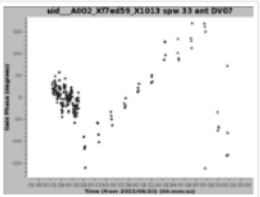
DV04
Spw 33



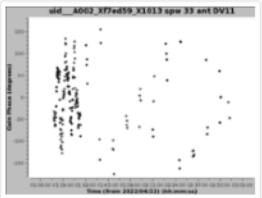
DV05
Spw 33



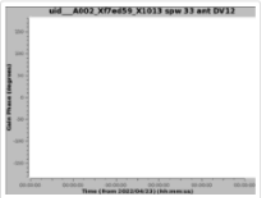
DV06
Spw 33



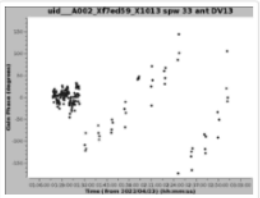
DV07
Spw 33



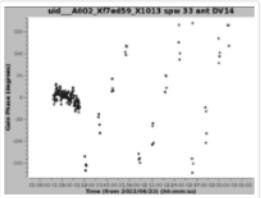
DV11
Spw 33



DV12
Spw 33



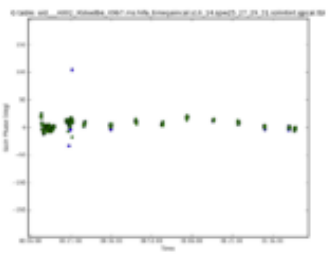
DV13
Spw 33



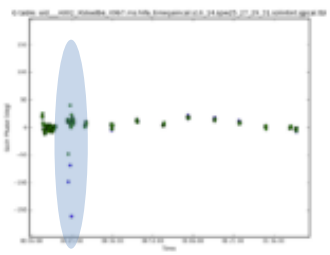
DV14
Spw 33

This data might need to be flagged. Check the calibrated data in applycal to see if there are outliers at this time.

High phase slopes and wrapping are typically not real. This is likely an issue with the antenna positions.



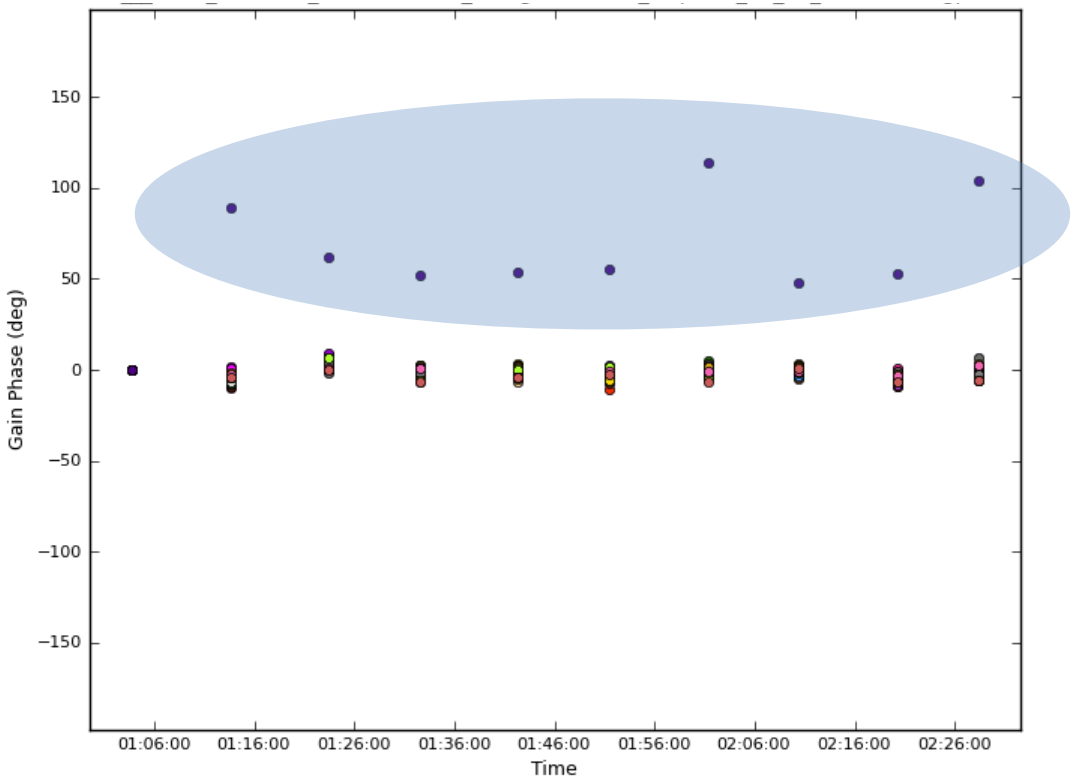
uid___A002_Xbbadbe_X9b7.ms
DA63
Spw 25



uid___A002_Xbbadbe_X9b7.ms
DA63
Spw 27

hifa_timegaincal: Phase Offsets vs Time

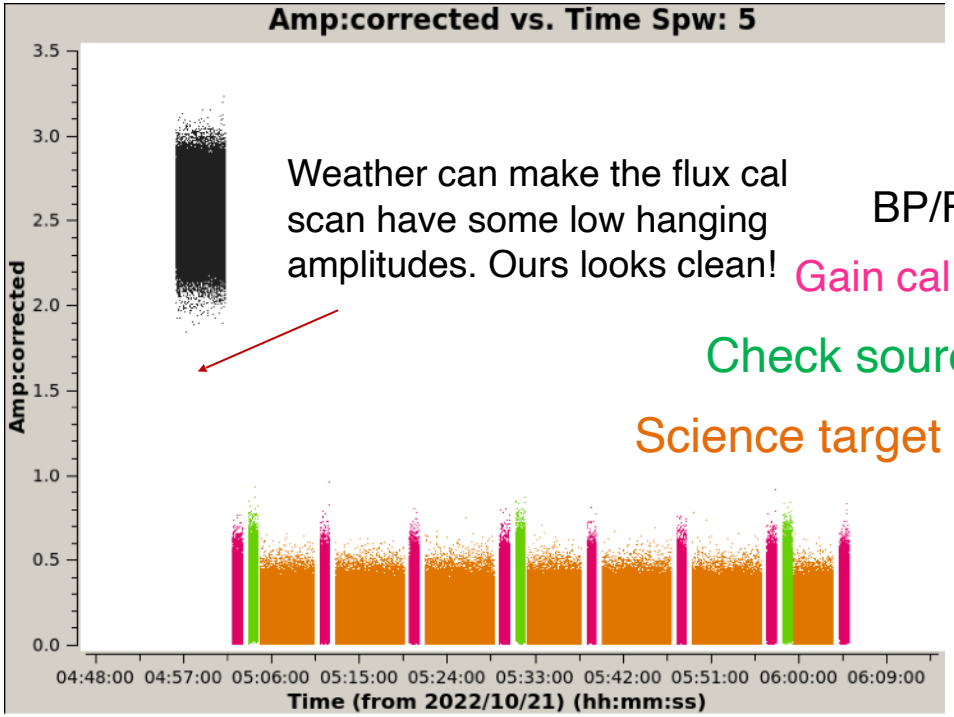
- These are diagnostic plots used to inspect antennas for issues that may occur when using spw mapping or spw combine to increase the SNR.
- Outliers >50 degrees may need to be flagged.



