NIKA run 2 offline processing

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A summary

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

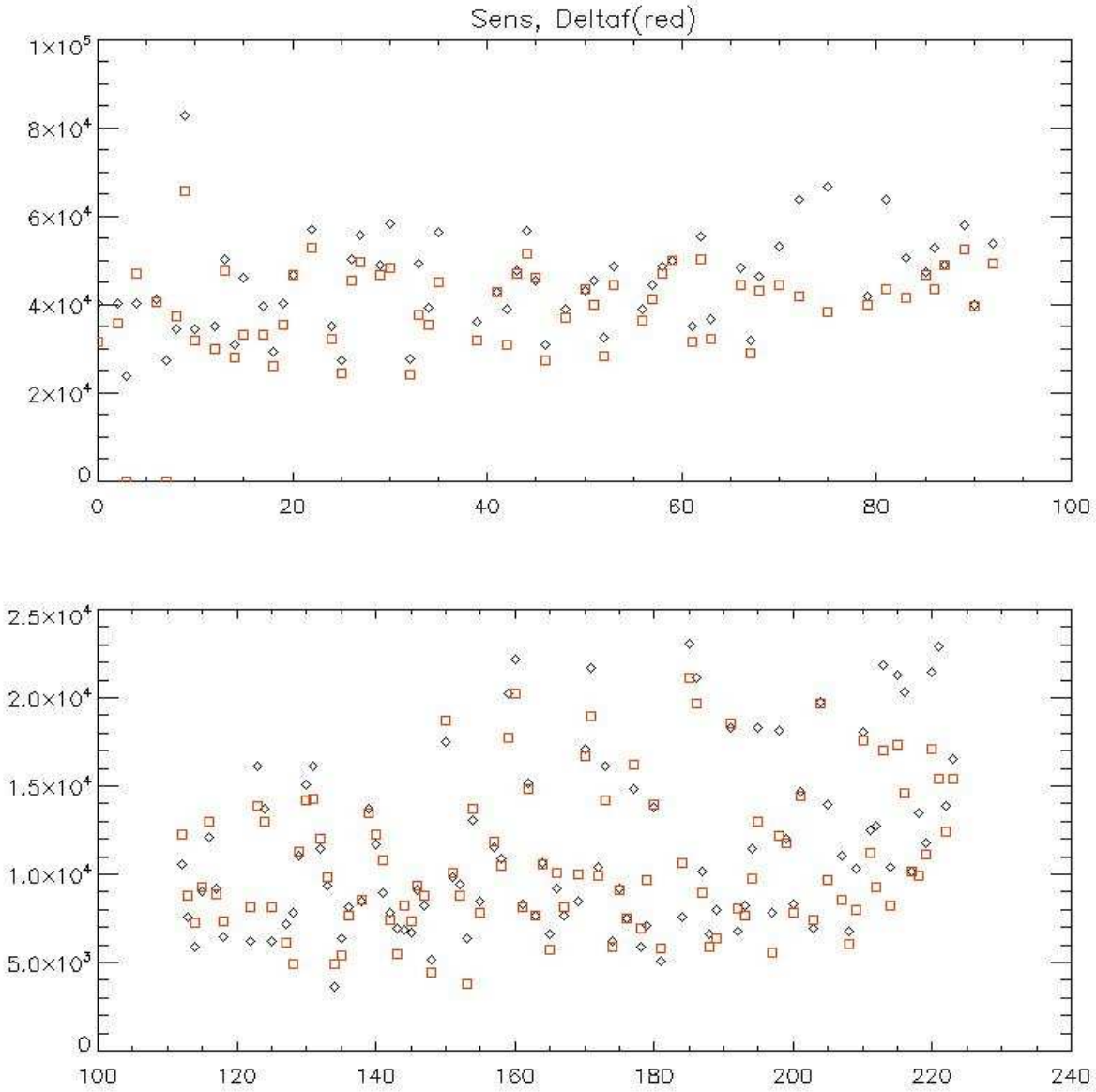
Calibration

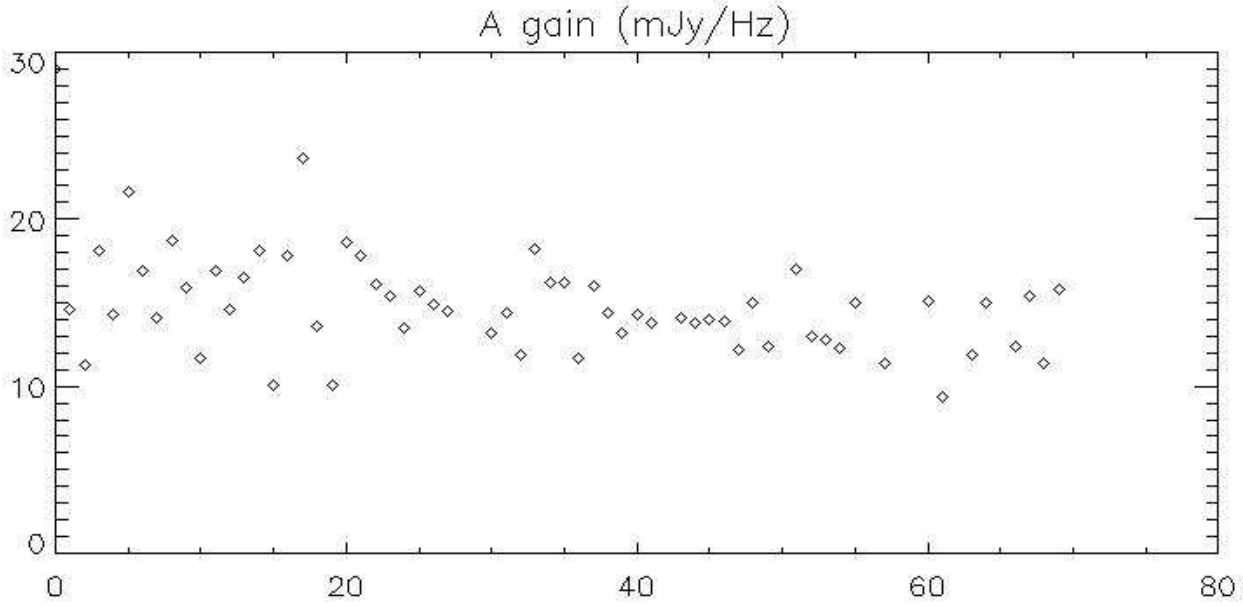
- Only using RF signal. An improved method wrt run1.
- RF is response in frequency. Assumed to be linear with power
- Typically, from I, Q, get complex phase on the calibration circle, then translate to the equivalent frequency shift, as measured during kid tuning (at least one per source).
- v2: try to correct for non-linearity

