Introduction to CCB Observing

BSM

23feb09

1. Quick overview of the instrument
2. Observing: Configuring
3. Observing: Pointing and Focus
4. Looking at the data
5. Sensitivity
6. Current work

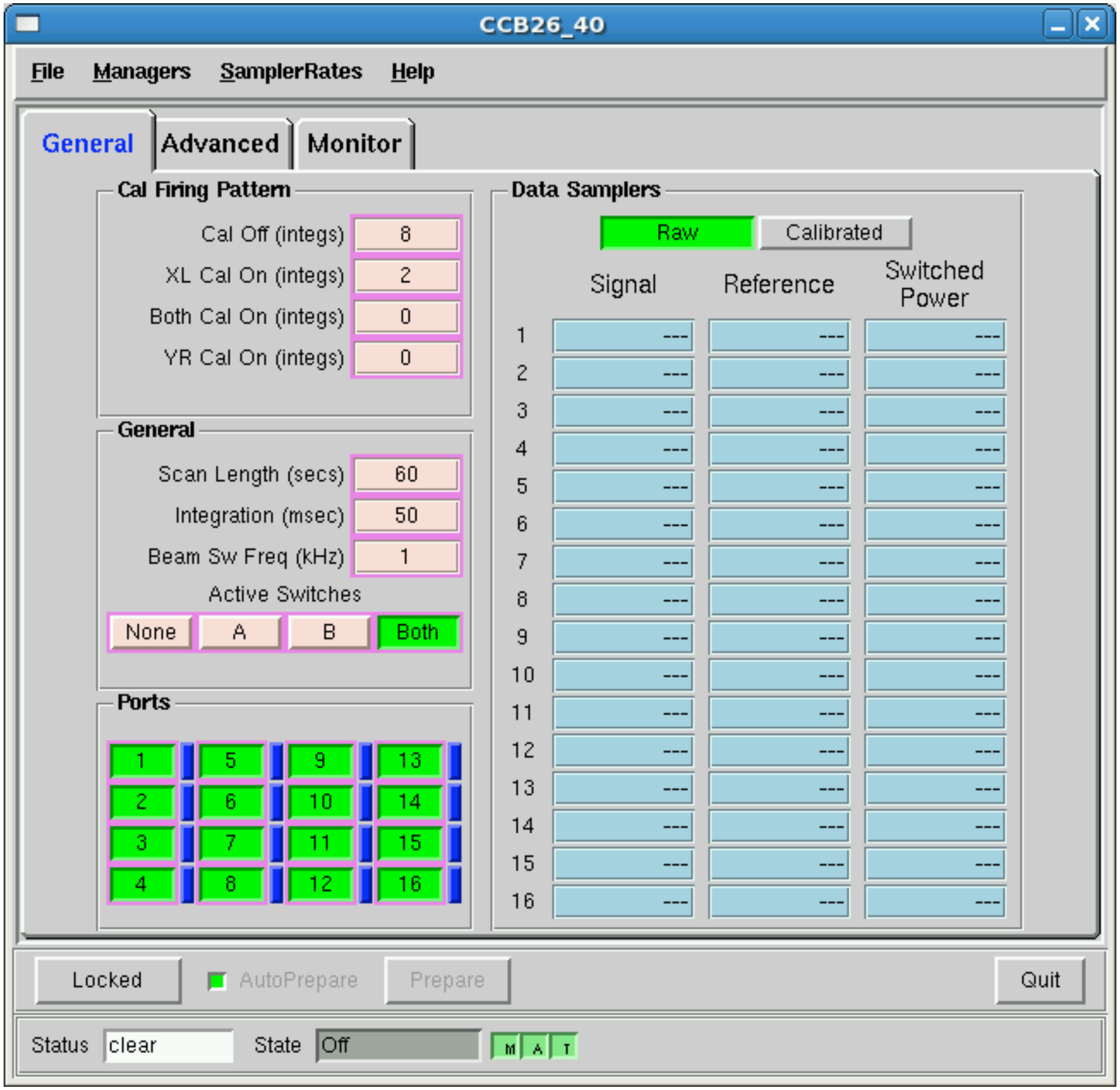
Caltech Continuum Backend

Goal: provide sensitive broad-band continuum capability

- Direct RF detection -- reduce system complexity, improve stability
  - no IF's , mixers, etc.
  - Ka receiver: 16 (8) channels of 3.5 GHz bandwidth each
    - 2 beams x 2 (1) pol'n x 4 frequency channels
- Rapid beamswitching (4 kHz is standard)
  - cal and beam switch (aka phase switch) control is by CCB/Ka direct connection -- doesn't use switching signal master
  - arrangement of cal switching slightly different: done on a whole integration basis, not within an integration
  - (10% blanking warning is standard)
- Cals are controlled independently rather than together to allow full calibration (needed because of leakage terms inherent in the rx architecture)

Configuration

- receiver = 'Rcvr26_40'
- beam = 'B12'
- obstype = 'Continuum'
- backend = 'CCB'
- nwin = 4
- restfreq = 27000.0,32000.0,35000.0,38000.0
- deltafreq = 0.0,0.0,0.0,0.0
- bandwidth = 600.0,600.0,600.0,600.0
- swmode = "sp"
- swtype = "bsw"
- ccb.cal_off_integs = 20
- ccb.XL_on_integs=2
- ccb.YR_on_integs=2
- ccb.both_on_integs=2
- tint = 0.005
- Ccb.bswfreq = 4
- pol = "Circular"
- vdef='Radio'
- vframe='topo'

