



# The VLA Pipeline

John Tobin

# Pipeline Overview

- The ‘real-time’ pipeline is automatically run on all Scheduling Blocks as soon as the raw data are ingested into the archive:
  - Flagged and calibrated visibility data are delivered to users
  - All pipeline output undergoes basic quality assurance checks by NRAO staff
  - Pipeline should run correctly on all ‘standard’ Stokes I science SBs
  - Detailed checks are made for C-band and higher continuum projects as part of Science Ready Data Products (SRDP) processing
    - Reports generated are archived as pipeline products
  - Imaging and self-calibration (if needed) are left to the end users to perform at their institution or on NRAO computing

# Pipeline Overview

- Current versions available:
  - CASA integrated pipeline: compatible with ALMA pipeline infrastructure, and used as real-time pipeline since Sep 2015
    - recommended pipeline version
    - Instructions for installation and operation of the VLA CASA Calibration Pipeline are available at <http://go.nrao.edu/vla-pipe>
    - Uses CASA 6.1.2, similar to current real-time pipeline
    - See the VLA CASA pipeline guide at <http://go.nrao.edu/vla-casa-tut>
  - “scripted” pipeline: collection of python scripts that use CASA tasks wherever possible, but also uses toolkit calls. It was the original VLA pipeline and used on all science data from 2013 and until Sep 2015.
    - Final update for CASA 5.3, no further updates planned
    - Portions more easily modified relative to CASA integrated

# Will the Pipeline work for you?

- The pipeline successfully completes on ~92% 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 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 may be needed in these cases

\*CASA 5.6.2 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 a  $S/N=3$  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 or MS)
    - Retrieves the observing set-up from metadata
  - Hanning smooths<sup>\*</sup>
  - Applies deterministic flags (online flags, shadowed data, end channels of spectral windows, etc.)
  - Identifies primary calibrators and loads calibrator<sup>1</sup> models

<sup>\*</sup> 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 (i.e., masers).

<sup>1</sup> Models only available for 3C48, 3C138, 3C147, and 3C286

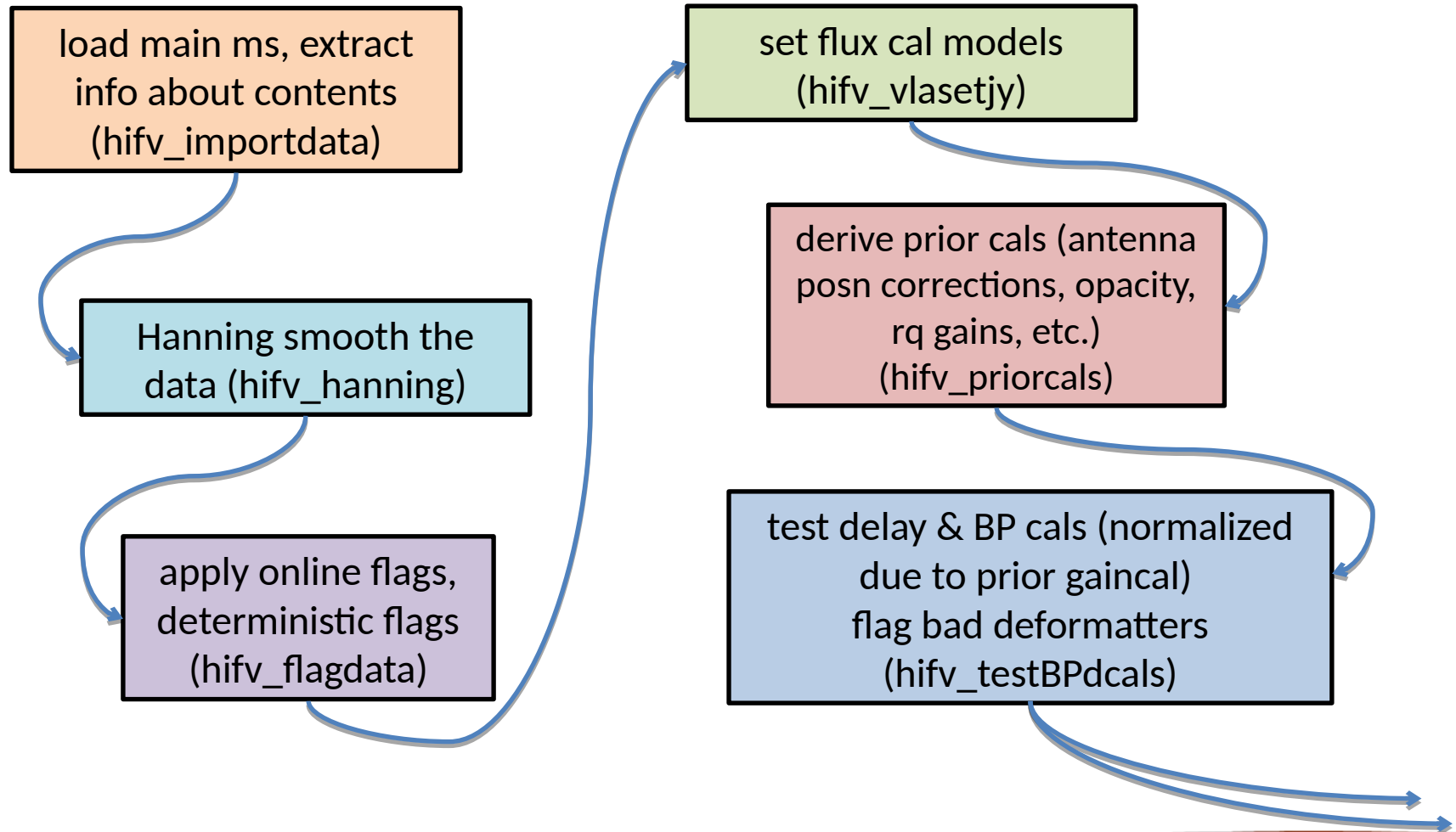


# (Real-Time) Heuristics (II)

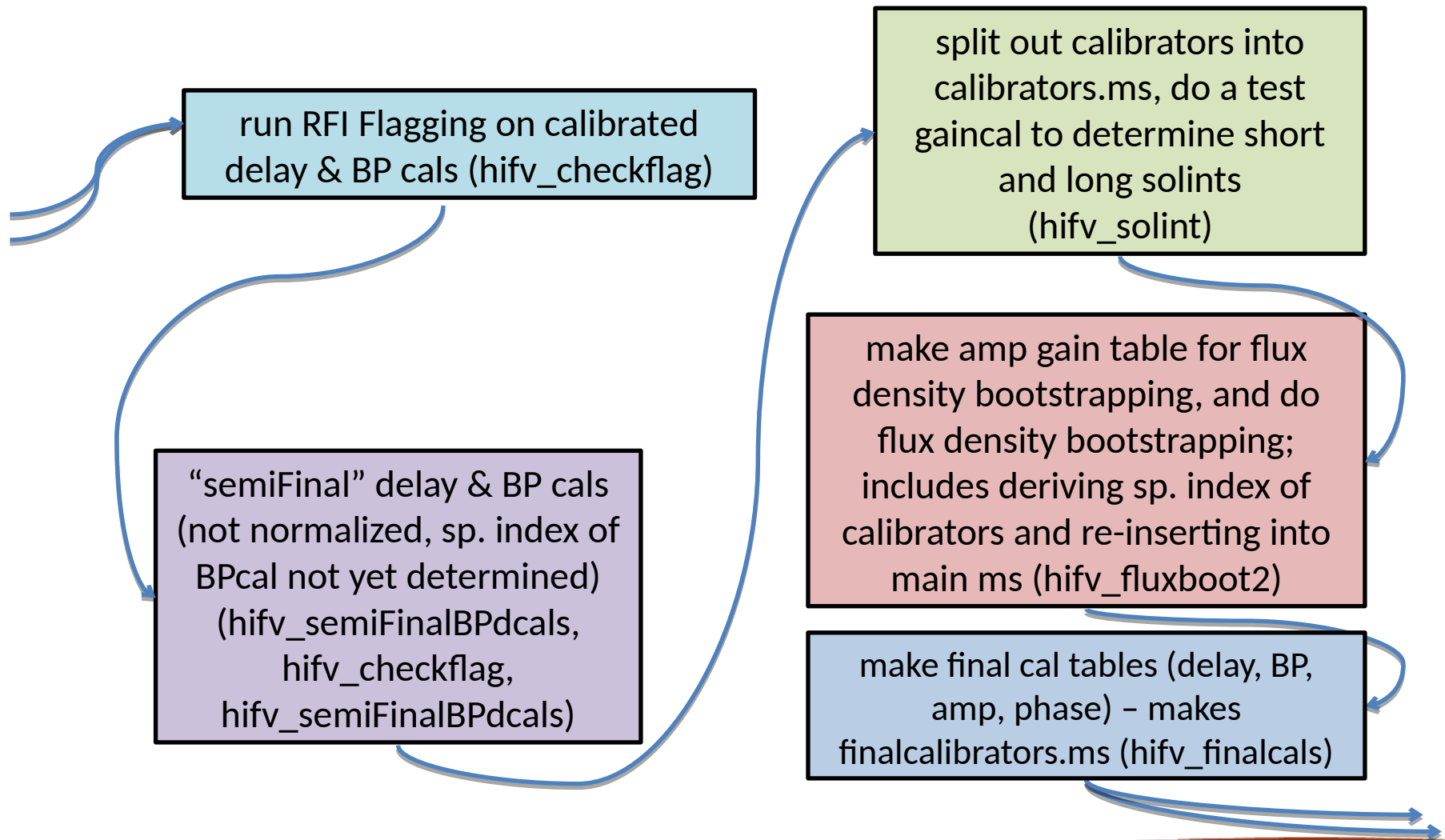
- Derives all prior calibrations (antenna position corrections, gain curves, atmospheric opacity, requantizer gains)
- Iteratively determines initial delay and bandpass solutions, including running RFLAG, and identifying system problems
- Derives initial gain solutions, does flux density bootstrapping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

<sup>\*</sup>May want to modify inputs and/or omit entirely for spectral line.

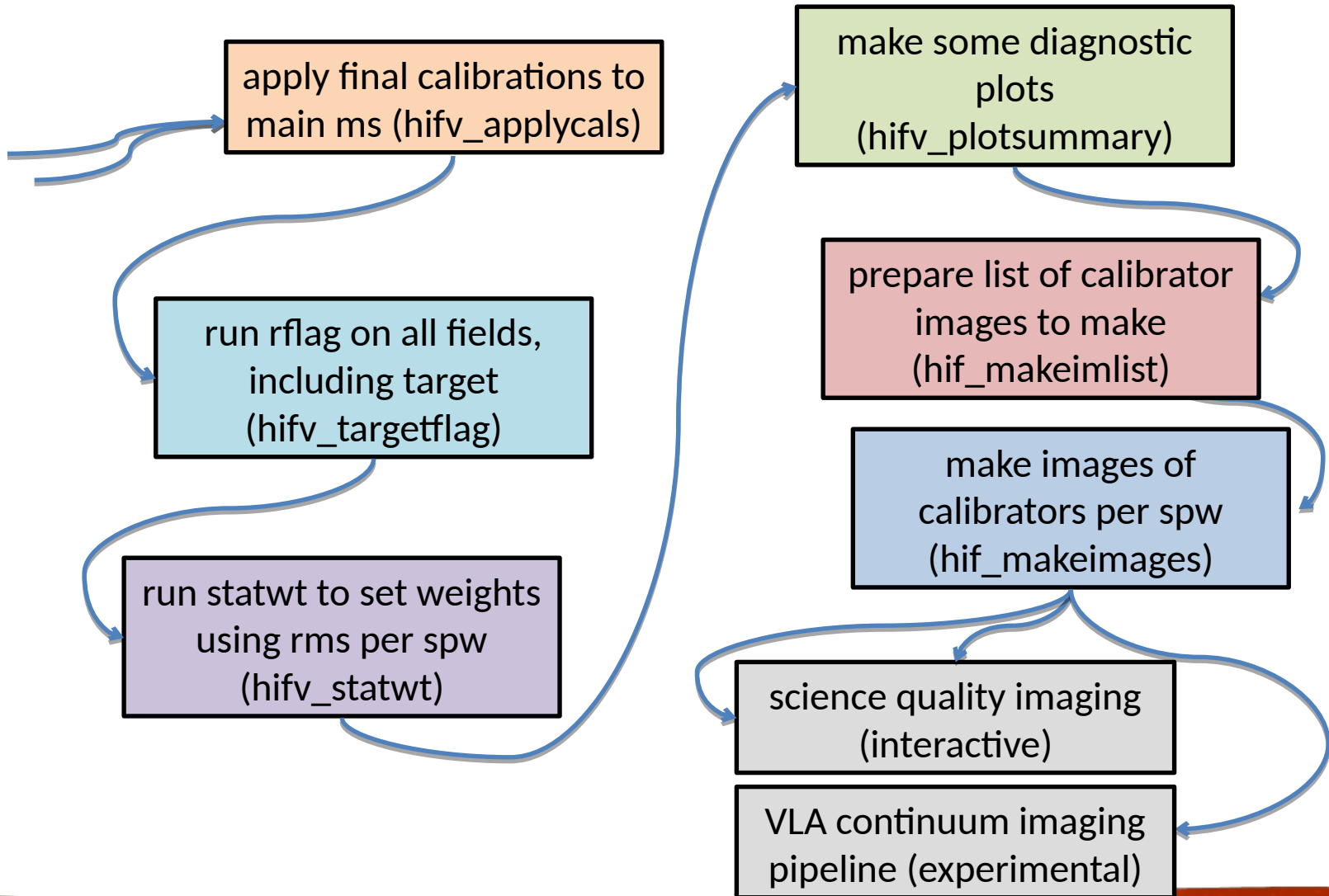
# Flow chart (CASA pipeline)



# Flow chart



# Flow chart



# Pipeline Weblog

- Pipeline weblog is created in real-time (can check while running)
  - Sometimes browser security issues, informational page will render telling you how to fix the problem
  - located in *pipeline-YYYYMMDDTHHMMSSS/html/index.html* in pipeline working directory
- Diagnostic plots and tables for most stages.
- CASA log file by task or as a whole (can be really large)
- Calibrator images per observing band.
- Example used here, and in our Pipeline CASA Guide:  
<https://casa.nrao.edu/Data/EVLA/Pipeline/CASA6.1.2/html/>



## Observation Overview

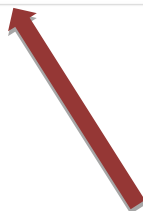
Project	uid://evla/pdb/14411854
Principal Investigator	Prof. Dominik A. Riechers
Observation Start	2013-03-23 05:09:03 UTC
Observation End	2013-03-23 08:08:30 UTC

## Pipeline Summary

Pipeline Version	2020.1.0.36
CASA Version	6.1.2.7 (environment)
Pipeline Start	2020-12-08 14:15:32 UTC
Execution Duration	1 day, 9:47:08

## 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/17165245									
Session: default									
<a href="#">13A-398.sb17165245.eb19476558.56374.213876608796.ms</a>	1cm (Ka)	27	2013-03-23 05:09:03	2013-03-23 08:08:30	2:17:48	40.0 m	1.0 km	441.9 m	146.0 GB



# Pipeline Weblog

Session: default  
13A-398.sb17165245.eb19476558.56374.213876608

## Overview of '13A-398.sb17165245.eb19476558.56374.213876608796.ms'

### Observation Execution Time

Start Time	2013-03-23 05:09:03
End Time	2013-03-23 08:08:30
Total Time on Source	2:55:04
Total Time on Science Target	2:17:48

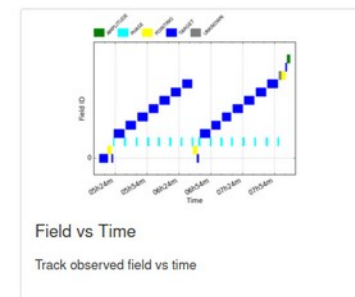
[LISTOBS OUTPUT](#)

### Spatial Setup

Science Targets	'CP1', 'CP2', 'CP3', 'CP4', 'CP5', 'CP6', 'CP7', 'J1041+0610' and 'J1331+3030'
Calibrators	'J1041+0610' and 'J1331+3030'

### Antenna Setup

Min Baseline	40.0 m
Max Baseline	1.0 km
Number of Baselines	351
Number of Antennas	27



### Spectral Setup

All Bands	'1cm (Ka)' and '3cm (X)'
Science Bands	'1cm (Ka)'
VLA Bands: Basebands: Freq range: [spws]	KA: A1C1: 34.975 GHz to 37.023 GHz: [2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17] KA: A2C2: 36.975 GHz to 39.023 GHz: [18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33] KA: B1D1: 30.975 GHz to 33.023 GHz: [34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49] KA: B2D2: 32.975 GHz to 35.023 GHz: [50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65]

### Sky Setup

Min Elevation	39.55 degrees
Max Elevation	82.72 degrees







# Pipeline Weblog



## Task Summaries


Task	QA Score	Duration
1. <b>hifv_importdata</b> : Register VLA measurement sets with the pipeline	1.00	1:07:38
2. <b>hifv_hanning</b> : VLA Hanning Smoothing	No QA  N/A	1:31:31
3. <b>hifv_flagdata</b> : VLA Deterministic flagging	0.93	3:43:51
4. <b>hifv_vlasetjy</b> : Set calibrator model visibilities	1.00	0:47:08
5. <b>hifv_priorcals</b> : Priorcals (gaincurves, opacities, antenna positions corrections, rq gains, and switched power)	No QA  N/A	4:45:00
6. <b>hifv_testBPdcals</b> : Initial test calibrations	1.00	2:08:26
7. <b>hifv_checkflag</b> : Checkflag summary	1.00	2:14:05
8. <b>hifv_semiFinalBPdcals</b> : Semi-final delay and bandpass calibrations	1.00	0:52:30
9. <b>hifv_checkflag</b> : Checkflag summary	1.00	0:34:26
10. <b>hifv_semiFinalBPdcals</b> : Semi-final delay and bandpass calibrations	1.00	0:52:15
11. <b>hifv_solint</b> : Determine solint and Test gain calibrations	1.00	0:37:56
12. <b>hifv_fluxboot2</b> : Gain table for flux density bootstrapping	Max rms of the residuals is 0.005302409583238838  0.83	1:17:40
13. <b>hifv_finalcals</b> : Final Calibration Tables	1.00	1:49:20
14. <b>hifv_applycals</b> : Apply calibrations from context	1.00	1:52:33
15. <b>hifv_targetflag</b> : Targetflag	1.00	2:07:19
16. <b>hifv_statwt</b> : Reweight visibilities	1.00	2:49:26
17. <b>hifv_plotsummary</b> : VLA Plot Summary	1.00	2:28:22
18. <b>hif_makeimlist</b> : Set-up parameters for bandpass calibrator & phase calibrator imaging	1.00	0:21:46
19. <b>hif_makeimages</b> : Make calibrator images	1.00	1:26:20
20. <b>hifv_exportdata</b> : Prepare pipeline data products for export	1.00	0:19:29



# 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\_fluxboot2 *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)


[Home](#)
[By Topic](#)
[By Task](#)

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\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotssummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

Project Code N/A

## 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
13A-398.sb17165245.eb19476558.56374.213876608796.ms	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	<a href="#">View</a>

Flagging agent status per measurement set.

### Template Files

Measurement Set	Other Online Flags	Flagging Template	
	File	Number of Statements	File
13A-398.sb17165245.eb19476558.56374.213876608796.ms	13A-398.sb17165245.eb19476558.56374.213876608796.flagonline.txt	2665	

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		
All Data	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	13A-398.sb17165245.eb19476558.56374.213876608796.ms
Science Spectral Windows	3.12%	9.76%	0.00%	0.00%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%
Bandpass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flux	3.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.45%	0.08%	3.22%	1.36%	11.12%	11.12%
Phase	3.12%	35.09%	0.00%	0.00%	0.24%	0.00%	0.00%	6.44%	0.23%	1.26%	1.39%	9.56%	9.56%
Target	3.12%	6.05%	0.00%	0.00%	0.82%	0.00%	0.00%	6.40%	0.09%	0.00%	1.40%	8.71%	8.71%
13A-398.sb17165245.eb19476558.56374.213876608796.ms	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	

Percent of data flagged as a fraction of the specified data selection, with the Flagging Agent columns giving this information per flagging agent.

# Deterministic Flags (hifv\_flagdata)

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\_semiFinalBPDcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotssummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

Data Selection (by intent)	Before Task	ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband	Total Science	13A-398.sb17165245.eb19476558.56374.213876608796.ms
All Data	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%
Science Spectral Windows	3.12%	9.76%	0.00%	0.00%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%
Bandpass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flux	3.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.45%	0.08%	3.22%	1.36%	11.12%	11.12%
Phase	3.12%	35.09%	0.00%	0.00%	0.24%	0.00%	0.00%	6.44%	0.23%	1.26%	1.39%	9.56%	9.56%
Target	3.12%	6.05%	0.00%	0.00%	0.82%	0.00%	0.00%	6.40%	0.09%	0.00%	1.40%	8.71%	8.71%
13A-398.sb17165245.eb19476558.56374.213876608796.ms	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%

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.

