

ALMA SOFTWARES (Observing Tool and CASA)

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EUROPEAN ARC
ALMA Regional Centre || Czech

Autumn ALMA Workshop
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Basic tool for ALMA

CASA

OBSERVING
TOOL



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SPLATALOGUE

(database for astronomical
spectroscopy)



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(database for astronomical
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**ALMA
OBSERVATION
SUPPORT TOOL**
(simulates ALMA observations)



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HELPDESK



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HELPDESK

**USER
PORTAL**



CASA – Common Astronomy Software Applications

CASA is a set C++ application libraries for the data reduction and analysis of radio astronomical data, developed for ALMA and EVLA projects but also for data from other radio, millimeter, and sub-mm telescopes. The package can process both interferometric and single dish data.

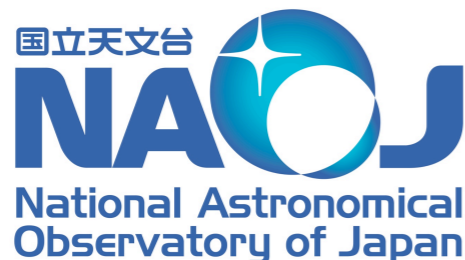


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CASA is developed by an international consortium of scientists based at the:

- * National Radio Astronomical Observatory (NRAO) – **guidance**,
- * European Southern Observatory (ESO),
- * National Astronomical Observatory of Japan (NAOJ),
- * CSIRO Australia Telescope National Facility (CSIRO/ATNF),
- * Netherlands Institute for Radio Astronomy (ASTRON).



CASA

The latest CASA release 4.1.0 (31 May 2013) is available for the following operating systems:

Linux

- * RedHat 5.7 and 6.3 (64-bit)

Mac OS

- * Mac OS 10.6 (Snow Leopard; 64-bit),
- * Mac OS 10.7 & 10.8 (Lion/Mountain Lion; 64-bit)

CASA may also work on other flavors of Linux. The list above covers those operating systems that was a regularly tested. Note that from CASA 4.1 and onwards we support Mac OS 10.8 but may discontinue support for Mac OS 10.6. We will also restrict support of the Linux version to 64-bit.



Starting up CASA

command: **casapy**

After started CASA a list of available tools are displayed and the “logger widow” will appear.

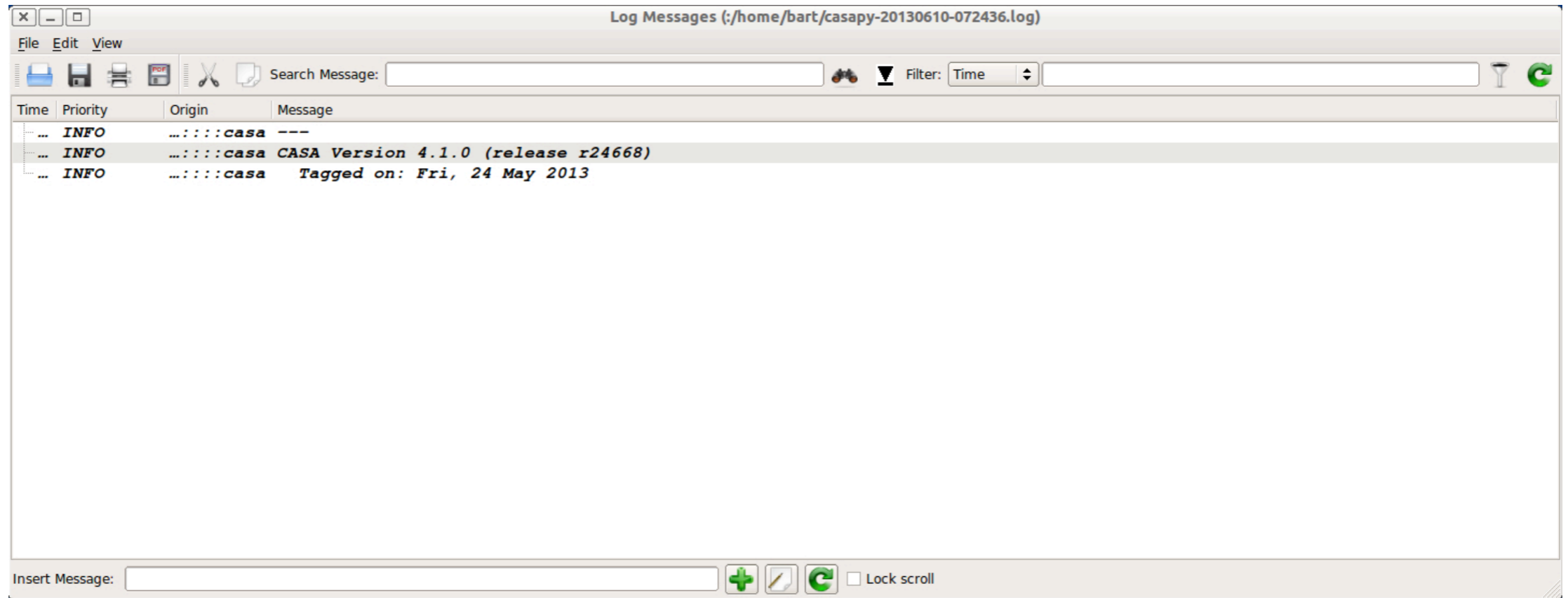
```
bart@arc: ~
are cached or not.
=====
CASA Version 4.1.0 (r24668)
  Compiled on: Sat 2013/05/25 00:43:29 UTC
-----
For help use the following commands:
tasklist           - Task list organized by category
taskhelp           - One line summary of available tasks
help taskname      - Full help for task
toolhelp           - One line summary of available tools
help par.parametername - Full help for parameter name
-----
Activating auto-logging. Current session state plus future input saved.
Filename          : ipython-20130610-072445.log
Mode              : backup
Output logging    : False
Raw input log     : False
Timestamping      : False
State             : active
*** Loading ATNF ASAP Package...
*** ... ASAP (trunk rev#23916) import complete ***

CASA <2>: █
```



