

4th LOFAR Data Processing School 2016

Tutorial 4

# Data reduction of International LOFAR observations in *AIPS*

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The only fundamental step in the LOFAR Long Baseline calibration that requires *AIPS* is the fringe-fitting, which is performed with task ‘FRING’. For completeness we will do the phase calibration, inspection of the solutions and the data, imaging, and self-calibration also in *AIPS*. This brief manual lists the main steps required to obtain an image from the data corresponding to observation id. L244445. Several steps have been conducted before generating the input FITS file. In particular we have flagged and averaged the data, calibrated the core and remote stations with the bright Dutch calibrator 3C196, we have form station TS001 by coherently adding the core stations, we have combined the 16 subbands in one single MS file, we have converted that file from linear to circular polarization, we have exported the data to a UVFITS file. We have removed the core stations (just to reduce the data volumn for this tutorial, we have fixed the data weights with FIXWT, and we have scaled the amplitudes of the international stations to a reasonable level.

It is important to remark that here we just present some hints to introduce the user to the *AIPS* work style, although further detailed and conscientious treatment would be required for a detailed data reduction. For a nearly complete explanation of the *AIPS* capabilities, the reader is referred to the *AIPS CookBook*. However, even the *CookBook* is not complete, and it has to be considered just as a guide or model, and to be completed with the specialized information detailed in the `explain` information of each task. The *AIPS* message (MSG) window should be checked for possible error messages

## 4.1 Accessing *AIPS*

Before entering *AIPS* it is useful to define an environment within the shell, before entering *AIPS*, that will be our working path, here we will use MYAREA, although it can be named elsehow:

```
> export MYAREA=$PWD
> export DATA='/data/scratch/DATASCHOOL2016_T4/'
> . /opt/cep/aips/LOGIN.SH
> aips tpok tv=local:0
```

Your ID number is 7XX, where XX is your user number (lods01–lods25). *AIPS* works with an internal data area for each user ID. To list the files loaded into *AIPS* you can write PCAT to see the whole file list of the current user (or UCAT for *uv*-files and MCAT for the images). The first time you access your ID number that list should be empty. The corresponding slot number of the file will be used hereafter to identify and apply any task to that file. We will use the input GETN followed by the slot number. In case we need to delete a file in the *AIPS* file system, we have to do:

```
> GETN i                to select the file to be removed
> ZAP                    to definitely delete the file (forever!)
```

Some parameter names are used by different tasks. If you do not set the parameters, the current value will be used. It is recommended to use DEFAULT to set the parameters for the current task to the default values to avoid using parameters with values used for other task. You can access a task, for instance FRING, in three ways:

```
> TASK 'FRING'          Uses current parameters
> TGET FRING            Sets the parameters from the last call to that task
> DEFAULT FRING         Loads the default parameters for that task
```

To review the list of parameters, read the documentation, or run a task, you can use, respectively:

```
> INP FRING             or simply INP
> EXPLAIN FRING        or simply EXPLAIN
> GO FRING              or simply GO
```

Finally, to exit *AIPS* and close all the windows use:

```
> KLEENEX
```

## 4.2 Loading and inspecting data

We are going to load the fits file L244445\_J0834+5534.T4.UVDATA.FITS, located in the directory \$D defined above before entering *AIPS*.

**FITLD** Loads data form UVFITS files into *AIPS*

- > TASK 'FITLD'; DEFAULT select the task with default parameters
- > DATAIN 'MYAREA:<filename>' let the inverted commas opened to read lower-case
- > OUTNAME 'L244445' name of the output file within *AIPS*
- > GO FITLD to run the program and load the data

- ✓ Where *filename* is L244445\_J0834+5534.T4.UVDATA.FITS
- ✓ Check the message (MSG) window for additional information on how the task is executed, possible errors and warnings.

Once the data is loaded it will be assigned the first slot number. We can select the file and see its header by doing:

- > PCAT list the whole file list
- > GETN 1 to specify the input file
- > IMHEADER show some file properties

```
AIPS 1: Image=MULTI      (UV)      Filename=L244445      .UVDATA.      1
AIPS 1: Telescope=LOFAR      Receiver=LOFAR
AIPS 1: Observer=unknown      User #= 500
AIPS 1: Observ. date=25-SEP-2014      Map date=19-NOV-2014
AIPS 1: # visibilities      829294      Sort order TB
AIPS 1: Rand axes: UU-L VV-L WW-L TIME1 BASELINE SOURCE INTTIM
AIPS 1: -----
AIPS 1: Type      Pixels      Coord value      at Pixel      Coord incr      Rotat
AIPS 1: COMPLEX      3      1.0000000E+00      1.00      1.0000000E+00      0.00
AIPS 1: STOKES      4      -1.0000000E+00      1.00      -1.0000000E+00      0.00
AIPS 1: FREQ      64      1.4284515E+08      32.00      4.8828125E+04      0.00
AIPS 1: IF      1      1.0000000E+00      1.00      1.0000000E+00      0.00
AIPS 1: RA      1      08 34 54.904      1.00      3600.000      0.00
AIPS 1: DEC      1      55 34 21.070      1.00      3600.000      0.00
AIPS 1: -----
AIPS 1: Coordinate equinox 2000.00
AIPS 1: Rest freq      0.000      Vel type: OPTICAL wrt YOU
AIPS 1: Alt ref. value      0.000000E+00 wrt pixel      32.00
AIPS 1: Maximum version number of extension files of type HI is      1
AIPS 1: Maximum version number of extension files of type FQ is      1
AIPS 1: Maximum version number of extension files of type AN is      1
```

```

AIPS 1: Maximum version number of extension files of type CL is 1
AIPS 1: Maximum version number of extension files of type SU is 1
AIPS 1: Maximum version number of extension files of type XX is 1
AIPS 1: Maximum version number of extension files of type NX is 1

```

- ✓ Check the number of stokes, frequency channels, IF (=subbands), source coordinates.
- ✓ The important tables: CL - calibration, SN - solution, FG - flags, AN - antenna list.

**LISTR** To acquire the list of scans and other general information as frequency, source names, scan structure, and times.

```

> TASK 'LISTR'; DEFAULT    load task with default values
> GETN 1                    to specify the input file
> OPTY 'scan'              to list the scan of the current file
> GO LISTR                  to run the program and list the project scans

```

- ✓ How many scans are observed? What is their duration? And the total project time?
- ✓ Identify the source name (only one source, named BEAM\_4)
- ✓ Search all the frequency subbands observed (only 1 in this case)

```

File = L244445      .UVDATA.    1 Vol = 1  Userid = 500
Freq = 0.142845154 GHz  Ncor = 4  No. vis = 829294
Scan summary listing

```

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID	START
1	BEAM_4	: 0000		1	0/07:30:02 - 0/08:29:59	1	1
2	BEAM_4	: 0000		1	0/08:30:03 - 0/09:30:00	1	206740
3	BEAM_4	: 0000		1	0/09:30:04 - 0/10:30:01	1	414188
4	BEAM_4	: 0000		1	0/10:30:05 - 0/11:29:58	1	621857

Source summary

Velocity type = ' ' Definition = ' '

ID	Source	Qual	Calcode	RA(2000.0)	Dec(2000.0)	No. vis
1	BEAM_4	: 0000		08:34:54.9040	55:34:21.070	829294

ID	Source	Freq(GHz)	Velocity(Km/s)	Rest freq (GHz)
1	All Sources	0.1428	0.0000	0.0000

Frequency Table summary

FQID	IF#	Freq(GHz)	BW(kHz)	Ch.Sep(kHz)	Sideband	Bandcode
1	1	0.14284515	3125.0002	48.8281	1	

---

**PRTAN** To print the AN table, in order to list the corresponding antenna numbers and information about their position we can use this task.

```
> TASK 'PRTAN'; DEFAULT    load task with default values
> GETN 1                    to specify the input file
> INVER 1                   number version of the table to copy
> GO PRTAN                  to run the program and print the list of antennas
```

```
Ant  1 = RS106HBA BX= 3827528.8700 BY= 473231.4485 BZ= 5064054.3288
Ant  2 = RS205HBA BX= 3829802.9420 BY= 467576.4445 BZ= 5062863.2298
Ant  3 = RS208HBA BX= 3846076.5820 BY= 471051.7245 BZ= 5050270.5708
Ant  4 = RS210HBA BX= 3876150.8338 BY= 471625.5204 BZ= 5027318.9108
```