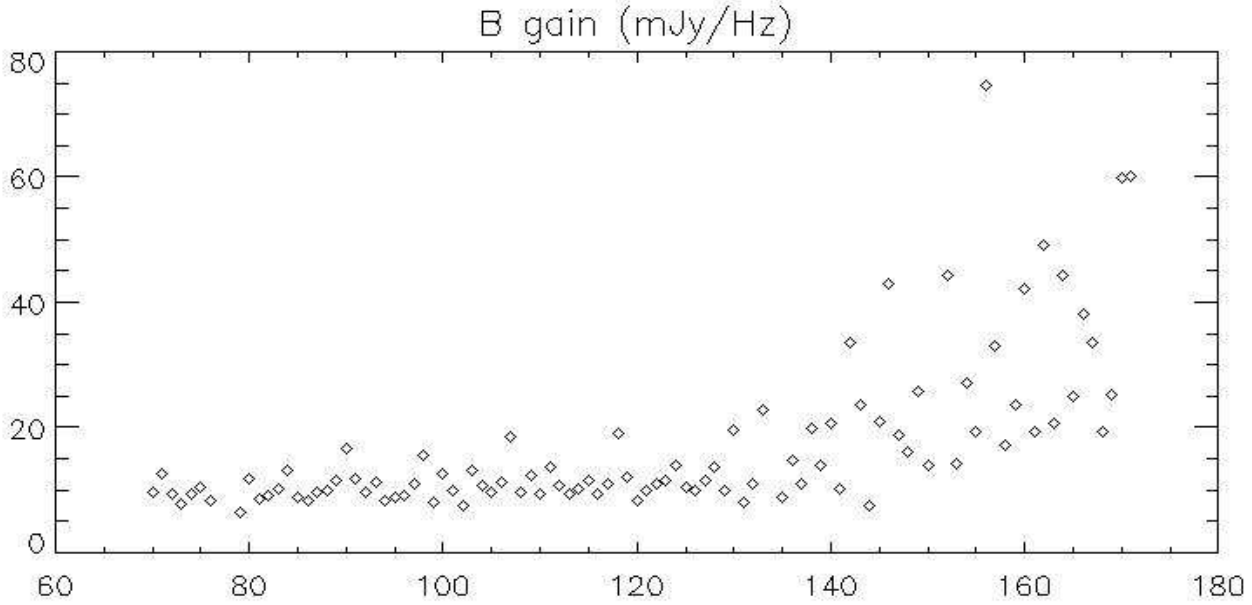
see separate report

- v3: include a 1 kHz dI/df, dQ/df measurement: ready for Oct 2011

Response Hz/rad

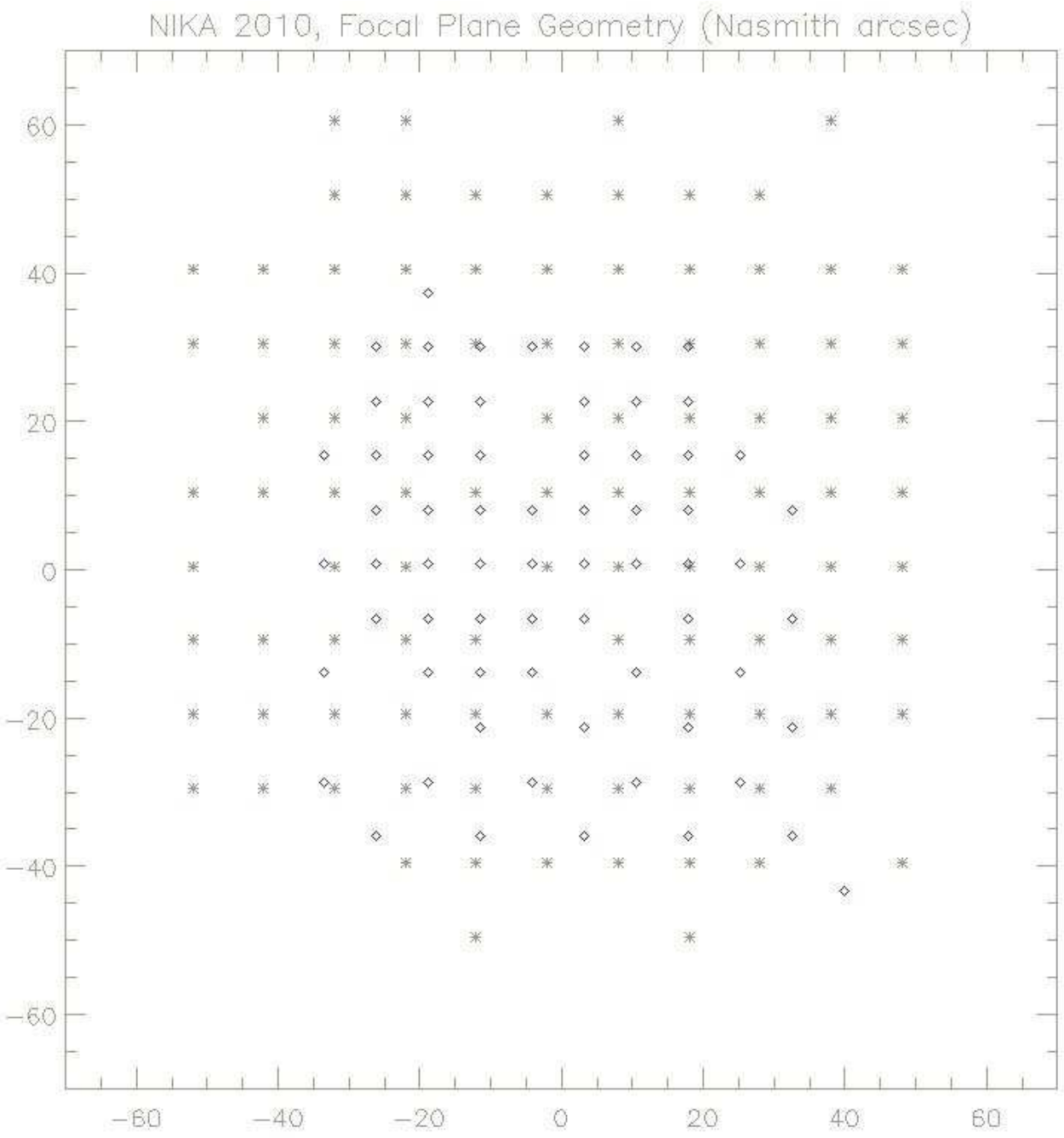



A gain (mJy/Hz)
30
20
10
0
0
20
40
60
80


B gain (mJy/Hz)
80
60
40
20
0
60
80
100
120
140
