Continued NS II tests with AF Rack and Spectrometer
Project TBASErdn021211, December 11, 2002

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1 Setup

Continuing spectrometer tests from previous day (TBASErdn021210). A noise source was injected directly into the Analog Filter Rack SF modules, and the spectrometer used to take scans. Spectra were measured and ratioed in $Sig - Ref/Ref$ fashion. [Note: I found in midst of the tests that I failed to connect the Cal TTL control cable, so cal was not firing in scans 1 through 54. For later scans it was connected.] Spectrometer was configured as CalOn/CalOff, 1 second switch rate, blanking 0.002 seconds.

Note:

SF1 ⇒ HSS0
SF2 ⇒ HSS2
SF3 ⇒ HSS4
SF4 ⇒ HSS6
SF5 ⇒ HSS1
SF6 ⇒ HSS3
SF7 ⇒ HSS5
SF8 ⇒ HSS7

2 200 MHz Modes

2.1 Spectrometer Mode 1W2-045-200

Noise Source II outputs were connected into SF 3,4,7,8. Configured Spectrometer to A1 (Bank A, Quadrant 1), 8192 lags, 3-level, 200 MHz mode: 1W2-045-200. SF3/HSS4 & SF7/HSS5 used. 20 second integrations, 120 second scan time.

Scan 1 st@ 13:44:57 → Scan 10 fi @ 14:06:02.

Discussion: Figure 1 shows the spectra from scan 1. Figure 2 plots T_a/T_{sys} for HSS4 with alternate scans taken as Ref and Sig. The standard deviation is consistant at 10.5×10^{-4}, and DC offsets fluctuate a few parts in 10^4. Figure 3 is a similar plot for HSS5. Figure 4 (HSS4) and Figure 5 (HSS5) show the ratioed spectra when scans 1-2 and scans 1-10 are paired. Note that scans 1 and 10 were taken 20 minutes apart.

2.2 Spectrometer Mode 1W2-067-200

Reconfigured spectrometer to mode 1W2-067-200. SF4-HSS6 and SF8-HSS7 used.

Scan 11 st @ 14:07:00 → Scan 20 fi @ 14:28:14.

Discussion: Figure 6 shows the spectra from scan 11. Figures 7 and 8 correspond to figures 2 and 3 in the previous section. Figures 9 and 10 correspond to Figures 4 and 5.

The results for this mode are very similar to the previous mode. The only thing of note is that the SF4-HSS6 combination shows somewhat higher slope in the spectra than the other three checked today.

2.3 Spectrometer Mode 1W2-0XX-200, Two Banks, HSS4-7

Reconfigured spectrometer to a two bank, two quadrant mode, four sampler mode.
Bank A, Quadrant 1 - Mode 1W2-045-200 - 8192 lags
Bank B, Quadrant 2 - Mode 1W2-167-200 - 8192 lags

Scan 21 st @ 14:34:21 → scan 30 fi @ 14:55:45

Discussion: Figure 11 shows the spectra from scan 21, bank A. Compare to Figure 1. Figure 12 shows the spectra from scan 21, bank B. Compare to Figure 6. Analysis plots of ratioed spectra were viewed, but not saved as the results were equivalent to those given above.

2.4 Spectrometer Mode 1W2-0XX-200, Two Banks, HSS0-3

Moved NS II to SF 1, 2, 5, and 6 inputs. Reconfigured spectrometer to record corresponding samplers.
Bank A, Quadrant 1 - Mode 1W2-001-200
Bank B, Quadrant 2 - Mode 1W2-123-200

Scan 31 st @ 15:00:27 → scan 40 fi @ 15:21:52

Discussion: Figure 13 shows the two spectra collected from Bank A (HSS0, HSS1), and may be compared to Figure 7 in the TBASErdn021210 report. Figure 14 shows the spectra from Bank B (HSS2, HSS3), and may be compared to Figure 10 in the TBASErdn021210 report. The four sampler outputs were analyzed, but again the results were so unremarkable the plots were not saved.

There is essentially no difference in ratioed spectra standard deviation for adjacent scans and for scans taken 20 minutes apart.

In the same configuration, did two 10 minute scans with 30 second integrations.

Scan 41 st @ 15:24:40 → scan 42 fi @ 15:44:54

Discussion: The four samplers' ratioed spectra are flat with standard deviation of $4.6 \pm 0.1 \times 10^{-4}$. Figure 15 shows an example, for HSS3.

3 800 MHz Modes

3.1 Spectrometer Mode 1W2-0XX-800, Two Banks, HSS0-3

Changed to try various 800MHz modes. Added 6dB to NSII output attenuator to get near optimum sampler levels. Stayed in two bank, two quadrant, four sampler configuration:
Bank A, Quadrant 1 - Mode 1W2-001-800 - 2048 lags
Bank B, Quadrant 2 - Mode 1W2-123-800 - 2048 lags
20 second integration time, 120 second scan time.

Scans 43 and 44 accidently setup with mismatched integration times in two banks. Ignored.

Scan 45 st @ 15:57:42 → scan 54 fi @ 16:19:06

Discussion: Figures 16 and 17 show the four spectra from scan 45. Note the spike at 340 MHz in all four. This also dominates the ratioed spectra, Figures 18-21. Figures 22-25 show ratioed spectra for paired scans 45-46 and 45-54. The SF5-HSS1 data shows noticable structure after 20 minutes. It seemed to gradually detoriate as shown in Figure 26, scans 46-54 all ratioed to scan 45.

At this time, I realized that I forgot to hookup the cal control cable, so previous scans had no cal firing. Connected it now, and decided to repeat above test.

Scan 55 st @ 16:25:23 → scan 64 fi @ 16:46:48

Discussion: Figure 27 shows the calOn and calOff phases of scan 55 for HSS0. The only notable difference in the analysis of this sequence of scans compared to the previous ten, is that all the 55-64 scan ratios show some structure similar to that seen in Figure 26.

3.2 Spectrometer Mode 1W2-0XX-800, Two Banks, HSS4-7

Reconfigured to other 4 samplers.
Bank A, Quadrant 1 - Mode 1W2-045-800 - 2048 lags
Bank B, Quadrant 2 - Mode 1W2-167-800 - 2048 lags

Ran for 40 minutes over lunch.

Scan 65 st @ 16:54:24 → scan 84 fi @ 17:37:17

Discussion: Figures 28 and 29 show the four spectra from scan 65. Figures 30 and 31 show the ratios of alternate scans for HSS4 and HSS6; plots for HSS5 and HSS7 are similar. Note there are noticable DC offsets (the traces should be uniformally spaced by 0.002 units). However, all four samplers showed the same pattern of offsets, so it is probably related to the known periodic cycling of the Equipment Room temperature.

The ratioed spectra develop more structure as the Signal scan moves further in time away from a Reference scan. Figures 32-35 show the results of using scan 65 as a Reference, and Signal scans at multiples of 6 minutes later. Note the feature at 525MHz that grows with time.

3.3 Spectrometer Mode 1W1-XY-800, Four Banks, HSS0,2,4,6

Reconfigured the spectrometer to a four bank, four quadrant, one sampler per quadrant mode.
Bank A, Quadrant 1 - Mode 1W1-00-800 - 4096 lags
Bank B, Quadrant 2 - Mode 1W1-12-800 - 4096 lags
Bank C, Quadrant 3 - Mode 1W1-24-800 - 4096 lags
Bank D, Quadrant 4 - Mode 1W1-36-800 - 4096 lags

Scan 85 st @ 18:00:54 → scan 94 fi @ 18:22:25

Discussion: Figure 36 shows the four spectra from scan 85. Figure 37 shows the ratios of alternate scans for HSS0; plots for the other three samplers are similar. Note there are noticable DC offsets (the traces should be uniformally spaced by 0.002 units). Figure 38 shows the ratios taking scan 85 as the reference and scans 86, 89, and 94 as signal. Increasing DC offsets and baseline structures are seen as the difference in time between signal and reference increases. Data from other banks was examined, and was similar to that plotted.

3.4 Spectrometer Mode 1W1-XY-800, Four Banks, HSS1,3,5,7

Reconfigured the spectrometer to use the odd numbered samplers:
Bank A, Quadrant 1 - Mode 1W1-01-800 - 4096 lags
Bank B, Quadrant 2 - Mode 1W1-13-800 - 4096 lags
Bank C, Quadrant 3 - Mode 1W1-25-800 - 4096 lags
Bank D, Quadrant 4 - Mode 1W1-37-800 - 4096 lags

Scan 95 st @ 18:27:50 → scan 104 fi @ 18:49:20

Discussion: Figure 39 shows the four spectra from scan 95. Figure 40 shows the ratios of alternate scans for HSS0; plots for the other three samplers are similar. Note there are noticable DC offsets (the traces should be uniformally spaced by 0.002 units). Figure 41 shows the ratios taking scan 95 as the reference and scans 96, 99, and 104 as signal. DC offsets and baseline structure were not as large as seen in Figure 38. However, it is known that Equipment Room temperature cycling comes and goes and that may explain the difference in behavior. Data from other banks was examined, and was similar to that plotted.

3.5 Spectrometer Mode 1W1-XY-800, Four Banks, HSS1,3,5,7

In earlier tests, it was found that LO Blanking generated by LO1, and enabled in the Switching Signal Selector, typically caused severe baseline distortions, due to a bug in how blanking signals were handled in the Spectrometer. John Ford and Rich Lacasse recently reported progress in correction of the blanking bug, and we now attempted to retest with LO Blanking enabled. The LO1 manager was selected in the Scan Coordinator, causing it to go into Running mode when scans were taken. It was configured to barycentric Rest Frame, with $F_{rest} = 23904MHz$, $F_{if} = 6000MHz$, $Tol = 10Hz$. It is expected that this configuration would cause LO1 to generate doppler tracking commands during the scans described below, but that was not independently confirmed. The scan duration was changed from 120 seconds to 300 seconds - otherwise, the spectrometer and IF configuration was not changed at all.

Scan 105 st @ 18:55:11 → scan 114 fi @ 19:48:39

Discussion: Figure 42 shows ratioed spectra for alternate scans. No evidence of problems caused by the LO Blanking is seen, and the baselines seem quite good. Data from other banks was examined, and was similar to that plotted.