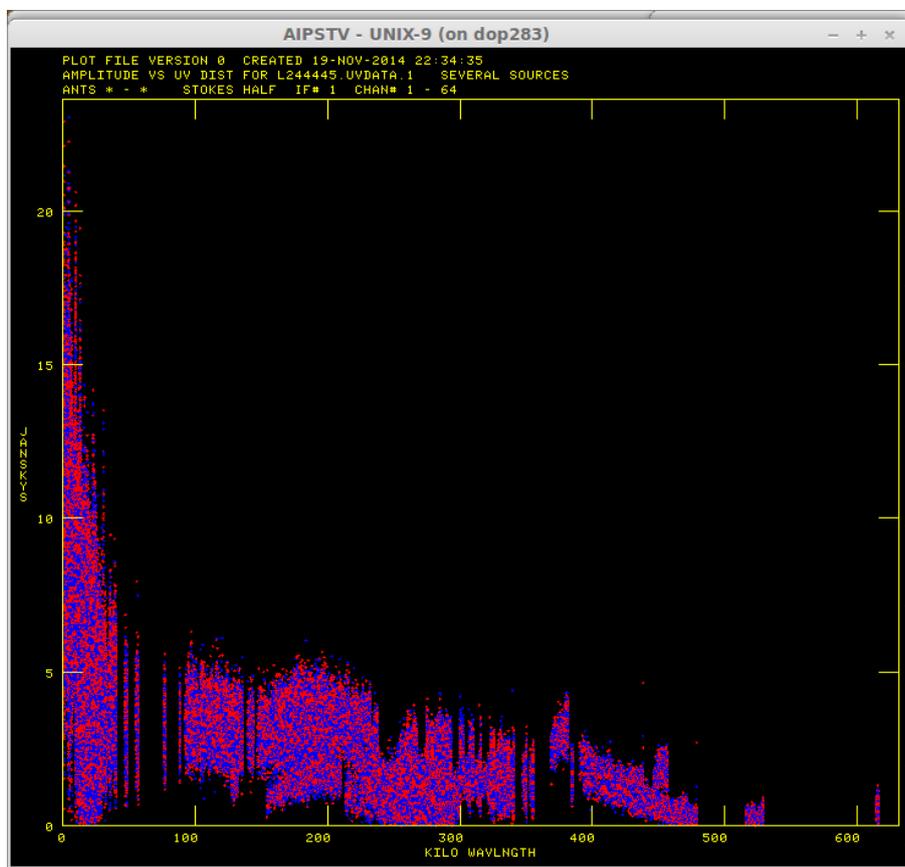
- ✓ Identify which antenna numbers correspond to Remote Stations (RS)
- ✓ Identify which antenna numbers correspond to International stations
- ✓ Identify which antenna numbers correspond to Core Stations (CS)
- ✓ Identify which antenna number correspond to the tied station (TS)
- ✓ Remember or annotate them

### 4.3 Tools for data examination

**UVPLT** We can use the AIPS\_TV to plot the visibilities as a function of time or *uv*-distance.

> TASK 'UVPLT'; INP	to review the inputs
> GETN 1	to specify the input file
> UVRANGE 0, 0	to select the <i>uv</i> -range. Set 0 to whole range
> TIMER 0	corresponding time range. 8 values for initial and final time. 0 to use all the times
> STOKES 'HALF'	Can also select RR, LL, LR, LR, I
> BIF 0; EIF 0	first and last IF to plot. Set 0 to whole range
> BCHAN 0; ECHAN 0	first and last baseband channel to plot. Set 0 to all
> NCHAV 64	To average all channels together
> ANTEN 0; BASEL 0	list of antenna combination to plot
> DOCAL 2	to apply the CL calibration to the data
> GAINUSE 1	CL version to apply
> XINC 5	XINC <i>n</i> will plot 1 visibility every <i>n</i> . Use 10 if the plot is too slow
> BPARM 0	X and Y axis. Set 11, 0 to amp vs time. Set 0 to amp vs <i>uv</i> -dist. Set 6, 7, 2, 0 to <i>uv</i> -coverage
> DO3COL 1	to activate multiple color plots for IF/Channels
> DOTV 1	plot on TV
> GO UVPLT	to run the program and plot the data

- ✓ What is the longest baseline?
- ✓ Can you identify the RS-RS baselines? Use `UVRANGE 0, 60` to see them better.
- ✓ Set `ANTEN 45 0` to see only baselines to the TS001 station.
- ✓ You can fix the scale by setting `BPARAM 0, 0, 1, 0, 600, 0, 15, 0`.
- ✓ Now plot `ANTEN 1, 0` (a remote station). Can you see the difference in the dispersion with respect to TS001?
- ✓ Now plot only the international-international baselines by setting  
`ANTEN 15,16,17,18,19,20,21,22`, and  
`BASEL 15,16,17,18,19,20,21,22`
- ✓ How long is the shortest Int-Int baseline?
- ✓ Now plot only the RS-RS baselines by setting  
`ANTEN 1,2,3,4,5,6,7,8,9,10,11,12,13,14`, and  
`BASEL 1,2,3,4,5,6,7,8,9,10,11,12,13,14`
- ✓ How long is the longest RS-RS baseline?
- ✓ You can repeat all the previous steps but plotting phases vs uv-distances. Set:  
`BPARAM 0, 2, 1, 0, 600, -180, 180, 0`. You can see that for the RS there is some structure. Are you convinced now that the phases look messy at long baselines?
- ✓ You can do a uvplot by setting `BPARAM 6, 7, 2, 0` including all the stations. Can you see that the longest baselines are more scarce than the shorter ones?