Logger window

The CASA “Log Message” allows you to monitor the outcome of any command executed in the main CASA window.



Data Format

Data format in CASA:

- * data are stored in tables,
- * visibility data are stored in Measurement Set (MS) table,
- * the MS is a directory on the disk. An MS consists of:
 - * MAIN table containing the visibility data,
 - * sub-tables containing auxiliary information or secondary information.

```
bart@arc: ~/Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms
bart@arc:~$ cd Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms/
bart@arc:~/Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms$ ls
ANTENNA          POLARIZATION    table.f10      table.f19      table.f5
ASDM_ANTENNA    PROCESSOR       table.f11      table.f2       table.f6
ASDM_STATION    SORTED_TABLE    table.f12      table.f20      table.f7
CALDEVICE        SOURCE          table.f13      table.f21      table.f8
DATA_DESCRIPTION SPECTRAL_WINDOW table.f14      table.f21_TSM0 table.f9
FEED             STATE           table.f15      table.f22      table.info
FIELD           SYSCAL          table.f16      table.f22_TSM1 table.lock
FLAG_CMD        SYSPower       table.f17      table.f23
HISTORY         WEATHER         table.f17_TSM1 table.f23_TSM1
OBSERVATION     table.dat       table.f18      table.f3
POINTING        table.f1        table.f18_TSM1 table.f4
bart@arc:~/Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms$
```



Is ANTENNA → table.dat table.f0 table.info table.lock



Browse a Table

command: **browsetable**

This task allows you to display any CASA table.

```
bart@arc: ~/Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms
CASA Version 4.1.0 (r24668)
  Compiled on: Sat 2013/05/25 00:43:29 UTC

-----
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
-----

Activating auto-logging. Current session state plus future input saved.
Filename          : ipython-20130611-110127.log
Mode               : backup
Output logging    : False
Raw input log     : False
Timestamping      : False
State              : active
*** Loading ATNF ASAP Package...
*** ... ASAP (trunk rev#23916) import complete ***

CASA <2>: browsetable
-----> browsetable()

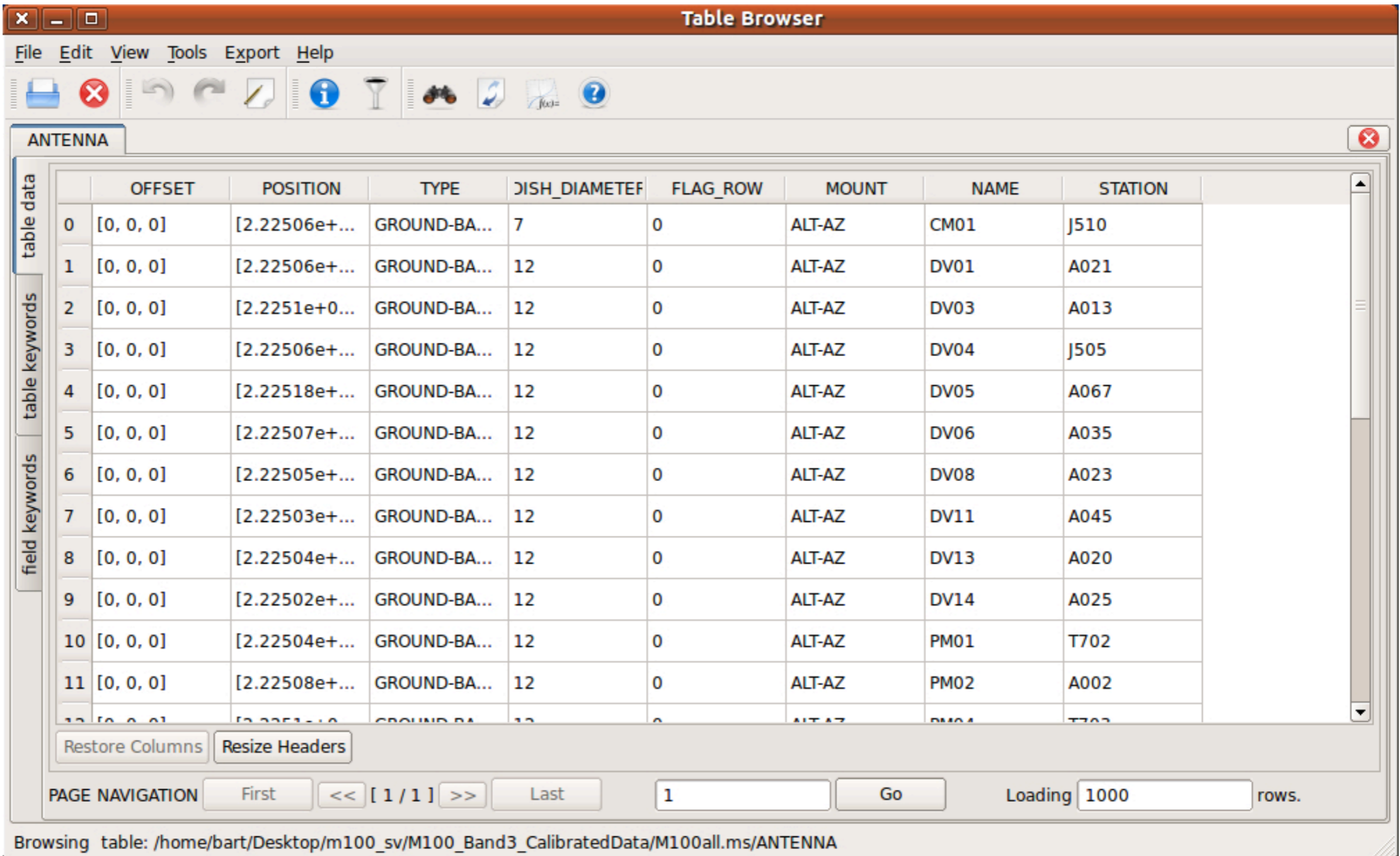
CASA <3>: □
```



