

Simulating ALMA data



Bjorn Emonts

NRAO

CASA User Liaison

Credits:

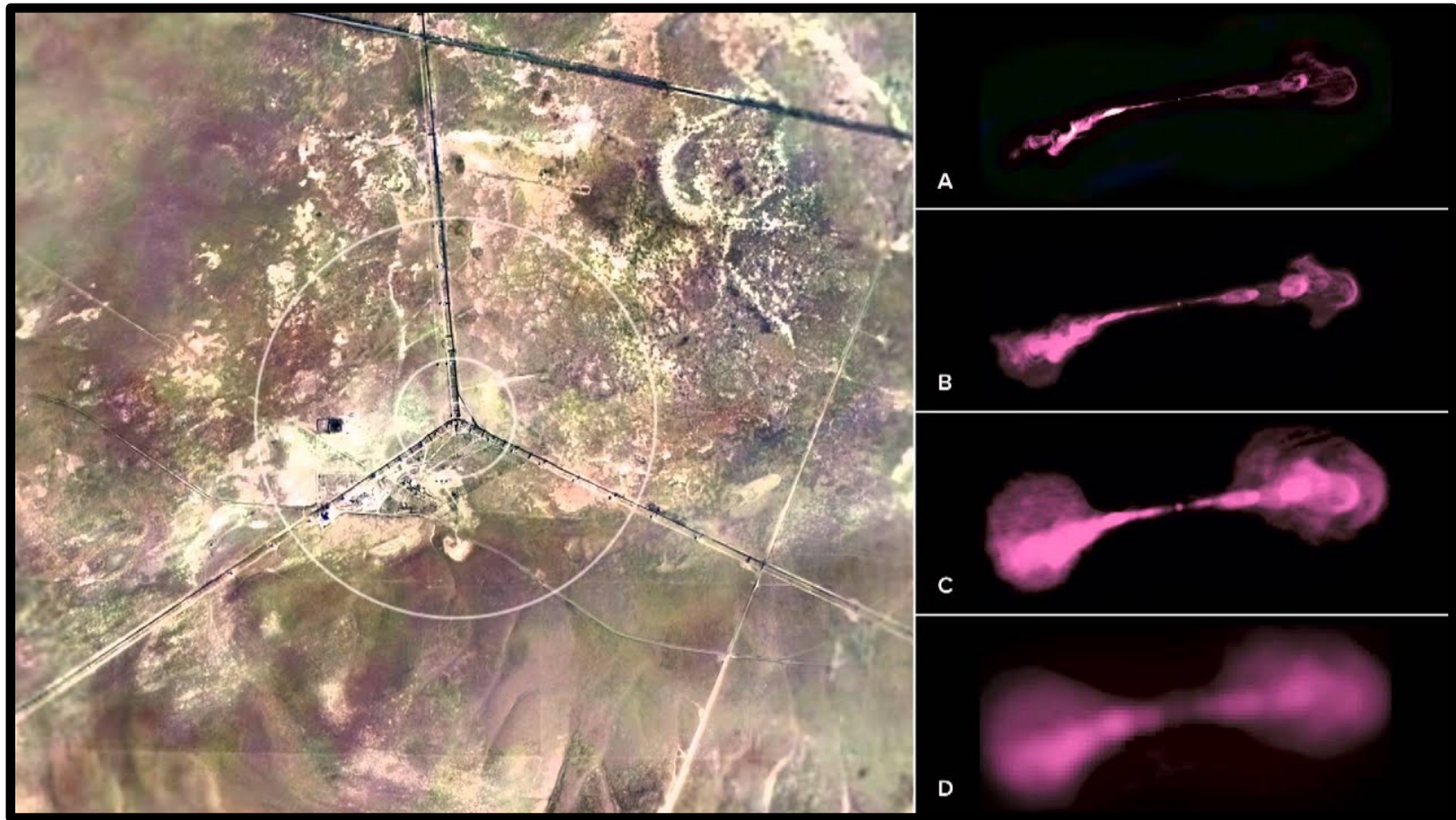
Remy Indebetouw (NRAO)

Andrew McNichols (NRAO)



