High performance 1.9m station for 23cm EME

How a 1.9m mesh wire dish can outperform most current 3m+ system
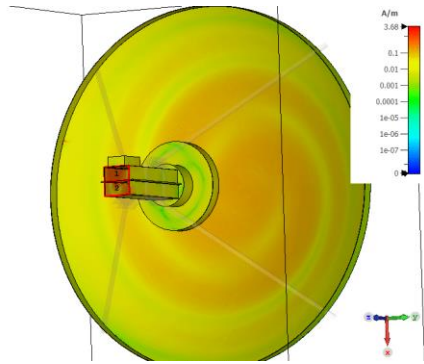
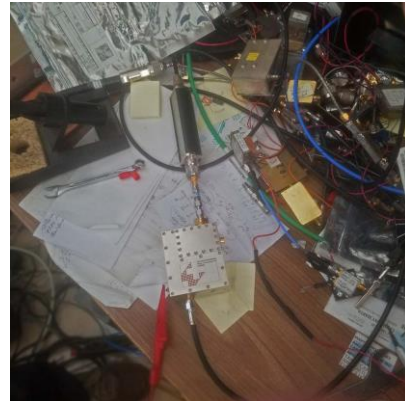**August 9, 2024**

Bill Siino

KB2SA

AGENDA

- Acknowledgements

- Why use a 1.9m dish?

- Hardware highlights

- Simulation highlights

- 1.9m feed on 4.88m dish

- Noteworthy 1.9m 23cm QSOs

- What's next?

ACKNOWLEDGEMENTS

WHO HELPED

- Rastislav (Rasto) Galuscak (OM6AA) for hundreds of hours of simulation

- Rfspin s.r.o. for the use of SIMULIA CST Studio Suite® www.rfspin.com

- Bob Atkins (KA1GT) for his idea on using a square to round waveguide taper

- Paul Chominski (WA6PY) for expert advice, measurements and review

- Mats Bengtsson (KD5FZX) for building the optimized "KB2SA feed" and reporting excellent performance using a solid 4.88M, f/d = 0.39 dish.
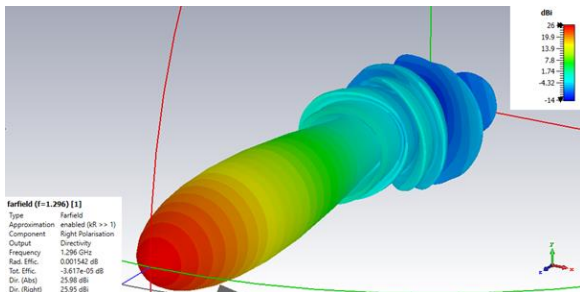
WHY USE A 1.9M DISH?
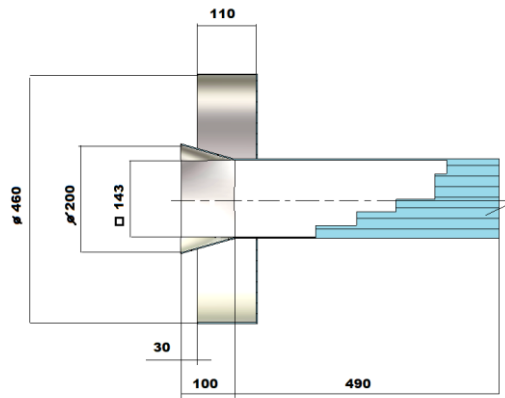
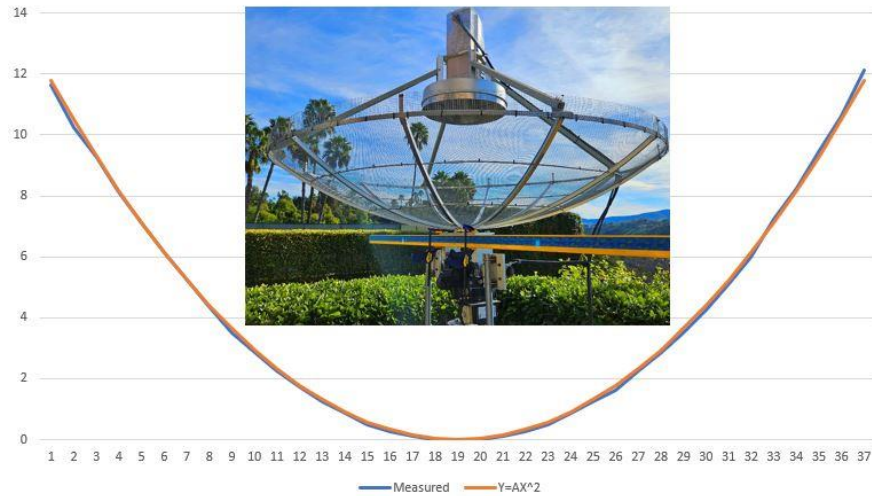# WHY USE A 1.9M DISH?

