Amplitude Calibration

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ANTAB File Production

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- Calibration provided via the tpi monitoring
- Continuous $T_{\rm sys}$ is given by:

$$T_{\rm sys} = T_{\rm cal} \times \frac{\rm tpi - tpzero}{(\rm tpical - tpi')}$$

- For VLBA racks, AGC gain level (tpgain) used as proxy for tpi:

$$\rm tpi = tpi' \times 10^{\frac{tpgain - tpgain'}{10}}$$

- $T_{\rm cal}$ measured during CL*** experiments, as a function of frequency. RXG files used in calculating the $T_{\rm sys}$
- $\rm tpdiff = tpical - tpi'$

The Astronomer's Perspective

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The final user is interested in the SEFD (in Jy) of each telescope as a function of time.

- $\mathrm{SEFD} = \frac{\mathrm{T_{sys}}}{\mathrm{DPFU} \times \mathrm{POLY(ELEV)}}$

  (K band is more complicated)

- Small amplitude errors are recovered using "Amplitude Closures"
- This only allows the relative amplitudes of the stations to be determined, not the absolute flux scale
- Subtle features may be irrecoverable if the errors are large
- Poorly calibrated stations are often disposed of during the calibration process – your efforts are wasted.
- Accurate a priori calibration is a must!

Running Antabfs

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Download from `ftp://ftp.jive.nl/pub/reynolds/antabfs.tar.gz`

Documentation distributed with tarball – `docs/antabfs.pdf`

Requires RXG files:

- Produced with GNPLT
- Contains gain curves and T_{cal} as a function of frequency

All other information is extracted from the log

Demo to come. . .

Antabfs – the Gory Details

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- Uses `flagr` output to remove off-source tpi
- Obviously bad data removed according to simple criteria (negative values, overflows)
- tpdiff need further editing – several statistical options available
  - Automated editing a possibility for some experiments
- Uses *interpolated* (in time) values of tpdiff to calculate T_{sys}
- Uses *interpolated* (in frequency) values of T_{cal} to calculate T_{sys}
- Always under development – suggestions welcome

Stability of $T_{\rm cal}$

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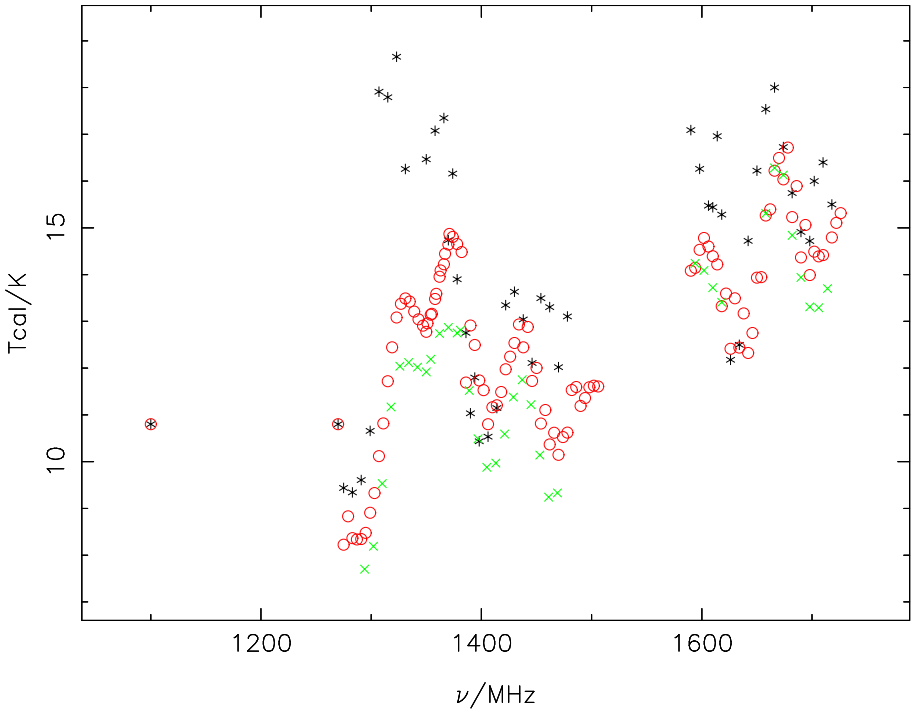
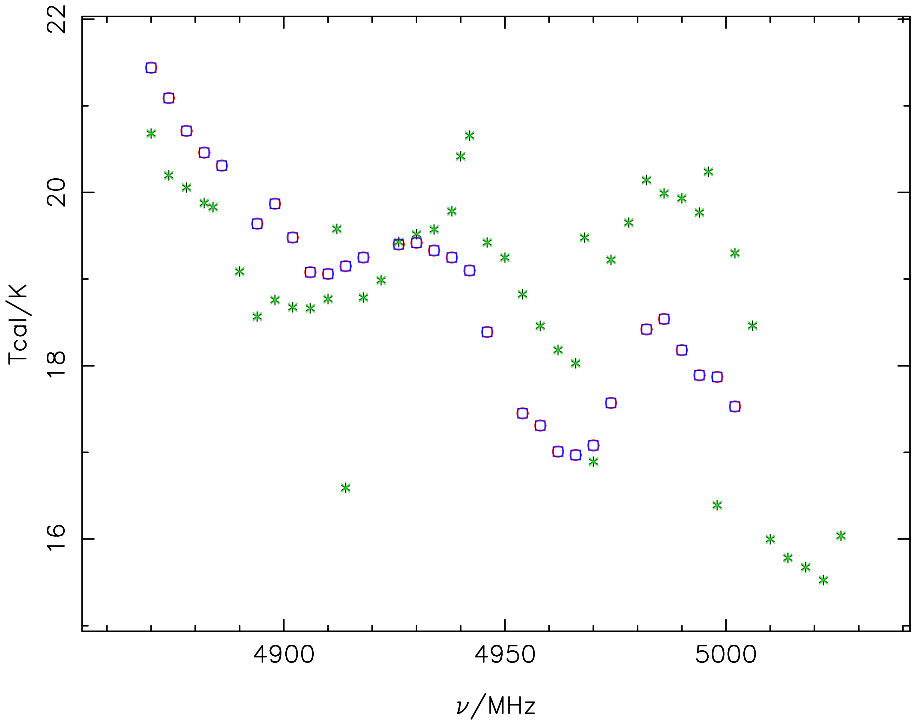
Monitoring is necessary.



