



EUROPEAN ARC
ALMA Regional Centre || IRAM



ALMA imaging simulators

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ALMA imaging simulators

- CASA **simdata** task
 - CASA task using tool tool
- Observation Support Tool (**OST**)
 - Web-based interface using CASA tool tool

Using same
engines but with
different scripts
& interfaces

- **GILDAS** imaging simulator
 - Using GILDAS/MAPPING
 - Not an official ALMA software

simdata

```
CASA <5>: inp
-----> inp()

# simdata :: mosaic simulation task:
project      = 'sim'      # root for output file names
modifymodel  = False     # modify model image
skymodel     = '$project.skymodel' # model image to observe or modify

setpointings =
  integration = True      # integration (sampling) time
  direction   = '10s'     # "J2000 19h00m00 -40d00m00" or "" to center on model
  mapsize     = ['1arcmin', '1arcmin'] # angular size of map or "" to cover model
  maptype     = 'hexagonal' # hexagonal, square, etc
  pointingspacing = '1arcmin' # spacing in between pointings or "" for 0.5 PB

predict      =
  complete    = True     # calculate visibilities using ptgfile
  bandwidth   = '2GHz'   # optional componentlist to observe with skymodel
  antennalist = 'alma.out10.cfg' # optional bandwidth if simulating from components only
  refdate     = '2012/05/21/22:05:00' # antenna position file or "" for no interferometric MS
  totaltime   = '7200s'  # time/date of observation *see help
  caldirection = '1Jy'   # total time of observation
  calflux      = '1Jy'   # pt source calibrator [experimental]
  sdantlist    = ''      # single dish antenna position file or "" for no total power MS
  sdant        = 0       # single dish antenna index in file

thermalnoise =
  leakage      = ''      # add thermal noise: [tsys-atmtsys-manual|'']
  image        = 0.0     # cross polarization
  analyze      = False   # (re)image $project.ms to $project.image
  graphics     = False   # (only first 6 selected outputs will be displayed)
  verbose      = 'screen' # display graphics at each stage to [screen|file|both|none]
  overwrite    = False   # overwrite files starting with $project
  async        = False   # If true the taskname must be started using simdata(...)

CASA <6>: 
```

simdata

Simulating Observations in CASA 3.1 – CASA Guides

ADS astro-ph ESO-ERP ESO Phoenelist ARC TWiki ARC internal TWiki ALMA Science IPT ALMA Sim Library SciOpsWiki SERVVS casa/osx_distro DesignDocuSummary ESO Science Wiki

http://casaguides.nrao.edu/index.php?title=Simulating_Observations_in_CASA_3.1

Google

Log in

page discussion view source history

Simulating Observations in CASA 3.1

Navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go Search

toolbox

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link

Contents [hide]

- 1 Introduction
- 2 Steps to simulation
- 3 Tutorials, Recipes, and Example images
- 4 Technical and Planning

Introduction

Simulation capability in CASA follows the usual two-layered structure: there is a beginner-level python task interface called `simdata`, which calls methods in the `sm C++ tool1`. The task interface turns a model of the sky (2 to 4 dimensions including frequency and Stokes) into the visibilities that would be measured with ALMA, (E)VLBA, CARMA, SMA, ATCA, PoB, etc. The task also can produce a cleaned image of the model visibilities, compare that image with your input convolved with the synthesized beam, and calculate a fidelity image. `simdata` can add thermal noise (from receiver, atmosphere, and ground) to the visibilities.

NOTE FOR ALMA OBSERVERS: the receiver temperatures in bands 6, 7 and 9, and the sideband gain in band 9 have recently been revised in the ALMA sensitivity calculator. These revisions are not in the current version of `simdata`. Thus, the sensitivities in these bands measured from `simdata` outputs will be incorrect. (We expect the 3.2 version of CASA will contain the corrected values.) In general, because the ALMA sensitivity calculator will be used for the technical assessment of ALMA proposals, only values from it should be used to estimate exposure times in ALMA proposals.

The `sm tool` has methods that can be used to add phase delay variations, gain fluctuations and drift, cross-polarization, and (coming soon) bandpass and pointing errors to your simulated data. `sm` also has more flexibility in adding thermal noise than `simdata`, for example for new observatories that are unknown to `simdata`.

New for CASA version 3.1.0: The `simdata` task is the task formerly known in 3.0.2 as `simdat-a2`. The old version of `simdata` has been removed.

CASA simulation uses the `aatm` atmospheric model, a thin wrapper of Juan Pardo's `ATM` library, to accurately calculate all atmospheric corruption terms (noise, phase delay) accurately as a function of frequency and site characteristics.

Part of CASA's simulation routines are generic ephemeris and geodesy calculations available in python - see `simutil.py`.

Note on cleaning: just as is the case for real images, cleaning images produced by `simdata` can lead to a spurious decrease in object fluxes and noise on the image ("clean bias"), particularly for Early Science configurations, where the dynamic range of the beam is low. Users should always clean images with care, using a small number of iterations and/or a conservative (3-5-sigma) threshold, and boxing bright sources.

