

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 main table

ms sub tables

```
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	<i>FT of image made from MS</i> <i>FT of supplied model image</i> <i>FT of calibrator flux density</i>	<i>Copy of visibilities with calibration tables applied</i> (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
```

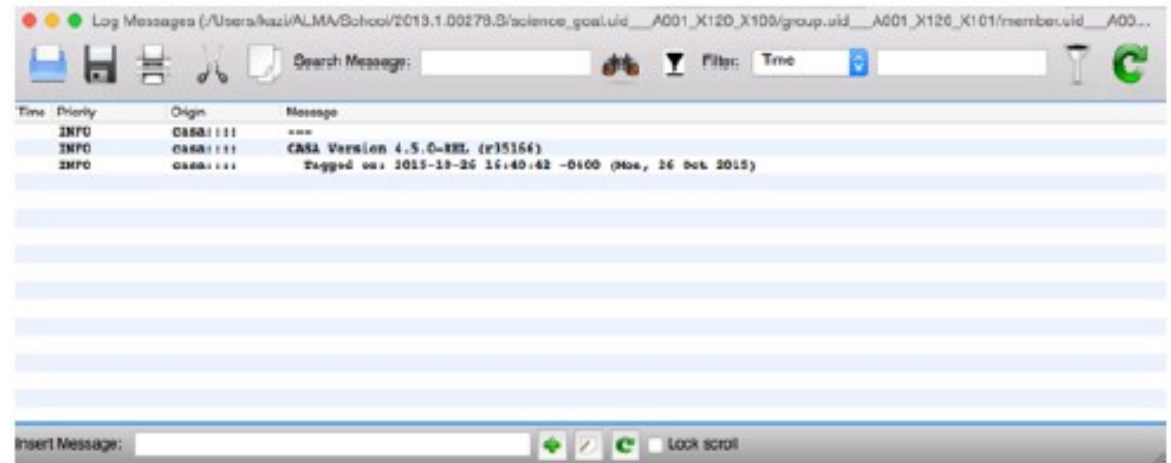
for versions < 4.7.0

```
$ casa
```

for versions > 4.7.0

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 infile (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>:

CASA <40>:

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

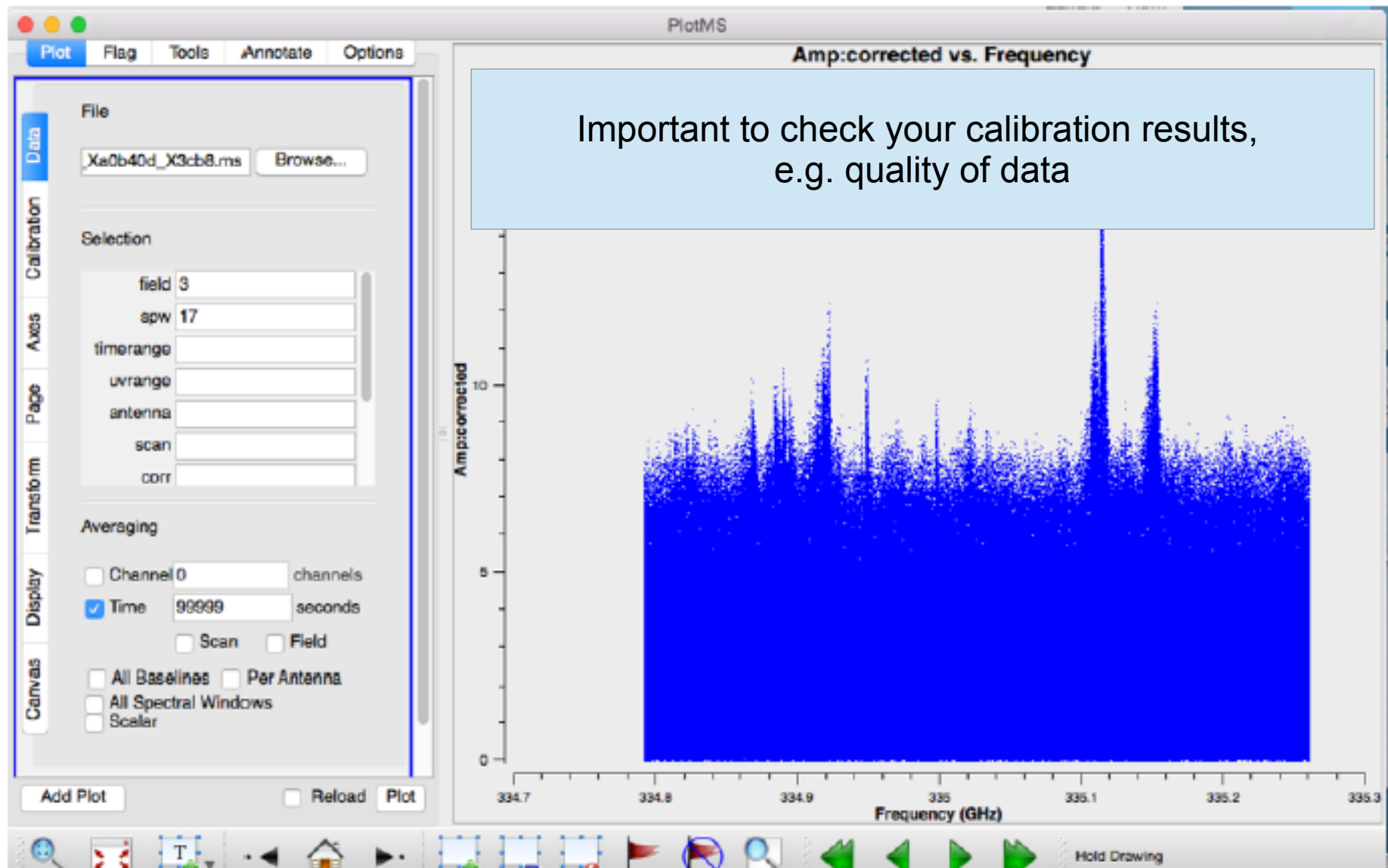
antenna='DV01' - selects all baselines with DV01