4 Conclusions

Four 200 MHz one-bank and two-bank, and five 800 MHz two-bank and four-bank configurations were evaluated. No crashes or system faults were encountered during the tests.

Generally, the 200 MHz configurations showed flatter baselines over 20 minute durations than the 800 MHz modes. Two spurious birdies were obvious in the 800 MHz modes. The spike near 340 MHz is characteristic of bad lags occasionally seen in the spectrometer digital section. The spike near 530 MHz is generated in an amplifier in Noise Source II as it can be seen with a spectrum analyzer at its output. The degradations in the 800 MHz baselines over time is most likely due to known Equipment Room temperature fluctuations, but we will attempt to confirm this in subsequent tests. These tests do illustrate that some baseline structure is introduced within the Equipment Room equipment, especially for longer times between Signal and Reference scans.

No problems were seen when LO Blanking was enabled, so hopefully that bug has been laid to rest. It was also gratifing that the multibank modes worked so well.

H

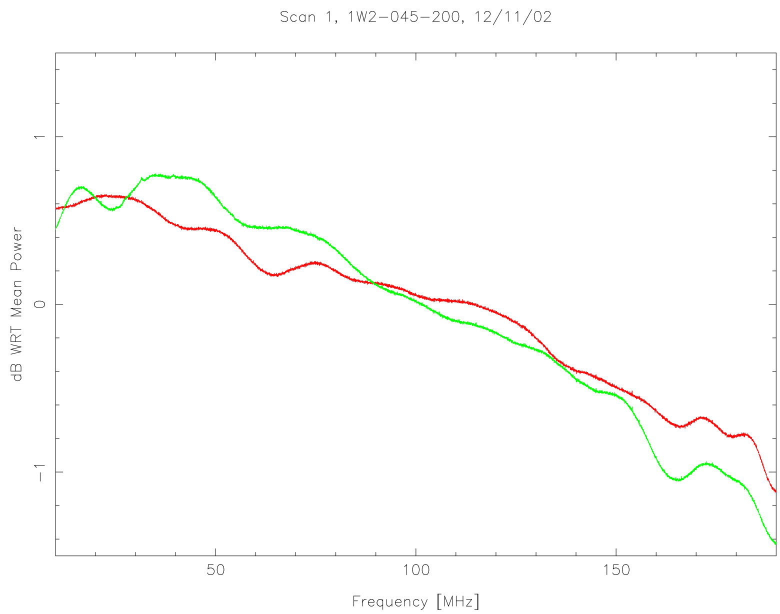

Figure 1: Spectra from scan 1. Red is from HSS4; green from HSS5.

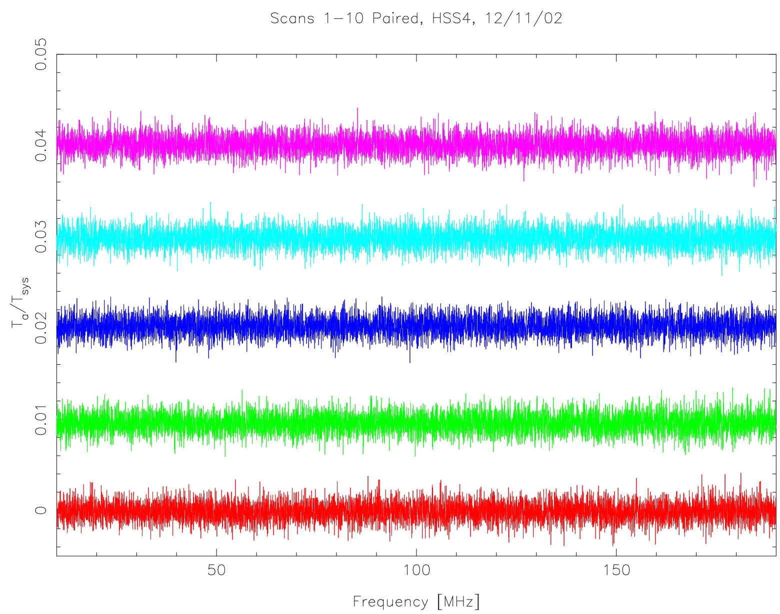

Figure 2: T_a/T_{sys} for HSS4 with alternate scans taken as Ref and Sig.

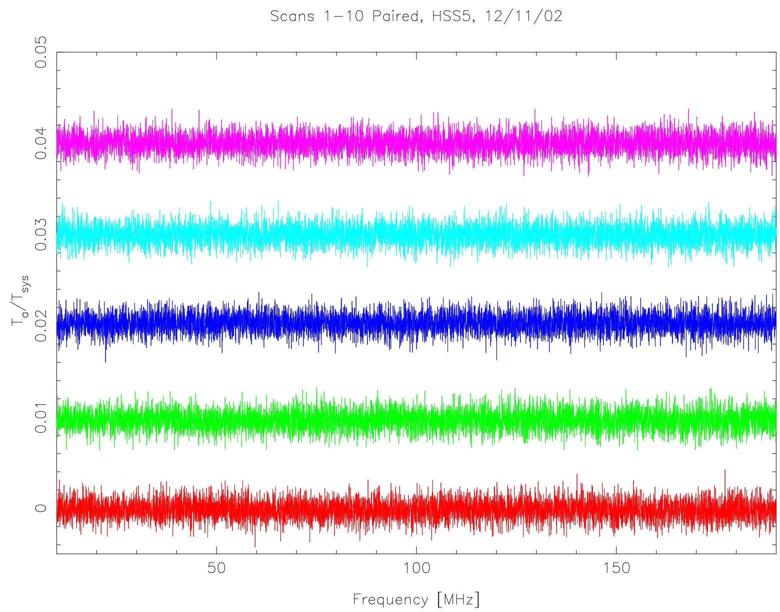

Figure 3: T_a/T_{sys} for HSS5 with alternate scans taken as Ref and Sig.

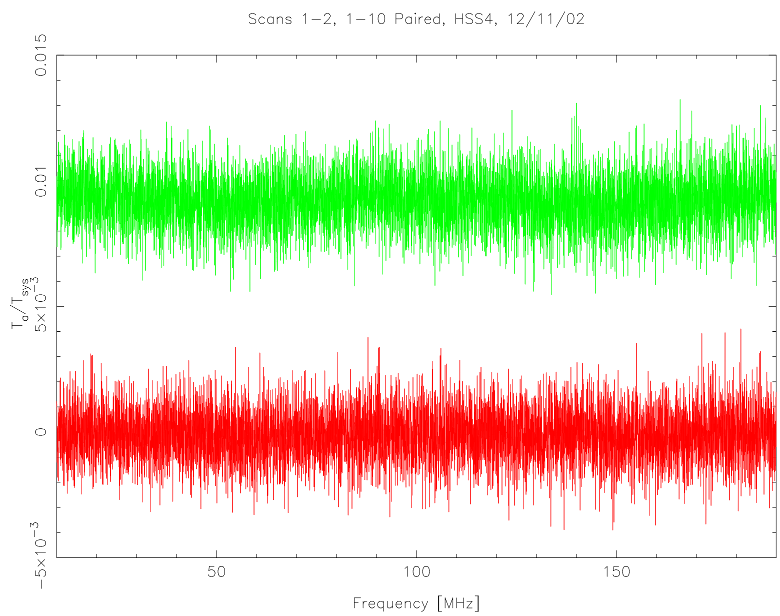

Figure 4: T_a/T_{sys} for HSS4 when scans 1-2 (red) and scans 1-10 (green) are paired. Note that scans 1 and 10 were taken 20 minutes apart.

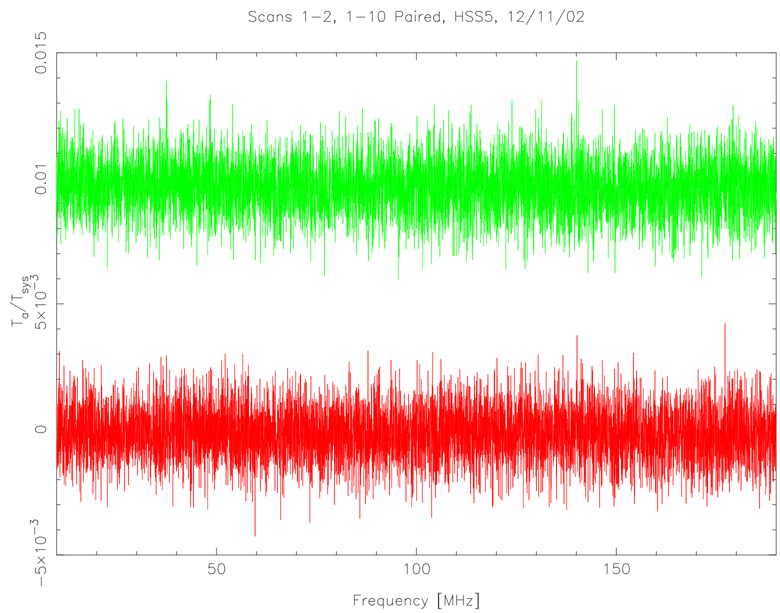

Figure 5: T_a/T_{sys} for HSS5 when scans 1-2 (red) and scans 1-10 (green) are paired. Note that scans 1 and 10 were taken 20 minutes apart.

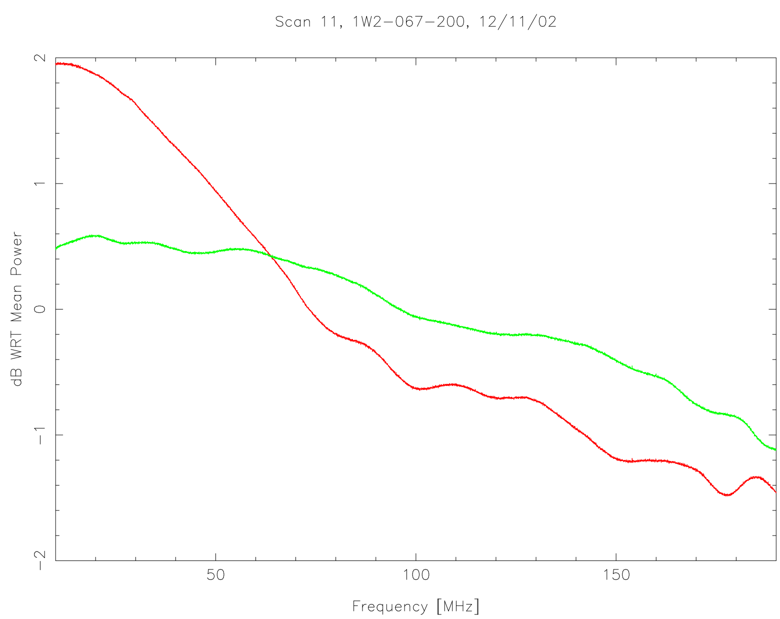

Figure 6: Spectra from scan 11. Red is from HSS6; green from HSS7.

