ASTRON
Netherlands Institute for Radio Astronomy

STELLAR

LOFAR

Initial direction-independent calibration and data reduction with

`prefactor`

T2

Alexander Drabent
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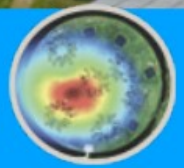
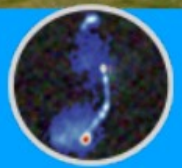
TLS





6th LOFAR Data School

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Topics of the tutorial:

– capabilites of prefactor
– set up and run the pipeline
– troubleshooting / diagnostics

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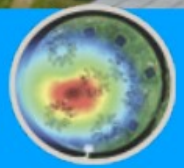
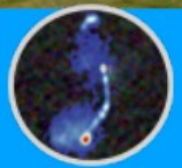
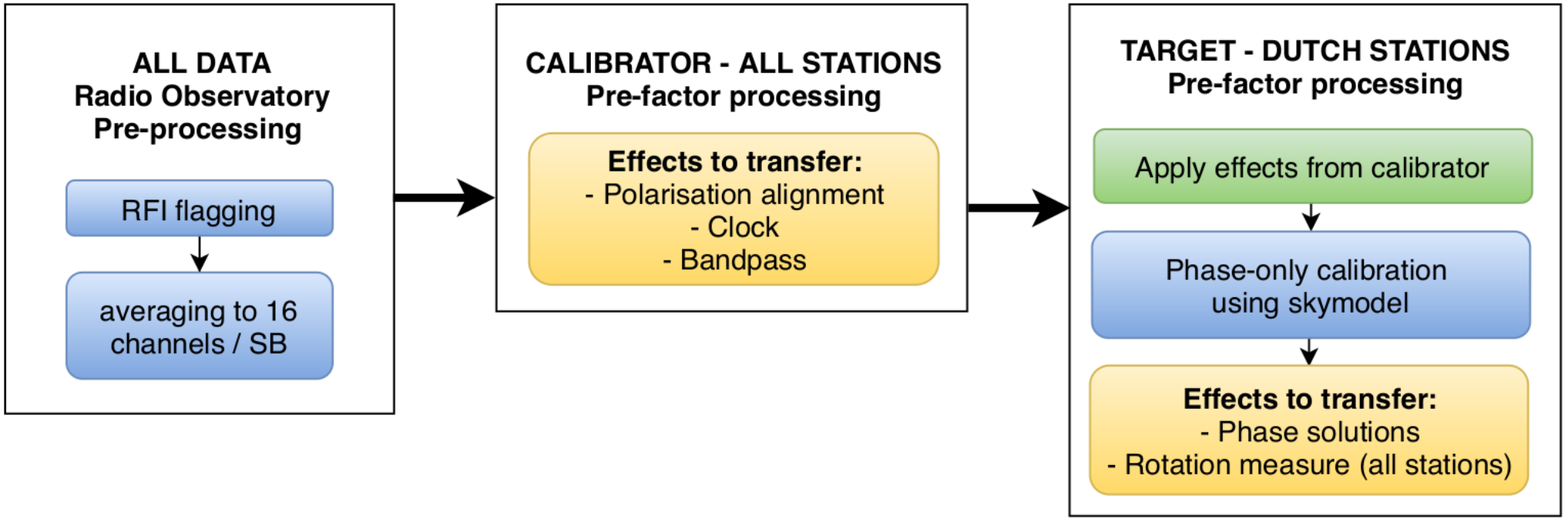




6th LOFAR Data School

L. Morabito+in prep.



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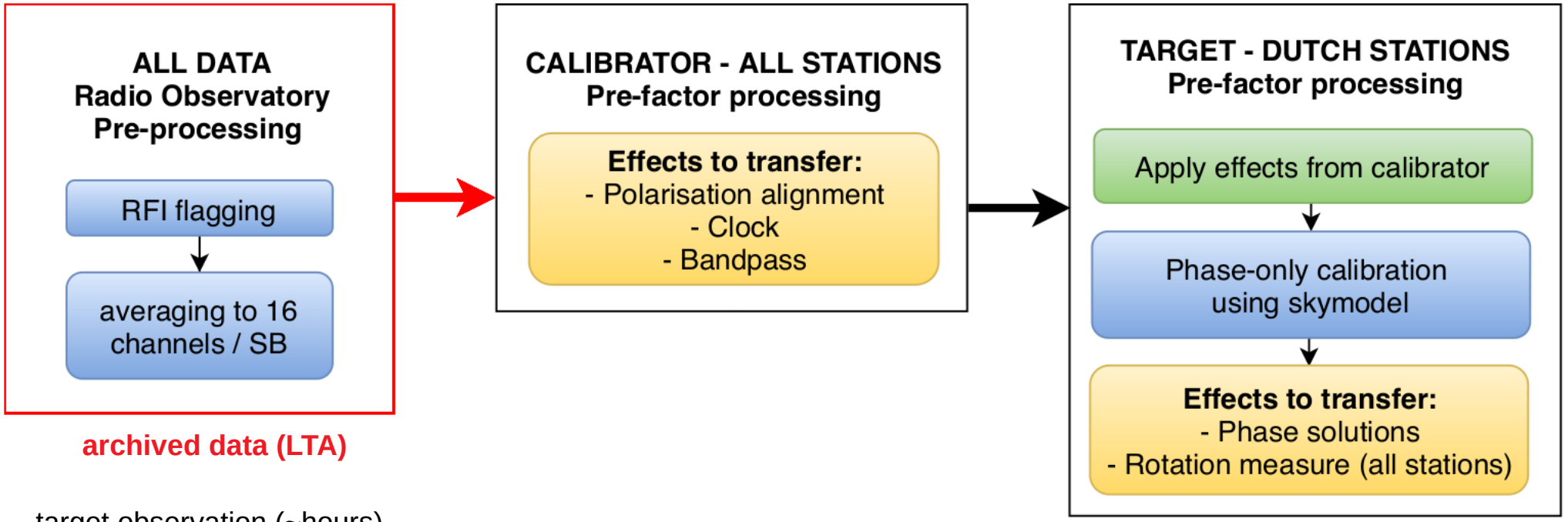
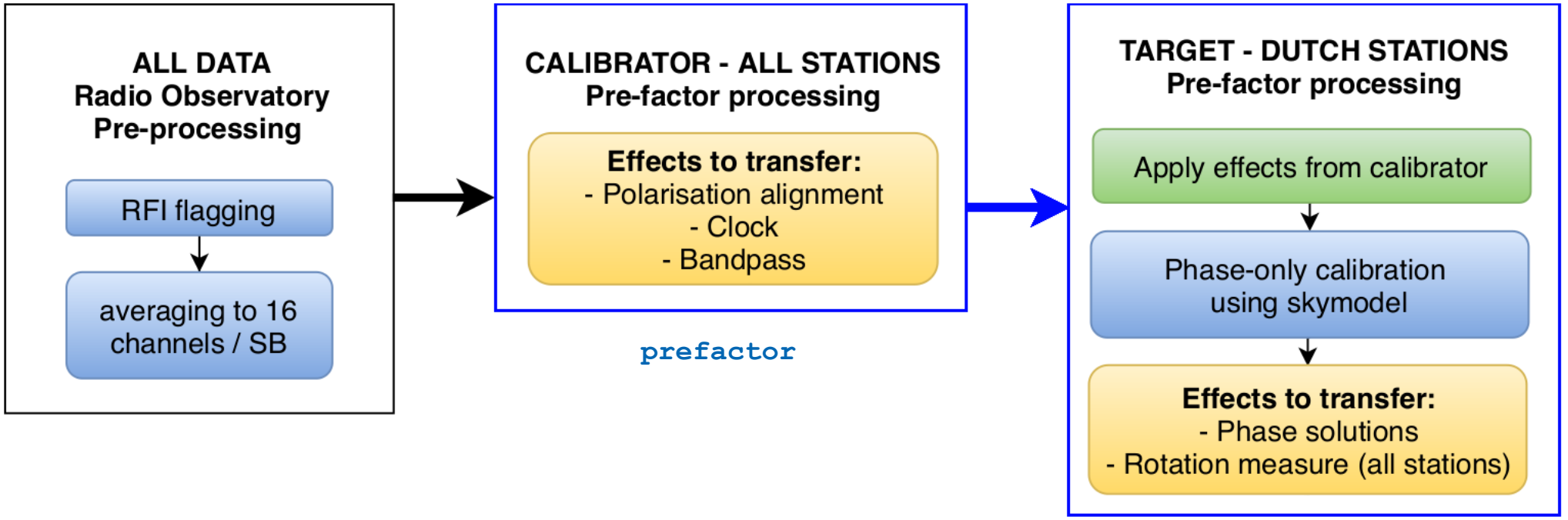


target observation (~hours)
+ bookended calibrator observation (~10mins)

→ **see lofarschool email to download both data sets**

https://lta.lofar.eu

L. Morabito+in prep.



https://github.com/lofar-astron/prefactor

Capabilities of prefactor

- removal of **clock** offsets between core and remote stations (using clock-TEC separation)
- correction of the **polarization alignment** between **XX** and **YY**
- robust time-independent **bandass** correction
- ionospheric **RM corrections** with RMextract
- removal of the **element beam**
- advanced **flagging** and **interpolation** of bad data
- mitigation of **broad-band RFI** and **bad stations**
- **direction-independent phase correction** of the target, using a global sky model
- detailed **diagnostics**

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instrumental effects

- ionospheric **RM corrections** with RMextract
- removal of the **element beam**
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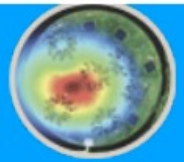
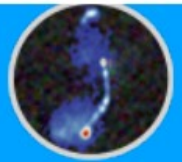
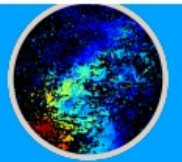
extracted from a calibrator observation and transferred to the target

- mitigation of **broad-band RFI** and **bad stations**
- **direction-independent phase correction** of the target, using a global sky model
- detailed **diagnostics**



Software packages in use:

- **genericpipeline:** pipeline framework using parsets, mapfiles and creates overall logs

  https://www.astron.nl/citt/genericpipeline

- Default PreProcessing Pipeline (**DPPP**): main data handling tasks, e.g., averaging, flagging, calibrating, applying solutions

  https://www.astron.nl/citt/DP3

  https://www.github.com/lofar-astron/DP3

- LOFAR Solution tools (**LoSoTo**): analysing/extracting parameters from calibration solutions, see tutorial **T1**

  https://github.com/revoltek/losoto

lofar-astron / **prefactor**

Unwatch 24 | Star 21 | Fork 28

Code | Issues 19 | Pull requests | Actions | Projects | Wiki | Security | Insights | Settings

master | 5 branches | 13 tags | Go to file | Add file | Code

Alexander Drabent fix plots — b3c2f8a 3 hours ago — **801** commits

bin	clean bin, add plots showing runtime, #75	17 months ago
docs	Update conf.py	16 months ago
plugins	Merge pull request #271 from lofar-astron/python3	8 months ago
rfistrategies	Add default LBA and HBA rfi strategies	2 years ago
scripts	add 3C380 as trusted source	6 days ago
skymodels	Modified 3C380 skymodel to high res model. Also added entry in REA...	8 days ago
solutions	allow solutions transfer from reference, #239	2 years ago
.gitignore	Bugfixes	5 years ago
Concatenate.parset	Remove DPPP interpolate steps (issue #246)	2 years ago
Initial-Subtract-IDG-LowMemory.pa...	Fix header comments	17 months ago
Initial-Subtract-IDG.parset	Fix header comments	17 months ago
Initial-Subtract.parset	Fix header comments	17 months ago
LICENSE.txt	Added GPL license as discussed in: #146	3 years ago
Pre-Facet-Calibrator.parset	fix plots	3 hours ago
Pre-Facet-Image.parset	Add imaging pipeline	
Pre-Facet-Target.parset	fix plots	

About

Pre facet calibration pipeline

www.astron.nl/citt/prefactor

Readme

GPL-3.0 License

Releases 13

Version 3.1 Latest
3 hours ago

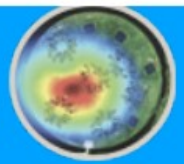
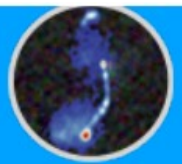
+ 12 releases

Packages

No packages published
Publish your first package

Contributors 20

https://www.github.com/lofar-astron/prefactor/

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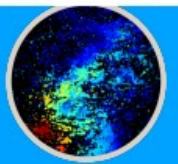

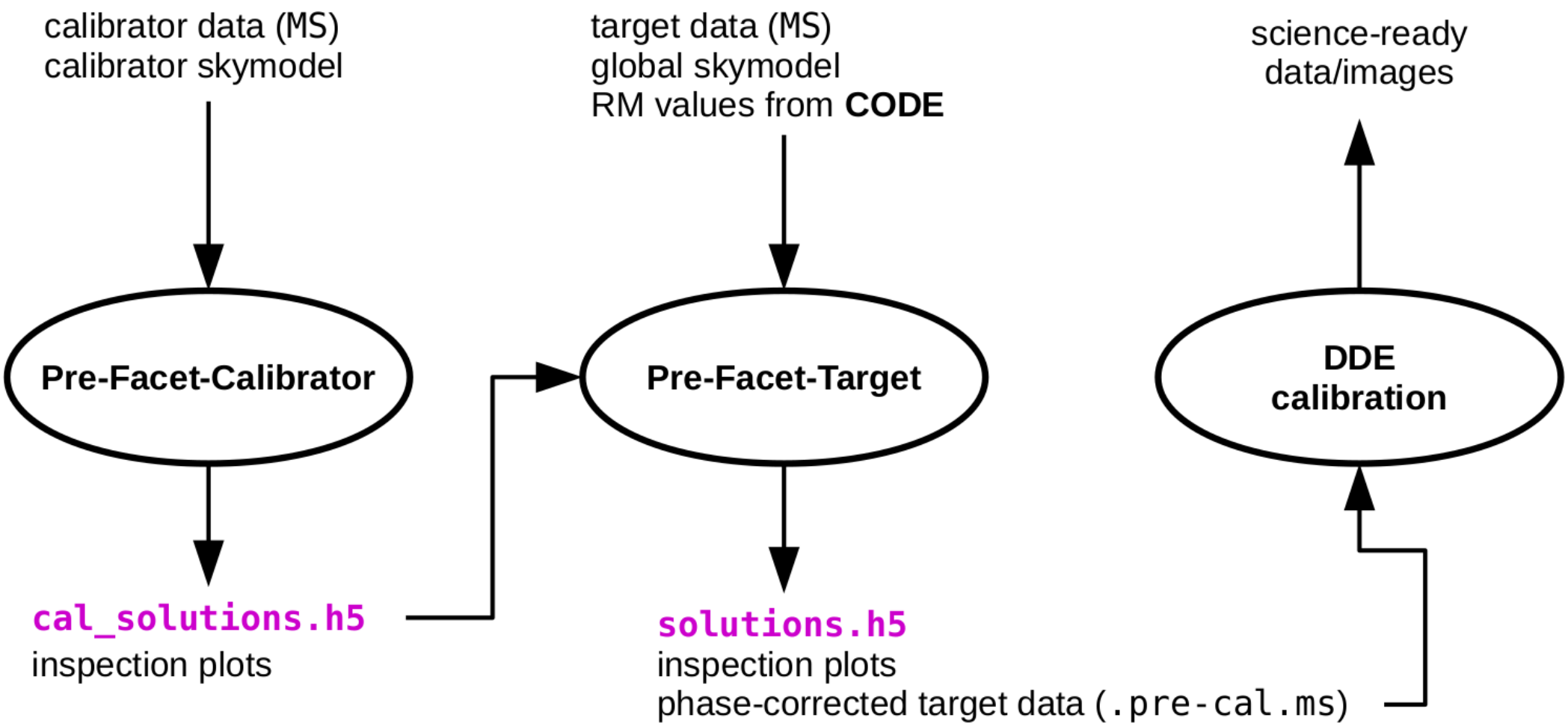
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calibrator skymodel
Pre-Facet-Calibrator
cal_solutions.h5
inspection plots
target data (MS)
global skymodel
RM values from CODE
Pre-Facet-Target
solutions.h5
inspection plots
phase-corrected target data (.pre-cal.ms)
science-ready
data/images
DDE
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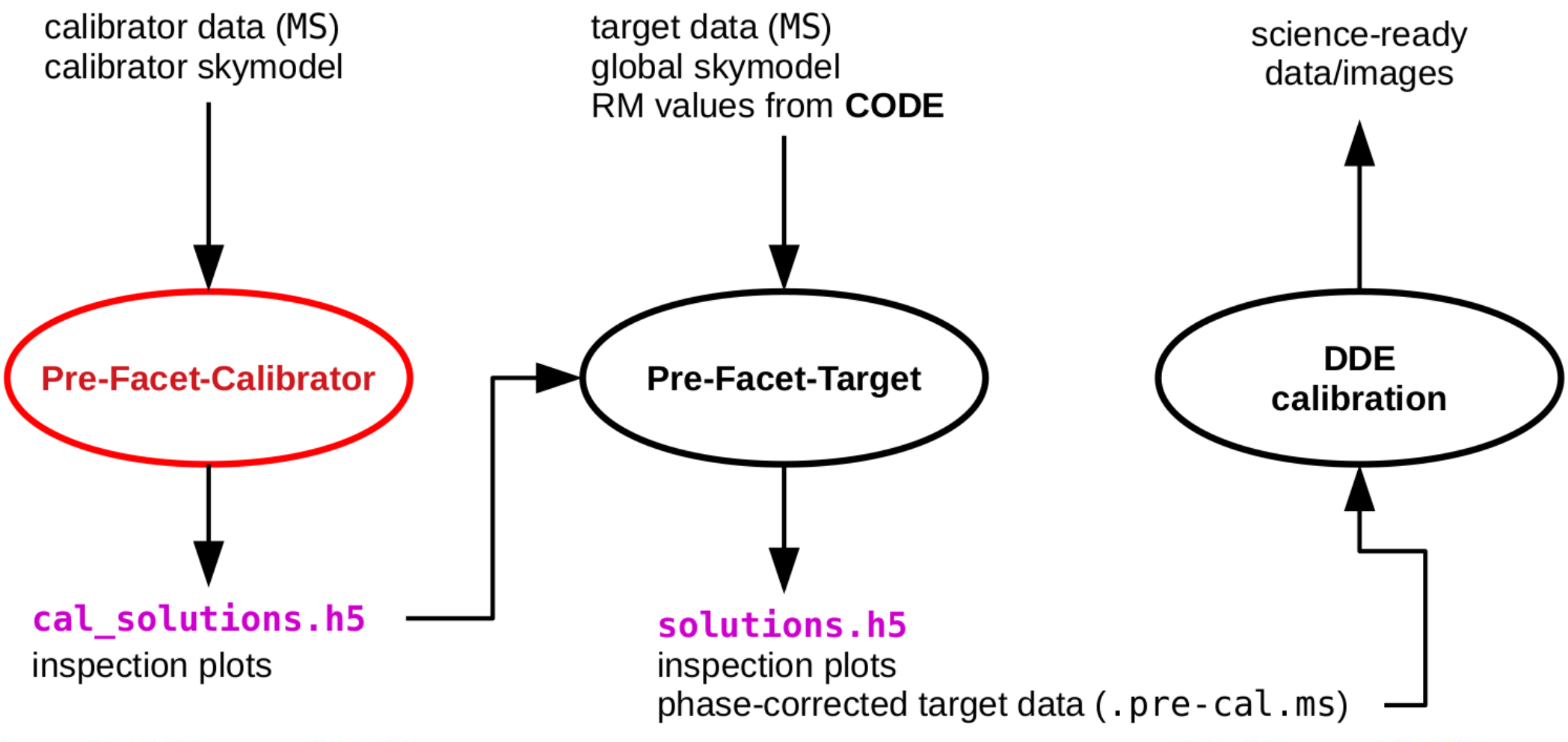
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inspection plots
phase-corrected target data (.pre-cal.ms)
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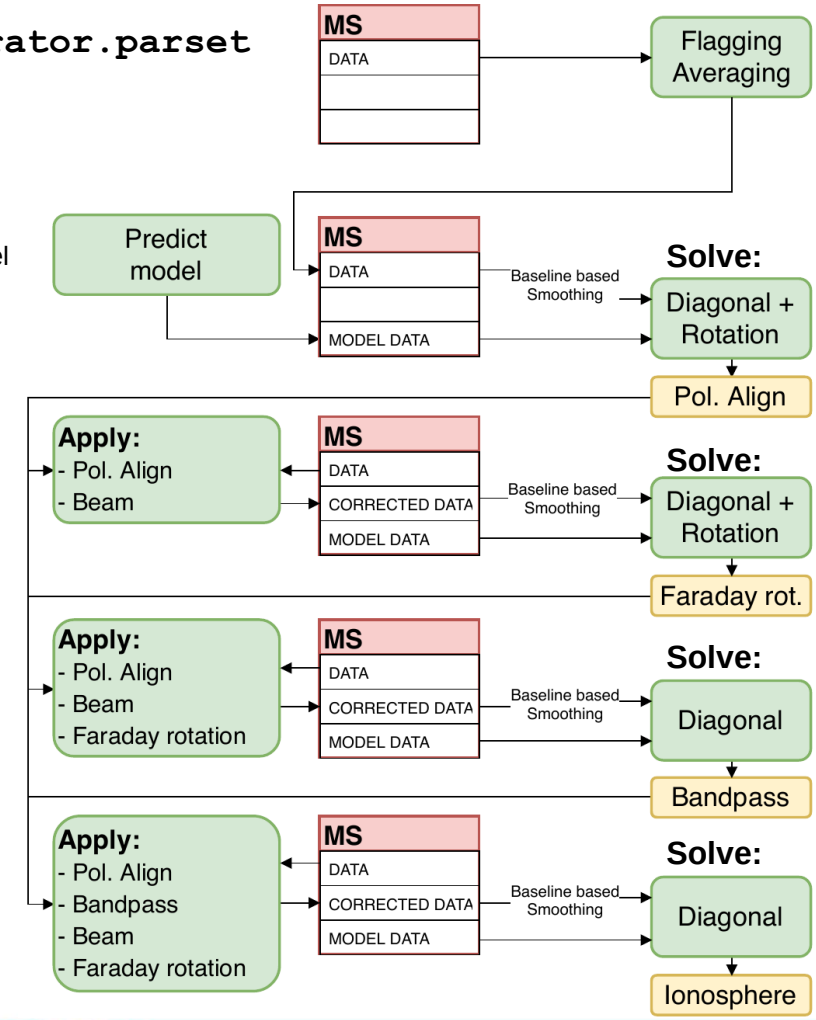
Pre-Facet-Calibrator.parset

