Offset Dishes for Microwave EME

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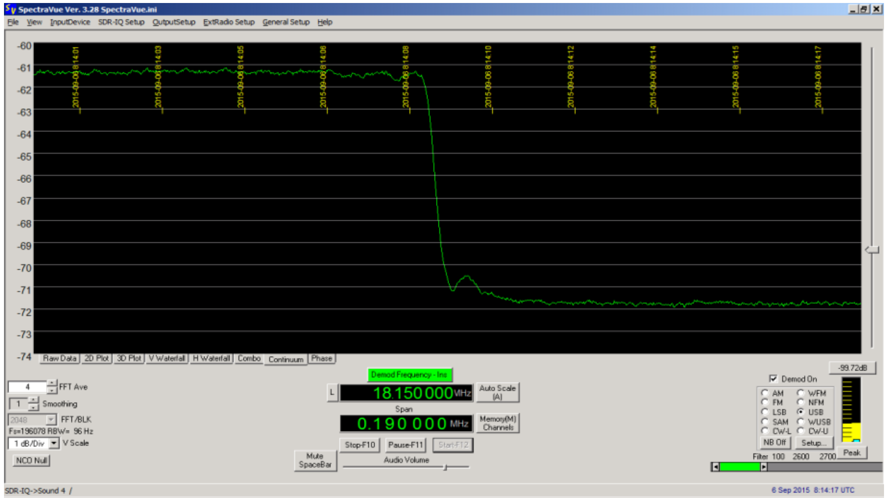
http://www.urel.feec.vutbr.cz/esl/files/EME/EME.htm

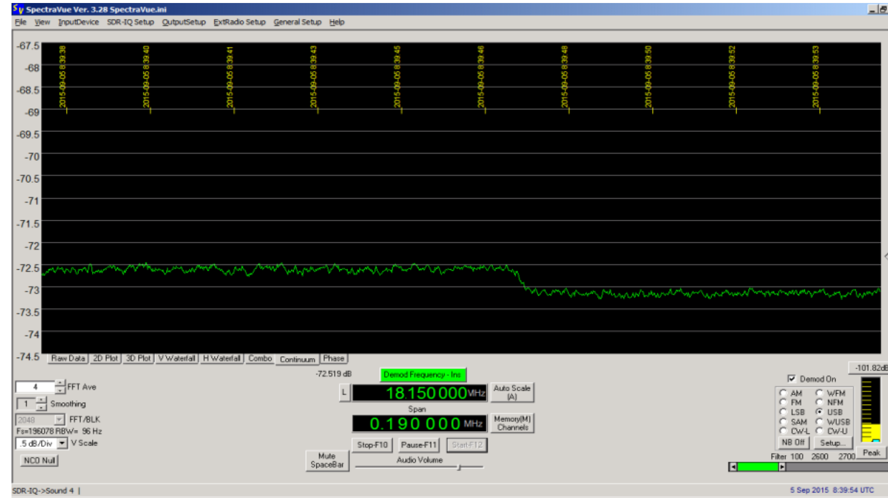
Outline

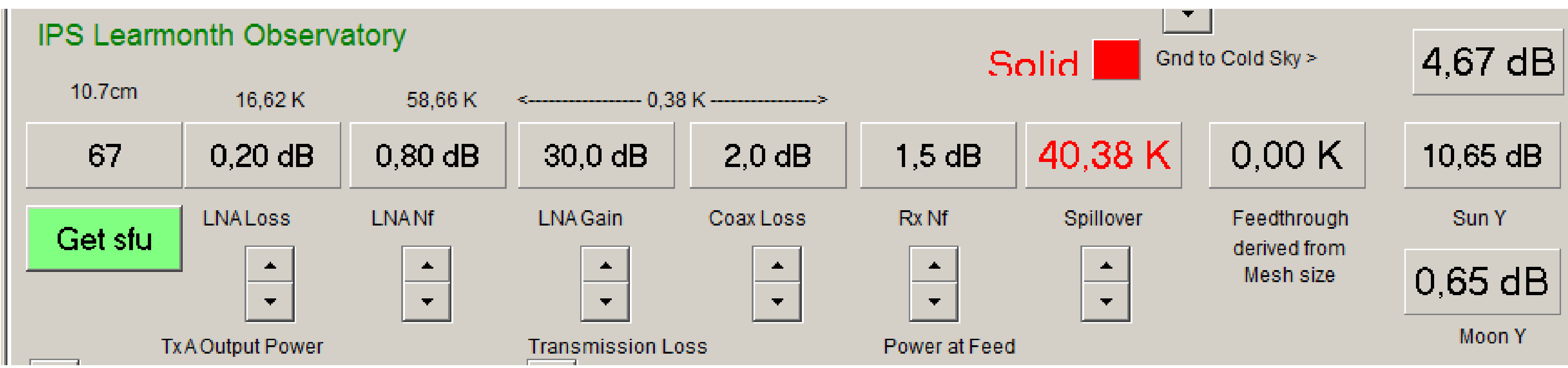
1. Axial-symetric versus offset dish
2. Parabolic antennas arrangement
3. Offset dish geometry
4. Optimized feed for offset dish
5. Offset dish feed position
6. Achievement

