The VLA Pipeline

Drew Medlin – 2022-10-12

Pipeline Overview

- With the start of (Jansky) VLA Full Operations (January 2013), pipeline automatically run on all Scheduling Blocks as soon as the data are ingested into the archive (over 24,700 to date):
  - Deliver flagged and calibrated visibility data
  - You will self-calibrate and image visibility data to meet science goals, using resources at home institution or NRAO computing resources

- Automated pipeline should run correctly on all "standard" Stokes I science SBs; "standard" means:
  - 128 MHz spws, but may work on other set-ups as well
    - Some constraints on strength of calibrators needed
  - Contains correctly labeled and complete scan intents

Pipeline Overview

- Current versions available:
  - CASA integrated pipeline: compatible with ALMA pipeline infrastructure, and used as real-time pipeline since Sep 2015
  - "scripted" pipeline: collection of python scripts that use CASA tasks wherever possible, but also uses toolkit calls; readable and easy to modify. It was the original VLA pipeline and in use in real-time pipeline operations from early 2013 and until Sep 2015.

Pipeline Overview

- Real-time pipeline at NRAO:
  - Minimal human intervention: Pipeline is run automatically on *every* science SB as it completes (not just “continuum”)
  - Pipeline output undergoes basic quality assurance checks by NRAO staff, and detailed checks are made for most C-band and higher continuum; reports generated are archived as pipeline products

- At your home institution:
  - Instructions for installation and operation of the VLA CASA Calibration Pipeline are available at http://go.nrao.edu/vla-pipe
    - Uses CASA 6.2.1, similar to current real-time pipeline
    - See the VLA CASA pipeline guide at http://go.nrao.edu/vla-casa-tut

Pipeline Overview

- Scripted pipelines for CASA versions through 5.3.0 also available
  - Provides more flexibility in how to use the pipeline, options suitable for spectral line datasets, mixed correlator set-ups, multi-band observations, etc.
  - Working to incorporate some of these into the CASA integrated pipeline

Will the Pipeline work for you?

- The pipeline successfully completes on ~96% of all science SBs observed on the VLA; whether the output can be used for science depends on the science goal, and whether the observations were correctly set up
  - Pipeline includes Hanning smoothing, RFI flagging, and weight calculations that may not be appropriate for (some) spectral line projects.
  - No polarization calibration (yet) but can use pipeline output as a starting point.*
  - Will probably work for data taken since May 2012, may work for earlier EVLA data, likely that extra flagging and editing are needed in these cases

*CASA 5.4.1 and later, requires that you have used the correct polarization intents when setting up the observations

Pipeline Requirements

- "Standard" Stokes I science SB means:
  - 128 MHz spws (64 MHz for L-band; default setup), but may work on other set-ups as well
    - Can work for narrower BWs, depends on the strength of the calibrators
    - Heuristics currently make some assumptions about the strength of the calibrators, in particular, the delay calibrator
      - currently requires the SNR=3 limit on initial gain calibration *per integration*
  - Contains correctly labeled and complete scan intents
    - And also that the observations have been set up correctly!

Pipeline Requirements

- Correct observation set-up
  - Independent of whether you want to run the pipeline!
  - Remember: simple observing set-ups are always easier to calibrate
  - Do not skimp on calibration to spend more time on your target – you may end up not being able to calibrate the target data at all
    - Spending 3 minutes pointing could buy you more sensitivity than doubling the time on your target.

Pipeline Requirements

- Scan intents
  - The pipeline relies entirely on correct *scan intents* to be defined in each SB
  - In order for the pipeline to run successfully on an SB it must contain, *at minimum*, scans with the following intents:
    - A flux density scale calibrator scan that observes one of the primary calibrators (3C48, 3C138, 3C147, or 3C286)* – this will also be used as the delay and bandpass calibrator if no bandpass or delay calibrator is defined
    - Complex gain calibrator scans

*Some of these calibrators are variable (especially 3C48, 3C138), use 3C286 if possible

(Real-Time) Heuristics (I)

- Assuming requirements are met, the pipeline:
  - Loads the data (SDM-BDF → MS)
  - Hanning smoothing*
  - Retrieves information about the observing set-up from the data
  - Applies deterministic flags (online flags, shadowed data, end channels of spectral windows, etc.)
  - Identifies primary calibrators and loads models

*May want to modify inputs and/or omit entirely for spectral line reductions, unless heavily impacted by RFI or dealing with a very strong spectral line feature.

(Real-Time) Heuristics (II)

- Derives all prior calibrations (antenna position corrections, gain curves, atmospheric opacity, requantizer gains)
- Iteratively determines initial delay and bandpass solutions, including running RFLAG, and identifying system problems
- Derives initial gain solutions, does flux density bootstrapping and derives spectral index of all calibrators, sets models.
- Derives final delay, bandpass, and complex gain calibrations
- Applies all calibrations to the MS
- Runs RFLAG algorithm on all fields, including target*
- Runs statwt to derive proper relative weights per antenna/spw*

*May want to modify inputs and/or omit entirely for spectral line.

Pipeline Weblog

https://casa.nrao.edu/Data/EVLA/Pipeline/S-CASA6.2.1/html/

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Observation Overview

Project	uid://evla/pdb/35621723
Principal Investigator	Dr. Emmanuel Momjian
Observation Start	2018-10-04 05:41:35 UTC
Observation End	2018-10-04 08:32:45 UTC

Pipeline Summary

Pipeline Version	2021.2.0.128
CASA Version	6.2.1.7 (environment)
IERSeop2000 Version	0001.0151 (last date: 2021-08-01 00:00:00)
IERSpredict Version	0623.0600 (last date: 2022-01-01 00:00:00)
Pipeline Start	2021-11-16 15:08:01 UTC
Execution Duration	4:31:14

Observation Summary

Measurement Set	Receivers	Num Antennas	Time (UTC)			Baseline Length			Size
			Start	End	On Target	Min	Max	RMS	
Scheduling Block ID: uid://evla/pdbsb/35624494									
Session: default									
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	13cm (S)	27	2018-10-04 05:41:35	2018-10-04 08:32:45	2:13:55	40.0 m	1.0 km	441.9 m	11.7 GB
TDRW0001.sb35624494.eb35628826.58395.23719237269_target.ms	13cm (S)	27	2018-10-04 06:04:00	2018-10-04 08:30:00	2:13:55	40.0 m	1.0 km	441.9 m	9.2 GB

Pipeline Weblog

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Session: default

TDRW0001.sb35624494.eb35628826

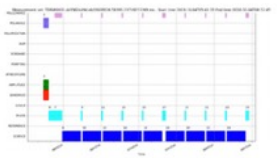
TDRW0001.sb35624494.eb35628826

Overview of 'TDRW0001.sb35624494.eb35628826.58395.23719237269.ms'

Observation Execution Time

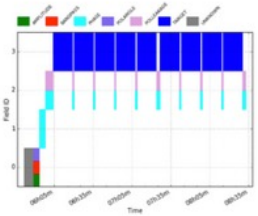
Start Time	2018-10-04 05:41:35
End Time	2018-10-04 08:32:45
Total Time on Source	2:49:14
Total Time on Science Target	2:13:55

LISTOBS OUTPUT



Intent vs Time

Track scan intent vs time



Field vs Time

Track observed field vs time

Spatial Setup

Science Targets	'3C75'
Calibrators	'0137+331=3C48', 'J0259+0747' and 'J2355+4950'

Spectral Setup

All Bands	'13cm (S)' and '6cm (C)'
Science Bands	'13cm (S)'
VLA Bands: Basebands: Freq range: [spws]	S: A0C0: 2.487 GHz to 3.511 GHz: [2,3,4,5,6,7,8,9]

