DEUTERIUM ARRAY MEMO #024

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To: Deuterium Array Group

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Subject: Summary of performance on prototype array with 15 elements.

Some data was taken on 16 and 17 April 2003 with 15 elements of a single polarization. The dipoles were arranged in a 4x4 square on the lower left corner (viewed from the rear) with a missing element. Figure 1 shows a photo of the array. The array orientation was Az = 120°, El = 53°. Figure 2 shows the receiver

Figure 1 – Array shown at Az=60°

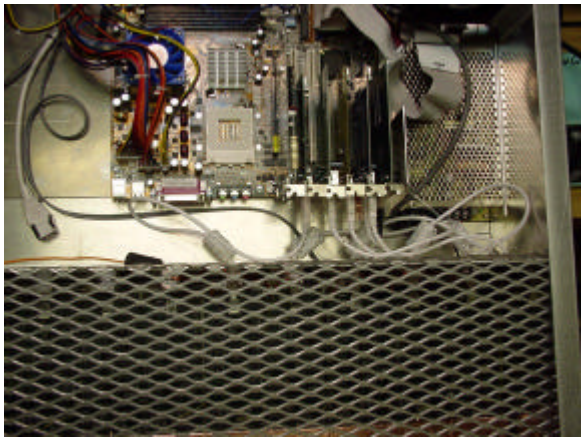

Figure 2 - receiver

1] Average correlation on the Sun

The average correlation between dipoles with the Sun 30 degrees the normal to the ground plane was

0.25±0.02

On those days the solar flux interpolated to 327 MHz was about 2×10^5 Jy. Given a sensitivity of each dipole of 2×10^{-4} K/Jy we expect 40 K. Solving for the system noise (excluding the Sun's contribution)

$$40/(T_s+40)=0.25$$

so that $T_s=120\pm20K$

This relatively high system noise is explained by a 40K contribution from the second state noise. [We plan to solve this problem in the future by operating without the added 3.5 dB lossy filter which is needed at the current Haystack location. Also there is some noise contribution from the mixer and I.F. which will be reduced in future receivers.]

2] Normalized beam response

The normalized beam on the Sun was 4.2 ± 0.2 compared with 0.8 ± 0.05 on cold sky at night. Figure 3 shows the measured beam response as a function of the electronic scan angle measured on the Sun. The response is close to cosine squared .

