

DEUTERIUM ARRAY MEMO #057

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886
October 4, 2004

Telephone: 978-692-4764
Fax: 781-981-0590

To: Deuterium Array Group

From: Alan E.E. Rogers

Subject: Simulations of the noise in spectral exclusion

The spectral error which results from excluding narrowband channels before smoothing the spectrum can be estimated from the transform of the covariance matrix as described in memo 56. To verify the expression in memo 56 I have simulated 2000 spectra, computed the standard deviation in each point of the spectra following spectral exclusion and compared the result with the calculated standard deviation.

Figure 1 shows the results. The top plot is the spectral exclusion applied. At 327.35 MHz 1 channel is excluded, at 327.40 MHz 2 channels are excluded and at 327.45 MHz 4 adjacent channels are excluded. The middle plot shows the standard deviation in the spectra from 2000 trials and the bottom plot shows the calculated standard deviation from the covariance matrix. The agreement between the simulations and theory is perfect within the expected variation due to the limited number of trials. The following table give the calculated standard deviations for the cases of several RFI exclusion patterns.

Calculated std. dev	RFI exclusion pattern
1.0	No exclusion
1.1	1 adjacent channel
1.2	2 adjacent channel
1.3	3 adjacent channel
1.5	4 adjacent channel
1.7	5 adjacent channel
2.0	6 adjacent channel
2.4	7 adjacent channel
2.8	8 adjacent channel
3.4	9 adjacent channel
1.4	Every other channel

The standard deviation is normalized to unity for no spectral exclusion. For 1024 narrowband channels smoothed to 128 Fourier components the resolution is reduced by a factor of 8 and the noise is reduced by a factor of square of 8.

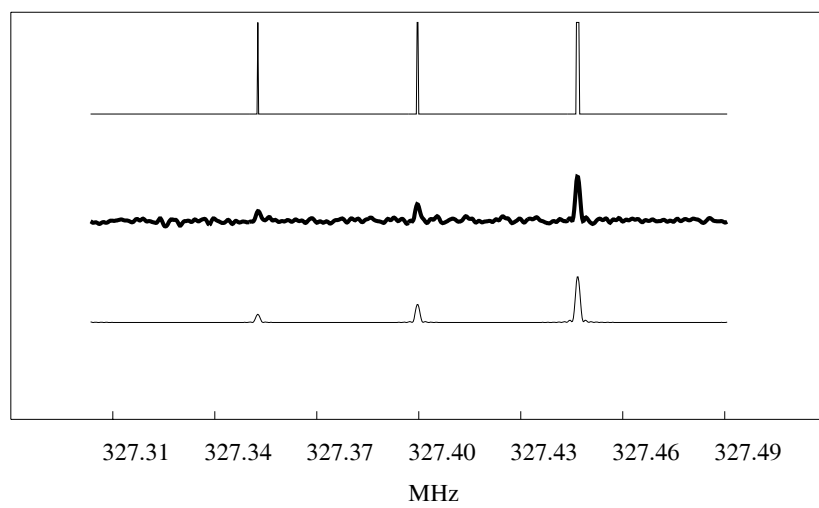


Figure 1. Tests of spectral exclusion