Data Processing: Visibility Calibration

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The delivered ALMA data consist of the amplitudes and phases for the combined signals from pairs of antennas. These are called visibility data.

The goal of visibility calibration is to make the following corrections to the visibility data:

- Correct phase variations versus frequency
- Correct amplitude variations versus frequency
- Correct phase variations versus time
- Correct amplitude variations versus time

These corrections are derived from up to three different calibration sources.

The calibration scripts we are using contain a series of steps. To execute individual step "N", enter the following commands into CASA:

```
mysteps=[N]
execfile('uid___A002_X87544a_X25eb.ms.scriptForCalibration.py')
```

Multiple commands can be executed at once.

Not specifying anything will execute all of the commands.

The rest of this presentation describes each calibration step in more detail.

The data processing steps can be divided into three broad groups:

0-1: Data import
2-8: A priori calibration
9-19: Calibration

Step 0: Import of the ASDM

The purpose of this step is to convert the data from its native ALMA format (the ASDM format) into a standard CASA measurement set.

Both the ASDM format and the CASA data format use an object oriented file system. The input and output to ALMA commands are actually directories that contain multiple binary tables.

Contents of the example measurement set:

```
ANTENNA/                POLARIZATION/       table.f17asdmindex  table.f24
ASDM_ANTENNA/           PROCESSOR/          table.f18           table.f24_TSM1
ASDM_CALATMOSPHERE/     SOURCE/             table.f19           table.f24_TSM2
ASDM_CALWVR/            SPECTRAL_WINDOW/    table.f2            table.f24_TSM3
ASDM_CORRELATORMODE/    STATE/              table.f20           table.f24_TSM4
ASDM_RECEIVER/          SYSCAL/             table.f20_TSM0      table.f3
ASDM_SBSUMMARY/         SYSPOWER/           table.f21           table.f4
ASDM_SOURCE/            WEATHER/            table.f21_TSM1      table.f5
ASDM_STATION/           table.dat           table.f21_TSM2      table.f6
CALDEVICE/              table.f1            table.f21_TSM3      table.f7
DATA_DESCRIPTION/       table.f10           table.f21_TSM4      table.f8
FEED/                   table.f11           table.f22           table.f9
FIELD/                  table.f12           table.f22_TSM1      table.info
FLAG_CMD/               table.f13           table.f22_TSM2      table.lock
HISTORY/                table.f14           table.f23
OBSERVATION/            table.f15           table.f23_TSM1
POINTING/               table.f16           table.f23_TSM2
```

Step 1: Fix SYSCAL table times

The system temperature (Tsys) measurements may include recording errors. Occasionally, multiple measurements have the same timestamp. This step corrects these errors.

Step 2: Fixplanets

This command fixes coordinate information for any Solar System objects in the measurement set (which may have had their coordinates set to 0 during the observations).

Step 3: Listobs

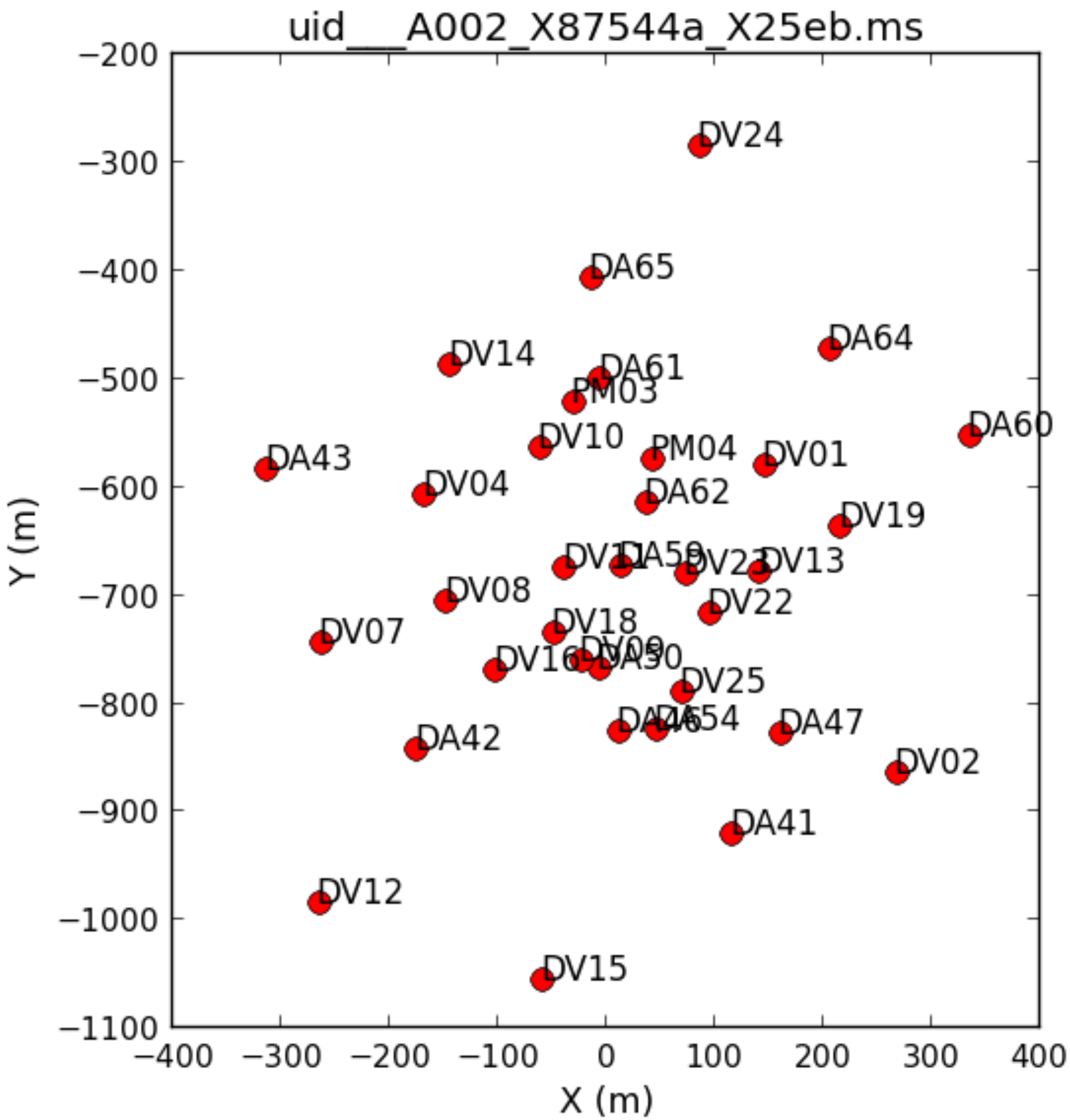
The listobs command will list a large amount of information about the observations. We run this step again later in step 9, so we will look at the listobs file in more detail then.

At this point in time, it would be useful to use plotants to produces a plot showing the locations of antennas in the array.

This is not included in standard calibration scripts, but it should be.

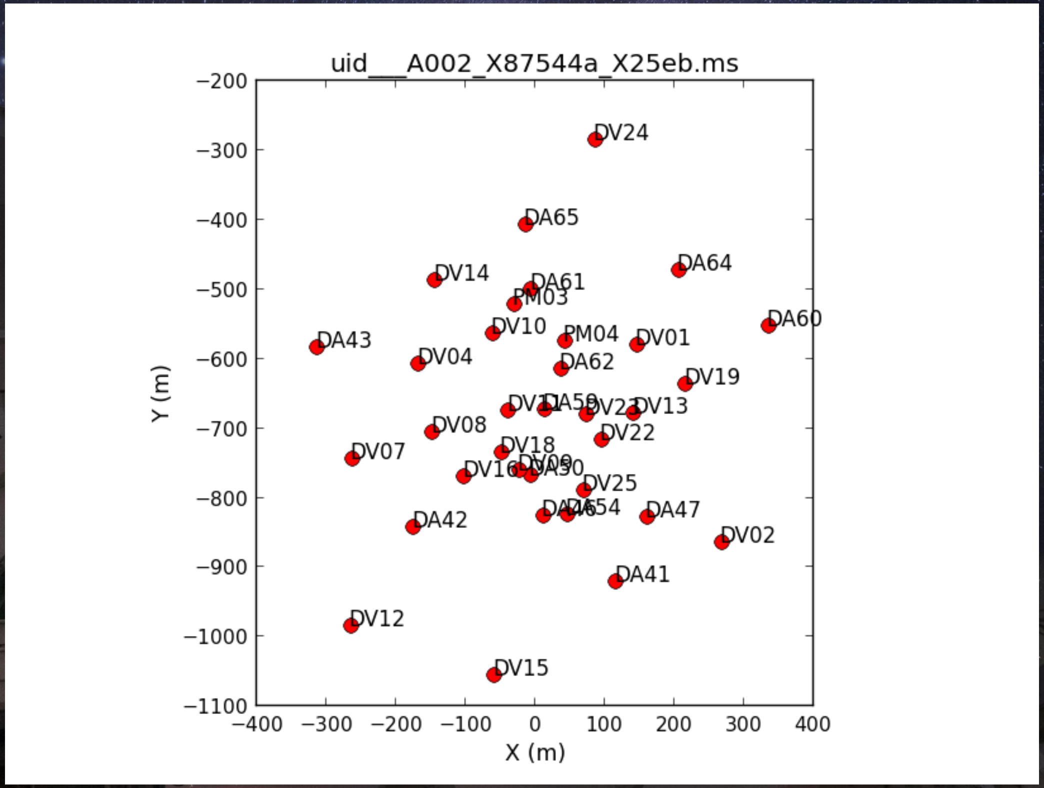
To execute this command, type the following:

```
plotants(vis='uid___A002_X87544a_X25eb.ms')
```


uid___A002_X87544a_X25eb.ms
Y (m)
X (m)
−200
−300
−400
−500
−600
−700
−800
−900
−1000
−1100
−400
−300
−200
−100
0
100
200
300
400
DV24
DA65
DA64
DV14
DA61
PM03
DA60
DV10
PM04
DV01
DA43
DV04
DA62
DV19
DV13
DV08
DV22
DV07
DV18
DV16
DV25
DA47
DA42
DV02
DA41
DV12
DV15

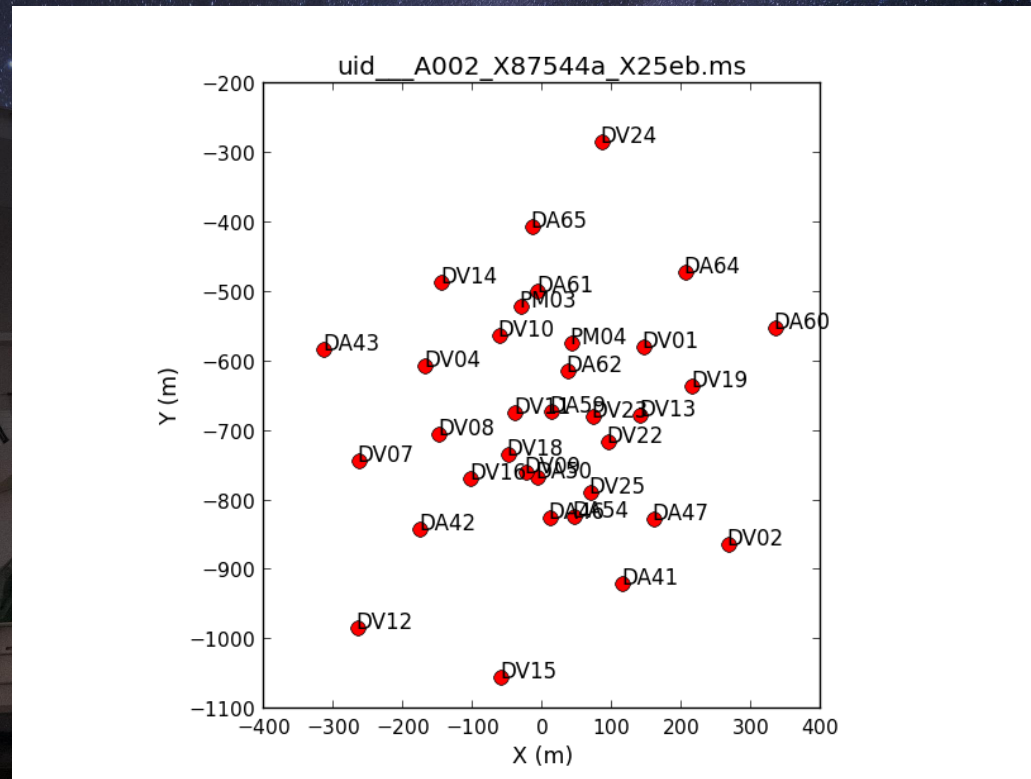
This plot can be used to select the reference antenna, which is used in many of the data processing steps.

The antenna needs to be from the centre of the array.



Antennas on long baselines will tend to produce noisier data than antennas on short baselines.

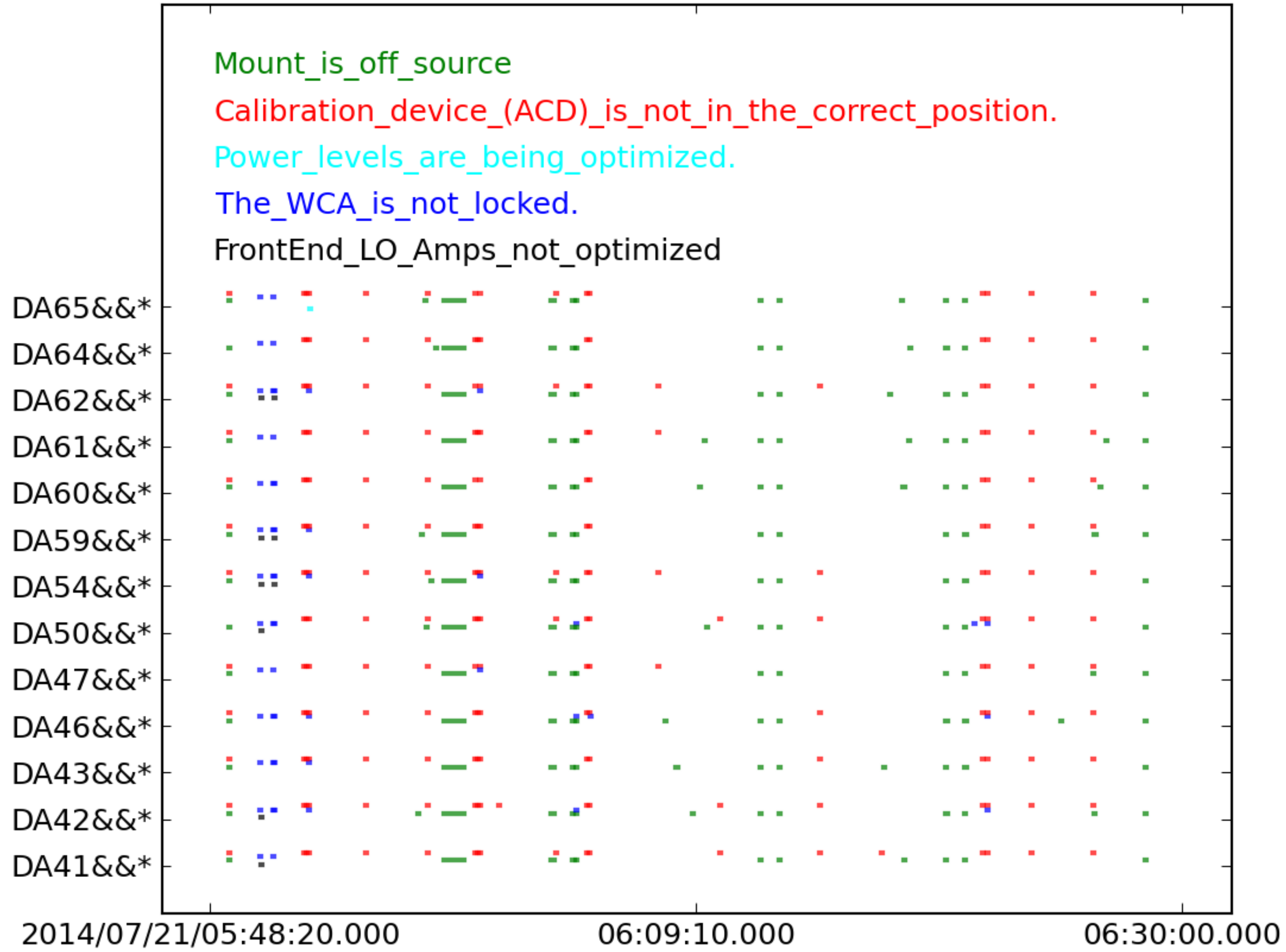
This figure can be used to diagnose these types of issues.