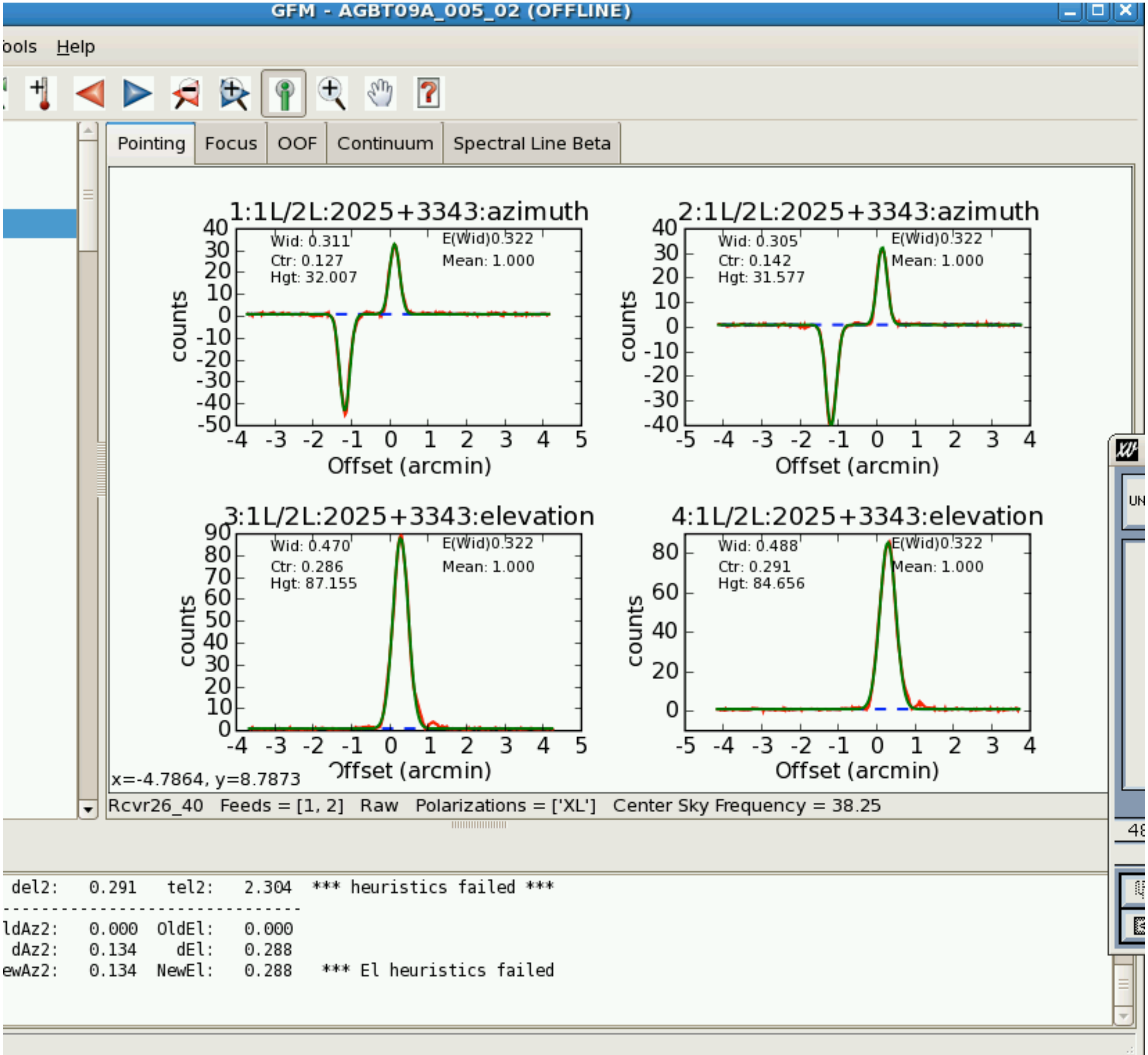

CCB26_40
File Managers SamplerRates Help
General Advanced Monitor
Cal Firing Pattern
Cal Off (integs) 8
XL Cal On (integs) 2
Both Cal On (integs) 0
YR Cal On (integs) 0
General
Scan Length (secs) 60
Integration (msec) 50
Beam Sw Freq (kHz) 1
Active Switches
None A B Both
Ports
1 5 9 13
2 6 10 14
3 7 11 15
4 8 12 16
Data Samplers
Raw Calibrated
Signal Reference Switched Power
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Locked AutoPrepare Prepare Quit
Status clear State Off M A T

