

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886**

December 27, 2016

Telephone: 781-981-5414

Fax: 781-981-0590

To: EDGES Group
From: Alan E.E. Rogers
Subject: Simulations of the reduction of beam effects by averaging over GHA

The sensitivity tests discussed in memo #222 point out that the EDGES low band is still very sensitive to beam effects even with the extended ground plane. While plans to deploy a second low band antenna and the use of nighttime data with the galaxy up (GHA=0) will help quantify and reduce other instrumental errors questions of the accuracy of the beam corrections may still remain.

Table 1 shows the results simulations of antenna beam corrections made over a range of Galactic center hour angle. A 4 term polynomial fit was made to the simulated spectra over a 60 to 99 MHz range. The average of rms values over the range of GHA as well as the rms residual of the spectrum averaged over the range of GHA is shown for the extended, square 6-18, 9-15, and one hour range of GHA and antenna NS and EW.

Ground plane	Antenna orientation	GHA	average rms mK	rms of average mK	Sig max mK
Extended	NS	6-18	59	42	160
Square 10×10	NS	6-18	141	100	400
Infinite	NS	6-18	57	57	250
extended	NS	9-15	54	33	130
Square 10×10	NS	9-15	120	100	460
Infinite	NS	9-15	41	41	180
Extended	EW	9-15	49	35	150
Extended	NS	12	-	48	390
Extended	EW	9-15	43	17	60

Table 1. Simulations of beam corrections with 4 polynomial terms removed. Also shown is the maximum signal obtained in a search for an absorption.

Figures 1 to 4 show the beam correction vs GHA for the extended (with perforated, see memo #204) ground plane for 9-15 GHA with orientation NS and EW and for the full range of GHA NS and EW. These figures show that the residuals to the beam corrections change on the scale of about 1 hour and tend to average to a significantly lower value. Also the difference between a NS and EW orientation which allow a comparison of the results from the orientations to be used test the accuracy of the beam corrections. As a result, we plan to orient the second low band antenna in the EW direction and possibly reorient the current low band antenna.