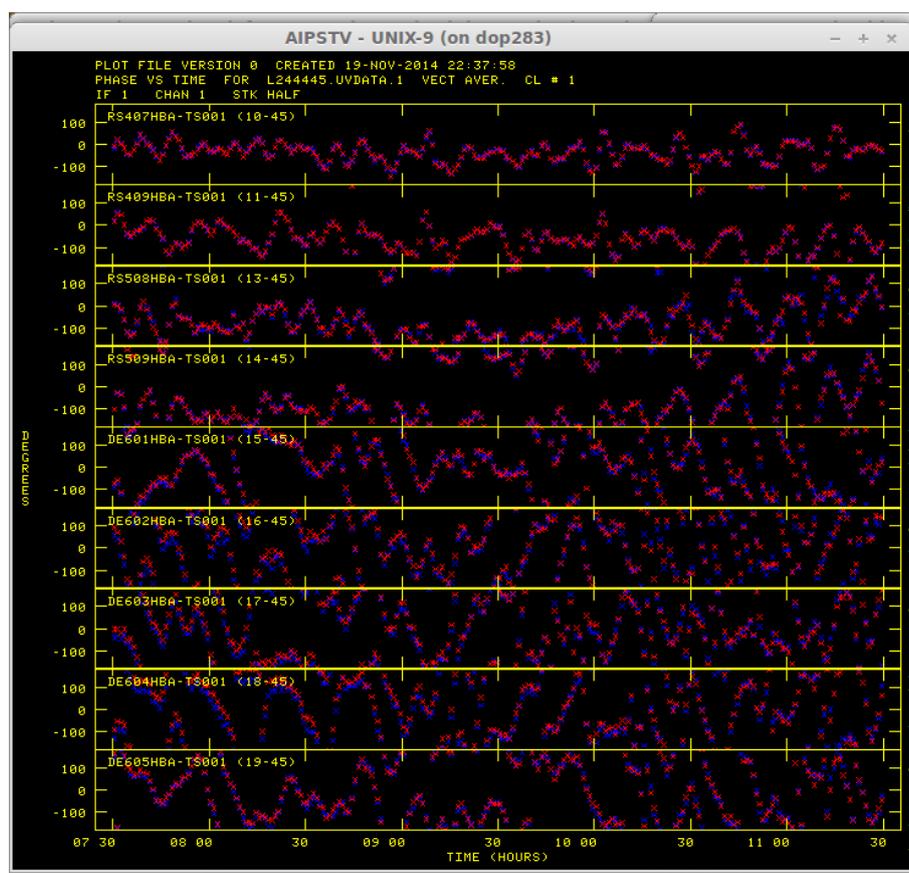
**V PLOT** This task is very useful to plot the phases versus time for every baseline with the reference antenna. It can also plot the model of a CLEAN image.

```

> TASK 'V PLOT'; DEFAULT      select the task with default parameters
> GETN 1                      to specify the input file
> TIMER 0                    corresponding time range. 8 values for initial and
                             final time. 0 to all the times
> STOKES 'HALF'              Can select RR, LL, LR, LR, I
> ANTEN 45                   usually set the reference antenna
> BASEL 0                    list of baselines to plot
> DOCAL 2                    to apply the CL calibration to the data
> GAINUSE 1                  CL version to apply
> SOLINT 1                   time interval to average in minutes.
> APARM 0                    default. Can set list values to flag points
> BPARAM 0, 2, 1, 0, 0, -180, 180, 0
                             plot parameters for phase plot vs time with fixed
                             angle range. Set 0, 1, 0 for amplitude and 0, -1, 0
                             for both
> NPLOTS 9                   maximum number of plots per page (one for each
                             baseline)
> DOTV 1                     plot on TV. Set -1 to make a PL plot
> GRCHAN 1                   select the graphic channel, 0-8 (to superimpose
                             plots)
> DO3COL 1                   to activate multiple color plots for IF/Channels
> TVINI                      to clean the TV server
> GO V PLOT                  to run the program and plot the phases

```

- ✓ Look at the MSG server! To proceed with more baselines you have to press B or C. D to finish.
- ✓ You can change SOLINT to average less or more data in time.
- ✓ Note how fast the phases with International Baselines change with time. Specially at the end of the observation, after 10:00 UTC.
- ✓ You can zoom on a shorter time by using TIMER 0, 8, 30, 00, 0, 9, 30, 00. If you can follow the phases is because this source is bright.



