Summary of Data Analysis: Low-Band 2, East-West Antenna, With NO Balun Shield

Raul A. Monsalve
raul.monsalve@colorado.edu

CASA, University of Colorado Boulder
SESE, Arizona State University

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Here we show results for the analysis of data from the Low-Band 2 instrument with the antenna in the E-W orientation and NO balun shield. Reports for other Low-Band datasets can be found here:

`http://loco.lab.asu.edu/loco-memos/edges_reports/report105.pdf`
`http://loco.lab.asu.edu/loco-memos/edges_reports/report106.pdf`
`http://loco.lab.asu.edu/loco-memos/edges_reports/report107.pdf`
`http://loco.lab.asu.edu/loco-memos/edges_reports/report108.pdf`

Nominal choices and calibration settings:

1. Dates: 2017-181 to 2017-239
2. Sun cut: none
3. Moon cut: none
4. Receiver calibration S11 file: s11_calibration_low_band_LNA25degC_2017-03-02-02-53-40.txt
5. Receiver parameter polynomial terms: Nfit=6, Wfit=5
6. Antenna S11 file: S11_blade_low_band_2017_180.txt
7. Antenna S11 modeling: 9 polynomial terms after removal of delay
8. Balun loss correction: yes
9. Ground loss correction: yes, 0.5%
10. Beam correction: yes, using beam file *newniv* rotated to $\mathrm{AZ} = +87°$, and Haslam sky map scaled to 76 MHz using $\beta = -2.5$.

The results are summarized in the following figures.

The first seven figures (after Figure 1 described below) provide a overview of the data.

- Figure 2: daily residuals to 7-term polynomial over 50-100 MHz, for all days considered. The GHA range is 0-24 hr.
- Figure 3: residuals for 4-hr GHA averages, to 7-term polynomial over 50-100 MHz.
- Figure 4: residuals for 6-hr GHA averages, to 6-term polynomial over 61-95 MHz.
- Figure 5: residuals for 6-hr GHA averages, to 6-term polynomial plus 21-cm signature, over 61-95 MHz. The signature center and duration are not fixed, but found by maximizing the SNR.
- Figure 6: amplitude of 21-cm signature as a function of GHA for 6-hour averages, in parallel to the total sky temperature. The signature center and duration, different from case to case, are shown at the bottom.
- Figure 7: residuals and model for average over GHA 0-24 hr, to 1) 6-term polynomial over 50-100 MHz; 2) 5-term polynomial over 61-95 MHz; 3) 5-term polynomial plus 21-cm signature over 61-95 MHz.
- Figure 8: residuals and model for average over GHA 0-16 hr, to 1) 6-term polynomial over 50-100 MHz; 2) 5-term polynomial over 61-95 MHz; 3) 5-term polynomial plus 21-cm signature over 61-95 MHz.

The next three figures show the results for the nominal data average, and compare them with those obtained for different data cuts and calibrations. All the cases correspond to data averages over GHA 0-16 hr and 61-95 MHz, modeled with a 5-term polynomial plus a 21-cm signature. In these cases, the frequency and duration of the 21-cm signature, as well as its amplitude, are found by maximizing the ratio SNR $= |a_{21}/\sigma_{21}|$.

- Figure 9: residuals and 21-cm signature for three different averages of consecutive subsets of data.
- Figure 10: residuals and 21-cm signature for three alternative receiver calibrations: 1) Nfit=6, Wfit=5, at 23°C, 2) Nfit=6, Wfit=5, at 27°C, and 3) Nfit=7, Wfit=7, at 25°C.
- Figure 11: residuals and 21-cm signature for two alternative corrections: 1) applying no ground loss correction, and 2) applying no beam correction.

Finally, Table 1 presents the amplitude estimates for the different data cuts and calibration alternatives, and Figure 1 shows the values.

Table 1: Signature amplitude estimates for all the cases considered. In all cases, the GHA range is 0-16 hr. The frequency range is 61-95 MHz and, in addition to the signature, the fit model includes five polynomial terms.

