OBSERVATION SIMULATIONS

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PORTUGUESE ALMA COMMUNITY DAY 2015

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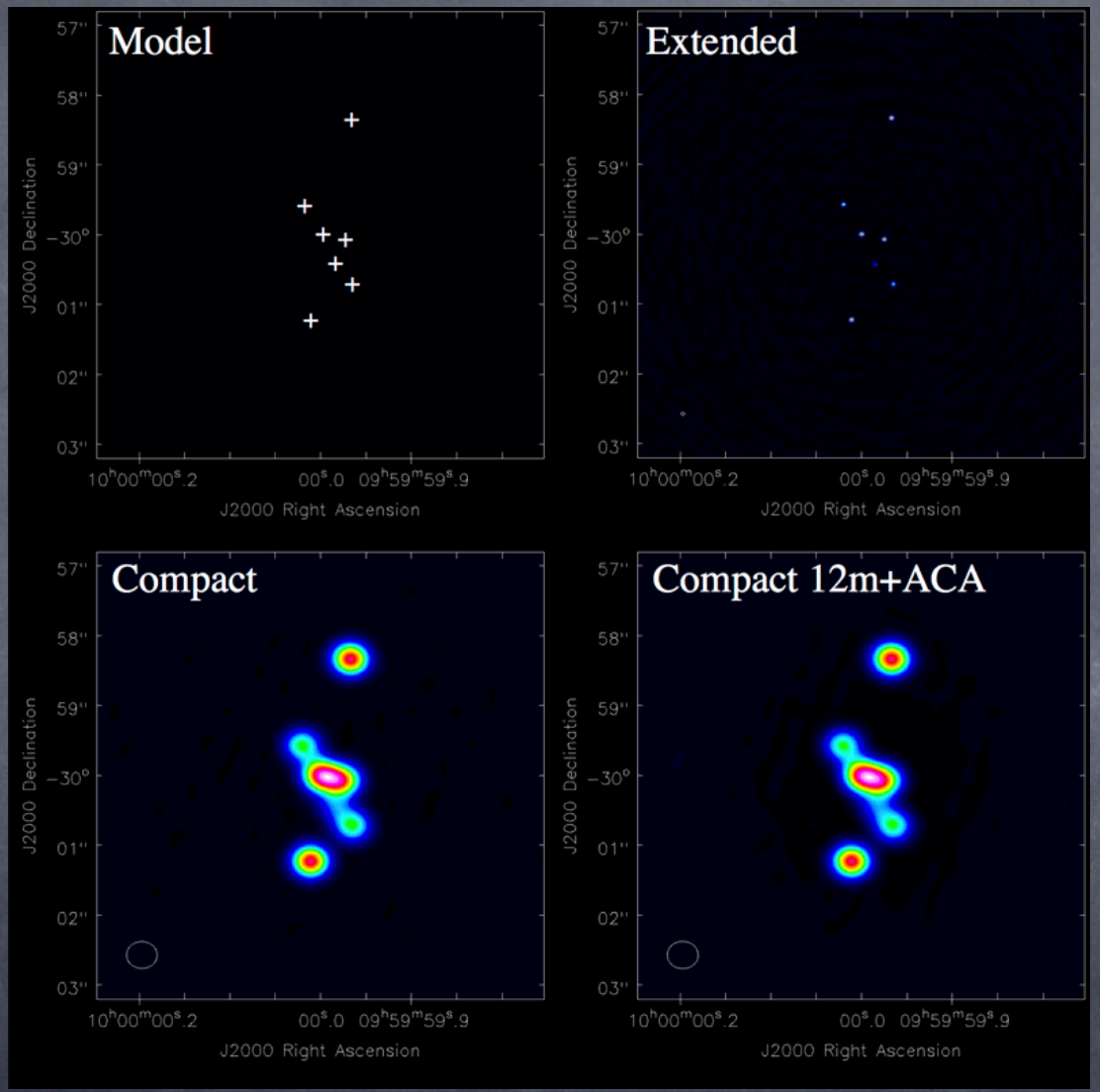
instituto de astrofísica
e ciências do espaço

WHY SIMULATE?

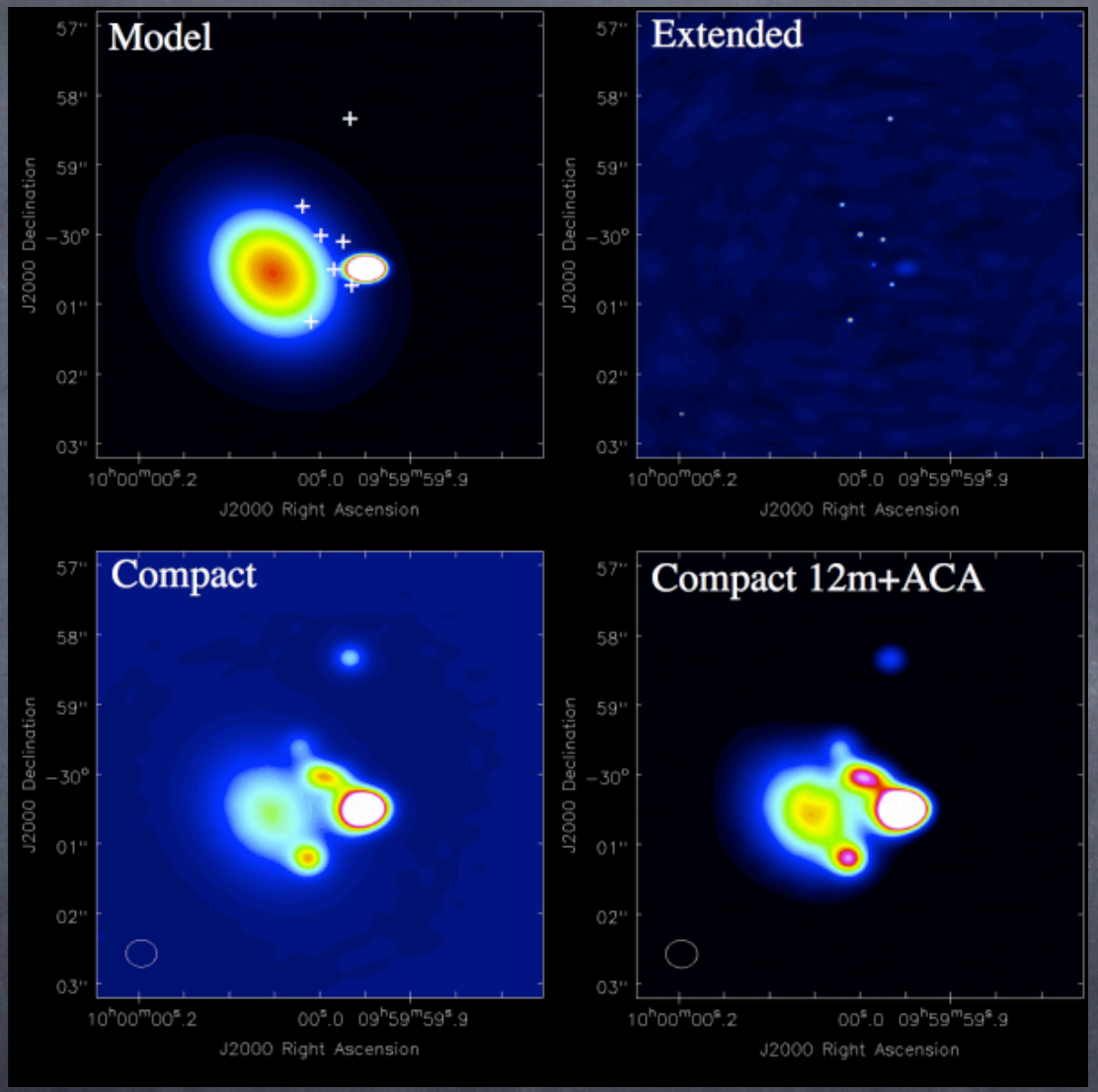
- UNDERSTAND HOW AN INTERFEROMETER WORKS
- IDENTIFY BEST CONFIGURATION
- JUSTIFY THE NEED FOR 7M OR TOTAL-POWER ARRAY
- JUSTIFY MORE TIME ON SOURCE
- ...