skymodels/3c286-SH.skymodel

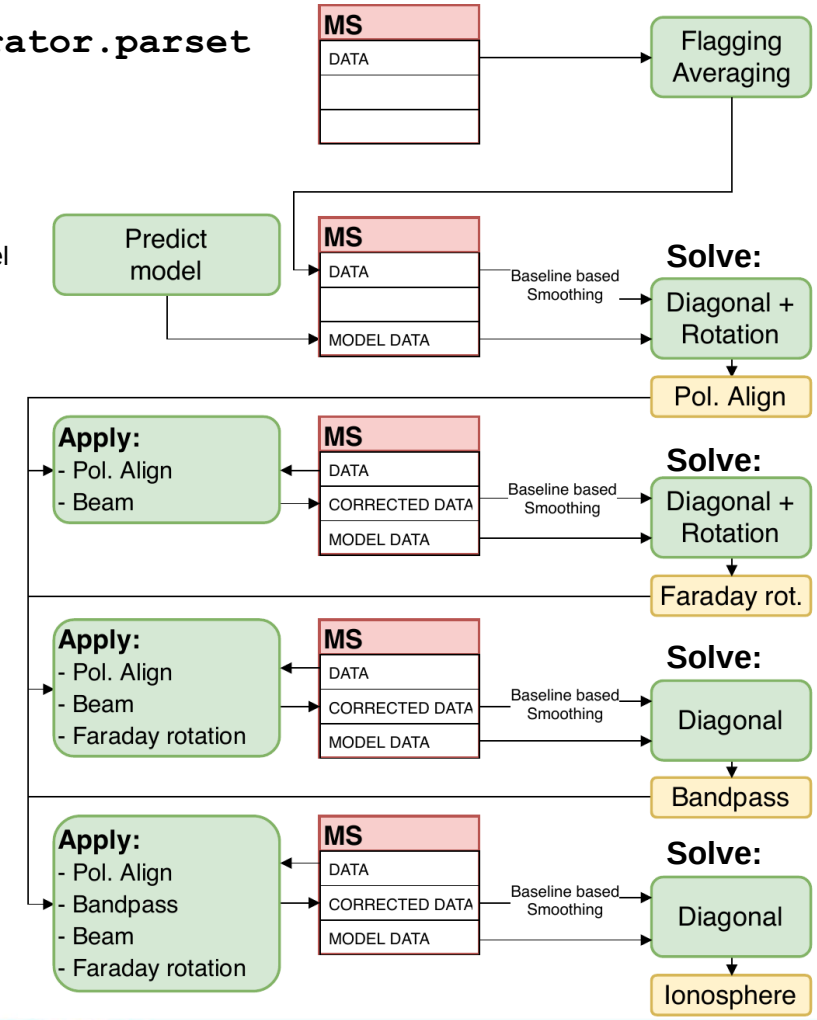


DPPP
LoSoTo

(de Gasperin+2019)

Pre-Facet-Calibrator.parset

skymodels/3c286-SH.skymodel



Reverting the measurement equation

observed visibility between stations i and j

$$\mathbf{V}_{ij}^{obs} = \mathbf{J}_i \mathbf{V}_{ij}^{\text{true}} \mathbf{J}_j^{\mathsf{T}}$$

see **Calibration Basics** in H. Elder's talk (**T1**)

Rotation + Diagonal

$$\begin{pmatrix} G_{xx} & G_{xy} \\ G_{yx} & G_{yy} \end{pmatrix} = \begin{pmatrix} cos(\alpha) & sin(\alpha) \\ -sin(\alpha) & cos(\alpha) \end{pmatrix} \cdot \begin{pmatrix} G_{xx} & 0 \\ 0 & G_{yy} \end{pmatrix}$$

see **Ionospheric Effects** in M. Mevius' talk (**D2**)

DPPP
LoSoTo

(de Gasperin+2019)

Install prefactor within your Docker/Singularity container

```
root@936bc303e232:~/dockertest# git clone https://github.com/lofar-astron/prefactor.git
Cloning into 'prefactor'...
remote: Enumerating objects: 164, done.
remote: Counting objects: 100% (164/164), done.
remote: Compressing objects: 100% (122/122), done.
remote: Total 4163 (delta 100), reused 90 (delta 42), pack-reused 3999
Receiving objects: 100% (4163/4163), 165.18 MiB | 4.95 MiB/s, done.
Resolving deltas: 100% (2866/2866), done.
root@936bc303e232:~/dockertest# cd prefactor/
root@936bc303e232:~/dockertest/prefactor# git checkout 'V3.1'
Note: checking out 'V3.1'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

  git checkout -b <new-branch-name>

HEAD is now at b3c2f8a fix plots
root@936bc303e232:~/dockertest/prefactor# cp Pre-Facet-Calibrator.parset  Pre-Facet-Target.parset ..
```

check whether your data is in the right location

```
root@936bc303e232:~/dockertest# ls -d 3C286/L228161_SB*.MS
3C286/L228161_SB000_uv.dppp.MS  3C286/L228161_SB038_uv.dppp.MS  3C286/L228161_SB076_uv.dppp.MS  3C286/L228161_SB114_uv.dppp.MS  3C286/L228161_SB152_uv.dppp.MS  3C286/L228161_SB190_uv.dppp.MS  3C286/L22816
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3C286/L228161_SB029_uv.dppp.MS  3C286/L228161_SB067_uv.dppp.MS  3C286/L228161_SB105_uv.dppp.MS  3C286/L228161_SB143_uv.dppp.MS  3C286/L228161_SB181_uv.dppp.MS  3C286/L228161_SB219_uv.dppp.MS  3C286/L22816
3C286/L228161_SB030_uv.dppp.MS  3C286/L228161_SB068_uv.dppp.MS  3C286/L228161_SB106_uv.dppp.MS  3C286/L228161_SB144_uv.dppp.MS  3C286/L228161_SB182_uv.dppp.MS  3C286/L228161_SB220_uv.dppp.MS  3C286/L22816
3C286/L228161_SB031_uv.dppp.MS  3C286/L228161_SB069_uv.dppp.MS  3C286/L228161_SB107_uv.dppp.MS  3C286/L228161_SB145_uv.dppp.MS  3C286/L228161_SB183_uv.dppp.MS  3C286/L228161_SB221_uv.dppp.MS  3C286/L22816
3C286/L228161_SB032_uv.dppp.MS  3C286/L228161_SB070_uv.dppp.MS  3C286/L228161_SB108_uv.dppp.MS  3C286/L228161_SB146_uv.dppp.MS  3C286/L228161_SB184_uv.dppp.MS  3C286/L228161_SB222_uv.dppp.MS  3C286/L22816
3C286/L228161_SB033_uv.dppp.MS  3C286/L228161_SB071_uv.dppp.MS  3C286/L228161_SB109_uv.dppp.MS  3C286/L228161_SB147_uv.dppp.MS  3C286/L228161_SB185_uv.dppp.MS  3C286/L228161_SB223_uv.dppp.MS  3C286/L22816
3C286/L228161_SB034_uv.dppp.MS  3C286/L228161_SB072_uv.dppp.MS  3C286/L228161_SB110_uv.dppp.MS  3C286/L228161_SB148_uv.dppp.MS  3C286/L228161_SB186_uv.dppp.MS  3C286/L228161_SB224_uv.dppp.MS  3C286/L22816
3C286/L228161_SB035_uv.dppp.MS  3C286/L228161_SB073_uv.dppp.MS  3C286/L228161_SB111_uv.dppp.MS  3C286/L228161_SB149_uv.dppp.MS  3C286/L228161_SB187_uv.dppp.MS  3C286/L228161_SB225_uv.dppp.MS  3C286/L22816
3C286/L228161_SB036_uv.dppp.MS  3C286/L228161_SB074_uv.dppp.MS  3C286/L228161_SB112_uv.dppp.MS  3C286/L228161_SB150_uv.dppp.MS  3C286/L228161_SB188_uv.dppp.MS  3C286/L228161_SB226_uv.dppp.MS  3C286/L22816
3C286/L228161_SB037_uv.dppp.MS  3C286/L228161_SB075_uv.dppp.MS  3C286/L228161_SB113_uv.dppp.MS  3C286/L228161_SB151_uv.dppp.MS  3C286/L228161_SB189_uv.dppp.MS  3C286/L228161_SB227_uv.dppp.MS  3C286/L22816
root@936bc303e232:~/dockertest#
```
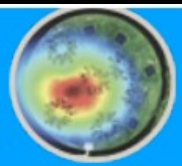
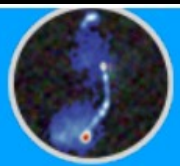
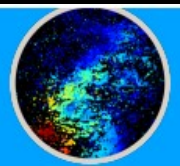






```
root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

##############################################################################
# Pre-Facet Calibrator Calibration Pipeline v3.0 (04/09/2019)                #
#                                                                            #
# Calibrator part of the basic Pre-Facet calibration pipeline:               #
# - requires LOFAR software version  >= 3.1.0                                #
# - requires losoto software version >= 2.0.0                                #
# - expects shared filesystem, that all nodes can reach all files!           #
#   (E.g. a single workstation or compute cluster with shared filesystem     #
#   doesn't work on multiple nodes on CEP3.)                                 #
##############################################################################

############################################
### parameters you will need to adjust. ##
############################################
## information about the calibrator data
! cal_input_path           =  /home/alex/dockertest/3C286                    ## specify the directory where your calibrator data is st
! cal_input_pattern        =  L228161*.MS                                    ## regular expression pattern of all your calibrator file

## location of the software
! prefactor_directory      =  /home/alex/dockertest/prefactor/               ## path to your prefactor copy
! losoto_directory         =  /opt/lofarsoft                                 ## path to your local LoSoTo installation
! aoflagger                =  /opt/lofarsoft/bin/aoflagger                   ## path to your aoflagger executable

############################################
### parameters you may need to adjust   ##
############################################

! refant                   =  'CS00.*'                                       ## regular expression of reference antennas from which to
! flag_baselines           =  []                                             ## NDPPP-compatible pattern for baselines or stations to
! process_baselines_cal    =  *&                                             ## performs A-Team-clipping/demixing and direction-indepe
! filter_baselines         =  {{ process_baselines_cal }}                    ## selects only this set of baselines to be processed. Ch
! do_smooth                =  False                                          ## enable or disable baseline-based smoothing
! rfistrategy              =  HBAdefault.rfis                                ## strategy to be applied with the statistical flagger (A
! maxGinterpolate          =  30                                             ## amount of channels in which interpolation should be pe
! ampRange                 =  [0, 0]                                         ## range of median amplitudes accepted per station. Use [
! skip_international       =  True                                           ## skip fitting the bandpass for international stations (
! raw_data                 =  False                                          ## use autoweight, set to True in case you are using raw
```

adjust parameters in the parset

```
root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

################################################################################
# Pre-Facet Calibrator Calibration Pipeline v3.0 (04/09/2019)                  #
#                                                                              #
# Calibrator part of the basic Pre-Facet calibration pipeline:                 #
# - requires LOFAR software version  >= 3.1.0                                  #
# - requires losoto software version >= 2.0.0                                  #
# - expects shared filesystem, that all nodes can reach all files!             #
#   (E.g. a single workstation or compute cluster with shared filesystem #
#   doesn't work on multiple nodes on CEP3.)                                   #
################################################################################

############################################
### parameters you will need to adjust. ##
############################################
## information about the calibrator data
! cal_input_path           =  /home/alex/dockertest/3C286
! cal_input_pattern        =  L228161*.MS

## location of the software
! prefactor_directory      =  /home/alex/dockertest/prefactor/
! losoto_directory         =  /opt/lofarsoft
! aoflagger                =  /opt/lofarsoft/bin/aoflagger

############################################
### parameters you may need to adjust   ##
############################################

! refant                   =  'CS00.*'
! flag_baselines           =  []
! process_baselines_cal    =  *&
! filter_baselines         =  {{ process_baselines_cal }}
! do_smooth                =  False
! rfistrategy              =  HBAdefault.rfis
! maxzinterpolate          =  30
! ampRange                 =  [0, 0]
! skip_international       =  True
! raw_data                 =  False

## specify the directory where your calibrator data is st
## regular expression pattern of all your calibrator file

## path to your prefactor copy
## path to your local LoSoTo installation
## path to your aoflagger executable

## regular expression of reference antennas from which to
## NDPPP-compatible pattern for baselines or stations to
## performs A-Team-clipping/demixing and direction-indepe
## selects only this set of baselines to be processed. Ch
## enable or disable baseline-based smoothing
## strategy to be applied with the statistical flagger (A
## amount of channels in which interpolation should be pe
## range of median amplitudes accepted per station. Use [
## skip fitting the bandpass for international stations (
## use autoweight, set to True in case you are using raw
```

adjust parameters in the parset

ensure MS data is bind to your container

specify the location where you put the calibrator MS

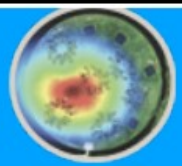
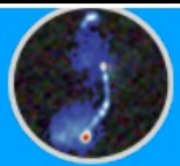
location of prefactor

```
root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

##############################################################################
# Pre-Facet Calibrator Calibration Pipeline v3.0 (04/09/2019)                #
#                                                                            #
# Calibrator part of the basic Pre-Facet calibration pipeline:               #
# - requires LOFAR software version  >= 3.1.0                                #
# - requires losoto software version >= 2.0.0                                #
# - expects shared filesystem, that all nodes can reach all files!           #
#   (E.g. a single workstation or compute cluster with shared filesystem     #
#   doesn't work on multiple nodes on CEP3.)                                 #
##############################################################################

############################################
### parameters you will need to adjust. ##
############################################
## information about the calibrator data
! cal_input_path           =  /home/alex/dockertest/3C286
! cal_input_pattern        =  L228161*.MS

## location of the software
! prefactor_directory      =  /home/alex/dockertest/prefactor/
! losoto_directory         =  /opt/lofarsoft
! aoflagger                =  /opt/lofarsoft/bin/aoflagger

############################################
### parameters you may need to adjust   ##
############################################

! refant                   =  'CS00.*'
! flag_baselines           =  []
! process_baselines_cal    =  *&
! filter_baselines         =  {{ process_baselines_cal }}
! do_smooth                =  False
! rfistrategy              =  HBAdefault.rfis
! max2interpolate          =  30
! ampRange                 =  [0, 0]
! skip_international       =  True
! raw_data                 =  False
```

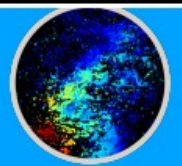
adjust parameters in the parset

regular expression
of the calibrator MS

location of specific software
used in your image

6th LOFAR Data School



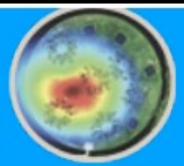
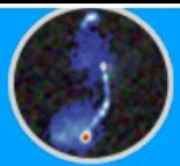
```
root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

##############################################################################
# Pre-Facet Calibrator Calibration Pipeline v3.0 (04/09/2019)                #
#                                                                            #
# Calibrator part of the basic Pre-Facet calibration pipeline:               #
# - requires LOFAR software version  >= 3.1.0                                #
# - requires losoto software version >= 2.0.0                                #
# - expects shared filesystem, that all nodes can reach all files!           #
#   (E.g. a single workstation or compute cluster with shared filesystem     #
#   doesn't work on multiple nodes on CEP3.)                                 #
##############################################################################

############################################
### parameters you will need to adjust. ##
############################################
## information about the calibrator data
! cal_input_path           =  /home/alex/dockertest/3C286          ## specify the directory where your calibrator data is st
! cal_input_pattern        =  L228161*.MS                          ## regular expression pattern of all your calibrator file

## location of the software
! prefactor_directory      =  /home/alex/dockertest/prefactor/     ## path to your prefactor copy
! losoto_directory         =  /opt/lofarsoft                       ## path to your local LoSoTo installation
! aoflagger                =  /opt/lofarsoft/bin/aoflagger         ## path to your aoflagger executable

############################################
### parameters you may need to adjust   ##
############################################

! refant                   =  'CS00.*'                             ## regular expression of reference antennas from which to
! flag_baselines           =  []                                   ## NDPPP-compatible pattern for baselines or stations to
! process_baselines_cal    =  *&                                   ## performs A-Team-clipping/demixing and direction-indepe
! filter_baselines         =  {{ process_baselines_cal }}          ## selects only this set of baselines to be processed. Ch
! do_smooth                =  False                                ## enable or disable baseline-based smoothing
! rfistrategy              =  HBAdefault.rfis                      ## strategy to be applied with the statistical flagger (A
! max2interpolate          =  30                                   ## amount of channels in which interpolation should be pe
! ampRange                 =  [0, 0]                               ## range of median amplitudes accepted per station. Use [
! skip_international       =  True                                 ## skip fitting the bandpass for international stations (
! raw_data                 =  False                                ## use autoweight, set to True in case you are using raw
```

adjust parameters in the parset

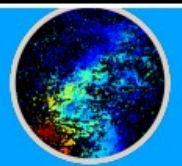
regular expression of the calibrator MS

choose a minimum of 100 SBs, e.g., L228161*SB0*.MS

location of specific software used in your image

6th LOFAR Data School



adjust parameters in the parset

```
root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

################################################################################
# Pre-Facet Calibrator Calibration Pipeline v3.0 (04/09/2019)                  #
#                                                                              #
# Calibrator part of the basic Pre-Facet calibration pipeline:                 #
# - requires LOFAR software version  >= 3.1.0                                  #
# - requires losoto software version >= 2.0.0                                  #
# - expects shared filesystem, that all nodes can reach all files!             #
#   (E.g. a single workstation or compute cluster with shared filesystem #
#   doesn't work on multiple nodes on CEP3.)                                   #
################################################################################

############################################
### parameters you will need to adjust. ##
############################################
## information about the calibrator data
! cal_input_path           =  /home/alex/dockertest/3C286
! cal_input_pattern        =  L228161*.MS

## location of the software
! prefactor_directory      =  /home/alex/dockertest/prefactor/
! losoto_directory         =  /opt/lofarsoft
! aoflagger                =  /opt/lofarsoft/bin/aoflagger

############################################
### parameters you may need to adjust   ##
############################################

! refant                   =  'CS00.*'
! flag_baselines           =  []
! process_baselines_cal    =  *&
! filter_baselines         =  {{ process_baselines_cal }}
! do_smooth                =  False
! rfistrategy              =  HBAdefault.rfis
! maxzinterpolate          =  30
! ampRange                 =  [0, 0]
! skip_international       =  True
! raw_data                 =  False

## specify the directory where your calibrator data is st
## regular expression pattern of all your calibrator file

## path to your prefactor copy
## path to your local LoSoTo installation
## path to your aoflagger executable

## regular expression of reference antennas from which to
## NDPPP-compatible pattern for baselines or stations to
## performs A-Team-clipping/demixing and direction-indepe
## selects only this set of baselines to be processed. Ch
## enable or disable baseline-based smoothing
## strategy to be applied with the statistical flagger (A
## amount of channels in which interpolation should be pe
## range of median amplitudes accepted per station. Use [
## skip fitting the bandpass for international stations (
## use autoweight, set to True in case you are using raw
```

regular expression of the calibrator MS

choose a minimum of 100 SBs, e.g., L228161*SB0*.MS

location of specific software used in your image

parameter section

root@936bc303e232:~/dockertest# vi Pre-Facet-Calibrator.parset

If you have troubles calibrating your data changing parameters may help:

– nearby A-Team sources may require **demixing**
– for raw data you may perform **additional flagging**
– remove broken stations right from the beginning
– enable **solutions transfer** from template bandpass for International Stations if calibrator is not supported
– use your own skymodels

LBA observations need different parameters

Visit:
https://www.astron.nl/citt/prefactor/calibrator.html#user-defined-parameter-configuration

```
! ampRange                = [0, 0]
! skip_international       = True
! raw_data                 = False
```

range of median amplitudes accepted per station. Use [
skip fitting the bandpass for international stations (
use autoweight, set to True in case you are using raw

check your computing ressources

```
##########################################
### parameters for pipeline performance ##
##########################################

! num_proc_per_node        =  input.output.max_per_node
! num_proc_per_node_limit  =  4
! max_dppp_threads         =  10
! memoryperc               =  20
! min_length               =  50
! overhead                 =  0.8
! min_separation           =  30
! max_separation_arcmin    =  1.0
```

```
## number of processes to use per step per node (usually
## number of processes to use per step per node for tasks
## number of threads per process for NDPPP
## maximum of memory used for aoflagger in raw_flagging m
## minimum amount of subbands to concatenate in frequency
## Only use this fraction of the available memory for der
## minimal accepted distance to an A-team source on the s
## maximum distance to the phase center for which a skymo
```

reduce the amount of launched jobs at the same time if you have a small machine

`max_dppp_threads * num_proc_per_node < max_proc_per_node`

```
##############################################################
##                                                          ##
##    BEGIN PIPELINE: DO NOT UPDATE BELOW THIS LINE!        ##
##                                                          ##
##############################################################

# which steps to run
pipeline.steps             =  [prep, PA, FR, bandpass, ion, finalize]


# pipeline substeps
pipeline.steps.prep        =  [createmap_cal, combine_data_map, check_Ateam_separation, mk_cal_values_dir, createmap_prepcal, createmap_instcal, create_ate
urcedb, expand_sourcedb, expand_skymodel, calib_cal_parmmap, h5imp_cal_map, smooth_data, predict_cal, find_refant]

pipeline.steps.PA          =  [calib_cal, h5imp_cal_PA, prepare_losoto_PA, process_losoto_PA, h5exp_cal_PA, apply_PA, apply_beam]
pipeline.steps.FR          =  [smooth_corrected, calib_cal,  h5imp_cal_FR, prepare_losoto_FR, process_losoto_FR, h5exp_cal_FR, apply_FR]
pipeline.steps.bandpass    =  [smooth_corrected, calib_cal2, h5imp_cal_bandpass, prepare_losoto_bandpass, prepare_losoto_bandpasstrans, process_losoto_band
pipeline.steps.ion         =  [smooth_corrected, calib_cal2, h5imp_cal_ion, prepare_losoto_ion, process_losoto_ion, h5exp_cal_ion]
pipeline.steps.finalize    =  [h5parm_name {{ final_apply }}, make_summary]

################################
## Mapping calibrator files  ##
################################

# generate a mapfile of all the calibrator data
createmap_cal.control.kind                              =   plugin
createmap_cal.control.type                              =   createMapfile
createmap_cal.control.method                            =   mapfile_from_folder
createmap_cal.control.mapfile_dir                       =   {{ mapfile_dir }}
createmap_cal.control.filename                          =   createmap_cal.mapfile
createmap_cal.control.folder                            =   {{ cal_input_path }}
createmap_cal.control.pattern                           =   {{ cal_input_pattern }}

# combine all entries into one mapfile, for the sortmap script
combine_data_map.control.kind                           =   plugin
combine_data_map.control.type                           =   createMapfile
combine_data_map.control.method                         =   mapfile_all_to_one
combine_data_map.control.mapfile_dir                    =   {{ mapfile_dir }}
combine_data_map.control.filename                       =   combine_data_map.mapfile
```

scroll down to see pipeline description

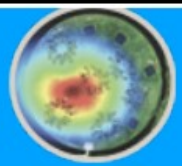
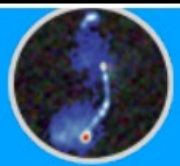
definition of single steps

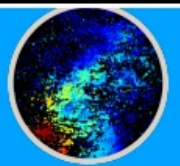
```
root@936bc303e232:~/dockertest# cp /opt/lofarsoft/share/pipeline/pipeline.cfg .
root@936bc303e232:~/dockertest# vi pipeline.cfg
```

copy pipeline config file

```
[DEFAULT]
lofarroot = /opt/lofarsoft
casaroot = /opt/lofarsoft
pyraproot =
hdf5root =
wcsroot =
aoflaggerroot=
pythonpath = /opt/lofarsoft/lib/python2.7/site-packages
runtime_directory = %(working_directory)s
recipe_directories = [%(pythonpath)s/lofarpipe/recipes]
working_directory = /home/alex/dockertest/working_directory
task_files = [%(lofarroot)s/share/pipeline/tasks.cfg]

[layout]
job_directory = %(runtime_directory)s/%(job_name)s

[cluster]
clusterdesc = %(lofarroot)s/share/cep2.clusterdesc

[deploy]
engine_ppath = %(pythonpath)s:%(pyraproot)s/lib:/opt/cep/pythonlibs/lib/python/site-packages
engine_lpath = %(lofarroot)s/lib:%(casaroot)s/lib:%(pyraproot)s/lib:%(hdf5root)s/lib:%(wcsroot)s/lib

[logging]
log_file = %(runtime_directory)s/log/pipeline-%(job_name)s-%(start_time)s.log
xml_stat_file = %(runtime_directory)s/log/pipeline-%(job_name)s-%(start_time)s-statistics.xml

[feedback]
# Method of providing feedback to LOFAR.
# Valid options:
#    messagebus    Send feedback and status using LCS/MessageBus
#    none          Do NOT send feedback and status
method = none

[remote]
method = local
max_per_node = 56
~
```

adjust config file
to your needs



```
[DEFAULT]
lofarroot = /opt/lofarsoft
casaroot = /opt/lofarsoft
pyraproot =
hdf5root =
wcsroot =
aoflaggerroot=
pythonpath = /opt/lofarsoft/lib/python2.7/site-packages
runtime_directory = %(working_directory)s
recipe_directories = [%(pythonpath)s/lofarpipe/recipes]
working_directory = /home/alex/dockertest/working_directory
task_files = [%(lofarroot)s/share/pipeline/tasks.cfg]

[layout]
job_directory = %(runtime_directory)s/%(job_name)s

[cluster]
clusterdesc = %(lofarroot)s/share/cep2.clusterdesc

[deploy]
engine_ppath = %(pythonpath)s:%(pyraproot)s/lib:/opt/cep/pythonlibs/lib/python/site-packages
engine_lpath = %(lofarroot)s/lib:%(casaroot)s/lib:%(pyraproot)s/lib:%(hdf5root)s/lib:%(wcsroot)s/lib

[logging]
log_file = %(runtime_directory)s/log/pipeline-%(job_name)s-%(start_time)s.log
xml_stat_file = %(runtime_directory)s/log/pipeline-%(job_name)s-%(start_time)s-statistics.xml

[feedback]
# Method of providing feedback to LOFAR.
# Valid options:
#    messagebus    Send feedback and status using LCS/MessageBus
#    none          Do NOT send feedback and status
method = none

[remote]
method = local
max_per_node = 56
~
```

adjust config file
to your needs

make sure the working_directory exists

run on a local machine using 56 threads, check **nproc**

running prefactor

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/utilities.pyc : Using default subprocess module!
QPID support NOT enabled! Will NOT connect to any broker, and messages will be lost!
Reading configuration file: pipeline.cfg
Reading task definition file(s): /opt/lofarsoft/share/pipeline/tasks.cfg
2021-03-17 17:48:06 DEBUG   genericpipeline: Pipeline start time: 2021-03-17T17:48:06
2021-03-17 17:48:06 INFO    genericpipeline: LOFAR Pipeline (Pre-Facet-Calibrator) starting.
2021-03-17 17:48:06 INFO    genericpipeline: SASID = , MOMID = , Feedback method = none
NYI: validate_steps
log4cplus:ERROR No appenders could be found for logger (LCS.Common.EXCEPTION).
log4cplus:ERROR Please initialize the log4cplus system properly.
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step createmap_cal
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step combine_data_map
FILE:  ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/dockertest/3C286/L228161_SB001_uv.dppp.MS', '/home/alex/dockertest/3C286/L22816
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step check_Ateam_separation
2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: recipe executable_args started
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: Starting /home/alex/dockertest/prefactor//scripts/check_Ateam_separation.py run
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2021-03-17 17:48:07 INFO    genericpipeline.executable_args: Subprocess starting: /bin/sh -c python /opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/re
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2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arguments         = ["['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/doc
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arg dictionary    = {'min_separation': '30', 'outputimage': '/home/alex/dockertest/working_dir
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: environment       = {'LOFARDATAROOT': '/opt/lofarsoft/data', 'OMP_NUM_THREADS': '8', 'PYTHONPA
2021-03-17 17:48:08 INFO    node.936bc303e232.python_plugin: Processing ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/dockertest/3C2
```

load software environment first:

```
source /opt/lofarsoft/lofarinit.sh
```

running prefactor

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
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2021-03-17 17:48:06 DEBUG   genericpipeline: Pipeline start time: 2021-03-17T17:48:06
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2021-03-17 17:48:07 INFO    genericpipeline: Beginning step check_Ateam_separation
2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: recipe executable_args started
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2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arg dictionary    = {'min_separation': '30', 'outputimage': '/home/alex/dockertest/working_dir
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2021-03-17 17:48:08 INFO    node.936bc303e232.python_plugin: Processing ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/dockertest/3C2
```

- create working directory
-d enables DEBUG mode
-c specifies pipeline configuration

reading the log

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
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2021-03-17 17:48:07 INFO    genericpipeline: Beginning step check_Ateam_separation
2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
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2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arg dictionary    = {'min_separation': '30', 'outputimage': '/home/alex/dockertest/working_dir
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```

time/date ERRORLEVEL program stdout

reading the log

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
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2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
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```

Beginning step keyword always marks a new step

reading the log

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/utilities.pyc : Using default subprocess module!
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2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
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```

Starting for python scripts

reading the log

```
root@936bc303e232:~/dockertest# mkdir -p working_directory
root@936bc303e232:~/dockertest# genericpipeline.py -v -d -c pipeline.cfg Pre-Facet-Calibrator.parset
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/utilities.pyc : Using default subprocess module!
QPID support NOT enabled! Will NOT connect to any broker, and messages will be lost!
Reading configuration file: pipeline.cfg
Reading task definition file(s): /opt/lofarsoft/share/pipeline/tasks.cfg
2021-03-17 17:48:06 DEBUG   genericpipeline: Pipeline start time: 2021-03-17T17:48:06
2021-03-17 17:48:06 INFO    genericpipeline: LOFAR Pipeline (Pre-Facet-Calibrator) starting.
2021-03-17 17:48:06 INFO    genericpipeline: SASID = , MOMID = , Feedback method = none
NYI: validate_steps
log4cplus:ERROR No appenders could be found for logger (LCS.Common.EXCEPTION).
log4cplus:ERROR Please initialize the log4cplus system properly.
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step createmap_cal
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step combine_data_map
FILE:  ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/dockertest/3C286/L228161_SB001_uv.dppp.MS', '/home/alex/dockertest/3C286/L22816
2021-03-17 17:48:07 INFO    genericpipeline: Beginning step check_Ateam_separation
2021-03-17 17:48:07 INFO    genericpipeline: Running task: pythonplugin
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/subprocessgroup.pyc : Using default subprocess module!
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: recipe executable_args started
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: Starting /home/alex/dockertest/prefactor//scripts/check_Ateam_separation.py run
Reading configuration file: pipeline.cfg
Reading task definition file(s): /opt/lofarsoft/share/pipeline/tasks.cfg
2021-03-17 17:48:07 DEBUG   genericpipeline.executable_args: Pipeline start time: 2021-03-17T17:48:06
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: Limiting to 56 simultaneous jobs/node
2021-03-17 17:48:07 DEBUG   genericpipeline.executable_args: Job dispatcher at 172.17.0.12:38815
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: ********** Remote method is local
2021-03-17 17:48:07 INFO    genericpipeline.executable_args: Subprocess starting: /bin/sh -c python /opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/re
2021-03-17 17:48:08 INFO    genericpipeline.executable_args: Waiting for compute threads...
2021-03-17 17:48:08 WARNING genericpipeline.executable_args: /opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/utilities.pyc : Using default sub
2021-03-17 17:48:08 DEBUG   genericpipeline.executable_args: Request for job 0 from ('172.17.0.12', 51630)
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: infile            = ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/docke
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: executable        = /home/alex/dockertest/prefactor//scripts/check_Ateam_separation.py
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: working directory = /home/alex/dockertest/working_directory/Pre-Facet-Calibrator
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arguments         = ["['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/doc
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: arg dictionary    = {'min_separation': '30', 'outputimage': '/home/alex/dockertest/working_dir
2021-03-17 17:48:08 DEBUG   node.936bc303e232.python_plugin: environment       = {'LOFARDATAROOT': '/opt/lofarsoft/data', 'OMP_NUM_THREADS': '8', 'PYTHONPA
2021-03-17 17:48:08 INFO    node.936bc303e232.python_plugin: Processing ['/home/alex/dockertest/3C286/L228161_SB000_uv.dppp.MS', '/home/alex/dockertest/3C2
```

Details of the running task

```
root@936bc303e232:~/dockertest# cd working_directory
root@936bc303e232:~/dockertest/working_directory# ls
Pre-Facet-Calibrator  log
root@936bc303e232:~/dockertest/working_directory# cd log
root@936bc303e232:~/dockertest/working_directory/log# ls
pipeline-Pre-Facet-Calibrator-2021-03-17T17:48:06-statistics.xml  pipeline-Pre-Facet-Calibrator-2021-03-17T17:48:06.log
root@936bc303e232:~/dockertest/working_directory/log#
```

job_directory

logfile

```
root@936bc303e232:~/dockertest# cd working_directory
root@936bc303e232:~/dockertest/working_directory# ls
Pre-Facet-Calibrator  log
root@936bc303e232:~/dockertest/working_directory# cd log
root@936bc303e232:~/dockertest/working_directory/log# ls
pipeline-Pre-Facet-Calibrator-2021-03-17T17:48:06-statistics.xml  pipeline-Pre-Facet-Calibrator-2021-03-17T17:48:06.log
root@936bc303e232:~/dockertest/working_directory/log#
```

job_directory

logfile

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/parsets#
```

parset files for **DPPP** and **LoSoTo**

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/mapfiles#
```

mapfiles to track the used input/output files

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/results#
```

calibration results

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator# ls statefile
statefile
```

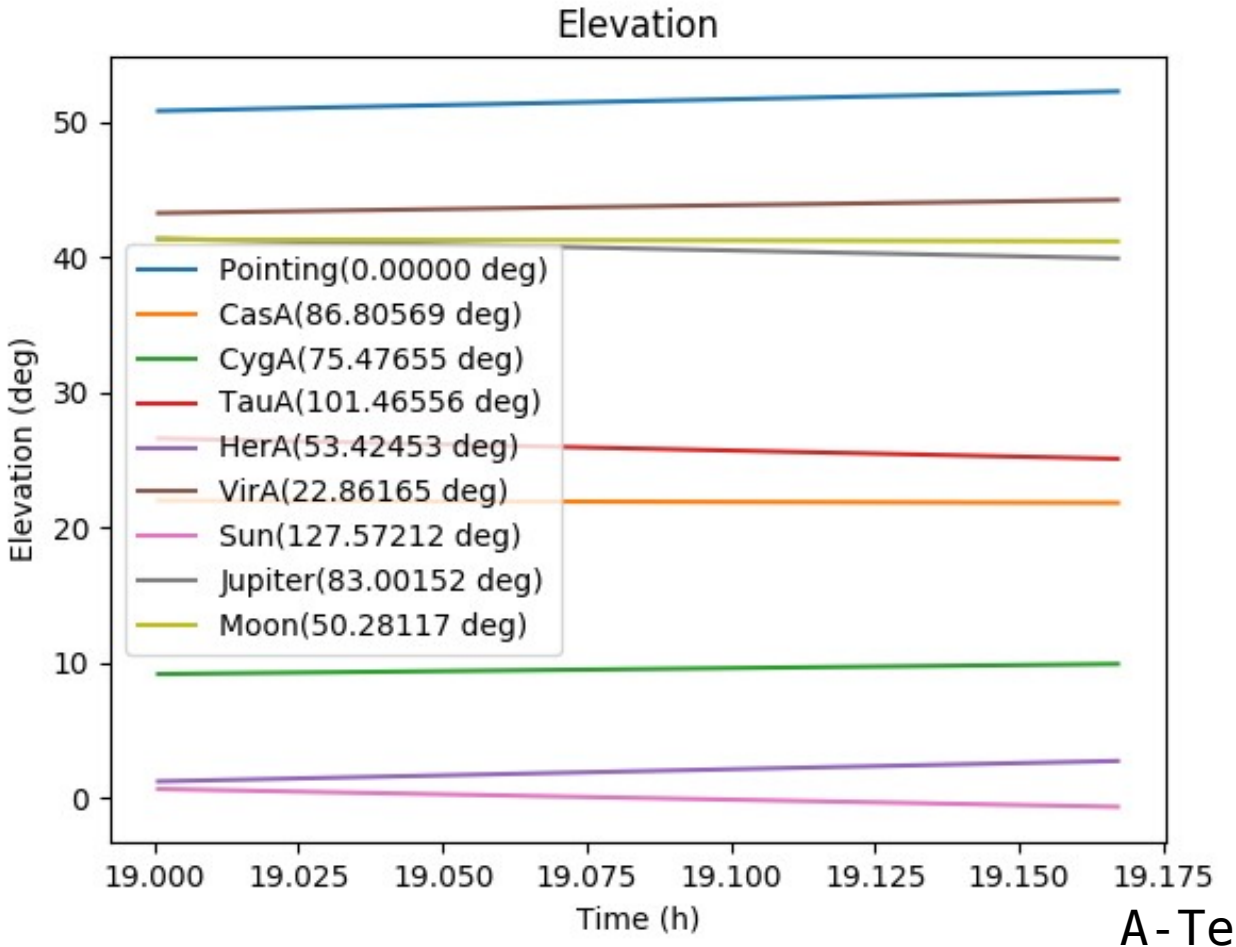
statefile of the pipeline

```
root@936bc303e232:~/dockertest# prefactor/bin/statefile_manipulation.py working_directory/Pre-Facet-Calibrator/statefile
Statefile Manipulator
/opt/lofarsoft/lib/python2.7/site-packages/lofarpipe/support/utilities.pyc : Using default subprocess module!
Current states:
Setup:  {'task_files': ['/opt/lofarsoft/share/pipeline/tasks.cfg'], 'runtime_directory': '/home/alex/dockertest/working_directory', 'dry_run': False, 'loglevel': 'INFO', 'start_time': '2021-
List of finished steps for Pre-Facet-Calibrator:
Step Nr.: 1  Task: pythonplugin  Name: check_Ateam_separation
Step Nr.: 2  Task: executable_args  Name: make_sourcedb_ateam
Step Nr.: 3  Task: dppp  Name: ndppp_prep_cal
Step Nr.: 4  Task: pythonplugin  Name: ms_concat
Step Nr.: 5  Task: executable_args  Name: aoflag
Step Nr.: 6  Task: pythonplugin  Name: sky_cal
Step Nr.: 7  Task: executable_args  Name: make_sourcedb
Step Nr.: 8  Task: executable_args  Name: smooth_data
Step Nr.: 9  Task: dppp  Name: predict_cal
Step Nr.: 10  Task: dppp  Name: calib_cal
Step Nr.: 11  Task: executable_args  Name: h5imp_cal_PA
Step Nr.: 12  Task: executable_args  Name: process_losoto_PA
Step Nr.: 13  Task: executable_args  Name: h5exp_cal_PA
Step Nr.: 14  Task: dppp  Name: apply_PA
Step Nr.: 15  Task: dppp  Name: apply_beam
Step Nr.: 16  Task: executable_args  Name: smooth_corrected
Step Nr.: 17  Task: dppp  Name: calib_cal1
Step Nr.: 18  Task: executable_args  Name: h5imp_cal_FR
Step Nr.: 19  Task: executable_args  Name: process_losoto_FR
Step Nr.: 20  Task: executable_args  Name: h5exp_cal_FR
Step Nr.: 21  Task: dppp  Name: apply_FR
Step Nr.: 22  Task: executable_args  Name: smooth_corrected1
Step Nr.: 23  Task: dppp  Name: calib_cal2
Step Nr.: 24  Task: executable_args  Name: h5imp_cal_bandpass
Step Nr.: 25  Task: executable_args  Name: process_losoto_bandpass
Step Nr.: 26  Task: executable_args  Name: h5exp_cal_bandpass
Step Nr.: 27  Task: pythonplugin  Name: h5parm_name
Step Nr.: 28  Task: pythonplugin  Name: transfer_solutions
Step Nr.: 29  Task: dppp  Name: apply_PA1
Step Nr.: 30  Task: dppp  Name: apply_bandpass
Step Nr.: 31  Task: dppp  Name: apply_beam1
Step Nr.: 32  Task: dppp  Name: apply_FR1
Step Nr.: 33  Task: executable_args  Name: smooth_corrected2
Step Nr.: 34  Task: dppp  Name: calib_cal21
Step Nr.: 35  Task: executable_args  Name: h5imp_cal_ion
Step Nr.: 36  Task: executable_args  Name: process_losoto_ion
Step Nr.: 37  Task: executable_args  Name: h5exp_cal_ion
Step Nr.: 38  Task: pythonplugin  Name: h5parm_name1
Step Nr.: 39  Task: pythonplugin  Name: make_summary
Delete last steps including number:
```