Case	Description	Amplitude estimate [mK]
0	Nominal	478 ± 36
1	1st data subset	345 ± 59
2	2st data subset	585 ± 69
3	3st data subset	589 ± 68
4	recv cal2017, Nfit=6, Wfit=5, 23°C	516 ± 37
5	recv cal2017, Nfit=6, Wfit=5, 27°C	475 ± 39
6	recv cal2017, Nfit=7, Wfit=7, 25°C	515 ± 38
7	No ground loss correction	486 ± 36
8	No beam correction	485 ± 38

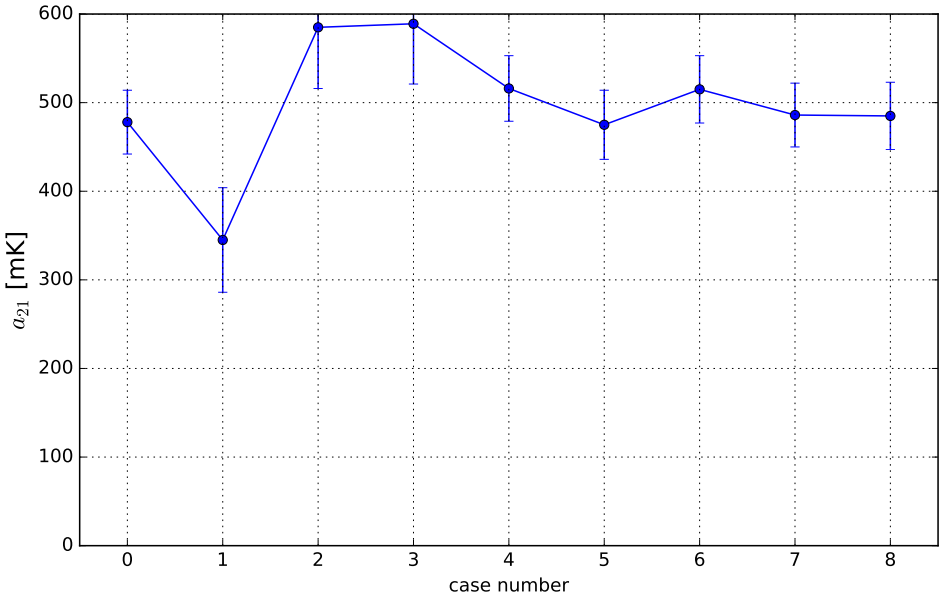

Figure 1: Signature amplitude for the cases of Table 1.