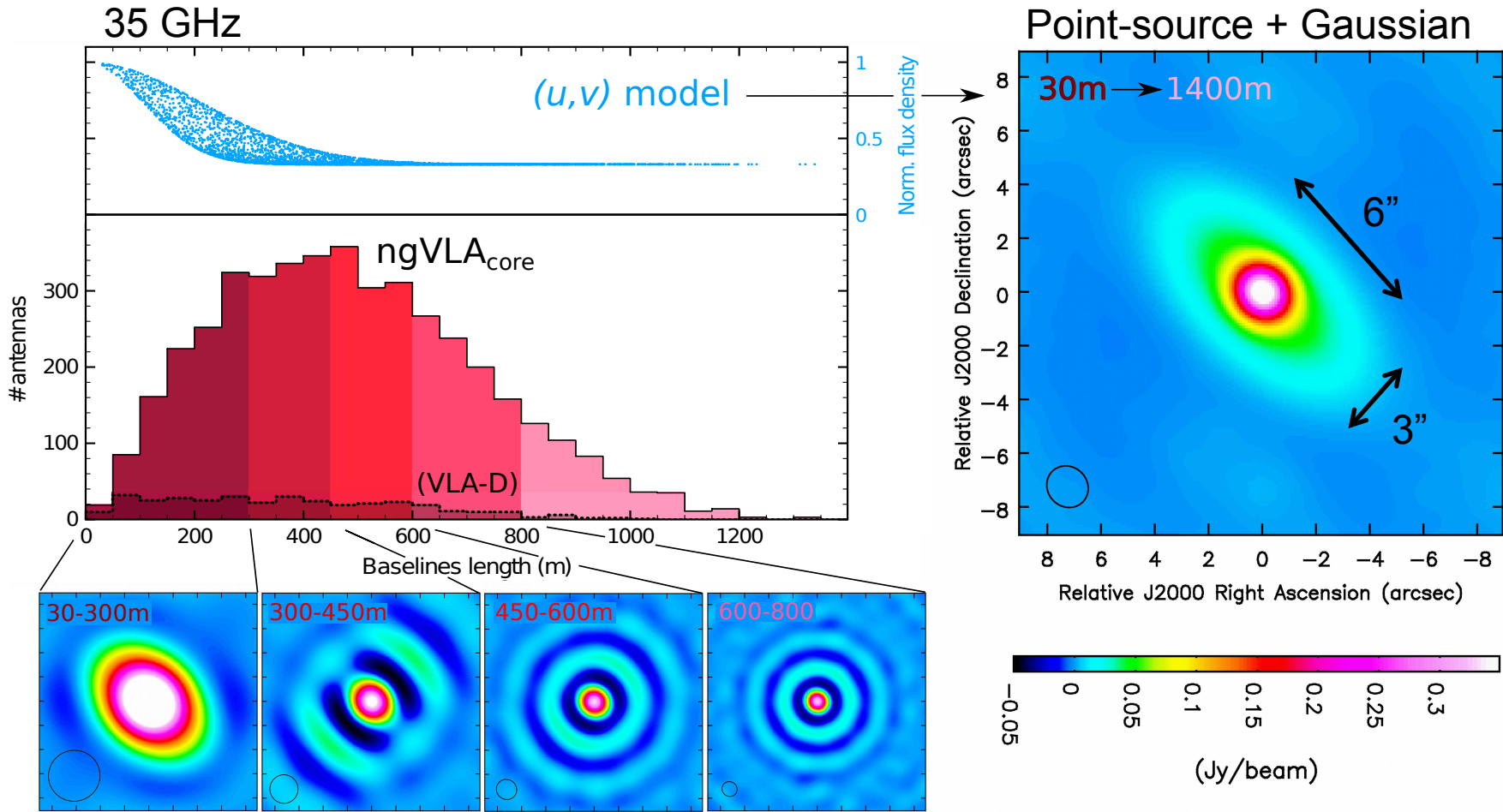
Why simulate ALMA observations?