160
180

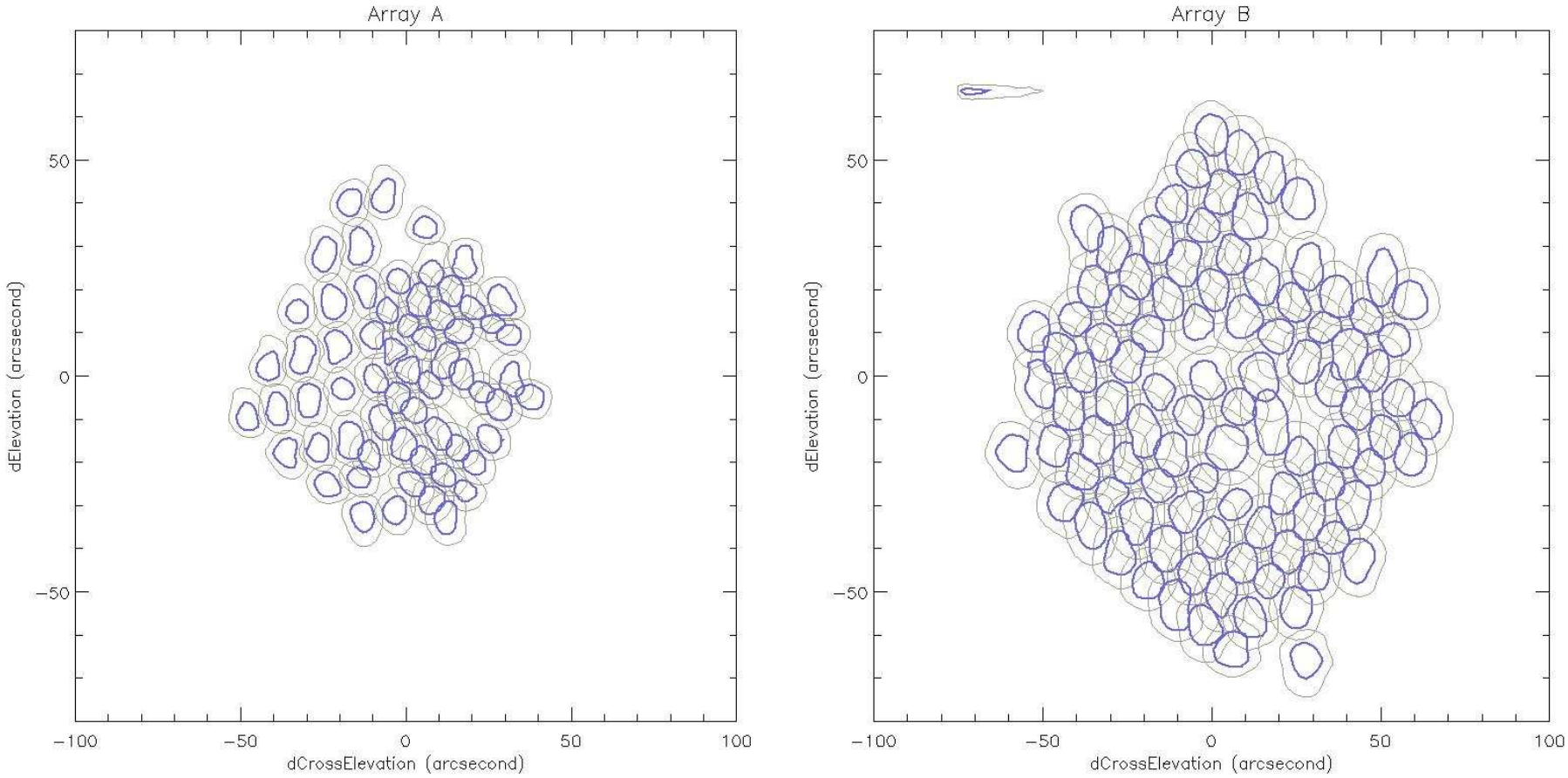
Focal Plane geometry

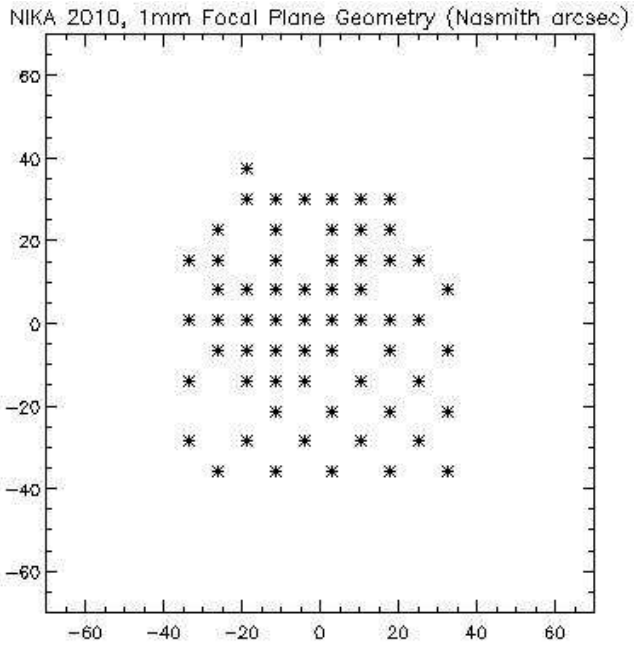
- On the 18th October 2010, the final best geometry was obtained.
- It includes an offset (X, Y), a rotation and a scaling
- Offset between two arrays is B-A: 0”,-1”