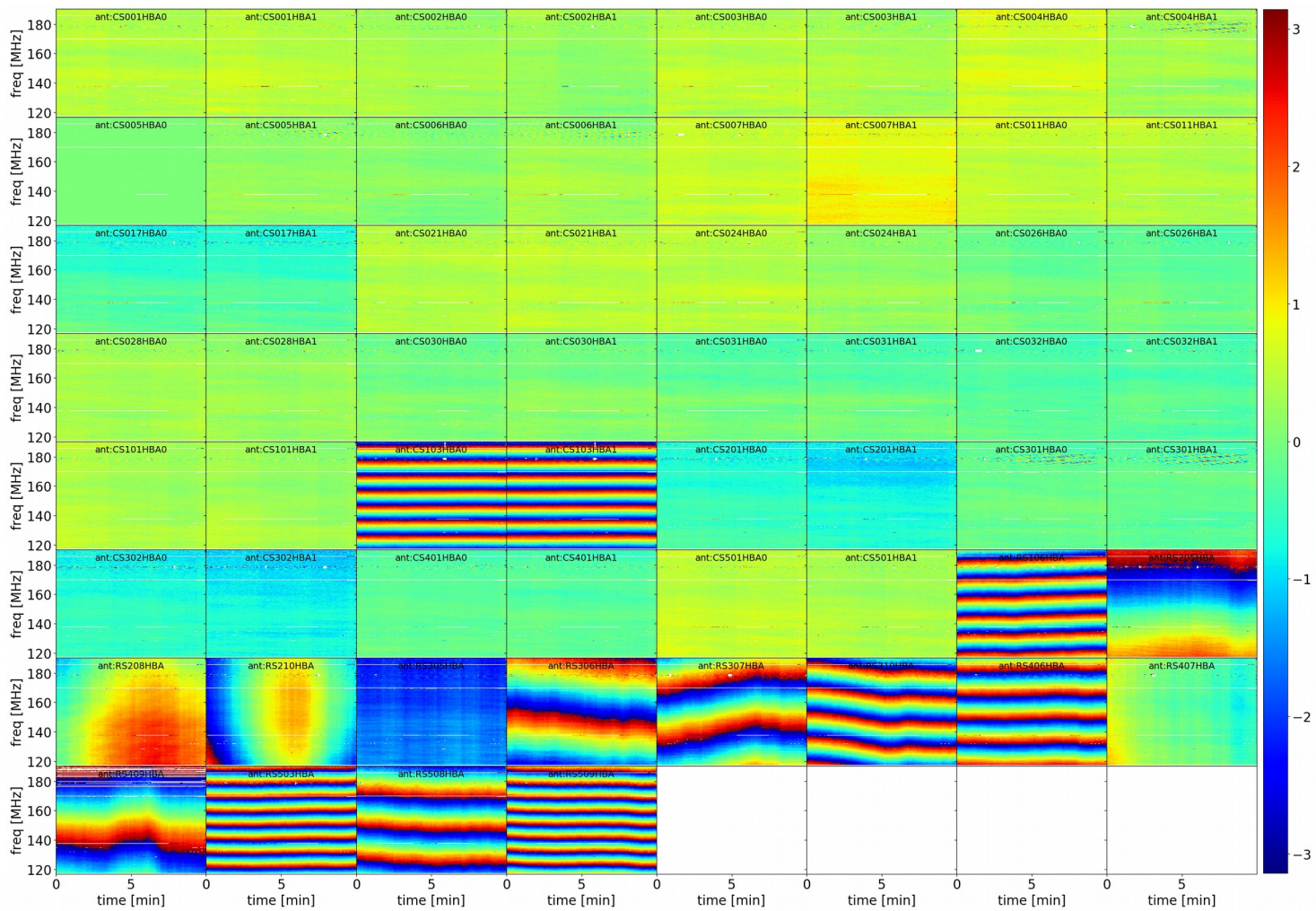
re-starting the pipeline from a certain step

