EDGES MEMO # 225

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December 29, 2016

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To: EDGES Group

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Subject: Amplitude of absorption signature vs Galactic Center hour angle

A flattened absorption signature obtained from low band data averaged over 12 hours GHA for many days is discussed in memo 222. The amplitude of a 20 MHz FWHM signature centered at 78 MHz is examined as a function of GHA with 1 hour average over each hour for 10 day blocks from 2016_260 to 2016_359. Figure 1 shows the absorption magnitude vs GHA while Figure 2 limits the data to nighttime. The degree of flattening chosen was equal to 7 as defined in memo 220. In each case a least squares solution is made using 4 polynomial terms plus the absorption term. Beam correction has been applied using FEKO method of moments with GF card to model soil under the extended ground plane with perforated sides. A soil dielectric of 3.5 and conductivity of 2e-2 S/m was used. The error bars are ± 1 sigma based on a noise estimate from the rms of the residuals.

Figure 3 shows the results of simulations for which the "reference" model is derived using the Haslam sky map convolved with the FEKO beam for the blade antenna on the extended ground plane on solid with dielectric 3.5 and conductivity 2e-2 S/m. A 0.5 K absorption with 20 MHz FWHM centered at 78 MHz is added to the simulated spectrum.

Plot #	
10	No beam corrections
20	-50 picoseconds offset to antenna S11
30	Dielectric 13 conductivity 1e-2
40	Dielectric 3.5 conductivity 1e-2
50	Dielectric 3.5 conductivity 5e-2
60	Dielectric 4.5 conductivity 2e-2
70	Antenna azimuth offset -2 degrees
80	Antenna azimuth offset +2 degrees
90	No losses
100	0.1 dB offset to antenna S11

Table 1. List of changes to simulated data for plots of the absorption depth.

Comments on the results:

Figure 1 shows a fair level of repeatability in the range of GHA from about 6 to 14 hours. The average of days 330-339 is the poorest. This is probably because of some days with rain and consequently wet soil which increases the dielectric constant and conductivity. The simulations

shown in Figure 3 show an increased dependence on GHA especially above GHA=12 for changes in the soil.

In generating the plots a filtering process was employed in which any one hour block of data with rms residual from the 4 term fit was 50% higher than the average was excluded. This filtering excluded data with high residuals which were due to rain or other environmental factors like the moisture condensation on the antennal panels discussed in memos 154, 161 and 178.

Plot #	
30	Dielectric 4.5 conductivity 1e-2
40	Dielectric 2.5 conductivity 2e-2
50	Dielectric 3.5 conductivity 5e-2
60	Dielectric 3.5 conductivity 5e-3

Table 2. Changes from Table 1 for simulations in Figure 5.

Figure 4 shows the variation of the amplitude of the best fit absorption signature at 78 MHz with 20 MHz FWHM and flattening of 7. In this case the data is from the time span when the ground plane was a 10m ×10m square.

Figure 5 shows the corresponding simulations for the effects of the soil and other changes. It is clear that beam effects are the major cause of the variation of signature amplitude with GHA. Averages over nighttime GHA from 6 to 18 hours and all days