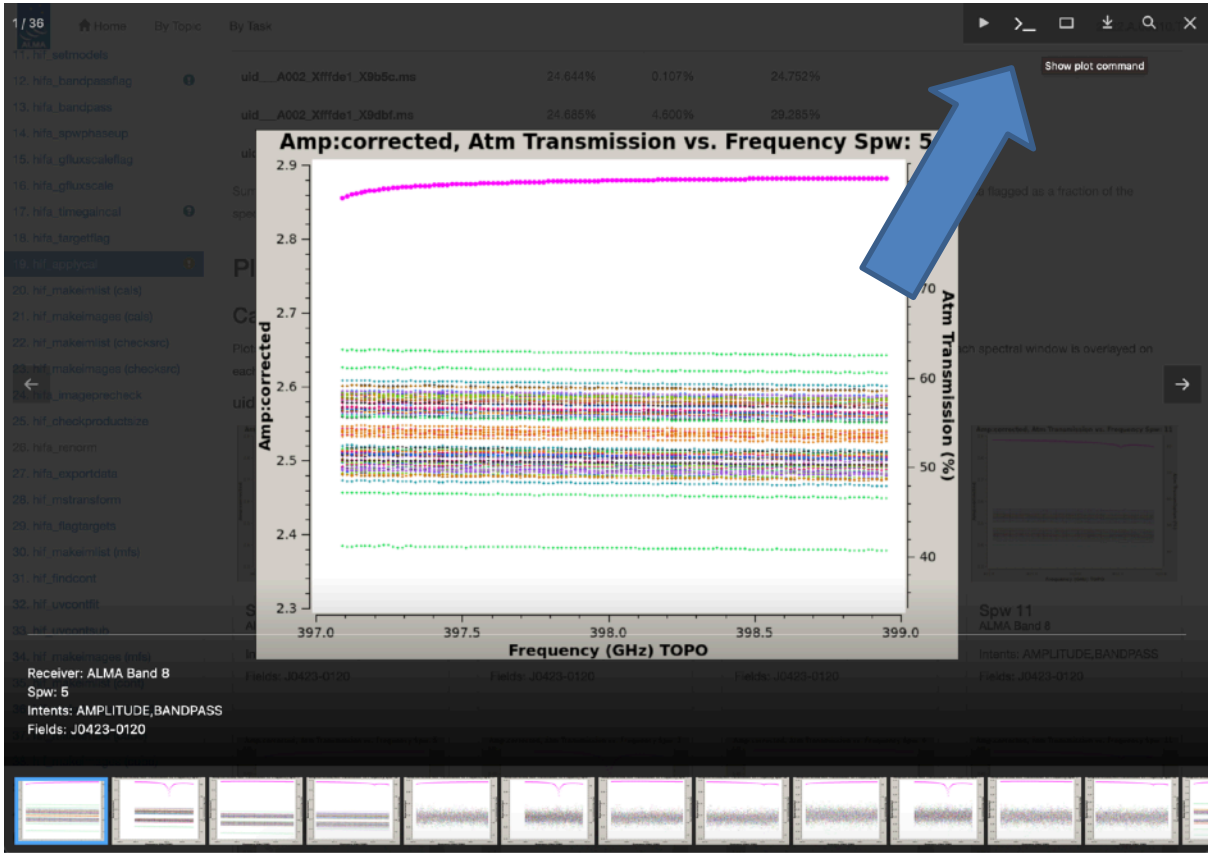
hif_applycal

- Applies the calibration tables
- Plots the calibrated data
- Outliers at this stage may need flagging
- Per-antenna plots are provided for Amp vs Time only, other outliers may need to be located by plotting manually with plotms

Contents



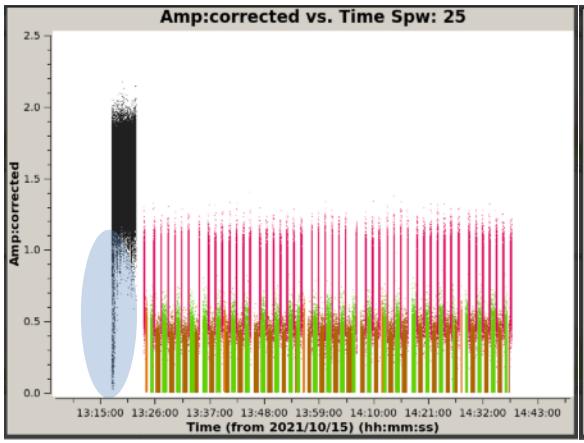
Retrieve Plotting Commands

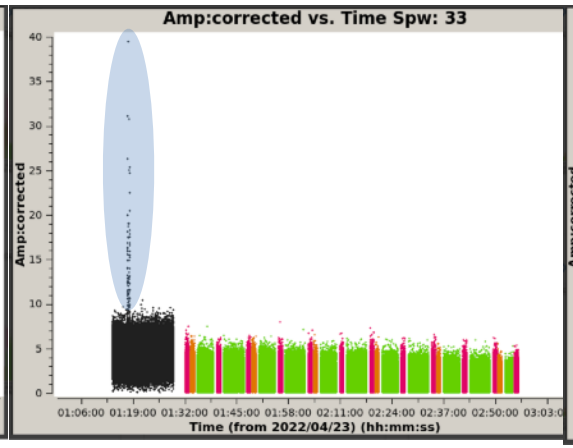


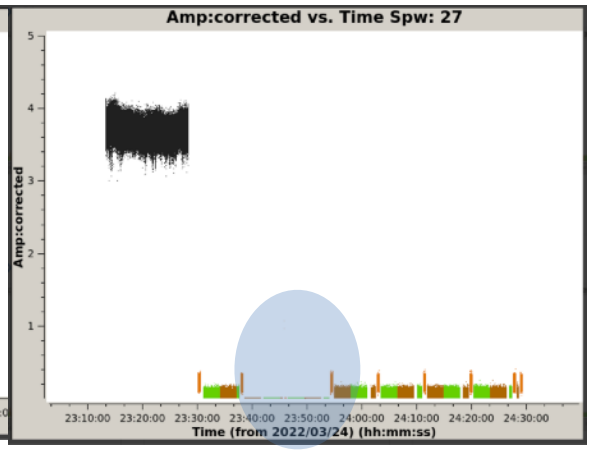
Plot Command

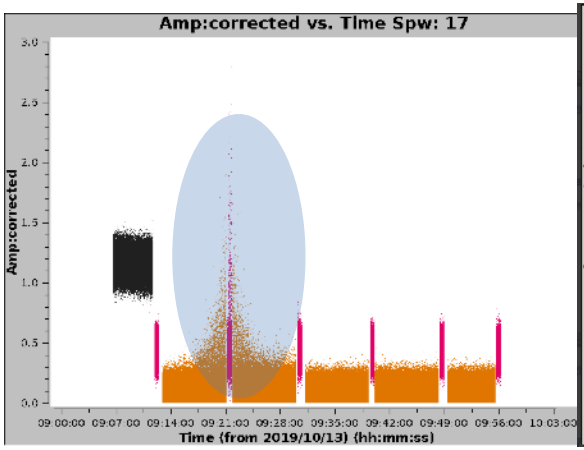
plotms(vis='uid___A002_Xfffde1_X9b5c.ms', xaxis='freq', yaxis='amp', ydatacolumn='corrected', field='J0423-0120', spw='5', correlation='XX,YY', intent='CALIBRATE_FLUX#ON_SOURCE', avgtime='1e8', avgscan=True, avgantenna=True, yselfscale=True, coloraxis='antenna1', plotrange=[0, 0, 0, 0], plotfile='uid___A002_Xfffde1_X9b5c.ms-J0423-0120-spw05-AMPLITUDE-amp_vs_freq-XX_YY.png', overwrite=True, showgui=False, clearplots=True, showatm=True)

