Report on Effect of Deformations in Patriot 12 Meter Reflector at Arecibo

Rami Adada
Graham Taylor
6/3/11

Purpose

This short study was performed to estimate the effect on performance of deformations in the main and sub-reflectors of the Patriot 12 meter antenna installed at Arecibo. All calculations were performed in Ticra GRASP version 9.8.1.

Configuration

Photogrammetry was used to measure the position and orientation of the reflectors. The following table summarizes the deviations of these dimensions from ideal design values as functions of the antenna elevation.

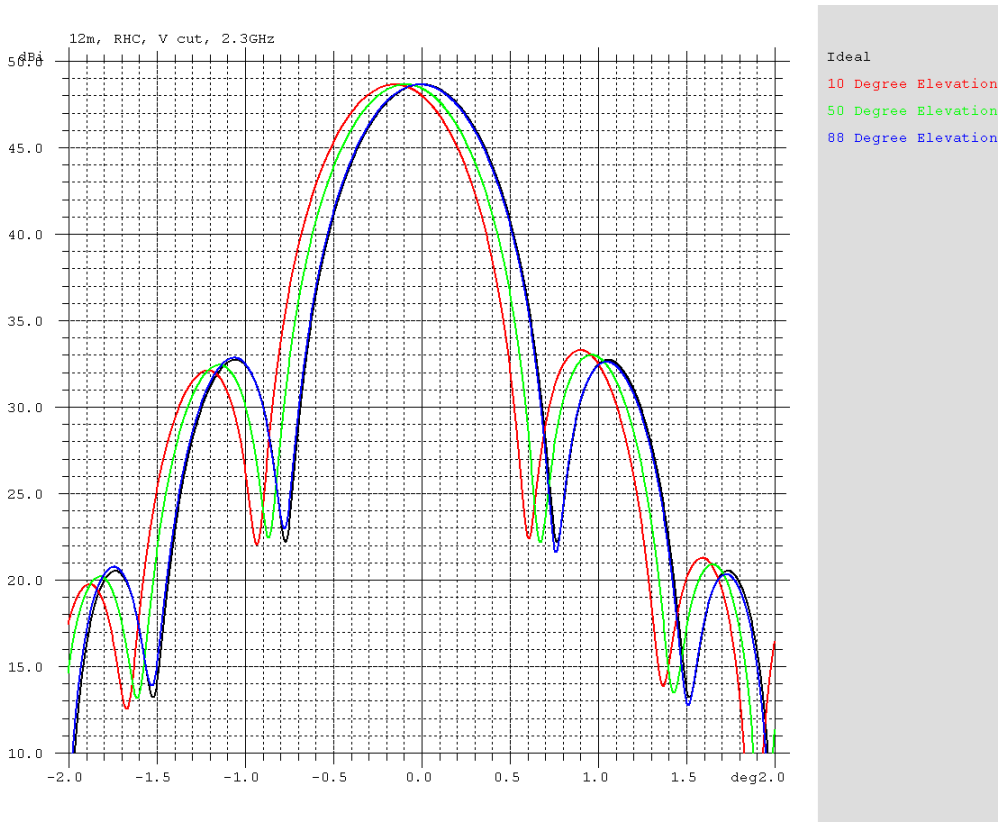
Elevation(deg)	10	50	88
Main Reflector: y coordinate deviation[1] (in)	-0.2031	-0.1311	-0.1296
Main Reflector: z (focal distance) deviation (in)	0.008	0	0.006
Main Reflector: angular (elevation) deviation (deg)	-0.046	-0.032	0
Subreflector: y deviation (in)	-0.089	0	0.145
Subreflector: angular (elevation) deviation (deg)	-0.08	0	0.08