Amplitude $= 0.5 \pm 0.18$ for extended ground plane

$= 0.6 \pm 0.5$ for 10m × 10m ground plane

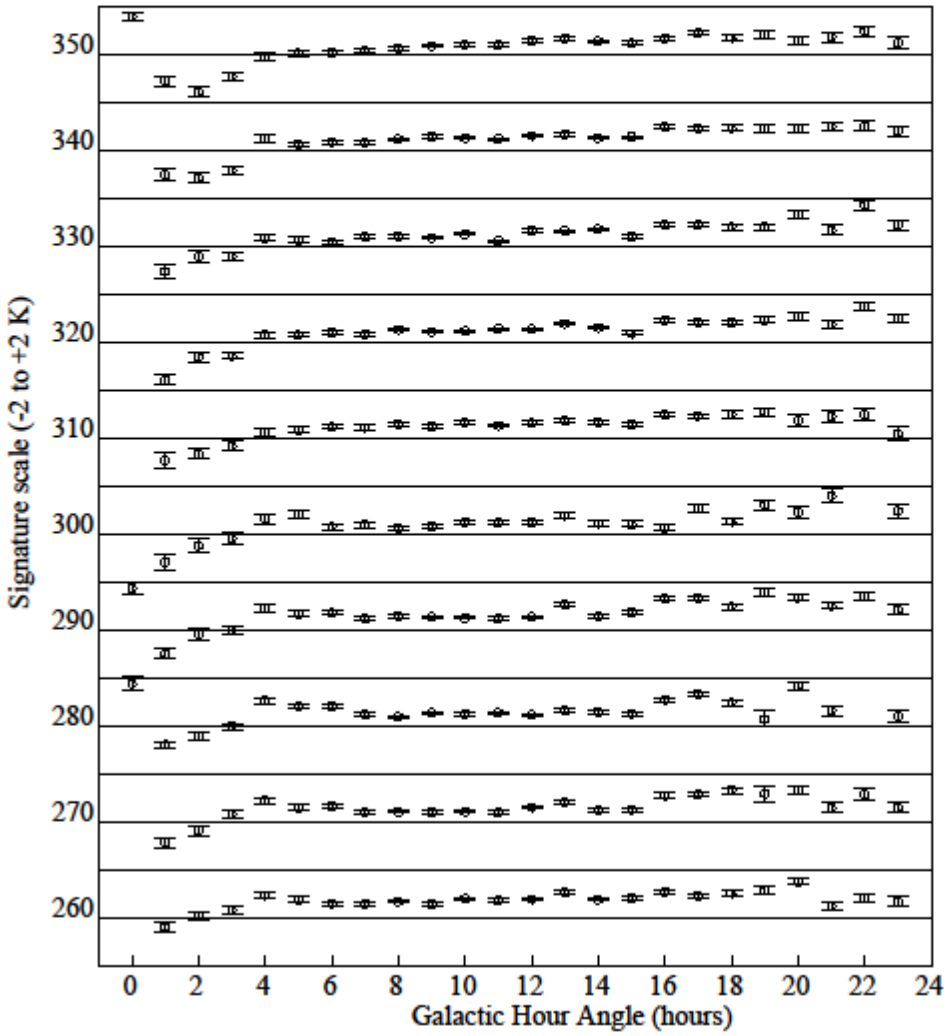

Figure 1. Amplitude of absorption signature from 10 day blocks of data with extended ground plane from 2016_260 to 2016_359.