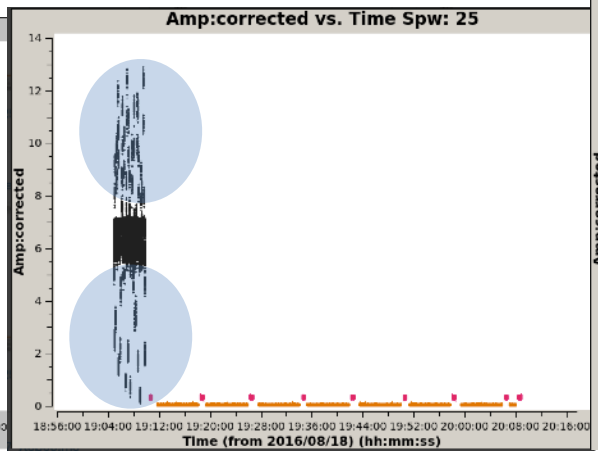
Typical Issues in Amp vs Time

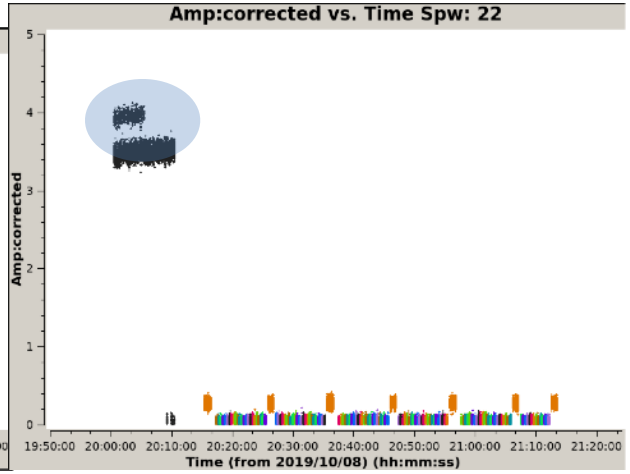




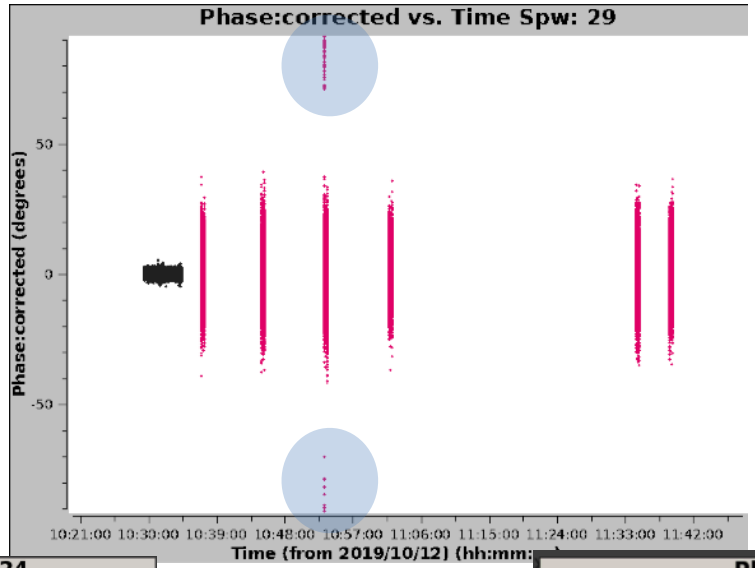


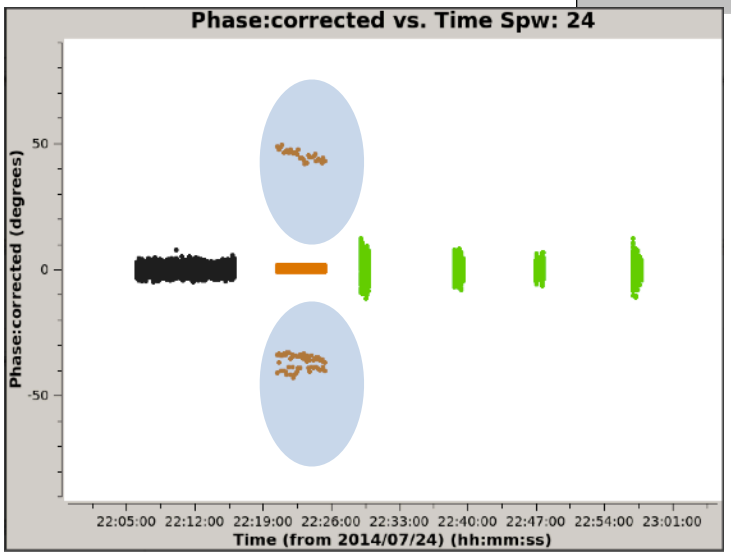




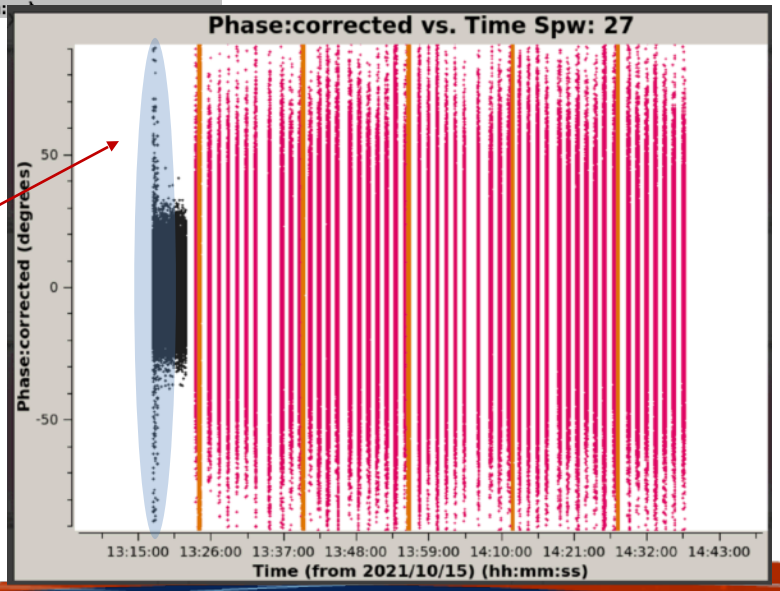


Typical Issues in Phase vs Time

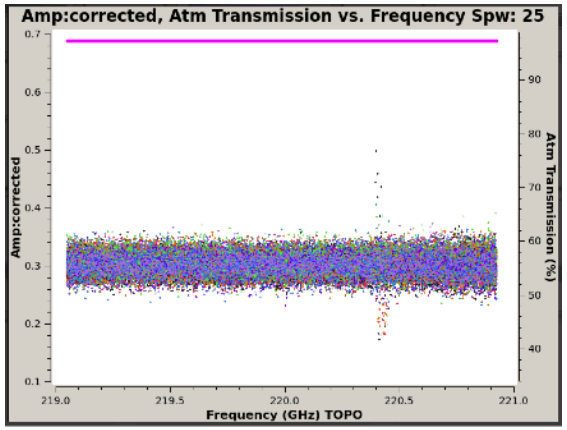


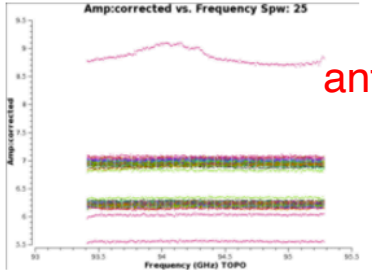


flag a short timerange



Typical Issues in Amp vs Freq

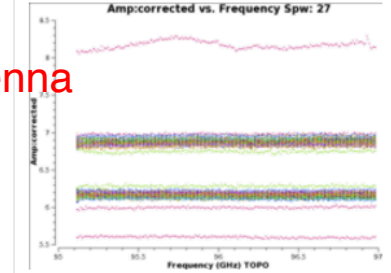




antenna

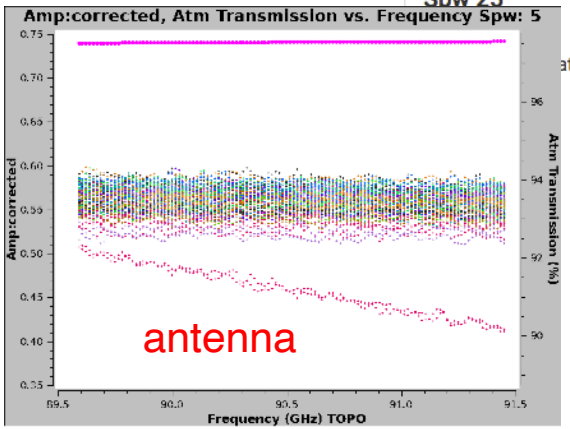
Spw 25

...tor: J0854+2006.