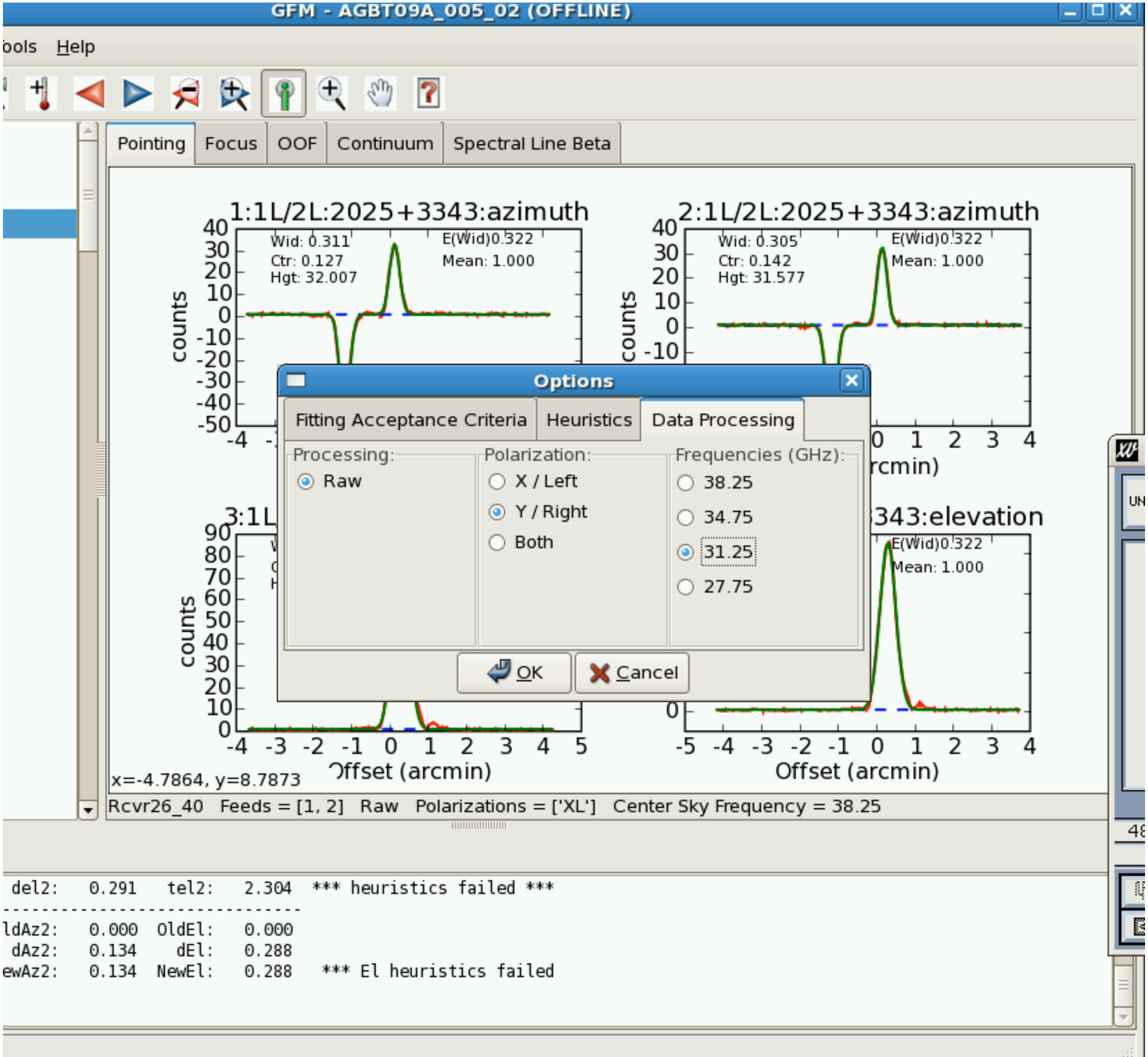
Pointing & Focus with GFM

- With about the reliability of other receivers, “Just works”
- Similar problems occur (cabling/beam IDs can be confused after new installation, requiring the usual workarounds)

But:

- Data are “raw” (in counts), beamswitched
    - we should fix this
- Because Ka only has one polarization GFM often issues lots of harmless complaints.


GFM - AGBT09A_005_02 (OFFLINE)
ools Help
Pointing
Focus
OOF
Continuum
Spectral Line Beta
1:1L/2L:2025+3343:azimuth
Wid: 0.311
Ctr: 0.127
Hgt: 32.007
E(Wid)0.322
Mean: 1.000
counts
Offset (arcmin)
2:1L/2L:2025+3343:azimuth
Wid: 0.305
Ctr: 0.142
Hgt: 31.577
E(Wid)0.322
Mean: 1.000
counts
Offset (arcmin)
3:1L/2L:2025+3343:elevation
Wid: 0.470
Ctr: 0.286
Hgt: 87.155
E(Wid)0.322
Mean: 1.000
counts
Offset (arcmin)
4:1L/2L:2025+3343:elevation
Wid: 0.488
Ctr: 0.291
Hgt: 84.656
E(Wid)0.322
Mean: 1.000
counts
Offset (arcmin)
x=-4.7864, y=8.7873
Rcvr26_40 Feeds = [1, 2] Raw Polarizations = ['XL'] Center Sky Frequency = 38.25
del2: 0.291 tel2: 2.304 *** heuristics failed ***
----
ldAz2: 0.000 OldEl: 0.000
dAz2: 0.134 dEl: 0.288
ewAz2: 0.134 NewEl: 0.288 *** El heuristics failed



GFM - AGBT09A_005_02 (OFFLINE)
ools Help
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1:1L/2L:2025+3343:azimuth
Wid: 0.311
Ctr: 0.127
Hgt: 32.007
E(Wid)0.322
Mean: 1.000
2:1L/2L:2025+3343:azimuth
Wid: 0.305
Ctr: 0.142
Hgt: 31.577
E(Wid)0.322
Mean: 1.000
343:elevation
E(Wid)0.322
Mean: 1.000
counts
Offset (arcmin)
x=-4.7864, y=8.7873
Options
Fitting Acceptance Criteria
Heuristics
Data Processing
Processing:
Raw
Polarization:
X / Left
Y / Right
Both
Frequencies (GHz):
38.25
34.75
31.25
27.75
OK
Cancel
Rcvr26_40 Feeds = [1, 2] Raw Polarizations = ['XL'] Center Sky Frequency = 38.25
del2: 0.291 tel2: 2.304 *** heuristics failed ***
ldAz2: 0.000 OldEl: 0.000
dAz2: 0.134 dEl: 0.288
ewAz2: 0.134 NewEl: 0.288 *** El heuristics failed

Template SBs

In ~bmason/ccbPub   (*.turtle)

- Pointing/Focus
- Point source photometry   75%+ of observations
- Mapping
    - data reduction is experimental (my scripts;OBIT)
    - key is correcting for the beamswitching.
- skydips

- ALWAYS recommend to observe primary flux calibrator

If feasible (3c48, 3c147, 3c286) -- calibration transferrable.

peak/focus

Nod (included in peak/focus template SB)

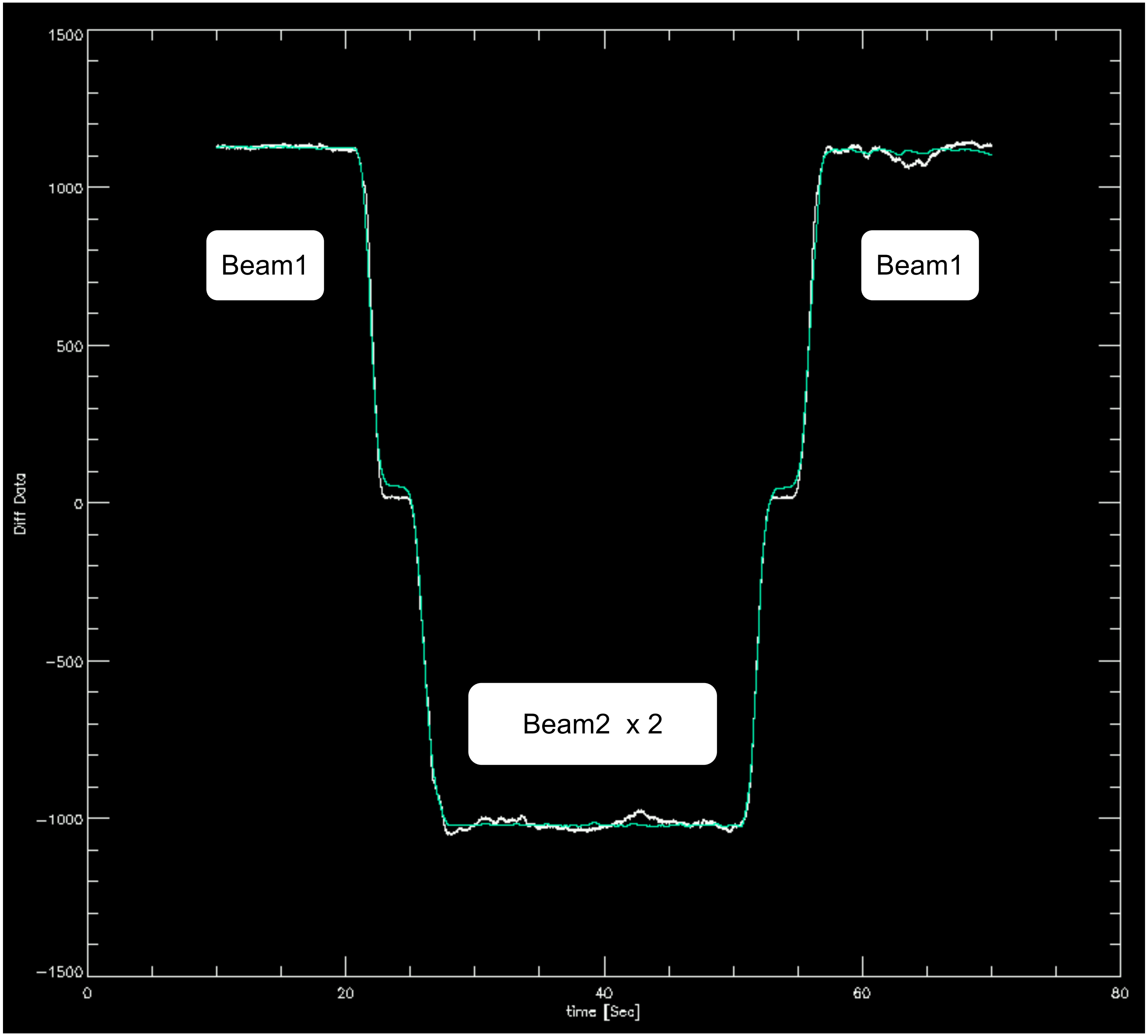
- However, Tcals and RF gains are stable so calibration is transferrable over days to weeks.

