LST binned Low-band data analysis
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The preliminary results from the dual band analysis promoted us to examine the data binned over LST/GHA. The dual band analysis was done so far with data averaged over all LSTs.

Using the EDGES-estimate code, I tried to estimate the parameters of the absorption feature and the foreground only for the Low band LST binned data.

1.) Paper data:
We use the public release of the data from the loco page and fit for 4 absorption parameters and 5 linlog foreground parameters. The estimation was done using polychord using nlive = 1024. The values of the parameters obtained are shown in the plot below.

Fig1: Likelihood distributions for the foreground and 21cm model parameters. Beta and p1 are highly correlated with each other. And in the absorption parameters, the amplitude is seen to be correlated with the temperature at 75MHz.
Fig2: Residues Vs Frequency obtained after fitting the data to the best fit foreground + absorption model.

Notes
-- We are able to reproduce the parameters reported in the Bowman 2018 paper with the edges estimate code
-- This provides a first step cross check
-- An important lesson learnt: The beta value had to be tightly constrained between -2.53 and -2.57.
-- I don’t see the high correlation between the foreground parameters as noted in the paper. Likely because I am using a different foreground model compared to the nature paper.

2.) Use the data I have - GHA binning & day averaging - My pipeline:
We reproduce the same results as in section 1 but now by binning and averaging the data using my pipeline. Days Used: 2016_258 to 2017_095. The plot below compares the data processed here with the online release data. The data from my pipeline is kept in the raw frequency resolution.

Fig3: Averaged spectra between GHA 6 to 18hr for all the days Vs Frequency. The two curves compare the data sets - a.) online release, b.) data averaged with my pipeline.
The data was fit in its raw frequency resolutions (with 8193 points) for the 5 linlog foreground parameters and 4 absorption parameters. The estimation was done with
polychord using 1024 nlive similar to the previous section. In the first run, Beta was constrained with a prior being a normal distribution with the center at -2.5 and scale 0.1. The results of this run is shown below:

![Fig4: Likelihood distributions for the foreground and 21cm model parameters. In addition to the absorption amplitude being correlated with the temperature at 75MHz, all the foreground parameters are seen to be highly correlated. The Beta value is too high.](image1)

![Fig5: Residues Vs Frequency obtained after fitting the data to the best fit foreground + absorption model.](image2)
In the second run, **tighter constraints** are placed on Beta with the prior being a normal distribution with the center at -2.5 and **scale 0.02**. The results of this run is shown below:

![Likelihood distributions for the foreground and 21cm model parameters.](image)

**Fig6:** Likelihood distributions for the foreground and 21cm model parameters. In comparison with fig1, more correlation is seen between the foreground parameters. And in the absorption parameters, the amplitude is seen to be correlated with the temperature at 75MHz.(as before). **Tau is High!**

![Residues Vs Frequency obtained after fitting the data to the best fit foreground + absorption model.](image)

**Fig7:** Residues Vs Frequency obtained after fitting the data to the best fit foreground + absorption model.

**Notes:**
Optimal parameter values for paper data Vs My data:
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Paper data</th>
<th>Raw resolution (new averaging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A21</td>
<td>592 mK +/- 244 uK</td>
<td>388mK +/- 2.715 uK</td>
</tr>
<tr>
<td>tau</td>
<td>6.25 +/- 0.15</td>
<td>15.5 +/- 0.075</td>
</tr>
<tr>
<td>Width</td>
<td>18.8 MHz +/- 11.3 KHz</td>
<td>18.9 MHz +/- 0.24 KHz</td>
</tr>
<tr>
<td>nu0</td>
<td>78.23 MHz +/- 2.8 KHz</td>
<td>78.3 MHz +/- 0.065 KHz</td>
</tr>
<tr>
<td>Beta</td>
<td>-2.56 +/- 2.54e-4</td>
<td>-2.55 +/- 3.58e-5</td>
</tr>
<tr>
<td>T75/p0</td>
<td>1751 K +/- 200 uK</td>
<td>1729 K +/- 2.3 uK</td>
</tr>
<tr>
<td>gamma/p1</td>
<td>-8.4 +/- 780</td>
<td>-43.3 +/- 107</td>
</tr>
</tbody>
</table>

**Old Trials - Will redo**

1.) Data binned in 20 min chunks - used one LST bin (LST=0hr):
2.) Data binned in 20 min chunks - used 2 LST bins (LST=0hr & 12 hr):

The results from the above two trials did not make sense. So we decided to split the entire data into two time bins of 12hr each

3.) **Data split in half - binned in 12 hr chunks;**

Days used: 2016_258 to 2017_017
Frequency bins: raw resolution (8193)
Absorption parameters: 4 terms, Same for both the bins
Foreground params: 4 terms, two sets

**Priors:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta (0-12hr)</td>
<td>Norm dist centered at -2.5 with scale 0.2</td>
</tr>
<tr>
<td>Beta(12-24hr)</td>
<td>Norm dist centered at -2.5 with scale 0.2</td>
</tr>
</tbody>
</table>
- The center of the absorption feature is as expected ~ 77.8 - 78.4 MHz
- The beta value for GHA 0 to 12 ~ -1.95 to -1.938
- The beta value for GHA 12 to 24 ~ -2.85 to -2.9
- The absorption amplitude is higher than expected ~ 0.68 - 0.76 K
- The tau covers a wide range - 3.2 - 5.4

APPENDIX:

Make Residual Plots
```python
[d]: /home/mbunyanyi/low_level/low_level codes/low level/low_level step 1/look_at_param

[1]: from plotly.graph_objs import Figure, Scatter, layout

plot = Figure(
    name='Low level plot',
    xref='x',
    yref='y',
    xaxis='x',
    yaxis='y',
    showlegend=True,
    title='Plot of Low Level Data',
    width=800,
    height=600,
)

data = Scatter(
    x=[1, 2, 3, 4],
    y=[5, 6, 7, 8],
    mode='lines',
    line=dict(color='rgb(0, 0, 0)'),
)

plot.add_trace(data)

plot.update_layout(
    title='Low Level Plot',
    xaxis_title='X Axis',
    yaxis_title='Y Axis',
    legend_title='Legend Title',
)

plot.show()
```