#1. Proposed resolution / array configuration



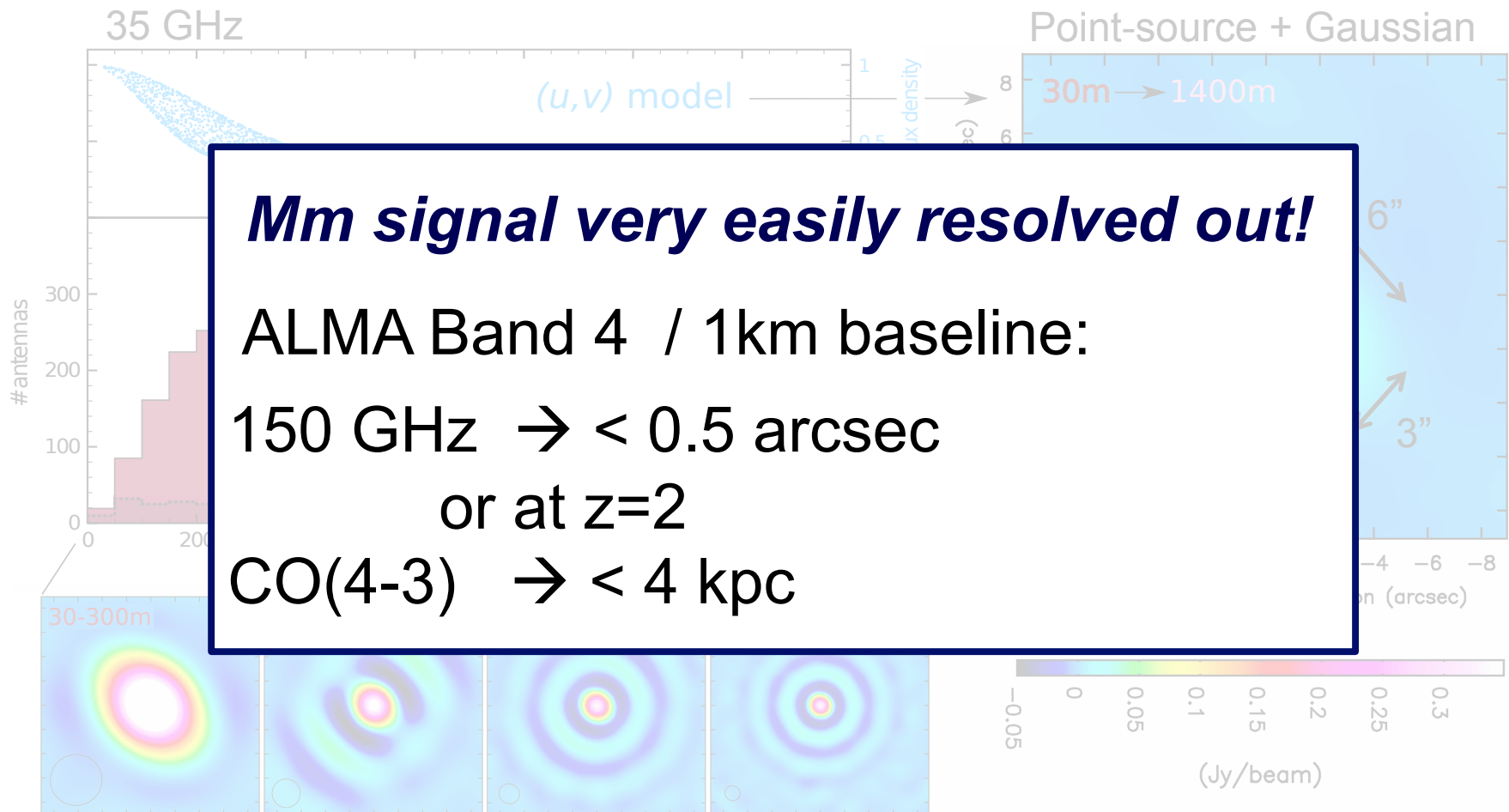
Why simulate ALMA observations?

#1. Proposed resolution / array configuration

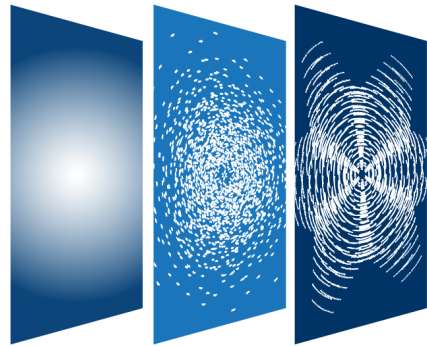


Why simulate ALMA observations?