LESS COULD BE MORE

- Virtually invisible to weather
- Nearly invisible to guests
- Easy to tune & service
- Wide beamwidth hides tracking errors (-1 db when 2° off)
- Short Tx cable to feed (14')

HARDWARE HIGHLIGHTS

Measured (to mesh) vs Y=AX^2
Same @ 30° & 90°

HARDWARE HIGHLIGHTS

- ***Excellent parabolic surface***
- ***Low loss Rx probe to LNA input***
  Amphenol AD-SMAPSMAP-2
  RLC Electronics SR-2MIN-H
  HUBER+SUHNER 32_SMA-50-0-1/111_NE
- ***Precise feed construction and dimensions***
- Fiberglass struts
- S12 isolation disk
- Dish collar ring

- D = Dish Diameter = 75.5" (1.92 M)
- Y = Measured every 2" along X
- Subtract Bias from Y to zero in center
- Y = A * X^2 (Select A for best fit)
- Actual Focus Point (f) = 1 / (4*A) = 27.47"
- Actual f/D = 27.47" / 75.5" = **0.364**
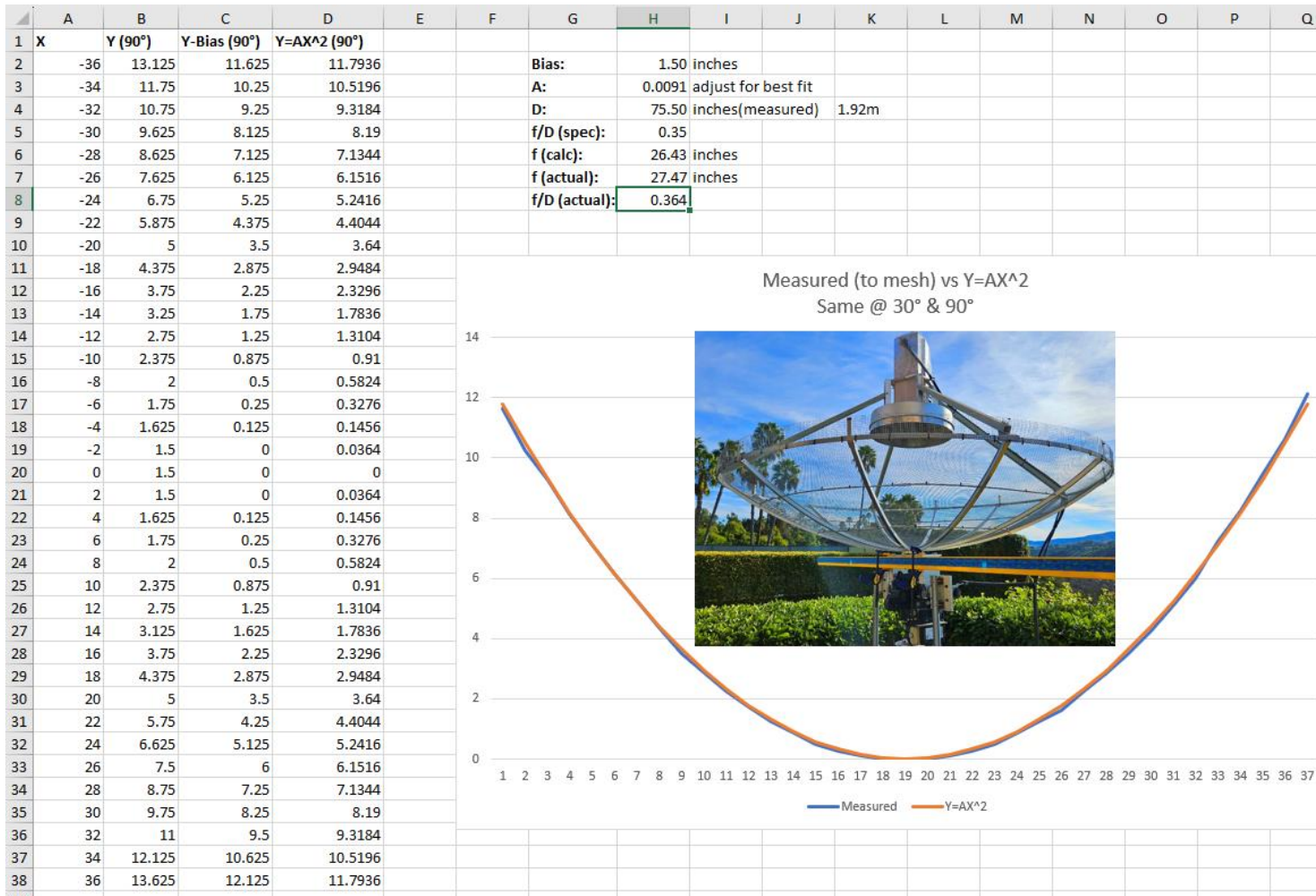
EXCELLENT PARABOLA