Browse a Table

command: `browsetable`

This task allows you to display any CASA table.

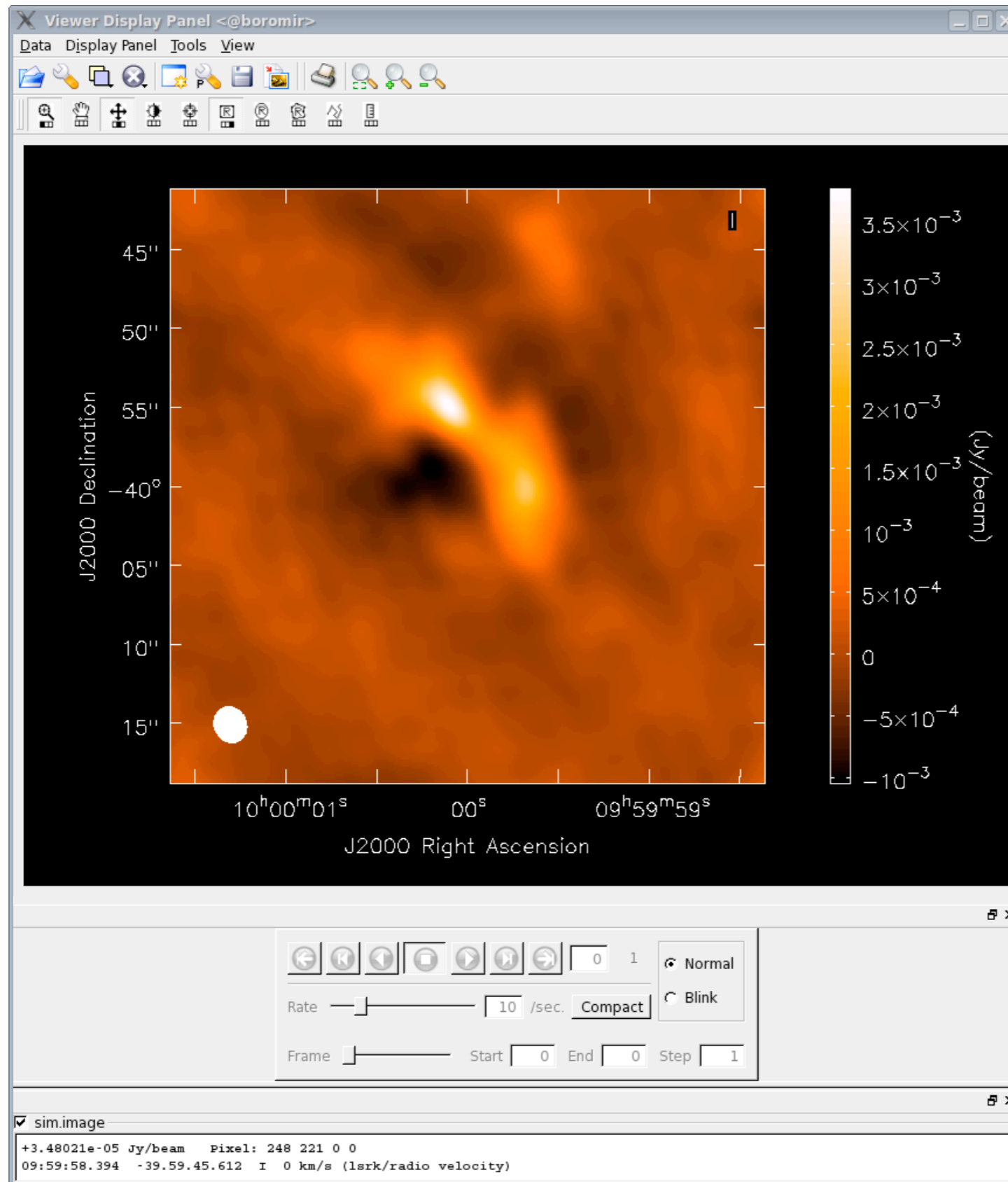


The screenshot shows the 'Table Browser' window in CASA. The window title is 'Table Browser'. The menu bar includes 'File', 'Edit', 'View', 'Tools', 'Export', and 'Help'. The toolbar contains icons for printing, closing, undo, redo, search, filter, zoom, and help. The main area displays a table with the following columns: OFFSET, POSITION, TYPE, DISH_DIAMETER, FLAG_ROW, MOUNT, NAME, and STATION. The table is titled 'ANTENNA' and contains 12 rows of data. The status bar at the bottom shows 'Browsing table: /home/bart/Desktop/m100_sv/M100_Band3_CalibratedData/M100all.ms/ANTENNA' and 'Loading 1000 rows.'.

