

QAC examples (**dc2019**)

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<https://github.com/teuben/QAC>

or via

<https://github.com/teuben/dc2010/contrib>

running CASA scripts

- CASA <1>: `execfile("foo.py")`
- `% casa -c foo.py`
- `% casa -nogui -c foo.py > foo.log 2>&1`

!!! CASA6 will run in Jupyter Notebooks !!!

Why this QAC wrapper?

- Showcase different Data Combination techniques (see also: **contrib/rica**)
- Short python commands, all starting with **qac_**
- Easier to orchestrate complex simulations from the unix shell
 - Regression and Reproducibility
 - (ngVLA array design project)
- Project directory based (much like the CASA simulation software)
- Provide CASA fixes/shortcuts
- Communications to CASA team with bug reports
- Not always flexible enough for real date (but cf. M100 workflows)

!!! CASA6 will run in Jupyter Notebooks !!!

QAC: novel things

- `qac_project(pdir)`: all work is below a specified directory `pdir`
- `qac_noise()`: get a map with specified RMS (*Carilli et al 2017*)
- `qac_clean()`: optional list **niter=[0,1000,4000]**
 - **startmodel=**
- `qac_clean1()`: optional **t=False** to use `clean` (vs. `tclean`)
-

Data Combination: verification & robustness

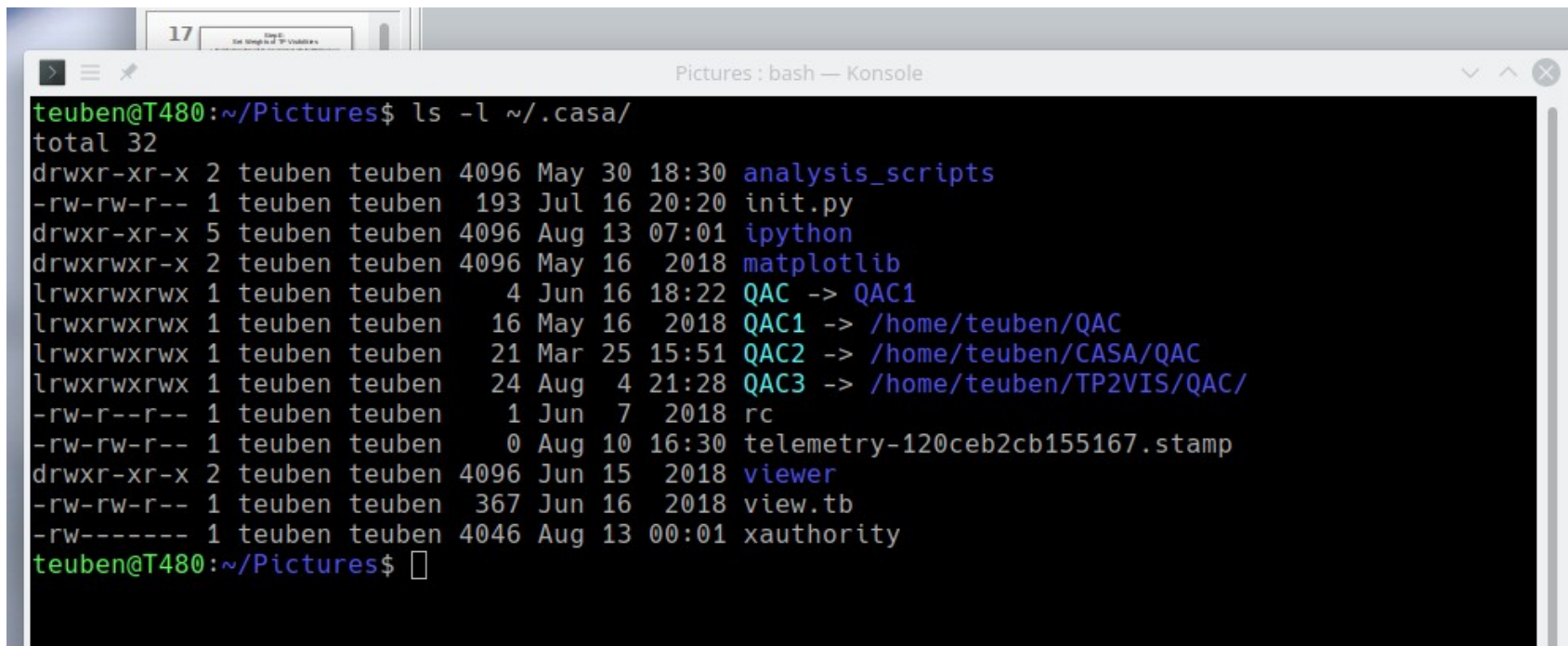
- Models:
 - You know what you put in!
 - **Skymodel**
 - Total flux
 - Power Spectral Density (PSD) index
 - Brightness Distribution Function (BDF) – e.g. Sawada et al. 2018
- Find a science goal to check on your data
 - **M100**
 - Total flux convergence
 - Cloud spectrum (clumpfind, ...)
 - Rotation curve from a moment-1 velocity field

QAC

- Installation uses a patch to **~/.casa/init.py**
 - This allows users to select which tp2vis to use
 - The public version cannot use VP=1, only **contrib/tp2vis.py**
- Benchmark:
 - CMD: **cd QAC/test ; make bench**
- Examples driven via **QAC/test/Makefile** and look for the “slideXXX” targets

~/.casa/init.py

`execfile(os.environ['HOME'] + '/.casa/QAC/casa.init.py')`



A terminal window titled "Pictures : bash — Konsole" showing the output of the command `ls -l ~/.casa/`. The window has a standard macOS-style title bar with a close button. The terminal output lists various files and directories in the `~/.casa/` directory, including `analysis_scripts`, `init.py`, `ipython`, `matplotlib`, `QAC` (with subdirectories `QAC1`, `QAC2`, and `QAC3`), `rc`, `telemetry-120ceb2cb155167.stamp`, `viewer`, `view.tb`, and `xauthority`. The permissions, owner, group, size, and date for each file are also displayed.

```
teuben@T480:~/Pictures$ ls -l ~/.casa/
total 32
drwxr-xr-x  2 teuben teuben 4096 May 30 18:30 analysis_scripts
-rw-rw-r--  1 teuben teuben  193 Jul 16 20:20 init.py
drwxr-xr-x  5 teuben teuben 4096 Aug 13 07:01 ipython
drwxrwxr-x  2 teuben teuben 4096 May 16  2018 matplotlib
lrwxrwxrwx  1 teuben teuben   4 Jun 16 18:22 QAC -> QAC1
lrwxrwxrwx  1 teuben teuben  16 May 16  2018 QAC1 -> /home/teuben/QAC
lrwxrwxrwx  1 teuben teuben  21 Mar 25 15:51 QAC2 -> /home/teuben/CASA/QAC
lrwxrwxrwx  1 teuben teuben  24 Aug  4 21:28 QAC3 -> /home/teuben/TP2VIS/QAC/
-rw-r--r--  1 teuben teuben   1 Jun  7  2018 rc
-rw-rw-r--  1 teuben teuben   0 Aug 10 16:30 telemetry-120ceb2cb155167.stamp
drwxr-xr-x  2 teuben teuben 4096 Jun 15  2018 viewer
-rw-rw-r--  1 teuben teuben  367 Jun 16  2018 view.tb
-rw-----  1 teuben teuben 4046 Aug 13 00:01 xauthority
teuben@T480:~/Pictures$
```