Antenna Setup

Min Baseline	40.0 m

Sky Setup

Min Elevation	36.89 degrees

Pipeline Weblog

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Session: default

TDRW0001.sb35624494.eb35628826

TDRW0001.sb35624494.eb35628826

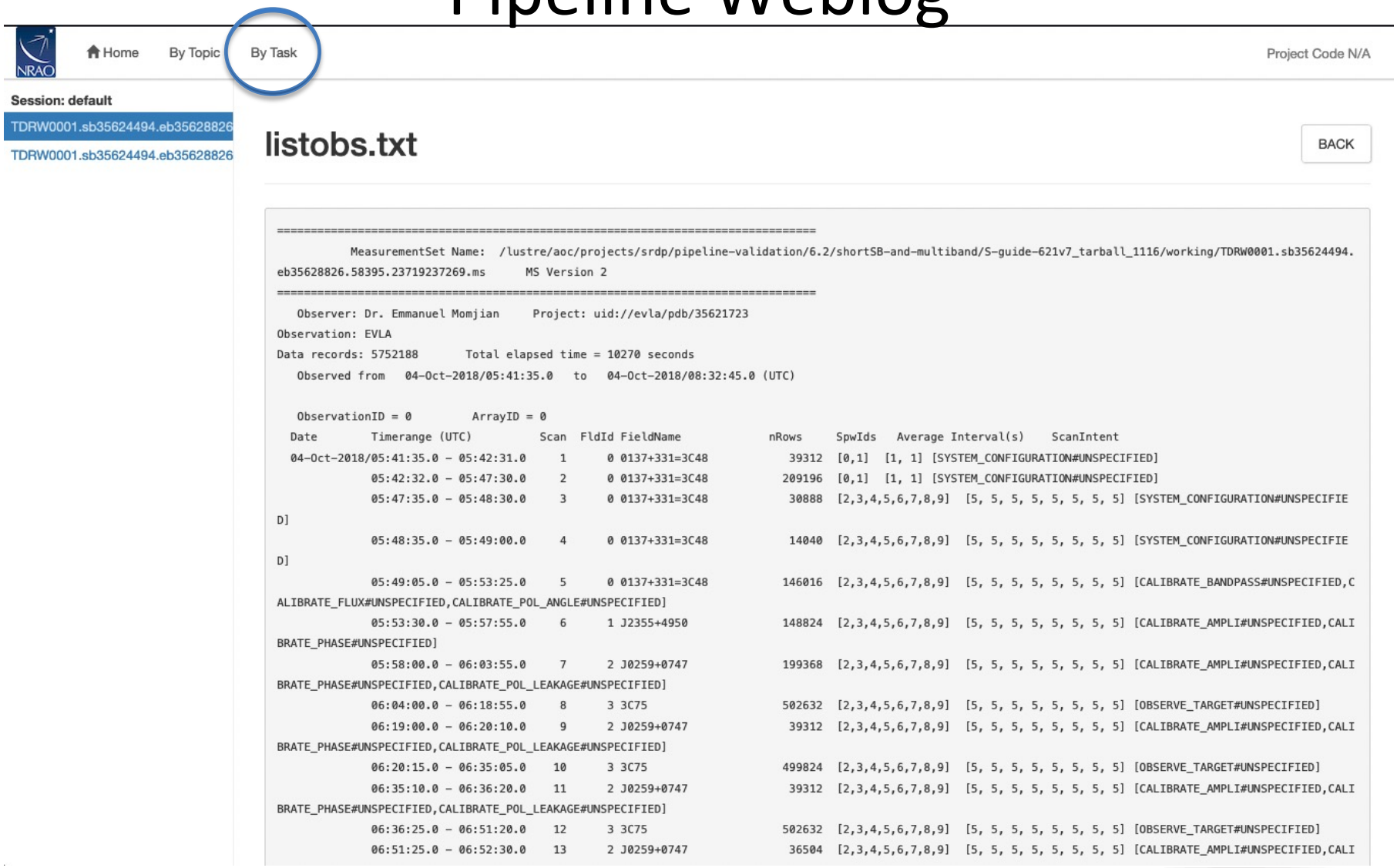
listobs.txt

BACK

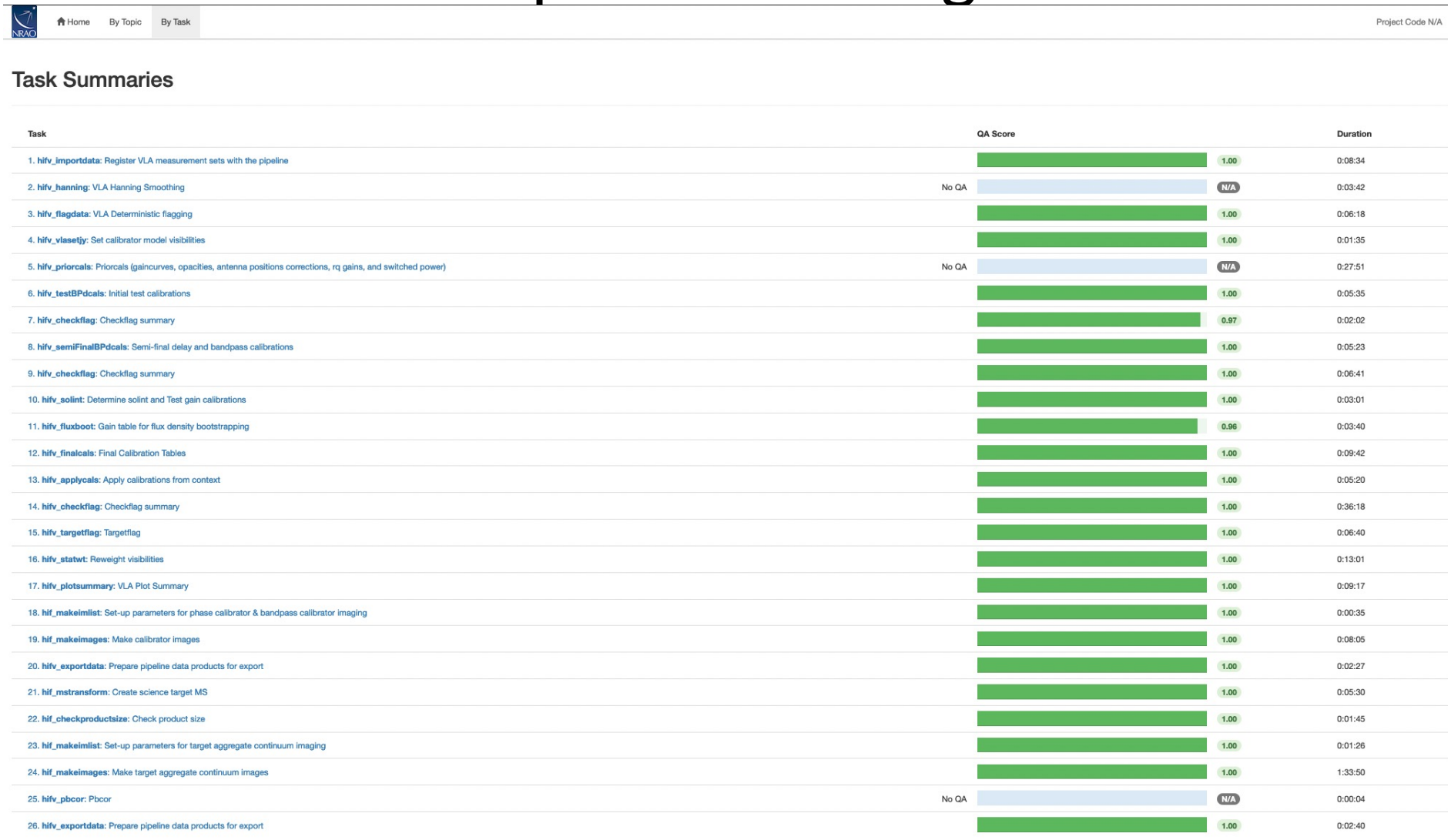
```
================================================================================
           MeasurementSet Name:  /lustre/aoc/projects/srdp/pipeline-validation/6.2/shortSB-and-multiband/S-guide-621v7_tarball_1116/working/TDRW0001.sb35624494.
eb35628826.58395.23719237269.ms      MS Version 2
================================================================================
   Observer: Dr. Emmanuel Momjian     Project: uid://evla/pdb/35621723
Observation: EVLA
Data records: 5752188       Total elapsed time = 10270 seconds
   Observed from   04-Oct-2018/05:41:35.0   to   04-Oct-2018/08:32:45.0 (UTC)

   ObservationID = 0         ArrayID = 0
  Date        Timerange (UTC)          Scan  FldId FieldName             nRows     SpwIds   Average Interval(s)    ScanIntent
  04-Oct-2018/05:41:35.0 - 05:42:31.0     1      0 0137+331=3C48           39312  [0,1]  [1, 1] [SYSTEM_CONFIGURATION#UNSPECIFIED]
              05:42:32.0 - 05:47:30.0     2      0 0137+331=3C48          209196  [0,1]  [1, 1] [SYSTEM_CONFIGURATION#UNSPECIFIED]
              05:47:35.0 - 05:48:30.0     3      0 0137+331=3C48           30888  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [SYSTEM_CONFIGURATION#UNSPECIFIE
D]
              05:48:35.0 - 05:49:00.0     4      0 0137+331=3C48           14040  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [SYSTEM_CONFIGURATION#UNSPECIFIE
D]
              05:49:05.0 - 05:53:25.0     5      0 0137+331=3C48          146016  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_BANDPASS#UNSPECIFIED,C
ALIBRATE_FLUX#UNSPECIFIED,CALIBRATE_POL_ANGLE#UNSPECIFIED]
              05:53:30.0 - 05:57:55.0     6      1 J2355+4950             148824  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_AMPLI#UNSPECIFIED,CALI
BRATE_PHASE#UNSPECIFIED]
              05:58:00.0 - 06:03:55.0     7      2 J0259+0747             199368  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_AMPLI#UNSPECIFIED,CALI
BRATE_PHASE#UNSPECIFIED,CALIBRATE_POL_LEAKAGE#UNSPECIFIED]
              06:04:00.0 - 06:18:55.0     8      3 3C75                   502632  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [OBSERVE_TARGET#UNSPECIFIED]
              06:19:00.0 - 06:20:10.0     9      2 J0259+0747              39312  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_AMPLI#UNSPECIFIED,CALI
BRATE_PHASE#UNSPECIFIED,CALIBRATE_POL_LEAKAGE#UNSPECIFIED]
              06:20:15.0 - 06:35:05.0    10      3 3C75                   499824  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [OBSERVE_TARGET#UNSPECIFIED]
              06:35:10.0 - 06:36:20.0    11      2 J0259+0747              39312  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_AMPLI#UNSPECIFIED,CALI
BRATE_PHASE#UNSPECIFIED,CALIBRATE_POL_LEAKAGE#UNSPECIFIED]
              06:36:25.0 - 06:51:20.0    12      3 3C75                   502632  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [OBSERVE_TARGET#UNSPECIFIED]
              06:51:25.0 - 06:52:30.0    13      2 J0259+0747              36504  [2,3,4,5,6,7,8,9]  [5, 5, 5, 5, 5, 5, 5, 5] [CALIBRATE_AMPLI#UNSPECIFIED,CALI
```

Pipeline Weblog



Pipeline Weblog



Home | By Topic | By Task | Project Code N/A

Task Summaries

Task	QA Score	Duration
1. **hifv_importdata**: Register VLA measurement sets with the pipeline	1.00	0:08:34
2. **hifv_hanning**: VLA Hanning Smoothing	No QA N/A	0:03:42
3. **hifv_flagdata**: VLA Deterministic flagging	1.00	0:06:18
4. **hifv_vlasetjy**: Set calibrator model visibilities	1.00	0:01:35
5. **hifv_priorcals**: Priorcals (gaincurves, opacities, antenna positions corrections, rq gains, and switched power)	No QA N/A	0:27:51
6. **hifv_testBPdcals**: Initial test calibrations	1.00	0:05:35
7. **hifv_checkflag**: Checkflag summary	0.97	0:02:02
8. **hifv_semiFinalBPdcals**: Semi-final delay and bandpass calibrations	1.00	0:05:23
9. **hifv_checkflag**: Checkflag summary	1.00	0:06:41
10. **hifv_solint**: Determine solint and Test gain calibrations	1.00	0:03:01
11. **hifv_fluxboot**: Gain table for flux density bootstrapping	0.96	0:03:40
12. **hifv_finalcals**: Final Calibration Tables	1.00	0:09:42
13. **hifv_applycals**: Apply calibrations from context	1.00	0:05:20
14. **hifv_checkflag**: Checkflag summary	1.00	0:36:18
15. **hifv_targetflag**: Targetflag	1.00	0:06:40
16. **hifv_statwt**: Reweight visibilities	1.00	0:13:01
17. **hifv_plotsummary**: VLA Plot Summary	1.00	0:09:17
18. **hif_makeimlist**: Set-up parameters for phase calibrator & bandpass calibrator imaging	1.00	0:00:35
19. **hif_makeimages**: Make calibrator images	1.00	0:08:05
20. **hifv_exportdata**: Prepare pipeline data products for export	1.00	0:02:27
21. **hif_mstransform**: Create science target MS	1.00	0:05:30
22. **hif_checkproductsize**: Check product size	1.00	0:01:45
23. **hif_makeimlist**: Set-up parameters for target aggregate continuum imaging	1.00	0:01:26
24. **hif_makeimages**: Make target aggregate continuum images	1.00	1:33:50
25. **hifv_pbcor**: Pbcor	No QA N/A	0:00:04
26. **hifv_exportdata**: Prepare pipeline data products for export	1.00	0:02:40

Pipeline Weblog

- The following pipeline steps provide key checks for calibration quality:
  - hifv_flagdata *deterministic flagged data fraction*
  - hifv_testBPdcals *hardware problems and other obs. issues*
  - hifv_solint *solution intervals for phase cals, input gain tables*
  - hifv_fluxboot *fitted calibrator flux densities and spectral indices*
  - hifv_finalcals *final calibration tables applied to the data*
  - hifv_plotsummary *useful diagnostic plots of calibrated data*

Deterministic Flags (hifv_flagdata)

Go forward one page (⌘→)
Pull down to show history

By Task

Project Code N/A

Tasks in execution order

1. hifv_importdata
2. hifv_hanning
3. hifv_flagdata
4. hifv_vlasetjy
5. hifv_priorcals
6. hifv_testBPdcals
7. hifv_checkflag
8. hifv_semiFinalBPdcals
9. hifv_checkflag
10. hifv_solint
11. hifv_fluxboot
12. hifv_finalcals
13. hifv_applycals
14. hifv_checkflag
15. hifv_targetflag
16. hifv_statwt
17. hifv_plotsummary
18. hif_makeimlist (cals)
19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

3. VLA Deterministic Flagging

BACK

Flagging agents

Measurement Set	ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband	Agent Commands
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	✔	✔	✔	✔	✖	✔	✔	✔	✔	✔	View

Flagging agent status per measurement set.

Template Files

	Other Online Flags		Flagging Template	
Measurement Set	File	Number of Statements	File	Number of Statements
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	TDRW0001.sb35624494.eb35628826.58395.23719237269.flagonline.txt	678		

Files used for template flagging steps.

Flagged data summary

Data Selection (by intent)	Before Task	Flagging Agent (Total Vis)			Flagging Agent (Science Vis)							Total Science	Measurement Set
		ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband		TDRW0001.sb35624494.eb35628826.58395.23719237269.ms
All Data	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	4.448%
Science Spectral Windows	3.125%	5.831%	0.000%	0.595%	0.755%	0.000%	0.000%	0.000%	0.000%	0.000%	3.602%	4.357%	4.357%
Bandpass	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Flux	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Phase	3.125%	28.775%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Target	3.125%	1.948%	0.000%	0.000%	0.626%	0.000%	0.000%	0.000%	0.000%	0.000%	3.606%	4.232%	4.232%
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	

Summary of flagged data. Each cell states the amount of data flagged as a fraction of the specified data selection, with the *Flagging Agent* columns giving this information per flagging agent.

Flagging reason vs time

Deterministic Flags (hifv_flagdata)

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Project Code N/A

Tasks in execution order

1. hifv_importdata
2. hifv_hanning
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5. hifv_priorcals
6. hifv_testBPdcals
7. hifv_checkflag
8. hifv_semiFinalBPdcals
9. hifv_checkflag
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12. hifv_finalcals
13. hifv_applycals
14. hifv_checkflag
15. hifv_targetflag
16. hifv_statwt
17. hifv_plotsummary
18. hif_makeimlist (cals)
19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

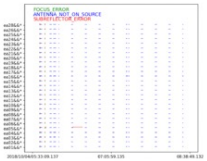
		Flagging Agent (Total Vis)			Flagging Agent (Science Vis)								Measurement Set
Data Selection (by intent)	Before Task	ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband	Total Science	TDRW0001.sb35624494.eb35628826.58395.23719237269.ms
All Data	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	4.448%
Science Spectral Windows	3.125%	5.831%	0.000%	0.595%	0.755%	0.000%	0.000%	0.000%	0.000%	0.000%	3.602%	4.357%	4.357%
Bandpass	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Flux	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Phase	3.125%	28.775%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Target	3.125%	1.948%	0.000%	0.000%	0.626%	0.000%	0.000%	0.000%	0.000%	0.000%	3.606%	4.232%	4.232%
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	

Summary of flagged data. Each cell states the amount of data flagged as a fraction of the specified data selection, with the *Flagging Agent* columns giving this information per flagging agent.

Flagging reason vs time

Plots of flagging reason vs time. The reasons for flagging the data are defined in the plot legend.

TDRW0001.sb35624494.eb35628826.58395.23719237269.ms



Pipeline QA

Input Parameters

Tasks Execution Statistics

CASA logs for stage 3

- View or download stage3/casapy.log (123.0 KB)

Deterministic Flags (hifv_flagdata)

Home | By Topic | By Task

Project Code N/A

Tasks in execution order

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19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

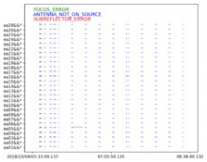
		Flagging Agent (Total Vis)			Flagging Agent (Science Vis)								Measurement Set
Data Selection (by intent)	Before Task	ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband	Total Science	TDRW0001.sb35624494.eb35628826.58395.23719237269.ms
All Data	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	4.448%
Science Spectral Windows	3.125%	5.831%	0.000%	0.595%	0.755%	0.000%	0.000%	0.000%	0.000%	0.000%	3.602%	4.357%	4.357%
Bandpass	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Flux	3.125%	1.863%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Phase	3.125%	28.775%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	3.629%	3.629%	3.629%
Target	3.125%	1.948%	0.000%	0.000%	0.626%	0.000%	0.000%	0.000%	0.000%	0.000%	3.606%	4.232%	4.232%
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms	3.125%	7.358%	0.000%	2.892%	0.850%	0.000%	0.000%	0.000%	0.000%	0.000%	3.598%	4.448%	

Summary of flagged data. Each cell states the amount of data flagged as a fraction of the specified data selection, with the *Flagging Agent* columns giving this information per flagging agent.

