

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886
February 28, 2017

Telephone: 781-981-5414
Fax: 781-981-0590

To: EDGES Group
From: Alan E.E. Rogers
Subject: Comparison of the effect of systematics in 4 and 5 term search for absorption in low band data.

Two sets of low band data are available for analysis:

“Old” set

Period	2015_284	to 2016_246
Ground plane	Original	9.8×9.9 m
Receiver calibration	2015_240 at 25C	
Antenna S11	2015_342, 2016_175, 2016_177, 2016_243	

“New” set

Period	2016_259	to 2017_017
Ground plane	Perforated	20×20 m as per memo 204

The “reference” processing included beam correction assuming an antenna azimuth of 354 degrees and FEKO beam derived using soil dielectric 3.5 and conductivity $2e-2$ S/m.

The tests of systematics reported in memo 222 have been extended to include all the data up to the failure of the receiver in January 2017 due to a lightning strike. In addition, the effect of large errors in the LNA S11 has been looked at following tests of the temperature sensitivity of the LNA S11. With 4 polynomial terms removed over a frequency range of 60 to 99 MHz the nominal signature reported in memo 222 is found to have the highest SNR in a 2-D grid search with

- a) Center frequency $60 + \text{width}/2$ to $99 - \text{width}/2$
 - b) FWHM width from 1 to 30 MHz
- For the following range of systematic errors
- Antenna S11 ± 0.3 dB ± 100 ps
 - LNA S11 ± 1 dB ± 100 ps
 - Beam correction full to none
 - Balun loss correction full to none

Table 1 shows a sample of results for 4 terms removed and for 5 terms removed over a reduced frequency range. The effect of no beam correction is to reduce the SNR in the case of only 4 terms removed. When 5 terms are removed the beam correction has little effect even using the data with the original ground plane. The analysis includes all nighttime data in the range of GHA

from 4 to 16 hours. This averaging is largely responsible for the reduction of the effect of beam correction. Without balun loss correction a different signature is found in the search unless the search is made with 5 terms in which case the result is close to the “reference” signature.

Test	4 terms 60-99 MHz				5 terms 65-95 MHz				
	Freq. MHz	SNR	Amp K	Width MHz	Freq MHz	SNR	Amp K	Width MHz	
Ref. new	78.1	31	0.49	20.3	78.1	19	0.44	18.5	N
Ref. old	78.1	30	0.48	20.4	77.7	21	0.49	19.1	O
No beam corr.	78.9	10	0.37	22.9	78.5	25	0.50	18.1	N
No beam corr.	78.1	13	0.54	18.3	78.5	15	0.36	17.1	O
LNA S11 +1dB	76.2	13	0.47	25.0	77.7	22	0.48	19.3	N
No balun corr.	72.3	11	0.27	8.6	78.5	18	0.40	17.8	N

Table 1. A sample of results. N = “New” dataset. O = “Old” dataset.