Running QAC

cd QAC/test

- Benchmark should work: **make bench**
 - Make sure you have symlinks to the data/ directory
 - CMD1: `cd QAC ; make data` # fetch the data (or data2)
 - CMD2: `cd QAC/test ; make data` # symlinks to the real data
 - Some more guidance in the Makefile
 - CMD1: `make sky1`
 - CMD2: `make sky2`
 - CMD3: `make sky3`


```
teuben@T480:~/QAC/test$ make -n sky3
time casa --nogui -c sky3.py pdir="sky3" > sky3.log 2>&1
cp sky3.log sky3
teuben@T480:~/QAC/test$
```

```
emac25@T480
File Edit Options Buffers Tools Makefile Help

[Icons] Save Undo [Icons] Search

test: bash test4:
export VI1=1
$(CASA) test4.py > test4.log 2>&1
tail -8 test4.log

test5:
$(CASA) test5.py > test5.log 2>&1
tail -8 test5.log

#
# 26.42user 2.87system 0:22.91elapsed 127%CPU
sky3:
$(CASA) sky3.py pdir="sky3" > sky3.log 2>&1
cp sky3.log sky3

dish3:
casa -c sky3.py test="sky_12" pixel_m=0.025
casa -c sky3.py test="sky_25" pixel_m=0.025 dish=25
casa -c sky3.py test="sky_50" pixel_m=0.025 dish=25 dish3=50
casa -c sky3.py test="sky_99" pixel_m=0.025 dish=99

dish4:
casa -c sky3.py pdir="sky3a" dish=20 > sky3a.log
casa -c sky3.py pdir="sky3b" dish=40 > sky3b.log
casa -c sky3.py pdir="sky3c" dish=40 dish3=20 > sky3c.log
casa -c sky3.py pdir="sky3d" dish=20 dish3=40 > sky3d.log
casa -c sky3.py pdir="sky3e" > sky3e.log
casa -c sky3.py pdir="sky3f" > sky3f.log # without qac_tpdish()
qac_tpdish()

dish5:
@echo Single pointing
casa -c sky3.py pdir="sky3_1" dish=20 grid=0
@echo 7 point pointing
@echo 115 pointings
casa -c sky3.py pdir="sky3_2" dish=20 grid=10 pixel_m=0.025
@echo 23 pointings
casa -c sky3.py pdir="sky3_2" dish=20 grid=10 pixel_m=0.01

-:***- Makefile<test> 71% L380 Git:master (GNUmakefile)

wfactor = 0.05 # weight factor

# -- do not change parameters below this ---
import sys
for arg in qac_argv(sys.argv):
    exec(arg)

# report, add Dtime
qac_begin(pdir)
qac_log("REPORT")
qac_version()
tp2vis_version()
qac_project(pdir)

ptg = "%s/%s.ptg" % (pdir,pdir) # pointing mosaic for the ptg

if grid > 0:
    # create a mosaic of pointings
    p = qac_im_ptg(phasecenter,imsize_m,pixel_m,grid,rect=True,outfile=ptg)
else:
    # create a single pointing
    qac_ptg(phasecenter,ptg)
    p = [phasecenter]

qac_log("TP2VIS")

if True:
    qac_tpdish('ALMATP', dish) # default in tp2vis is 12m
    qac_tpdish('VIRTUAL',dish) # default in tp2vis is 12m
    qac_vp(VP) # VP=1 means True

if grid == 0:
    qac_plot(model, mode=1, plot=pdir + '/' + model + '.png')

tpms = qac_tp_vis(pdir,model,ptg,phasecenter=phasecenter,deconv=False,maxuv=5*dish/6.
0,nvgrp=nvgrp,fix=0)
tp2viswt(tpms,wfactor,'multiply')
tp2vispl(tpms,outfig=pdir+'/tp2vispl.png')

qac_clean1(pdir + '/clean0', tpms, imsize_s, pixel_s, phasecenter=phasecenter, niter=
aniter)

-:--- sky3.py 29% L82 Git:master (Python)
```

sky1b.log vs. sky1a.log - TkDiff 4.2

File Edit View Mark Merge Help

1 : 30c30

Merge: Diff: Mark:

sky1b/sky1b.log

```
2 =====
3 The start-up time of CASA may vary
4 depending on whether the shared libraries
5 are cached or not.
6 =====
7
8 []0;IPython: QAC/test[]IPython 5.1.0 -- An enhanced Interactive Python.
9
10 CASA 5.5.0-149 -- Common Astronomy Software Applications
11
12 Found an existing telemetry logfile: /home/teuben/.casa/casastats-550-149-120ceb2cb155167-
13 Telemetry initialized. Telemetry will send anonymized usage statistics to NRAO.
14 You can disable telemetry by adding the following line to your ~/.casarc file:
15 EnableTelemetry: False
16 QAC: Root /home/teuben/.casa/QAC
17 QAC: Load src/qac.py
18 QAC: Load src/ssc.py
19 QAC: Load src/plot.py
20 QAC: Load contrib/tp2vis.py
21 QAC: Skip distribute/tp2vis.py
22 QAC: Skip tp2vis/tp2vis.py
23 QAC: qac: version 5-aug-2019
24 qac_root: /home/teuben/.casa/QAC
25 casa:5.5.0-149
26 data:/home/teuben/QAC/casa/casa-release-5.5.0-149.el7/data
27 None
28 Added au
29 --> CrashReporter initialized.
30 !QAC_PROJECT sky1b
31
```

sky1a/sky1a.log

```
2 =====
3 The start-up time of CASA may vary
4 depending on whether the shared libraries
5 are cached or not.
6 =====
7
8 []0;IPython: QAC/test[]IPython 5.1.0 -- An enhanced Interactive Python.
9
10 CASA 5.5.0-149 -- Common Astronomy Software Applications
11
12 Found an existing telemetry logfile: /home/teuben/.casa/casastats-550-149-120ceb2cb155167-
13 Telemetry initialized. Telemetry will send anonymized usage statistics to NRAO.
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18 QAC: Load src/ssc.py
19 QAC: Load src/plot.py
20 QAC: Load contrib/tp2vis.py
21 QAC: Skip distribute/tp2vis.py
22 QAC: Skip tp2vis/tp2vis.py
23 QAC: qac: version 5-aug-2019
24 qac_root: /home/teuben/.casa/QAC
25 casa:5.5.0-149
26 data:/home/teuben/QAC/casa/casa-release-5.5.0-149.el7/data
27 None
28 Added au
29 --> CrashReporter initialized.
30 !QAC_PROJECT sky1a
31
```