	OFFSET	POSITION	TYPE	DISH_DIAMETER	FLAG_ROW	MOUNT	NAME	STATION
0	[0, 0, 0]	[2.22506e+...	GROUND-BA...	7	0	ALT-AZ	CM01	J510
1	[0, 0, 0]	[2.22506e+...	GROUND-BA...	12	0	ALT-AZ	DV01	A021
2	[0, 0, 0]	[2.2251e+0...	GROUND-BA...	12	0	ALT-AZ	DV03	A013
3	[0, 0, 0]	[2.22506e+...	GROUND-BA...	12	0	ALT-AZ	DV04	J505
4	[0, 0, 0]	[2.22518e+...	GROUND-BA...	12	0	ALT-AZ	DV05	A067
5	[0, 0, 0]	[2.22507e+...	GROUND-BA...	12	0	ALT-AZ	DV06	A035
6	[0, 0, 0]	[2.22505e+...	GROUND-BA...	12	0	ALT-AZ	DV08	A023
7	[0, 0, 0]	[2.22503e+...	GROUND-BA...	12	0	ALT-AZ	DV11	A045
8	[0, 0, 0]	[2.22504e+...	GROUND-BA...	12	0	ALT-AZ	DV13	A020
9	[0, 0, 0]	[2.22502e+...	GROUND-BA...	12	0	ALT-AZ	DV14	A025
10	[0, 0, 0]	[2.22504e+...	GROUND-BA...	12	0	ALT-AZ	PM01	T702
11	[0, 0, 0]	[2.22508e+...	GROUND-BA...	12	0	ALT-AZ	PM02	A002



