EDGES MEMO #252

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886

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Telephone: 617-715-5533
Fax: 781-981-0590

To: EDGES Group

From: Alan E.E. Rogers

Subject: Simulations of signature search with different number of added functions

A specific absorption signature is detected using a weighted least squares solution for the signature plus a number of polynomial terms or physical functions needed to remove instrumental errors, residual beam chromaticity, deviations of the foreground model, as well as ionospheric absorption and emissions. In general the more terms that are needed requires longer integrations to lower the noise level as a greater fraction of the signature is absorbed by the added functions. A measure of this "absorption" is given by the rms residual obtained for a least squared solution for data with a simulated signature using only the added functions.

Table 1 shows the results for the EDGES polynomial and physical functions.

Functions type	Number of terms	rms residual (mK)
EDGES Polynomial	1	237
EDGES Polynomial	2	200
EDGES Polynomial	3	103
EDGES Polynomial	4	79
EDGES Polynomial	5	37
EDGES Polynomial	6	33
EDGES Polynomial	7	32
EDGES Polynomial	8	32
Physical	2	200
Physical	3	132
Physical	4	64
Physical	5	48

Table 1. rms residuals to 0.5 K signature at 78.5 MHz. FWHM=18.5 MHz, tau=7.

Figures 1 and 2 show plots for 4 and 6 polynomial terms respectively. The data is simulated for GHA=12 hrs without added noise. The physical functions are scale, spectral index, gamma, ionospheric absorption and ionospheric emission. In general the noise needs to be below the rms residual levels listed in the table for a significant signature detection.

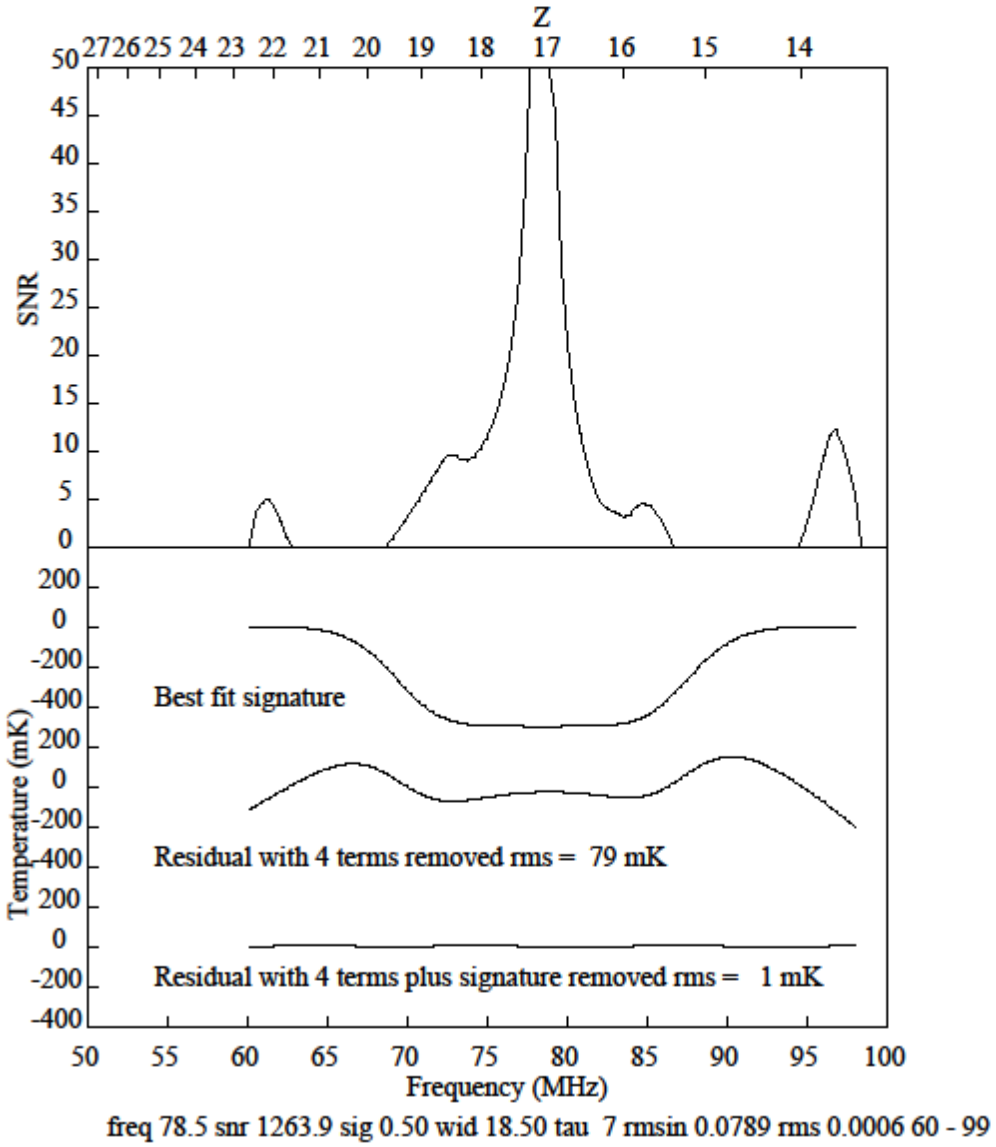
Z
27 26 25 24 23 22 21 20 19 18 17 16 15 14
SNR
Best fit signature
Residual with 4 terms removed rms = 79 mK
Residual with 4 terms plus signature removed rms = 1 mK
Temperature (mK)
Frequency (MHz)
freq 78.5 snr 1263.9 sig 0.50 wid 18.50 tau 7 rmsin 0.0789 rms 0.0006 60 - 99