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sky1b.log vs. sky1a.log - TkDiff 4.2

File Edit View Mark Merge Help

2 : 39c39 Merge: Diff: Mark:

sky1b/sky1b.log

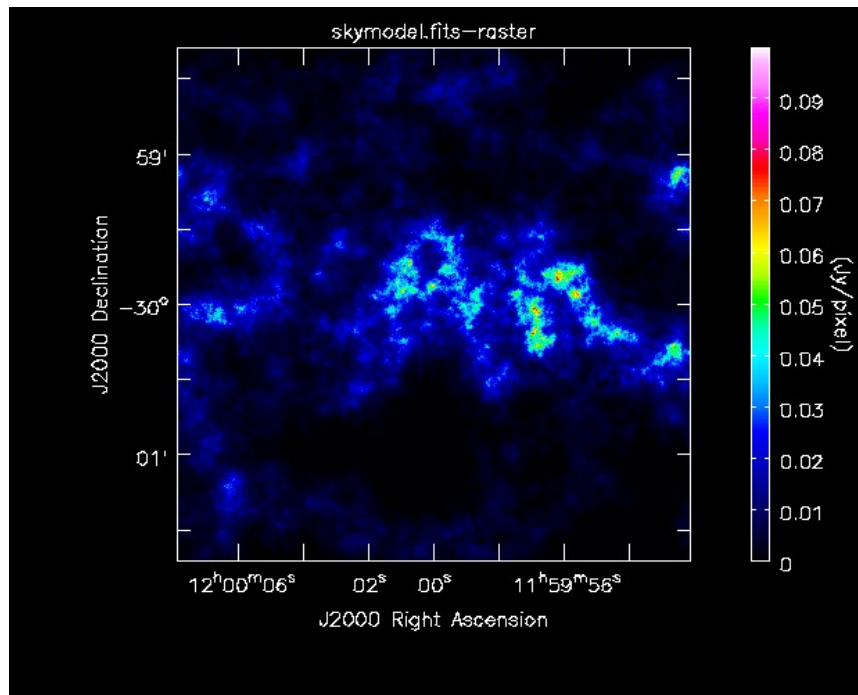
```
7
8 []0;IPython: QAC/test[]IPython 5.1.0 -- An enhanced Interactive Python.
9
10 CASA 5.5.0-149 -- Common Astronomy Software Applications
11
12 Found an existing telemetry logfile: /home/teuben/.casa/casastats-550-149-120ceb2cb155167-
13 Telemetry initialized. Telemetry will send anonymized usage statistics to NRAO.
14 You can disable telemetry by adding the following line to your ~/.casarc file:
15 EnableTelemetry: False
16 QAC: Root /home/teuben/.casa/QAC
17 QAC: Load src/qac.py
18 QAC: Load src/ssc.py
19 QAC: Load src/plot.py
20 QAC: Load contrib/tp2vis.py
21 QAC: Skip distribute/tp2vis.py
22 QAC: Skip tp2vis/tp2vis.py
23 QAC: qac: version 5-aug-2019
24 qac_root: /home/teuben/.casa/QAC
25 casa:5.5.0-149
26 data:/home/teuben/QAC/casa/casa-release-5.5.0-149.el7/data
27 None
28 Added au
29 --> CrashReporter initialized.
30 !QAC PROJECT sky1b
31
32 ===== QAC: REPORT
33
34 qac: version 5-aug-2019
35 qac_root: /home/teuben/.casa/QAC
36 casa:5.5.0-149
```

sky1a/sky1a.log

```
7
8 []0;IPython: QAC/test[]IPython 5.1.0 -- An enhanced Interactive Python.
9
10 CASA 5.5.0-149 -- Common Astronomy Software Applications
11
12 Found an existing telemetry logfile: /home/teuben/.casa/casastats-550-149-120ceb2cb155167-
13 Telemetry initialized. Telemetry will send anonymized usage statistics to NRAO.
14 You can disable telemetry by adding the following line to your ~/.casarc file:
15 EnableTelemetry: False
16 QAC: Root /home/teuben/.casa/QAC
17 QAC: Load src/qac.py
18 QAC: Load src/ssc.py
19 QAC: Load src/plot.py
20 QAC: Load contrib/tp2vis.py
21 QAC: Skip distribute/tp2vis.py
22 QAC: Skip tp2vis/tp2vis.py
23 QAC: qac: version 5-aug-2019
24 qac_root: /home/teuben/.casa/QAC
25 casa:5.5.0-149
26 data:/home/teuben/QAC/casa/casa-release-5.5.0-149.el7/data
27 None
28 Added au
29 --> CrashReporter initialized.
30 !QAC PROJECT sky1a
31
32 ===== QAC: REPORT
33
34 qac: version 5-aug-2019
35 qac_root: /home/teuben/.casa/QAC
36 casa:5.5.0-149
```

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QAC: skymodel.fits (4k x 4k map)



