Test of long dipole on the soil at Karoo
Jeff Peterson, CMU

25 cm antenna
March 2019

Next deployment:
Bury rf box
Place plate at grade.
Remove bushes to
at least 20 M diameter

16 radials. each 40m long, 1mm bare stranded copper wire, in contact with soil

Auxiliary Experiment: Place source between two opposite radials and measure S11

Goals:

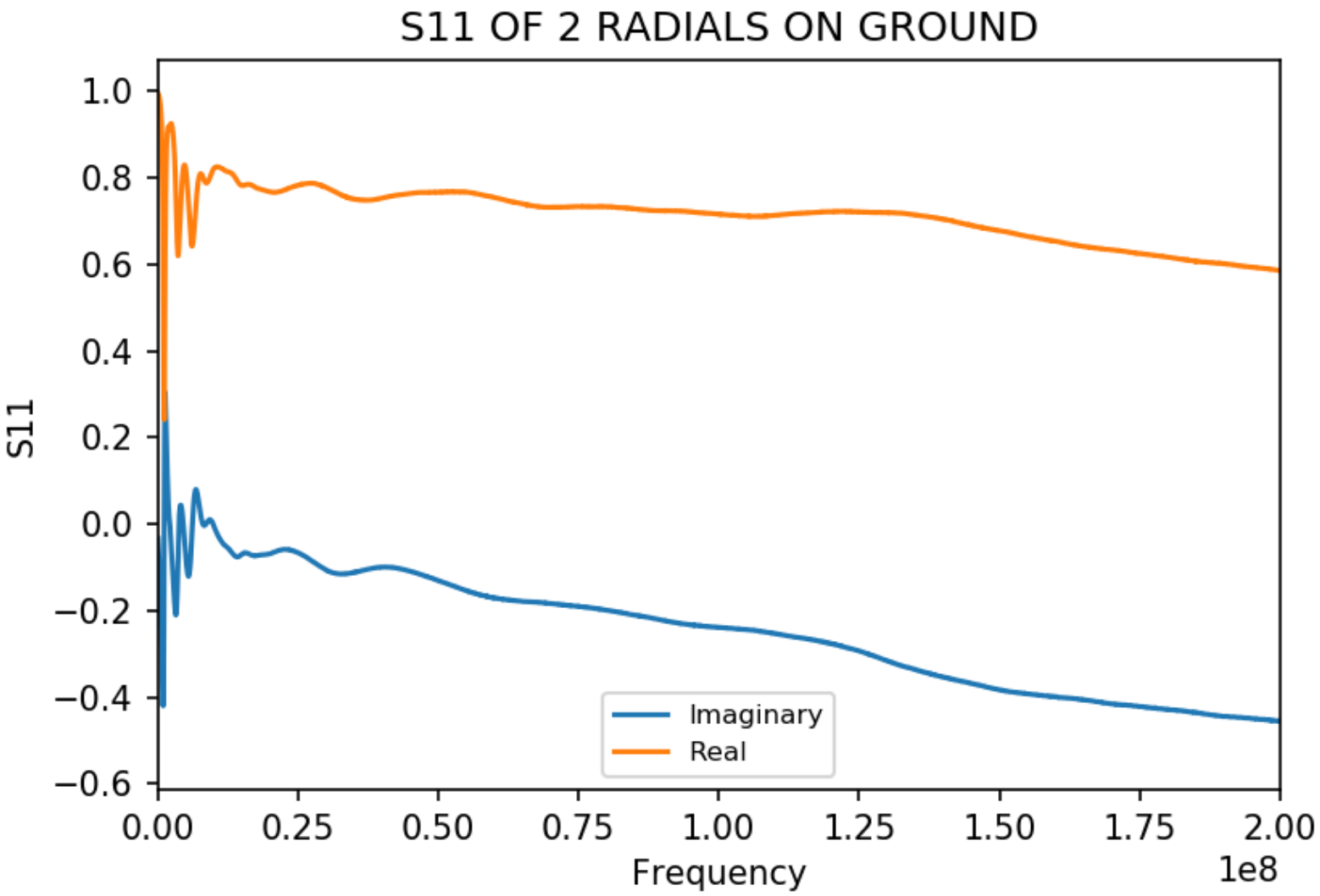
1) Are 80 M radials long enough?

2) Provide “ground truth” data to calibrate simulations.

