

GLOW Interferometry School 2012
Bielefeld

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Casa



Casa (<http://casa.nrao.edu>) is a software package to calibrate, image, and analyse radio data (interferometric and single dish).

- Python-Based

- interactive / non-interactive

- complex, proprietary data format ("Measurement sets", or MS)

- becoming a standard (including its derivatives) for
Lofar, ASKAP, EVLA, ALMA

- continuously evolving

Useful web pages:

-Home page: <http://casa.nrao.edu>

-Useful guides: http://casaguides.nrao.edu/index.php?title=Main_Page

-User forum: <https://science.nrao.edu/forums> → select Casa

Installation:

-get & extract tarball; adjust `$PATH`; done

Your reference: the Casa cookbook

-http://casa.nrao.edu/Doc/COOKBOOK/casa__COOKBOOK.pdf

Representation of data in Casa: the Measurement Set (MS)

- Measurement Sets are collections of tables and subtables
- MS on disk are just directories with files and subdirectories
- can copy/rename/move/delete MS with Casa or UNIX tools
- MS have three visibility columns – Beware!
 - "data" – guess what...
 - "corrected" – data with calibration applied
 - "model" – what the data should look like
- touching a MS with Casa for the first time may need time, since two columns are filled (this behaviour may be omitted in future releases)
- after calibration, gains etc need to be applied to "data" to get "corrected" data.

Casa tasks

-everything in Casa is performed by "tasks"

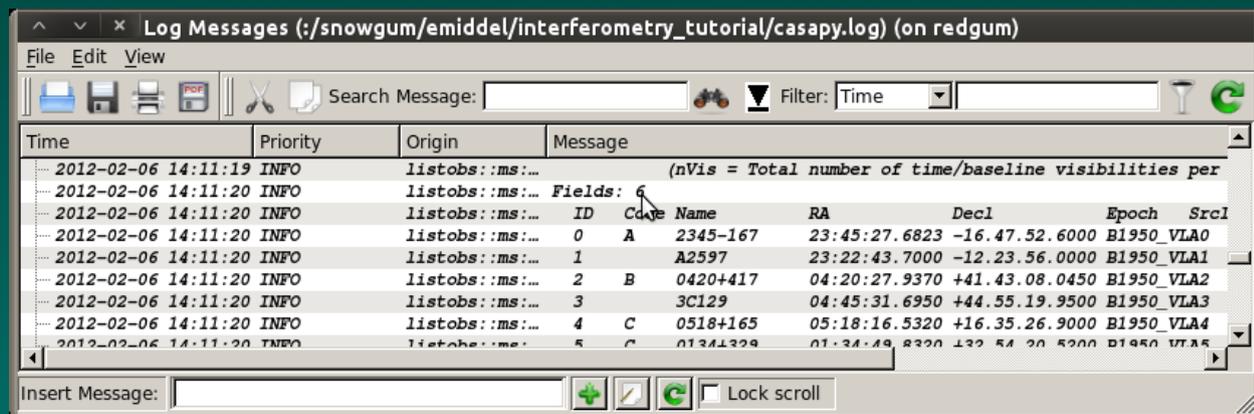
-a task has parameters, or "inputs"

-tasks can be executed interactively or non-interactively

-in both cases, the Casa shell is used (like a Python prompt)

-upon execution, parameters are saved to a file <task>.last

-a log window is provided for messages, to keep the terminal clear
IT'S IMPORTANT - LOOK AT IT.



Casa tasks – interactive vs non-interactive use

-interactive use:

- easy to look up possible inputs with short description
- structured presentation of inputs
- reads <task>.last file → potential for stuff-ups!
- that's about it

-non-interactive use:

- easy to copy & paste from scripts
- reproducible: unset inputs will use the default
- keeps record of what you've done
- IMPORTANT SCIENTIFIC PRACTICE
- can be included in calibration scripts
- quick iterations possible by using command line history