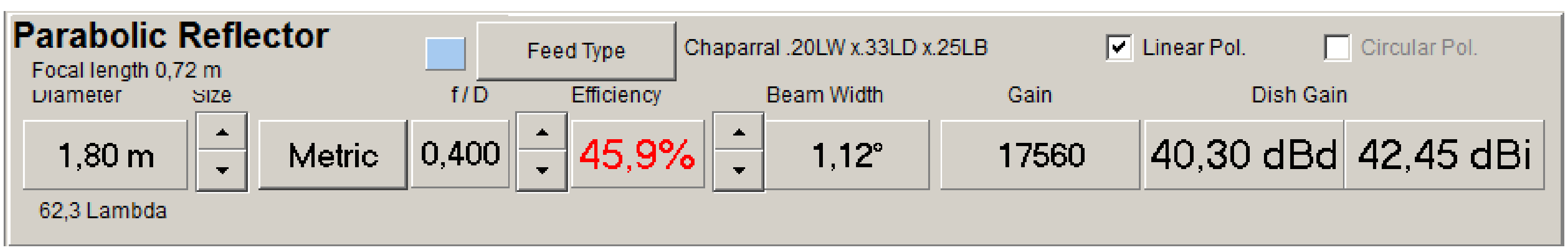

SKYON

Axial focus dish 1,8 m










W5LUA

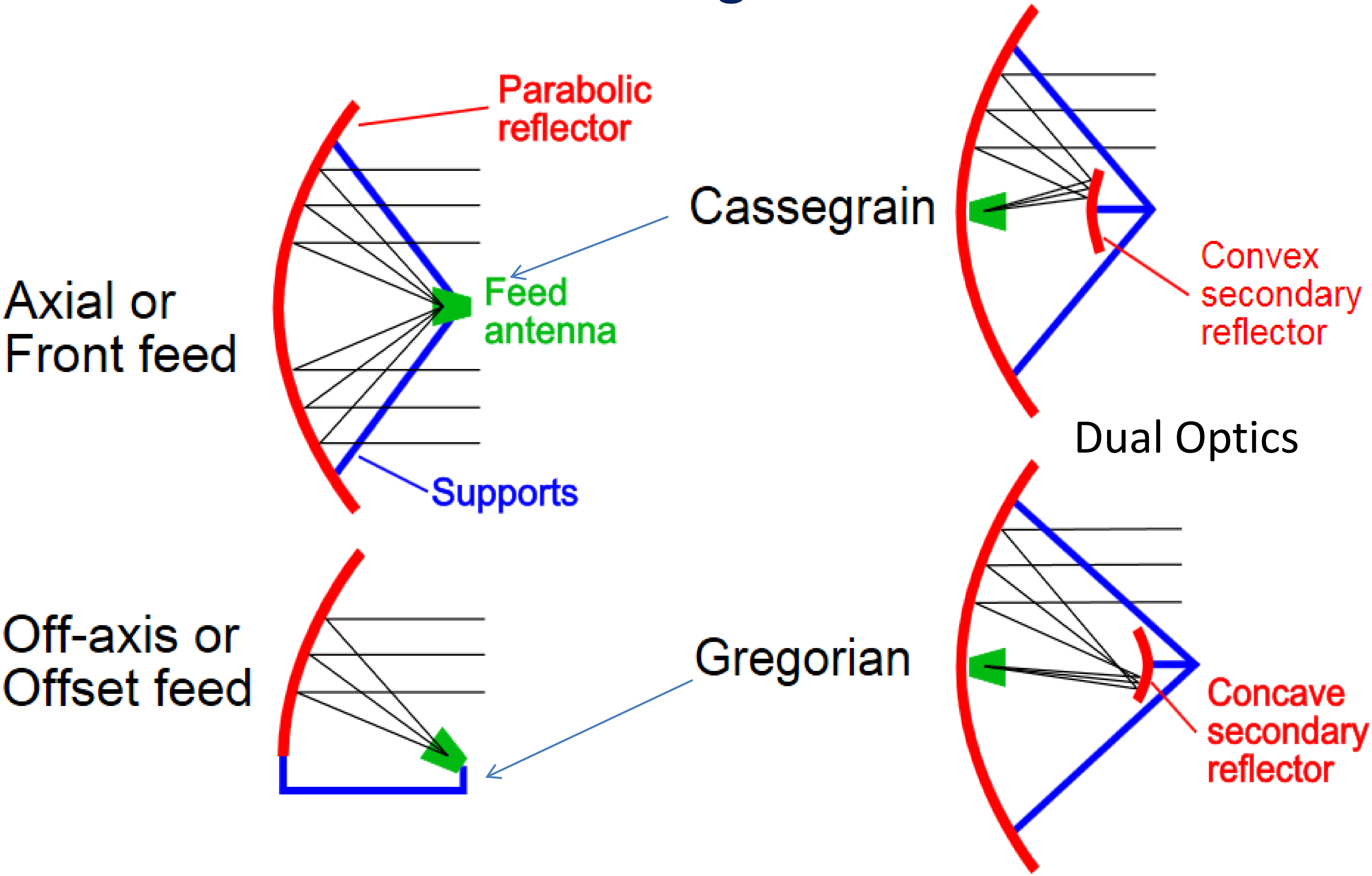

SETI


OE5JFL


MeerKAT


Green Bank Observatory

Parabolic antennas arrangement



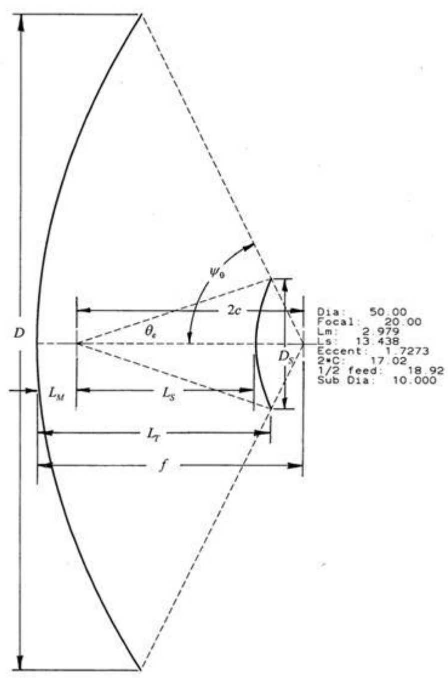
Circular paraboloid
Axial-symetric dish
Conventional dish

Basic parameters: D, f/D

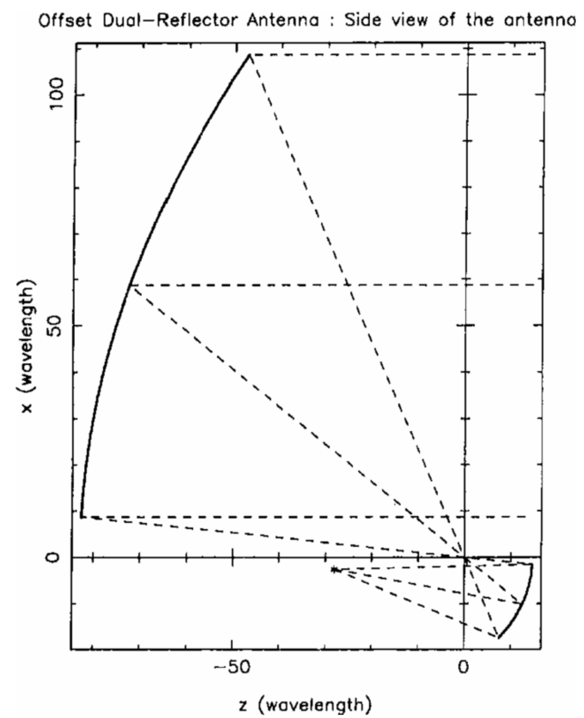
Offset focus dish

Basic parameters: D, f/D, Offset angle

Both can be Prime focus dish – single optics



Dual optics

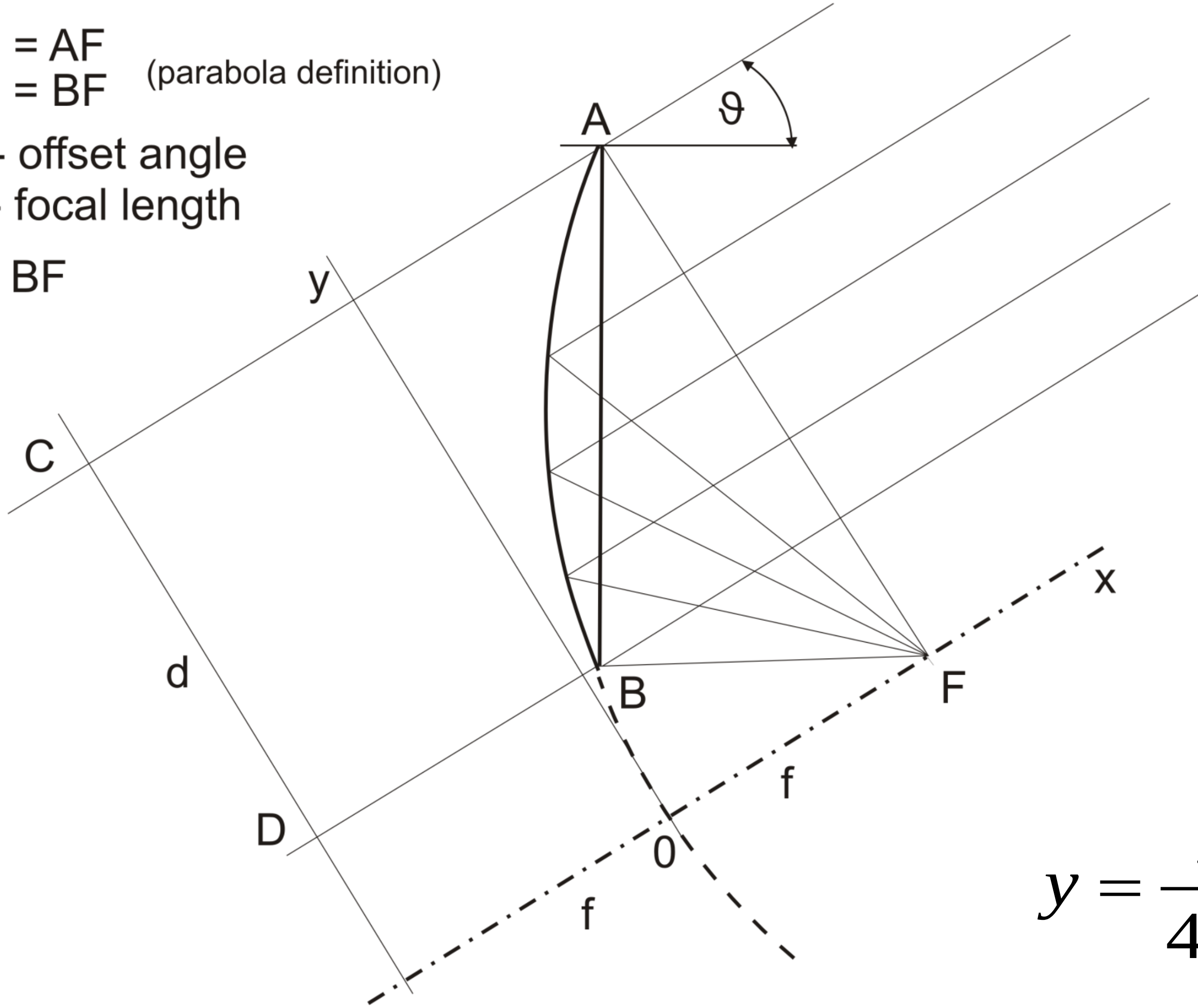


Offset dish geometry

AC = AF
BD = BF (parabola definition)

