EDGES MEMO # 215

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Subject: Tests of Galaxy calibration using low band data from extended ground plane

The Galaxy calibration method first discussed in memo #48 2009 has been most recently explored in memo 202. In memo #202 it is shown that the "difference spectrum," which is the Galaxy down spectrum minus the scaled down Galaxy up spectrum, is relatively insensitive to instrumental parameters. However, it is very sensitive to the beam correction and hence is probably not useful for extraction of the EoR signature from the low band data taken with the original small ground plane. For example, the "difference" spectrum in Figure 1 of memo 202 is substantially different from that in Figure 2 of memo 202 with only a small change in soil conductivity.

Figure 1 shows the Galaxy up, Galaxy down and difference spectra from 55 to 99 MHz obtained from 2016_258 to 2016_281 with 5 physical terms removed. Beam correction is made with FEKO simulation of the extended ground plane shown in Figure 1 of memo 204 with soil dielectric 3.5 and conductivity 2e-2 S/m. Figure 2 is the result of using dielectric 13 and conductivity 1e-1 S/m. Figure 3 shows the spectra of Figure 2 which used S11 data from 2015_342 processed with S11 data from 2016_175. The effect of the difference of the S11 data for Galaxy Up and Galaxy down is shown in Figure 4 and 5. Other tests of the sensitivity of the difference spectrum included changing the bias in antenna S11 by 0.05 dB, removing the balun loss, removing the ground loss and beam correction with an infinite ground. The largest change in the difference which is shown in Figure 6 occurred when the balun loss was removed.

The Galactic calibration results suggest that the dip 70 MHz in the spectrum reported in memo 208 may be due to an error in antenna S11, loss, receiver calibration or other instrumental error rather than a resonance. Also the results suggest that the dip at 85 MHz discussed in memo 203 is probably part of the broader structure seen in Figures 1, 2 and 3. Tests of the origin this broader structure using spectra with only 3 or 4 terms removed are under study as more data becomes available.