CASA



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

CASA



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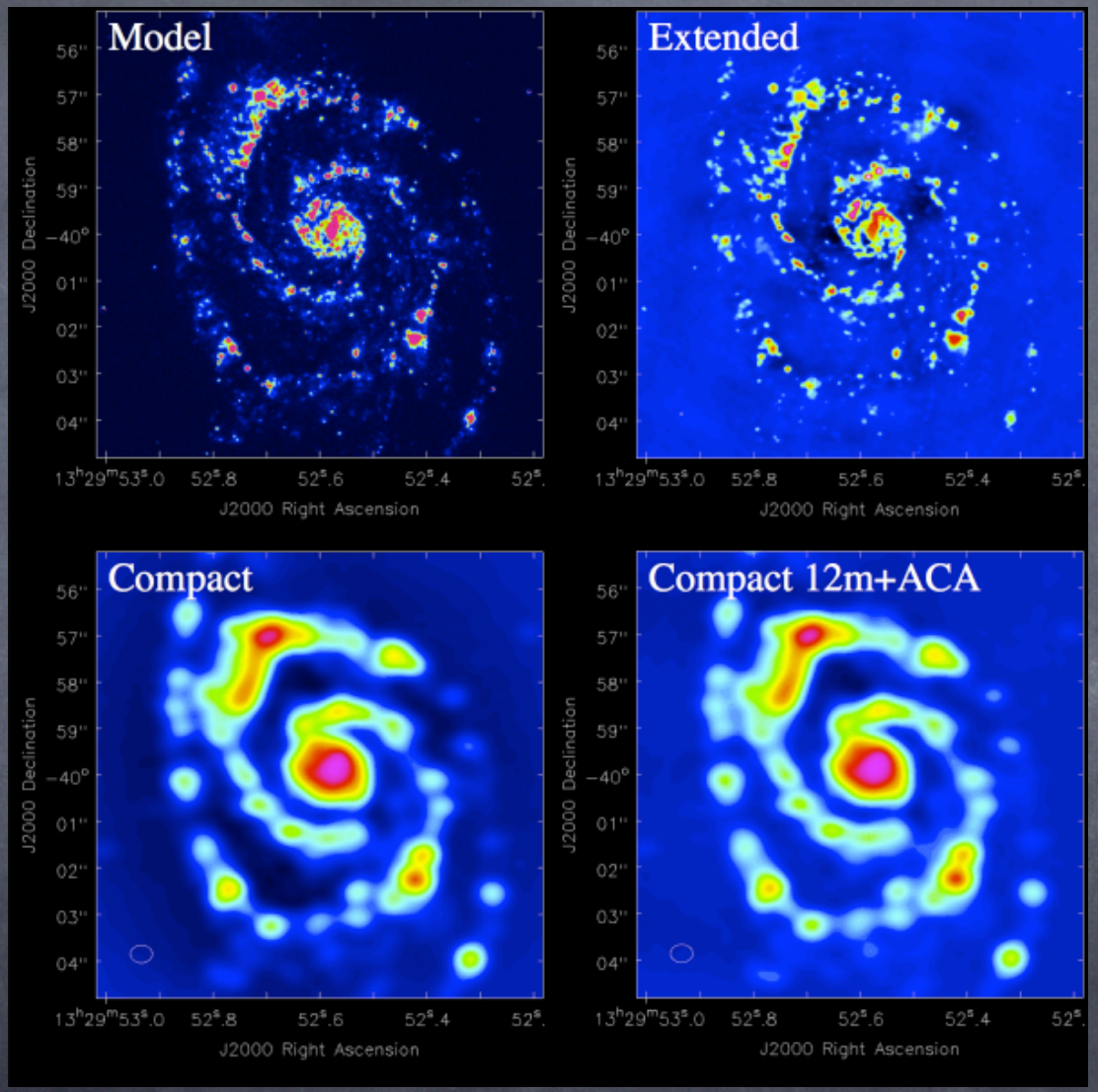
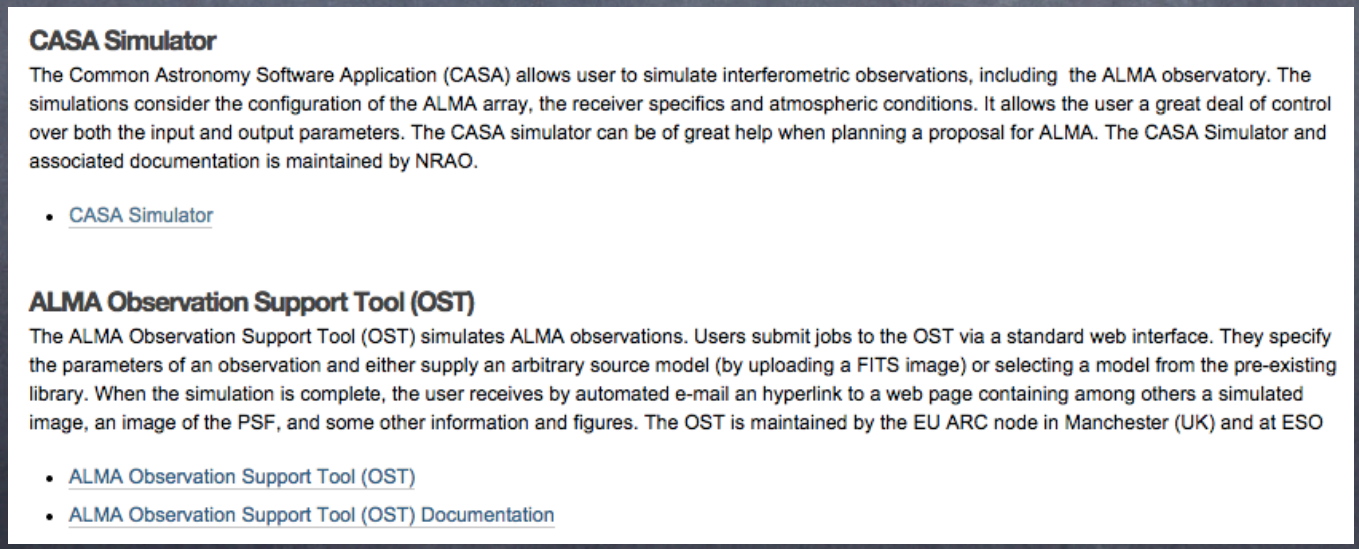