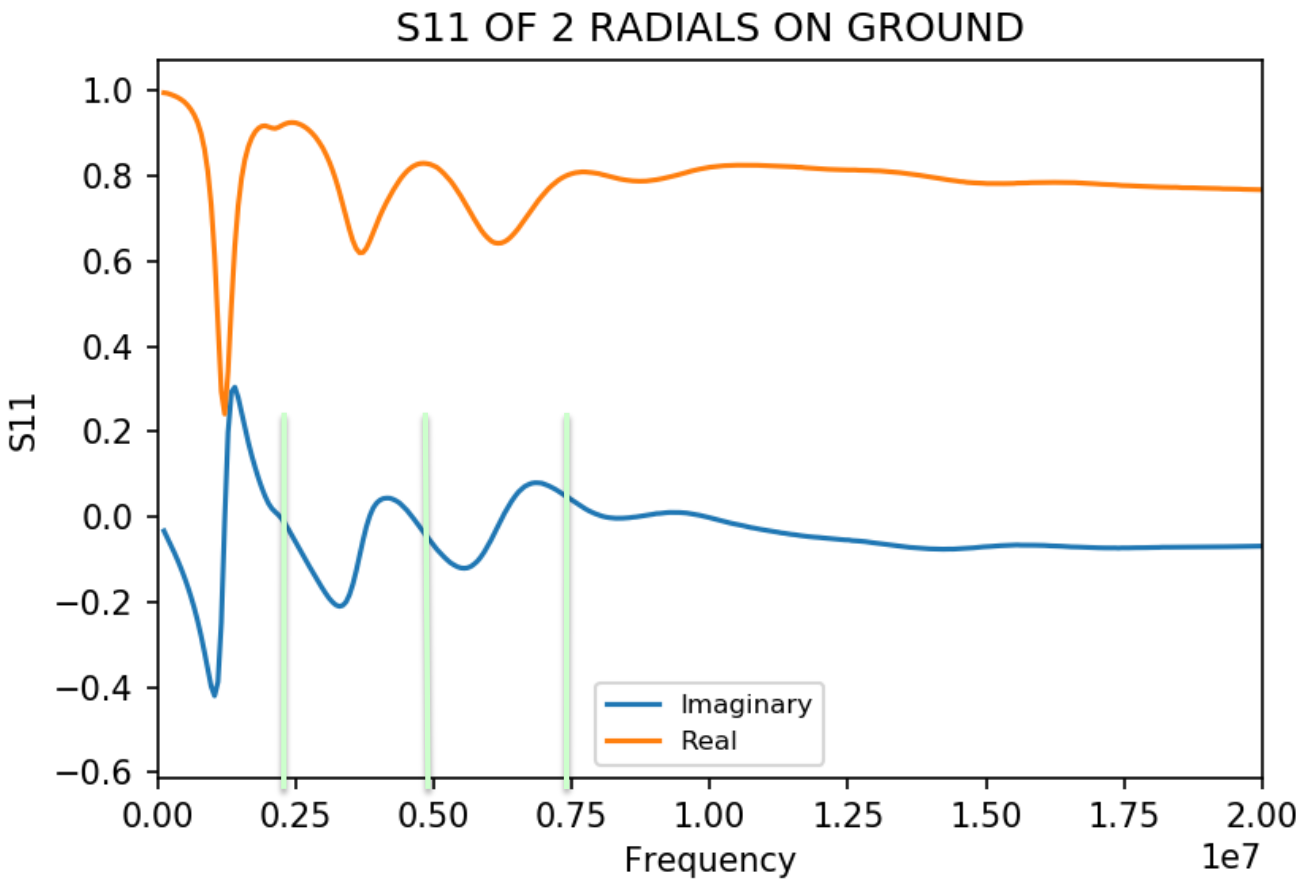
Radials dodge and jump some 20-50 cm bushes—worst cases shown


gies
FieldFox
RF Analyzer
N9913A
4 GHz
86%
Thu, 21 Mar 2019 4:38:52 AM
S11
M1: 172.694 MHz 67.0 Ω -j135.0 Ω
6.826 pF
50Ω
j50
j25
j100
j10
j250
0
10
25
50
100
250
∞
-j10
-j250
-j25
-j50
-j100
5 kHz
6
IF BW 10 kHz
Output Power High
Stop 250.0 MHz
Swp 3.26 s
Device
File Type
More

