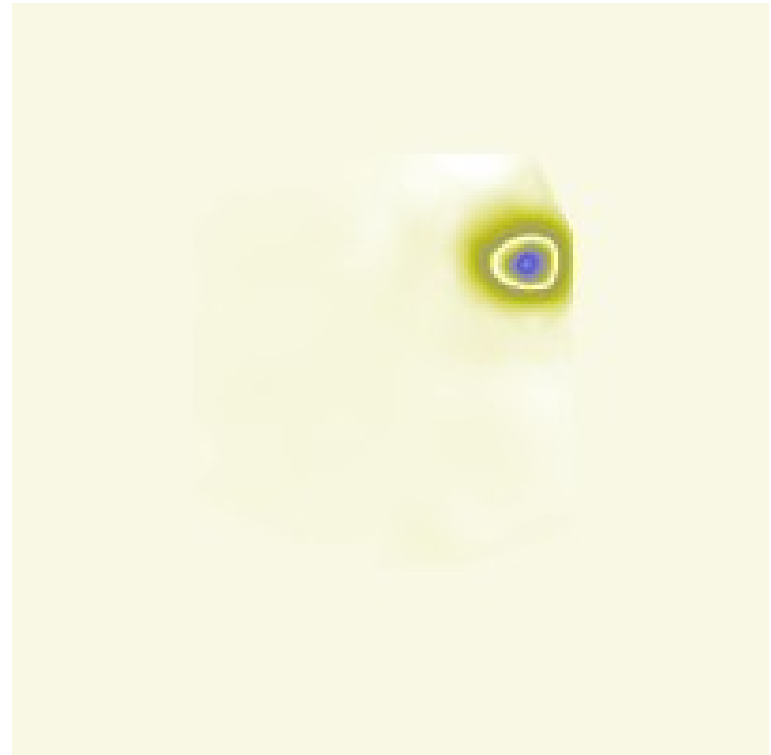


NIKA run 2 offline processing

F.-X. Désert (IPAG) on behalf of the NIKA team



Mars 1mm A channel 18/10

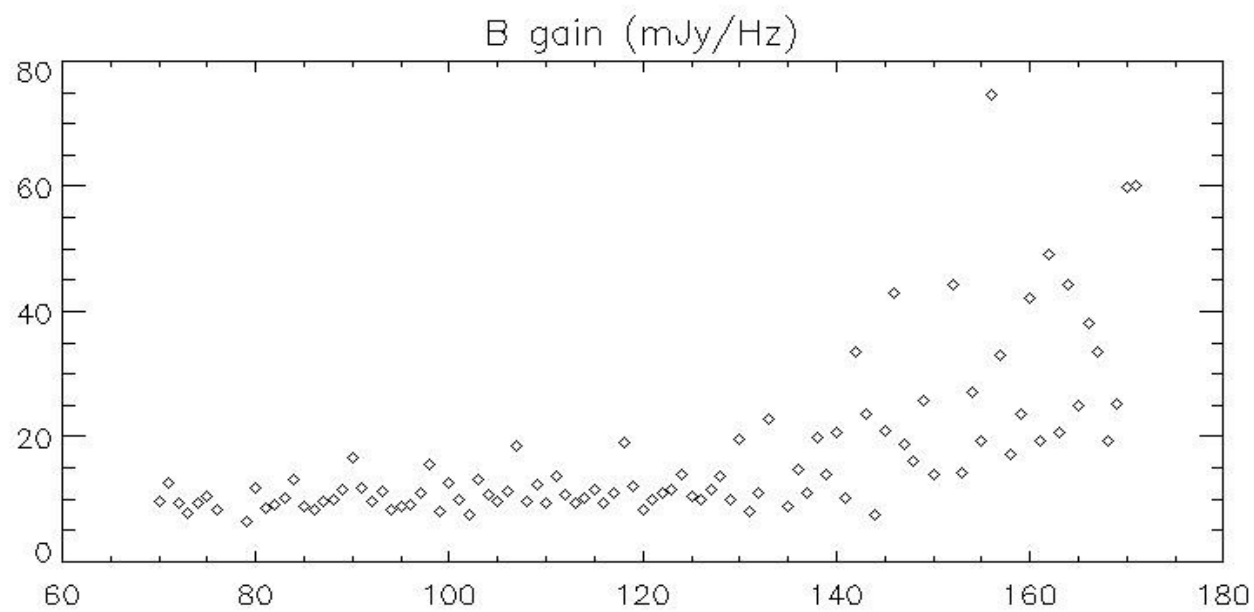
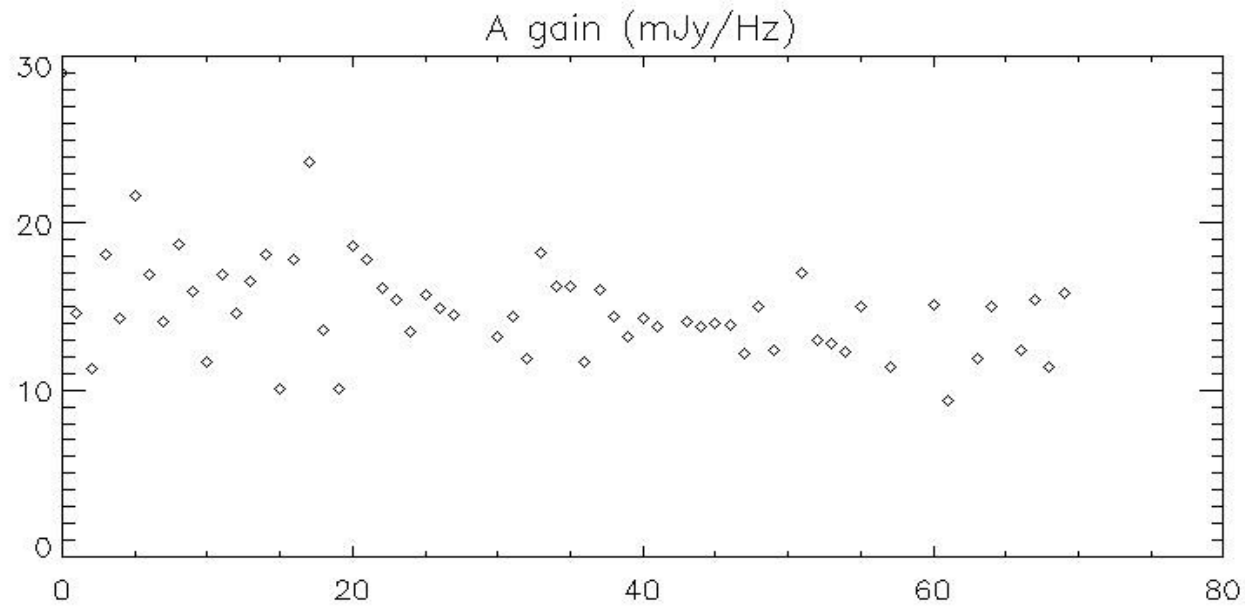
2mm B channel
NIKArun2 IRAM meeting 20101126 FXD

Characteristics

- 224 TOI outputs
- 172 kids - 12 (optical double, blind,bad)
- And 24+10 off resonance data, 18 undef
- 62 at 1mm , 98 at 2mm (valid pixels)
- FWHM: 12", 15.5"
- Pointing accuracy determination:
<2 arcsecond per detector
- Array pointing accuracy: < 1arcsec