Viewer – view an image or visibility data set

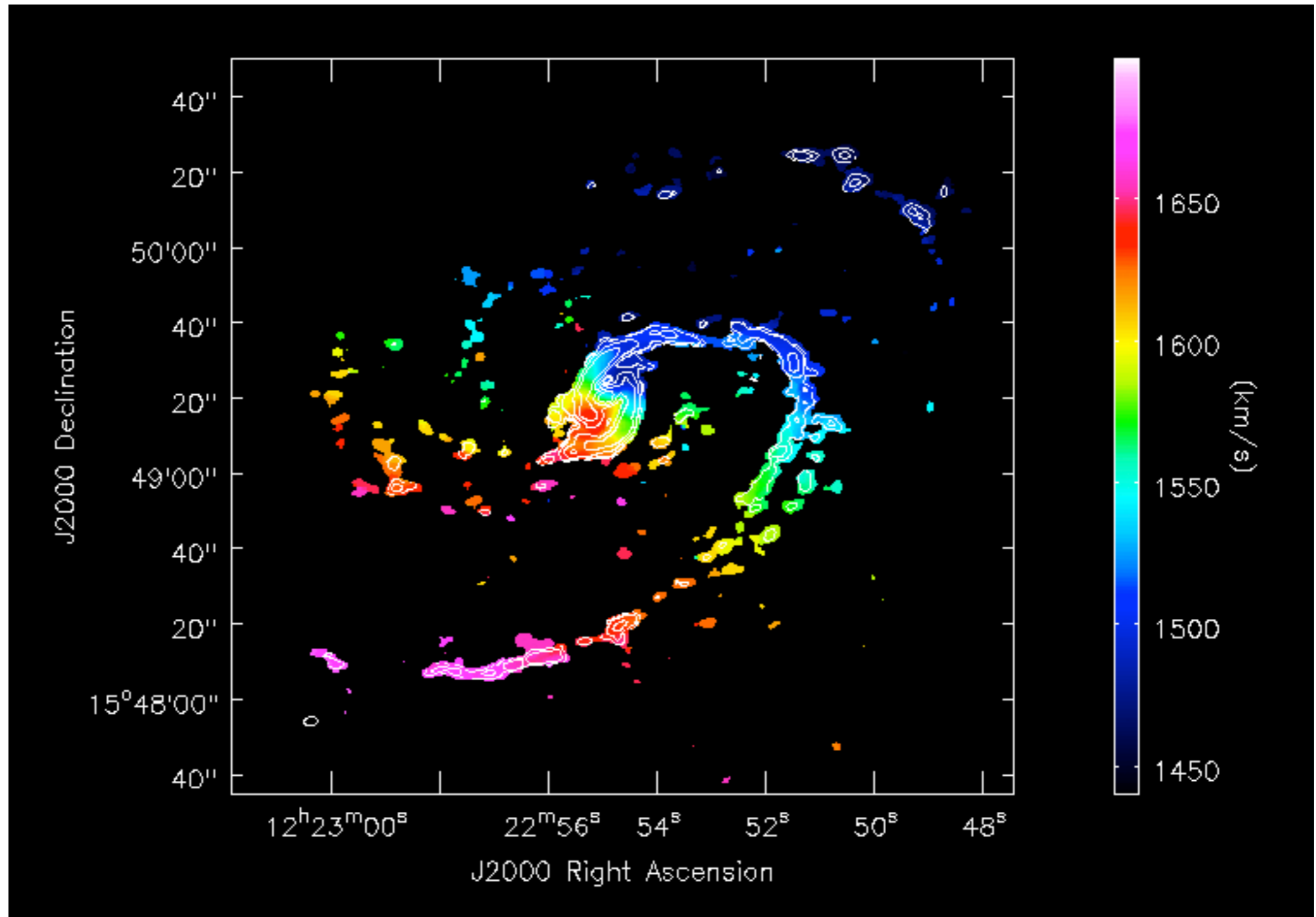


In a typical CASA session you will use tools such as:

- * **plotxy**: 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



CASA Result



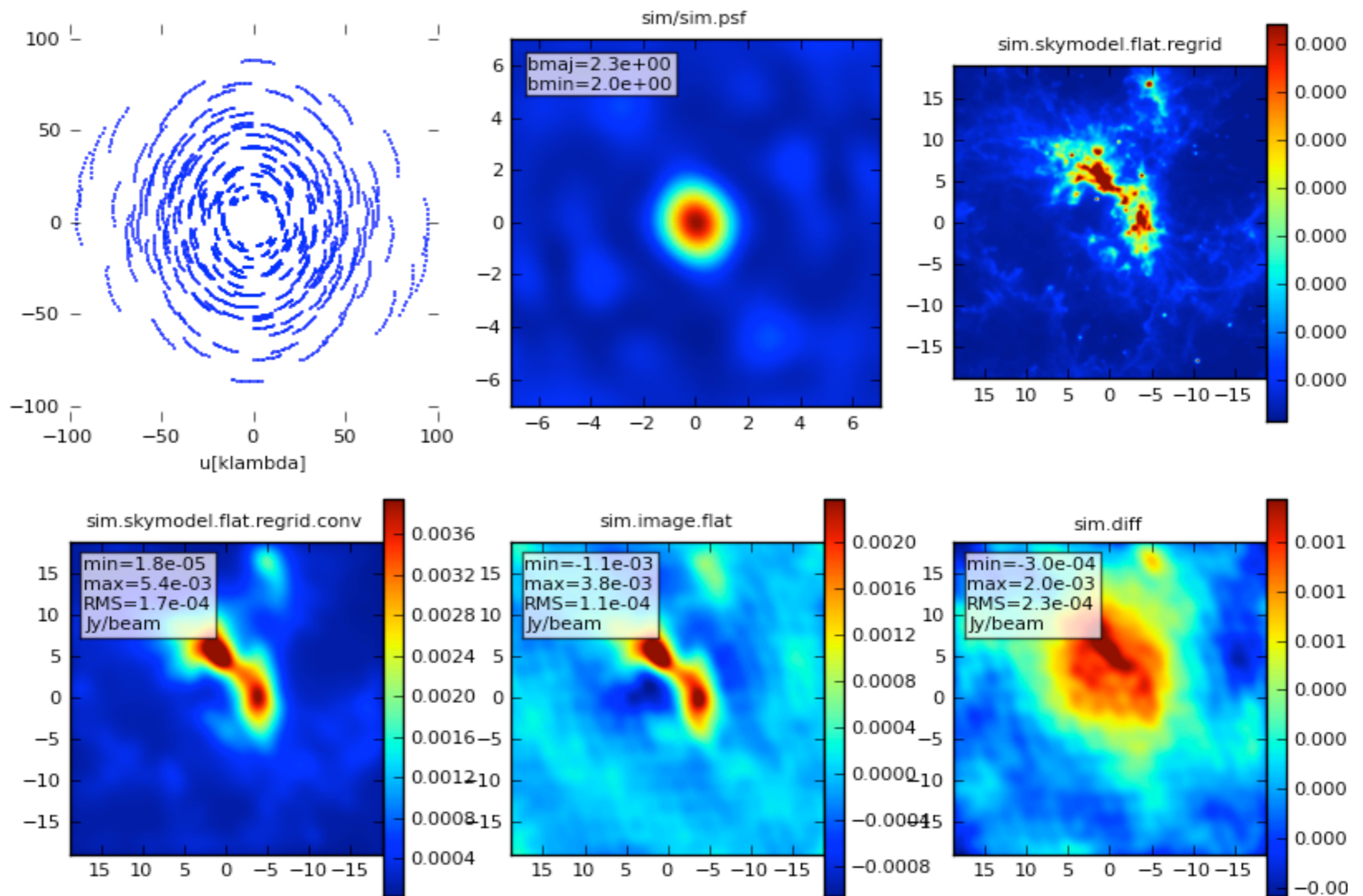
Intensity-weighted CO(1-0) velocity field of the grand-design spiral galaxy M100 (**Band 3** 84–116 GHz), with total intensity contours overlaid.

