

# *CASA*

*Introduction*

**Sandra Etoke**

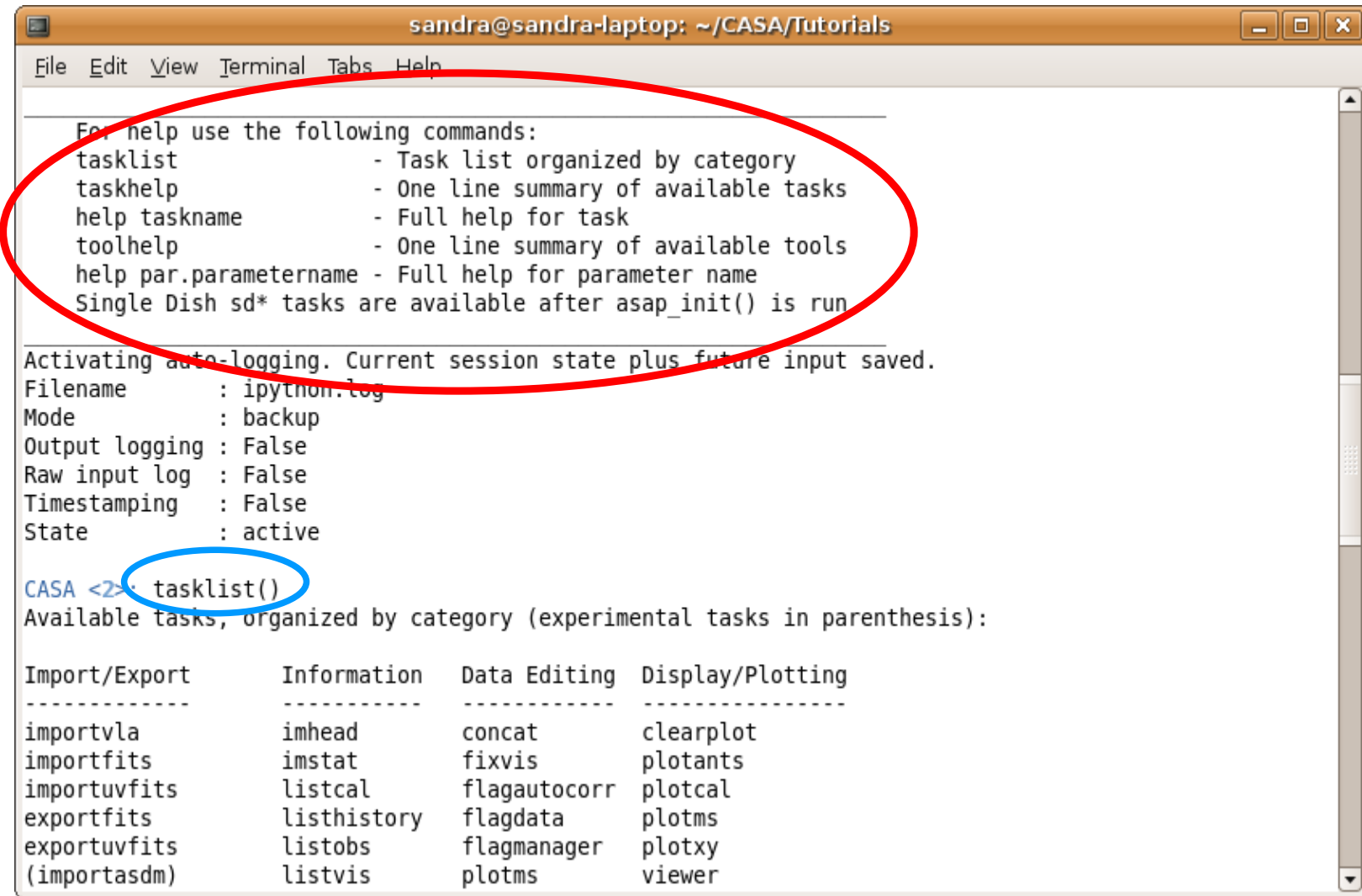
# CASA

- *CASA = Common Astronomy Software Applications*
- CASA interface: IPython
- CASA delivers:
  - a series of **Tasks** for data processing and analysis  
e.g. “plotcal”, “clean”
  - a “**Toolkit**” in order to support pipeline processing, algorithm development, and the construction of tasks themselves.  
e.g. “plotcal” belongs to the calibration utilities tool (cb)  
“clean” belongs to the Imaging utilities tool (im)

## Starting up CASA

MyComputer\$ `casapy`

After you have successfully started CASA a list of available tasks and tools are displayed



```
sandra@sandra-laptop: ~/CASA/Tutorials
File Edit View Terminal Tabs Help

For help use the following commands:
tasklist           - Task list organized by category
taskhelp           - One line summary of available tasks
help taskname      - Full help for task
toolhelp           - One line summary of available tools
help par.parametername - Full help for parameter name
Single Dish sd* tasks are available after asap_init() is run

Activating auto-logging. Current session state plus future input saved.
Filename          : ipython.log
Mode               : backup
Output logging    : False
Raw input log     : False
Timestamping      : False
State             : active

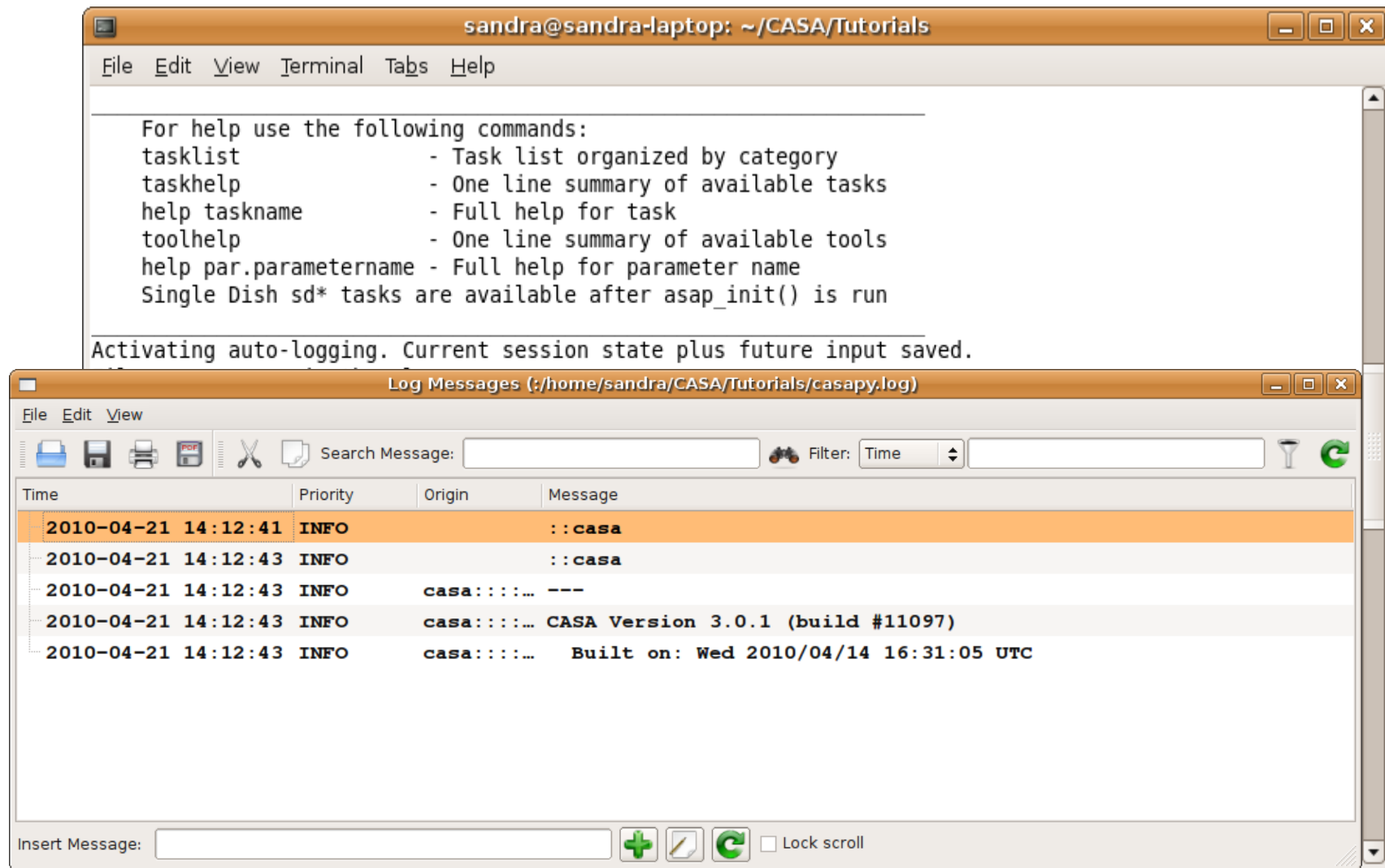
CASA <2> tasklist()
Available tasks, organized by category (experimental tasks in parenthesis):

Import/Export      Information    Data Editing    Display/Plotting
-----
importvla           imhead         concat          clearplot
importfits          imstat         fixvis          plotants
importuvfits        listcal        flagautocorr    plotcal
exportfits          listhistory    flagdata        plotms
exportuvfits        listobs        flagmanager     plotxy
(importasdm)        listvis        plotms          viewer
```