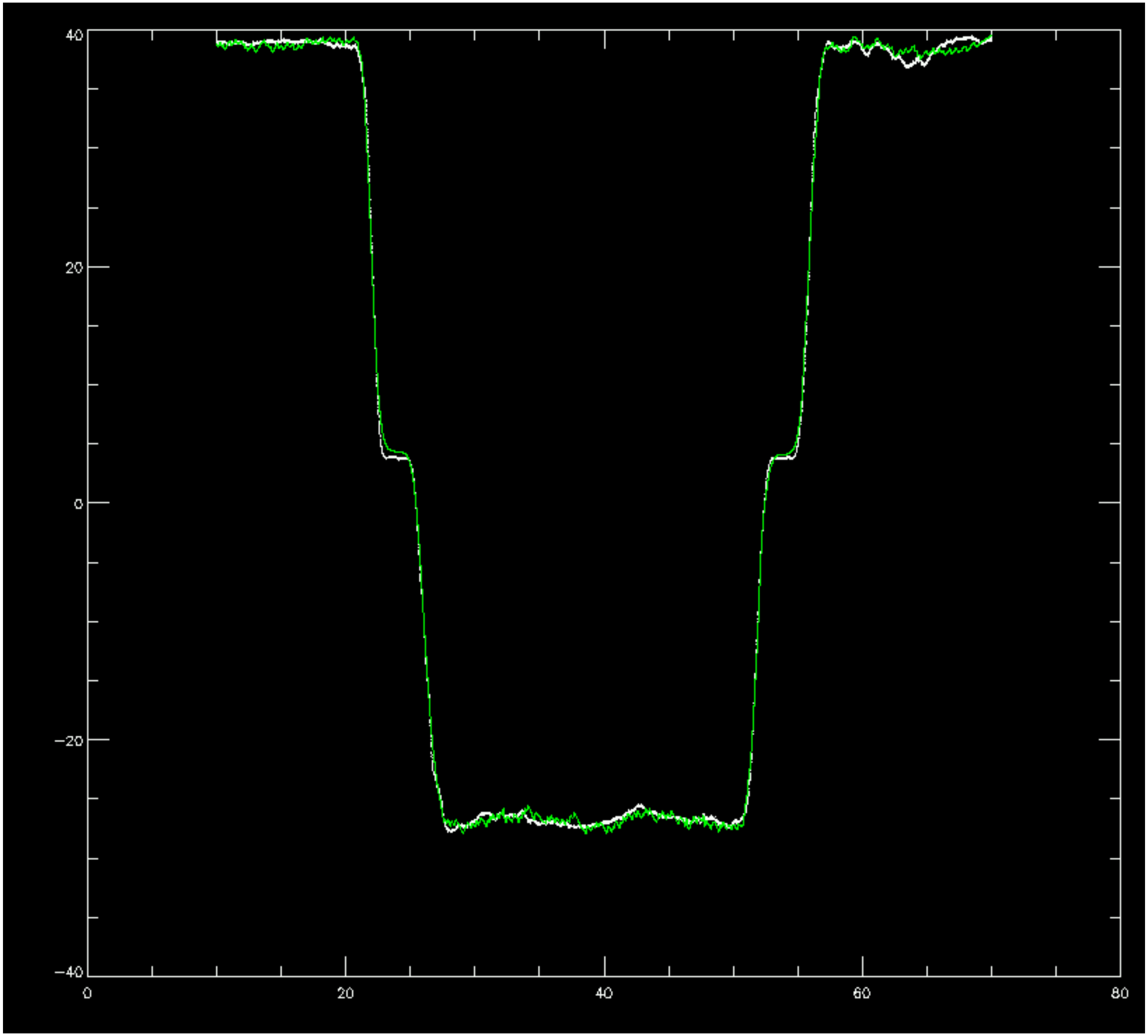
Quick Look Data Reduction

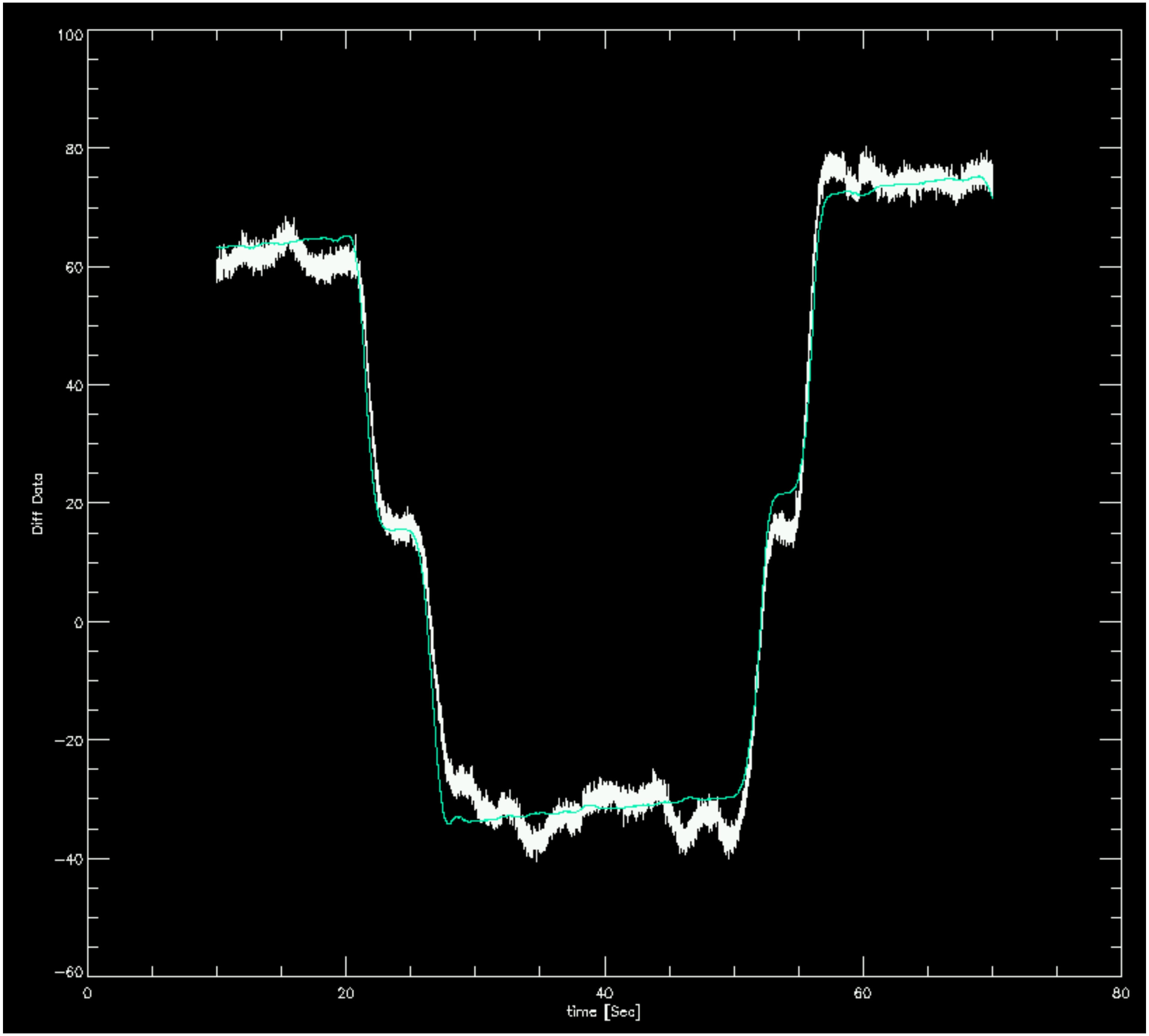
- Uses my IDL scripts
- ~bmason/ccbPub/ccbidl
  - Shell script to launch regular IDL
- Basic commands in ~bmason/ccbPub/README.txt

- Basic observation: on-the-fly nod
  - 70 seconds: 10sec dwell, On/Off/Off/On (symmetric nod), 10 sec slews.
  - Compute template source response (given source Ra/Dec and telescope position as a function of time) and fit
  - Can be generalized to fit for pointing offset in each observation if SNR >1