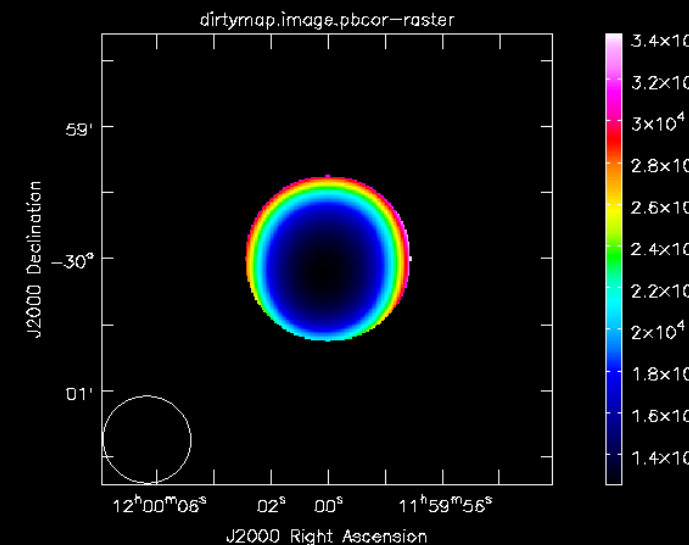
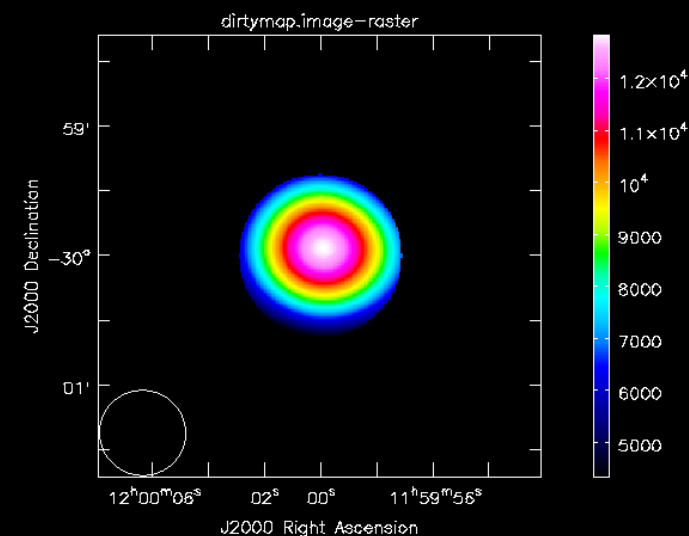
- 4096 x 4096
- Jy/Pixel
- Total flux: 113.1 kJy

Note: **skymodel_16k.fits** has 262.9 MJy

QAC slide 1: – 1 beam

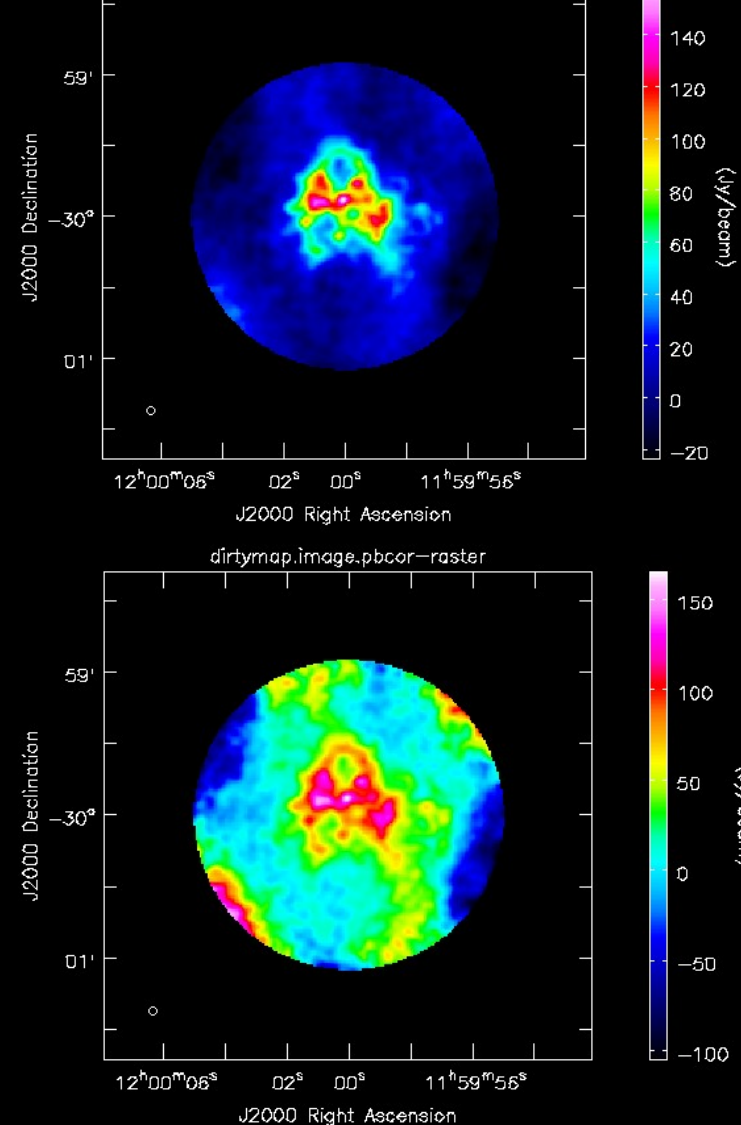
- One pointing
- CMD: **sky3.py grid=0**
 - Flux = 21.9 kJy
 - Flux = 46.8 kJy (pbcor)
- “Slide 2” explores mosaic
- Get a better PBCOR?