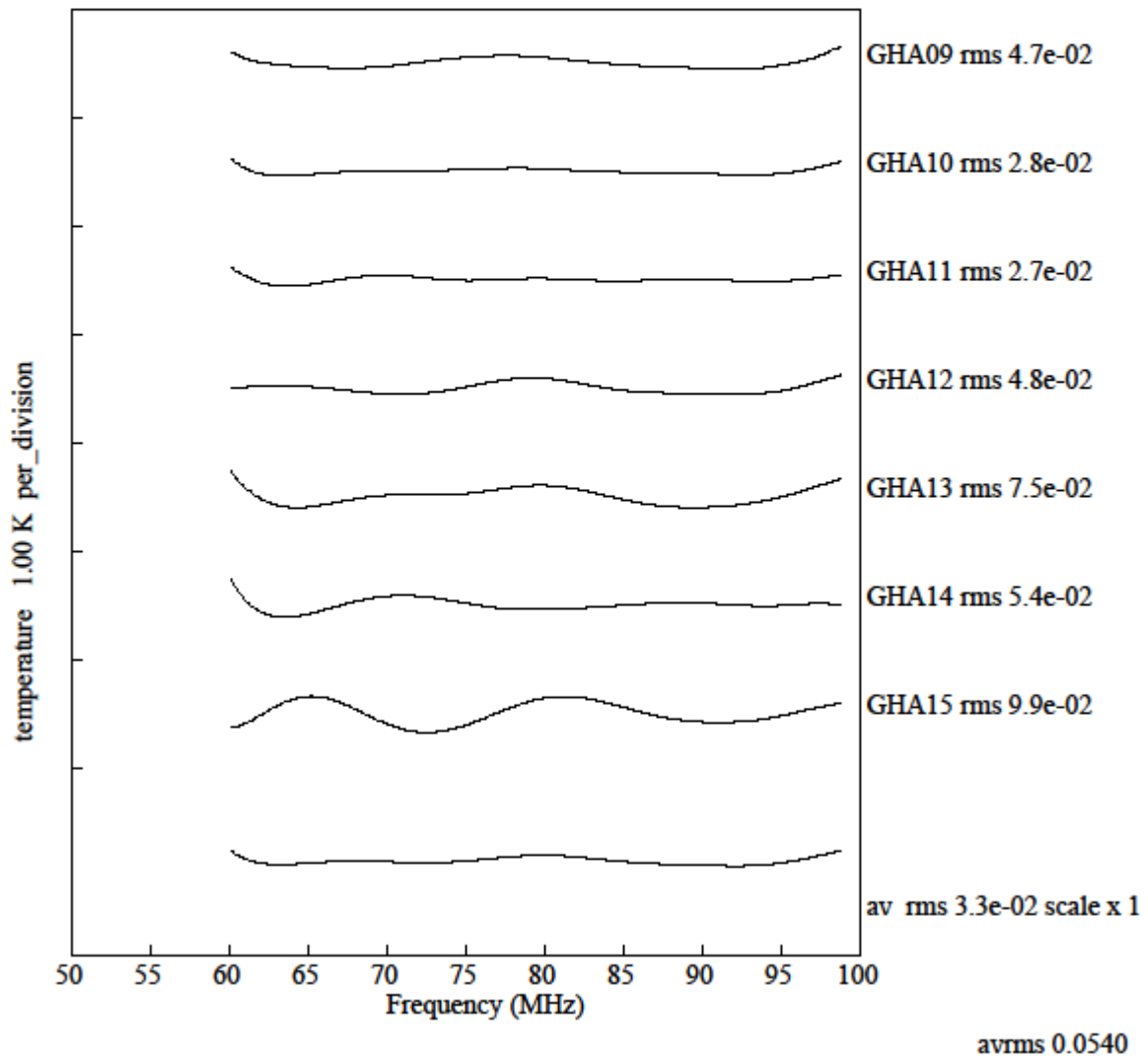


Figure 1. Residual spectra from simulation using 4 term polynomial antenna beams using FEKO of blade antenna oriented NS on extended ground plane with soil dielectric 3.5 and conductivity $2e-2$ S/m.