Sample interactive session:

```
Shell - Konsole <4>
Session Edit View Bookmarks Settings Help

CASA <2>: tget importasdm
-----> tget(importasdm)
Sorry - no task.last or .saved

CASA <3>: inp
-----> inp()
# importasdm :: Convert an ALMA Science Data Model observation into a CASA visibility file
asdm           =      ''      # Name of input asdm directory (on disk)
vis            =      ''      # Root name of the ms to be created. Note the .ms is NOT added
singledish     =      False   # Set true to output single-dish data format
corr_mode      =      'all'   # specifies the correlation mode to be considered on input. A quoted
                                # string containing a sequence of ao, co, ac, or all separated by
                                # whitespaces is expected
srt            =      'all'   # specifies the spectral resolution type to be considered on input. A
                                # quoted string containing a sequence of fr, ca, bw, or all separated
                                # whitespaces is expected
time_sampling  =      'all'   # specifies the time sampling (INTEGRATION and/or SUBINTEGRATION) to
                                # considered on input. A quoted string containing a sequence of i, si
                                # all separated by whitespaces is expected
ocorr_mode     =      'ca'    # output data for correlation mode AUTO_ONLY (ao) or CROSS_ONLY (co) o
                                # CROSS_AND_AUTO (ca)
compression   =      False   # Flag for turning on data compression
asis          =      ''      # Creates verbatim copies of the ASDMtables in the output measurement s
                                # Value given must be a string of table names separated by spaces; A
                                # wildcard is allowed.
wvr_corrected_data =      'no' # Specifies which values are considered in the SDM binary data to fill
                                # DATA column in the MAIN table of the MS. Expected values for this
                                # option are: no, for uncorrected data (default), yes, for the correc
                                # data, and both, for for corrected and uncorrected data. Note if bot
                                # selected two measurement sets are created, one with uncorrected dat
                                # and the other with corrected data.
verbose        =      False   # Output lots of information while the filler is working
overwrite      =      False   # Over write an existing MS
showversion    =      False   # Report the version of asdm2MS being used
async          =      False   # If true the taskname must be started using importasdm(...)

CASA <4>: █
```

Type <parameter>=<value> as needed, then type "GO".

Sample interactive session:

```
Terminal (on redgum)
File Edit View Terminal Tabs Help

Terminal
-----> tget(importvla)
Restored parameters from file importvla.last

CASA <3>: inp
-----> inp()
# importvla :: Import VLA archive file(s) to a measurement set
archivefiles = ['AT166_1', 'AT166_2'] # Name of input VLA archive file(s)
vis          = 'at166B.ms'          # Name of output visibility file
bandname     = 'C'                  # VLA frequency band name: ''=>obtain all bands in the archive file
frequencytol = '150000.0Hz'        # Frequency shift to define a unique spectra window (Hz)
project      = ''                  # Project name: '' => all projects in files
starttime   = ''                  # start time to search for data
stoptime    = ''                  # end time to search for data
applysys    = True                 # apply nominal sensitivitiy scaling to data and weights
autocorr    = False                # import autocorrelations to ms, if set to True
antnamescheme = 'new'              # 'old' or 'new'; 'VA04' or '04' for VLA ant 4
keepblanks  = False                # Fill scans with blank (empty) source names (e.g. tipping scans)
evlabands   = False                # Use updated eVLA frequencies and bandwidths for bands and wavelengths
async       = False                # If true the taskname must be started using importvla(...)

CASA <4>: bandname='G'

CASA <5>: inp
-----> inp()
# importvla :: Import VLA archive file(s) to a measurement set
archivefiles = ['AT166_1', 'AT166_2'] # Name of input VLA archive file(s)
vis          = 'at166B.ms'          # Name of output visibility file
bandname     = 'G'                  # VLA frequency band name: ''=>obtain all bands in the archive file
frequencytol = '150000.0Hz'        # Frequency shift to define a unique spectra window (Hz)
project      = ''                  # Project name: '' => all projects in files
starttime   = ''                  # start time to search for data
stoptime    = ''                  # end time to search for data
applysys    = True                 # apply nominal sensitivitiy scaling to data and weights
autocorr    = False                # import autocorrelations to ms, if set to True
antnamescheme = 'new'              # 'old' or 'new'; 'VA04' or '04' for VLA ant 4
keepblanks  = False                # Fill scans with blank (empty) source names (e.g. tipping scans)
evlabands   = False                # Use updated eVLA frequencies and bandwidths for bands and wavelengths
async       = False                # If true the taskname must be started using importvla(...)

CASA <6>: █
```

Blue = not default, red=invalid

Sample non-interactive session:

```
importasdm(asdm='leo2pt.55183.452640752315',  
vis='awesome_data.ms')
```

Done.

Trivia:

-quantities in Casa: Some Casa tasks can interpret things like '10khz', '5deg', and '3klambda'.

-to get help in the shell, either type

```
help(task)
```

Or

```
task?
```

Data selection

-one can select data Based on time, frequency, antenna, Baseline, fields, scans

-selection has to be "turned on" in tasks By setting `selectdata=True`

Some examples, taken from

<http://www.aoc.nrao.edu/~sbhatnag/misc/msselection>

Antenna/Baseline selection:

`baseline=1,2,3` selects Bsl Between antennas 1, 2 and 3 and all others

`baseline=1,2,3&` selects Baseline Between antennas 1,2 and 3 only.

`baseline=1,2,3 & 4,5,6` selects Baselines Between antennas 1,2,3 and 4,5,6.