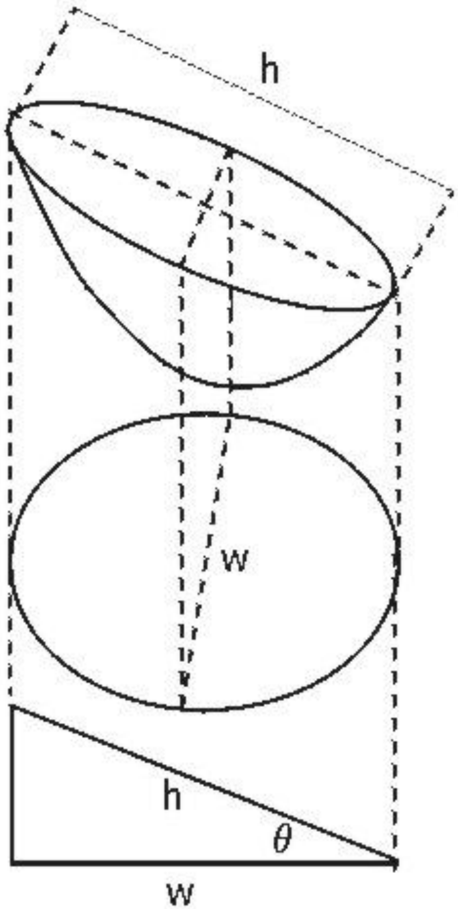
ϑ - offset angle
f - focal length

f < BF



$$y = \frac{x^2}{4 \cdot f}$$

Legon’s equition



Every oblique section through a paraboloid of revolution describes an ellipse.

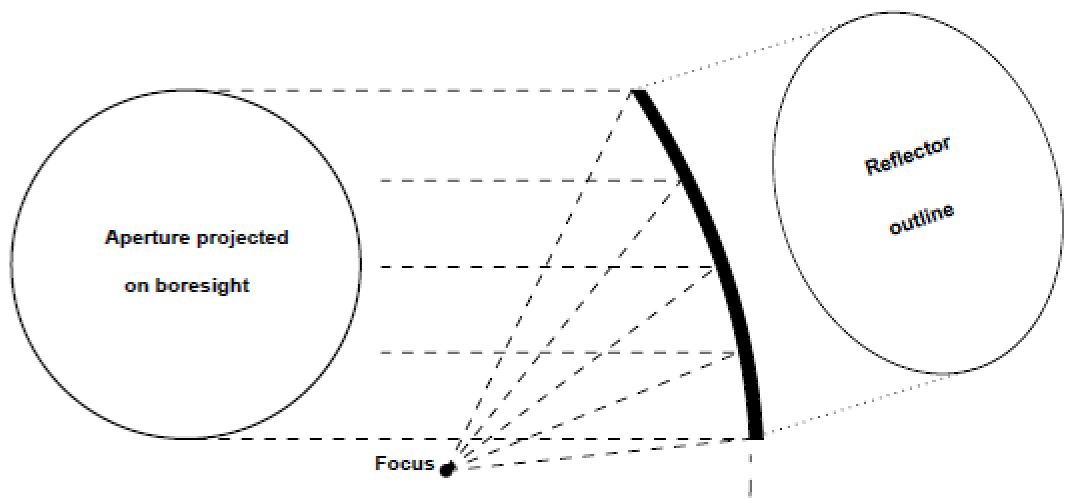
The orthogonal projection of that ellipse onto a plane perpendicular to the axis of revolution describes a circle.

The angle of the cut, θ, is given by

$$\cos\theta = w / h$$

$$f = \frac{w^3}{16 \cdot h \cdot d}$$

d - offset dish depth



Offset focus dish versus **Axial focus dish**

Advantages

The dish is not blocked by feed and its support structure – higher efficiency (higher G)

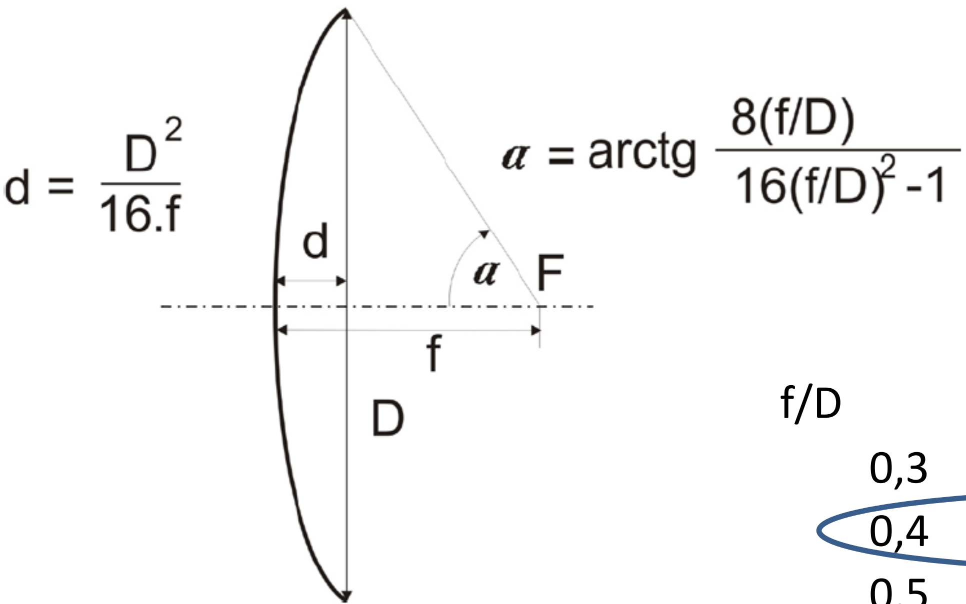
If the antenna is pointing with low elevation then the feedhorn is pointing towards the sky and spilover of the feed pattern would receive less noise from the cool sky. (lower T)

