EDGES MEMO #442

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To: EDGES group

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Subject: Further examination of 60 MHz resonance at GHA 4 to 6 hours at the WA

A possible resonance in the 48x48m ground plane at the WA is studied in memo 421 and 431. This is a fairly sharp resonance and it could be due to 2 slots as simulated in memo 429. Another possibility is that is due to a scintillation of a point radio source as discussed in memo 438 but it now appears that this possibility is ruled out because the resonance is present in data when the sun is more than 20 degrees below the horizon which makes the presence of scintillations from 3c273 unlikely as discussed in memo 441.

Tests of the residuals with 5 logllog terms removed covering GHA 0 to 6.5 hours in 30 minute blocks are made in Figure 1. The data was beam corrected using the FEKO beam for the 48x48m ground plane with soil conductivity 1e-2 S/m and dielectric 3.5. The beam was smoothed with a 9-term polynomial and only data with the sun more than 20 degrees below the horizon was used. The 2018 21-cm absorption of 0.5 K centered at 78 MHz with 19 MHz width tau = 4 was subtracted from the sky map. The beam chromaticity at low values of GHA is fairly sensitive to the soil conductivity and using a soil conductivity of 2e-2 S/m beam correction significantly reduces the residuals as shown the Figure 2. A soil conductivity of 2e-2 S/m was also found to give the lowest residuals in the EDGES-2 data as discussed in Mahesh et al. 2021.

Another possible cause of the “60 MHz resonance” is coupling between the hut, which acts as an antenna” and EDGES-3 via the DC power cable. A simple test of this potential mechanism has been made by a FEKO simulation in which a wire is run on the soil from the hut under the 48x48m ground plane, which has been raised by 2 cm above the soil, to the antenna. In this test I found that the effect on the beam did not change if the wire was not electrically connected to the hut whereas there was a large increase in the beam using a FEKO model when the wire is run over the ground plane. Measurements of potential slots using the methods described in memo 435 and ASU memo 200 were made at the WA by Nivetida Mahesh and Akshatha Vydula in February 2024 (see ASU memo 201) but no resonances below 178 MHz were found. A new survey of the ground plane was made, some bumps in the ground plane were pinned down and some gaps were shorted with clamps or ties but it will take time to get enough data to see if there are improvements in the beam chromaticity.

Ref:

Mahesh, N., Bowman, J.D., Mozdzen, T.J., Rogers, A.E., Monsalve, R.A., Murray, S.G. and Lewis, D., 2021. Validation of the EDGES Low-band Antenna Beam Model. *The Astronomical Journal*, *162*(2), p.38