## Starting up CASA

MyComputer\$ `casapy`

After you have successfully started CASA a list of available tasks and tools are displayed and the “logger window” will appear.



## in-line help

e.g.:

`help clean` (`help 'clean'` or `help(clean)`: are fine too !!)

`help par.field` (`help (par.field)` works too !!)

this last syntax is also used for accessing the help of methods attached to a specific tool:

e.g., tool: ia method: subimage

`help ia.subimage`

other alternative: `pdoc` or just ...?

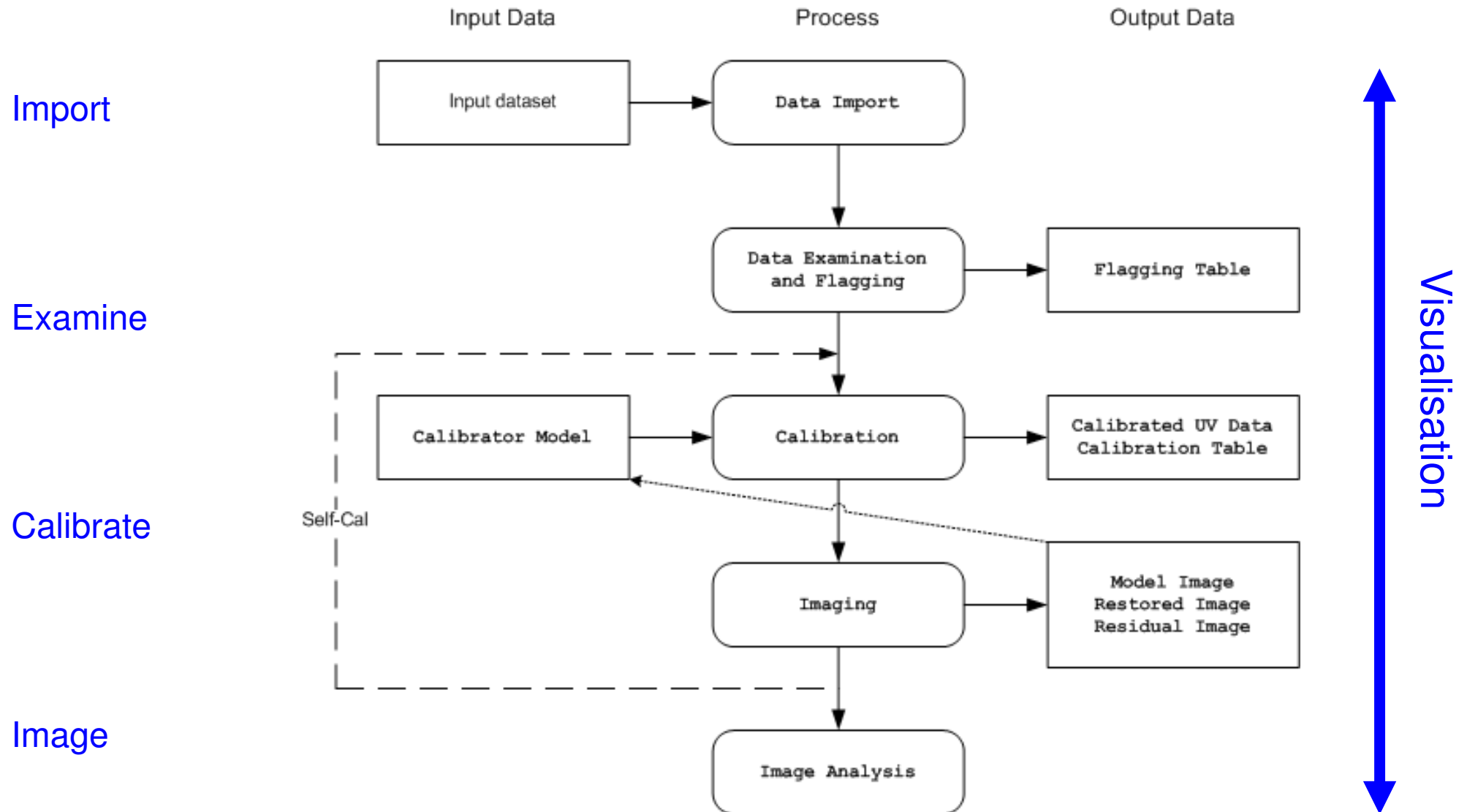
e.g.,

`pdoc clean`

`clean?` (`?clean` works too !!)

^ Beware though that typing “`help`” at the casapy prompt WITH NO ARGUMENTS will BRING UP THE NATIVE PYTHON HELP, and give you the `help>` prompt for further information; hitting <RETURN> at the help prompt returns you to the CASA prompt.