Flagging reason vs time

Plots of flagging reason vs time. The reasons for flagging the data are defined in the plot legend.

TDRW0001.sb35624494.eb35628826.58395.23719237269.ms



Pipeline QA

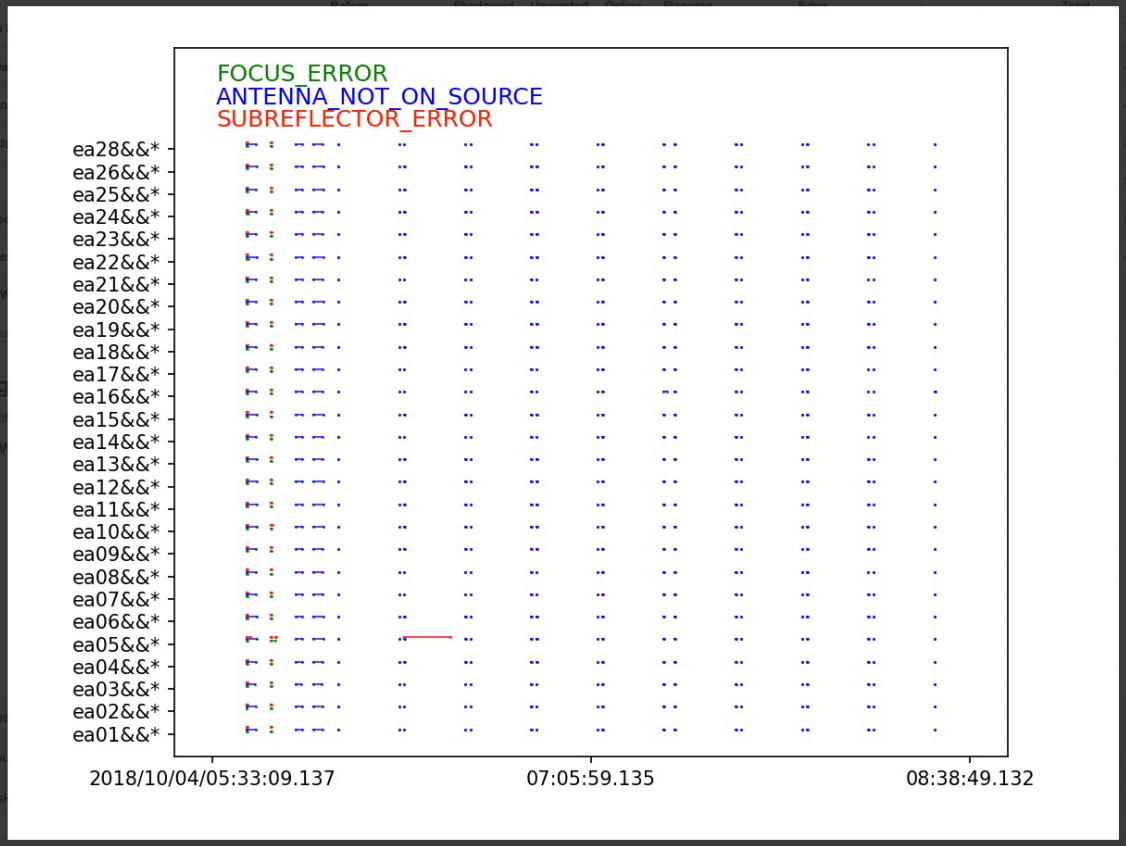
Input Parameters

Tasks Execution Statistics

CASA logs for stage 3

- View or download stage3/casapy.log (123.0 KB)

Deterministic Flags (hifv_flagdata)



Hardware Issues (hifv_testBPdcals)

Home | By Topic | By Task

Project Code N/A

Tasks in execution order

1. hifv_importdata
2. hifv_hanning
3. hifv_flagdata
4. hifv_vlasetjy
5. hifv_priorcals
6. hifv_testBPdcals
7. hifv_checkflag
8. hifv_semiFinalBPdcals
9. hifv_checkflag
10. hifv_solint
11. hifv_fluxboot
12. hifv_finalcals
13. hifv_applycals
14. hifv_checkflag
15. hifv_targetflag
16. hifv_statwt
17. hifv_plotsummary
18. hif_makeimlist (cals)
19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

6. Initial test calibrations

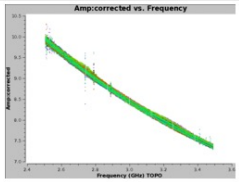
BACK

Initial test calibrations using bandpass and delay calibrators

Plots: Test delay plots | Gain Amplitude | Gain Phase | BP Amp solution | BP Phase solution

testBPdcals summary plot

TDRW0001.sb35624494.eb35628826.58395.23719237269.ms



Initial calibrated bandpass

Flag bad deformatters

Identify and flag basebands with bad deformatters or RFI based on bandpass (BP) table amps and phases.

BP Table Amps

Antenna	SPWs	Band / Basebands
None	None	S

BP Table Phases

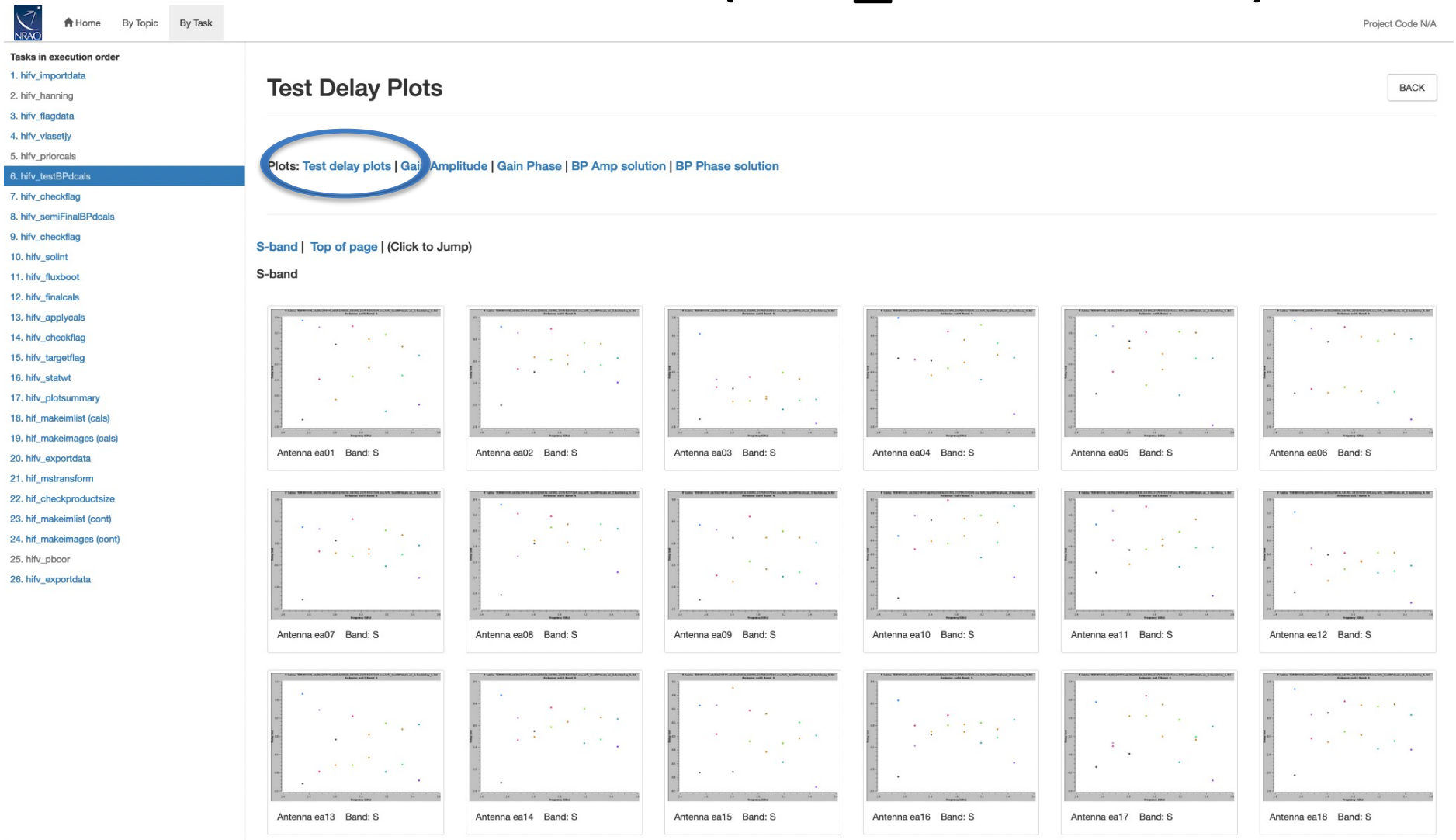
Antenna	SPWs	Band / Basebands
None	None	S

