Simulating ALMA data

Toby Brown
McMaster University

Credits:
Bjorn Emonts (NRAO)
Remy Indebetouw (NRAO)
Andrew McNichols (NRAO)

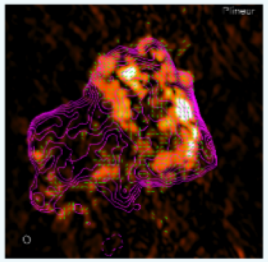
Simulating Interferometry Data

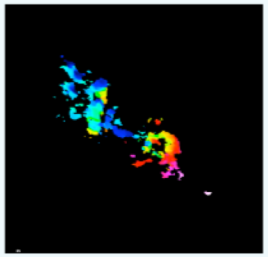
- CASA can take any image and simulate how it would look if observed by ALMA or an other interferometer (e.g., SMA, CARMA, etc.)
- Demonstrate to TAC that proposal is feasible, will achieve desired results, and you have expertise in dealing with radio data
- CASAguides includes several walkthroughs: https://casaguides.nrao.edu/index.php/Simulating_Observations_in_CASA_5.4

- CASA Basics
  - CASA Homepage Information on the latest releases, documentation, and support
  - CASA mailing lists Please subscribe to receive information on releases, critical bugs, etc.
  - Installing CASA Where to obtain CASA, and how to install it in different operating systems
  - Overviews
    - Guide to CASA syntax, task execution, and scripting
    - CASA calibration, imaging, and a description of basic tasks
    - CASA Python Overview Includes basics of python, and guides to arrays and plotting
- CASA Documentation
  - CASA Reference Manual & Cookbook HTML and the PDF Version
  - CASA Task Reference
  - CASA Toolkit Manual

CASA Tutorials

- ALMA Guides/Tutorials
- Karl G. Jansky VLA Tutorials
- Simulating Observations
- pre-upgrade VLA Tutorials
- ATCA Tutorials
- CARMA Tutorials
- SMA Tutorials
- Extracting Scripts from Tutorials





log in

Release 4.7.2 is now

Newsletter #4

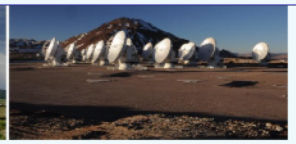
Community Day Event da (Gainesville,

A Community Day ia University

LBO Community Day igan (Ann Arbor,

Community Day Event nto, Canada

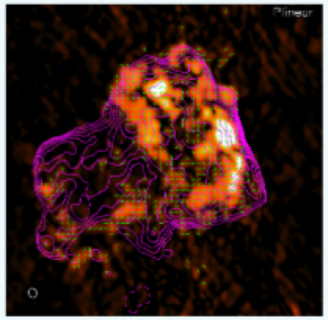
Common Astronomy Software Applications

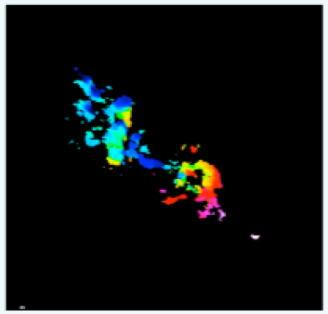


- 30 March 2017: ALMA Community Day Event at Rice University (Houston TX)
- 4 April 2017: ALMA Community Day Event at the University of Hawaii (Honolulu, HI)
- 5 April 2017: ALMA Community Day Event at the University of Texas (Austin, TX)
- 5 April 2017: ALMA Community Day Event at

- CASA Basics
  - CASA Homepage Information on the latest releases, documentation, and support
  - CASA mailing lists Please subscribe to receive information on releases, critical bugs, etc.
  - Installing CASA Where to obtain CASA, and how to install it in different operating systems
  - Overviews
    - Guide to CASA syntax, task execution, and scripting
    - CASA calibration, imaging, and a description of basic tasks
    - CASA Python Overview Includes basics of python, and guides to arrays and plotting
- CASA Documentation
  - CASA Reference Manual & Cookbook HTML and the PDF Version
  - CASA Task Reference
  - CASA Toolkit Manual

- ALMA Guides/Tutorials
- Karl G. Jansky VLA Tutorials
- Simulating Observations
- pre-upgrade VLA Tutorials
- ATCA Tutorials
- CARMA Tutorials
- SMA Tutorials
- Extracting Scripts from Tutorials





https://casaguides.nrao.edu

How to simulate ALMA observations?