Because `simdata` is still actively being developed, documentation may lag reality, please email `rindebet@nrao.edu` with any questions - It's my job to help you use this software. In particular, you may find that some of the presentations and graphics below show parameter inputs that are slightly different from the latest version of CASA.

Steps to simulation

Users of the most recent version of CASA, 3.1.0 and later should use `simdata`. If you are using CASA 3.0.2, you should use `simdata2`.

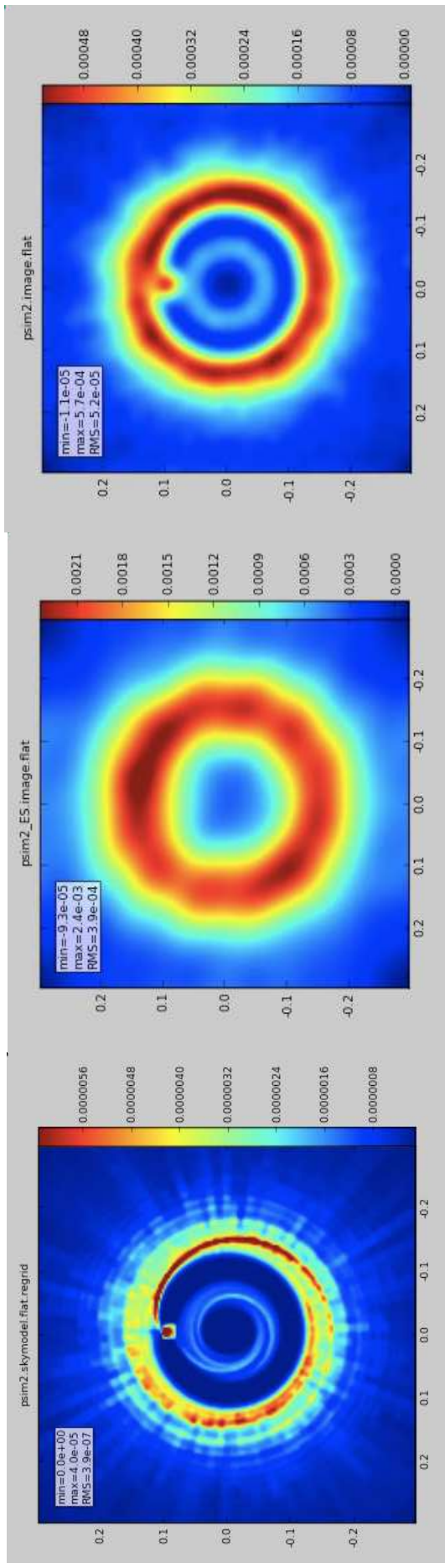
simdata (named simata2 in CASA 3.0.2) Obtaining CASA [g](#)

1. Install CASA

Done



simdata



Model – from
Wolf & D’Angelo
2005

Band 9 Early
Science (30 min)

Band 9 Full
ALMA (10 min)

... NO NOISE ...

OST

ALMA observation support tool

ADS astro-ph ESO ESO-ERP ESO Phoenicist ARC TWiki ARC internal TWiki ALMA Science IPT ALMASW ALMA Sim Library SciOpsWiki SERVVS casa/osx_distro DesignDocuSummary

http://almaost.jb.man.ac.uk/

Google

ALMA Observation Support Tool

ALMA

Queue Status • Help

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

You may upload your own model here (max 5MB)

Browse...

Declination

-35d00m00.0s

Ensure correct formatting of this string

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

Single

Selecting single will apply primary beam attenuation

Start hour angle

0.0

Deviation of start of observation from transit

On-source time in hours

3

Maximum duration is 24 hours

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

Good (PWV = 0.5 mm)

