DEUTERIUM ARRAY MEMO #004

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

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

To: Deuterium Array Group

From: Alan E.E. Rogers

Subject: D1 array "project book"

This memo will be occasionally updated to contain the latest thinking on various parameters and features of the array. These parameters may change as we gain more insight into the design, complete design studied etc.

1.0 Frequency coverage

Nominal frequency coverage	322 to 328.6 MHz
Deuterium rest frequency	327, 384, 352.52 Hz
Wavelength	92 cm
1 km/s	1.092 kHz
Instantaneous bandwidth for D1 expt.	500 kHz
Number of frequency bins	1024
Resolution	500 Hz

1.1 Station antenna array

Number of elements	25×2
Polarization	dual linear
Element spacing	0.8 λ (29 inches) nominal
Element height above ground plane	0.2 λ (7.2 inches) nominal
Ground plane size	14.5' × 14.5'
Nominal collecting minimum area	12 m^2
Nominal beamwidth	12 degrees
Electronic steering	± 20 degrees
Mechanical steering	15 to 90 degrees pointing South
Antenna temperature (at 20 degrees elevation) due to sidelobes on the ground ("spillover)	<20 K

1.2 Analog receiving portion

LNA noise temperature	< 20 K
Analog bandwidth	> 10 MHz
Flatness	< ± 1 dB
Slope	< 0.01 dB/100 kHz
Curvature	< 0.001 dB/ 100 kHz^2
Rejection of any images in band 326.4 to 328.4 MHz	>50 dB
Rejection of images outside band	>80 dB
Input 3rd order intercept	>10 dBm

1.3 Station antenna processing

Number of receiver channels i.e. one for each element plus one for GPS Signal processing	50 + 1
Minimum duty cycle i.e. data processed continuously with maximum of 10 % overhead	90%

a) D1 expt.

The D1 experiment and other observations which will use the stations independently require no interferometric processing at a central facility. For these observations the 25 digitally filtered for each polarization outputs need to be combined after FFT for form 25 beams. The spectrum for each element and the spectrum from each beam need to be accumulated. The advantage of preserving the spectrum from each element is for diagnostics and interference sensing.

1.4 Overall receiving system

Range of signal in band 326.9-327.9 MHz to be handled by A/D	>20 dB
Max. level of spurious signals referred To input	< - 220 dBm
Max. RFI radiated by station Electronics in 322-329 MHz band	< - 200 dBm
Max. RFI in other bands	< - 130 dBm

1.5 Array configuration

8×8 quasi-regular (32 stations)
15 m E-W spacing on ground
45 m N-S spacing on ground

Nominal synthesis resolution	30 minute of arc
Total collecting area	384 m^2
Equivalent dish diam.	≈ 25 m

Aperture synthesis processing:

1.6 Array aperture synthesis processing

For example: To cover the 640 km/s velocity band with 10 km/s resolution for a single station beam there will be 64 complex spectral points from each polarization from each station every 100 microseconds. Assuming 8 bits per complex sample, this corresponds to a data rate of 41 MB/s and a processing requirement of about 1 GFLOPS for all baselines and both polarizations. This processing rate could be handled by a commercial SHARC, C60 or power PC VME board interfaced to the central processing computer.