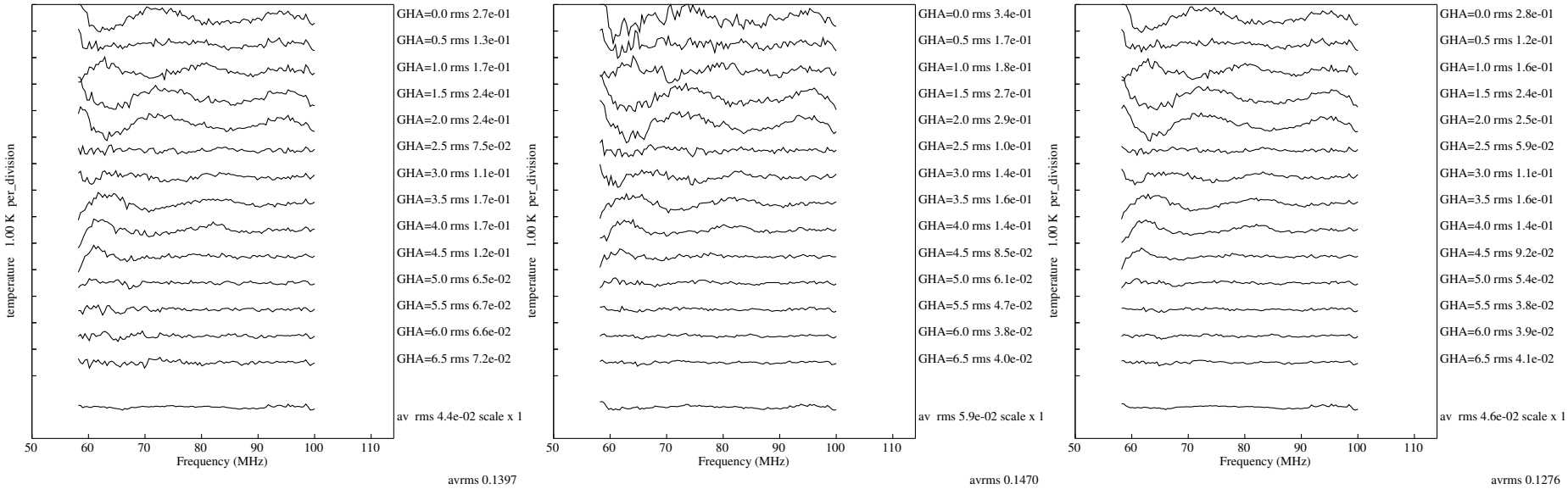

Figure 1. Residuals with 5-terms removed for day 2023 54 – 215 on the left, 2023_215 to 2024_050 in the middle and 2023_054 to 2024_050 on the right.

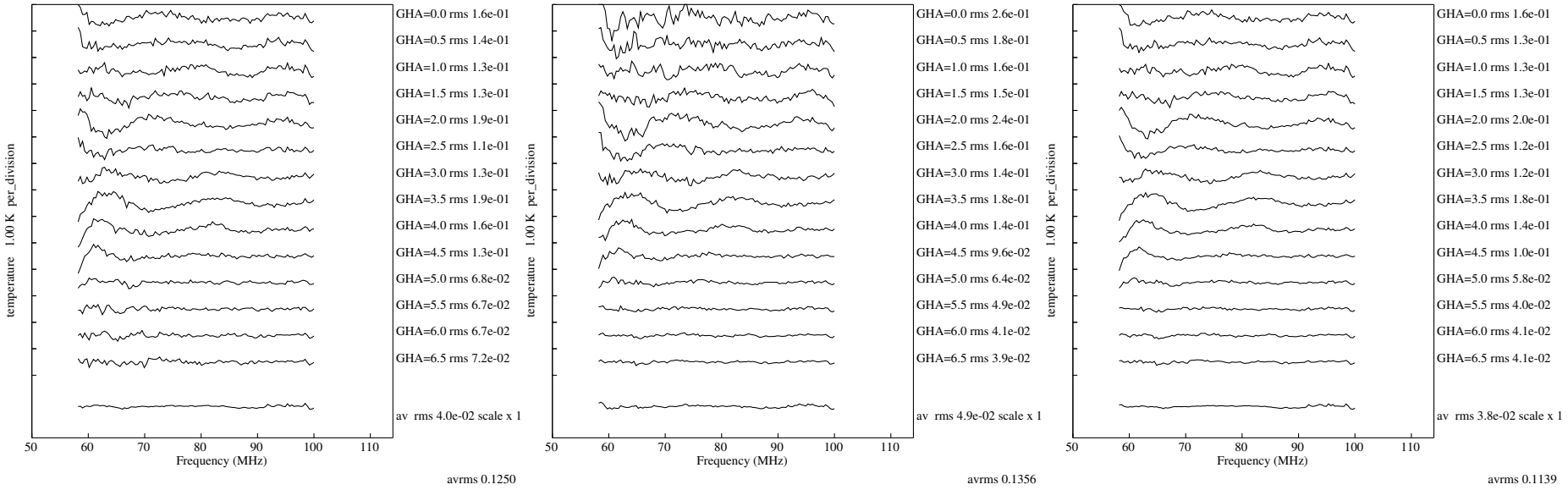

Figure 2. Same as in Figure 1 but with soil conductivity of 2e-2 S/m.