http://casaguides.nrao.edu/index.php?title=Guide_To_Simulating_ALMA_Data

AVAILABLE TOOLS

- CASA - SIMOBSERVE, SIMANALYZE, SIMALMA
- ALMA OBSERVATION SUPPORT TOOL (OST, WEB)
- VIRTUAL RADIO INTERFEROMETER (VRI, WEB)



CASA Simulator

The Common Astronomy Software Application (CASA) allows user to simulate interferometric observations, including the ALMA observatory. The simulations consider the configuration of the ALMA array, the receiver specifics and atmospheric conditions. It allows the user a great deal of control over both the input and output parameters. The CASA simulator can be of great help when planning a proposal for ALMA. The CASA Simulator and associated documentation is maintained by NRAO.

- CASA Simulator

ALMA Observation Support Tool (OST)

The ALMA Observation Support Tool (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 among others a simulated image, an image of the PSF, 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)
- ALMA Observation Support Tool (OST) Documentation

HTTP://ALMASCIENCE.ESO.ORG/DOCUMENTS-AND-TOOLS

CASA

- SIMOBSERVE - SIMULATES THE OBSERVED VISIBILITIES; ALLOWS THE CHANGE OF IMAGE PROPERTIES ON-THE-FLY (PIXEL-SCALE, ...)

```
#  simobserve :: mosaic simulation task
project              =      'sim'        #  root prefix for output file names
skymodel             =        ''         #  model image to observe
complist             =        ''         #  componentlist to observe
setpointings         =       True
     integration     =      '10s'        #  integration (sampling) time
     direction       =        ''         #  "J2000 19h00m00 -40d00m00" or "" to center on model
     mapsize         =   ['', '']        #  angular size of map or "" to cover model
     maptype         =     'ALMA'        #  hexagonal, square (raster), ALMA, etc
     pointingspacing =         ''        #  spacing in between pointings or "0.25PB" or "" for Nyquist

obsmode              =      'int'        #  observation mode to simulate [int(interferometer)|sd(singledish)|""(none)]
     antennalist     = 'alma_cycle1_1.cfg' #  interferometer antenna position file
     refdate         = '2014/05/21'      #  date of observation - not critical unless concatting simulations
     hourangle       =  'transit'        #  hour angle of observation center e.g. -3:00:00, or "transit"
     totaltime       =    '7200s'        #  total time of observation or number of repetitions
     caldirection    =        ''         #  pt source calibrator [experimental]
     calflux         =      '1Jy'

thermalnoise         =        ''         #  add thermal noise: [tsys-atm|tsys-manual|""]
leakage              =       0.0         #  cross polarization (interferometer only)
graphics             =     'both'        #  display graphics at each stage to [screen|file|both|none]
```

