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To: EDGES Group

From: Alan E.E. Rogers

Subject: Results from the EDGES-1 antenna which is electrically small at low band.

Data from the EDGES-1 deployment in 2011 and 2012 has been processed in the 60-100 MHz range. In this frequency range the Fourpoint antenna is electrically small and has a high reflection coefficient in the range which results in an efficiency of 6.7% at 65 MHz. However, there are the following advantages to an electrically small antenna.

1] The beam chromaticity is very small
2] The antenna S11 is very smooth and can be fit with a low order polynomial

Figure 1 shows the antenna S11 which was calculated using FEKO. Figure 2 shows the residuals to the calibrated spectra with 7 polynomial terms removed. The 2011 and 2012 data are labelled 1: and 2: respectively. The calibration was made using the S11 from FEKO shown in Figure 1 along with noise waves receiver gain and offsets taken from EDGES-2 receiver – 3. While the EDGES-1 receiver was only approximately calibrated in the laboratory its design was similar to the EDGES-2 receivers. The sky noise obtained was about 1000 K at 75 MHz with an rms fit 200 K to a spectral index of -2.5. EDGES-1 used a ferrite balun assumed to have no loss with very small delay as the receiver was mounted with the input very close to the antenna panels instead of being under the ground plane. The ambiguities in a signature which fits the simulated data are similar and are the result of having to use 7 terms over the relatively narrow bandwidth of 63-100 MHz.

Figure 3 shows the result of a signature search with a marginal result close to those obtained from lowband 1 and 2. The result is marginal in that there are other peaks which fits the data almost as well. Figure 4 is generated by adding a 0.5 k $\tau = 7$ signature with center at 78 MHz, width of 20 MHz along with 50 mK noise per 195 kHz channel and solving for a signature plus 7 polynomial terms. More work and understanding of the losses and calibration of the receiver used in 2011 and 2012 is needed but will probably only have a small effect on the amplitude of the retrieved signature.

fit 0.0004 p-p dB

fit 0.0019 p-p deg

magnitude(thin line)
phase(thick line)

27 term Fit to antenna S11   rms diff 0.000 dB 0.000 deg
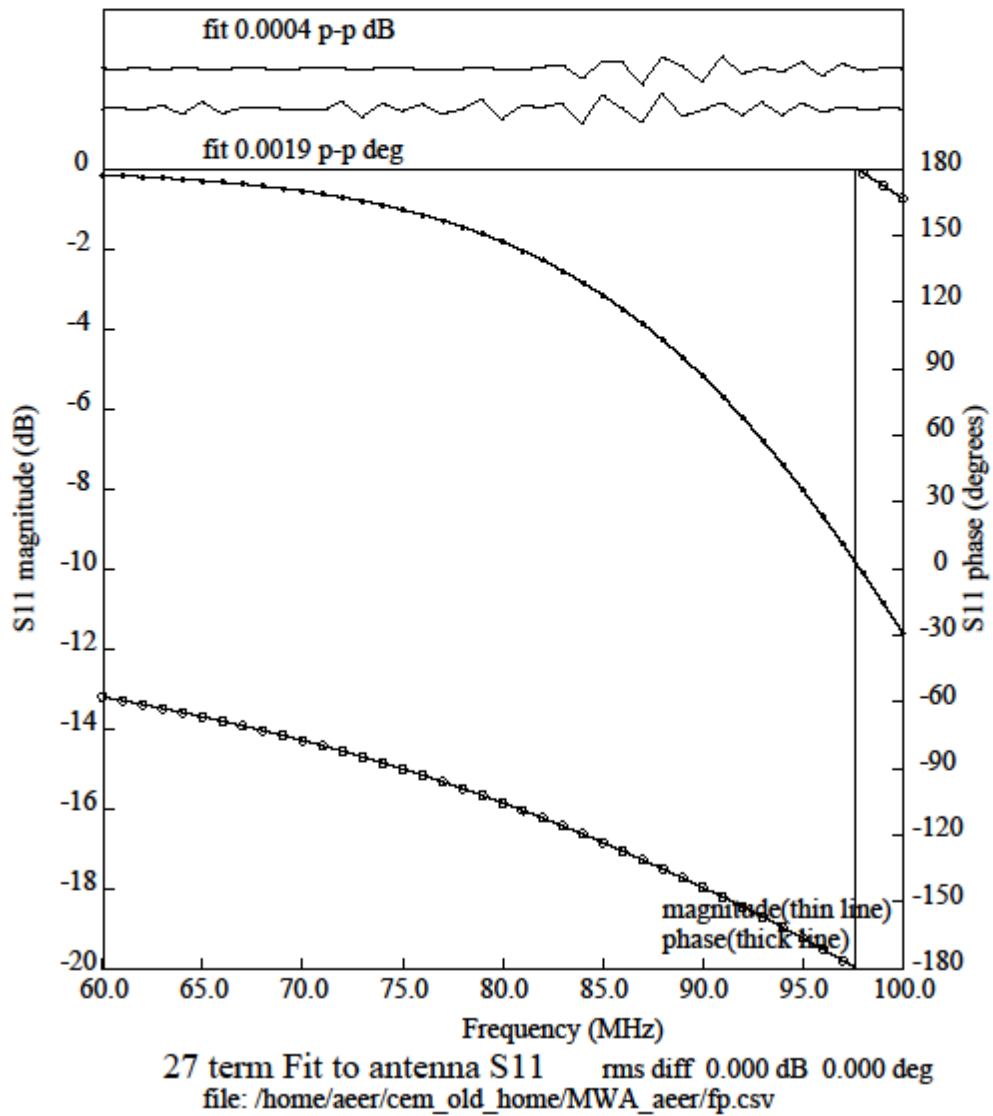file: /home/aeer/cem_old_home/MWA_aeer/fp.csv

