MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886

March 7, 2019

Telephone: 617-715-5571
Fax: 617-715-0590

To: EDGES Group

From: Alan E.E. Rogers

Subject: Simulations of EDGES-3 antenna and wire grid ground plane

1] Wire grid size and wire grid spacing

Size m	Spacing cm	Total wire length m	Ground loss at 60 MHz
16×30	25	1920	5%
30×30	25	3840	3%
16×30	12.5	3840	1%
30×30	12.5	7680	0.55%
30×30	6.25	15,360	0.2%

Table 1 Ground loss vs size and wire spacing

The estimated loss for a 30×30 m wire grid with 6.25 cm wire spacing is about the same as the 30×30 m mesh ground plane but requires a substantial length of wire and would probably take more than a day to construct. In practice the best choice is the 16×30 m grid using a spacing of 12.5 cm (~5"). These loss estimates were obtained using the method described in memo 258 which ignores the effects of ground conductivity. This method gives slightly higher but more reliable loss estimates.

2] beam chromaticity and antenna match

The simulations given in memo 294 have been extended to larger ground planes and include the effects of adding more structure to the EDGES-3 antenna in the form of metal pipes to allow the use of cables to provide a DC voltage to charge the batteries. The general result is that while the pipes have little effect on beam chromaticity they improve the antenna match at the low end so that an S11 of about -10 dB is achieved at 60 MHz. The S11 from FEKO simulations is shown in Figure 1.

The details of the dimensions which give the best S11 are:

Pipe diameter   1.0"

Pipe separation 1.73"

Pipe length   16.5"
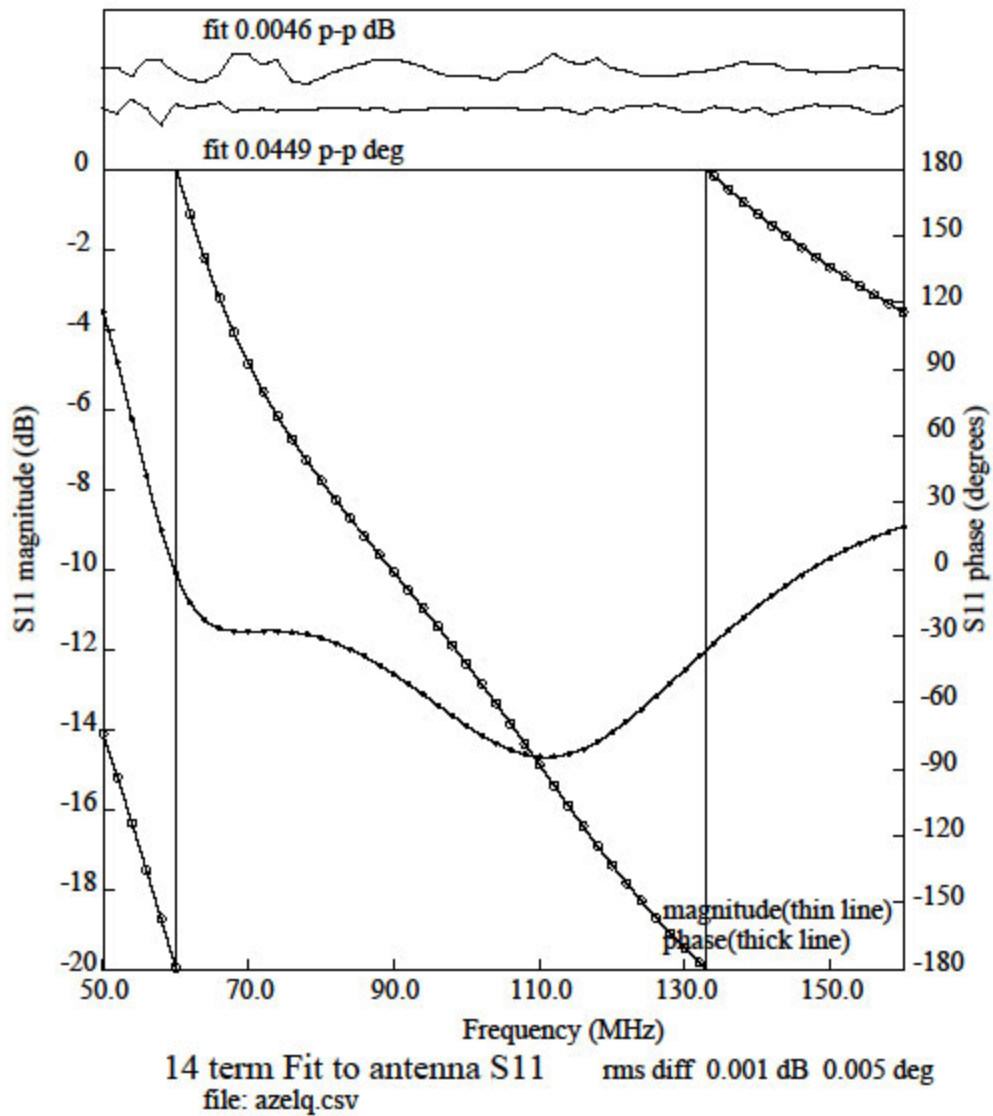
along with a diagram of the fiber/cable path shown in Figure 2.
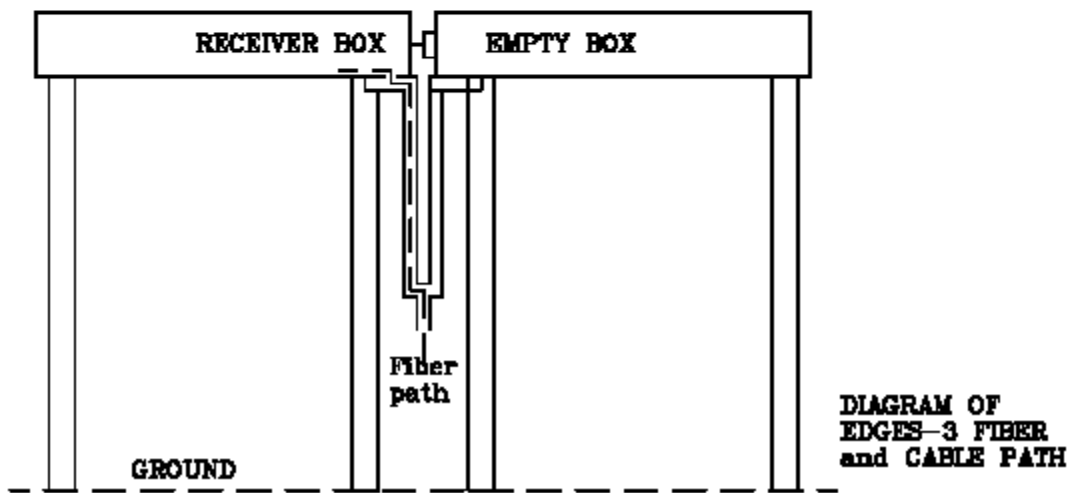
Figure 1. FEKO simulation of antenna S11

Figure 2.