That means higher G/T

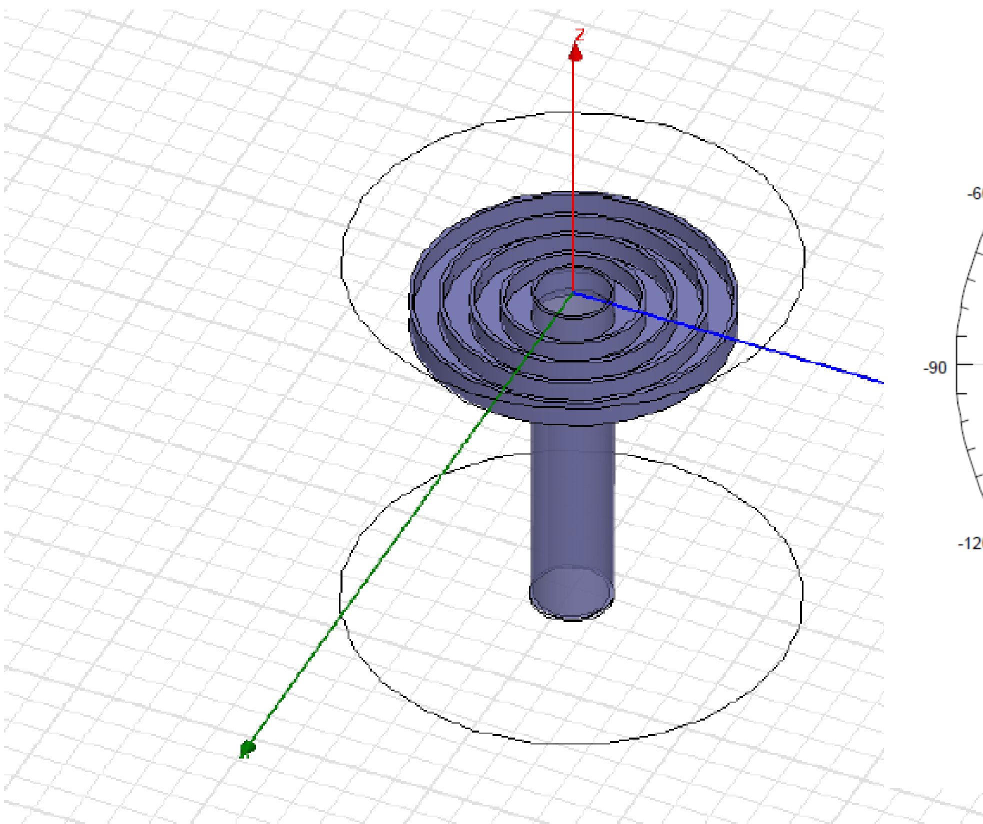
Disadvantages

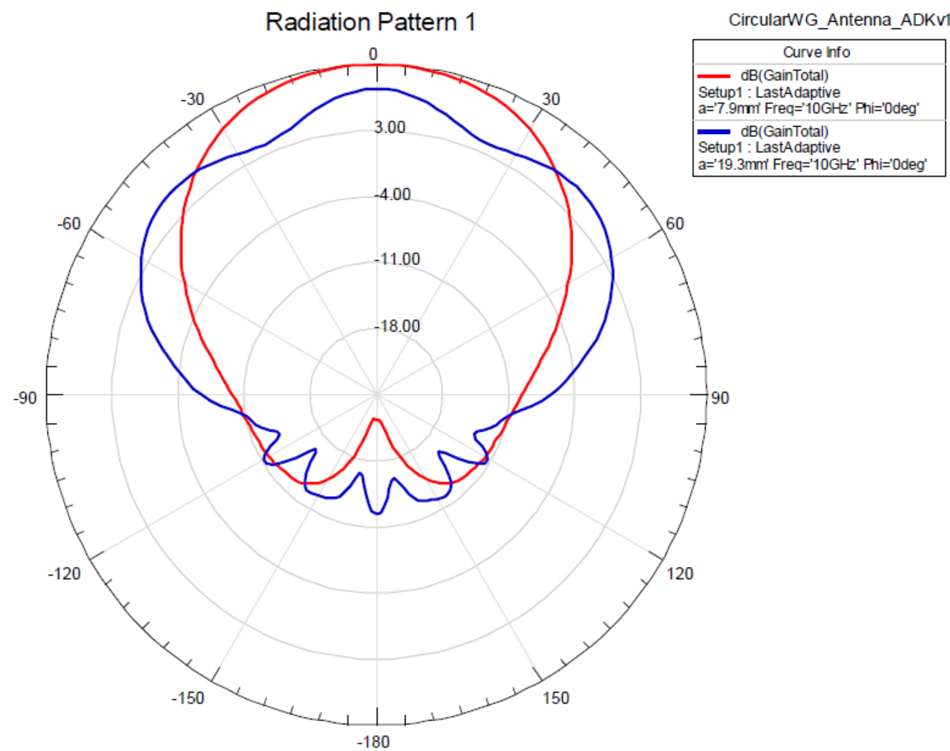
Much complicated geometry – difficult focusing

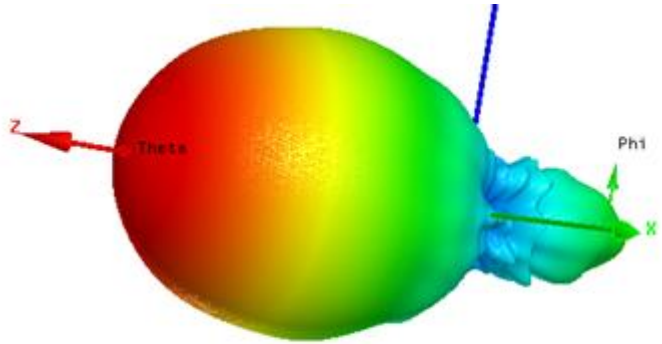
Because the f/D ratio is usual higher the feed pattern need to be with narrow beamwidth. It can be difficult to achieved on lower frequencies.

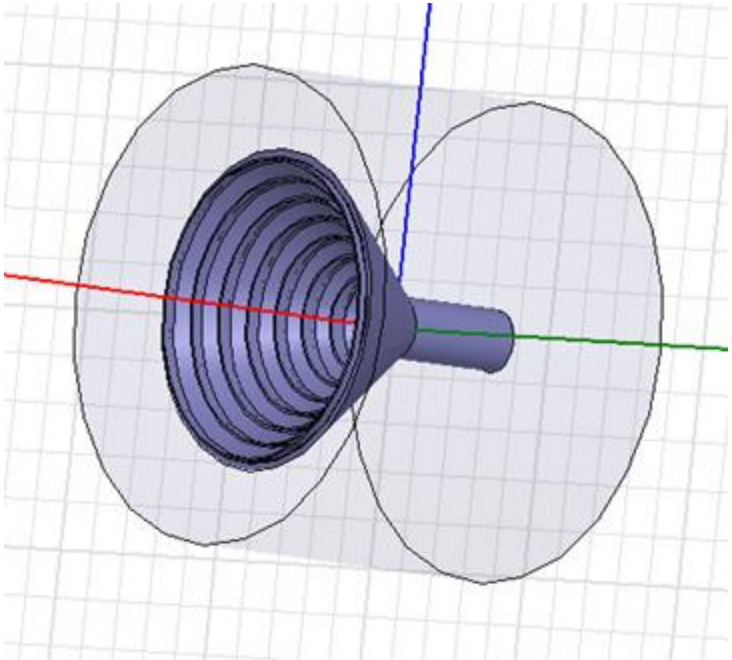


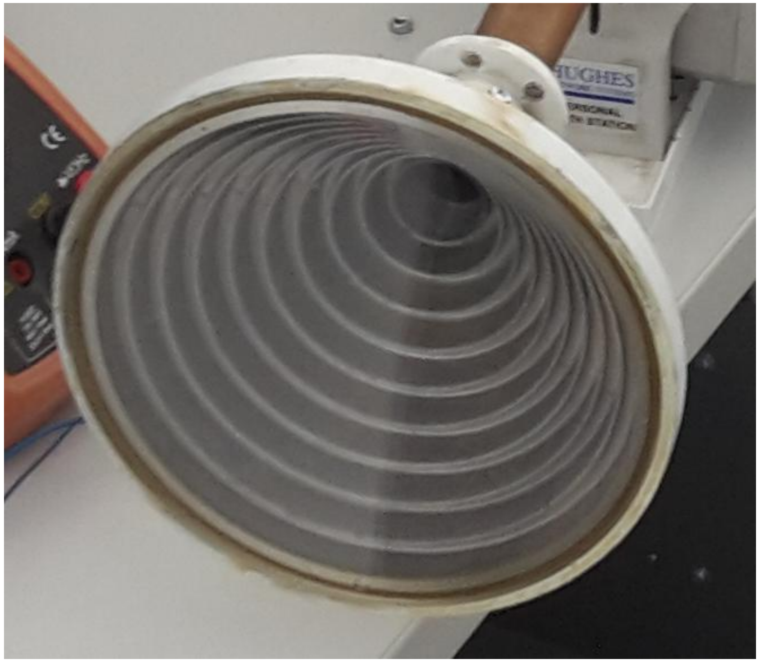
f/D	alpha	2*alpha
0,3	79,61114	159,2223
0,4	64,01077	128,0215
0,5	53,1301	106,2602
0,6	45,23973	90,47946
0,7	39,30765	78,6153
0,8	34,70805	69,4161
0,9	31,04822	62,09644