“Data processing flow chart”  
(CASA cookbook- Ch. 1.5 From Loading Data to Images)



# Functionality Census

- Import: [importuvfits](#) (for uv FITS e.g. from AIPS), [importfits](#) (for image FITS)
- Export: [exportuvfits](#) (for uv FITS), [exportuvfits](#) (for image FITS)
- Information: [listobs](#), [listcal](#), [listhistory](#), [imhead](#)
- Editing: [flagautocorr](#), [flagdata](#), [flagmanager](#), [plotxy/plotms,viewer](#)
- Display: [clearplot](#), [plotants](#), [plotcal](#), [plotxy/plotms](#), [viewer](#)
- Calibration: [accum](#), [applycal](#), [bandpass](#), [gaincal](#), [fluxscale](#),  
[clearcal](#), [listcal](#), [smoothcal](#)
- Imaging: [clean](#), [feather](#), [ft](#), [invert](#), [makeask](#), [mosaic](#)
- Modelling: [setjy](#), [uvcontsub](#), [uvmodelfit](#)
- Analysis: [imhead](#), [imcontsub](#), [imfit](#), [immath](#), [immoments](#), [imstat](#),  
[imval](#), [imregrid](#)

# Task parameter manipulation

default

to reset a task to its default values

*e.g. default(clean)*

inp

to get the current values of task parameters

*e.g. inp*

*inp(clean)*

tput/saveinputs

to save task parameters values

*e.g. tput clean*

*saveinputs('clean','clean1.jupiter.save')*

tget/execfile

to restore task parameters values

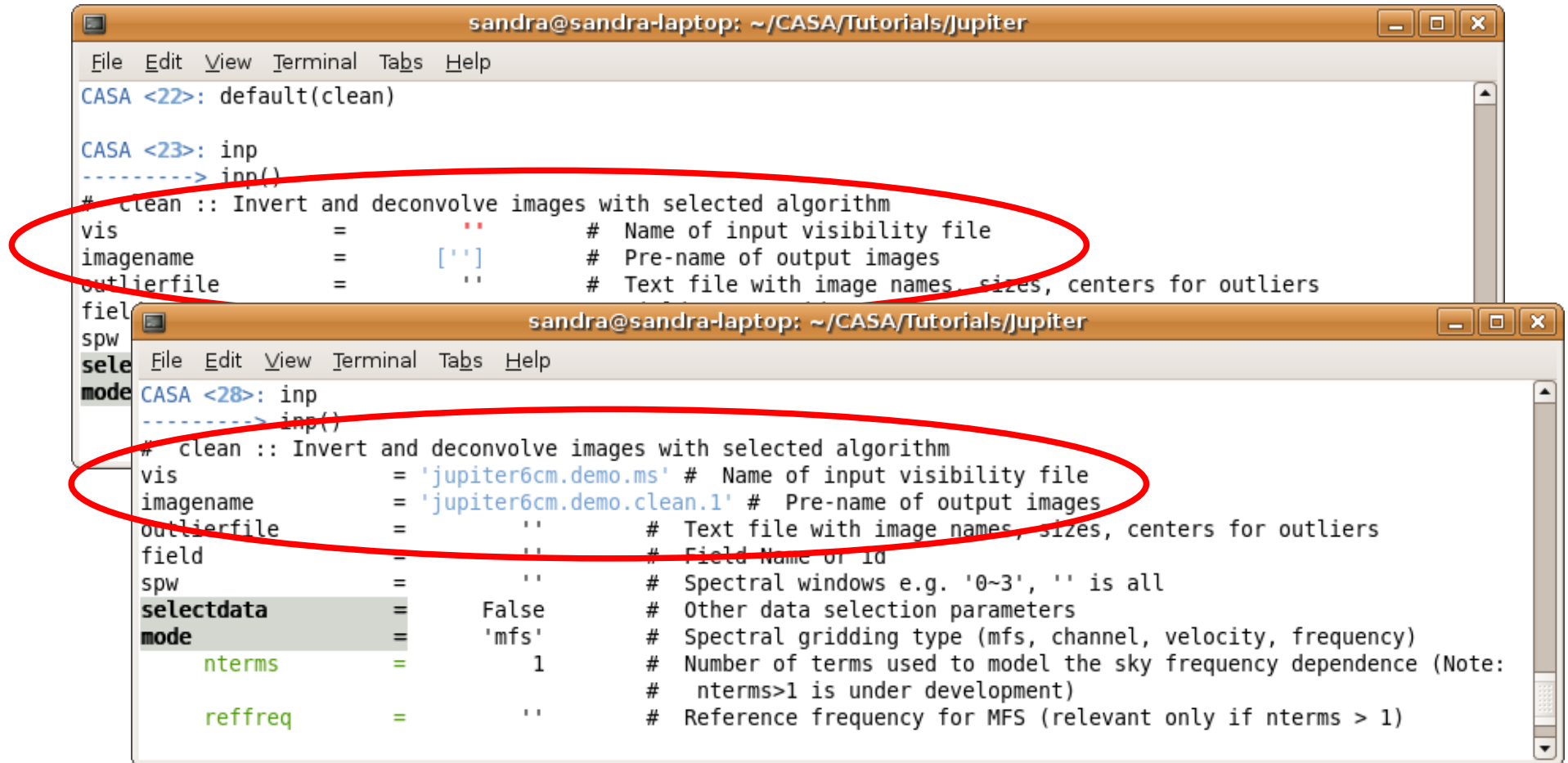
*e.g. tget clean*

*execfile('clean1.jupiter.save')*



# Syntax

- **Selection:** most of it through **strings**, some through **numbers and lists**



```
sandra@sandra-laptop: ~/CASA/Tutorials/Jupiter
File Edit View Terminal Tabs Help
CASA <22>: default(clean)

CASA <23>: inp
-----> inp()
# clean :: Invert and deconvolve images with selected algorithm
vis = '' # Name of input visibility file
imagename = [''] # Pre-name of output images
outlierfile = '' # Text file with image names, sizes, centers for outliers
field = '' # Field Name or ID
spw = '' # Spectral windows e.g. '0~3', '' is all
selectdata = False # Other data selection parameters
mode = 'mfs' # Spectral gridding type (mfs, channel, velocity, frequency)
nterms = 1 # Number of terms used to model the sky frequency dependence (Note:
# nterms>1 is under development)
reffreq = '' # Reference frequency for MFS (relevant only if nterms > 1)
```

- most common selection parameters:

field, spw

selectdata (**expendable** for sub-parameter selection when set to 'True')

