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To: EDGES Group

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Subject: Estimates of the flux and spectral index of the quiet Sun.

An initial estimate of the flux and spectral index of the quite Sun can be made from EDGES data by making a 2 parameter fit to calibrated spectra taken on 24 January 2015. The functions were $f^{-2.52}$ and f^{-s} for the foreground, and solar emission respectively, where s is the spectral index of the quiet Sun in the 100 to 190 MHz range. Figure 1 shows the calibrated data residuals to a single parameter fit to $f^{-2.52}$ without beam correction. Figure 2 and 3 residuals to a 2 parameter fit without and with beam correction. The best overall fit to the full range of GHA was found with a value of -2.52 for the foreground spectral index and 0.5 for the Sun's spectral index using a grid search whose results are given in Table 1.

Foreground index	Solar index	Peak Sun K	rms (K)
-2.50	0.5	65	1.78
-2.52	0.5	72	1.70
-2.54	0.5	79	1.82
-2.52	-0.5	100	1.87
-2.52	0.5	72	1.70
-2.52	1.0	63	2.00

Table 1. Grid search for spectral index of foreground and quiet Sun.

These observations are not able to accurately determine the solar spectrum because without data taken at night at the same sidereal time the best foreground information is not yet available so that these parameters can be fixed. Simultaneous solution of scale, spectral index and ionosphere requires 4 parameters and adding a fifth parameter for the Sun results in an almost singular covariance matrix owing to the high correlation between the functions. A spectral index of about 0.5 ± 05 is consistent with flux density spectral index measurements of Erickson (1977) who obtained a value of 2.38 ± 0.1 which corresponds to a spectral index of 0.38 ± 0.1 following the subtraction of 2 to convert to the brightness temperature spectral index. Converting the peak Sun temperature of 72±20 K to a flux density at 245 MHz gives a flux density of $16\pm5\times10^{-22}$ W/m^2/Hz compared with 20×10^{-22} W/m^2/Hz measured at Learmonth on 24 Jan 2015 at 05 UTC.