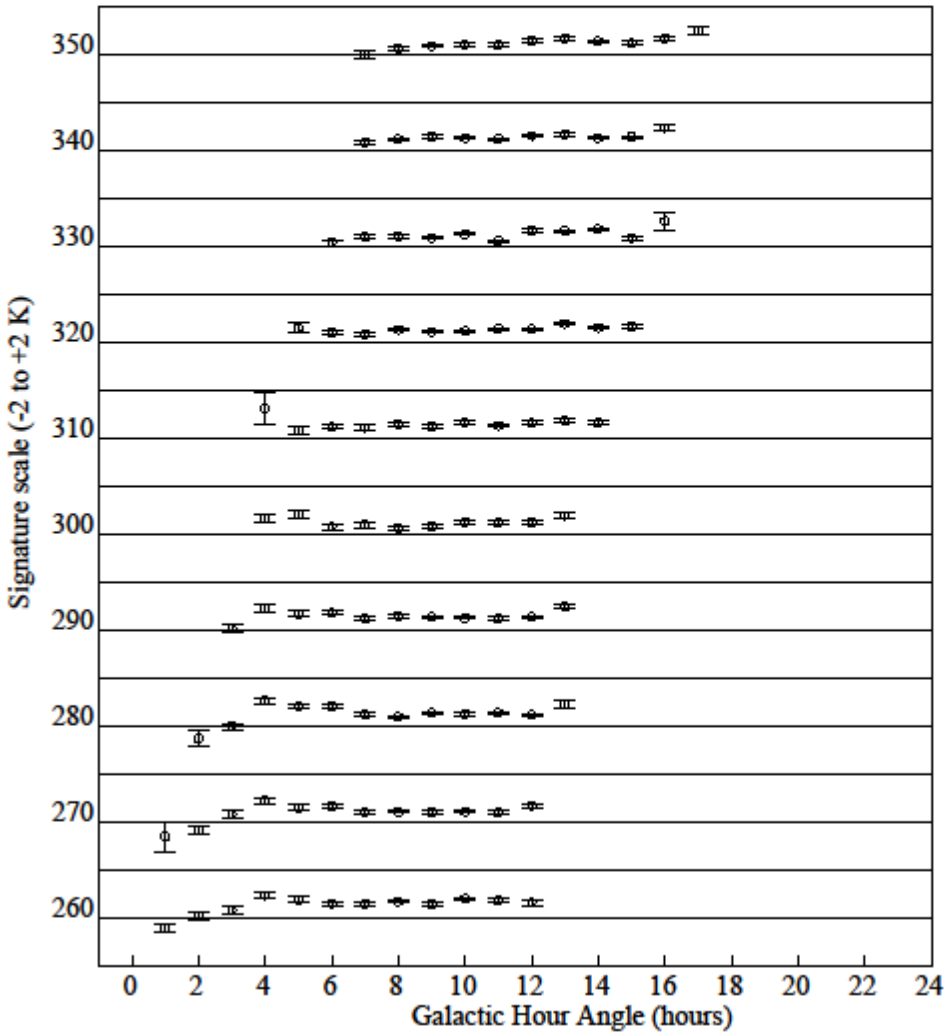

Figure 2. Same as figure 1 for nighttime only.