# Syntax

field

**string** for the source name(s) or ID(s)

wildcard '\*' can be used

*e.g.: field = '1331+305'*

*field = '3C\*'*

*field = '0,1,3~5'            i.e. source with ID 0,1,3,4,5*

spw

**string** for the spectral window ID(s) + channels if appropriate

':' to make the separation between the spw and the channels

'^ ' as separator of channels from step/width

*e.g.: spw = '0~2'            i.e. spw 0,1,2*

*spw = '1:10~30'            i.e. spw 1 chan. 10 to 30*

*spw = '2~5:5~54^5'        i.e. spw 2,3,4,5 chan. 5 to 54 in step of 5*

# Syntax

## selectdata=True

antenna

**string** with antenna name or ID

( $\wedge$  VLA name: 1-28 BUT ID 0-27)

e.g.: *antenna = '1~5,11'*

*antenna = 'VA\*'*

timerange

**string** with date/time range

*timerange='T0~T1' select from T0 to T1*

*missing fields in T1 are replaced by corresponding fields of T0,*

*timerange='T\_start+dT' also valid*

e.g.: *timerange = '2007/10/16/01:00:00~2007/10/06:30:00'*

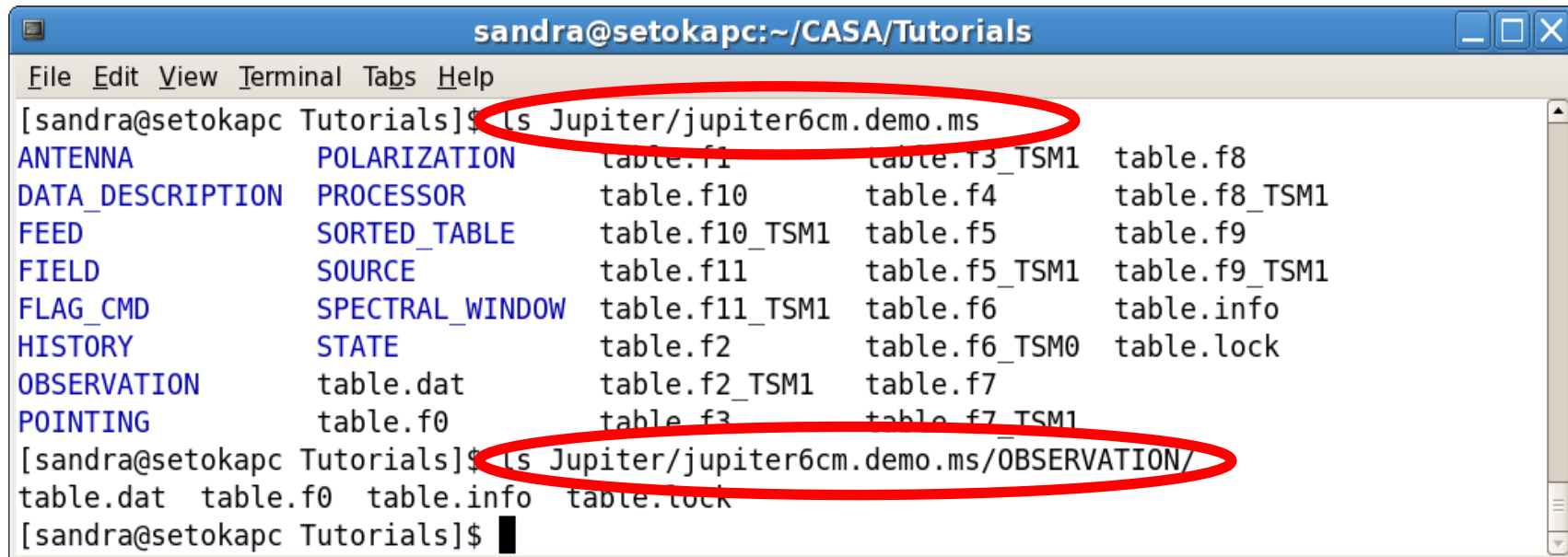
*timerange = '2007/10/16/01:00:00~06:30:00'*

*timerange = '2007/10/16/01:00:00+01:00:00'*

# CASA Data Format

- Data format in CASA: data (*i.e.*, *visibilities*, *images* and *calibration*) are stored in tables
  - visibility data are stored in **Measurement Set (MS)** table
- The MS is a directory on disk. It consists of
- a MAIN table containing the visibility data
  - sub-tables (=sub-directories), containing auxiliary information (e.g. FIELD, SOURCES ...)

EX:



A terminal window titled "sandra@setokapc:~/CASA/Tutorials" displays the output of the command `ls Jupiter/jupiter6cm.demo.ms`. The output lists various files and sub-directories in a table-like format. Two red circles highlight the command and the sub-directory `OBSERVATION/`.

File	Edit	View	Terminal	Help
[sandra@setokapc Tutorials]\$ <code>ls Jupiter/jupiter6cm.demo.ms</code>				
ANTENNA	POLARIZATION	table.f1	table.f3_TSM1	table.f8
DATA_DESCRIPTION	PROCESSOR	table.f10	table.f4	table.f8_TSM1
FEED	SORTED_TABLE	table.f10_TSM1	table.f5	table.f9
FIELD	SOURCE	table.f11	table.f5_TSM1	table.f9_TSM1
FLAG_CMD	SPECTRAL_WINDOW	table.f11_TSM1	table.f6	table.info
HISTORY	STATE	table.f2	table.f6_TSM0	table.lock
OBSERVATION	table.dat	table.f2_TSM1	table.f7	
POINTING	table.f0	table.f3	table.f7_TSM1	
[sandra@setokapc Tutorials]\$ <code>ls Jupiter/jupiter6cm.demo.ms/OBSERVATION/</code>				
table.dat	table.f0	table.info	table.lock	
[sandra@setokapc Tutorials]\$				

## The CASA tools with GUI

In a typical CASA session you will use tools such as:

- `plotxy/plotms`: *An X-Y plotter/interactive flagger for visibility data*
- `plotcal`: *An all-purpose plotter for calibration results*
- `browsetable`: *allows you to display any CASA table, e.g. Measurement Sets*
- `viewer`: *View an image or visibility data set*
- `clean`: *Deconvolve an image with selected algorithm*

# The CASA tools with GUI

In a typical CASA session you will use tools such as:

- plotxy/plotms: *An X-Y plotter/interactive flagger for visibility data*
- plotcal: *An all-purpose plotter for calibration results*
- **browsetable**: *allows you to display any CASA table, e.g. Measurement Sets*
- viewer: *View an image or visibility data set*
- clean: *Deconvolve an image with selected algorithm*

*Data philosophy:*

*Original data kept intact*

*there are “scratch columns” created when needed [created by calibration & imaging tools]:*

- **CORRECTED\_DATA**
- **MODEL\_DATA**
- **IMAGING\_WEIGHTS**

Table Browser

File Edit View Tools Export Help

juiter6cm.demo.ms

	UVW	FLAG	FLAG_CATEGORY	WEIGHT	SIGMA	ANTENNA1	ANTENNA2	ARRAY_ID	DATA
0	[-68.7658, ~...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0.333...	[0, 0, 1.732...	0	9	0	0
1	[-68.7658, ~...	[4, 1] Boolean	[0, 0, 0] Boo...	[0.333333, ...	[1.73205, 0,...	0	9	0	1
2	[-218.848, 4...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0, 0]	[0, 0, 0, 0]	7	9	0	0
3	[-218.848, 4...	[4, 1] Boolean	[0, 0, 0] Boo...	[0.333333, ...	[1.73205, 0,...	7	9	0	1
4	[-16.7846, 1...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0, 0]	[0, 0, 0, 0]	4	9	0	0
5	[-16.7846, 1...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0.333...	[0, 0, 1.732...	4	9	0	1
6	[150.083, -8...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0, 0]	[0, 0, 0, 0]	0	7	0	0
7	[150.083, -8...	[4, 1] Boolean	[0, 0, 0] Boo...	[0.333333, ...	[1.73205, 1,...	0	7	0	1
8	[-51.9812, ~...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0, 0, 0]	[0, 0, 0, 0]	0	4	0	0
9	[-51.9812, ~...	[4, 1] Boolean	[0, 0, 0] Boo...	[0, 0.33333...	[0, 1.73205,...	0	4	0	1

Restore Columns Resize Headers

PAGE NAVIGATION First << [ 1 / 2022 ] >> Last 1 Go Loading 1000 rows.

