LOCO EDGES REPORT #116

First Tests of Absorption Feature Below 90 MHz in EDGES High-Band Data with Blade Antenna

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1 Description

Here we present results of a preliminary analysis of the EDGES High-Band Blade data gathered in 2015-2016. The purpose is to evaluate the presence of the absorption feature reported in Bowman et al. (2018) below 90 MHz.

The data considered in the analysis are as follows:

- Dates range: 2015-206 to 2016-258.
- Frequency range: 80-120 MHz
- Sun elevation cut: only $\leq 0°$.
- Moon elevation cut: only $\leq 0°$.
- RFI cleaned.
- Full calibration applied.

The calibration details are:

- Receiver calibration using lab data from 2015 (although in this report we show results over 80-120 MHz, the receiver calibration is done over 65-195 MHz).
- Antenna S11: 2015-262.
- Balun+connector loss from analytical model.
- 0.5% ground loss with flat frequency profile.
- Beam chromaticity correction using beam file
  azelq_blade9.35w_9.35l_hgt52_gf2.5hplus3.5_2e-2.txt
  and using sky model based on the 408-MHZ Haslam and 45-MHz Guzman maps.

2 Results

We analyze the following cases:

1. First, the data are averaged into six 4-hr GHA spectra.
2. Then, the data are averaged into two 12-hr GHA spectra.
3. Finally, we find the GHA range that produces the lowest residuals. This turned out to be GHA 7-15 hr.

In all cases, the spectra are first modeled using only a foreground model (EDGES polynomial). Then, we add the 21-cm flattened Gaussian model of Bowman et al. (2018).

The EDGES polynomial has 7 terms in the region of low foregrounds, and 8 terms in the region of high foregrounds.

The parameters of the 21-cm model were varied manually until (in conjunction with a fresh set of foreground parameters fitted in each try) the RMS of the residuals were minimized.

Table 1 summarizes the results. It shows the number of foreground terms used, the rms of the residuals when fitting only the foreground model, the rms after adding the best-fit 21-cm model, and the best-fit 21-cm parameters themselves.

Figures 1-6 show the results for the cases with 4-hr GHA averages. Figures 7 and 8 show the results for the 12-hr averages. Figure 9 shows the results for the range GHA 7-15 hr.

Although preliminary, this analysis shows that the High-Band Blade data are broadly consistent with an absorption feature below 90 MHz. Here we make the assumption that our polynomial model is adequate to model the sky foreground coupled with errors in instrument calibration.

Among the next steps, we have to conduct a blind and thorough 21-cm parameter search. This is the subject of the next report.

Table 1: Summary of Results

GHA range [hr]	N terms foreground	rms WITHOUT 21-cm model [mK]	rms WITH 21-cm model [mK]	A [K]	ν_r [MHz]	w [MHz]	τ	Figure
0-4	8	54	45	0.9	79	20	9	1
4-8	8	38	23	0.9	77.5	22	11	2
8-12	7	26	13	0.7	78	19.5	7	3
12-16	7	30	19	0.7	78	21	5	4
16-20	7	39	24	0.7	78	20.5	10	5
20-24	8	66	34	0.85	79.5	20.5	12	6
6-18	7	27	14	0.7	78	20	7	7
$-6 <$GHA< 6	8	47	29	0.9	78	22	12	8
7-15	7	25	12	0.7	78	20	7	9