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/results/inspection# ls
A-Team_elevation_calibrator.png  ampBFlag_polYY.png                 bandpass_time4906292402.5165825_polXX.png  fr_amp_polXX.png  fr_ph_poldif.png        ion_
ampAFlag_polXX.png               bandpass_polXX.png                 bandpass_time4906292402.5165825_polYY.png  fr_amp_polYY.png  fr_rotangle.png         ion_
ampAFlag_polYY.png               bandpass_polYY.png                 clock.png                                  fr_ph_polXX.png   ion_ampAFlag_polXX.png  ion_
ampBFlag_polXX.png               bandpass_time4906292402.5165825.png fr.png                                     fr_ph_polYY.png   ion_ampAFlag_polYY.png  ion_
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/results/inspection#
```

inspecting
calibration results



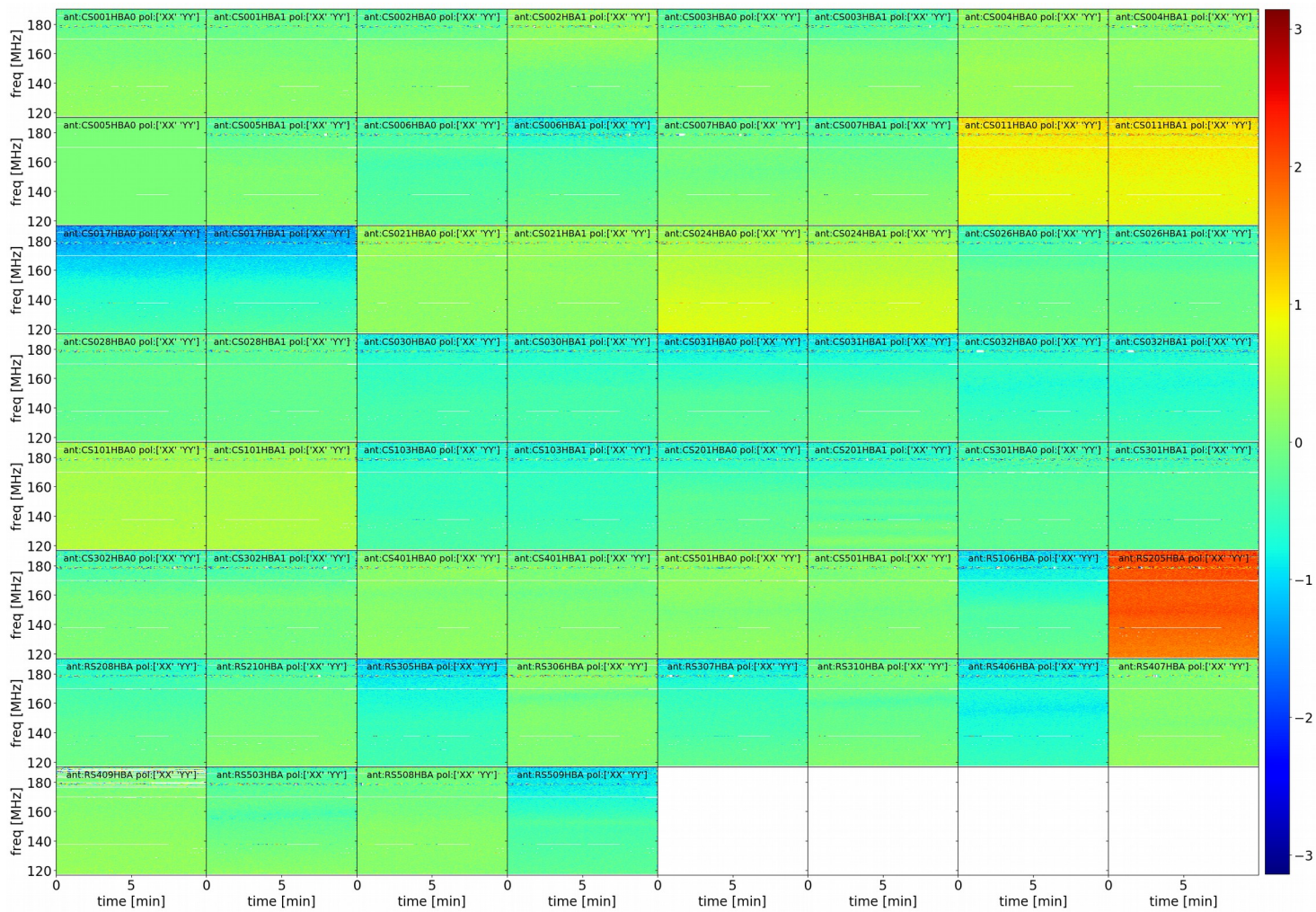
A-Team_elevation_calibrator.png



1st iteration of calibration

$$\mathbf{J}_{\text{pol. misalignment}} = \begin{pmatrix} 1 & 0 \\ 0 & e^{2\pi i \nu \Delta t} \end{pmatrix}$$

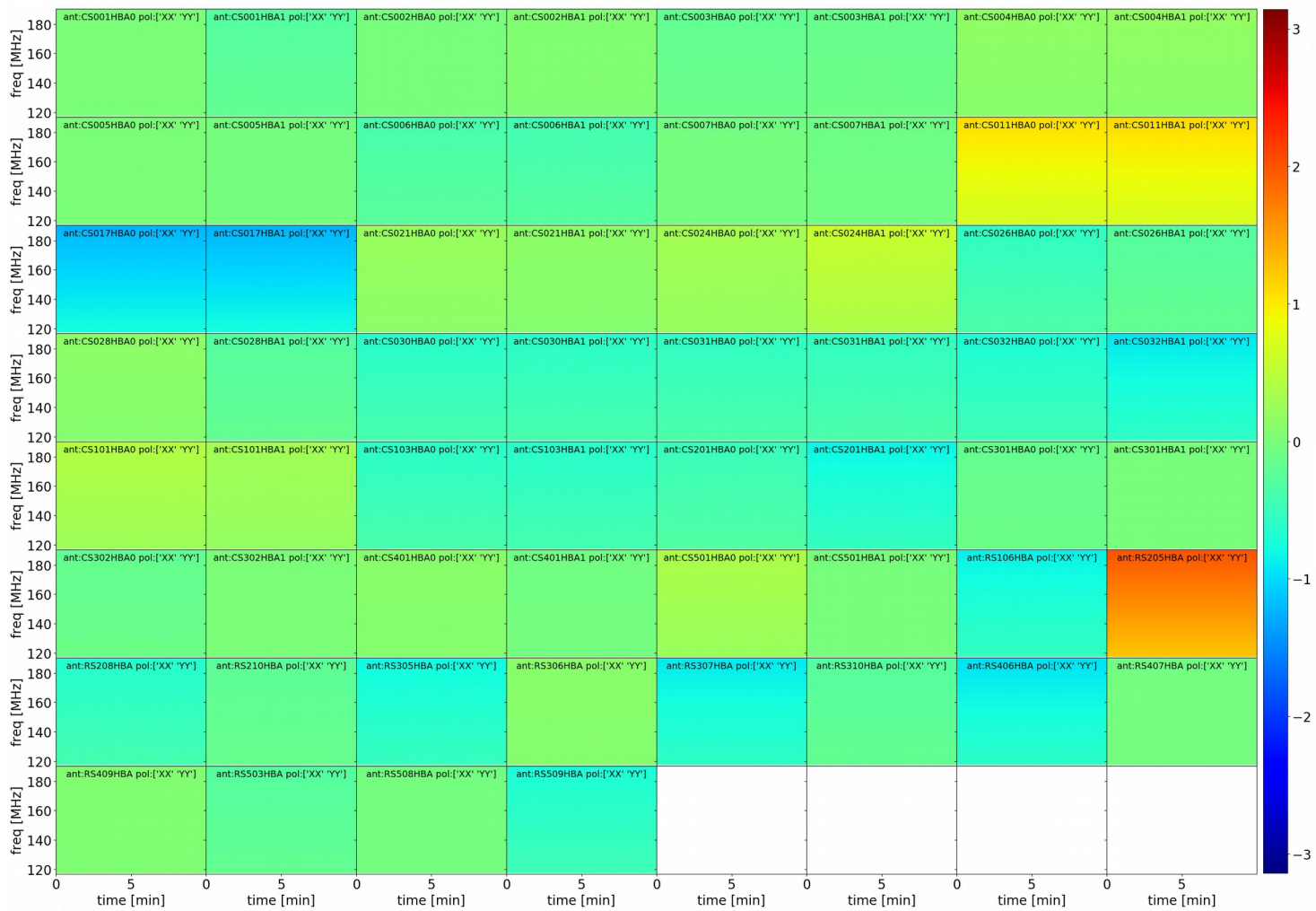
`polalign_ph_polXX.png`



1st iteration of calibration

$$\mathbf{J}_{\text{pol. misalignment}} = \begin{pmatrix} 1 & 0 \\ 0 & e^{2\pi i \nu \Delta t} \end{pmatrix}$$

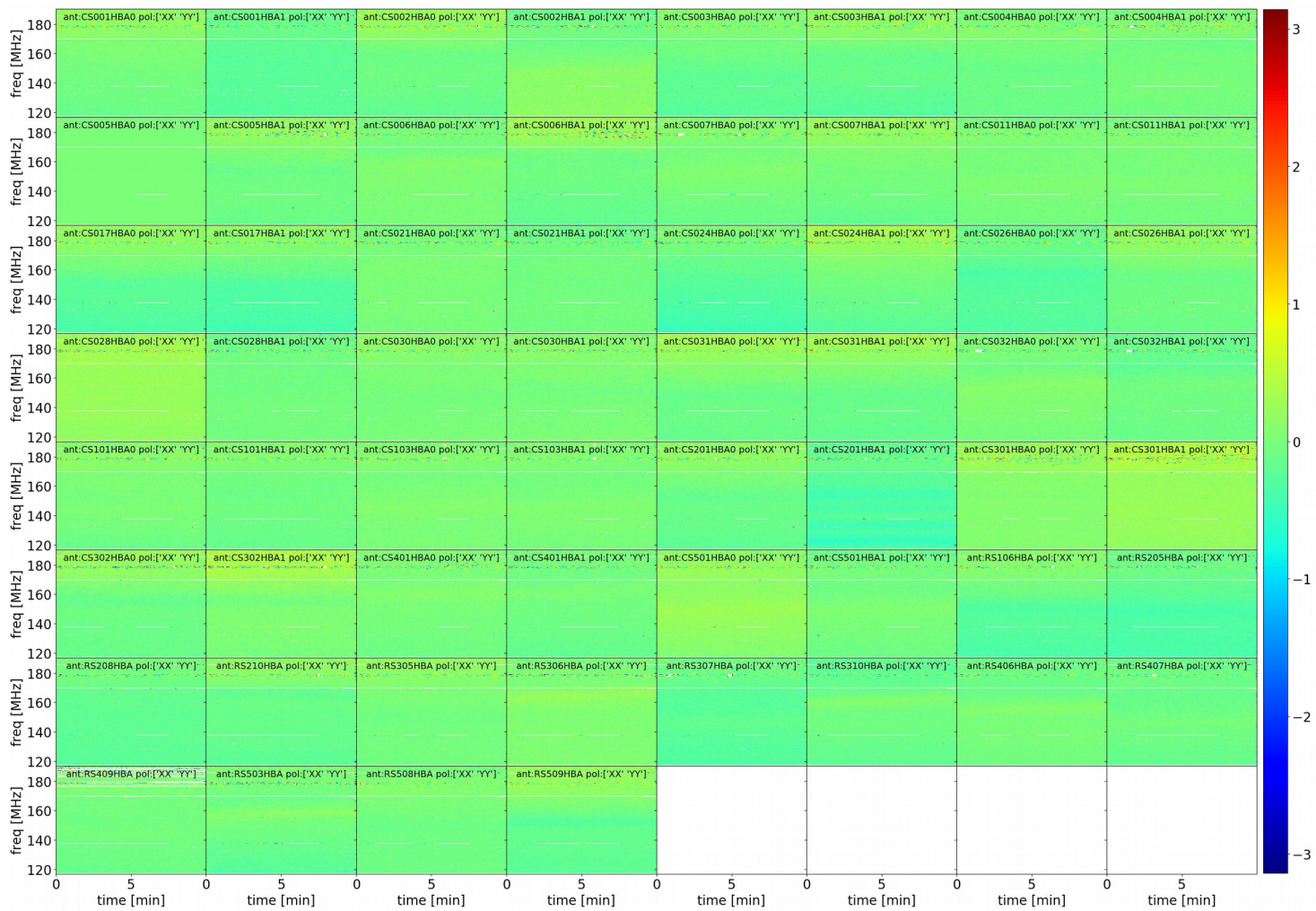
polalign_ph_poldif.png



1st iteration of calibration

$$\mathbf{J}_{\text{pol. misalignment}} = \begin{pmatrix} 1 & 0 \\ 0 & e^{2\pi i \nu \Delta t} \end{pmatrix}$$

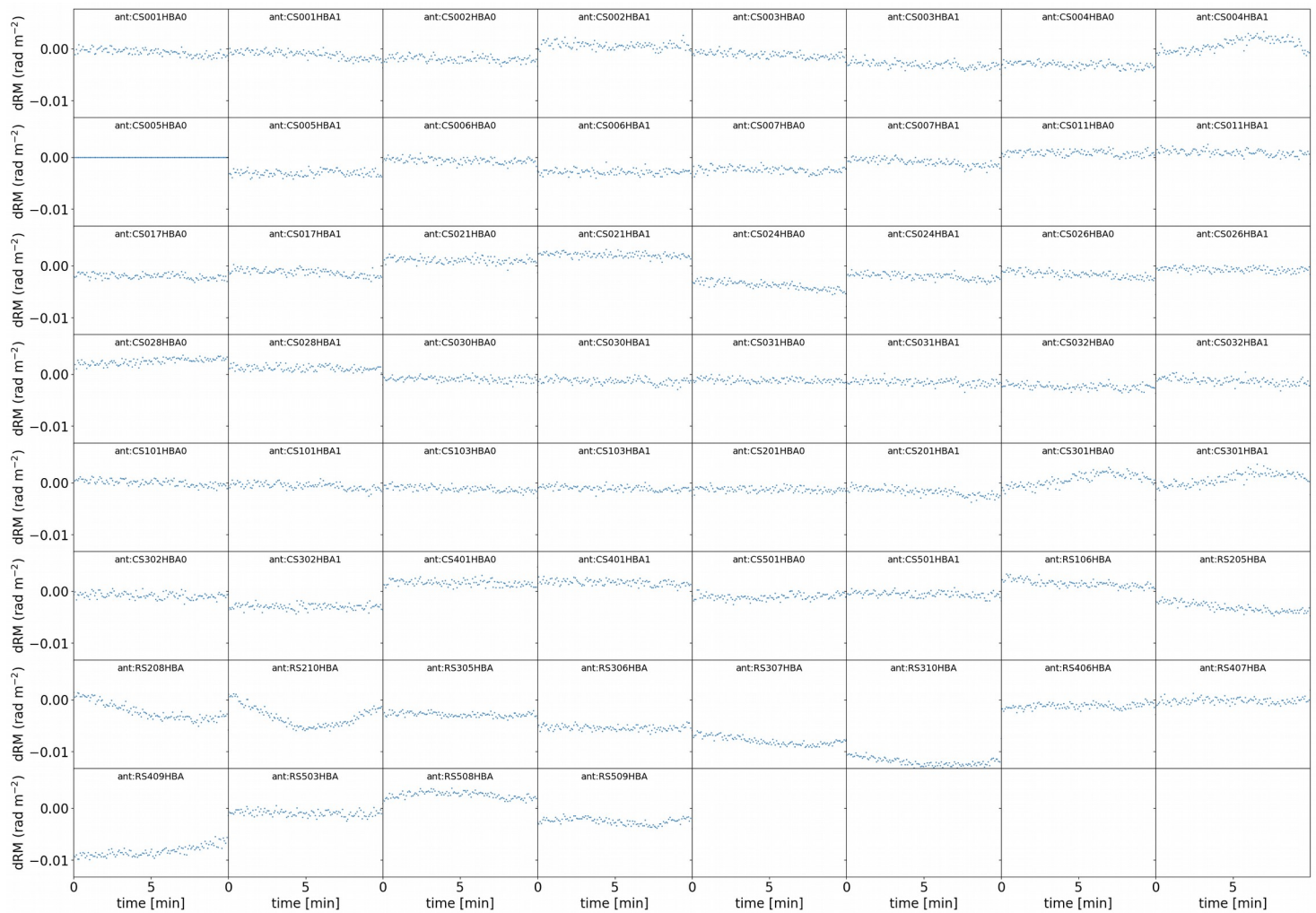
`polalign.png`



2nd iteration of calibration after correcting for **PA + beam**

→ no XX-YY phase offsets

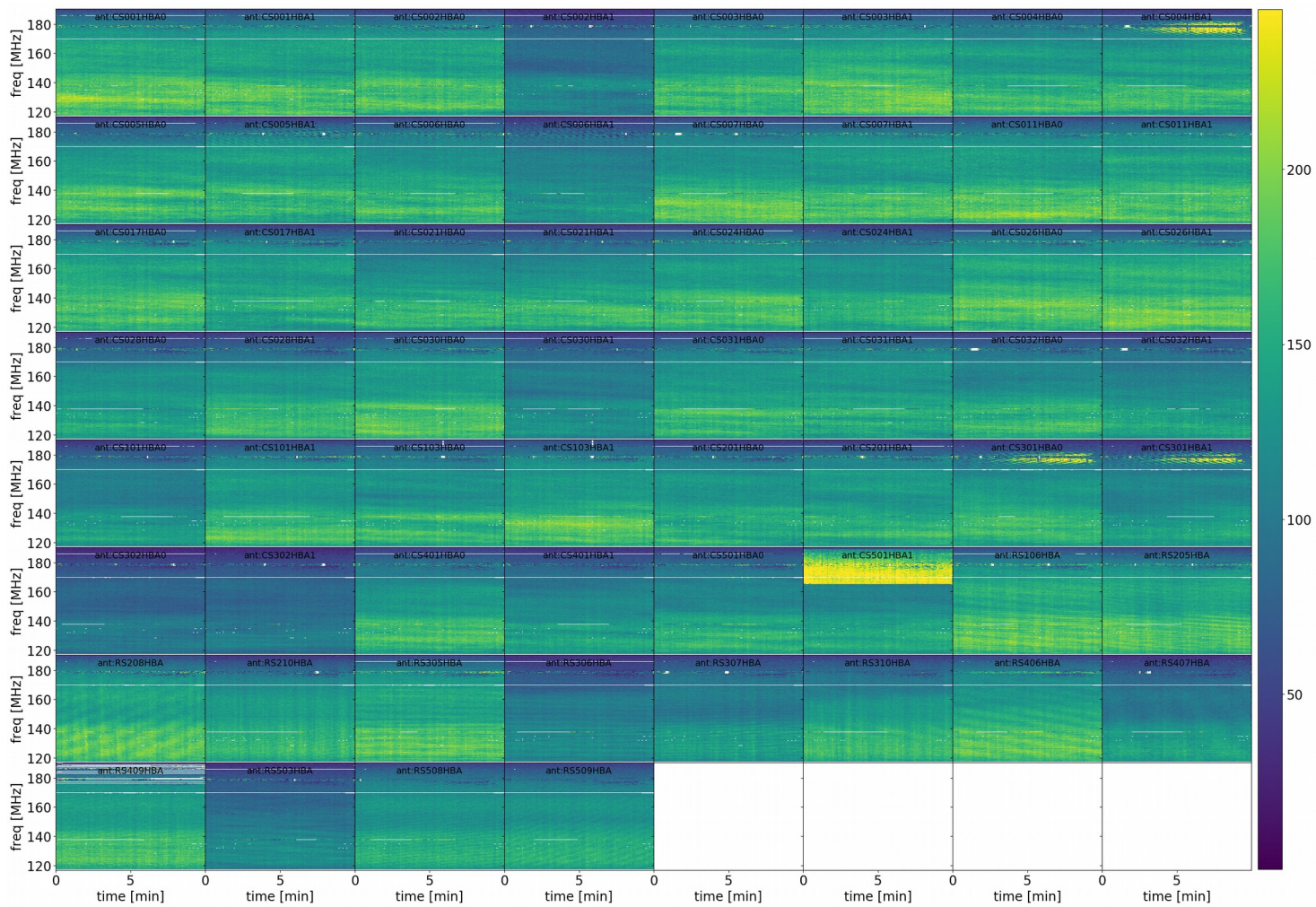
`fr_ph_poldif.png`



2nd iteration of calibration after correcting for **PA + beam**

$$\beta = \mathrm{RM}\lambda^2$$

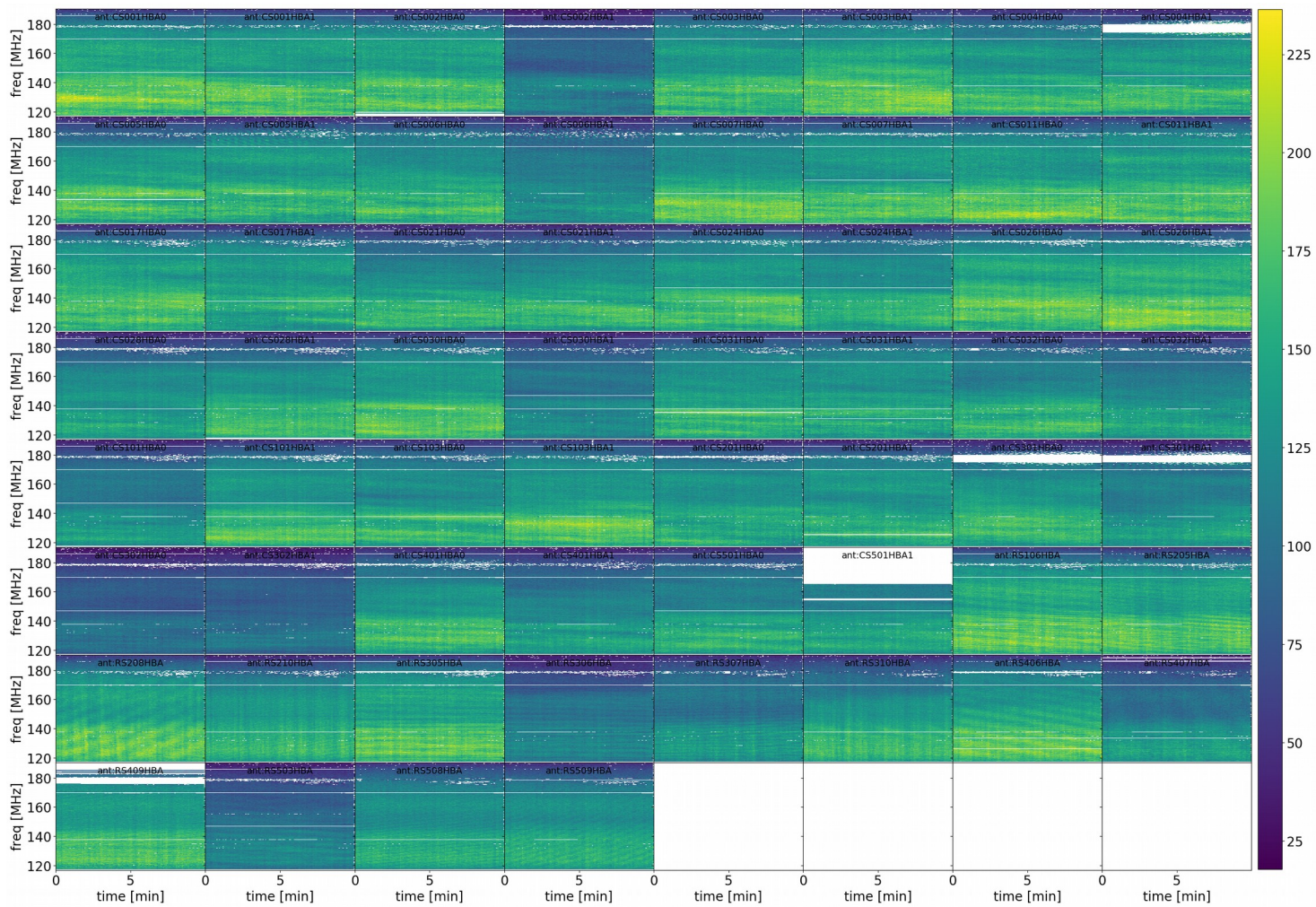
`fr.png`



3rd iteration of calibration after correcting for **PA + beam + FR** (wide-band flagged)

$$\mathbf{J}_{\text{bandpass}} = \begin{pmatrix} a_{xx} & 0 \\ 0 & a_{yy} \end{pmatrix}$$

`ampBFlag_polXX.png`

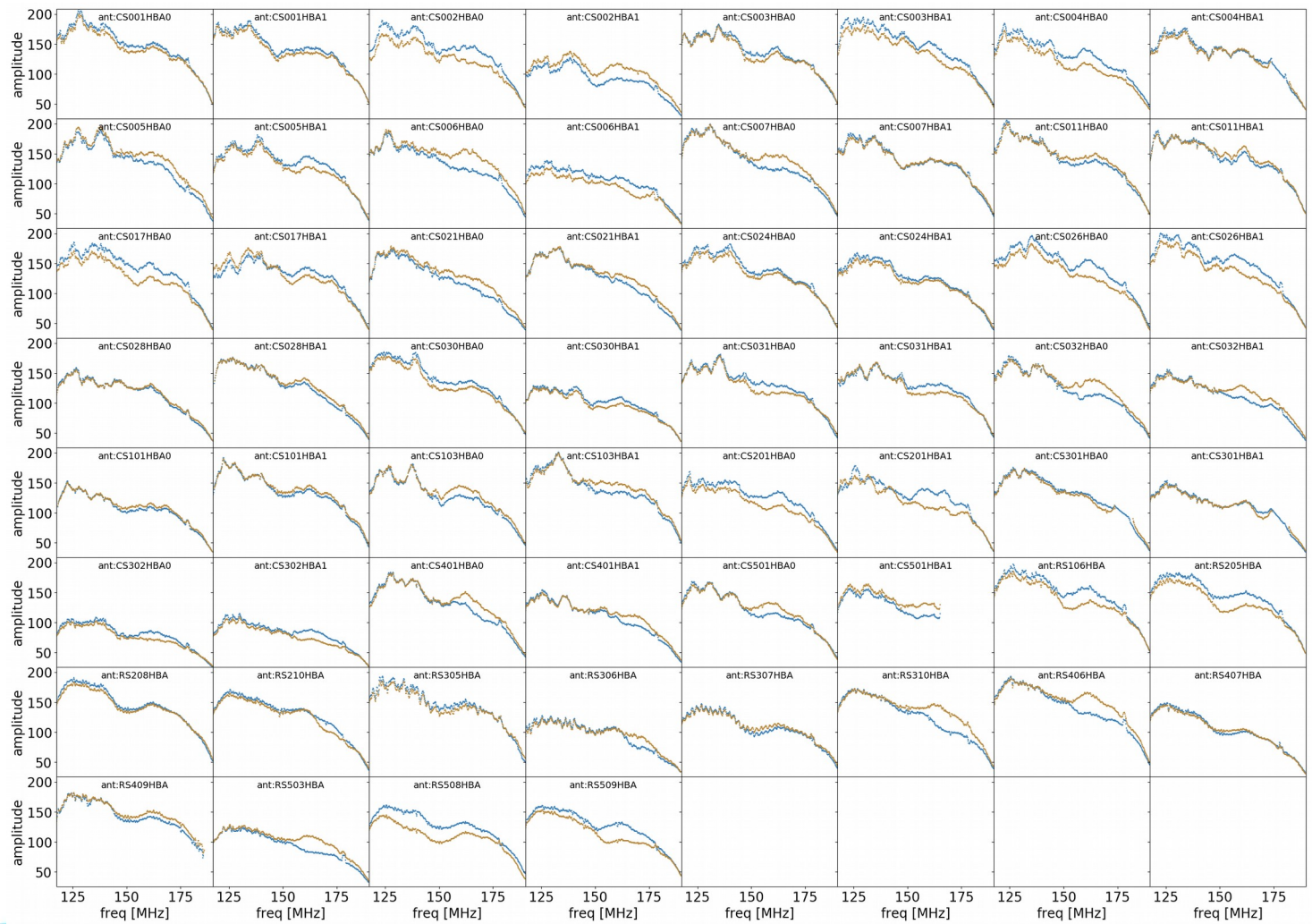


3rd iteration of calibration after correcting for **PA + beam + FR** (wide-band flagged)

flags applied

$$\mathbf{J}_{\text{bandpass}} = \begin{pmatrix} a_{xx} & 0 \\ 0 & a_{yy} \end{pmatrix}$$

`ampAFlag_polXX.png`

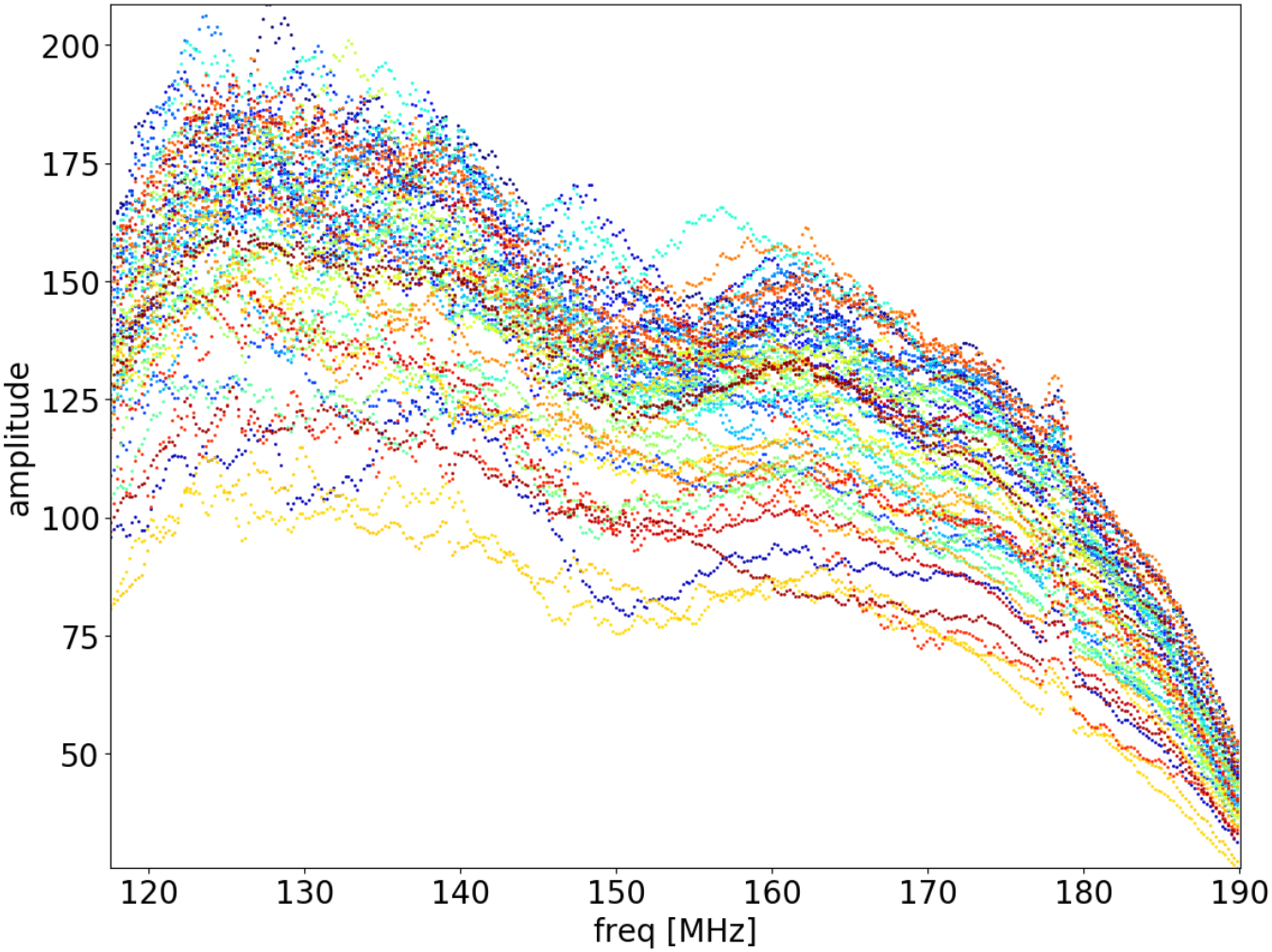


3rd iteration of calibration after correcting for **PA + beam + FR** (smoothed + interpolated)

flags applied

$$\mathbf{J}_{\text{bandpass}} = \begin{pmatrix} a_{xx} & 0 \\ 0 & a_{yy} \end{pmatrix}$$

`bandpass_time??.png`

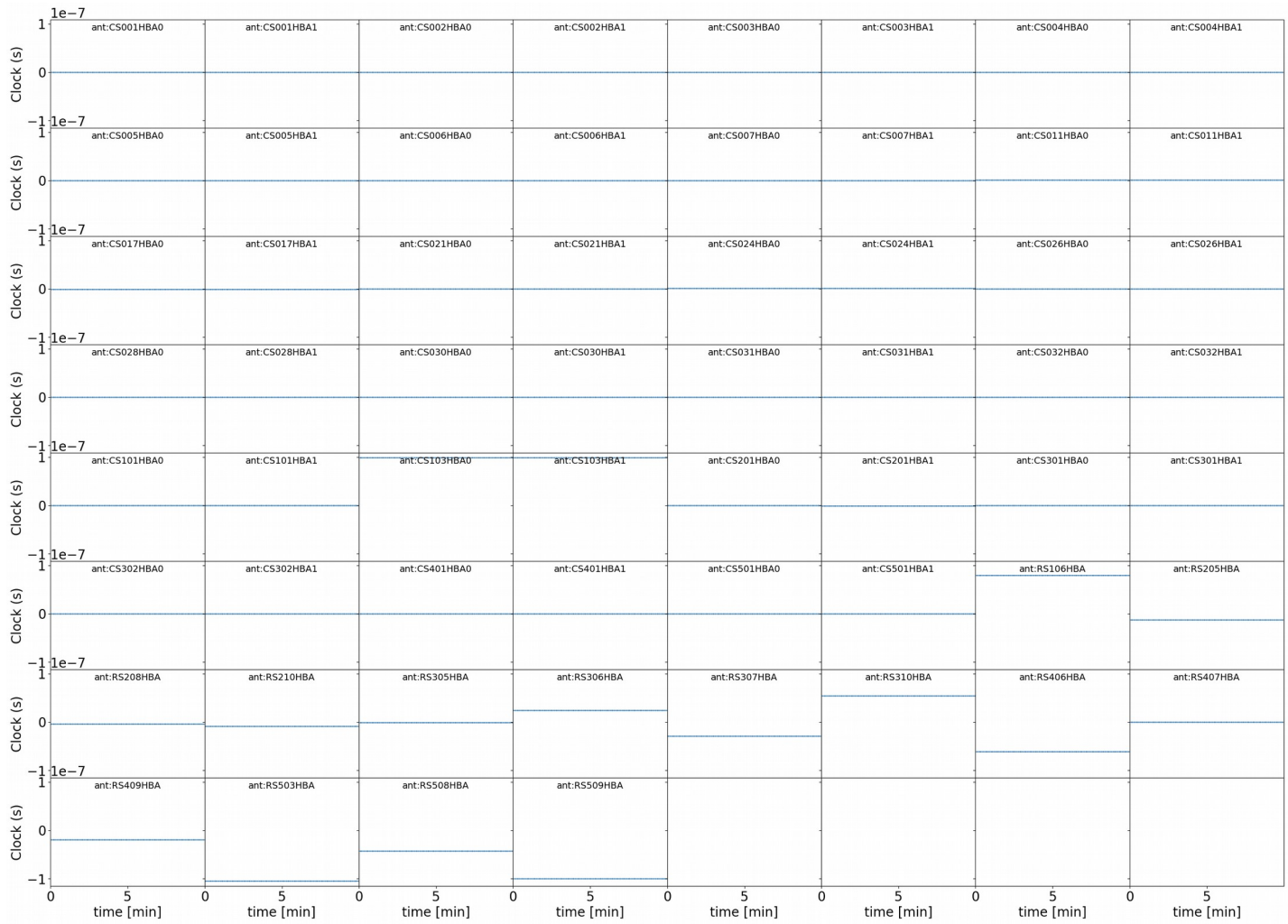


3rd iteration of calibration
after correcting for
PA + beam + FR
(smoothed + interpolated)

automatic detection
and proper interpolation
and re-gridding

$$\mathbf{J}_{\text{bandpass}} = \begin{pmatrix} a_{xx} & 0 \\ 0 & a_{yy} \end{pmatrix}$$

`bandpass_time??_polXX.png`

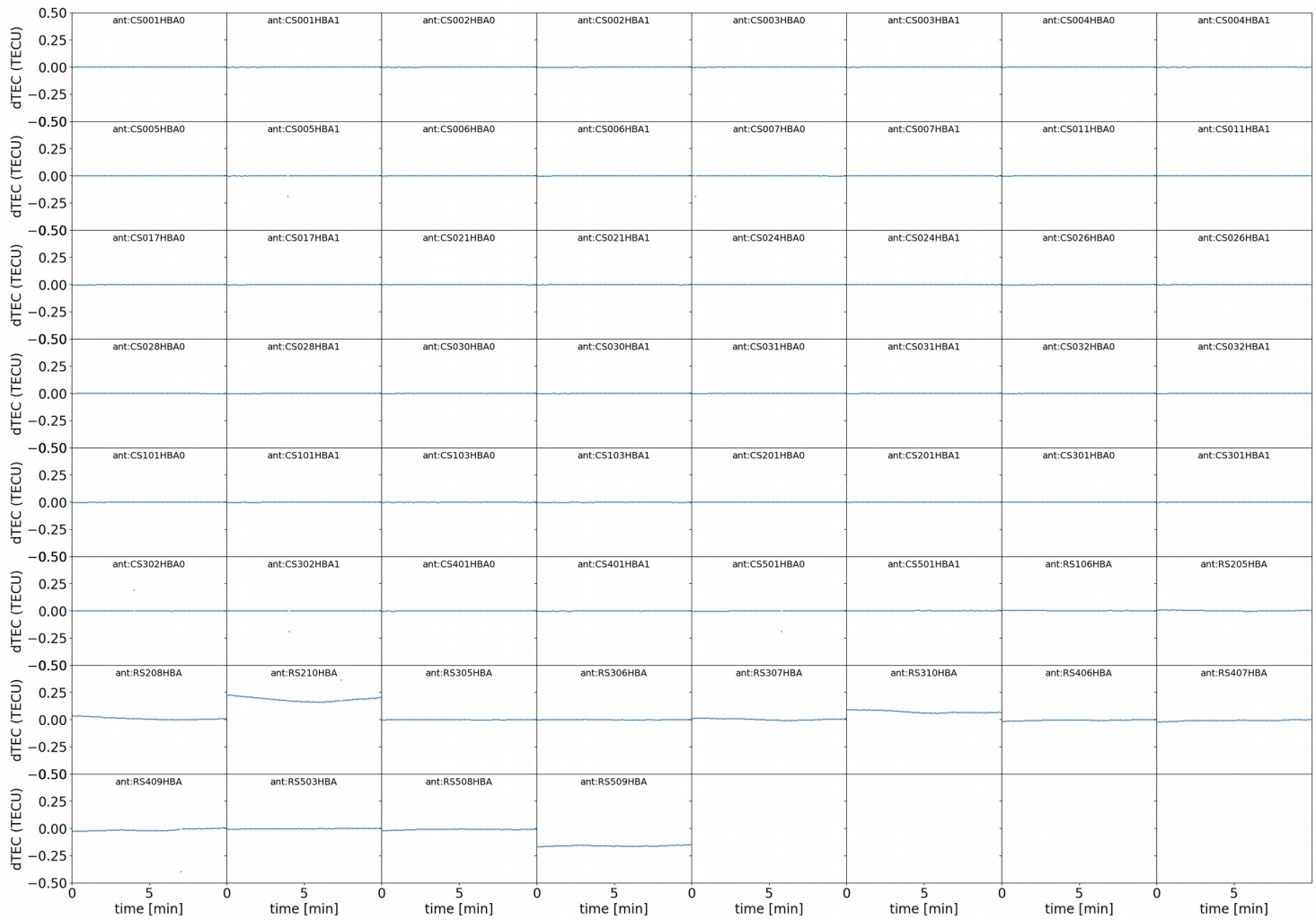


4th iteration of calibration after correcting for **PA + bandpass + beam + FR**

$$\mathbf{J}_{\text{clock}} = e^{2\pi i \nu t} \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\Delta\phi_{\text{clock}} \propto \Delta t \nu$$

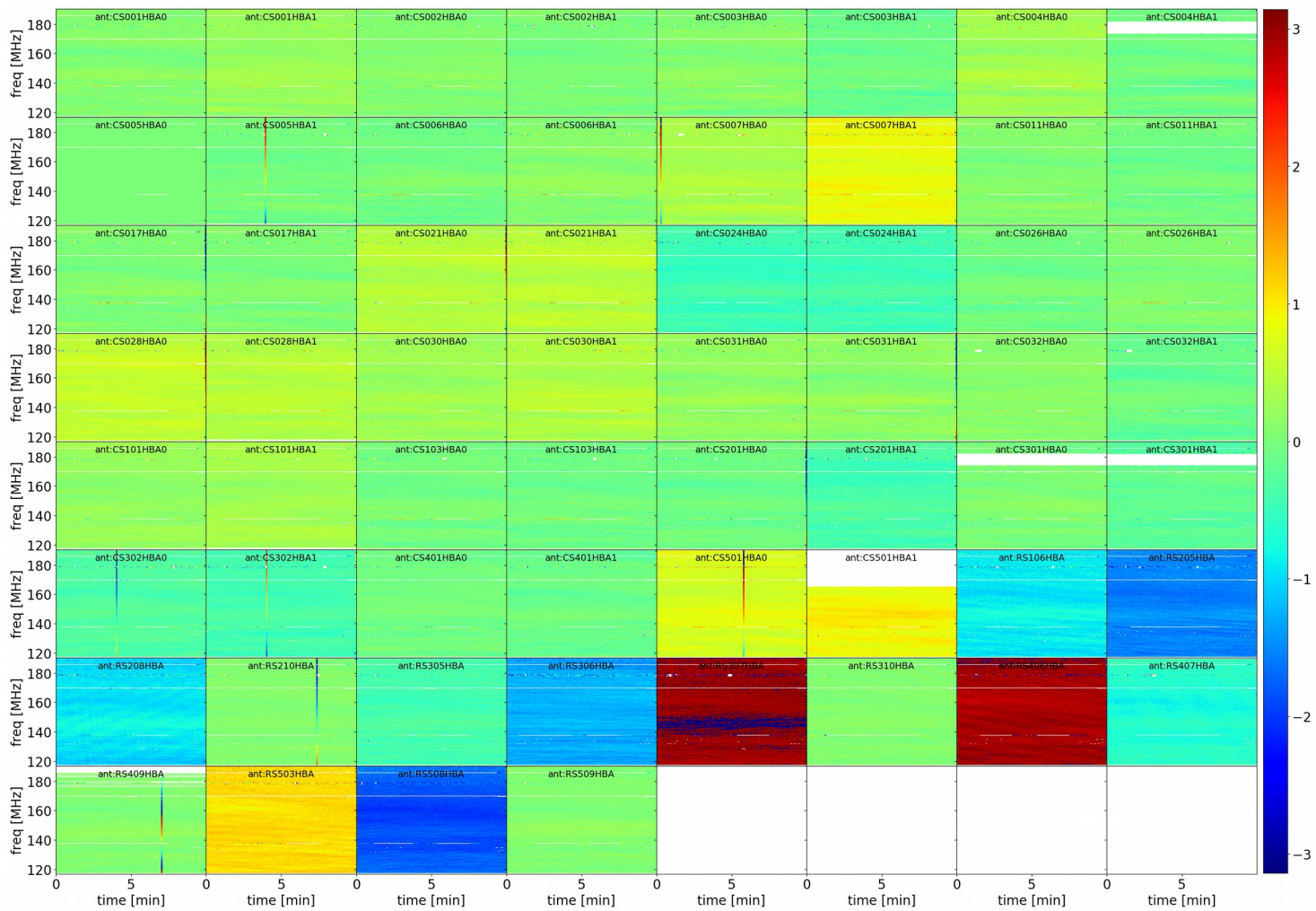
`clock.png`



4th iteration of calibration after correcting for **PA + bandpass + beam + FR**

$$\Delta\phi_{\mathrm{TEC}} \propto \Delta\mathrm{TEC}\nu^{-1}$$

`tec.png`



4th iteration of calibration after correcting for **PA + bandpass + beam + FR**

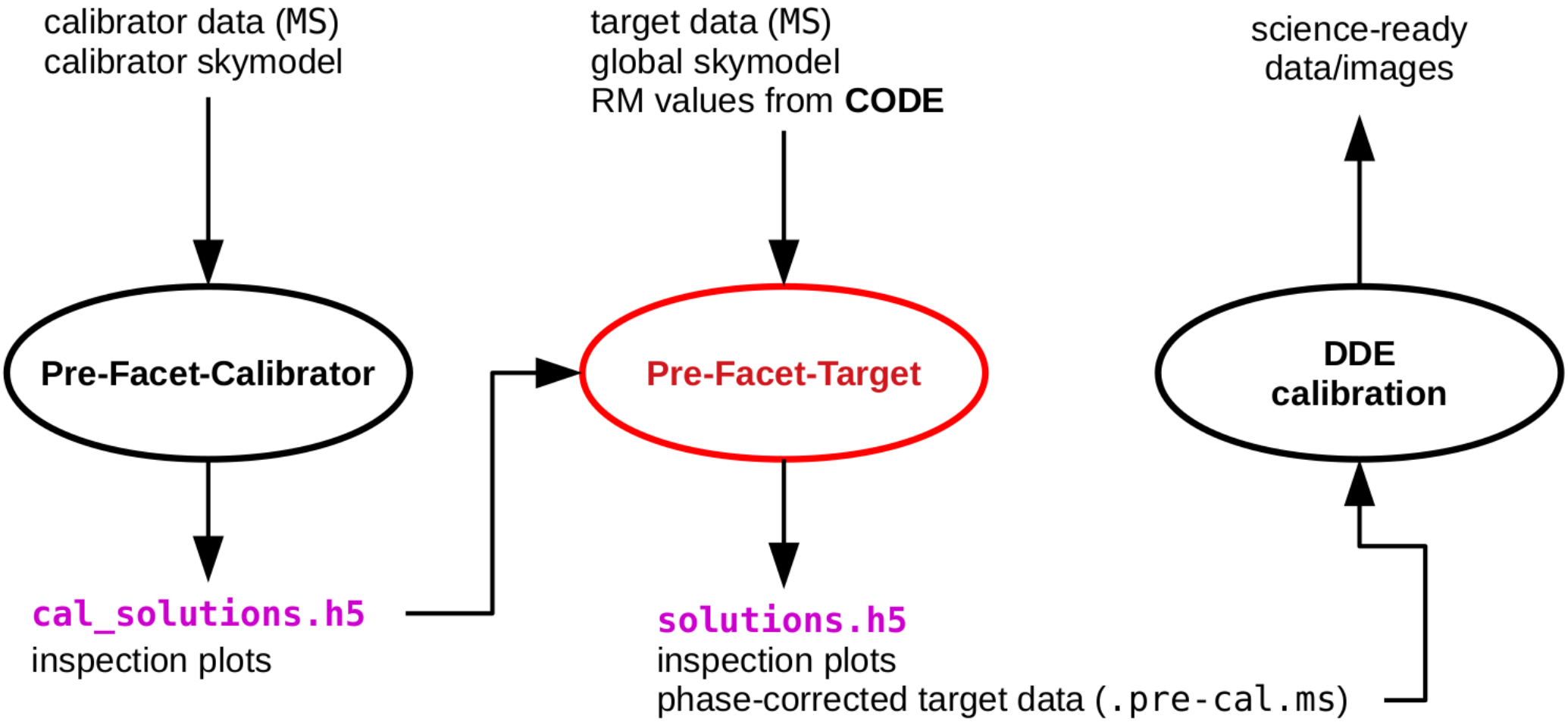
only phase offset left

`ion_ph-res.png`