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

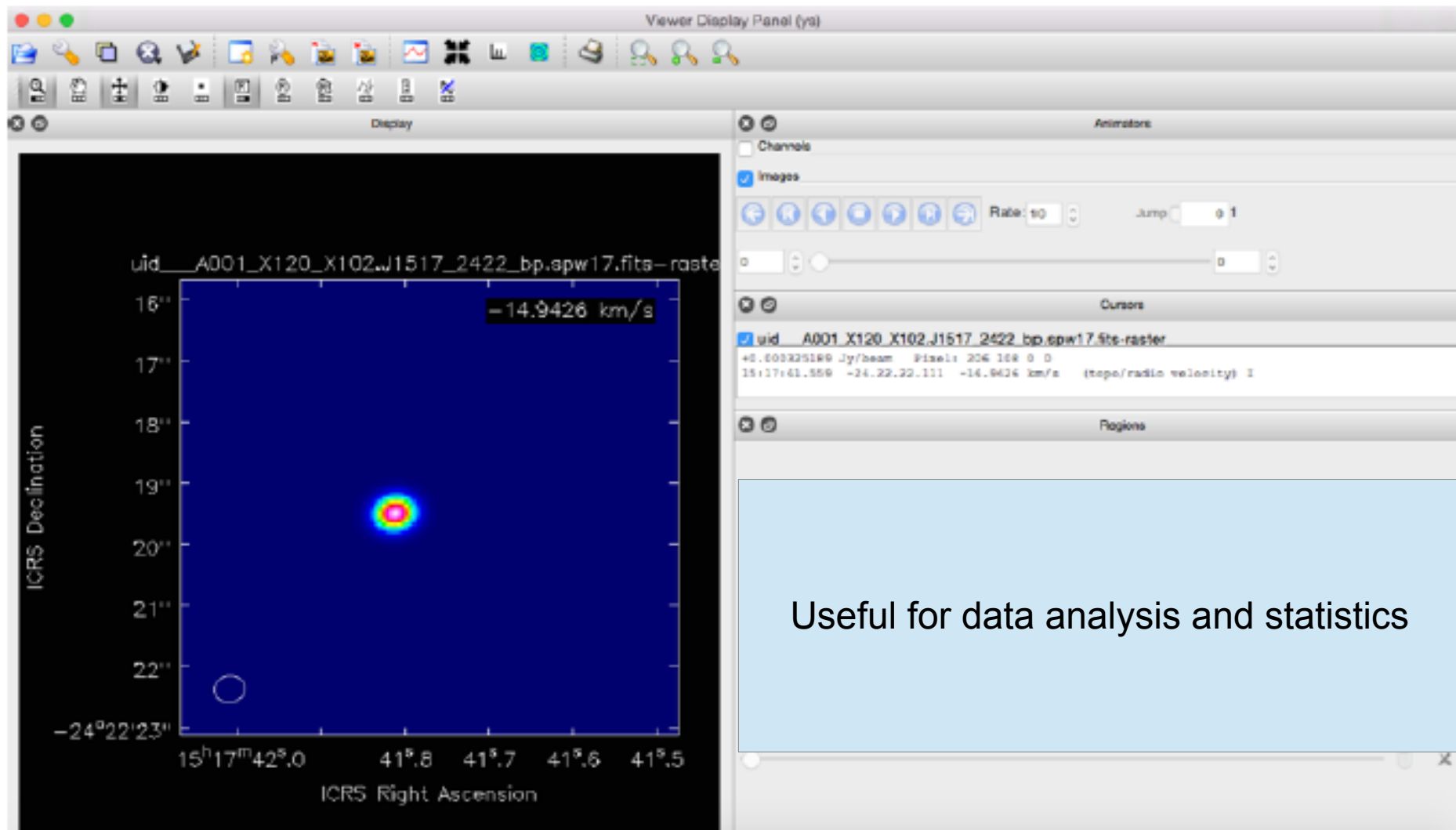
timerange = '06:24:00~06:30:00' - selects timerange