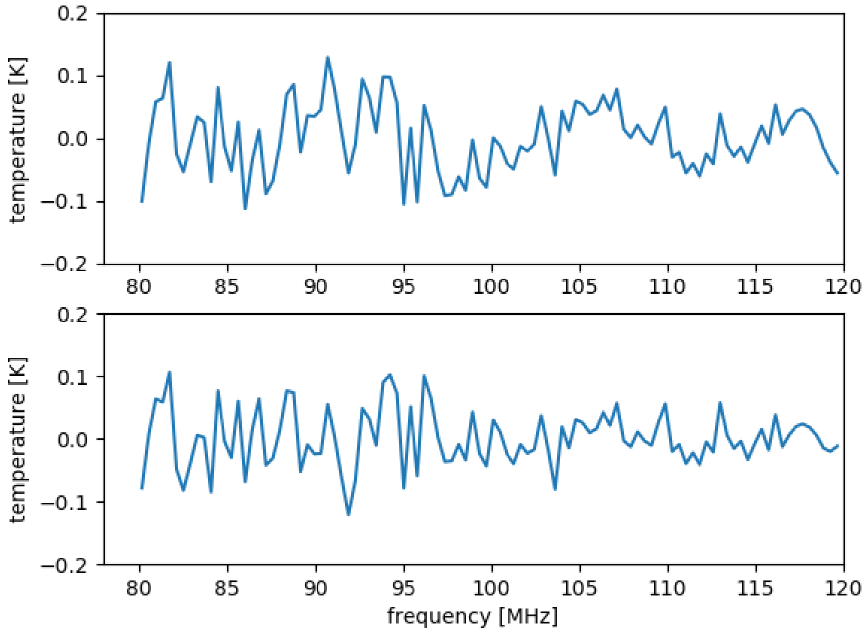

Figure 1: Residuals for GHA range 0-4 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

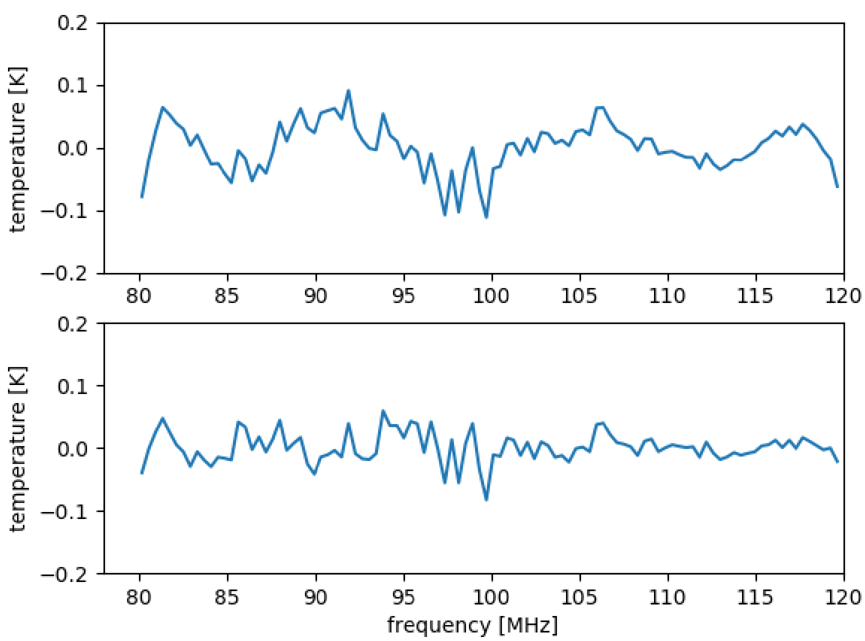

Figure 2: Residuals for GHA range 4-8 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