Calibration

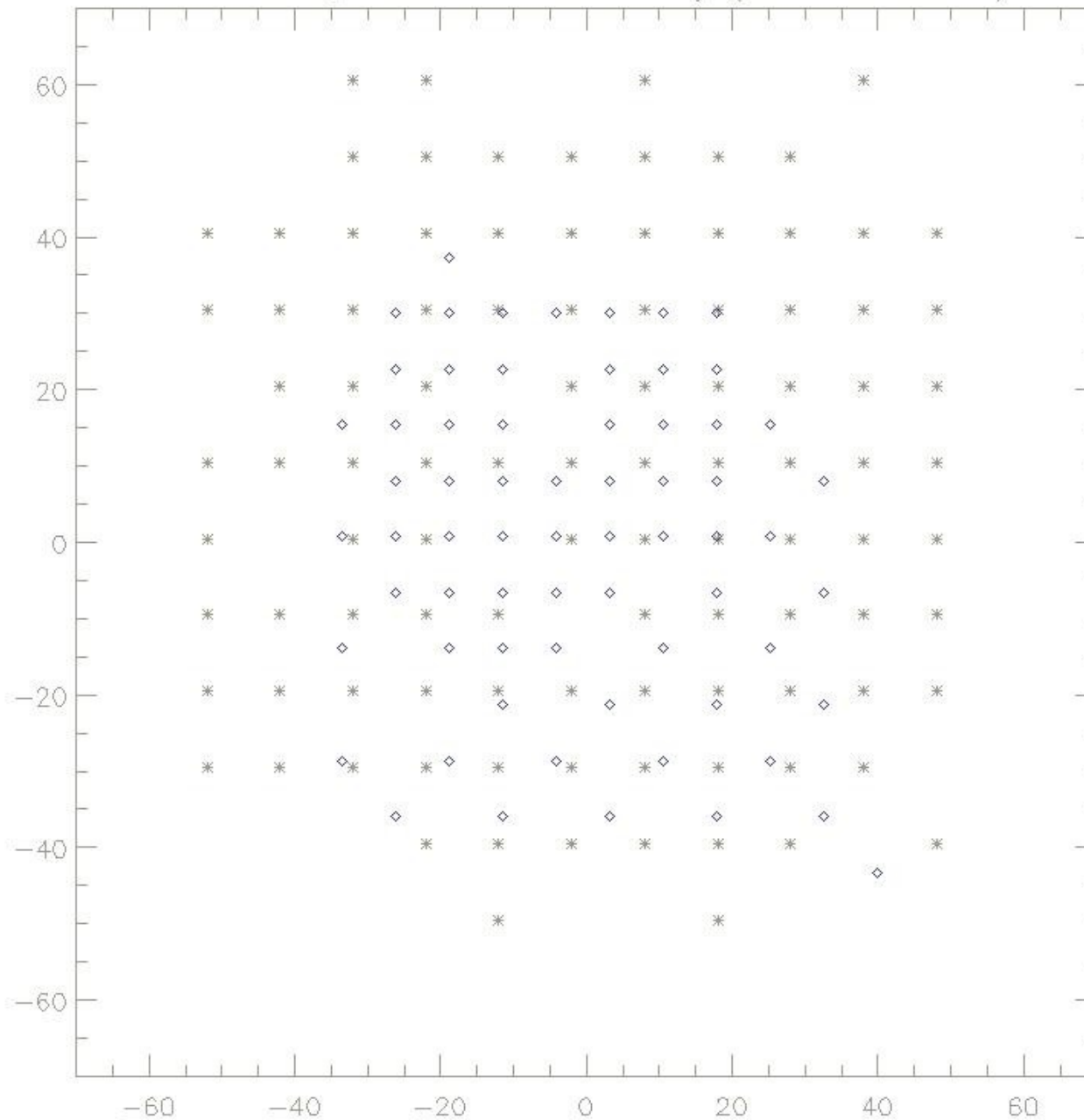
- Only using RF signal. An improved method wrt run1.
- RF is response in frequency. Assumed to be linear with power
- Typically, from I, Q, get complex phase on the calibration circle, then translate to the equivalent frequency shift, as measured during kid tuning (at least one per source).



Focal Plane geometry

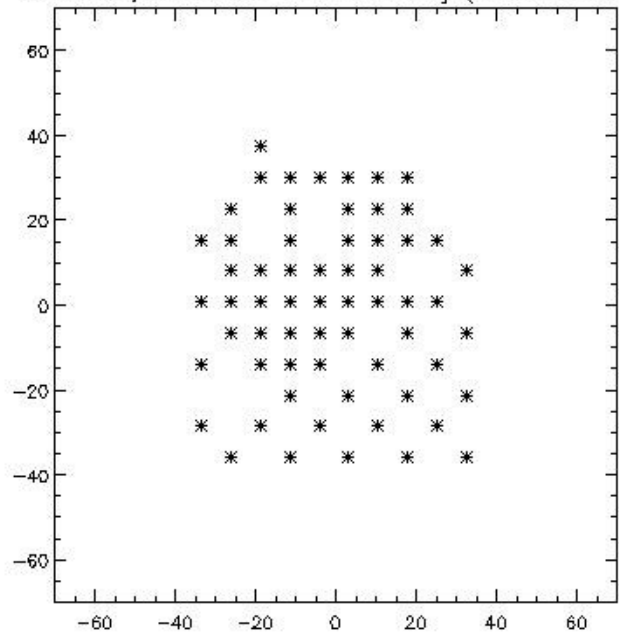
- On the 18th October 2010, the final best geometry was obtained.
- It includes an offset (X, Y), a rotation and a scaling
- Offset between two arrays is B-A: 0", -1"

NIKA 2010, Focal Plane Geometry (Nasmith arcsec)

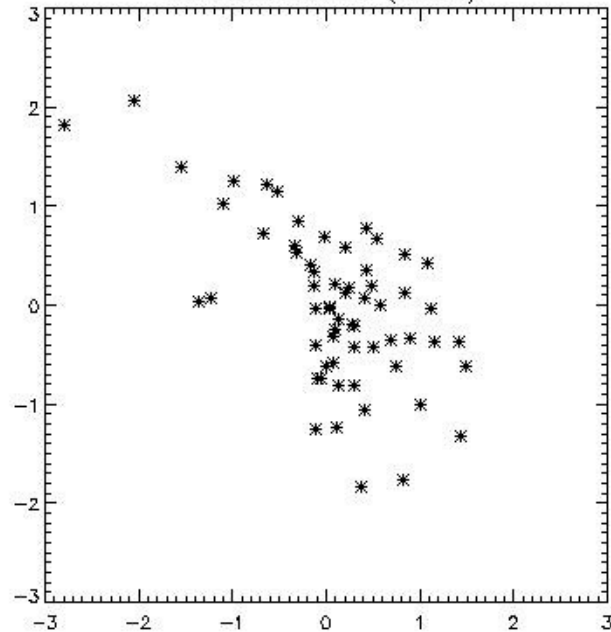


Diamonds:
A at 1mm
Stars:
B at 2mm

NIKA 2010, 1mm Focal Plane Geometry (Nasmith arcsec)

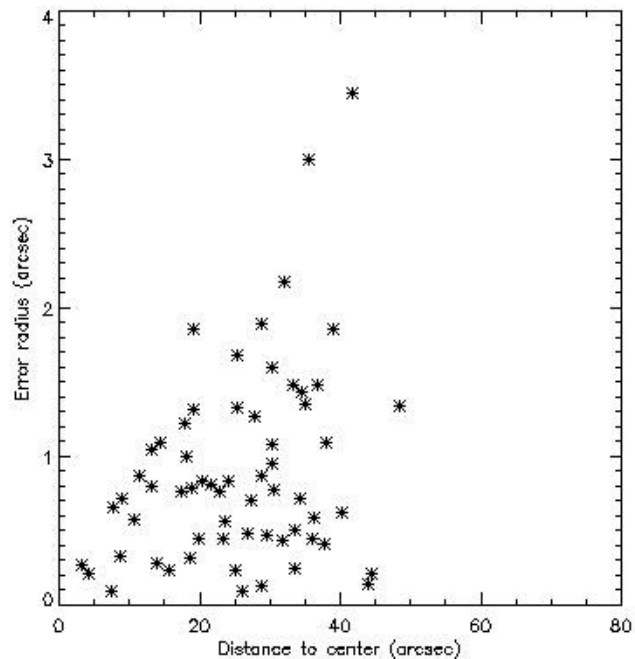
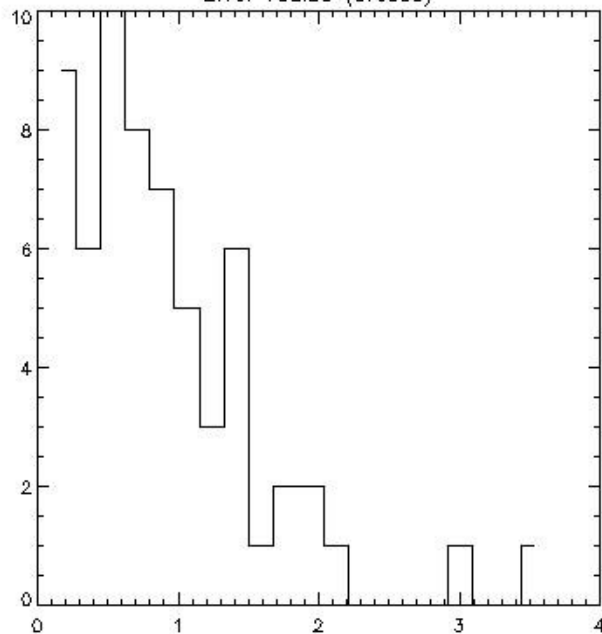


Azel Position error (arcsec)