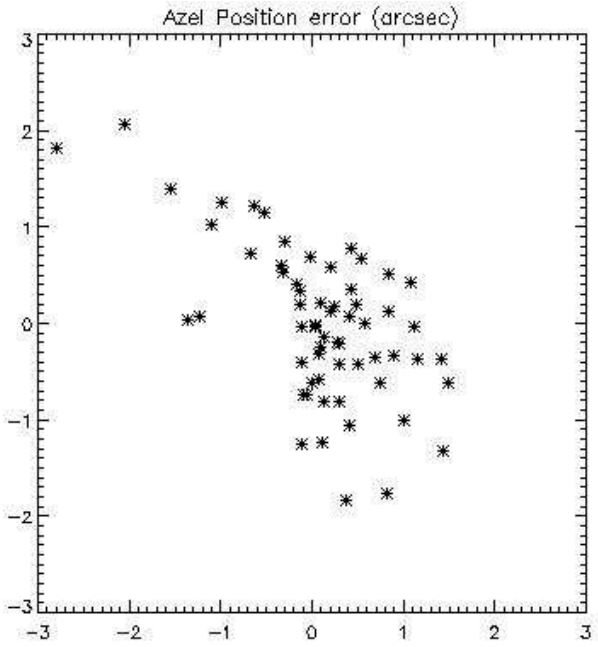


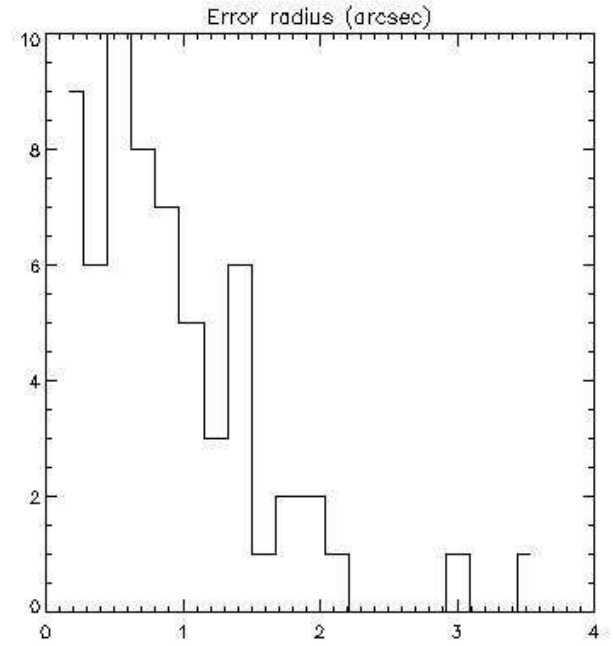
Diamonds:
A at 1mm
Stars:
B at 2mm

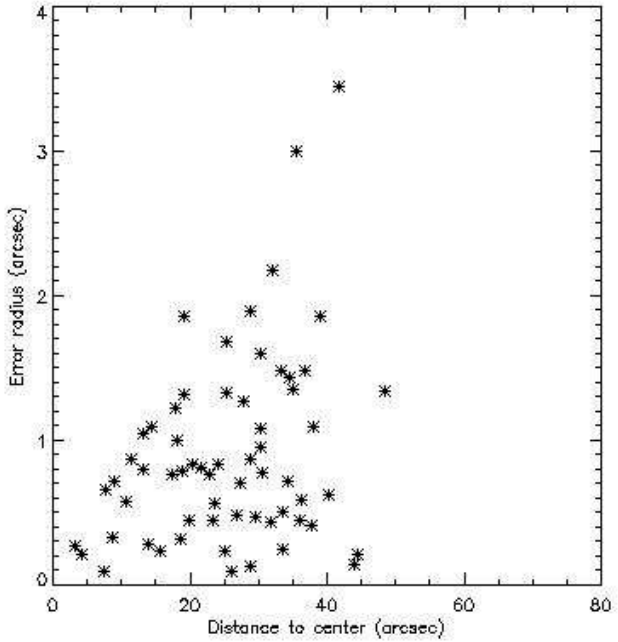
Beams at 1.2 and 2.1 mm



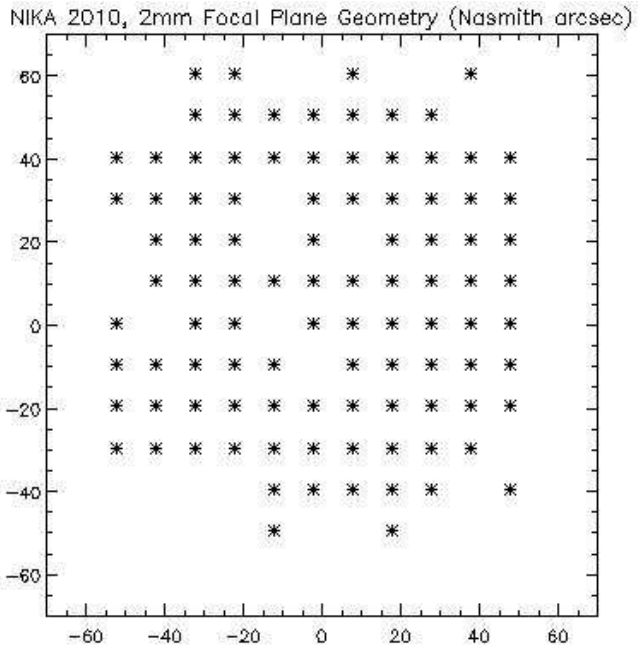


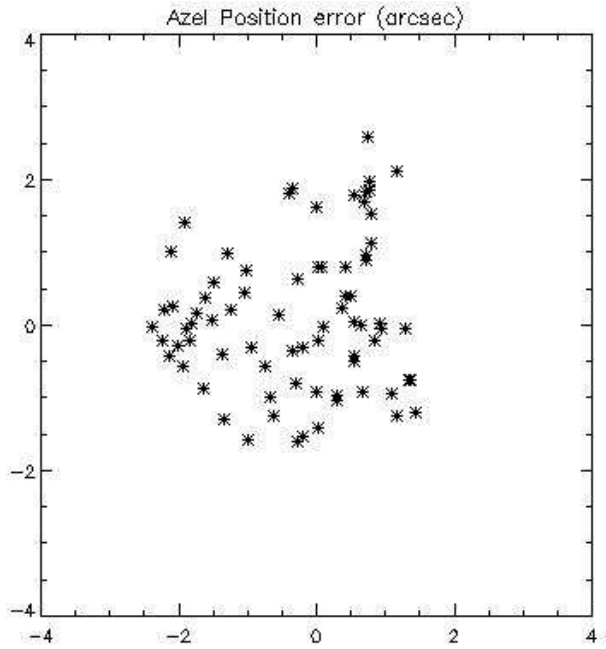


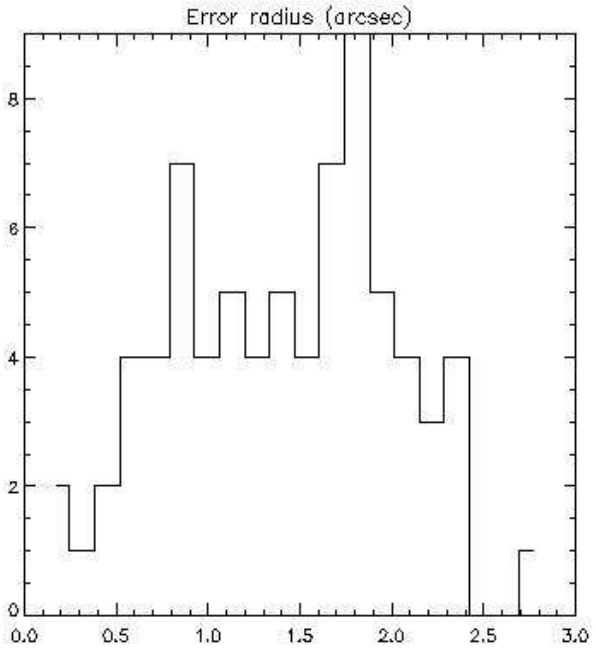


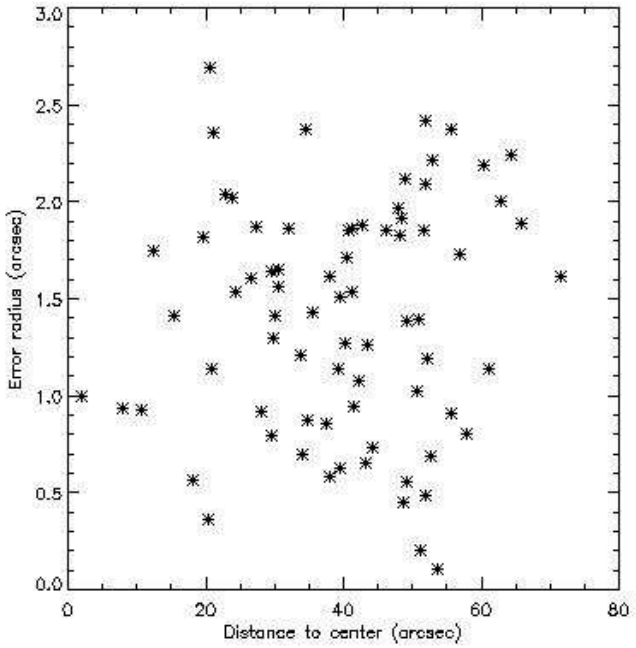


Average misposition 1.1 arcsec Determined on Mars 20101018 Scan 129









