Introduction to Casa

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The ALMA measurement set

CASA is a set of C++ application libraries running through a python interface. The software has been designed to calibrate, edit, image, and analyze interferometric and single dish data, in particular the ALMA and JVLA data.

The native uvdata format is the measurement set (*.ms).

A measurement set with a large number of tables, containing the observed visibilities, various calibration tables, flags and models.

ms sub tables

ms main table

```
localhost:working kazi$ ls uid___A002_Xa0b40d_X3cb8.ms
ANTENNA/                    SOURCE/                     table.f17                   table.f23
ASDM_ANTENNA/               SPECTRAL_WINDOW/            table.f17_TSM1              table.f23_TSM1
ASDM_CALATMOSPHERE/         STATE/                      table.f17_TSM2              table.f23_TSM2
ASDM_CALWVR/                SYSCAL/                     table.f17_TSM3              table.f24
ASDM_RECEIVER/              SYSPOWER/                   table.f17_TSM4              table.f24_TSM1
ASDM_SOURCE/                Source.xml                  table.f18                   table.f24_TSM2
ASDM_STATION/               WEATHER/                    table.f19                   table.f24_TSM3
CALDEVICE/                  casapy-20160203-115402.log  table.f2                    table.f24_TSM4
DATA_DESCRIPTION/           ipython-20160203-115403.log table.f20                   table.f3
FEED/                       table.dat                   table.f20_TSM0              table.f4
FIELD/                      table.f1                    table.f21                   table.f5
FLAG_CMD/                   table.f10                   table.f21_TSM1              table.f6
HISTORY/                    table.f11                   table.f21_TSM2              table.f7
OBSERVATION/                table.f12                   table.f21_TSM3              table.f8
POINTING/                   table.f13                   table.f21_TSM4              table.f9
POLARIZATION/               table.f14                   table.f22                   table.info
PROCESSOR/                  table.f15                   table.f22_TSM1              table.lock
SORTED_TABLE/               table.f16                   table.f22_TSM2
```

The ALMA measurement set

Organized in a MAIN table with four columns:

Data - Model - Corrected data - Flags

The original visibilities are never overwritten when calibration or flags are applied, but copied with applied correction/edit to corrected data column. The ms structure stays always the same

MAIN	Model, e.g.:	Corrected data	Flags
Original visibility data	*FT of image made from MS* *FT of supplied model image* *FT of calibrator flux density*	*Copy of visibilities with calibration tables applied* (Used in imaging but not calibration)	(Edits are stored here first; backup tables can be made and used to modify)