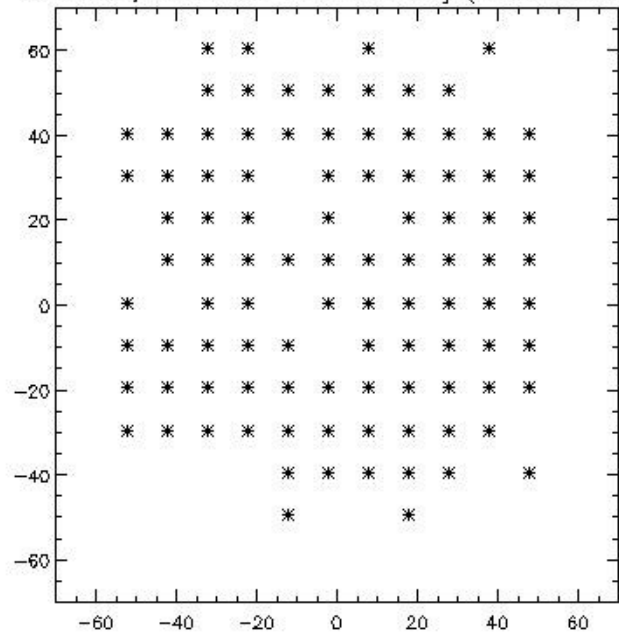


Average
misposition
1.1 arcsec
Determined
on Mars
20101018
Scan 129

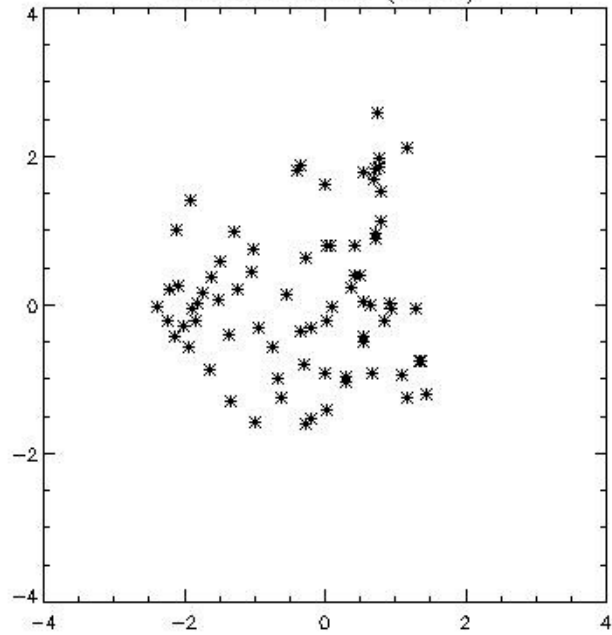
Error radius (arcsec)



NIKA 2010, 2mm Focal Plane Geometry (Nasmyth arcsec)

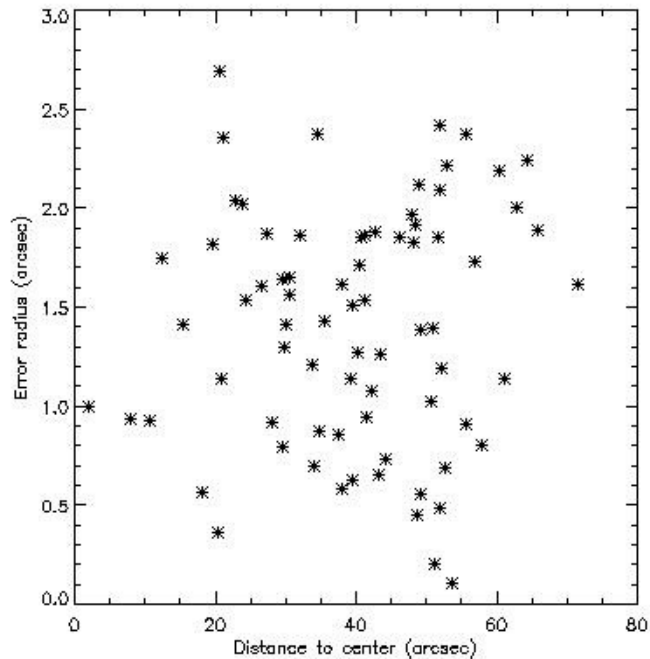
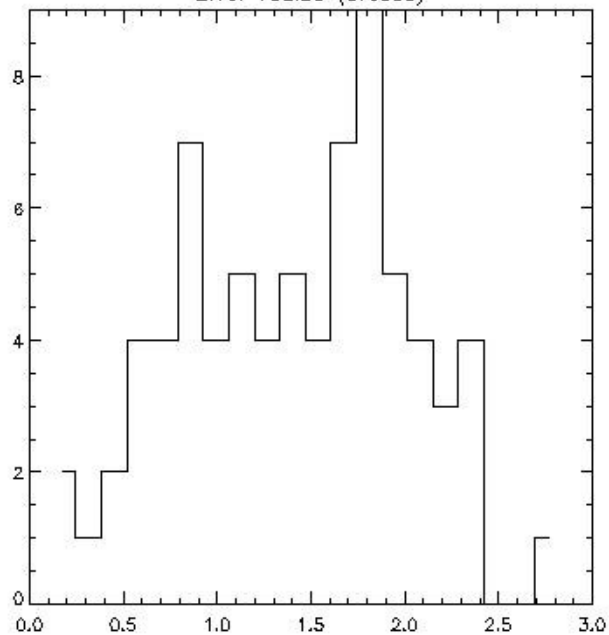


Azel Position error (arcsec)



Average
misposition
1.5 arcsec

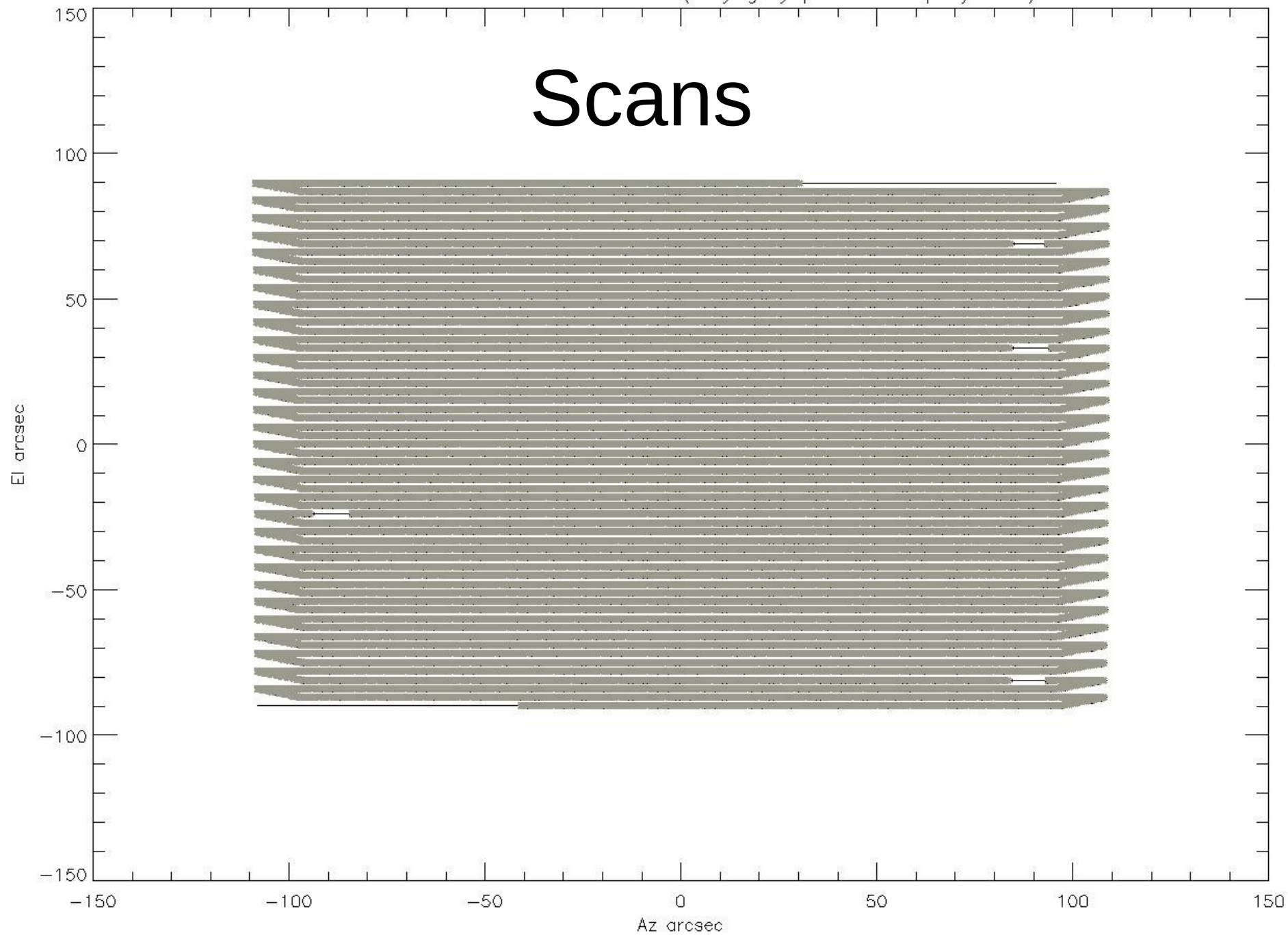
Error radius (arcsec)



