EDGES MEMO #200

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To: EDGES Group

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Subject: Spectral index from high and low band

The spectral index of the sky noise temperature at 150 and 75 MHz is derived from the high and low band data from days 2015_286 to 2016_120. Figures 1 and 2 show the results for high and low band using a frequency range of 90-190 and 61-99 MHz. Beam corrections were made using an infinite ground plane for high band and a "GF" ground plane with dielectric constant 3.5 and conductivity 10^{-2} S/m for low band.

Table 1 shows the results of fitting a constant plus a Gaussian to represent the "dip" in spectra index around the transit of the Galactic center. Note that there is some dependency of the width and center LST of the dip. This is mostly the result of a significant dependency of the beam correction in the LST range 17.75±4 hours.

Band	Beam	# terms	LST_of_dip	FWHM (hrs)	rms
High	Inf	2	17.6	6.4	0.006
High	GF	2	17.5	5.9	0.006
High	Inf	3	17.3	4.4	0.007
High	GF	3	17.3	4.6	0.008
Low	Inf	2	16.7	8.7	0.011
Low	GF	2	16.7	7.8	0.007
Low	Inf	3	16.7	8.7	0.011
Low	GF	3	16.7	7.9	0.007

Table 1.

The spectral index can also be derived from the ratio of the calibrated antenna temperature at 150 and 75 MHz from the high and low bands. Beam correction is not applied as it is assumed to be the same for high and low band.

$$\text{beta} = \log\left(T75/T150\right)/\log\left(150/75\right)$$

The result is shown in Figure 3. The limitations of this result is a combination of the differences in the high and low band ground planes and the effect of the ionosphere.

In order to compare the EDGES results with the spectral index of skymaps the blade antenna beam at midband is convolved with a sky temperature and spectral index map made from the combination of the 45 MHz Sky map of Guzmán et al. (available from www.das.uchile.cl/survey45mhz) and the Haslam 408 MHz map. The spectral index for the sky was calculated using

$$\text{beta} = \log\left(S45/\left(S408-3\right)\right)/\log\left(408/45\right)$$

instead of using the Galactic temperature spectral index map of Guzmán et al. which has the isotropic extragalactic temperature subtracted.

Guzmám, Andres E., Jorge May, Hector Alvarez, and Koitiro Maeda. “All-sky Galactic radiation at 45 MHz and spectral index between 45 and 408 MHz.” *Astronomy & Astrophysics 525* (2011): A138.