CMD: `cd QAC/test; make slide1`



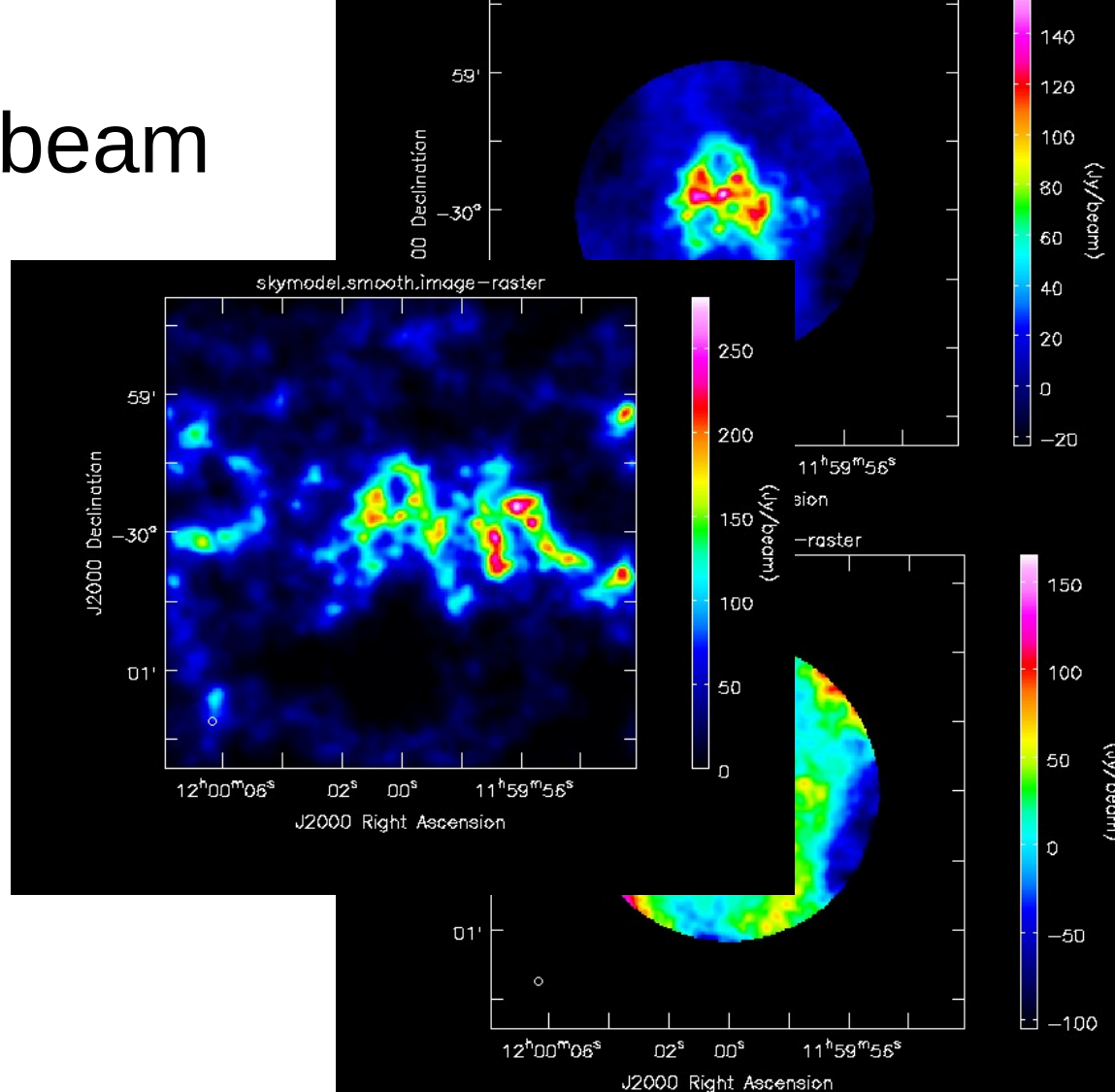
QAC slide 3: – 1 beam

- Due to a “bug” TP2VIS can use bigger dish:
- CMD: **sky3.py dish=211**
 - Resolution matches C43-1
 - Flux = 15.6 kJy
 - Flux = 21.0 kJy (pbcor)
 - Flux = 112.3 kJy (smooth map)



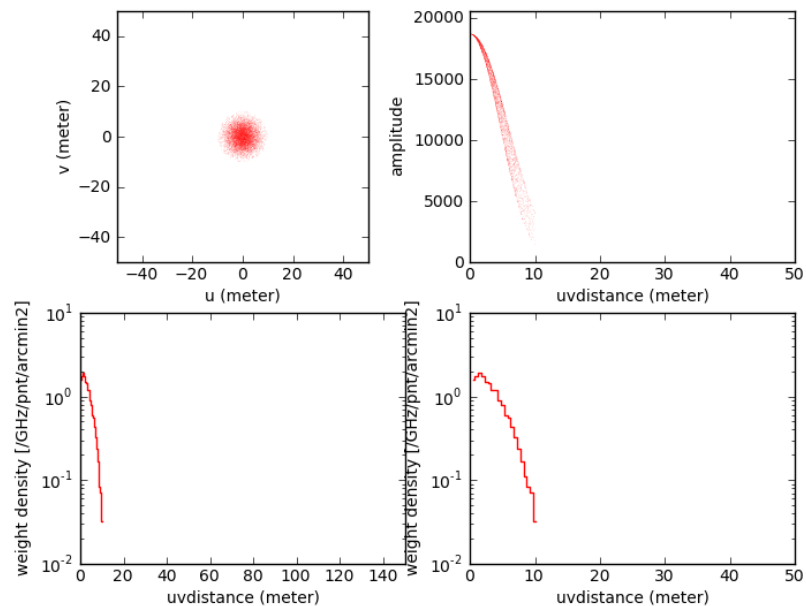
QAC slide 3: – 1 beam

- Due to a “bug” TP2VIS can use bigger dish:
- CMD: **sky3.py dish=211**
 - Resolution matches C43-1
 - Flux = 15.6 kJy
 - Flux = 21.0 kJy (pbcor)
 - Flux = 112.3 kJy (smooth map)