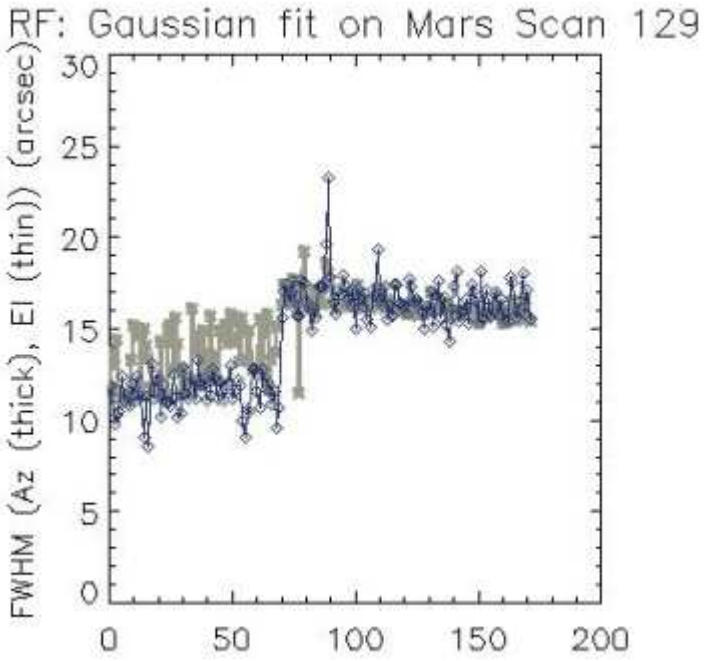
Average misposition 1.5 arcsec

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.
- NIKA Oct2011: do a full pointing model + Focus: Robert Zylka's lead

Beams

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



Photometry

- Done with fixed width gaussian of 12 and 19 arcsec FHWM
- Linearity

Using planets : 10% reproducibility within a planet