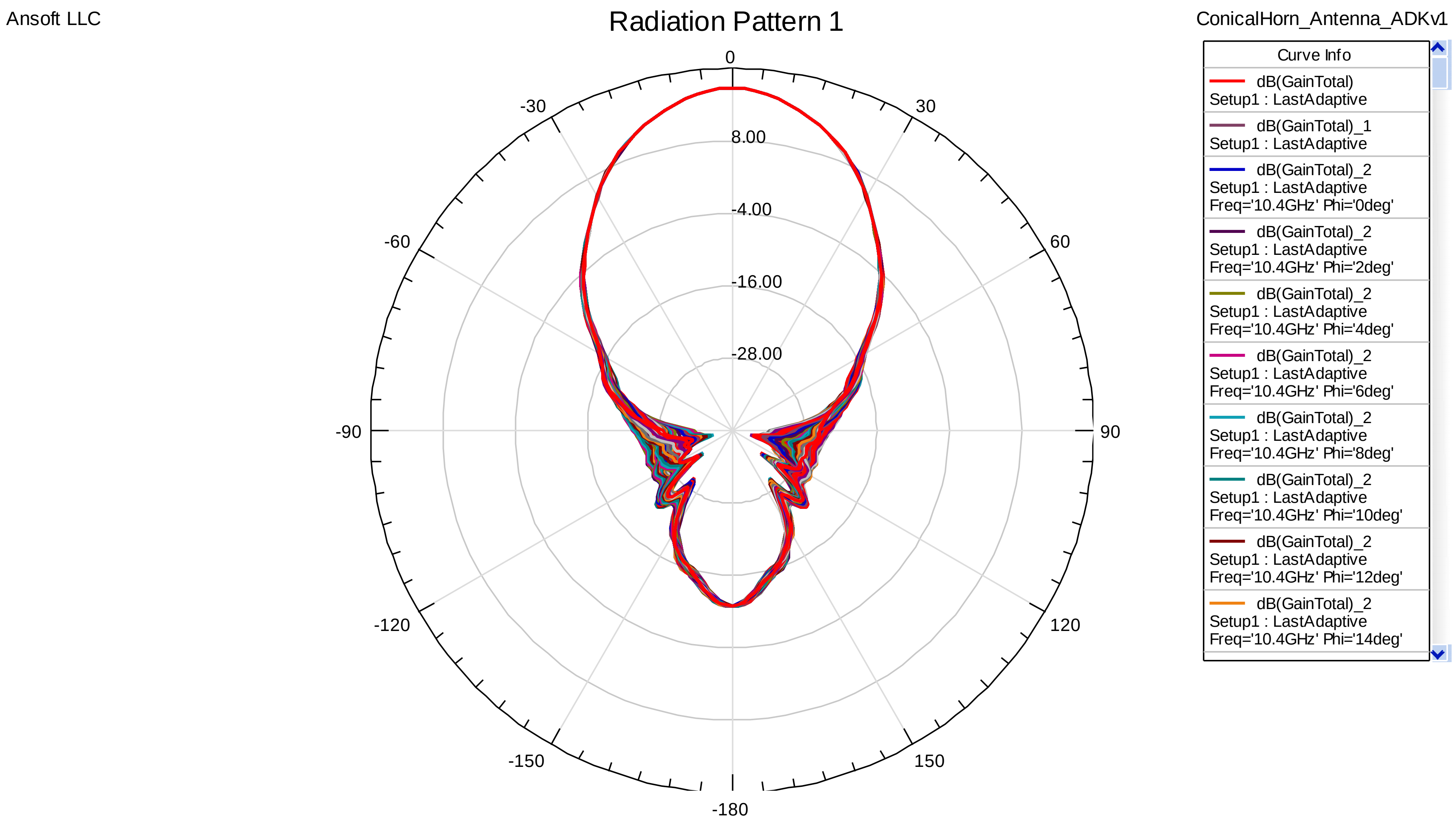

Radiation Pattern 1
CircularWG_Antenna_ADKv1
Curve Info
dB(GainTotal)
Setup1 : LastAdaptive
a='7.9mm' Freq='10GHz' Phi='0deg'
dB(GainTotal)
Setup1 : LastAdaptive
a='19.3mm' Freq='10GHz' Phi='0deg'
0
-30
30
-60
60
-90
90
-120
120
-150
150
-180
3.00
-4.00
-11.00
-18.00







