Simulating ALMA data for proposals

Toby Brown
McMaster University

Thanks to:
Bjorn Emonts (NRAO)
Remy Indebetouw (NRAO)
Andrew McNichols (NRAO)

Why Simulate Your Data?

1. CASA can take any image and simulate how it would look if observed by ALMA (or an other interferometer) – easily
2. Demonstrate to TAC that proposal is feasible, will achieve desired results, and you have expertise in dealing with radio data

CASAguides includes several walkthroughs:
https://casaguides.nrao.edu/index.php/Simulating_Observations_in_CASA_5.4

How to simulate ALMA observations?

CASA simulation tasks:

- simobserve
- simanalyze

simalma

Configuration files:

ALMA Cycles 0 – 7 + ACA
VLA, ngVLA, ATCA, PdbI, WSRT,
CARMA, MeerKAT, SMA, VLBA

Note: ALMA Cycle 7 config files → CASA 5.6

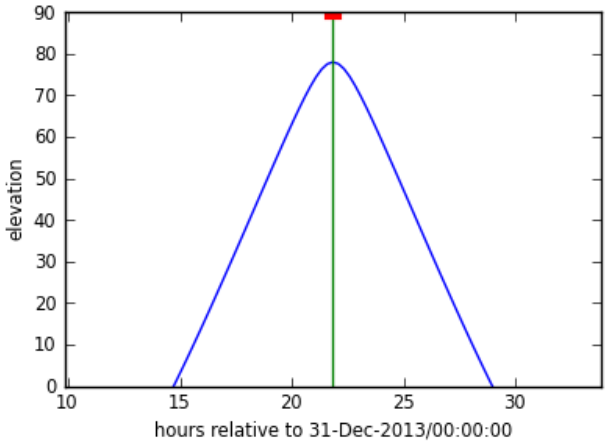
SIMALMA

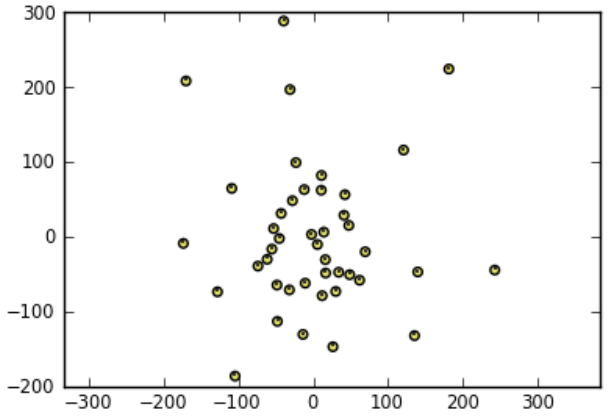
1. Simobserve

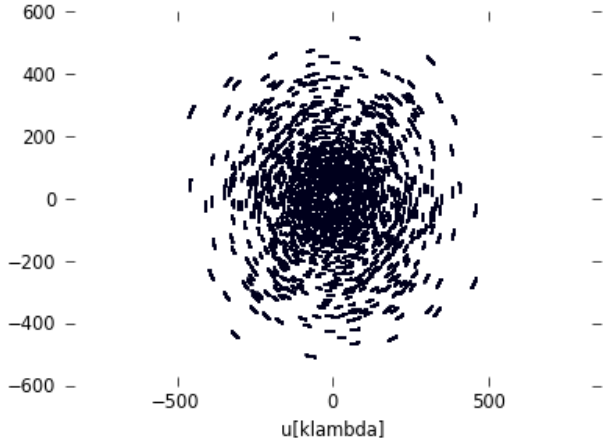
Simulate visibilities (MS) for each configuration