CASA

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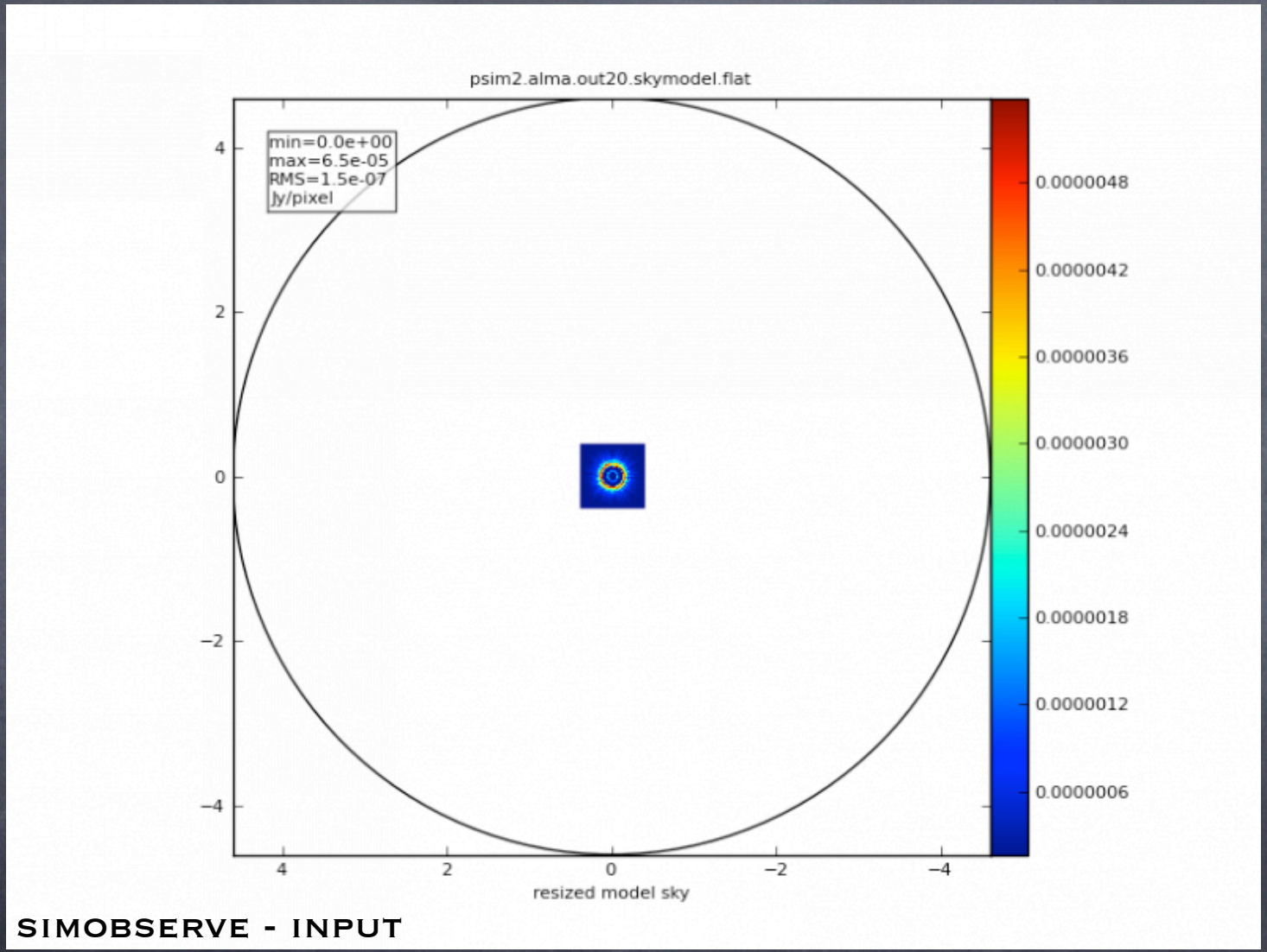
```

<CASADIR>/DATA/ALMA/SIMMOS/
AND DOCS&TOOLS WEBPAGE

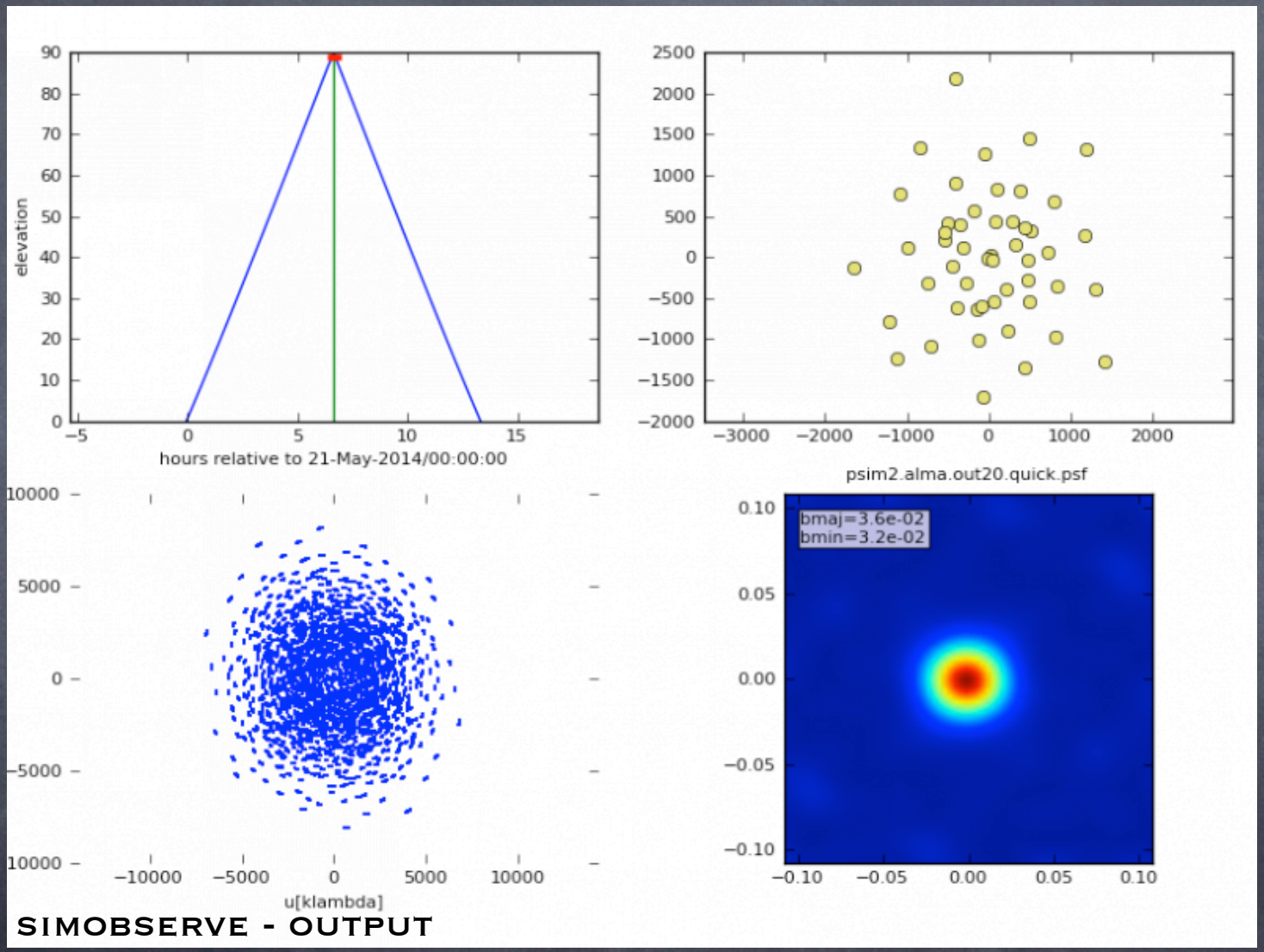
CASA



SIMOBSERVE - INPUT

http://casaguides.nrao.edu/index.php?title=Protoplanetary_Disk_Simulation_(CASA_4.2)

CASA



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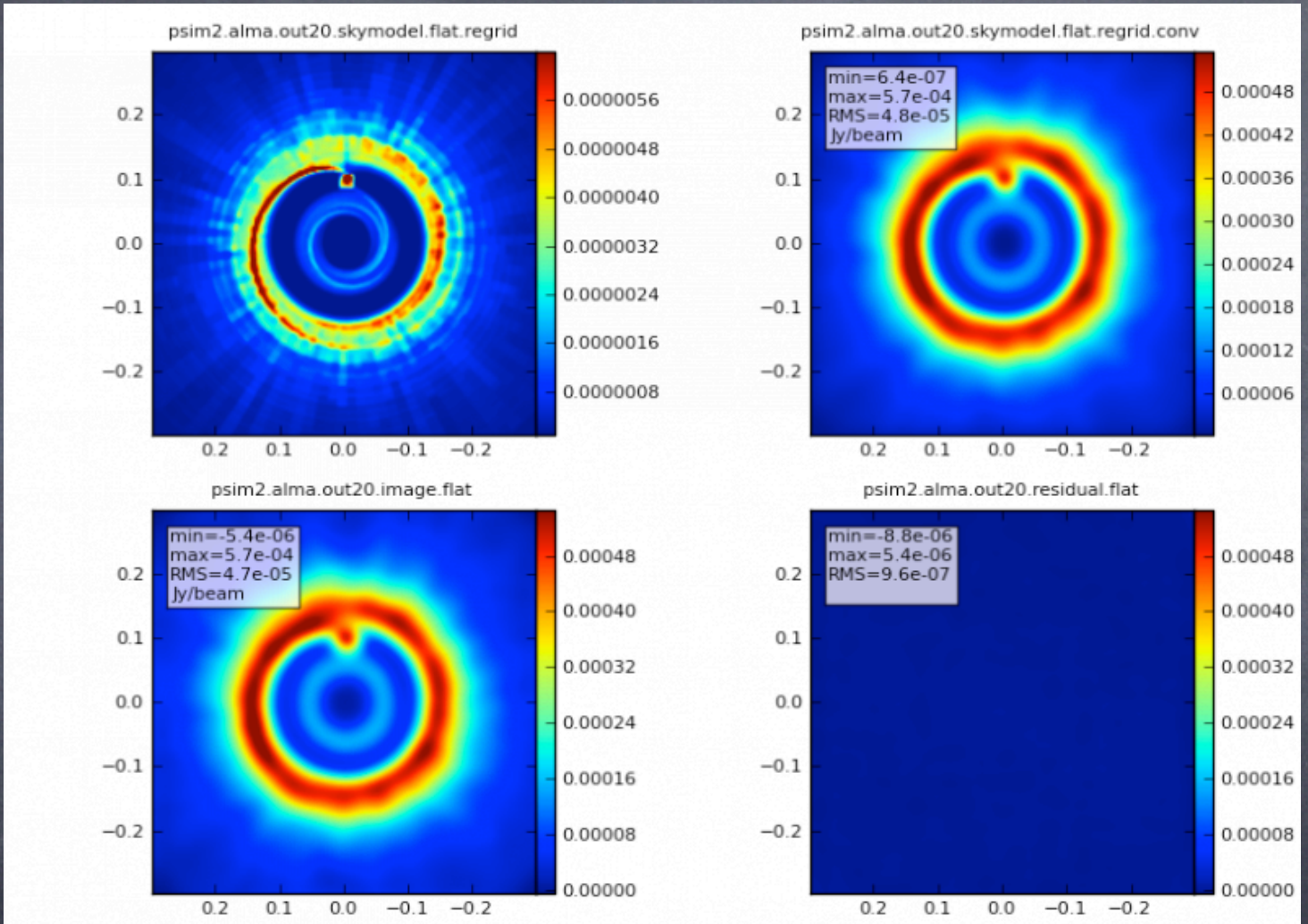