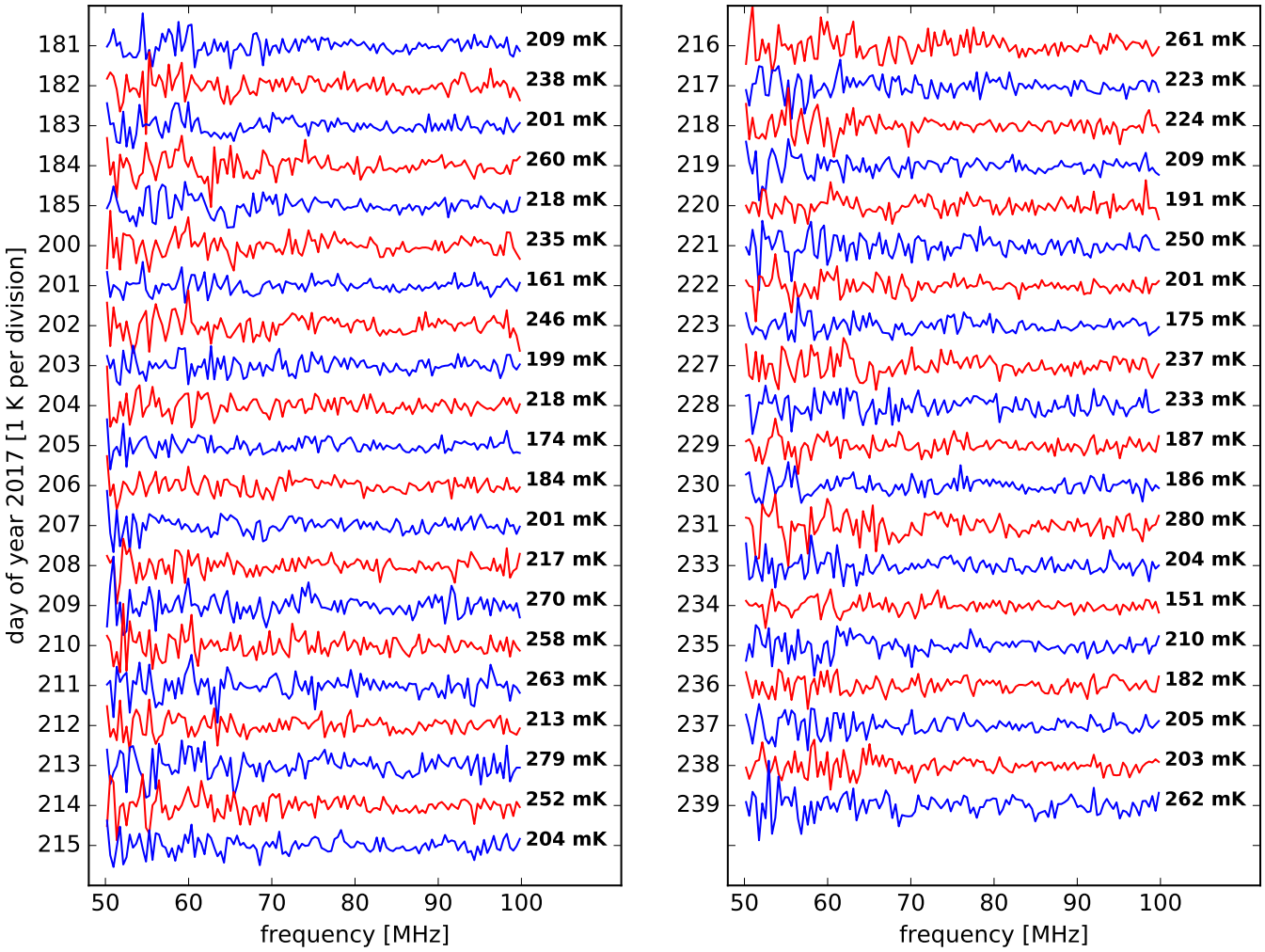

Figure 2: Daily residuals to 7-term polynomial over 50-100 MHz, for all days considered. The GHA range is 0-24 hr.

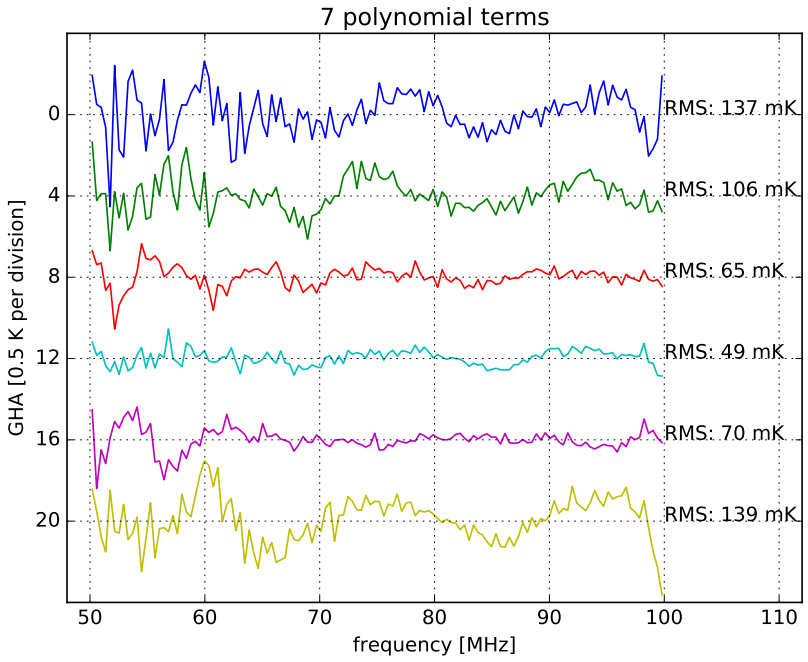

Figure 3: Residuals for 4-hr GHA averages, to 7-term polynomial over 50-100 MHz.