Step 4: A priori flagging

Some of the data are either not useful or not needed for the rest of the calibration and can be discarded. This includes the following:

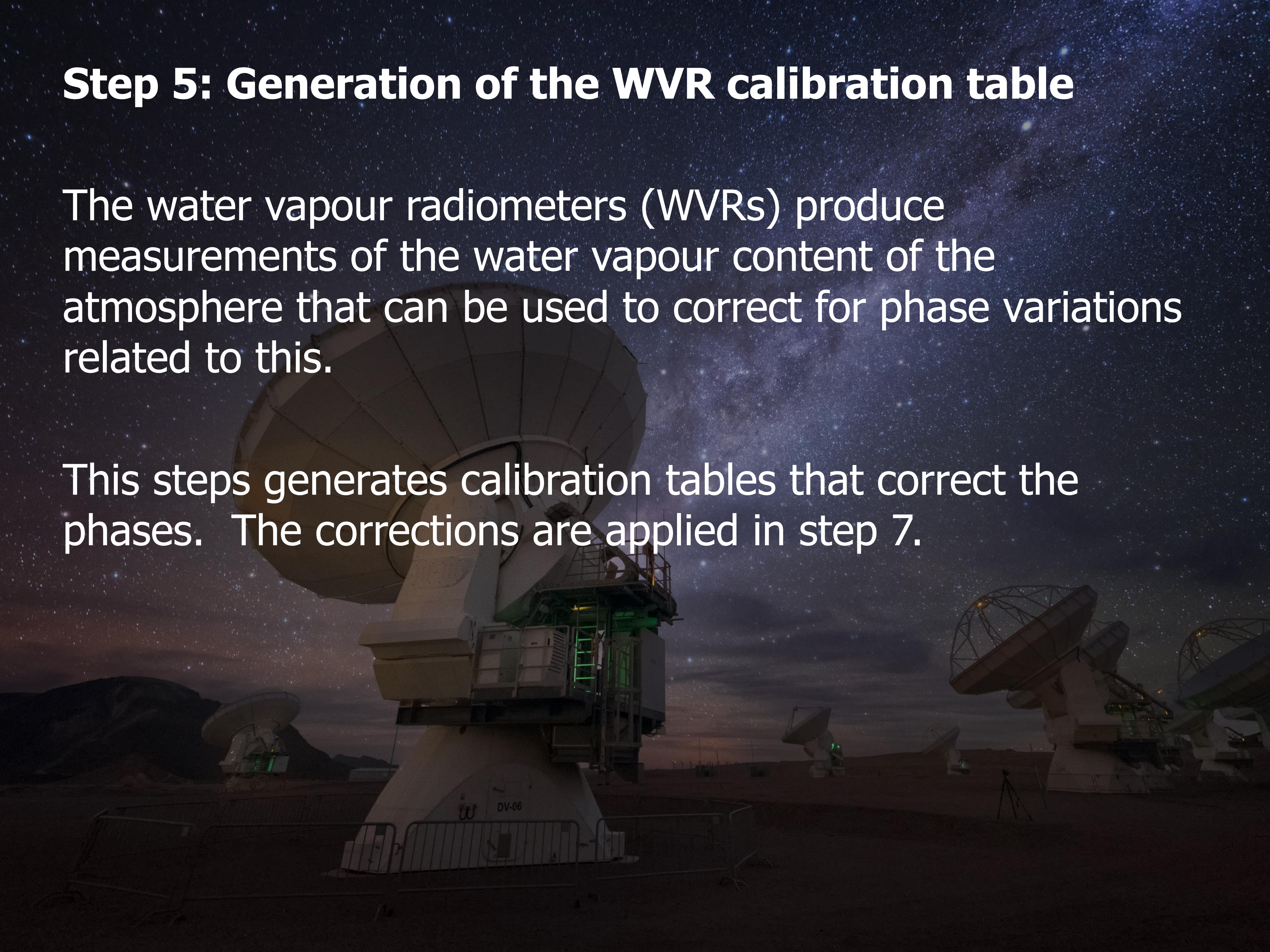
- Autocorrelated data
- Pointing and atmosphere measurements
- Data taken when the telescope is not ready for observing (for example, the telescope is slewing, etc)

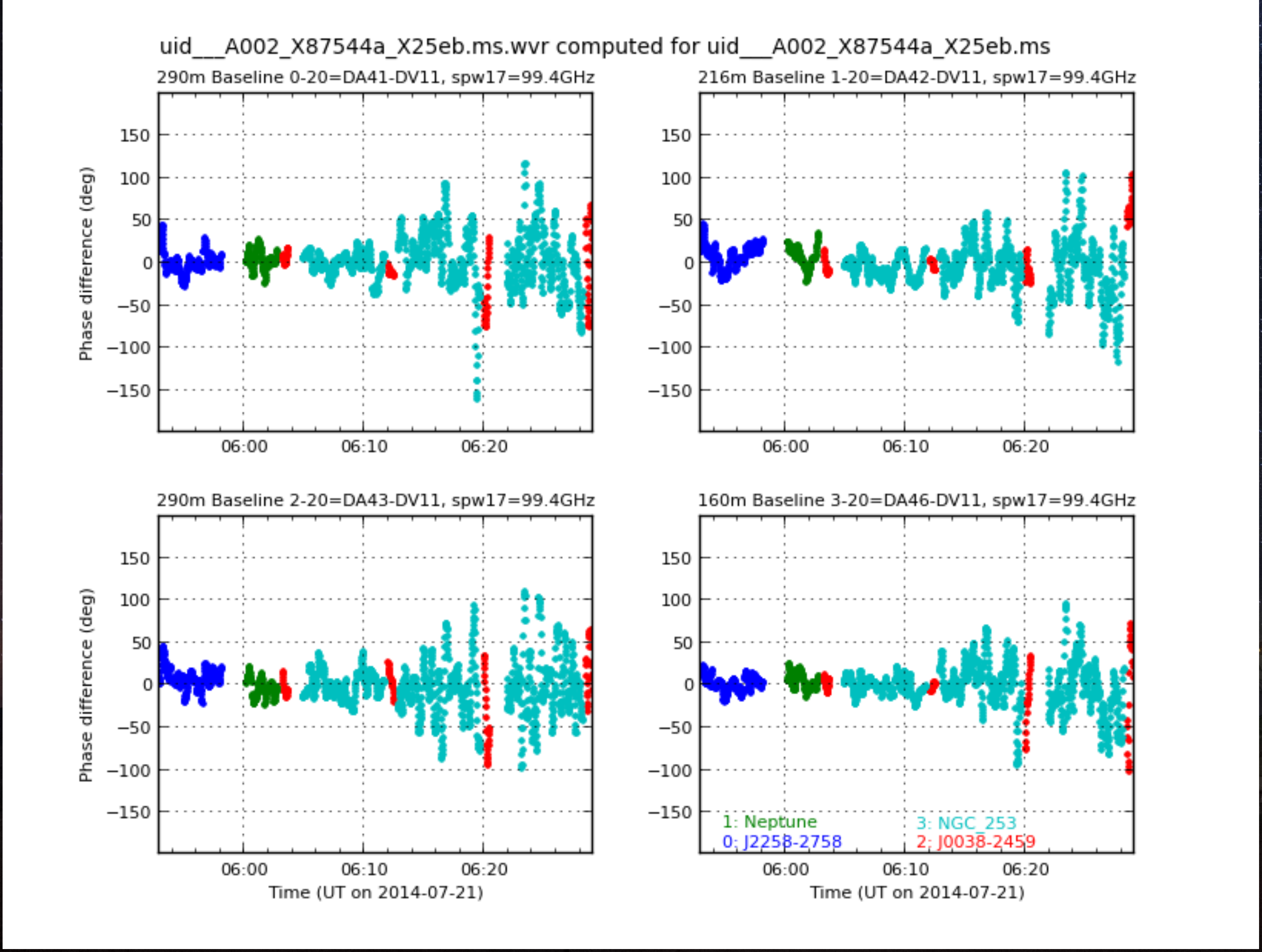

Mount_is_off_source
Calibration_device_(ACD)_is_not_in_the_correct_position.
Power_levels_are_being_optimized.
The_WCA_is_not_locked.
FrontEnd_LO_Amps_not_optimized
DA65&&*
DA64&&*
DA62&&*
DA61&&*
DA60&&*
DA59&&*
DA54&&*
DA50&&*
DA47&&*
DA46&&*
DA43&&*
DA42&&*
DA41&&*
2014/07/21/05:48:20.000
06:09:10.000
06:30:00.000

Step 5: Generation of the WVR calibration table

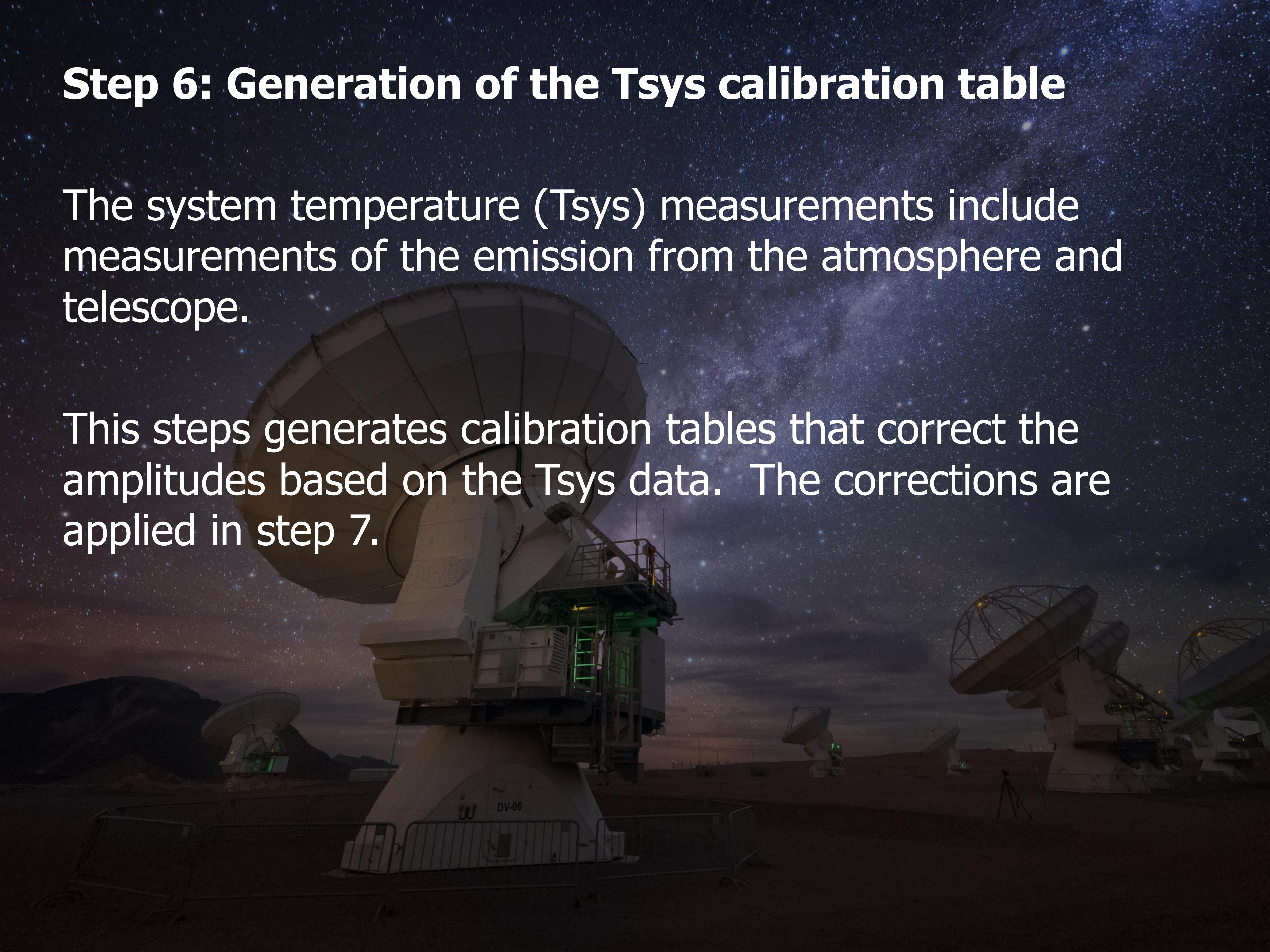
The water vapour radiometers (WVRs) produce measurements of the water vapour content of the atmosphere that can be used to correct for phase variations related to this.

This steps generates calibration tables that correct the phases. The corrections are applied in step 7.





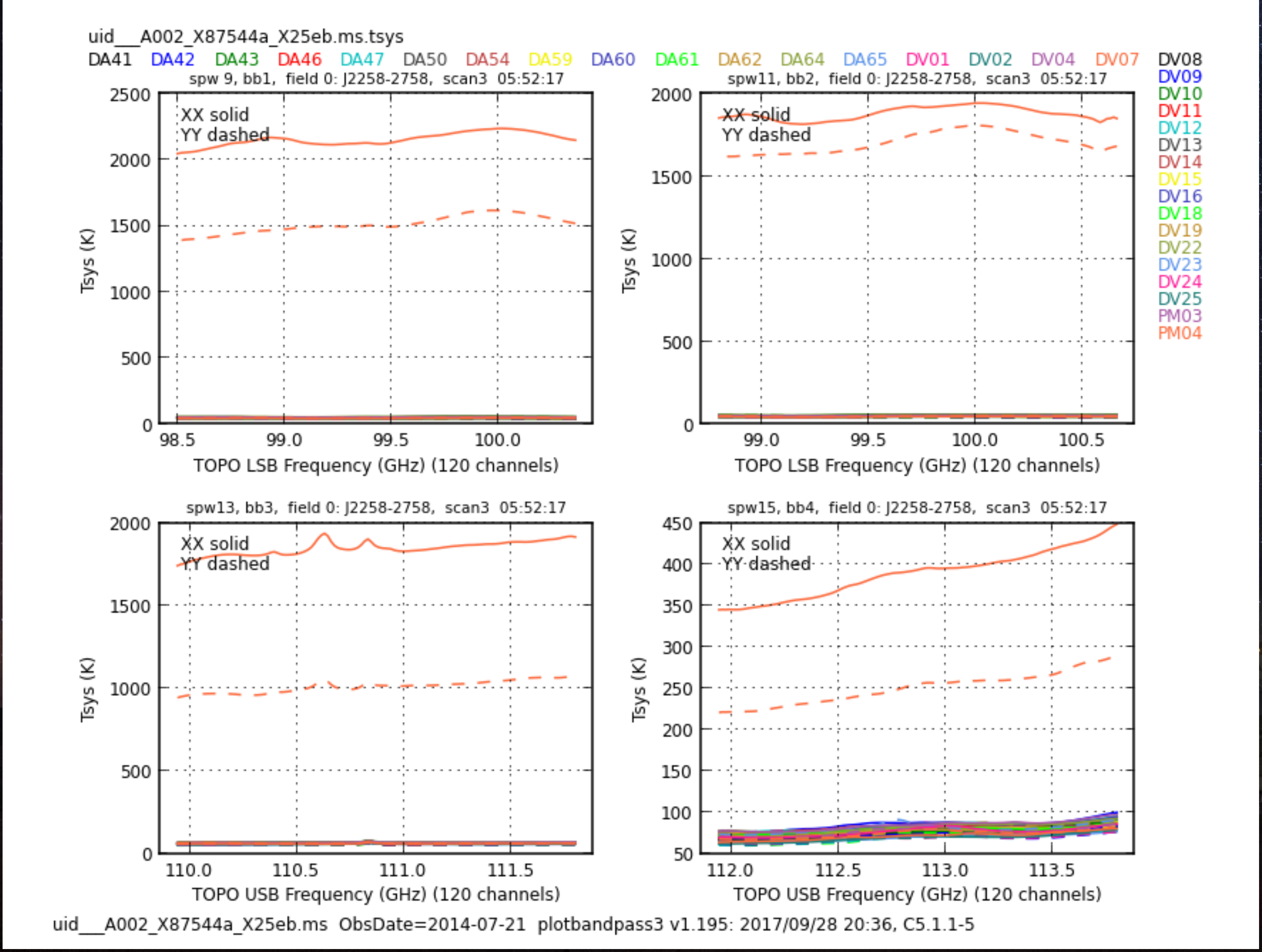
uid___A002_X87544a_X25eb.ms.wvr computed for uid___A002_X87544a_X25eb.ms
290m Baseline 0-20=DA41-DV11, spw17=99.4GHz
216m Baseline 1-20=DA42-DV11, spw17=99.4GHz
290m Baseline 2-20=DA43-DV11, spw17=99.4GHz
160m Baseline 3-20=DA46-DV11, spw17=99.4GHz
Phase difference (deg)
150
100
50
0
−50
−100
−150
06:00
06:10
06:20
Time (UT on 2014-07-21)
1: Neptune
0: J2258-2758
3: NGC_253
2: J0038-2459