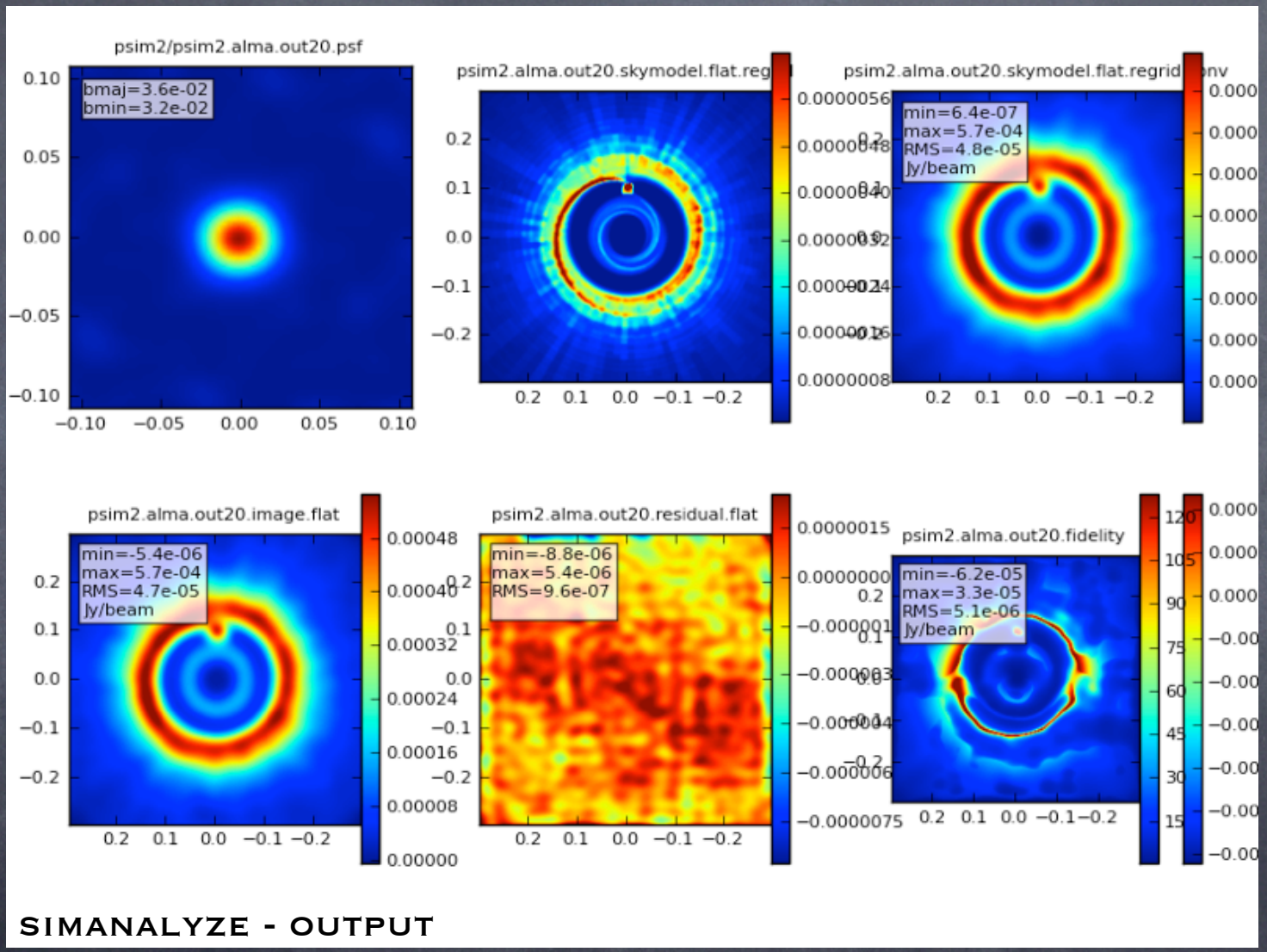
CASA



SIMANALYZE - INPUT

http://casaguides.nrao.edu/index.php?title=Protoplanetary_Disk_Simulation_(CASA_4.2)

CASA



SIMANALYZE - OUTPUT

http://casaguides.nrao.edu/index.php?title=Protoplanetary_Disk_Simulation_(CASA_4.2)

CASA

- SIMANALYZE - IMAGES THE OUTPUT FROM SIMOBSERVE; PROVIDES QUALITY ANALYSIS, SUCH AS IMAGE FIDELITY, |I| / MAX[|I - T|, 0.7RMS].