13A-398.sb17165245.eb19476558.56374.213876608796.ms



- Pipeline QA
- Input Parameters
- Tasks Execution Statistics

# Deterministic Flags (hifv\_flagdata)

- 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\_semiFinalBPDcals
  11. hifv\_solint
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotssummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

Data Selection (by intent)	Before Task	ANOS	Shadowed Antennas	Unwanted Intents	Other Online Flags	Flagging Template	Autocorr	Edge Channels	Clipping	Quack	Baseband	Total Science	13A-398.sb17165245.eb19476558.56374.213876608796.ms
All Data	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%
Science Spectral Windows	3.12%	9.76%	0.00%	0.00%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	8.84%
Bandpass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Flux	3.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.45%	0.08%	3.22%	1.36%	11.12%	11.12%
Phase	3.12%	35.09%	0.00%	0.00%	0.24%	0.00%	0.00%	6.44%	0.23%	1.26%	1.39%	9.56%	9.56%
Target	3.12%	6.05%	0.00%	0.00%	0.82%	0.00%	0.00%	6.40%	0.09%	0.00%	1.40%	8.71%	8.71%
13A-398.sb17165245.eb19476558.56374.213876608796.ms	3.12%	10.20%	0.00%	0.28%	0.75%	0.00%	0.00%	6.40%	0.11%	0.19%	1.40%	8.84%	

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

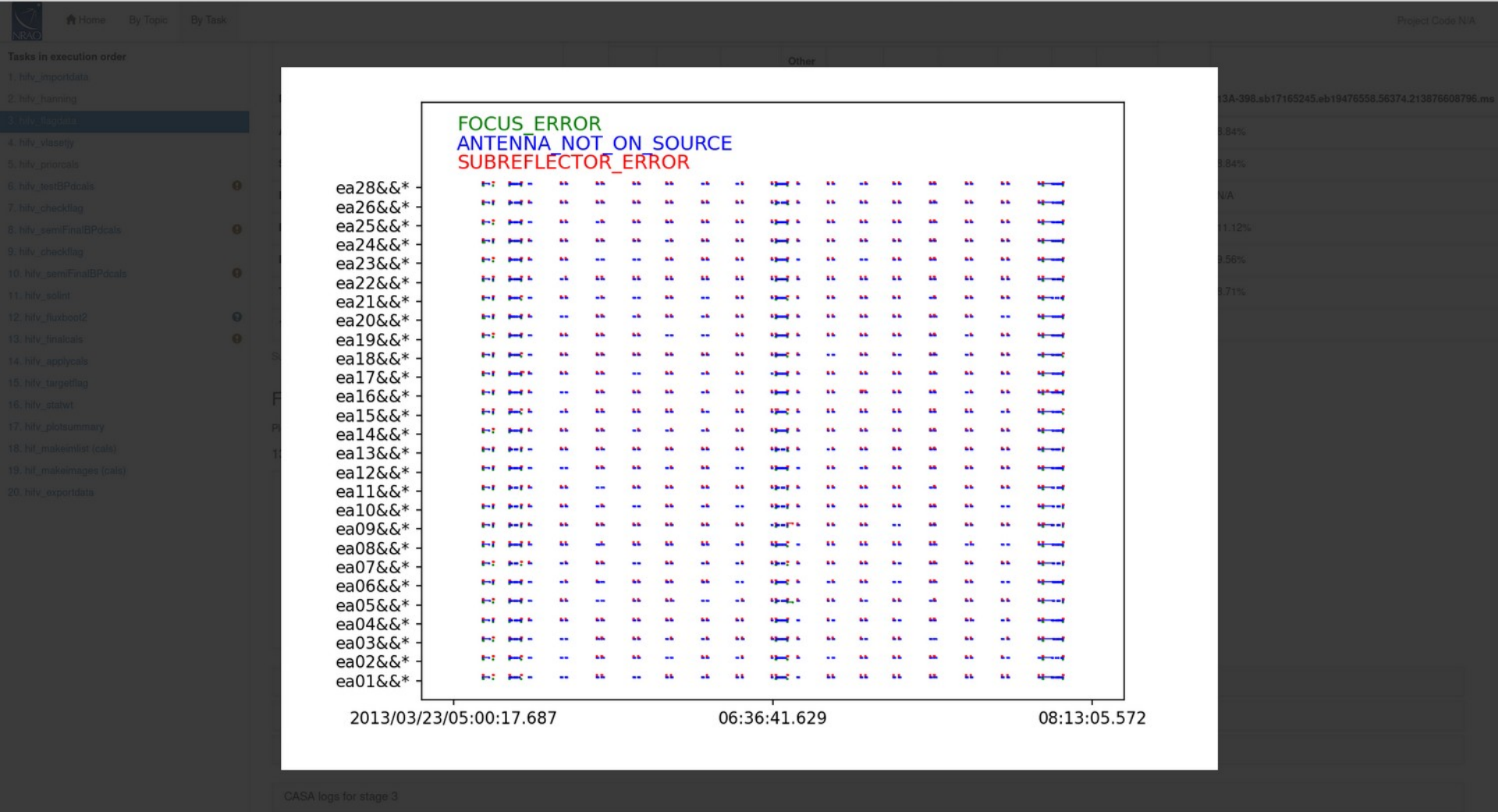
Plots of flagging reason vs time. The reasons for flagging the data are defined in the plot legend.

13A-398.sb17165245.eb19476558.56374.213876608796.ms



- Pipeline QA
- Input Parameters
- Tasks Execution Statistics

# Deterministic Flags (hifv\_flagdata)



# Hardware Issues (hifv\_testBPdcal)

- Tasks in execution order
1. hifv\_importdata
  2. hifv\_hanning
  3. hifv\_flagdata
  4. hifv\_vlasetj
  5. hifv\_priorcals
  6. hifv\_testBPdcal
  7. hifv\_checkflag
  8. hifv\_semiFinalBPdcal
  9. hifv\_checkflag
  10. hifv\_semiFinalBPdcal
  11. hifv\_solint
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotssummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

## Task notifications

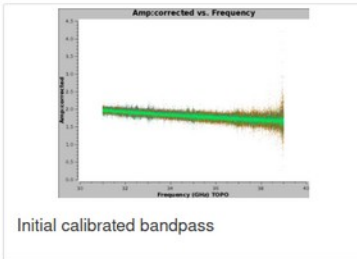
**Warning!** Antenna ea21, spws: 50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65 have a flagging fraction of 1.0.

Initial test calibrations using bandpass and delay calibrators

Plots: [Test delay plots](#) | [Gain Amplitude](#) | [Gain Phase](#) | [BP Amp solution](#) | [BP Phase solution](#)

## testBPdcal summary plot

13A-398.sb17165245.eb19476558.56374.213876608796.ms



## 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	A

## BP Table Phases

Antenna	SPWs	Band / Basebands
None	None	A



# Hardware Issues (hifv\_testBPdcal)

- Tasks in execution order
1. hifv\_importdata
  2. hifv\_hanning
  3. hifv\_flagdata
  4. hifv\_vlasetjy
  5. hifv\_priorcals
  6. hifv\_testBPdcal
  7. hifv\_checkflag
  8. hifv\_semiFinalBPdcal
  9. hifv\_checkflag
  10. hifv\_semiFinalBPdcal
  11. hifv\_solint
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotssummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

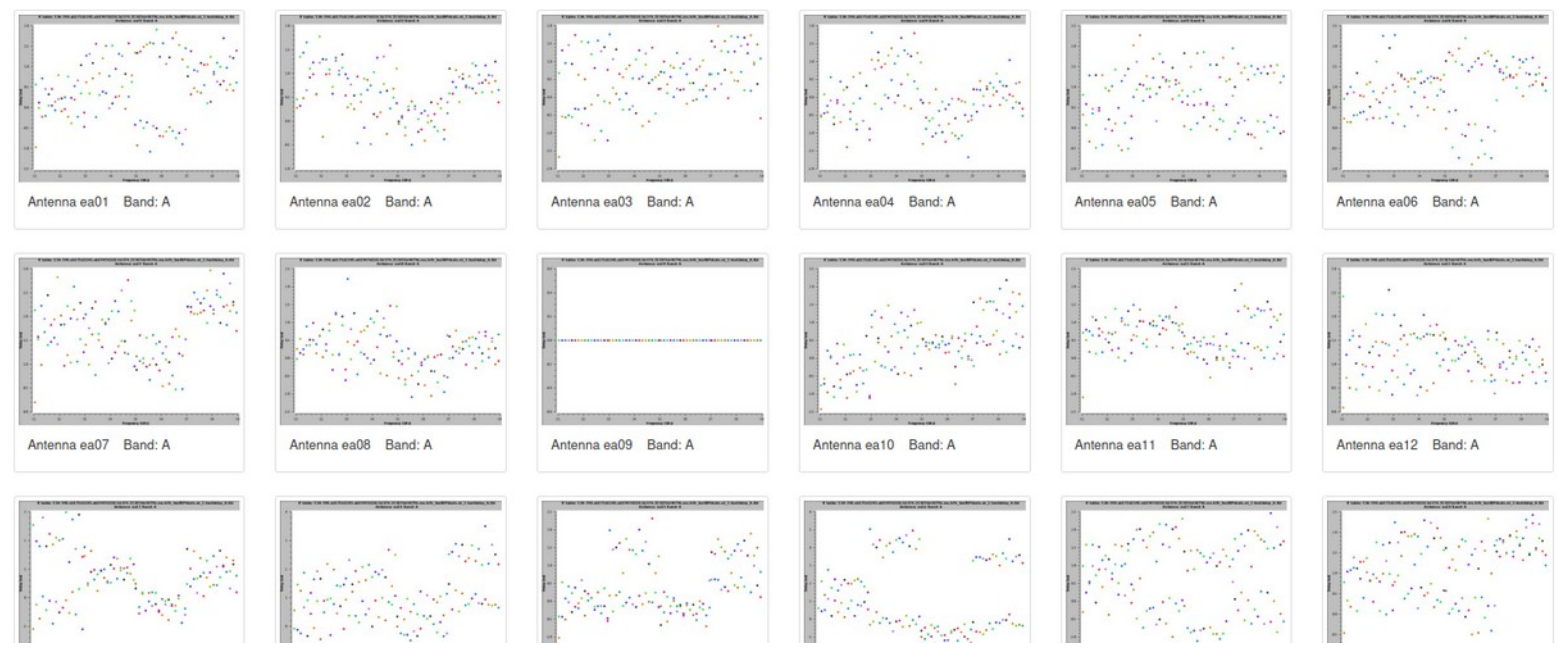
## Test Delay Plots

BACK

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

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Hardware Issues (hifv\_testBPdcal)

- Tasks in execution order
1. hifv\_importdata
  2. hifv\_hanning
  3. hifv\_flagdata
  4. hifv\_vlasetjy
  5. hifv\_priorcals
  6. hifv\_testBPdcal **1**
  7. hifv\_checkflag
  8. hifv\_semiFinalBPdcal **1**
  9. hifv\_checkflag
  10. hifv\_semiFinalBPdcal **1**
  11. hifv\_solint
  12. hifv\_fluxboot2 **1**
  13. hifv\_finalcals **1**
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotssummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

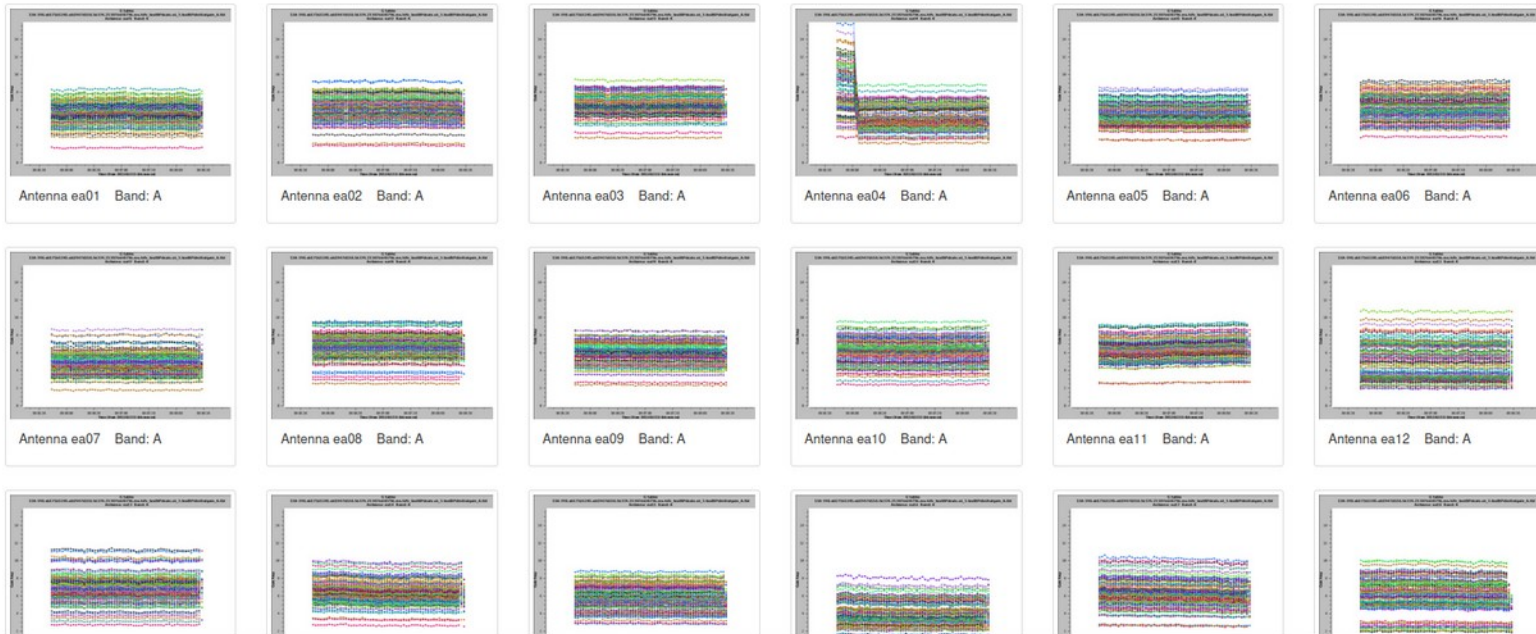
## Amp Gain Plots

BACK

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

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Hardware Issues (hifv\_testBPdcal)

- Tasks in execution order
1. hifv\_importdata
  2. hifv\_hanning
  3. hifv\_flagdata
  4. hifv\_vlasetjy
  5. hifv\_priorcals
  6. hifv\_testBPdcal
  7. hifv\_checkflag
  8. hifv\_semiFinalBPdcal
  9. hifv\_checkflag
  10. hifv\_semiFinalBPdcal
  11. hifv\_solint
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotsummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

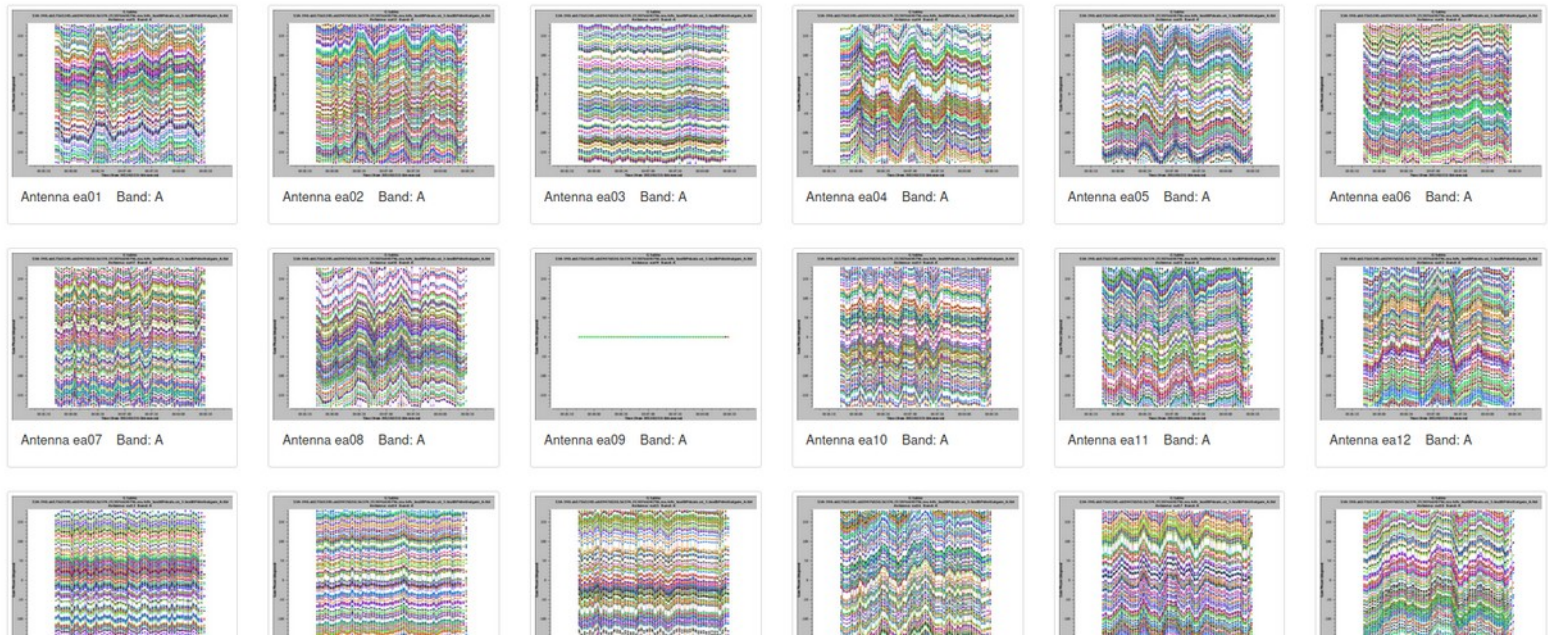
## Phase Gain Plots

BACK

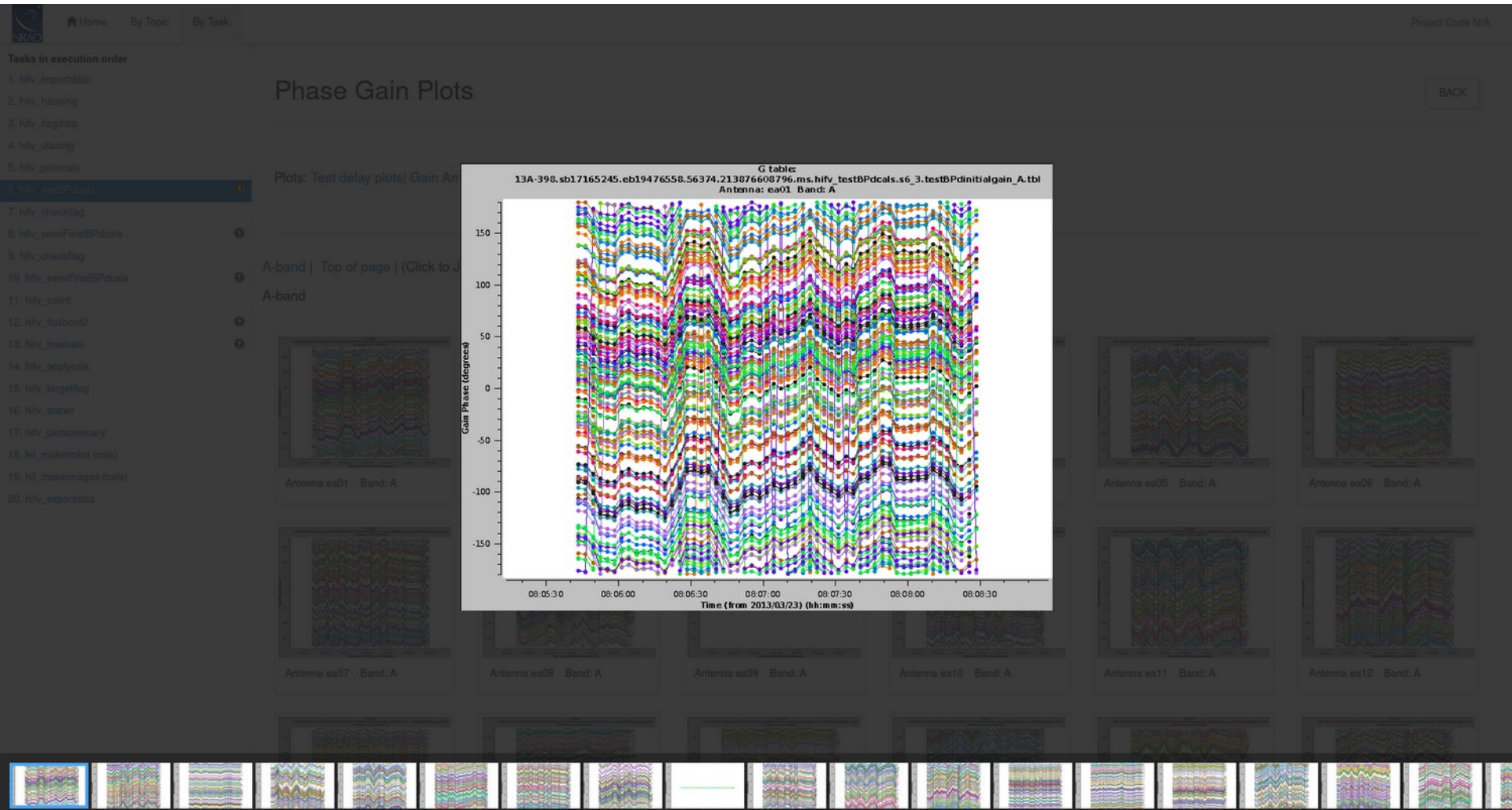
Plots: Test delay plots | Gain Amplitude | Gain Phase | BP Amplitude solution | BP Phase solution