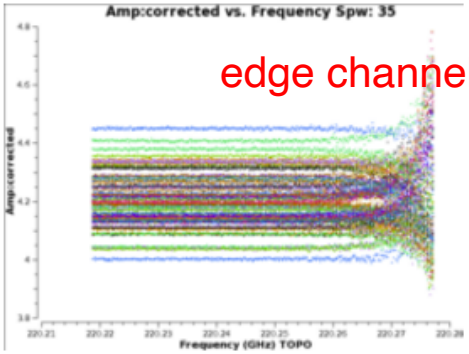


Spw 27
ALMA Band 3

Amplitude calibrator: J0854+2006.



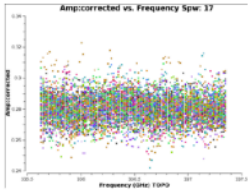
antenna



edge channels

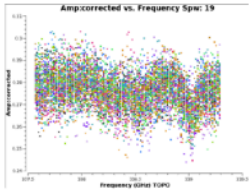
Spw 35
ALMA Band 6

Bandpass calibrator: J1924-2914.



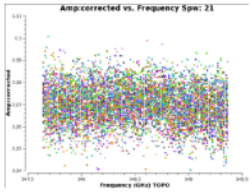
Spw 17
ALMA Band 7

Phase calibrator: J0241-0815.



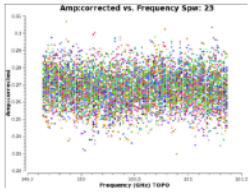
Spw 19
ALMA Band 7

Phase calibrator: J0241-0815.



Spw 21
ALMA Band 7

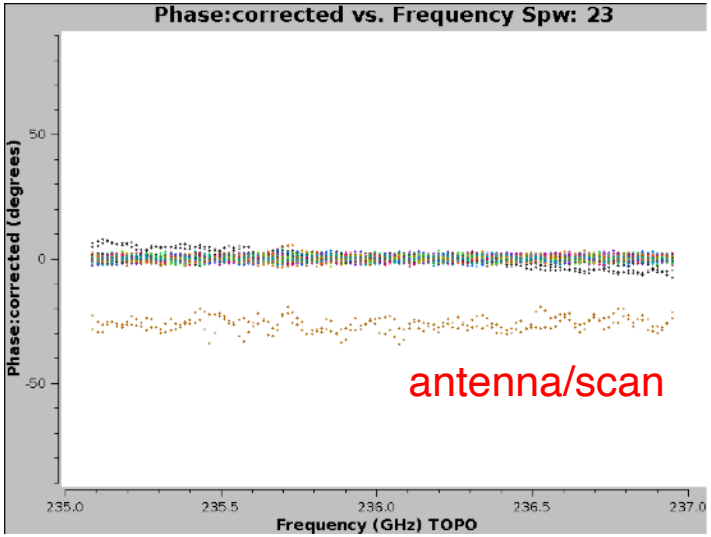
Phase calibrator: J0241-0815.