```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Calibrator/results/cal_values# ls
cal_solutions.h5

root@936bc303e232:~/dockertest/working_directory# more Pre-Facet-Calibrator.log
Software versions currently used:
Ubuntu 18.04 bionic 4.15.0-91-generic #92-Ubuntu SMP Fri Feb 28 11:09:48 UTC 2020
DPPP 4.1
AOFlagger 2.14.0 (2019-02-14)
losoto 2.1
lsmtool 1.4.1
WSClean version 2.10.1 (2020-07-20)
Python 2.7.17
matplotlib 2.2.5, scipy 1.2.3, astropy 2.0.16

Antennas removed from the data: NONE
A-Team sources close to the phase reference center: VirA

Amount of flagged solutions per station and solution table:
Station   polalign faraday  bandpass  clock
CS001HBA0   0.00%    0.00%    0.29%    0.00%
CS001HBA1   0.00%    0.00%    0.29%    0.00%
CS002HBA0   0.00%    0.00%    0.29%    0.00%

Overall amount of flagged data in the final data:
Station
CS001HBA0      6.89%
CS001HBA1      6.76%
CS002HBA0      7.06%
CS002HBA1      7.02%
CS003HBA0      6.61%
CS003HBA1      6.79%
CS004HBA0      6.82%
```

calibration solutions

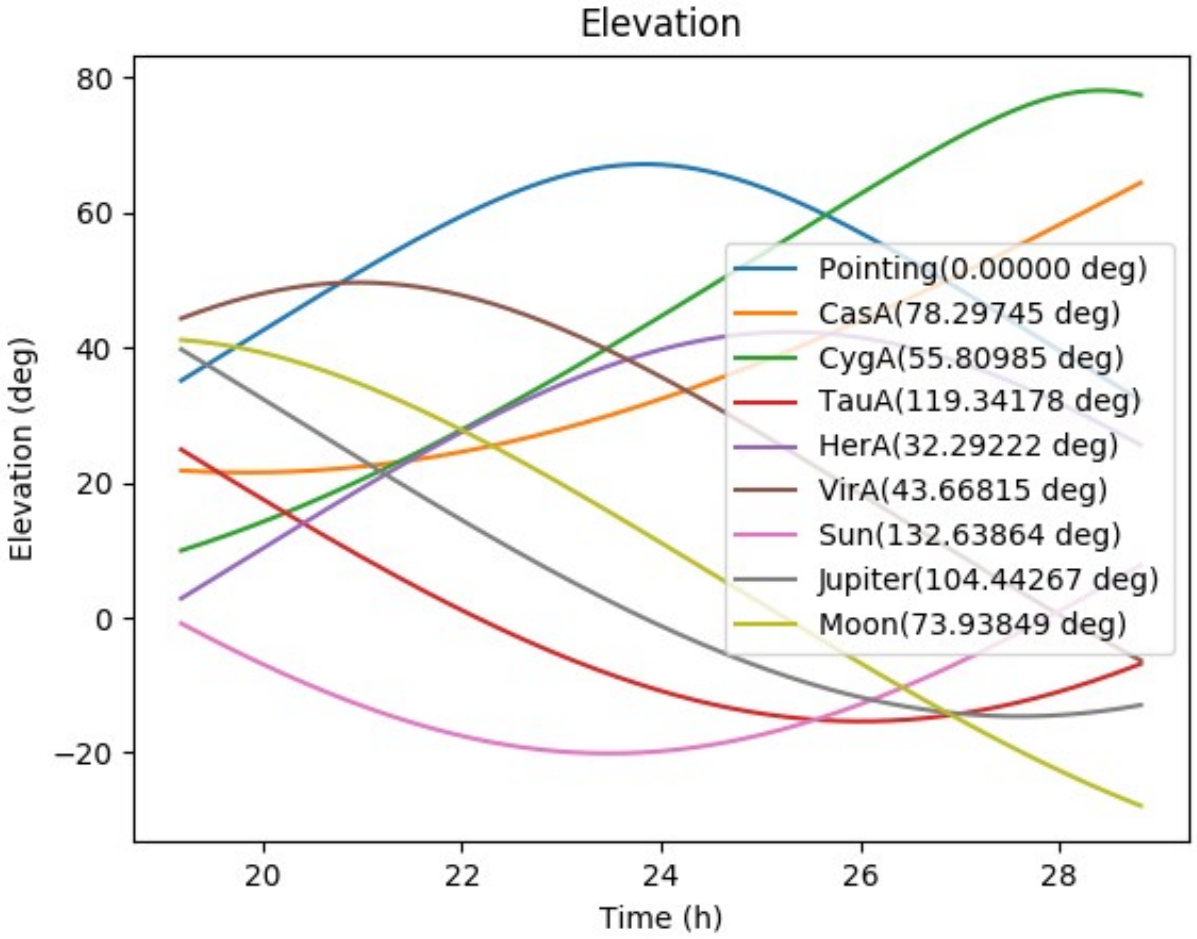
summary file


calibrator data (MS)
calibrator skymodel
Pre-Facet-Calibrator
cal_solutions.h5
inspection plots
target data (MS)
global skymodel
RM values from CODE
Pre-Facet-Target
solutions.h5
inspection plots
phase-corrected target data (.pre-cal.ms)
science-ready
data/images
DDE
calibration

