Spectral Index Comparisons Between GSM and EDGES High-Band Measurements

Raul Monsalve

SESE, Arizona State University
CASA, University of Colorado Boulder

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Summary

This document present spectral results, primarily β, γ, and residuals, for three cases:

1. Only the Global Sky Model (GSM).
2. EDGES data and the the convolution of GSM with a beam model, but without applying beam correction.
3. EDGES data and the the convolution of GSM with a beam model, after applying beam correction.

In all cases the model used for the fit was:

$$\log(T^{*}_{\text{meas}}) = \log(T_{150\text{MHz}}) - \beta \left[\log \left(\frac{\nu}{150\text{MHz}} \right) \right] - \gamma \left[\log \left(\frac{\nu}{150\text{MHz}} \right) \right]^{2}, \quad (1)$$

where the fit parameters were $\log(T_{150\text{MHz}})$, β, and γ. Except for the "only GSM" case, the T^{*}_{meas} input data is equal to $T_{\text{meas}} - T_{CMB}$ where T_{meas} is the measured or simulated calibrated antenna temperature that includes the CMB temperature of 2.725 K.

In all cases, the beam factor assumes a foreground map at 150 MHz scaled down from the 408-MHz Haslam map with a spectral index of 2.5 within Galactic latitudes of $\pm 10^{\circ}$ and 2.57 outside this band. The scaling has been done by, first, removing the CMB temperature from the Haslam map at 408 MHz, and then adding it back at 150 MHz.

1. Only GSM

Spectral Properties of the GSM: β

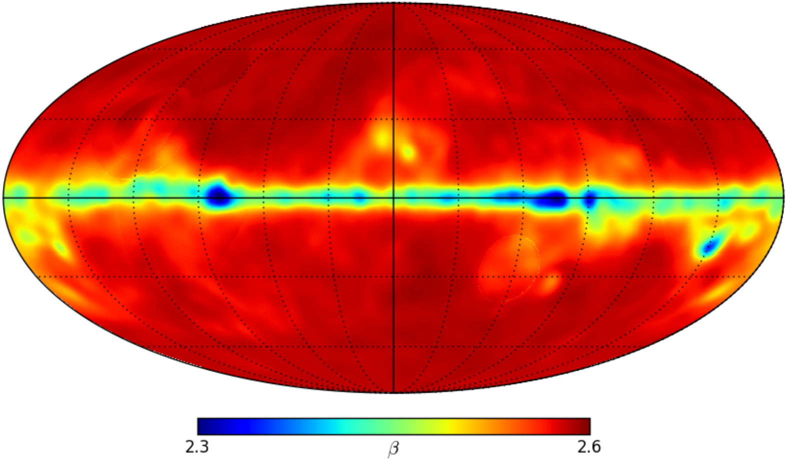

Figure : (1): β from fitting equation 1 directly to each spatial pixel of the GSM maps in the range 100-200 MHz. The map center corresponds to long/lat = $(0^\circ, 0^\circ)$ and the grid lines correspond to separations of 30°.

Spectral Properties of the GSM: γ

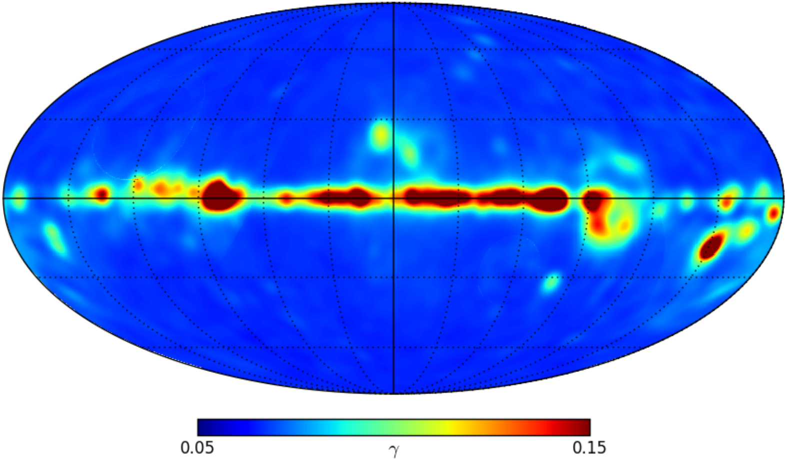

Figure : (2): γ from fitting equation 1 directly to each spatial pixel of the GSM maps in the range 100-200 MHz. The map center corresponds to long/lat = (0°, 0°) and the grid lines correspond to separations of 30°.