`baseline=1~3` same as `baseline=1,2,3`

`baseline=1~3&` same as `baseline=1,2,3&`

`baseline=1~3 & 4~5` same as `baseline= 1,2,3&4,5,6`

Frequency selection:

chan=1;2;3 selects channels 1,2 and 3.

chan=1~3 selects channels 1,2 and 3.

chan=0~10^2 selects channels in the range [0,10] with a step size of 2

chan=1421MHz selects a frequency channel corresponding to the frequency 1421.0 MHz

chan=1421~1500MHz selects all channels in the range [1421.0, 1500.0] MHz

Field (or source) selection:

field=1,2,3,4 selects field IDs 1,2,3 and 4

field=1~4 same as above

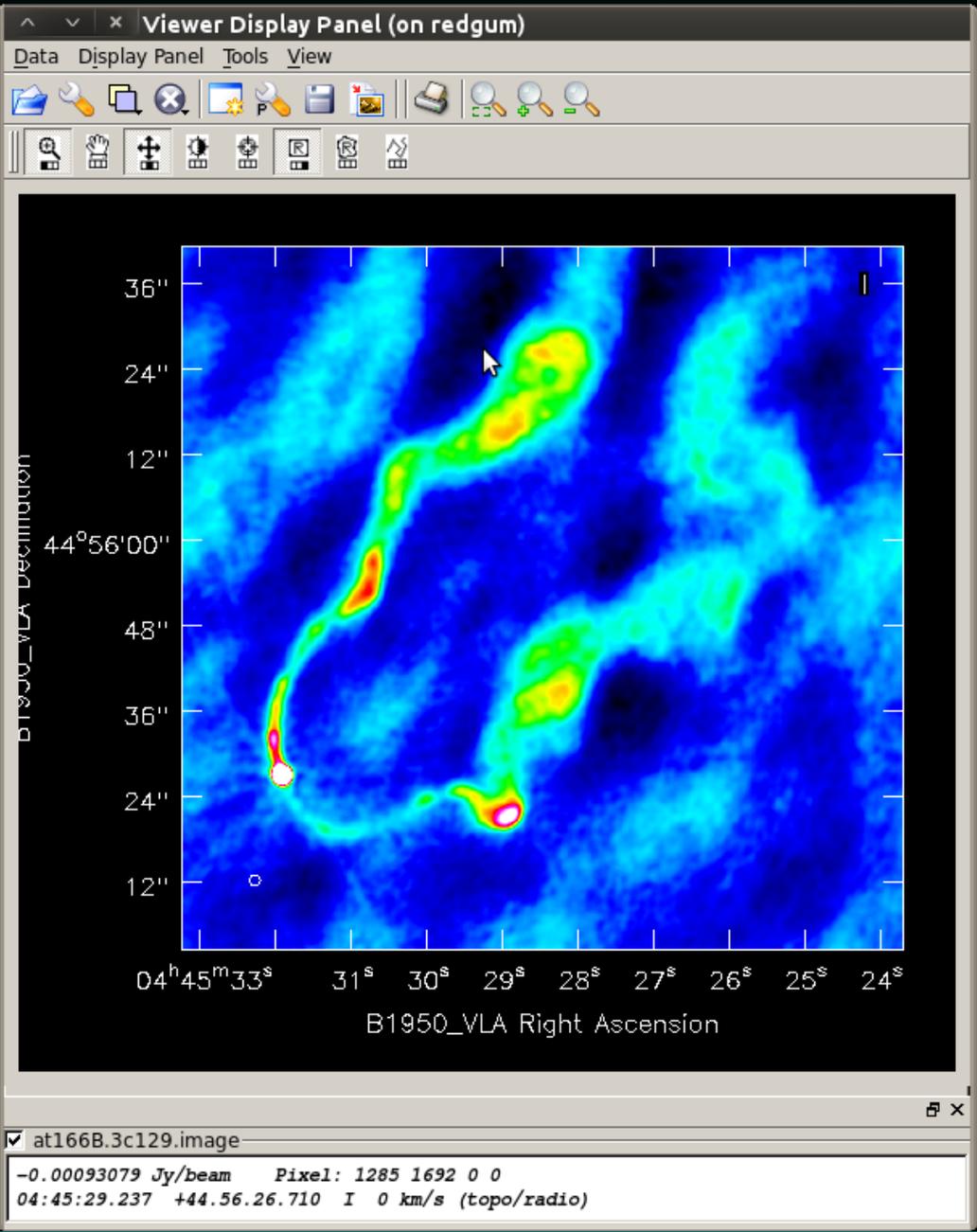
field=1~4, VIRGO A , 3C* selects field IDs 1,2,3,4 field named "VIRGO A" and all fields with names starting with "3C".