Measure It!

- Ruze's equation ($685.81 * (\varepsilon/\lambda)^2$) estimates gain loss in db due to RMS surface errors (ε). If λ = 230 mm and ε = 5 mm, loss = 0.3 dB.
- The effort to <u>estimate</u> the gain loss is usually far more complex than the effort to fix it.
- Tweak "A" in ideal parabola to best fit measured parabola.
- Correct deformation throughout and calculate actual f and f/D.

	A	B	C	D	E	F	G	H	I	J	K
1	X	Y (90°)	Y-Bias (90°)	Y=AX^2 (90°)							
2	-36	13.125	11.625	11.7936			Bias:	1.50	inches		
3	-34	11.75	10.25	10.5196			A:	0.0091	adjust for best fit		
4	-32	10.75	9.25	9.3184			D:	75.50	inches(measured)	1.92m	
5	-30	9.625	8.125	8.19			f/D (spec):	0.35			
6	-28	8.625	7.125	7.1344			f (calc):	26.43	inches		
7	-26	7.625	6.125	6.1516			f (actual):	27.47	inches		
8	-24	6.75	5.25	5.2416			f/D (actual):	0.364			
9	-22	5.875	4.375	4.4044							
10	-20	5	3.5	3.64							
11	-18	4.375	2.875	2.9484							
12	-16	3.75	2.25	2.3296							
13	-14	3.25	1.75	1.7836							
14	-12	2.75	1.25	1.3104							
15	-10	2.375	0.875	0.91							
16	-8	2	0.5	0.5824							
17	-6	1.75	0.25	0.3276							
18	-4	1.625	0.125	0.1456							
19	-2	1.5	0	0.0364							
20	0	1.5	0	0							
21	2	1.5	0	0.0364							
22	4	1.625	0.125	0.1456							
23	6	1.75	0.25	0.3276							
24	8	2	0.5	0.5824							
25	10	2.375	0.875	0.91							
26	12	2.75	1.25	1.3104							
27	14	3.125	1.625	1.7836							
28	16	3.75	2.25	2.3296							
29	18	4.375	2.875	2.9484							
30	20	5	3.5	3.64							
31	22	5.75	4.25	4.4044							
32	24	6.625	5.125	5.2416							
33	26	7.5	6	6.1516							
34	28	8.75	7.25	7.1344							
35	30	9.75	8.25	8.19							
36	32	11	9.5	9.3184							
37	34	12.125	10.625	10.5196							
38	36	13.625	12.125	11.7936							

Measured (to mesh) vs Y=AX^2
Same @ 30° & 90°

Measured   Y=AX^2

ASSUME:

85° F ambient (300K)

LNA NF = 0.25 dB

No TX port noise (S12 is high)

Relay + connector loss = 0.1 dB

- Equivalent LNA noise = 300 * (10^((0.25+0.1)/10) − 1) = **25.18K**
- LNA noise = 300 * (10^((0.25)/10) − 1) = **17.78K**
- Antenna noise @ 30° elevation = **12K**

Rx performance loss = 10 * LOG[(25.18+12) / (17.78+12)] = **.96 dB**

1 dB for every 0.1 dB

- With typical 23cm LNA NF and antenna noise, a 0.1 dB loss between the RX probe and LNA input decrease RX sensitivity by almost 1 dB.