Erickson, W.C., T.E. Gergely, M.R. Kundu, and M.J. Mahoney. "Determination of the decameter wavelength spectrum of the quiet Sun." *Solar Physics* **54**, no.1 (1977): 57-63.
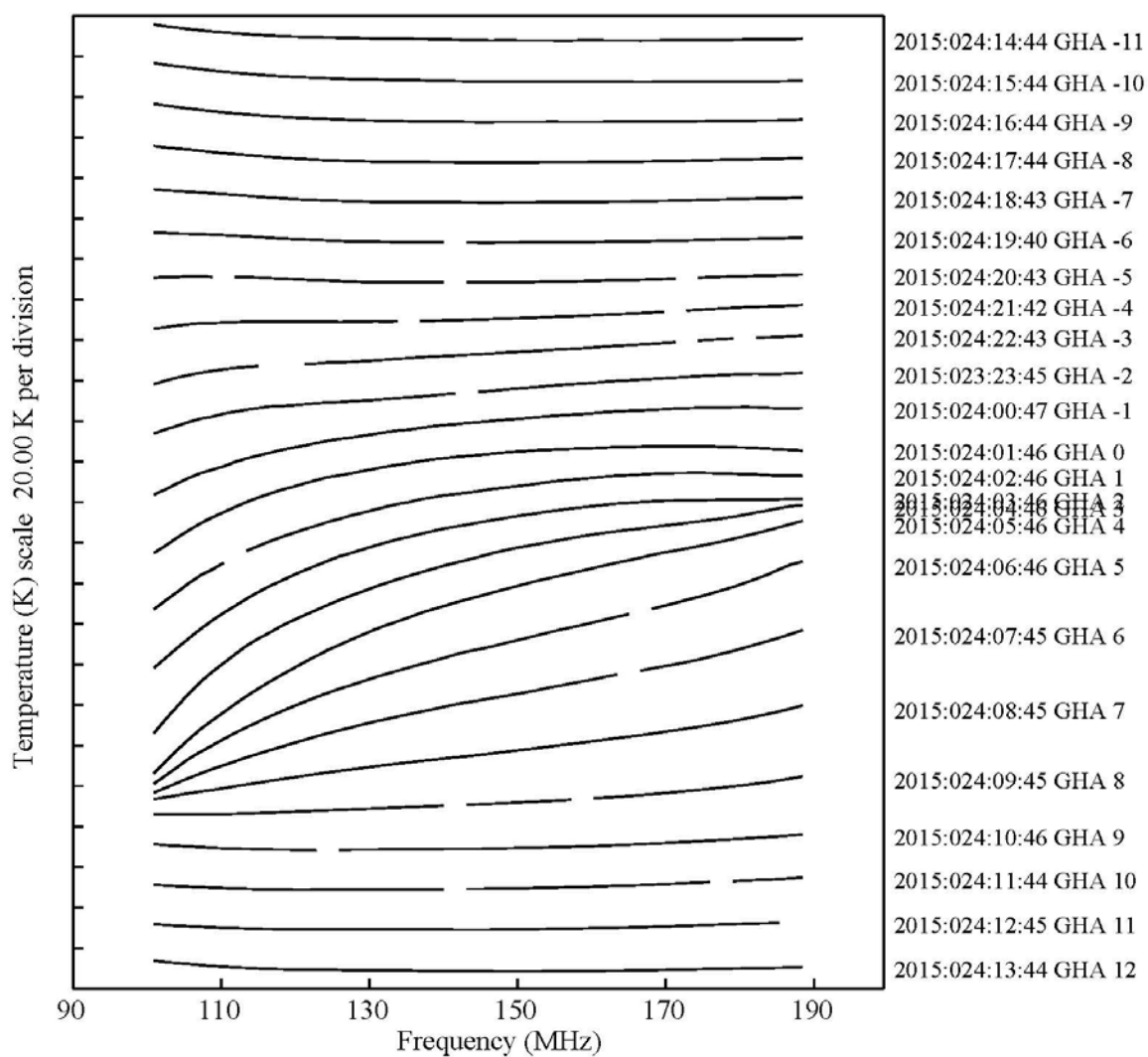
Figure 1. Residuals of calibrated spectra to spectral index of -2.52.