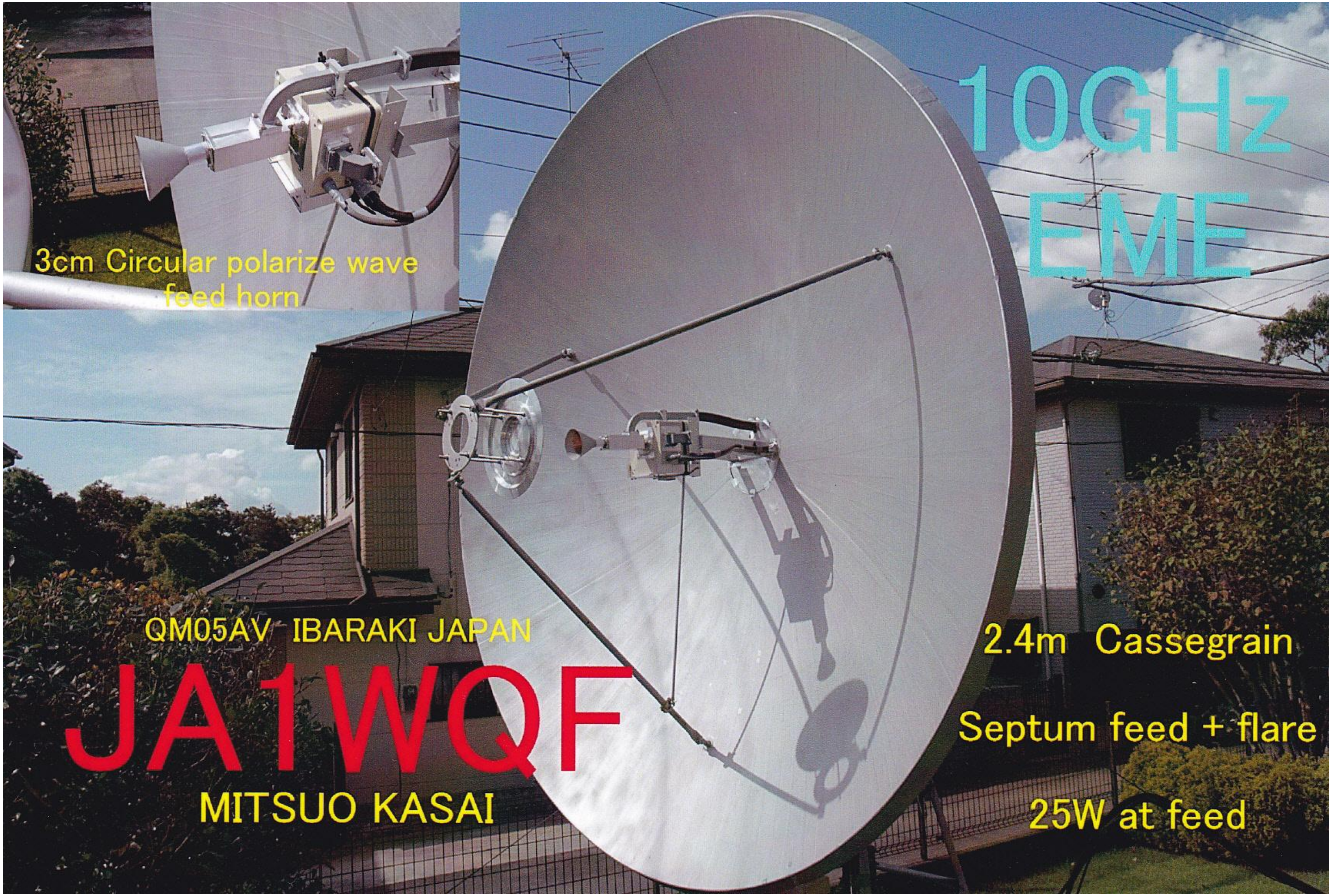
Feedhorn for the f/D = 0.8



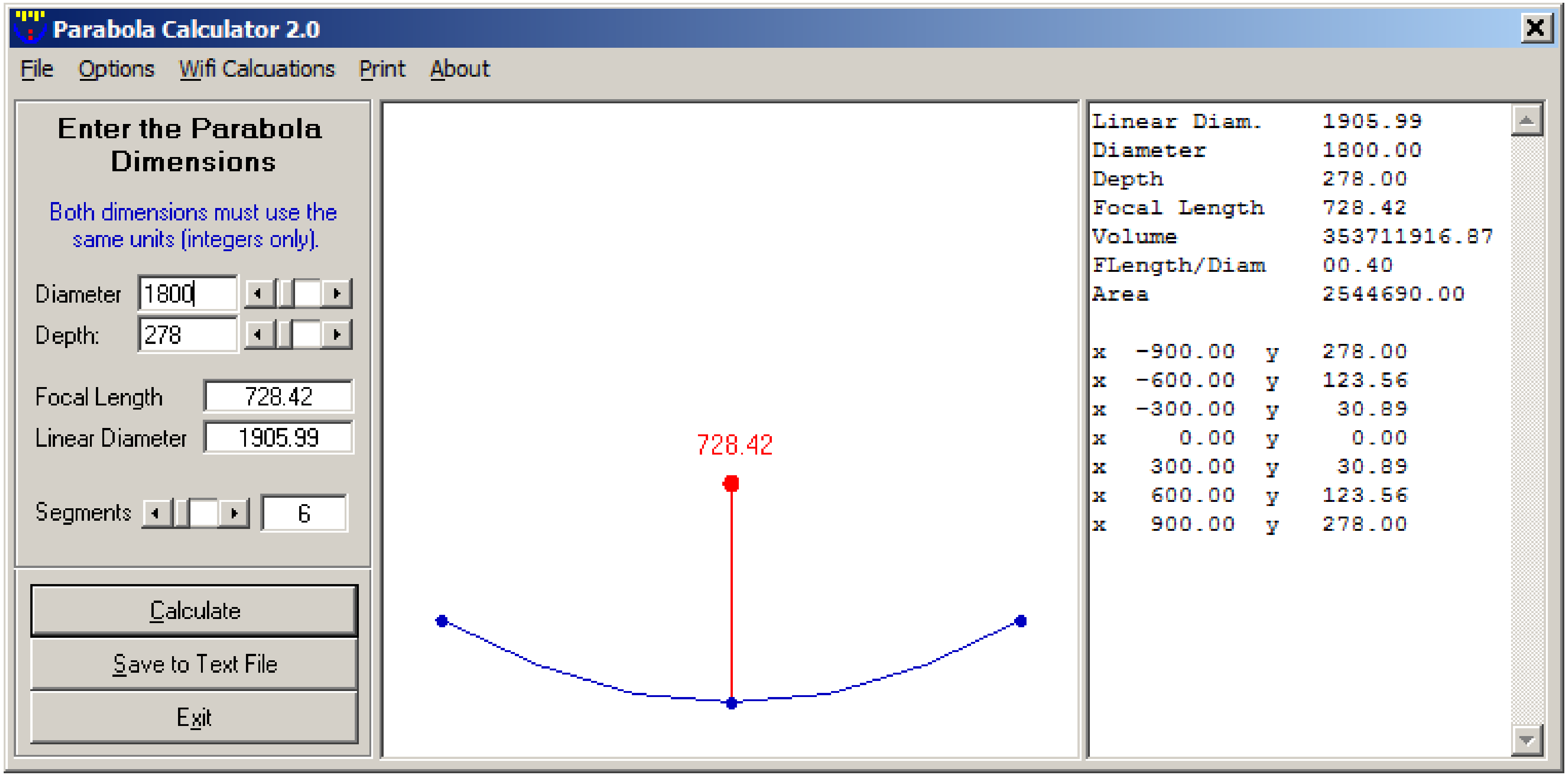
Ansoft LLC
Radiation Pattern 1
ConicalHorn_Antenna_ADKv1
Curve Info
dB(GainTotal)
Setup1 : LastAdaptive
dB(GainTotal)_1
Setup1 : LastAdaptive
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='0deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='2deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='4deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='6deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='8deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='10deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='12deg'
dB(GainTotal)_2
Setup1 : LastAdaptive
Freq='10.4GHz' Phi='14deg'
0
30
60
90
120
150
-180
-150
-120
-90
-60
-30
8.00
-4.00
-16.00
-28.00

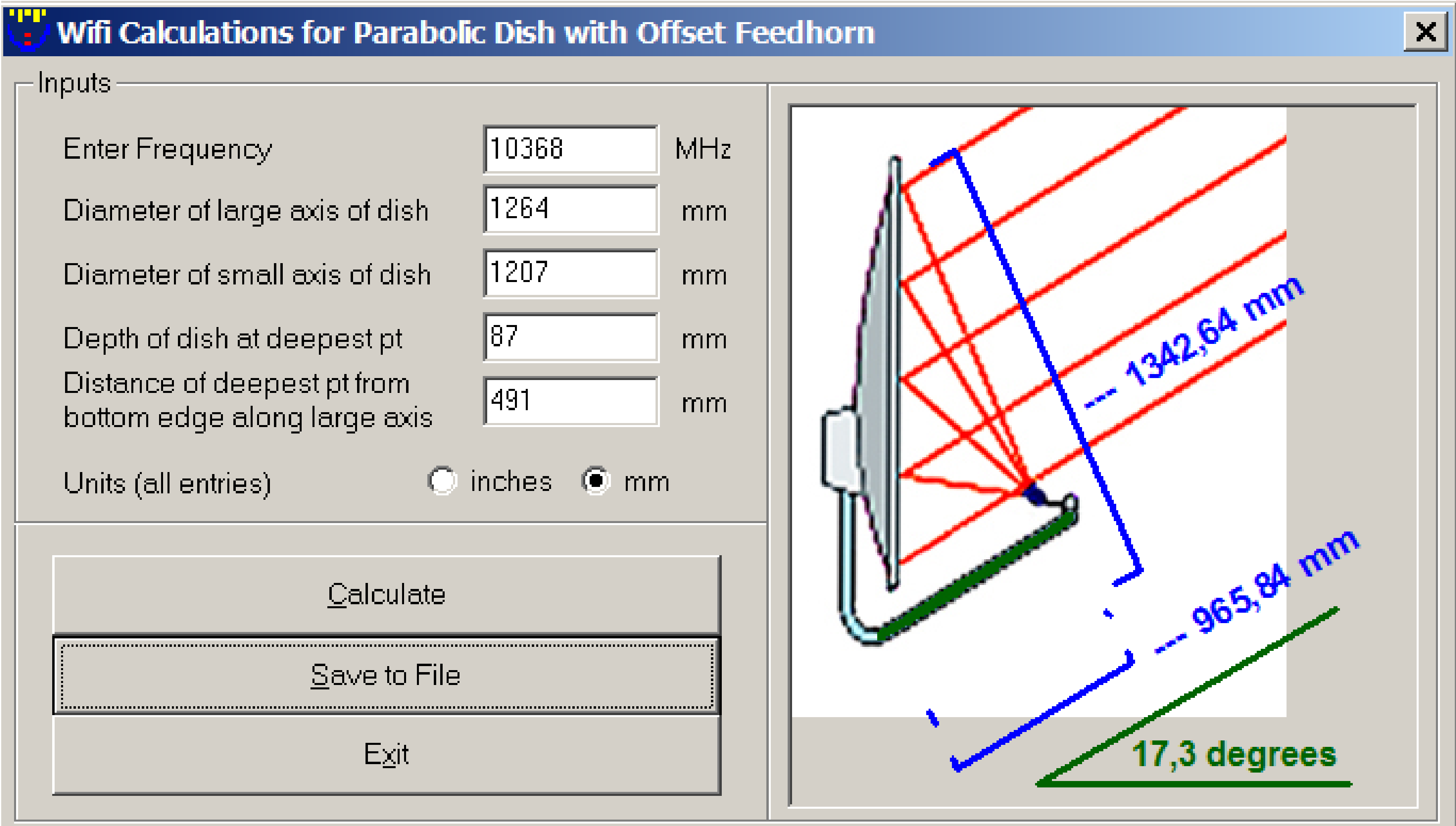
Dual Optics

DF1OI


3cm Circular polarize wave
feed horn
10GHz
EME
QM05AV IBARAKI JAPAN
JA1WQF
MITSUO KASAI
2.4m Cassegrain
Septum feed + flare
25W at feed

http://www.w1ghz.org/10g/software.htm





Wifi Calculations for Parabolic Dish with Offset Feedhorn
Inputs
Enter Frequency
10368
MHz
Diameter of large axis of dish
1264
mm
Diameter of small axis of dish
1207
mm
Depth of dish at deepest pt
87
mm
Distance of deepest pt from bottom edge along large axis
491
mm
Units (all entries)
inches
mm
Calculate
Save to File
Exit
1342,64 mm
965,84 mm
17,3 degrees

$$1207\,mm \times 0{,}8 = 965{,}6\,mm$$

The Focal Length is 965,84 mm.