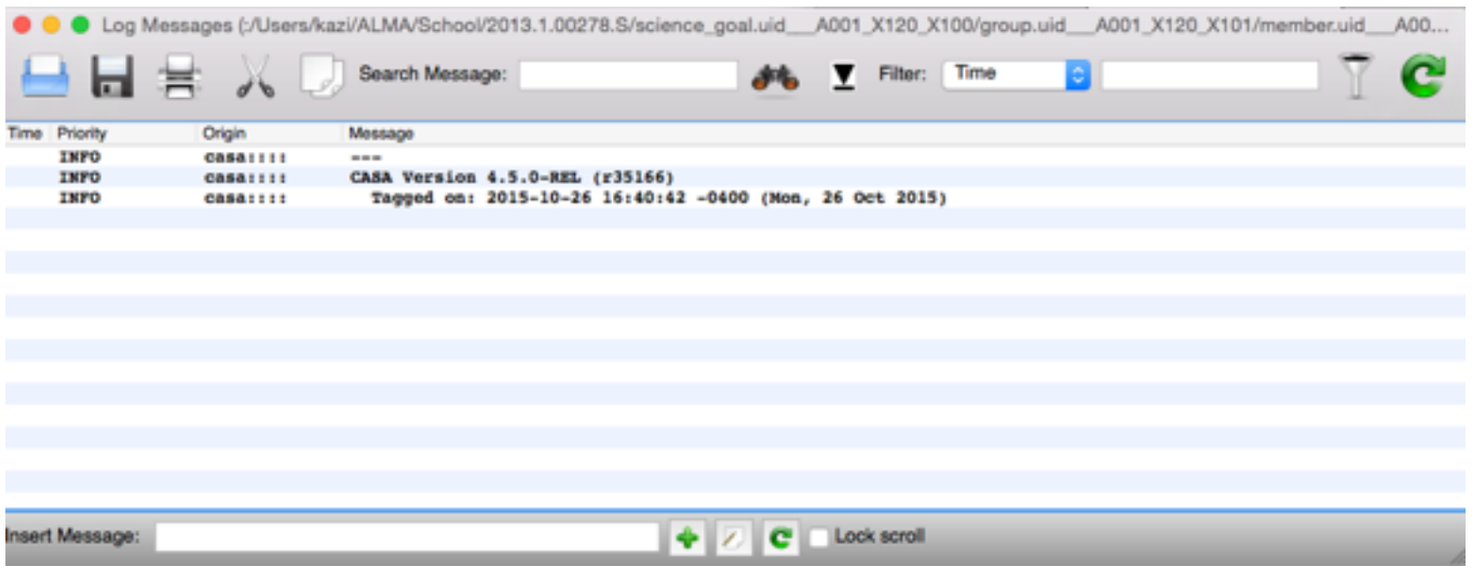
Starting Casa

- Start Casa by:

```
$ casapy
```

When starting Casa, a logger window opens up - in which the history and the output of the tasks is written.

When exiting casa the logger content gets written into casapy-*.log and all the commands given will finish in ipython*.log



Most common commands

to obtain the list of tasks

```
$> tasklist
```

to see the input of a task

```
$> inp listobs
```

launch task

```
$> go listobs
```

to run a file

```
$> execfile('name_of_file')
```

to obtain the previously used parameters

```
$> tget concat
```

to obtain the task in default setting

```
$> default('split')
```

to see the summary info of a task and about its adverbs

```
$> help flagdata
```

open help menu with `$> help` to get info on modules (casa tasks), keywords (python keywords, such as if, from and while) and topics (python objects such as floats, classes)

Casa tasks

Inp flagdata shows the arguments of the task

blue - not a default value, needs to be set
black - default value
red - erroneous value (here, missing '')
green - sub parameters

```
CASA <37>: inp
---------> inp()
#  flagdata :: All-purpose flagging task based on data-selections and flagging modes/algorithms.
vis                 = 'uid___A002_Xa0b40d_X3cb8.ms.split.cal' #  Name of MS file or calibration table to flag
mode                =   'manual'          #  Flagging mode
     field          =           18         #  Field names or field index numbers: '' ==> all, field='0~2,3C286'
     spw            =            1         #  Spectral-window/frequency/channel: '' ==> all, spw='0:17~19'
     antenna        =           ''         #  Antenna/baselines: '' ==> all, antenna ='3,VA04'
     timerange      =           ''         #  Time range: '' ==> all,timerange='09:14:0~09:54:0'
     correlation    =           ''         #  Correlation: '' ==> all, correlation='XX,YY'
     scan           =            8         #  Scan numbers: '' ==> all
     intent         =           ''         #  Observation intent: '' ==> all, intent='CAL*POINT*'
     array          =           ''         #  (Sub)array numbers: '' ==> all
     uvrange        =           ''         #  UV range: '' ==> all; uvrange ='0~100klambda', default units=meters
     observation    =           ''         #  Observation ID: '' ==> all
     feed           =           ''         #  Multi-feed numbers: Not yet implemented
     autocorr       =        False         #  Flag only the auto-correlations

action              =    'apply'          #  Action to perform in MS and/or in inpfile (none/apply/calculate)
     display        =           ''         #  Display data and/or end-of-MS reports at runtime (data/report/both).
     flagbackup     =         True         #  Back up the state of flags before the run

savepars            =        False         #  Save the current parameters to the FLAG_CMD table or to a file
async               =        False         #  If true the taskname must be started using flagdata(...)

CASA <38>:

CASA <39>:
```