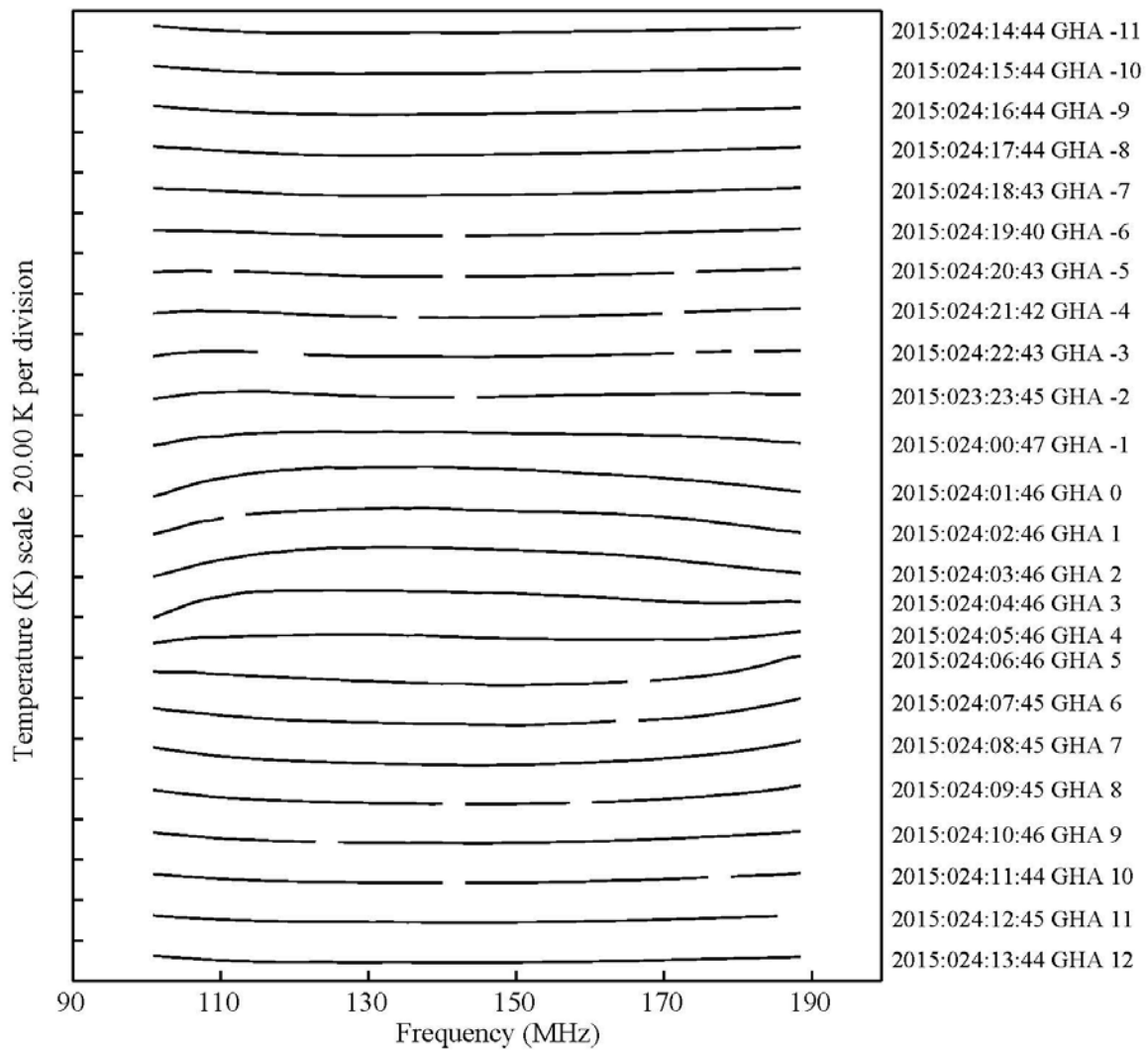
Figure 2. Residuals of calibrated spectra to fit which included a term for solar emission. Overall rms of 2.2 K.
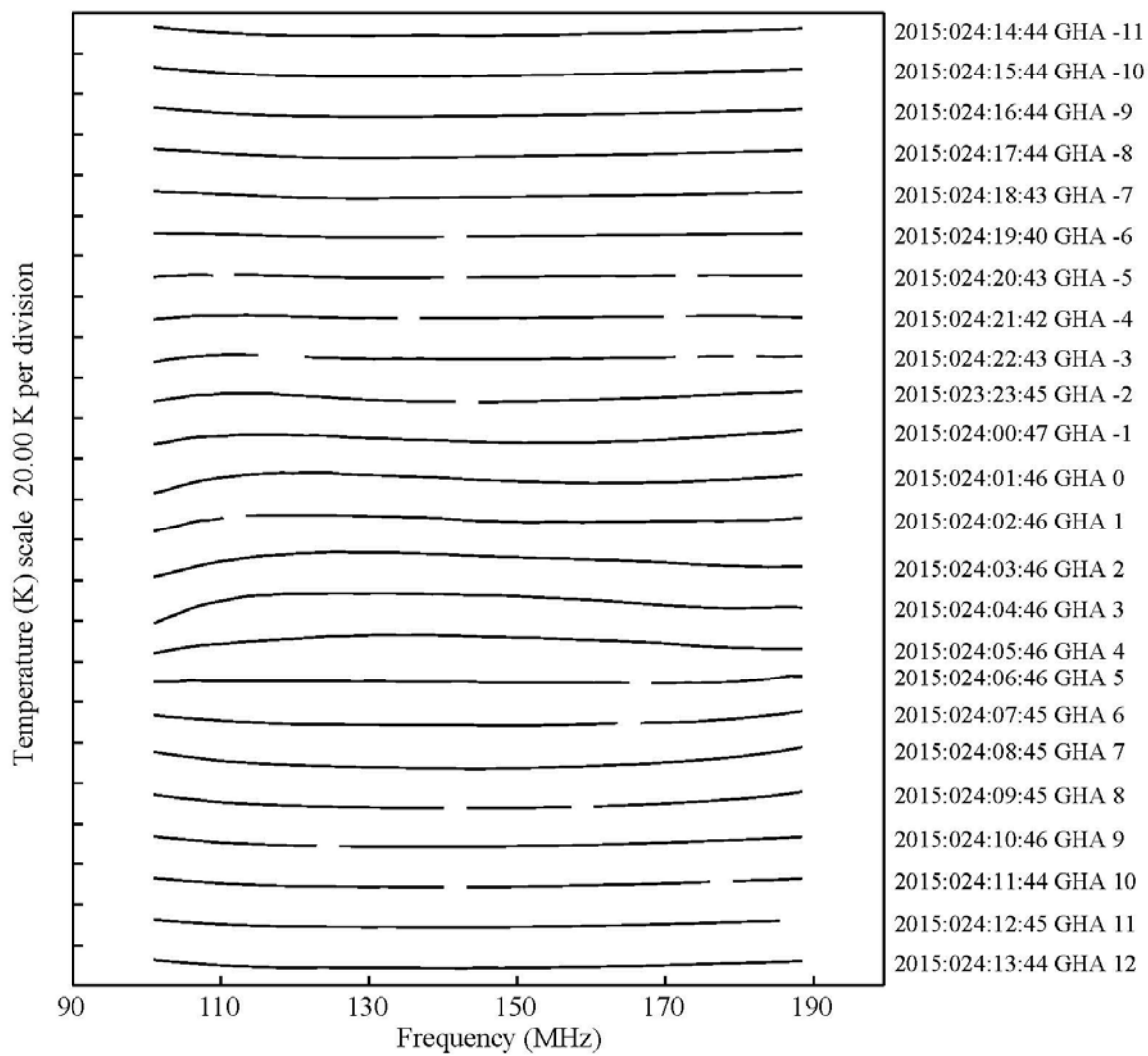
Figure 3. Residuals to best 2 parameter fit following beam correction. Overall rms 1.7K.