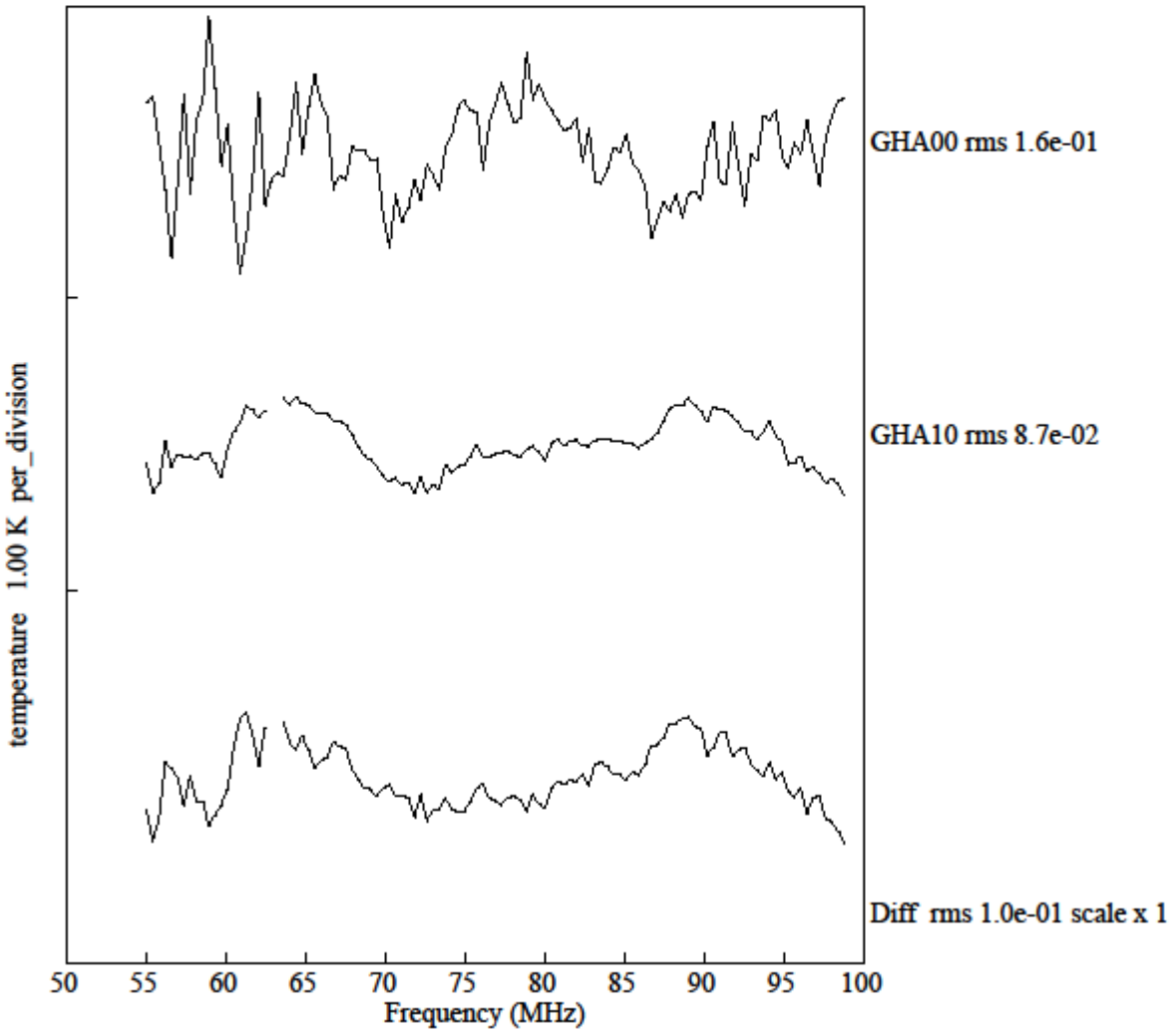

Figure 1. Galaxy up (GHA00), Galaxy down (GHA10) with beam correction with extended ground plane dielectric 3.5 conductivity 2e-2.