```
root@936bc303e232:~/dockertest# vi Pre-Facet-Target.parset

##############################################################################
# Pre-Facet Target Calibration Pipeline v3.0 (04/09/2019)                    #
#                                                                            #
# Target part of the basic Pre-Facet calibration pipeline:                   #
# - requires LOFAR software version  >= 3.1.0                                #
# - requires losoto software version >= 2.0.0                                #
# - expects shared filesystem, that all nodes can reach all files!           #
#   (E.g. a single workstation or compute cluster with shared filesystem     #
#   doesn't work on multiple nodes on CEP3.)                                 #
##############################################################################

################################################
### parameters you will need to adjust. ##
################################################

## information about the target data
! target_input_path         =  /home/alex/dockertest/A2069/                          ## specify the directory where your target data is stored
! target_input_pattern      =  L228163*.MS                                ## regular expression pattern of all your target files
                               choose a minimum of 10 SBs, e.g., L228163*SB00*.MS
## location of the software
! prefactor_directory       =  /home/alex/dockertest/prefactor                       ## path to your prefactor copy
! losoto_directory          =  /opt/lofarsoft/                          ## path to your local LoSoTo installation
! aoflagger                 =  /opt/lofarsoft/bin/aoflagger             ## path to your aoflagger executable

## location of the calibrator solutions
! cal_solutions             =  input.output.job_directory/../Pre-Facet-Calibrator/results/cal_values/cal_solutions.h5
```

adjust parameters in the target parset

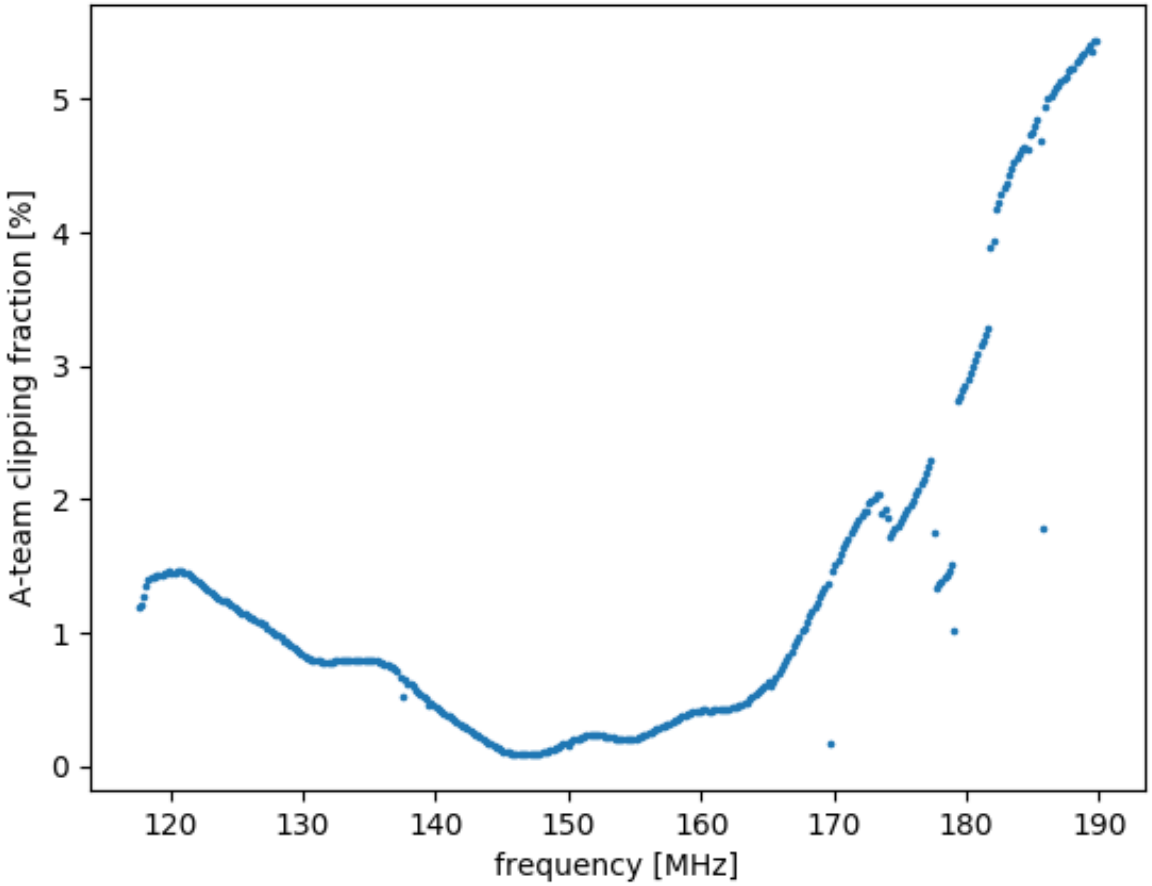
calibrator solutions as input



none of the A-Team sources is closer than **30°**

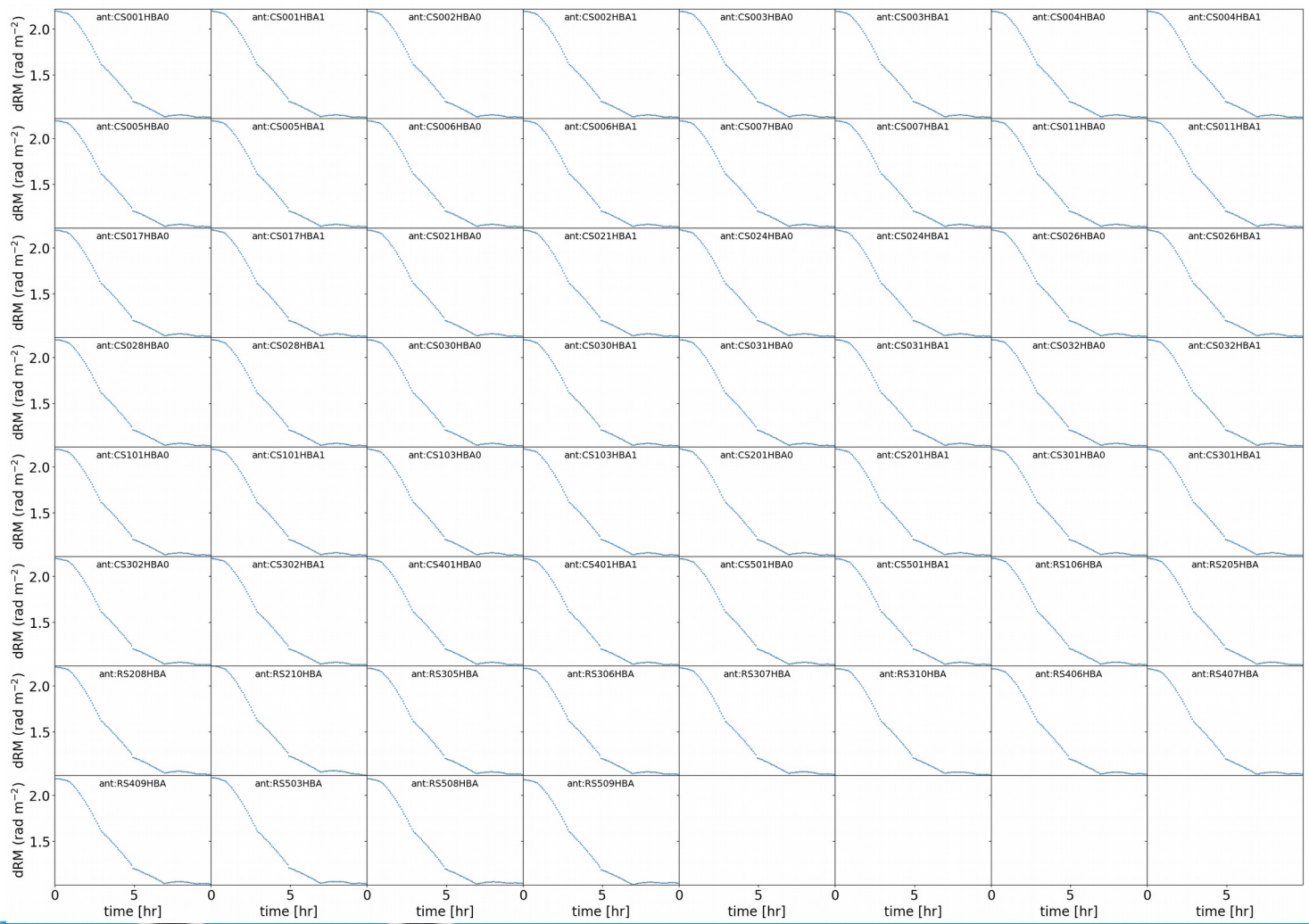
potentially contaminated UV data can be flagged

A-Team_elevation_target.png



data clipped due to potential contamination by A-Team sources is acceptable

Ateamclipper.png

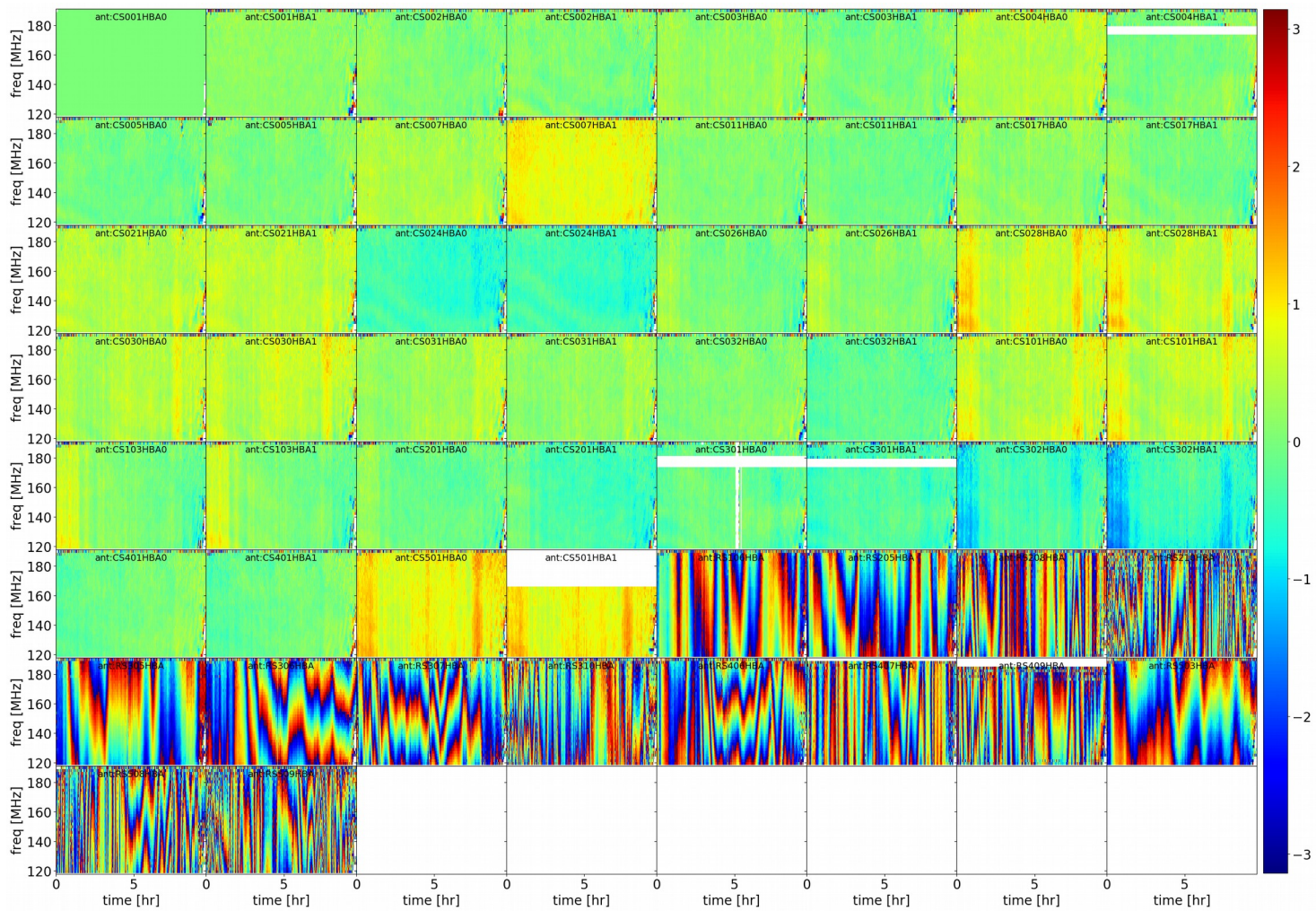


include RM values from **CODE**

$$\beta = \mathrm{RM}\lambda^2$$

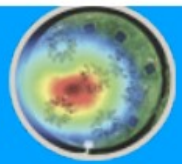
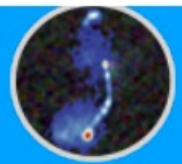
see **Ionospheric Effects** in M. Mevius' talk (**D2**)

`RMextract.png`

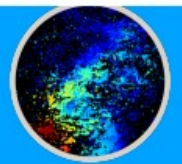


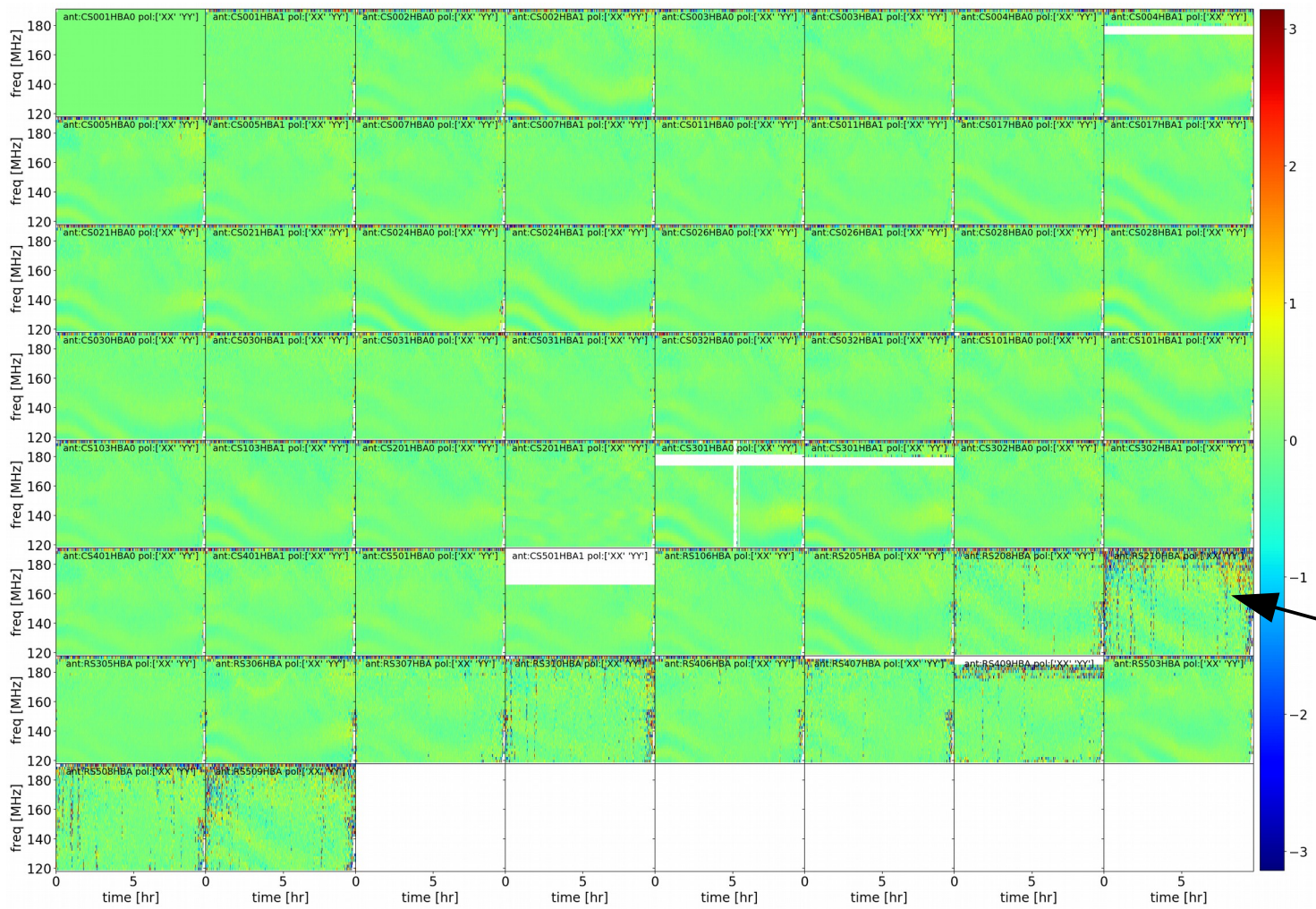
phase corrections for the target field using global skymodel

ph_polXX.png

6th LOFAR Data School

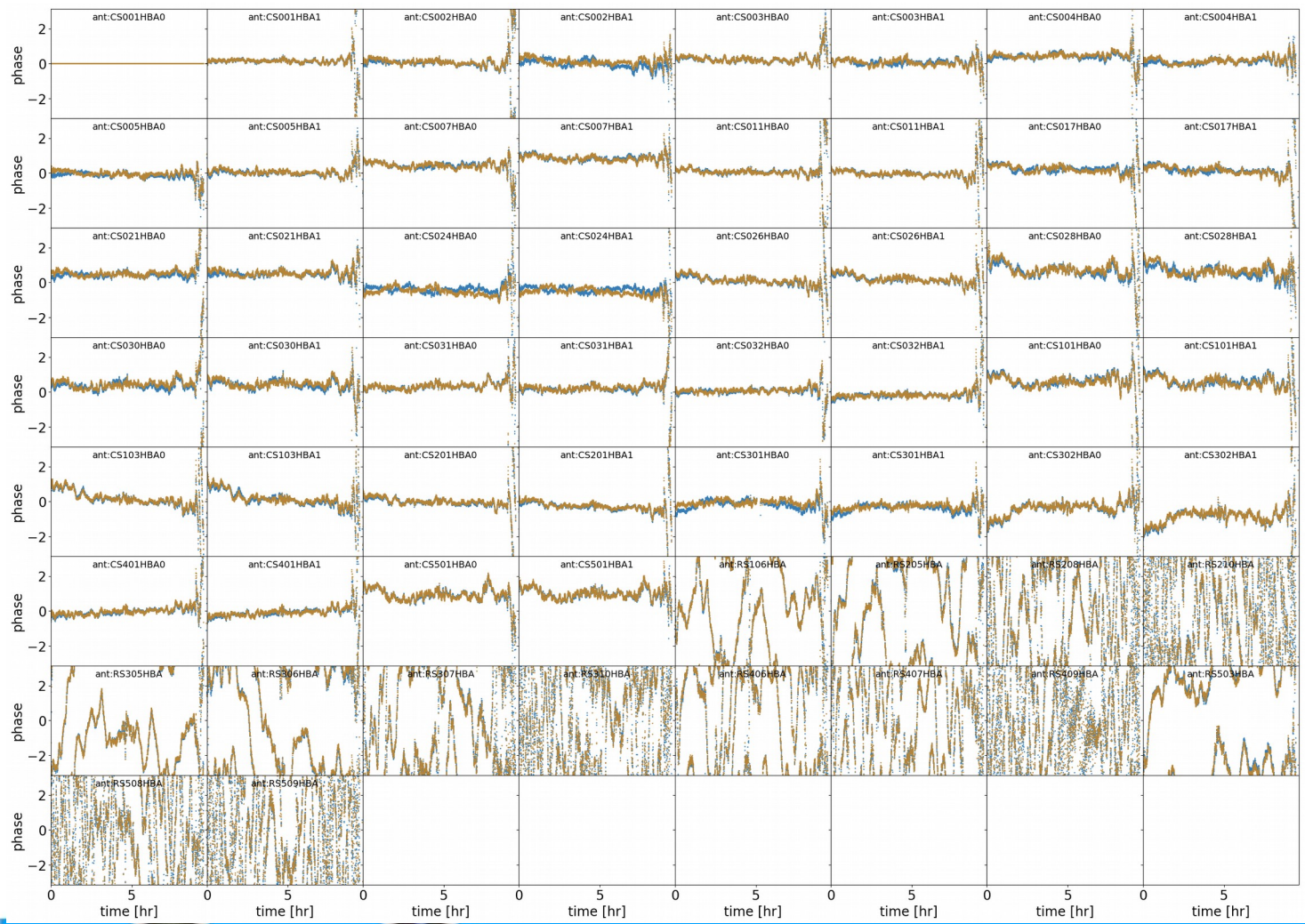




in **XX-YY** still some phase residuals are left.

Noisy parts pop up

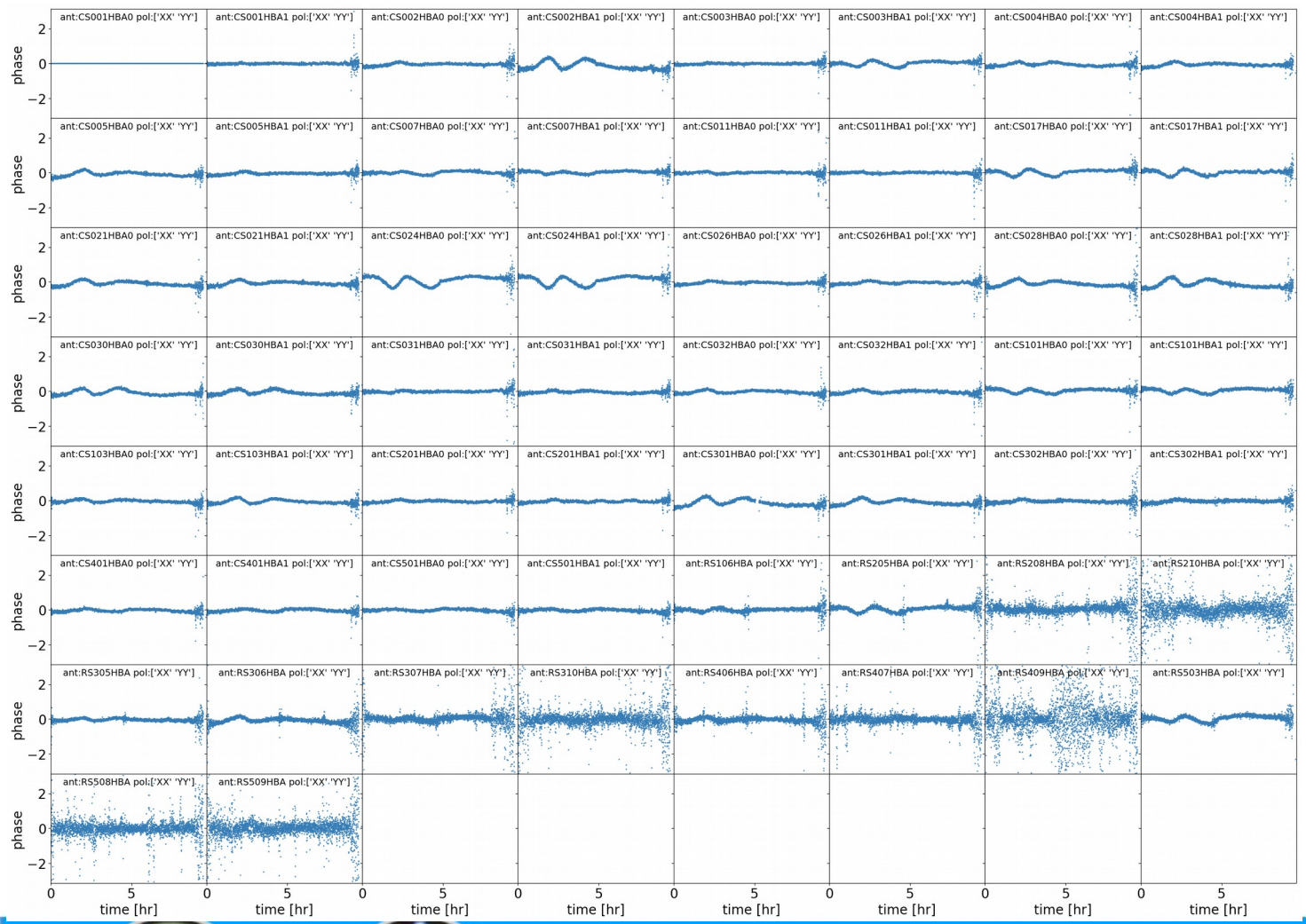
`ph_poldif.png`



additional time-resolved diagnostics for separate frequency chunks

XX, **YY**

`ph_freq??.png`

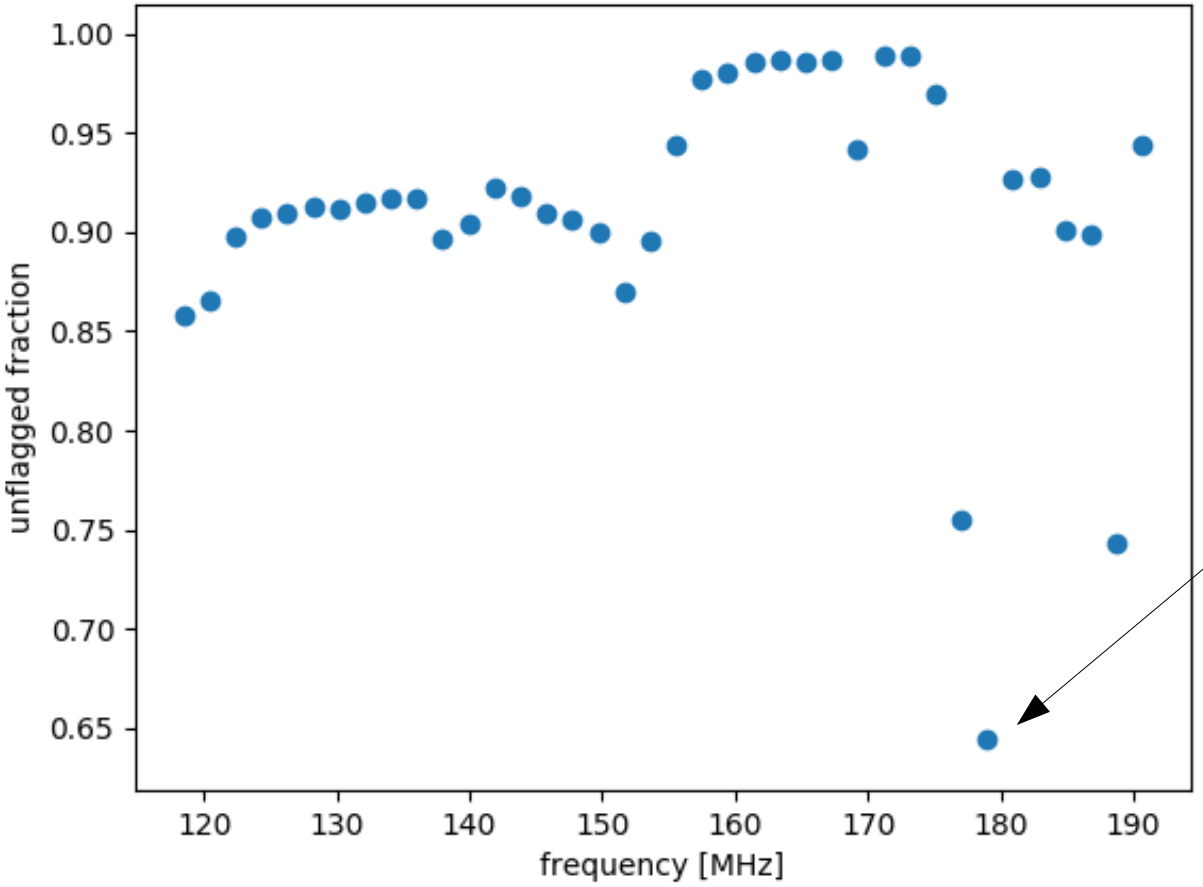


additional time-resolved diagnostics for separate frequency chunks

XX-YY residuals can be easily spotted

noise increased at Remote Station

`ph_poldif_freq??.png`



helpful for quality assessment

easily spot bad frequency ranges

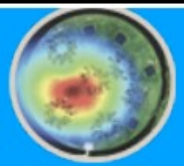
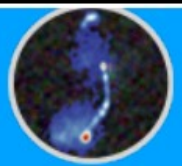
`unflagged_fraction.png`

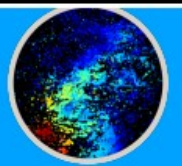
```
root@936bc303e232:~/dockertest/working_directory/Pre-Facet-Target/results# ls
L228163_SB000_uv.dppp_124701747t_118MHz.pre-cal.ms  cal_values  inspection
```

pre-calibrated compressed target data
→ input for DDE calibration

solutions.h5

inspection plots

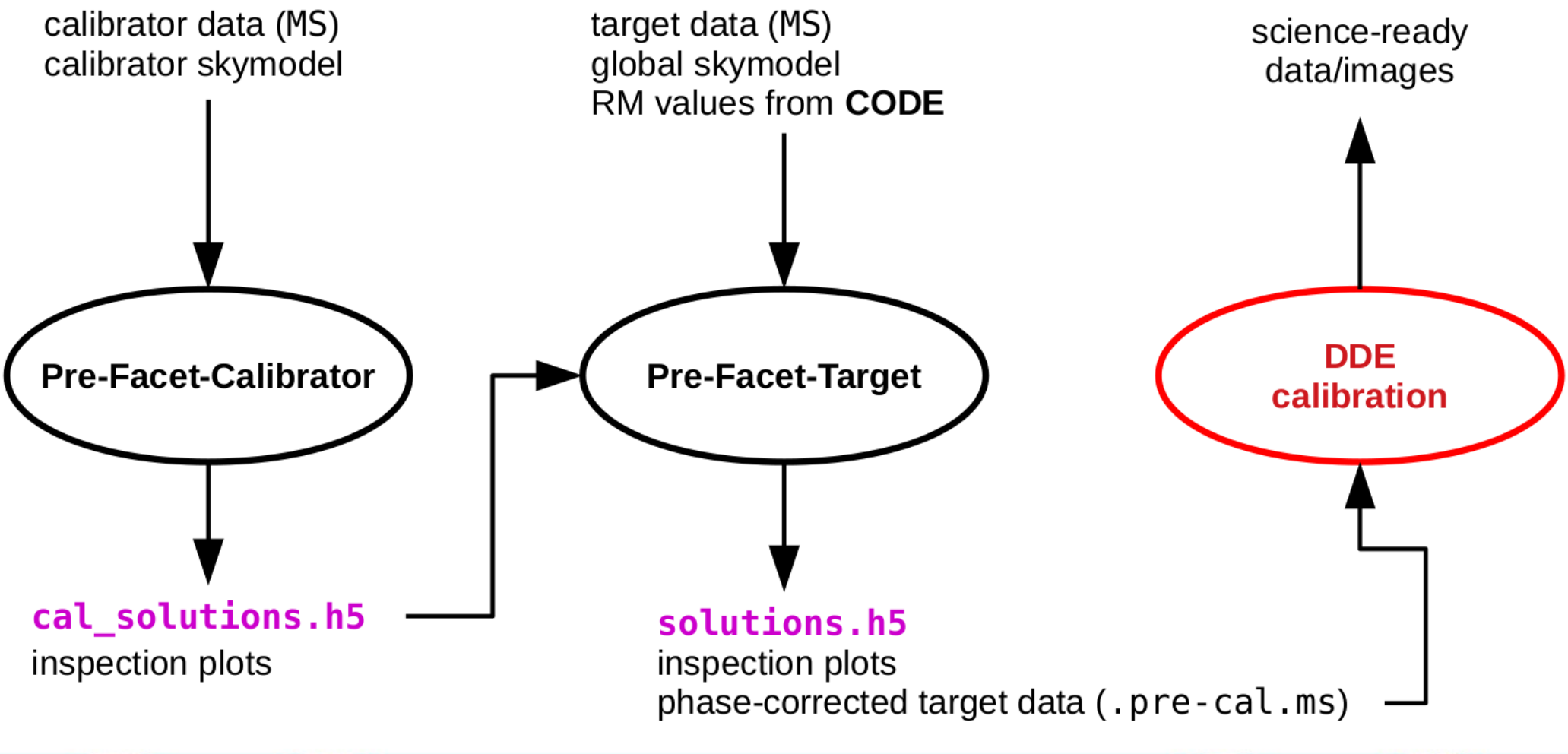


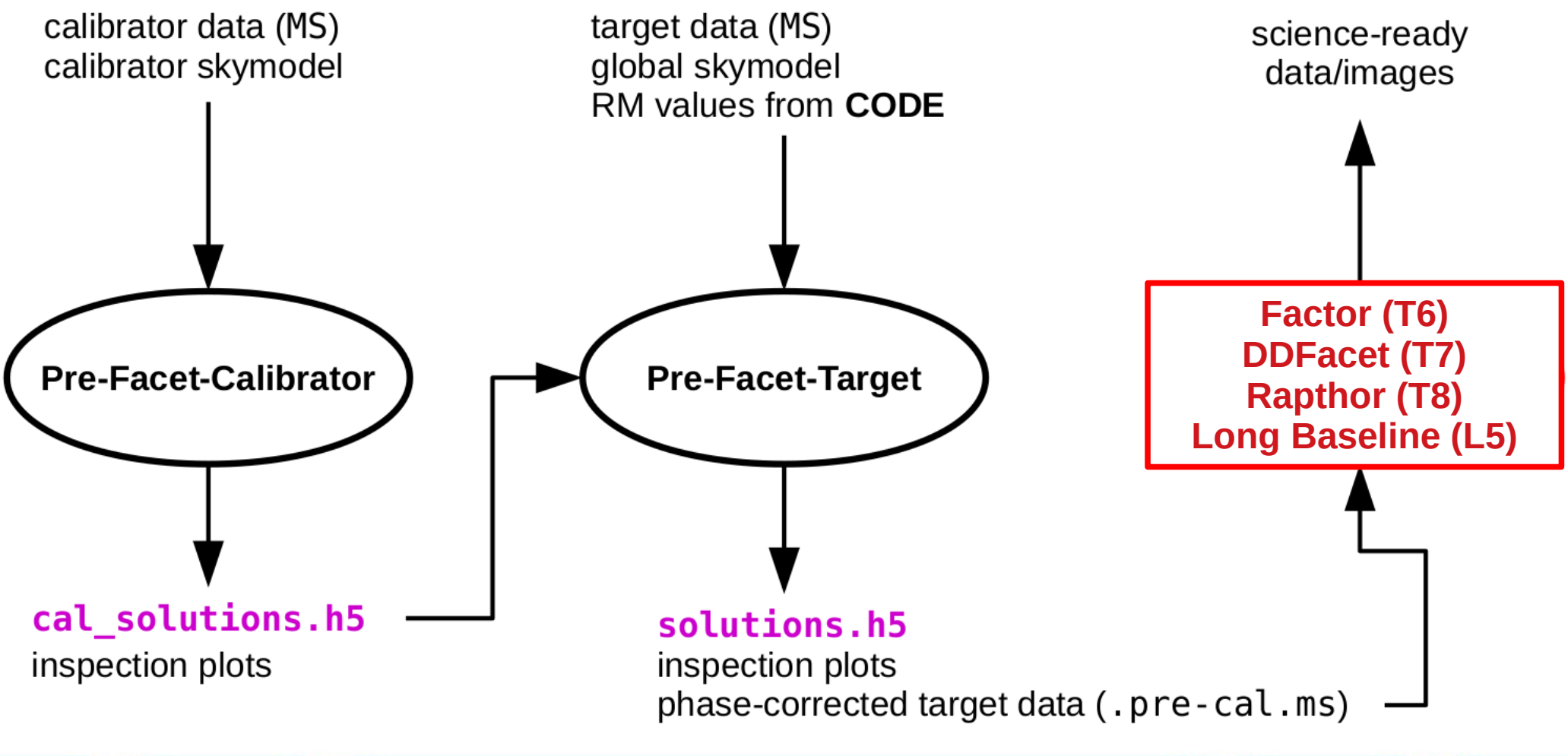
```
root@729a90debae1: /dockertest/working_directory# more Pre-Facet-Target.log
Software versions currently used:
Ubuntu 18.04 bionic 4.15.0-91-generic #92-Ubuntu SMP Fri Feb 28 11:09:48 UTC 2020
DPPP 4.1
AOFlagger 2.14.0 (2019-02-14)
losoto 2.1
lsmtool 1.4.1
WSClean version 2.10.1 (2020-07-20)
Python 2.7.17
matplotlib 2.2.5, scipy 1.2.3, astropy 2.0.16