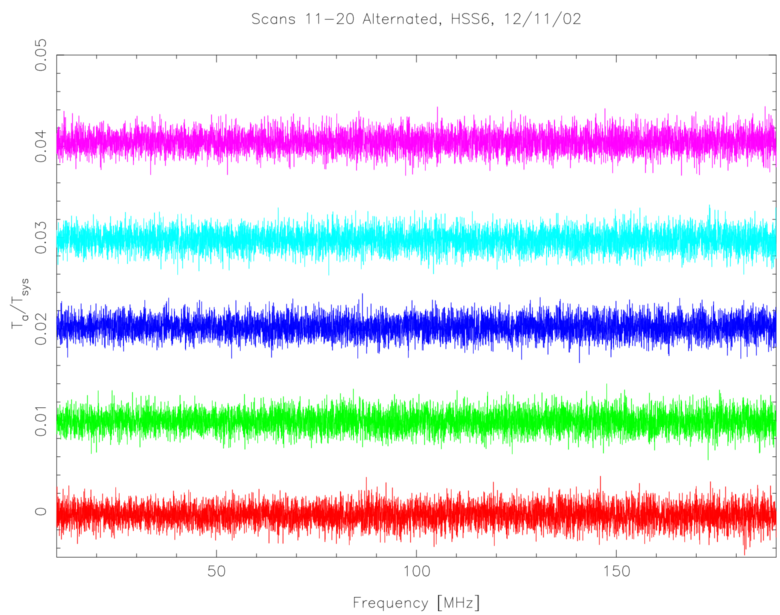

Figure 7: T_a/T_{sys} for HSS6 with alternate scans taken as Ref and Sig.

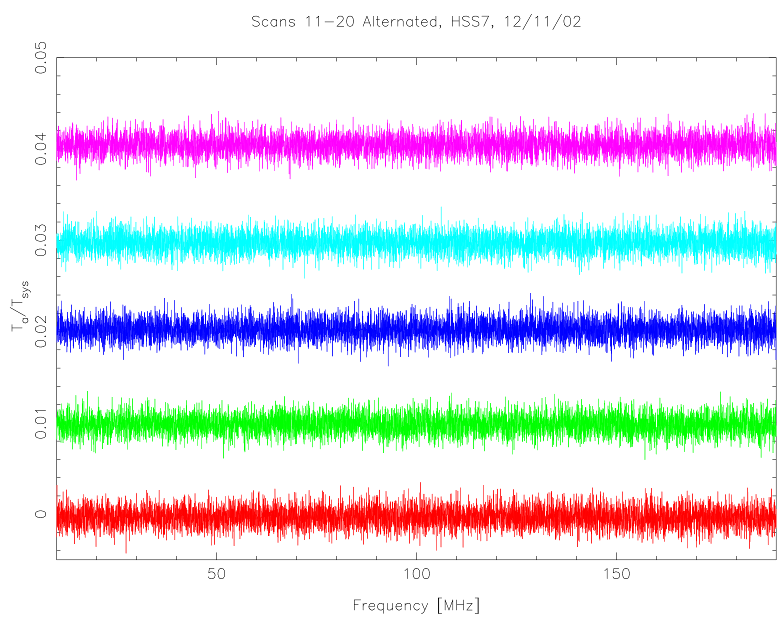

Figure 8: T_a/T_{sys} for HSS7 with alternate scans taken as Ref and Sig.

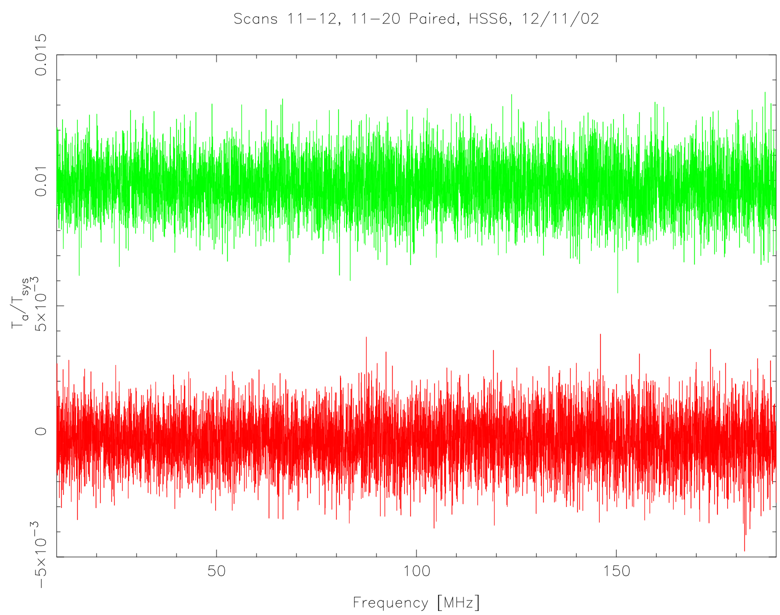

Figure 9: T_a/T_{sys} for HSS6 when scans 11-12 (red) and scans 11-20 (green) are paired. Note that scans 11 and 20 were taken 20 minutes apart.

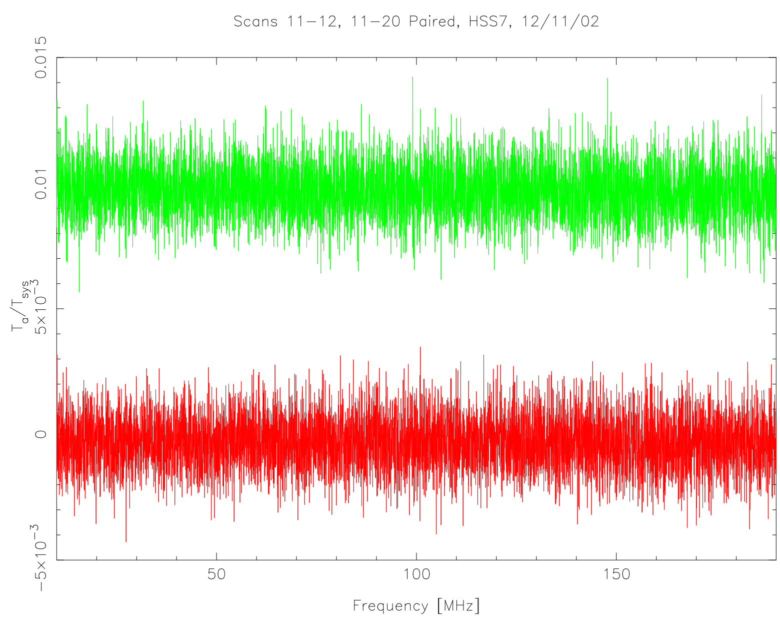

Figure 10: T_a/T_{sys} for HSS7 when scans 11-12 (red) and scans 11-20 (green) are paired. Note that scans 11 and 20 were taken 20 minutes apart.

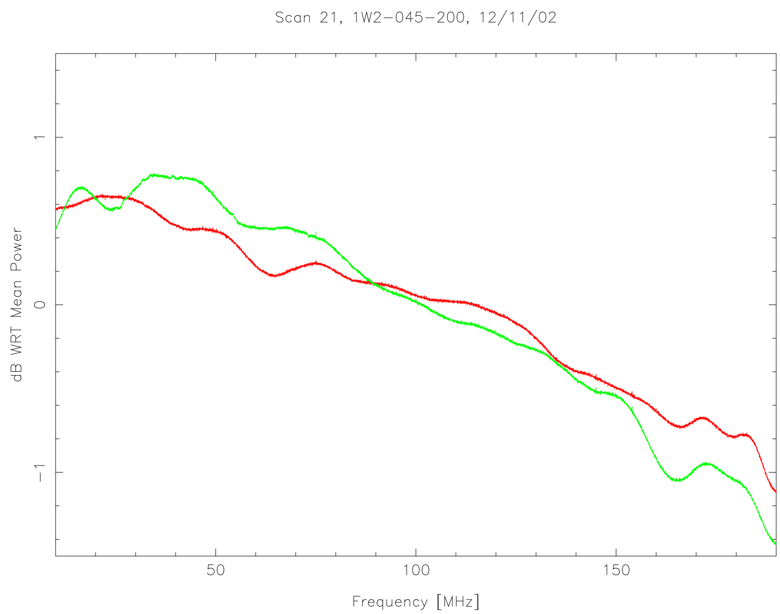

Figure 11: Two-quadrant mode 1W2-0XX-200 spectra for HSS4 (red) and HSS5 (green).

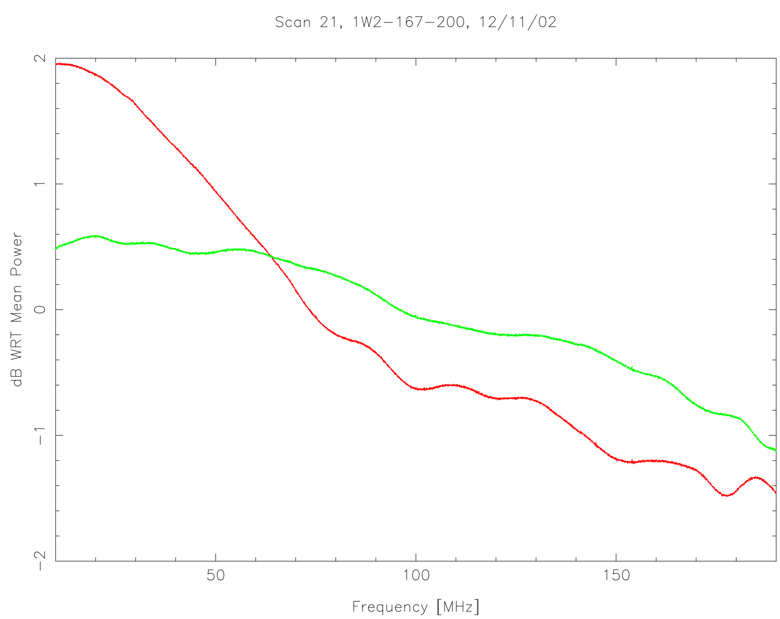

Figure 12: Two-quadrant mode 1W2-0XX-200 spectra for HSS6 (red) and HSS7 (green).