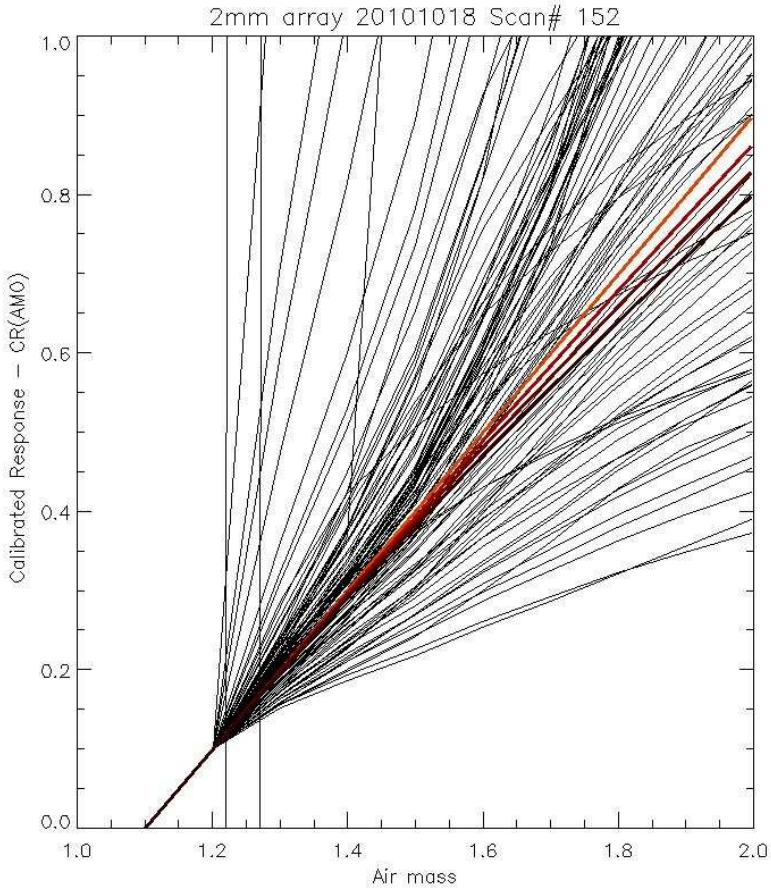
Neptune (19.5, 7.4 Jy) vs Uranus (54.8, 20.7):

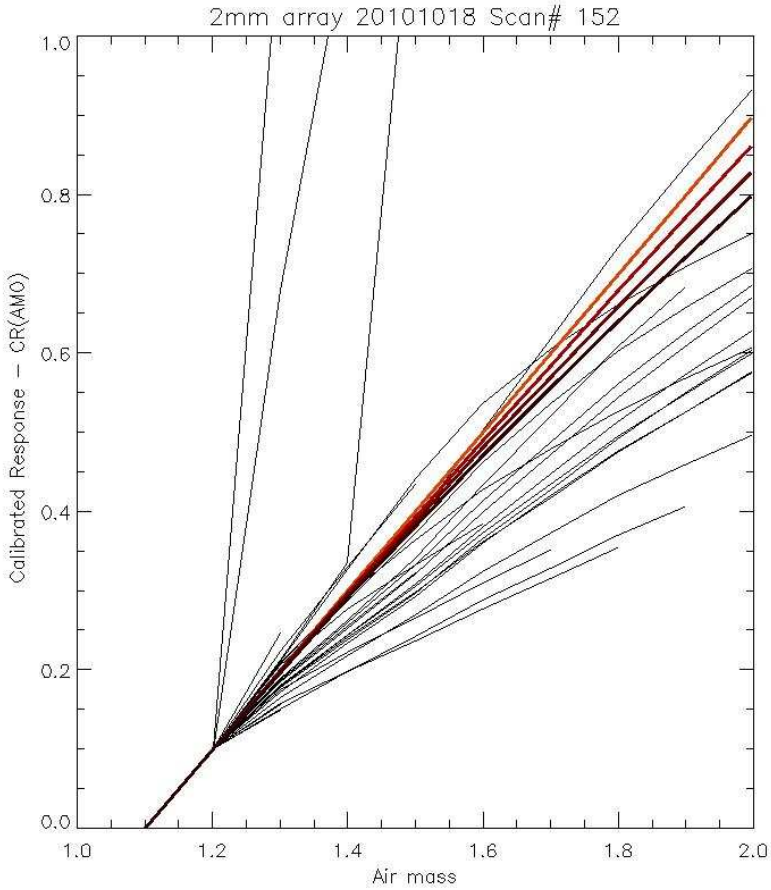
Found 16.9, 7.0 Jy *i.e.* 15% precision

MWC349: see below

- intercalibration (aka flat field) to be done
- Use Tau225GHz, a nu^2 law and the elevation to correct for opacity effects
- Skydips too non-linear.
- OnOff (wobbler) data not reduced : will do in Summer 2011

