DEUTERIUM ARRAY MEMO #019

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February 6, 2003

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To: Deuterium Array Group

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Subject: Estimate of RFI sensitivity for D1 array

In memo 002 I made some estimates in terms of radiated power at various distances. In order to put the estimates in terms of the RFI seen with the active antenna on the RFI monitor I now estimate the levels in terms of fractional and antenna temperature units.

We expect the D1 signal to be about 1e-5 or 1mK.

For one polarization of a single active antenna assuming a 100K system and 24 hours integration at 80% efficiency:

theoretical rms noise in 244 Hz = 2.4e-4 = 24mK = -191 dBm

When a beam is formed from 25 elements of one polarization the theoretical noise in 244 Hz is still 2.4e-4 = 24mK but 1mK of RFI in each element will produce only 1/25 mK = 0.04mK as the RFI at worst will appear with random phase in the output of each element. This means that RFI at a level of 25mK could appear in the final integration at the same level as expected from the D1 line. This doesn't change with both polarizations and 32 arrays because if the RFI enters each station in an equivalent manner the 1 month observing with 32 stations in both polarizations in equivalent to 64 months = 5.3 yrs observing with a single station at one polarization.

Using the argument above we should be O.K. if we can reach the theoretical noise from one polarization of one element in 24 hours. Therefore any RFI which we can see in the active antenna in 24 hours is a potential problem. We might do somewhat better in our rejection of the RFI if the RFI is present about equally in the signal beam which tracks the source and the reference beams which are off the source. In this case the effects of RFI will cancel when we subtract the average of the reference beams from the signal beam.

At present the level of RFI being received (from Westford) is about 4K with the LL computer running[*]. We need about 22 dB of rejection to bring this down to the 25mK level.

[*] The RFI levels dropped to about 0.3k with the LL computers turned off.