```
#  simanalyze :: image and analyze simulated datasets
project             =      'sim'        #  root prefix for output file names
image               =       True        #  (re)image $project.*.ms to $project.image
     vis            =  'default'        #  Measurement Set(s) to image
     modelimage     =         ''        #  prior image to use in clean e.g. existing single dish image
     imsize         =          0        #  output image size in pixels (x,y) or 0 to match model
     imdirection    =         ''        #  set output image direction, (otherwise center on the model)
     cell           =         ''        #  cell size with units or "" to equal model
     niter          =        500        #  maximum number of iterations (0 for dirty image)
     threshold      =   '0.1mJy'        #  flux level (+units) to stop cleaning
     weighting      =  'natural'        #  weighting to apply to visibilities
     mask           =         []        #  Cleanbox(es), mask image(s), region(s), or a level
     outertaper     =         []        #  uv-taper on outer baselines in uv-plane
     stokes         =        'I'        #  Stokes params to image

analyze             =      False        #  (only first 6 selected outputs will be displayed)
graphics            =     'both'        #  display graphics at each stage to [screen|file|both|none]
```

CASA

- SIMALMA - ALLOWS SIMULATIONS PUTTING TOGETHER 12M+7M+TP ARRAYS.

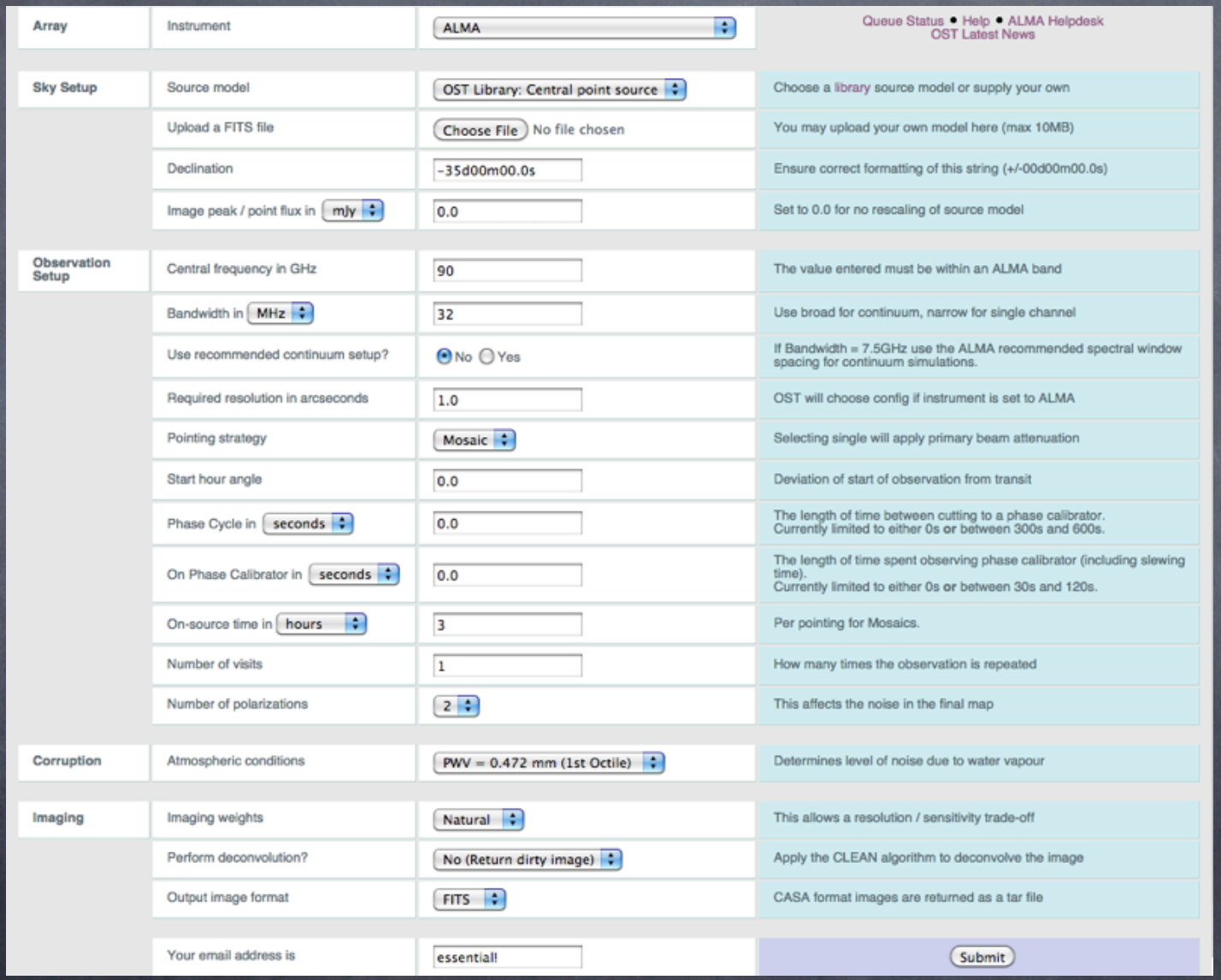
```
#  simalma :: (Experimental) simple simulation task for ALMA
project             =      'sim'        #  root prefix for output file names
skymodel            =        ''         #  model image to observe
complist            =        ''         #  componentlist to observe
setpointings        =      True
     integration    =      '10s'        #  integration (sampling) time
     direction      =        ''         #  "J2000 19h00m00 -40d00m00" or "" to center on model
     mapsize        =    ['', '']       #  angular size of map or "" to cover model