Pipeline QA

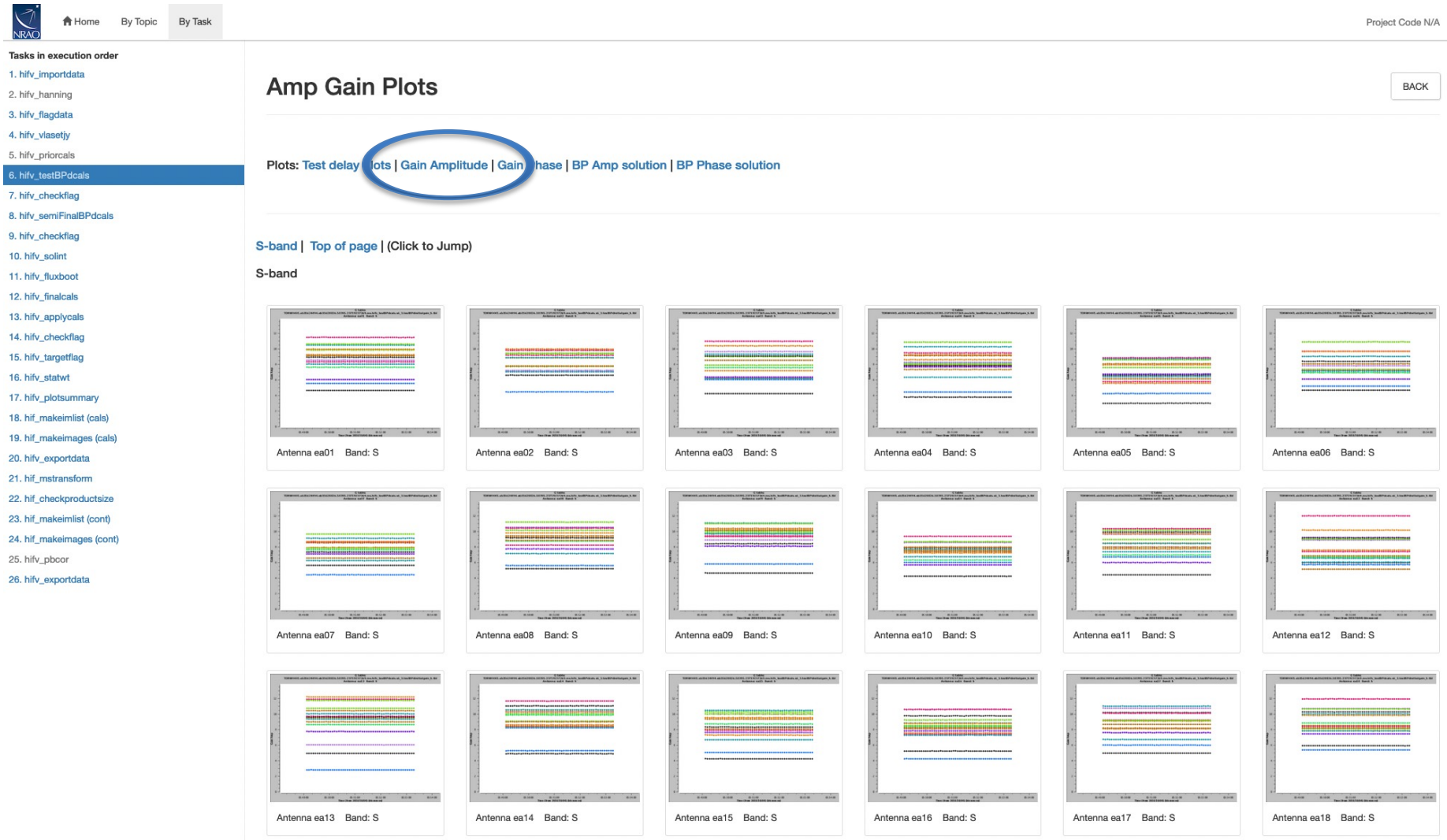
Input Parameters

Tasks Execution Statistics

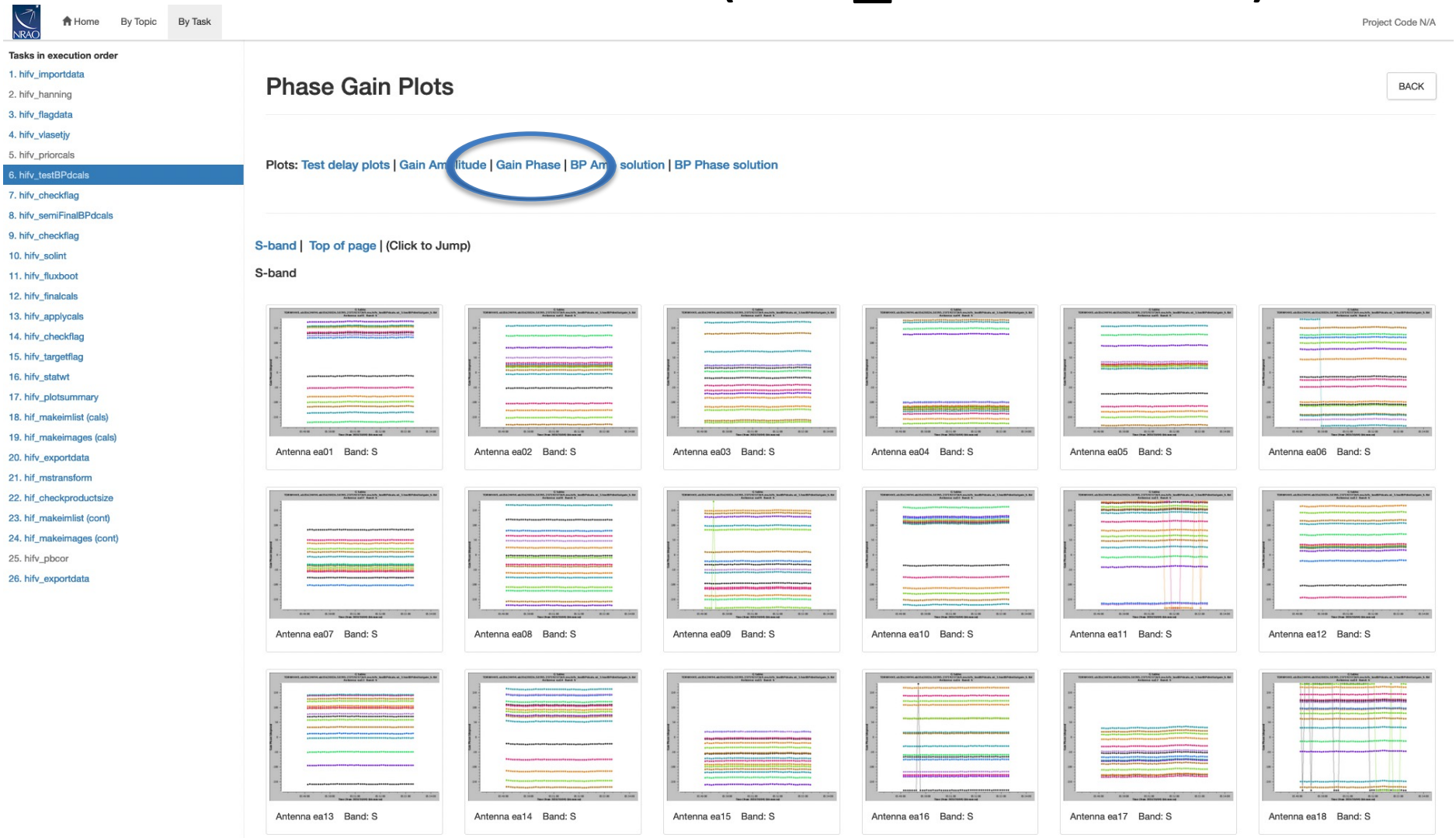
Hardware Issues (hifv_testBPdcals)



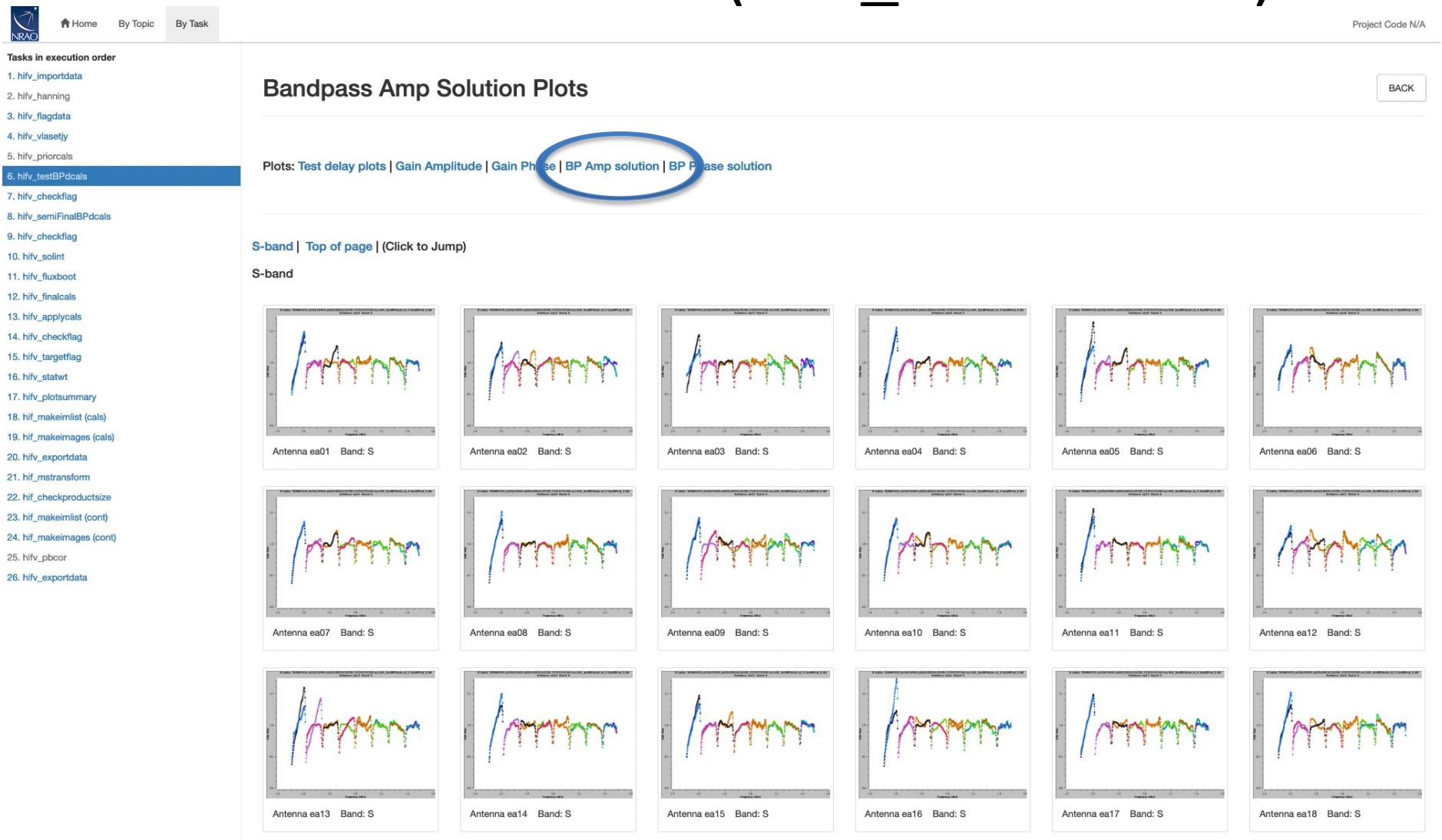
Hardware Issues (hifv_testBPdcals)



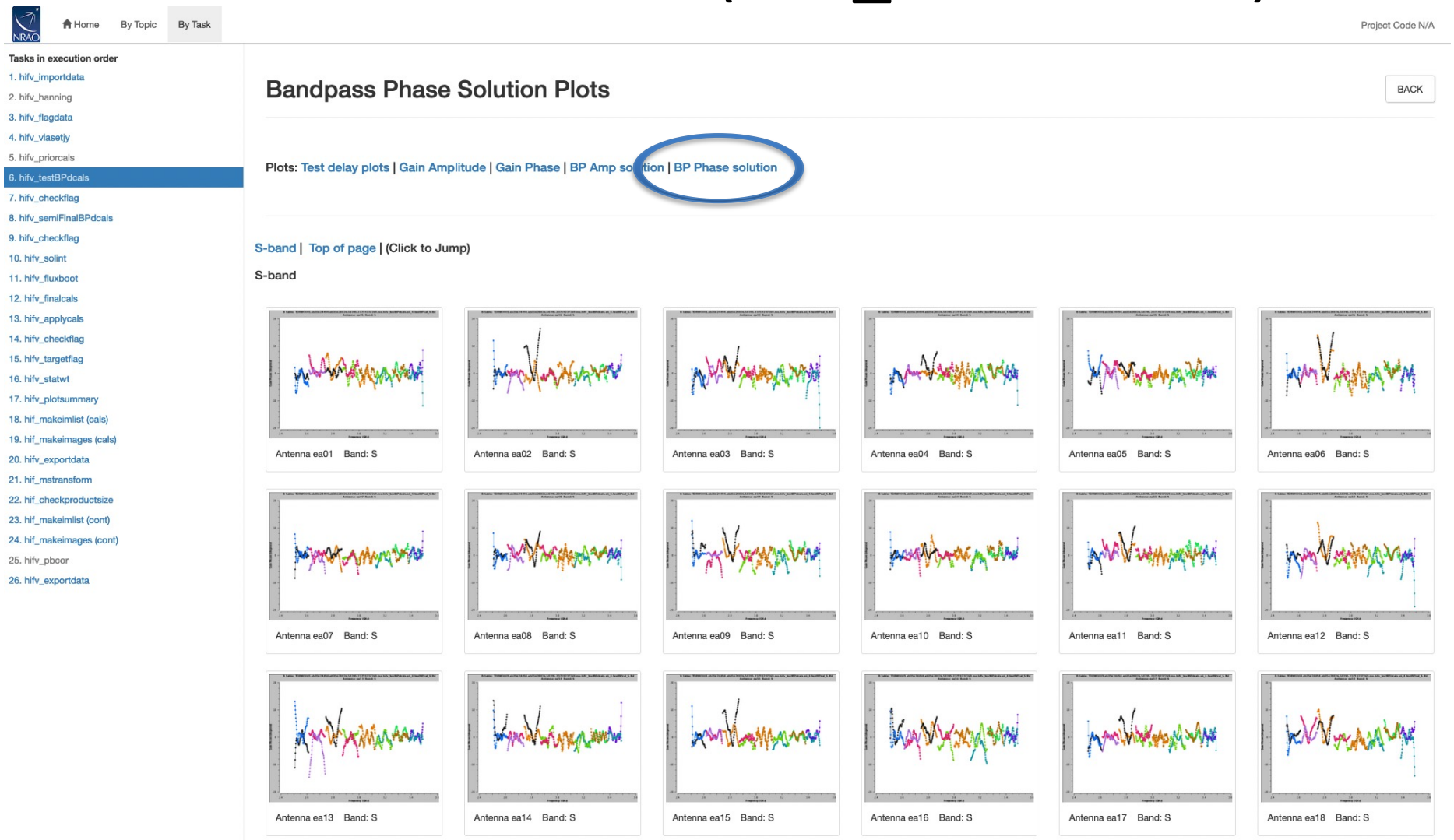
Hardware Issues (hifv_testBPdcals)