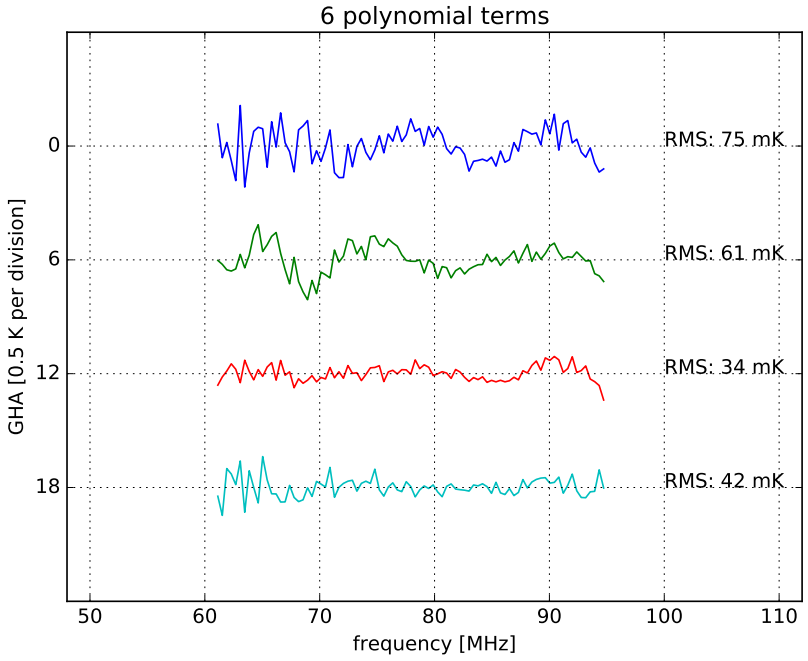

Figure 4: Residuals for 6-hr GHA averages, to 6-term polynomial over 61-95 MHz.

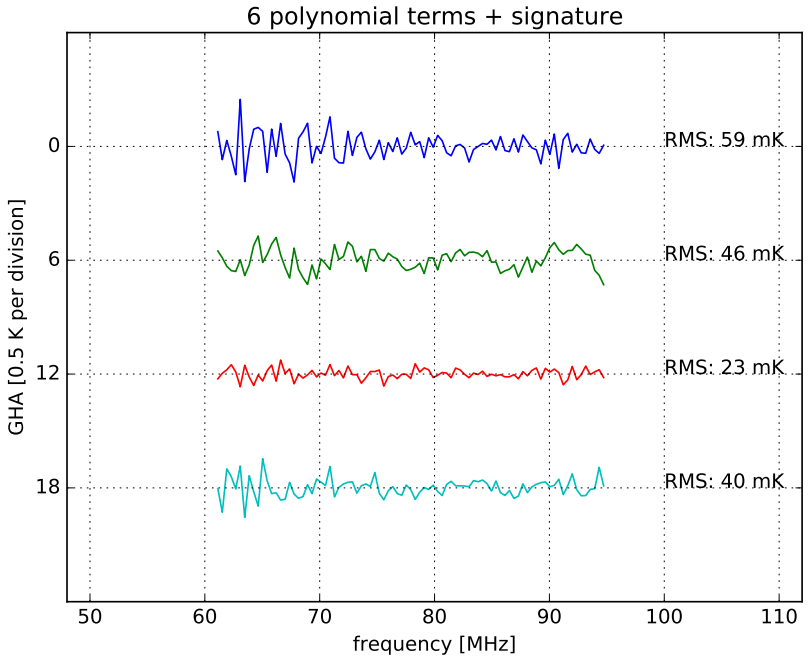

Figure 5: Residuals for 6-hr GHA averages, to 6-term polynomial plus 21-cm signature, over 61-95 MHz. The signature center and duration are not fixed, but found by maximizing the SNR.

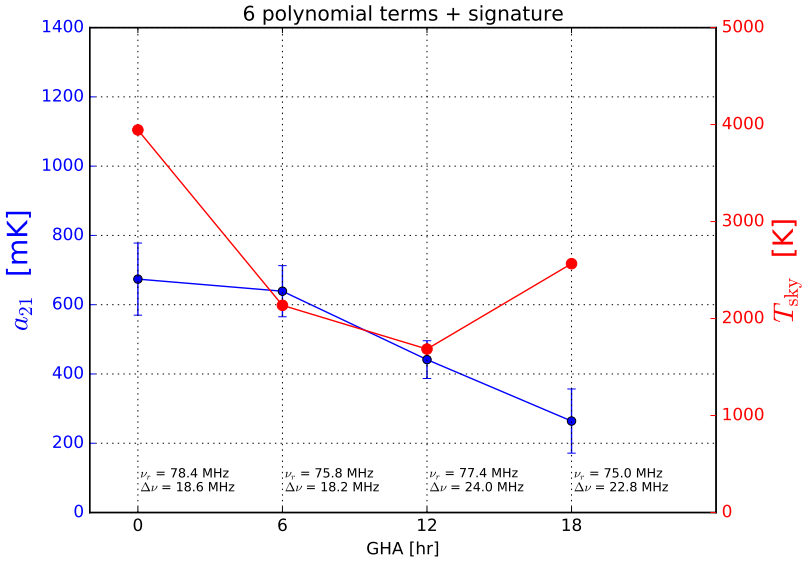

Figure 6: Amplitude of 21-cm signature as a function of GHA for 6-hour averages, in parallel to the total sky temperature at the frequency of the signature center. The signature center and duration are shown at the bottom.