Pointing

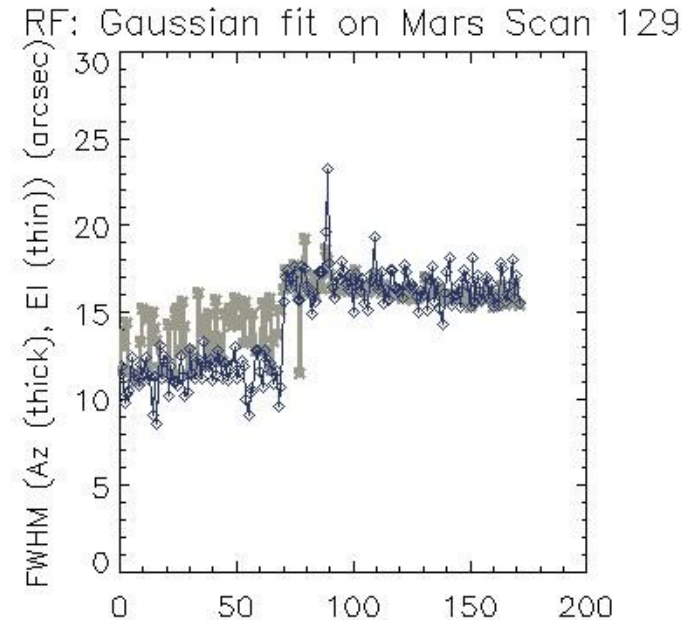
- A full pointing solution was not established
- We rely on EMIR pointing model
- From source to source, we can measure 1 to 2 arcsecond pointing corrections (not actuated on the telescope)
- We propagate the most recent planet/quasar offset corrections in AzEl to the observed source offline.
- Focus data: QLA reduced. Not redone yet.

Scans



Beams

- Width 12.5 & 16 arcsec
- Dispersion ~ 1 arcsec
- Total beam (not done)



Photometry

- Done with fixed width gaussian of 12 and 19 arcsec FWHM

- Linearity

Using planets : 10% reproducibility within a planet

Neptune (19.5, 7.4 Jy) vs Uranus (54.8, 20.7):

Found 16.9, 7.0 Jy *i.e.* 15% precision

MWC349: see below

- intercalibration (aka flat field) to be done
- Use Tau225GHz, a ν^2 law and the elevation to correct for opacity effects
- Skydips not reduced.
- OnOff (wobbler) data not reduced

20101018, using Mars

2 scans on MWC349

RFA	Flux from final map is	2.9079 +- 0.0695
RFB	Flux from final map is	1.3585 +- 0.0100
RFA	Flux from final det avg is	2.8946 +- 0.1657
RFB	Flux from final det avg is	1.3121 +- 0.0608
Chi2 is	9.86318 165.398 5.40503 30.0968	
ARF Flux evolution	2.8507 2.9987	
ARF Flux Error evolution	0.0881 0.1130	
BRF Flux evolution	1.3455 1.3820	
BRF Flux Error evolution	0.0128 0.0162	
NEFD (mJy.s ^{1/2} /beam) A&B	2529.9 1364.2	
Total Exposure Time (s)	504	
Valid data integration time (and ratio with Exp Time)	473 0.940	
Total Telescope time (and ratio with Exp Time)	681 1.353	

20101019, using Uranus

2 scans #200 and #201 MWC349

RFA	Flux from final map is	1.8091 +- 0.0213
RFB	Flux from final map is	0.9765 +- 0.0024
RFA	Flux from final det avg is	1.7773 +- 0.0736
RFB	Flux from final det avg is	1.0003 +- 0.0474
Chi2 is	10.8586 530.067	11.2759 251.169
ARF Flux evolution	1.7671	1.8606
ARF Flux Error evolution	0.0286	0.0317
BRF Flux evolution	0.9882	0.9780
BRF Flux Error evolution	0.0031	0.0036
NEFD (mJy.s ^{1/2} /beam) A&B	1098.8	1064.8
Total Exposure Time (s)	504	
Valid data integration time (and ratio with Exp Time)	495	0.983
Total Telescope time (and ratio with Exp Time)	703	1.396

; Pixelisation influence is at the 2% level

; The fluxes are off the official values (2.01 and 1.49 Jy) by 12% and 30%

; But they are stable

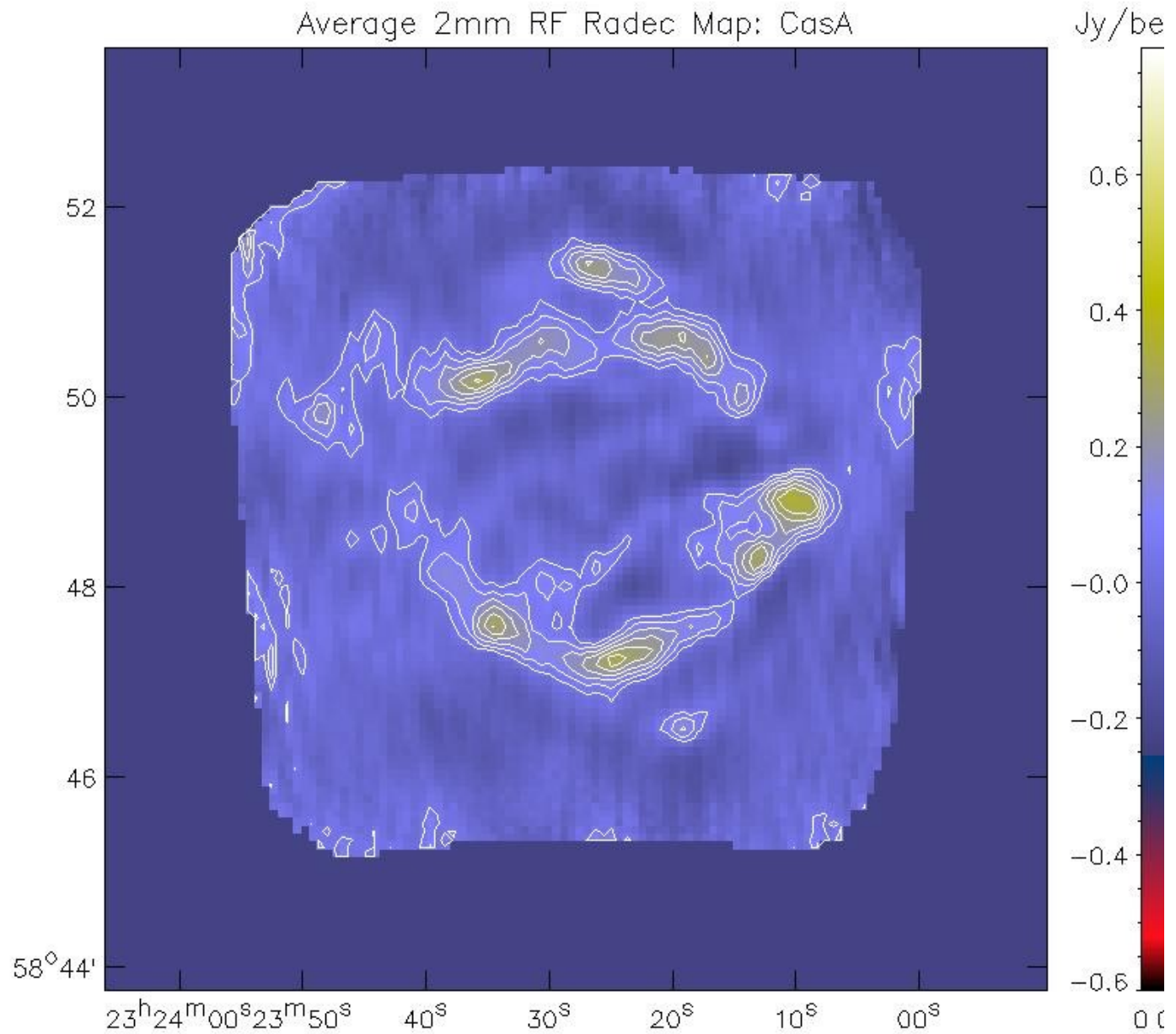
Map-Making

- An individual map per kid per scan is produced with interpolation to the 4 nearest grid points.
- Pointing is done by offsetting with the Focal Plane Geometry from on-the-fly (Evlin) center coordinates.
- Noise is evaluated at the detector map level by histogram fitting (after outliers are removed). Noise is corrected for the pixel correlation.
- Maps are done in AzEl and RaDec independently. Conversion from AzEl to RaDec done with home-made parallactic angle. Checked on several unambiguous sources.