Skydips





RF vs NF

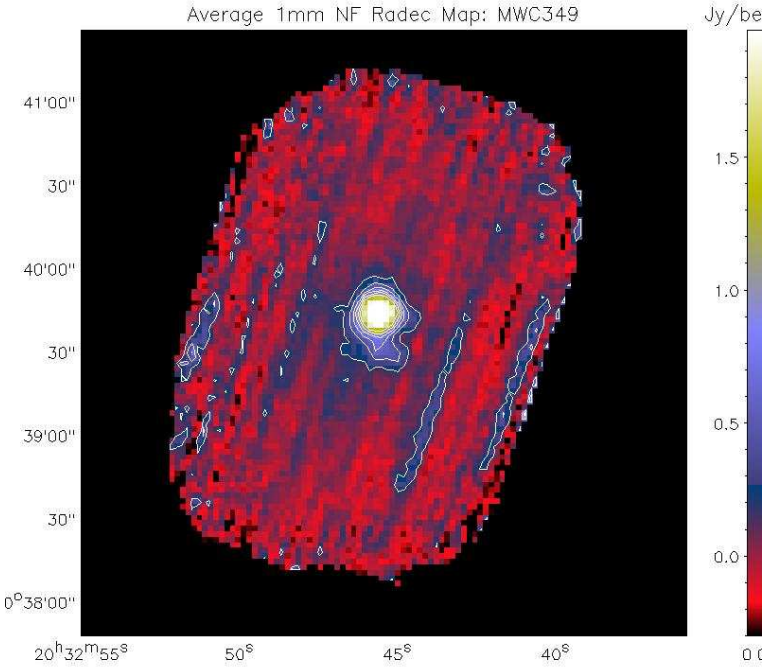
Map-Making

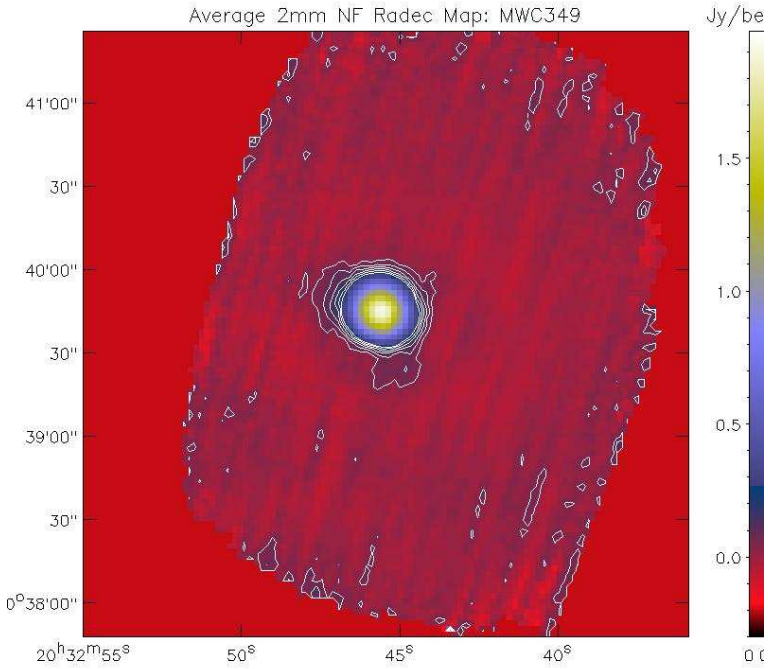
- TOI are prepared: flagged for glitches and jumps
- An individual map per kid per scan is produced with interpolation to the 4 nearest grid points.
- Pointing is done by offsetting with the Focal Plane Geometry from on-the-fly (Evlin) center coordinates.
- Noise is evaluated at the detector map level 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

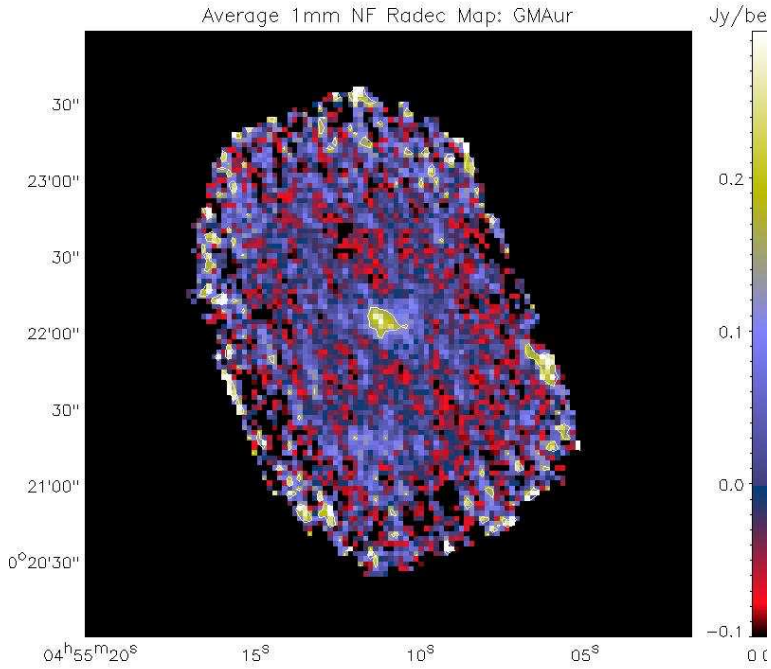
- Necessary to remove the zero level
- The standard value is by 110 arcsec with a boxcar filter.
- Bandpass for sky noise decorrelation is 10-110 arcsec.
- Only strong sources are masked (no bias for the detection of weak sources). Photometric efficiency is taken into account