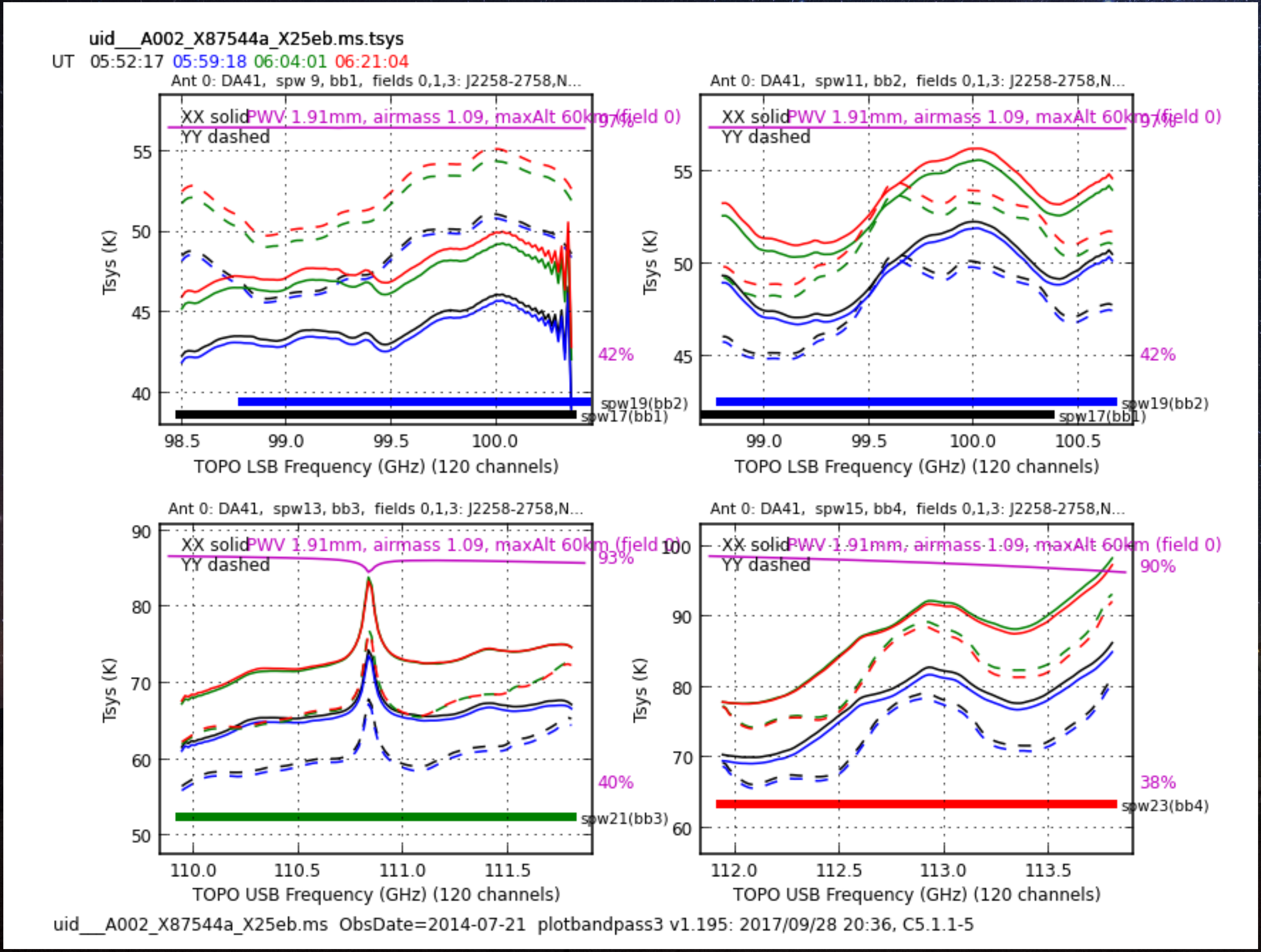


Step 6: Generation of the Tsys calibration table

The system temperature (Tsys) measurements include measurements of the emission from the atmosphere and telescope.

This steps generates calibration tables that correct the amplitudes based on the Tsys data. The corrections are applied in step 7.


uid___A002_X87544a_X25eb.ms.tsys
DA41 DA42 DA43 DA46 DA47 DA50 DA54 DA59 DA60 DA61 DA62 DA64 DA65 DV01 DV02 DV04 DV07
DV08 DV09 DV10 DV11 DV12 DV13 DV14 DV15 DV16 DV18 DV19 DV22 DV23 DV24 DV25 PM03 PM04
spw 9, bb1, field 0: J2258-2758, scan3 05:52:17
spw11, bb2, field 0: J2258-2758, scan3 05:52:17
spw13, bb3, field 0: J2258-2758, scan3 05:52:17
spw15, bb4, field 0: J2258-2758, scan3 05:52:17
XX solid
YY dashed
Tsys (K)
TOPO LSB Frequency (GHz) (120 channels)
TOPO USB Frequency (GHz) (120 channels)
uid___A002_X87544a_X25eb.ms ObsDate=2014-07-21 plotbandpass3 v1.195: 2017/09/28 20:36, C5.1.1-5

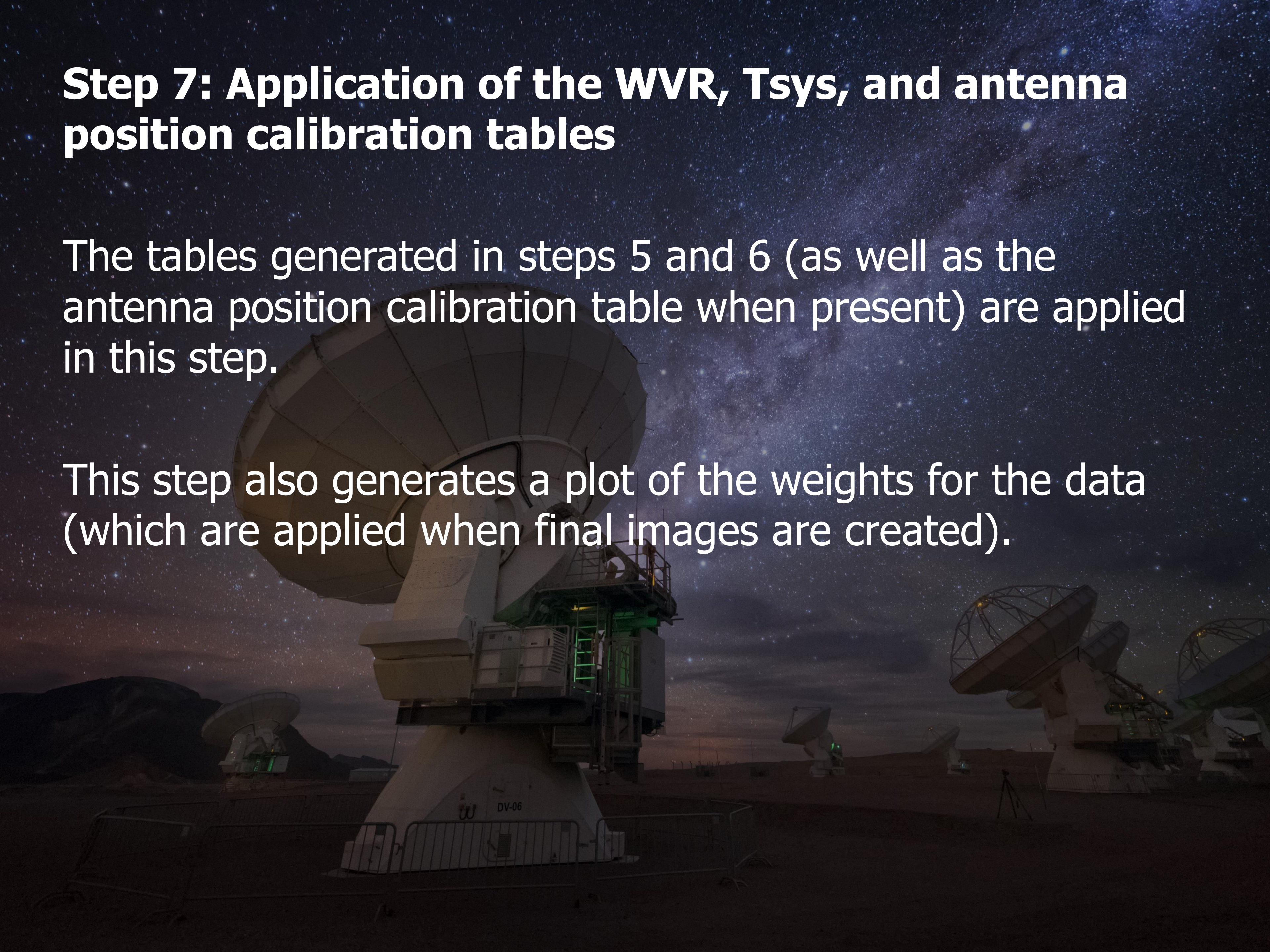

uid___A002_X87544a_X25eb.ms.tsys
UT 05:52:17 05:59:18 06:04:01 06:21:04
Ant 0: DA41, spw 9, bb1, fields 0,1,3: J2258-2758,N...
XX solid
YY dashed
PWV 1.91mm, airmass 1.09, maxAlt 60km (field 0)
97%
42%
spw19(bb2)
spw17(bb1)
Tsys (K)
TOPO LSB Frequency (GHz) (120 channels)
Ant 0: DA41, spw11, bb2, fields 0,1,3: J2258-2758,N...
Ant 0: DA41, spw13, bb3, fields 0,1,3: J2258-2758,N...
93%
40%
spw21(bb3)
TOPO USB Frequency (GHz) (120 channels)
Ant 0: DA41, spw15, bb4, fields 0,1,3: J2258-2758,N...
90%
38%
spw23(bb4)
uid___A002_X87544a_X25eb.ms ObsDate=2014-07-21 plotbandpass3 v1.195: 2017/09/28 20:36, C5.1.1-5

[Generation of the antenna position calibration table]

Corrections to antenna positions can be very important if the antennas are on long baselines. This step generates a calibration table that corrects the positions.

For most other data, though, the corrections may be unnecessary. In this situation, a table filled with zeroes is created.

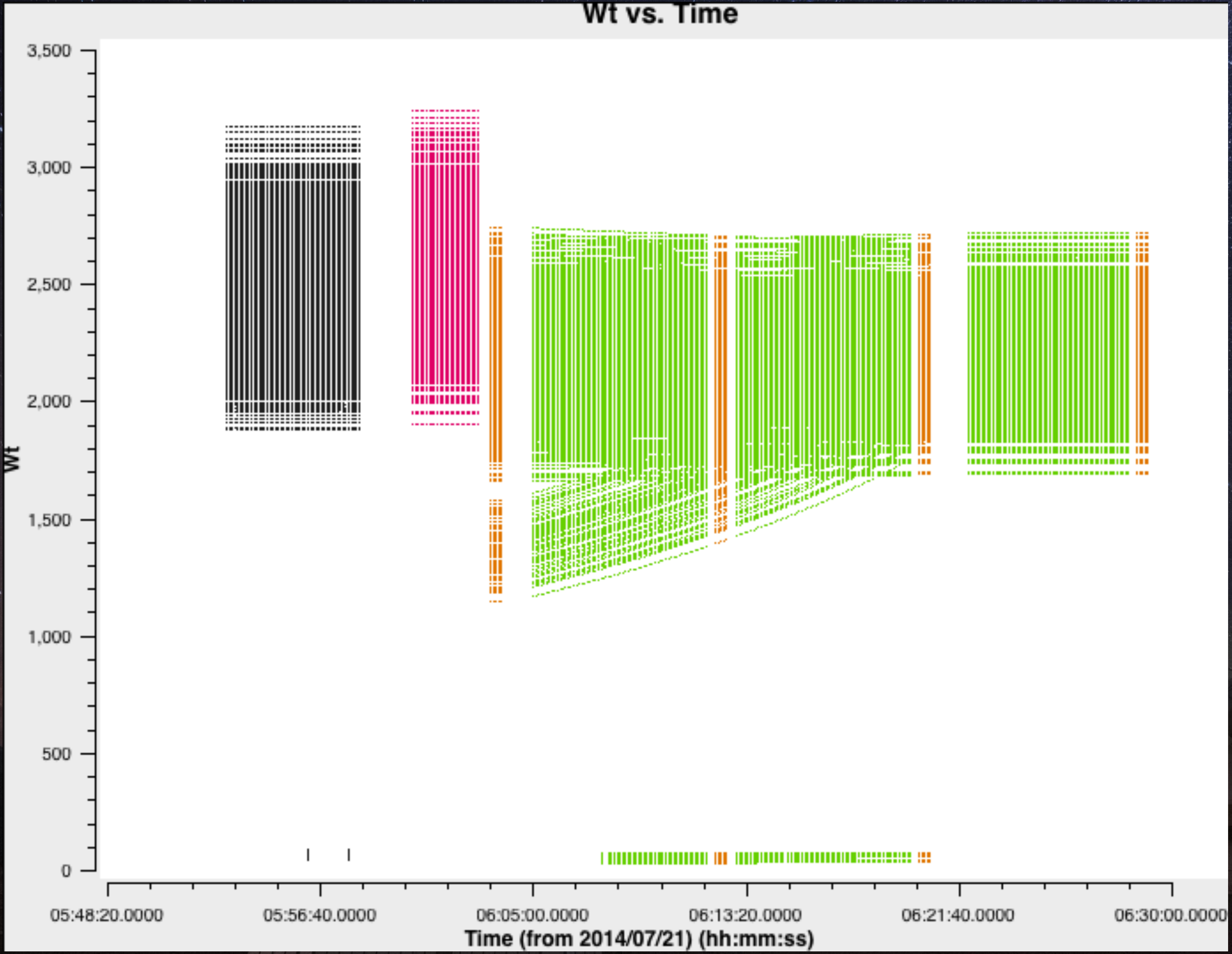
(Depending on when the data are generated, the corrections may have already been incorporated into the measurement set. The script generator did not even create a line for this step, so presumably it is not needed.)



Step 7: Application of the WVR, Tsys, and antenna position calibration tables

The tables generated in steps 5 and 6 (as well as the antenna position calibration table when present) are applied in this step.

This step also generates a plot of the weights for the data (which are applied when final images are created).



Wt vs. Time
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Wt
05:48:20.0000
05:56:40.0000
06:05:00.0000
06:13:20.0000
06:21:40.0000
06:30:00.0000
Time (from 2014/07/21) (hh:mm:ss)

Step 8: Split out science spws

In this step, the data for the science and calibration sources is separated from the other data.

For the example dataset, the original measurement set included over 25 spectral windows (spws), while the output from this step has only 4 spws.

This is the end of the a priori calibration.

Step 9: Listobs and save initial flags

The listobs command will list a large amount of information about the observations, including the following:

- Basic observation information (PI, project ID, dates, etc)
- List of the sequence of observations performed
- List of the fields
- List of the spectral windows
- List of the sources (the spectral windows for each field)
- List of the antennas

The other part of this step saves data related to flagging. This is done several times throughout the script.