**POSSM** Now we can plot the amplitude and phases vs frequency.

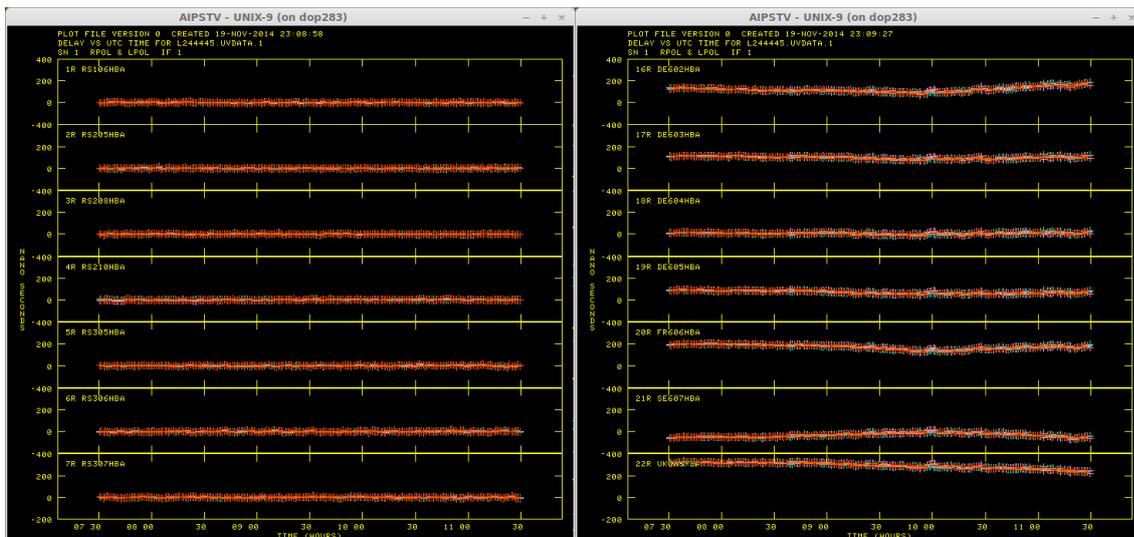
- |                         |   |
|-------------------------|---|
| > TASK 'POSSM'; DEFAULT | select the task with default parameters   |
| > GETN 1                | to specify the input file   |
| > TIMER 0               | corresponding time range. 8 values for initial and final time. 0 to all the times |
| > STOKES 'HALF'         | Can select RR, LL, LR, LR, I  |
| > BCHAN 0; ECHAN 0      | plotting whole range is recommended   |
| > ANTEN 45, 0           | list of reference antennas to plot  |
| > BASEL 0               | combination of antennas to plot   |





- > ANTEN 0 list of antennas to plot
- > PIXRANGE -150e-9,350e-9 set the range of the Y axis
- > NPLOTS 7 number of plots per page
- > OPTYPE 'DELA' plots delays. Also possible: AMP, DELA, MDEL, RATE
- > OPCODE 'ALSI' to plot the two polarizations together
- > DOTV 1 plot on TV
- > D03COL 1 to activate multiple color plots for IF/Channels
- > TVINI to clean the TV server
- > GO SNPLT to run the program and plot the table values

- ✓ In these plot we see the residual delays corrected by FRING.
- ✓ The RS have values of  $\pm 10$  ns. The international stations have values up to 300 ns, with variability of about 30 ns per hour.
- ✓ You can use PIXRANGE 0 to better see the small-scale variations of the differential delay at each station.



**CLCAL** The FRING solutions are in solution table SN1. To be applied the corrections to the data, the solutions have to be transferred to a CL table using task CLCAL. We combine the previous calibration CL1 with the FRING solutions SN1 to produce a new calibration table CL 2.

- > TASK 'CLCAL'; DEFAULT select the task with default parameters
- > GETN 1 to specify the input file
- > OPCODE 'CALI' to calibrate the data
- > INTERPOL 'CUBE' fit third order polynomial to phases and rates
- > SNVER 1 input SN table containing solutions to be interpolated