Filtering

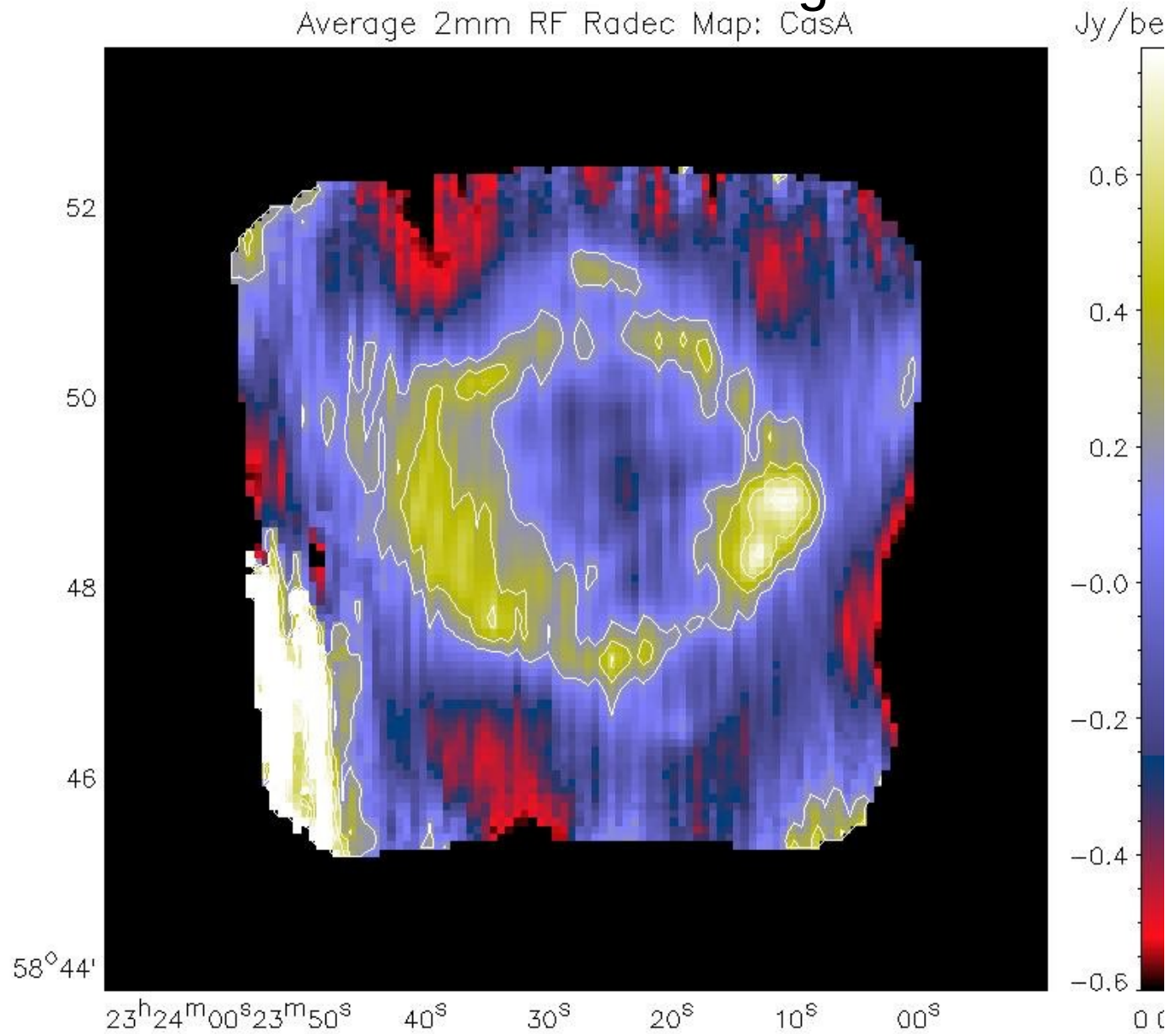
- Necessary to remove the zero level
- The standard value is by 110 arcsec with a boxcar filter.
- Bandpass for sky noise decorrelation is 10-110 arcsec.
- Only strong sources are masked (no bias for the detection of weak sources).
Photometric efficiency is taken into account

Effect of baseline filtering 110"

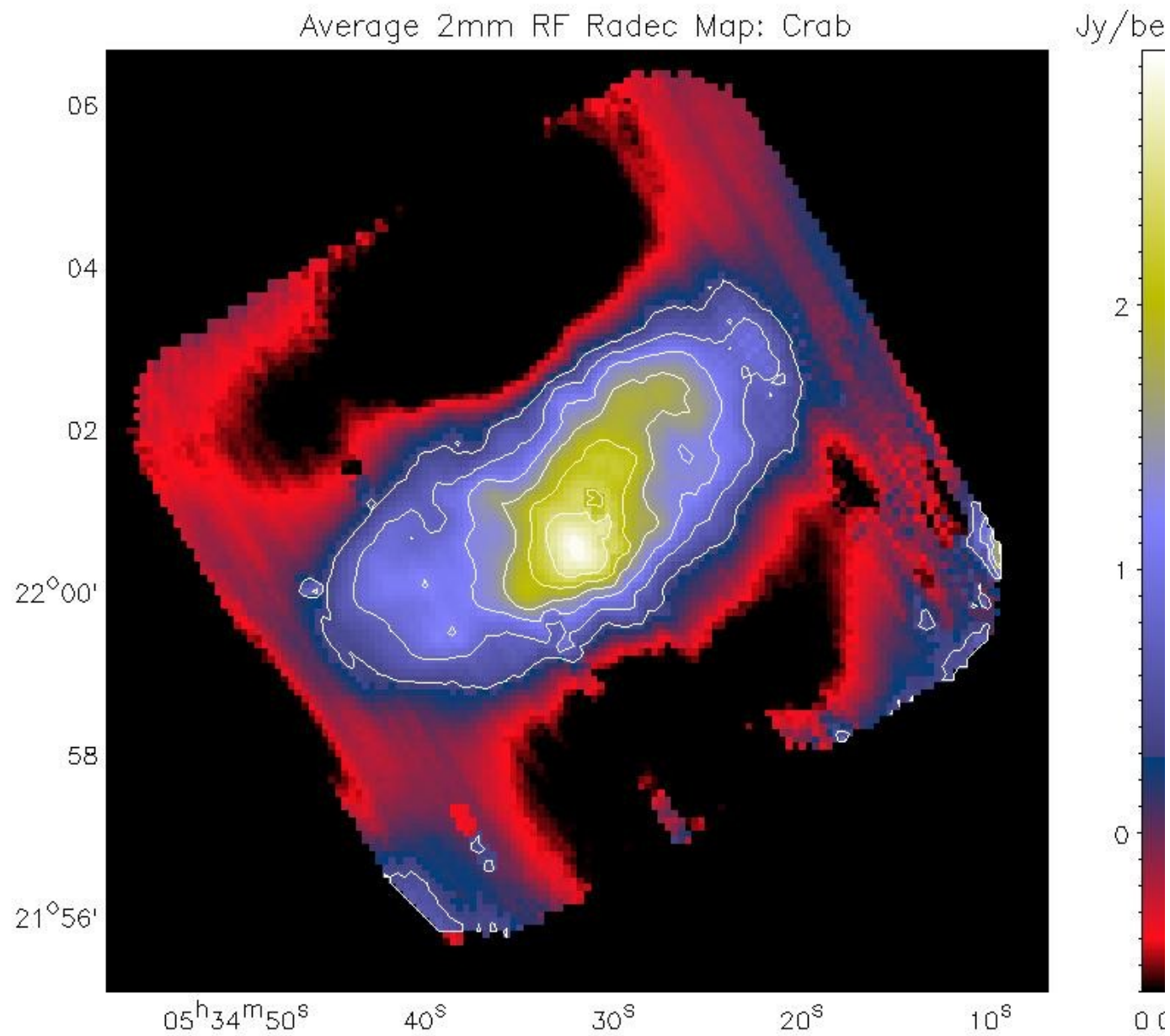


Effect of baseline filtering 440"