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

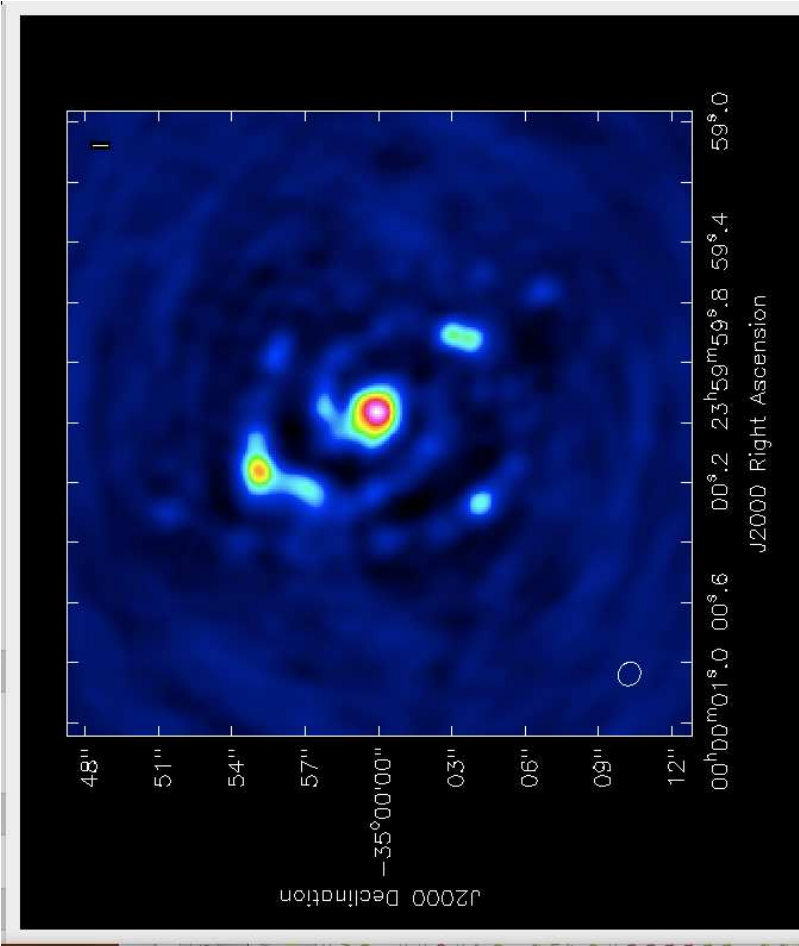
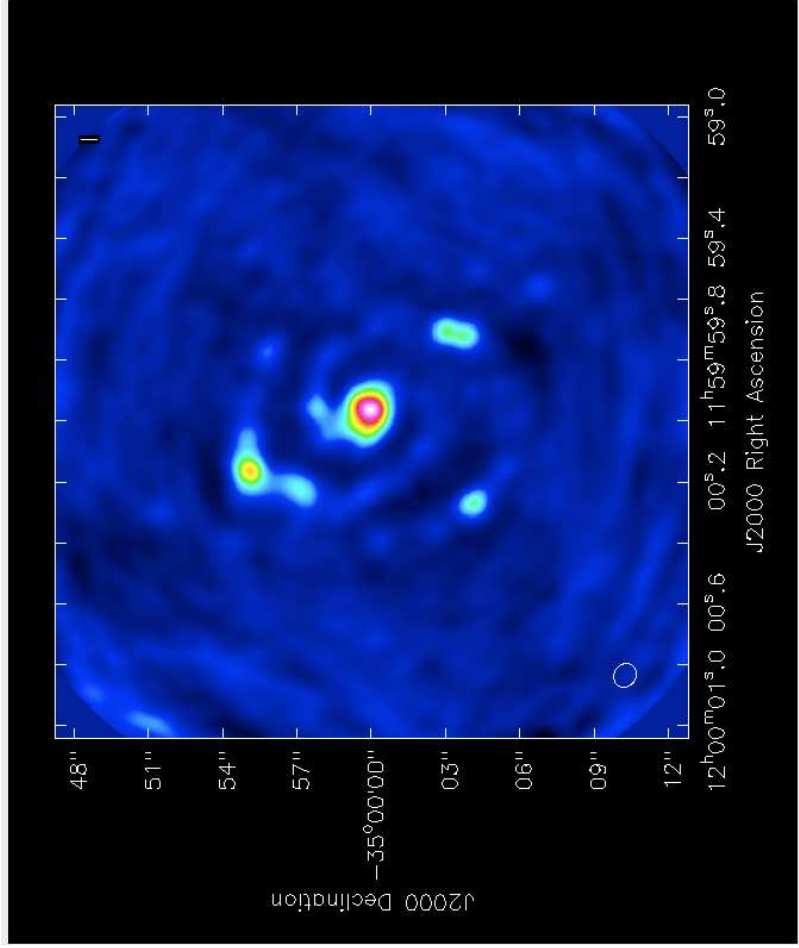
essential!