- *6' of LMR-600 on 23cm is 0.3 dB. This would decrease RX sensitivity by 2.46 dB.*

Define:

Dish Gain Loss (dB) = 10 * LOG (X / (X − 1))
X = 10 ^ (Mesh Loss (dB) / 10)
S = S1 = S2 = 6 mm
D = 2*R1 = 2*R2 = 0.55 mm
L = 230 mm (23 cm wavelength in mm)
V = LN (1 / (1 - EXP (-π*D/S))) = 1.38

GAIN LOSS WITH MESH

<0.2 dB if holes < Lamba/10

- S, D specified for popular galvanized fence wire mesh

- Dish gain loss **.022 dB** @ 23 cm
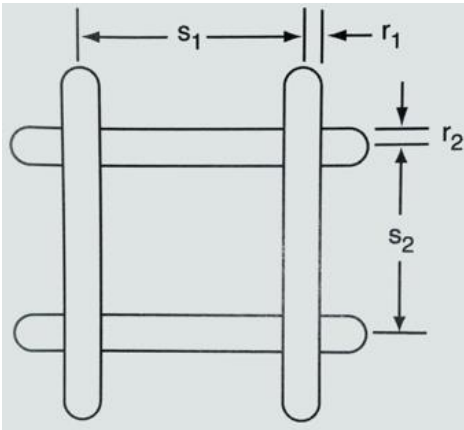
Mesh Loss (dB) = 20 * LOG (L / (2 * S * V)) = 22.9 dB
X = 10 ^ (22.9 / 10) = 194.98

Dish Gain Loss (dB) = 10 * LOG (194.98 / (194.98 -1)) = .022 dB

910W @ TX PORT

1200W PA Near Dish

- IC-9700 @ 35% → **3W**

- Q5 Signal 2330PA → **28W**

- 52' LMR-600-DB → **20W**

- Kuhne 1200W → **1,020W**

- 14' LMR-600-FR → **910W**

- All measured with calibrated Bird 4410A w/4410-15 slug and Bird 500-WA-MFN-30 attenuator.

SIMULATION HIGHLIGHTS
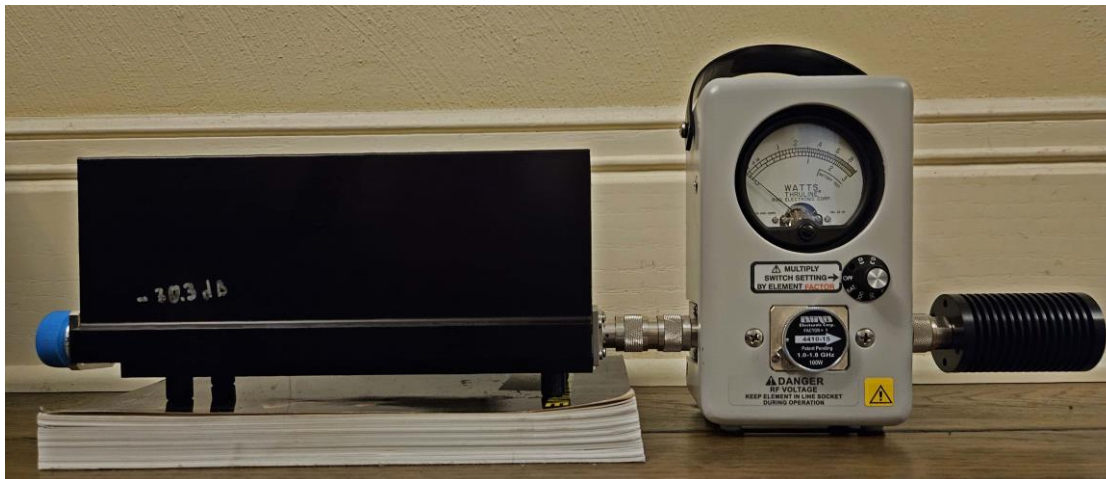
Created using
SIMULIA CST Studio Suite®