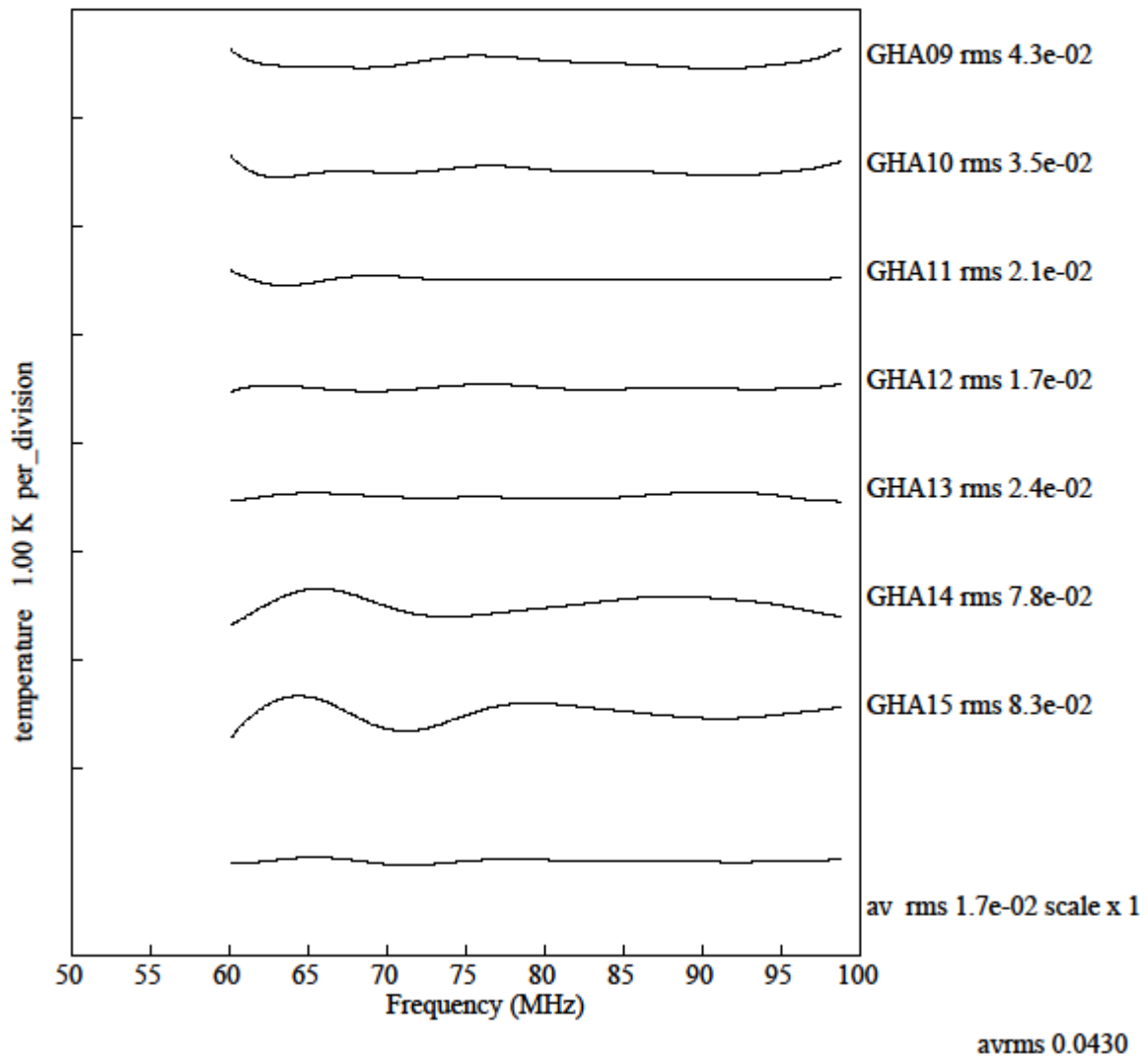


Figure 2. Antenna orientation EW.

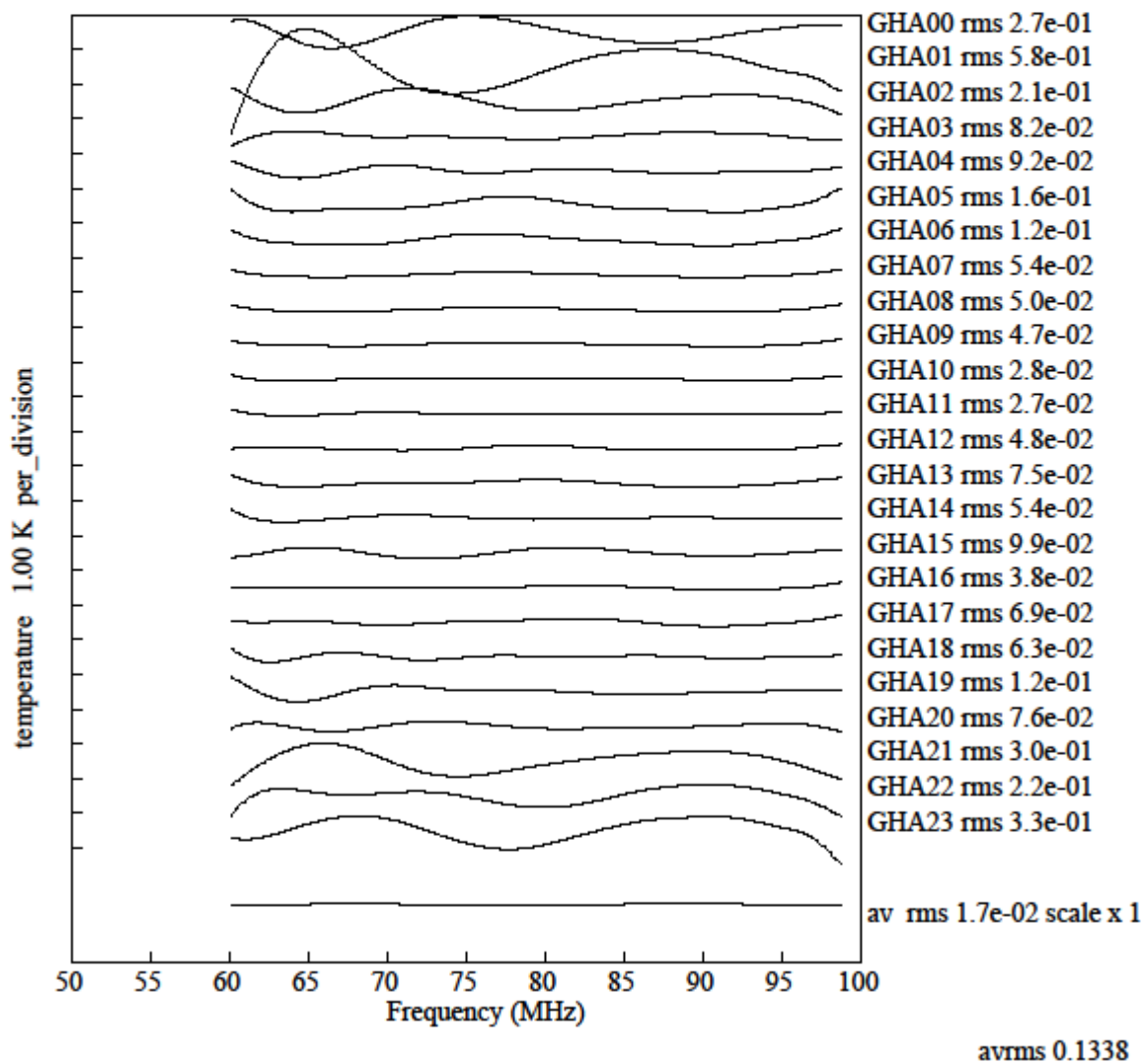


Figure 3. Same as Figure 1 over full range of GHA.

