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 m²
- 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
- 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 50 + 1
- i.e. one for each element
- plus one for GPS Signal processing
- Minimum duty cycle 90%
- i.e. data processed continuously
- with maximum of 10 % overhead

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 m²
- 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.