Submit

Done

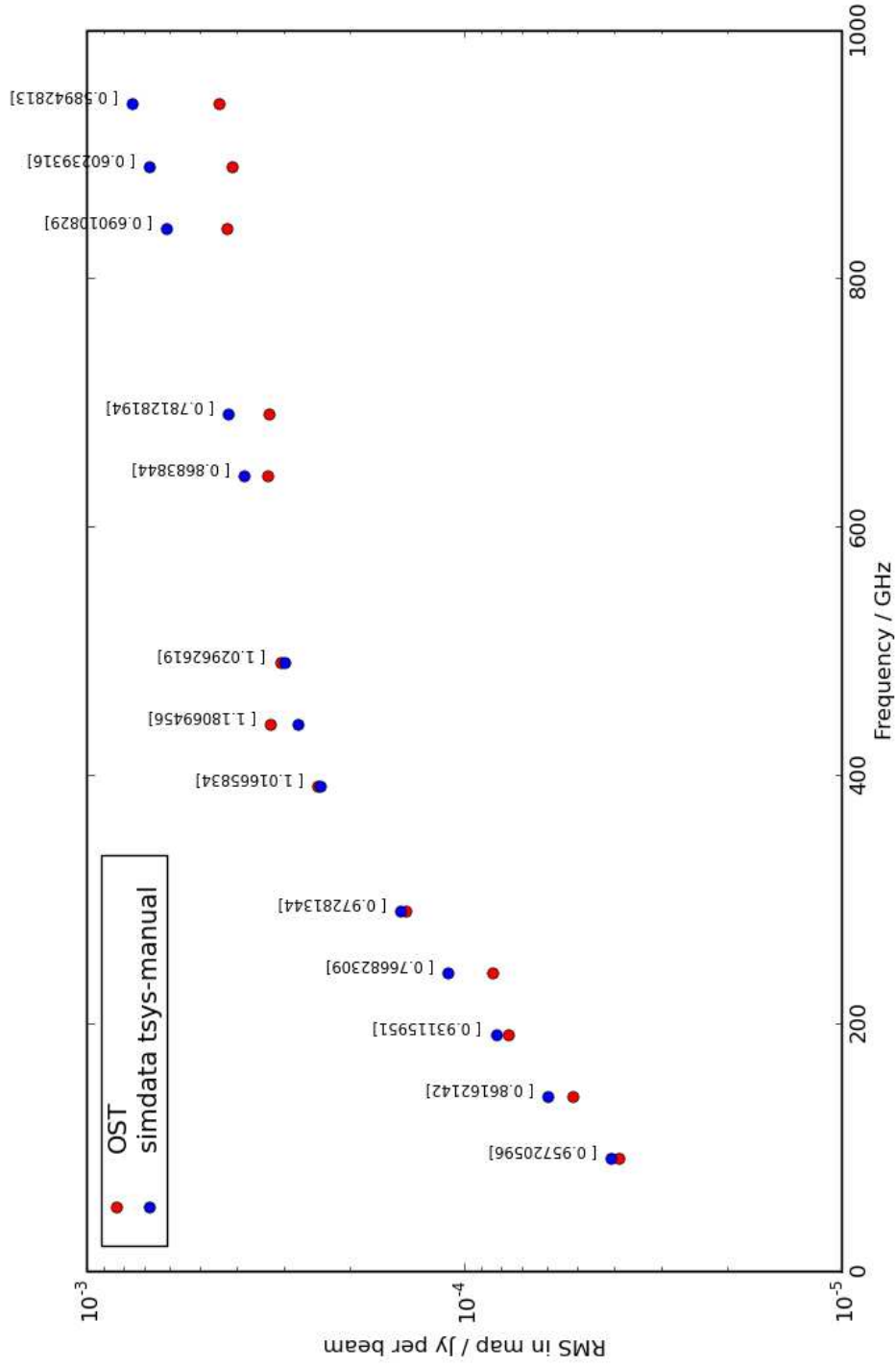


Simdata vs OST





Simdata vs OST





GILDAS simulator

Disributed with GILDAS.
Documented in ALMA memo 398 (Pety, Gueth, Guilloteau).

ALMA+ACA Simulation (email: alma-simulation@iram.fr)					
GO	ABORT	HELP			
LOAD		COMPUTE	COMPARE	DISPLAY	EXPERT
Input model file		/users/softs/gildas/gildas/gildas-exe-25nov/demo/w51ha.gdf			File
Output directory name					File
Simulation kind		ALMA only			Choices
Observation Setup	SHOW SOURCE	Parameters	Help		
Configuration Setup	SHOW CONF	Parameters	Help		
Pointing Errors	SHOW POINT	Parameters	Help		
Amplitude conditions	SHOW AMP	Parameters	Help		
Phase conditions	SHOW PHASE	Parameters	Help		
Deconvolution setup	COMPUTE	Parameters	Help		
Display results	DISPLAY	Parameters	Help		
Expert setup	EXPERT	Parameters	Help		
File location	SETUP	Parameters	Help		