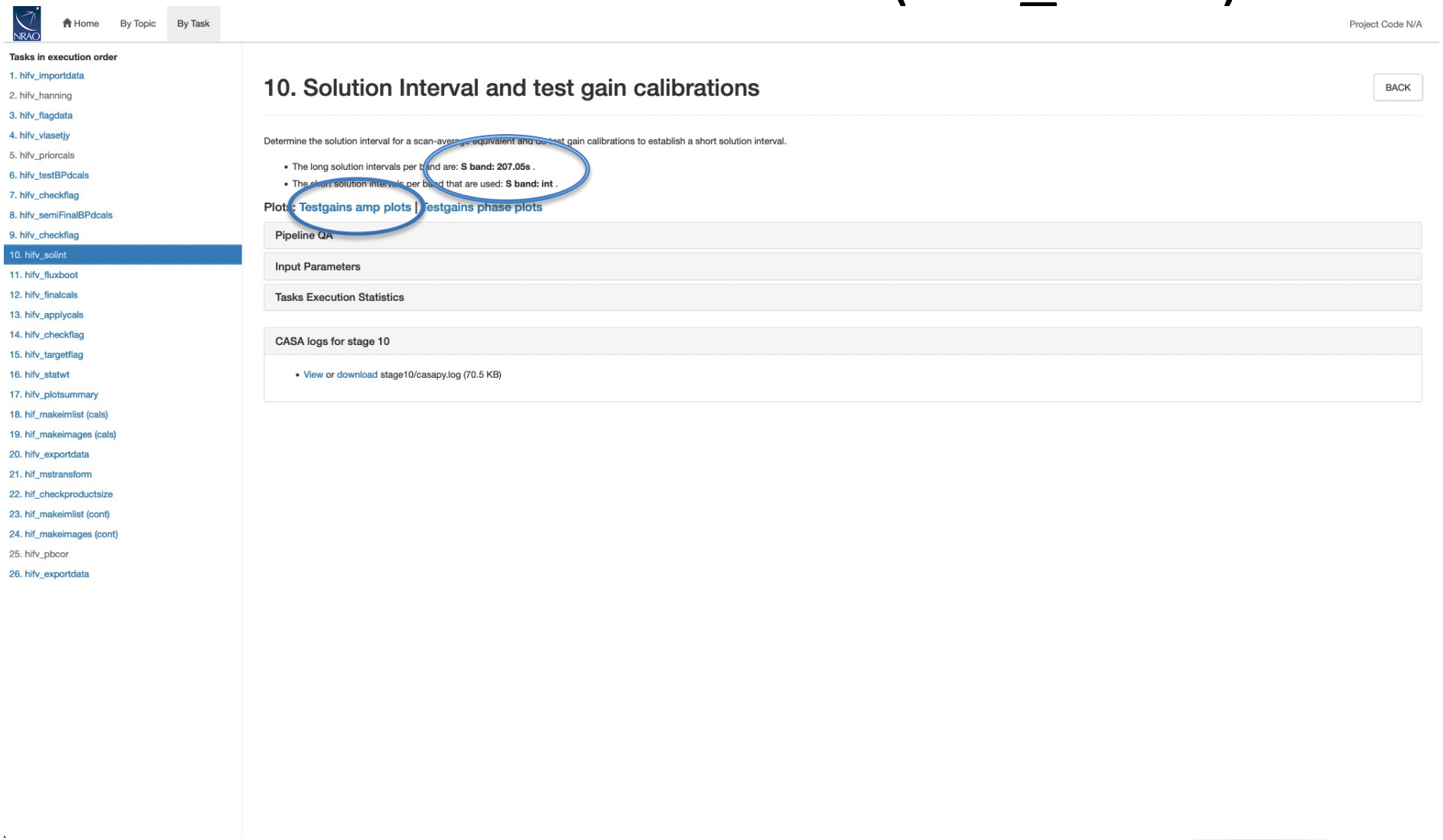
Hardware Issues (hifv_testBPdcals)



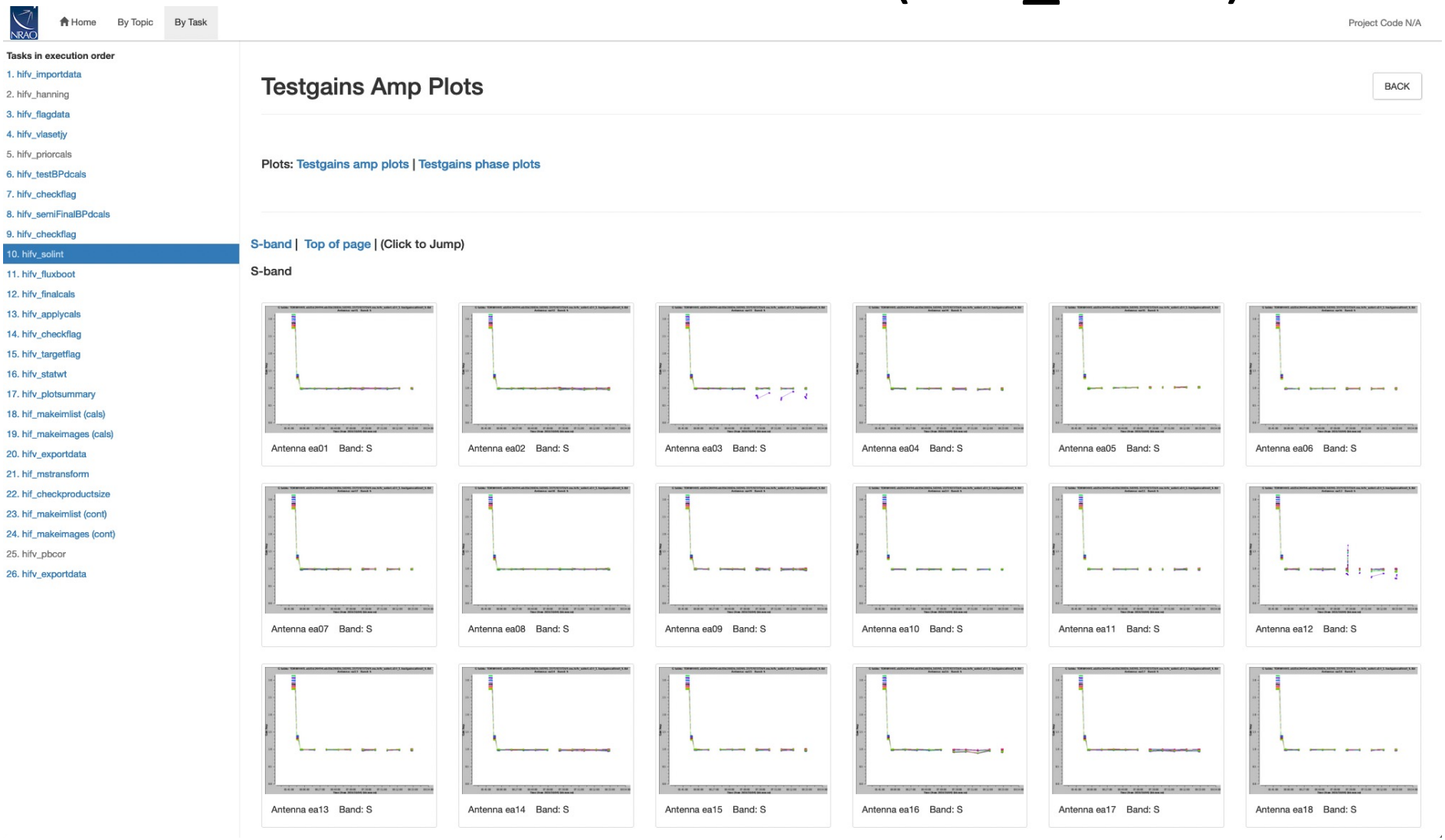
Hardware Issues (hifv_testBPdcals)



Gain Solution Intervals (hifv_solint)



Gain Solution Intervals (hifv_solint)



Flux Density Bootstrapping (hifv_fluxboot)

Home | By Topic | By Task | Project Code N/A

Tasks in execution order

1. hifv_importdata
2. hifv_hanning
3. hifv_flagdata
4. hifv_vlasetjy
5. hifv_priorcals
6. hifv_testBPdcals
7. hifv_checkflag
8. hifv_semiFinalBPdcals
9. hifv_checkflag
10. hifv_solint
11. hifv_fluxboot
12. hifv_finalcals
13. hifv_applycals
14. hifv_checkflag
15. hifv_targetflag
16. hifv_statwt
17. hifv_plotsummary
18. hif_makeimlist (cals)
19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

11. Flux density bootstrapping and spectral index fitting

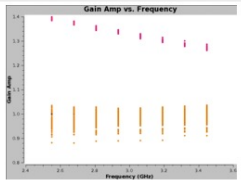
BACK

Make a gain table that includes gain and opacity corrections for final amp cal and for flux density bootstrapping.

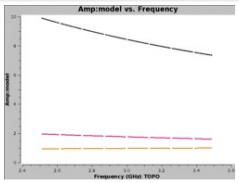
Fit the spectral index of calibrators with a power-law and put the fit in the model column.

Fluxboot summary plots

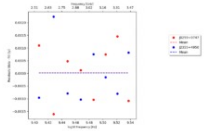
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms



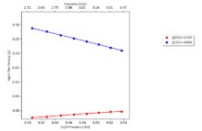
Caltable: fluxgaincal.g. Plot of amp vs. freq.



Model calibrator. Plot of amp vs. freq.



Fluxboot residuals vs. frequency



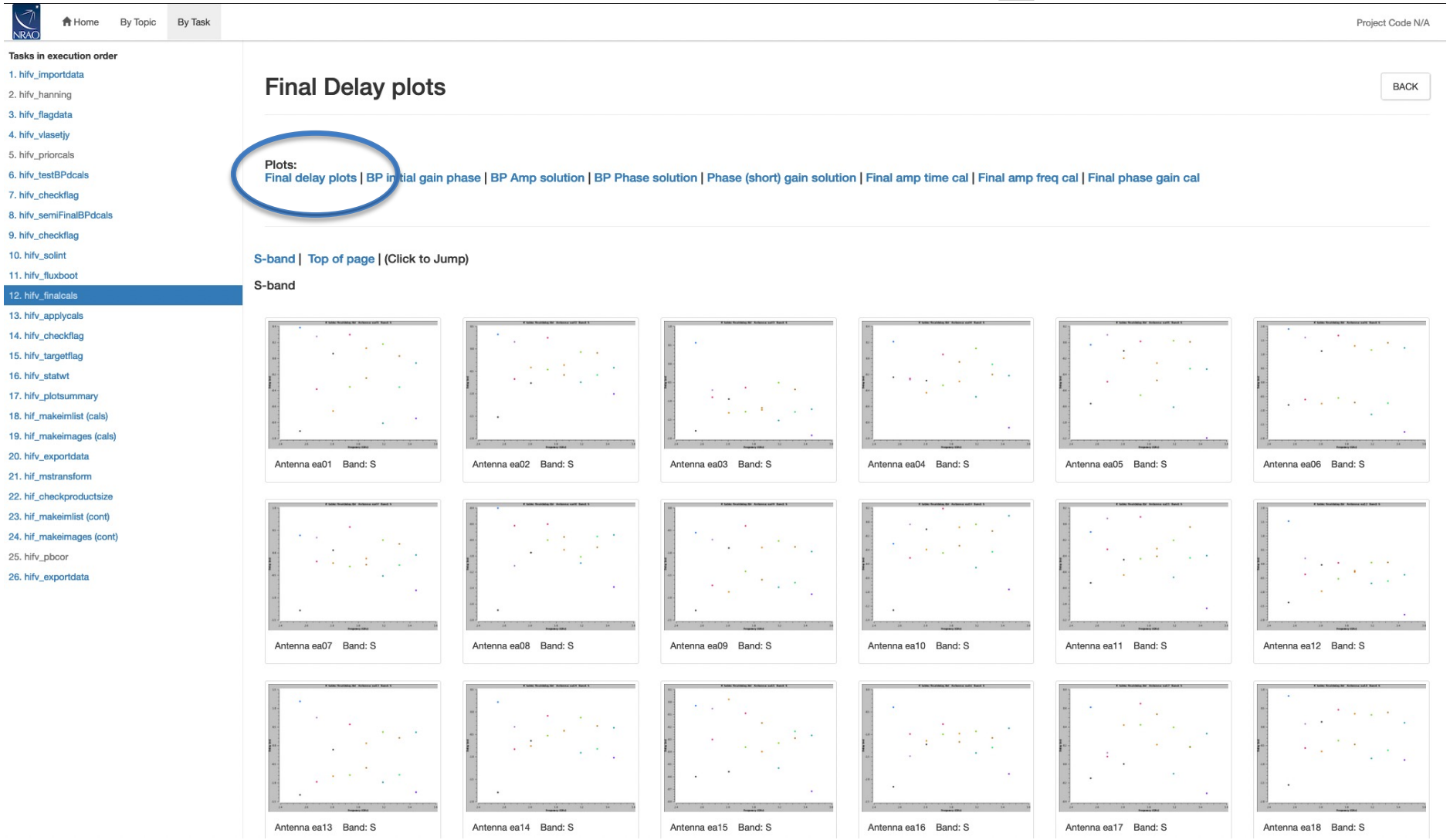
Flux vs. frequency

Source	Fit Order	Band	Band Center [GHz]	Flux density [Jy] (at Band Center)	Spectral Index	2nd order coeff	3rd order coeff	4th order coeff
J0259+0747	2	S	3.00000	0.97152 +/- 0.00072	0.16942 +/- 0.00518	-0.14589 +/- 0.13172	----	----
J2355+4950				1.76341 +/- 0.00077	-0.59833 +/- 0.00333	-0.19761 +/- 0.08241		

