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To:      Deuterium Array Group

From:    Alan E.E. Rogers

Subject:  Impact of reducing the number of elements in each array

The cost of the D1 array could be reduced by decreasing the number of elements in each array. The original proposal called for 25 dual polarized elements per station or ground plane. In practice this number is reduced to 24 if we don't implement the 4 channel section designated for GPS timing. GPS timing is not needed for the deuterium search observations or any observing that uses the stations as independent telescopes. The difference between 24 and 25 is not significant as omitting one outer element does very little to the beam patterns.

A reduction from 24 to 16 would be significant as it would increase the half power beamwidth from 12 to 15 degrees. The cost saving (about 100K$) would be substantial if one motherboard could handle both polarizations or 32 channels (8 USB + 1 clock USB port). The observing impact is not easy to evaluate. For the D1 observations of Galactic anticenter the D1 line might be reduced by the ratio of the beamwidths because the Galactic H1 emission limited to about 12 degrees at half power points in latitude. The more extended beam in longitude might also have some impact as the velocity crowding is reduced at the edges of the beam. If we assume at 15:12 reduction then we would need to observe for 1.56 longer for the same SNR. In this case a better trade might be to reduce the number of stations. Observations of Cassiopeia A looking for D1 in absorption or measuring the carbon recombination lines would be degraded by the reduced collecting area in the ratio 16:24. The continuum strength of Cas A would be reduced from 30 K to 20K. Since Cas A doesn't dominate the system noise in this case one would have to observe for twice as long so again a better trade is to reduce the number of stations.