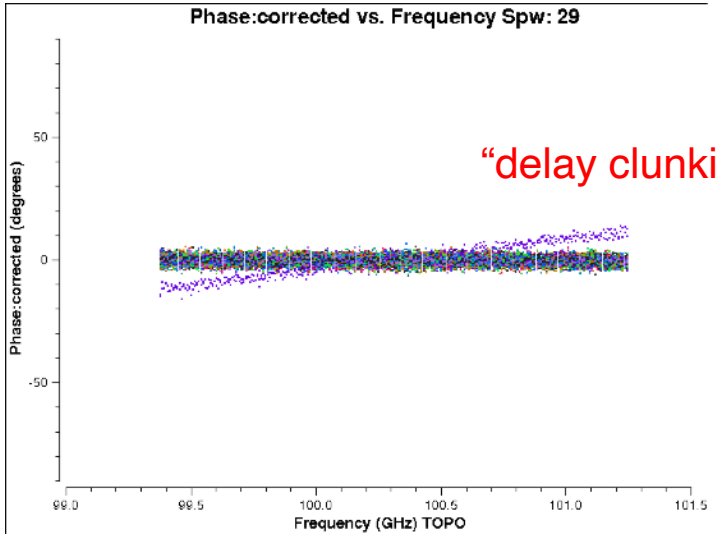


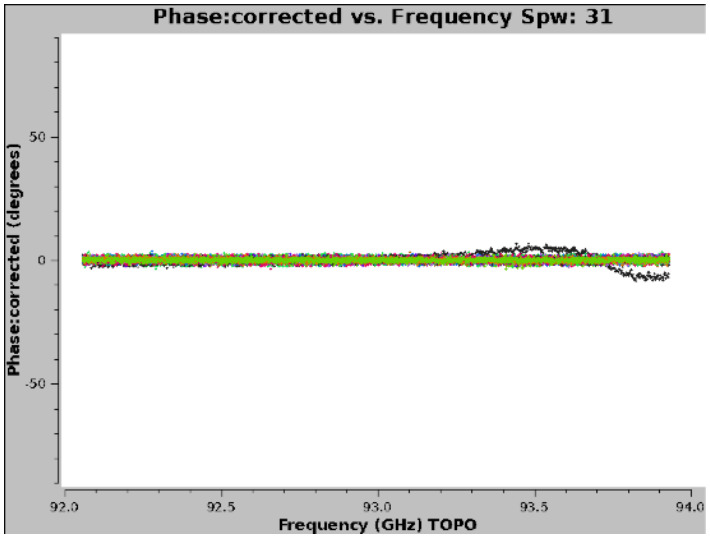
Spw 23
ALMA Band 7

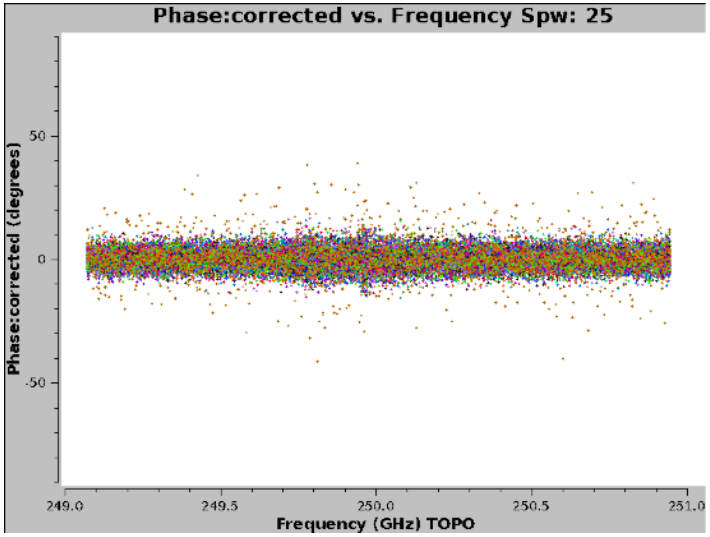
Phase calibrator: J0241-0815.

Typical Issues in Phase vs Freq





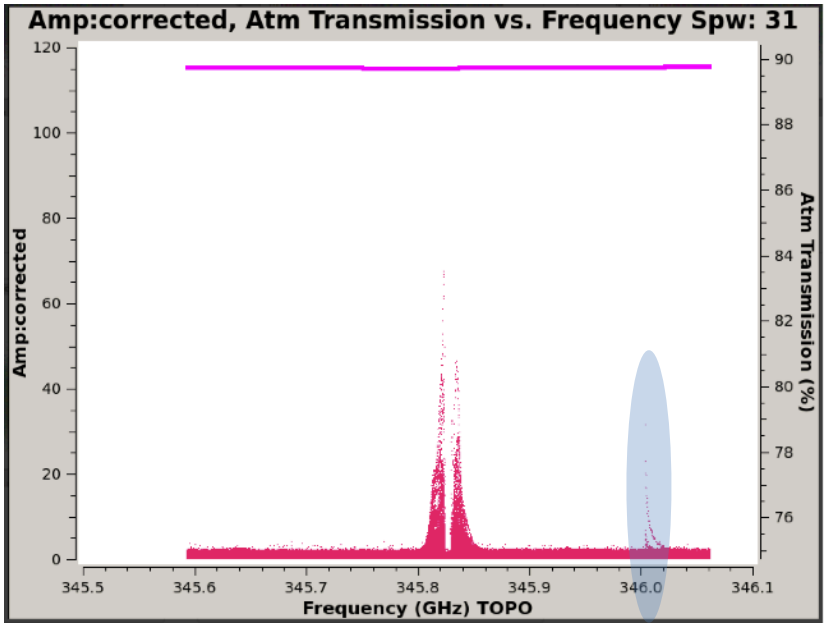


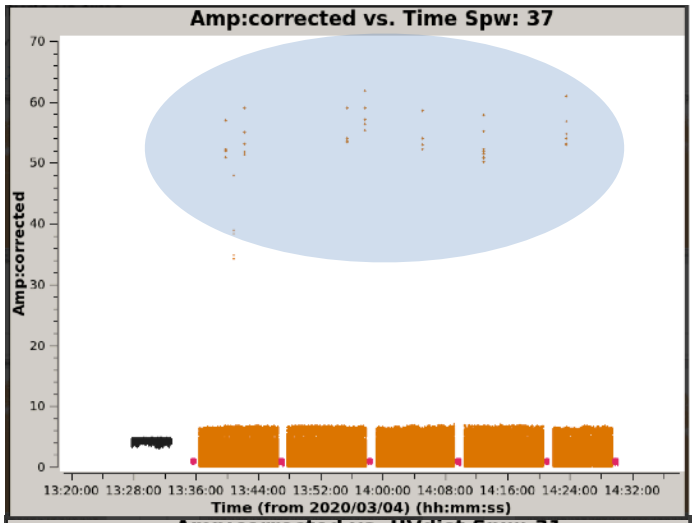


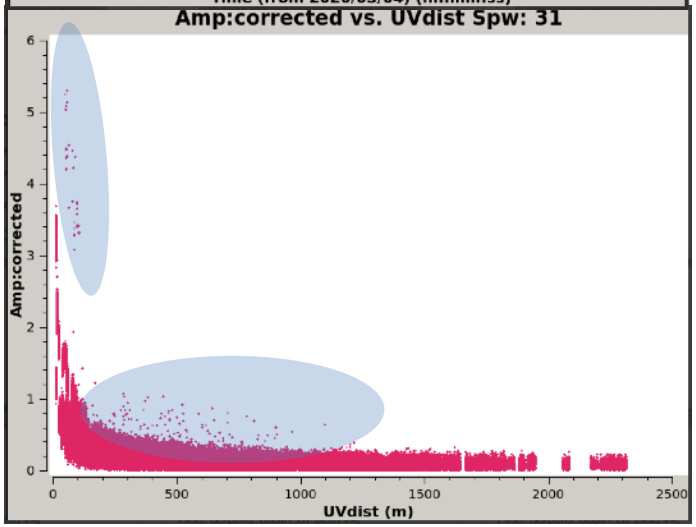
Symmetric outliers could be due to averaging over a small amount of data (if some scans are flagged for that antenna)

Typical Issues in target data

- Be conservative in flagging target data.