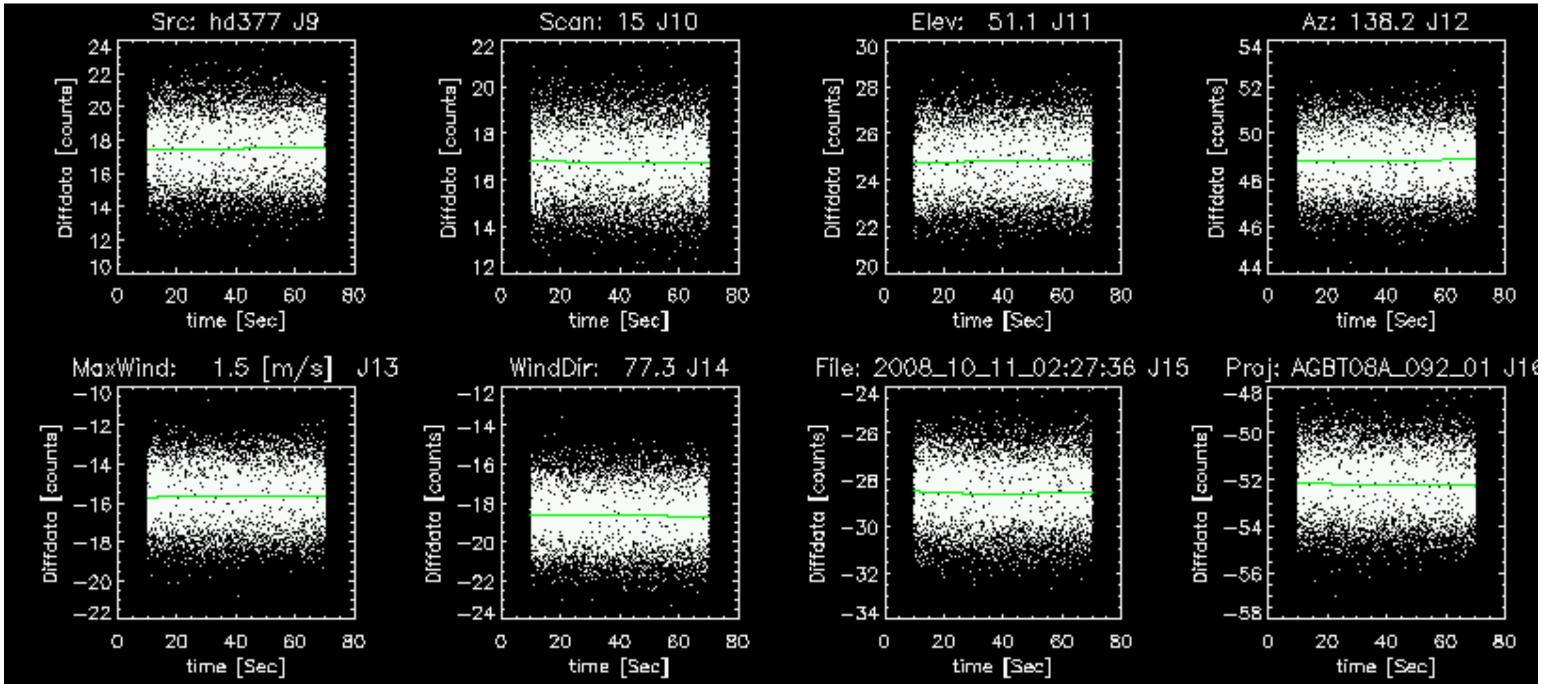
Beamswitched power: Beam 1 - Beam 2



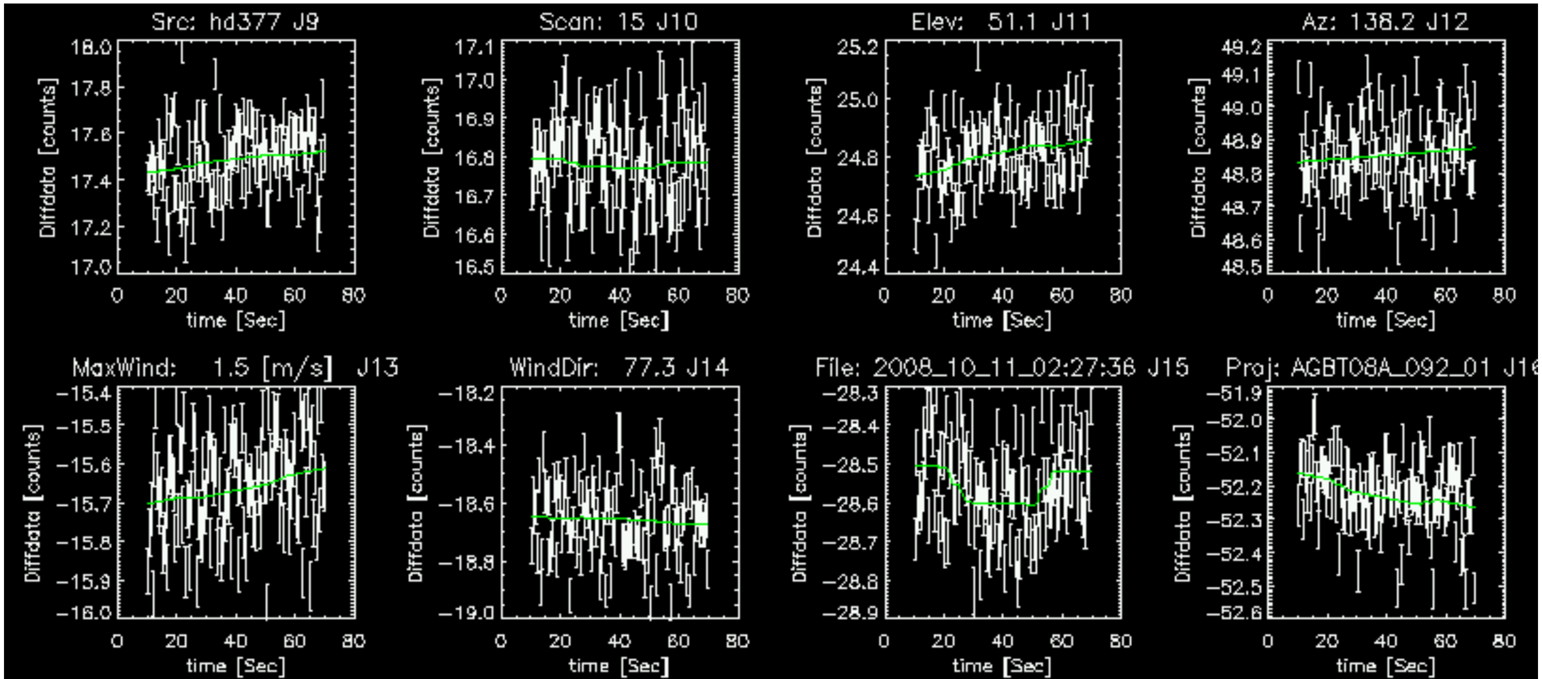

40
20
0