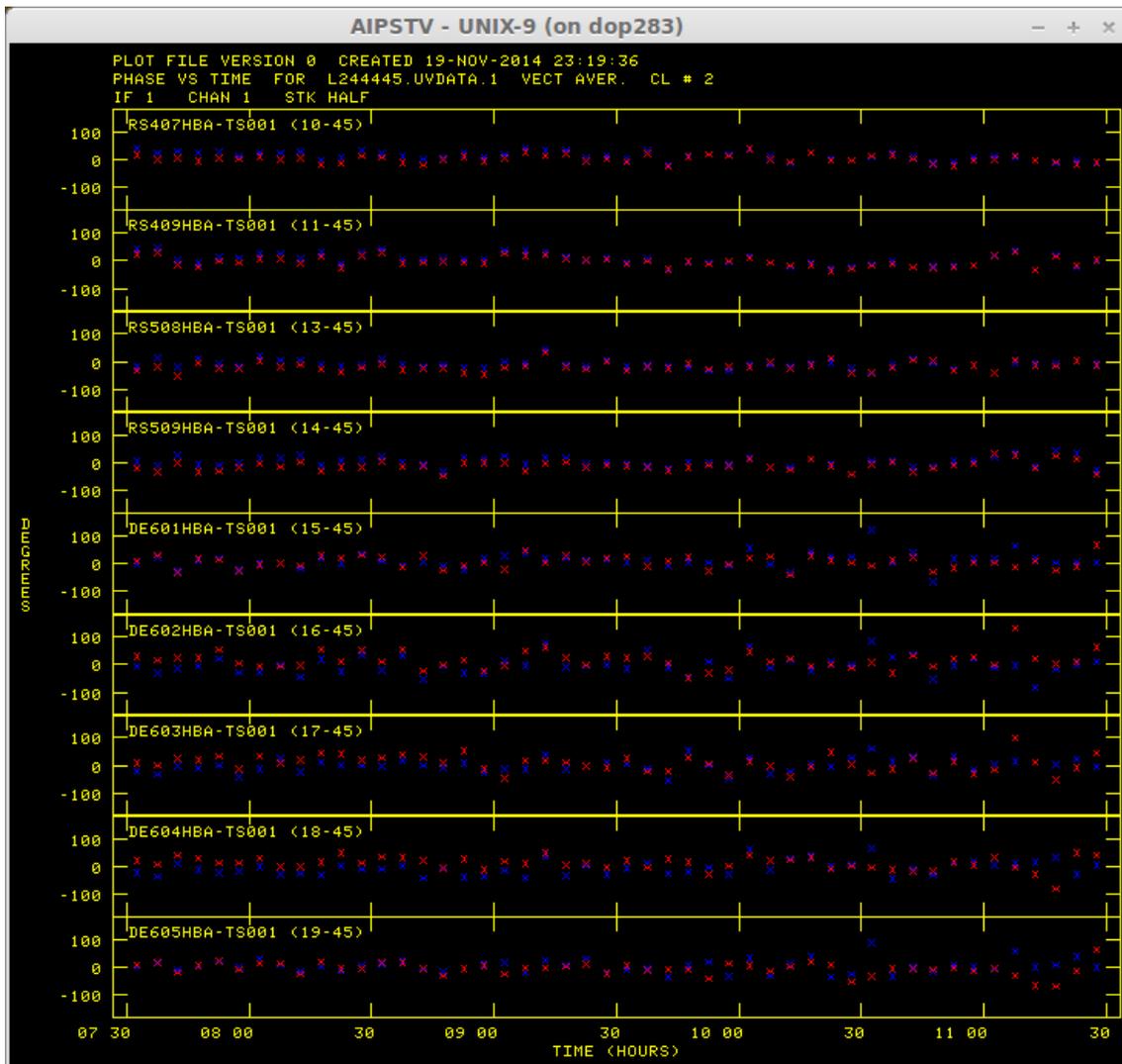
- 
- > GAINVER 1                   input CLversion to which solutions are to be applied
  - > GAINUSE 2                   output CL version with updated calibration information
  - > REFANT 45                   select the number of the reference antenna
  - > GO CLCAL                    to run the program and apply the SN solutions to the CL

- ✓ The warning is not important.
- ✓ Note the message: “Applying SN tables to CL table 1, writing CL table 2”.

**V PLOT** Now let’s check how the phases have improved. Against time:

- > TASK ‘V PLOT’; DEFAULT    select the task with default parameters
- > GETN 1                    to specify the input file
- > STOKES ‘HALF’             Can select RR, LL, LR, LR, I
- > ANTEN 45                  usually set the reference antenna
- > BASEL 0                   list of baselines to plot
- > DOCAL 2                   to apply the CL calibration to the data
- > GAINUSE 2                 CL version to apply
- > SOLINT 5                  time interval to average in minutes.
- > BPARAM 0, 2, 1, 0, 0, -180, 180, 0  
                             plot parameters for phase plot vs time with fixed angle range. Set 0, 1, 0 for amplitude and 0, -1, 0 for both
- > NPLOTS 9                 maximum number of plots per page
- > DOTV 1                    plot on TV. Set -1 to make a PL plot
- > GRCHAN 1                 select the graphic channel, 0–8 (to superimpose plots)
- > DO3COL 1                 to activate multiple color plots for IF/Channels
- > TVINI                     to clean the TV server
- > GO V PLOT                 to run the program and plot the phases

- ✓ You can compare the phases before the calibration by setting `GAINUSE 1`.
- ✓ The phases are around 0, although there is still a high dispersion. That can be improved with self-calibration, where the source structure is also taken into account.
- ✓ You can also plot the phases vs  $uv$ -distance using `UVPLT`.