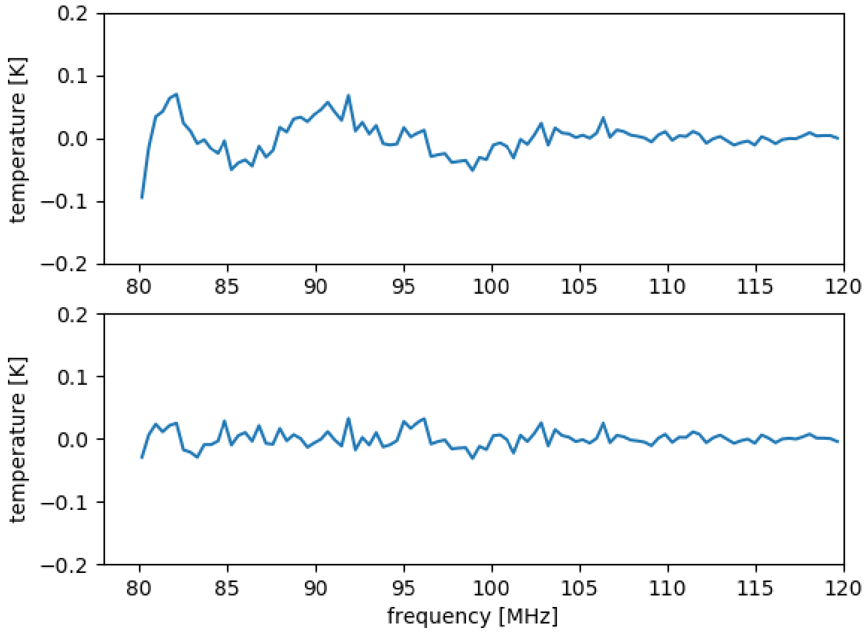

Figure 3: Residuals for GHA range 8-12 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

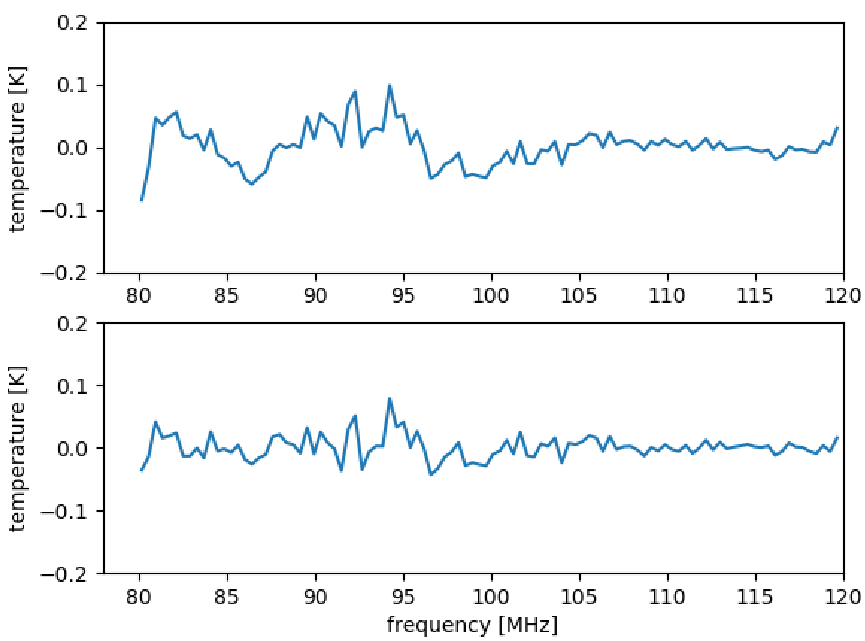

Figure 4: Residuals for GHA range 12-16 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

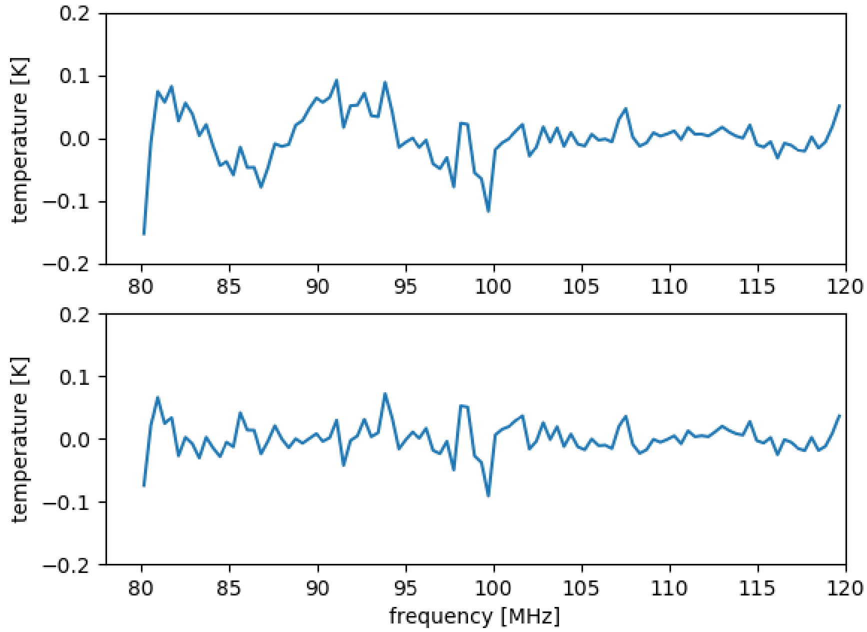

Figure 5: Residuals for GHA range 16-20 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