#1. Proposed resolution / array configuration



How to simulate ALMA observations?



CASA

Common Astronomy
Software Applications

1. CASA simulation tasks:

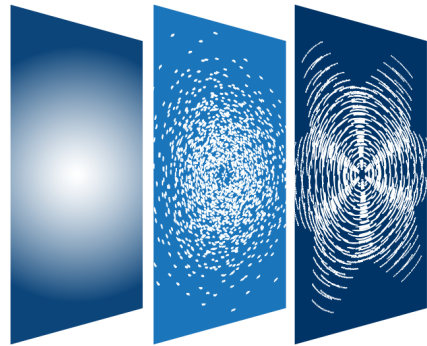
- simobserve
 - simanalyze
- } simalma

Based on old CLEAN task

Manual imaging / pipeline

→ TCLEAN !

How to simulate ALMA observations?



CASA

Common Astronomy
Software Applications

1. CASA simulation tasks:

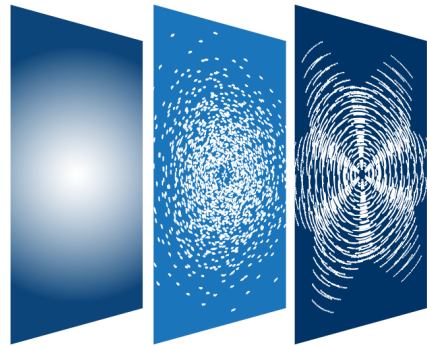
- simobserve
 - simanalyze
- } simalma

2. Simulator tools:

sm tool / simutil



How to simulate ALMA observations?



CASA

Common Astronomy
Software Applications

1. CASA simulation tasks:

- simobserve
 - simanalyze
- } simalma

2. Simulator tools:

sm tool / simutil

3. Configuration files:

ALMA Cycle 0 – 6 + ACA

VLA, ngVLA, ATCA, PdBI, WSRT, CARMA, MeerKAT, SMA, VLBA

*Note: ALMA Cycle-7 config files → CASA 5.5
identical to Cycle-6 config files in CASA 5.4!*



How to simulate ALMA observations?



1. CASA simulation tasks:

- simobserve
 - simanalyze
- } simalma

2. Simulator tools:

sm tool / simutil

3. Configuration files:

ALMA Cycle 0 – 6 + ACA

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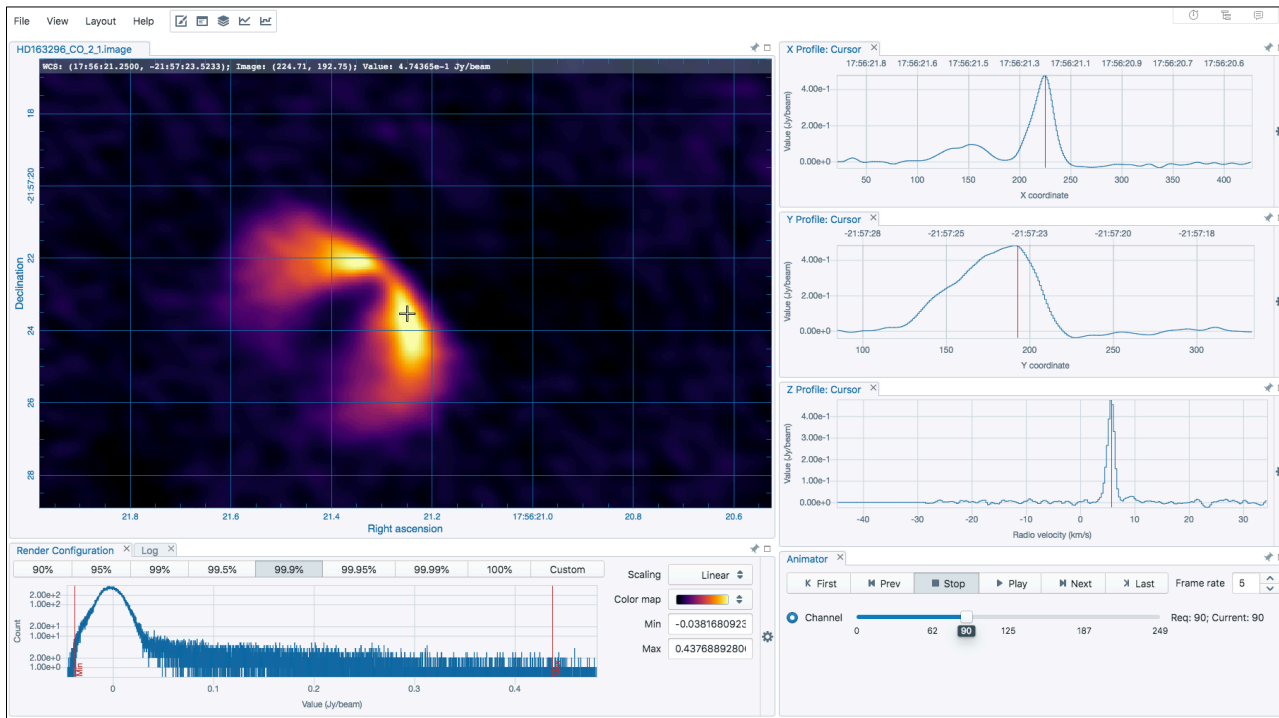
4. Visualization images:

CASA Viewer / CARTA



How to simulate ALMA observations?

Cube Analysis and Rendering Tool for Astronomy



CARTA version 1
released Dec 2018
*Limited features, but
now rapid progress!*

In future will replace
CASA Viewer

<https://cartavis.github.io/>

Consortium:
ASIAA, IDIA, NRAO,
Univ. Alberta

4. Visualization images:

CASA Viewer / **CARTA**

How to simulate ALMA observations?



- Home
- CASA 5.5.0
- Latest
- CASA 5.4.1
- CASA 5.4.0
- CASA 5.3.0
- CASA 5.1.2
- CASA 5.1.1
- CASA 5.1.0
- CASA 5.0.0

CASA Documentation

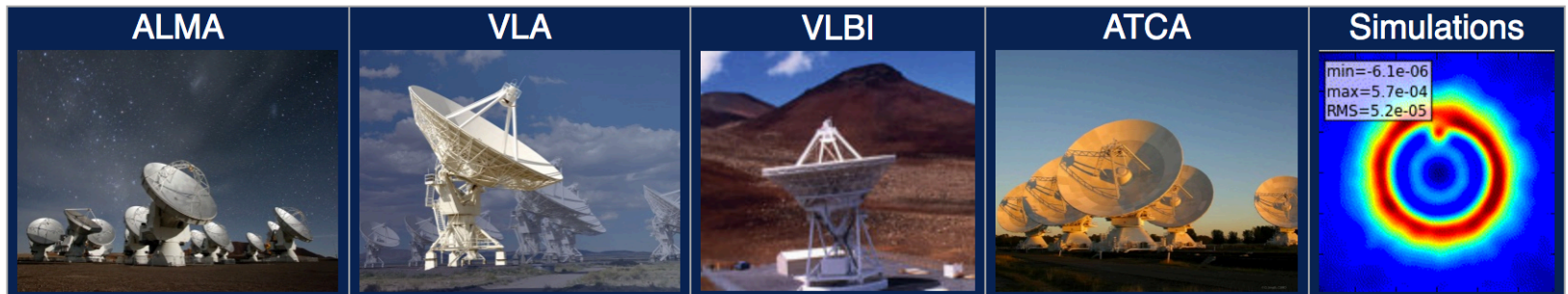
CASA Docs

Official CASA documentation
<https://casa.nrao.edu/casadocs/>

CASA Guides

Telescope-specific CASA strategies
<https://casaguides.nrao.edu/>

CASA Tutorials



SIMALMA

CASA Guides:
<https://casaguides.nrao.edu/>

```
# Model sky = Halpha image of M51
os.system('curl https://casaguides.nrao.edu/images/3/3f/M51ha.fits.txt -f -o M51ha.fits')
skymodel          = "M51ha.fits"
```