A-band | Top of page | (Click to Jump)

A-band



# Hardware Issues (hifv\_testBPdcal)



# Hardware Issues (hifv\_testBPdcal)

Project Code N/A

Home By Topic **By Task**

Tasks in execution order

1. hifv\_importdata
2. hifv\_hanning
3. hifv\_flagdata
4. hifv\_vlasetfy
5. hifv\_priorcals
- 6. hifv\_testBPdcal**
7. hifv\_checkflag
8. hifv\_semiFinalBPdcal
9. hifv\_checkflag
10. hifv\_semiFinalBPdcal
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotsummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

## Bandpass Amp Solution Plots

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

A-band | Top of page | (Click to Jump)

A-band

Antenna ea01 Band: A

Antenna ea02 Band: A

Antenna ea03 Band: A

Antenna ea04 Band: A

Antenna ea05 Band: A

Antenna ea06 Band: A

Antenna ea07 Band: A

Antenna ea08 Band: A

Antenna ea09 Band: A

Antenna ea10 Band: A

Antenna ea11 Band: A

Antenna ea12 Band: A

Antenna ea13 Band: A

Antenna ea14 Band: A

Antenna ea15 Band: A

Antenna ea16 Band: A

Antenna ea17 Band: A

Antenna ea18 Band: A

# Hardware Issues (hifv\_testBPdcals)

NRAO 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\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotsummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

## Bandpass Phase Solution Plots

Plots: [Test delay plots](#) | [Gain Amplitude](#) | [Gain Phase](#) | [BP Amp solution](#) | [BP Phase solution](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band

Antenna	Band
Antenna ea01	Band: A
Antenna ea02	Band: A
Antenna ea03	Band: A
Antenna ea04	Band: A
Antenna ea05	Band: A
Antenna ea06	Band: A
Antenna ea07	Band: A
Antenna ea08	Band: A
Antenna ea09	Band: A
Antenna ea10	Band: A
Antenna ea11	Band: A
Antenna ea12	Band: A
Antenna ea13	Band: A
Antenna ea14	Band: A
Antenna ea15	Band: A
Antenna ea16	Band: A
Antenna ea17	Band: A
Antenna ea18	Band: A

# Gain Solution Intervals (hifv\_solint)

The screenshot shows the NRAO task execution interface. On the left is a sidebar with a list of tasks in execution order, with '11. hifv\_solint' selected. The main content area is titled '11. Solution Interval and test gain calibrations'. It contains a description: 'Determine the solution interval for a scan-average equivalent and do test gain calibrations to establish a short solution interval.' Below this are two bullet points: '• The long solution intervals for band are: **A band: 75.75s**.' and '• The short solution intervals per band that are used: **A band: in**.'. There are also links for 'Plots: Testgains amp plots | Testgains phase plots' and sections for 'Pipeline QA', 'Input Parameters', 'Tasks Execution Statistics', and 'CASA logs for stage 11' which includes a link to 'View or download stage11/casapy.log (608.3 KB)'. A 'BACK' button is in the top right. A vertical sidebar on the right shows thumbnails of other task stages.

# Gain Solution Intervals (hifv\_solint)

- 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\_semiFinalBPdcals
  - 11. hifv\_solint**
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotsummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

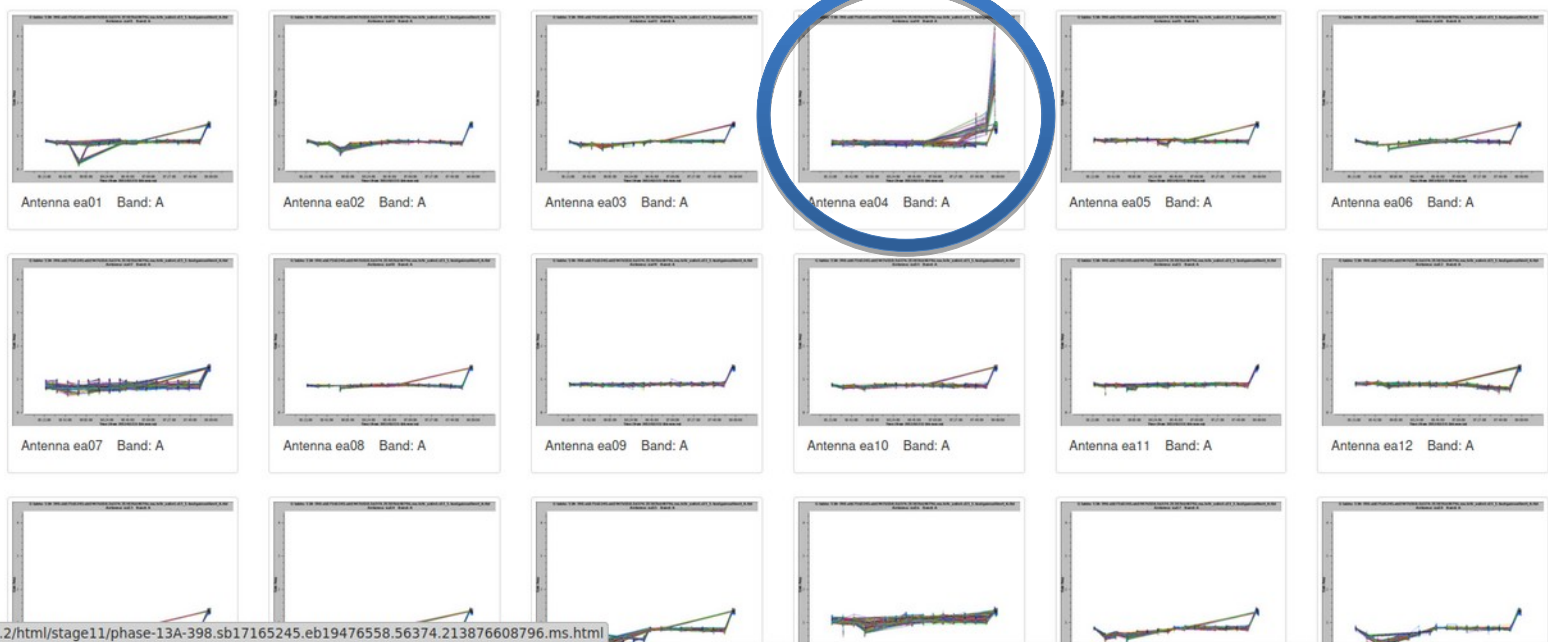
## Testgains Amp Plots

BACK

Plots: [Testgains amp plots](#) | [Testgains phase plots](#)

A-band | [Top of page](#) | (Click to Jump)

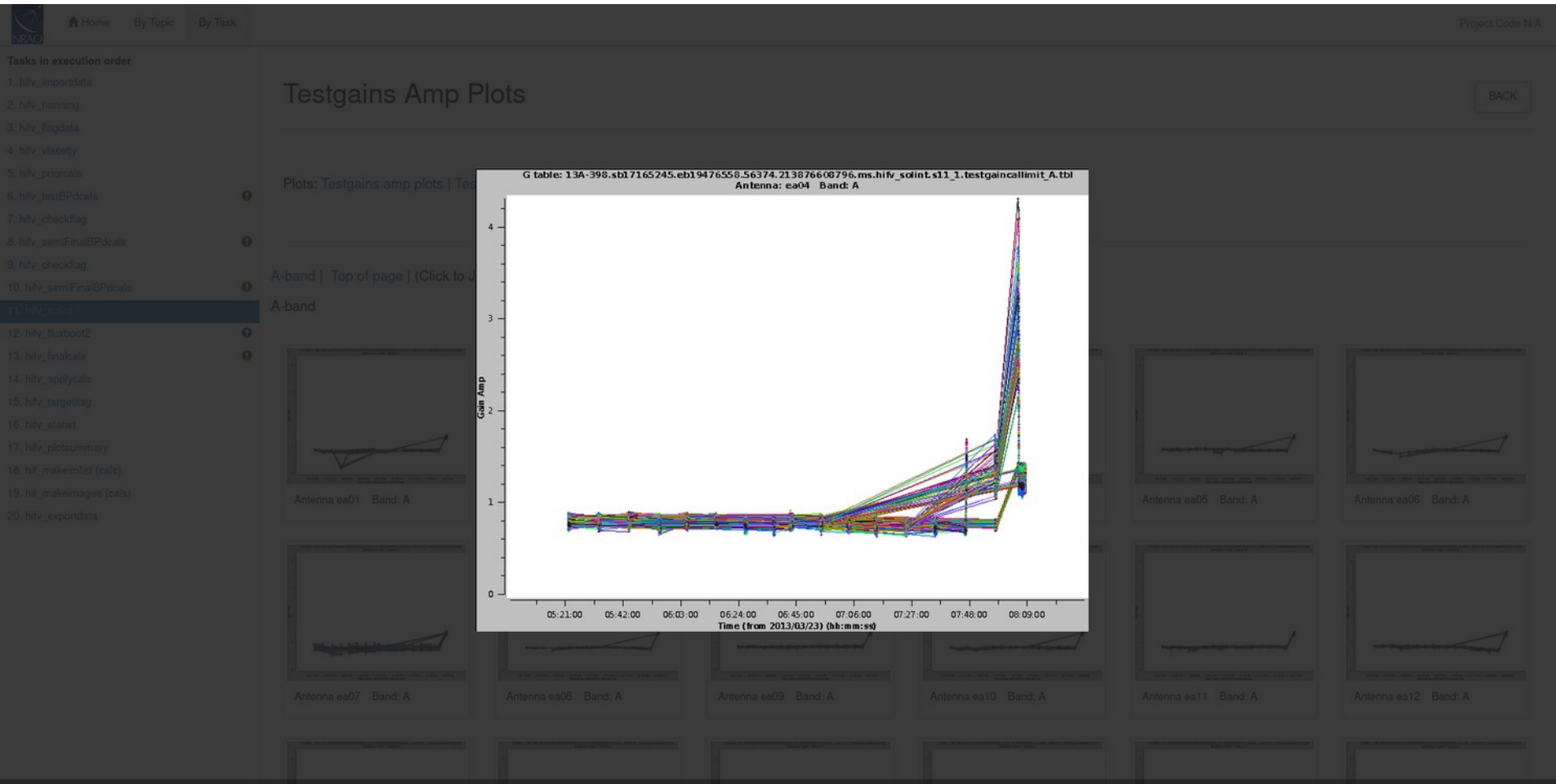
A-band



<https://casa.nrao.edu/Data/EVLA/Pipeline/CASA6.1.2/html/stage11/phase-13A-398.sb17165245.eb19476558.56374.213876608796.ms.html>



# Gain Solution Intervals (hifv\_solint)



# Flux Density Bootstrapping (hifv\_fluxboot2)

- 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\_semiFinalBPDcals
  11. hifv\_solint
  12. hifv\_fluxboot2
  13. hifv\_finalcals
  14. hifv\_applycals
  15. hifv\_targetflag
  16. hifv\_statwt
  17. hifv\_plotssummary
  18. hif\_makeimlist (cals)
  19. hif\_makeimages (cals)
  20. hifv\_exportdata

## 12. Flux density bootstrapping and spectral index fitting

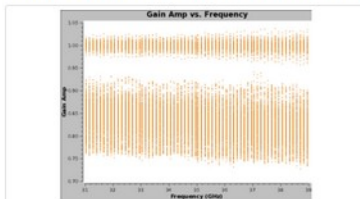
BACK

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

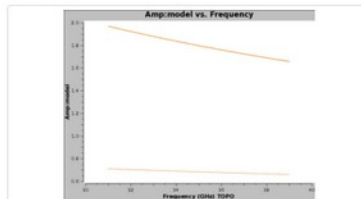
Fit the spectral index of calibrators with a power-law and put the fit in the model column.

### Fluxboot summary plots

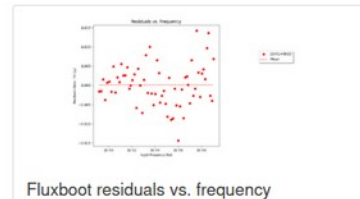
13A-398.sb17165245.eb19476558.56374.213876608796.ms



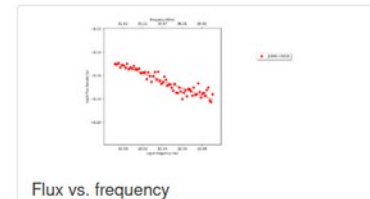
Caltable: fluxgaincal.g. Plot of amp vs. freq.



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
J1041+0610	1	A	35.00000	0.68286 +/- 0.00064	-0.31871 +/- 0.01398	----	----	----

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
J1041+0610	31.039	0.7079	0.005843	0.7095	-0.001558
	31.167	0.7074	0.006000	0.7086	-0.001493
	31.295	0.7092	0.007022	0.7077	0.001584
	31.423	0.7029	0.005594	0.7067	-0.003784
	31.551	0.7065	0.005343	0.7058	0.000720
	31.679	0.7059	0.005863	0.7049	0.000973
	31.807	0.7024	0.005819	0.7040	-0.001650
	31.935	0.7080	0.006131	0.7031	0.004930

# Final Calibration Tables (hifv\_finalcals)

The screenshot shows the NRAO task execution interface. On the left is a sidebar with a list of tasks in execution order, with '13. hifv\_finalcals' selected. The main content area is titled '13. Final calibration tables' and includes a 'BACK' button. Below the title is a 'Task notifications' section with a yellow warning: 'Warning! Antenna ea21, spws: 50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65 have a flagging fraction of 1.0.' The 'Plots' section is circled in blue and contains links for 'Final delay plots | BP initial gain phase | BP Amp solution | BP Phase solution | Phase (short) gain solution | Final amp time cal | Final amp freq cal | Final phase gain cal'. Other sections include 'Pipeline QA', 'Input Parameters', 'Tasks Execution Statistics', and 'CASA logs for stage 13' with a link to 'View or download stage13/casapy.log (813.4 KB)'.

# Final Calibration Tables (hifv\_finalcals)

- 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\_semiFinalBPdcals
  - 11. hifv\_solint
  - 12. hifv\_fluxboot2
  - 13. hifv\_finalcals**
  - 14. hifv\_applycals
  - 15. hifv\_targetflag
  - 16. hifv\_statwt
  - 17. hifv\_plotsummary
  - 18. hif\_makeimlist (cals)
  - 19. hif\_makeimages (cals)
  - 20. hifv\_exportdata

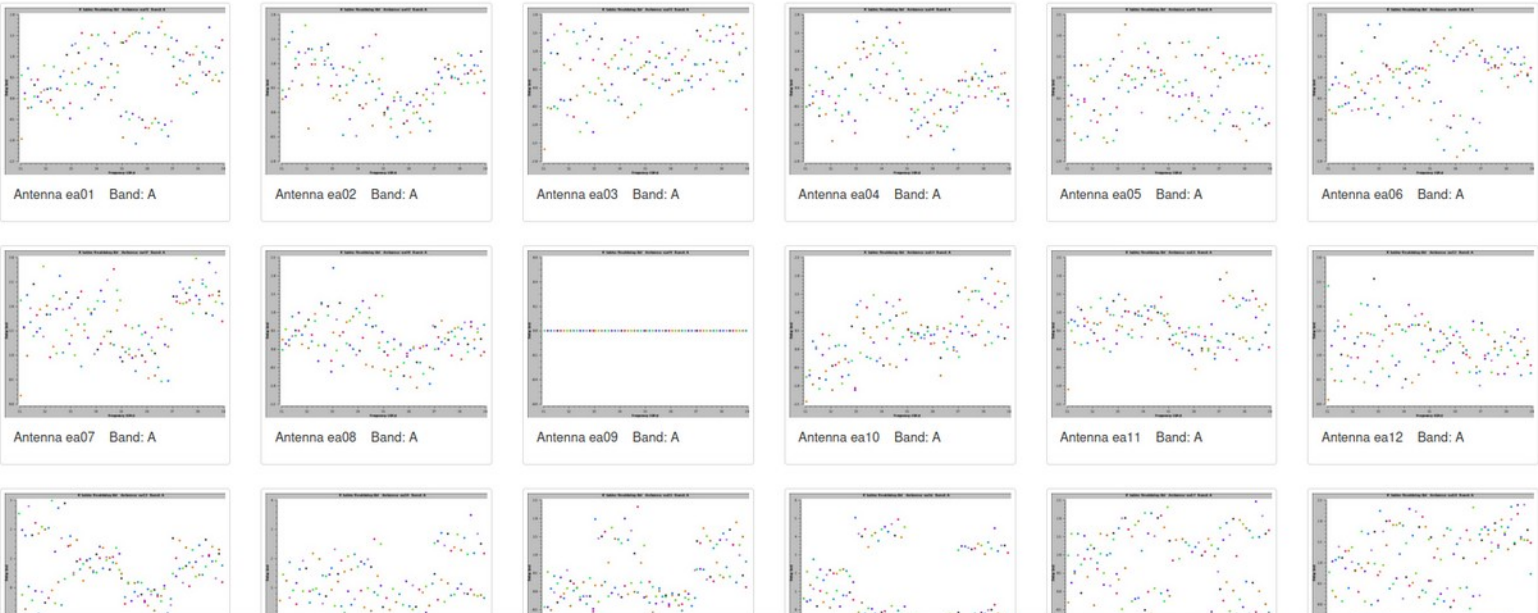
## Final Delay plots

BACK

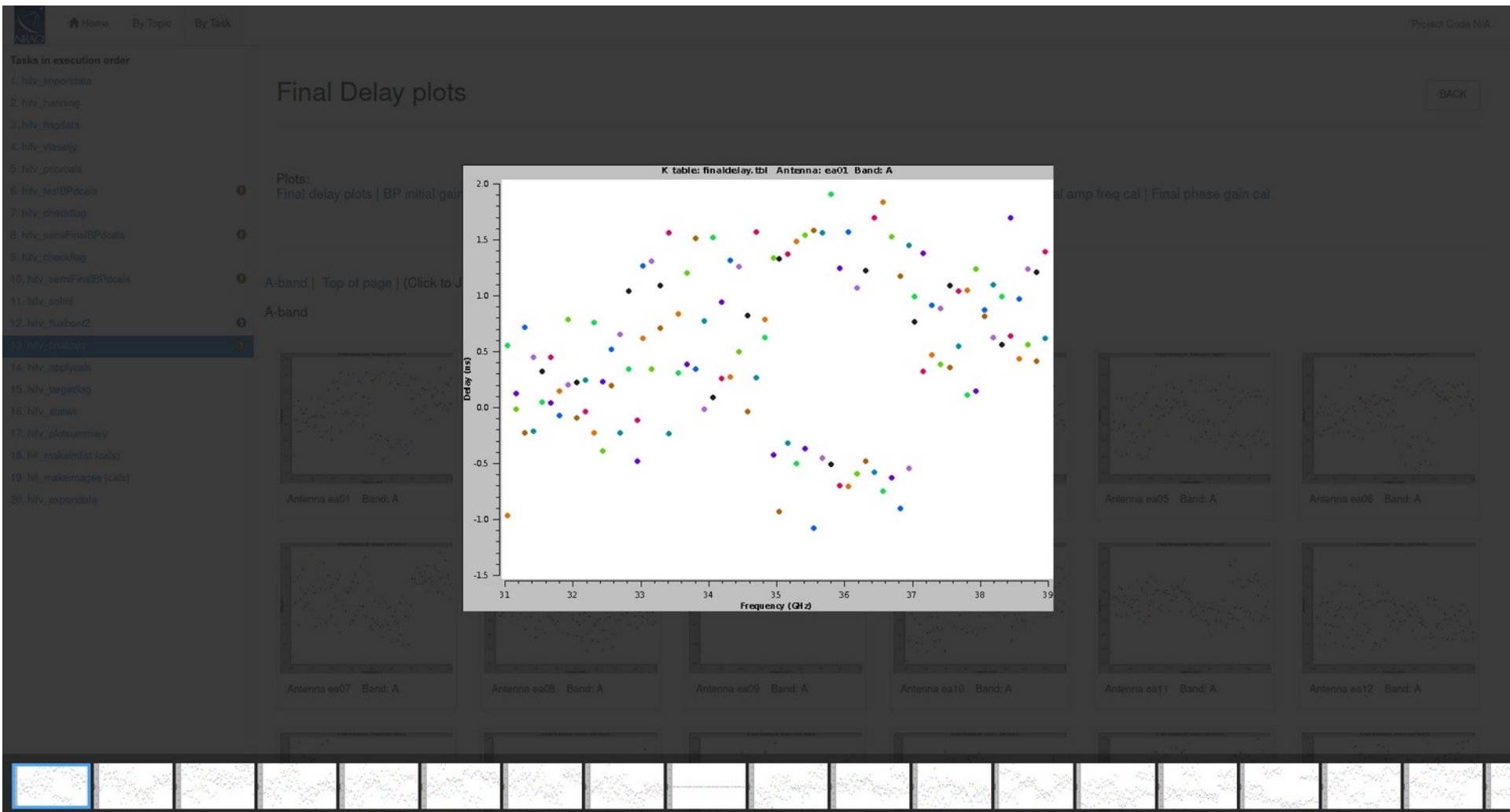
Plots:  
[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP Phase solution](#) | [Phase \(short\) gain solution](#) | [Final amp time cal](#) | [Final amp freq cal](#) | [Final phase gain cal](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