Data selection

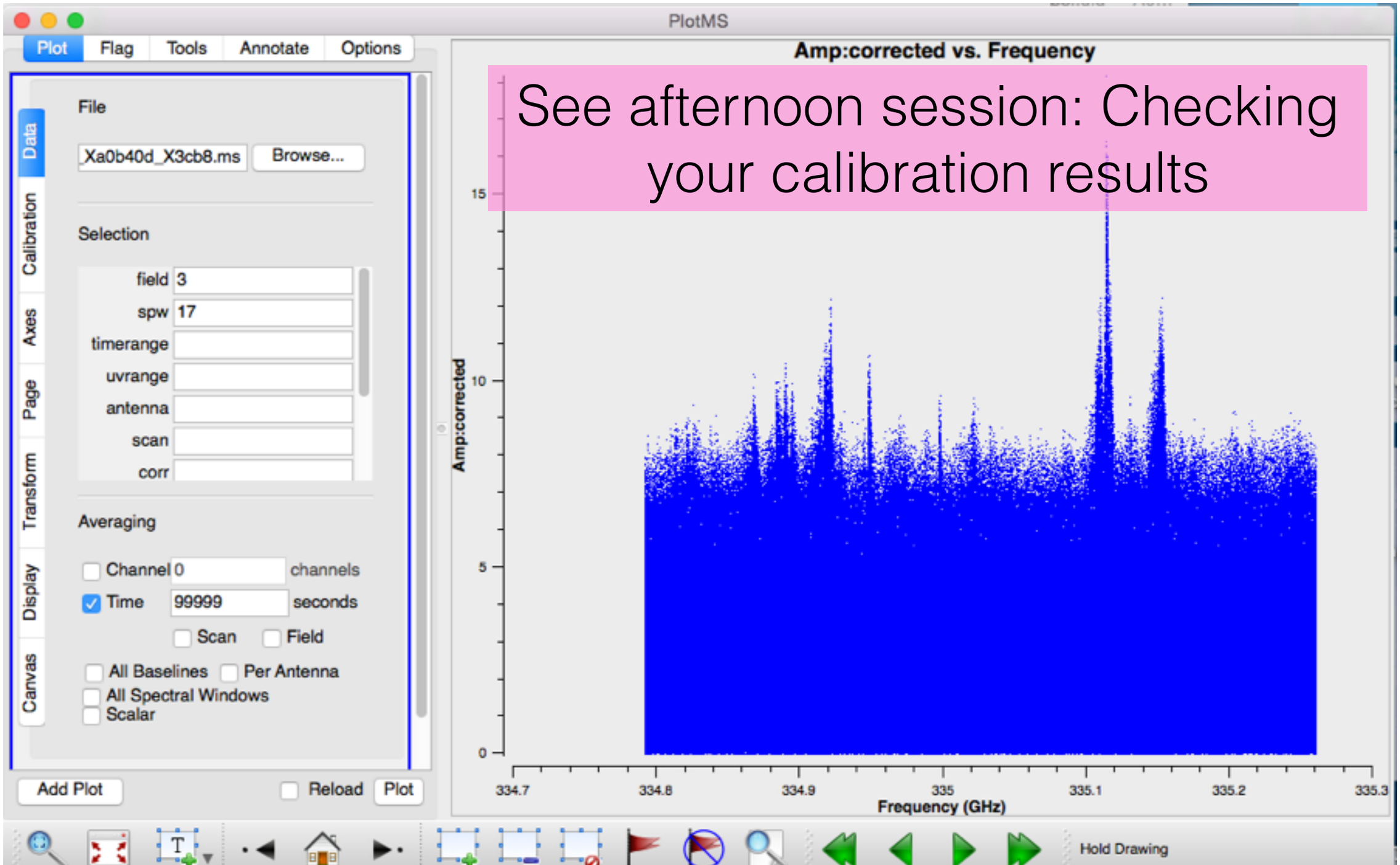
field='Tita*' - use * as a wildcard
field='2' - use field_id as name

spw='' - selects all spw
spw='1~3' - selects spw 1,2,3 (~ gives a range)
spw='2:100~200,3' - selects chan 100 to 200 from spw2, and spw3

antenna='DV01' - selects all baselines with DV01
antenna ='!DV01' - selects all baselines except those with DV01