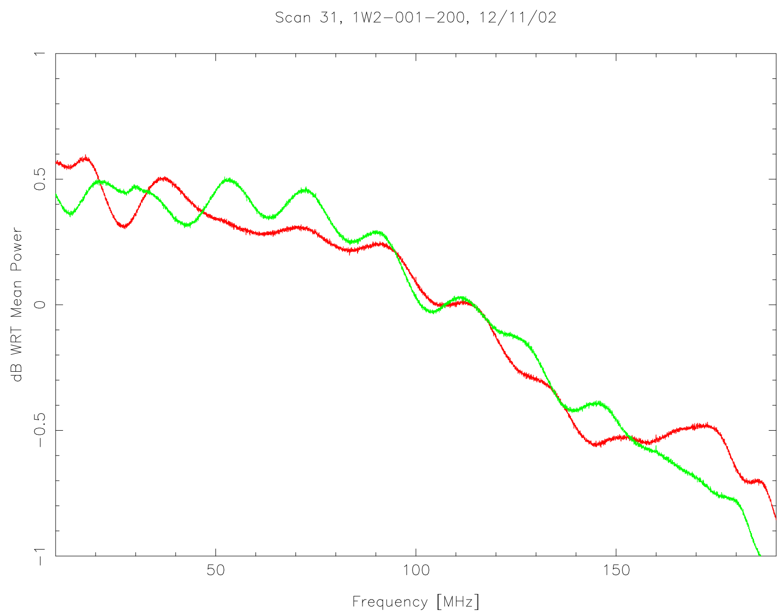

Figure 13: Two-quadrant mode 1W2-0XX-200 spectra for HSS0 (red) and HSS1 (green).

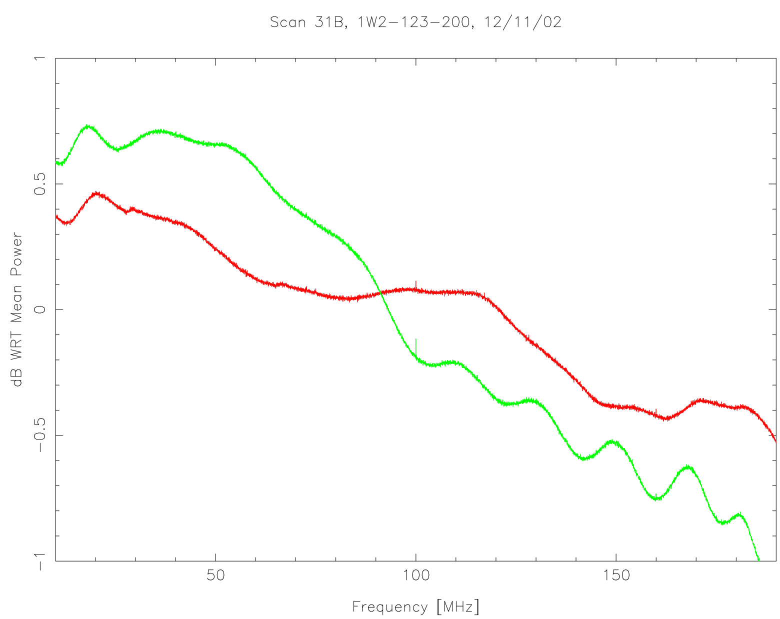

Figure 14: Two-quadrant mode 1W2-0XX-200 spectra for HSS2 (red) and HSS3 (green).

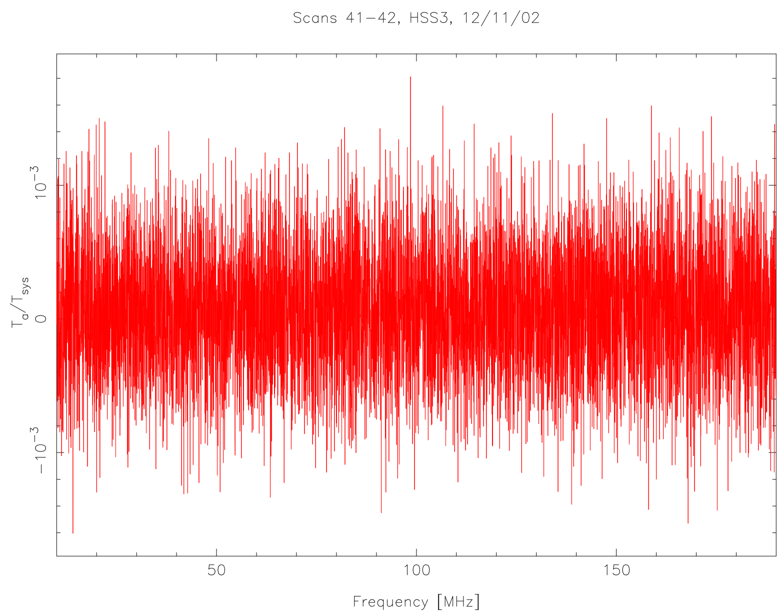

Figure 15: Two-quadrant mode 1W2-0XX-200 spectra for HSS3 (red) using two 10 minute scans.

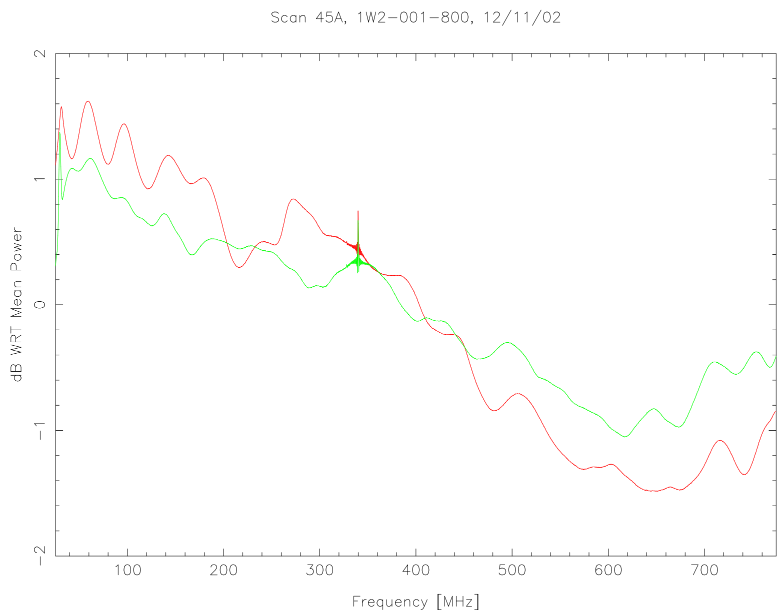

Figure 16: Two-quadrant mode 1W2-0XX-800 spectra for HSS0 (red) and HSS1 (green).

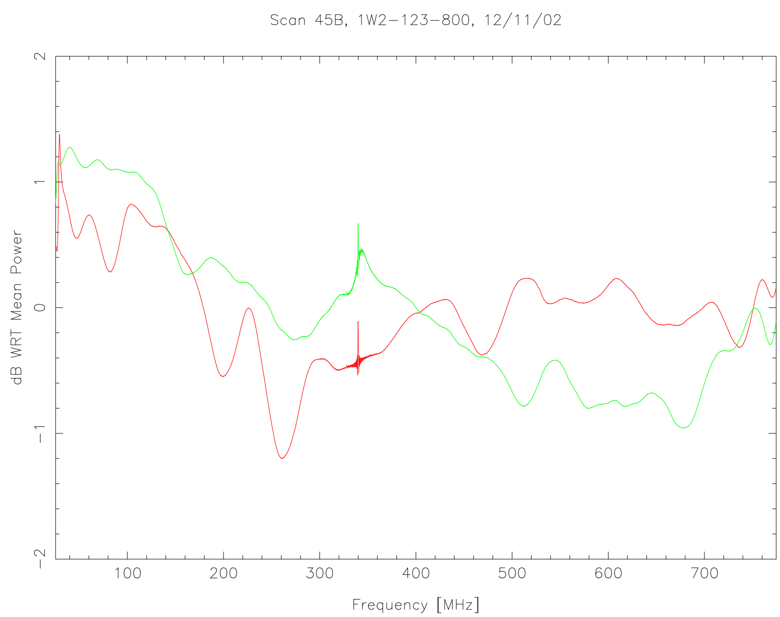

Figure 17: Two-quadrant mode 1W2-0XX-800 spectra for HSS2 (red) and HSS3 (green).

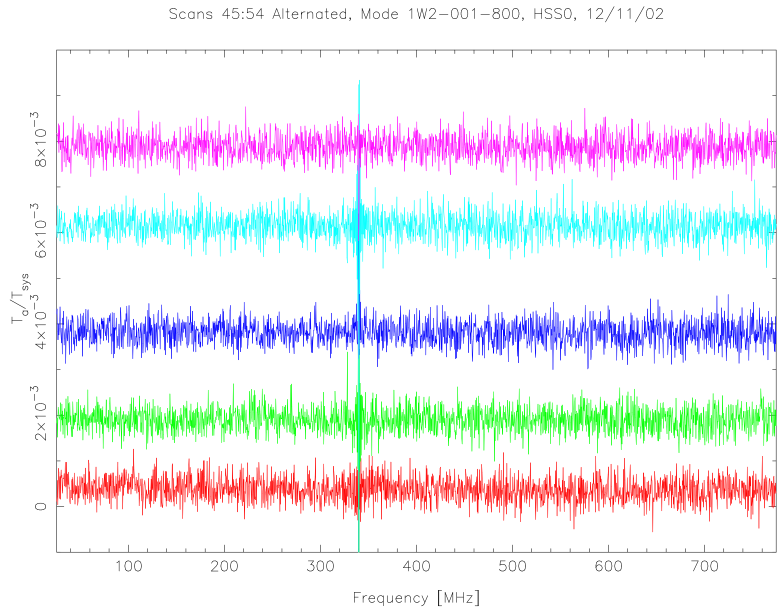

Figure 18: T_a/T_{sys} for HSS0 with alternate scans taken as Ref and Sig.

