EDGES MEMO #251

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To: EDGES Group

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Subject: Simulations of signature detection with small ground plane.

EDGES lowband systems currently use a large ground plane in order to reduce both the ground loss and beam chromaticity. In order to evaluate the potential for additional deployments without a large ground plane systems with small ground planes are studied. For small square ground planes in the range of 1 to 4 meters the beam chromaticity increases as the ground plane size is increased while the ground loss decreases with ground plane size.

It is not until the ground plane exceeds the 20×20 m with added perforations that chromaticity drops to approach the chromaticity of the small ground planes but the ground loss could be a serious problem so full simulations are needed to find the best compromise.

		4	5	6
Ground plane size	Loss	Amp (K)	Amp (K)	Amp (K)
14 × 14 m	0.005	0.30	0.52	0.50
5.6 × 5.6 m	0.04	0.25	0.55	0.51
4.2 × 4.2 m	0.08	0.46	0.50	0.53
2.8 × 2.8 m	0.18	0.01	0.80	0.58

Table 1 simulated loss (as a fraction) and signature amplitude for various ground plane sizes using blade antenna on square ground plane over soil with dielectric 3.5 and conductivity 2e-2 S/m

Table shows amplitudes of 0.5 K signature at 78.5 MHz, width 18.5 MHz and τ=7 for 4, 5 and 6 term polynomial removed and frequency range 60-99 MHz.

To illustrate the relative effects of loss and beam chromaticity Figure 1 and Figure 2 show the residuals without added signature for loss and beam respectively with 4 polynomial terms removed. While beam effects tend to average out over a range of GHA the loss effects increase in proportion to the sky noise.