dB(V/m)
69.9
60
50
40
30
20
10
9.54e-07
-15.4

e-field (f=1.296) [1]
Component   Abs
Frequency   1.296 GHz
Phase   0 °
Maximum (Solver)   66.0923 dB(V/m)
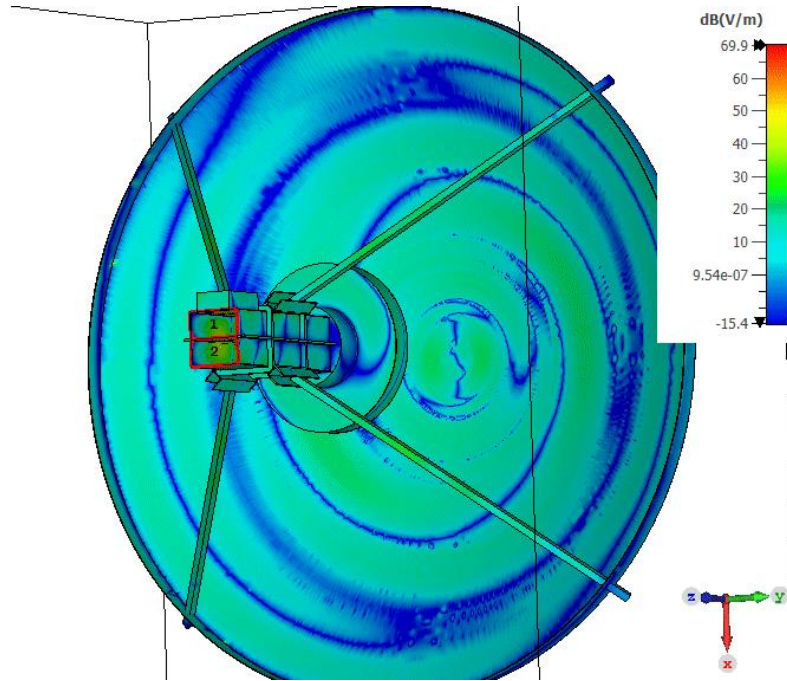
RA3AQ (2008) 23 cm
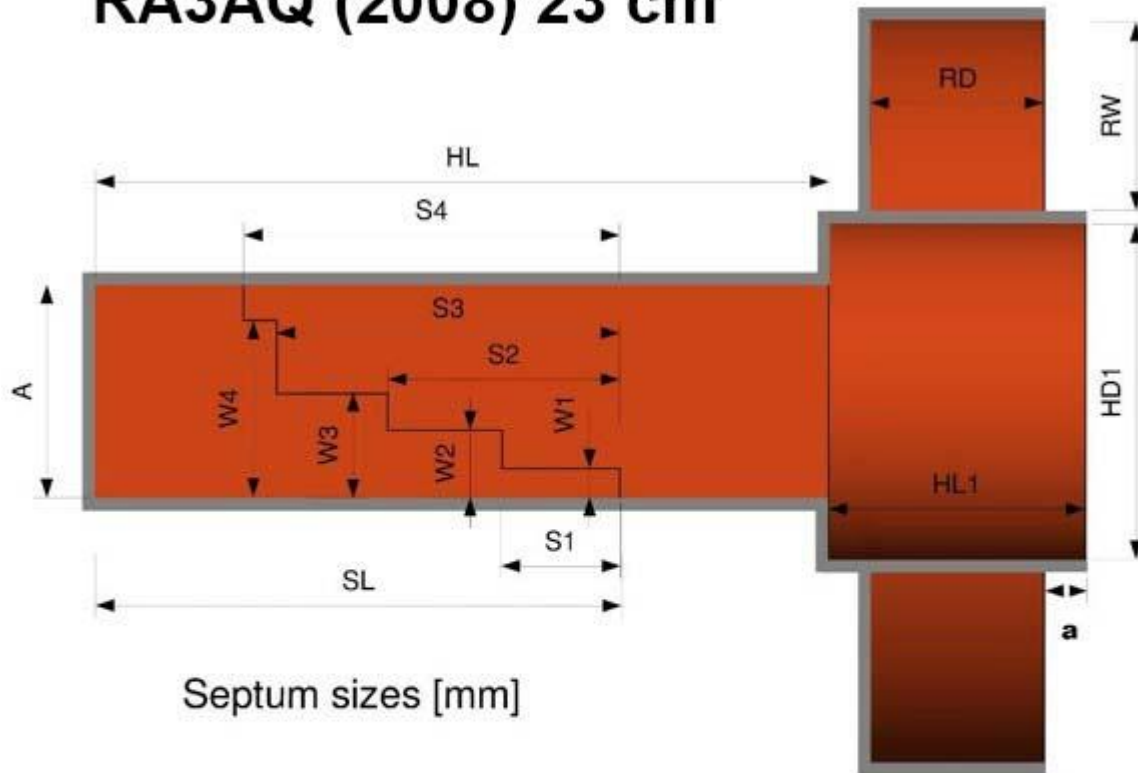
Septum sizes [mm]