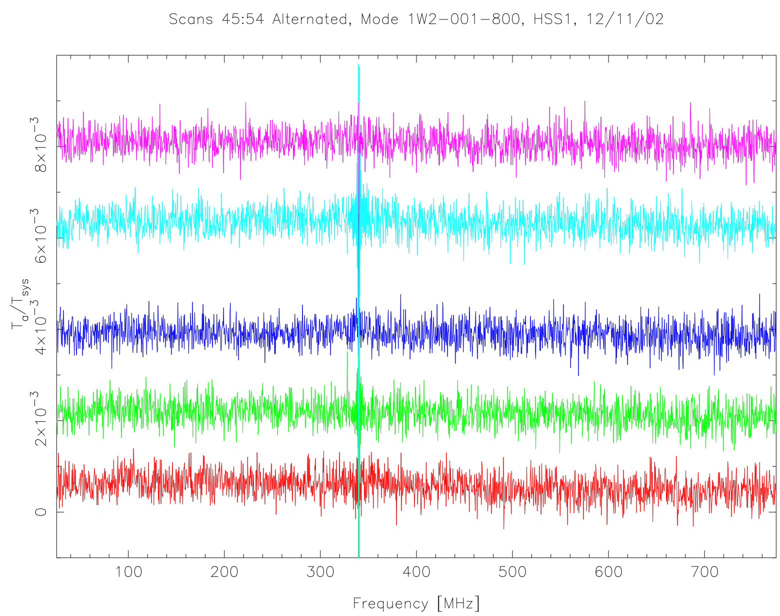

Figure 19: T_a/T_{sys} for HSS1 with alternate scans taken as Ref and Sig.

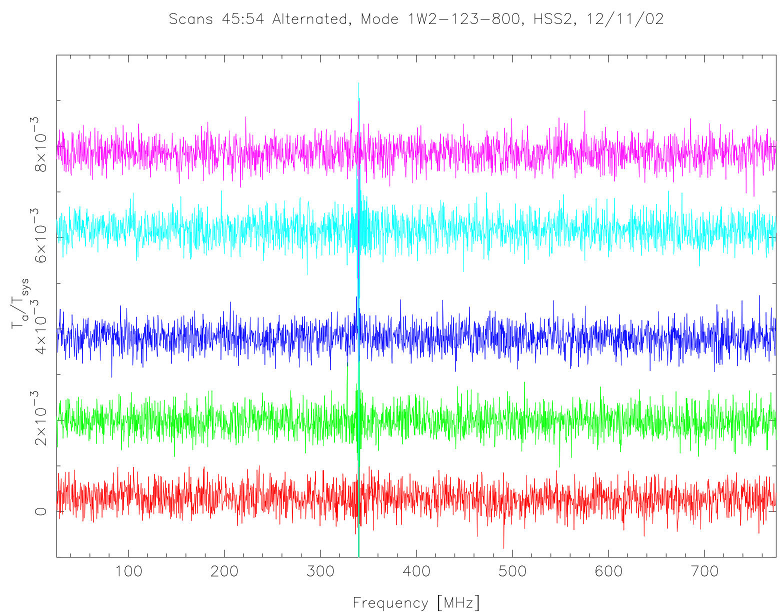

Figure 20: T_a/T_{sys} for HSS2 with alternate scans taken as Ref and Sig.

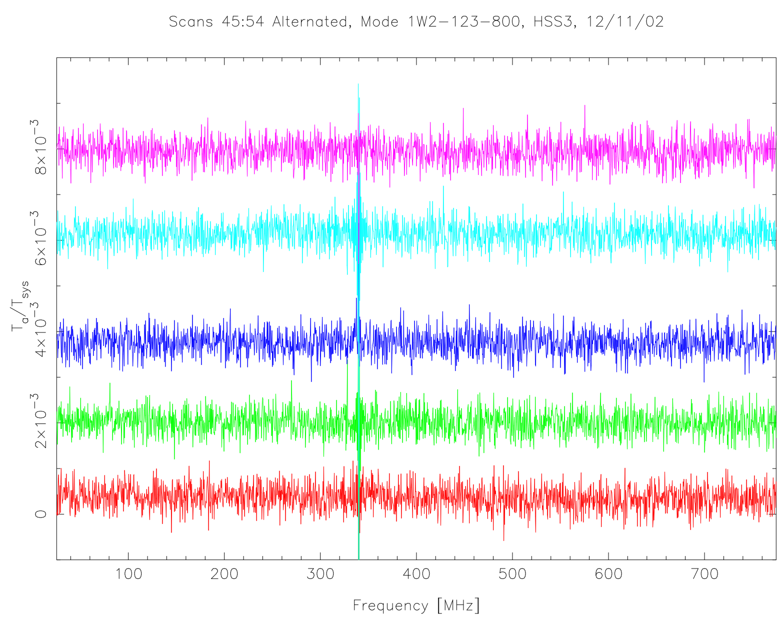

Figure 21: T_a/T_{sys} for HSS3 with alternate scans taken as Ref and Sig.

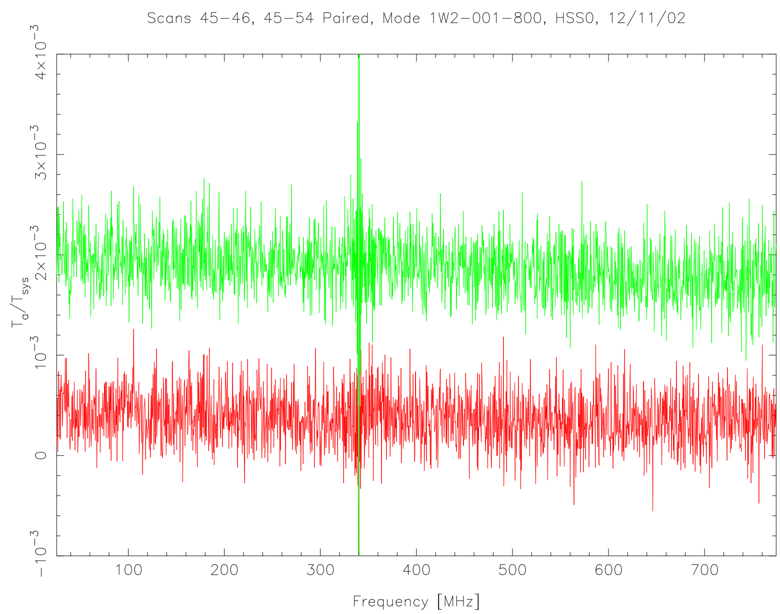

Figure 22: T_a/T_{sys} for HSS0 with scan 45 taken as Ref and scans 46 (red) and 54 (green) taken as Sig. Note that scan 54 was taken 20 minutes after 45.

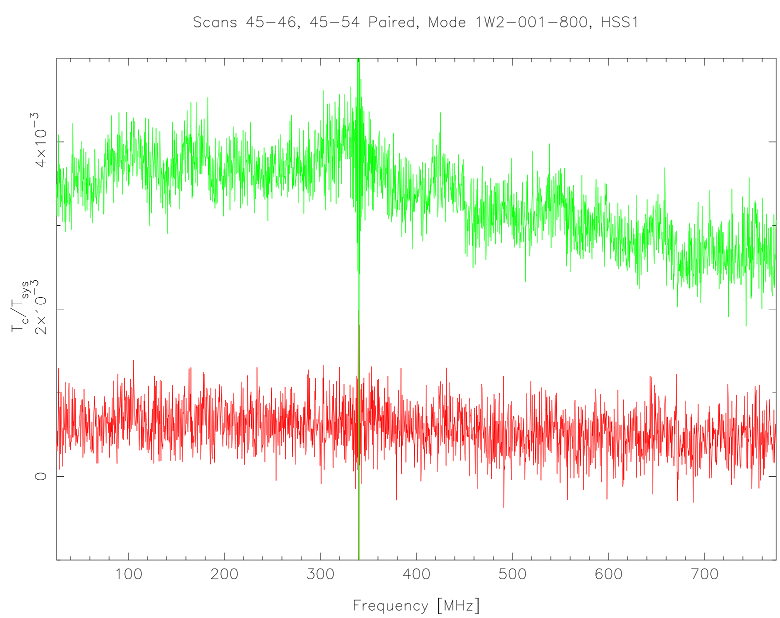

Figure 23: T_a/T_{sys} for HSS1 with scan 45 taken as Ref and scans 46 (red) and 54 (green) taken as Sig. Note that scan 54 was taken 20 minutes after 45.

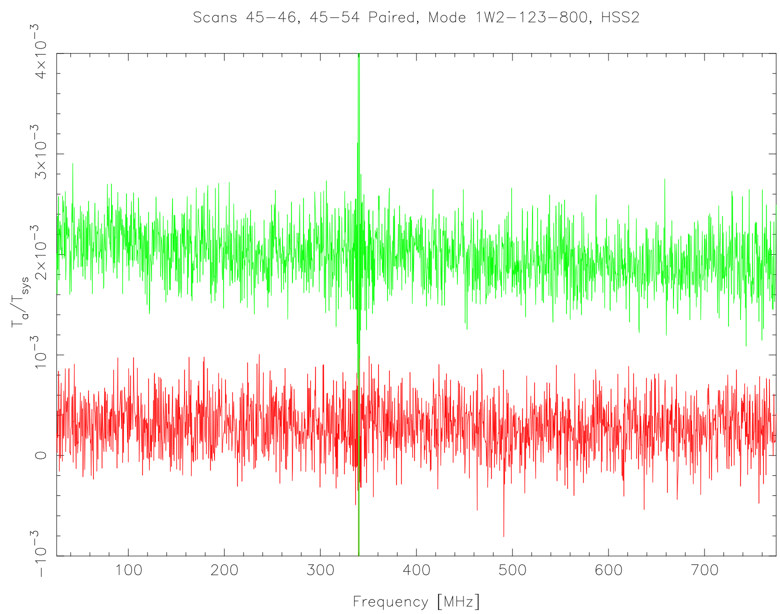

Figure 24: T_a/T_{sys} for HSS2 with scan 45 taken as Ref and scans 46 (red) and 54 (green) taken as Sig. Note that scan 54 was taken 20 minutes after 45.