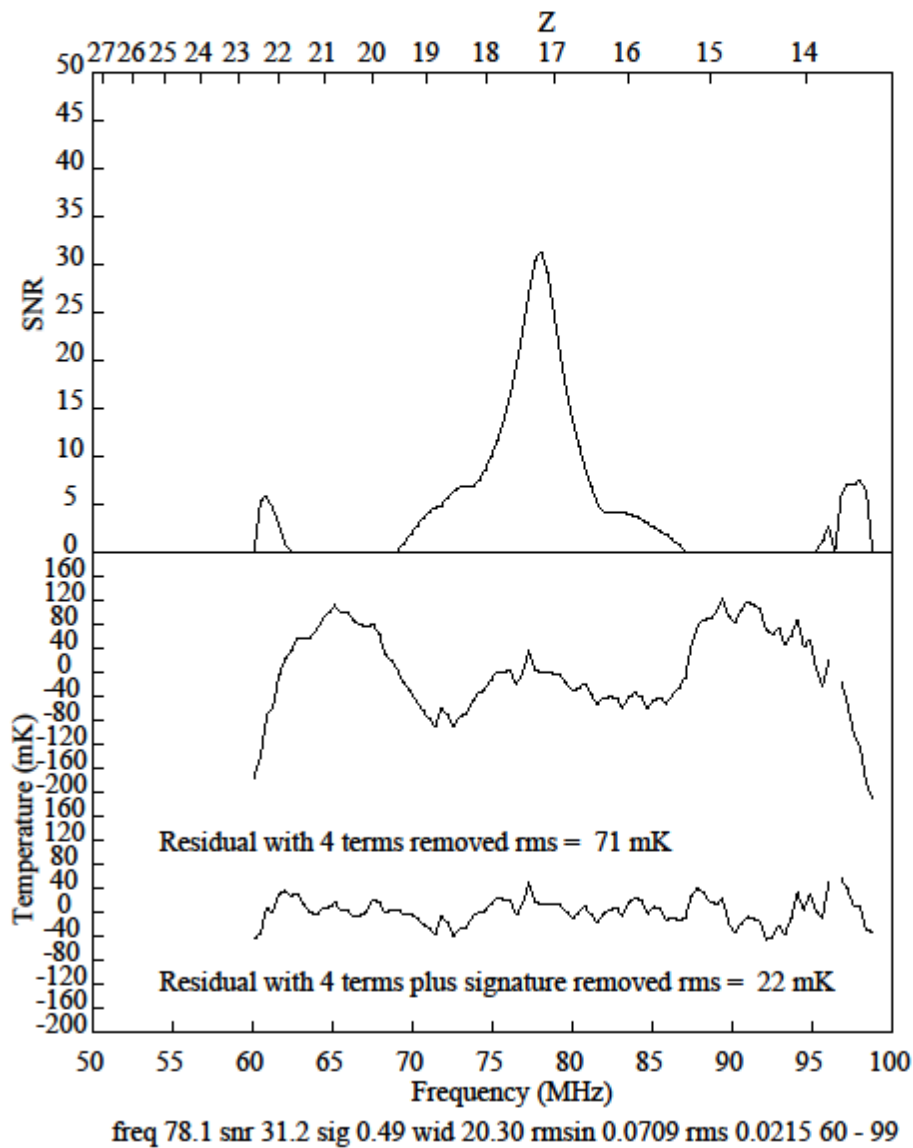


Figure 1. Absorption signature search using “reference” parameters for “new” dataset.

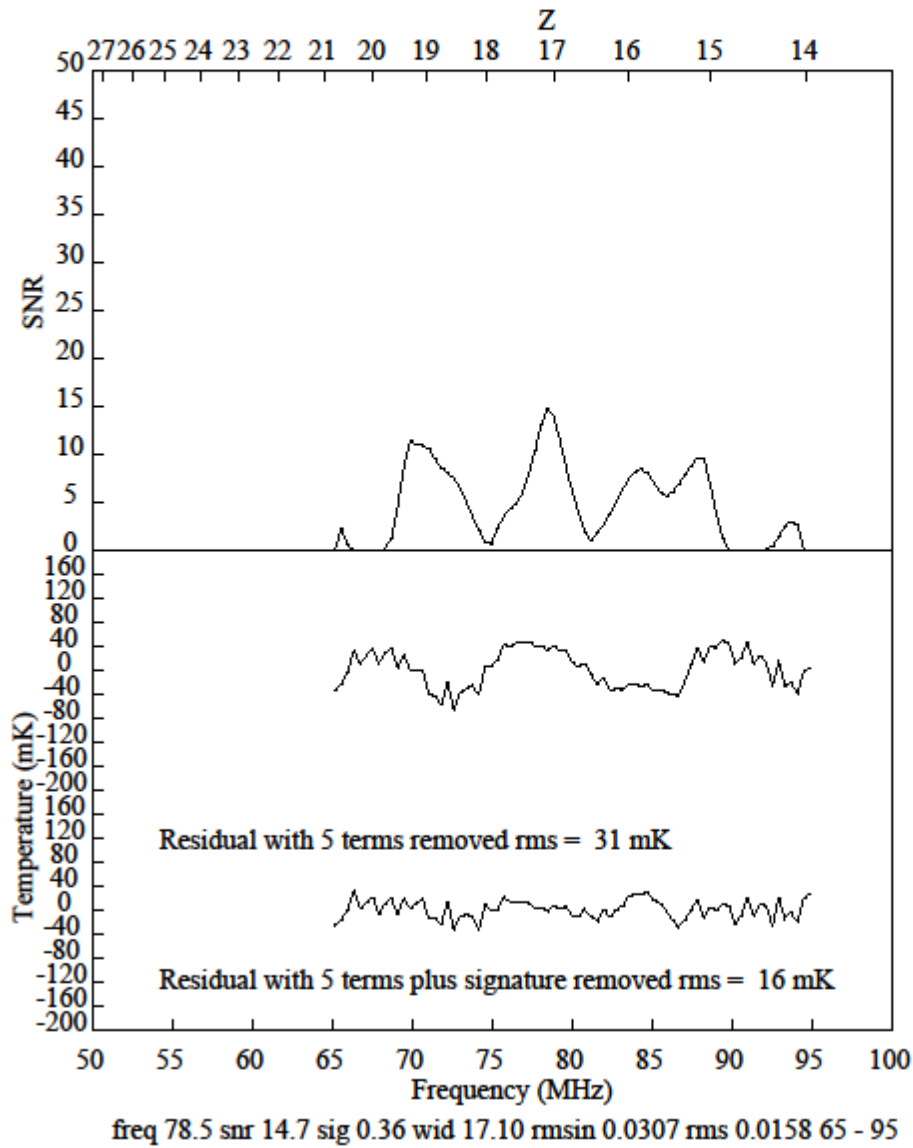


Figure 2. Absorption signature search using “old” dataset without beam correction.