Figure 1.

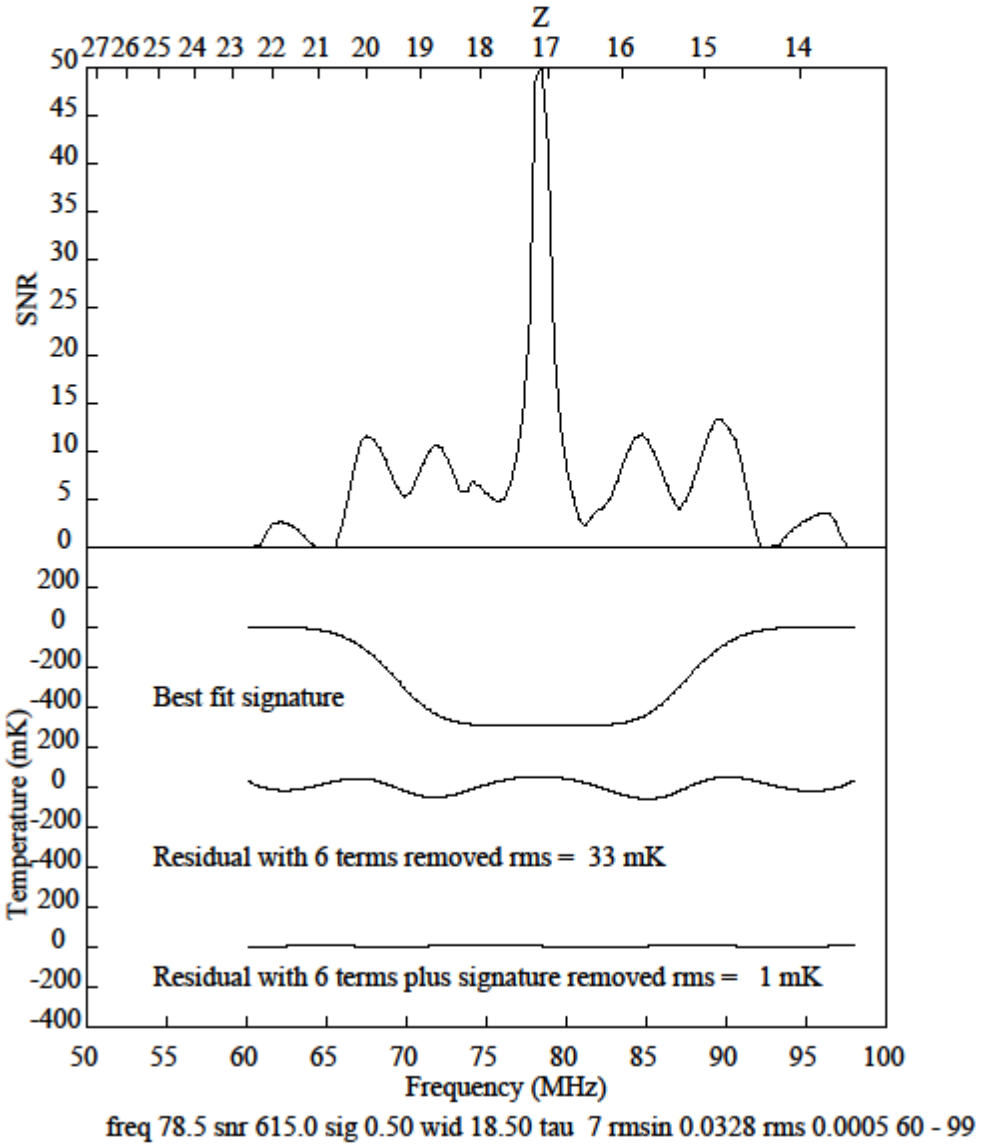
Z
27 26 25 24 23 22 21 20 19 18 17 16 15 14
SNR
Best fit signature
Residual with 6 terms removed rms = 33 mK
Residual with 6 terms plus signature removed rms = 1 mK
Temperature (mK)
Frequency (MHz)
freq 78.5 snr 615.0 sig 0.50 wid 18.50 tau 7 rmsin 0.0328 rms 0.0005 60 - 99

Figure 2.