Pretty things for GUI-lovers

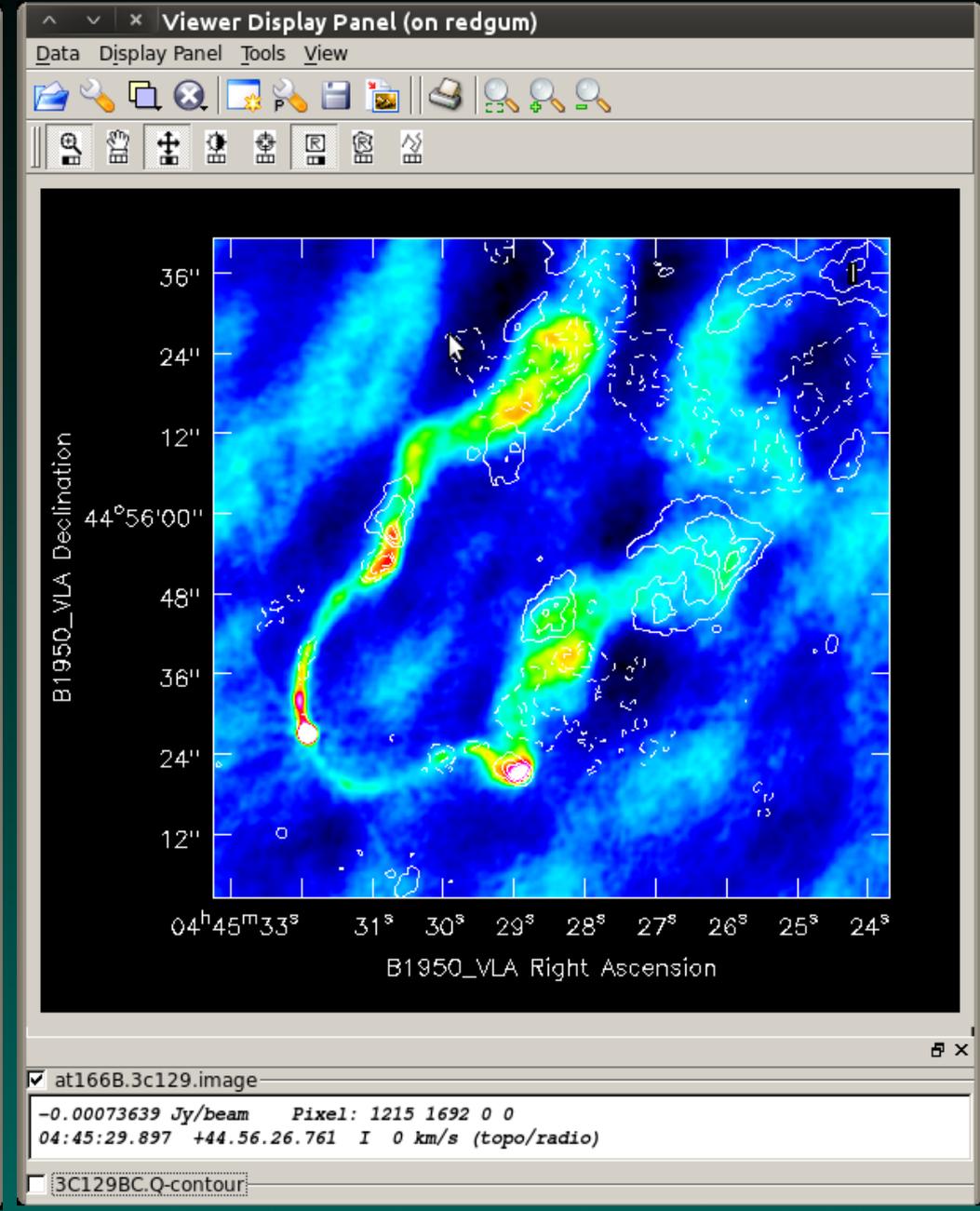
-the viewer

- used to display images
- can do raster, contour plots, and vector overlays
- can also display \neq flag visibilities
- plethora of settings to tune displays
- can be launched from UNIX prompt as "casaviewer"