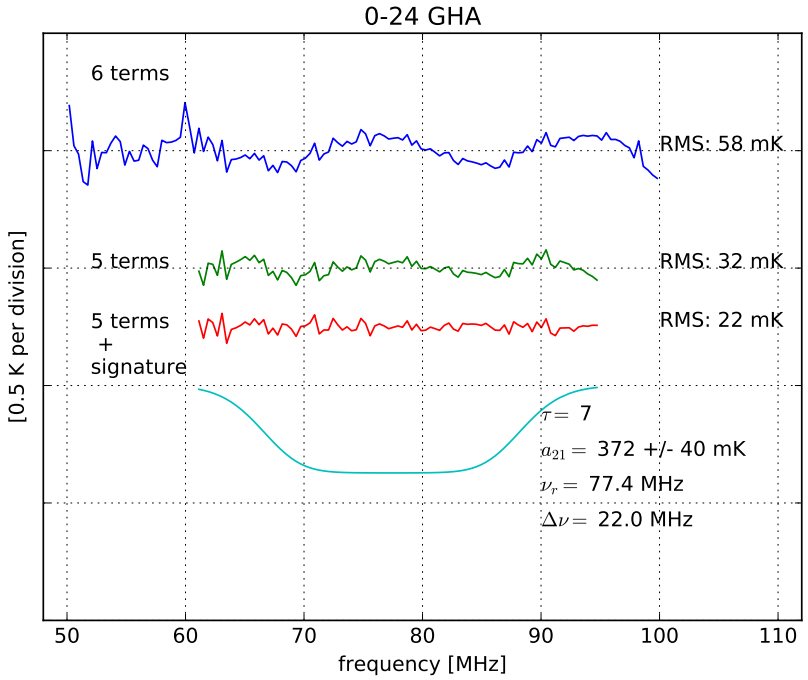

Figure 7: Residuals for average over 0-24 GHA, to 1) 6-term polynomial over 50-100 MHz (blue); 2) 5-term polynomial over 61-95 MHz (green); 3) 5-term polynomial plus 21-cm signature over 61-95 MHz (red). Also shown (cyan) is the best fit 21-cm signature over 61-95 MHz.

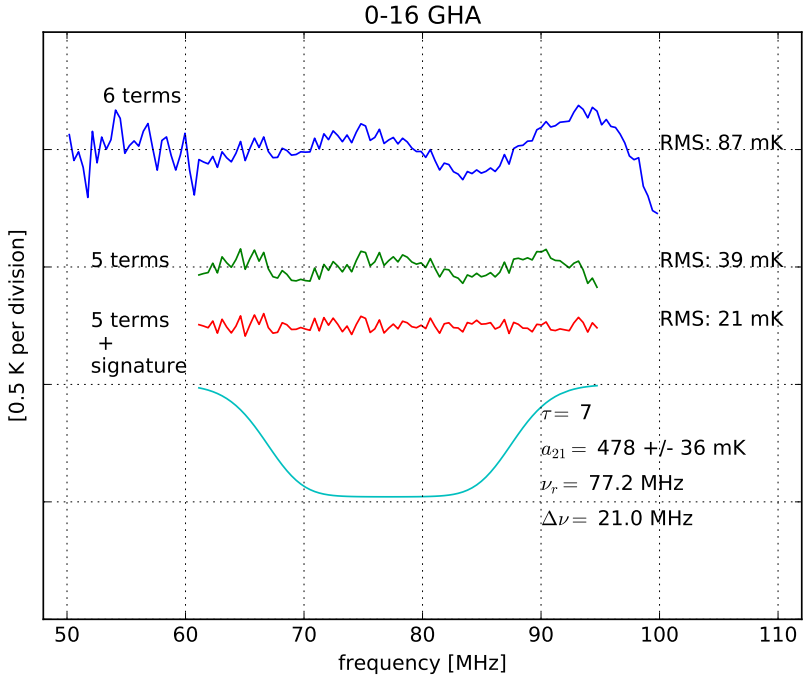

Figure 8: Residuals for average over 0-16 GHA, to 1) 6-term polynomial over 50-100 MHz (blue); 2) 5-term polynomial over 61-95 MHz (green); 3) 5-term polynomial plus 21-cm signature over 61-95 MHz (red). Also shown (cyan) is the best fit 21-cm signature over 61-95 MHz.