-20
-40
0
20
40
60
80



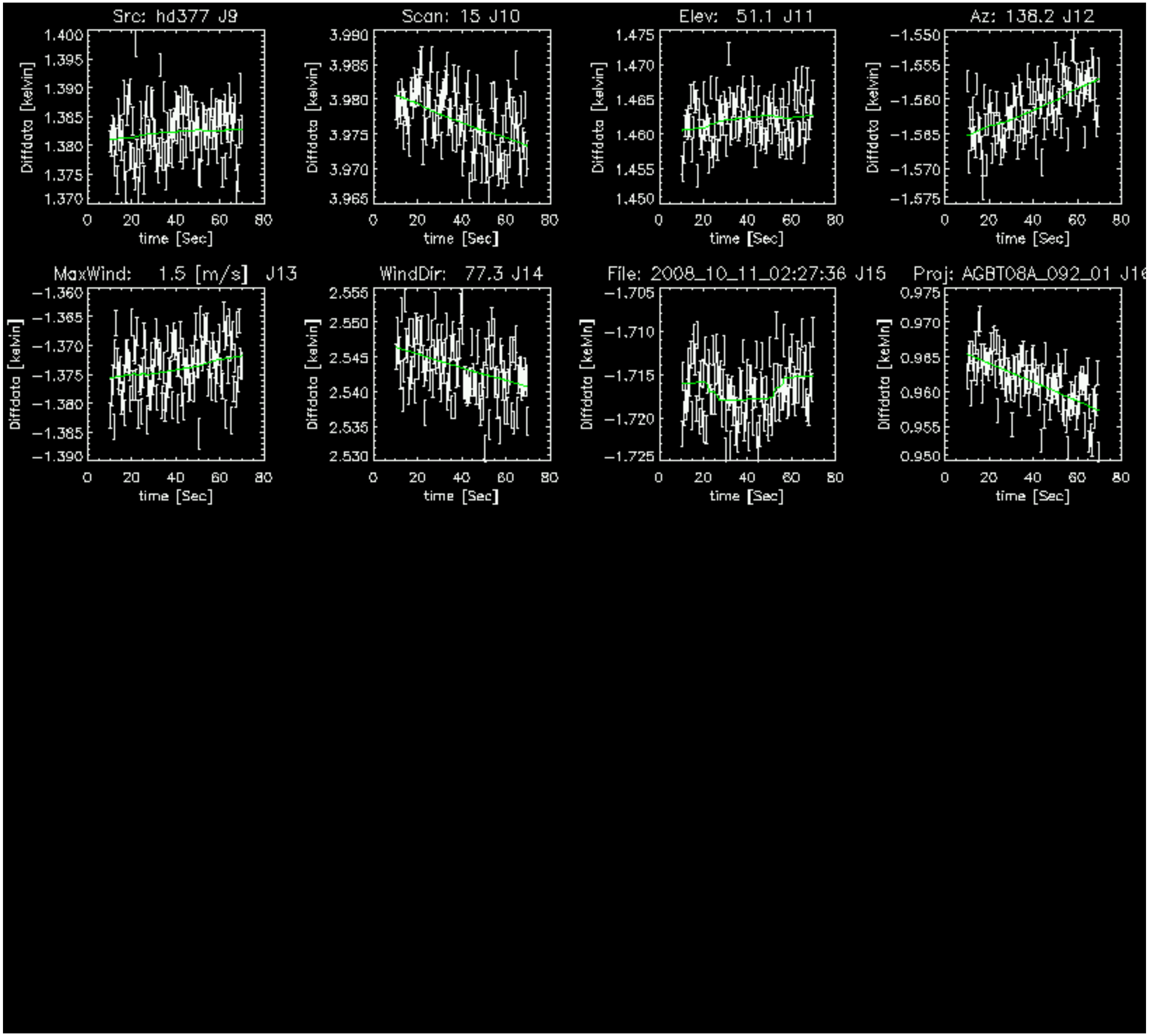
100
80
60
40
20
0
-20
-40
-60
Diff Data
0
20
40
60
80
time [Sec]

