EDGES MEMO #240

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Subject: Low band signature search using only Galaxy up data.

A search for an absorption signature using low band data for GHA from -0.5 to +0.5 hours provides another test of the sensitivity to error in beam correction, receiver calibration, LNA S11 and loss corrections. The result shown in Figure 1 finds a signature marginally consistent with the searches reported in memos 236, 237 and 239 provided 5-terms are used and the frequency range is limited to 67 to 95 MHz. Since very limited nighttime data is available both day and nighttime data from 2015 to 2017 was used. While memo 263 shows that with 5-term a consistent signature can be obtained without beam correction for GHA 4 to 16 hours beam correction in the case of GHA=0 beam correction is essential. The extreme sensitivity to beam correction for "Galaxy up" data is also shown in memo 240.

Further simulations of the effects of beam chromaticity on spectra taken at transit of the Galactic center are given in Table 1. "Galaxy up" observations can provide a good check on the receiver calibration, S11 accuracy of antenna and LNA as well as balun, and ground loss correction. If it can be shown that beam effects can be calculated with sufficient accuracy the "Galaxy Calibration" as described in memos 48, 55, 145, 171, 172, 202, 215, 217 and 222 can be used to improve overall accuracy of a global signature. An alternative to taking the difference between "Galaxy down" data and a scaled down version of "Galaxy up" is to use the "Galaxy up" data to find the best soil parameters and make checks on calibration etc.

Table 1 shows the large effect of beam correction on the absorption amplitude obtained from a signature search and the amplitude of a specific flattened absorption signature. From this table it is clear that even with the perforated ground plane a very accurate EM model of the beam is needed along with moderately accurate soil parameters. Note that the soil conductivity is more critical than the dielectric constant and even larger ground plane would be better.

	4 terms 60-99 MHz				5-terms 65-95 MHz				
	Freq (MHz)	SNR	Amp K	Width (MHz)	Freq (MHz)	SNR	Amp K	Width (MHz)	Amp K
Infinite total	75.8	24.7	0.87	15.8	82.8	25.6	0.17	24.3	-0.0
Perforated total	77.0	22.8	3.41	26.4	77.0	16.1	1.84	23.9	1.2
Diff. 2e-2 1e-2	66.8	23.1	0.69	8.4	76.6	19.1	0.96	23.1	0.7
Diff. 3.5 4.5	96.1	10.6	0.38	5.7	86.3	8.2	0.13	7.7	0.3
10m×10m total	88.3	25.3	8.51	14.5	77.0	23.3	1.94	23.3	1.6
Diff. 2e-2 1e-2	83.2	23.8	2.41	29.9	81.7	32.5	1.11	25.2	-0.3

Table 1. Simulations of beam correction on low band data for GHA=0. The last column is the absorption amplitude for signature at 78 Hz with 20 MHz FWHM.

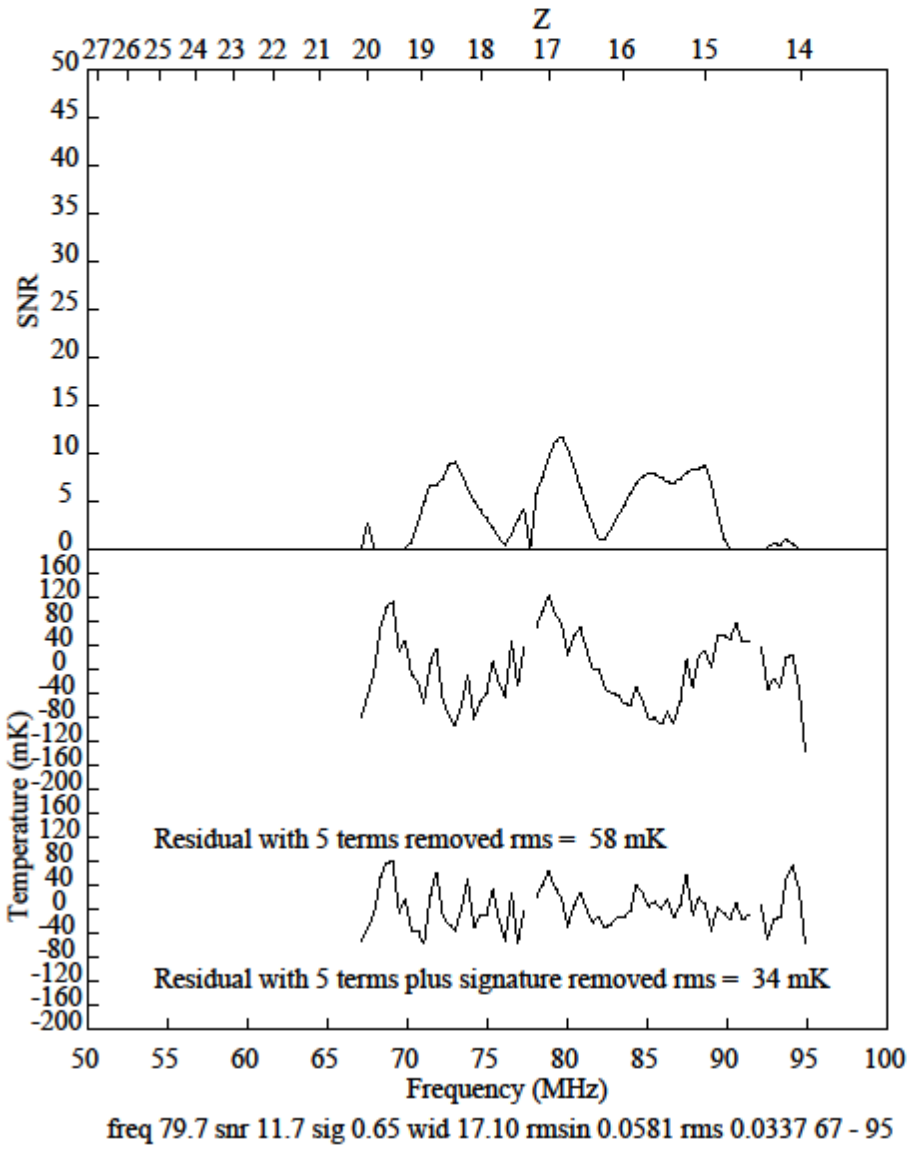

Figure 1. Signature search using “Galaxy up” data.