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To: EDGES Group
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Subject: Simulations of EoR signature detection

The EoR signature, r ,

$$\begin{aligned} r &= -(a/2)\sin((f - f_0)\pi/w) \quad w/2 < f < w/2 \\ &= -a/2 \quad f > w/2 \\ &= +a/2 \quad f < w/2 \end{aligned}$$

is added to the sky spectrum plus noise

$$S = 500(f/150)^{-2.5} + r + n$$

where a is the amplitude of the EoR “step”

w is the width of the EoR “step” MHz

f_0 is the frequency of the EoR “step” MHz

n is Gaussian noise

The spectrum, S , is then fit with a polynomial plus the EoR signature using weighted least squares. Simulations done with a noise level of 100 mK rms per 6 kHz channel gave the results in the table.

The general trends are as follows:

- 1] The detection threshold increases in approximate proportion to the number of terms in the polynomial needed to remove the systematics.
- 2] The detection threshold is approximately constant for a range of EoR signal width less than the bandwidth (100 MHz in these simulations) over which the polynomial is fit divided by the number of terms in the polynomial.
- 3] For EoR signal widths greater than the bandwidth divided by the number of terms in the polynomial the detection threshold increases at a rate greater than proportional to the EoR width.

The detection of thresholds given in the table are for a 50% probability of detection. For a 99% probability of detection the number should be approximately doubled.

Npoly	Sig_width (MHz)	Sig_threshold (mK)
7	5	25
	10	25
	20	50
	30	80
	40	100
13	5	50
	10	50
	20	100
	30	300
	40	1000

Table – Simulation results