CASA simulation tasks:

- simobserve
- simanalyze

simalma

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?

CASA

Search Site | Search

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

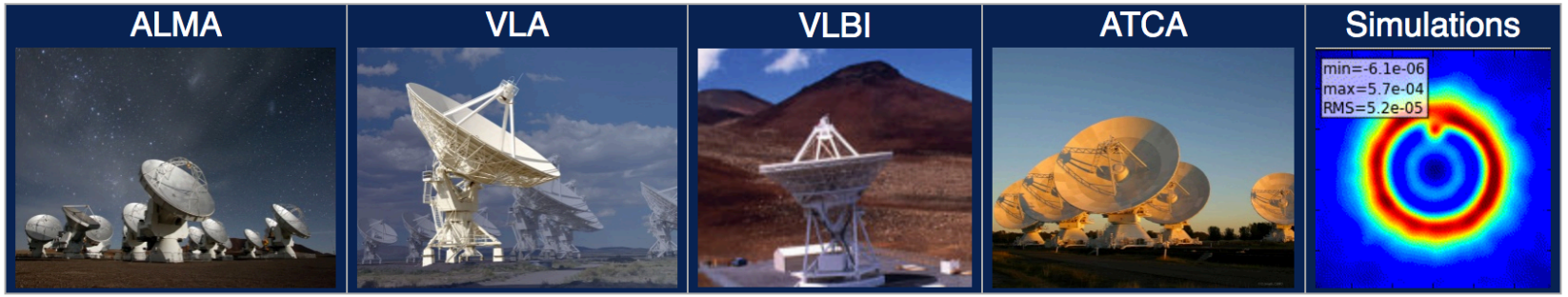
CASA Docs

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