Spectral Properties of the GSM: Maximum fit residuals

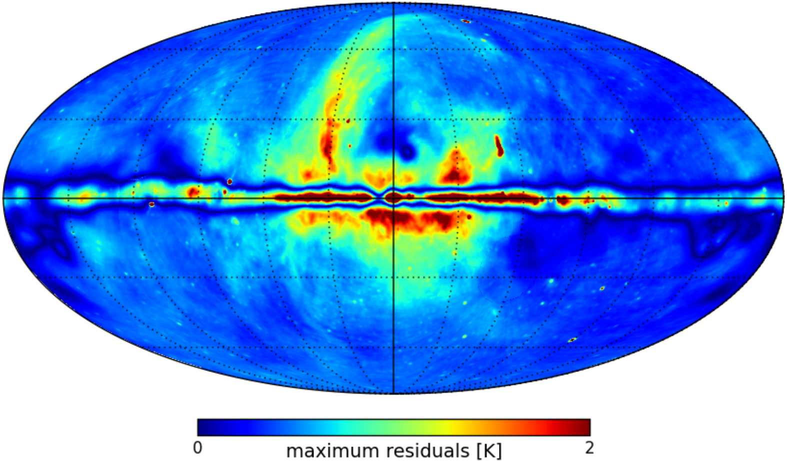

Figure : (3): Maximum fit residuals after fitting equation 1 directly to each spatial pixel of the GSM maps in the range 100-200 MHz. The center corresponds to long/lat = (0°, 0°) and the lines represent separations of 30°.

Spectral Properties of the GSM: Latitude averages

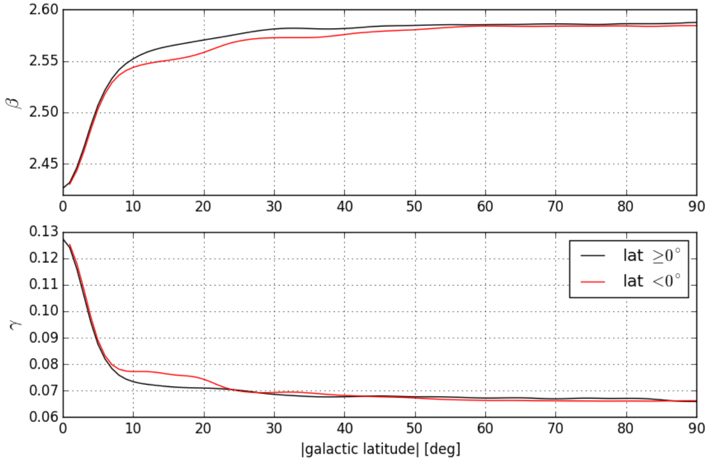

Figure : (4): Average β and γ across constant Galactic latitude.

2. Comparing GSM / Beam Model Convolution and EDGES Data, Without Applying Beam Correction

Comparisons With No Beam Correction: Summary

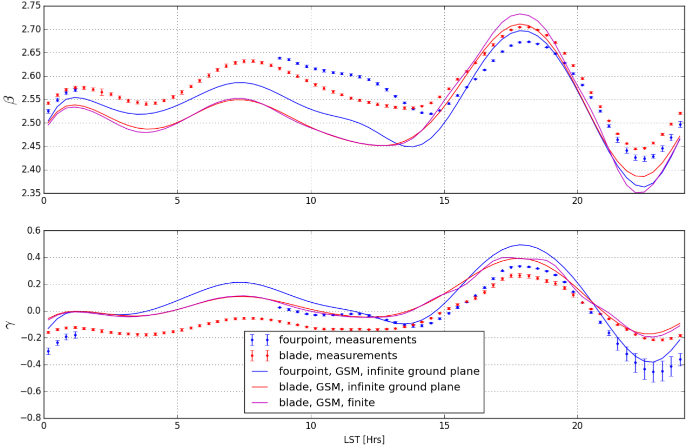

Figure : (5): β and γ as a function of LST for the measurements (points with error bars) and simulations (lines). No beam correction has been applied.

Comparisons With No Beam Correction: Fourpoint

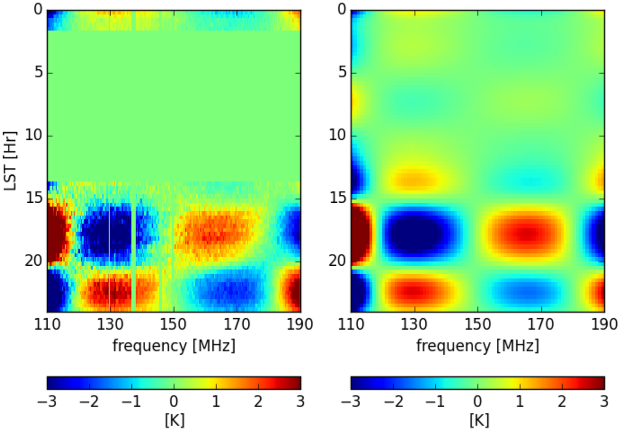

Figure : (6): Residuals for the fits shown in Figure 5. (LEFT) EDGES data with Fourpoint antenna. (RIGHT) GSM / Fourpoint simulation. There is good agreement between the two.