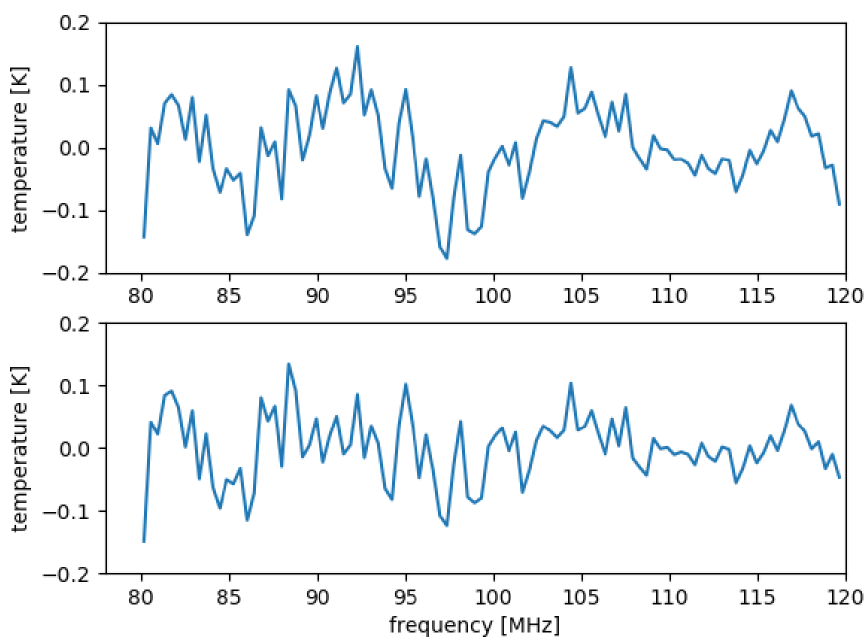

Figure 6: Residuals for GHA range 20-24 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

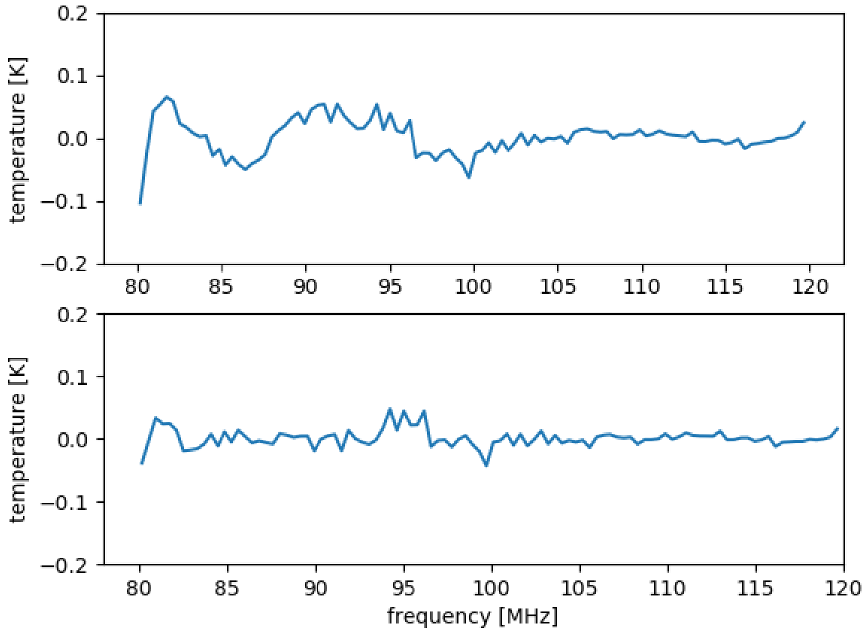

Figure 7: Residuals for GHA range 6-18 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