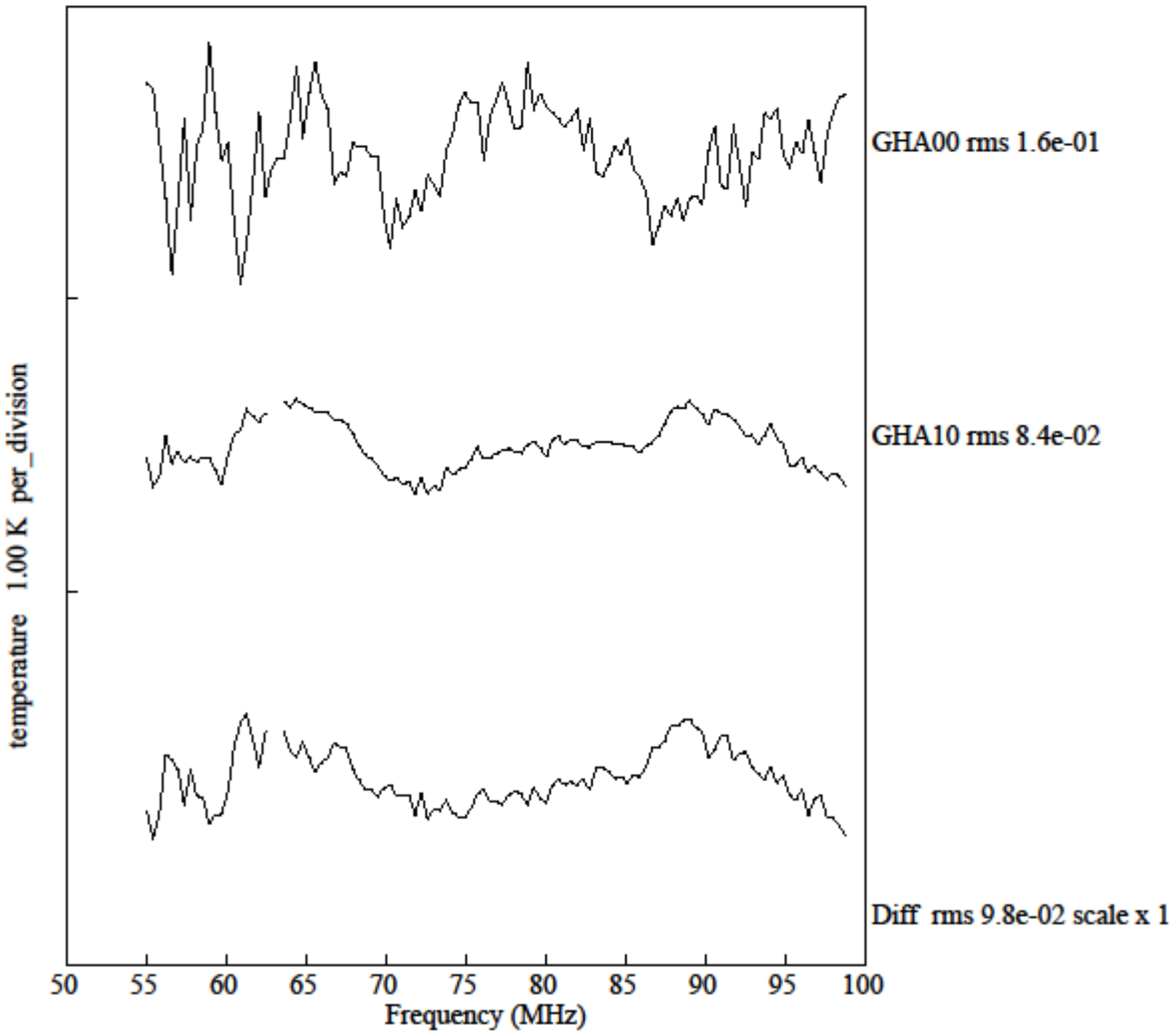

Figure 2. Beam correction with dielectric 13 and conductivity 1e-1.