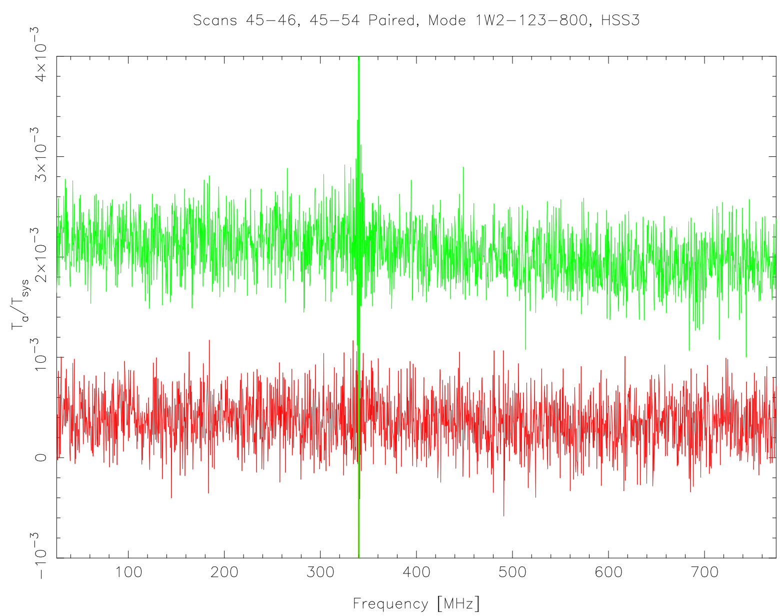

Figure 25: T_a/T_{sys} for HSS3 with scan 45 taken as Ref and scans 46 (red) and 54 (green) taken as Sig. Note that scan 54 was taken 20 minutes after 45.

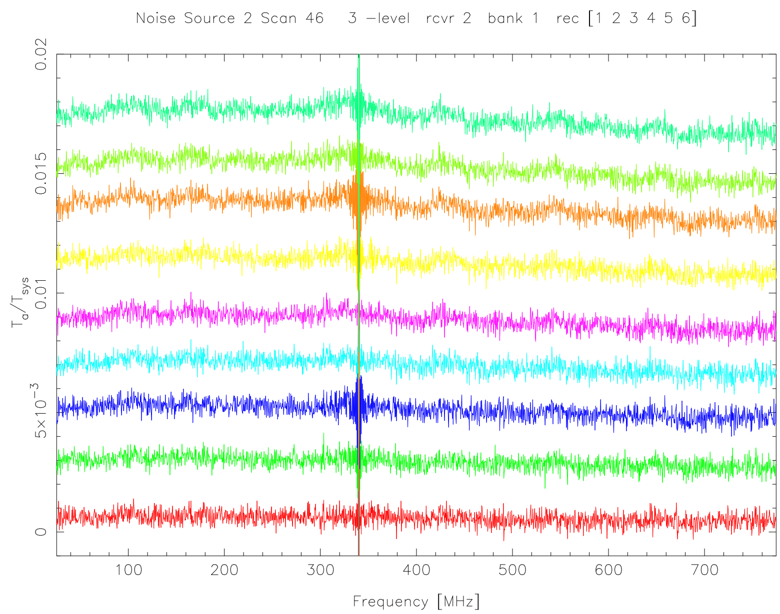

Figure 26: T_a/T_{sys} for HSS1 with scan 45 taken as Ref and scans 46 (bottom trace) through 54 (top trace) taken as Sig.

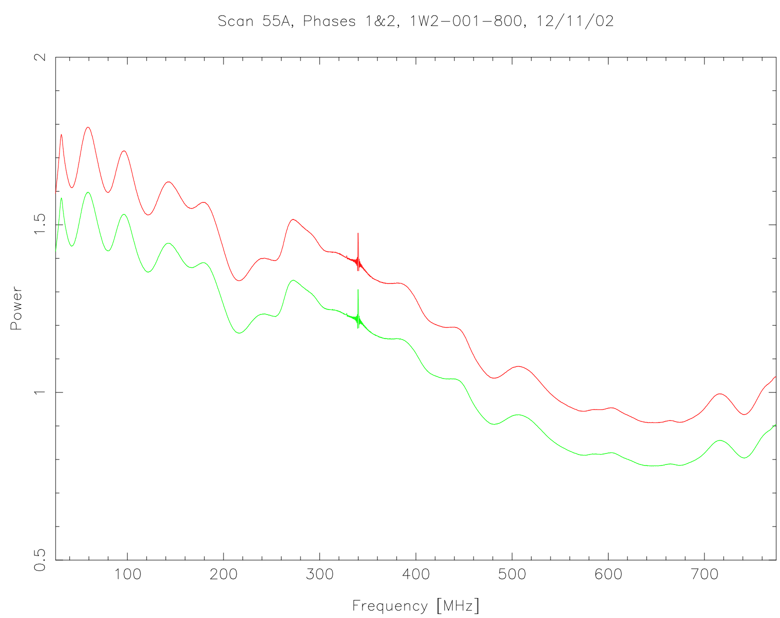

Figure 27: Two-quadrant mode 1W2-001-800 CalOn (red) and CalOff (green) spectra.

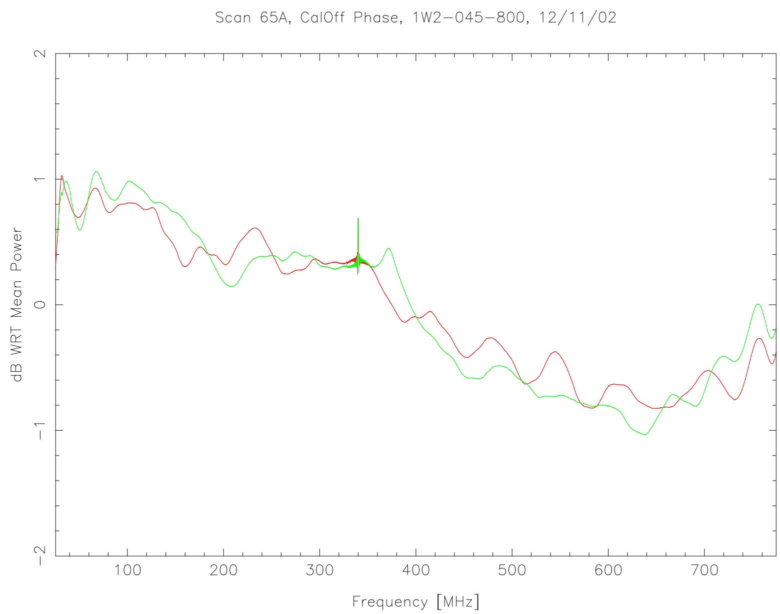

Figure 28: Two-quadrant mode 1W2-0XX-800 spectra for HSS4 (red) and HSS5 (green).

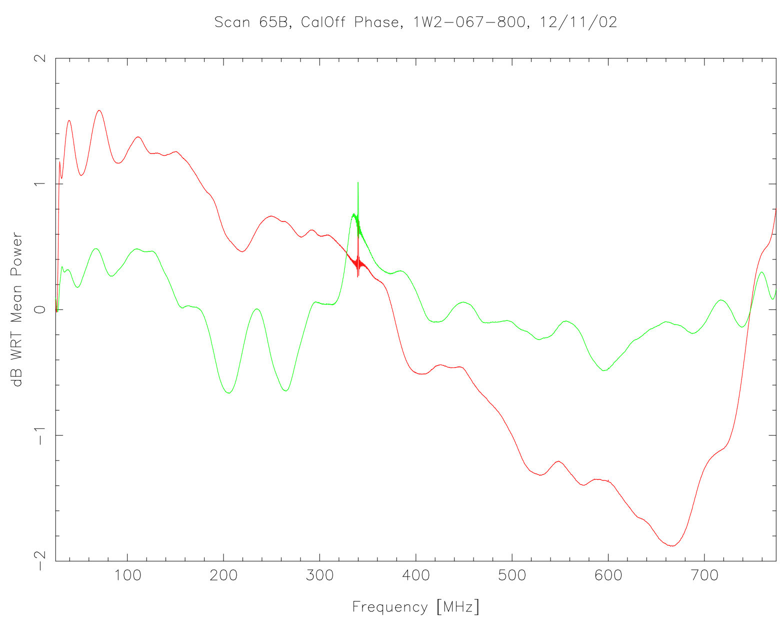

Figure 29: Two-quadrant mode 1W2-0XX-800 spectra for HSS6 (red) and HSS7 (green).

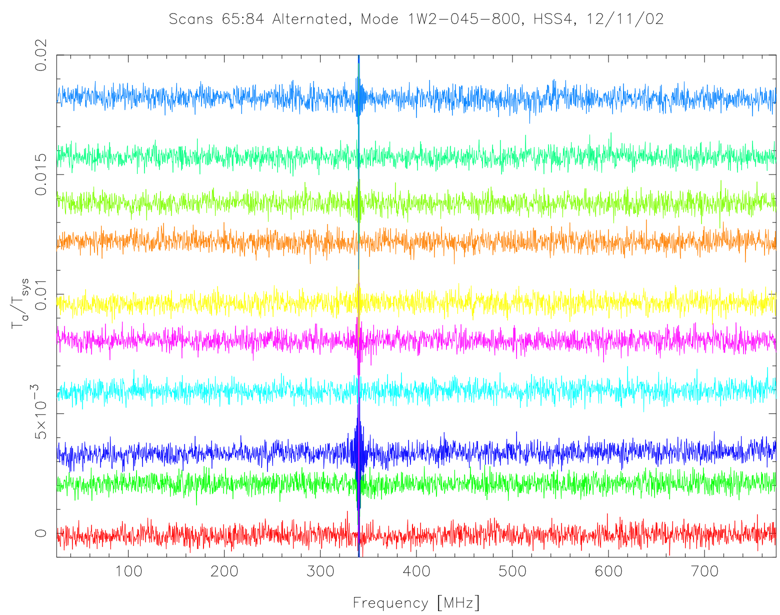

Figure 30: T_a/T_{sys} for HSS4 with alternate scans taken as Ref and Sig.