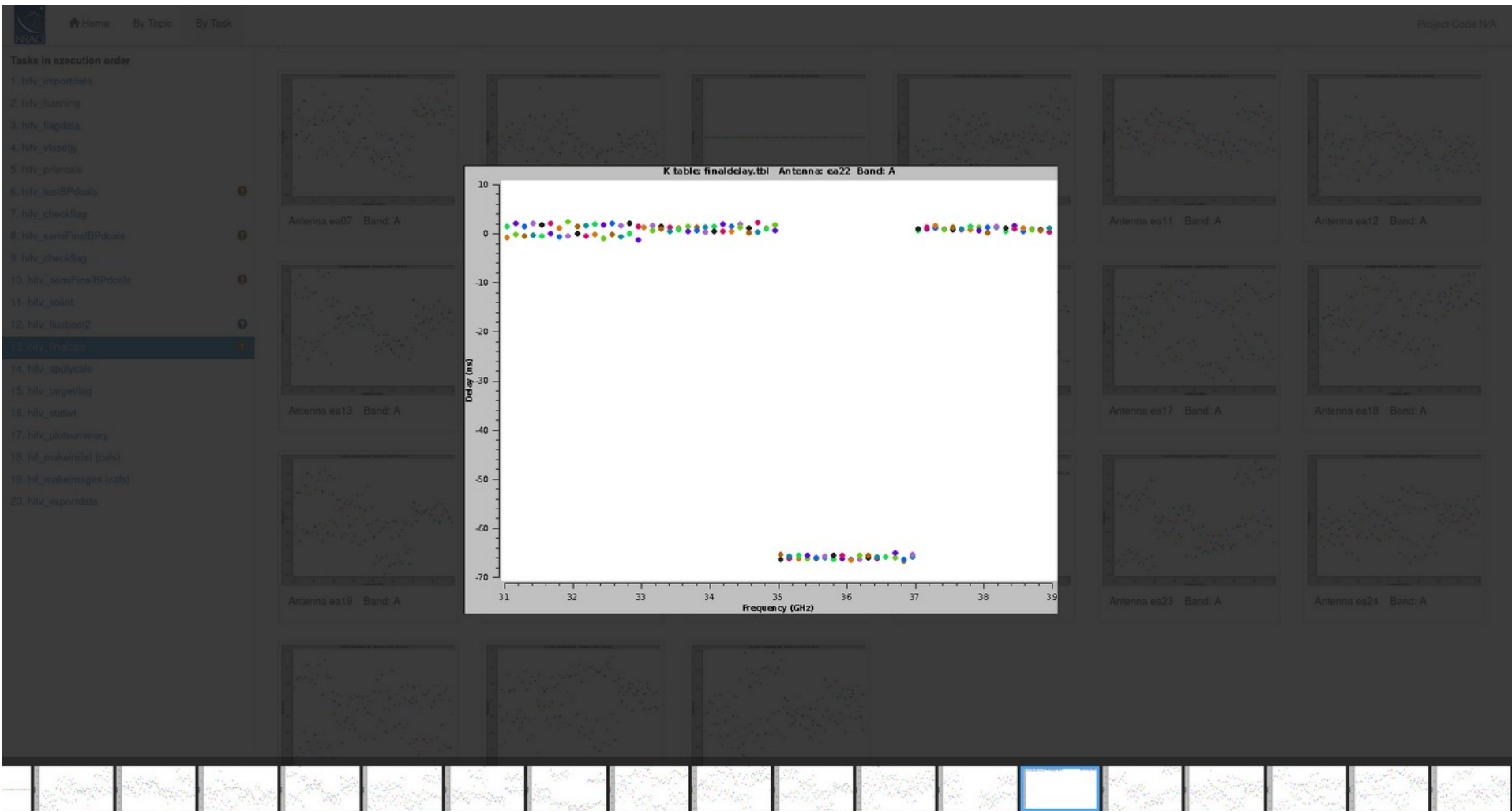
A-band



# Final Calibration Tables (hifv\_finalcals)



# Final Calibration Tables (hifv\_finalcals)



# Final Cal Tables: bandpass

- Tasks in execution order
- 1. hifv\_importdata
  - 2. hifv\_hanning
  - 3. hifv\_flagdata
  - 4. hifv\_vlasetfy
  - 5. hifv\_priorcals
  - 6. hifv\_testBPdcals
  - 7. hifv\_checkflag
  - 8. hifv\_semiFinalBPdcals
  - 9. hifv\_checkflag
  - 10. hifv\_semiFinalBPdcals
  - 11. hifv\_solint
  - 12. hifv\_fluxboot2
  - 13. hifv\_finalcals
  - 14. hifv\_applycals
  - 15. hifv\_targetflag
  - 16. hifv\_statwt
  - 17. hifv\_plotsummary
  - 18. hif\_makeimlist (cals)
  - 19. hif\_makeimages (cals)
  - 20. hifv\_exportdata

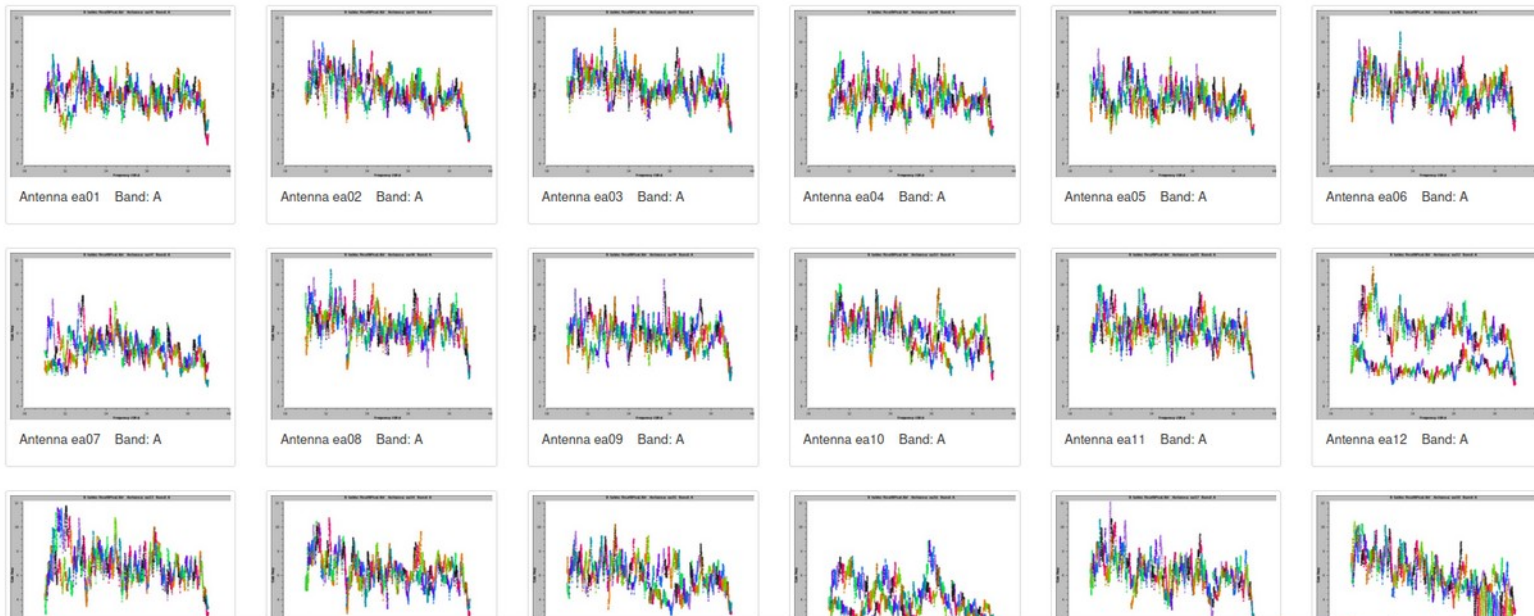
## Bp Amp Solution plots

BACK

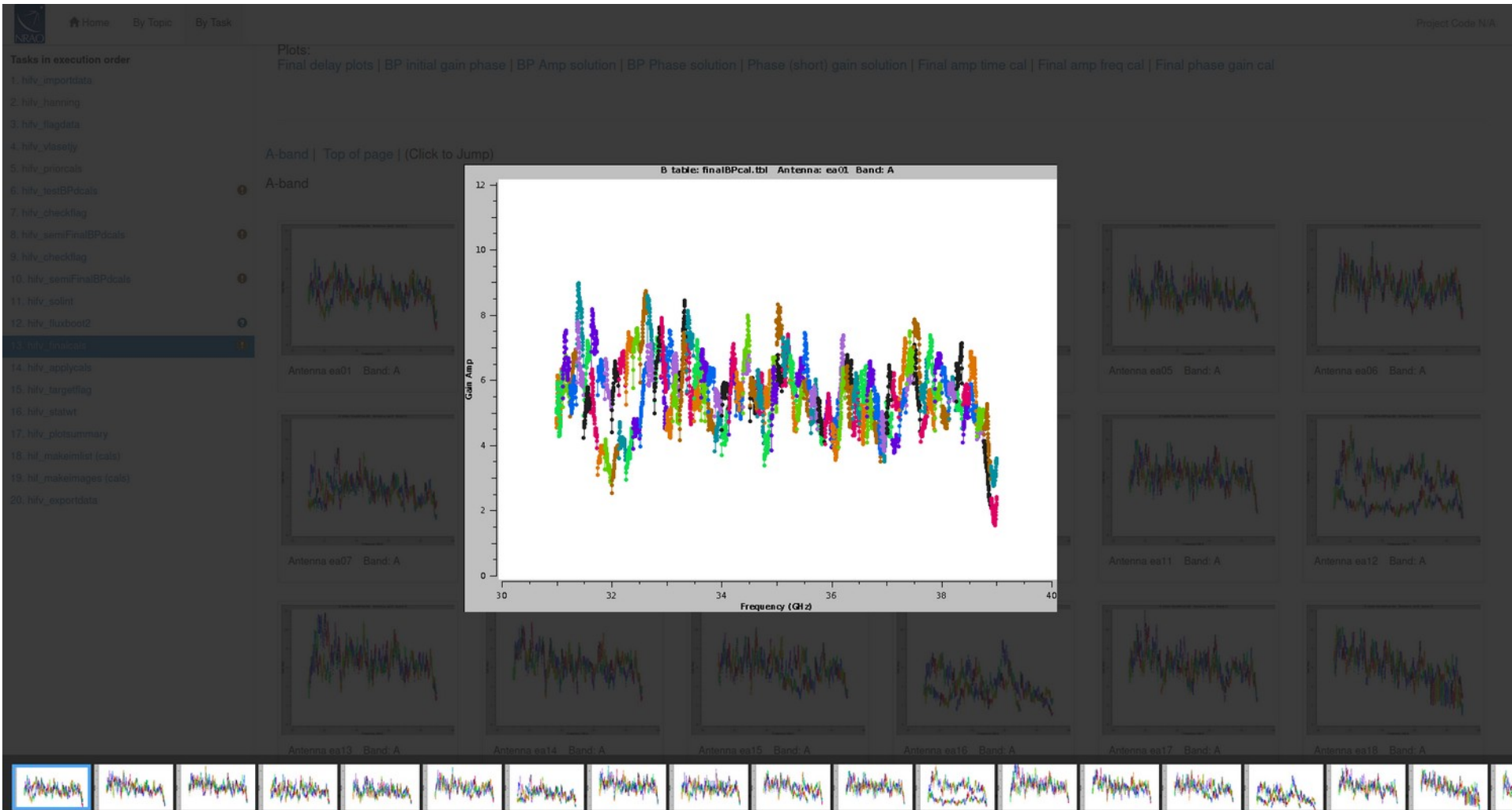
Plots:  
[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP phase solution](#) | [Phase \(short\) gain solution](#) | [Final amp time cal](#) | [Final amp freq cal](#) | [Final phase gain cal](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Final Cal Tables: bandpass





# Final Cal Tables: bandpass

### Tasks in execution order

- 1. hifv\_importdata
- 2. hifv\_hanning
- 3. hifv\_flagdata
- 4. hifv\_vlasety
- 5. hifv\_priorcals
- 6. hifv\_testBPdcals
- 7. hifv\_checkflag
- 8. hifv\_semiFinalBPdcals
- 9. hifv\_checkflag
- 10. hifv\_semiFinalBPdcals
- 11. hifv\_solint
- 12. hifv\_fluxboot2
- 13. hifv\_finalcals
- 14. hifv\_applycals
- 15. hifv\_targetflag
- 16. hifv\_statwt
- 17. hifv\_plotssummary
- 18. hif\_makeimlist (cals)
- 19. hif\_makeimages (cals)
- 20. hifv\_exportdata

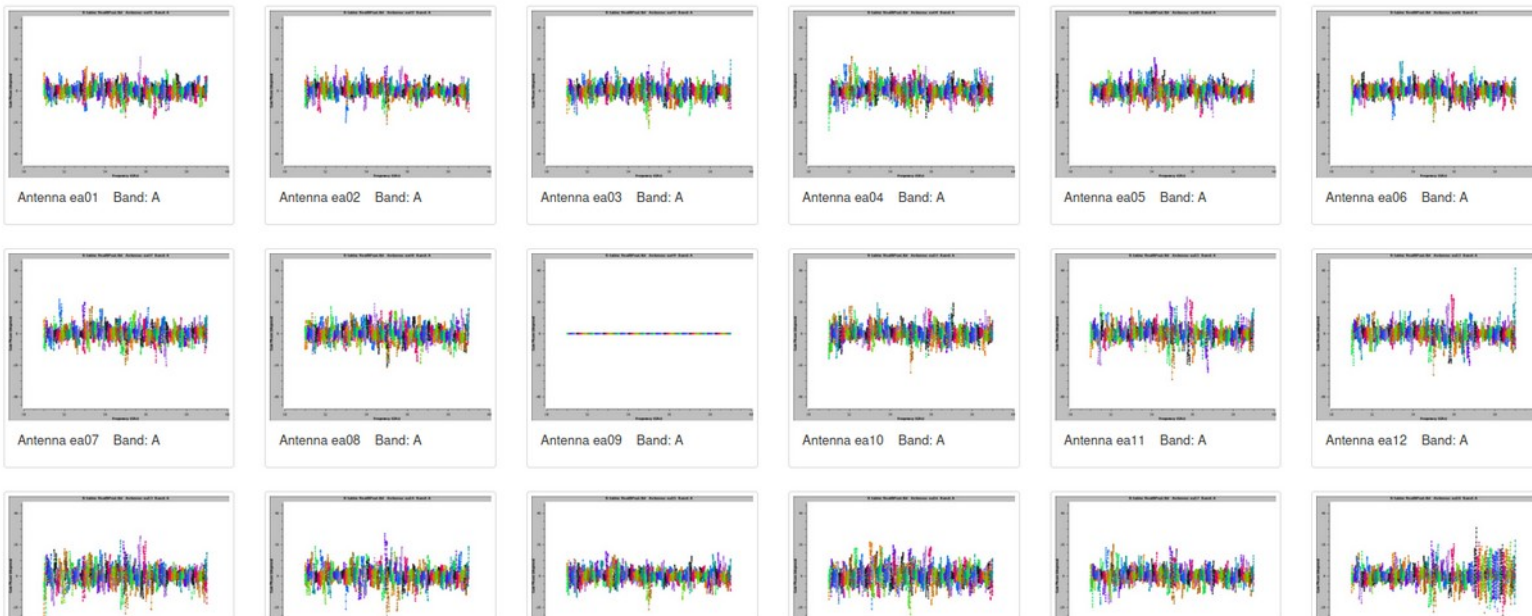
## Bp Phase Solution plots

BACK

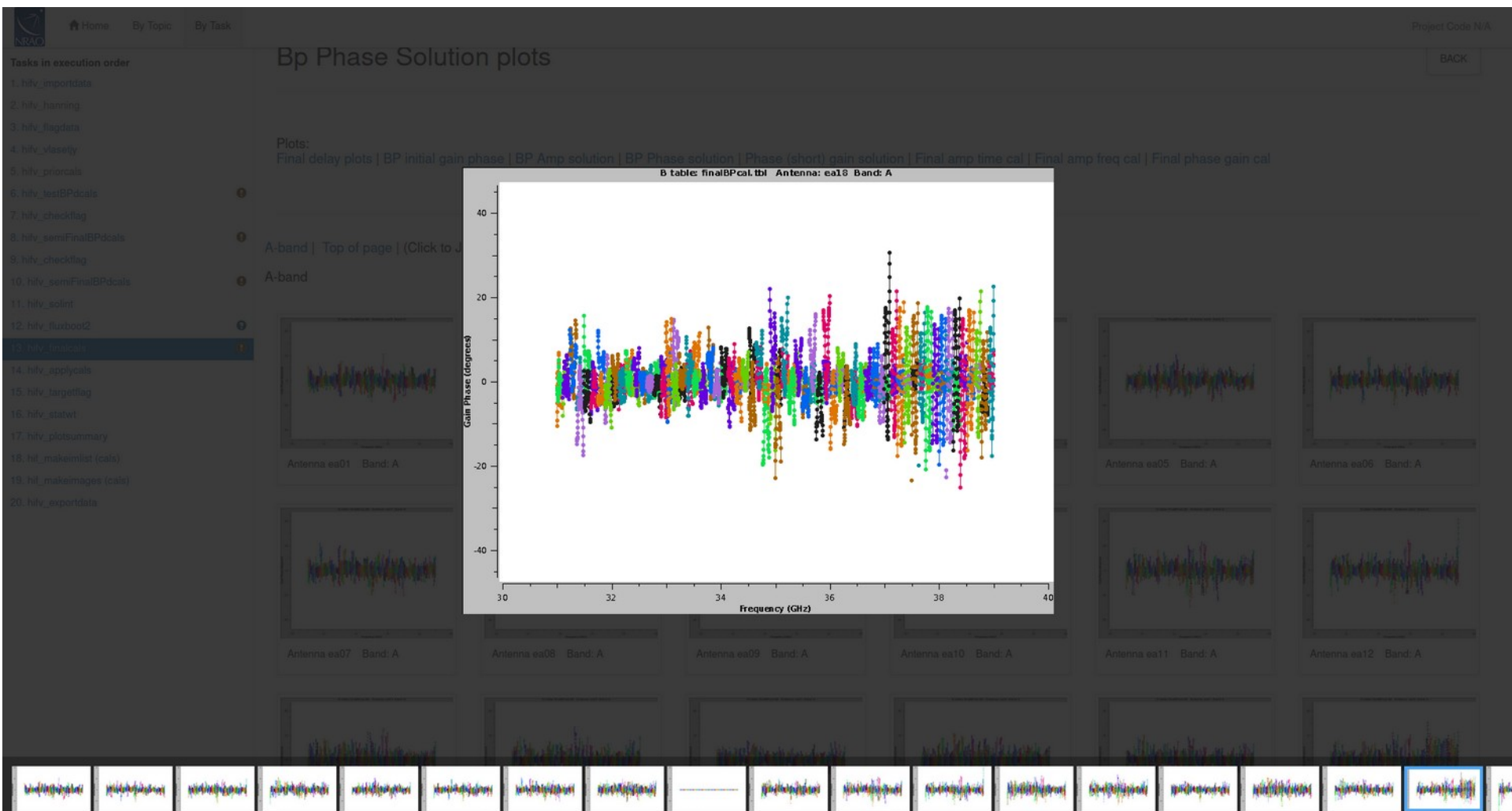
Plots:  
[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP Phase solution](#) | [Phase \(short\) gain solution](#) | [Final amp time cal](#) | [Final amp freq cal](#) | [Final phase gain cal](#)

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A-band



# Final Cal Tables: bandpass



# Final Cal Tables: amplitude and phase

 Home By Topic By Task

Tasks in execution order

1. hifv\_importdata
2. hifv\_hanning
3. hifv\_flagdata
4. hifv\_vlasetiy
5. hifv\_priorcals
6. hifv\_testBPdcals
7. hifv\_checkflag
8. hifv\_semiFinalBPdcals
9. hifv\_checkflag
10. hifv\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
- 13. hifv\_finalcals**
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotsummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