Stokes I as raster image

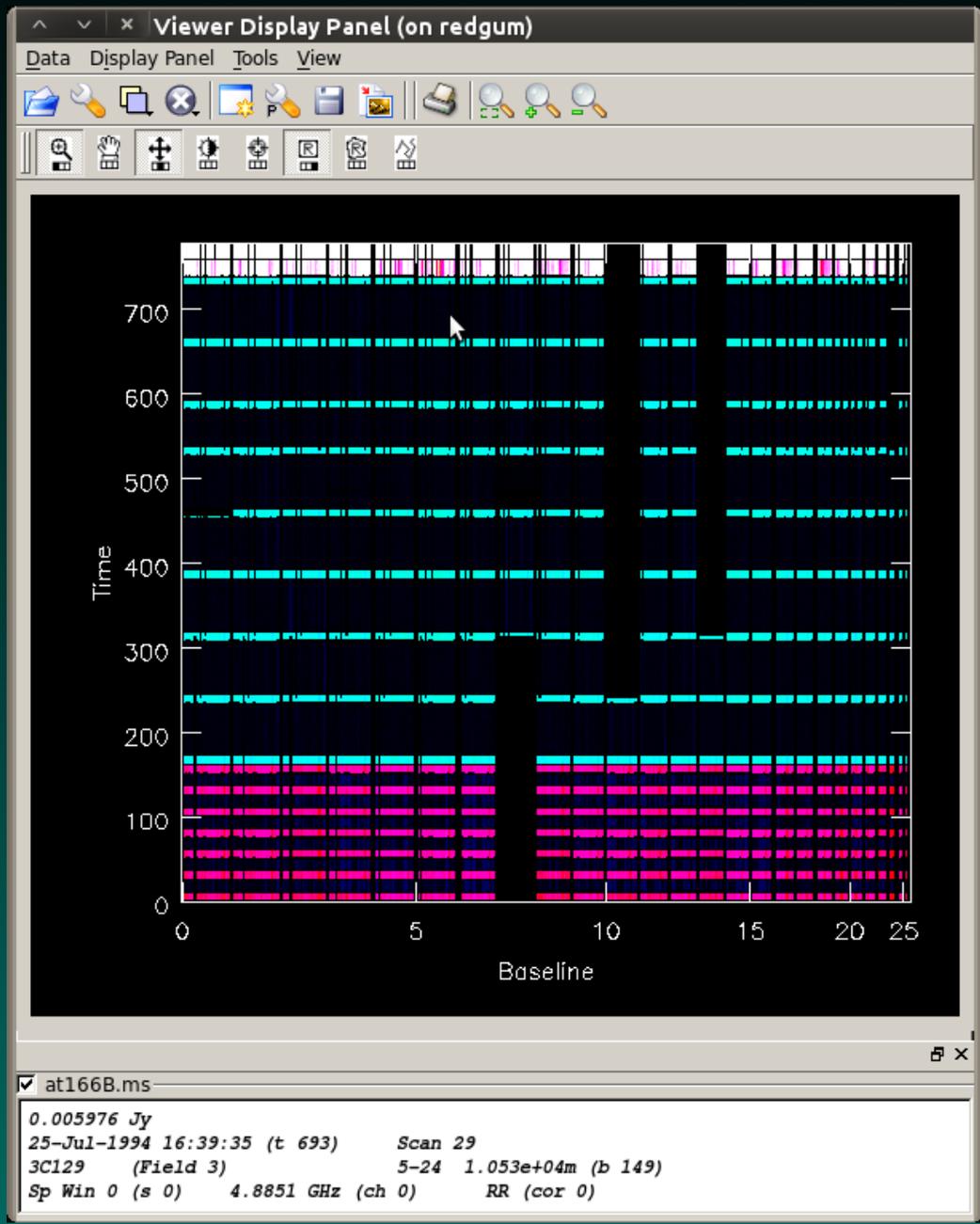
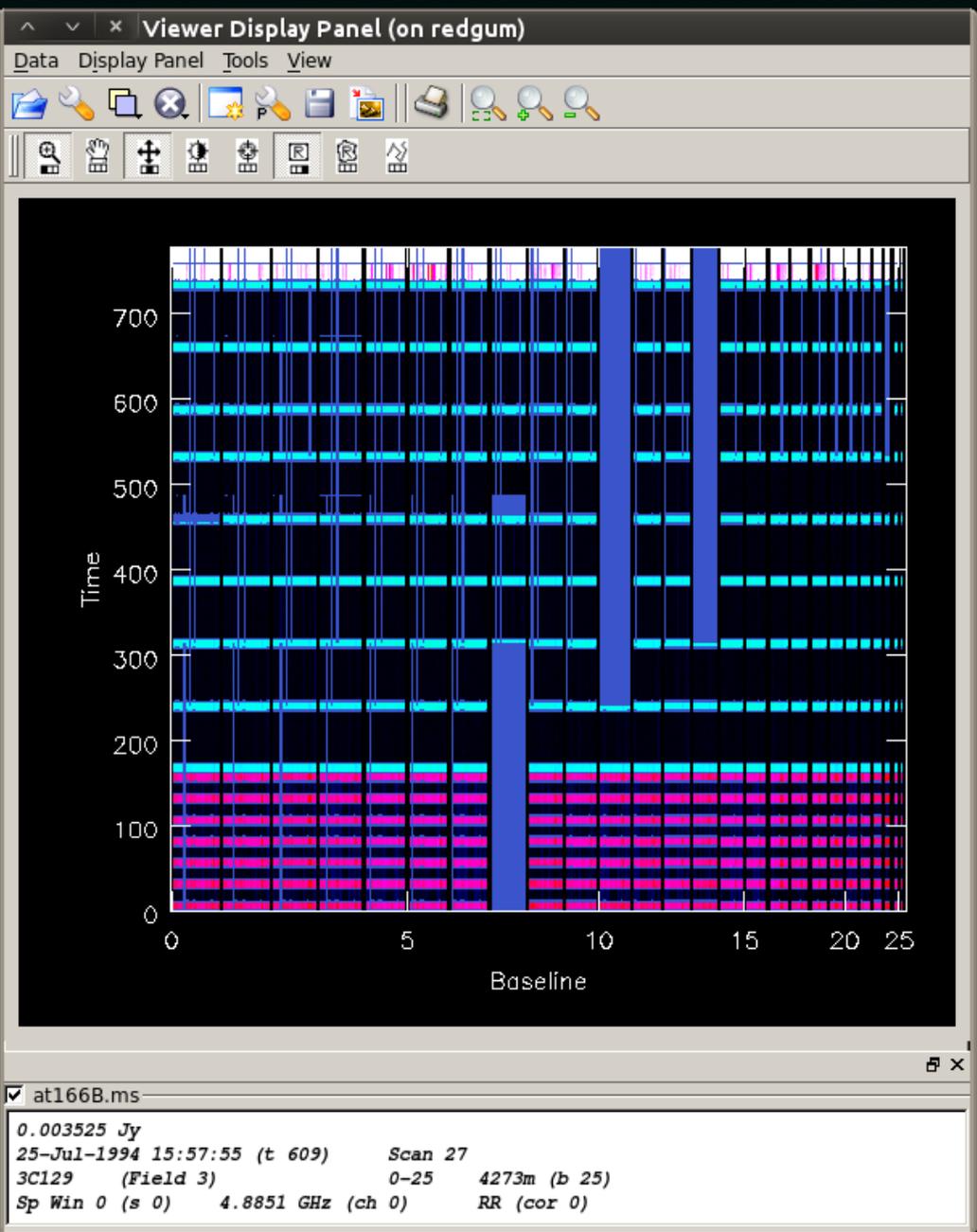