antennalist         = 'alma_cycle1_1.cfg' #  antenna position file of ALMA 12m array
hourangle           =  'transit'        #  hour angle of observation center e.g. -3:00:00, or "transit"
totaltime           =   '7200s'         #  total time of observation or number of repetitions
acaratio            =         0         #  Ratio of the total observation time for ACA in relation to 12-m array or 0 for no ACA
pwv                 =       0.0         #  Precipitable Water Vapor in mm, 0 for noise-free simulation
image               =      True         #  image simulated data
     imsize         =         0         #  output image size in pixels (x,y) or 0 to match model
     imdirection    =        ''         #  set output image direction, (otherwise center on the model)
     cell           =        ''         #  cell size with units or "" to equal model
     niter          =       500         #  maximum number of iterations (0 for dirty image)
     threshold      =   '0.1mJy'        #  flux level (+units) to stop cleaning

graphics            =     'both'        #  display graphics at each stage to [screen|file|both|none]
```

ALMA OST

HTTP://ALMAOST.JB.MAN.AC.UK./

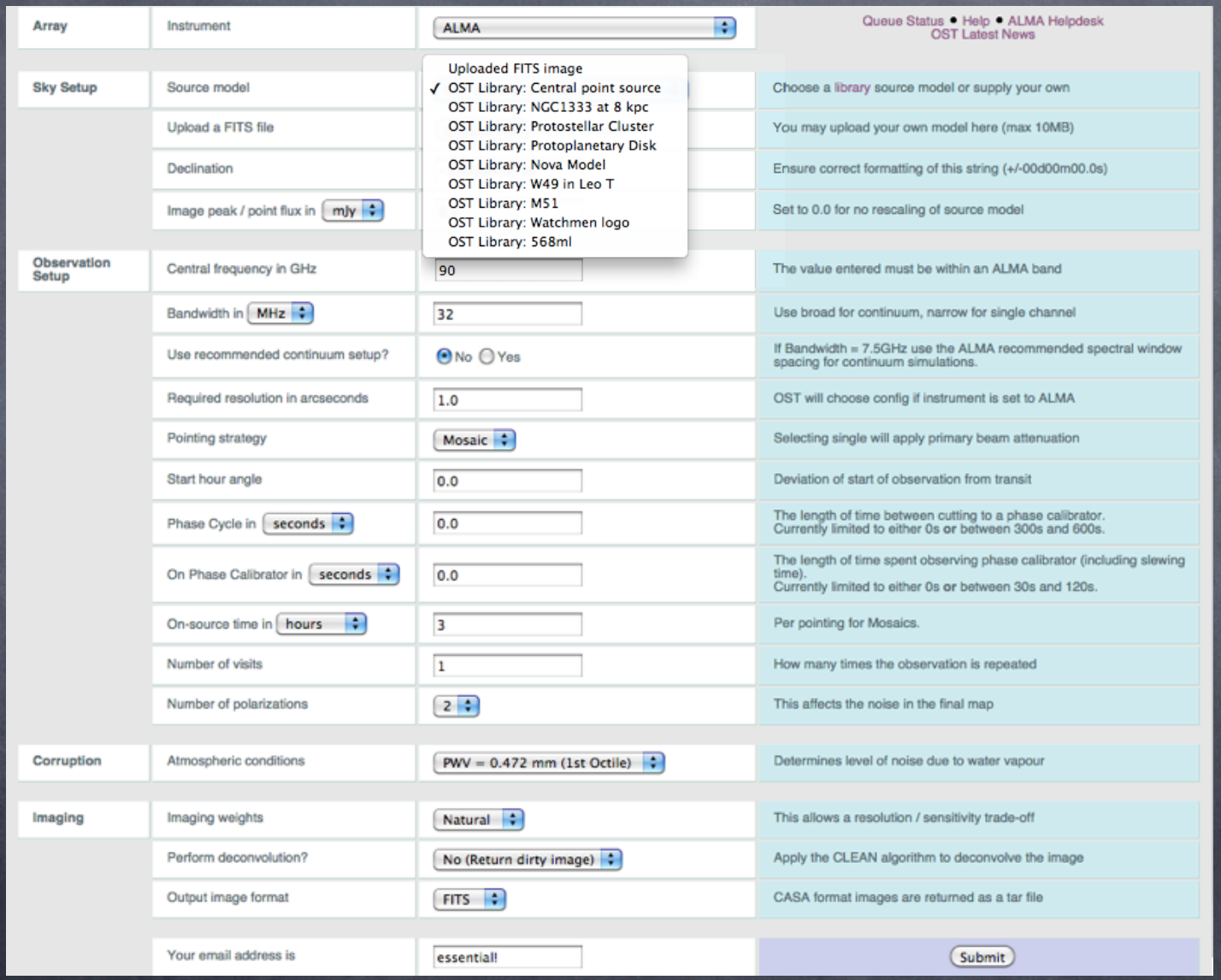


Array	Instrument	ALMA	Queue Status • Help • ALMA Helpdesk OST Latest News
Sky Setup	Source model	OST Library: Central point source	Choose a library source model or supply your own
	Upload a FITS file	Choose File No file chosen	You may upload your own model here (max 10MB)
	Declination	-35d00m00.0s	Ensure 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
	Use recommended continuum setup?	No Yes	If Bandwidth = 7.5GHz use the ALMA recommended spectral window spacing for continuum simulations.
	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 (including slewing time). Currently limited to either 0s or between 30s and 120s.
	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!	Submit

HEYWOOD ET AL. (2011)

ALMA OST

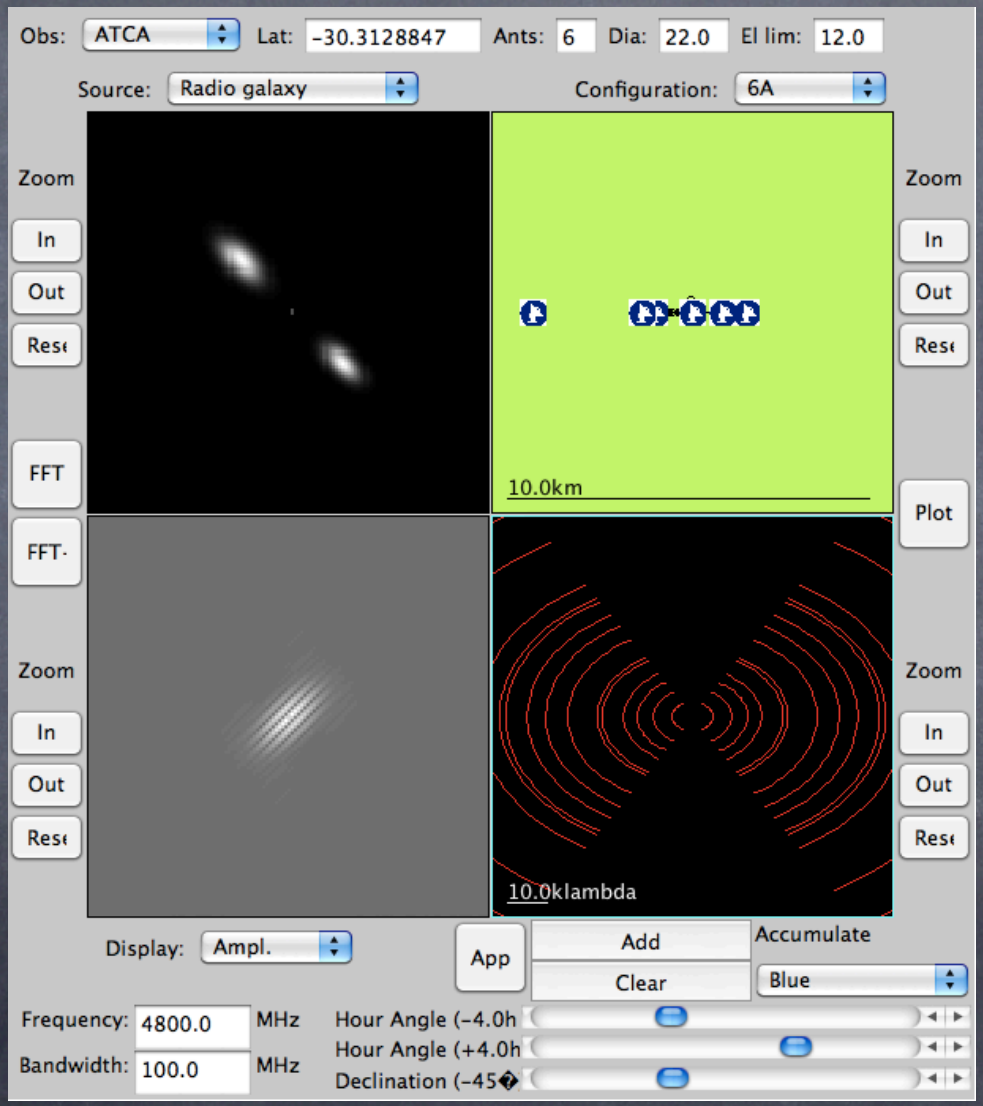
HTTP://ALMAOST.JB.MAN.AC.UK./



HEYWOOD ET AL. (2011)

VIRTUAL RADIO INTERF.

HTTP://WWW.NARRABRI.ATNF.CSIRO.AU/ASTRONOMY/VRI.HTML
HTTP://WWW.JB.MAN.AC.UK/VRI/



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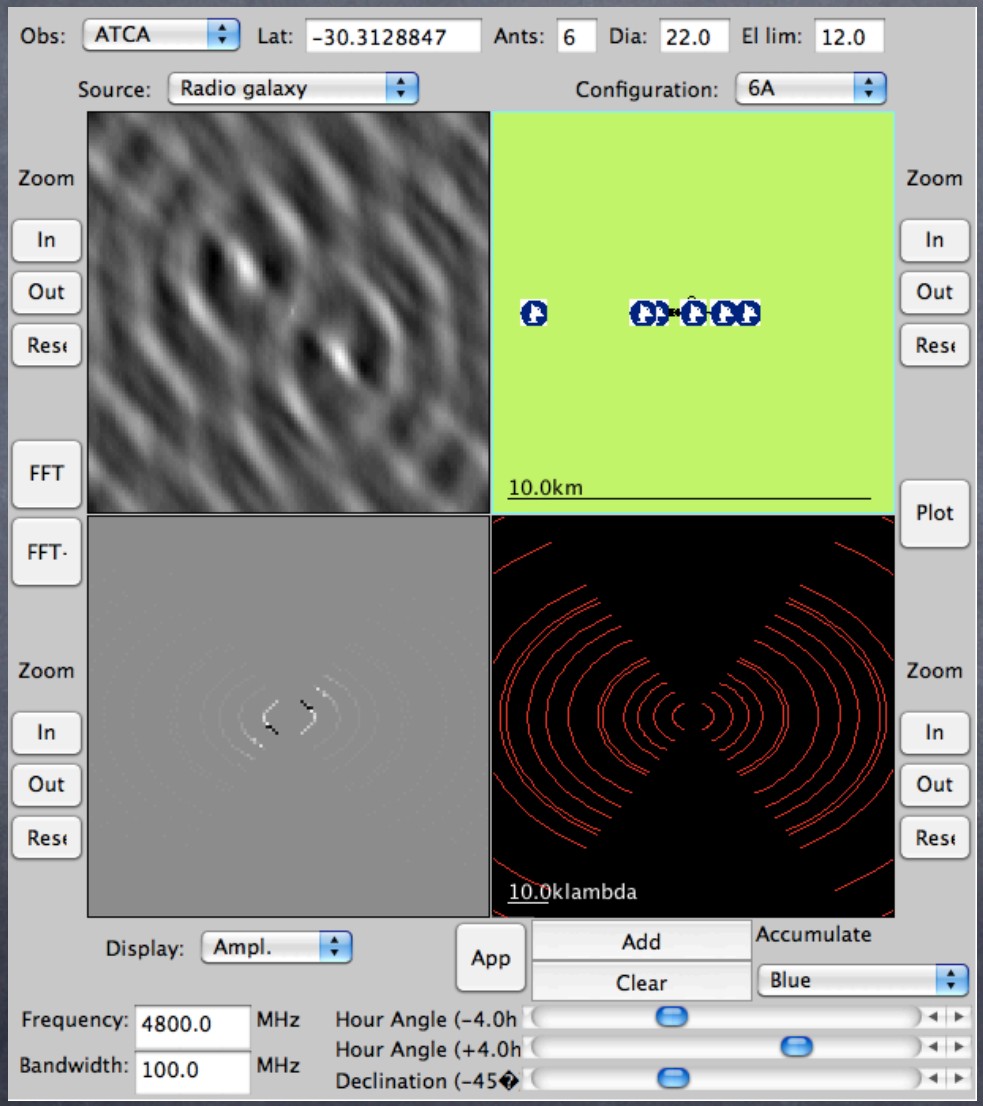

THANK YOU!