Project Code N/A

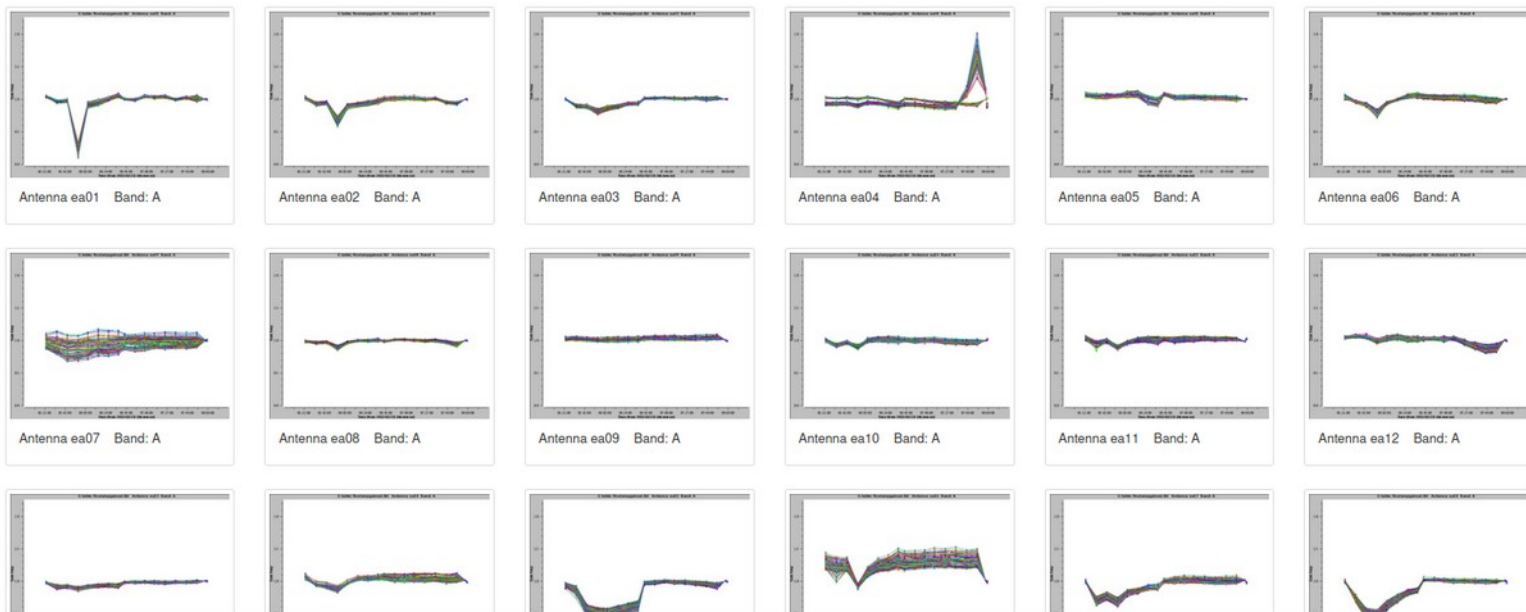
## Final Amp Time Cal plots

BACK

Plots:  
[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP Phase solution](#) | [Phase \(short\) gain solution](#) | **[Final amp time cal](#)** | [Final amp freq cal](#) | [Final phase gain cal](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Final Cal Tables: amplitude and phase



## Tasks in execution order

1. hifv\_importdata
2. hifv\_hanning
3. hifv\_flagdata
4. hifv\_vlasety
5. hifv\_priorcals
6. hifv\_testBPdcals
7. hifv\_checkflag
8. hifv\_semiFinalBPdcals
9. hifv\_checkflag
10. hifv\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotssummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

## Final Amp Freq Cal plots

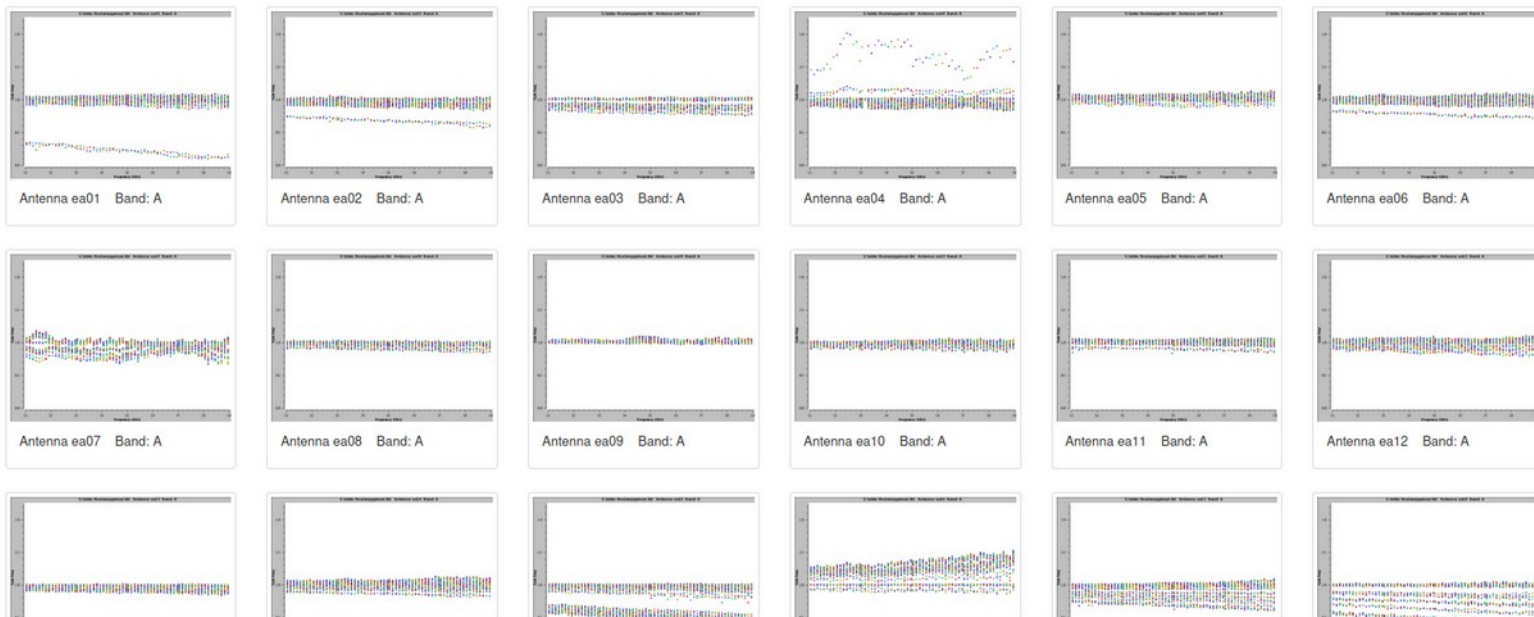
BACK

Plots:

[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP Phase solution](#) | [Phase \(short\) gain solution](#) | [Final amp time cal](#) | [Final amp freq cal](#) | [Final phase gain cal](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Final Cal Tables: amplitude and phase



## Tasks in execution order

1. hifv\_importdata
2. hifv\_hanning
3. hifv\_flagdata
4. hifv\_viasety
5. hifv\_priorcals
6. hifv\_testBPdcals
7. hifv\_checkflag
8. hifv\_semiFinalBPdcals
9. hifv\_checkflag
10. hifv\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotsummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata

## Final Phase Gain Cal plots

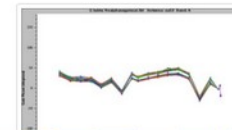
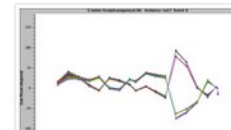
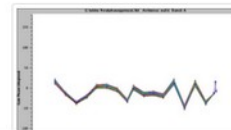
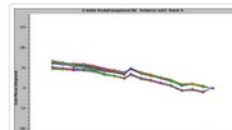
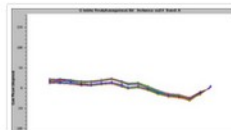
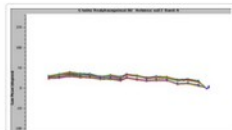
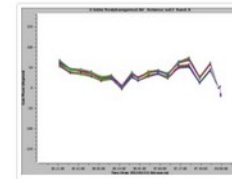
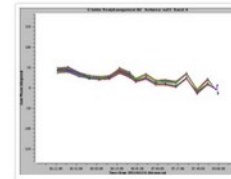
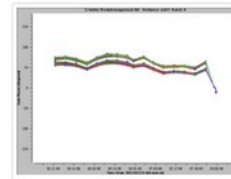
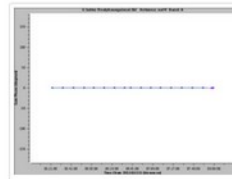
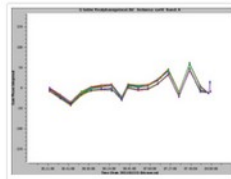
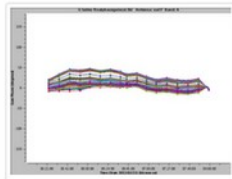
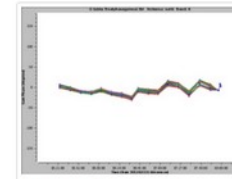
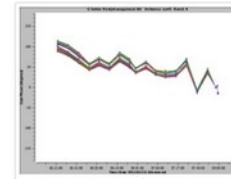
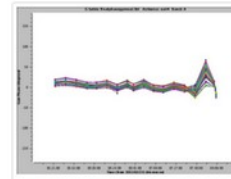
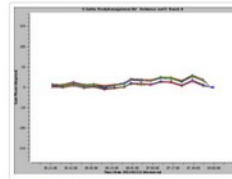
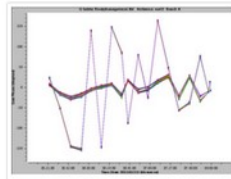
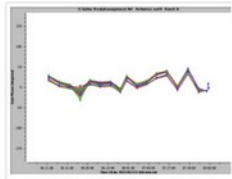
BACK

Plots:


[Final delay plots](#) | [BP initial gain phase](#) | [BP Amp solution](#) | [BP Phase solution](#) | [Phase \(short\) gain solution](#) | [Final amp time cal](#) | [Final amp freq cal](#) | [Final phase gain cal](#)

A-band | [Top of page](#) | [\(Click to Jump\)](#)

A-band



# Summary Plots (hifv\_plotsummary)

 Home By Topic By Task

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\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
- 17. hifv\_plotsummary**
18. hifv\_makeimlist (cals)
19. hifv\_makeimages (cals)
20. hifv\_exportdata

Project Code N/A

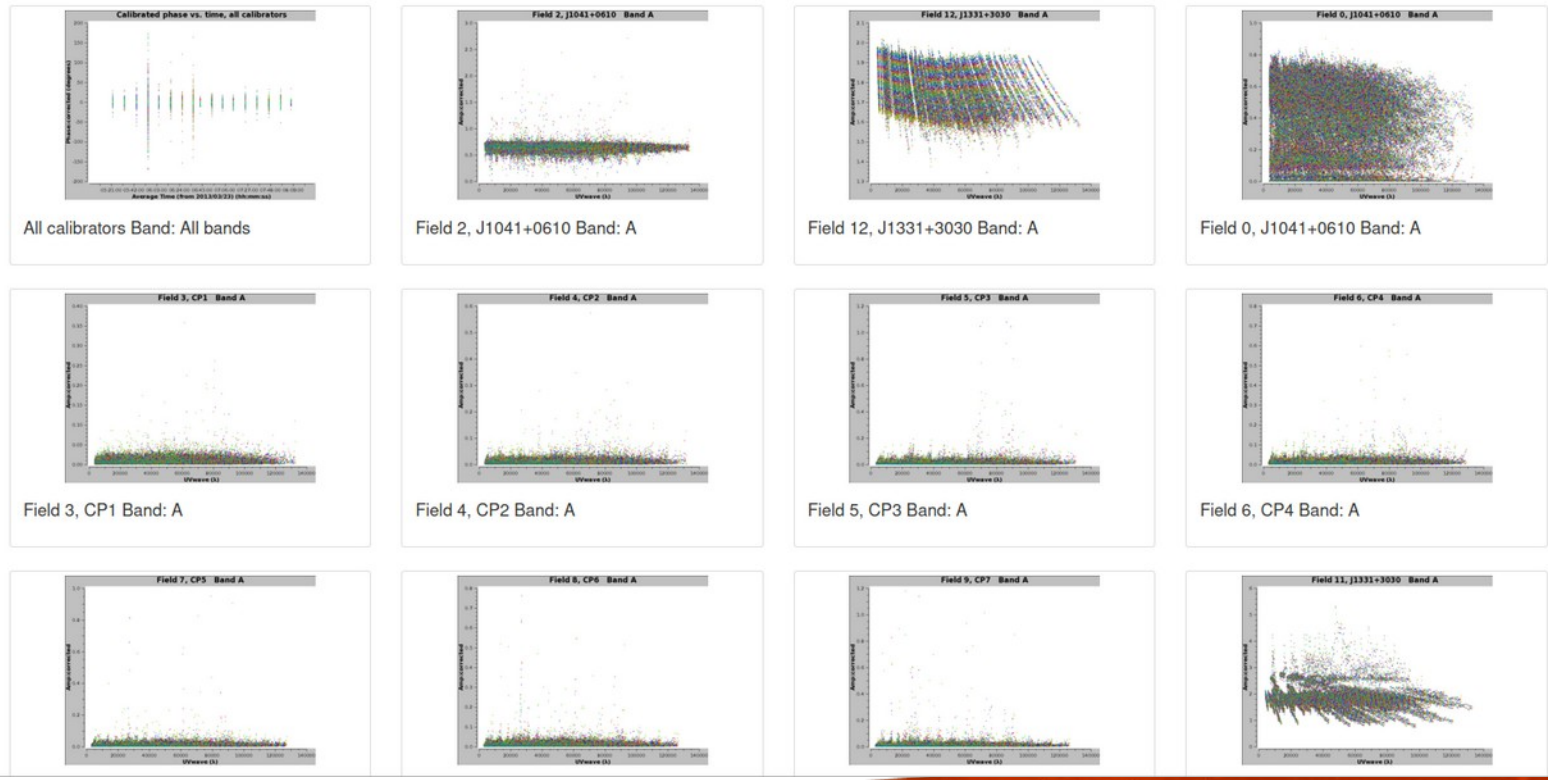
## 17. Plot Summary

BACK

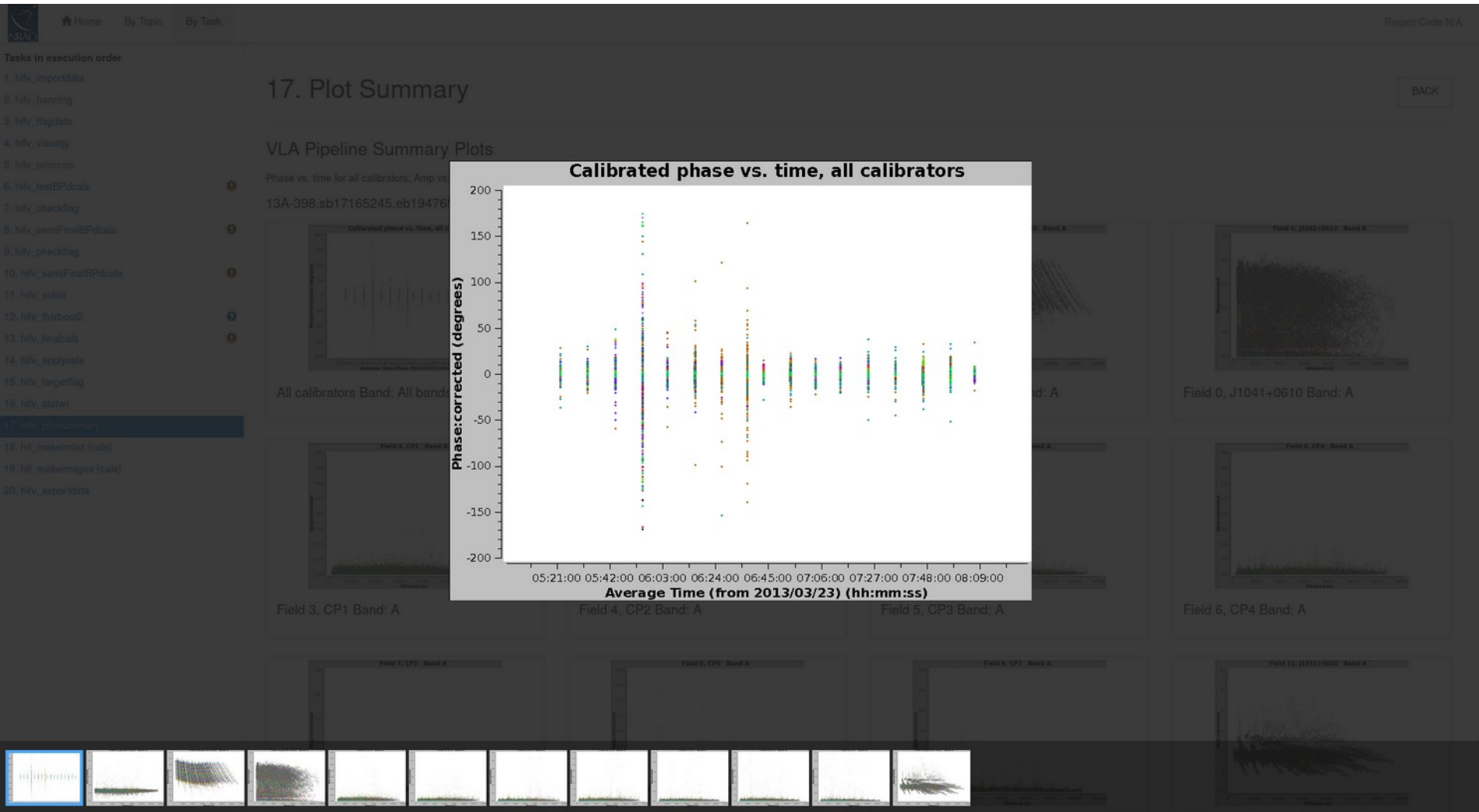
### VLA Pipeline Summary Plots

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.

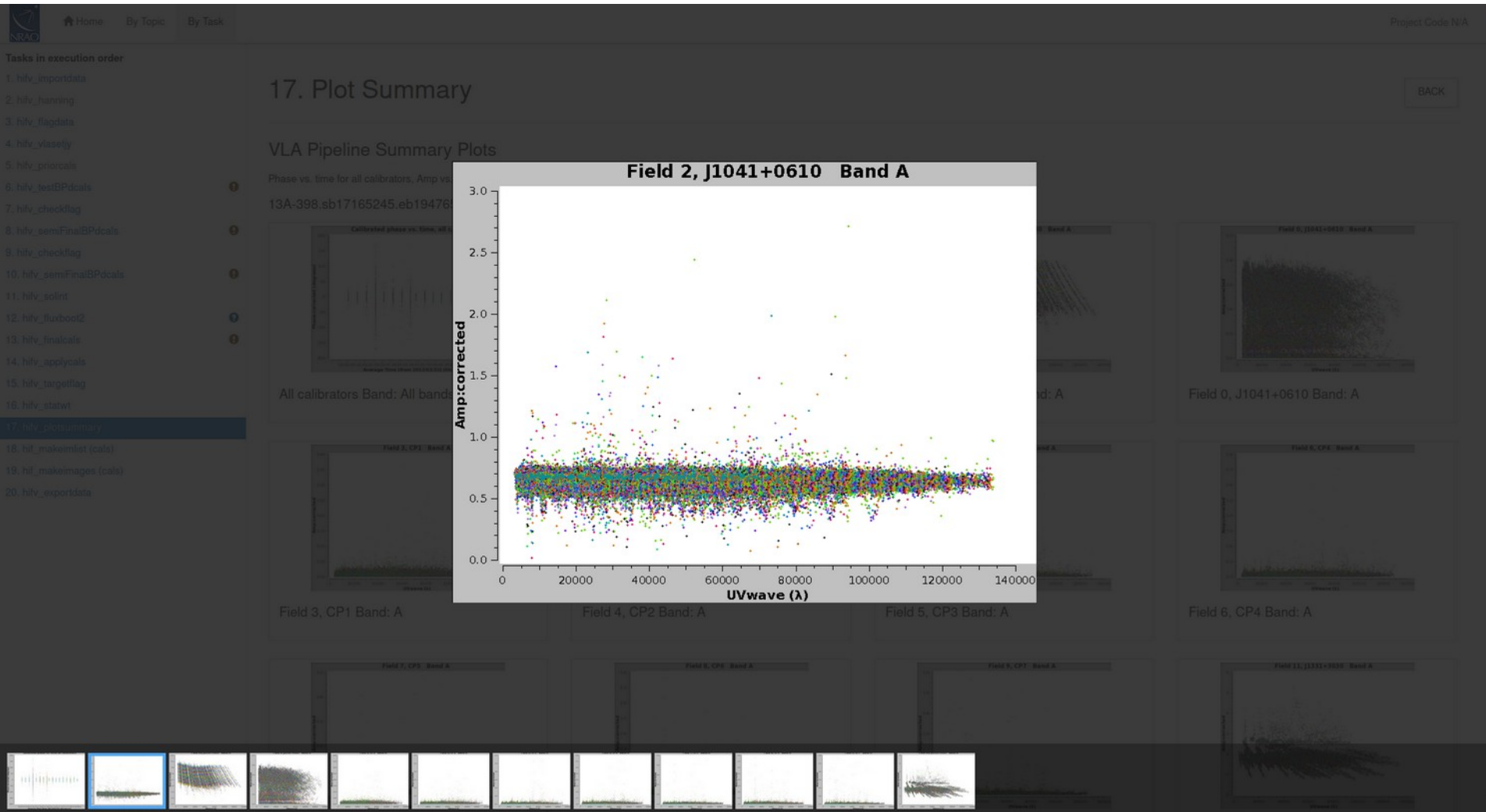
13A-398.sb17165245.eb19476558.56374.213876608796.ms