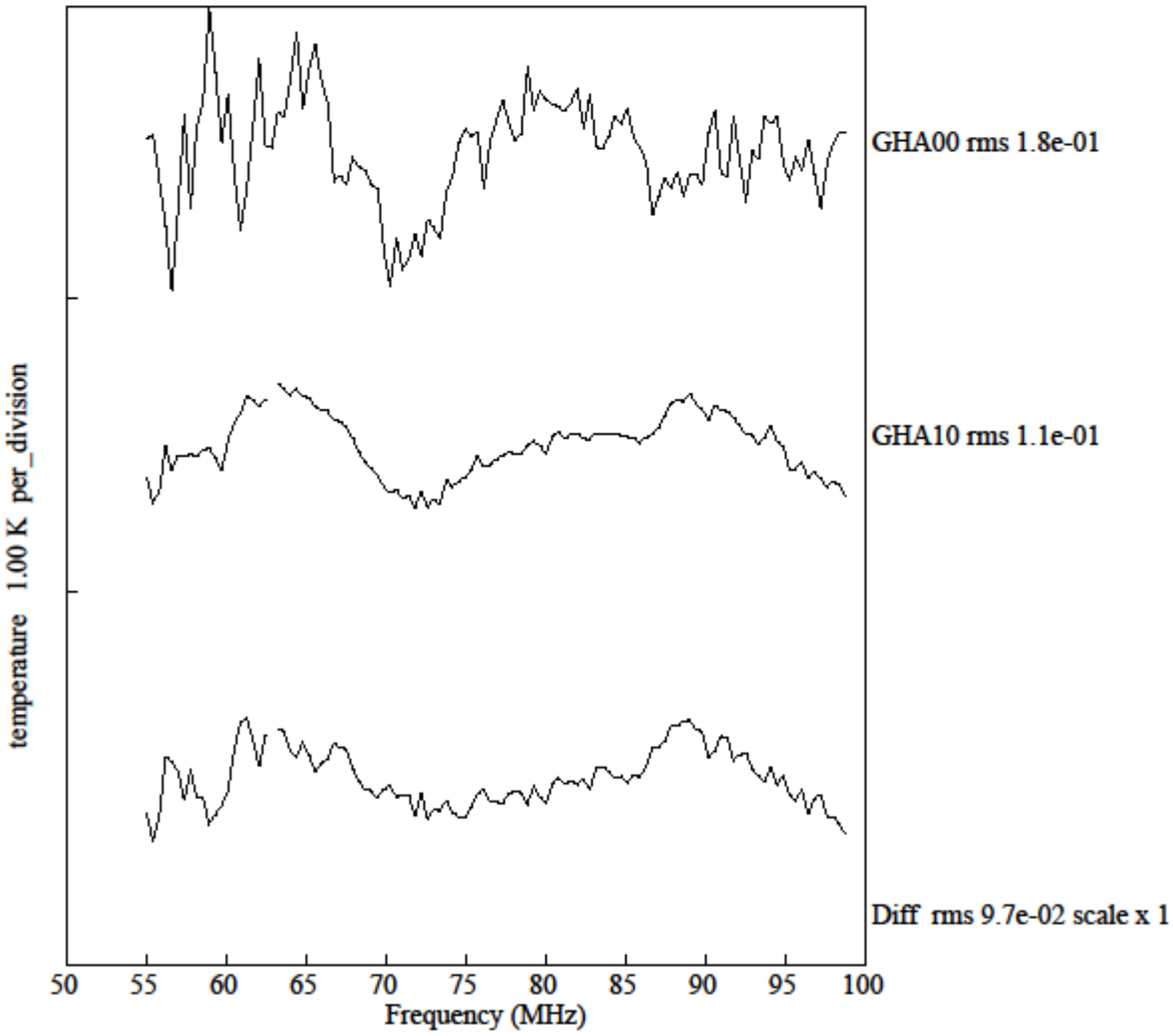

Figure 3. Antenna S11 from 2016_175.