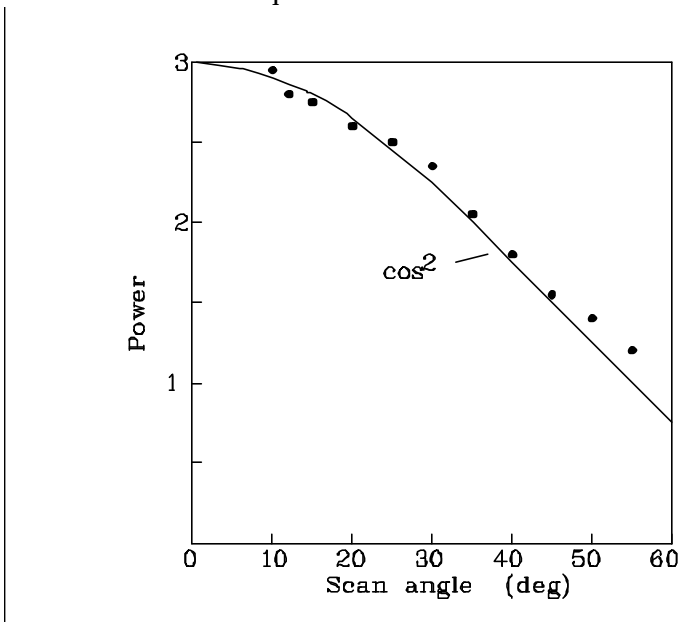

Figure 3 – beam response vs scan angle

3] Beam scan maps on the Sun

Figures 4,5 and 6 show beam scanned maps of the Sun taken about 70 minutes apart

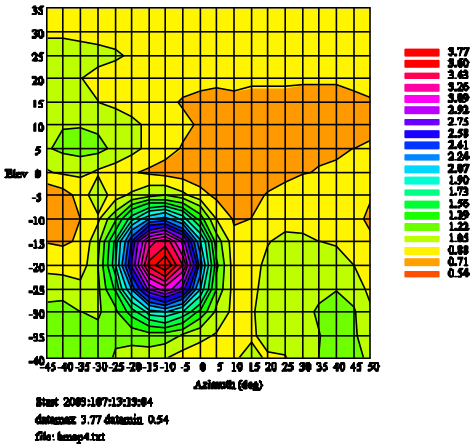

Figure 4

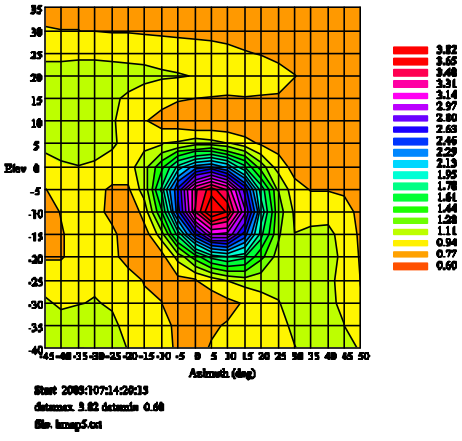

Figure 5

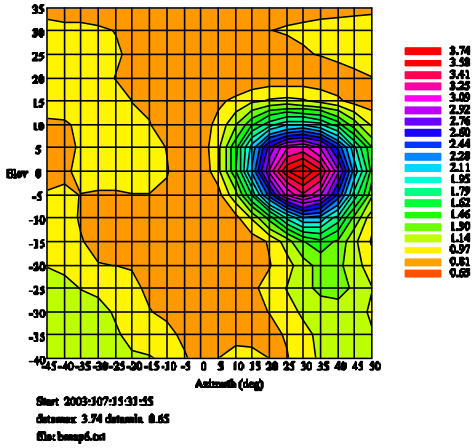

Figure 6

4] Detection of PSR 0329+54

The 4x4 array was rotated to a new azimuth of 60 degrees to be able to observe 0329+54 and Cas A. The pulsar was detected on Saturday at a peak pulse level of $3.5e^{-3}$ Tsys. This is about what is expected if the pulsar is running about 150 Jy peak flux during the pulse.

The pulse averaging with 4 ms resolution over a complete period of 712 ms is shown in figure 7.

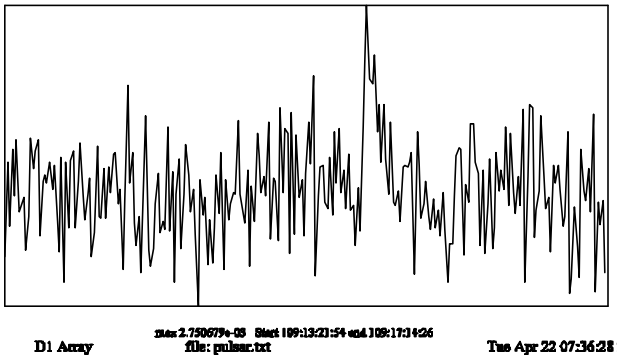

Figure 7 – Pulsar 0329+54

5] Current performance summary

Average correlation between elements on Sun	0.25 ± 0.02
Tsys assuming 2e5 J from the Sun	120 ± 20 K
Normalized beam on Sun (15 elements)	4.2 ± 0.2
Sensitivity	$2e^{-3}$ K/Jy
Effective aperture	6 m^2

Comments:

1] The noise temperature is higher than planed because there is about 40 K second stage noise. [This will be reduced if we don't use the added filters. In addition it can be reduced further with some minor changes to the receivers to reduce the I.F. noise by increasing the gain before the mixer.]

2] The effective aperture is a little low. Some of this is due to unequal gains which are not currently corrected in the software. Other causes are being examined.