# Summary Plots (hifv\_plotsummary)

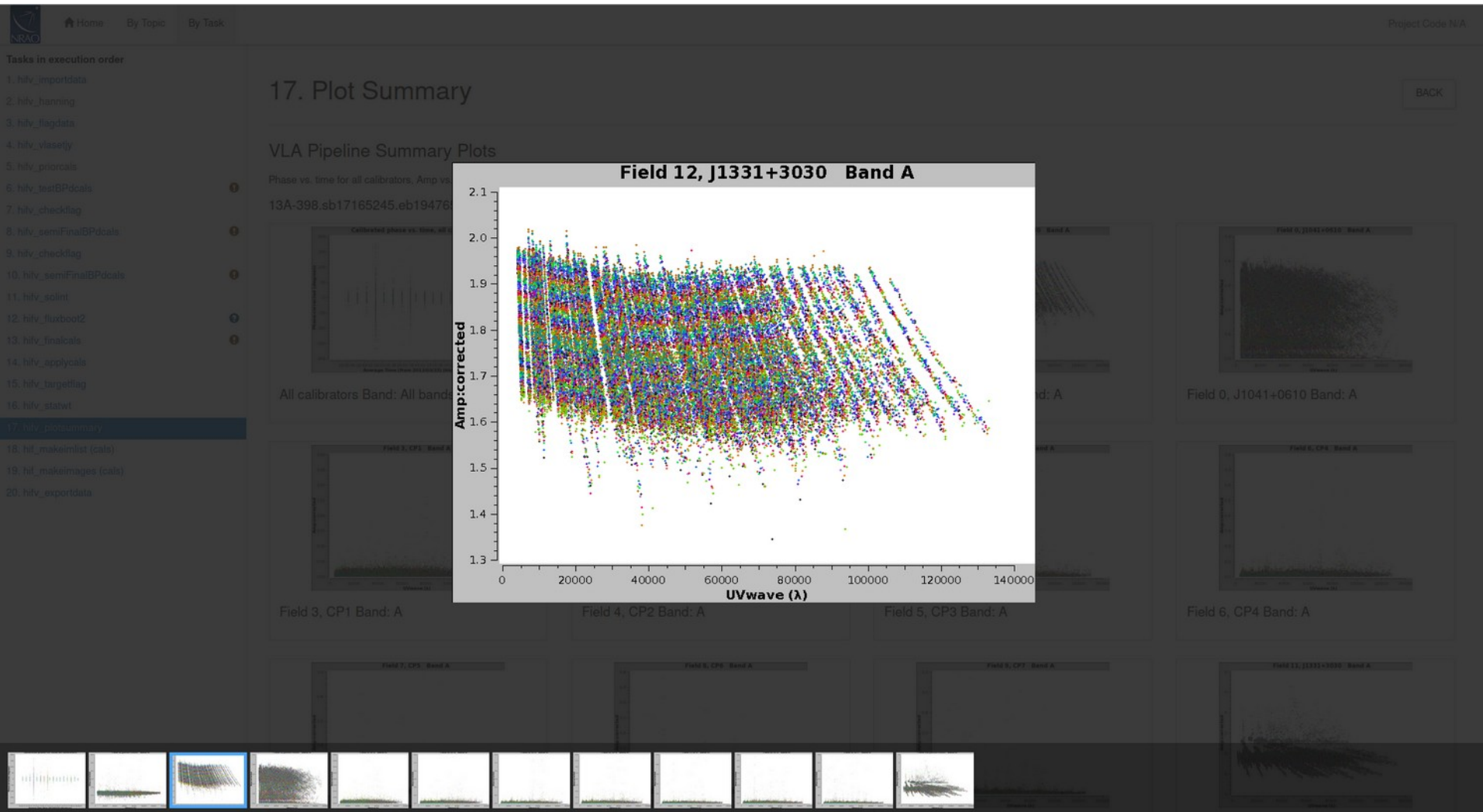


# Summary Plots (hifv\_plotsummary)

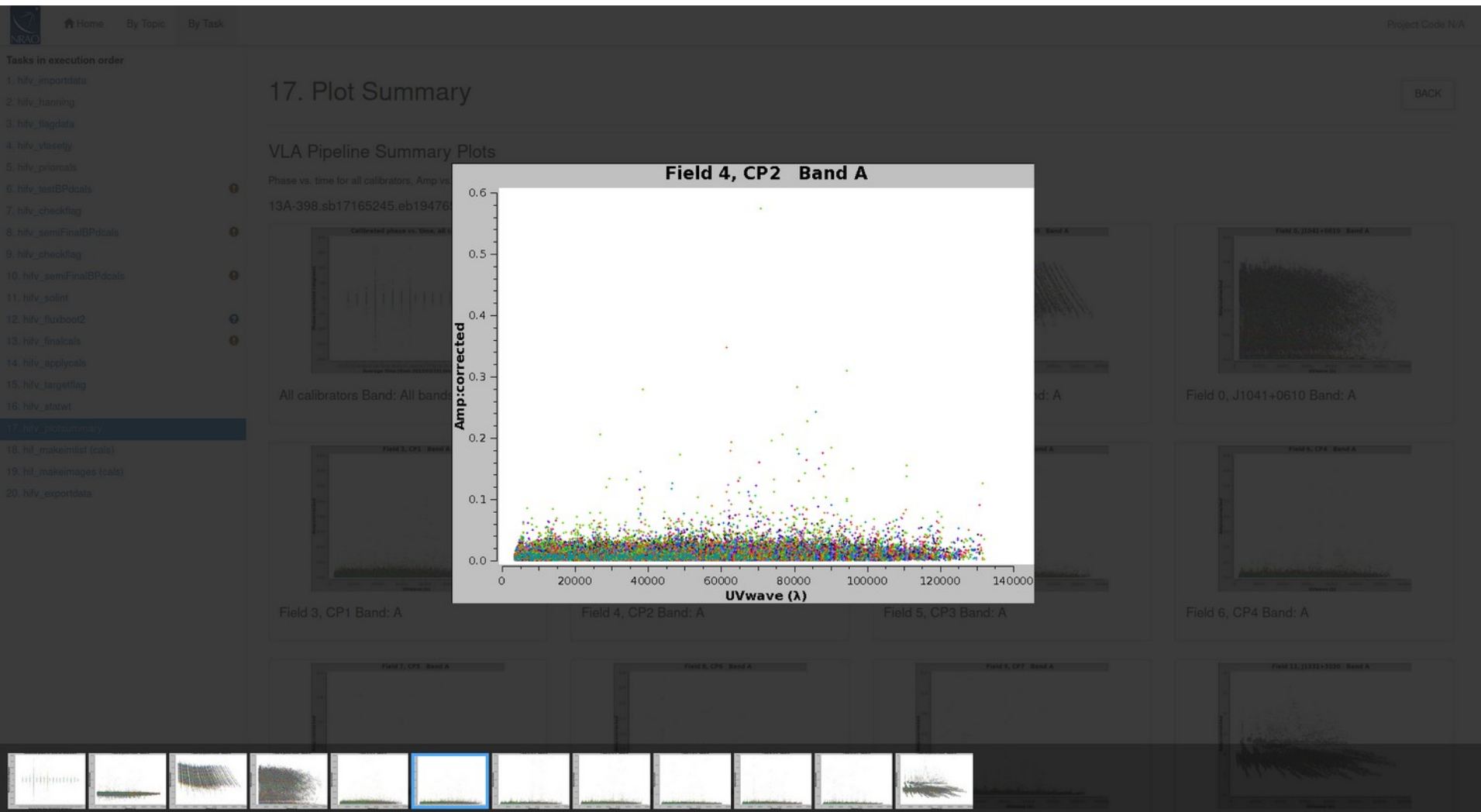




# Summary Plots (hifv\_plotsummary)



# Summary Plots (hifv\_plotsummary)



# Calibrator Images (hif\_makeimages)

NRAC Home By Topic By Task Project Code N/A

Tasks in execution order

1. hifv\_importdata
2. hifv\_hanning
3. hifv\_flagdata
4. hifv\_vlasety
5. hifv\_priorcals
6. hifv\_testBPdcals
7. hifv\_checkflag
8. hifv\_semiFinalBPdcals
9. hifv\_checkflag
10. hifv\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotsummary
18. hif\_makeimlist (cals)
- 19. hif\_makeimages (cals)**
20. hifv\_exportdata

## 19. Tclean/MakelImages

Make calibrator images

BACK

### Image Details

Field	Spw
J1041+0610 (PHASE)	10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 2, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 3, 30, 31.

[View other QA images...](#)

centre frequency of image	35.0009GHz (LSRK)
beam	2.09 x 1.86 arcsec
beam p.a.	5.4deg
final theoretical sensitivity	-
clean residual peak / scaled MAD	5.14
non-pbcor image RMS	9.9e-05 Jy/beam
pbcor image max / min	0.663 / -0.000423 Jy/beam
fractional bandwidth / nterms	23% / 2
aggregate bandwidth	8.19 GHz (LSRK)

# Calibrator Images (hif\_makeimages)

Project Code N/A

Home By Topic By Task

Tasks in execution order

1. hif\_importdata
2. hif\_hanning
3. hif\_flagdata
4. hif\_vlasetjy
5. hif\_priorscales
6. hif\_testBPDcals
7. hif\_checkflag
8. hif\_semiFinalBPDcals
9. hif\_checkflag
10. hif\_semiFinalBPDcals
11. hif\_solint
12. hif\_fluxboot2
13. hif\_finalcals
14. hif\_applycals
15. hif\_targetflag
16. hif\_statwt
17. hif\_plotsummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hif\_exportdata

Clean results for J1041+0610 (PHASE) SpW  
10,11,12,13,14,15,16,17,18,19,2,20,21,22,23,24,25,26,27,28,29,3,30,31,32,33,34,35,36,37,38,39,4,40,41,42,43,44,45,46,47,48,49,

BACK

Iteration	Image	Residual	Clean Mask
1			
0			

Primary Beam

PSF

Final Model


# Pipeline Products and Outputs

- Flag versions and calibration tables (archived)
- Calibrated MS (available for 15 days, not archived)
- Logs, including weblog used by quality assurance (QA) staff and QA report.
- Calibrated MSes can be retrieved later from new NRAO Archive
  - <https://data.nrao.edu>
  - Calibrated MSes are restored on-demand using NRAO computing and staged for download
  - You can also restore on your own (next presentation)
- If you are happy with the pipeline calibration, then:
  - Do further flagging if necessary
  - Split out your target and image

# Calibrated Data from Archive

Browser address bar: <https://data.nrao.edu/portal/#/> | 130% | Search

version: 3.9.3.1



**National Radio Astronomy Observatory**  
Enabling forefront research into the Universe at radio wavelengths

Archive Access Tool   Back   Log In   Legacy Archive   About

Search:

Active Search Inputs: Text Search Tobin ✕

Show Search Inputs

View Projects   View Observations   View Images   Page 1   Show 25 of 123 Projects

Project	Instrument	Title	First Obs	Last Obs	Execution Blocks
<input type="checkbox"/> 20B-080	EVLA	The Origin of the Unresolved Radio Emission of Radio-Quiet Quasars	2020-11-25 22:08	2021-02-14 17:58	7 execution blocks
<input checked="" type="checkbox"/> 20B-173	EVLA	Are Embedded Disks with Substructures Hiding Young Binaries?	2020-12-18 03:45	2021-02-07 03:48	10 execution blocks
<input type="checkbox"/> 20B-322	EVLA	eDisk: Early Planet Formation in Embedded Disks - A Long Wavelength Perspective	2020-12-10 00:38	2021-02-01 02:54	11 execution blocks
<input type="checkbox"/> 20B-373	EVLA	Disk Fragmentation around the Serpens-FIRS1 Intermediate Mass Protostar	2021-01-01 19:56	2021-01-29 16:55	5 execution blocks
<input type="checkbox"/> 20B-323	EVLA	Mapping the Two Dimensional Temperature of HH 212MMS	2020-12-24 03:07	2021-01-17 07:38	3 execution blocks

# Calibrated Data from Archive

Project	Instrument	Title	First Obs	Last Obs	Execution Blocks
20B-080	EVLA	The Origin of the Unresolved Radio Emission of Radio-Quiet Quasars	2020-11-25 22:08	2021-02-14 17:58	7 execution blocks
20B-173	EVLA	Are Embedded Disks with Substructures Hiding Young Binaries?	2020-12-18 03:45	2021-02-07 03:48	10 execution blocks

**Title:** Are Embedded Disks with Substructures Hiding Young Binaries?

**Abstract:** Recent high resolution observations of protostellar disks in Orion have shown that substructures similar to those found in older (1 - 10 Myr) protoplanetary disks are present at early times (<1 Myr). Though it seems likely at early times that those substructures are the result of dynamical interactions with large bodies hiding within the cavities, it remains unclear, whether those large bodies are stellar or substellar. To test whether these sources may be young binaries, we propose high resolution, long wavelength observations to search for free-free emission that is expected to come from the base of jets driven by young protostars. If found, such emission would indicate that we are indeed seeing young binary systems during their formation, which would place constraints on how such systems form. Alternatively, if no such evidence can be found, it would strengthen the case that we are observing planet formation at very early times, which would challenge current models of planet formation.

**PI:** Patrick Sheehan

**Legacy ID:** AS1635







**Co-Authors:** Laura Perez, John Tobin

**Proposal:** [Click to search](#)

Observations **Images**

0/10: selected (0/10.0 TB)

[View Selection\(s\)](#) [Clear All](#) **Download**

Archive File	Project	Instrument	Observation Start	Observation Stop	File Size	Array Config	Bands	Type	Cals	Scans
 20B-173.sb38913102.eb39278624.59252.05836896991	20B-173	EVLA	2021-02-07 01:24:03	2021-02-07 03:48:34	155.387 GB	A	Q, X	visibility		128
 20B-173.sb38915627.eb39266267.59246.20760625	20B-173	EVLA	2021-02-01 04:58:57	2021-02-01 07:23:29	161.074 GB	A	Q, X	visibility		128
 20B-173.sb38915432.eb39266415.59237.11258260676	20B-173	EVLA	2021-01-12	2021-01-12	142.000 GB	A	Q, X	visibility		128



# Calibrated Data from Archive

Launch Workflow Task on: 20B-173

**User Email (required):**

**Request Description:**

**Destination Directory:**  Specify directory (must be logged in & staff)

**Create tar file:**  Return results as a tar file

**Choose download data format:**

- SDM tables only (metadata only)
- SDM-BDF dataset (metadata + visibilities)
- Basic Measurement Set (uncalibrated)
- Calibrated Measurement Set

**Apply telescope flags:**  Apply flags generated during observing

**CASA|Pipeline Version:**

**Restore previous CMS:**

Estimated Processing Time: 19 hours





# Pipeline Products and Outputs

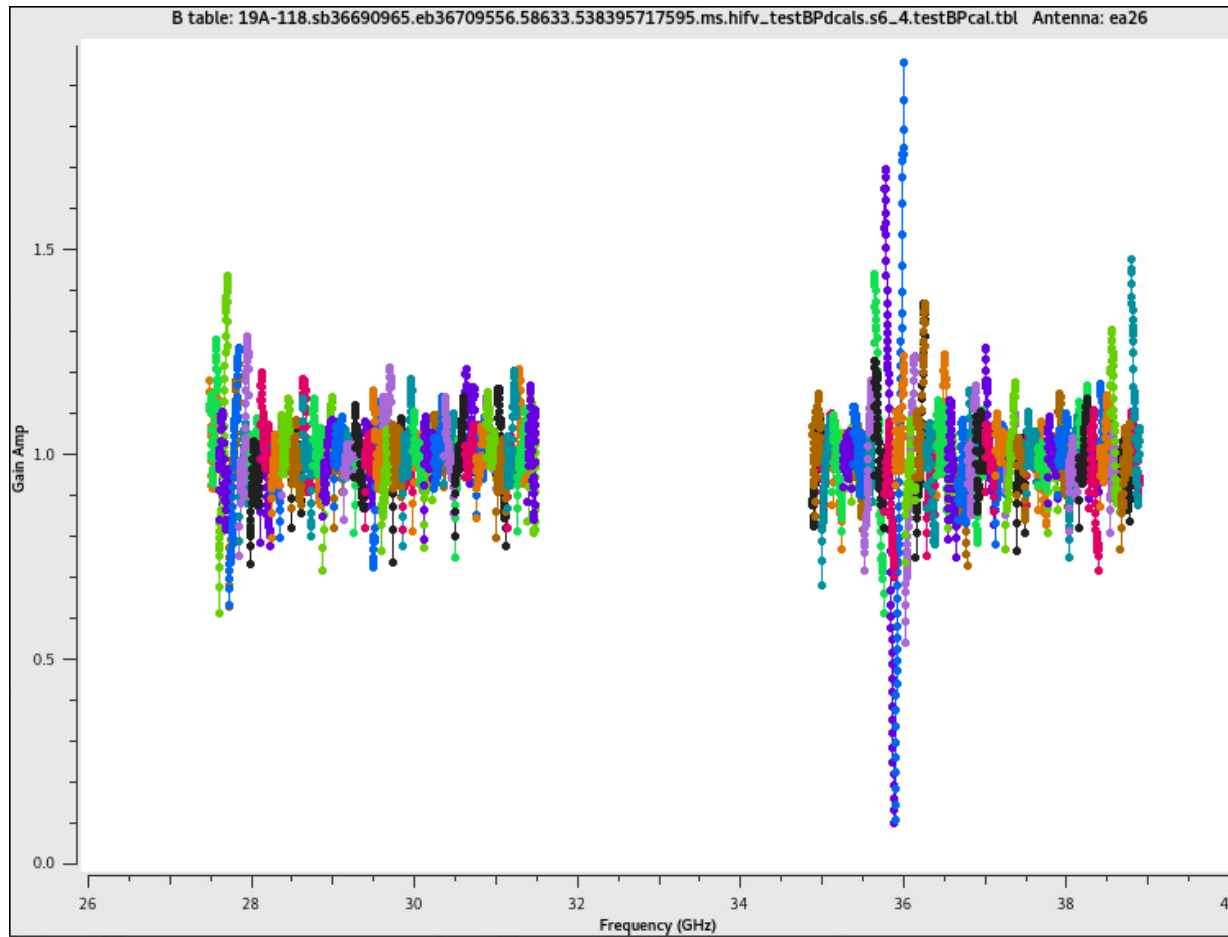
- In some cases the pipeline and/or the MS may need to be modified (and/or flagged) and rerun
  - Download the SDM from the archive plus pipeline scripts
  - Follow the directions at <http://go.nrao.edu/vla-pipe>
- In some cases the pipeline heuristics may not be appropriate for your data (e.g., some L-band set-ups do not work well with the pipeline yet, P-band)
  - Reduce data by hand

# 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 or reduce by hand*
  - 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 may be an exception)
    - *flag remaining bad spws*
  - Calibrators are too weak for given spw bandwidth
    - *reduce data by hand, bandpass smoothing, spectral window mapping*

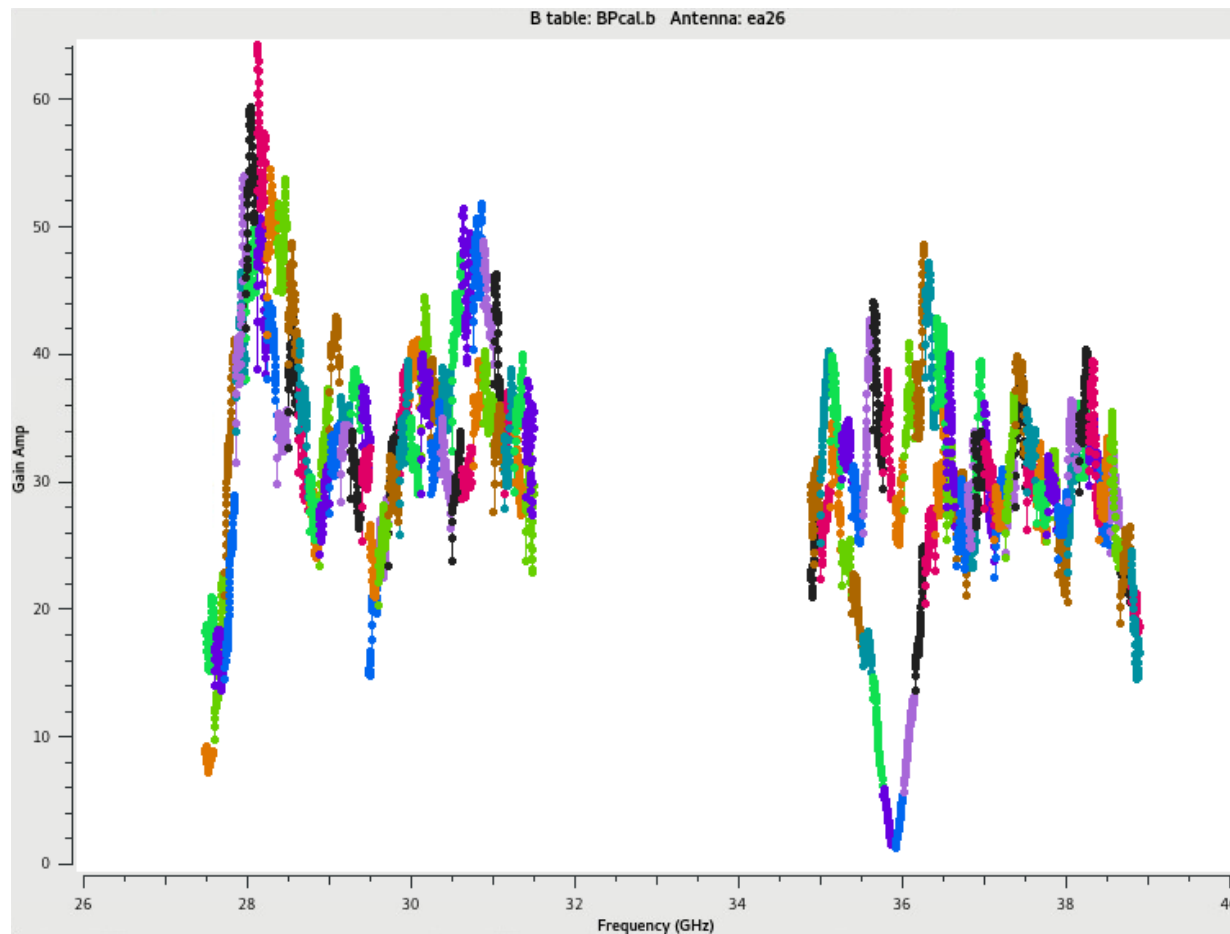
# Known failure modes and issues

hifv\_testBPdcals ea26 bandpass, bad data (DTS issue)