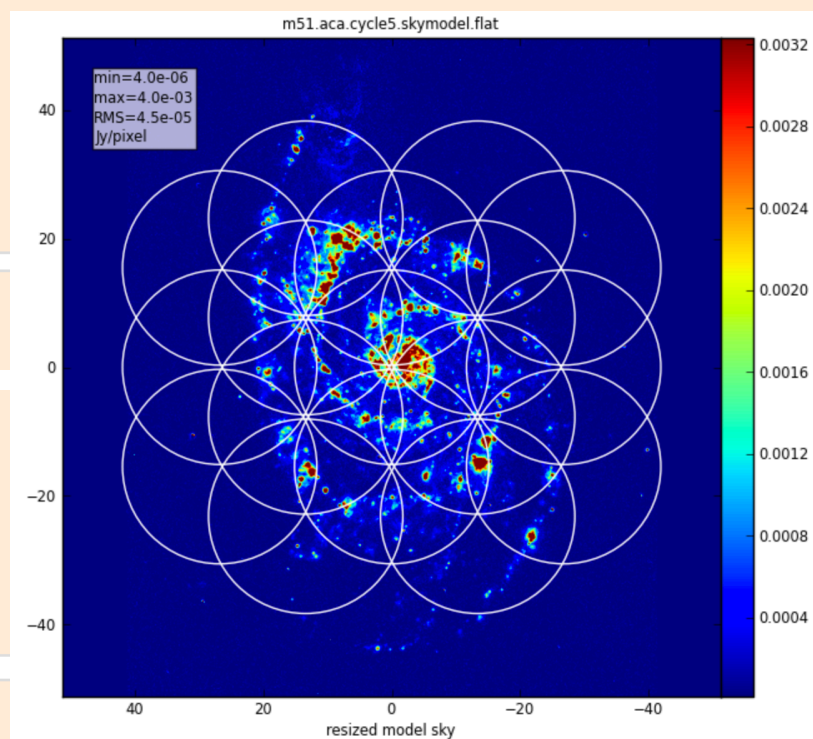
```
# Set model image parameters:
indirection="J2000 23h59m59.96s -34d59m59.50s"
incell="0.1arcsec"
inbright="0.004"
incenter="330.076GHz"
inwidth="50MHz"
```

```
antennalist=["alma.cycle6.3.cfg", "aca.cycle6.cfg"]
```

```
totaltime="1800s"
tpnant = 2
tptime="7200s"
pwv=0.6
mapsize="1arcmin"
```

```
inp
```

```
go
```



SIMALMA

```
# Model sky = Halpha image of M51
os.system('curl https://casaguides.nrao.edu/images/
skymodel = "M51ha.fits"
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indirection="J2000 23h59m59.96s -34d59m59.50s"
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totaltime="1800s"
tpnant = 2
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pwv=0.6
mapsize="1arcmin"
```

```
inp
```

```
go
```

```
IPython: CASA_testing/Simulations
File Edit View Search Terminal Help
-----> inp()
# simalma :: Simulation task for ALMA
project = 'm51' # root prefix for output file names
dryrun = False # dryrun=True will only produce the
# informative report, not run
# simobserve/analyze
skymodel = 'M51ha.fits' # model image to observe
inbright = '0.004' # scale surface brightness of brightest
# pixel e.g. "1.2Jy/pixel"
indirection = 'J2000 23h59m59.96s -34d59m59.50s' # set new direction
# e.g. "J2000 19h00m00 -40d00m00"
incell = '0.1arcsec' # set new cell/pixel size e.g.
# "0.1arcsec"
incenter = '330.076GHz' # set new frequency of center channel
# e.g. "89GHz" (required even for 2D
# model)
inwidth = '50MHz' # set new channel width e.g. "10MHz"
# (required even for 2D model)
complist = '' # componentlist to observe
setpointings = True
integration = '10s' # integration (sampling) time
direction = '' # "J2000 19h00m00 -40d00m00" or "" to
# center on model
mapsize = '1arcmin' # angular size of map or "" to cover
# model
antennalist = ['alma.cycle6.3.cfg', 'aca.cycle6.cfg'] # antenna
# position files of ALMA 12m and 7m
# arrays
hourangle = 'transit' # hour angle of observation center e.g.
# -3:00:00, or "transit"
totaltime = '1800s' # total time of observation; vector
# corresponding to antennalist
tpnant = 2 # Number of total power antennas to use
# (0-4)
tptime = '7200s' # total observation time for total
# power
pwv = 0.6 # 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 = 0 # 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]
verbose = False
overwrite = True # overwrite files starting with
# $project
CASA <67>: go
```