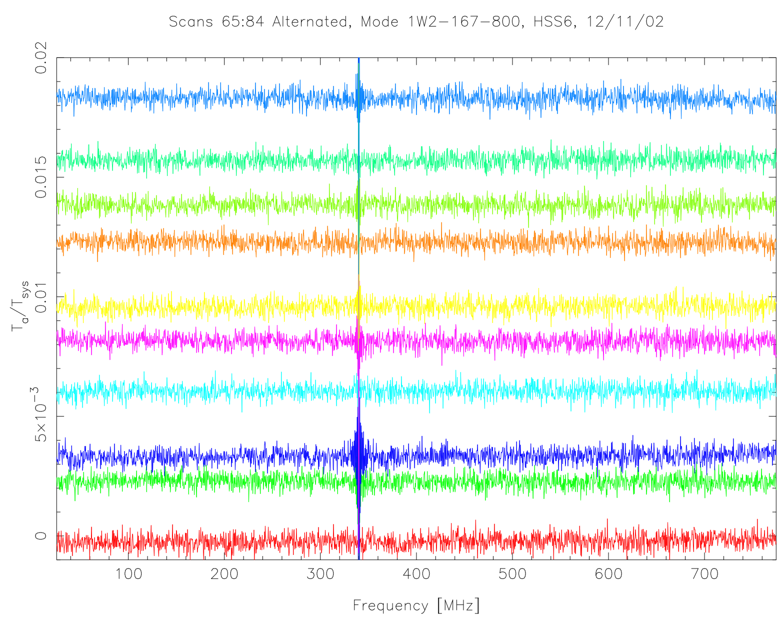

Figure 31: T_a/T_{sys} for HSS6 with alternate scans taken as Ref and Sig.

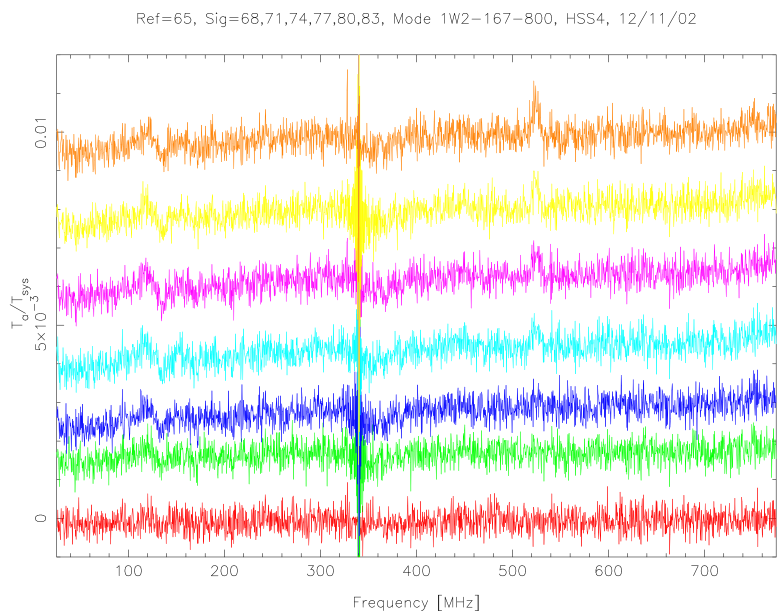

Figure 32: T_a/T_{sys} for HSS4 taking scan 65 as Ref and scans at multiples of 6 minutes away in time as Sig.

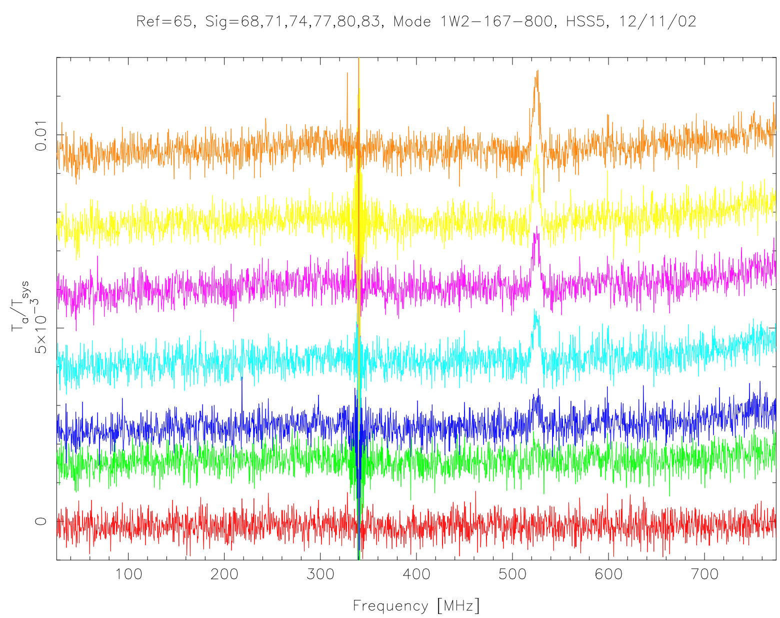

Figure 33: T_a/T_{sys} for HSS5 taking scan 65 as Ref and scans at multiples of 6 minutes away in time as Sig.

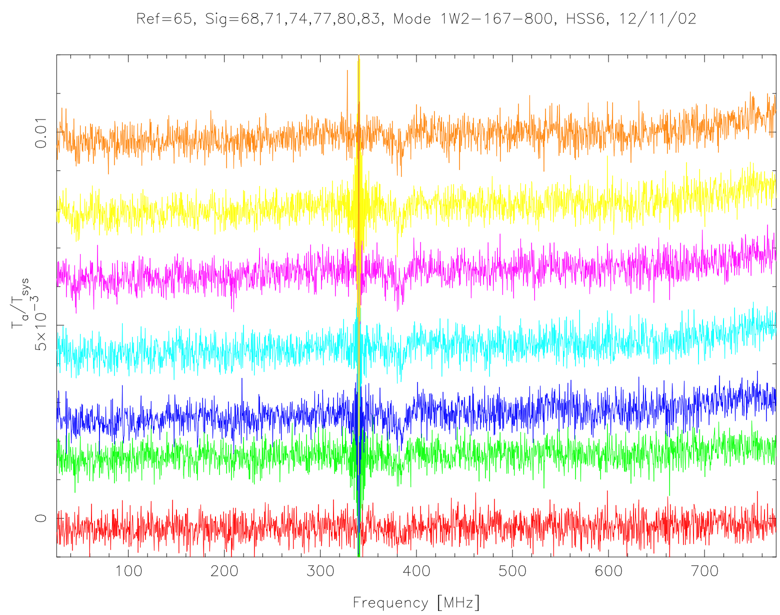

Figure 34: T_a/T_{sys} for HSS6 taking scan 65 as Ref and scans at multiples of 6 minutes away in time as Sig.

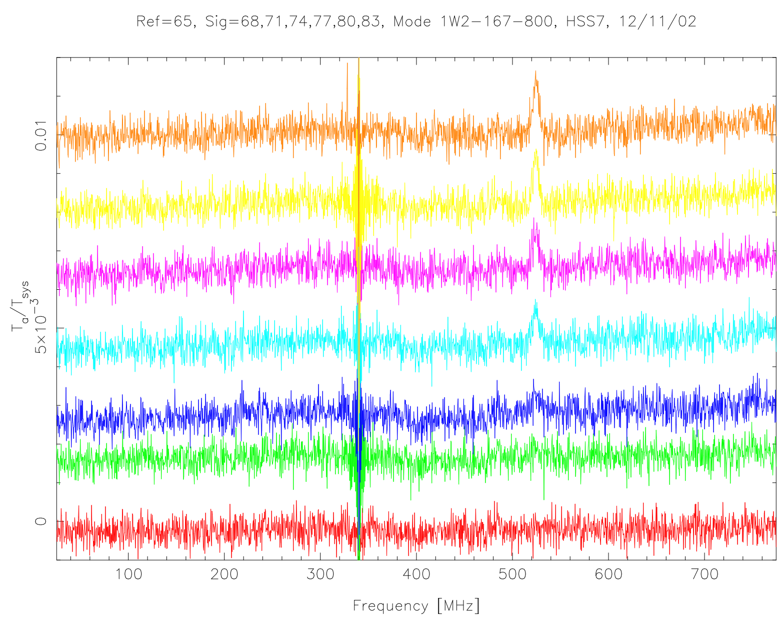

Figure 35: T_a/T_{sys} for HSS7 taking scan 65 as Ref and scans at multiples of 6 minutes away in time as Sig.

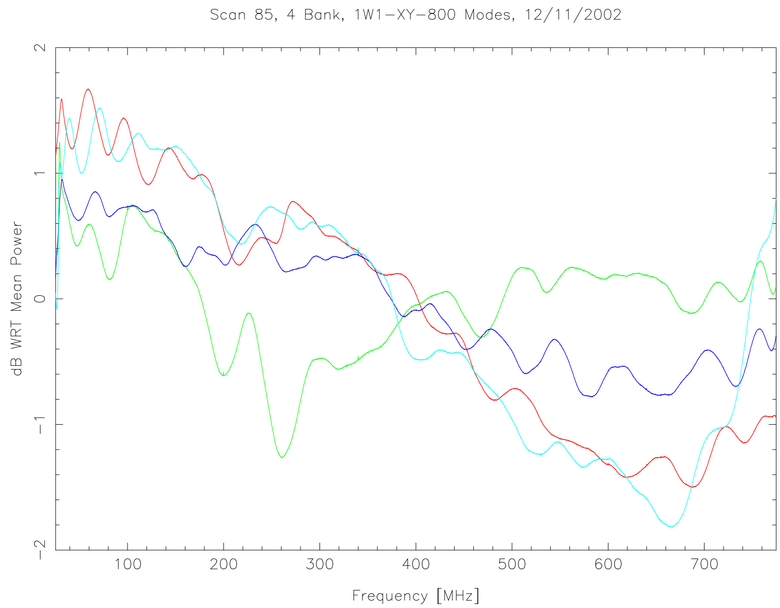

Figure 36: Four-quadrant, four bank mode 1W1-XY-800 spectra for HSS0 (red), HSS2 (green), HSS4 (blue), and HSS6 (cyan).

