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To: EDGES group
From: Alan E.E. Rogers
Subject: Further examination of potential resonances in the 48x48m ground plane at the WA

The location of what appear to be resonances in the EDGES-3 spectra discussed in memo 421 and shown in figure 3 of memo 421 for data from day 54 to 186 is unclear. Spans of 50 days starting at 2023_054 show bumps at about 60 MHz which shift down in frequency from about 62 to 58 MHz from 4 to 6 hours GHA. These bumps are in all spans of 50 days up to the latest data on day 270 although the SNR is marginal using only 30 minute blocks of GHA.

FEKO simulations of half-wave slots or half-wave dipoles located at an azimuth from the EDGES-3 antenna at the MRO of about 50+/-20 degrees have an effect in the GHA range of 2 to 6 hours GHA.

The estimate of the spacing between the wires to get a resonance down to 60 MHz based on an analysis similar to that in memo 209 is about 0.01 mm (10 microns) for a 15 cm long slot. This means that wires that are so close for a 0.02 mm feeler gauge is blocked are a potential source of a resonance and even those actually touching could be a problem as the zinc spray (if it was used) is not sufficiently conductive as discussed memo 327.

I have made many simulations of the effects of the hut which include a resonant slot at the height of the roof but I have been unable to get any significant effects above a 30 mK level. I have also made FEKO simulations of the effects of the cables to the hut and I have not been able to find any significant effects.

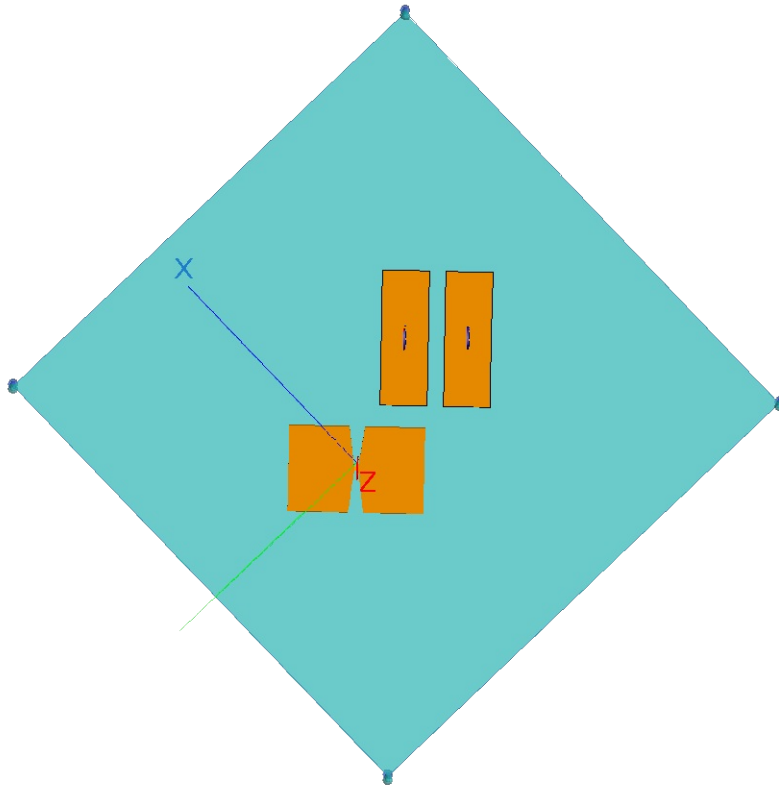
The residuals at GHA 1 and 1.5 hours in figure 3 of memo 421 are most likely due to some bumps in the ground plane and the residuals in figure 3 of memo 421 in the range of GHA 3 to 6 hours at 60 to 65 MHz could be a combination of slot resonances within a couple of meters of the baseplate as a simulation of single slot that agrees with the data has not been found.

A combination slots are needed but a series of FEKO simulations even just 2 slots would only be practical if the number potential locations can be reduced by an inspection.

We plan ask Lou Puls of the WA to take a careful look for potential slots the might have gaps under 0.1 mm concentrating on a region within 3m of the baseplate especially North East of the antenna.

