

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886**

June 2, 2022

Telephone: 617-715-5533

To: EDGES Group
From: Alan E.E. Rogers
Subject: Proposed ground plane and set-up deployment Houghton crater Devon Island

A 50x25m wire grid ground plane is proposed with the following parameters:

wire gauge: 18 awg multi-strand copper single conductor TFFN18BK25 12 2500ft reels \$296 each
length in direction of E-field 50m

spacing from 0 to 2m from antenna 6.25 cm number of pegs 128

spacing from 2 to 6m from antenna 12.5 cm number of pegs 128

spacing from 6 to 12m from antenna 25 cm number of pegs 96

spacing from 12 to 12.5m from antenna 50 cm number of pegs 4

total number of pegs 356 total wire length 8950m

fiber optic cable length 50m

DC power cable 50m 6 awg 2-conductor red/black powerwerx Wire-RB-06-250 250ft \$769

Approximate location lat 75.431 lon -89.81 degrees

Batteries Lithium ion 12v 100 Amp hours

Current ~ 2 amp idle ~ 6 amp fastspec running ~ 8 amp max with thermal control

Optimum orientation of ground plane for highest simulated Nature feature 10 degrees azimuth

| Ground plane | Azimuth deg | Center Freq MHz | SNR dB | absorption K | width MHz | rms1 mK | rms2 mK | rms3 mK |
|-----------------|-------------|-----------------|--------|--------------|-----------|---------|---------|---------|
| 50x25m | 0 | 77.7 | 68 | 0.58 | 18.7 | 62 | 9 | 93 |
| “ | 10 | 77.7 | 73 | 0.58 | 18.5 | 65 | 9 | 92 |
| “ | 45 | 77.7 | 46 | 0.57 | 17.4 | 75 | 16 | 102 |
| “ | 90 | 78.1 | 47 | 0.43 | 18.4 | 47 | 10 | 85 |
| “ | 135 | 77.7 | 46 | 0.57 | 17.4 | 76 | 16 | 102 |
| 30x30m | 10 | 78.1 | 50 | 0.47 | 19.7 | 42 | 9 | 85 |
| “ no permafrost | 10 | 78.1 | 78 | 0.50 | 19.5 | 46 | 6 | 61 |

Table 1. Simulations of 21-cm detection of flattened tau=7 gaussian 5-physical terms removed 55-95 MHz. No beam correction average over all GHA in 1-hour blocks.

These simulations assume a 50cm deep dry soil diel 3.5 1e-6 S/m over permafrost diel 7 1e-4 S/m. The last two entries are for a 30x30m sawtooth welded mesh ground plane at lat 75 degrees with permafrost and just soil diel 2e-2 S/m respectively. rms1 and rms2 rms value before and after fitting the 21-cm absorption respectively. rms3 is the average rms of the rms values for all 24 1 hour blocks of GHA. The simulation was made by adding the a 0.5 K absorption centered at 78 MHz with 19 MHz

width and $\tau=7$ to the Haslam sky map which was scaled with a spectral index of -2.5. The wire grid loss is about 0.8 % compared with under 0.4 % for the welded mesh. Smaller ground planes have been simulated in memos 378, 384, 388, 390 and 391.