F[MHz]	A	HL	SL	W1	W2	W3	W4	S1	S2	S3	S4
1296	143,0	475,0	340,0	22,2	46,9	70,9	117,7	75,6	148,6	220,5	242,3

Output section [mm]

F[MHz]	HD1	HL1	RW	RD
1296	214,0	173,0	118.0	81.0

SIMULATION HIGHLIGHTS

Starting Feed

- Simulations start with an RA3AQ-type feed tuned prior to simulations for maximum sun to cold sky with 1.9m mesh wire dish with f/d = 0.35

- Dish mesh S = 6 mm, D = 0.55 mm

- Updated to RW = 118 mm, RD = 60 mm and a = 30 mm based on highest sun to cold sky.

- Feed constructed from a modified RF HAMDESIGN feed.
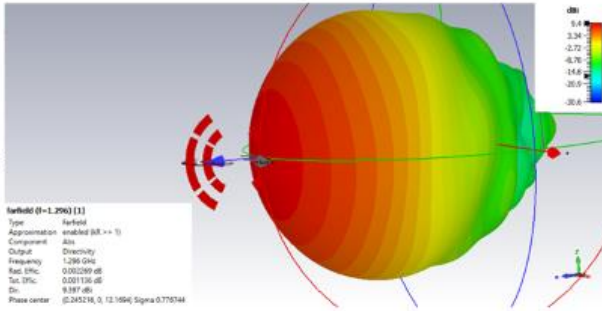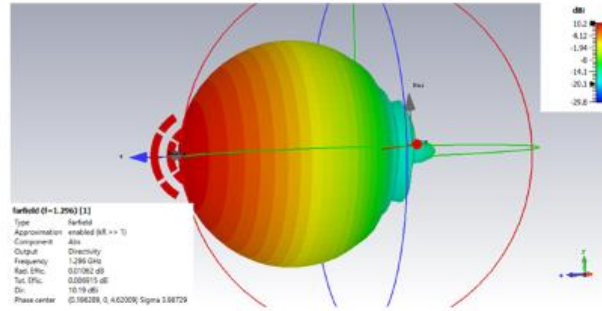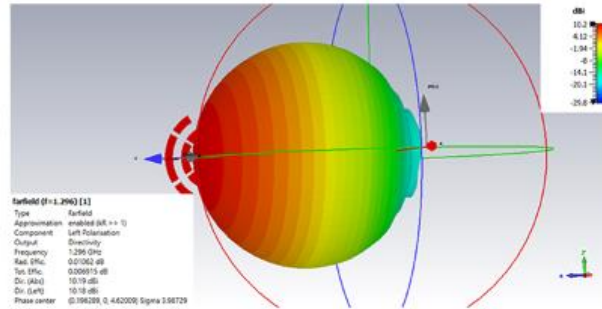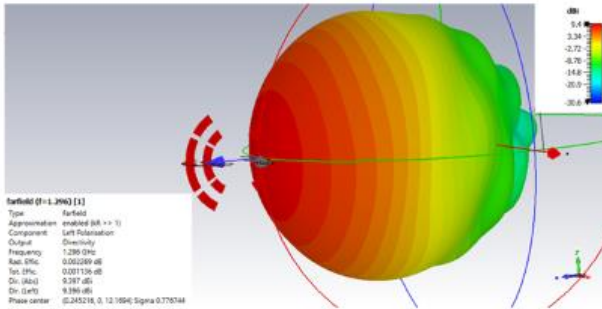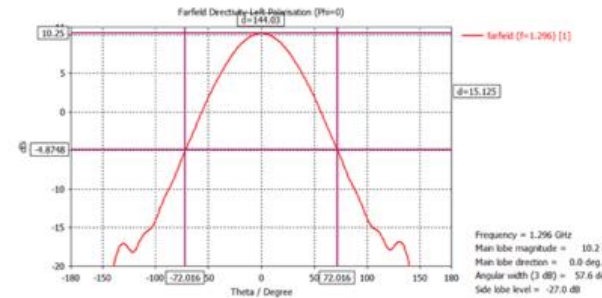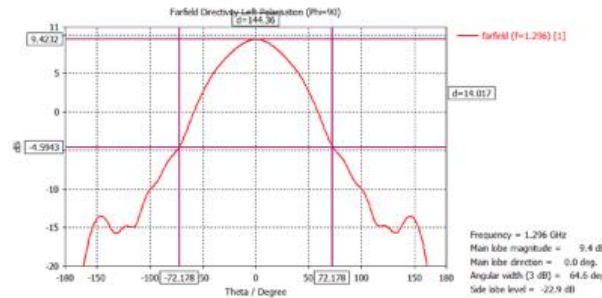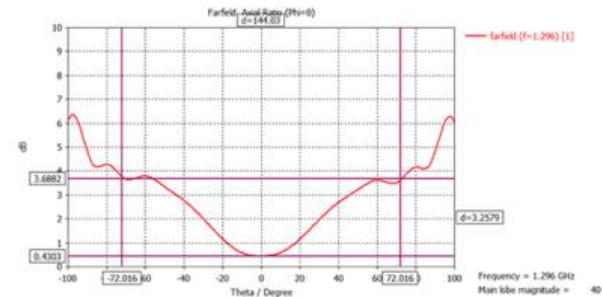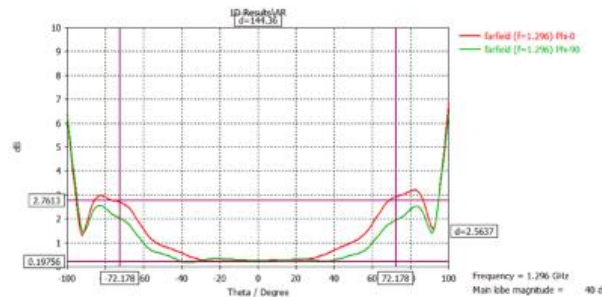
SIMULATION HIGHLIGHTS