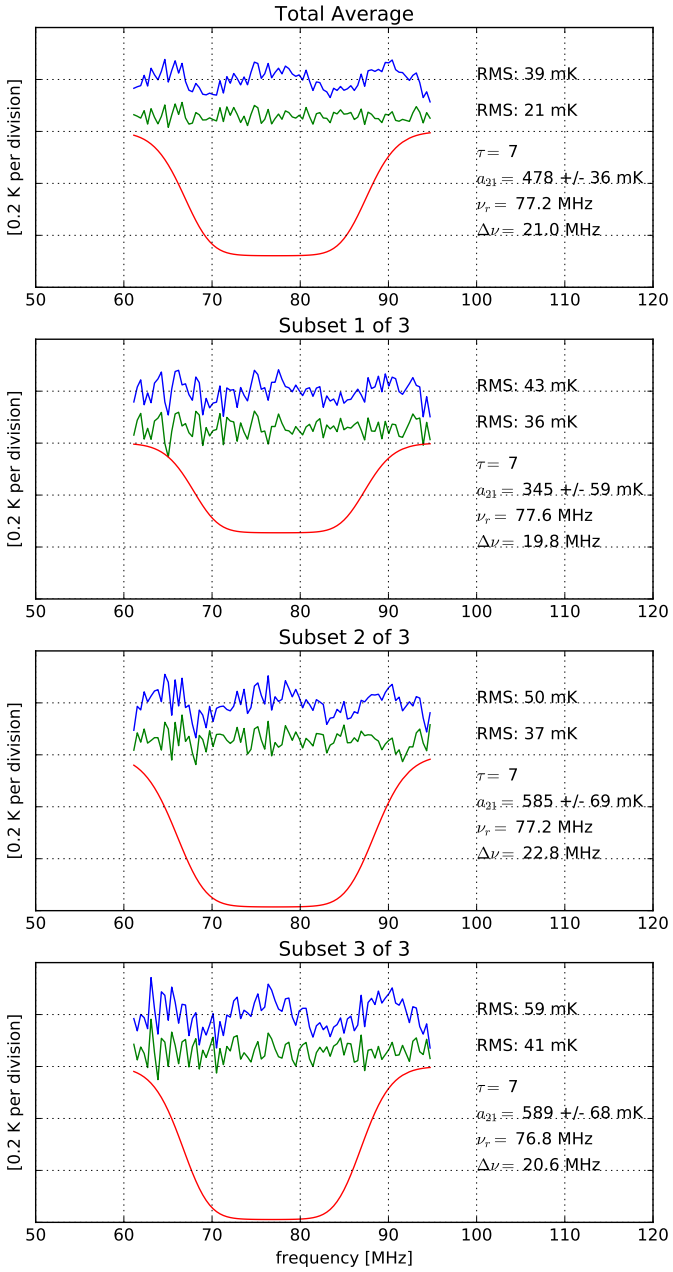

Figure 9: Residuals and 21-cm signature for three different averages of consecutive subsets of data. Each subset contains one third of the total data. Top panel is the nominal case.