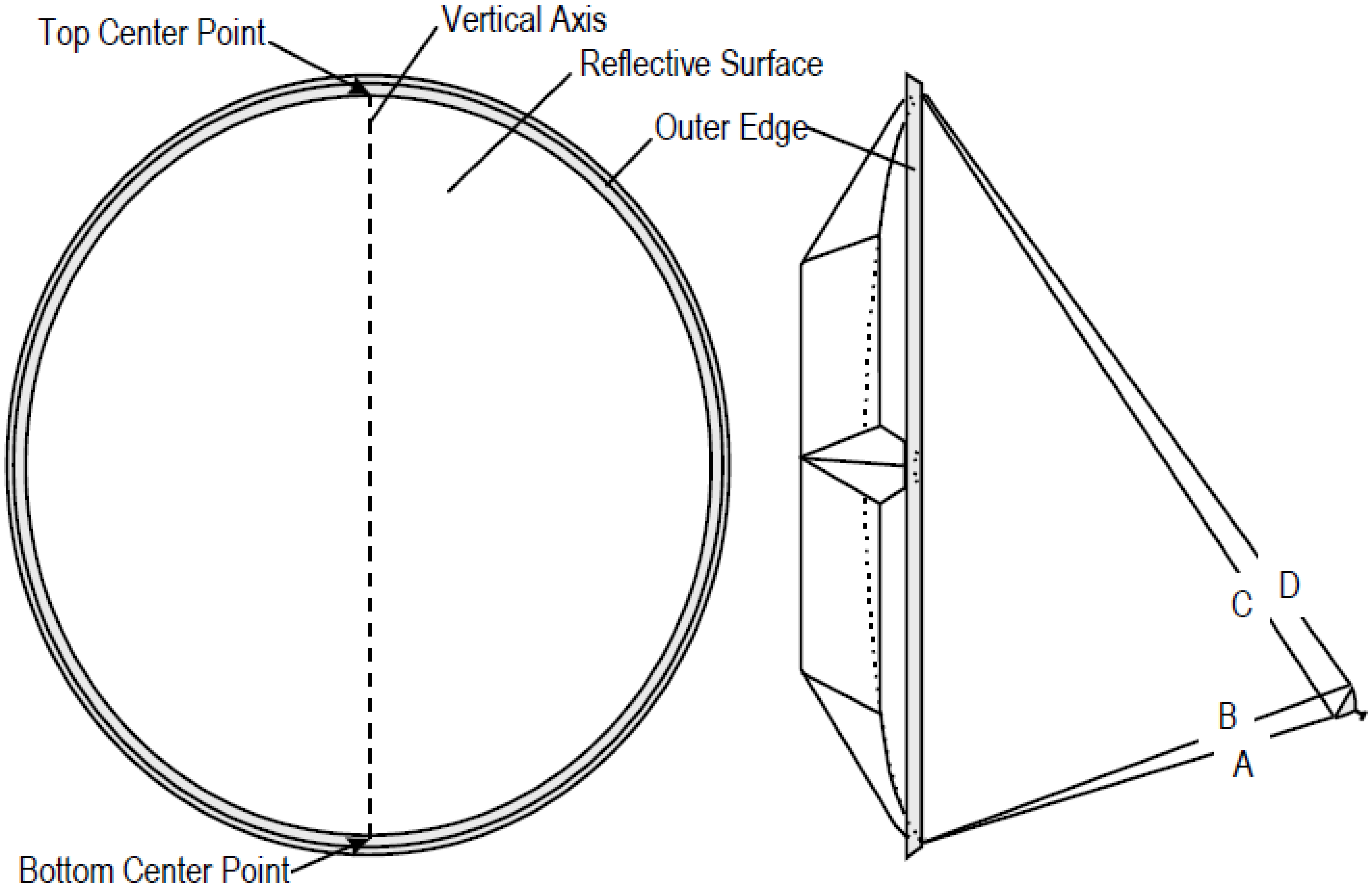
This offset reflector is a section of a full parabola with a diameter of 2413,08 mm whose vertex is at the bottom edge of the offset reflector. The full parabola has an f/D = 0,40, which determines criticality of focal length.

The focal point of the dish is 965,84 mm from the bottom edge of the reflector and 1342,64 mm from the top edge of the reflector.

For operation with the main beam on the horizon with the feed at the bottom, the dish must be tilted forward so that the large axis is 72,66 degrees above horizontal.

Illumination angle for feed = 63,98 degrees on the large axis and 64,41 degrees on the small axis. A feedhorn with a 3 dB beamwidth of 36,57 degrees is needed, equivalent to the feed for a conventional dish with f/D = 0,87.

Gain at 50% efficiency = 39,34 dBi.If you do really well, you might get 60% efficiency for a gain = 40,14 dBi.