Efflesberg C-band $T_{\rm cal}$ in Nov. 2002, May 2003 and Nov. 2003.



Onsala L-band $T_{\rm cal}$ in Nov. 2002 and Feb. 2004.

ANTAB File Format

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n04c3.antab (~/reynolds/t...ay05/n04c3/in/n04c3) - GVIM1

File Edit Tools Syntax Buffers Window Plugin Help

```
! Amplitude calibration data for EF in n04c3.
! For use with AIPS task ANTAB.
! Waveband(s) = c.
! LOs = 4840.00 4840.00.
! Produced on 2004-12-03 using antabfs.pl version 23 Jul 2004.
GAIN EF  ELEV DPFU=1.52,1.52        FREQ=4290,5390
POLY=9.6577E-01,1.5571E-03,-1.7710E-05
/
TSYS EF FT=1.0 TIMEOFF=0
INDEX= 'L1:2', 'R1:2', 'L3:4', 'R3:4'
/
!Column 1 = L1: bbc01, 4982.49 MHz, BW=8.000 MHz, LSB, Tcal= 1.7 K
!Column 1 = L2: bbc01, 4982.49 MHz, BW=8.000 MHz, USB, Tcal= 1.7 K
!Column 2 = R1: bbc02, 4982.49 MHz, BW=8.000 MHz, LSB, Tcal= 1.8 K
!Column 2 = R2: bbc02, 4982.49 MHz, BW=8.000 MHz, USB, Tcal= 1.8 K
!Column 3 = L3: bbc03, 4998.49 MHz, BW=8.000 MHz, LSB, Tcal= 1.7 K
!Column 3 = L4: bbc03, 4998.49 MHz, BW=8.000 MHz, USB, Tcal= 1.7 K
!Column 4 = R3: bbc04, 4998.49 MHz, BW=8.000 MHz, LSB, Tcal= 1.8 K
!Column 4 = R4: bbc04, 4998.49 MHz, BW=8.000 MHz, USB, Tcal= 1.8 K
! 302 04:13.71, scan=0001,n04c3,720,1320, source=3c273b
302 04:59.83 110.7 123.0 104.4 113.2
!302 04:59.90 108.3 119.4 102.3 110.3 ! tsys
302 05:00.01  97.7 107.3  92.7  99.7
302 05:00.35  97.8 107.4  92.8  99.9
302 05:00.68  97.9 107.9  93.0 100.5
                                          106,1         0%
```

New “extended ANTAB” format being worked on. . .

RXG File Format

JIVE
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tempxx.rxg (~/reynolds/antab/may04/rxg) - GVIM1

File Edit Tools Syntax Buffers Window Plugin Help

```
* calhhc.rxg - HartRAO 6.0cm C band receiver parameter definition
*
* first line: LO values and ranges, format:
*  type   frequencies
* if type is range, the two values: lower and upper frequencies
* if type is fixed, then one or two fixed value
* frequencies in MHz
*
*fixed 4840
range 4480 4960
*
* 2nd line: creation date
* format:  yyyy ddd or yyyy mm dd (0 is valid for all for intial set-up)
*
2004 05 24
*
* 3rd line: FWHM beamwidthm format:
*   model value
*
* if type is frequncy, then fwhm=value*1.22*c/(freq*diameter)
*                      value is 1.0 if omitted
* if type is constant, then fwhm=value (degrees)
*
frequency 1.0
*
* 4th line polarizations available
*
* one of both of lcp and rcp
*
lcp rcp
*
* 5th line: DPFU (degrees/Jansky) for polarizations in previous line in order
*
0.0651 0.0673
*
* 6th line: gain curve (only one) for ALL polarizations in 4th line
* TYPE FORM COEFFICENTS ...
*
* FORM = POLY only for now
* TYPE - ELEV and ALTAZ only for now
* COEFFICENTS - variable number of number values
*
* maximum coefficents 10
*
ELEV POLY 0.95745985 0.0030809667 -5.5784686e-05
*
* 7th and following lines: tcal versus frequency
*     Format: POL FREQ TCAL
*     where:
*             POL    polarization rcp or lcp
*             FREQ   frequency (MHz)
*             TCAL   degrees K
*
*     MAXIMUM ENTRIES 100, group by polarization
*                          then sorted by increasing freq
*
lcp 4000.0 5.8000
lcp 4100.0 5.8000
"tempxx.rxg" 541L, 11523C written                          1,1           Top
```

Calibration Accuracy

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tpdiff varies due to changes in receiver gain

- The more tpdiff the better (but cal-diode only fires during gaps in recording)
- Smooth changes easily modelled – jumps not so well

Points of note from the EVN experience:

- K band a real problem – poor sensitivity
- RFI problems at L band – 21 cm significantly worse than 18 cm
- 5 cm not great either – poor sensitivity (but spectral line. . .)

Calibration Accuracy

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- The EVN pipeline gives the amplitude corrections derived from self-cal for experiments correlated at JIVE.
- These are an *indicator* of the calibration accuracy.