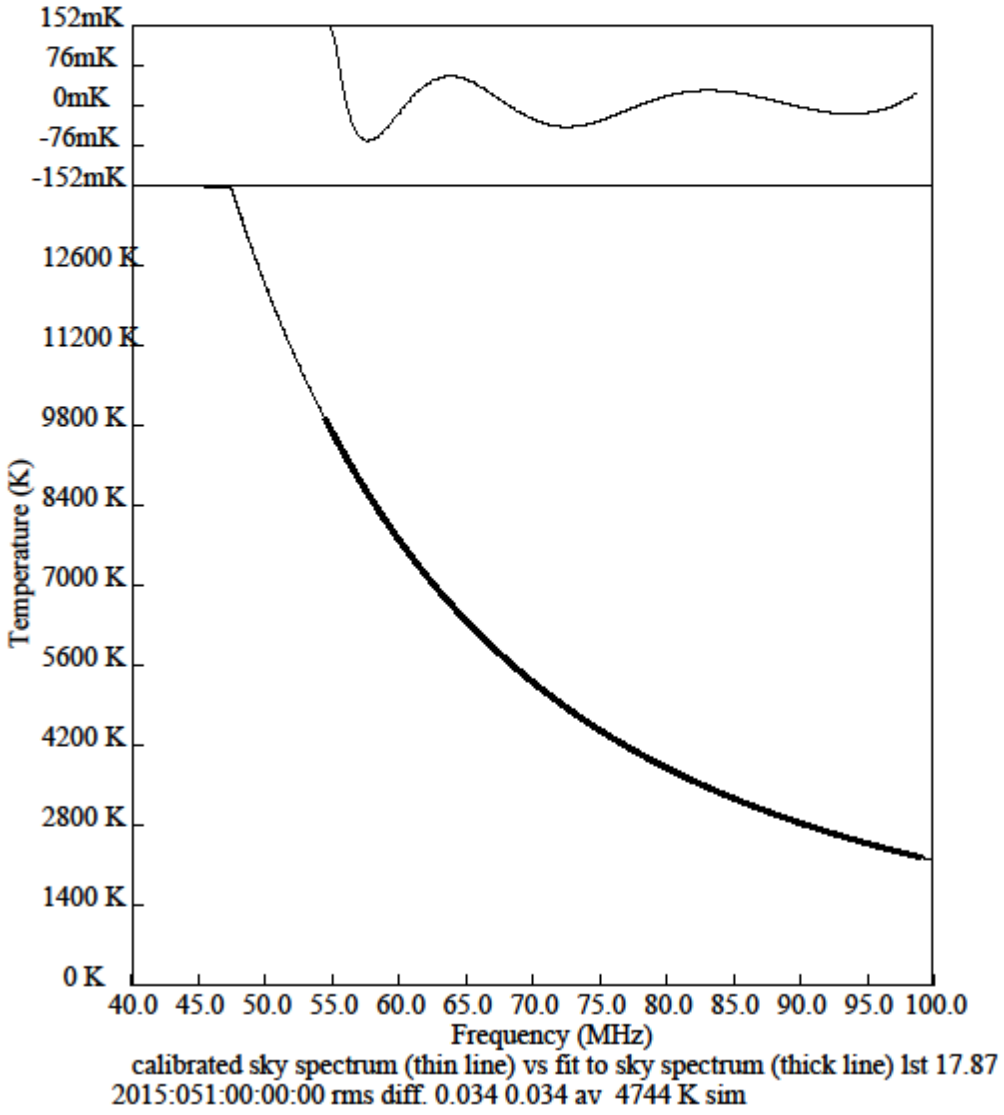

Figure 4. Simulated effect of the change in S11 for Galaxy up.

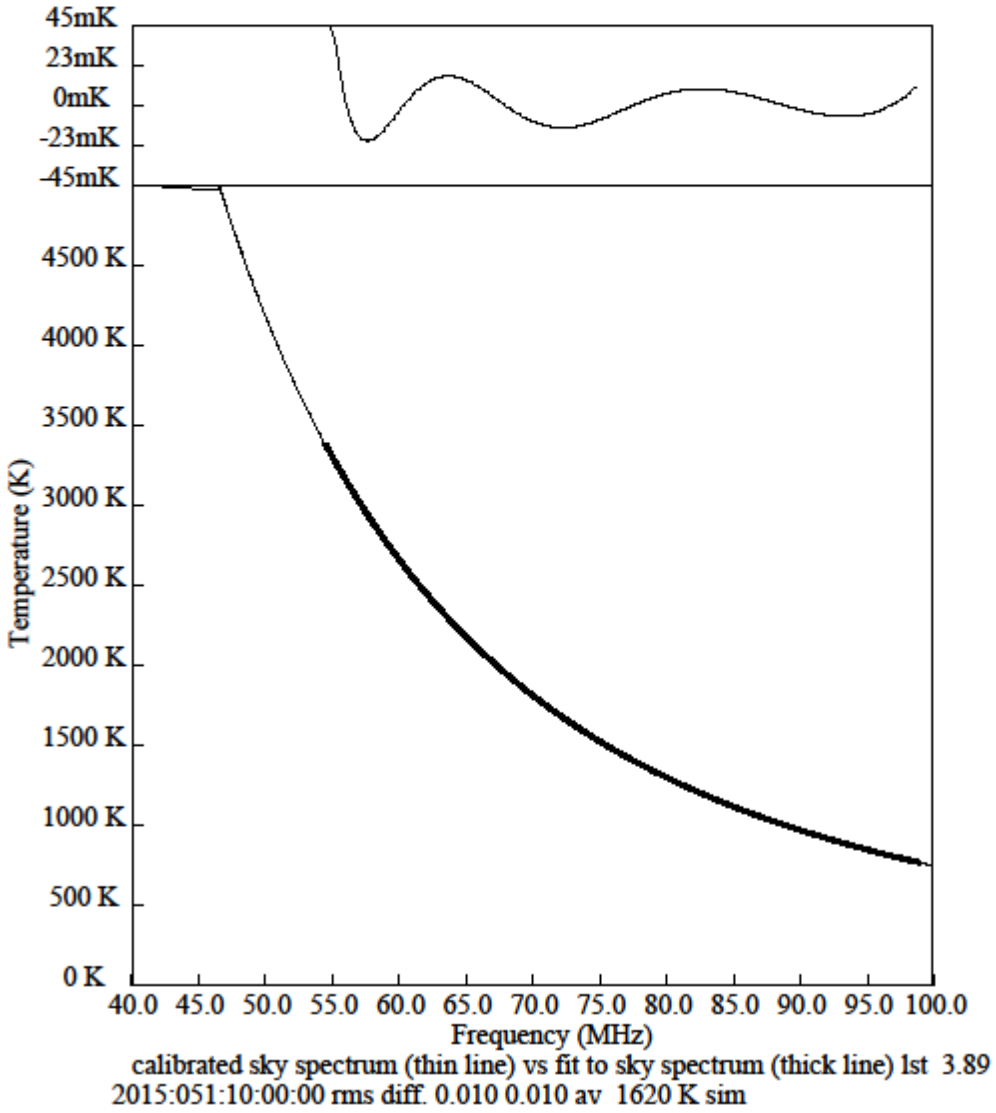

Figure 5. Simulated effect of the change of S11 for Galaxy down.