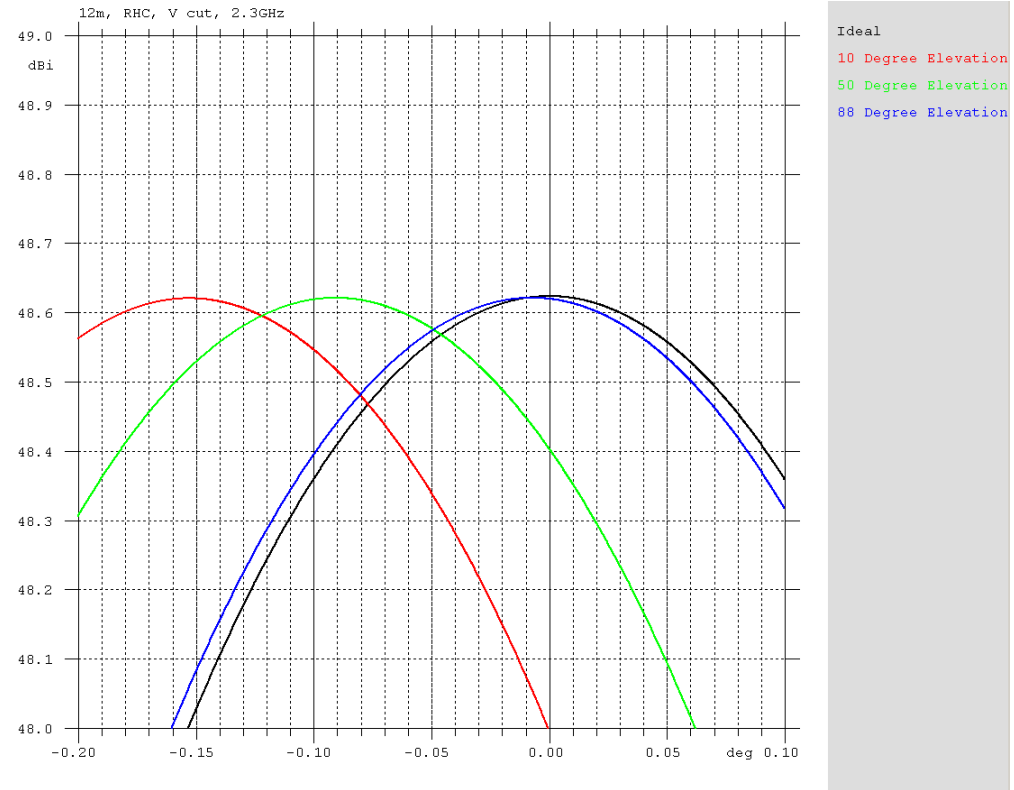
1) In the antenna coordinate system, y is in the elevation plane, orthogonal to z, the focal coordinate.