Simulating observations in CASA 4.1

command: **simobserve** & **simanalyze**

When planning an interferometric observation it is useful to simulate the output of the instrument under a variety of conditions. In CASA, interferometric observations can be simulated using task **simobserve** and quickly analyzed using task **simanalyze**.





Plot of the six outputs generated by **simanalyze** (Tarantula Nebula – 30 Doradus) (1) the uv coverage in the 2 hour observation; (2) the synthesized ("dirty") beam; (3) the original sky model; (4) the convolved model (sky model convolved with the output "clean" beam); (5) the clean image (the sky as observed with the interferometer after deconvolution); (6) and the difference between the clean image and the convolved model.



CASA on the web

CASA Home Page

<http://casa.nrao.edu>

Obtaining the CASA

http://casa.nrao.edu/casa_obtaining.shtml

CASA Cookbook

http://casa.nrao.edu/Doc/Cookbook/casa_cookbook.pdf

CASA Training Materials

http://casa.nrao.edu/casa_training.shtml

CASA Scripts and Data

http://casa.nrao.edu/casa_scripts.shtml





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- Knowledgebase/FAQ

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- Helpdesk
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- NA ARC
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This is the website for **The ALMA Science Portal**, served from one of the **ALMA Regional Centers (ARCs)** of the ALMA partner organizations: ESO, NRAO or NAOJ. You may switch between the different instances of the portal through the links to the appropriate ALMA partner at the top banner. Through this portal you can find details about the technical capabilities of ALMA, how to propose for observing time, and how to access ALMA data. It includes links to all official ALMA documents and tools, including those for preparing and submitting proposals and processing ALMA data. In order to access some of the tools, users must register with the project and login to the portal via the links at the top banner.

Each of the three ARCs provides additional **User Services**, including a **Helpdesk** for all user queries. Each ARC maintains additional web pages with information on region-specific user services, such as visitor and student programs, schools, workshops, financial programs and public outreach activities. These are accessed via the links under the **User Services at the ARCs** area in the left menu.

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Newsletter No. 9
May 23, 2012
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May 31, 2013

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Apr 08, 2013

ALMA Cycle 1 Proposal Review: Detailed Report
Mar 14, 2013

ALMA Director's Discretionary Time and Target of Opportunity activation
Mar 01, 2013

Access to ALMA Science data
Feb 04, 2013

More...

Local News

43rd YERAC
Jun 10, 2013

7th IRAM 30m Summer School
Jun 07, 2013

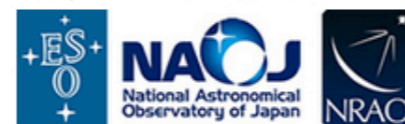
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CESRA Workshop 2013
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OBSERVING TOOL



ALMA SCIENCE PORTAL

WEB INTERFACE FOR ALMA USERS

ALMA, a worldwide collaboration



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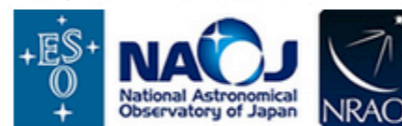
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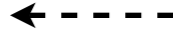
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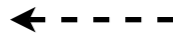
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OBSERVING TOOL



HELPDESK



ALMA SCIENCE PORTAL

WEB INTERFACE FOR ALMA USERS

Observing Tool

The ALMA Observing Tool (OT) is a Java application used for the preparation and submission of ALMA Phase I (observing proposal) and Phase II (telescope runfiles for accepted proposals) materials. Note that in order to submit proposals you will have to register with the ALMA Science Portal beforehand.

Download & Installation

The OT will run on most common operating systems, as long as you have Java 6 installed.

The ALMA OT is available in two versions: **Web Start** (recommended, automatically downloaded and installed on your computer) and **tarball** (installed manually).



OT Graphical User Interface

Project - Observing Tool for ALMA, version Cycle0

File Edit View Tool Search Help Perspective 1

Project Structure

Proposal Program

Unsubmitted Proposal

- Project
 - Proposal

Editors

Spectral Spatial Proposal

Proposal Information

Proposal Title

Proposal Cycle 2011.0

Abstract (max. 300 words)

Launch Editor

Scientific Category

- Cosmology and the High Redshift Universe
- Galaxies and Galactic Nuclei
- ISM/Astrochemistry/Star Formation/protoplanetary disks/exoplanets
- Stellar Evolution/the Sun and the Solar System

Proposal Type

- Standard
- Target Of Opportunity

Student Project

Continuation (Not Applicable)

Related Proposals

Previous Proposals Not Applicable for this cycle

Feedback

Problems Information Log

Description Suggestion

Overview

Contextual Help

- Please ensure you and your co-Is are registered with the [ALMA Science Portal](#)
- Create a new proposal by either:
 - Selecting *File > New Proposal*
 - Clicking on the icon in the toolbar
 - Or clicking on this [link](#)
- Click on the [proposal](#) tree node and complete the relevant fields.