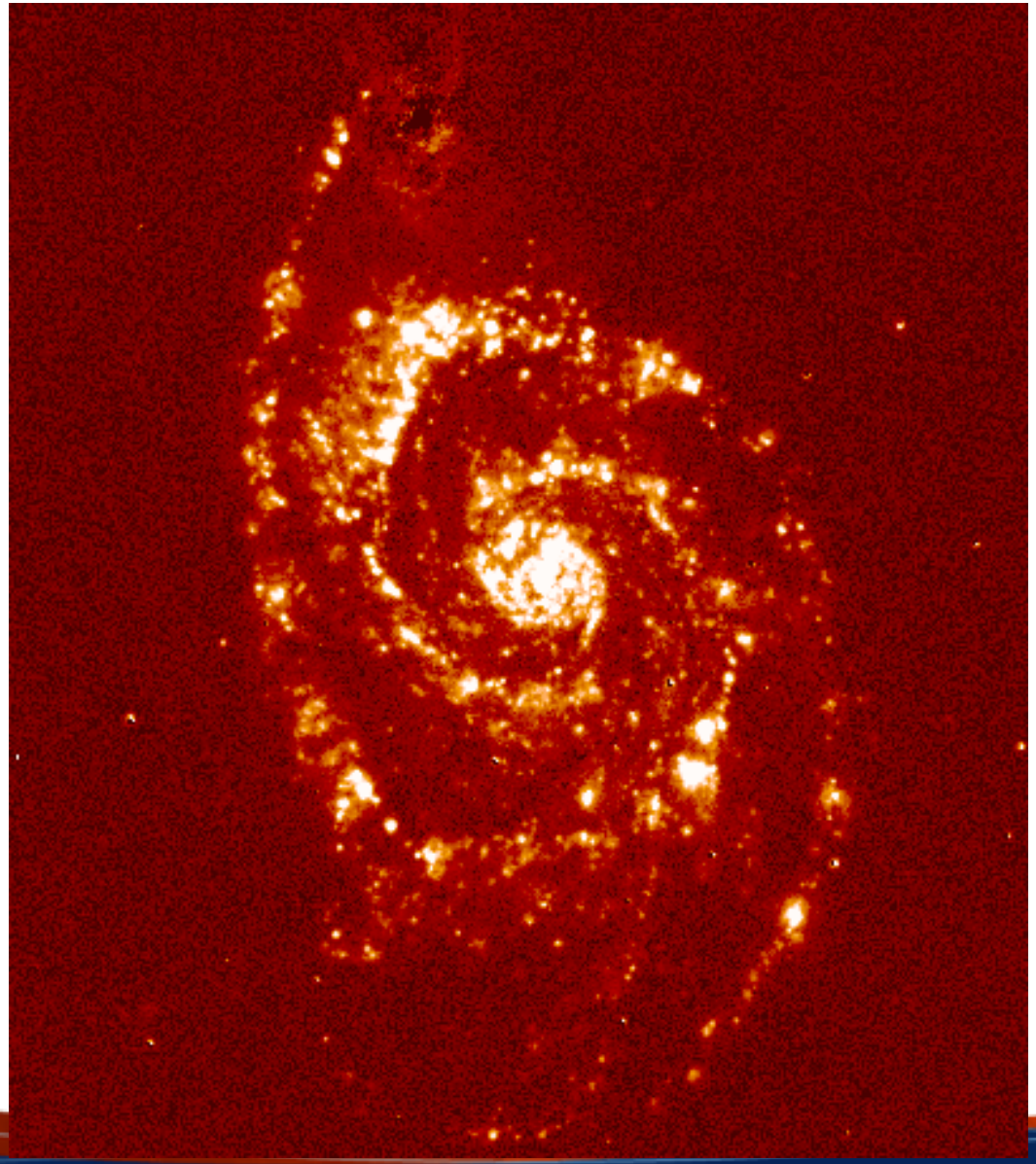
CASA Guides

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

CASA Tutorials



SIMALMA



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

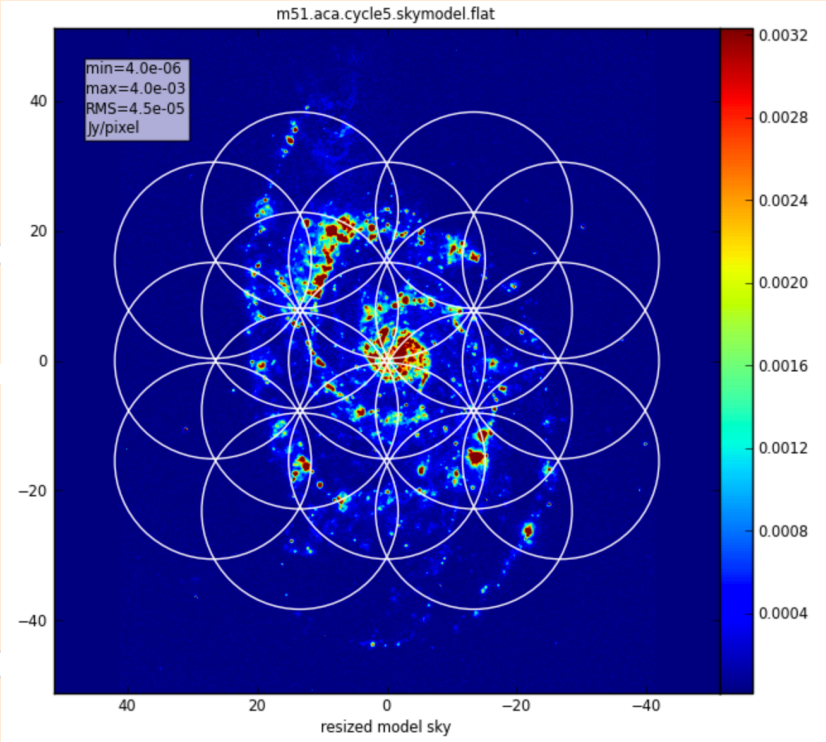
Continuum subtracted H alpha image of the nearby galaxy M51 (NGC 5194 -- provided by D. Thilker at NRAO).