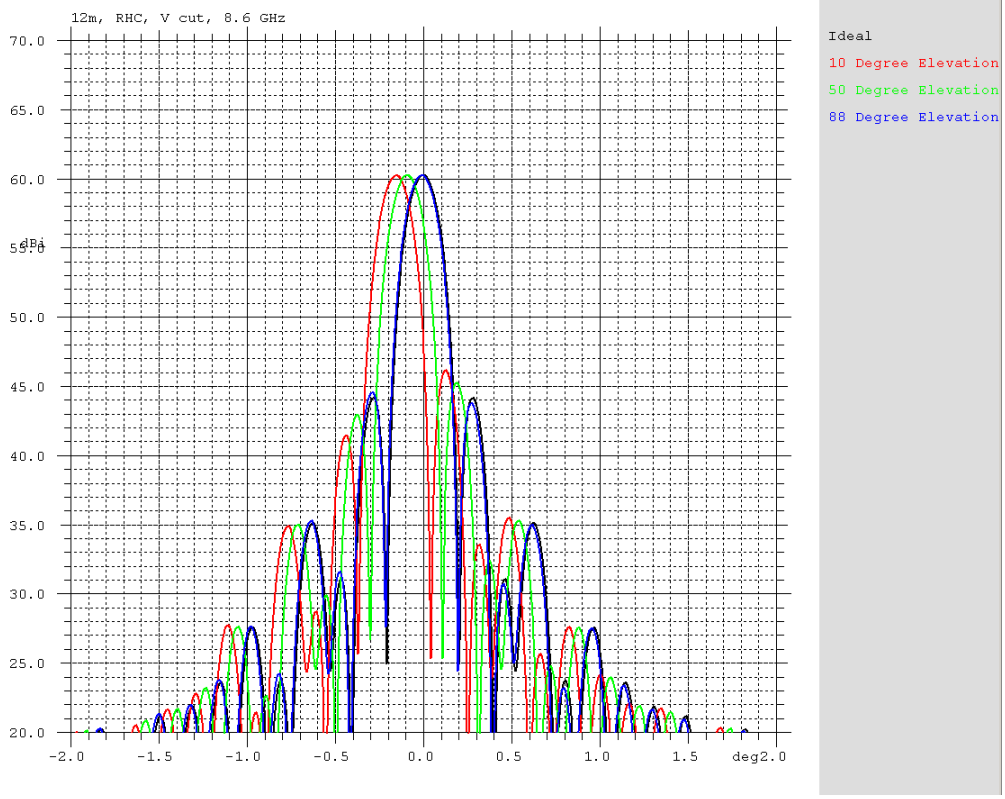
Conclusions

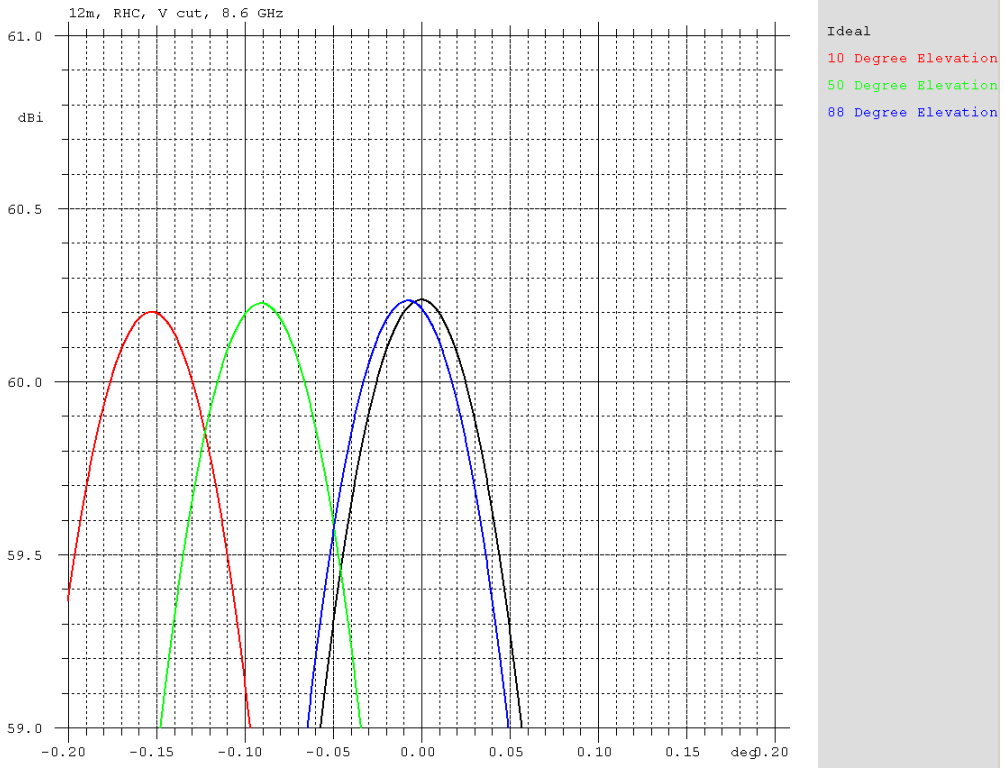
The figures below show the effect on right-hand circularly polarized far field radiation patterns in the vertical cut. Each full-scale plot is followed by an enlargement of the vicinity of the pattern peaks. In the case of simulations at 2.3 and 8.6 GHz, angular deviations are greatest for 10 degrees elevation and are less than 0.2 degrees. Changes in the gain for these frequencies are small compared to 0.1dB.

