EDGES MEMO #039

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Subject: Tests of the global neutral hydrogen signature in the 60-150 MHz band

This latest models of the global signature from Pritchard and Loeb show HI absorption at z~20 when the H spin temperature was below the CMB followed by emission at 2~10 when the H spin temperature is above the CMB and before most of the H is ionized. One feature of their models is a rapid change in slope over a very small range of frequencies as the ionization is completed. This relatively rapid change may in fact be the most detectable feature of the global signature which is extremely hard to distinguish from corruption of the spectrum by instrumental defects.

To test the detectability of these latest models I took the antenna temperature, T, to be

$$T = 600\left(f/100\right)^{-2.5} + m\left(f\right) + d\left(f\right)$$

Where *f* = frequency in MHz

m = model B from Pritchard and Loeb (arXiv:0802.2102)

d(*f*) = instrumental defect and a fit a polynomial of N terms to

$$x = \log\left(f\right), y = \log\left(T\right)$$

The log/log fit is perfect for any constant power and N ≥ 2 when model and d are zero. The table below given the peak to peak residual in ppm to fit for several cases:

N	A	B	C	D	E	F
2	110	116	38	106		
3	110	116	38	102		
4	80	116	17	50		
5	70	77	10	24	230	320
6	42	77	9	12	14	270
7	32	46	5	1.5	8	100
8	14	40	5	1.4	1.2	9
9	13	30	5	0.3	0.1	2.5

Case A	$d = 0$		60-150 MHz
B	$d = 0$		60-200 MHZ
C	$d = 0$		100-150 MHz
D	$d = 0$		60-120 MHz
E	$m = 0$	$d = 20 + 20\left(f/100\right)$	60-150 MHz
F	$m = 0$	$d = 20 + 20\left(f/100\right)$	60-200 MHz

Comments:
In practice N probably has to be greater than 5 to "soak up" the instrumental effects. At N=7 the model signature is reduced to 1.5 ppm with a frequency span of 60-120 MHz . The smaller span of 100-150 MHz has a much larger model signature residual of 5 ppm. This is entirely the result of the large second derivative with frequency of the model which occurs at about 125 MHz. The choice of instrumental error function, $d(f)$, is somewhat arbitrary but the trend with N and frequency span is typical for relatively smooth instrumental errors.