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To: EDGES group
From: Alan E.E. Rogers
Subject: Chromaticity of EDGES dipole on 48x48m ground plane raised 1m above the ground

The degradation of the ability to reject RFI and other signals, like scatter of sky noise from surrounding objects coming from low angles was analyzed in memo 4. Memo 4 also pointed out the substantial increase of antenna gain at the horizon when the dipole and the ground plane are raised by 1m.

FEKO simulations of the increase in beam chromaticity for raised ground planes are made in memo 391 and in this memo FEKO simulations show that in the case that a raised ground plane is the only option, owing to the difficulty of flattening the ground, a large 48x48m serrated ground plane like those used by EDGES-3 at the WA may have an acceptable chromaticity even when raised by 1m above the ground.

Table 1 shows the results of the simulations and Figure 1 shows the residuals to the 5-terms fits which result from the beam chromaticity with Nature feature added along with plots of the beam structure averaged from 76 to 80 MHz.

Ground plane	hgt m	avrms1	avrms2	freq MHz	amp K	width MHz	rms1	rms2	rms3
30x30m	0.01	158	135	74.4	0.89	20.9	106	63	77
30x30m	1.0	657	654	80.9	2.37	20.6	196	90	169
48x48m	1.0	199	185	78.1	0.46	18.4	78	48	48
48x48m	0.01	84	61	77.7	0.50	18.6	65	6	8

Table 1 Results of simulations with rms values in mK.

Table 1. Simulations using the Haslam map scaled by spectral index of -2.5 from 408 to 50-100 MHz to generate simulated data and then processed to obtain the "chromaticity" with 5-physical terms 55-97 MHz for the foreground removed.