Stokes I with Q contours overlaid



Visibility amplitudes per Baseline,
flagged data in Blue

flagged data masked out



Pretty things for GUI-lovers

-casamsplot

-all-singing, all-dancing visibility plotter

-plots almost any variable as a function of any other

-can flag & identify (yes!) visibilities

-can be launched from UNIX prompt as "casaplotms"

Amp vs. UVdist

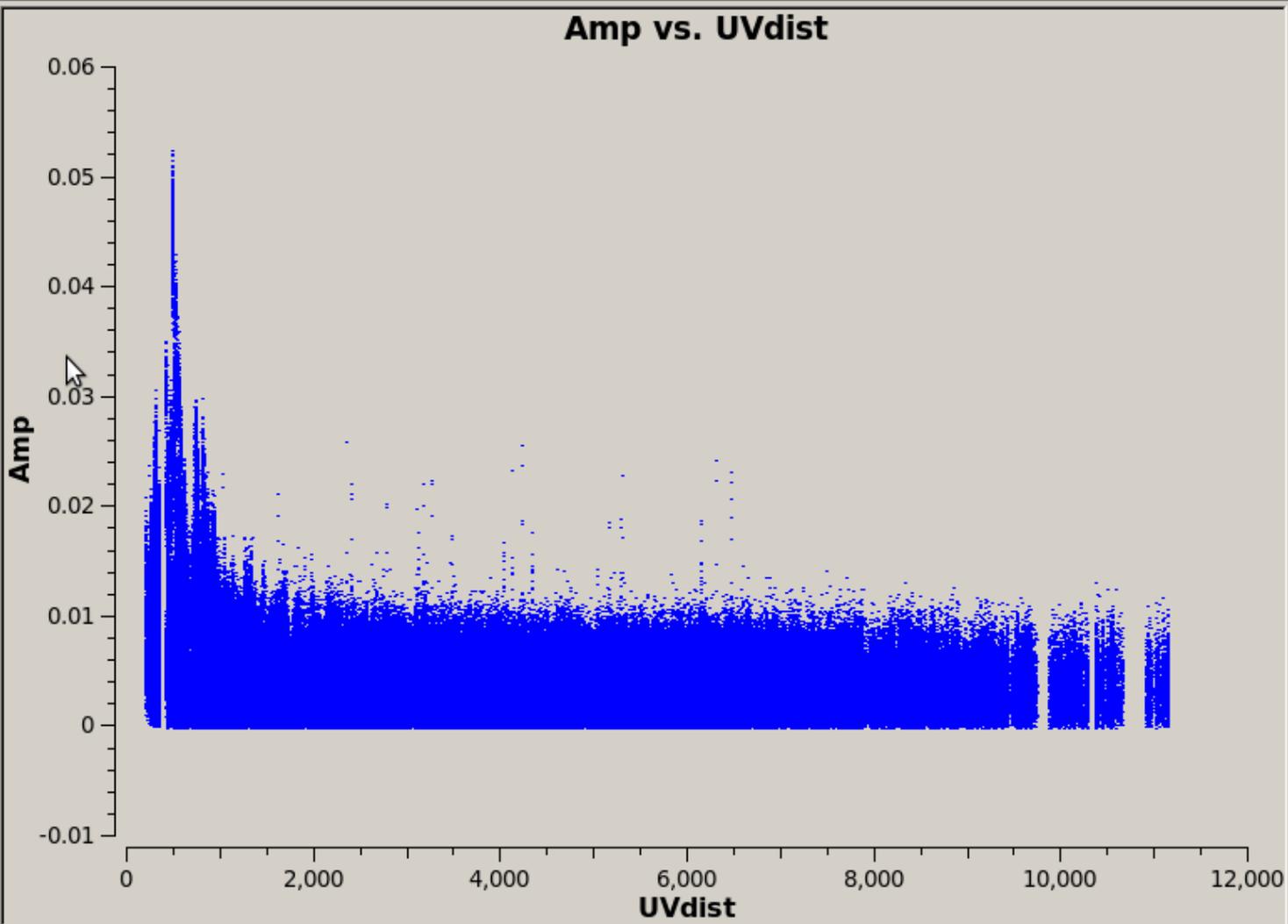
Data File Location
metry_tutorial/at166B.ms