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/image
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
```

IPython: CASA_testing/Simulations

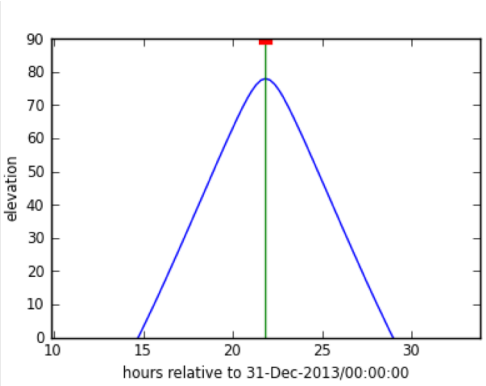
File Edit View Search Terminal Help

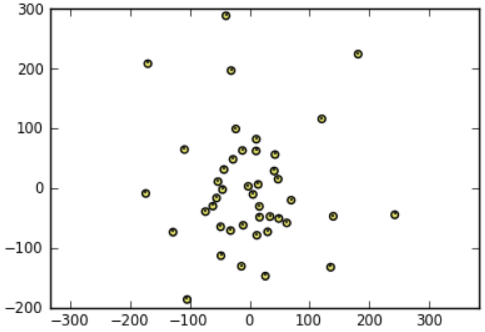
```
---------> inp()
#  simalma :: Simulation task for ALMA
project             =       'm51'        #  root prefix for output file names
dryrun              =       False        #  dryrun=True will only produce the
                                         #   informative report, not run
                                         #   simobserve/analyze
skymodel            = 'M51ha.fits'       #  model image to observe
     inbright       =     '0.004'        #  scale surface brightness of brighte
                                         #   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.
                                         #   -3:00:00, or "transit"
totaltime           =    '1800s'         #  total time of observation; vector
                                         #   corresponding to antennalist
tpnant              =             2      #  Number of total power antennas to u
                                         #   (0-4)
     tptime         =    '7200s'         #  total observation time for total
                                         #   power

pwv                 =         0.6        #  Precipitable Water Vapor in mm. 0 f
                                         #   noise-free simulation
image               =        True        #  image simulated data
     imsize         =           0        #  output image size in pixels (x,y) c
                                         #   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 cleanin

graphics            =      'both'        #  display graphics at each stage to
                                         #   [screen|file|both|none]
verbose             =       False
overwrite           =        True        #  overwrite files starting with
                                         #   $project