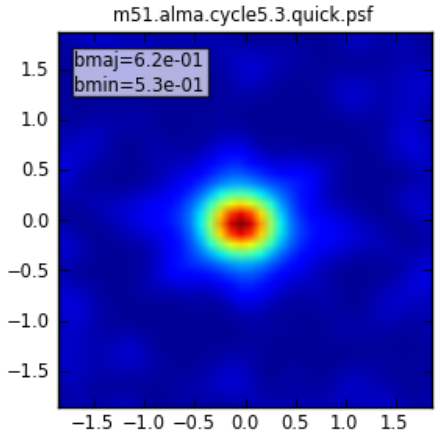
2. Simanalyze

Image MSs









SIMALMA

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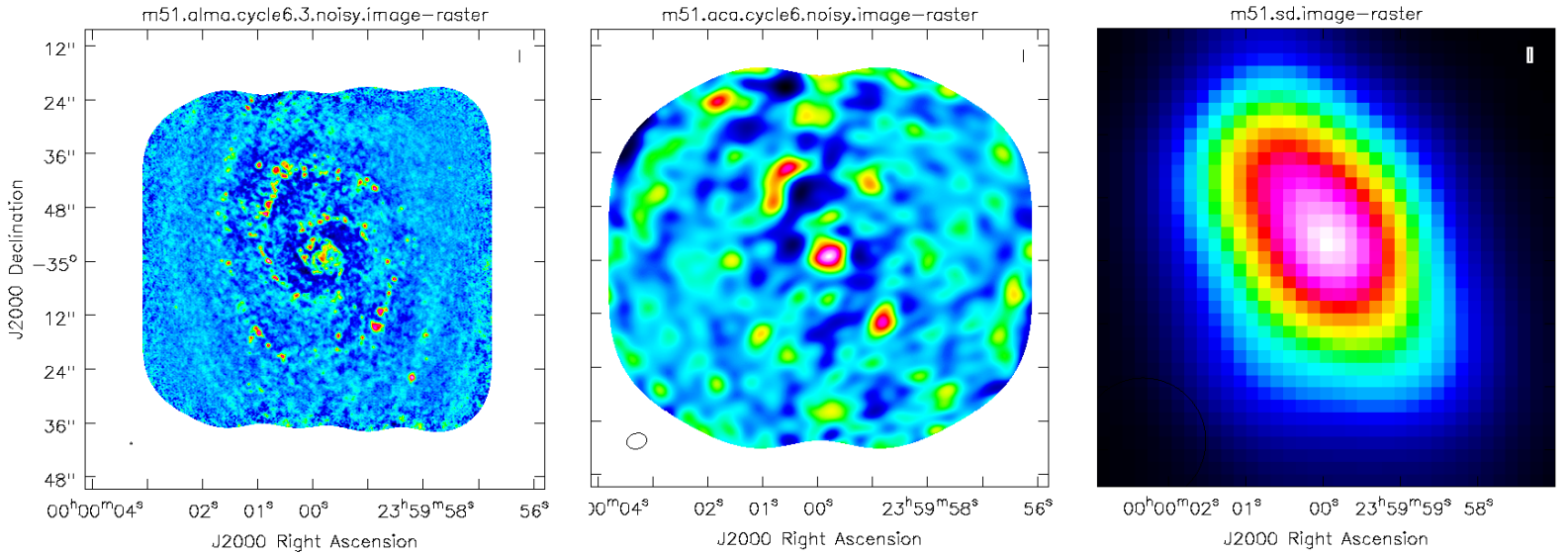
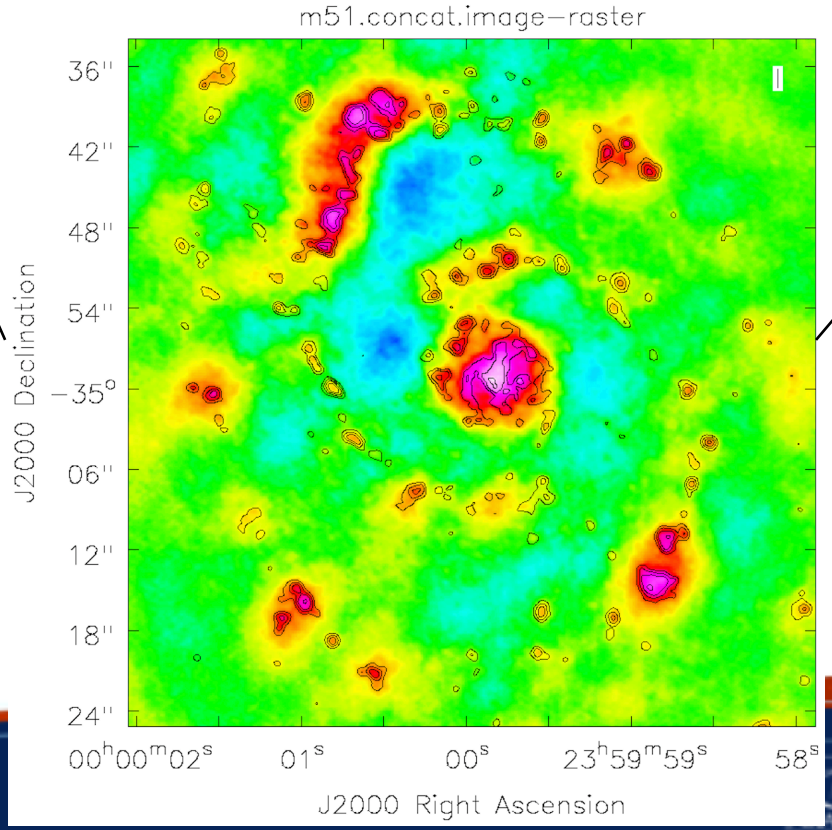
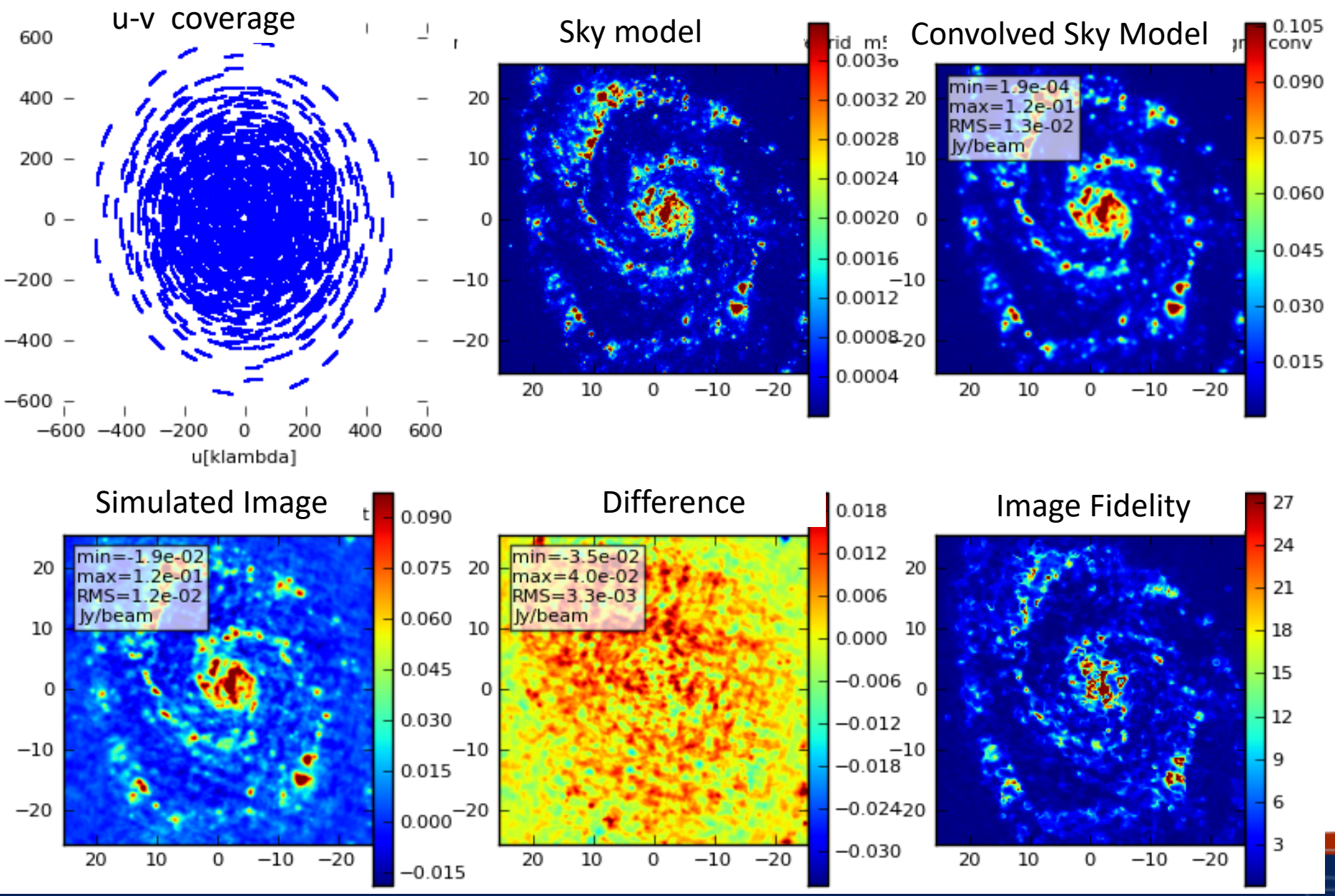
Image MS's