Step 10: Initial flagging

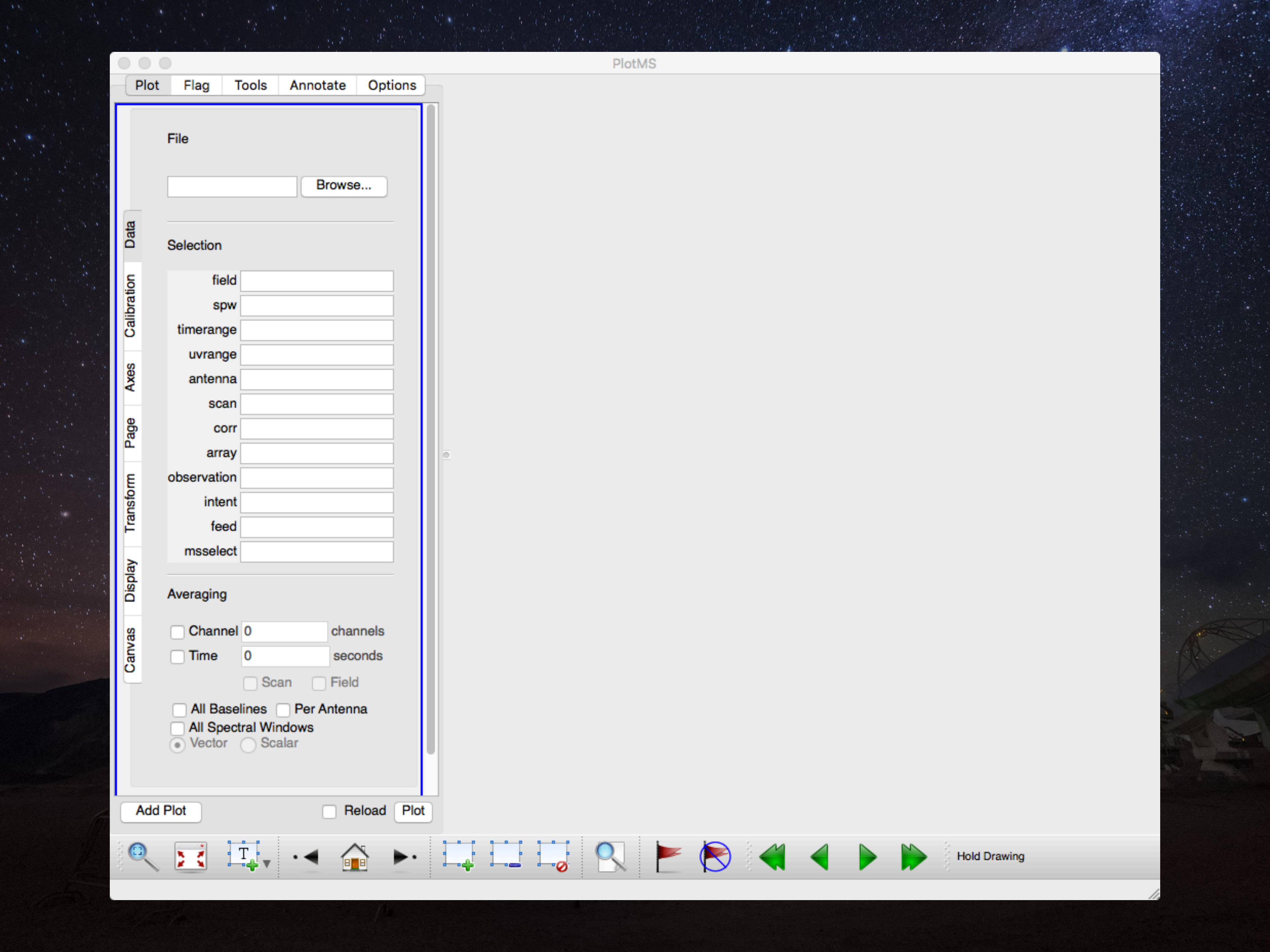
Any data that look abnormally noisy or are that are otherwise unusable are flagged (identified as bad) in this step and not used in any subsequent steps.

Standard scripts include flagdata commands to flag shadowed antennas (antennas that are blocked by other antennas) and edge channels in each of the spws.

At this point, it is good to check the quality of the data with plotms, which can be run by typing this at the CASA command prompt.

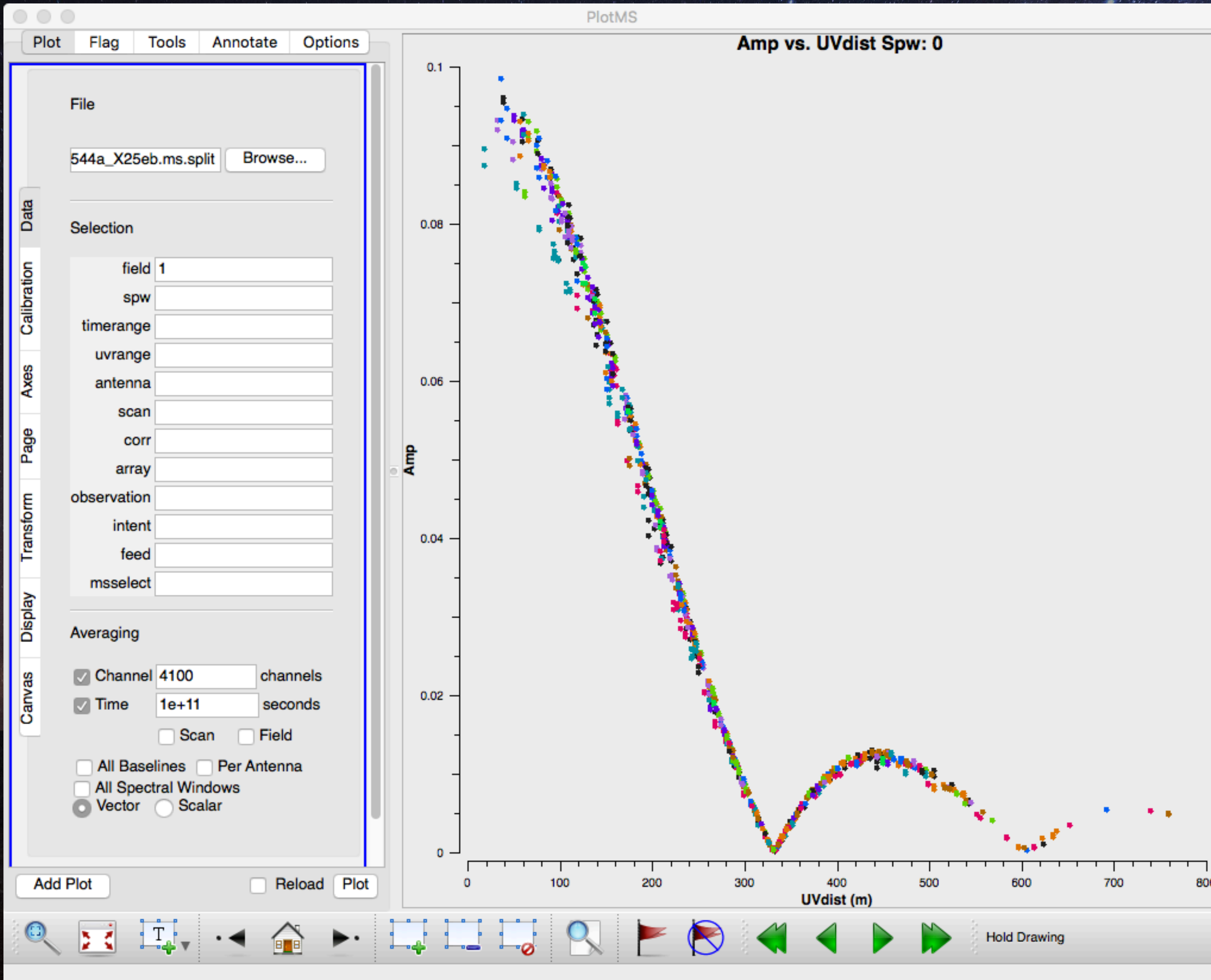
I recommend performing the following checks in the following order:

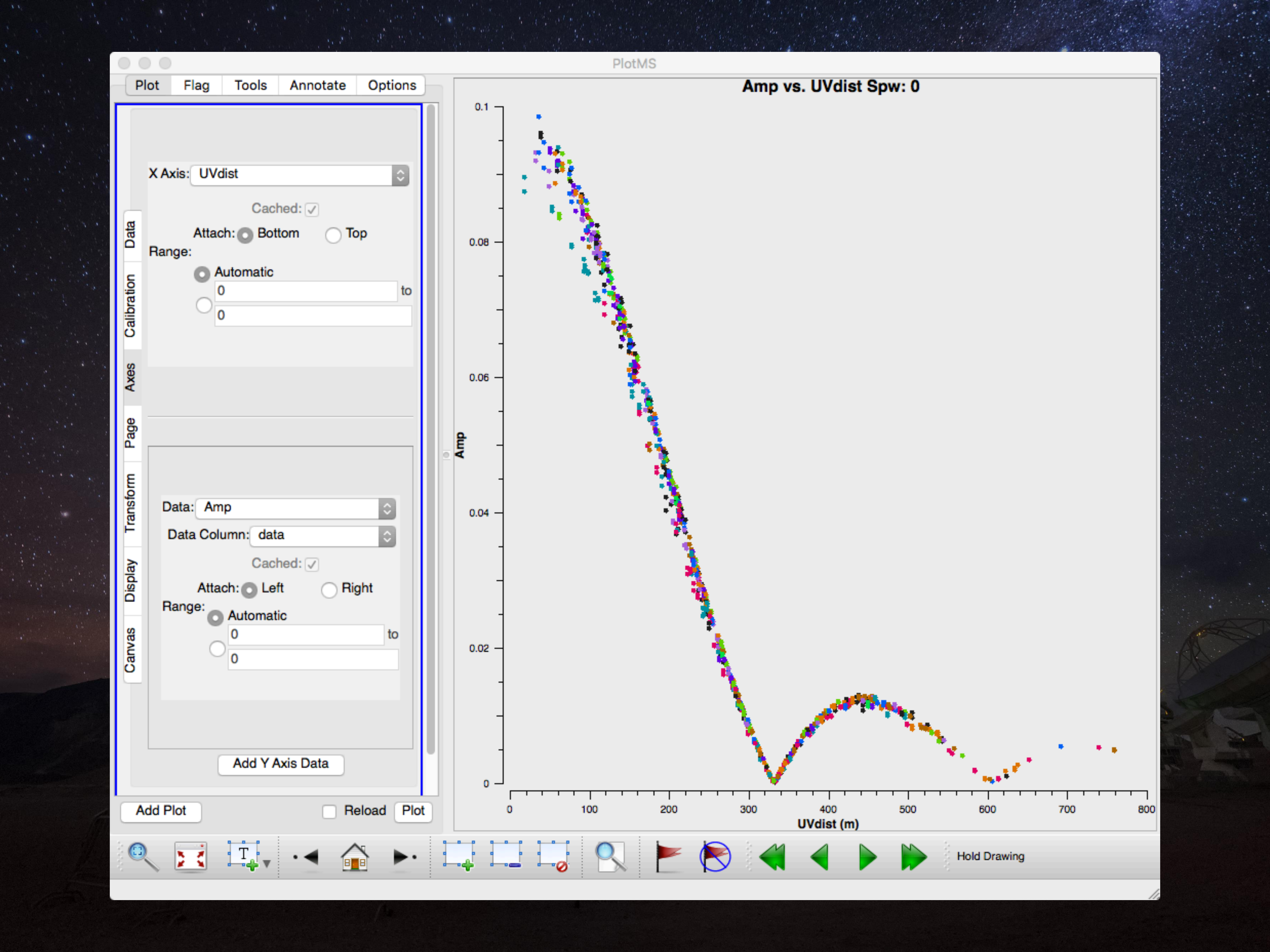
- Check amplitude versus uv distance for the amplitude or bandpass calibrator
- Check amplitude versus channel for the bandpass calibrator
- Check phase versus scan for the phase calibrator

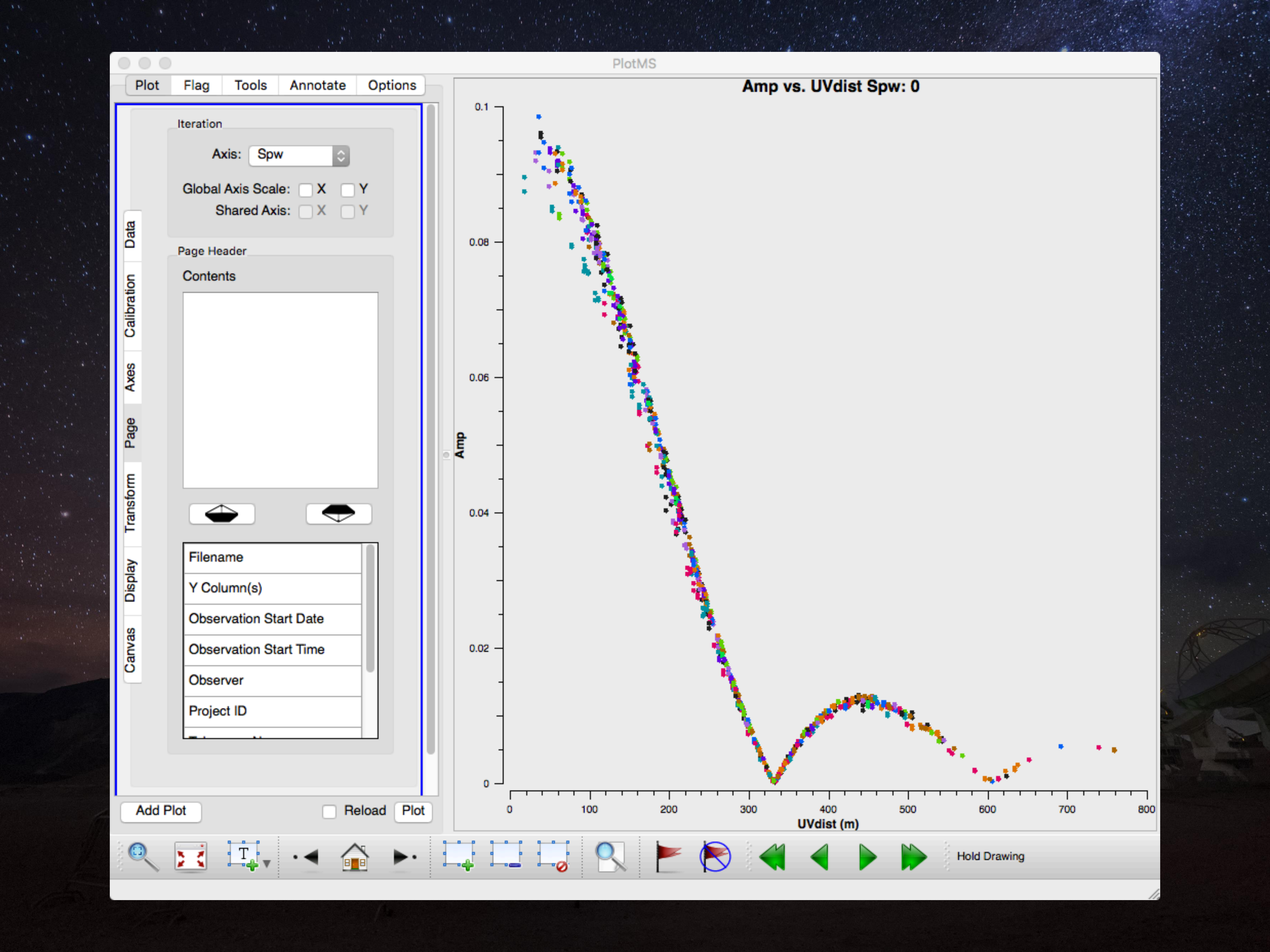

PlotMS
Plot
Flag
Tools
Annotate
Options
File
Browse...
Selection
field
spw
timerange
uvrange
antenna
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel
0
channels
Time
0
seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Hold Drawing

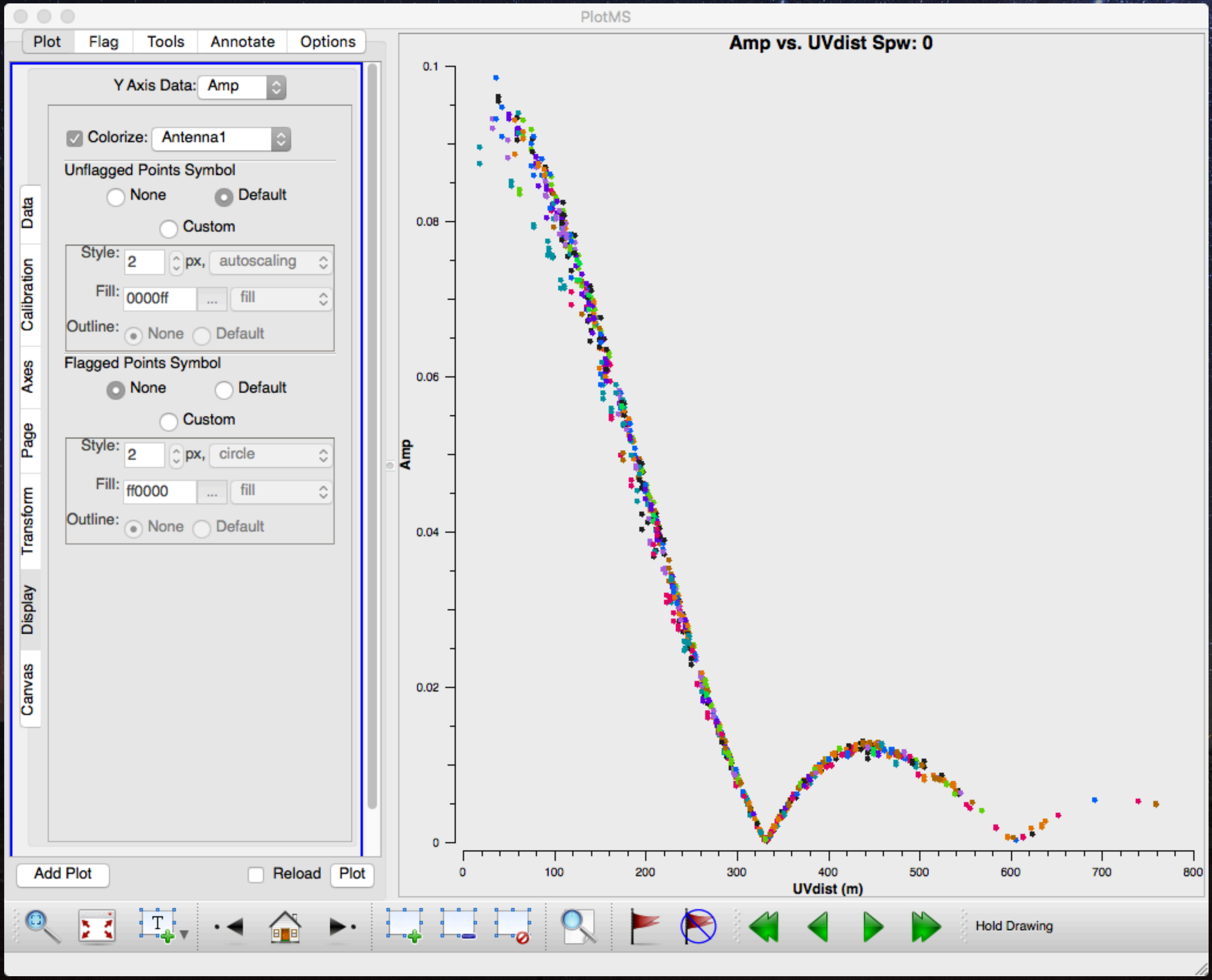
To check *amplitude versus uv distance*, set the following:

- Under the Data tab:
  - Set the file to the ms.split file created in step 8
  - Set the field to the number of the amplitude calibrator
  - Set channel averaging to 4100
  - Set time averaging to 1e11
- Under the Axes tab:
  - Set the x-axis to UVdist
  - Set the y-axis to Amp
- Under the Page tab:
  - Set axis to Spw
- Under the Display tab:
  - Set Colorize to Antenna1


PlotMS
Plot
Flag
Tools
Annotate
Options
File
544a_X25eb.ms.split
Browse...
Data
Calibration
Axes
Page
Transform
Display
Canvas
Selection
field
1
spw
timerange
uvrange
antenna
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel
4100
channels
Time
1e+11
seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Add Plot
Reload
Plot
Amp vs. UVdist Spw: 0
Amp
0.1
0.08
0.06
0.04
0.02
0
0
100
200
300
400
500
600
700
800
UVdist (m)
Hold Drawing

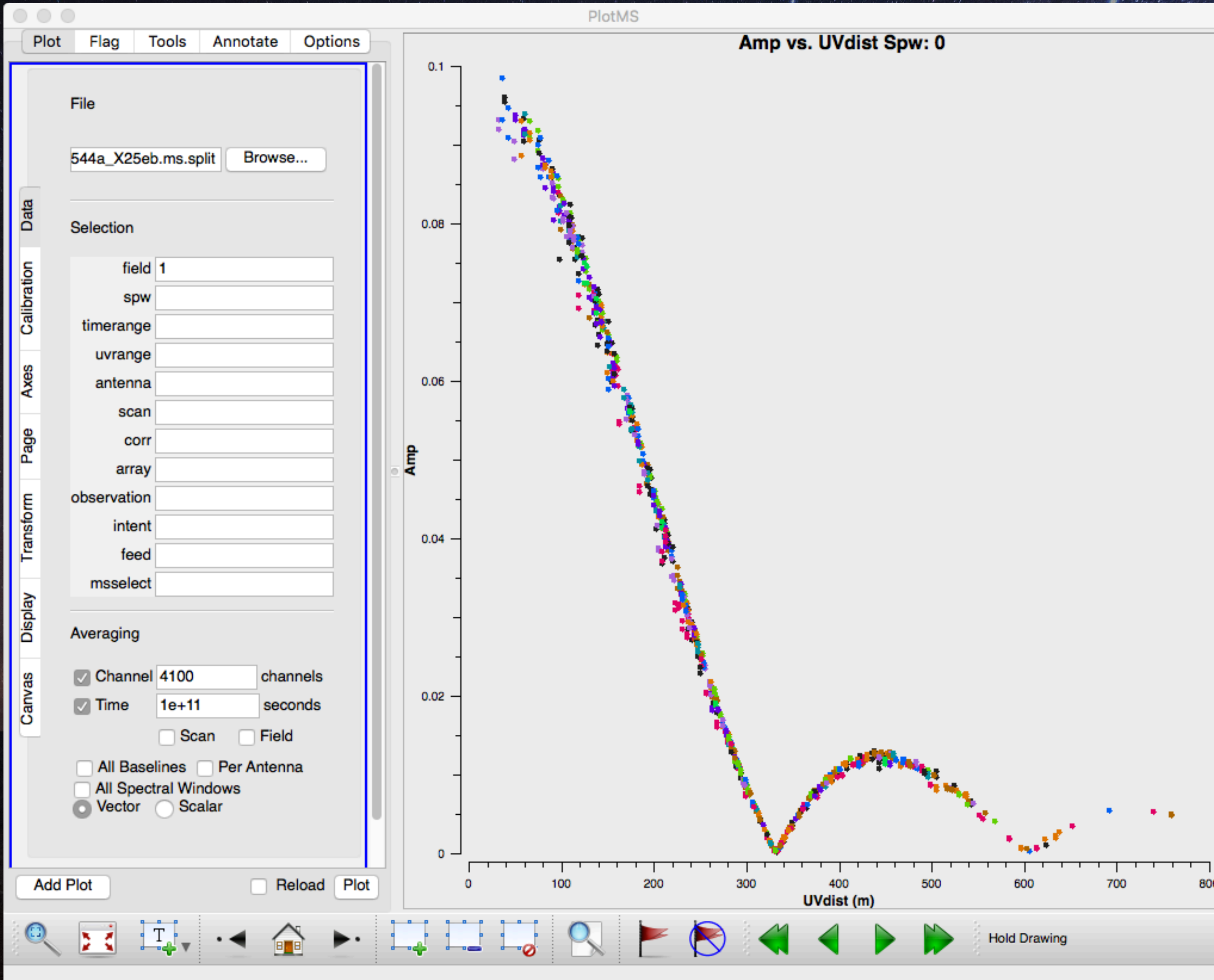

PlotMS
Plot
Flag
Tools
Annotate
Options
Data
Calibration
Axes
Page
Transform
Display
Canvas
X Axis: UVdist
Cached:
Attach: Bottom
Top
Range:
Automatic
0
to
0
Data: Amp
Data Column: data
Cached:
Attach: Left
Right
Range:
Automatic
0
to
0
Add Y Axis Data
Add Plot
Reload
Plot
Amp vs. UVdist Spw: 0
Amp
0.1
0.08
0.06
0.04
0.02
0
0
100
200
300
400
500
600
700
800
UVdist (m)
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
Iteration
Axis:
Spw
Global Axis Scale:
X
Y
Shared Axis:
X
Y
Page Header
Contents
Filename
Y Column(s)
Observation Start Date
Observation Start Time
Observer
Project ID
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. UVdist Spw: 0
Amp
0.1
0.08
0.06
0.04
0.02
0
0
100
200
300
400
500
600
700
800
UVdist (m)
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
Y Axis Data: Amp
Colorize: Antenna1
Unflagged Points Symbol
None
Default
Custom
Style: 2 px, autoscaling
Fill: 0000ff ... fill
Outline: None Default
Flagged Points Symbol
None
Default
Custom
Style: 2 px, circle
Fill: ff0000 ... fill
Outline: None Default
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. UVdist Spw: 0
Amp
UVdist (m)
0.1
0.08
0.06
0.04
0.02
0
0
100
200
300
400
500
600
700
800
Hold Drawing

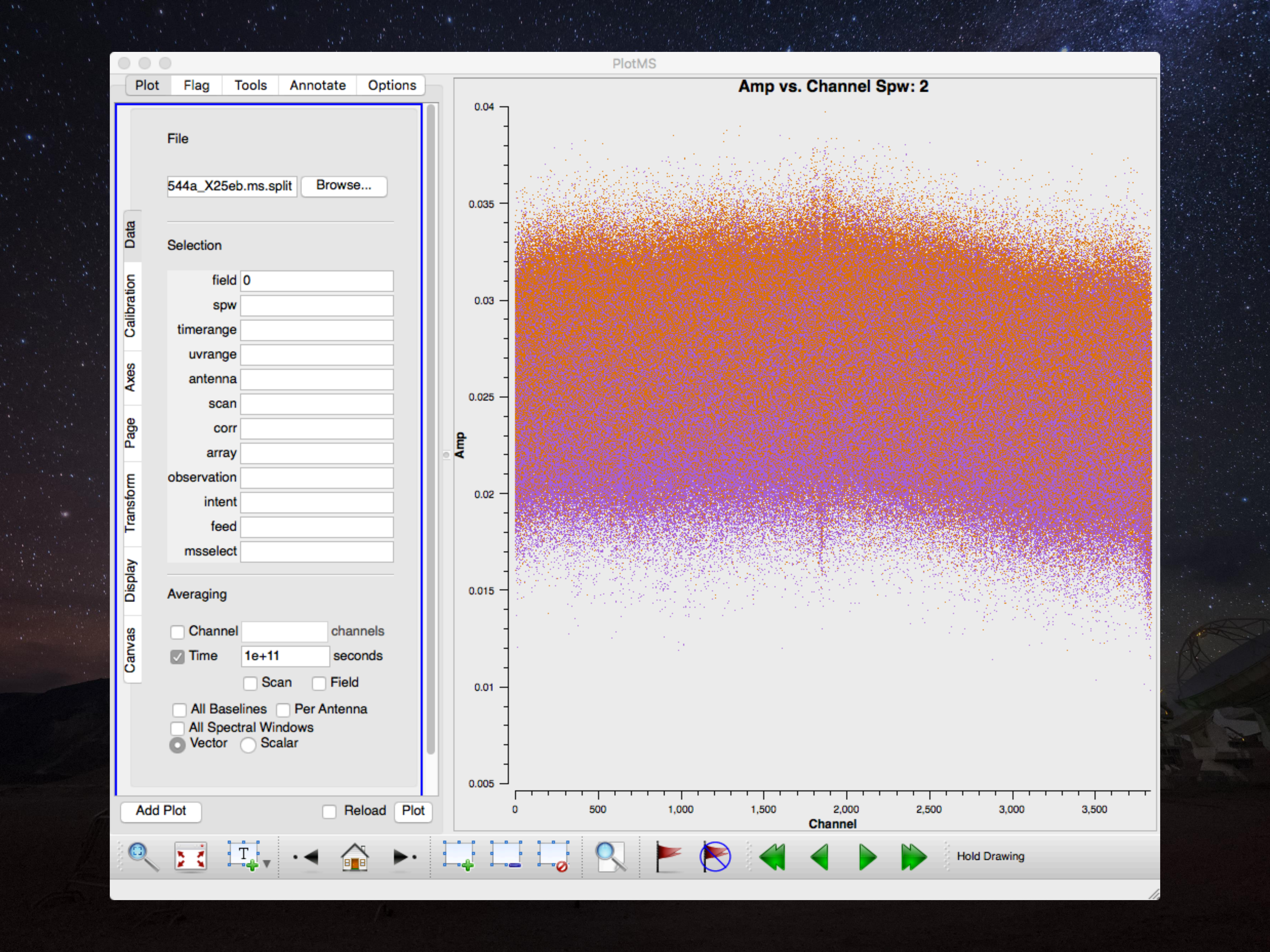
In the amplitude versus uv distance plots, most of the data should fall along a straight line (for unresolved or marginally resolved sources) or should follow something similar to a sinc^2 function (for resolved objects line Solar System objects).

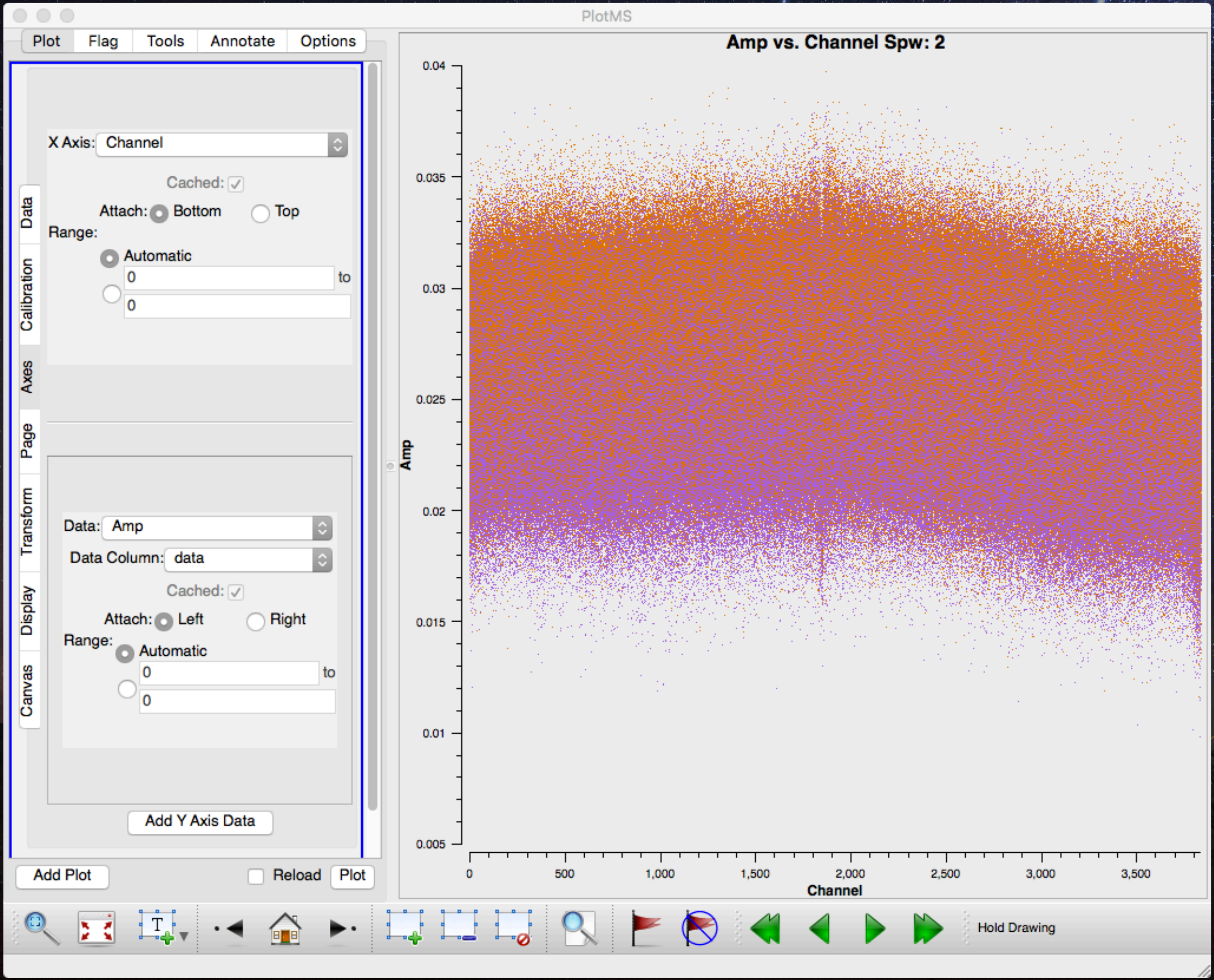
Data from bad antennas or baselines will appear as outliers from these trends.