CASA <67>: go
```

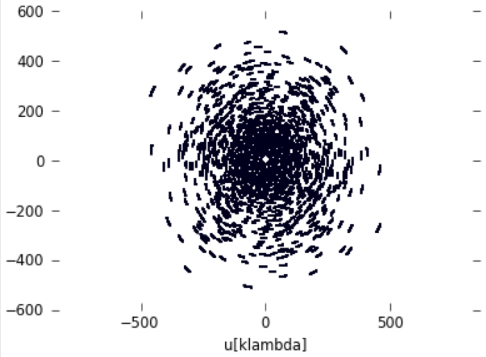
SIMALMA

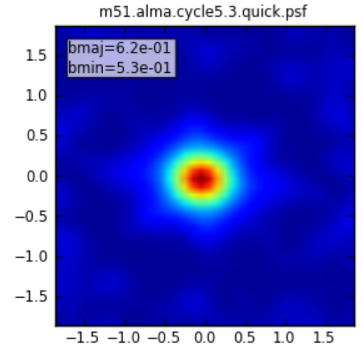
1. Simobserve

Simulate visibilities (MS) for each configuration









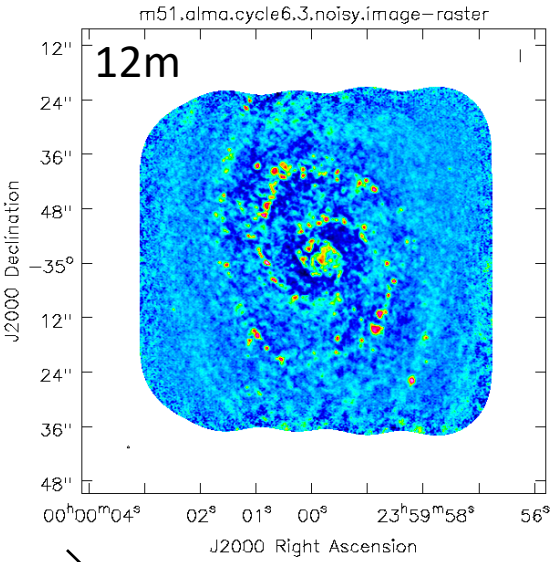
2. Simanalyze

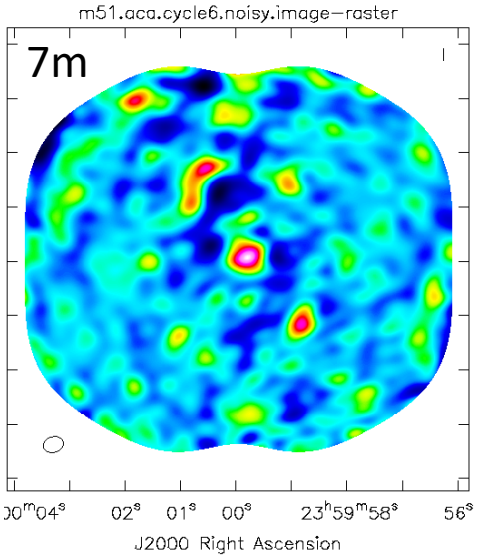