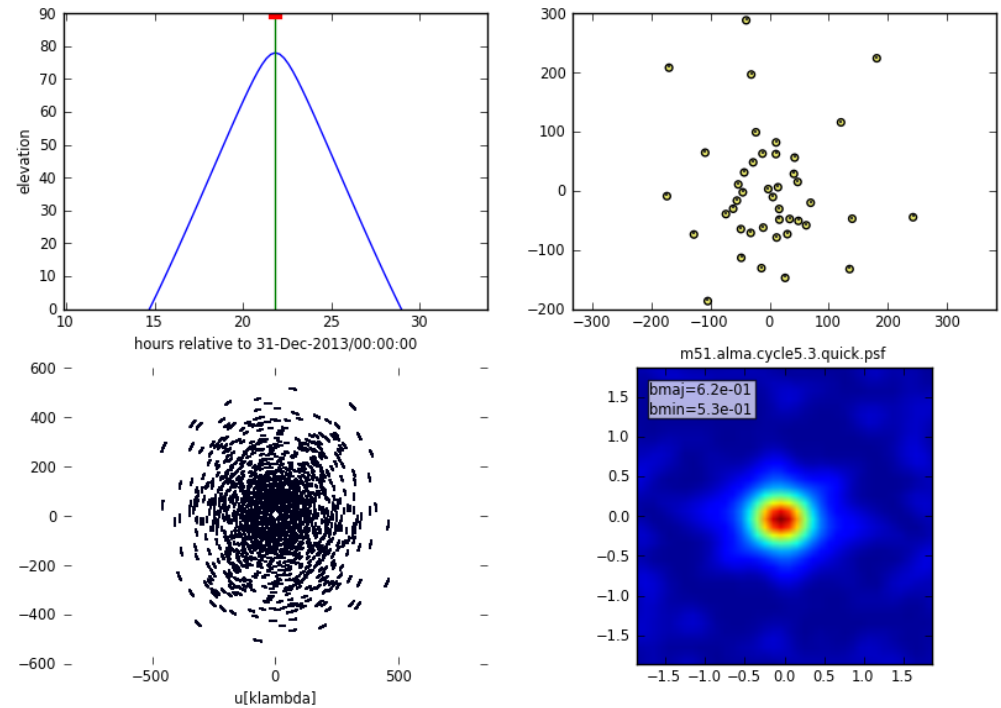
SIMALMA

1. Simobserve

Simulate visibilities (MS)
for each configuration

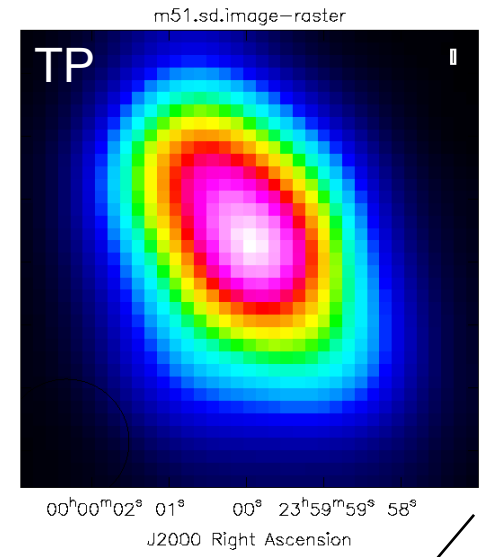
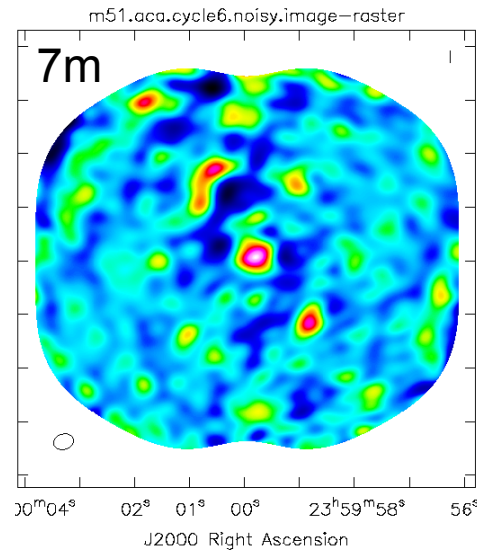
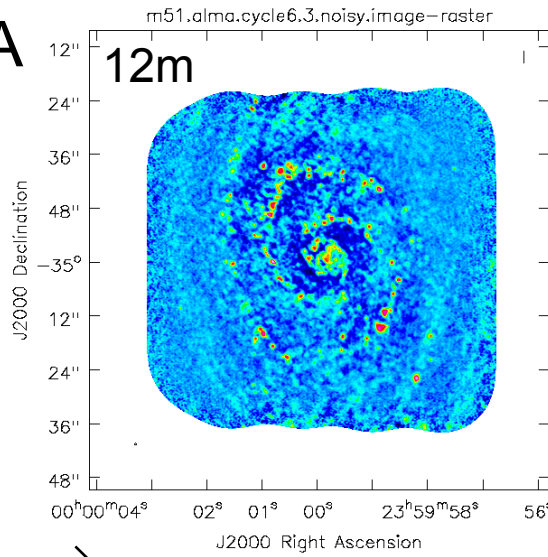