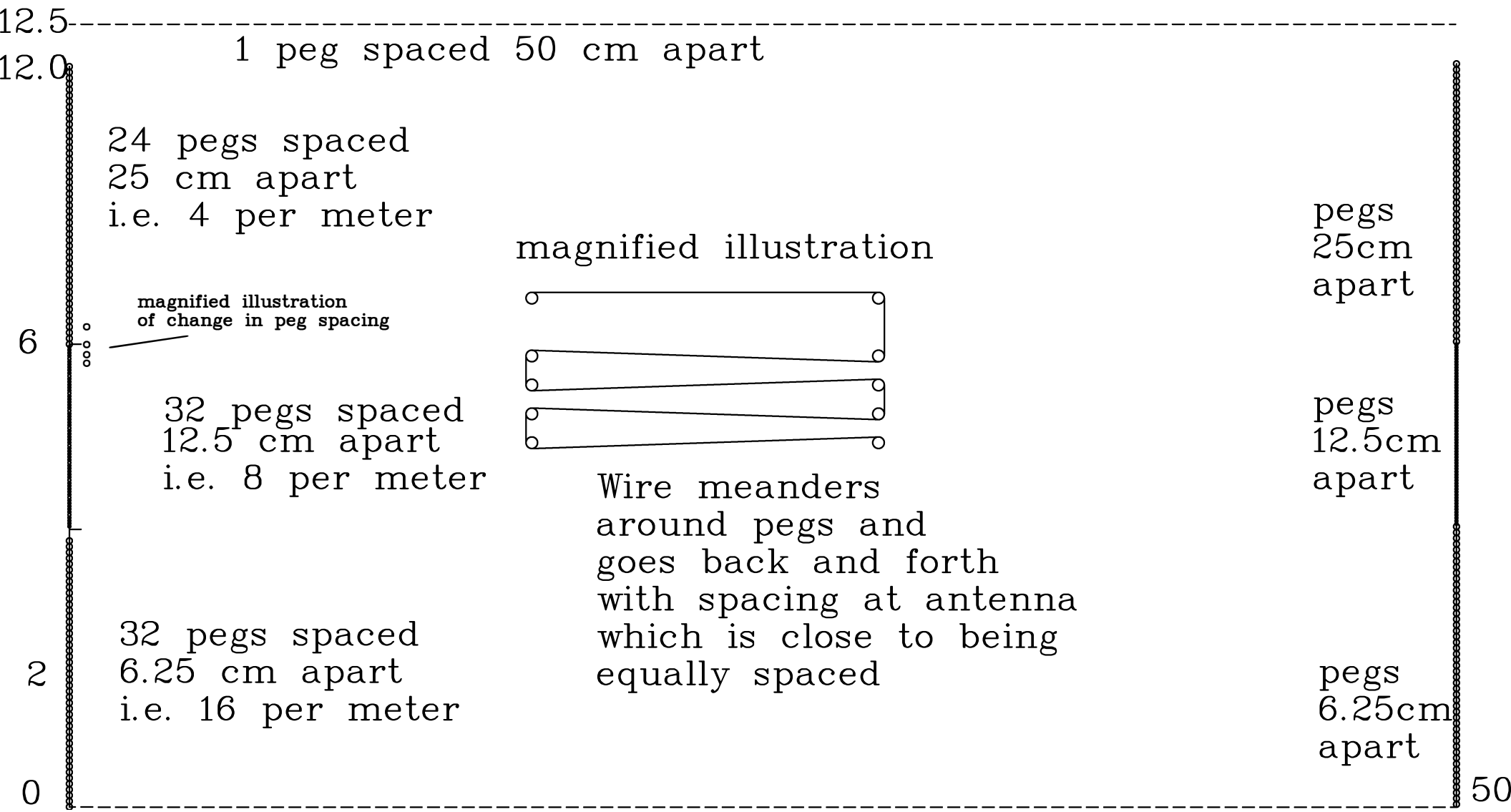
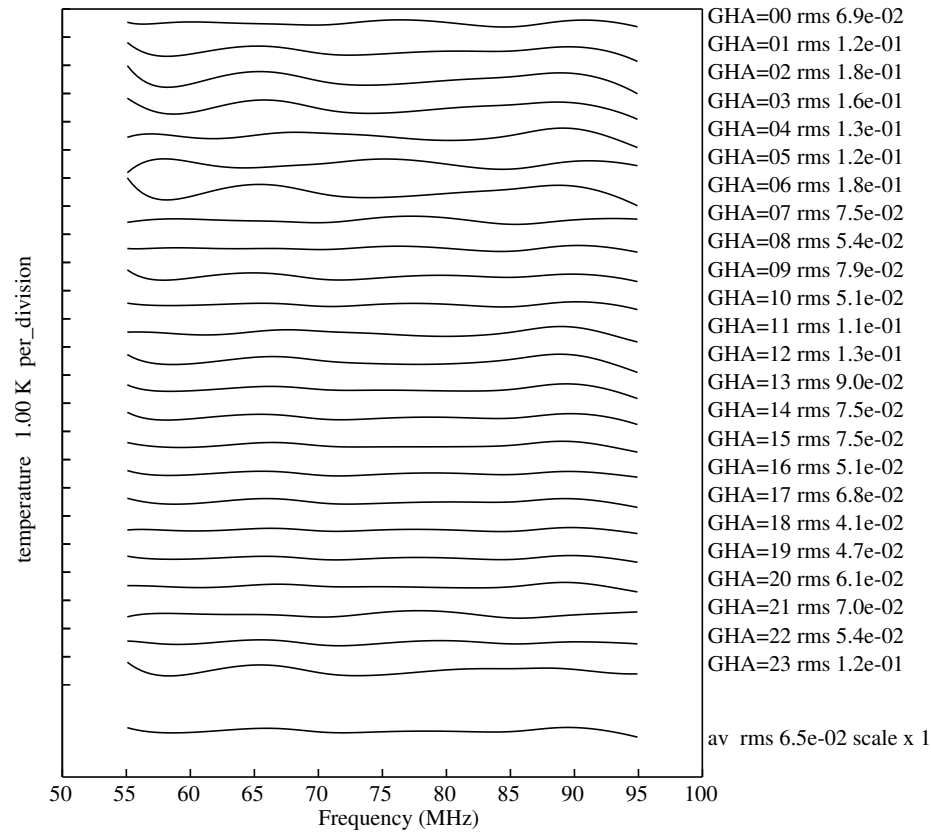
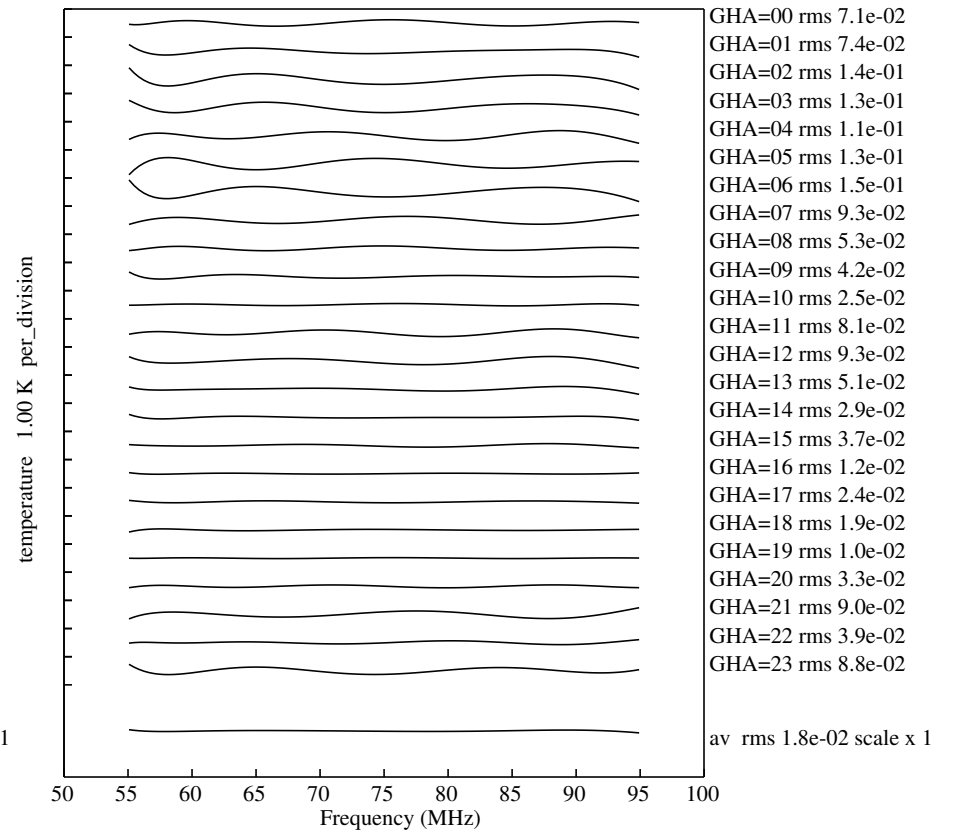


Figure 1. A sketch of the meandering 50x25m wire grid ground plane peg spacings.



avrms 0.0921



avrms 0.0678

Figure 2. Beam chromaticity of the 50x25m wire grid oriented at 10 degrees azimuth with added Nature absorption on the left and without added absorption on right.