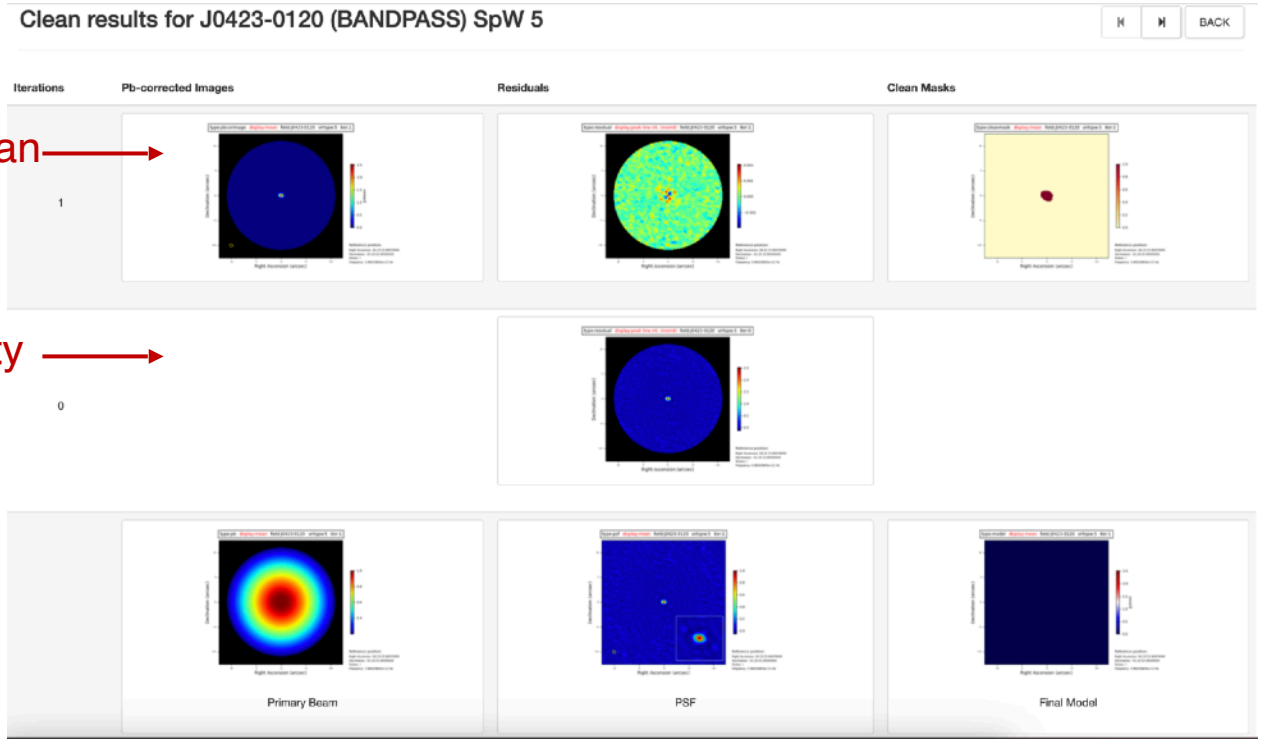


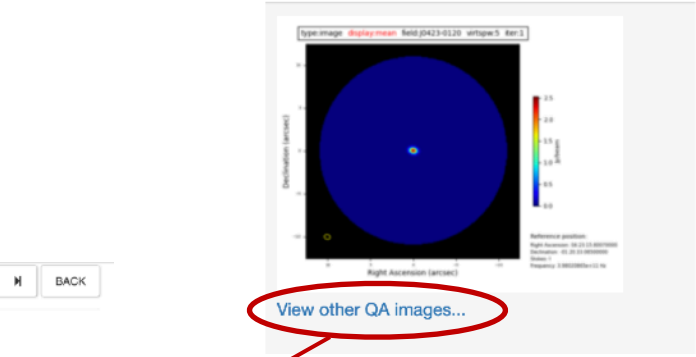




hif_makeimages (cals)

- Makes per-spw continuum images of each calibrat
- These should usually be point sources.

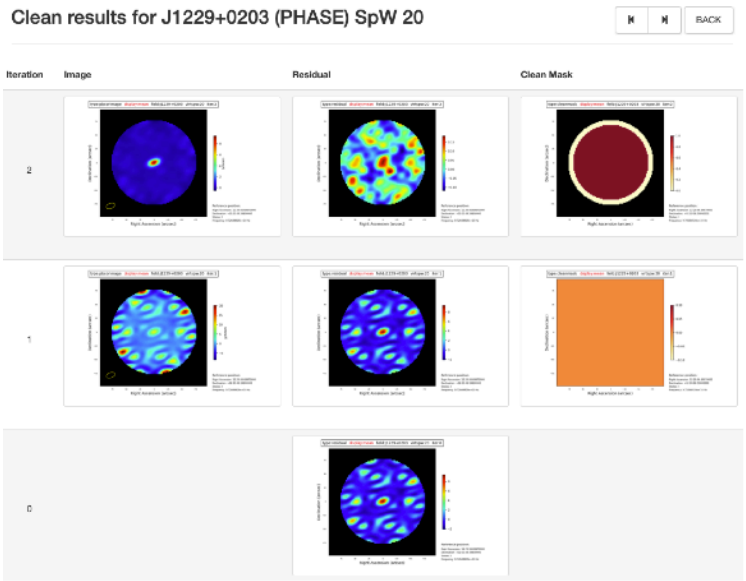




Typical Issues with Calibrator Imaging

"Warning! No automatic tclean mask found, switched to pb-based mask." This warning is common for 7m datasets where the sidelobes are present. No intervention is necessary.

"tclean reached niter limit" or "observed RMS noise exceeds DR corrected sensitivity." There is possibly bad data that needs to be flagged. Check applycal.



Check Source Imaging

- check source = “point-like fake target source a similar distance from gain cal as the actual target”
- per-spw, per-EB images for diagnostics
- Useful to assess the “phase transfer” (application of phase solutions derived from the gain calibrator to a nearby source source) for long baseline and high frequency data.
  - Check the position offset > should be low

Check Source Fit Results

EB	Field	Virtual SPW	Bandwidth (GHz)	Position offset (mas)	Position offset (synth beam)	Fitted Flux Density (mJy)	Image S/N	Fitted [Peak Intensity / Flux Density] Ratio	gfluxscale mean visibility	gfluxscale S/N	[Fitted / gfluxscale] Flux Density Ratio
uid___A002_Xf14fa3_X4ff5	J0603+1742	25	0.9375	4.09 +/- 0.82	0.10 +/- 0.019	28 +/- 1	41.04	0.72	42.72 +/- 0.50	85.73	0.66
		27	0.9375	3.53 +/- 0.73	0.09 +/- 0.019	27 +/- 1	43.06	0.73	42.41 +/- 0.37	115.05	0.64
		29	0.9375	3.50 +/- 0.79	0.09 +/- 0.020	28 +/- 1	42.14	0.70	42.30 +/- 0.39	108.10	0.66
		31	0.9375	4.39 +/- 0.79	0.11 +/- 0.020	27 +/- 1	41.06	0.70	41.39 +/- 0.41	101.38	0.66
		45	0.9375	10.37 +/- 0.80	0.24 +/- 0.019	22 +/- 1	36.95	0.86	42.12 +/- 0.50	83.84	0.51
		47	0.9375	8.95 +/- 0.70	0.23 +/- 0.018	22 +/- 1	40.39	0.86	41.56 +/- 0.45	93.18	0.52
		49	0.9375	9.54 +/- 0.70	0.24 +/- 0.018	21 +/- 1	39.31	0.90	41.35 +/- 0.44	94.03	0.52
		51	0.9375	8.79 +/- 0.73	0.23 +/- 0.019	21 +/- 1	38.05	0.87	41.26 +/- 0.44	92.78	0.50
		65	0.9375	38.46 +/- 5.27	0.98 +/- 0.135	16 +/- 2	15.21	0.30	41.00 +/- 0.45	91.13	0.38
		67	0.9375	41.75 +/- 5.95	1.08 +/- 0.154	16 +/- 2	16.66	0.24	40.97 +/- 0.40	101.69	0.39