When you are happy with the calibration and editing of your multi-source file, the task `SPLIT` can be used to apply the `CL`, `FG`, `BP`, ... tables and to write an  $uv$ -file containing the data for only one source.

**SPLIT** When you are happy with the calibration and editing of your, you can apply the `CL`, `FG`, etc., tables to the data itself, and to obtain a data file ready to be imaged.

- > `TASK 'SPLIT'; DEFAULT` select the task with default parameters
- > `GETN 1` to specify the input file

```
> DOCAL 2           to apply the last calibration
> GAINUSE 2         CL table to use
> APARAM 2, 0      all channels will be averaged in the output.
> GO SPLIT          to run the program
```

- ✓ Run PCAT and check that the splitted file is created in catalog slot number 2. From now on, to select that file you will need to use GETN 2. Do also IMH on that file to see that the number of frequency channels is now 1, and the number of visibilities is much smaller.

**FITTP** We note that once the phase calibration has been conducted with FRING, the next steps can be conducted in any other imaging program, like CASA, Difmap, AWMImager, Miriad, etc. You can export the split file as a FITS file to be used anywhere where.

```
> TASK 'FITTP'; DEFAULT  select the task with default parameters
> GETN 2                 to specify the input uv-file
> DATAOUT 'MYAREA:<filename>' output file
> GO FITTP               to run the program and export the file
```

## 4.5 Imaging the data

The *uv*-data have to be Fourier-transformed to derive the brightness distribution of the source and obtain an image. The algorithm to deconvolve the dirty map iteratively subtracts the dirty beam pattern from the brightest points of the map, obtaining a residual dirty map. Each iteration subtracts one pattern at one position of the sky, and that position and flux density is stored temporarily in what we call clean component. This cleaning process is repeated until the residual dirty map is smooth and featureless (all noise, and no more sources). In a final step, the temporary map that contains the clean components has to be convolved with an idealized interferometer beam (equivalent to the diffraction pattern), which is a two-dimensional Gaussian function with the FWHM of the dirty beam. The combination of the residual map and the convolved clean components provides the final recovered flux density distribution, it is to say, the image. **IMAGR** is the task that performs all this process.

**IMAGR** This task applies the deconvolution algorithm (CLEAN). It will generate a dirty (IBM) and a clean (ICLN) image, which contains a Clean Component CC table.

```

> TASK 'IMAGR'; DEFAULT      select the task with default parameters
> GETN 2                     to specify the input uv-file
> CELLSIZE 0.04              x,y pixel size, in arcsec.
> IMSIZE 1024                x,y size of the field to clean, in pixels. It must be
                             2n
> UVRANGE 10, 0             uv-range to image. Set 0 for full range
> UVTAPER 120, 120          Gaussian taper (kilo-lambda) at 30% level
> ROBUST -2                  weighting scheme parameter. Positive is natural
                             weighting and negative is uniform weighting
> NITER 1000                 max. number of CC. You can stop before reaching
                             it. Choose more if the final map is not clean enough
> GAIN 0.05                  loop gain parameter. Small is good for complex
                             sources
> FLUX 30e-3                 minimum flux to clean, in Jy
> CMETHOD 'DFT'           uses more accurate method, Direct Fourier Trans-
                             form
> DOTV 1                     to interactively clean the map using the AIPS.TV
> GO IMAGR                   to run the program and obtain an image

```

- ✓ You can clean interactively in the AIPS\_TV window. You can also run it automatically by setting DOTV -1
- ✓ Use Continue Cleaning to begin a new cycle. Left-click on it, and press A, B, C (the instructions are always displayed in the MSG server).
- ✓ You can use TVBOX to limit where to find clean components (CC).