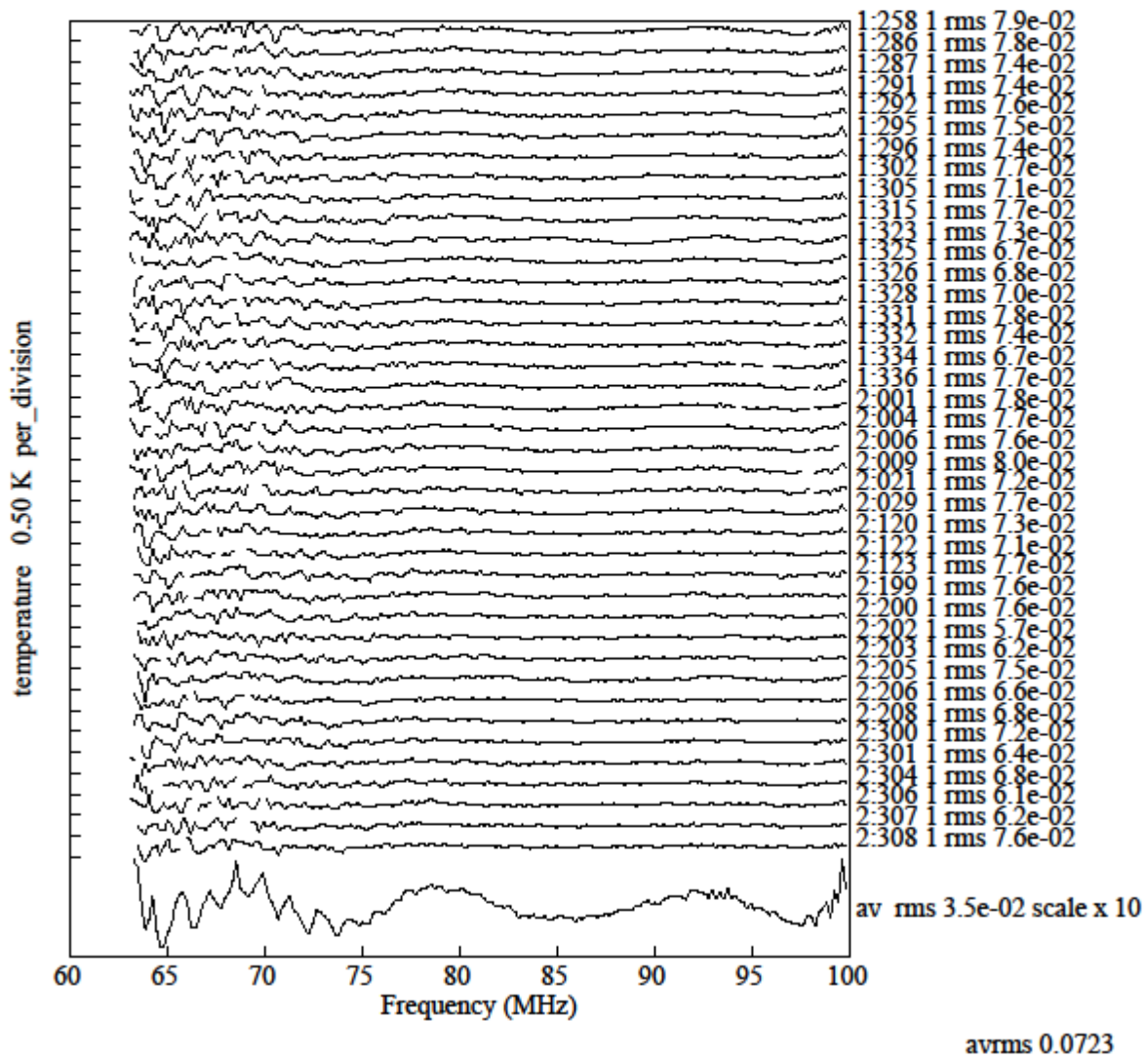Figure 1. S11 of EDGES-1 Fourpoint antenna 60-100 MHz.