Axes Selection
field 3C129
spw
Iter timerange
Trans uvrange
antenna
Display scan
array

Canvas Averaging
 Channel 0 channels
 Time 60 seconds
 Scan Field

Export
 All Baselines Per Antenna
 All Spectral Windows
 Scalar
All Verbose

force reload



V vs. U

Data
X Axis
U In Cache?

Attach to: Bottom Top

Axes
Range: Automatic
0 to 0

Trans
Y Axis
V In Cache?

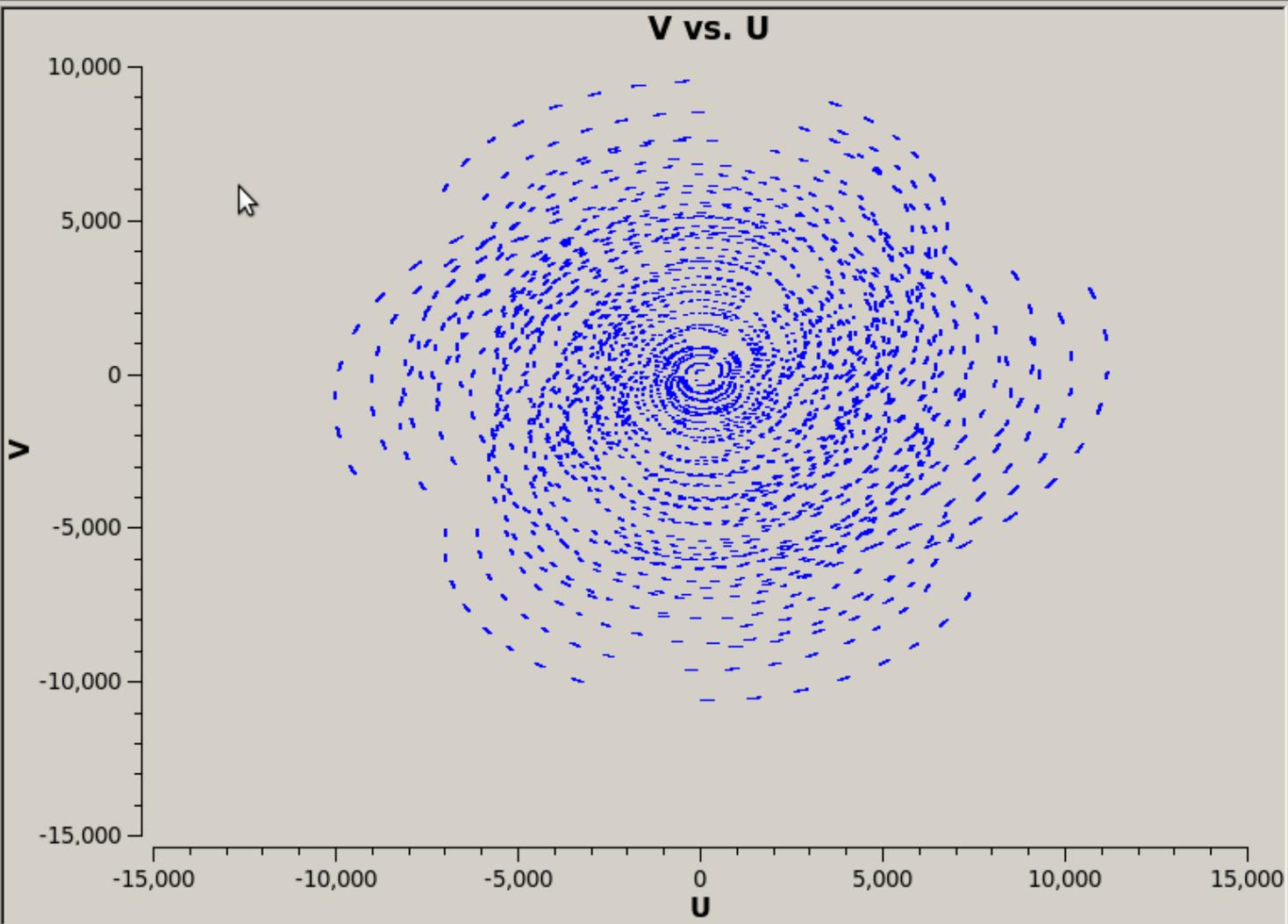
Display
Attach to: Left Right

Range: Automatic
0 to 0

Canvas

Export

force reload



PlotMS (on redgum)

