DEUTERIUM ARRAY MEMO #039

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886

October 3, 2003

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

To: Deuterium Array Group

From: Alan E.E. Rogers

Subject: Sensitivity of D1 array to RFI from the Westford Site.

The D1 array is extremely sensitive to lower level constant RFI. This type of RFI is the hardest to excise as it cannot be detected without a long integration and then if it is detected large amounts of data, if no all for a given frequency range need to be dropped. Formally we are only protected by the FCC part 15 specification which allows up to 200 microvolts/meter field strength at a distance of 3 m. This corresponds to a power level of -49 dBm into an isotropic antenna. In 24 hours the noise level in each channel of the D1 array is

$$T_{sys}\left(Bt\right)^{-1/2}$$
for $T_{sys} \approx 100K$
and B = 244 Hz

This corresponds to a level of -202 dBm[1] so we need 153 dB of isolation from a device radiating a signal at the part 15 limit with bandwidth less than our resolution of 244 Hz. For the 100 m path from Westford we have the following isolation.

1] Path loss between isotropic antennas

$$\frac{l^2}{\left(4^2 p^2 r^2\right)} = 63 \text{ dB for r} \approx 100 \text{ m}$$

2] Loss getting out of the building ≈ 10 to 20 dB
3] Loss through the woods ≈ 5-15 dB
4] Loss due to fence ≈ 10-20 dB (assuming we install fences at all stations)

for a total of about 88 ± 10 dB so that we need any emissions inside Westford to be more than about 50 dB below the part 15 limit. <u>In practical terms this means that any equipment that generates a signal that is detectable with a handheld receiver within a few feet of the equipment is a potential problem.</u>

[1] The expected signal from Galactic D[1] is about 1 mk or -205 dBm in on 244 Hz revolution.

Part 15 Limit

1 μV/meter = -116 dBm/meter^2
Part 15 limit: 200 μV/meter at 3 meters
= -70 dBm/meter^2
= -49 dBm isotropic
= -112 dBm into another isotropic antenna at 100 meters at 327 MHz.
= -132 dBm at 1 km free space
≈ -167 dBm at 10 km typical 35 dB/decade beyond 1 km
≈ -202 dBm at 100 km

1 mK in 244 Hz = -205 dBm
Expected signal from Galactic D1 ≈ 1 mK