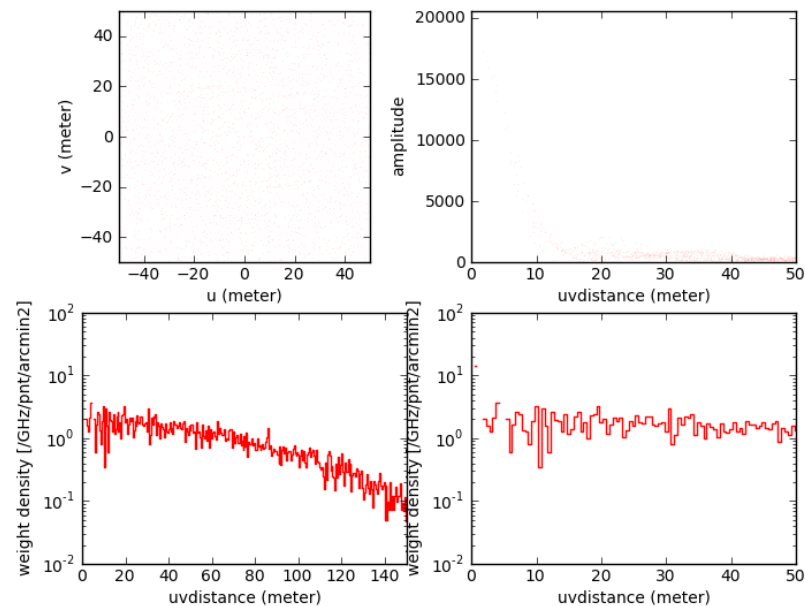


TP2VISPL: plot visibilities

dish=12



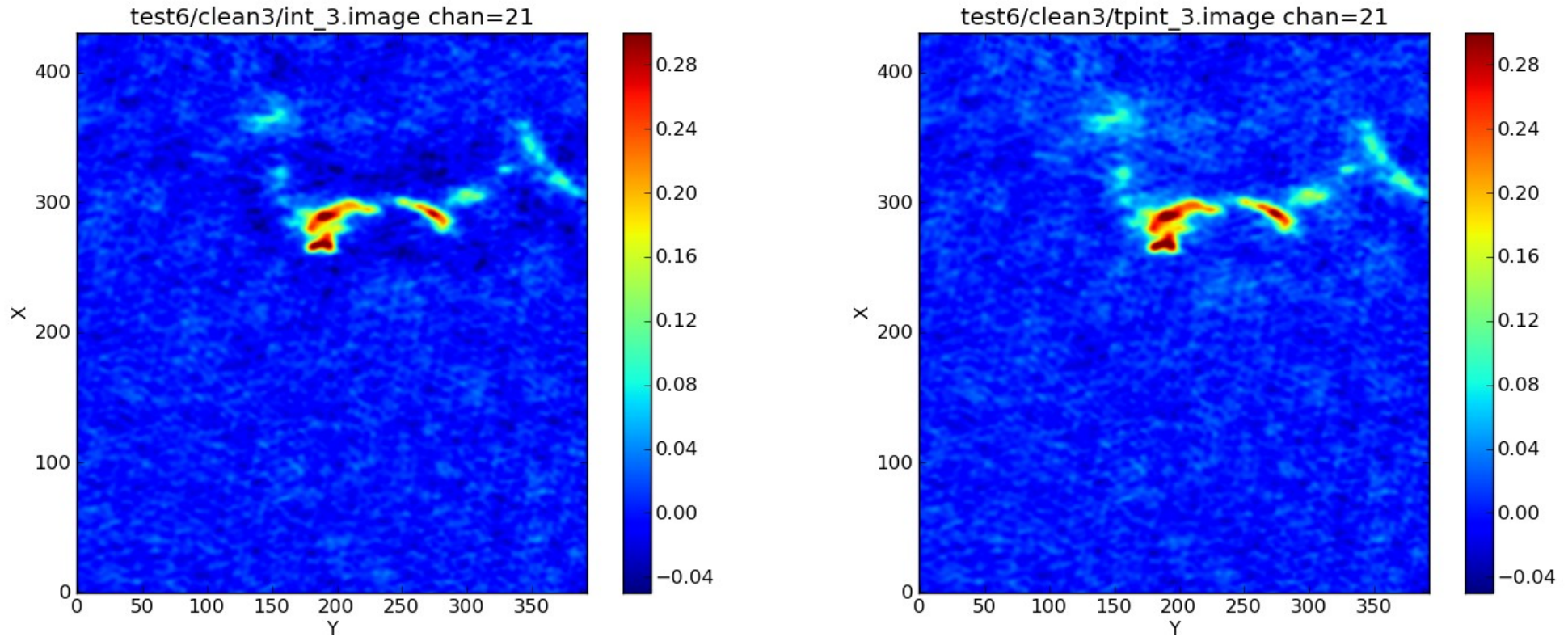
dish=211



Some QAC functions:

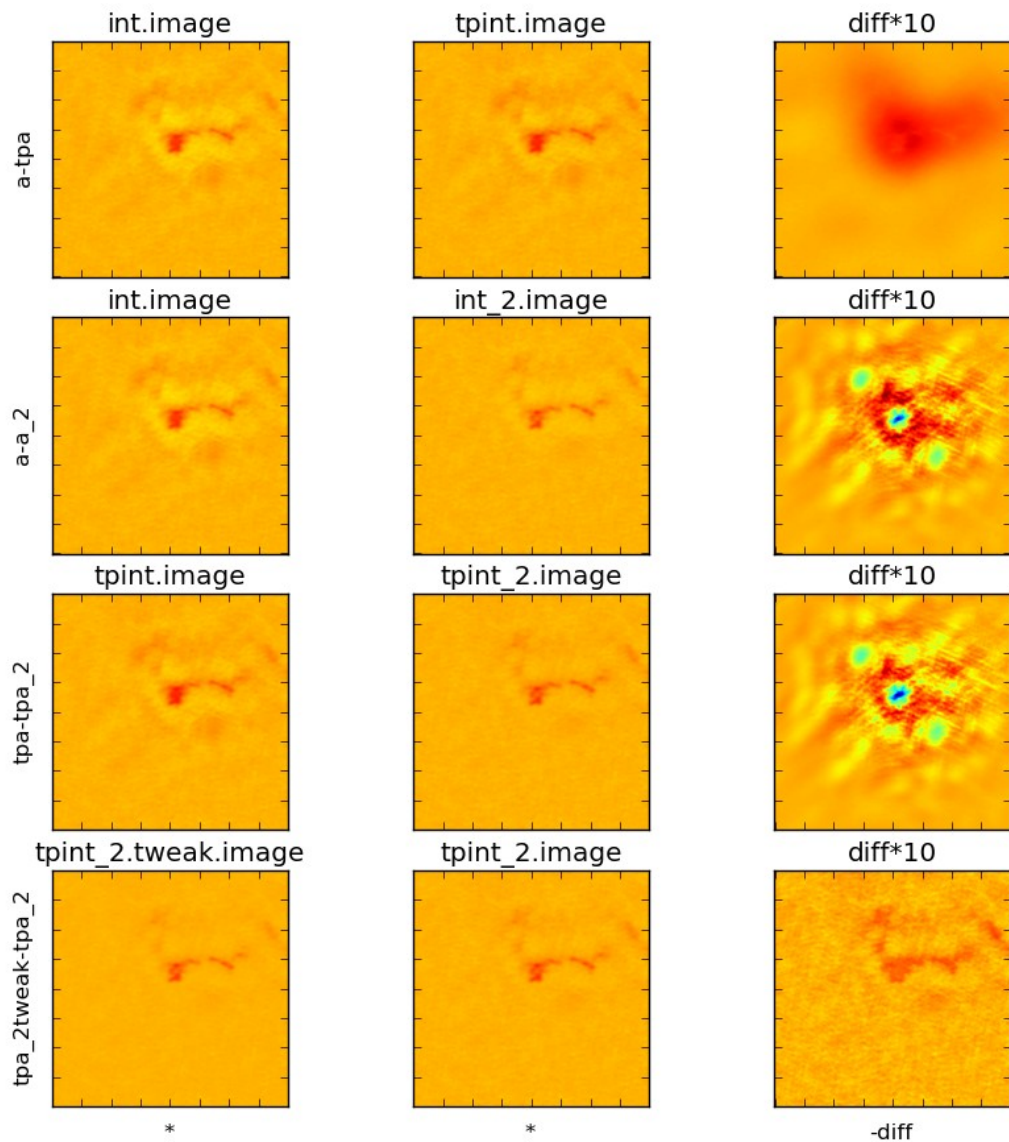
- qac_tp_vis
- qac_sd_vis
- qac_alma
- qac_vla
- qac_clean
- qac_tweak
- qac_feather
- qac_ssc
-
- qac_stats
- qac_fidelity
- qac_mom
- qac_plot_grid
- qac_beam
- qac_flux
- qac_psd