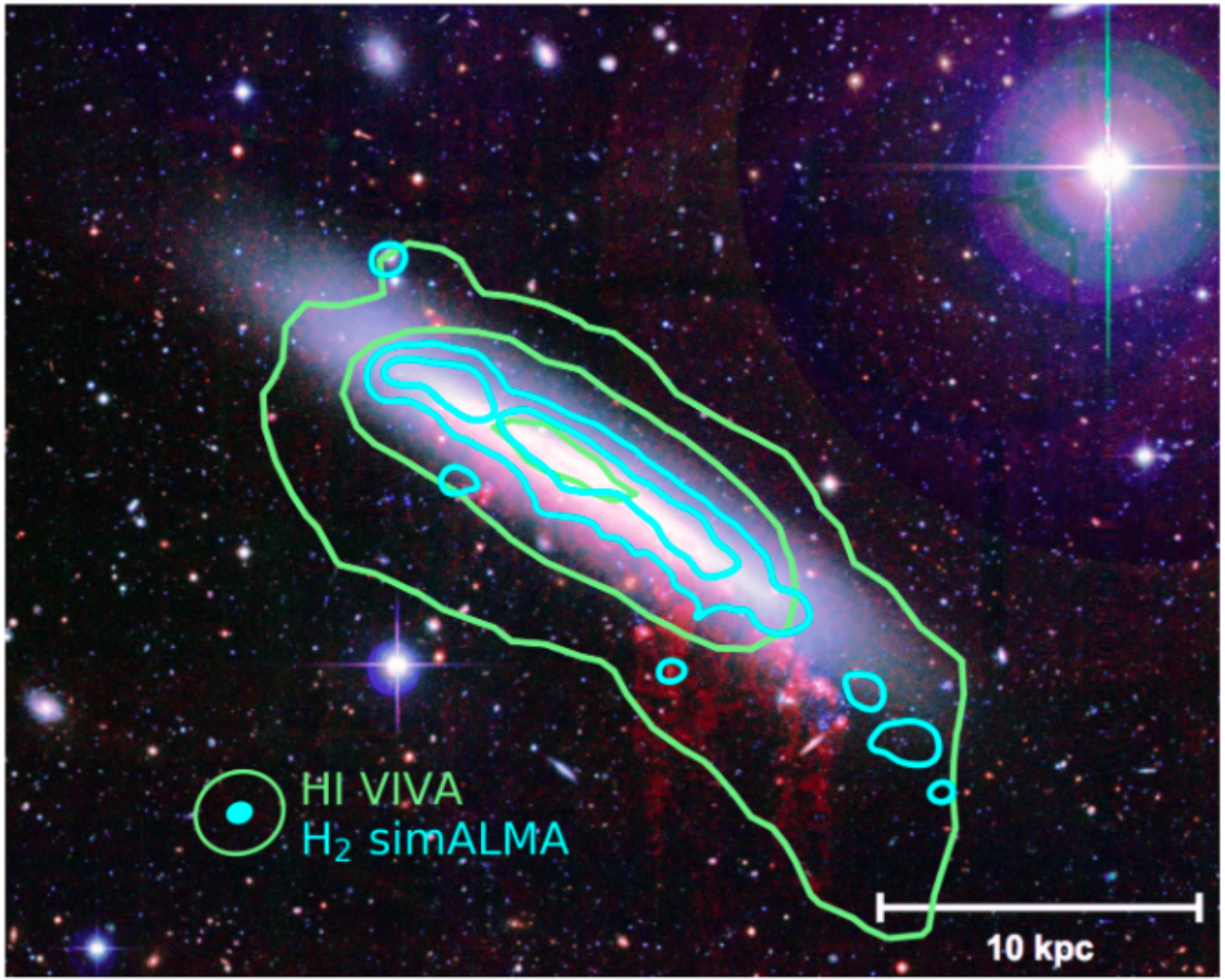




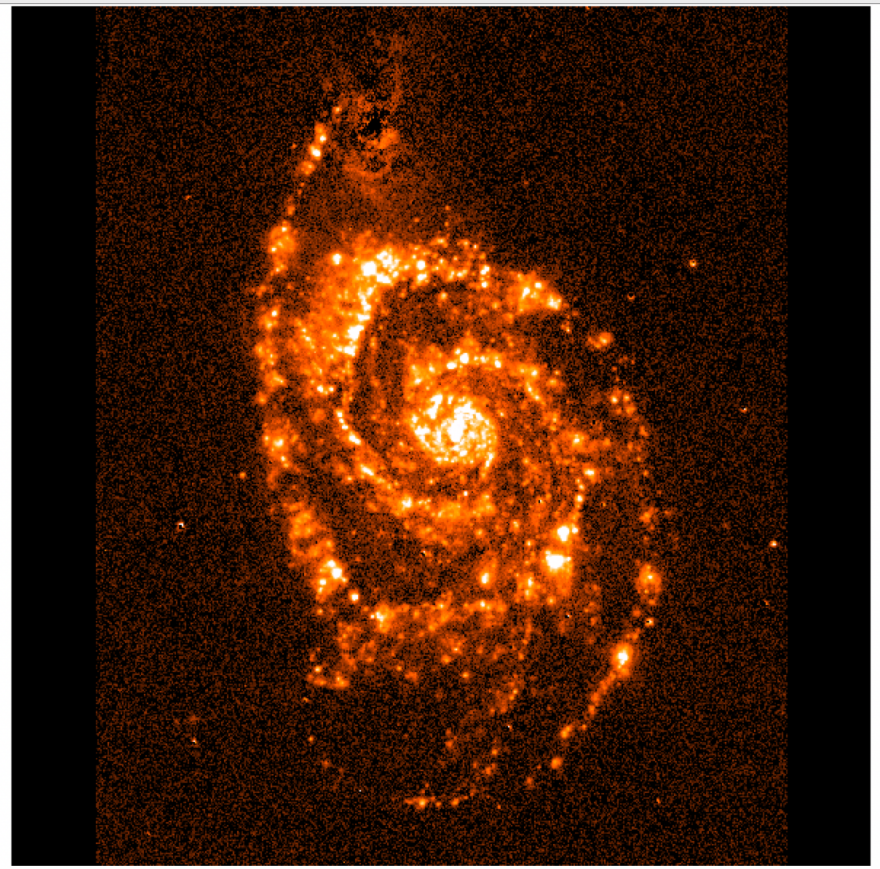
Create diagnostic plots based on simobserve and image



simALMA image of NGC 4330 used in proposal



SIMALMA Walkthrough: M51



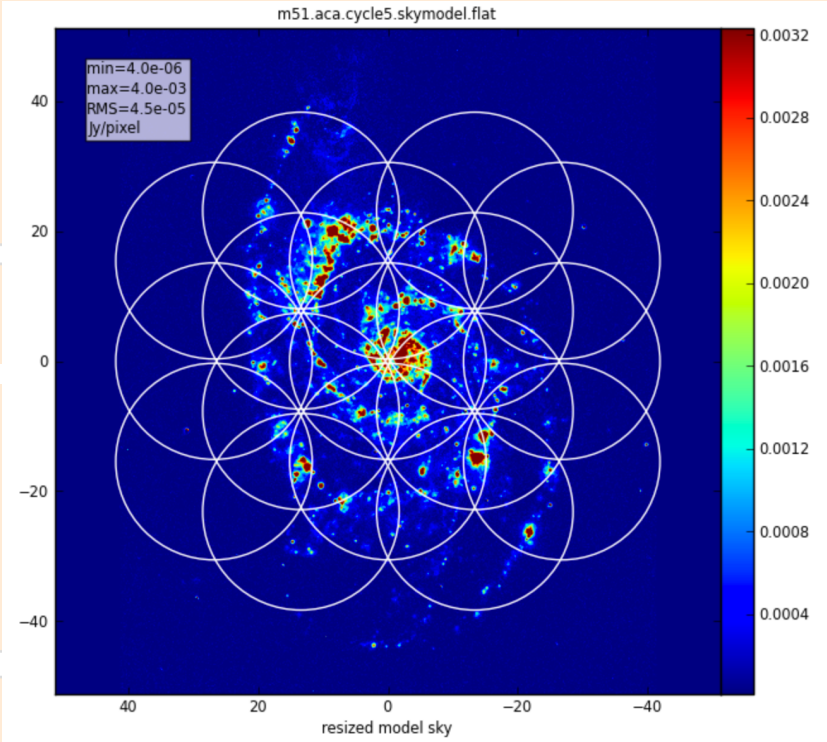
Continuum subtracted Hα image of nearby galaxy M51

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"
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inp
```

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go
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SIMALMA

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inp
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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
```

Try It Yourself!

- Simulate one of the model images at http://casaguides.nrao.edu/index.php?title=Sim_Inputs