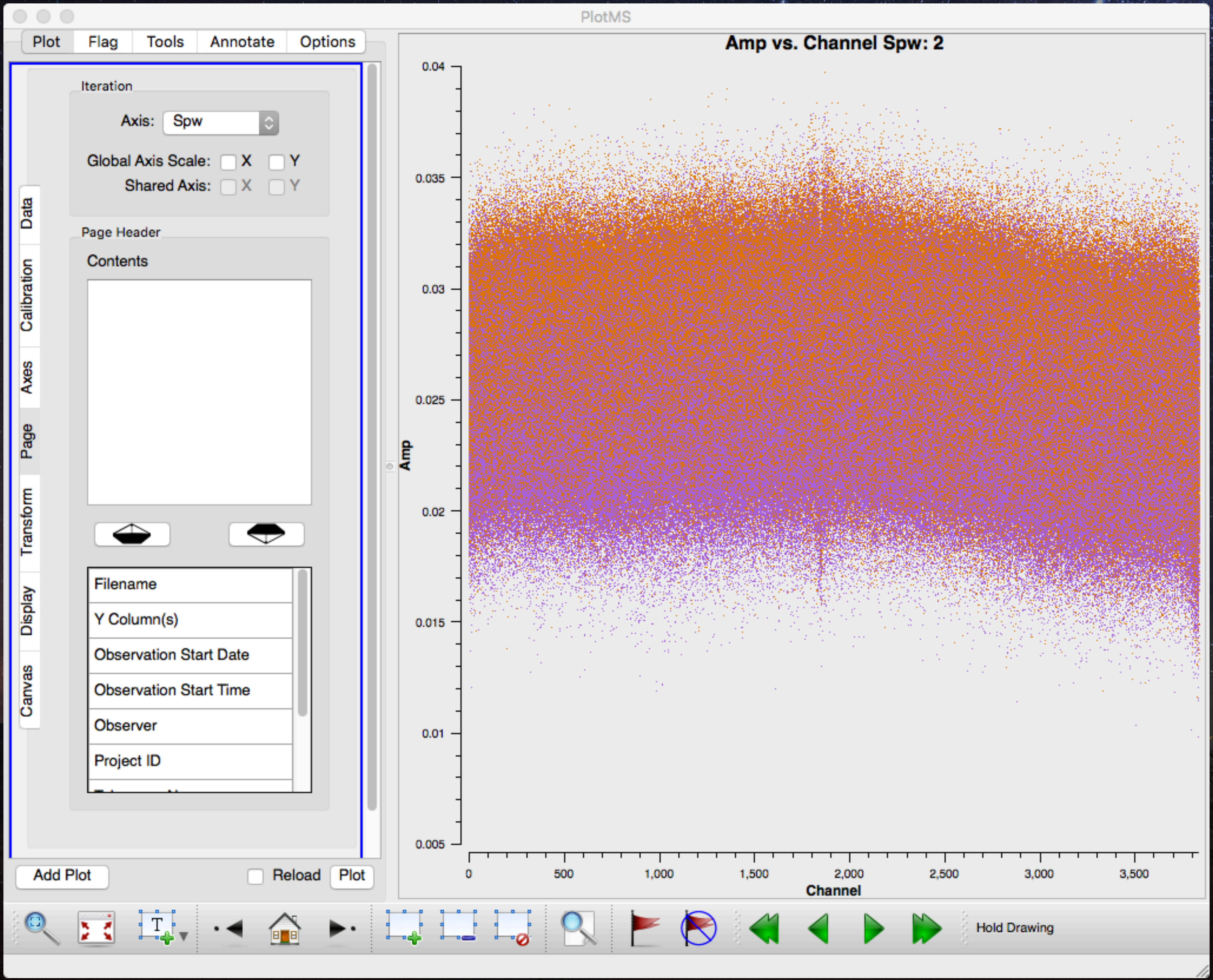

PlotMS
Plot
Flag
Tools
Annotate
Options
File
544a_X25eb.ms.split
Browse...
Selection
field
1
spw
timerange
uvrange
antenna
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel
4100
channels
Time
1e+11
seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. UVdist Spw: 0
Amp
0.1
0.08
0.06
0.04
0.02
0
0
100
200
300
400
500
600
700
800
UVdist (m)
Hold Drawing

To check *amplitude versus channel*, set the following:

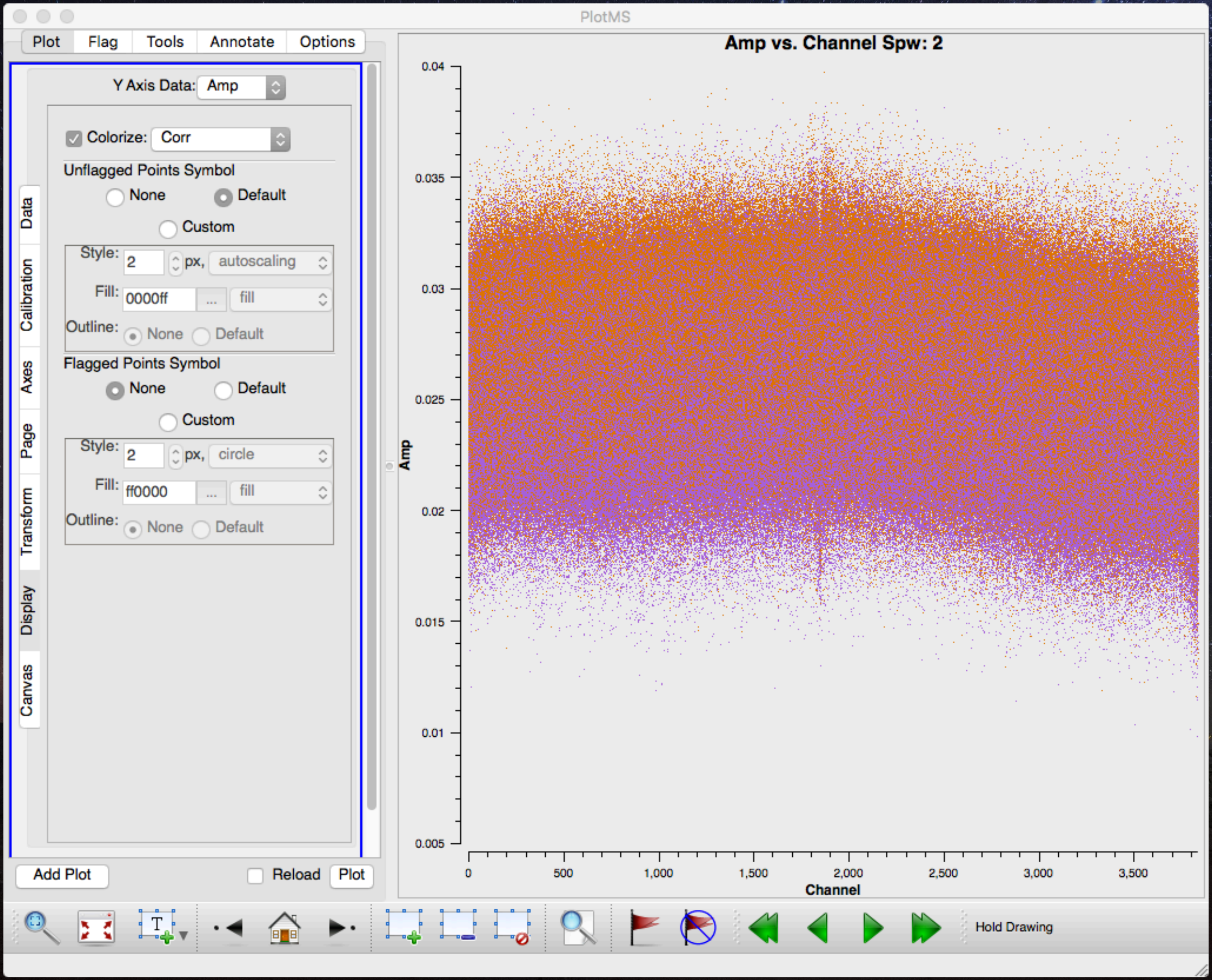
- Under the Data tab:
  - Set the file to the ms.split file created in step 8
  - Set the field to the number of the bandpass calibrator
  - Set time averaging to 1e11
- Under the Axes tab:
  - Set the x-axis to Channel
  - Set the y-axis to Amp
- Under the Page tab:
  - Set axis to Spw
- Under the Display tab:
  - Set Colorize to Corr (which will produce different colours for the XX and YY data)


PlotMS
Plot
Flag
Tools
Annotate
Options
File
544a_X25eb.ms.split
Browse...
Selection
field 0
spw
timerange
uvrange
antenna
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel
channels
Time 1e+11 seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. Channel Spw: 2
Amp
Channel
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
Data
Calibration
Axes
Page
Transform
Display
Canvas
X Axis: Channel
Cached:
Attach: Bottom
Top
Range:
Automatic
0
to
0
Data: Amp
Data Column: data
Cached:
Attach: Left
Right
Range:
Automatic
0
to
0
Add Y Axis Data
Add Plot
Reload
Plot
Amp vs. Channel Spw: 2
Amp
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Channel
Hold Drawing



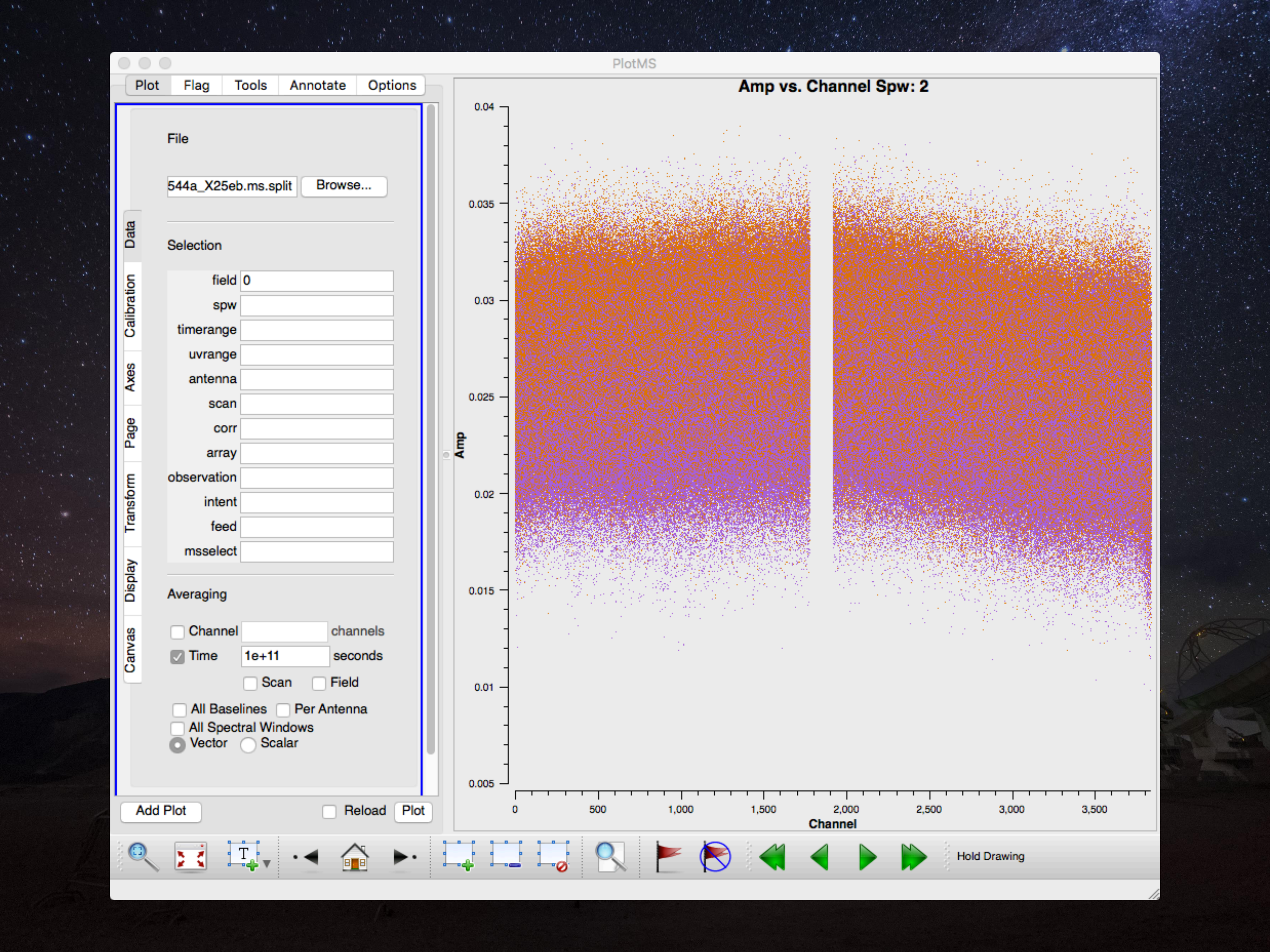
PlotMS
Plot
Flag
Tools
Annotate
Options
Iteration
Axis: Spw
Global Axis Scale: X Y
Shared Axis: X Y
Page Header
Contents
Filename
Y Column(s)
Observation Start Date
Observation Start Time
Observer
Project ID
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. Channel Spw: 2
Amp
Channel
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
Y Axis Data: Amp
Colorize: Corr
Unflagged Points Symbol
None
Default
Custom
Style: 2 px, autoscaling
Fill: 0000ff ... fill
Outline: None Default
Flagged Points Symbol
None
Default
Custom
Style: 2 px, circle
Fill: ff0000 ... fill
Outline: None Default
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. Channel Spw: 2
Amp
Channel
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Hold Drawing

In the amplitude versus channel plots, most of the data should fall along a relatively straight line or should at least look smooth.

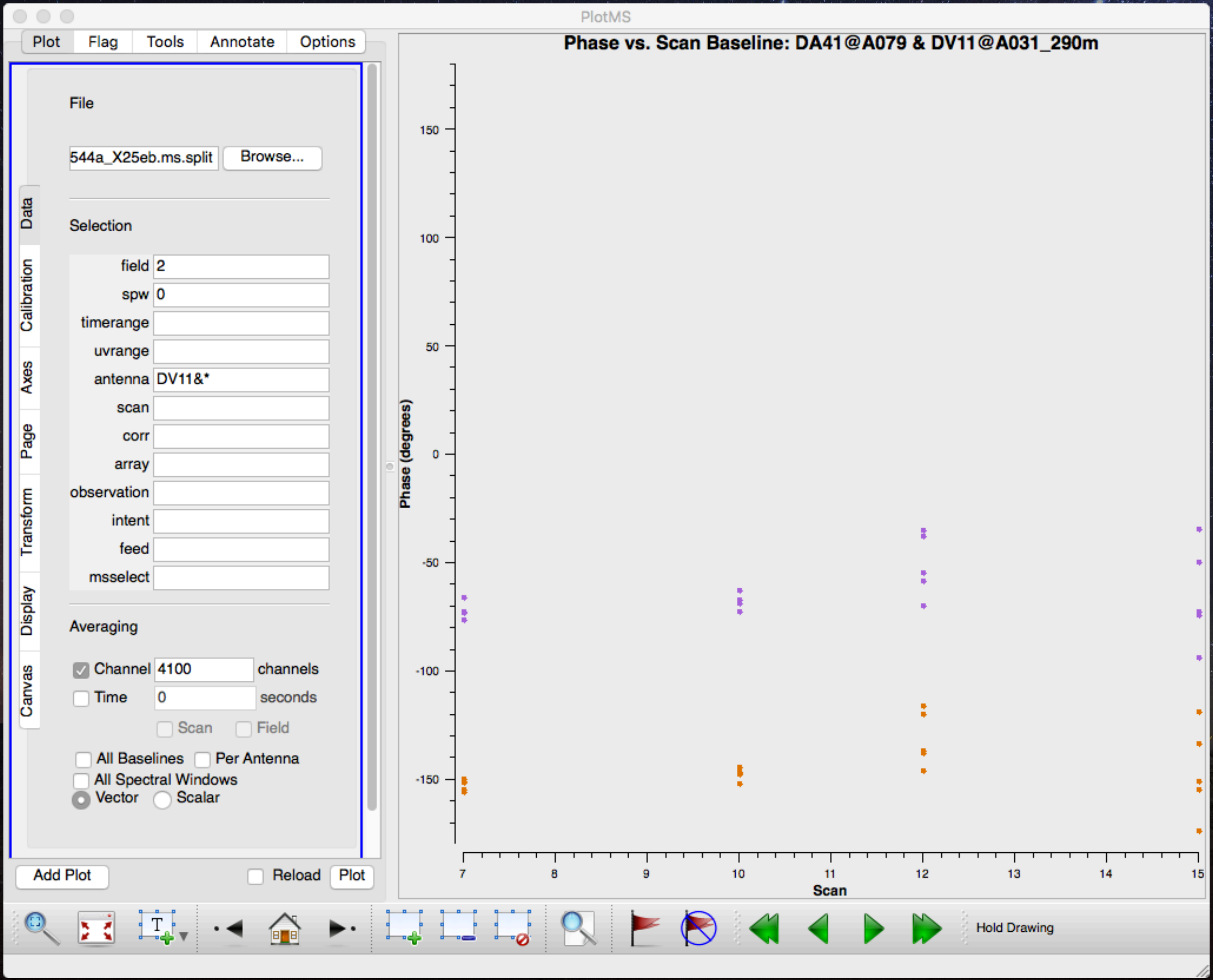
Data from the end channels will often appear either abnormally high or low. So will data from bad channels.

Additionally, atmospheric absorption features can be identified using these plots.