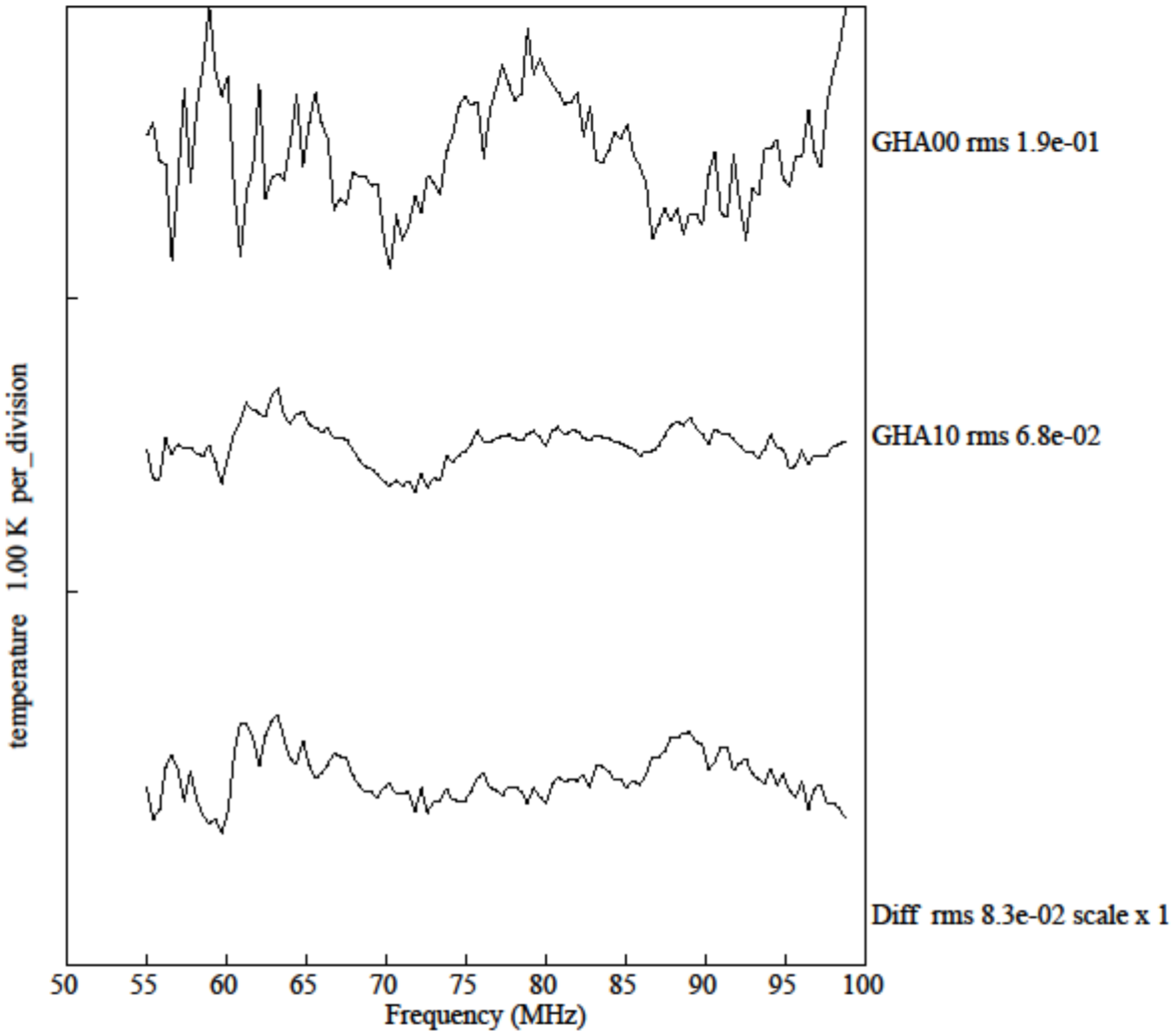

Figure 6. Difference spectra obtained without balun loss correction.