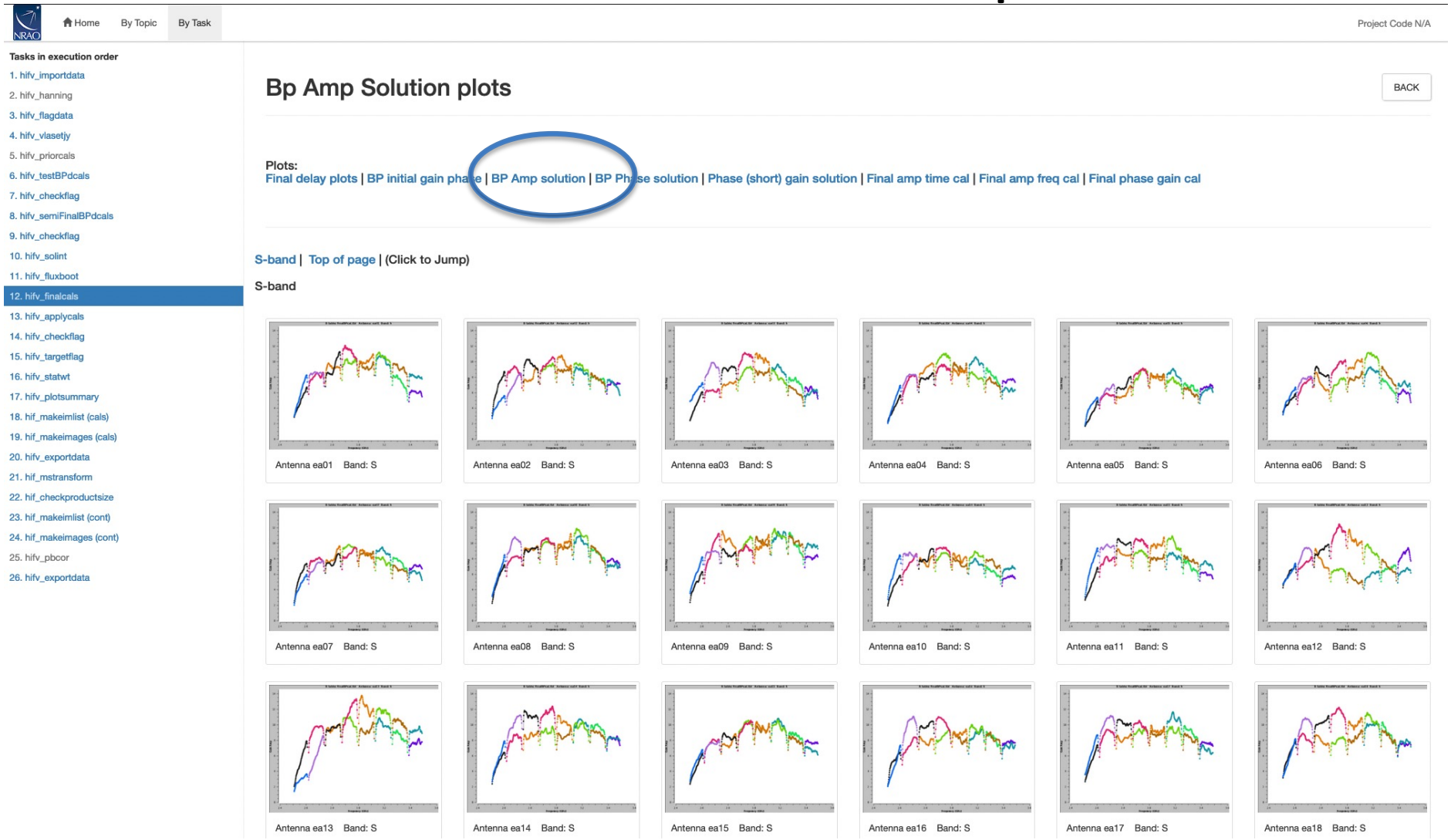
Table showing the flux density and spectral properties computed at each band center, based on the global coefficients of the fit across all bands.

Source	Frequency [GHz]	Data	Error	Fitted Data	Residual: Data-Fitted Data
J0259+0747	2.551	0.9447	0.002792	0.9436	0.001099
	2.679	0.9507	0.002612	0.9523	-0.001609
	2.807	0.9609	0.002617	0.9604	0.000483
	2.935	0.9680	0.002372	0.9679	0.000118
	3.063	0.9739	0.002462	0.9749	-0.001040
	3.191	0.9822	0.002410	0.9815	0.000744
	3.319	0.9891	0.002444	0.9877	0.001460
	3.447	0.9924	0.002332	0.9934	-0.001086
J2355+4950	2.551	1.9377	0.000822	1.9387	-0.000961
	2.679	1.8871	0.000859	1.8849	0.002237

Final Calibration Tables (hifv_finalcals)