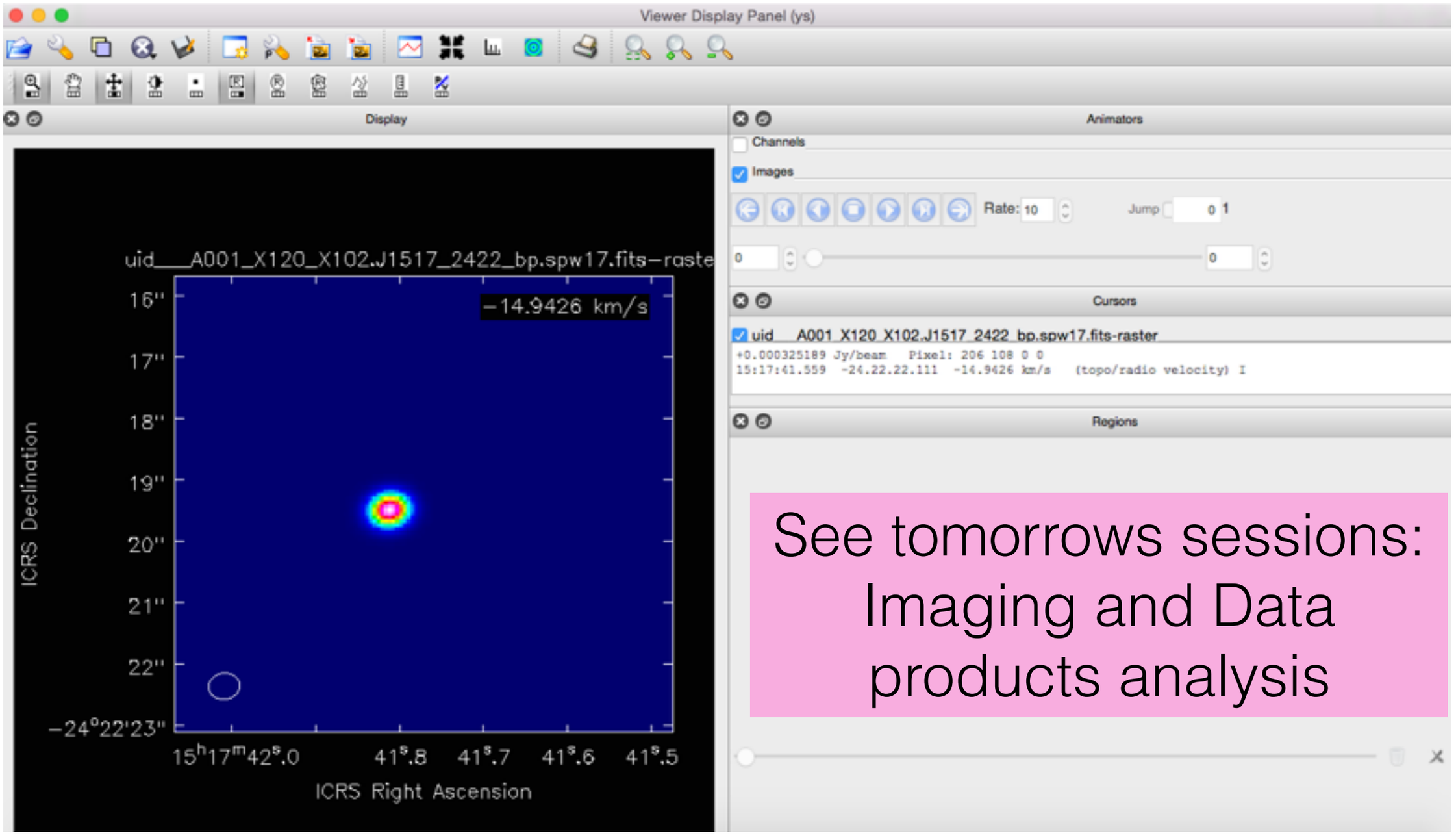
timerange = '06:24:00~06:30:00' - selects timerange
timerange = '<06:30:00' - selects times before a given time

Visualization of visibilities and calibration tables: plotms



See afternoon session: Checking your calibration results

visualization of images and image analysis: viewer



See tomorrows sessions: Imaging and Data products analysis

The right Casa version

- On the Casa website there are many versions (latest version 4.5.1)

- ALMA Archive data comes in raw format with a calibration script, which was created during quality assurance analysis of the dataset (ALMA data are delivered calibrated and with the proposed rms and resolution verified)

- To reduce your Archive data, you need to run the calibration script (scriptForPI.py) in the same version of Casa.

```
$> execfile('scriptForPI.py')
```