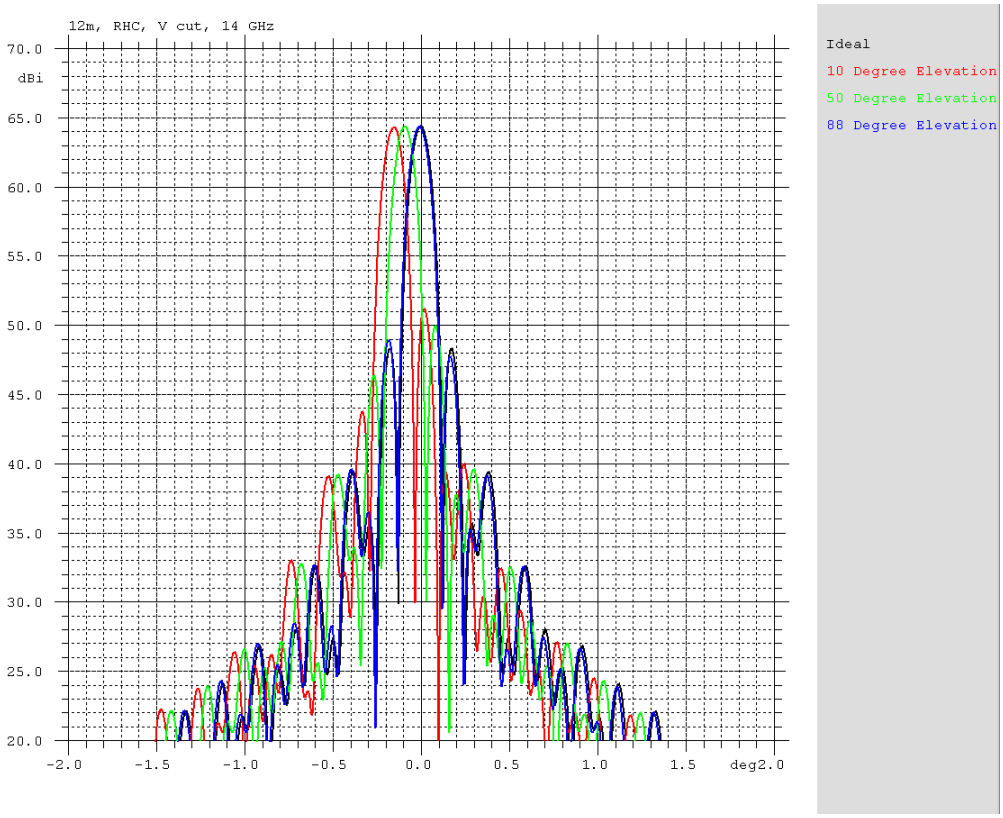
Angular deviations at 14 and 22 GHz are similar and gain losses, worst at 10 degrees elevation, amount to 0.1dB at 14 GHz and 0.2dB at 22 GHz.