Image MSs

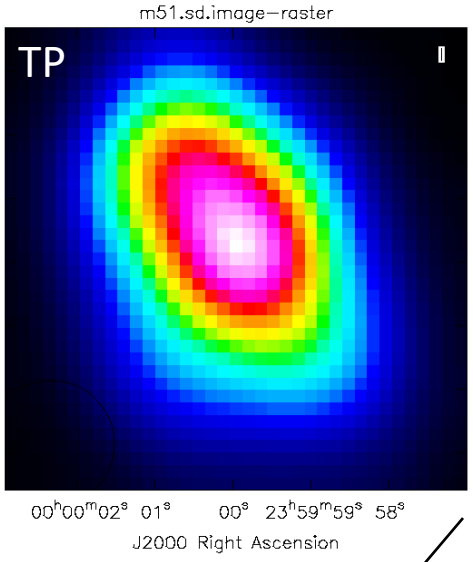
SIMALMA

1. Simc

Simula
each c

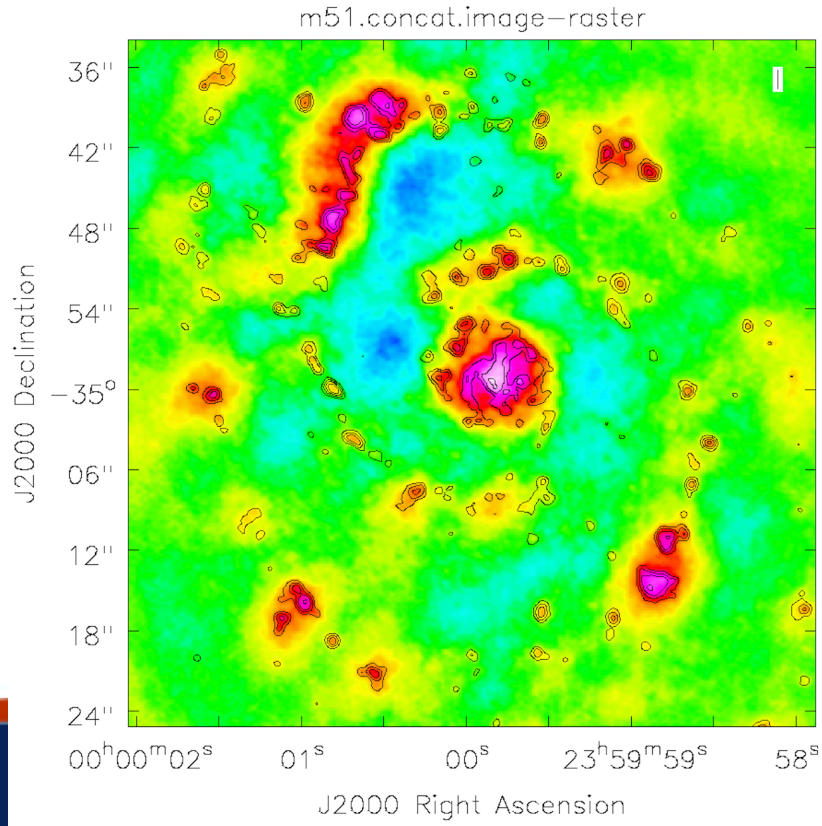




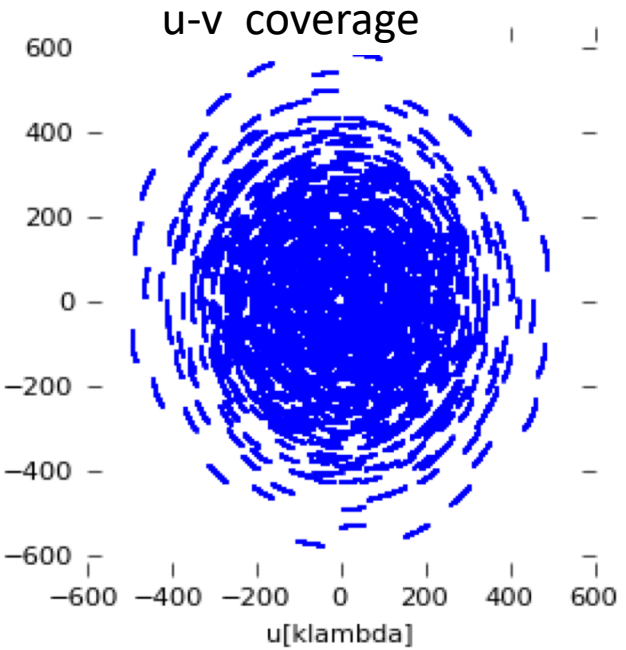


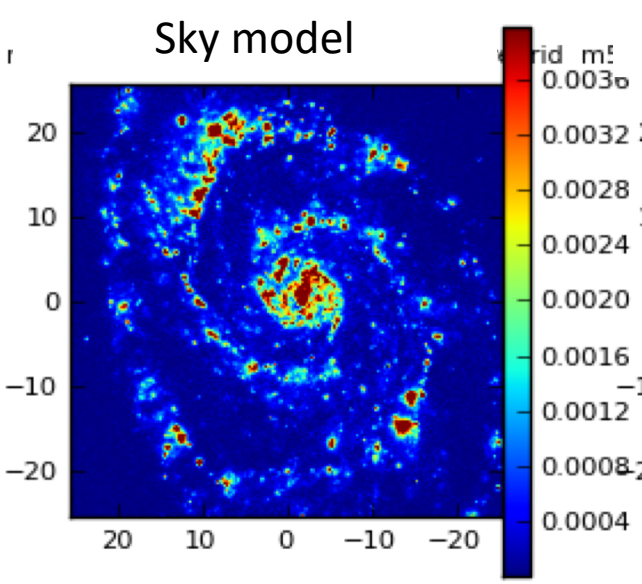
2. Simanalyze

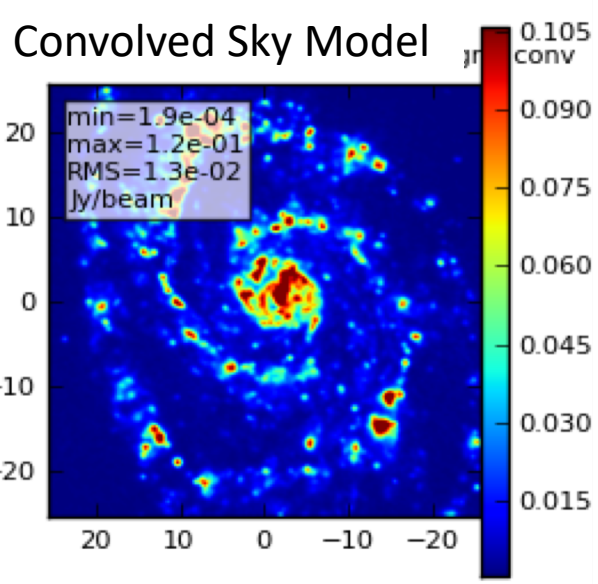