Comparisons With No Beam Correction: Blade

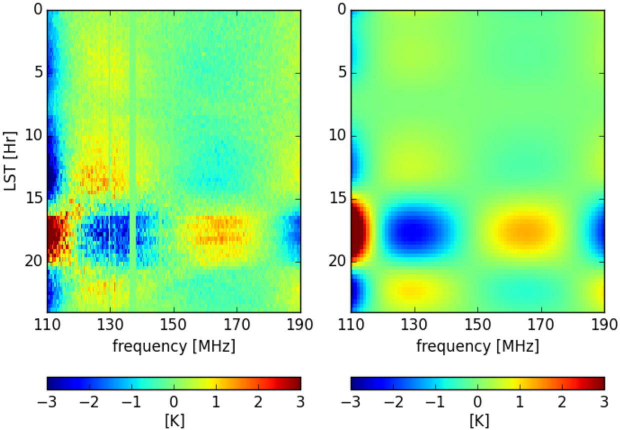

Figure : (7): Residuals for the fits shown in Figure 5. (LEFT) EDGES data with Blade antenna. (RIGHT) GSM / Blade simulation. There is good agreement between the two.

3. Comparing GSM / Beam Model Convolution and EDGES Data, After Applying Beam Correction

Comparisons With Beam Correction: Summary

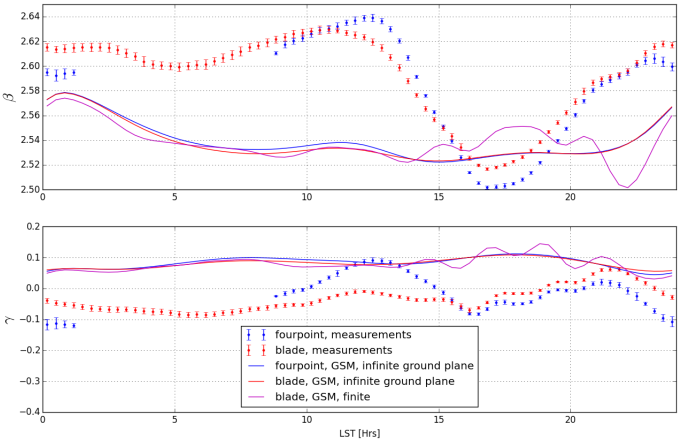

Figure : (8): β and γ as a function of LST for the measurements (points with error bars) and simulations (lines). Beam correction has been applied. The agreement is not good.

Comparisons With Beam Correction: Fourpoint

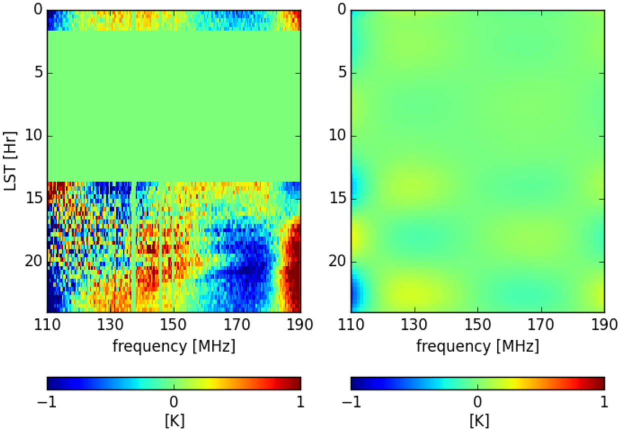

Figure : (9): Residuals for the fits shown in Figure 8. (LEFT) EDGES data with Fourpoint antenna. (RIGHT) GSM / Fourpoint simulation. The agreement between the two is not good.

Comparisons With Beam Correction: Blade

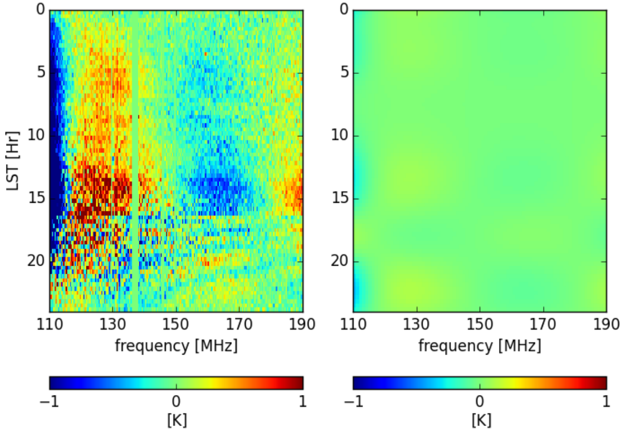

Figure : (10): Residuals for the fits shown in Figure 8. (LEFT) EDGES data with Blade antenna. (RIGHT) GSM / Blade simulation. The agreement between the two is not good.