Antennas removed from the data: CS006HBA1&&, CS006HBA0&&
A-Team sources close to the phase reference center: NONE

XX diffractive scale: 5.8 km
YY diffractive scale: 3.5 km

Changes applied to solutions.h5:
2021-03-04 19:37:37: Bad stations 'CS006HBA0', 'CS006HBA1' have not been added back.

Amount of flagged solutions per station and solution table:
Station   TGSSphase RMextract
CS001HBA0    0.05%     0.00%
CS001HBA1    0.00%     0.00%
CS002HBA0    0.05%     0.00%

Overall amount of flagged data in the final data:
Station
CS001HBA0      8.60%
CS001HBA1      8.70%
CS002HBA0      8.80%
```

check data/calibration quality

losoto -i solutions.h5

```
Summary of solutions.h5

Solution set 'target':
======================

Directions: AZ065

Stations: CS001HBA0     CS001HBA1     CS002HBA0     CS002HBA1
          CS003HBA0     CS003HBA1     CS004HBA0     CS004HBA1
          CS005HBA0     CS005HBA1     CS006HBA0     CS006HBA1
          CS007HBA0     CS007HBA1     CS011HBA0     CS011HBA1
          CS017HBA0     CS017HBA1     CS021HBA0     CS021HBA1
          CS024HBA0     CS024HBA1     CS026HBA0     CS026HBA1
          CS028HBA0     CS028HBA1     CS030HBA0     CS030HBA1
          CS031HBA0     CS031HBA1     CS032HBA0     CS032HBA1
          CS101HBA0     CS101HBA1     CS103HBA0     CS103HBA1
          CS201HBA0     CS201HBA1     CS301HBA0     CS301HBA1
          CS302HBA0     CS302HBA1     CS401HBA0     CS401HBA1
          CS501HBA0     CS501HBA1     RS106HBA      RS205HBA
          RS208HBA      RS210HBA      RS305HBA      RS306HBA
          RS307HBA      RS310HBA      RS406HBA      RS407HBA
          RS409HBA      RS503HBA      RS508HBA      RS509HBA

Solution table 'GSMphase' (type: phase): 3464 times, 37 freqs, 46 ants, 2 pols
    Flagged data: 1.582%

Solution table 'RMextract' (type: rotationmeasure): 60 ants, 119 times
    Flagged data: 0.000%
```


calibrator data (MS)
calibrator skymodel
Pre-Facet-Calibrator
cal_solutions.h5
inspection plots
target data (MS)
global skymodel
RM values from CODE
Pre-Facet-Target
solutions.h5
inspection plots
phase-corrected target data (.pre-cal.ms)
science-ready
data/images
DDE
calibration

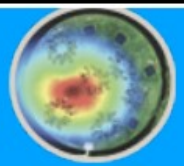
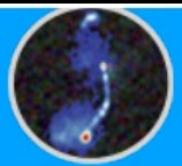
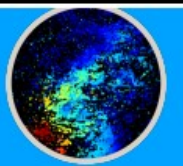

calibrator data (MS)
calibrator skymodel
Pre-Facet-Calibrator
cal_solutions.h5
inspection plots
target data (MS)
global skymodel
RM values from CODE
Pre-Facet-Target
solutions.h5
inspection plots
phase-corrected target data (.pre-cal.ms)
science-ready
data/images
Factor (T6)
DDFacet (T7)
Rapthor (T8)
Long Baseline (L5)

Initial direction-independent calibration and data reduction

Contact me during the hands-on sessions on Slack (March 24, 14:00 – 18:00 CET)

#t2-prefactor

- **Github repository**: https://www.github.com/lofar-astron/prefactor/
- **Documentation**: http://www.astron.nl/citt/prefactor/
- **FAQ**: https://github.com/lofar-astron/prefactor/wiki/Documentation%3A-Faq

- **Report issues at**:
  https://www.github.com/lofar-astron/prefactor/issues

TLS
Alexander Drabent
alex@tls-tautenburg.de