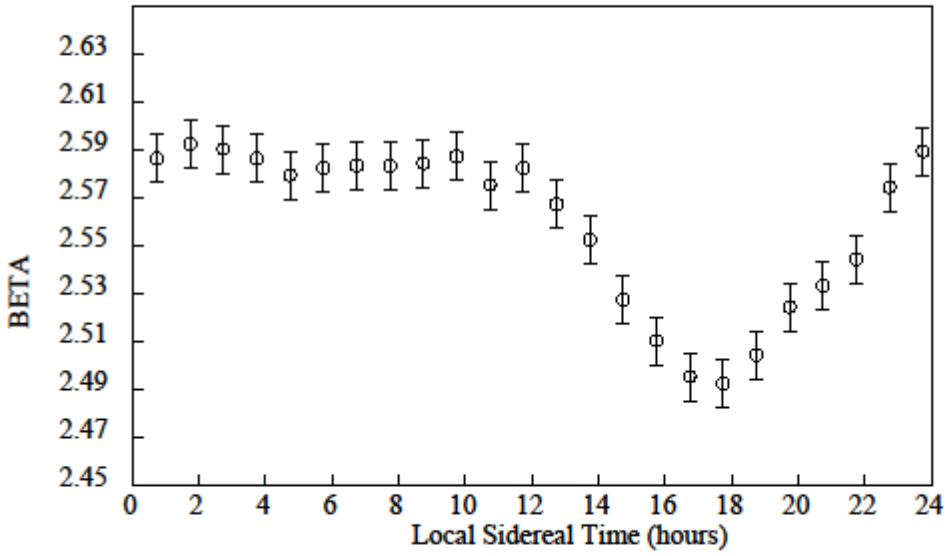

Figure 1. High band spectral index vs LST

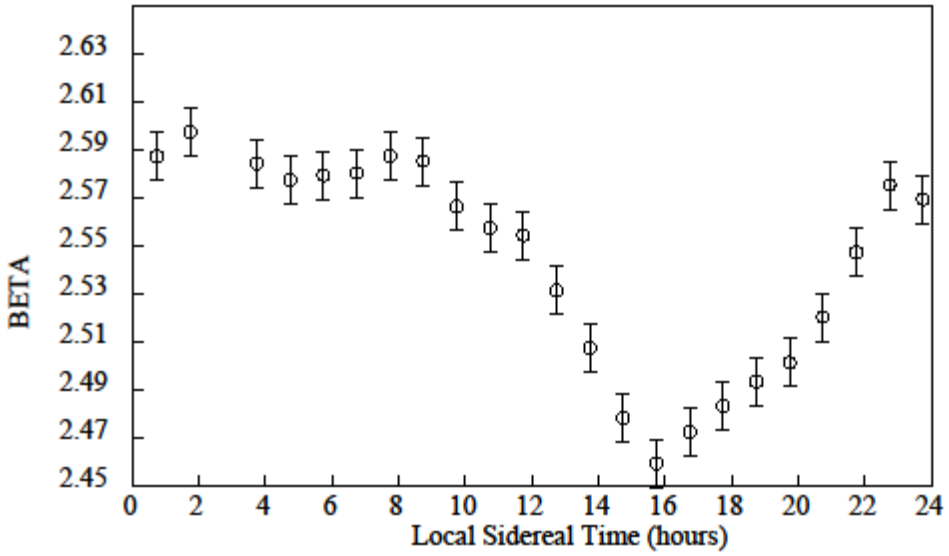

Figure 2. Low band spectral index vs LST.

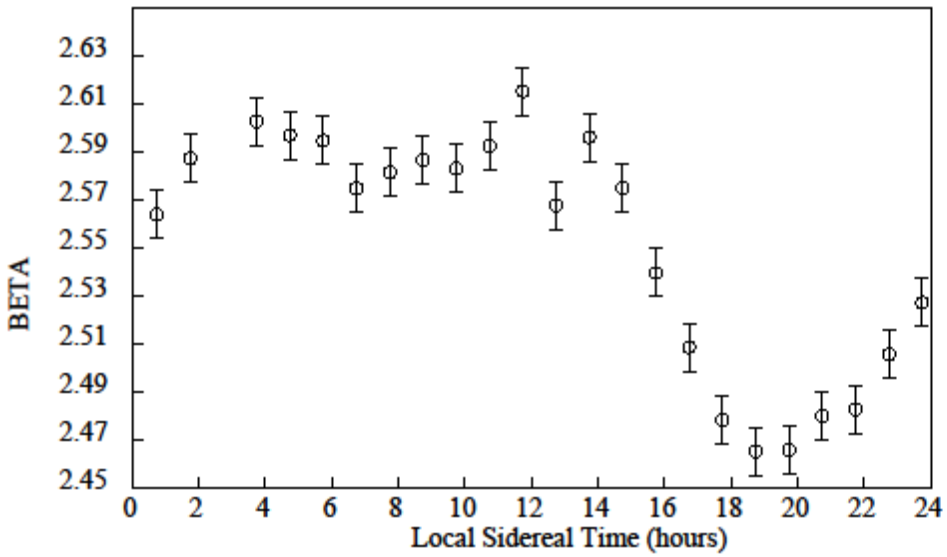

Figure 3. Spectral index from ratio of high and low band.

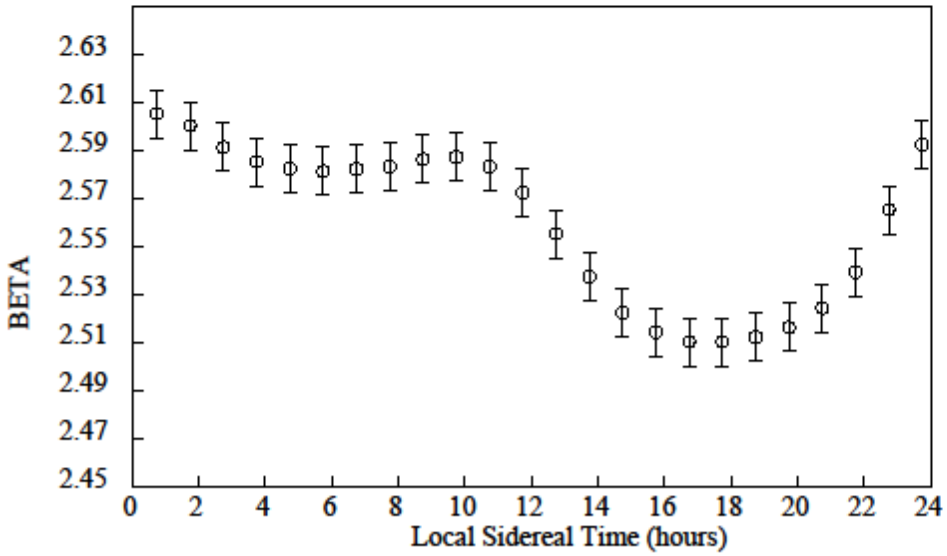

Figure 4. Spectral index from 408 and 45 MHz sky maps convolved with EDGES beam (achromatic)