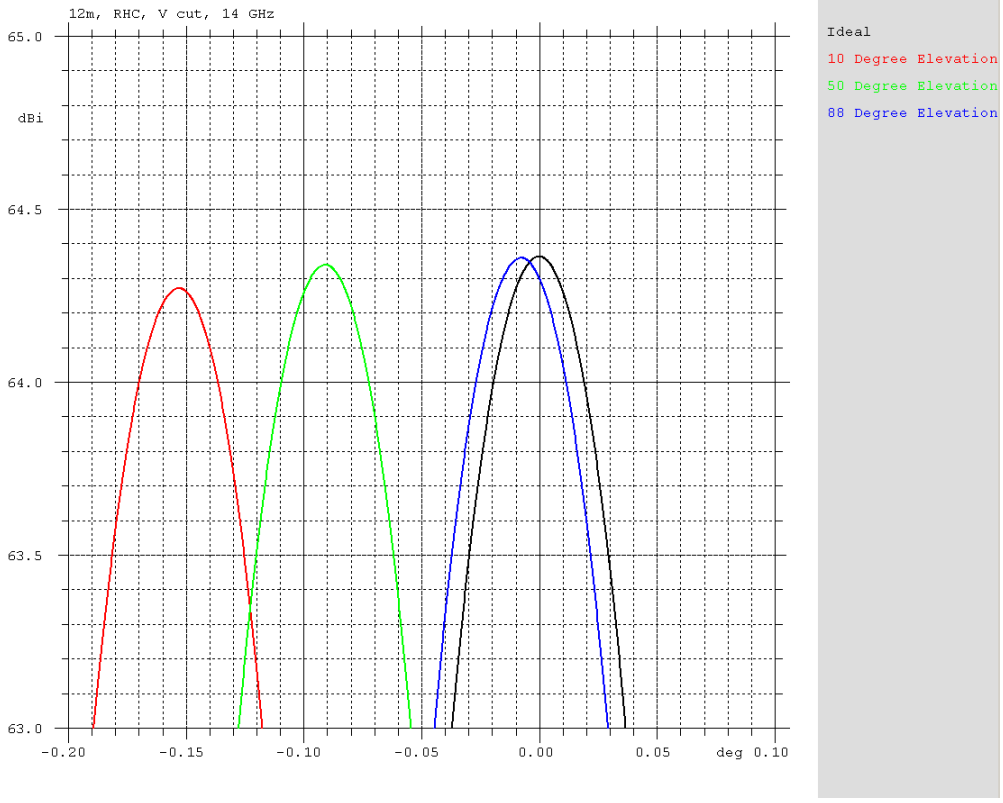

12m, RHC, V cut, 2.3GHz
dBi
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
deg2.0
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation

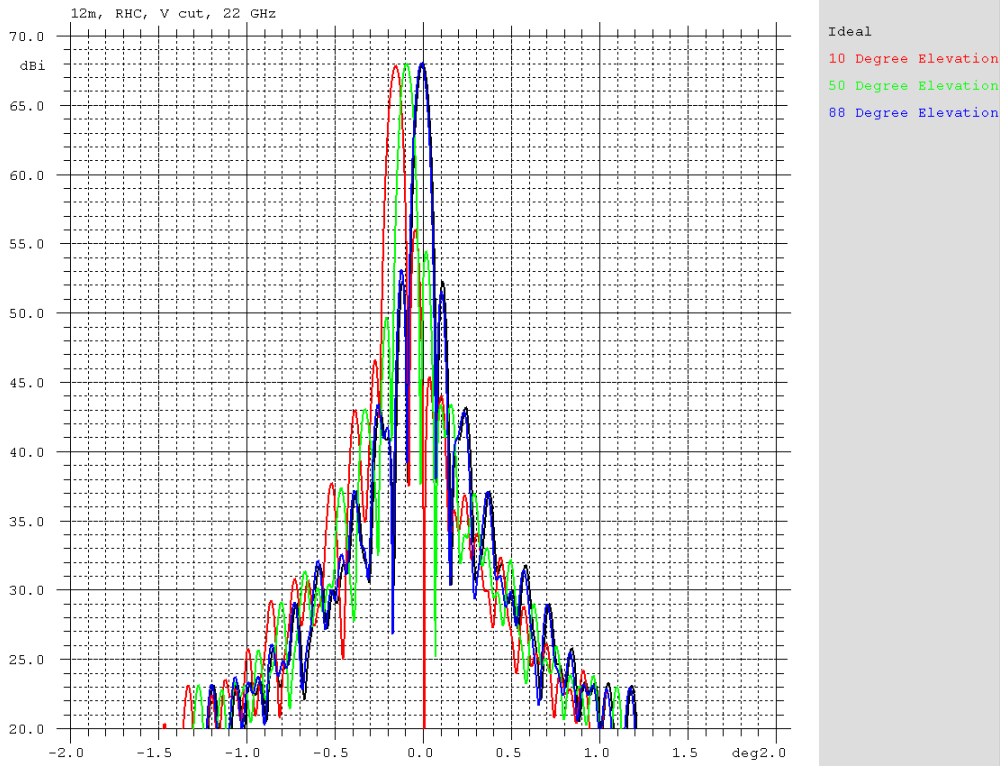

12m, RHC, V cut, 2.3GHz
49.0
dBi
48.9
48.8
48.7
48.6
48.5
48.4
48.3
48.2
48.1
48.0
-0.20
-0.15
-0.10
-0.05
0.00
0.05
deg 0.10
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation

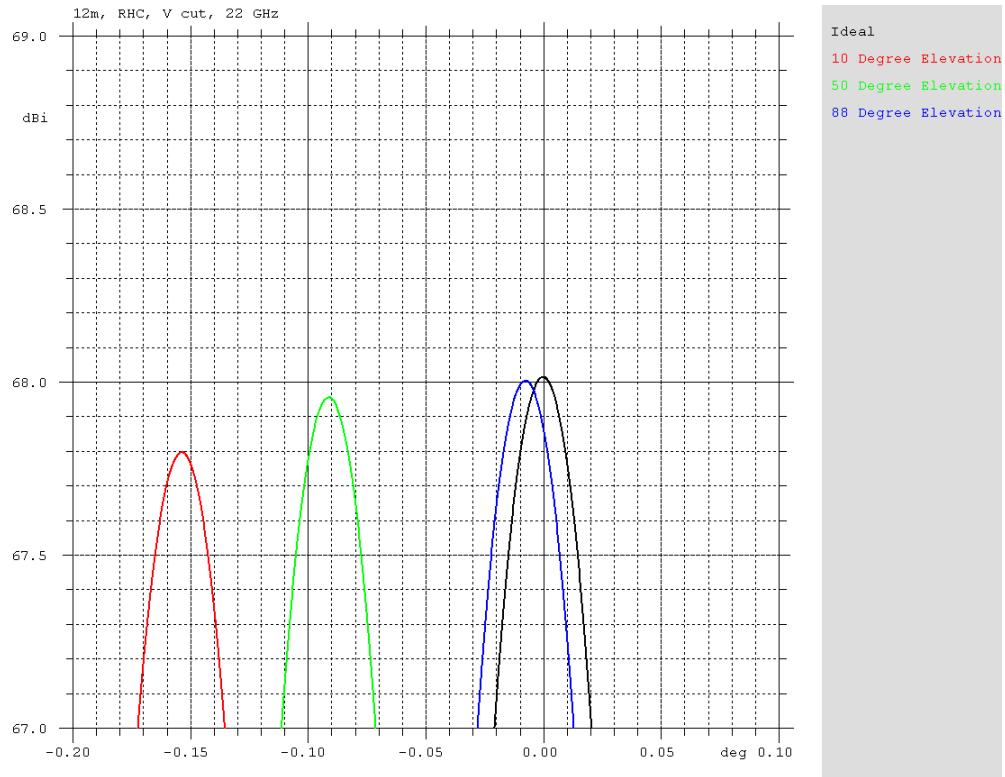

12m, RHC, V cut, 8.6 GHz
70.0
65.0
60.0
55.0
dBi
50.0
45.0
40.0
35.0
30.0
25.0
20.0
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
deg2.0
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation


12m, RHC, V cut, 8.6 GHz
61.0
dBi
60.5
60.0
59.5
59.0
-0.20
-0.15
-0.10
-0.05
0.00
0.05
0.10
0.15
deg0.20
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation


12m, RHC, V cut, 14 GHz
70.0
dBi
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
deg2.0
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation


12m, RHC, V cut, 14 GHz
65.0
dBi
64.5
64.0
63.5
63.0
-0.20
-0.15
-0.10
-0.05
0.00
0.05
deg 0.10
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation


12m, RHC, V cut, 22 GHz
70.0
dBi
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
deg2.0
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation


12m, RHC, V cut, 22 GHz
69.0
dBi
68.5
68.0
67.5
67.0
-0.20
-0.15
-0.10
-0.05
0.00
0.05
deg 0.10
Ideal
10 Degree Elevation
50 Degree Elevation
88 Degree Elevation