qac_plot



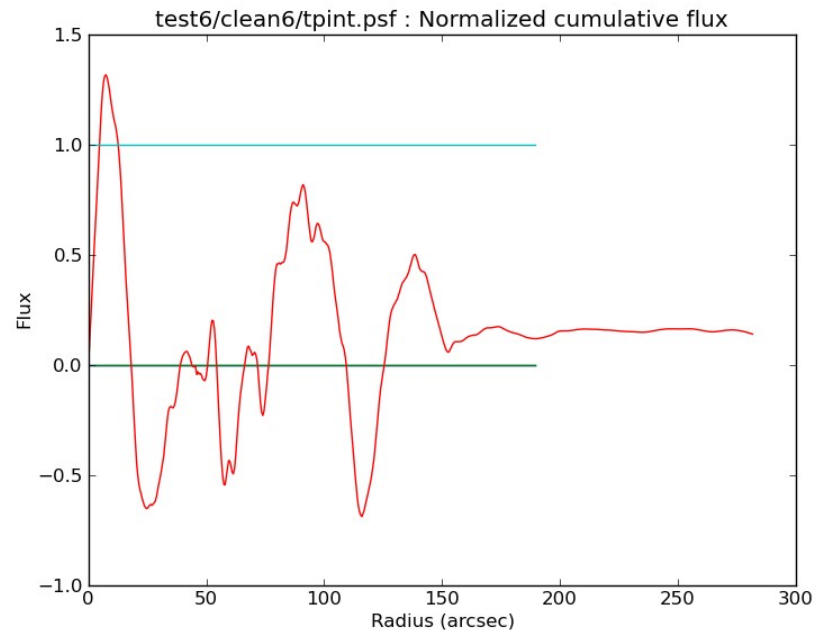
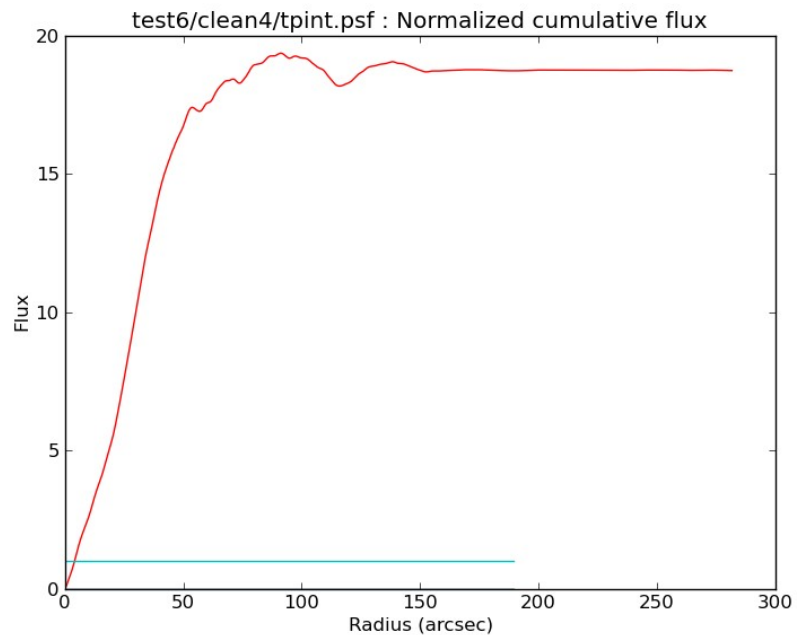
qac_plot('test6/clean3/tpint_3.image', channel=21, range=[-0.05,0.3],box=boxlist,plot='M100_fig4f.png')
(see workflow6.py)

qac_plot_grid



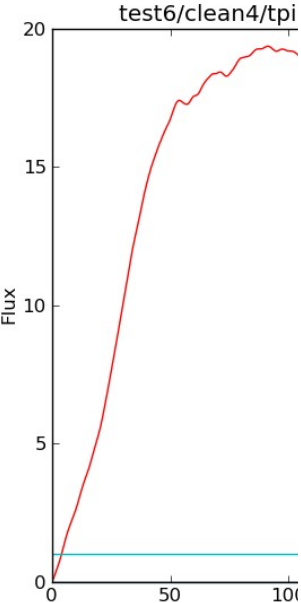
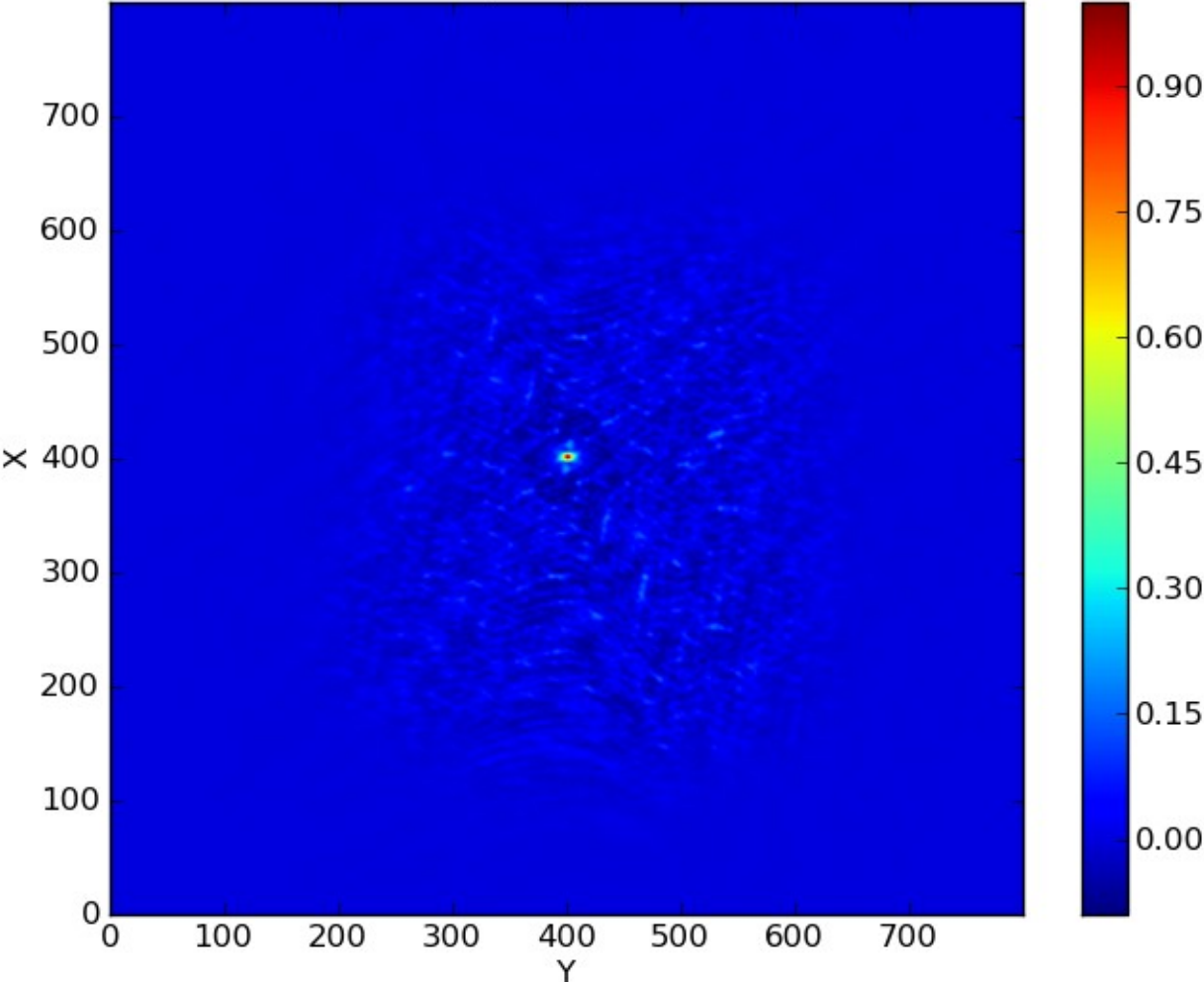
See: “make benchplot”