In the MSG server search lines similar to these ones:

```
DOP283> IMAGR1: Total Cleaned flux density = 3.029 Jy 1000 comps
DOP283> IMAGR1: Fit Gaussian FWHM = 1.462 x 0.984 arcsec, PA= 71.4
DOP283> IMAGR1: Reached minimum algorithm flux = 1.179 Jy iter= 17
```

- ✓ Do PCAT to check that the two new files are created. (CC). You can simply display the image in the AIPS\_TV by doing:

```
> DEFAULT TVLOD          to clean the TV server
> TVINI                  to clean the TV server
> GETN 4                 to specify the input image
> GO TVLOD               load the image
> TVPS                   uses color scale for better location of sources. Press
                        D to exit
```

**KNTR** This task generates contour plots. It can also produce grey-scale images, or both together.

```
> TASK 'KNTR'; DEFAULT  select the task with default parameters
> GETN 4                 to specify the input image file
> DOCONT 1               plot contours
> DOGREY -1              not to plot grey-scale
> DOVECT -1              not to plot polarization vectors
> BLC 0                  coordinates of the bottom left corner (in pixels)
> TRC 0                  coordinates of the top right corner (in pixels)
> CLEV 10e-3             set the rms of the map as a reference flux to contour
> LEVS=-3 3 4.2, 6, 8.5, 12, 17, 24, 34, 48, 68, 96, 136, 192, 271
>                         contour levels to plot, in ascending order
> DOTV 1                 plot on TV. Set -1 to make a PL plot
> GO KNTR                to run the program and plot the contour map
```

- ✓ Above the image, some information about the image is displayed. Below the image you will see some additional information.

## 4.6 Self-calibration

To improve the quality of the image of a source bright enough we can self-calibrate the *uv*-data. To do so, we use the **Clean Components** from a cleaned image as an initial model to determine the phase or amplitude calibration. The strategy consist of running the task **CALIB** over the `split` file, using as a model the CCs from the last image. This generates an **CALIB** file that can be cleaned again

**CALIB** Because the delays have already been calibrated with **FRING** the residual delays are small, and we can do a normal calibration. We first calibrate the phases.

```
> TASK 'CALIB'; DEFAULT    select the task with default parameters
> GETN 2                   to specify the input uv file to calibrate (SPLIT)
> GET2N 4                  to specify the input model from the best image.
                           This can be different if you have produced several
                           images! Use PCAT to know the catalog number of
                           your image
> UVRANGE 20, 0           uv-range to image. Set 0 for full range
> REFANT 45               select the number of the reference antenna
> SOLINT 1                time interval to average in minutes.
> SOLMODE 'P'             to calibrate only the phases. For amplitude and
                           phase we will use 'A&P'
> SNVER 0                 version of output table to be attached to the uv file
> GO CALIB                to run the program
```

- ✓ The MSG window should be checked to see the number of good solutions found. If the bad solutions are above 20% we have to increase the time interval.
- ✓ This will create a new `calib` file, containing the calibrated *uv*-data, as well as a **SN** table in the `split` file.

Now we can repeat this process iteratively. We make a new image with the calibrated data. We run **CALIB** again over the previous *uv* file. Usually 1–2 phase self-calibrations followed by an 'A&P' self-calibration works well. This process can be repeated iteratively. You can use the same parameters from previous executions, or define again all the parameters.

```
> TGET 'IMAGR'; DEFAULT    select the task with default parameters
> GETN 5                   to specify the input uv-file
> GO IMAGR                 to run the program and obtain an image

> TGET 'CALIB'; DEFAULT    select the task with default parameters
```

---

```

> GETN 5                to specify the input uv file to calibrate (SPLIT)
> GET2N 7              to specify the input model from the best image.
> SOLINT 0.5          time interval to average in minutes.
> SOLMODE 'P'        to calibrate only the phases
> GO CALIB           to run the program

```

One more cycle, now calibrating also the amplitudes.

```

> TGET 'IMAGR'; DEFAULT  select the task with default parameters
> GETN 8                to specify the input uv-file
> GO IMAGR             to run the program and obtain an image

> TGET 'CALIB'; DEFAULT  select the task with default parameters
> GETN 8                to specify the input uv file to calibrate (SPLIT)
> GET2N 10             to specify the input model from the best image.
> SOLINT 5            time interval to average in minutes.
> SOLMODE 'A&P'       to calibrate only the phases
> GO CALIB           to run the program

```

- ✓ When solving for phases the solution interval can be as short as the S/N of the fit allows.
- ✓ For 'A&P' is better to start with long intervals (even the whole observation), and then do more cycles reducing the solution interval.
- ✓ You can check how the phases and amplitudes are improving by using UVPLT, VPLOT, or plot the SN table with SNPLT.

Once you are happy with your self-calibration. You are ready to produce your final image:

```

> TGET 'IMAGR'; DEFAULT  select the task with default parameters
> GETN n                to specify the input uv-file
> GO IMAGR             to run the program and obtain an image

```