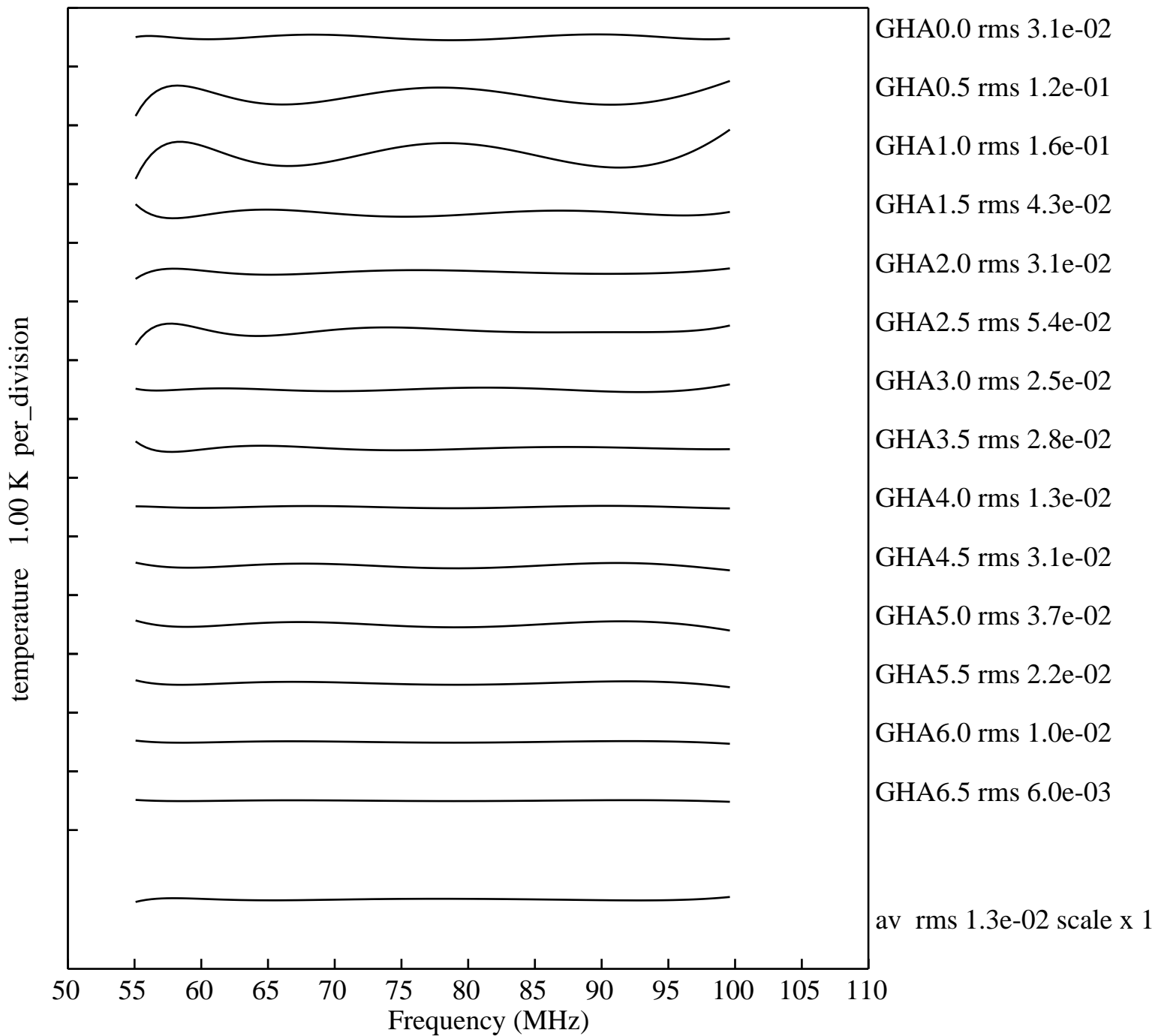
Figure 1 shows the result of a simulation of a 15 cm slot between wires close to the North east corner of the baseplate due to a gap produced by 100 pf and 2 ohms series resistance loading. This resonance drops in strength with added resistance and distance from the corner. Figure 2 shows the simulation when a second slot with the same length, capacitance and resistance is added along the mesh further west close to the north edge of the baseplate. Figure 3 shows the locations of the antenna and slots from the FEKO model used for Figure 2. While the beam chromaticity effects of the two slots doesn't accurately match the data in figure of memo 421 it does show that a downward frequency shift with an increase in GHA can be obtained with two slots.

The relatively smooth dips and bumps in the residuals in figure 3 of memo 4211 are probably due to tilts and bumps in the ground plane. Given the East-west orientation of the antenna simulations show very little effect in a north-south slope and the effect of a east-west tilt which is a maximum at GHA = 1.5 hours is only 100 mK with 4 deg tilt with the 5-physical terms removed from 55 - 100 MHz in figure 3. The effect of the deviations given in memo 406 without slope correction peaks at about GHA = 1.0 hours with a residual of 160 mK with a shape similar to that in the data in figure 3 of memo 421 is shown in Figure 4. All plots of the residuals from the simulations are made with 5 physical terms removed.



<p>Altair Feko™</p>	<p>test7</p> <p>2023-10-04 15:38</p>	<p>View direction</p> <p>Theta = 4°</p> <p>Phi = -43°</p>
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Figure 3. FEKO model for the antenna and the two slots. North is up and west on the left.



avrms 0.0434

Figure 4. The effect of the deviations of the ground plane given in memo 406 without slope correction