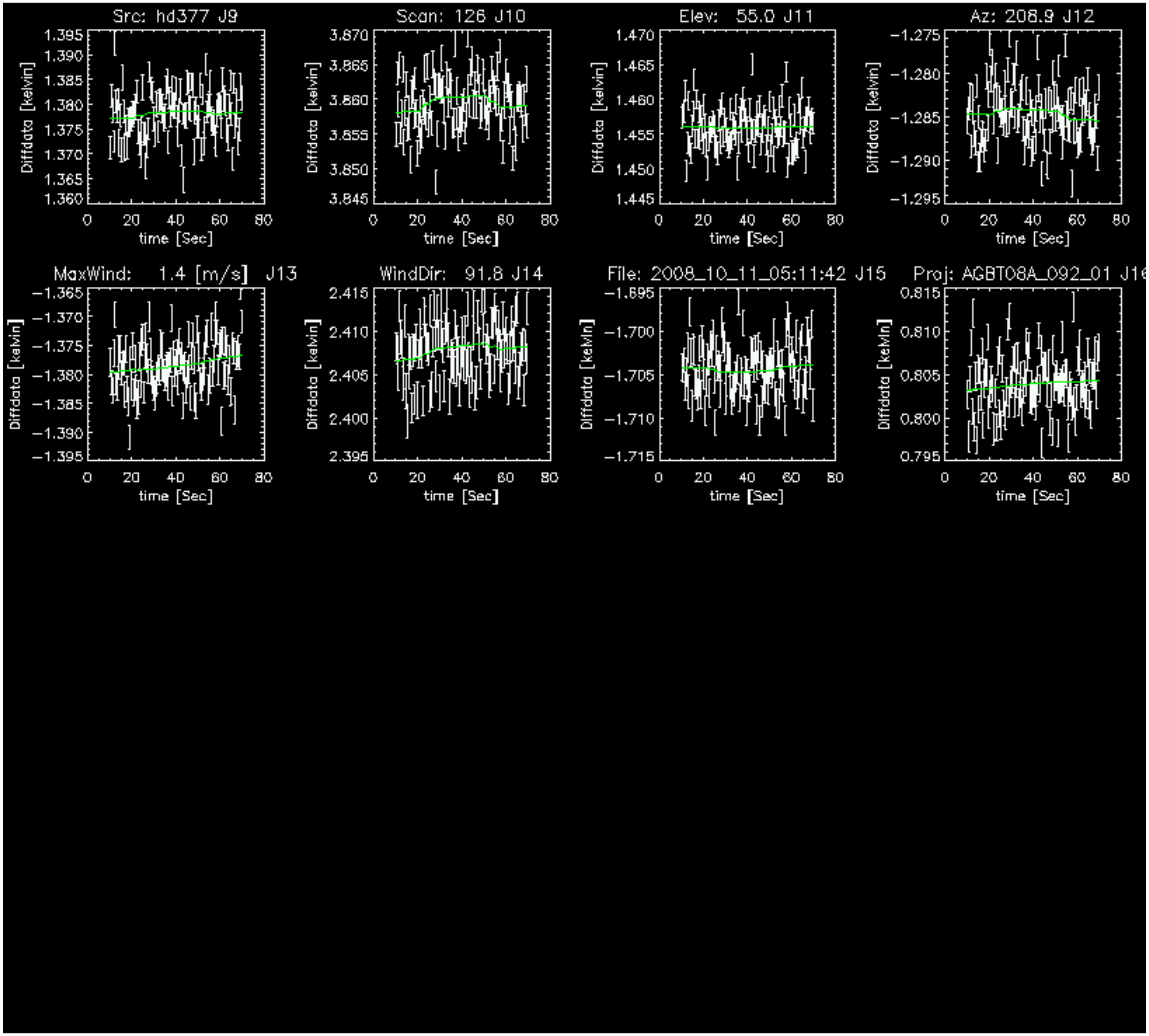


Indexscans,si	-- analagous to filling
Readccbotfnod,si[12],q	-- read scan 12 into variable q
Fitccbotfnod,q	-- fit the nod