Average 2mm RF Radec Map: CasA



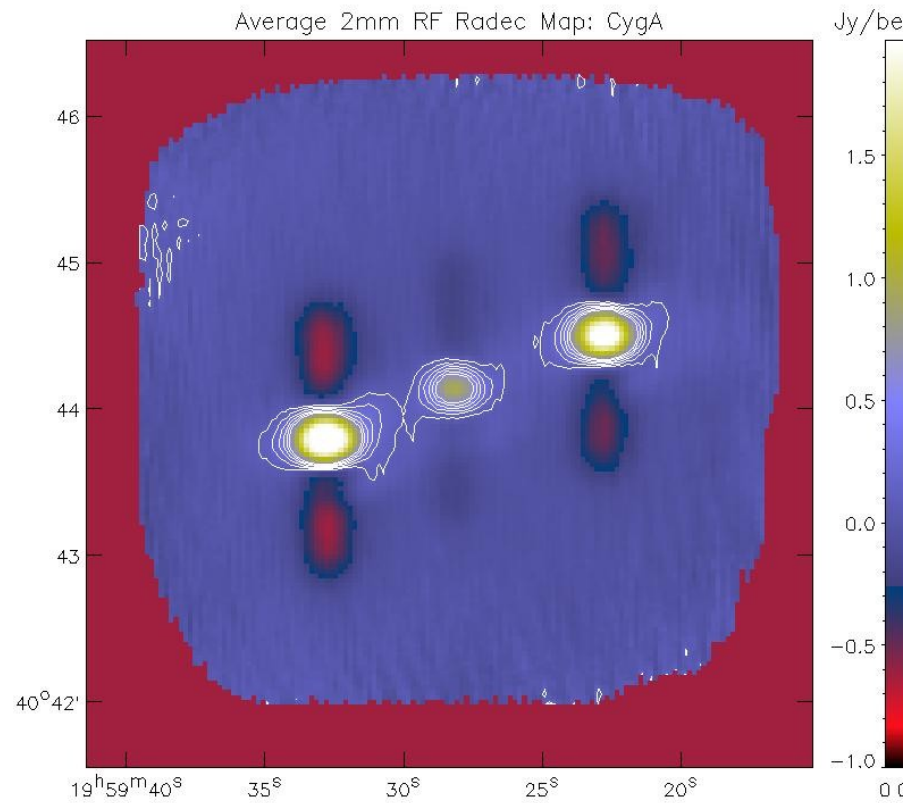
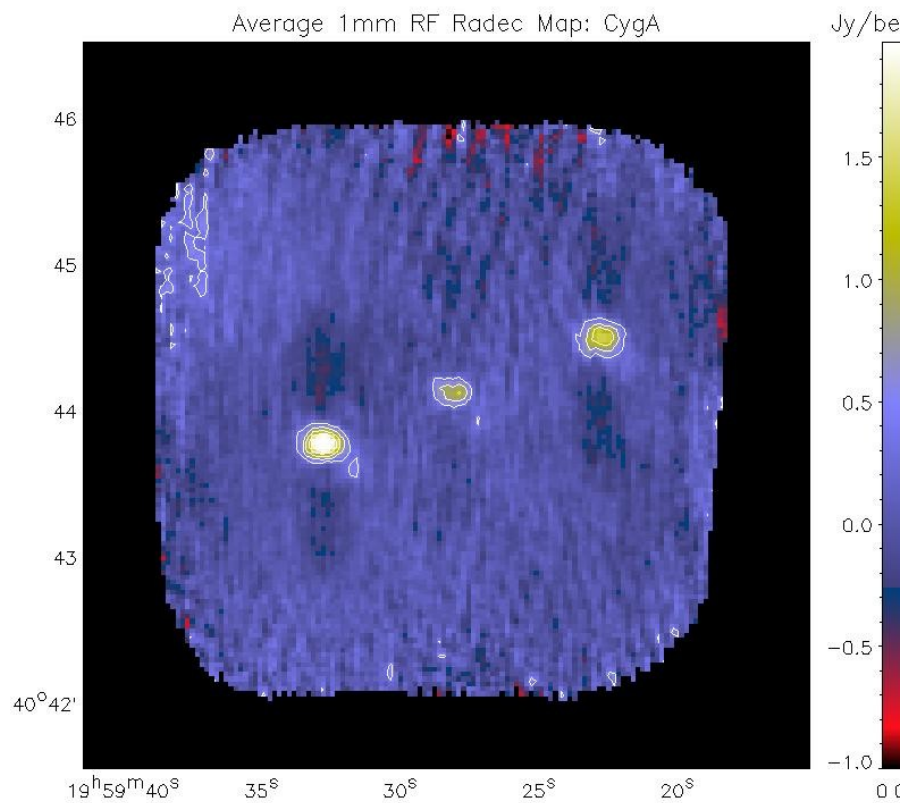
Average 2mm RF Radec Map: Crab



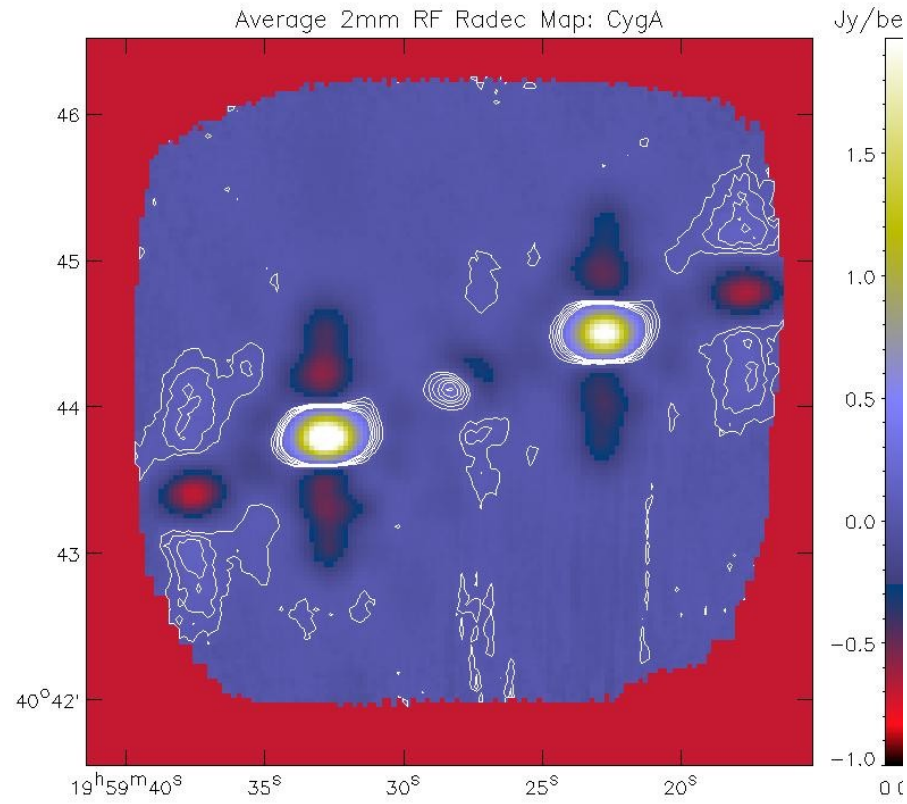
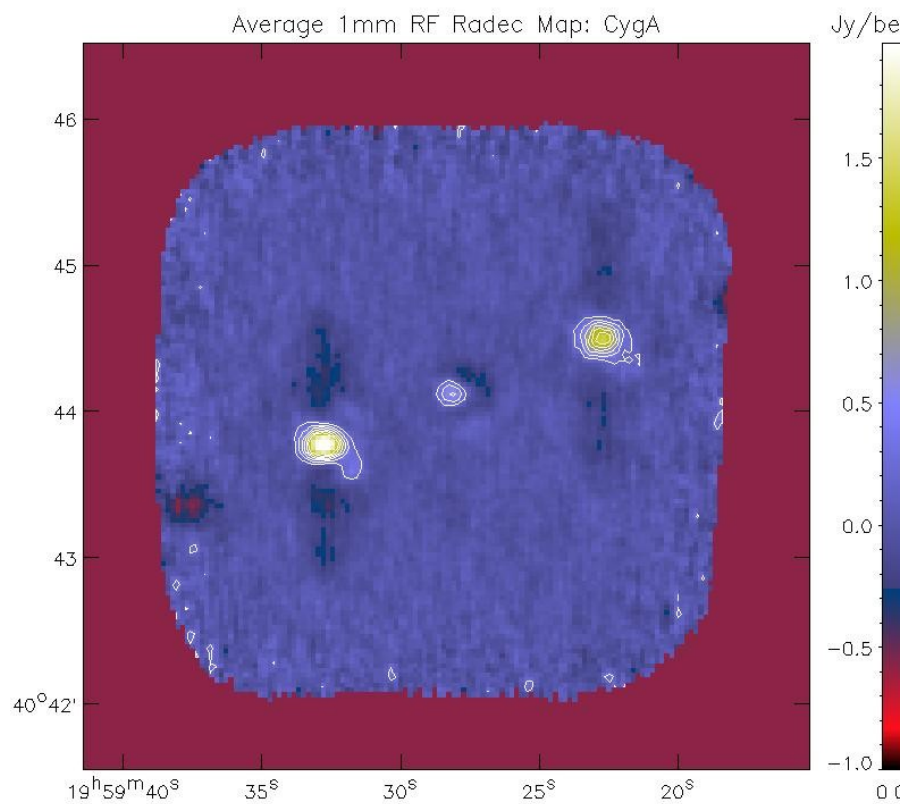
Noise components

- Glitches: 4 per detector per scan (6 min), can be 10 times that for some scans
- Jumps: 1 jump per detector per scan
- So far just mask the timeline around events in the processing
- Electronic noise: use of off-resonance (I not RF) signal to decorrelate
- Sky noise: use M pixels far from the given i pixel to decorrelate (irrespective of wavelength). Here use 25" avoidance radius.