2. Simanalyze

Imaging using
simulated MSs



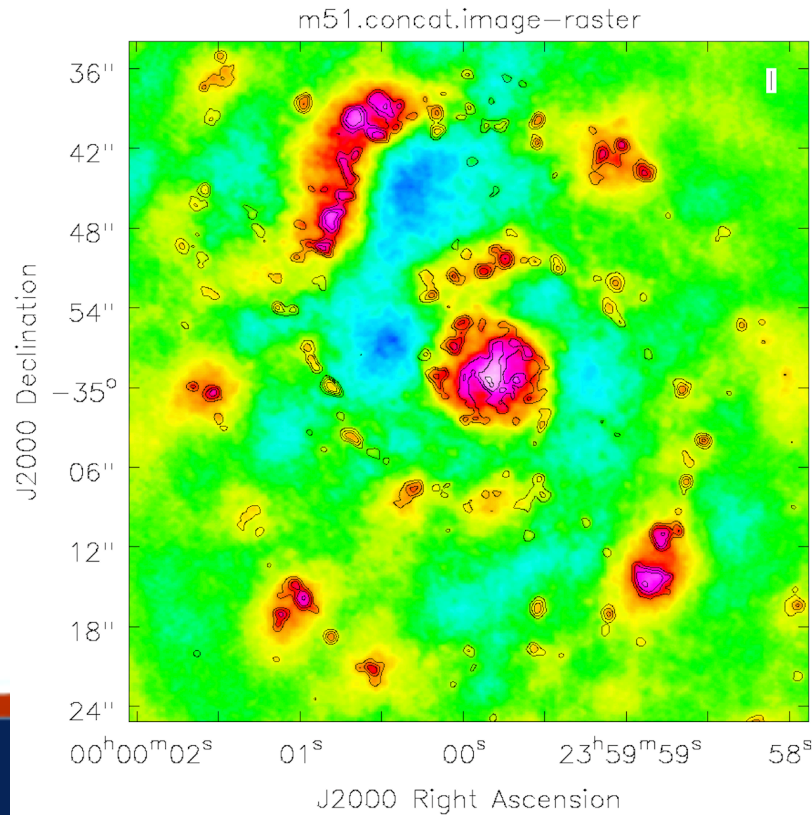
SIMALMA

1. Simulate
Simulated MSs
for each



2. Simanalyze

Imaging using
Simulated MSs



Questions?

CASA Guides

<https://casaguides.nrao.edu/>