Real and Imag of S11



200MHz


S11 OF 2 RADIALS ON GROUND
S11
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Frequency
1e7
Imaginary
Real

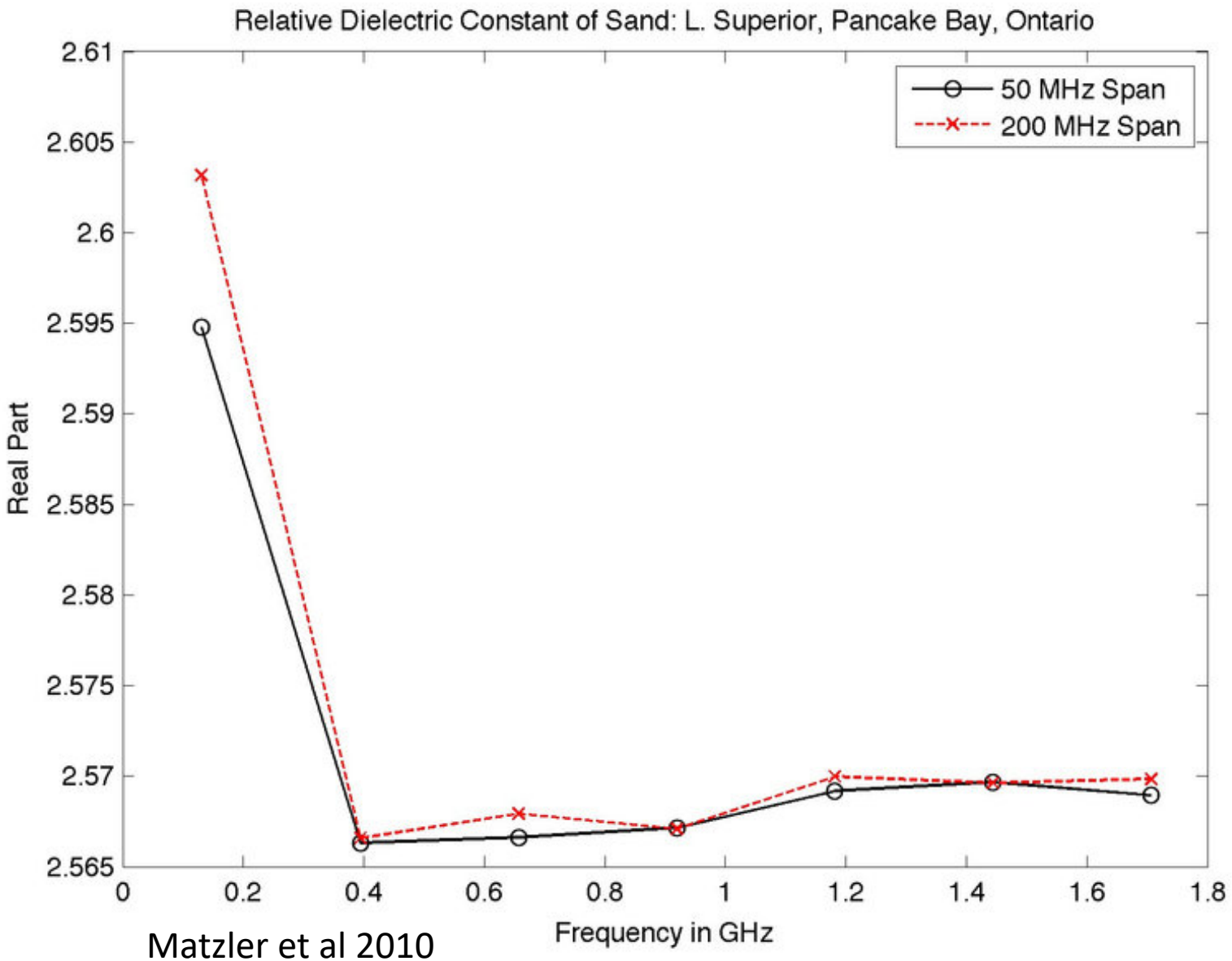
20 MHz

- n * Lambda = c/2.5Mhz = 120 meter
- Length = 80 m so n_eff = 1.5,
- permittivity = 2.25

- Only four cycles apparent.
- Exp decay length 1.5 Lambda
- Effective Loss Tangent ~ 0.1

- Wires are easily long enough.
- Any tiny remaining standing wave above 25 MHz can be removed by averaging 2.5 MHz.