# The CASA tools with GUI

In a typical CASA session you will use tools such as:

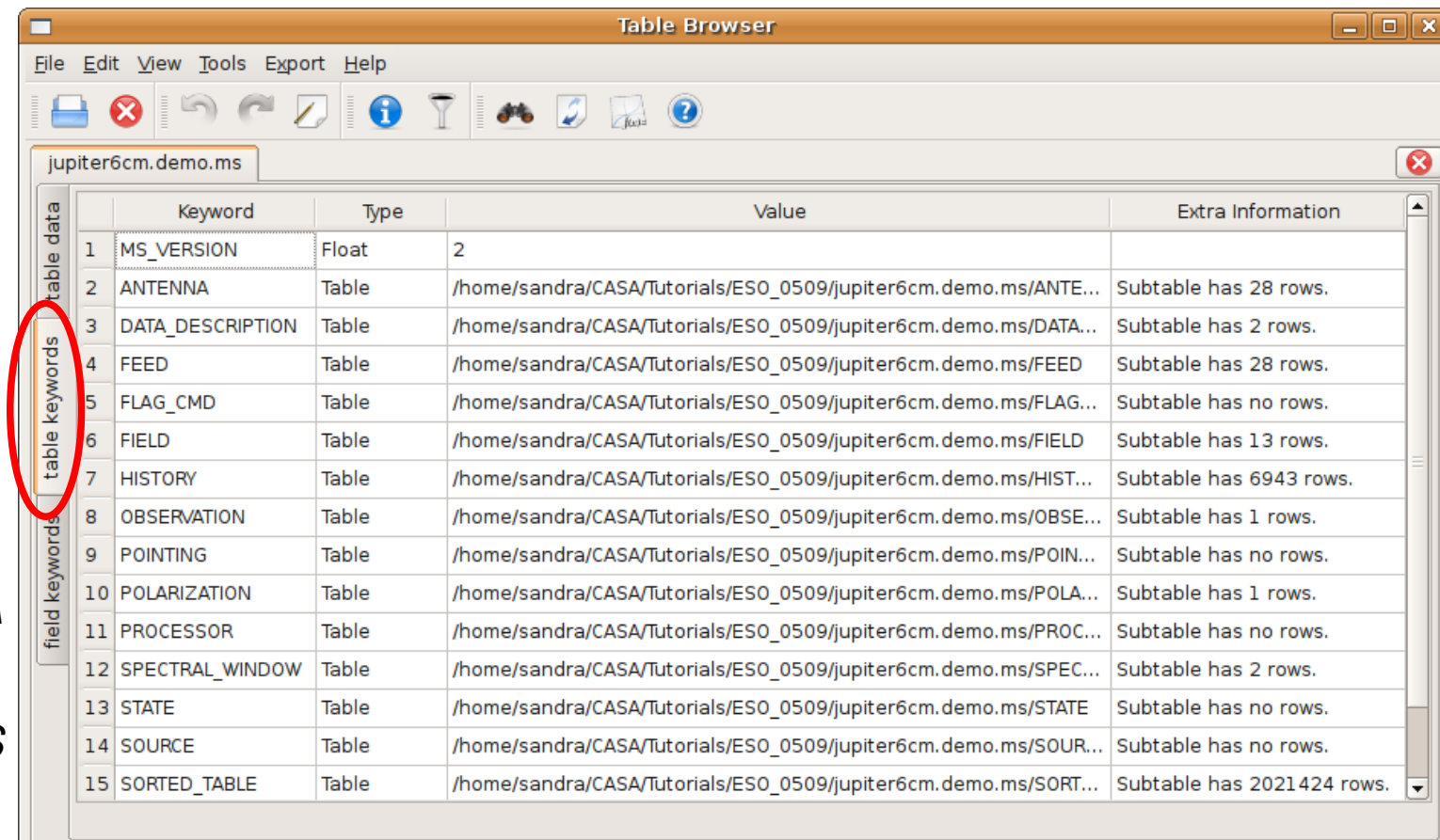
- `plotxy/plotms`: *An X-Y plotter/interactive flagger for visibility data*
- `plotcal`: *An all-purpose plotter for calibration results*
- `browsetable`: *allows you to display any CASA table, e.g. Measurement Sets*
- `viewer`: *View an image or visibility data set*
- `clean`: *Deconvolve an image with selected algorithm*

*Data philosophy:*

*Original data kept intact*

*there are “scratch columns” created when needed [created by calibration & imaging tools]:*

- `CORRECTED_DATA`
- `MODEL_DATA`
- `IMAGING_WEIGHTS`



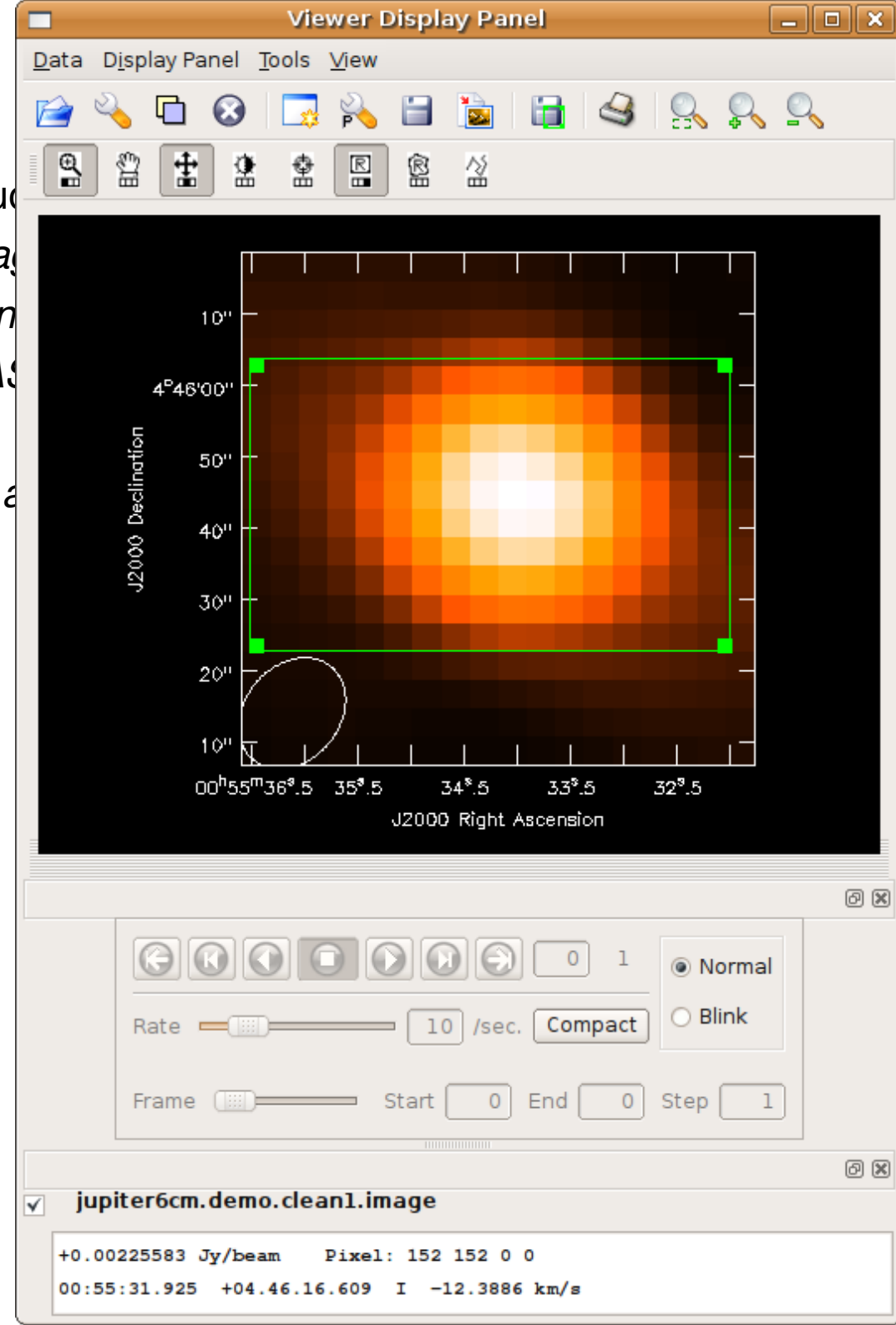
The screenshot shows the 'Table Browser' window with the file 'jupiter6cm.demo.ms' open. The table has 15 rows of keywords. The 'Table keywords' column is circled in red.