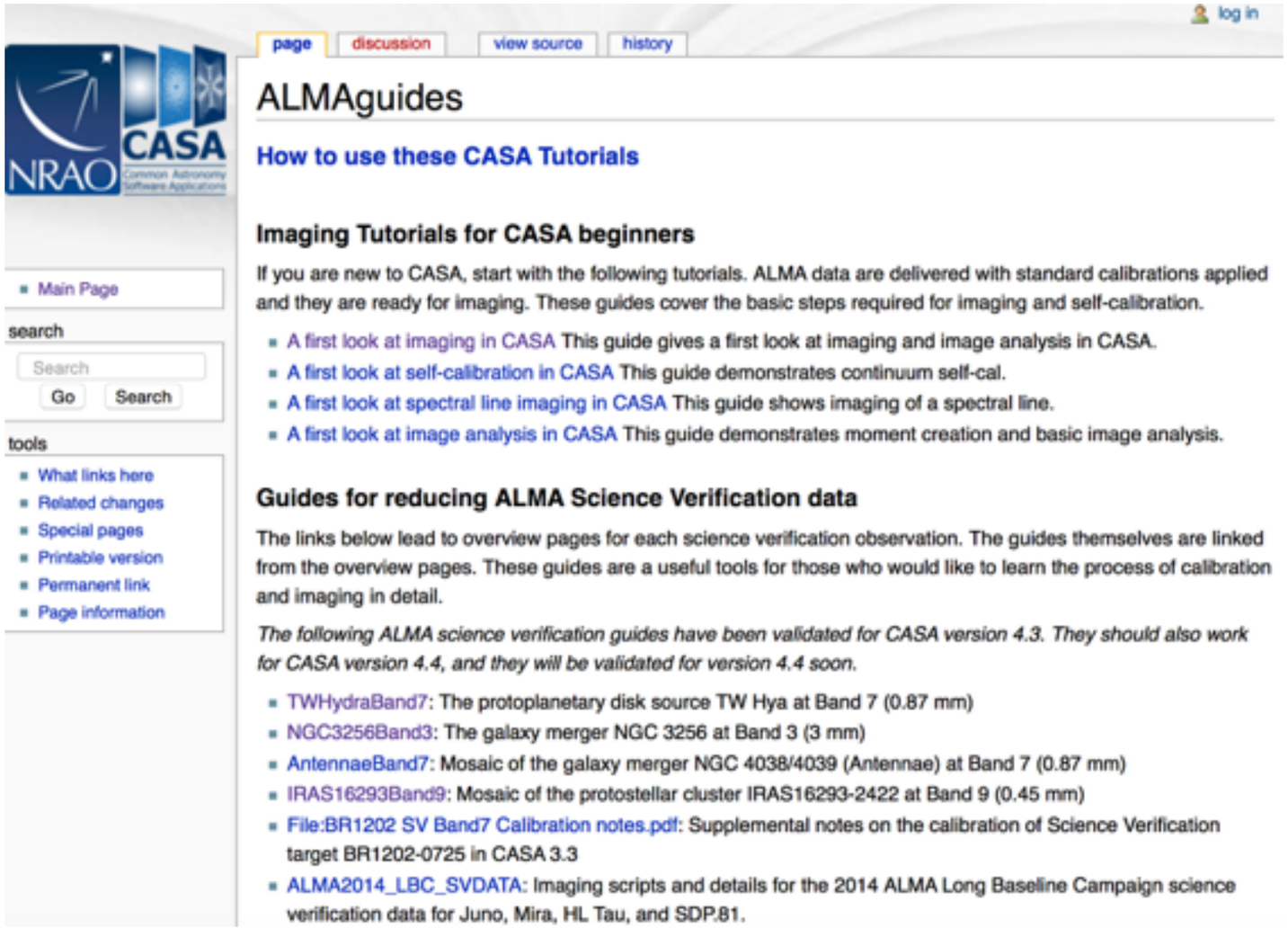
- If the data calibration was done by the pipeline (pipeline reduced data have a PPR*xml file in the script directory), then you need to download the pipeline version of CASA