hifa_renorm

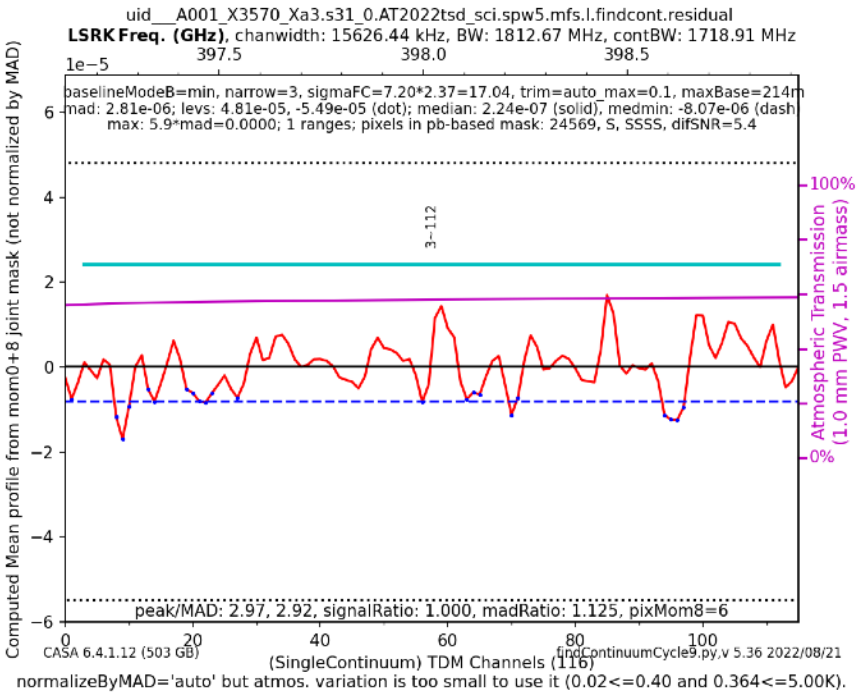
- "ALMA cross-correlations are divided by the auto-correlation as a function of frequency in the correlator. This has a variety of advantages for operations and calibration, but if there is strong line emission detected in the auto-correlation (i.e. as would be detected in a single dish spectrum), that emission can anomalously decrease the cross-correlation amplitude at those frequencies."
- This stage calculates a "renormalization" scale factor to correct for this.
  - See information in the pipeline weblog and:
    - https://help.almascience.org/kb/articles/what-errors-could-originate-from-the-correlator-spectral-normalization-and-tsys-calibration
    - https://help.almascience.org/kb/articles/what-are-the-amplitude-calibration-issues-caused-by-alma-s-normalization-strategy
- Operationally, renorm is only applied if the peak scaling factor is greater than 2% for a given execution, field, and spectral line (FDM) spw.

Imaging tasks

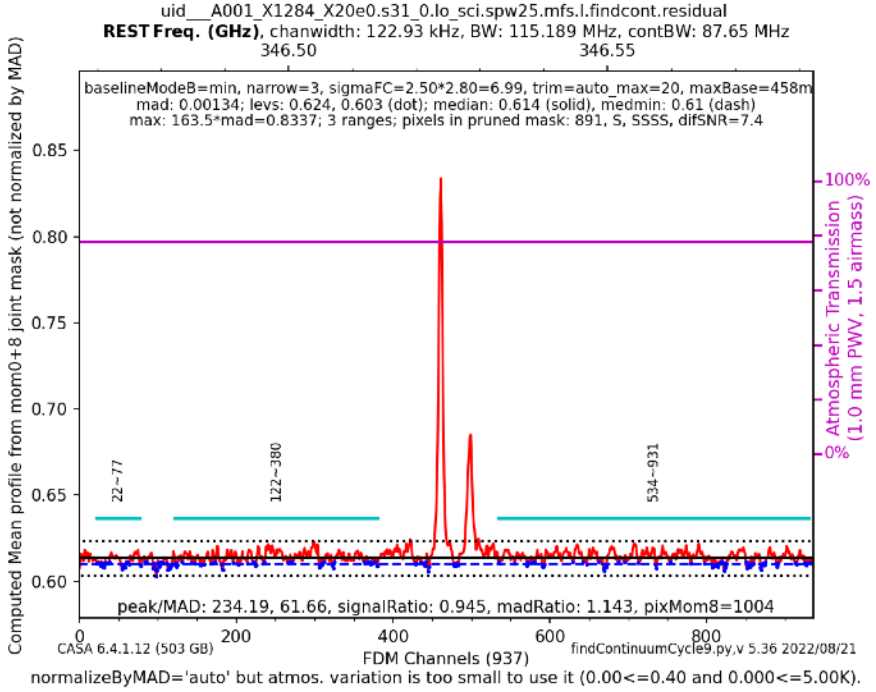
hif_findcont

- Creates initial image cubes (images not shown in weblog) and identifies continuum channels. Ranges covered by the teal line are identified as continuum and will be subtracted before line cube imaging.

Ours is all continuum



Here's a different one



hif_makeimlist and hif_makeimages

- mfs
  - Diagnostic per-spw mfs images are made. Images should look similar across spws, but noise may differ if bandwidth is significantly different.
- cont
  - aggregate continuum (all spw combined) is imaged, using the ranges found in findcont
  - weak sources may only show up here
- cube
  - Moment 0 and 8 maps
- tclean commands can be copied from weblog the same way as plotms commands
  - or, view the CASA log for that stage, and search for “executing tclean”

hif_makeimlist (cube)

- tclean parameters for the following imaging step are listed
- robust may differ (-2.0 to +2.0) based on the requested angular resolution
  - see hifa_imageprecheck
- nbin shows the number of channels combined in the cube
  - see hif_checkproductsize

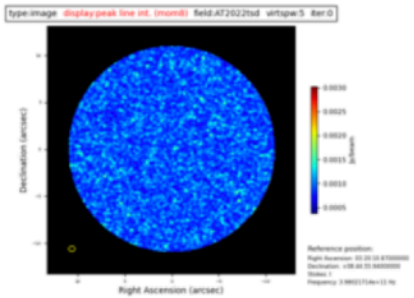
in this case (nchan = -1),
spectral setup channel width = cube channel width