	Keyword	Type	Value	Extra Information
1	MS_VERSION	Float	2	
2	ANTENNA	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/ANTE...	Subtable has 28 rows.
3	DATA_DESCRIPTION	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/DATA...	Subtable has 2 rows.
4	FEED	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/FEED	Subtable has 28 rows.
5	FLAG_CMD	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/FLAG...	Subtable has no rows.
6	FIELD	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/FIELD	Subtable has 13 rows.
7	HISTORY	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/HIST...	Subtable has 6943 rows.
8	OBSERVATION	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/OBSE...	Subtable has 1 rows.
9	POINTING	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/POIN...	Subtable has no rows.
10	POLARIZATION	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/POLA...	Subtable has 1 rows.
11	PROCESSOR	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/PROC...	Subtable has no rows.
12	SPECTRAL_WINDOW	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/SPEC...	Subtable has 2 rows.
13	STATE	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/STATE	Subtable has no rows.
14	SOURCE	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/SOUR...	Subtable has no rows.
15	SORTED_TABLE	Table	/home/sandra/CASA/Tutorials/ESO_0509/jupiter6cm.demo.ms/SORT...	Subtable has 2021424 rows.

## The CASA tools with GUI

In a typical CASA session you will use tools such as:

- `plotxy/plotms`: *An X-Y plotter/interactive flagging tool*
- `plotcal`: *An all-purpose plotter for calibration*
- `browsetable`: *allows you to display any CASA table*
- **viewer**: *View an image or visibility data set*
- `clean`: *Deconvolve an image with selected antennas*



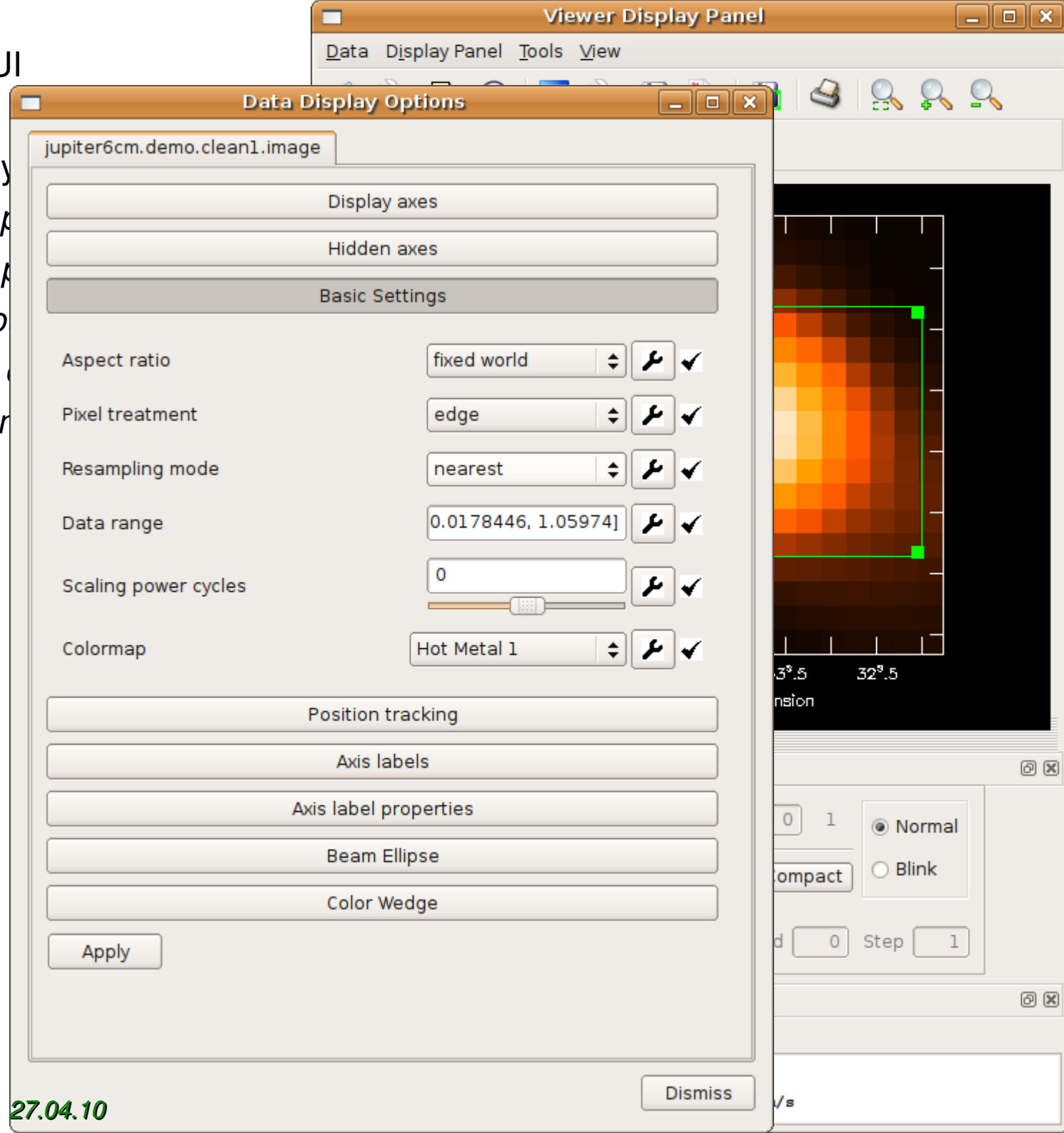


## The CASA tools with GUI

In a typical CASA session you can use:

- plotxy/plotms: *An X-Y plot*
- plotcal: *An all-purpose plot*
- browsetable: *allows you to browse tables*
- **viewer**: *View an image*
- clean: *Deconvolve an image*

The plot can be personalised with the **Data display** options and the **Display Panel Options** menu



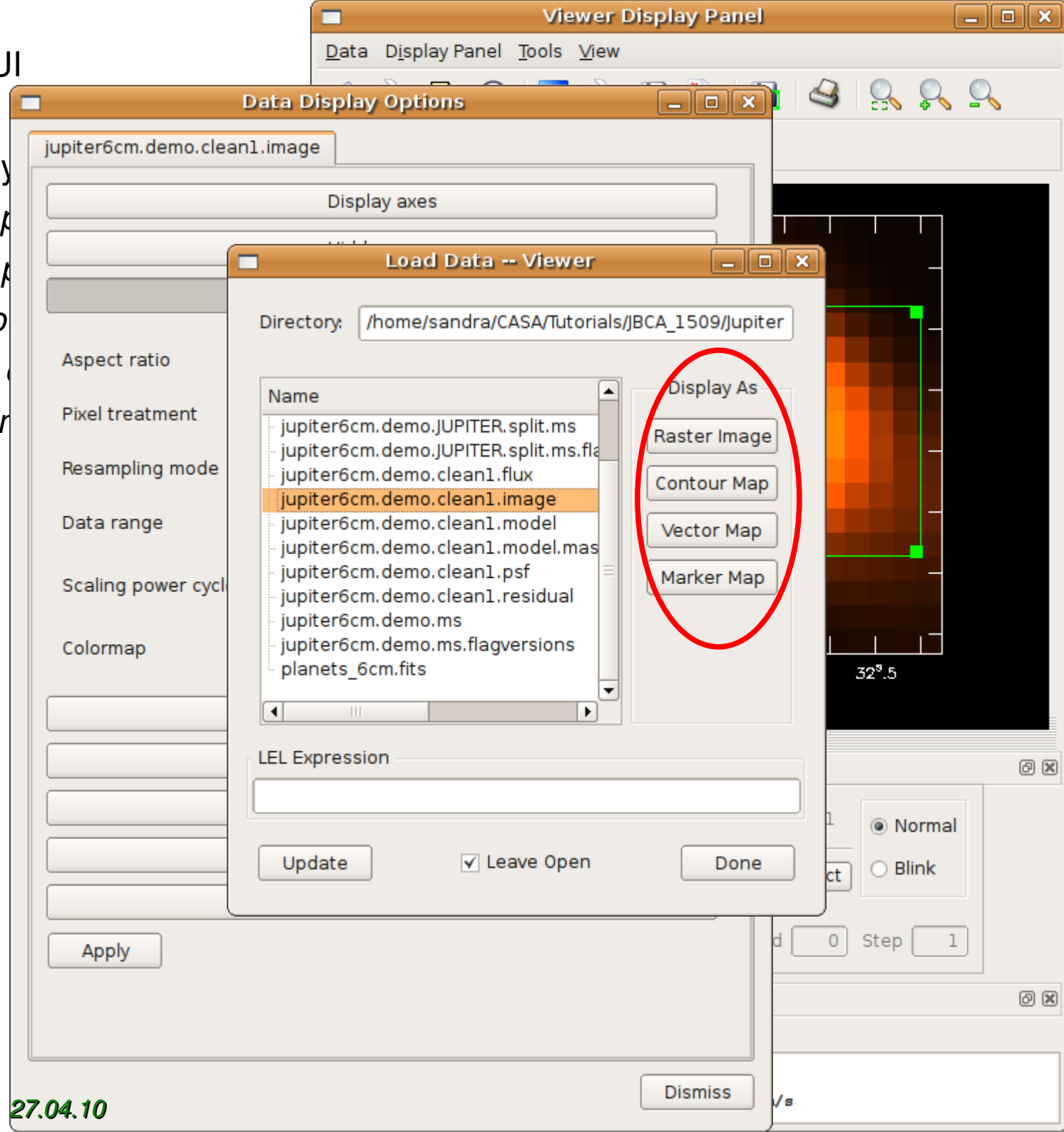
## The CASA tools with GUI

In a typical CASA session you can use:

- plotxy/plotms: *An X-Y plot*
- plotcal: *An all-purpose plot*
- browsetable: *allows you to browse tables*
- **viewer**: *View an image*
- clean: *Deconvolve an image*

The plot can be personalised with the **Data display** options and the **Display Panel Options** menu

You can also create a **spectral profile** (*Tool -> Spectral Profile*) or add a **contour map** (*Open -> Select file -> Display as "Contour Map"*) ...