Phase I: Science Proposal

New Science Proposal → Create Science Goals → Validate Science Proposal → Submit Science Proposal

Click on the overview steps to view the contextual help

Importing And Exporting Template Library Need More Help? View Phase 2 Steps

OT Graphical User Interface

Project - Observing Tool for ALMA, version Cycle0

File Edit View Tool Search Help Perspective 1

Menus and Toolbar

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OT Graphical User Interface

The screenshot displays the 'Project - Observing Tool for ALMA, version Cycle0' application window. The interface is divided into several panes:

- Project Structure:** Shows a tree view with 'Project' and 'Proposal' nodes.
- Editors:** Contains a 'Proposal Information' form with fields for 'Proposal Title', 'Proposal Cycle' (set to 2011.0), and 'Abstract (max. 300 words)'. Below these are radio buttons for 'Proposal Type' (Standard, Target Of Opportunity), checkboxes for 'Student Project' and 'Continuation', and text boxes for 'Related Proposals' and 'Previous Proposals'.
- Feedback:** Includes tabs for 'Problems', 'Information', and 'Log', with a table for reporting issues.
- Overview:** Features a 'Contextual Help' section with instructions on how to create a new proposal, and a 'Phase I: Science Proposal' flowchart showing steps: 'New Science Proposal' → 'Create Science Goals' → 'Validate Science Proposal' → 'Submit Science Proposal'. Additional buttons include 'Importing And Exporting', 'Template Library', 'Need More Help?', and 'View Phase 2 Steps'.

Menus and Toolbar

Editor window:
Enter your information here

OT Graphical User Interface

Menus and Toolbar

The Project Tree:
Shows the structure of your proposal

Editor window:
Enter your information here

Contextual Help

1. Please ensure you and your co-Is are registered with the [ALMA Science Portal](#)
2. Create a new proposal by either:
 - Selecting *File > New Proposal*
 - Clicking on the icon in the toolbar
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Phase I: Science Proposal

New Science Proposal → Create Science Goals → Validate Science Proposal → Submit Science Proposal

Click on the overview steps to view the contextual help

Importing And Exporting Template Library Need More Help? View Phase 2 Steps

OT Graphical User Interface

Project - Observing Tool for ALMA, version Cycle0

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Abstract (max. 300 words)
Launch Editor

Editor window:
Enter your information here

ISM/Astrochemistry/Star Formation/protoplanetary disks/exoplanets
Stellar Evolution/the Sun and the Solar System

Proposal Type
Standard Target Of Opportunity

Student Project
Continuation (Not Applicable)
Related Proposals
Previous Proposals Not Applicable for this cycle

Feedback panel:
When you validate, reports problems with your setup

Overview

Contextual Help

- Please ensure you and your co-Is are registered with the [ALMA Science Portal](#)
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Importing And Exporting Template Library Need More Help? View Phase 2 Steps

OT Graphical User Interface

Menus and Toolbar

The Project Tree:
Shows the structure of your proposal

Editor window:
Enter your information here

Feedback panel:
When you validate, reports problems with your setup

Overview panel:
Guides a user through the various steps required at both Phase I and II

Observing Tool – documentation

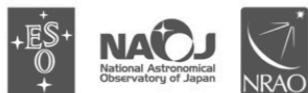
OT is still under construction

- * If you are a novice OT user you should start with the **OT Quickstart Guide**, which takes you through the basic steps of ALMA proposal preparation.

Doc 1.10, V2 | June, 2012

ALMA Observing Tool Quickstart Guide

Suzanna Randall, Evanthia Hatziminaoglou & Daniel Espada



www.almascience.org

ALMA, an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile.



Observing Tool – documentation

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- * Audio-visual illustrations of different aspects of the OT can be found in the **OT video tutorials**. These are recommended for novices and advanced users.
- * More in-depth information on the OT can be found in the **User Manual**, while concise explanations of all fields and menu items in the OT are given in the **Reference Manual**.



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ALMA helpdesk

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- * expect an answer within 2 working days.



ALMA helpdesk



Atacama Large Millimeter/submillimeter Array
In search of our Cosmic Origins

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ALMA helpdesk – Knowledgebase



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Live Chat Software by Kayako

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Knowledgebase

- General ALMA Queries (13)**
 - Can I submit a ticket in Japanese?
 - How close can ALMA observe to the Sun?
- Early Science - Cycle 1 (31)**
 - Can I use "breakpoints" in ALMA cycle 1?
 - The Cycle 1 Technical Handbook has some gaps in its discussion of ALMA receivers (SSB, 2SB, DSB). What else can you tell me about them?
- Resources & Observer Support (12)**
 - How do I arrange a visit to one of the ARCs?
 - Where can I find ALMA documentation and manuals?
- Project Planning (14)**
 - What should I include for the content of the Technical Justification and in what format should I submit it?
 - Where can I find the online ALMA observing simulator developed by the University of Manchester?
- ALMA Observing Tool (OT) (29)**
 - What do I do if I can't get the OT to work?
 - How do I deal with targets with unspecified coordinates in the OT?
- Proposal Handling (5)**
 - May I submit an identical proposal to more than one category, e.g. submitting a proposal on distant galaxies both to cosmology and to galaxy categories?
 - Which category should I submit a proposal on distant galaxies: "cosmology/high-z" or "Galaxies/Nuclei"?
- Archive & Data Retrieval (4)**
 - What observations will be taken in Science Verification, and when will the data become available? Will new SV targets be added before my Cycle 0 proposal is reviewed?
 - Will re-reduction improve the Cycle 0 data products provided by the archive?
- Offline Data Reduction and/or CASA (14)**
 - Where can I find data reduction tutorials and recipes using CASA?
 - Can I reduce ALMA data in software packages other than CASA, and is there support for that?
- Development Program (1)**
 - Where can I find responses to technical inquiries regarding the first North American Call for Studies of Proposed Development Upgrades for ALMA?