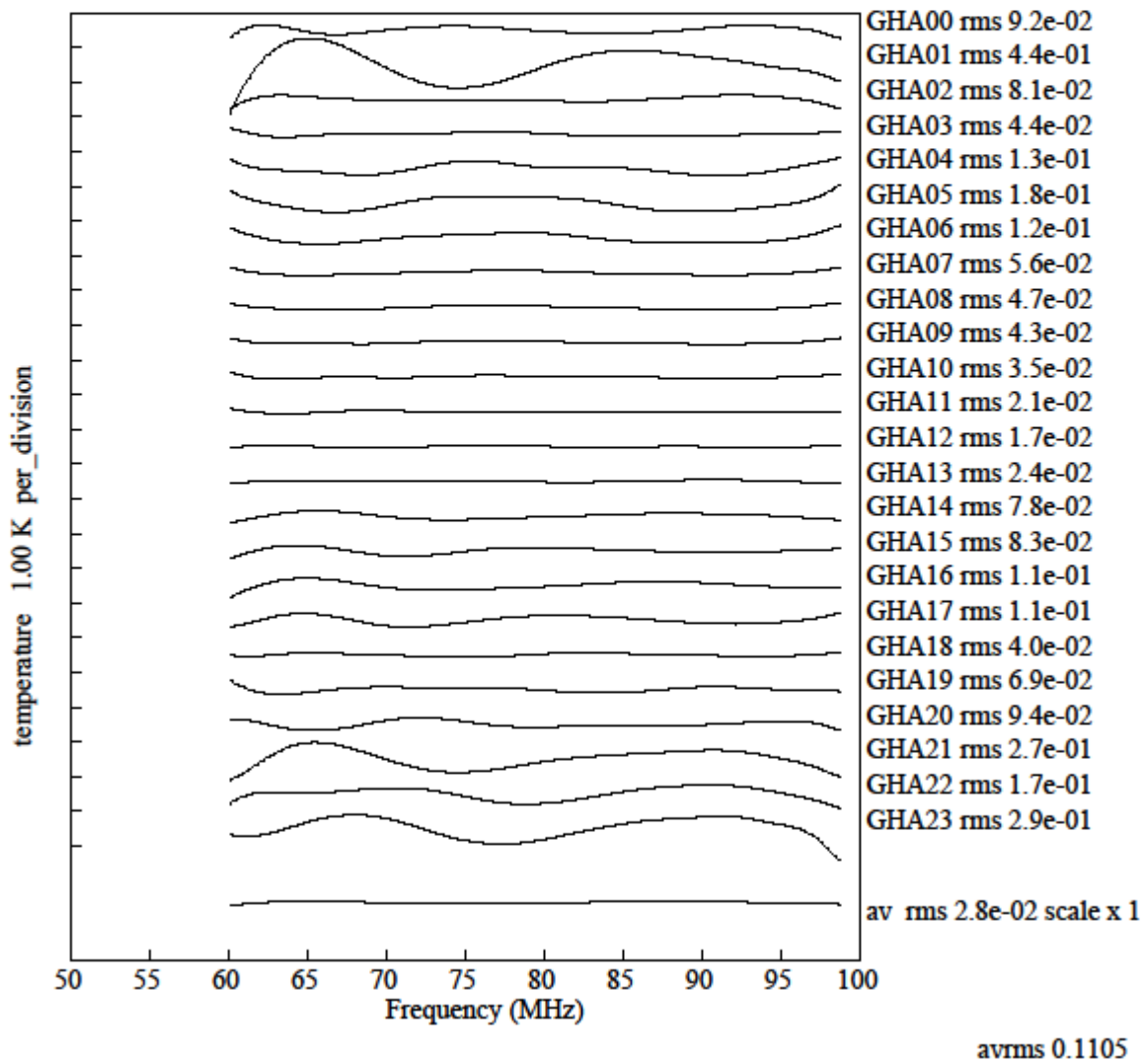


Figure 4. Same as Figure 2 over full range of GHA.