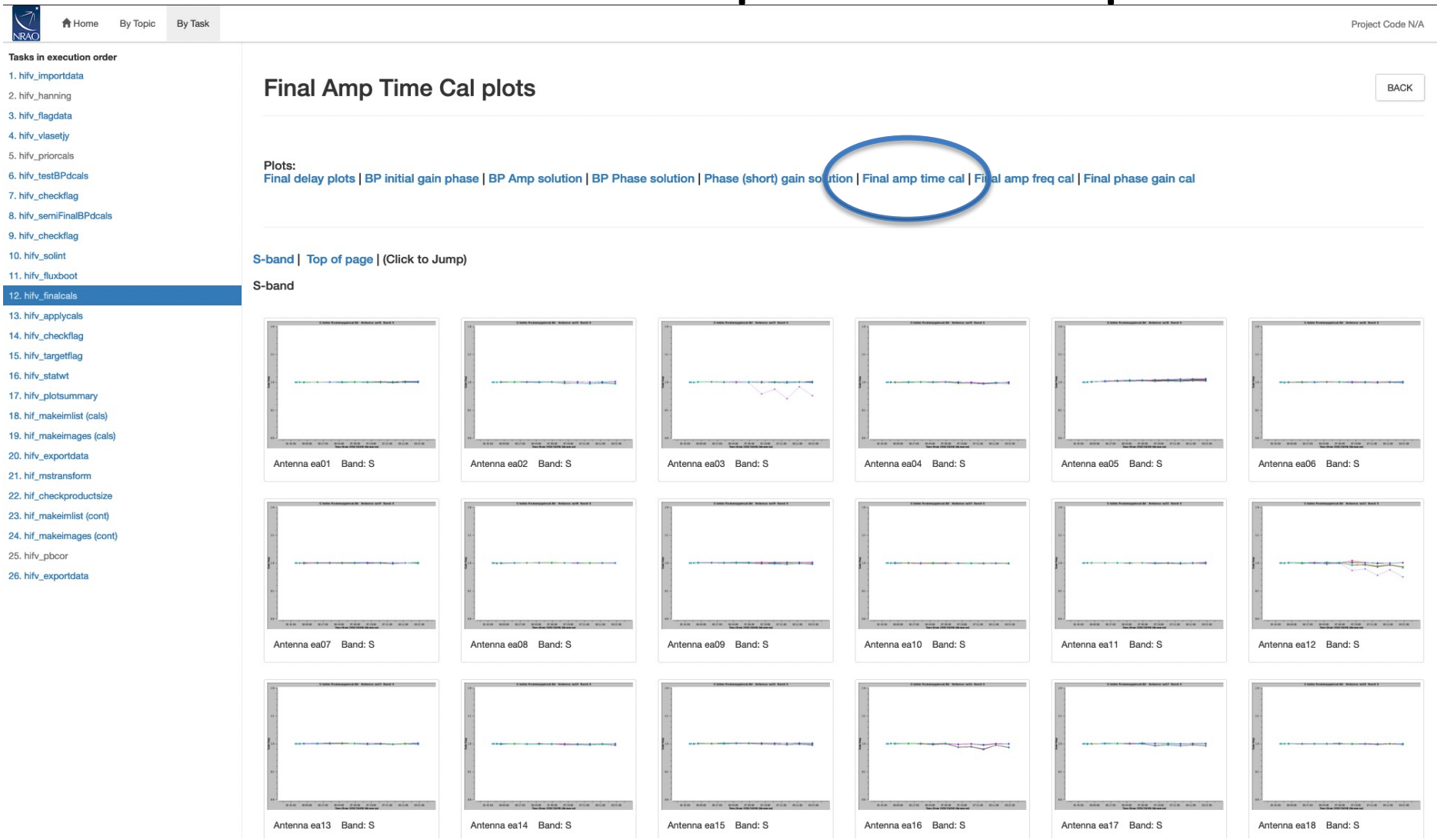


Final Cal Tables: bandpass

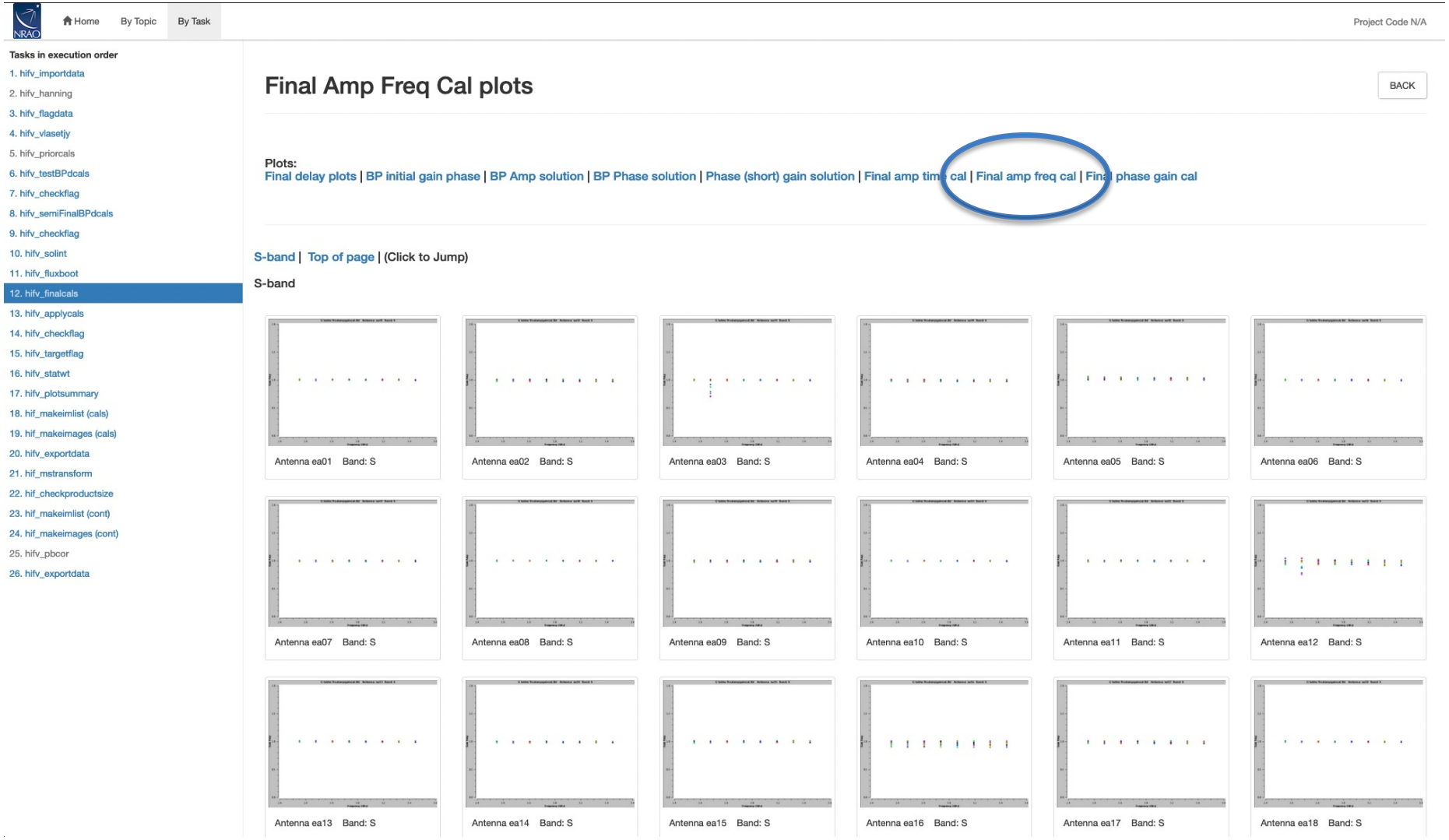


Final Cal Tables: bandpass

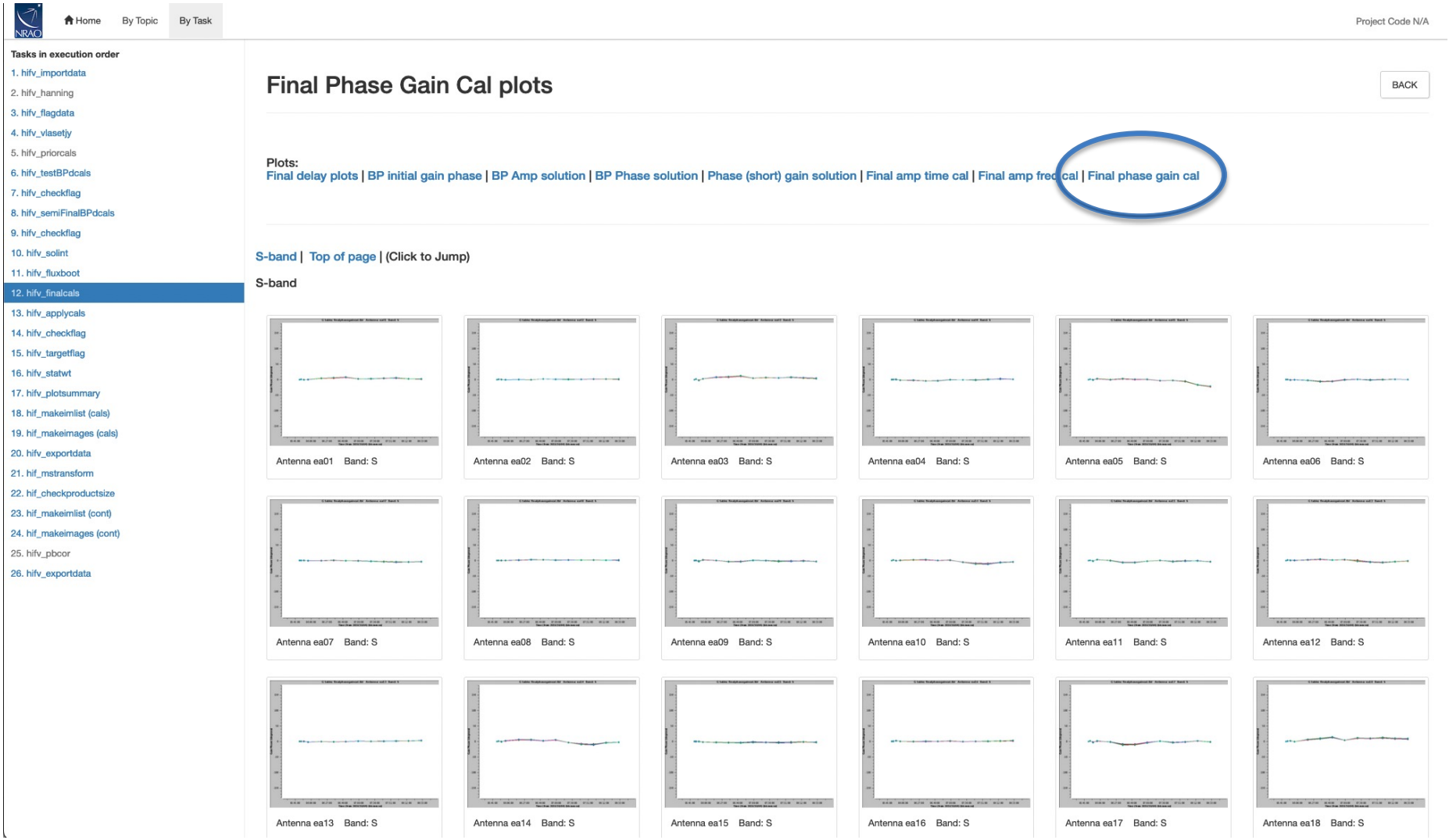
Final Cal Tables: amplitude and phase



Final Cal Tables: amplitude and phase



Final Cal Tables: amplitude and phase



Summary Plots (hifv_plotsummary)

Home | By Topic | By Task | Project Code N/A

Tasks in execution order

1. hifv_importdata
2. hifv_hanning
3. hifv_flagdata
4. hifv_vlasetjy
5. hifv_priorcals
6. hifv_testBPdcals
7. hifv_checkflag
8. hifv_semiFinalBPdcals
9. hifv_checkflag
10. hifv_solint
11. hifv_fluxboot
12. hifv_finalcals
13. hifv_applycals
14. hifv_checkflag
15. hifv_targetflag
16. hifv_statwt
17. hifv_plotsummary
18. hif_makeimlist (cals)
19. hif_makeimages (cals)
20. hifv_exportdata
21. hif_mstransform
22. hif_checkproductsize
23. hif_makeimlist (cont)
24. hif_makeimages (cont)
25. hifv_pbcor
26. hifv_exportdata

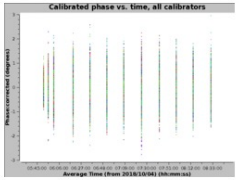
17. Plot Summary

BACK

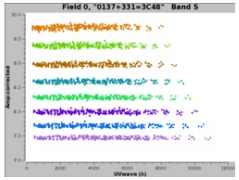
VLA Pipeline Summary Plots

Phase vs. time for all calibrators, Amp vs. UVwave for all calibrators, as well as a representative selection of fields with intent='TARGET' with Amp vs. UVwave plots.

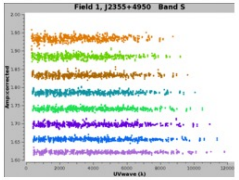
TDRW0001.sb35624494.eb35628826.58395.23719237269.ms



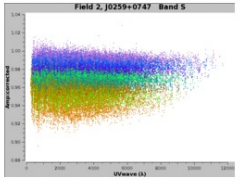
All calibrators Band: All bands



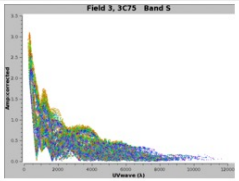
Field 0, "0137+331=3C48" Band: S



Field 1, J2355+4950 Band: S



Field 2, J0259+0747 Band: S

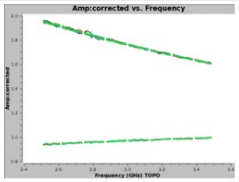


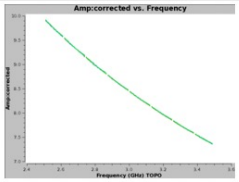
Field 3, 3C75 Band: S

Calibrated amplitude vs frequency

Plots of calibrated amplitude vs frequency for all antennas and correlations, coloured by antenna.

TDRW0001.sb35624494.eb35628826.58395.23719237269.ms





Pipeline Products and Outputs

- Flagged and Calibrated MS
- Final flag version and calibration tables (archived)
- Logs, including weblog used by quality assurance (QA) staff and QA report (archived).

Pipeline Products and Outputs

- The real-time pipeline produces a calibrated and flagged MS:
  - Calibrated MS may be requested through the archive data.nrao.edu (See next talk from Aaron!)
  - You may request a more detailed QA2 report from the data analysts (help.nrao.edu, Pipeline Department)
  - If you are happy with the pipeline calibration, then:
    - Do further flagging if necessary
    - Split out your target and image (imaging pipeline now available)
  - If you have the SDM or uncalibrated MS and the calibration and flag tables, instructions for applying flags and calibration tables may be found at http://go.nrao.edu/vla-pipe

Known failure modes and issues

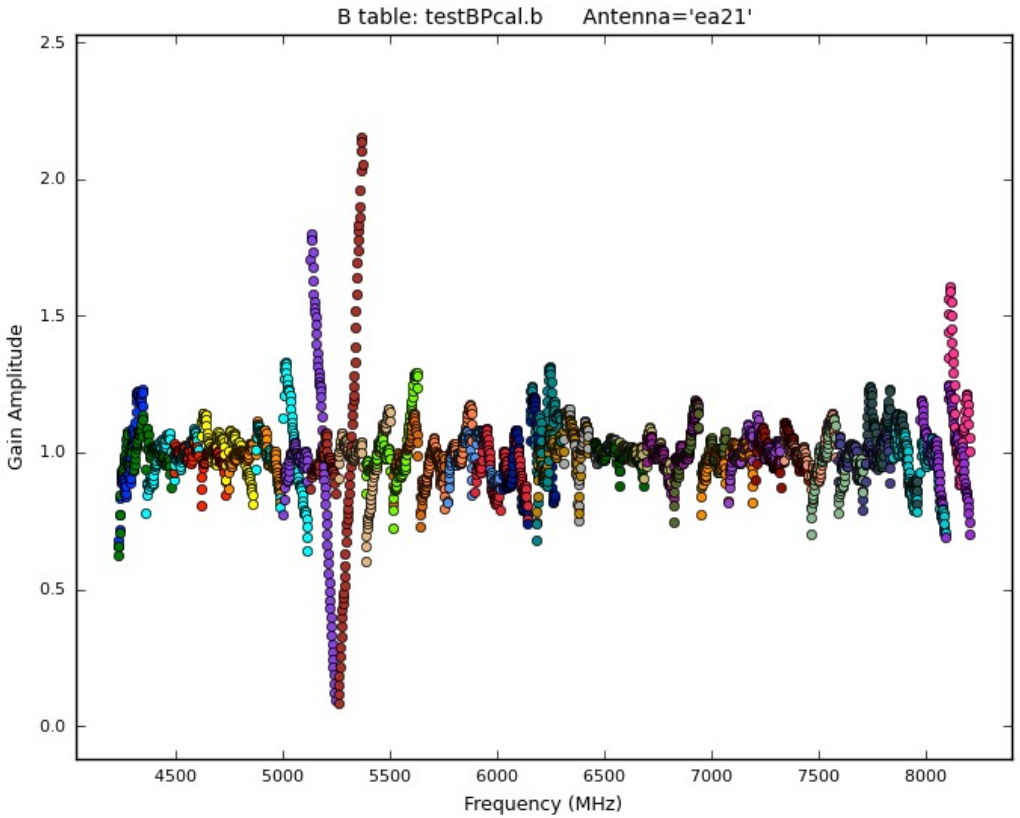
- In general the pipeline does very well, but there are possible failure modes:
  - No flux density or gain calibrator intents defined, or flux density calibrator not one for which we have models
    - *work around in scripted pipeline*
  - Wrong scan intents
    - *modify Scan.xml in SDM; see https://science.nrao.edu/facilities/vla/data-processing/pipeline#section-28*
  - Does not always identify deformatter problems (but does NOT usually have false positives – L-band an exception)
    - *flag remaining bad spws*
  - Calibrators are too weak for given spw bandwidth
    - *heuristics have been developed and are being tested*

Known failure modes and issues

- 6.2.1 specific failure modes:
  - Fluxboot fitorder >2, fit order 2 used, not higher, incorrect flux scale
    - *fixed in CASA+pipeline 6.4.1, available now*
  - Some setups cause overly long short solution interval
    - *fixed in CASA+pipeline 6.4.1, available now*

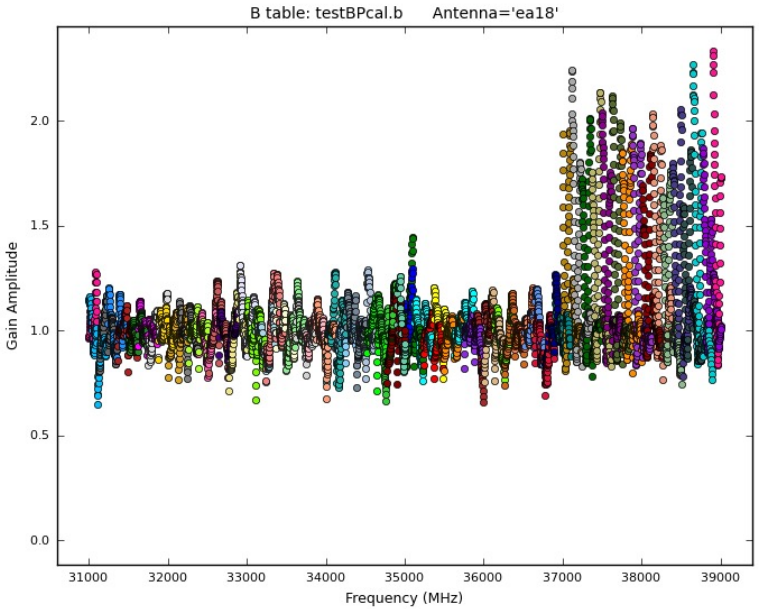
Known failure modes and issues

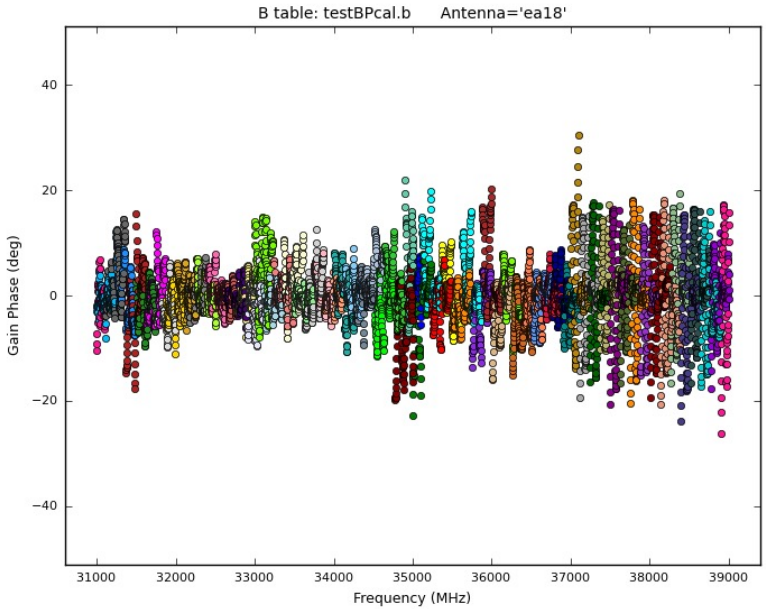
ea21 bandpass, bad data (DTS issue)