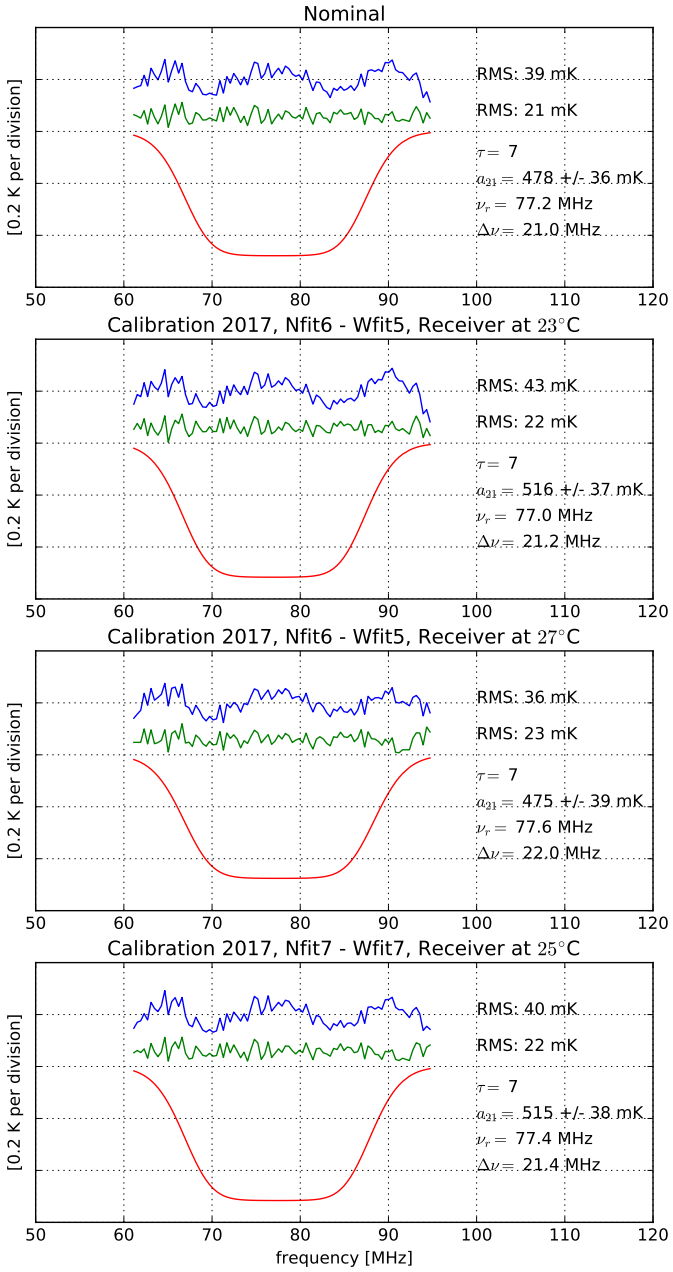

Figure 10: Residuals and 21-cm signature for three alternative receiver calibrations: 1) Nfit=6, Wfit=5, 23°C, 2) Nfit=6, Wfit=5, 27°C, and 3) Nfit=7, Wfit=7, 25°C. Top panel is the nominal case.

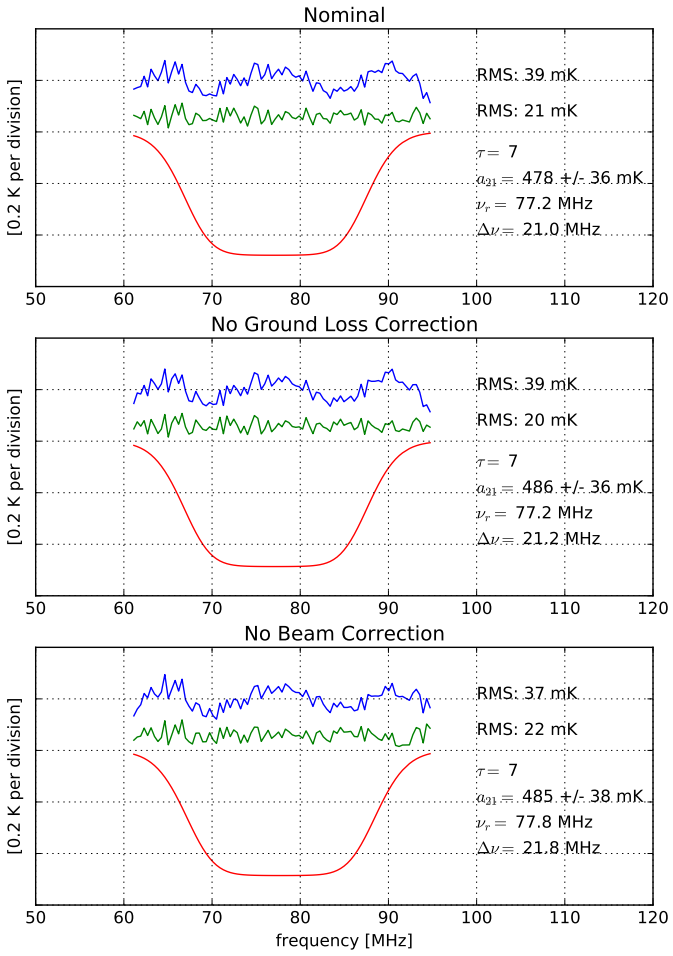

Figure 11: Residuals and 21-cm signature for two alternative corrections: 1) applying no ground loss correction, and 2) applying no beam correction. Top panel is the nominal case.