Figure 2. Residuals to EDGES-1 data from 2011 and 2012 with 7 polynomial terms removed.
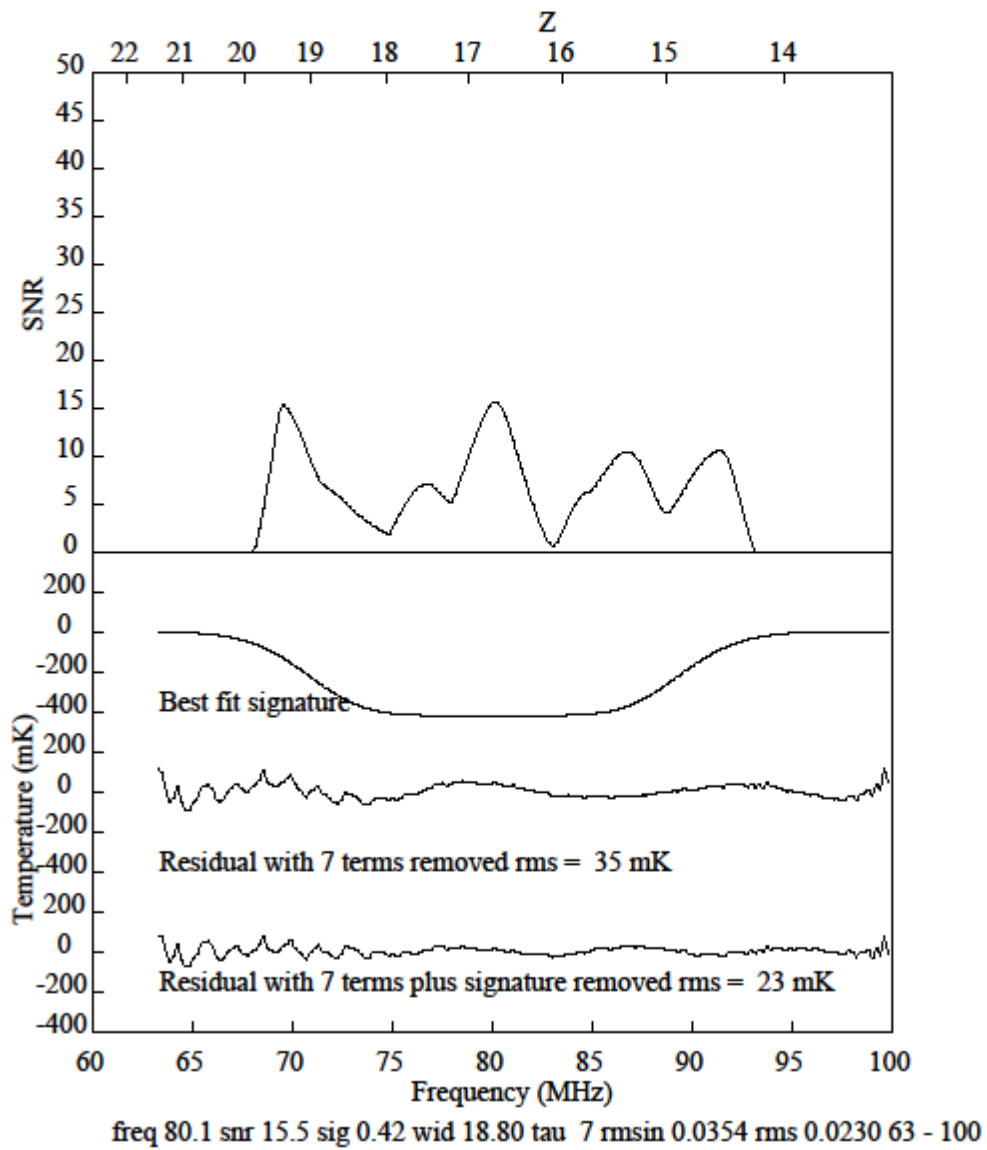