Cygnus A without sky noise decorrelation

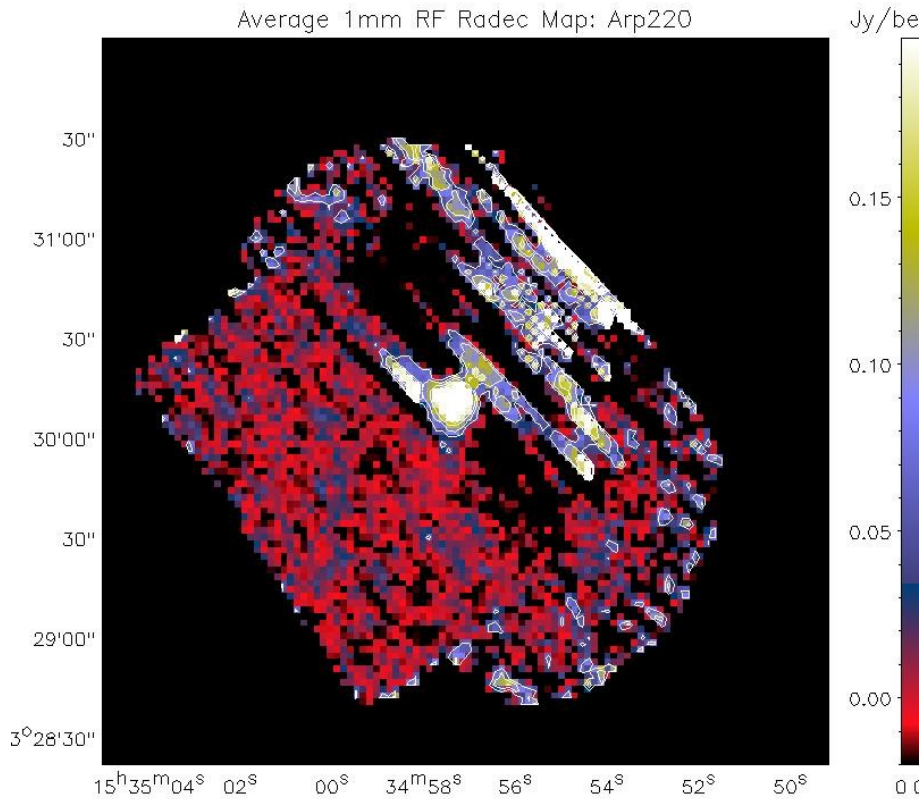


Cygnus A with sky noise decorrelation

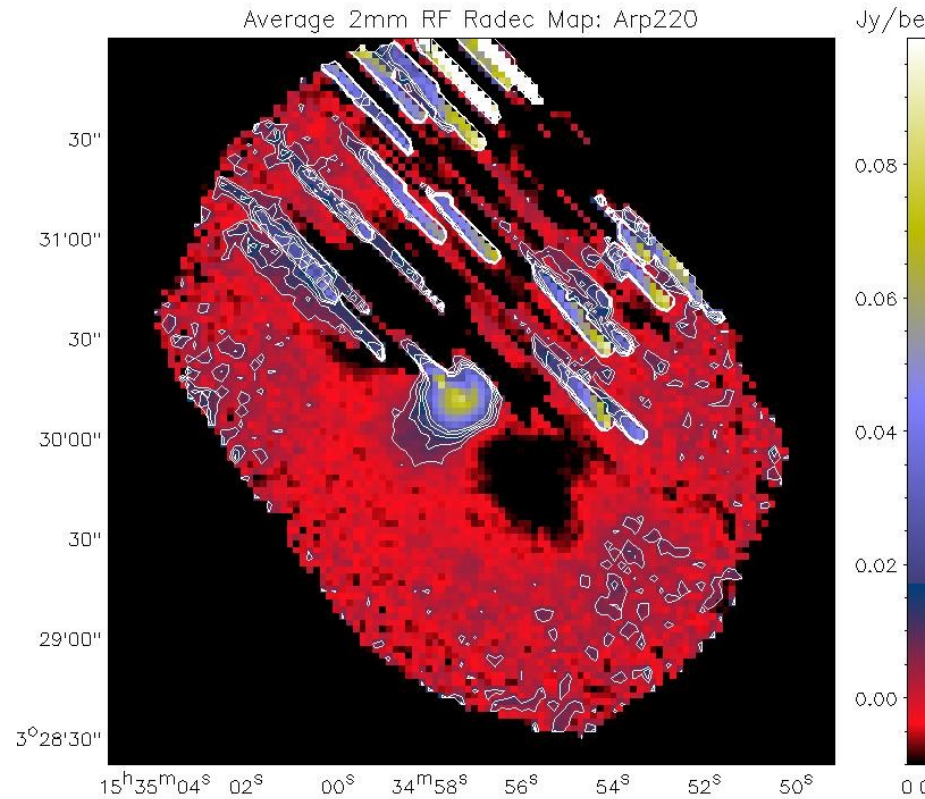


Effects of glitch/jumps/masking

Average 1mm RF Radec Map: Arp220



Average 2mm RF Radec Map: Arp220



Noise Performance

- Method of measurement

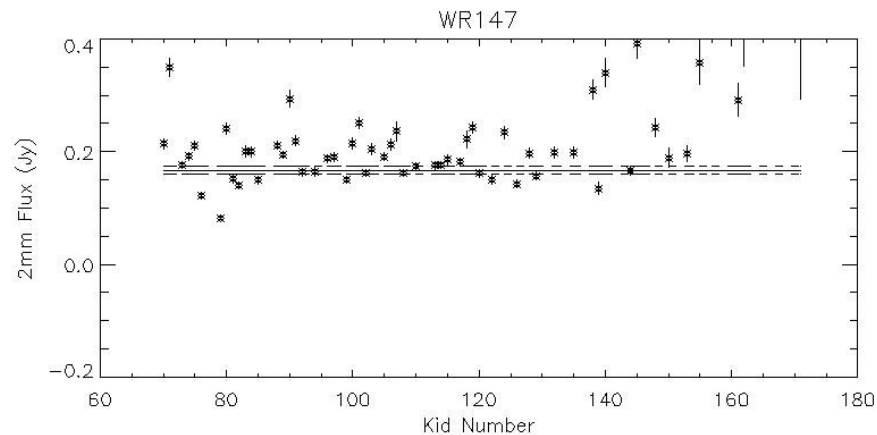
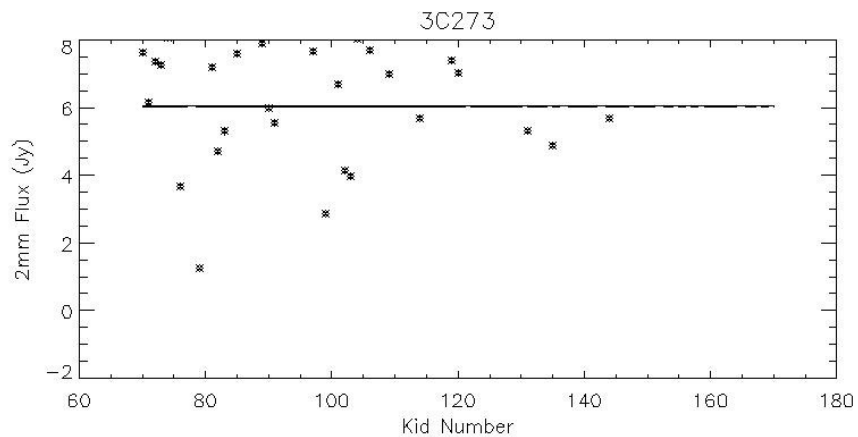
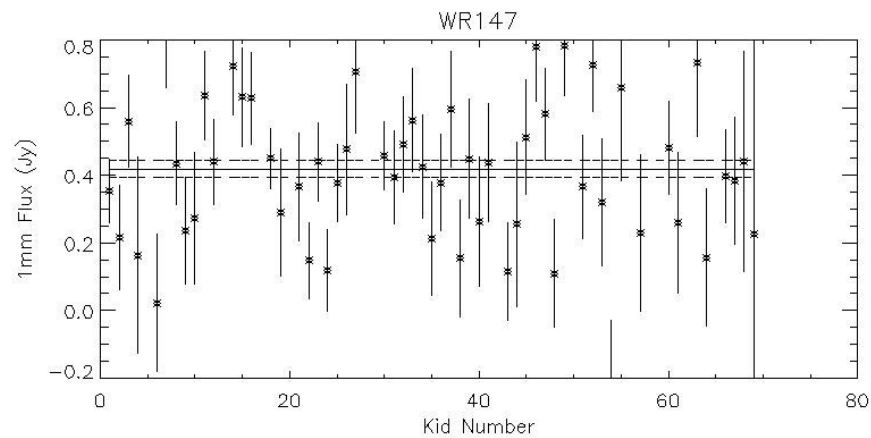
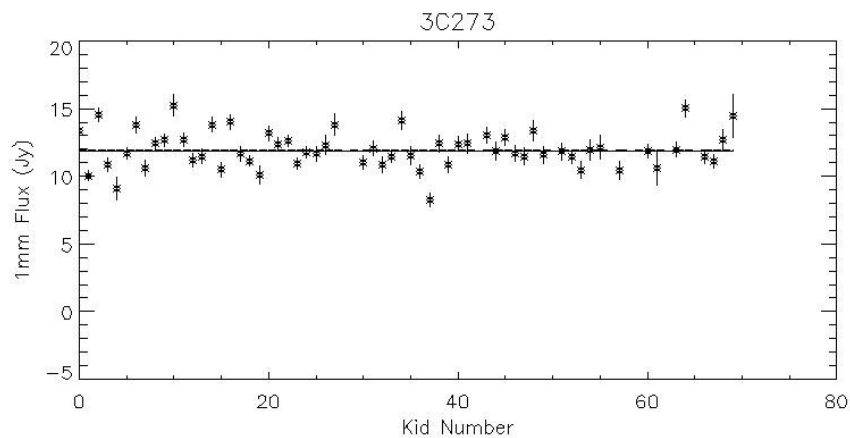
Either propagate the noise from
detector/scan noise maps

or

Measure dispersion of flux between
different detectors in the final map

- Results: Effective sensitivity taking into
account time spent on the source.