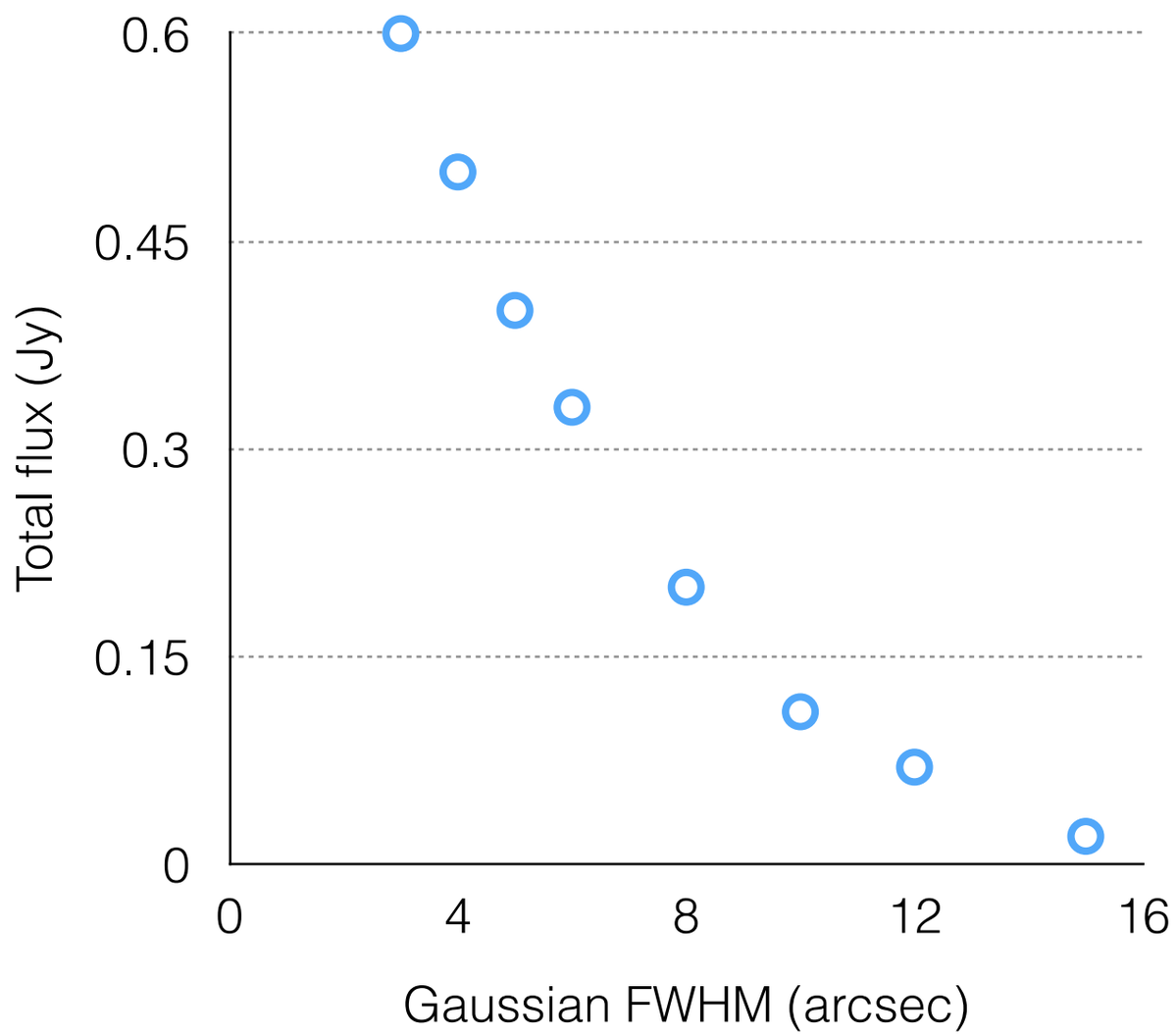
    - start casa pipeline version: `$ casapy –pipeline`

Casa online tutorials & documentation

Casaguides for ALMA: explain not only Casa commands but also ALMA data reduction (https://casaguides.nrao.edu/index.php/ALMAguides)

Cookbook and reference manual: recipes and detailed information on Casa tasks (http://casa.nrao.edu/docs/UserMan/UserMan.html)




0.6
0.45
0.3
0.15
0
Total flux (Jy)
0
4
8
12
16
Gaussian FWHM (arcsec)