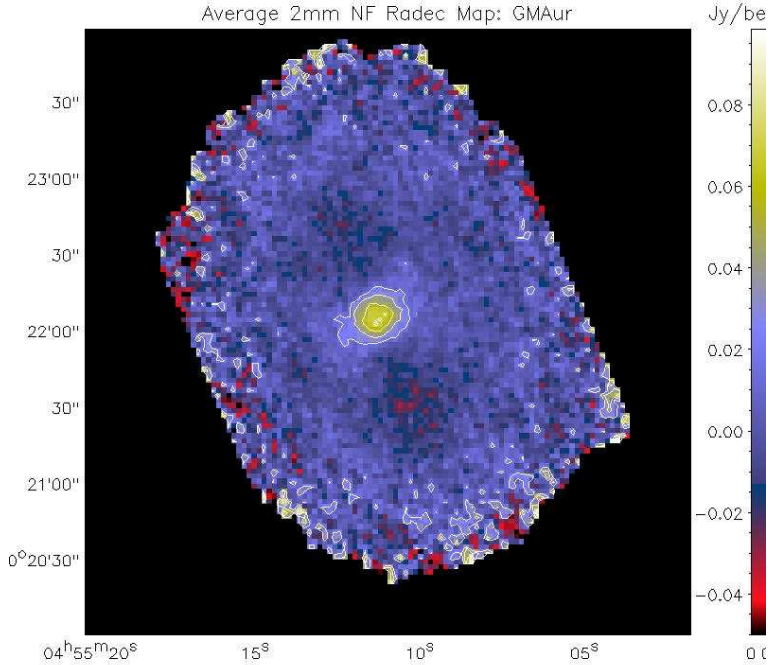
MWC349
No filtering but skynoise removal



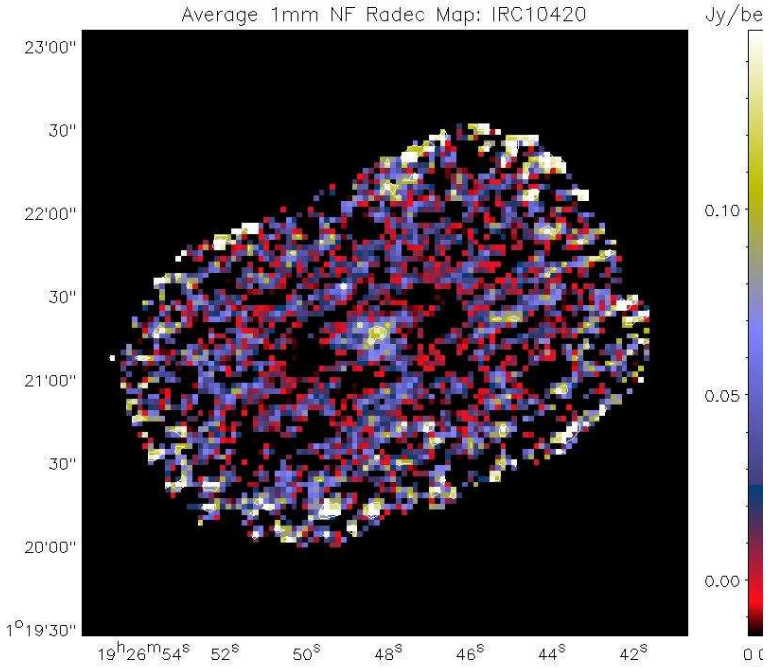


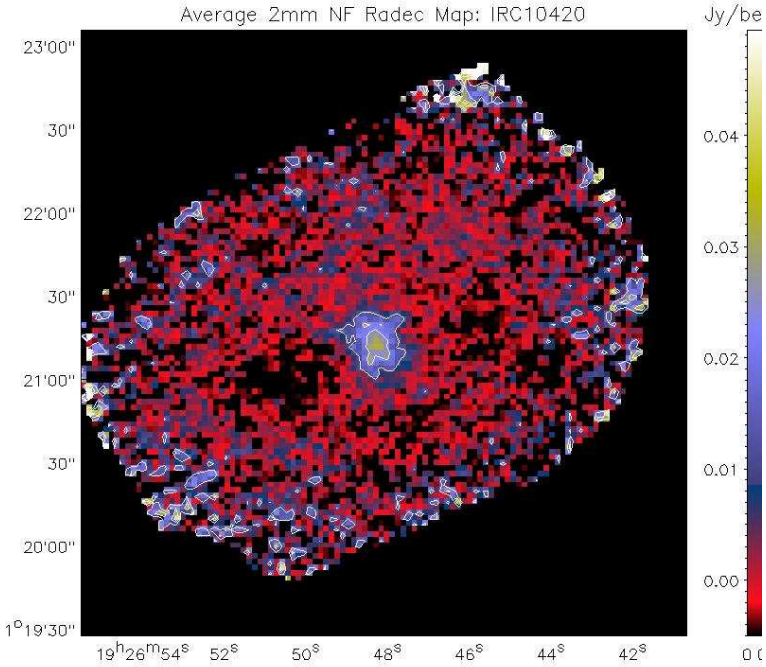
GM Aur
201+-19, 55.5+-1.2 mJy
500 s





IRC10420
106.0+-13, 24.0+-1.3 mJy
2000s





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.

Noise performance
Weak sources, Sky Decorrelation (mJy s1/2)
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 (mJy $s^{1/2}$) are

  370 @ 1mm,

  45 @ 2mm

Perspective

- Reduce all scans homogeneously (v2 in progress, v3 in January, v4 Summer 2011)
- 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

- 1mm too noisy at present for 2mm extended sources