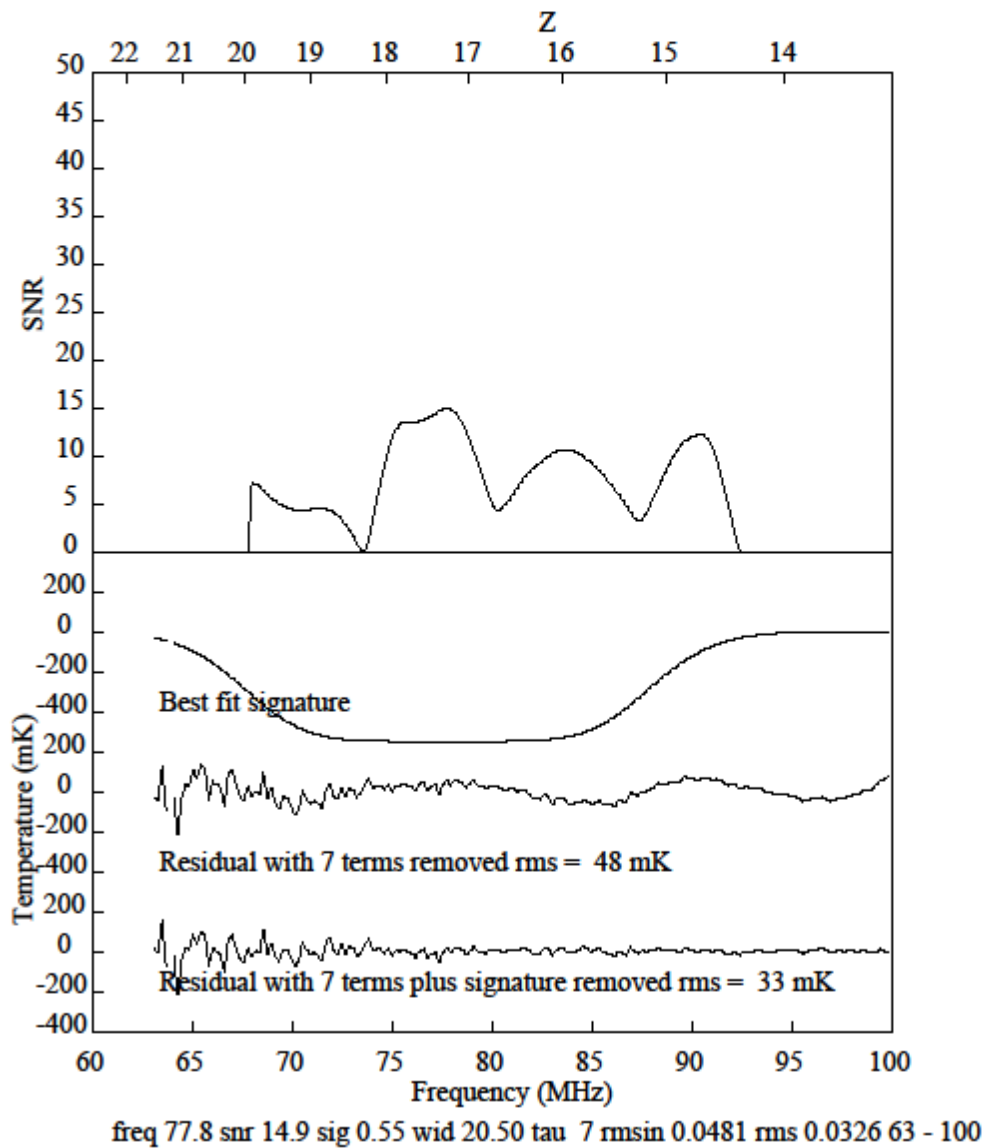
Figure 3. Signature search results.

Figure 4. Simulation of lowband signature search with 50 mK added noise.