Image MS

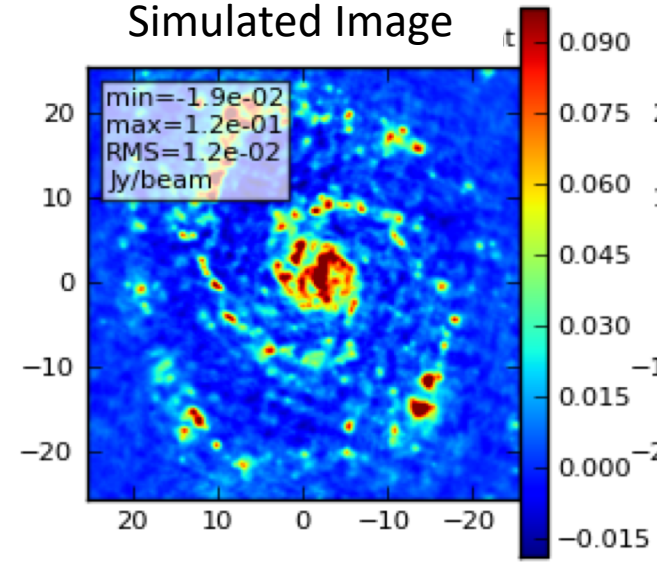


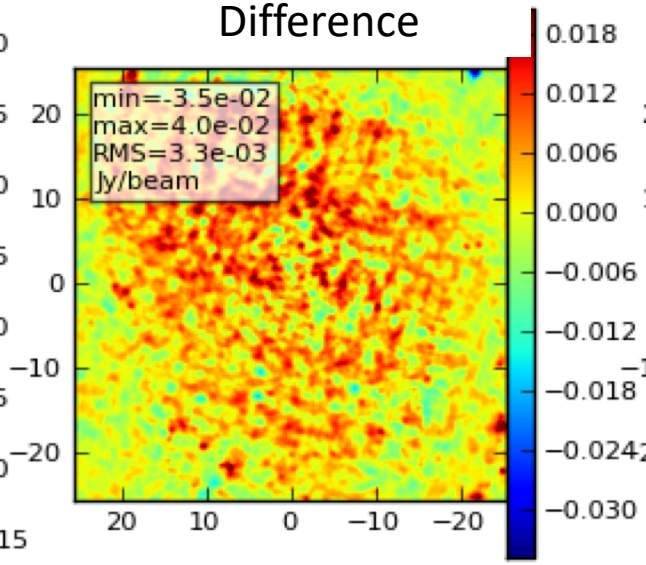
Create diagnostic plots based on simobserve and image

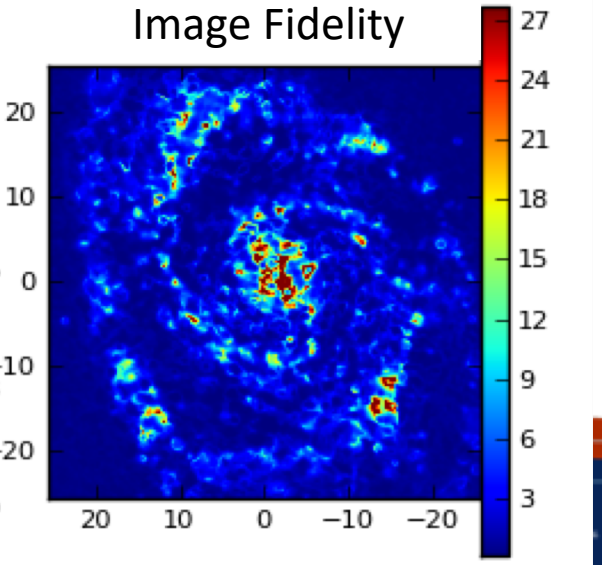












Try It Yourself!

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