qac_beam

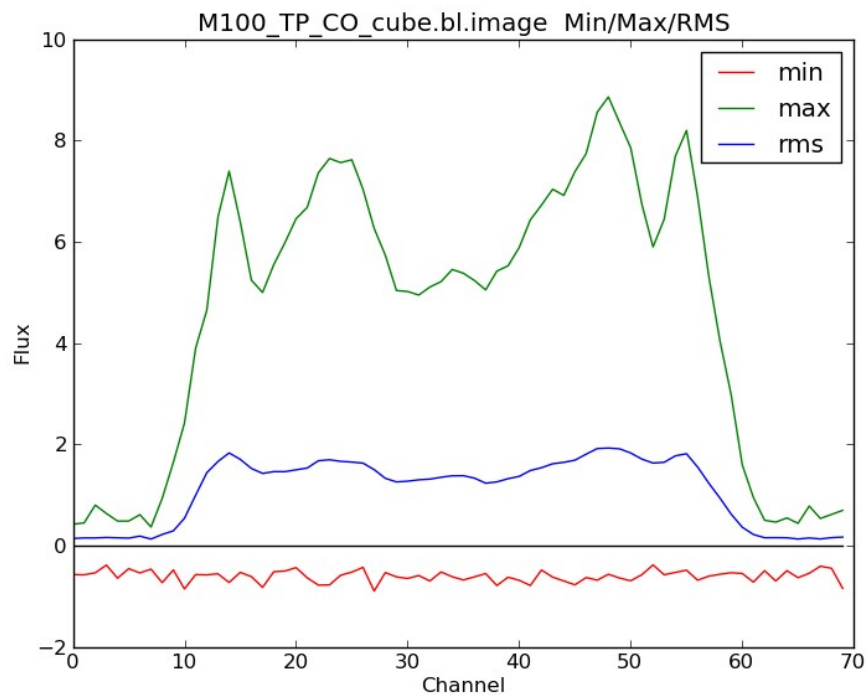


See: “make workflow6”

clean4/tpint.psf chan=0

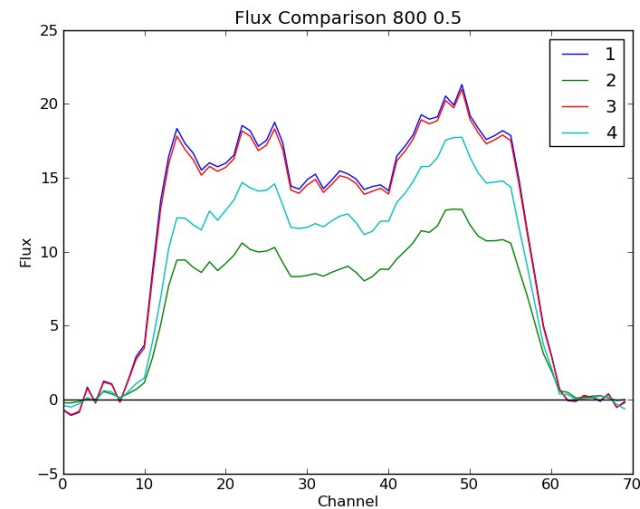


qac_flux

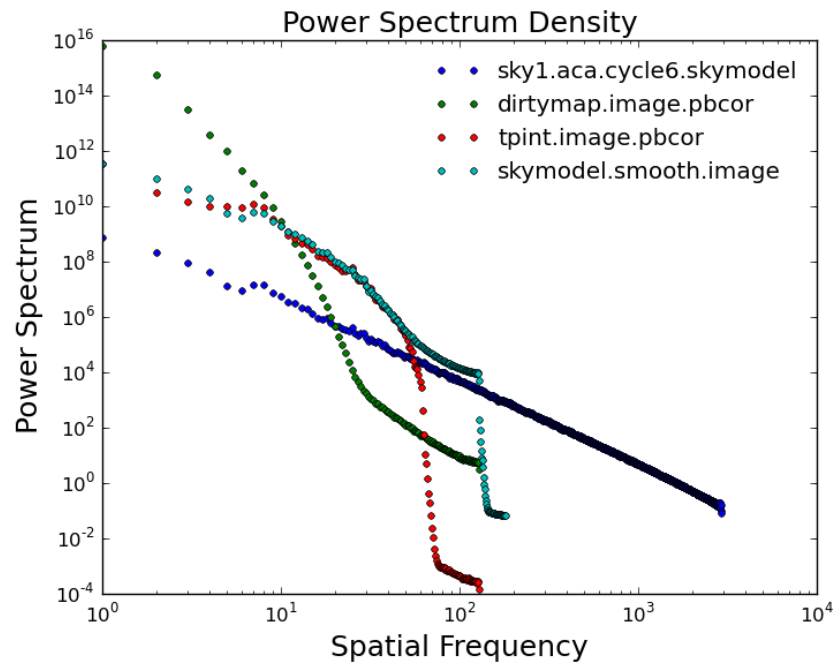


Sum: 322.825 Jy km/s (1 km/s)

See: workflow6.py



qac_psd



See: sky1.py

Projects

- Add another QAC method
 - Kauffmann using startmodel= ?
 - Adam's feather
- M100 with tp2vis
 - Amp scaling of 7m?
- Test and/or fix VP=1
- Find better PB for TP
 - The .pbcor file looks bad
- Look at dc2019/issues
 - <https://github.com/teuben/dc2019/issues>
 -
- Advanced Science Goals
 - Skymodel PSD
 - M100 Rotation Curve
 -
- Add strong POINT or GAUSS models to skymodel