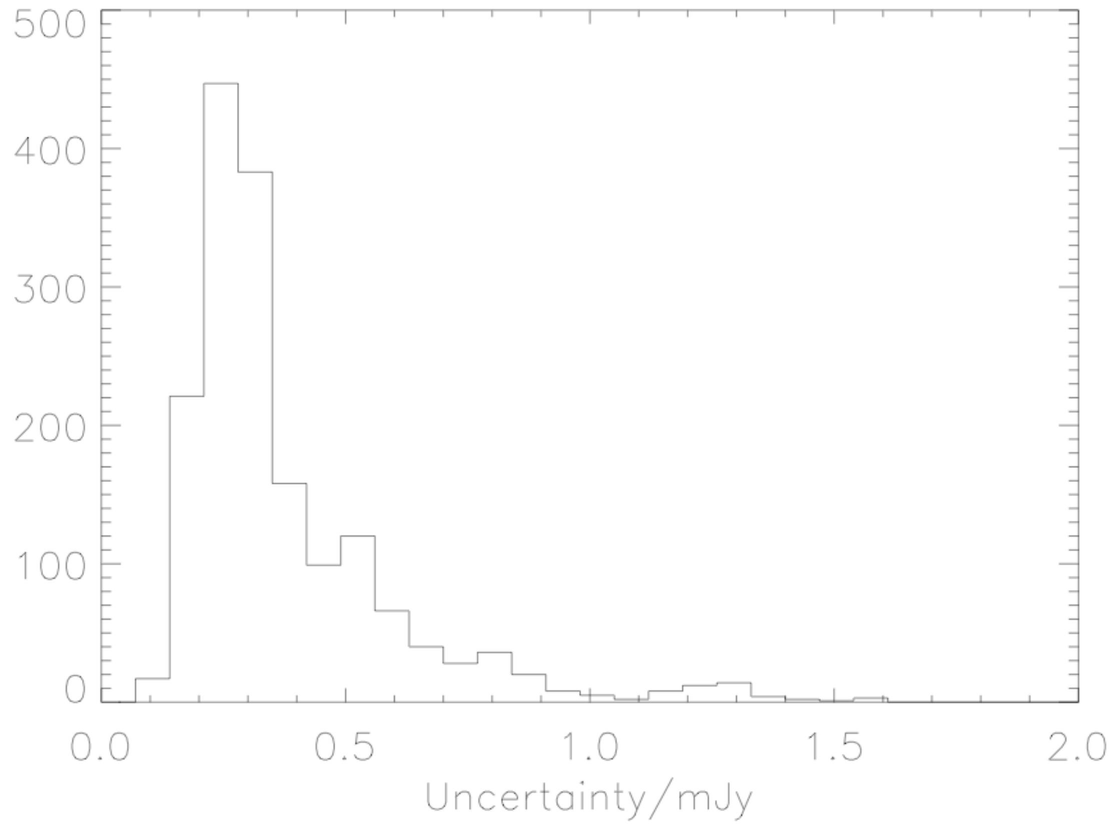


Indexscans,si
Readccbotfnod,si[12],q
Fitccbotfnod,q,binw=0.5 bin into 0.5 sec integs before fit


Src: hd377 J9
Scan: 15 J10
Elev: 51.1 J11
Az: 138.2 J12
MaxWind: 1.5 [m/s] J13
WindDir: 77.3 J14
File: 2008_10_11_02:27:36 J15
Proj: AGBT08A_092_01 J16
Diffdata [kelvin]
time [Sec]

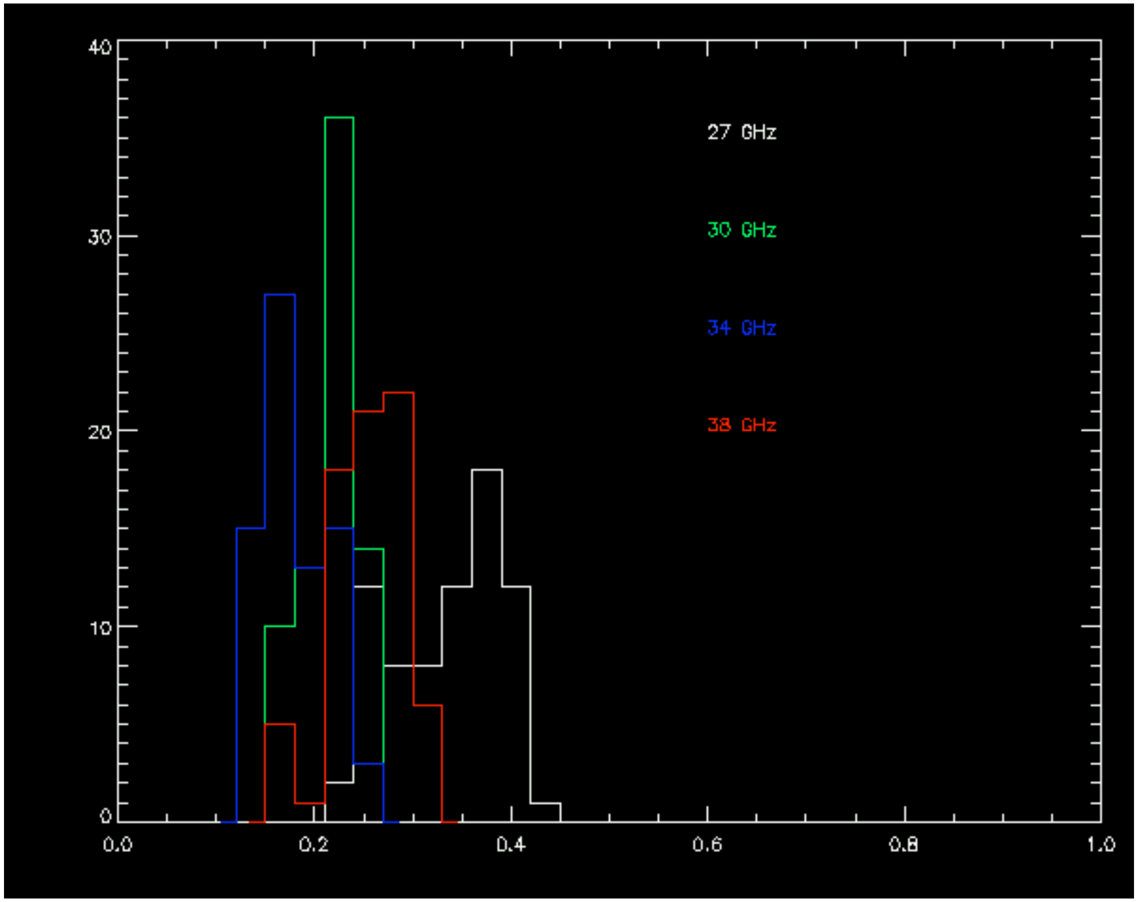

Src: hd377 J9
Scan: 126 J10
Elev: 55.0 J11
Az: 208.9 J12
MaxWind: 1.4 [m/s] J13
WindDir: 91.8 J14
File: 2008_10_11_05:11:42 J15
Proj: AGBT08A_092_01 J16
Diffdata [kelvin]
time [Sec]

Sensitivity



RMS uncertainty in mean (31 GHz channel -- old best): 70 second Nod measurement

New Sensitivity



150 uJy RMS (34 GHz)

100 uJy RMS (all combined)

Current Work

- Improve integration with GBT system
  - Tcals into Measurements database
  - GFM to calibrate data (instead of raw beamswitched)
- Streamline postprocessing data reduction
  - Quick look stable and easy to use
- Develop more precise photometry techniques
  - Impose small nutation in az and el on Nod and fit for pointing offsets, beam offsets
  - Preliminary: 3% RMS photometry at 38 GHz.