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

Visualization of visibilities and calibration tables: plotms



visualization of images and image analysis: viewer



The right Casa version

- On the Casa website there are many versions
- 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
```

V< 4.7.0

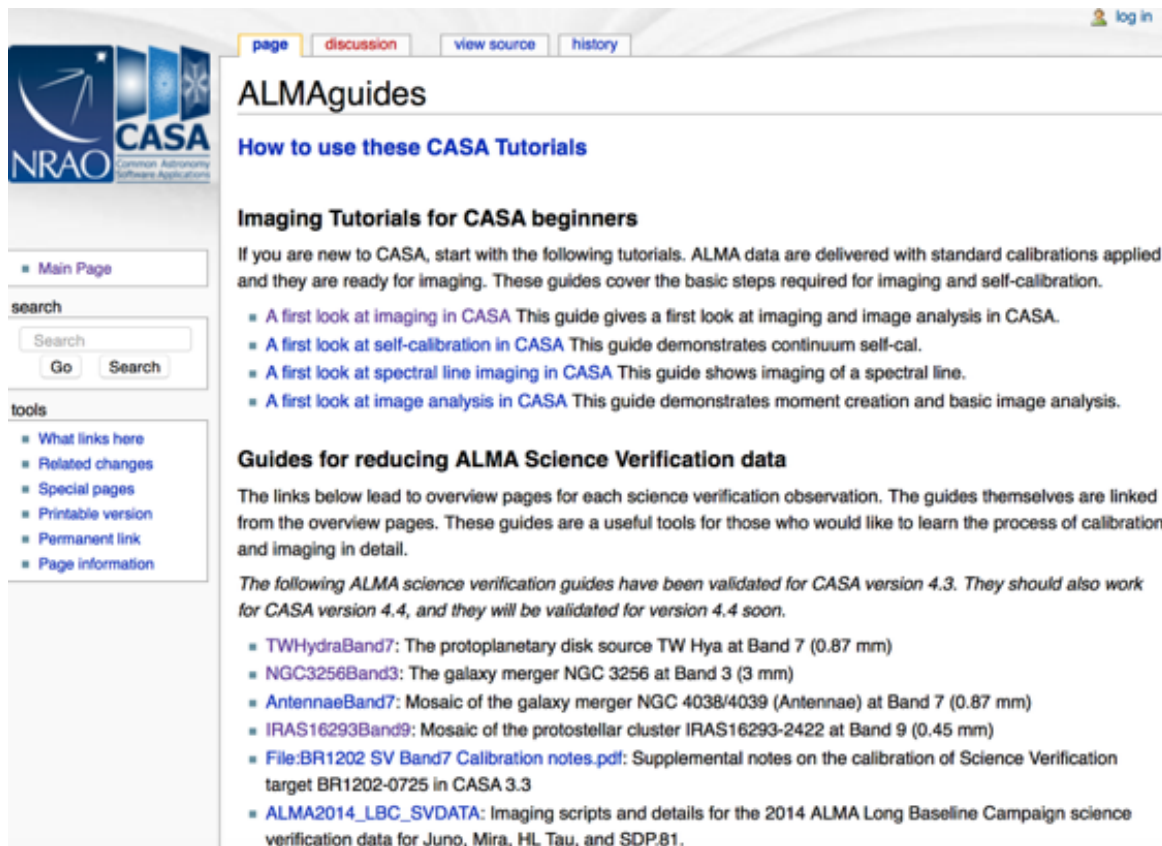
```
casapy --pipeline
```

V> 4.7.0

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>)



The screenshot shows the ALMAguides website interface. At the top, there are navigation tabs for 'page', 'discussion', 'view source', and 'history'. The main heading is 'ALMAguides' with a sub-heading 'How to use these CASA Tutorials'. Below this, there is a section titled 'Imaging Tutorials for CASA beginners' which includes an introductory paragraph and a list of four tutorial links. A second section, 'Guides for reducing ALMA Science Verification data', provides an overview and a list of specific science verification guides. The left sidebar contains a search bar, a 'Main Page' link, and a 'tools' section with links for 'What links here', 'Related changes', 'Special pages', 'Printable version', 'Permanent link', and 'Page information'.

page discussion view source history

ALMAguides

How to use these CASA Tutorials

Imaging Tutorials for CASA beginners

If you are new to CASA, start with the following tutorials. ALMA data are delivered with standard calibrations applied and they are ready for imaging. These guides cover the basic steps required for imaging and self-calibration.

- [A first look at imaging in CASA](#) This guide gives a first look at imaging and image analysis in CASA.
- [A first look at self-calibration in CASA](#) This guide demonstrates continuum self-cal.
- [A first look at spectral line imaging in CASA](#) This guide shows imaging of a spectral line.
- [A first look at image analysis in CASA](#) This guide demonstrates moment creation and basic image analysis.

Guides for reducing ALMA Science Verification data

The links below lead to overview pages for each science verification observation. The guides themselves are linked from the overview pages. These guides are a useful tools for those who would like to learn the process of calibration and imaging in detail.

The following ALMA science verification guides have been validated for CASA version 4.3. They should also work for CASA version 4.4, and they will be validated for version 4.4 soon.

- [TWHydraBand7](#): The protoplanetary disk source TW Hya at Band 7 (0.87 mm)
- [NGC3256Band3](#): The galaxy merger NGC 3256 at Band 3 (3 mm)
- [AntennaeBand7](#): Mosaic of the galaxy merger NGC 4038/4039 (Antennae) at Band 7 (0.87 mm)
- [IRAS16293Band9](#): Mosaic of the protostellar cluster IRAS16293-2422 at Band 9 (0.45 mm)
- [File:BR1202 SV Band7 Calibration notes.pdf](#): Supplemental notes on the calibration of Science Verification target BR1202-0725 in CASA 3.3
- [ALMA2014_LBC_SVDATA](#): Imaging scripts and details for the 2014 ALMA Long Baseline Campaign science verification data for Juno, Mira, HL Tau, and SDP.81.

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