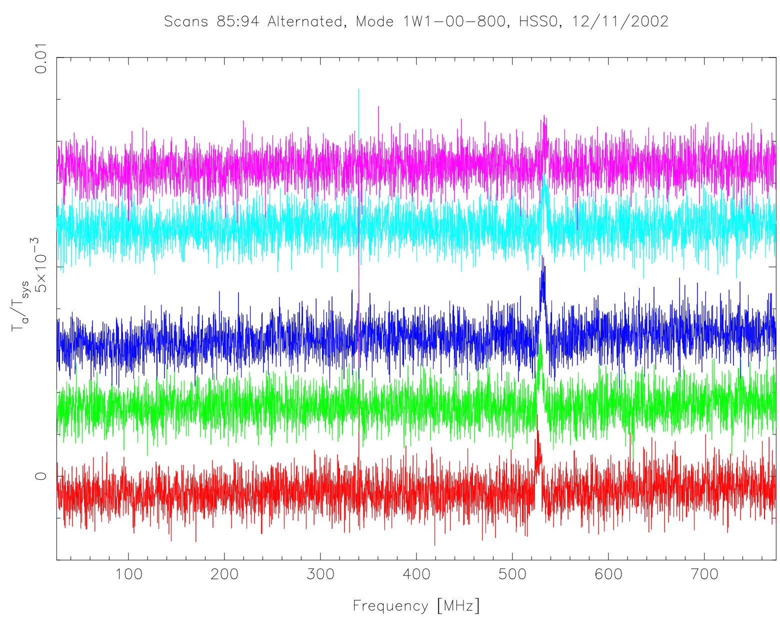

Figure 37: T_a/T_{sys} for HSS0 with alternate scans taken as Ref and Sig. The traces are offset by 0.002 units plus any DC offset in the data.

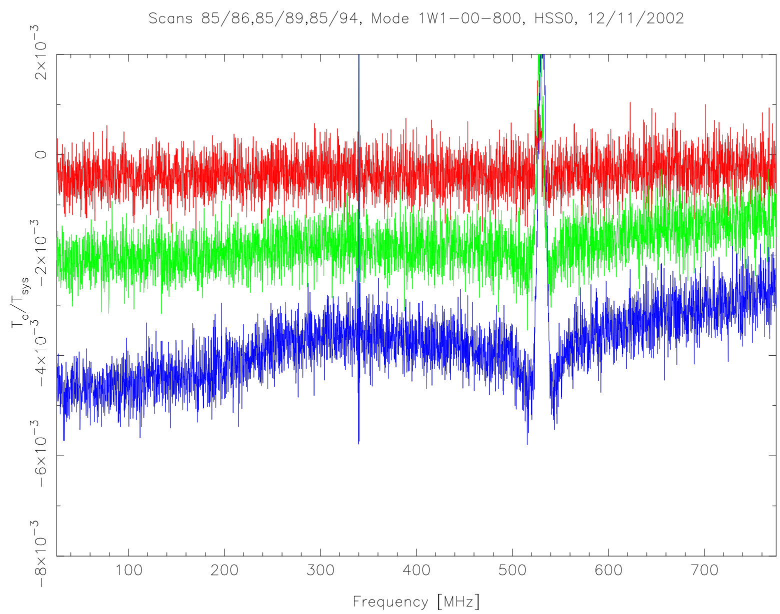

Figure 38: T_a/T_{sys} for HSS0 taking scan 85 as Ref and scans at 2, 8, and 20 minutes away in time as Sig. The DC offsets are in the data - the traces would otherwise overlay.

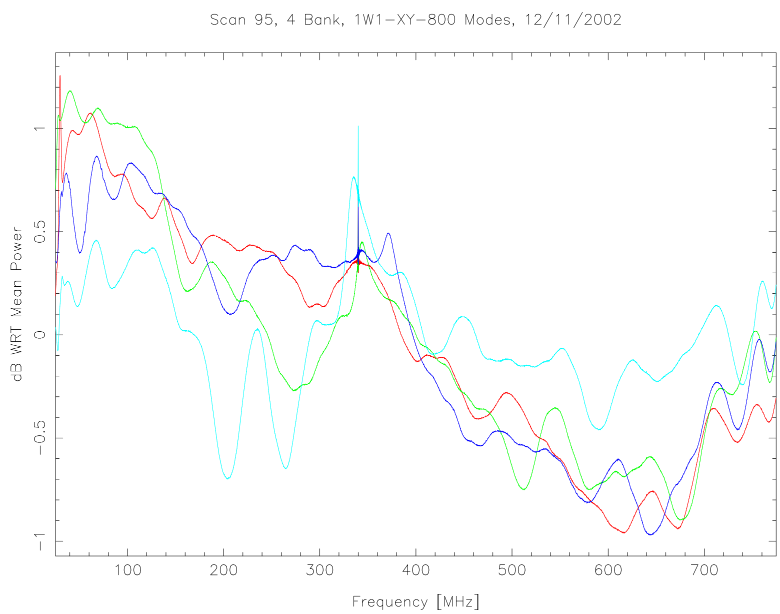

Figure 39: Four-quadrant, four bank mode 1W1-XY-800 spectra for HSS1 (red), HSS3 (green), HSS5 (blue), and HSS7 (cyan).

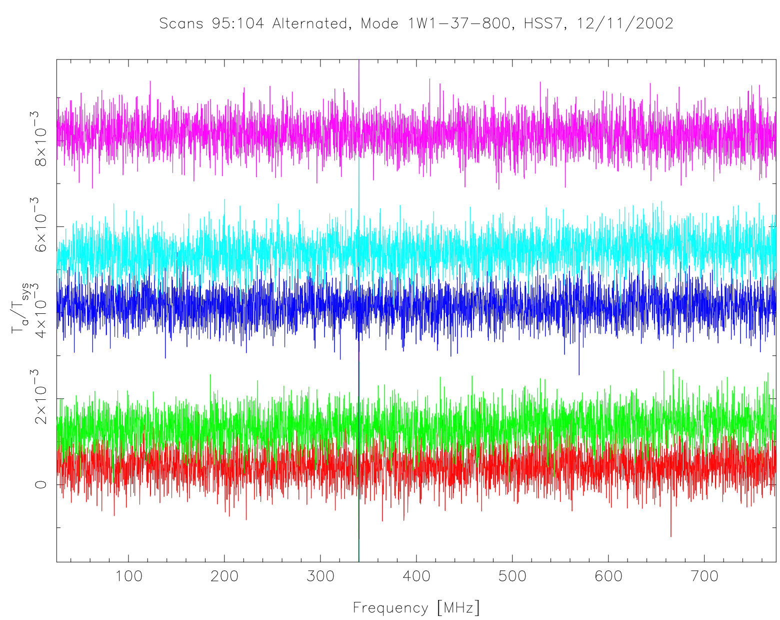

Figure 40: T_a/T_{sys} for HSS7 with alternate scans taken as Ref and Sig. The traces are offset by 0.002 units plus any DC offset in the data.

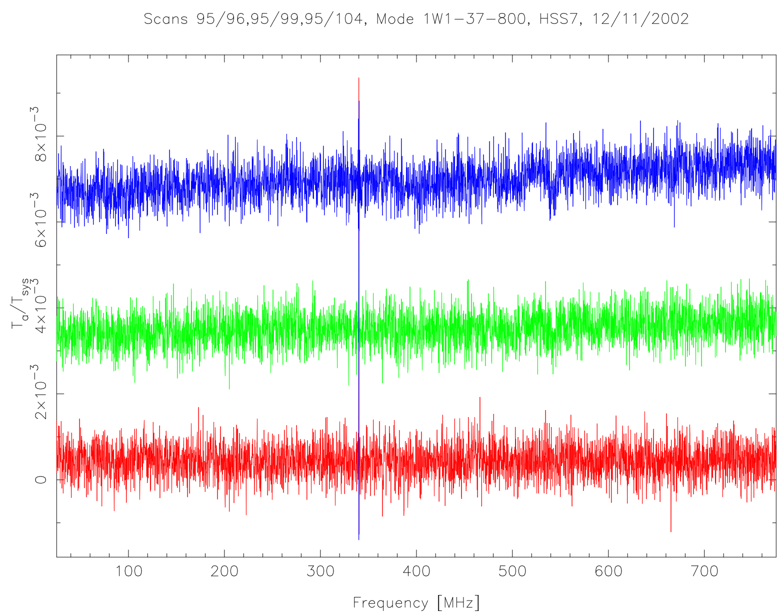

Figure 41: T_a/T_{sys} for HSS7 taking scan 95 as Ref and scans at 2, 8, and 20 minutes away in time as Sig. The traces are offset by 0.002 units plus any DC offset in the data.

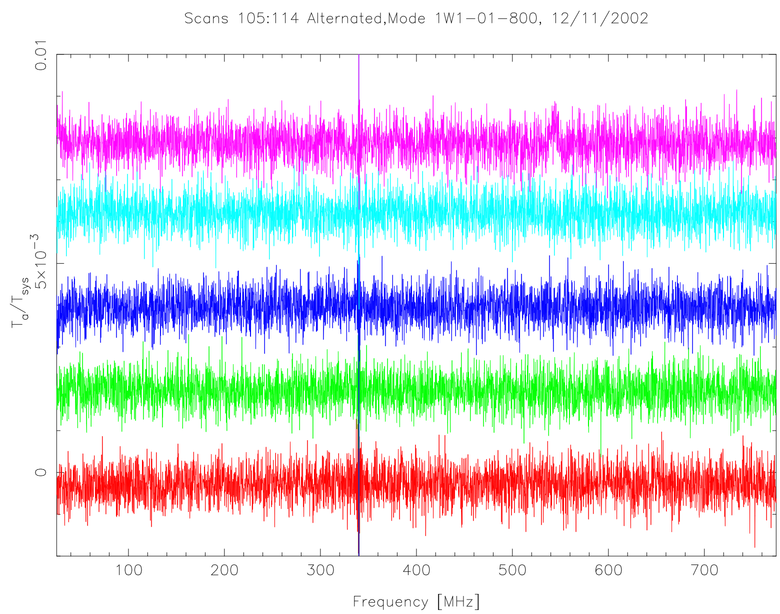

Figure 42: T_a/T_{sys} for HSS1 with LO Blanking enabled. Alternate scans are taken as Ref and Sig. The scans were 5 minutes duration. The traces are offset by 0.002 units plus any DC offset in the data.