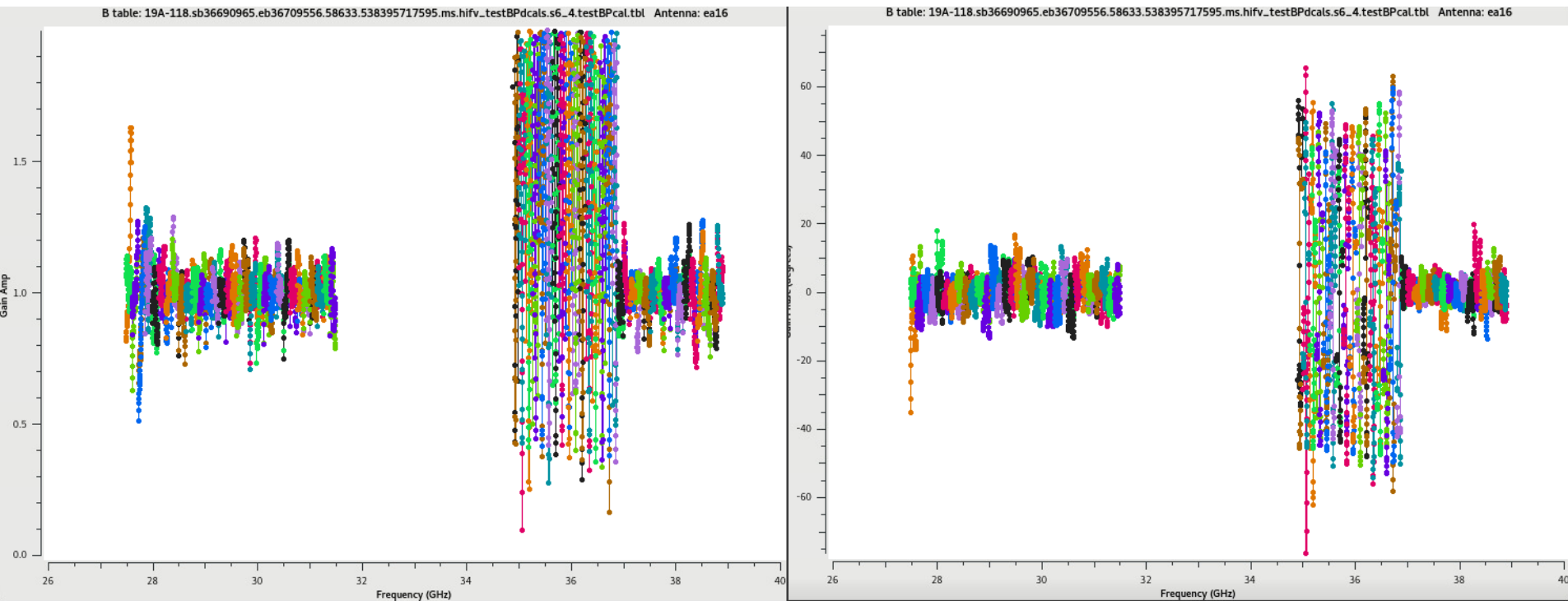
# Known failure modes and issues

hifv\_semifinalBPdcals ea26 bandpass, bad data (DTS issue)



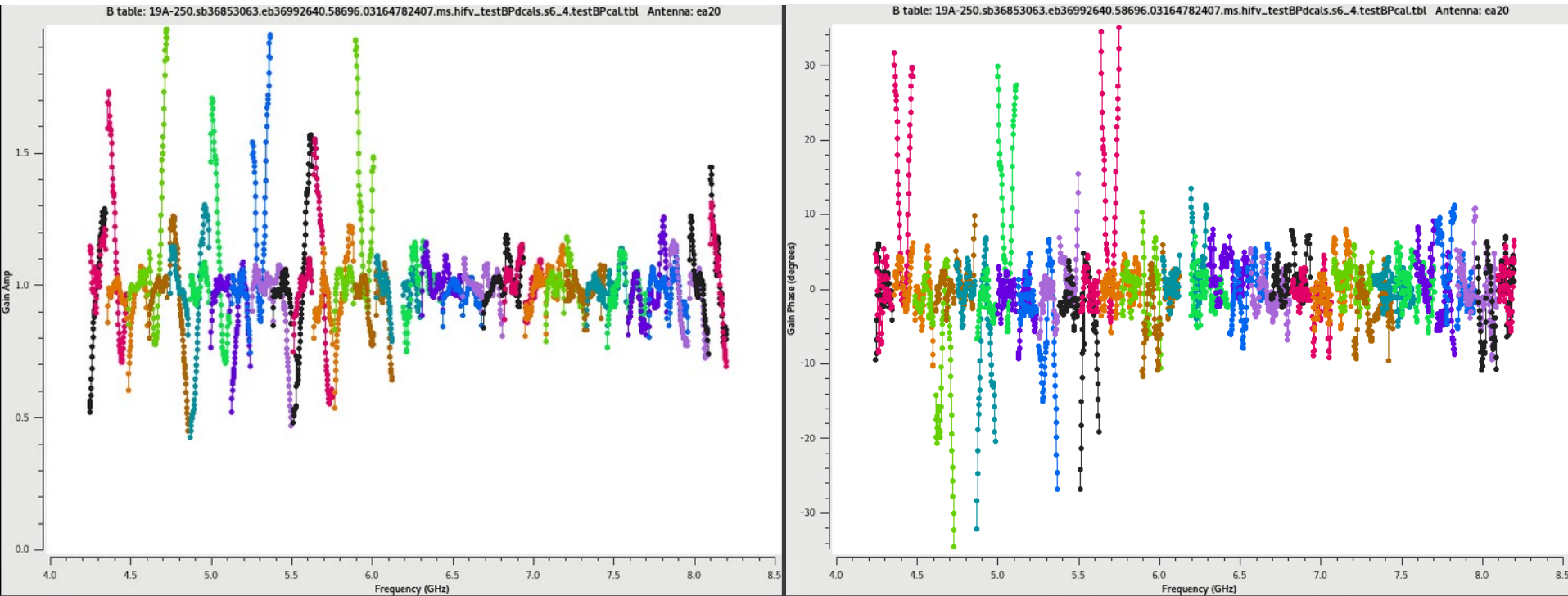
# Known failure modes and issues

ea16 Amp and Phase affected (DTS issue for 35-37GHz)



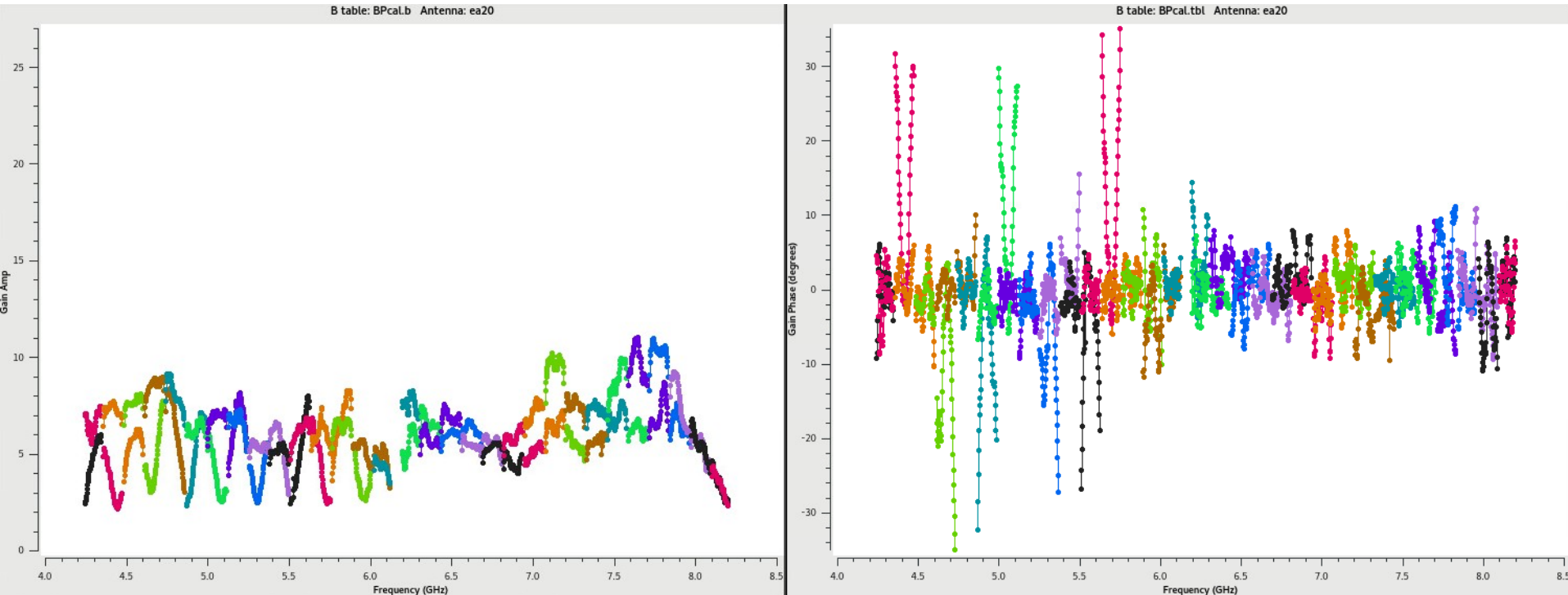
# Known failure modes and issues

hifv\_testBPdcal: ea20 bandpass, bad data (DTS issue)



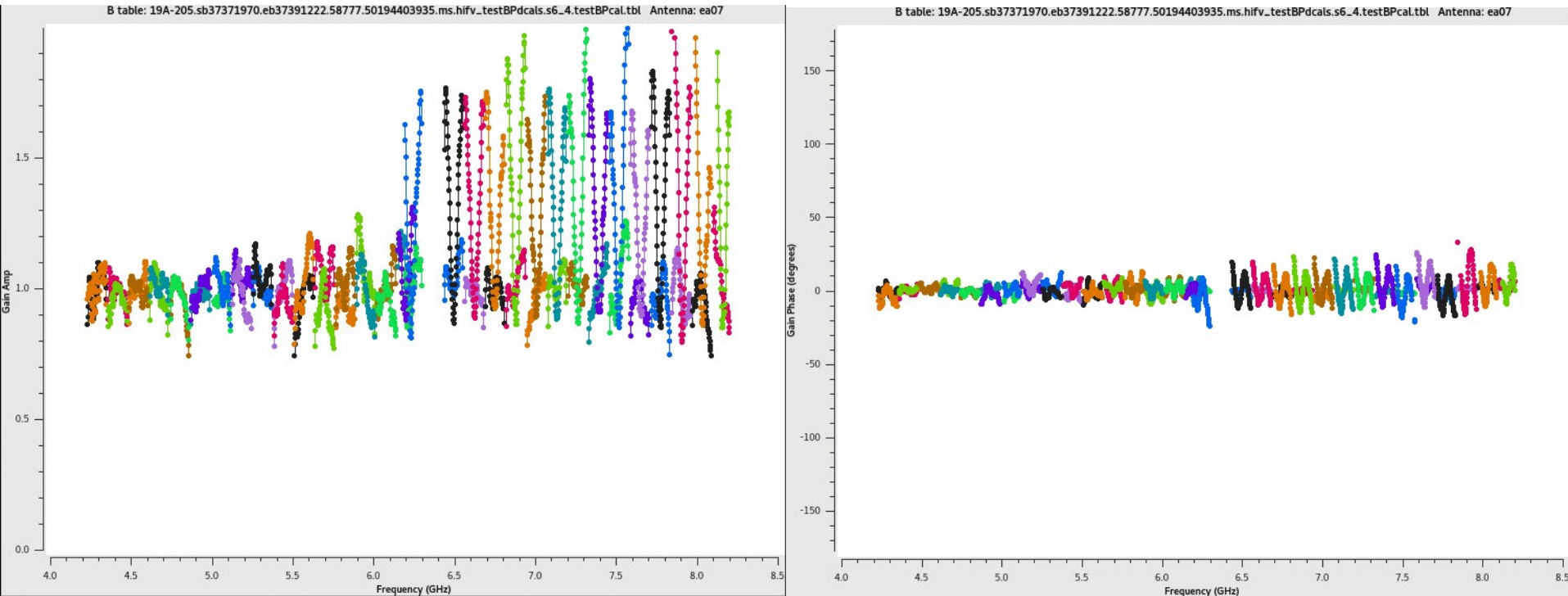
# Known failure modes and issues

hifv\_semifinalBPdcals: ea20 bandpass, bad data (DTS issue)



# Known failure modes and issues

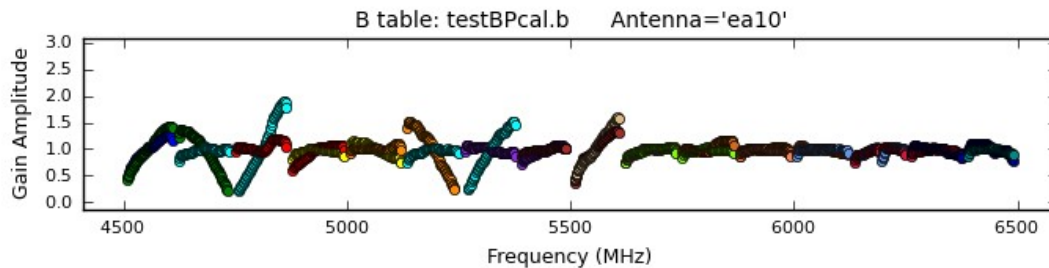
hifv\_testBPdcal: ea07 bandpass, bad data (DTS issue)



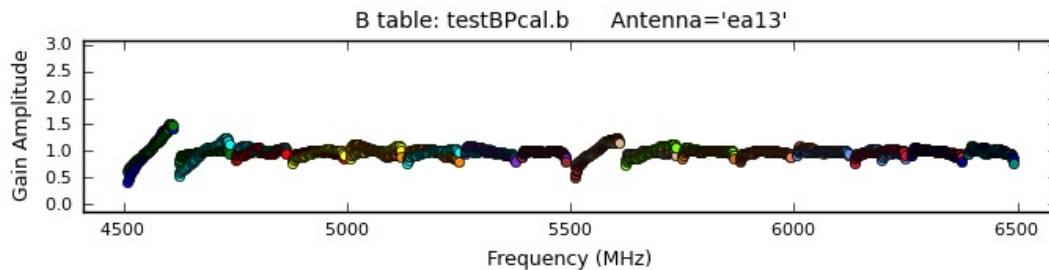
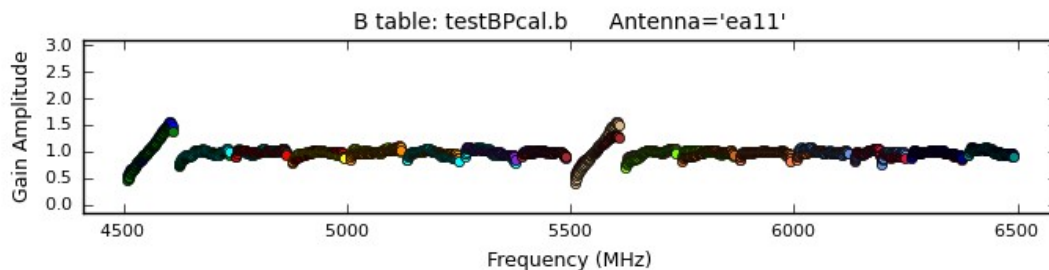


# Known failure modes and issues

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

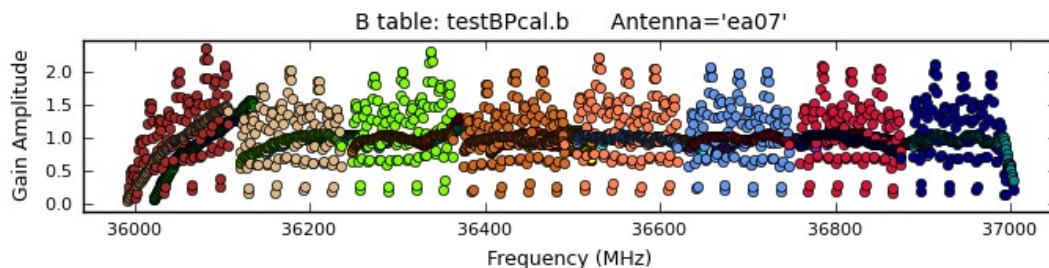


plot from scripted pipeline

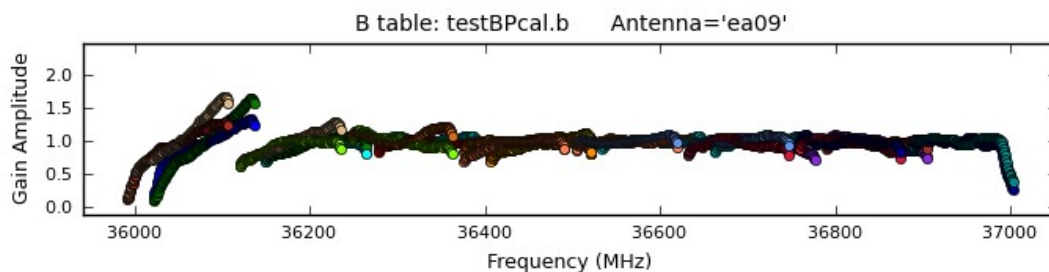
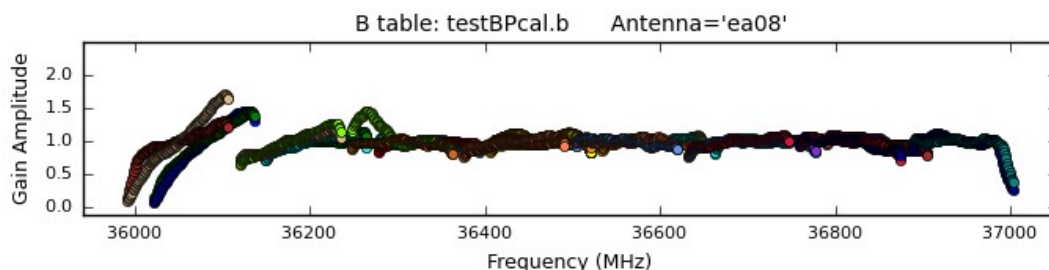


# Known failure modes and issues

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

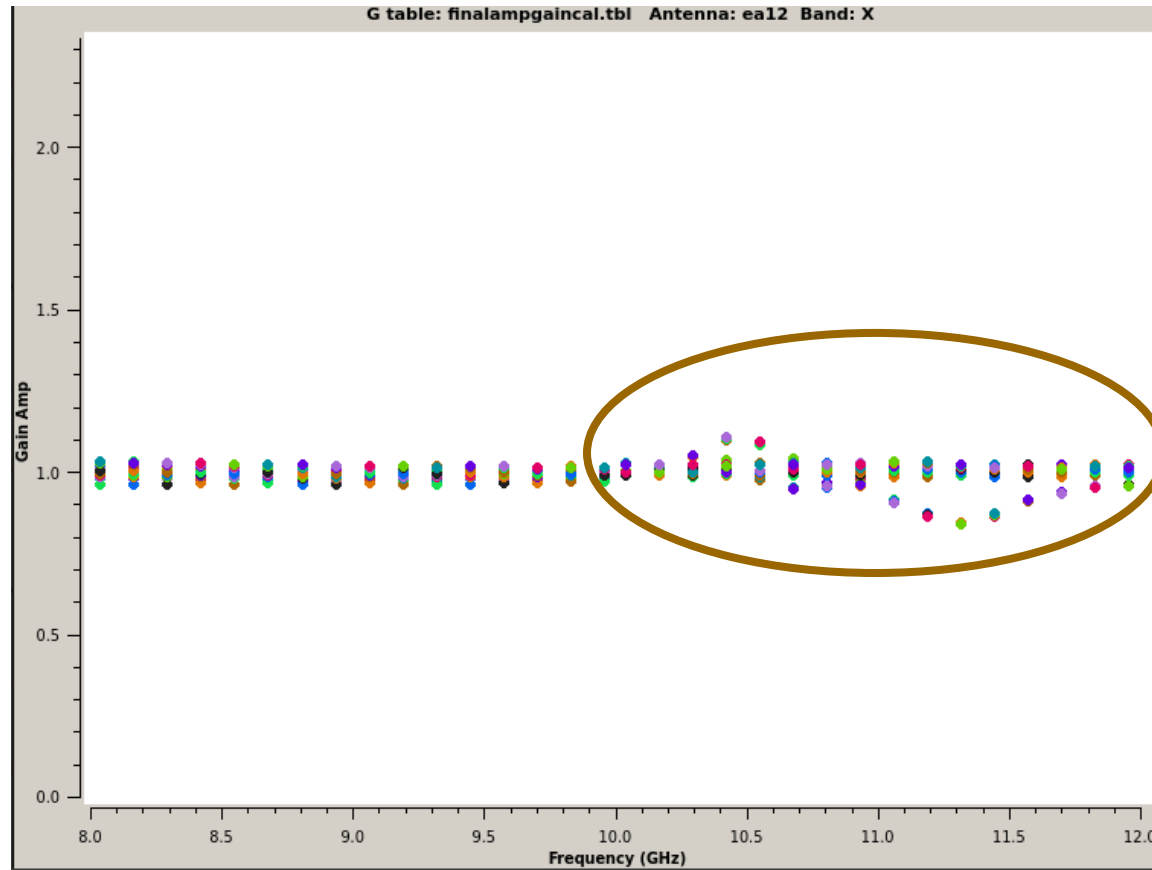


plot from scripted pipeline



# Known failure modes and issues

ea12 amp vs. frequency, switch issue 10 -12 GHz



# 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

⇒ 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

# The cont.dat file

```
Field: M82

SpectralWindow: 19
37.104~38.29GHz LSRK
38.30~39.104GHz LSRK

SpectralWindow: 37
31.360~32.123GHz LSRK
32.130~33.360GHz LSRK

Field: NGC3077

SpectralWindow: 37
31.360~32.123GHz LSRK
32.130~33.360GHz LSRK
```