Known failure modes and issues

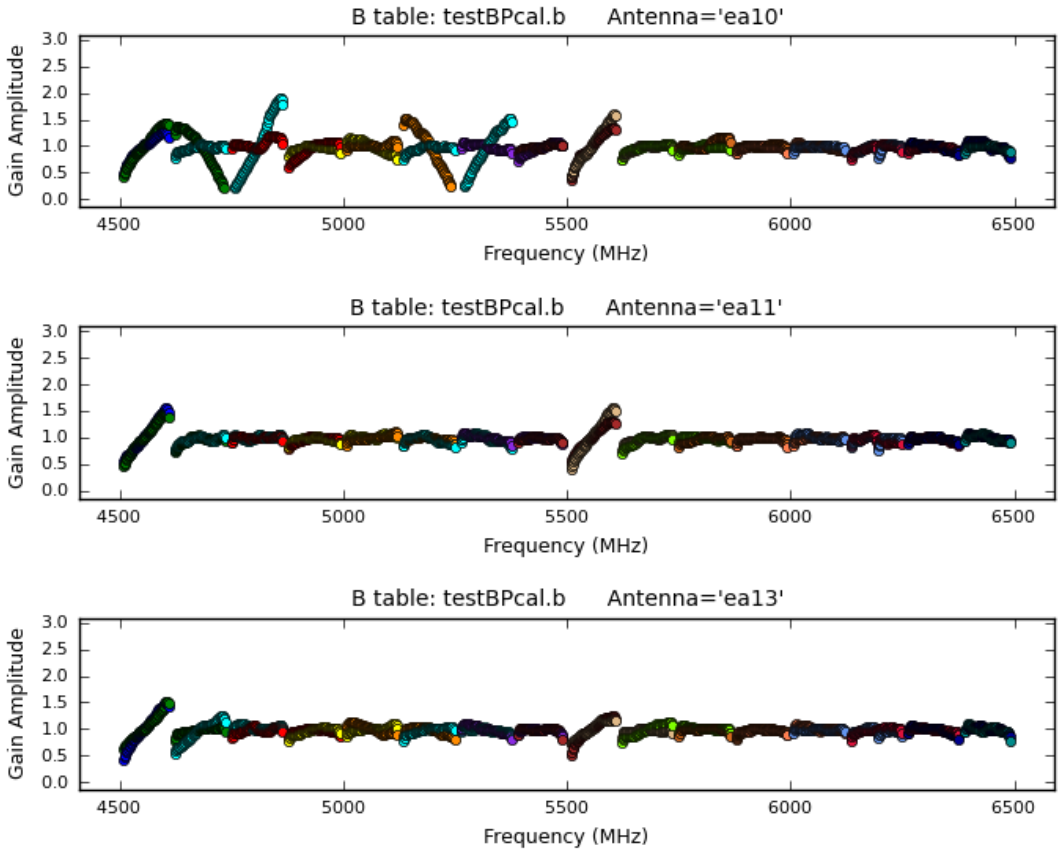
ea18 Amp **and** Phase affected (DTS issue for 37-39GHz)





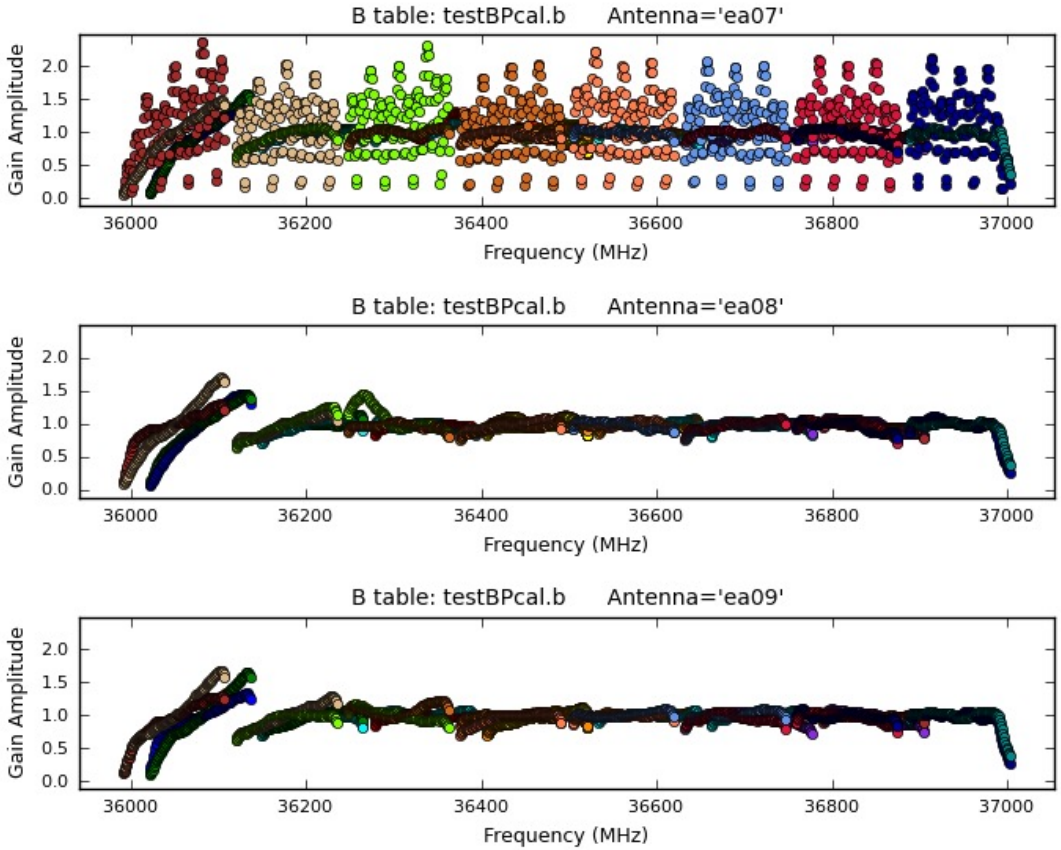
Known failure modes and issues

ea10 bandpass, bad data (DTS issue); ea11, ea12 OK



Known failure modes and issues

ea07 bandpass, bad data (DTS issue); ea08, ea09 OK



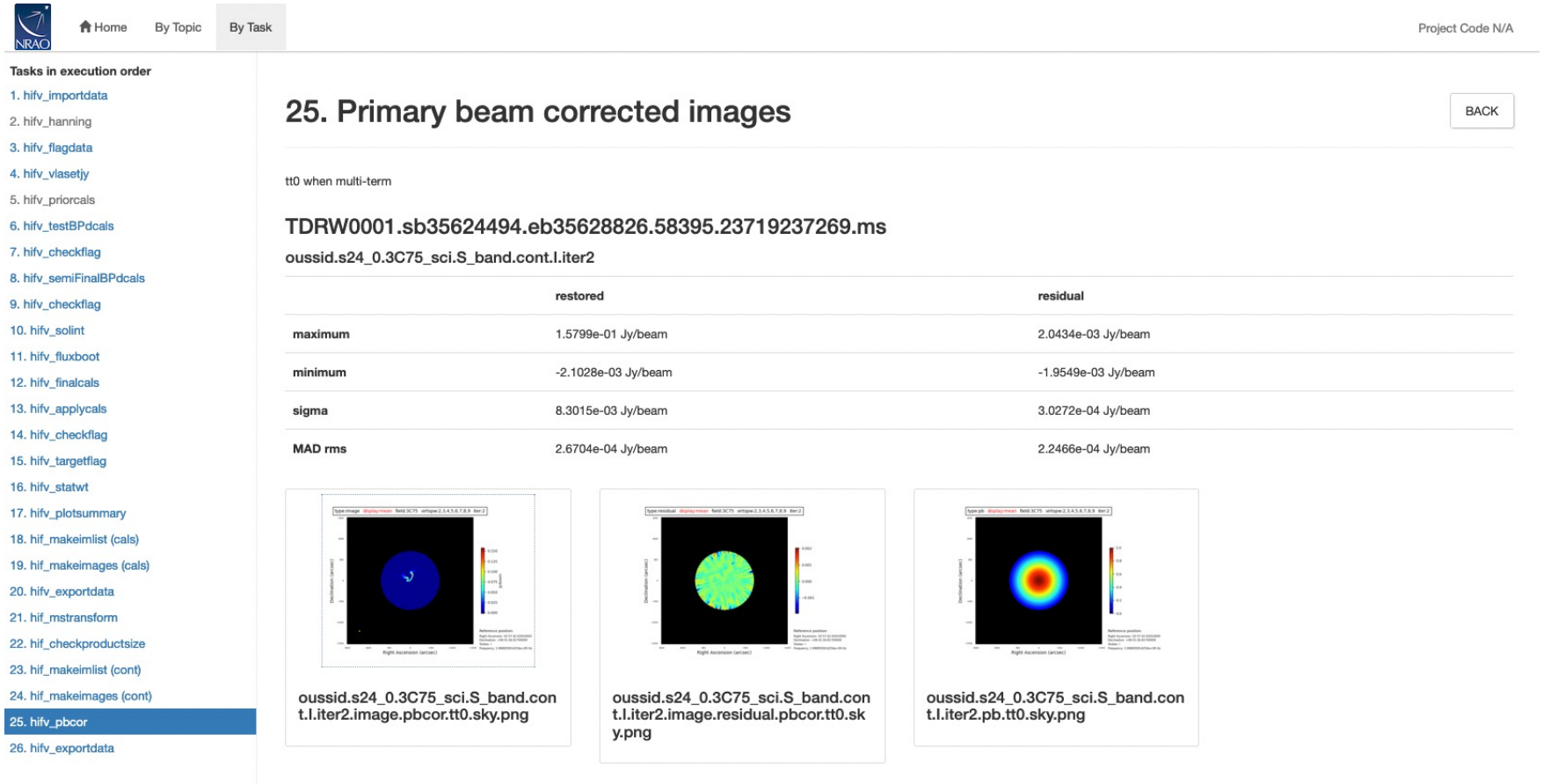
Science Ready Data Products (SRDP)

https://science.nrao.edu/srdp/home

- Continuum only
- C band or higher frequency currently
- SB setup and scan intents set correctly for pipeline
- Currently only those using 3C286 or 3C147 as flux cal
- Staff check quality in more detail, add extra flagging and rerun

Imaging Pipeline

https://science.nrao.edu/facilities/vla/data-processing/pipeline/VIPL



Future Developments

- Support for spectral line observations
- Polarization calibration tested for VLA Sky Survey (S-band), need polarization calibrator models for other bands
- More robust flux density bootstrapping that flags outliers
- Improved RFI flagging and detection of system issues
- Use of switched power data for determining weights

Viewing Weblogs

- The default security preferences in Firefox block weblogs on disk from being viewed directly:
  - Go to about:config: security.fileuri.strict_origin_policy to False
  - In CASA h_weblog() should open a browser tab with weblog
  - Host them as a server would

Starting the Pipeline

- SDM-BDF (MS possible, but online flags needed before)
- casa_pipescript.py

- /path/to/casa/bin/casa --pipeline
- On NRAO machines: casa-pipe

- execfile(`casa_pipescript.py')
  - Wait …

Considerations Before Running

- Disk space needed 3-4x raw data size, more if imaging
- Compute time: 30min to … a few days (weeks)
- Setup correct to work with the pipeline?
- Hanning smoothing, other changes

Questions?

- VLA CASA Calibration Pipeline information at:

  http://go.nrao.edu/vla-pipe

  CASA Integrated Pipeline & Scripted Pipeline available

- Have Questions?
- Need Help?
- Report a bug?

- Use the **NRAO HelpDesk**: **https://help.nrao.edu/**

- Submit your ticket under the **Pipeline Department.**

- Please include specific details when submitting HelpDesk tickets.
  (Project code, SB number, CASA/PL versions, errors, etc.)

www.nrao.edu
science.nrao.edu
public.nrao.edu

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Spectral line data

- Several steps in the real-time pipeline may not be appropriate for spectral line data:
  - Hanning smoothing (increases effective channel width)
  - Flags 5% of ***each*** spw edge and the first and last 10 channels of each baseband
  - Last run of RFLAG on target (may eliminate your line as interference!)
  - Statwt calculates rms based on scatter of channels per spw, per visibility; may want to run manually with channel selection turned on to eliminate use of channels containing line emission in calculating the rms

  $\Rightarrow$ *Specify a "cont.dat" file to avoid known lines for RFI flagging and statwt*

- With the above modifications, the pipeline will work with spectral line data as long as the calibrators are strong enough

Mixed correlator set-ups

- With WIDAR capabilities it is common to observe both wide and narrow spws to obtain both continuum and spectral line data simultaneously or multiple receiver bands
  - A single heuristic (e.g., gain calibration solution interval) for entire dataset may not be appropriate
- Solution:
  - Run pipeline through application of deterministic flags, including Hanning smoothing if you are going to use it
  - Split the MS by spw and/or scans
  - Run pipeline on split MSs WITHOUT Hanning smoothing (you have already applied it, if you are going to use it)
  - Warning: output flagging statistics may not be correct