Dispersion of flux

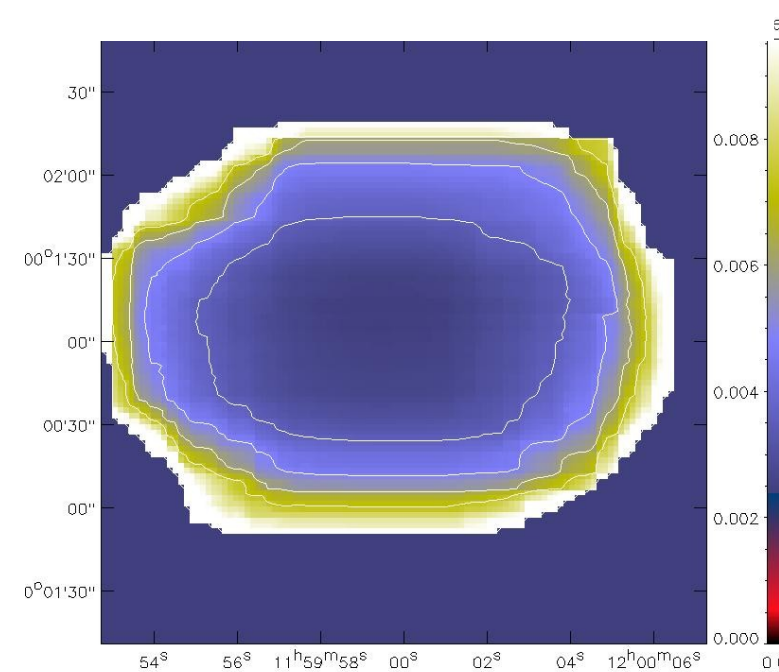
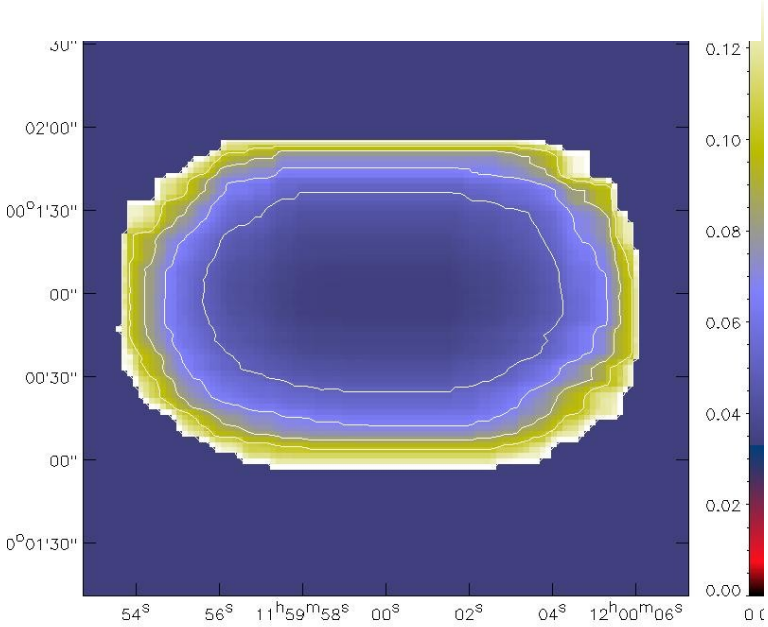
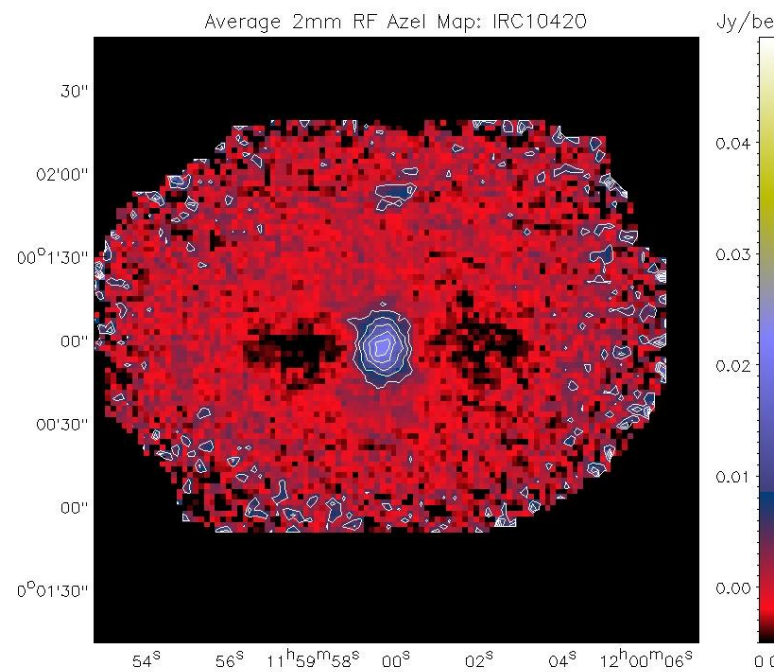
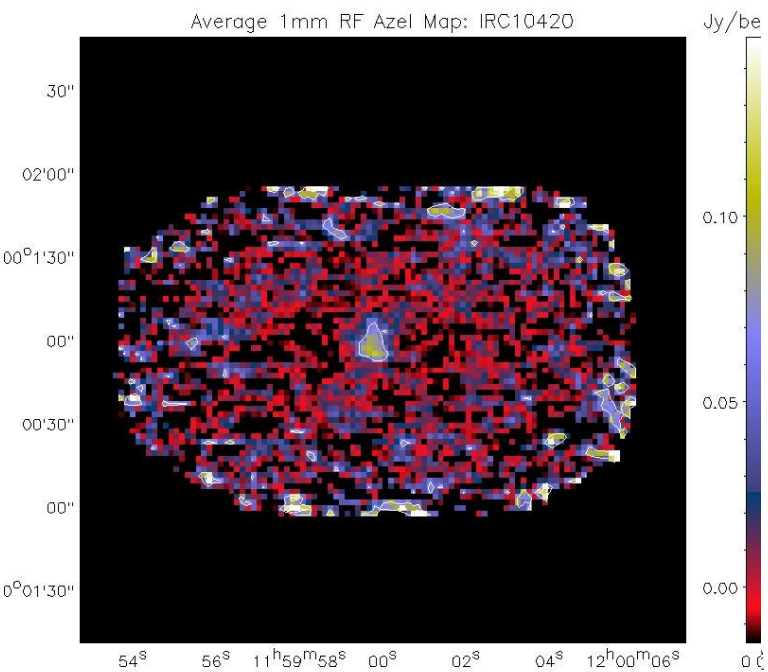


Noise performance

Strong sources No Sky Decorrelation ($\text{mJy s}^{1/2}$)

- Neptune (17, 7 Jy): NEFD is 2400, 4200
- MWC349 (1.7, 1Jy): 1100, 1100
- IRC10420 (94, 21 mJy): 530, 120

Dominated by source noise i.e.
photometric reproducibility



Noise performance

Weak sources, Sky Decorrelation ($\text{mJy s}^{1/2}$)

Use an exclusion radius of 25 arcseconds

- IRC10420 (94 ± 12 , 21 ± 1 mJy): 371, 45
- PSS2322+1944 (2 ± 12 , 1.1 ± 0.6 mJy):
330, 29
- Conservative NEFDs ($\text{mJy s}^{1/2}$) are
370 @ 1mm,
45 @ 2mm

Perspective

- Reduce all scans homogeneously (v2 in progress, v3 in January)
- Improve on photometric accuracy
 - use sky noise flat field
 - use circle to circle calibration (model)
 - next runs: modulate the frequency carrier
- Improve on sky noise decorrelation
 - optimize choice of detectors
 - Iterate map-making vs. sky noise timeline