The average of the rms residuals of each 1 hour block of GHA over all 24 hours is avrms1 and avrms2 with and without adding the Nature feature to the sky model respectively. The average of all 24 blocks after removing a 5 physical terms for the foreground is rms1 and rms2 are the averages before and after after a grid search for the feature using a fixed value of tau = 7. The columns labeled freq, amp and width are the best fit parameters obtained from the least squares absorption grid search without beam correction. The results were obtained for an azimuth of 270 degrees degrees. rms3 is the rms without adding the Nature feature after fitting the foreground.
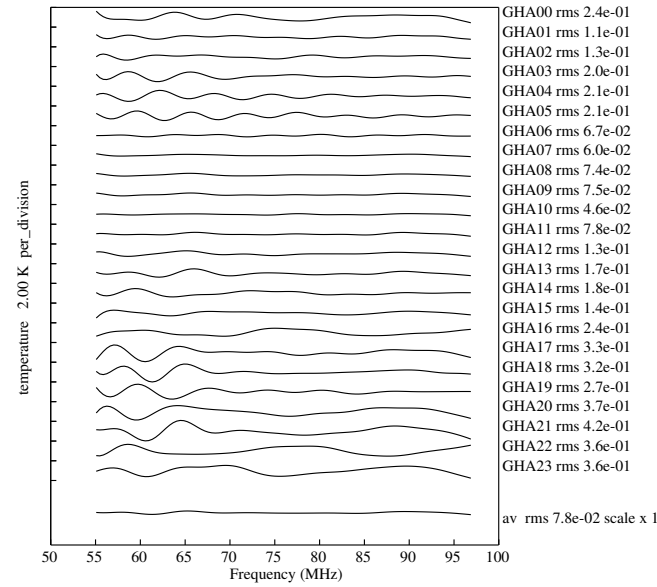
These simulations which show that a 30x30m raised by 1m has a very large beam chromaticity and a more reasonable chromaticity could be obtained by increasing its size to 48x48m.
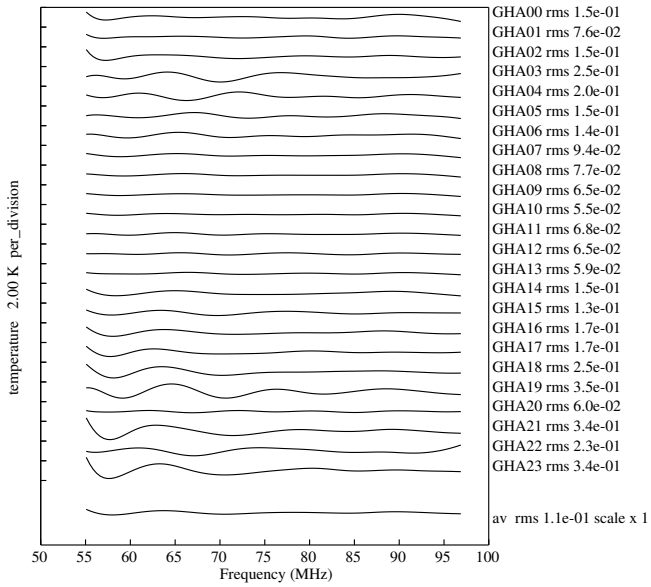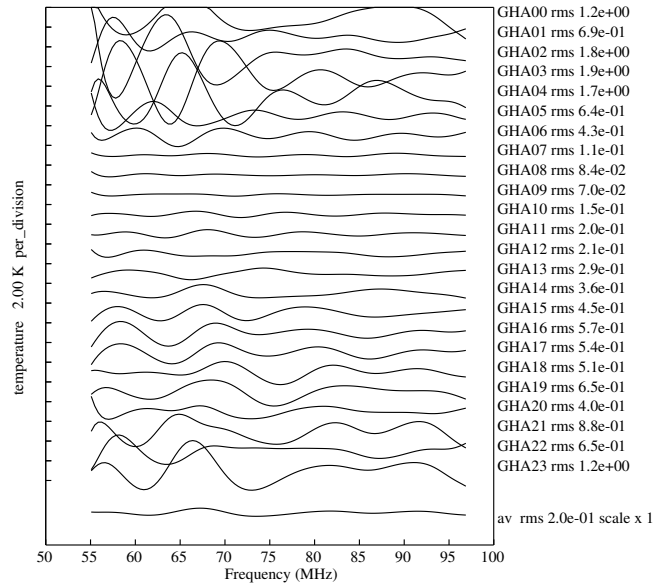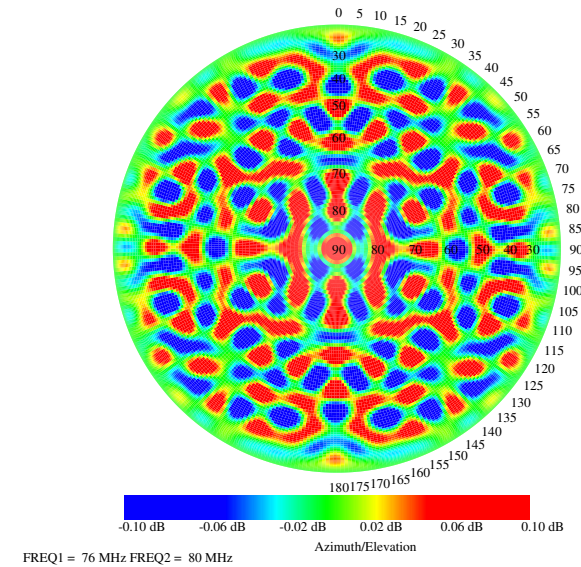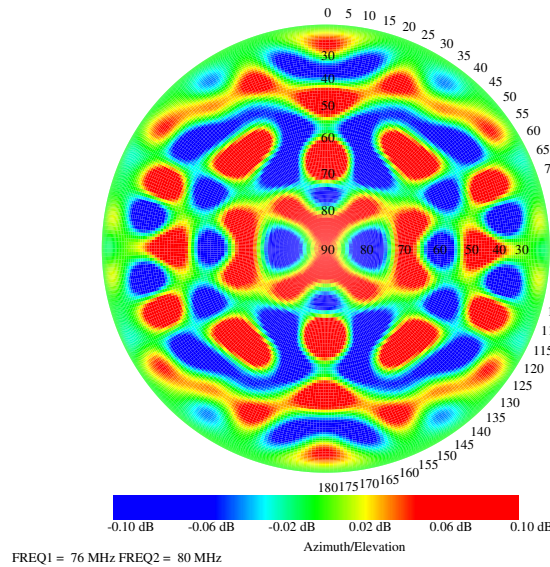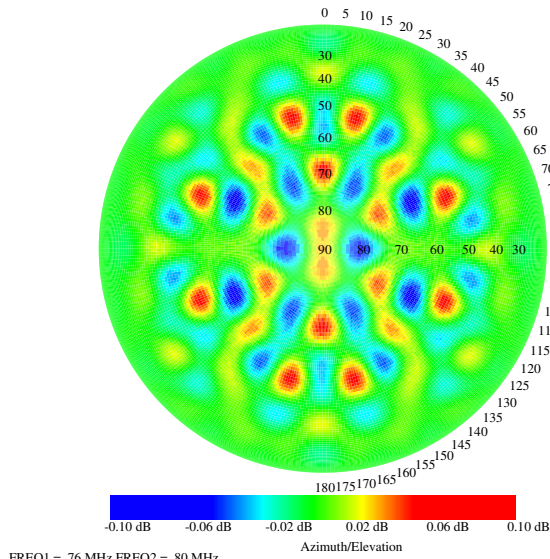
Figure 1. 30x30m ground plane raised by 1cm on the left, and raised by 1m in the middle with 48x48m ground plane raised by 1m on the right.