List of Clean Targets

field	intent	spw	phasecenter	cell	imsize	imagename	specmode	start	width	nbin	nchan	restfreq (LSRK)	robust	uvrange
AT2022tsd	TARGET	5	ICRS 03:20:10.8700 +008.44.55.940	['0.11arcsec']	[240, 240]	uid___A001_X3570_Xa3.sSTAGENUMBER.AT2022tsd_sci.spw5.cube	cube			-1	-1	None	0.5	None
AT2022tsd	TARGET	7	ICRS 03:20:10.8700 +008.44.55.940	['0.11arcsec']	[240, 240]	uid___A001_X3570_Xa3.sSTAGENUMBER.AT2022tsd_sci.spw7.cube	cube			-1	-1	None	0.5	None
AT2022tsd	TARGET	9	ICRS 03:20:10.8700 +008.44.55.940	['0.11arcsec']	[240, 240]	uid___A001_X3570_Xa3.sSTAGENUMBER.AT2022tsd_sci.spw9.cube	cube			-1	-1	None	0.5	None
AT2022tsd	TARGET	11	ICRS 03:20:10.8700 +008.44.55.940	['0.11arcsec']	[240, 240]	uid___A001_X3570_Xa3.sSTAGENUMBER.AT2022tsd_sci.spw11.cube	cube			-1	-1	None	0.5	None

hif_makeimages (cube): image stats

Field	Spw
AT2022tsd (TARGET)	5 / X1356666715#ALMA_RB_08#BB_1#SW-01

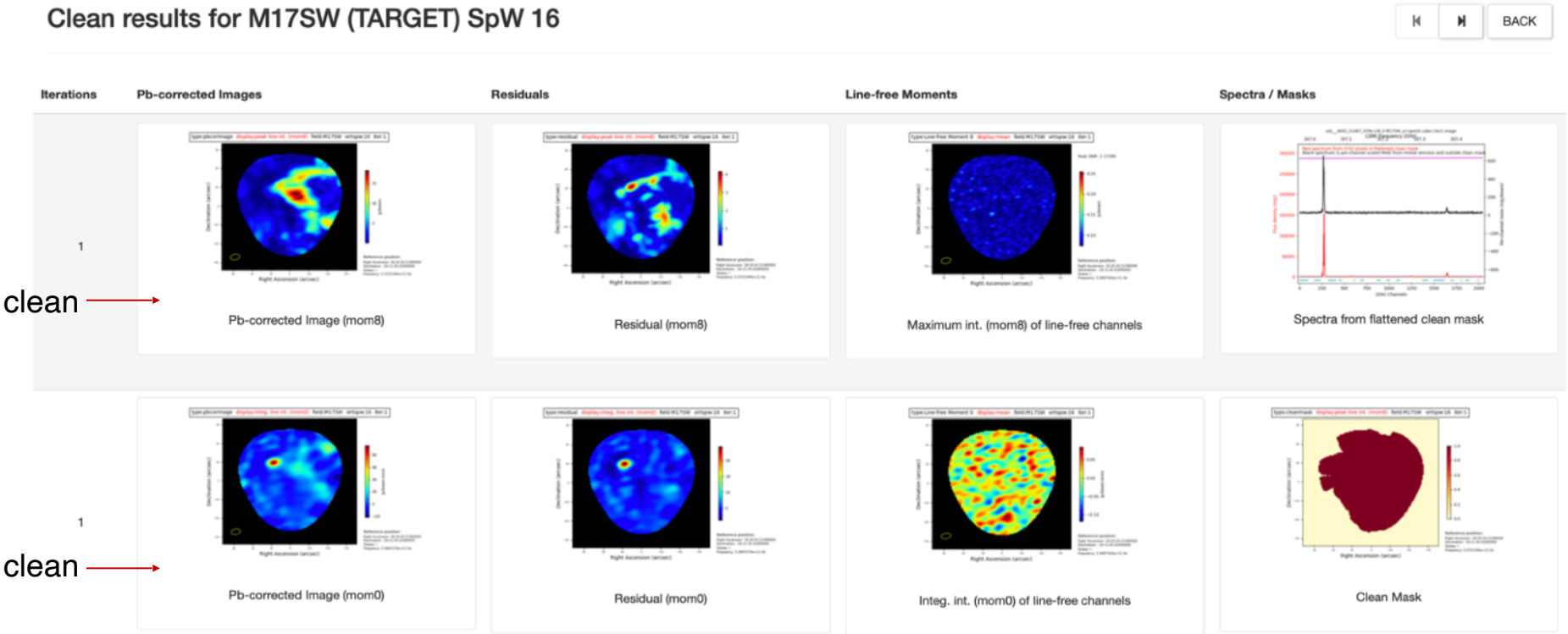


View other QA images...

centre / rest frequency of cube	398.0217GHz / 398.0000GHz (LSRK)
beam	0.678 x 0.559 arcsec
beam p.a.	-88.9deg
final theoretical sensitivity	0.34 mJy/beam
cleaning threshold	**findCont=AllCont, no cleaning** 0 Jy/beam Dirty DR: 5.4 DR correction: 1
clean residual peak / scaled MAD	-4.97
non-pbcor image RMS / RMS_{min} / RMS_{max}	0.38 / 0.35 / 0.42 mJy/beam
pbcor image max / min	4.98 / -5.04 mJy/beam
channels	116 x 15.6264MHz (LSRK)
score	1.00
image file	uid___A001_X3570_Xa3.s38_0.AT2022tsd_sci.spw5.cube.I.iter0.image

hif_makeimages (cube): View other QA images...

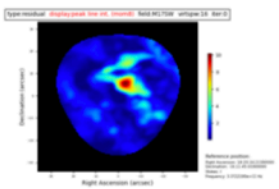
- Line Free moment maps should have no emission
- Red spectrum is from pixels in flattened clean mask
- Black spectrum is per-channel scaled MAD from imstat annulus and outside clean mask



hif_makeimages: cube > View other QA images...

0

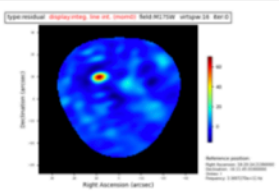
dirty →



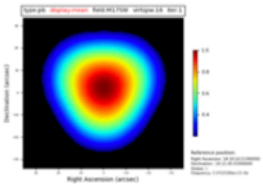
Residual (mom8)

0

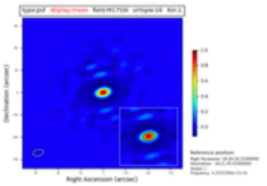
dirty →



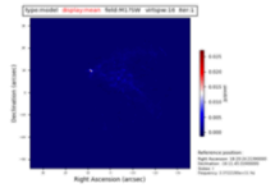
Residual (mom0)



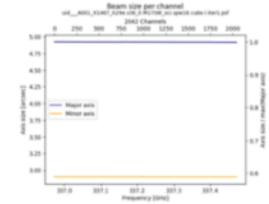
Primary Beam



PSF



Final Model



Beam per channel

Looking Ahead

- Single Dish Pipeline and Weblog have the same structure, but a different “recipe” or sequence of tasks
- Cycle 10 (2023.x)
  - Self-cal
  - Full polarization calibration (XY and YX)
- What do current pipelines NOT offer?
  - RFI flagging > included for VLA, but not necessary for ALMA!
  - Full polarization imaging
  - Solar
  - VLBI
  - other special observing modes

Can Do The Following With the Pipeline

- Obtain the calibrated measurement set
  - scriptForPI.py
  - casa_piperestorescript.py
  - SRDP
- Re-run the calibration pipeline, if needed
  - casa_pipescript.py
- Run the imaging pipeline
  - https://casaguides.nrao.edu/index.php?title=ALMA_Cycle_9_Imaging_Pipeline_Reprocessing
  - scriptForReprocessing.py
- See the slides that I will post (ALMA_imaging_pipeline_reprocessing.pdf) for general introduction on how to do these things

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