Is this permittivity reasonable?



Matzler et al 2010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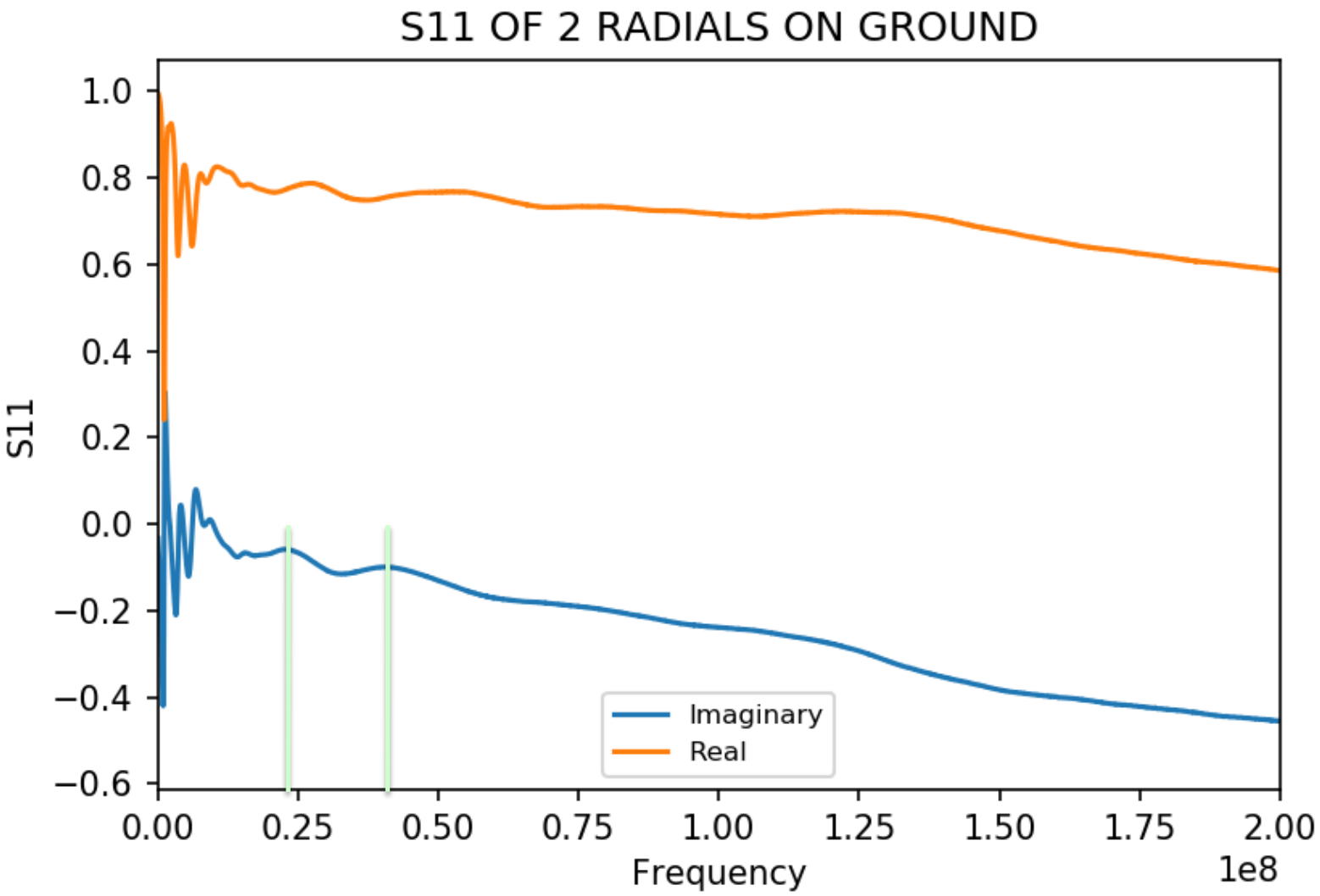
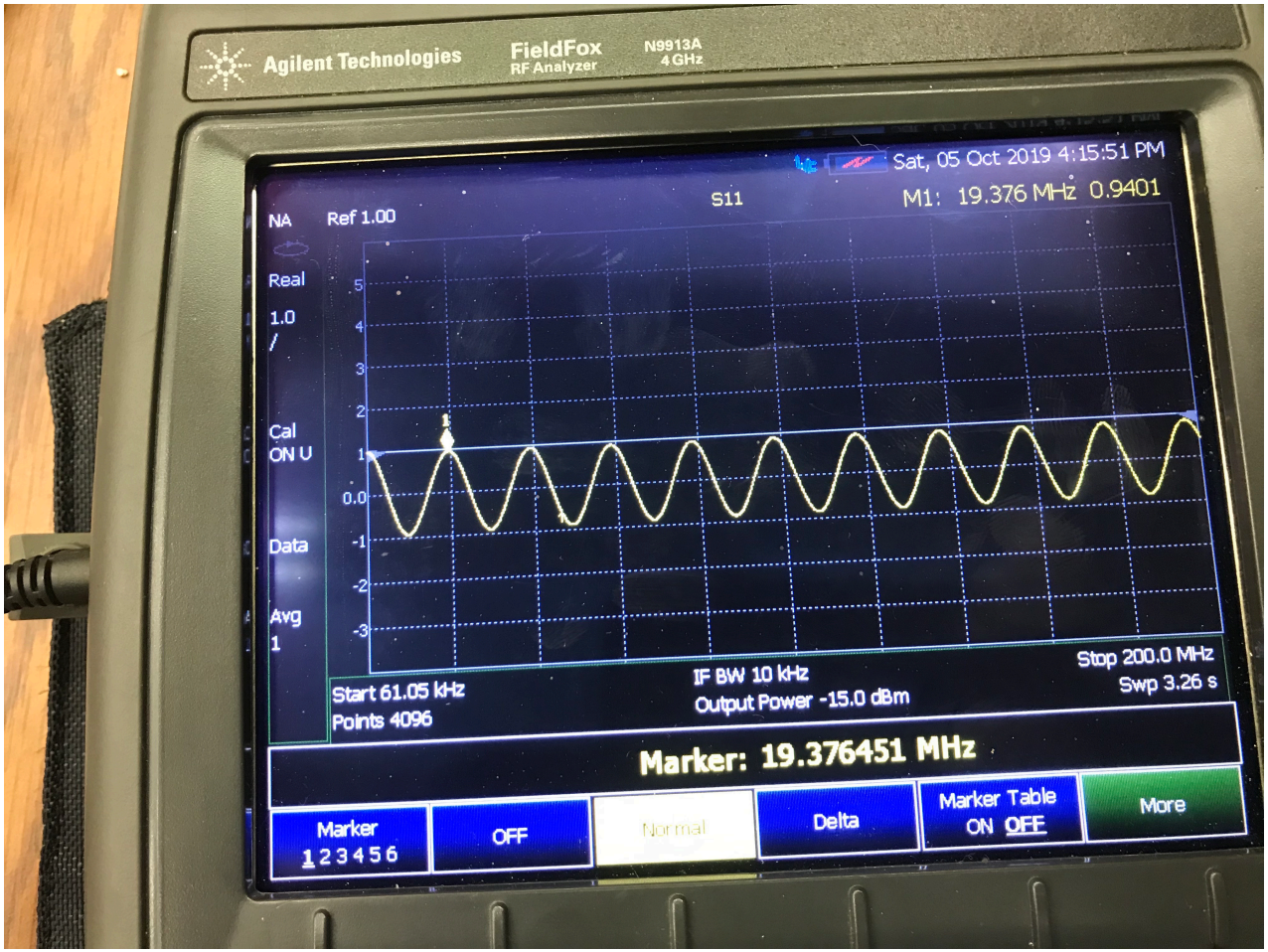


200MHz

- n * Lambda = c/16Mhz = 19 meter
- Physical distance to reflector: 19 m/ 1.5 = 12.5m
- Cable reflections? (calibration drift)
- Water table?
- Rock layer?

- Experiment designed to expose any radial end issues.
- Vertical antenna contains fields primarily above the soil and drives the radial in common mode rather than differential.

10 m cable in lab with open termination. Imag (S11).



- Actions—
- Simulate 80 M dipole on soil and adjust sim
  Parameters to match measured data.

- Then simulate actual antenna with those soil parameters.

- Next deployment: Place radials on surface of frozen lake?
- Bury RF box
- Eliminate cable when testing 80 M dipole on the soil/ice surface