- The *cont.dat* file enables you to specify the continuum regions within your spws.
  - Weights for whole spw set based on defined the continuum regions
  - RFI flagging only happens in continuum regions
- *statwt* and RFI flagging only carried out on spws specified in *cont.dat*
  - Other spws will not be process for RFI/*statwt*
  - Changes to this behavior proposed (process unspecified windows using default behavior)

# 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 `hivv_flagdata`, 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

# Multi-band data

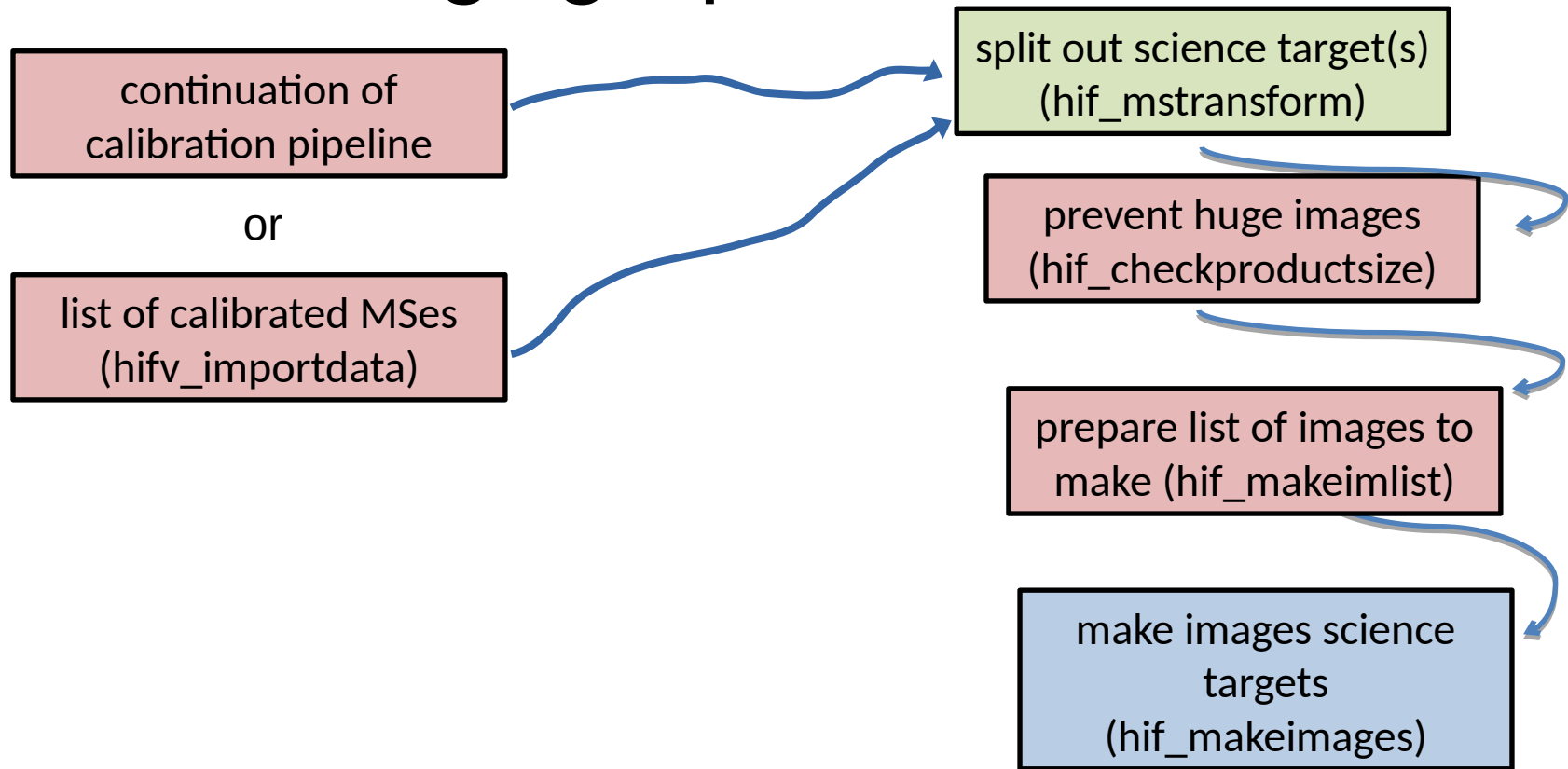
- Continuum data taken in multiple bands in a single EB handled properly by pipeline in single pass
  - All bands must use same flux density and bandpass calibrators
  - If using different flux/bandpass calcs per band
    - Split by spw and run each band individually

# VLA Imaging Pipeline

- Building on pipeline infrastructure, a VLA continuum imaging pipeline is now available
  - <https://science.nrao.edu/facilities/vla/data-processing/pipeline/VIPL>
  - Single image per-band, per-science target
  - Cleaning done without a mask to 5-sigma level
  - Robust=0.5 is used by default
  - Synthesized beam sampled by 5 pixels
  - Mosaicking not supported (each mosaic image is separate)
  - If possible, will create image encompassing entire primary beam
    - Images are limited to 16384
    - No w-projection
- One can certainly do better with their own tclean calls and masking
  - provides uniformly created image products to assess observed data



# VLA Imaging Pipeline - Flow chart




# VLA Imaging Pipeline


[Home](#)
[By Topic](#)
[By Task](#)
Project Code N/A

6. <b>hifv_testBPDcats</b> : Initial test calibrations	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:06:42
7. <b>hifv_checkflag</b> : Checkflag summary	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:01:47
8. <b>hifv_semiFinalBPDcats</b> : Semi-final delay and bandpass calibrations	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:06:04
9. <b>hifv_checkflag</b> : Checkflag summary	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:02:46
10. <b>hifv_semiFinalBPDcats</b> : Semi-final delay and bandpass calibrations	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:06:00
11. <b>hifv_solint</b> : Determine solint and Test gain calibrations	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:03:25
12. <b>hifv_fluxboot2</b> : Gain table for flux density bootstrapping	<div style="width: 97%; height: 10px; background-color: green;"></div>	0.97	0:04:33
13. <b>hifv_finalcats</b> : Final Calibration Tables	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:11:22
14. <b>hifv_applycats</b> : Apply calibrations from context	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:07:12
15. <b>hifv_targetflag</b> : Targetflag	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:09:57
16. <b>hifv_statwt</b> : Reweight visibilities	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:15:35
17. <b>hifv_plotsummary</b> : VLA Plot Summary	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:08:16
18. <b>hif_makeimlist</b> : Set-up parameters for bandpass calibrator & phase calibrator imaging	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:00:43
19. <b>hif_makeimages</b> : Make calibrator images	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:11:31
20. <b>hif_exportdata</b> : Prepare pipeline data products for export	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:01:20
21. <b>hif_mstransform</b> : Create science target MS	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:05:43
22. <b>hif_checkproductsizes</b> : Check product size	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:02:11
23. <b>hif_makeimlist</b> : Set-up parameters for target aggregate continuum imaging	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:01:46
24. <b>hif_makeimages</b> : Make target aggregate continuum images	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	1:35:21
25. <b>hif_exportdata</b> : Prepare pipeline data products for export	<div style="width: 100%; height: 10px; background-color: green;"></div>	1.00	0:01:25

# VLA Imaging Pipeline

[Home](#) [By Topic](#) [By Task](#) Project Code N/A

**Tasks in execution order**

- hifv\_importdata
- hifv\_hanning
- hifv\_flagdata
- hifv\_vlasetjy
- hifv\_priorcals
- hifv\_testBPdcal
- hifv\_checkflag
- hifv\_semiFinalBPdcal
- hifv\_checkflag
- hifv\_semiFinalBPdcal
- hifv\_solint
- hifv\_fluxboot2
- hifv\_finalcals
- hifv\_applycals
- hifv\_targetflag
- hifv\_statwt
- hifv\_plotsummary
- hif\_makeimlist (cals)
- hif\_makeimages (cals)
- hifv\_exportdata
- hif\_mstransform
- hif\_checkproductsizes
- hif\_makeimlist (cont)
- hif\_makeimages (cont)
- hifv\_exportdata

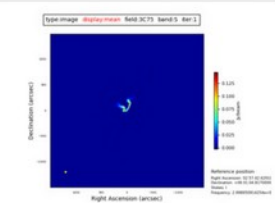
## 24. Tclean/MakeImages

Make target aggregate continuum images

[BACK](#)

### Image Details


Field	Spw
3C75 (TARGET)	2, 3, 4, 5, 6, 7, 8, 9 / EVLA_S#A0C0#2, EVLA_S#A0C0#3, EVLA_S#A0C0#4,



[View other QA images...](#)

<b>centre frequency of image</b>	2.9990GHz (LSRK)
<b>beam</b>	24.3 x 18.9 arcsec
<b>beam p.a.</b>	-35.7deg
<b>final theoretical sensitivity</b>	-
<b>clean residual peak / scaled MAD</b>	-11.43
<b>non-peak image RMS</b>	0.00013 / 1.0beam

# VLA Imaging Pipeline



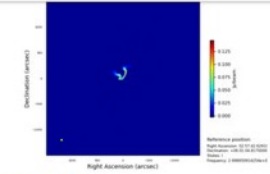
[Home](#)
[By Topic](#)
[By Task](#)

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\_semiFinalBPdcals
11. hifv\_solint
12. hifv\_fluxboot2
13. hifv\_finalcals
14. hifv\_applycals
15. hifv\_targetflag
16. hifv\_statwt
17. hifv\_plotssummary
18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata
21. hif\_mstransform
22. hif\_checkproductsizes
23. hif\_makeimlist (cont)
24. hif\_makeimages (cont)
25. hifv\_exportdata



[View other QA images...](#)

<b>centre frequency of image</b>	2.9990GHz (LSRK)
<b>beam</b>	24.3 x 18.9 arcsec
<b>beam p.a.</b>	-35.7deg
<b>final theoretical sensitivity</b>	-
<b>clean residual peak / scaled MAD</b>	-11.43
<b>non-pbcor image RMS</b>	0.00013 Jy/beam
<b>pbcor image max / min</b>	0.147 / -0.00258 Jy/beam
<b>fractional bandwidth / nterms</b>	34% / 2
<b>aggregate bandwidth</b>	1.02 GHz (LSRK)
<b>nsigma</b>	5.0
<b>n-sigma * initial scaled MAD of residual</b>	0.00516 Jy/beam
<b>n-sigma * final scaled MAD of residual</b>	0.000343 Jy/beam
<b>vis. amp. ratio</b>	10.82
<b>score</b>	1.00

# VLA Imaging Pipeline

Home By Topic By Task Project Code: N/A

Tasks in execution order

1. hlv\_importdata
2. hlv\_banning
3. hlv\_flagdata
4. hlv\_visatety
5. hlv\_priorcal
6. hlv\_testBPTcal
7. hlv\_checkflag
8. hlv\_semiFinalBPTcal
9. hlv\_checkflag
10. hlv\_semiFinalBPTcal
11. hlv\_solnt
12. hlv\_fluxboot2
13. hlv\_finalcal
14. hlv\_applycal
15. hlv\_targetflag
16. hlv\_starwt
17. hlv\_p0tsummary
18. hf\_makeimlist (cals)
19. hf\_makeimages (cals)
20. hlv\_exportdata
21. hf\_mstransform
22. hf\_checkproductsize
23. hf\_makeimlist (cont)
24. hf\_makeimlist (cont)
25. hlv\_exportdata

## 24. Tclean/MakeImages

Make target aggregate continuum images

BACK


### Image Details

Field	Spw
3C75 (TARGET)	2, 3, 4, 5, 6, 7, 8, 9
EVLA_S#A0C0#1	
centre frequency of image	2.9990GHz (LSRK)
beam	24.3 x 18.9 arcsec
beam p.a.	-35.70deg
final theoretical sensitivity	-
clean residual peak / scaled MAD	-11.43
non-pbcor image RMS	0.00013 Jy/beam
pbcor image rms (cont)	0.167 - 0.00063 Jy/beam

type:image display:mean field:3C75 band:S iter:1

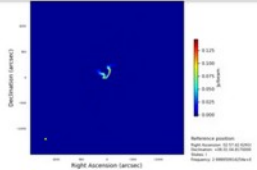
Reference position:  
Right Ascension: 02:57:42.62910  
Declination: +06:01:04.8170000  
Stokes: 1  
Frequency: 2.998950914254e+09

# VLA Imaging Pipeline


[Home](#)
[By Topic](#)
[By Task](#)
Project Code N/A

**Tasks in execution order**


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14. hifv\_applycals
15. hifv\_targetflag
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18. hif\_makeimlist (cals)
19. hif\_makeimages (cals)
20. hifv\_exportdata
21. hif\_mstransform
22. hif\_checkproductsizes
23. hif\_makeimlist (cont)
24. hif\_makeimages (cont)
25. hifv\_exportdata



[View other QA images...](#)

<b>centre frequency of image</b>	2.9990GHz (LSRK)
<b>beam</b>	24.3 x 18.9 arcsec
<b>beam p.a.</b>	-35.7deg
<b>final theoretical sensitivity</b>	-
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<b>score</b>	1.00

# VLA Imaging Pipeline

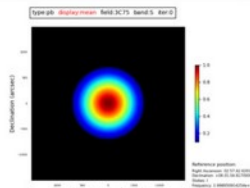
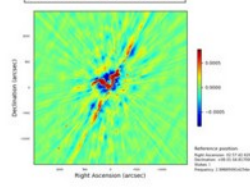
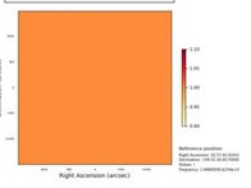
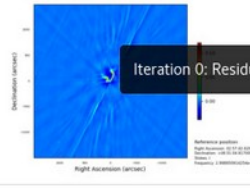
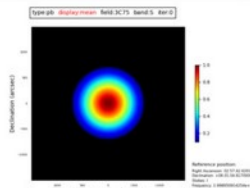
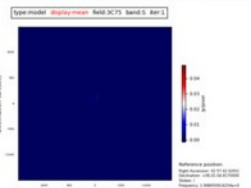
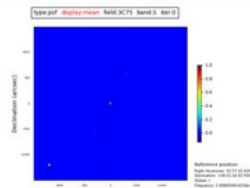
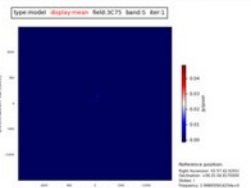
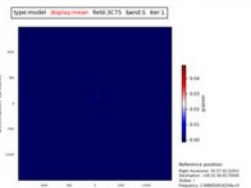
 Home By Topic **By Task** Project Code N/A

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23. hif\_makeimlist (cont)
24. hif\_makeimages (cont)
25. hifv\_exportdata

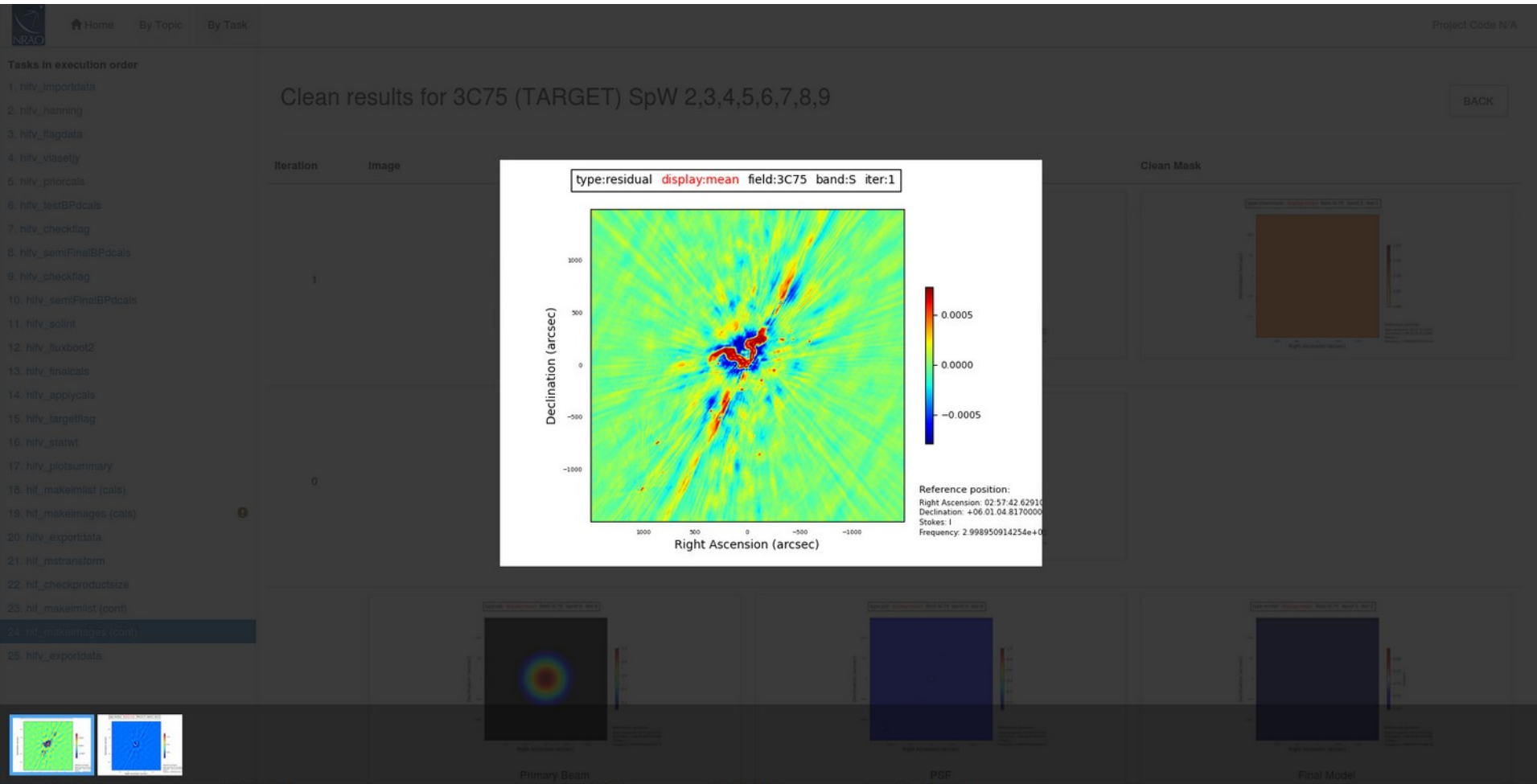
Clean results for 3C75 (TARGET) SpW 2,3,4,5,6,7,8,9

BACK

Iteration	Image	Residual	Clean Mask
1			
0		 <p>Iteration 0: Residual</p>	
			
			
			 <p>Final Model</p>

file:///lustre/aoc/sciops/jtobin/Polarization-guide-6.1/pipeline-procedure\_hifv\_calimage\_cont/html/stage24/oussid.s24\_0.3C75\_sci.S\_band.cont.l.iter0.residual.tt0.sky.png PSF

# VLA Imaging Pipeline





# Future Developments

- The NRAO Science Ready Data Products initiative is tentatively planning the following development over the next year:
  - Improved RFI flagging for calibrators and targets - VLASS derived
  - Improved detection of DTS issues and high delays
  - Gain outlier detection
  - Compression correction
  - Improved long solint calculation
  - Gain compression correction - VLASS derived
  - Imaging pipeline improvements
    - Mosaicking
    - Masking

# Questions?

- VLA CASA Calibration Pipeline information at:  
<http://go.nrao.edu/vla-pipe>
  - 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.)



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