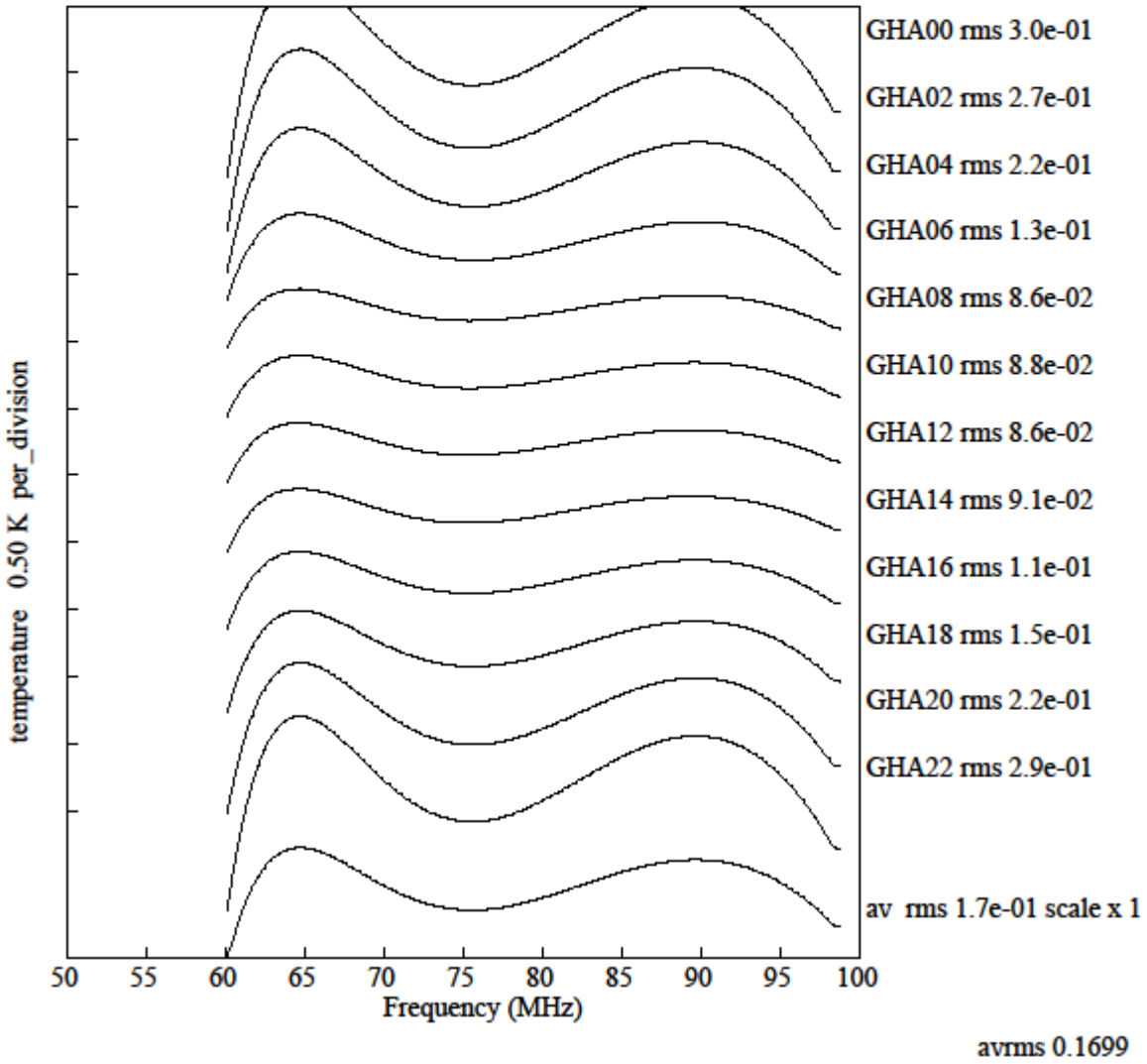

Figure 1. Simulated data for 2.8×2.8 m ground plane loss with 4 polynomial terms removed.

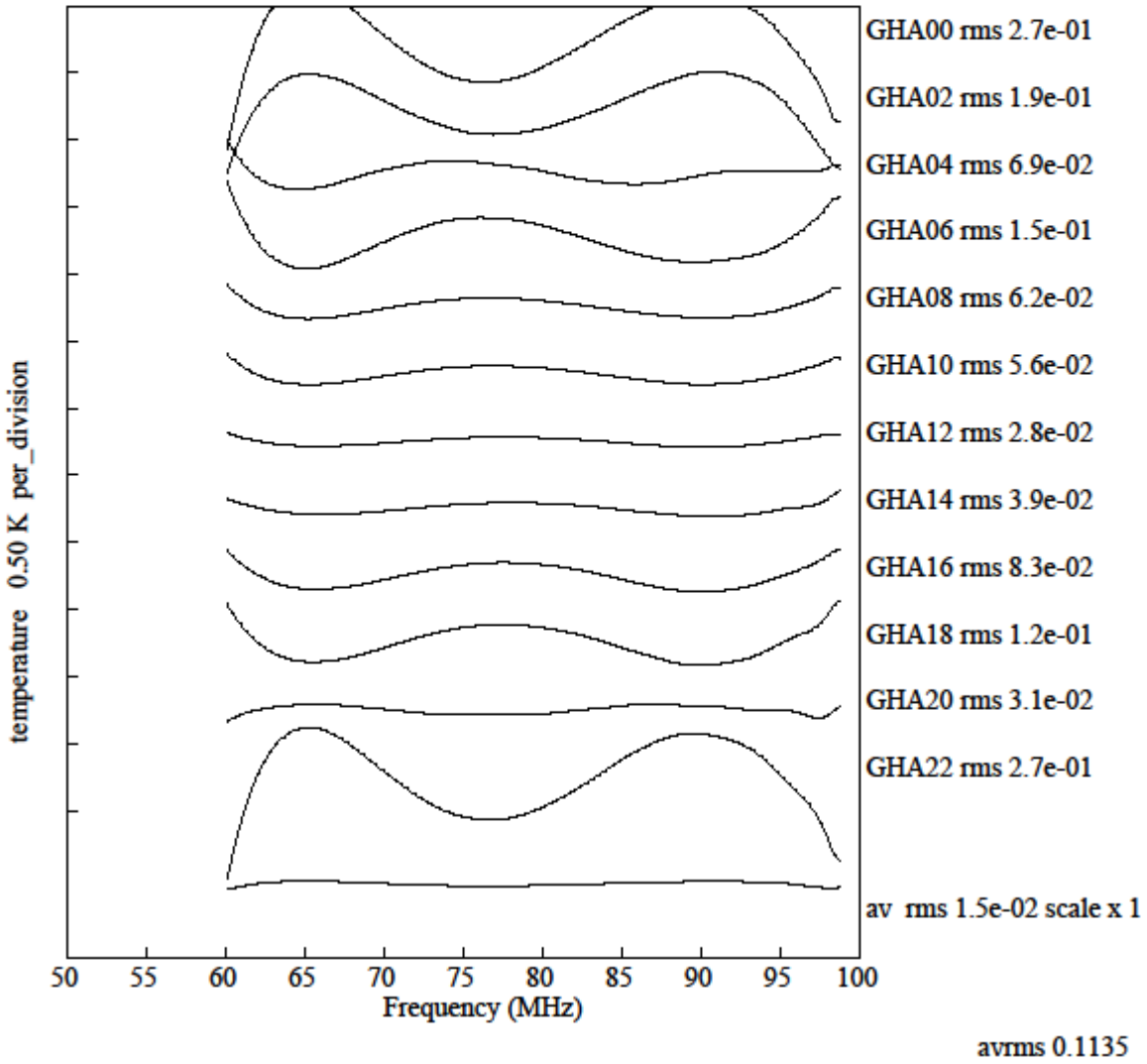

Figure 2. Simulated beam effects for lowband blade over 2.8×2.8 m ground plane with 4 polynomial terms removed.