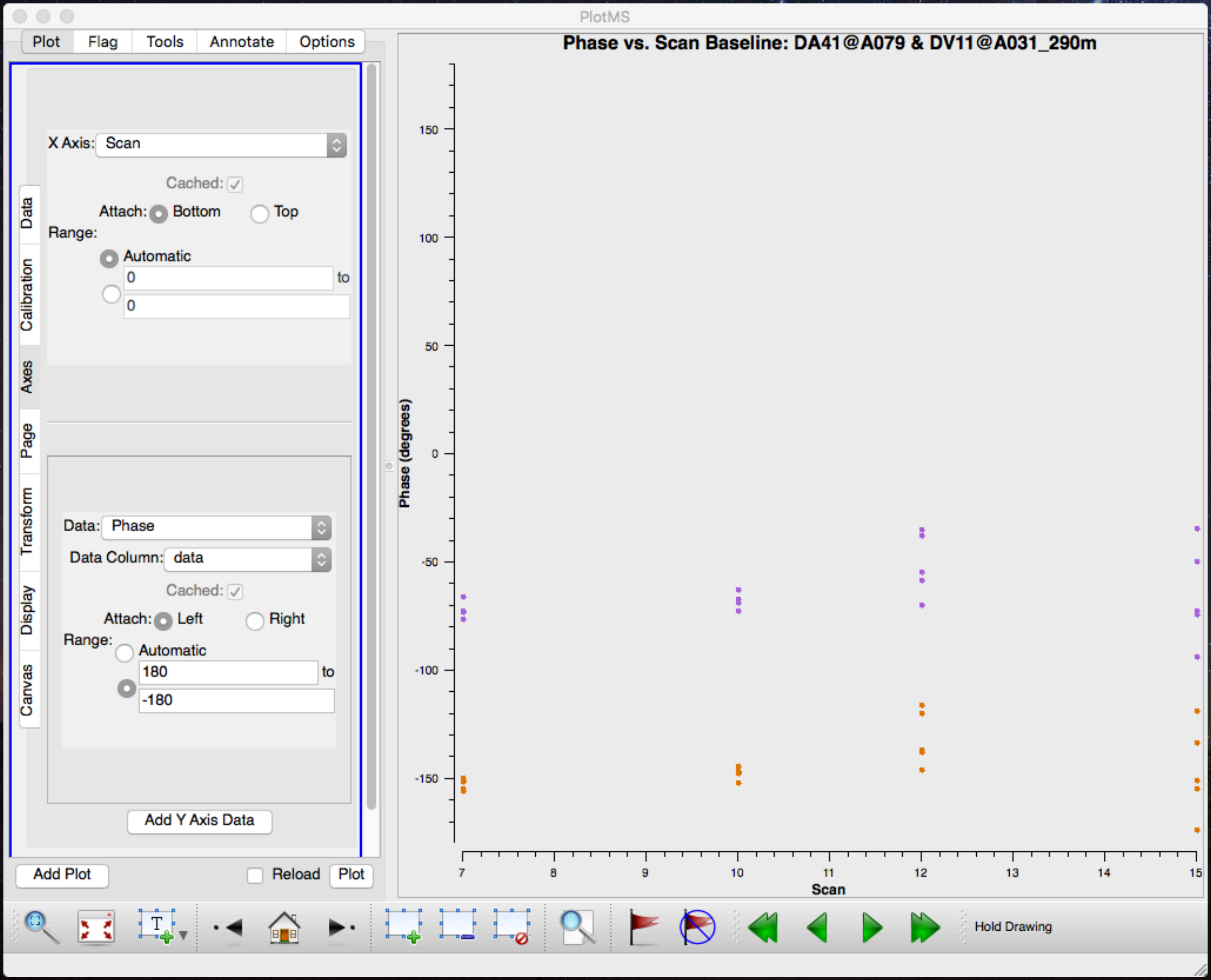

PlotMS
Plot
Flag
Tools
Annotate
Options
File
544a_X25eb.ms.split
Browse...
Selection
field 0
spw
timerange
uvrange
antenna
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel
channels
Time
1e+11
seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Amp vs. Channel Spw: 2
Amp
Channel
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Hold Drawing

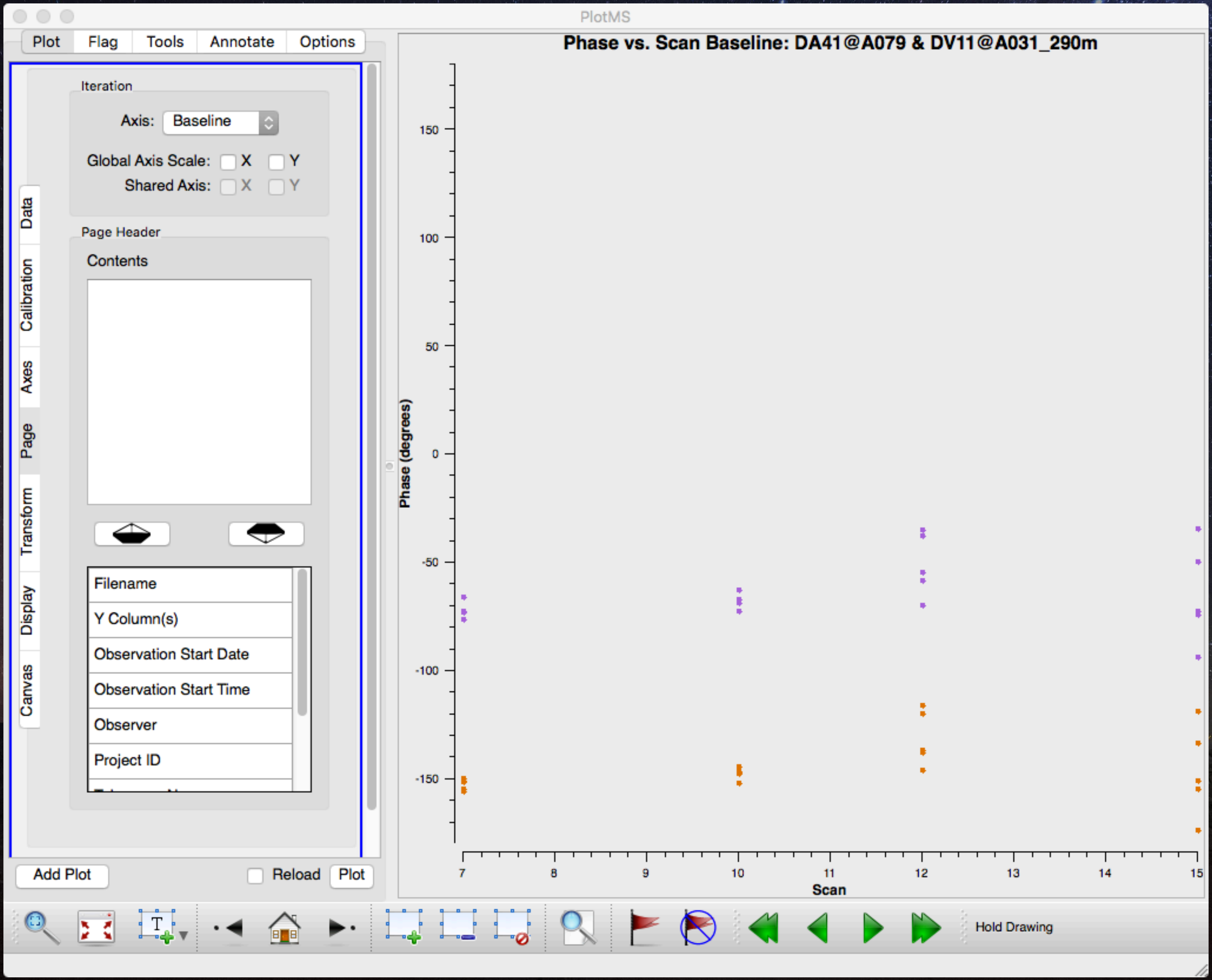
To check *phase versus scan*, set the following:

- Under the Data tab:
  - Set the file to the ms.split file created in step 8
  - Set the field to the number of the phase calibrator
  - Set the spw to one of the spw numbers (each one should be checked separately
  - Set the antenna to the reference antenna followed by "&*"
  - Set channel averaging to 4100
- Under the Axes tab:
  - Set the x-axis to Scan
  - Set the y-axis to Phase and set the range to 180 to -180
- Under the Page tab:
  - Set axis to Baseline
- Under the Display tab:
  - Set Colorize to Corr (which will produce different colours for the XX and YY data)

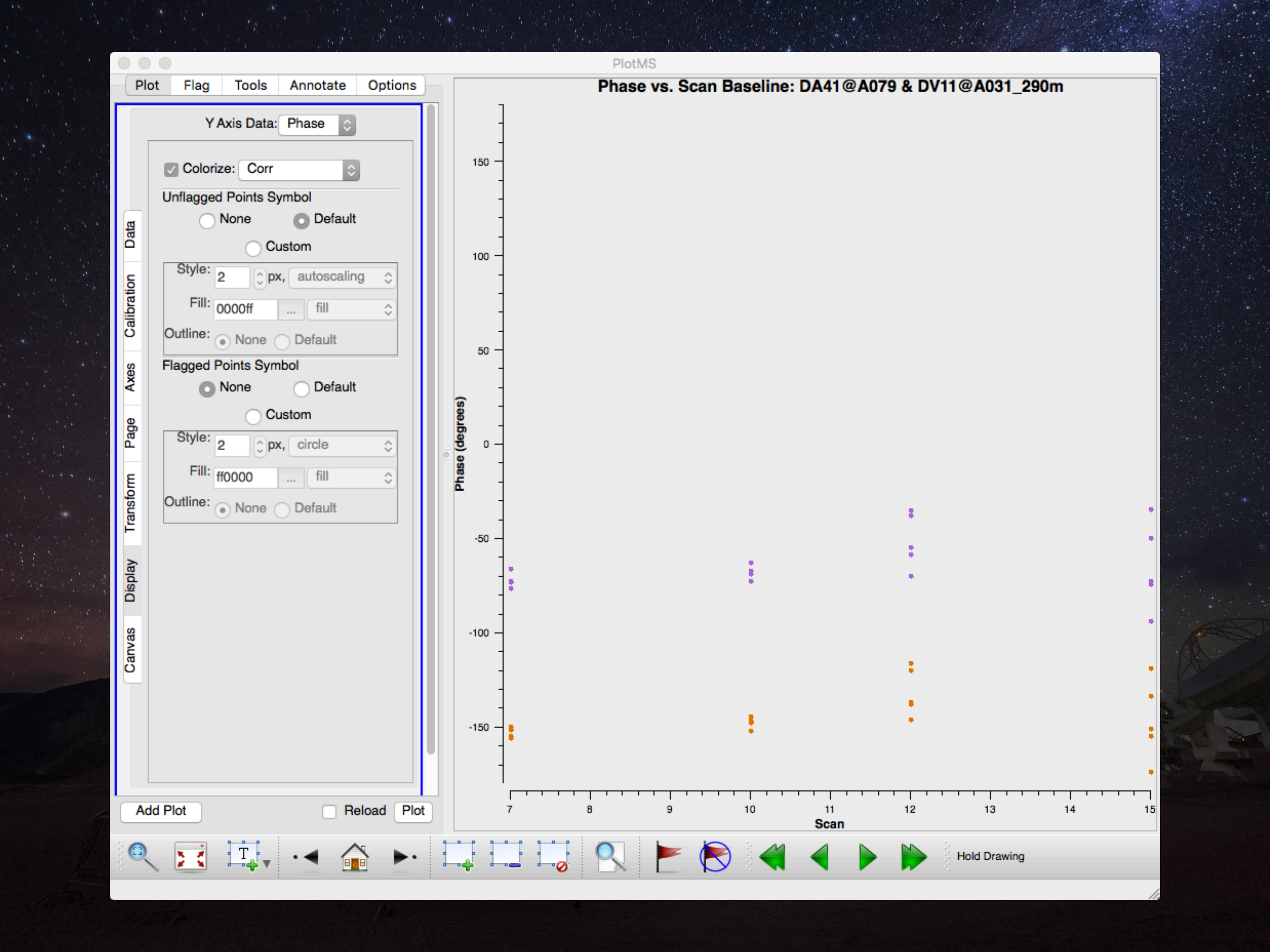


PlotMS
Plot
Flag
Tools
Annotate
Options
File
544a_X25eb.ms.split
Browse...
Selection
field 2
spw 0
timerange
uvrange
antenna DV11&*
scan
corr
array
observation
intent
feed
msselect
Averaging
Channel 4100 channels
Time 0 seconds
Scan
Field
All Baselines
Per Antenna
All Spectral Windows
Vector
Scalar
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Phase vs. Scan Baseline: DA41@A079 & DV11@A031_290m
Phase (degrees)
Scan
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
X Axis: Scan
Cached:
Attach: Bottom
Top
Range:
Automatic
0
to
0
Data
Calibration
Axes
Page
Transform
Display
Canvas
Data: Phase
Data Column: data
Cached:
Attach: Left
Right
Range:
Automatic
180
to
-180
Add Y Axis Data
Add Plot
Reload
Plot
Phase vs. Scan Baseline: DA41@A079 & DV11@A031_290m
Phase (degrees)
Scan
Hold Drawing



PlotMS
Plot
Flag
Tools
Annotate
Options
Iteration
Axis: Baseline
Global Axis Scale: X Y
Shared Axis: X Y
Page Header
Contents
Filename
Y Column(s)
Observation Start Date
Observation Start Time
Observer
Project ID
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Phase vs. Scan Baseline: DA41@A079 & DV11@A031_290m
Phase (degrees)
150
100
50
0
-50
-100
-150
7
8
9
10
11
12
13
14
15
Scan
Hold Drawing


PlotMS
Plot
Flag
Tools
Annotate
Options
Y Axis Data: Phase
Colorize: Corr
Unflagged Points Symbol
None
Default
Custom
Style: 2 px, autoscaling
Fill: 0000ff ... fill
Outline: None Default
Flagged Points Symbol
None
Default
Custom
Style: 2 px, circle
Fill: ff0000 ... fill
Outline: None Default
Data
Calibration
Axes
Page
Transform
Display
Canvas
Add Plot
Reload
Plot
Phase vs. Scan Baseline: DA41@A079 & DV11@A031_290m
Phase (degrees)
150
100
50
0
-50
-100
-150
Scan
7
8
9
10
11
12
13
14
15
Hold Drawing

In the phase versus scan plots, the phase data should look smooth enough that it should appear possible to interpolate between the phase calibration observations.

Data from bad scans will show abnormal scatter. (The data will also appear to have a high scatter if you forget to set the range for the y-axis).

Gradual changes in phases are acceptable, but if the phases change significantly (for example more than ~120 degrees) between phase calibrator observations, it may be necessary to flag the data from the antenna or baseline.

Step 11: Put a model for the flux calibrator into the measurement set

This step adds information indicating the flux density of one of the sources in the data (typically the amplitude calibrator, although a different source can be used if necessary).

Either a Solar System object or a quasar is used in this step.

The flux densities for Solar System objects are based on well-calibrated models (although the Ceres and Pallas models are suspect).

The quasar flux densities are based on a catalog of periodic measurements calibrated against Solar System objects.

Step 12: Save flags

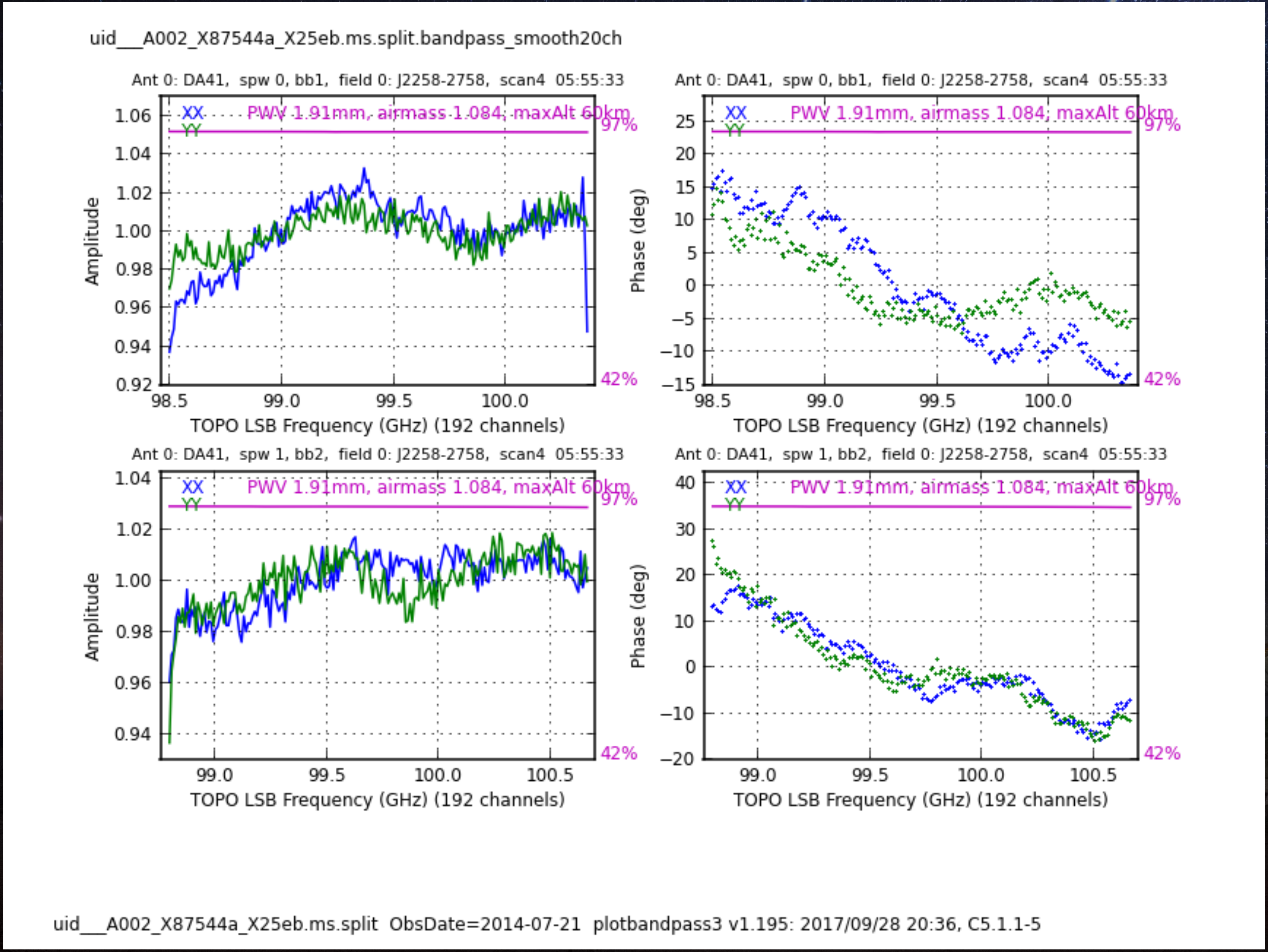
This is one of several steps where the flagging information is saved.