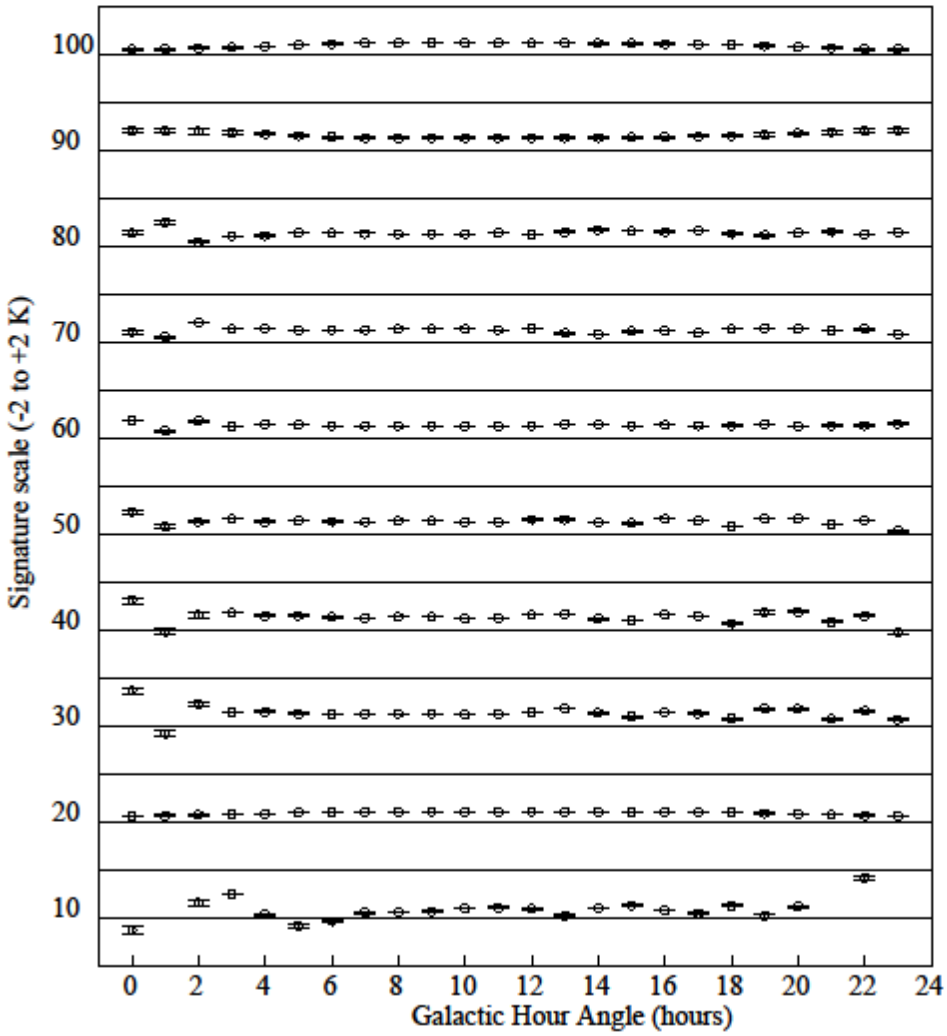

Figure 3. Simulations of the effect of changes in soil and other changes listed in table 1.