ACTIONS

ALMA+ACA Simul... ion@iram.fr

GO ABORT

LOAD COMPUTE COMPARE DISPLAY EXPERT HELP

Input model file /Users/softs/gildas/gildas-exe-25nov/demo/m51ha.gdf File

Output directory name ↕ File

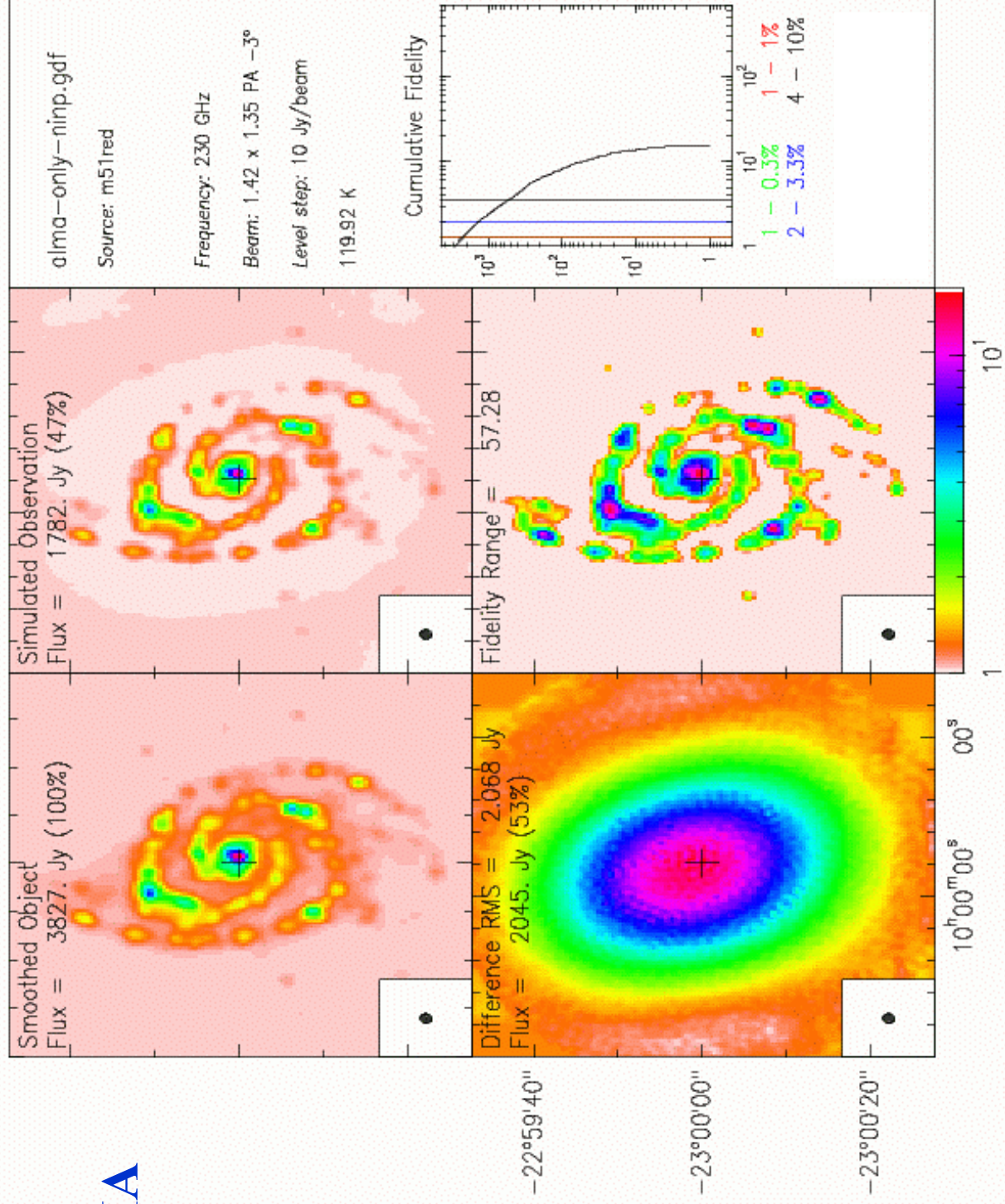
Simulation kind ALMA only Choices

Observation Setup	SHOW SOURCE	Parameters	Help
Configuration Setup	SHOW CONF	Parameters	Help
Pointing Errors	SHOW POINT	Parameters	Help
Amplitude conditions	SHOW AMP	Parameters	Help
Phase conditions	SHOW PHASE	Parameters	Help
Deconvolution setup	COMPUTE	Parameters	Help
Display results	DISPLAY	Parameters	Help
Expert setup	EXPERT	Parameters	Help
File location	SETUP	Parameters	Help