Step 13: Bandpass calibrations

In this step, variations in phase and amplitude versus channel are measured and stored in a bandpass calibration table.

The calibration source used for this is typically a very bright quasar with a featureless spectrum.

Before deriving the bandpass calibration, the phase variations versus time are measured in the bandpass calibration data.



uid___A002_X87544a_X25eb.ms.split.bandpass_smooth20ch
Ant 0: DA41, spw 0, bb1, field 0: J2258-2758, scan4 05:55:33
XX
YY
PWV 1.91mm, airmass 1.084, maxAlt 60km
97%
42%
Amplitude
Phase (deg)
TOPO LSB Frequency (GHz) (192 channels)
Ant 0: DA41, spw 1, bb2, field 0: J2258-2758, scan4 05:55:33
uid___A002_X87544a_X25eb.ms.split ObsDate=2014-07-21 plotbandpass3 v1.195: 2017/09/28 20:36, C5.1.1-5

Step 14: Save flags

This is one of several steps where the flagging information is saved.

Step 15: Gain calibrations

In this step, variations in phase and amplitude versus time are measured and stored in multiple calibration tables.

This step is complicated by the use of a resolved object as a flux calibrator. The Solar System object has more reliably-modelled fluxes, but the signal is not detected on some of the longer baselines.

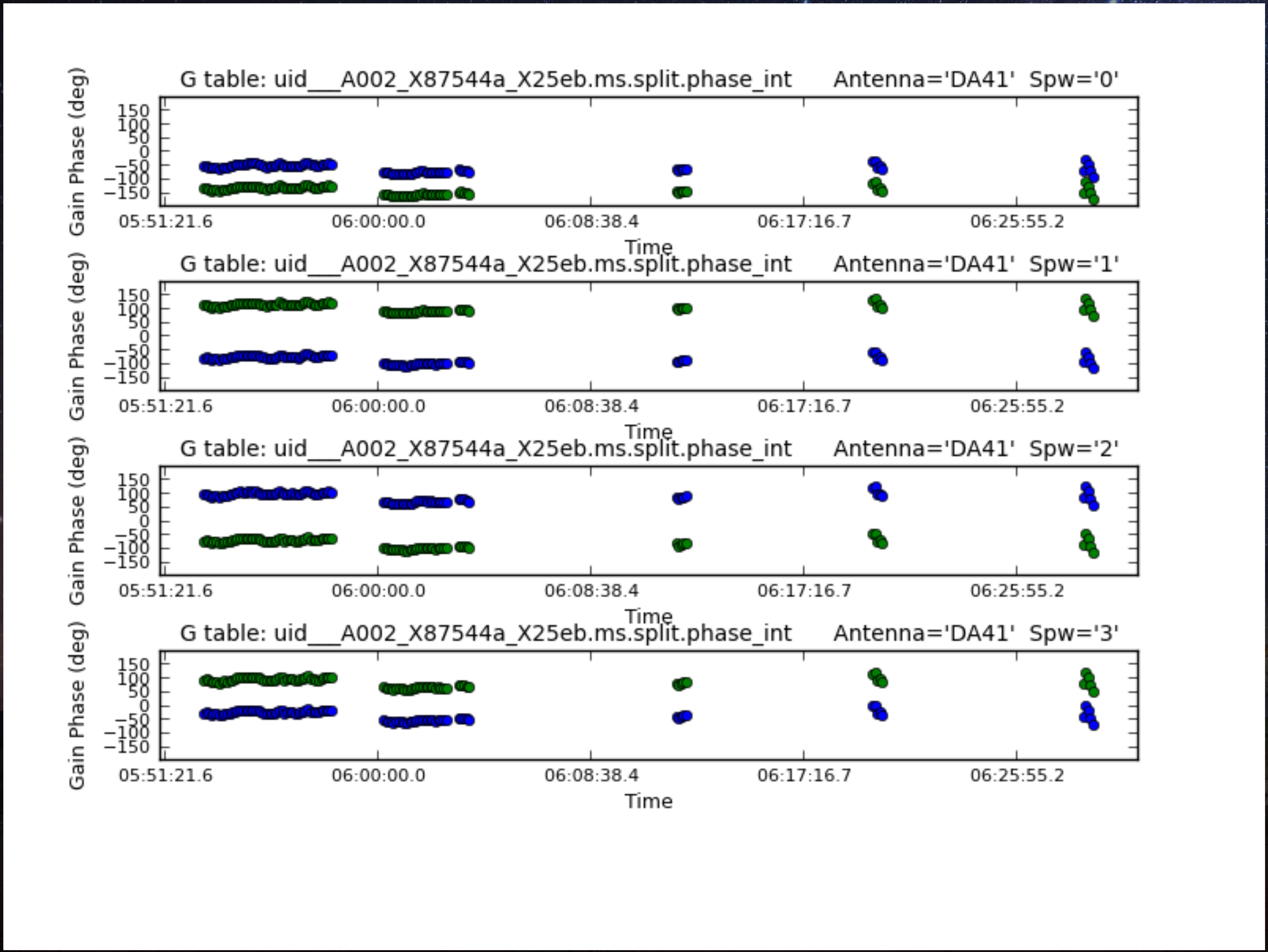
To properly calibrate the data, the flux calibration for the phase calibrator needs to be derived using the short baselines data for the flux calibrator. After that, the phase and amplitude calibration versus time can be derived for the science fields.

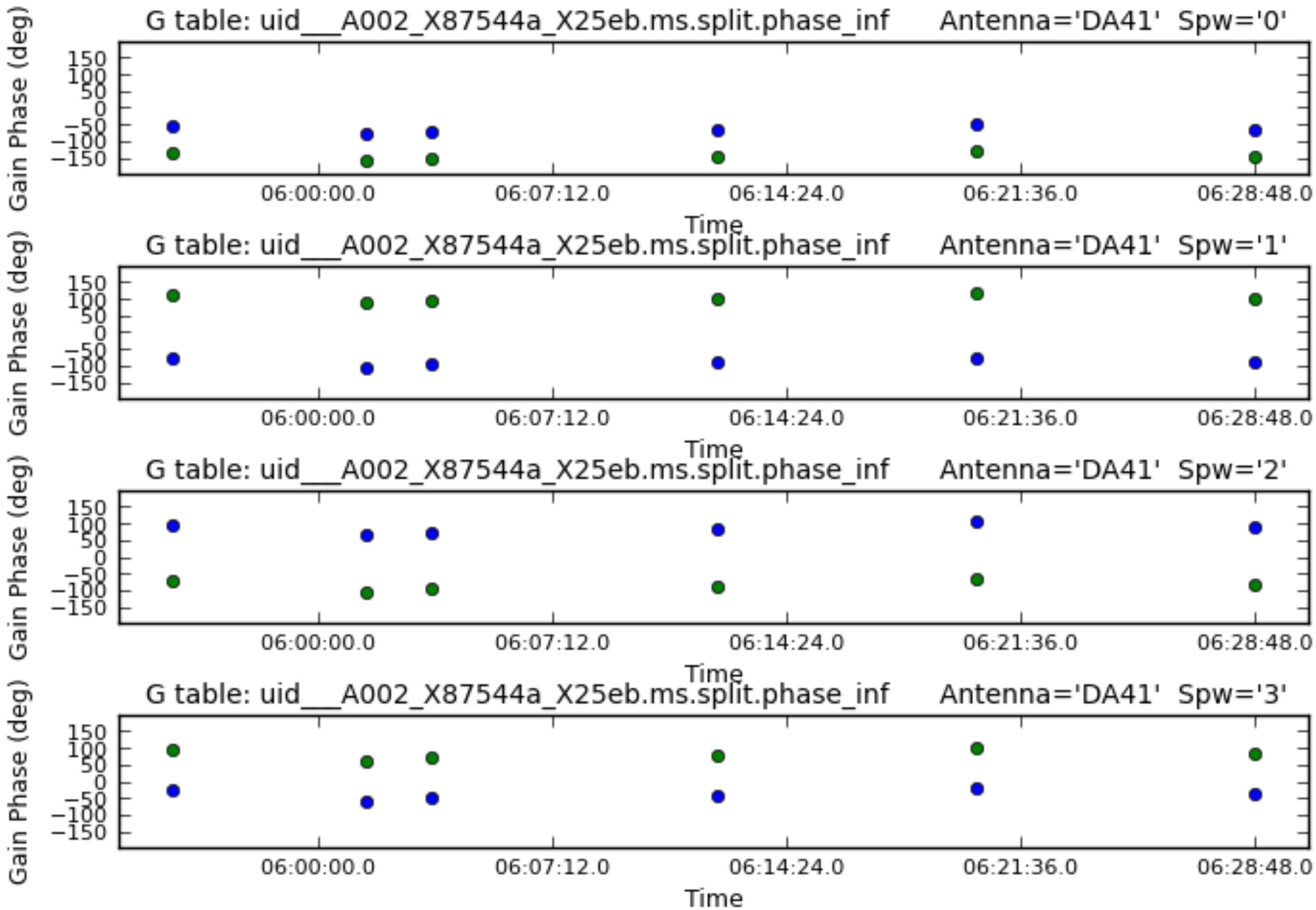
The first half of the steps used in this script are as follows:

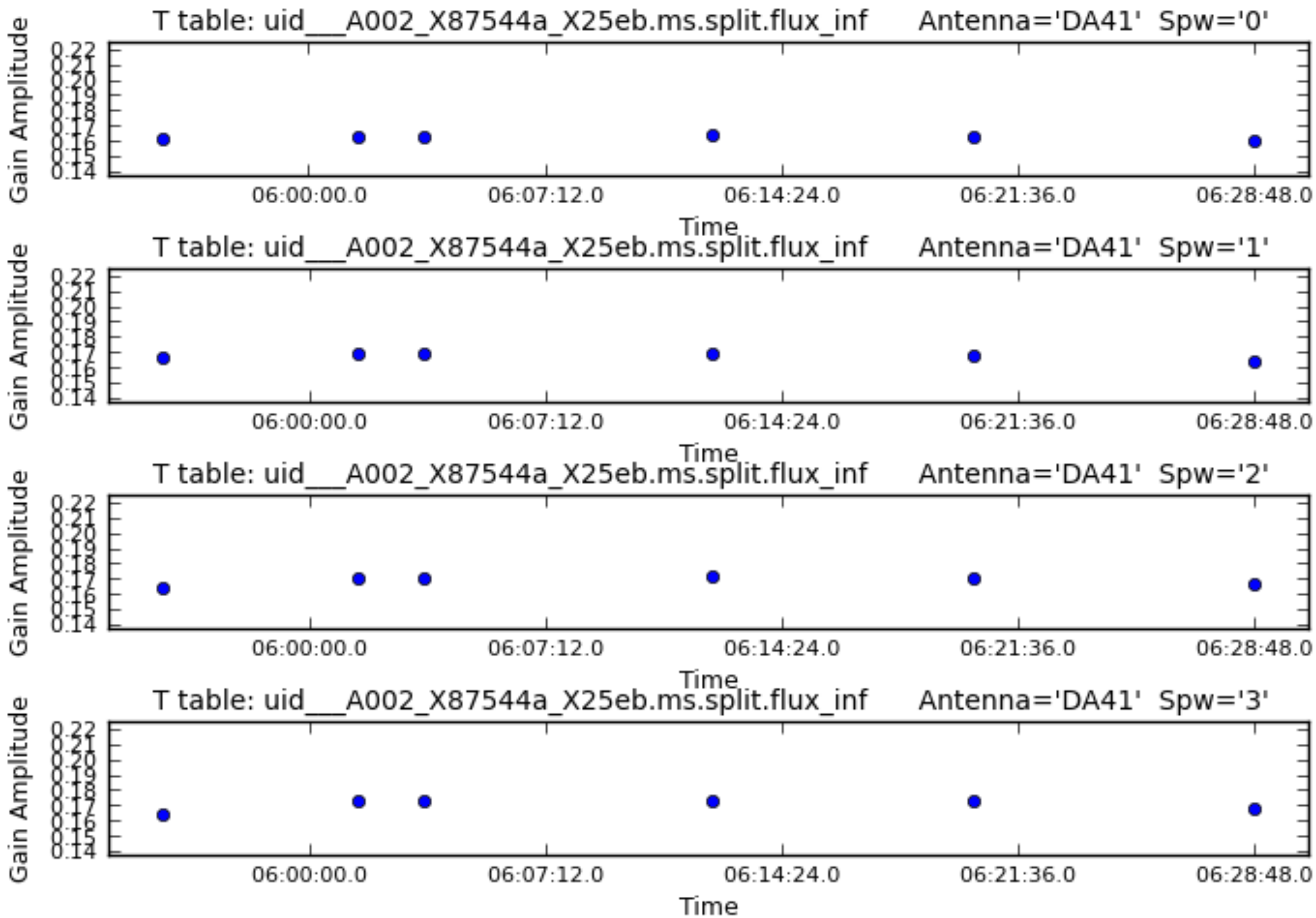
- The phase variations versus time are measured for every integration on short baselines
- The amplitude variations versus time are measured on short baselines
- The fluxes for the phase calibrator are rescaled using the amplitudes for the flux calibrator

The second half of the steps used in this script are as follows:

- The phase variations versus time are measured for every integration
- The amplitude variations versus time are measured
- The phase variations versus time are measured by averaging over each scan


G table: uid___A002_X87544a_X25eb.ms.split.phase_int Antenna='DA41' Spw='0'
G table: uid___A002_X87544a_X25eb.ms.split.phase_int Antenna='DA41' Spw='1'
G table: uid___A002_X87544a_X25eb.ms.split.phase_int Antenna='DA41' Spw='2'
G table: uid___A002_X87544a_X25eb.ms.split.phase_int Antenna='DA41' Spw='3'
Gain Phase (deg)
Time
05:51:21.6
06:00:00.0
06:08:38.4
06:17:16.7
06:25:55.2
150
100
50
0
−50
−100
−150


G table: uid___A002_X87544a_X25eb.ms.split.phase_inf Antenna='DA41' Spw='0'
G table: uid___A002_X87544a_X25eb.ms.split.phase_inf Antenna='DA41' Spw='1'
G table: uid___A002_X87544a_X25eb.ms.split.phase_inf Antenna='DA41' Spw='2'
G table: uid___A002_X87544a_X25eb.ms.split.phase_inf Antenna='DA41' Spw='3'
Gain Phase (deg)
150
100
50
0
−50
−100
−150
06:00:00.0
06:07:12.0
06:14:24.0
06:21:36.0
06:28:48.0
Time


T table: uid___A002_X87544a_X25eb.ms.split.flux_inf Antenna='DA41' Spw='0'
T table: uid___A002_X87544a_X25eb.ms.split.flux_inf Antenna='DA41' Spw='1'
T table: uid___A002_X87544a_X25eb.ms.split.flux_inf Antenna='DA41' Spw='2'
T table: uid___A002_X87544a_X25eb.ms.split.flux_inf Antenna='DA41' Spw='3'
Gain Amplitude
0.22
0.14
06:00:00.0
06:07:12.0
06:14:24.0
06:21:36.0
06:28:48.0
Time

Step 16: Save flags

This is one of several steps where the flagging information is saved.

Step 17: Application of the bandpass and gain calibration tables

The tables generated in steps 13 and 15 are applied to the data.

Step 18: Split out the corrected column

The fully corrected data are separated from the rest of the data and put into a new measurement set.

Step 19: Save flags

This is one of several steps where the flagging information is saved.