Are the water vapor measurements for the individual antennas, and the weather st...
Water vapor radiometer (WVR) measurements for the individual 12-m antennas are stored as part of the ASDM. (The 7m antennas are not equipped with WVRs.) The measurements are usually stored in spectral windows 1 to N of the ASDM, where N is the number o...




Splatalogue

Splatalogue is a database for astronomical spectroscopy. Users can search for atomic and molecular transitions lines using several different search parameters such as name, transition, frequency range, energy range, line strength, etc. The Splatalogue is maintained by NRAO.

Basic Advanced Expert

Quick Picker

<input type="checkbox"/> CO $v=0$	<input type="checkbox"/> $^{13}\text{CO } v=0$
<input type="checkbox"/> C ^{17}O	<input type="checkbox"/> C ^{18}O
<input type="checkbox"/> CH $_3\text{OH } v_t=0$	<input type="checkbox"/> H $_2\text{CO}$
<input type="checkbox"/> HCN $v=0$	<input type="checkbox"/> HNC $v=0$
<input type="checkbox"/> H $^{13}\text{CN } v=0$	<input type="checkbox"/> HC $^{15}\text{N } v=0$
<input type="checkbox"/> DCN $v=0$	<input type="checkbox"/> HCO $^+ v=0$
<input type="checkbox"/> CS	<input type="checkbox"/> H $^{13}\text{CO}^+$
<input type="checkbox"/> NH $_3$	<input type="checkbox"/> C I
<input type="checkbox"/> C II	<input type="checkbox"/> O I
<input type="checkbox"/> O III	<input type="checkbox"/> N II
<input type="checkbox"/> H $_2\text{O } v=0$	<input type="checkbox"/> HDO
<input type="checkbox"/> SiO $v=0$	



Search:

Telescope Bands:
ALMA Band 3 (84-116 GHz)
ALMA Band 4 (125-163 GHz)


Redshift:

Energy Range: Min Max E $_L$ (cm $^{-1}$) E $_L$ (K)

Frequency Range: Min Max Frequency Unit:

Astronomical Filters

- Top 20 list
- Planetary Atmosphere
- Hot Cores
- Dark Clouds
- Diffuse Clouds
- Comets
- AGB/PPN/PN
- Extragalactic



Scan to Mobile Splat






ALMA Observation Support Tool (OST)

The ALMA OST simulates ALMA observations. Users submit jobs to the OST via a standard web interface. They specify the parameters of an observation and either supply an arbitrary source model (by uploading a FITS image) or selecting a model from the pre-existing library. When the simulation is complete, the user receives by automated e-mail an hyperlink to a web page containing a simulated image, and some other information and figures. The OST is maintained by the EU ARC node in Manchester (UK) and at ESO



ALMA Observation Support Tool (OST)

Version 1.2 (ALMA Cycle 1)

[Queue Status](#) • [Help](#) • [ALMA Helpdesk](#)
[OST Latest News](#)

Array	Instrument	ALMA	
Sky Setup	Source model	OST Library: Central point source	Choose a library source model or supply your own
	Upload a FITS file	<input type="text"/> Browse...	You may upload your own model here (max 10MB)
	Declination	-35d00m00.0s	Ensure correct formatting of this string (+/-00d00m00.0s)
	Image peak / point flux in mJy	0.0	Set to 0.0 for no rescaling of source model
Observation Setup	Central frequency in GHz	90	The value entered must be within an ALMA band
	Bandwidth in MHz	32	Use broad for continuum, narrow for single channel
	Required resolution in arcseconds	1.0	OST will choose config if instrument is set to ALMA
	Pointing strategy	Mosaic	Selecting single will apply primary beam attenuation
	Start hour angle	0.0	Deviation of start of observation from transit
	Phase Cycle in seconds	0.0	The length of time between cutting to a phase calibrator (currently limited to either 0s or between 300s and 600s)
	On Phase Calibrator in seconds	0.0	The length of time spent observing phase calibrator (currently limited to either 0s or between 30s and 600s)
	On-source time in hours	3	Per pointing for Mosaics.
	Number of visits	1	How many times the observation is repeated
	Number of polarizations	2	This affects the noise in the final map
Corruption	Atmospheric conditions	PWV = 0.472 mm (1st Octile)	Determines level of noise due to water vapour
Imaging	Imaging weights	Natural	This allows a resolution / sensitivity trade-off
	Perform deconvolution?	No (Return dirty image)	Apply the CLEAN algorithm to deconvolve the image
	Output image format	FITS	CASA format images are returned as a tar file
	Your email address is	essential!	<input type="button" value="Submit"/>



Other useful tools for ALMA

ALMA Sensitivity Calculator

The ALMA Sensitivity Calculator (ASC) will calculate the necessary integration times for a given sensitivity, or vice versa, for your ALMA observing project.

<http://www.eso.org/sci/facilities/alma/observing/tools/etc/index.html>

Atmospheric Transmission at Chajnantor

This tool allows the user to model the atmospheric transmission as a function of frequency and amount of precipitable water vapor. The output is a plot of the transmission fraction. Up to six different amounts of water content can be selected.

<http://almascience.eso.org/about-alma/atmosphere-model>



THANK YOU