File View Help

Plots | Flagging | Tools | Annotator | Op

Phase vs. Time

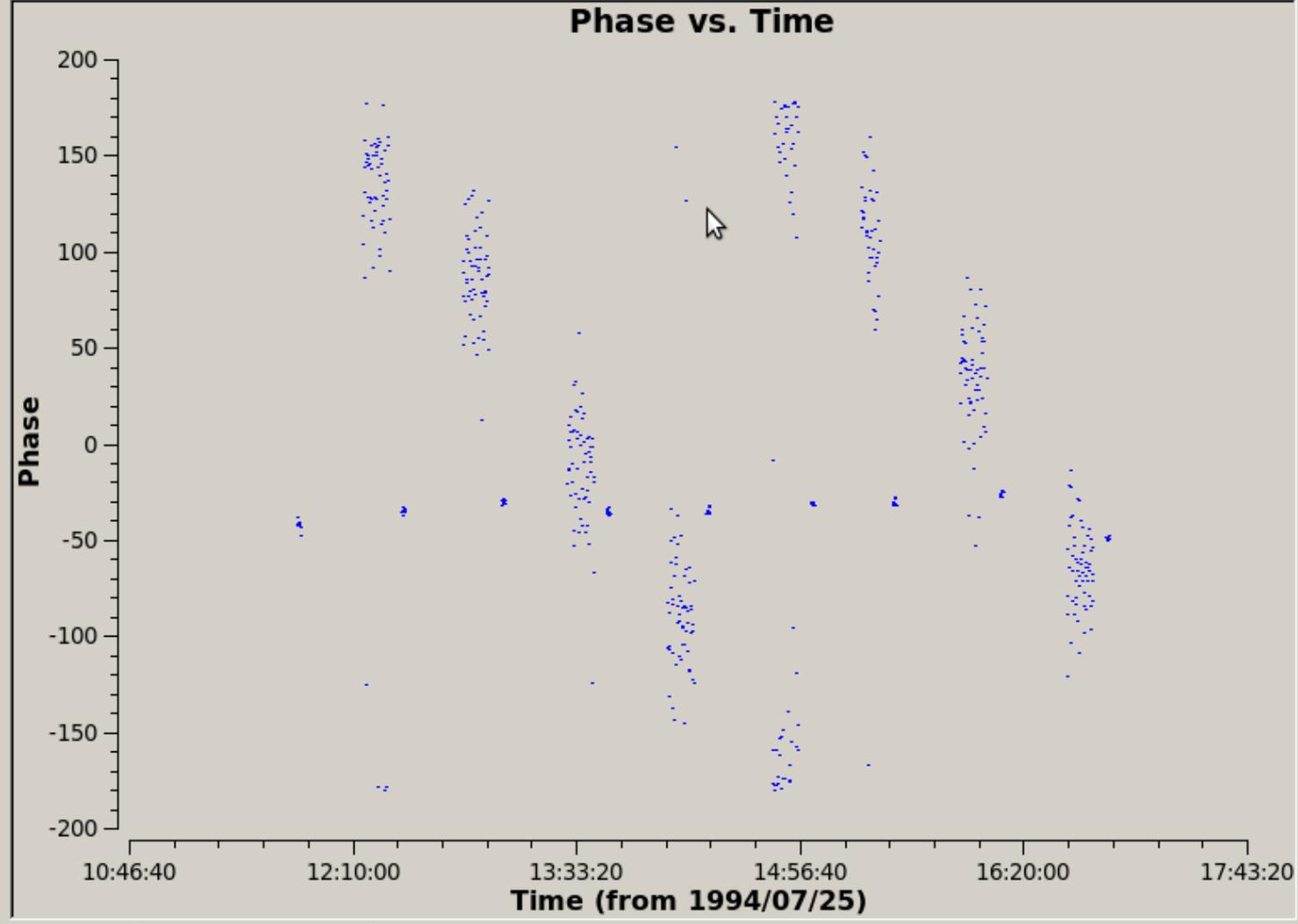
Data File Location
metry_tutorial/at166B.ms

Axes Selection
field 3C129,0420+417
spw 0
Iter timerange
Trans uvrange
antenna 6&21
Display scan
corr RR
array

Canvas Averaging
 Channel 0 channels
 Time 60 seconds
 Scan Field

Export
 All Baselines Per Antenna
 All Spectral Windows
 Scalar
All Verbose

force reload



Hold Drawing