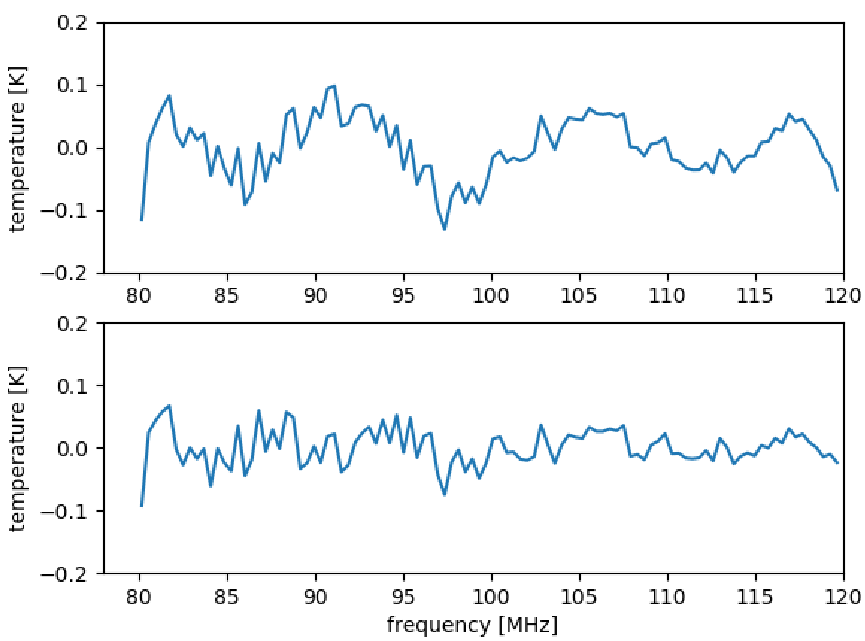

Figure 8: Residuals for GHA range [-6, 6] hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.

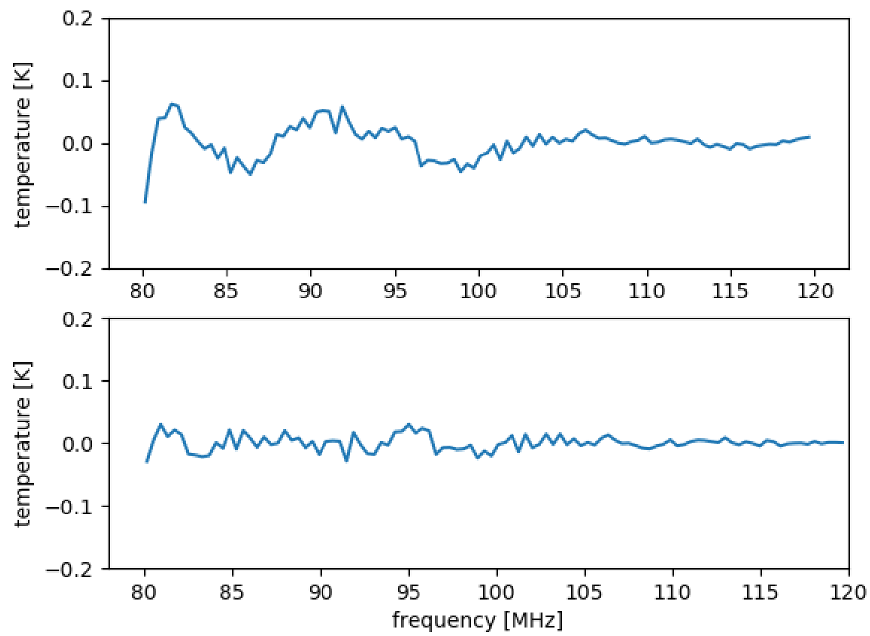

Figure 9: Residuals for GHA range 7-15 hr. (Top) Without 21-cm model. (Bottom) With 21-cm model.