GLOBAL INPUT PARAMETERS

DETAILED INPUT PARAMETERS

ALMA



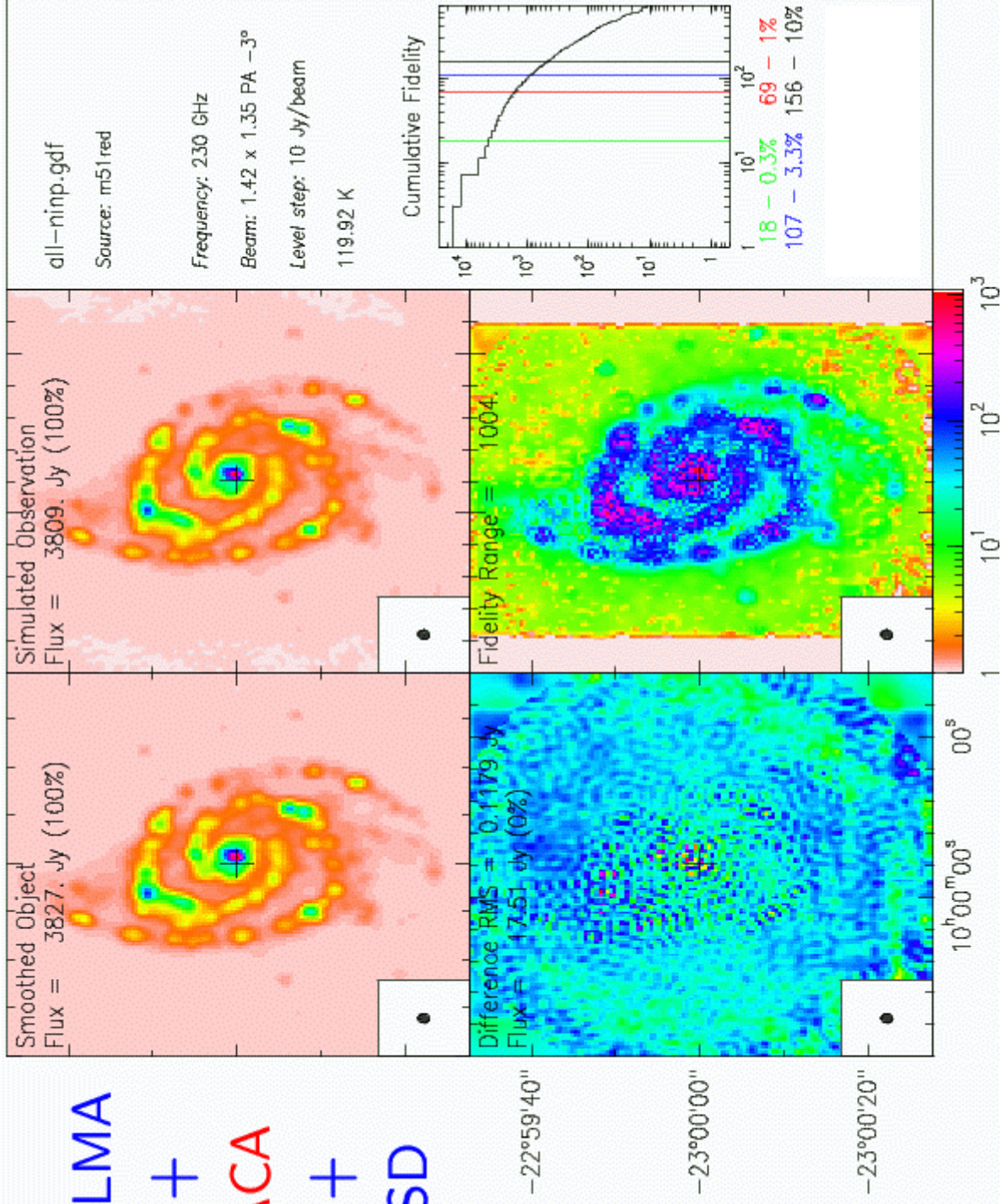
ALMA

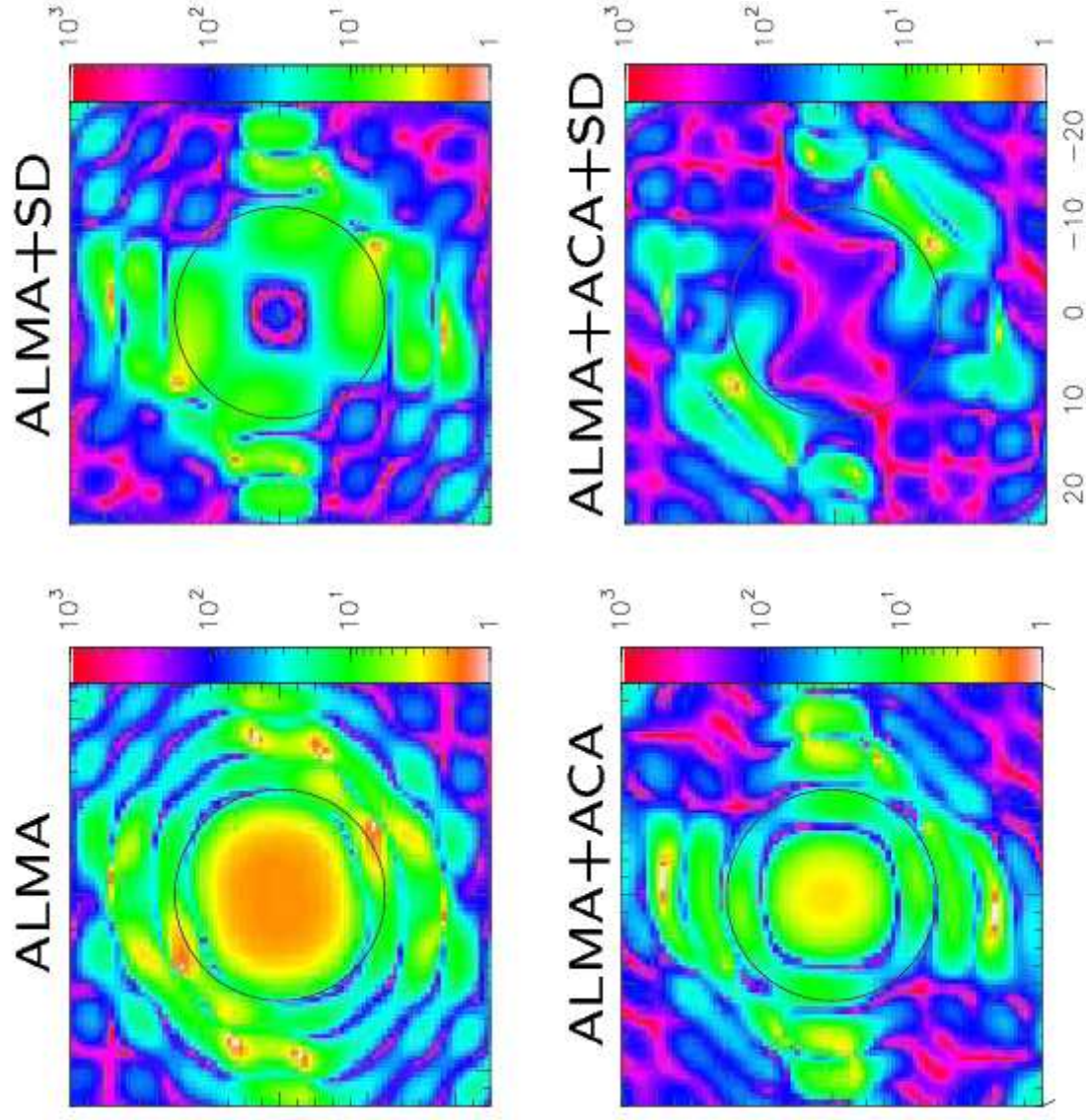
+

ACA

+

SD



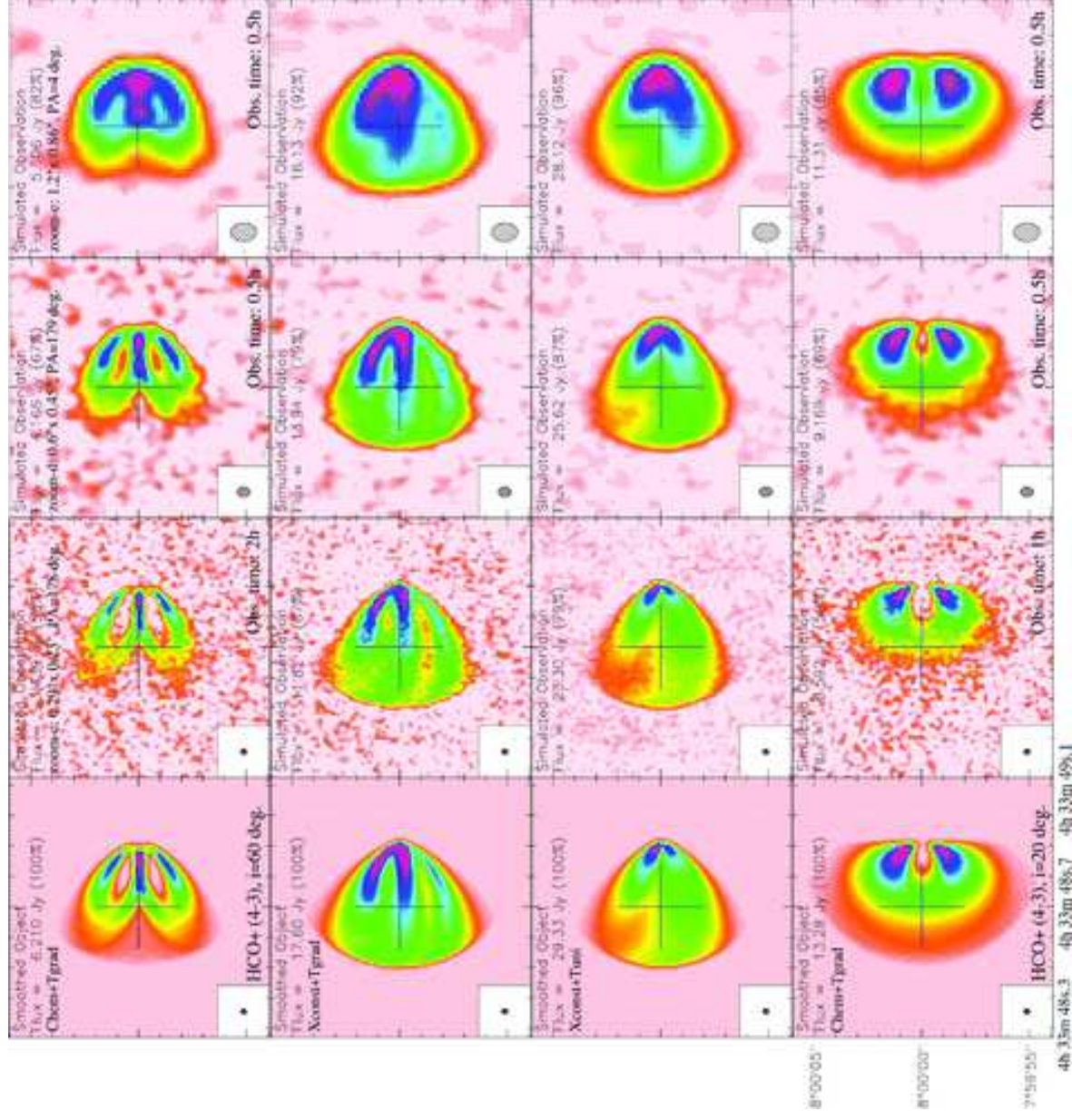


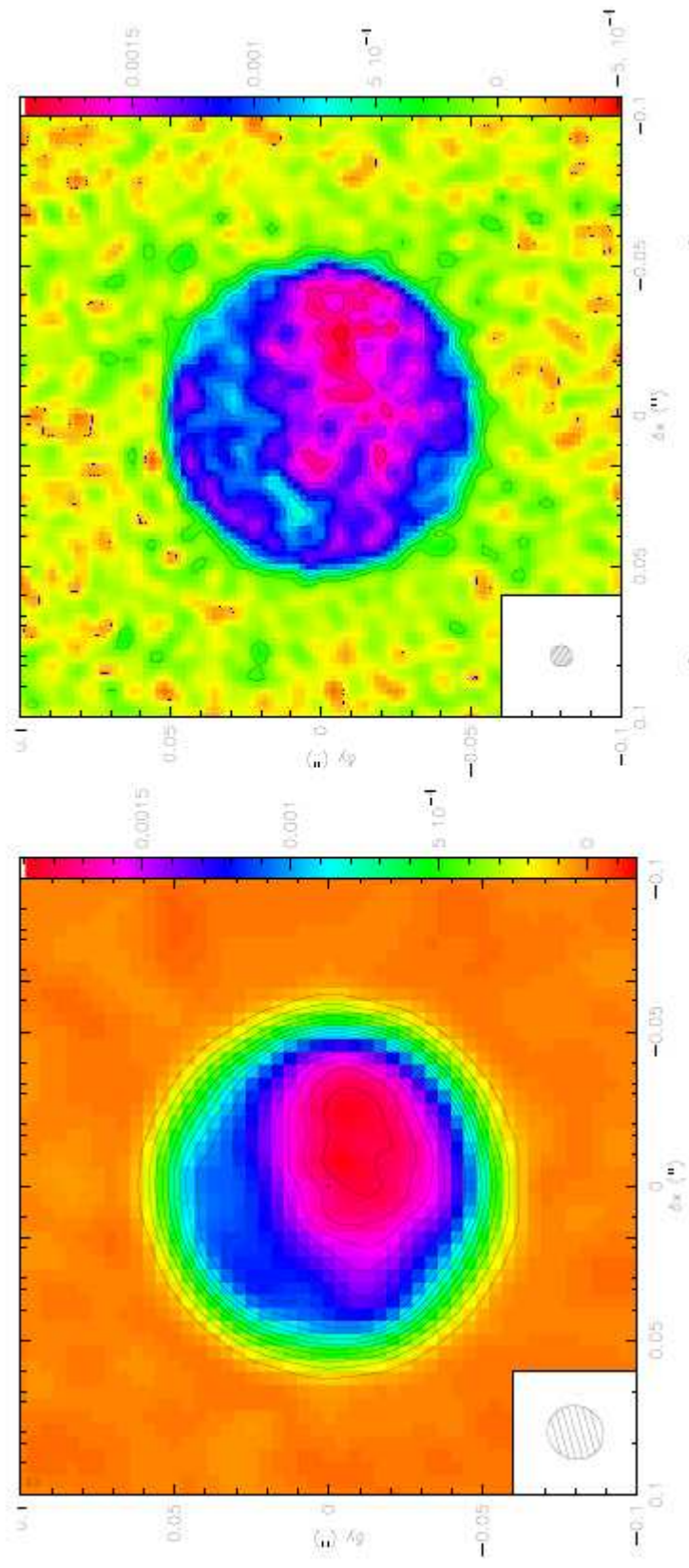
Fidelities in the uv plane

**HCO+(4-3) in
protoplanetary disk
(Semenov et al. 2008)**

Rows: 4 chemical models

Column: model + 3
simulations
(configurations and/or
observing time)





Pluto at 345 and 850 GHz – 10 km baselines (Mouillet et al. 2011)



Conclusions

- OST
 - simple web-based interface
 - **to test/plan observations**
- Simdata & GILDAS
 - more complex
 - scriptable
 - **to make more detailed studies**
- **Always keep a critical eye on these simulations!**