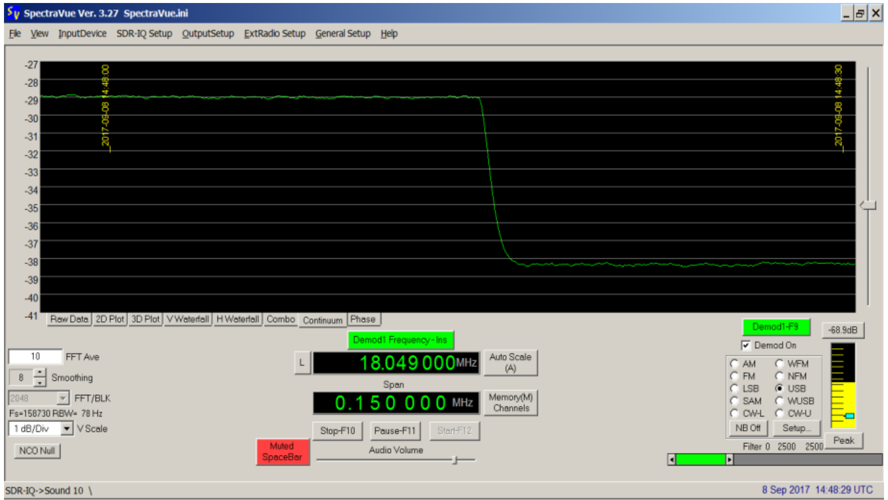
Front View

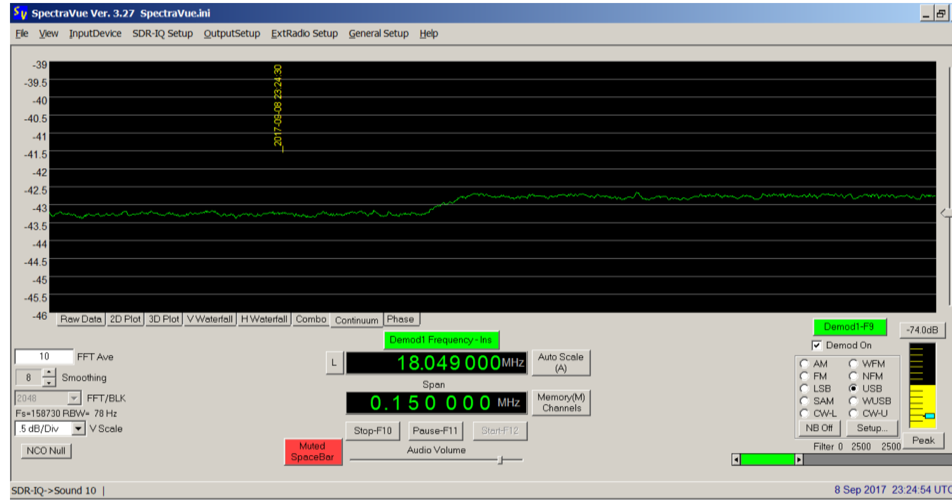
Side View

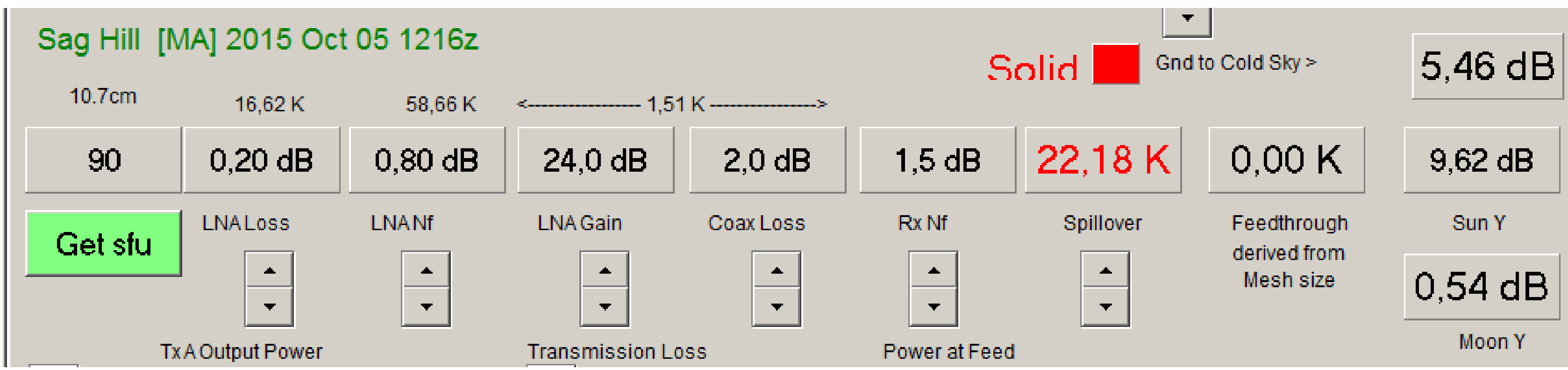
TABLE 2. PRODELIN KU BAND FEED HORN TRANSMIT AND RECEIVE VSAT ANTENNAS

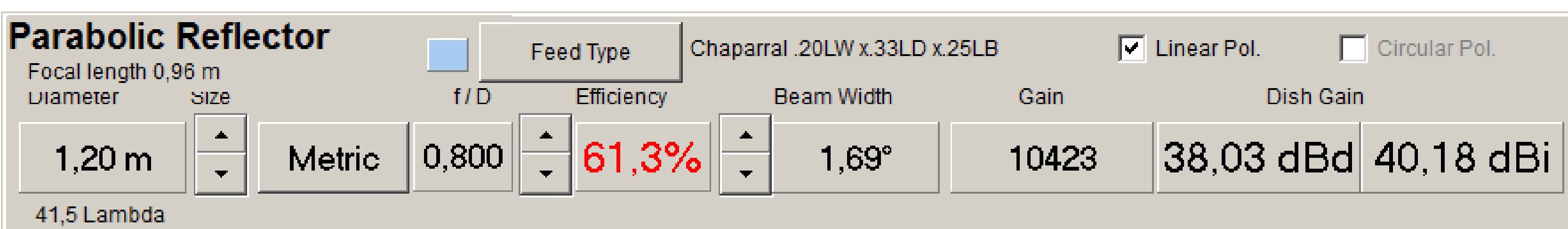
Antenna Size	1.2m		1.8m		2.4m		3.8m
Antenna Series (ratio, standard, type)	**1123/25** (0.6 F/d, non ETSI)	**1134** (0.8 F/d, ETSI)	**1183/84** (0.6 F/d, non ETSI)	**1194** (0.8 F/d, ETSI)	**1245/1246** (0.6 F/d, non ETSI, 1 piece antenna)	**1244** (0.8 F/d, ETSI, 4 piece antenna)	**1381** (0.6 F/d, non ETSI, 4 piece antenna)
A	26 in. (26" or 660 mm)	34.25 in. (34-1/4" or 820 mm)	40.114 in. (40-1/8" or 1019 mm)	53.31 in. (53-5/16" or 1354 mm)	55.56 in. (55-9/16" or 1411 mm)	72.64 in. (72-5/8" or 1845 mm)	86.95 in. (86-15/16" or 2209 mm)
B	29.88 in. (29-7/8" or 759 mm)	37.08 in. (37-1/16" or 942 mm)	44.107 in. (44-1/8" or 1120 mm)	56.13 in. (29-7/8" or 759 mm)	59.38 in. (59-3/8" or 1508 mm)	75.62 in. (75-5/8" or 1921 mm)	90.89 in. (90-7/8" or 2309 mm)
C	48.88 in. (48-7/8" or 1242 mm)	51.87 in. (51-7/8" or 1318 mm)	72.012 in. (72" or 1829 mm)	77.56 in. (77-9/16" or 1970 mm)	97.81 in. (97-13/16" or 2484 mm)	105.45 in. (105-7/16" or 2678 mm)	152.48 in. (152-1/2" or 3873 mm)
D	45.75 in. (45-3/4" or 1162 mm)	49.04 in. (49-1/16" or 1246 mm)	69.31 in. (69-5/16" or 1760 mm)	74.75 in. (74-3/4" or 1899 mm)	95.19 in. (95-3/16" or 2418 mm)	102.12 in. (102-1/8" or 2594 mm)	149.74 in. (149-3/4" or 3803 mm)

Offset dish 1,2 m

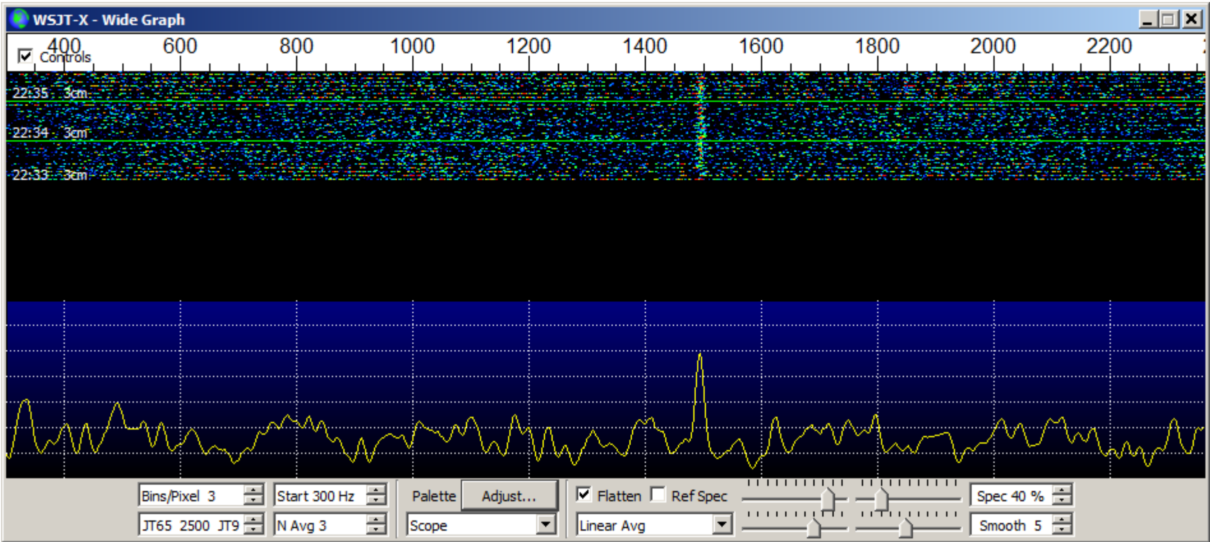








Echo



1,2 m offset dish

since June to middle October 2017 - 66 EME QSOs on 3 cm with 18 new initials as well as fulfilled WAC.

Smallest station worked

But do not expect any mystery given by offset angle!

Lots more than type of the dish (coventional dish versus offset) is important its fidelity.

Thank you for attention