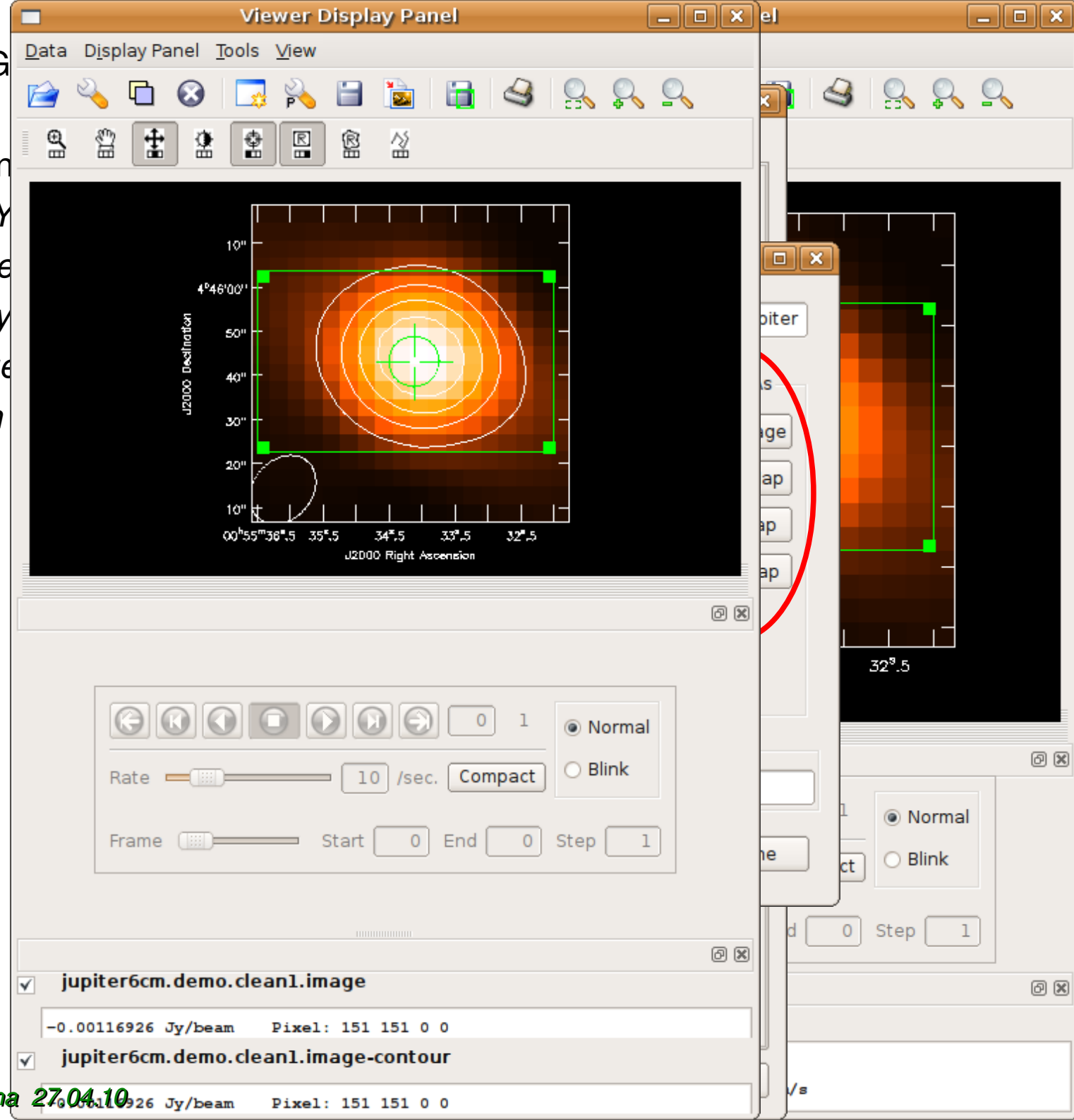
The CASA tools with G

In a typical CASA session

- plotxy/plotms: *An X-Y*
- plotcal: *An all-purpose*
- browsetable: *allows y*
- **viewer**: *View an image*
- clean: *Deconvolve an*

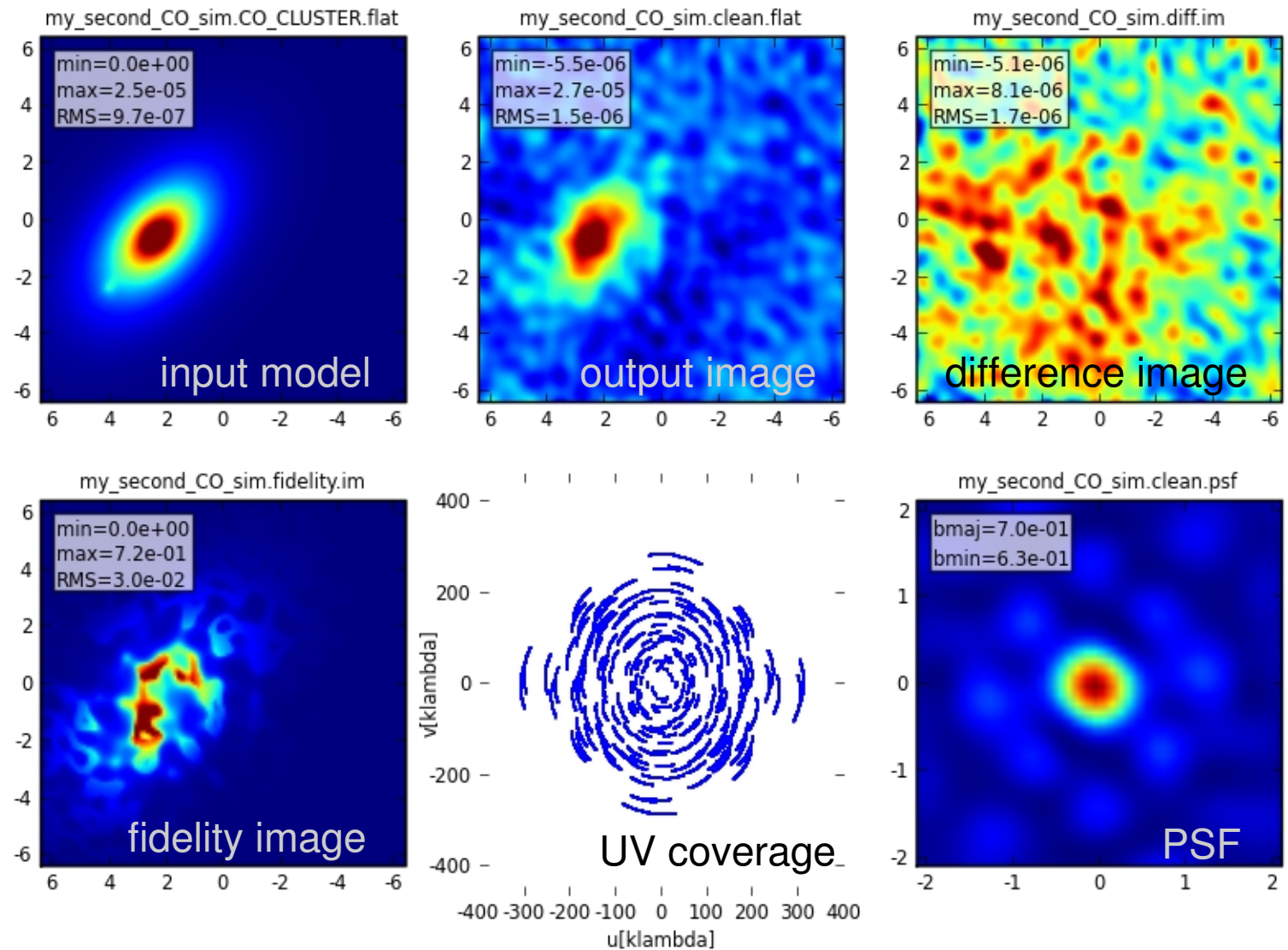
The plot can be personalised with the **Data display** options and the **Display Panel Options** menu

You can also create a **spectral profile** (*Tool -> Spectral Profile*) or add a **contour map** (*Open -> Select file -> Display as "Contour Map"*) ...



# Simulations

- simdata



*ex. for ALMA early science large configuration (Band 3)*

# CASA Documentation

- CASA home page : <http://casa.nrao.edu/>

*where to find news regarding CASA such as new release, link to the CASA user support material such as the User Reference cookbook, Toolkit Manual, CASA training material and CASA scripts & data*

- CASA Guides: [http://casaguides.nrao.edu/index.php?title=Main\\_Page](http://casaguides.nrao.edu/index.php?title=Main_Page)

*where to find all sort of guides related to the use of CASA*

- NRAO Services: <http://casa.nrao.edu>

*allow you in particular to register and download CASA*

# CASA Documentation++

- CASA Cookbook :

[http://casa.nrao.edu/Doc/Cookbook/casa\\_cookbook.pdf](http://casa.nrao.edu/Doc/Cookbook/casa_cookbook.pdf)

- CASA User Reference Manual:

<http://casa.nrao.edu/docs/casaref/CasaRef.html>

- Python Documentation and Tutorials:

<http://python.org/doc>

- iPython (CASA interface) Documentation and Tutorials:

<http://ipython.scipy.org/moin/Documentation>