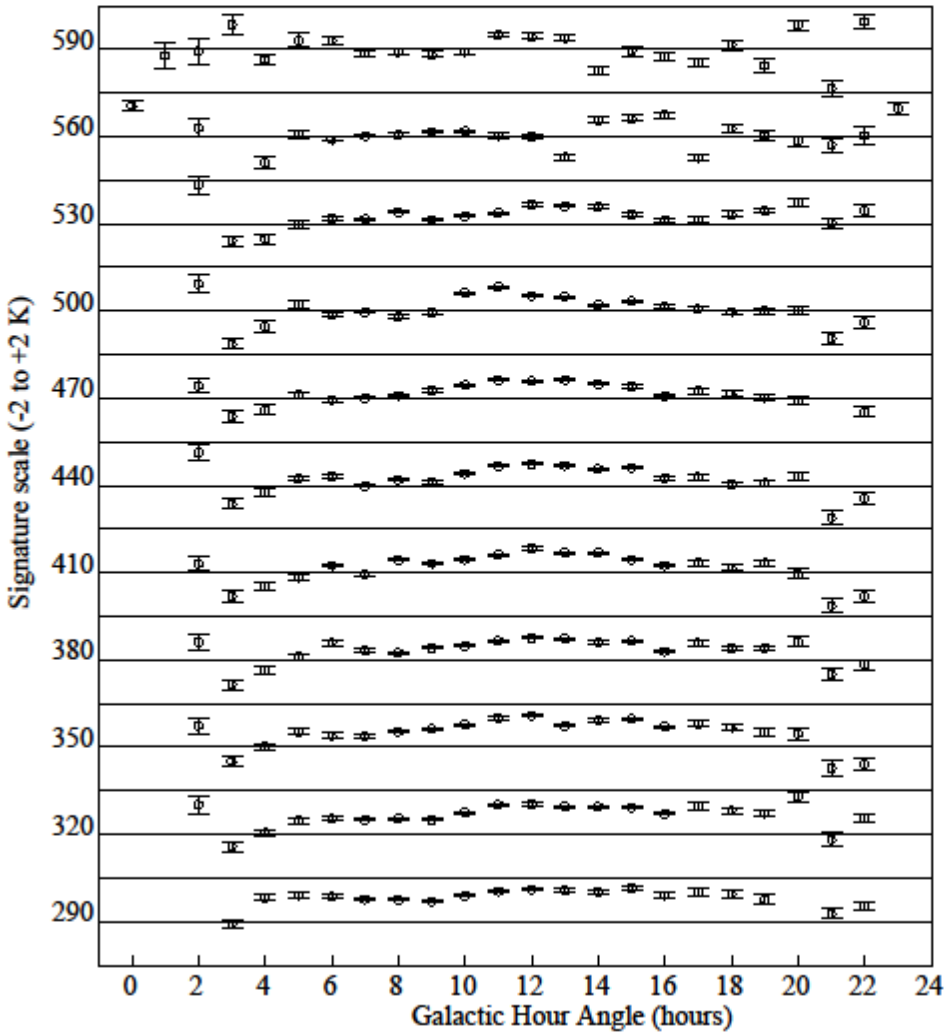

Figure 4. Amplitude of absorption signature from 30 day blocks of data with 10m × 10m ground plane from 2015_290 to 2016_253.

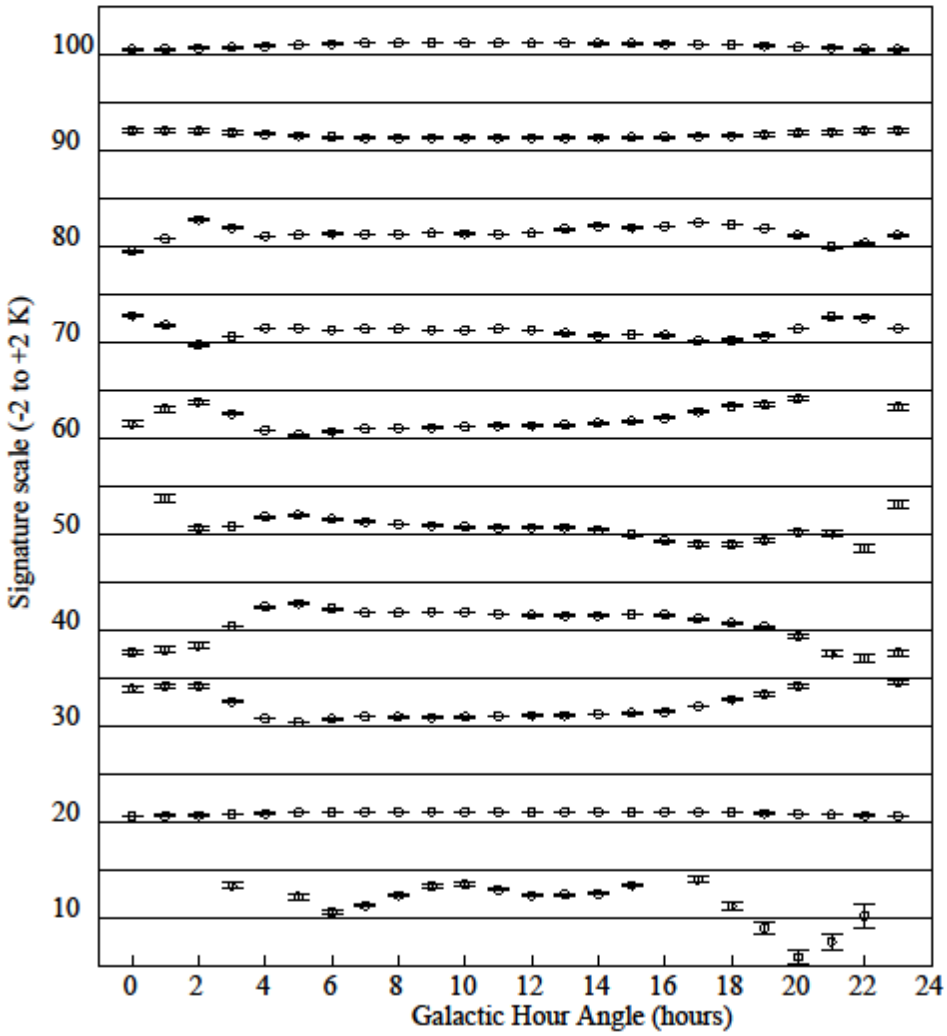

Figure 5. Simulations of the effect of changes (see tables 1 and 2) for original 10m × 10m ground plane.