Feed Only (no dish) With/Without Choke

- Feed only (no dish) shows noticeable narrower beamwidth and lower sidelobes with choke

- 3 db beamwidth reduced from 64.6° to 57.6°

- Sidelobes reduced 4 dB

- Axial ratio good with/without choke

SIMULATION HIGHLIGHTS

Feed + Dish
Fiberglass Struts
With/Without Choke

- Choke lowers sidelobes (as expected from the feed-only behavior)

- Lower sidelobes result in lower antenna noise vs. dish elevation

- Antenna noise calculated with OM6AA Antenna Noise Temperature Calculator (ANTC) fed with simulated radiation patterns.

- G/Ts $_{dB}$ = 10*LOG [10^(Gmax $_{dBi}$/10) /

  (LNA NF $_K$ + Antenna Noise $_K$)]
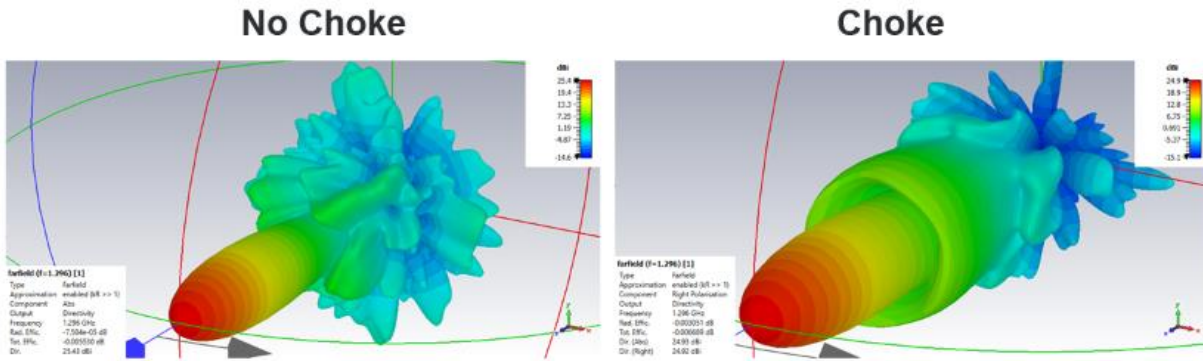
SIMULATION HIGHLIGHTS

**Feed + Dish
Aluminum Struts
With/Without Choke**

- Aluminum struts distort the beam and sidelobes

- Distortion is less noticeable with choke

- Noise temperature noticeably higher with Aluminum struts, even with choke (e.g., 3K @ 30°)

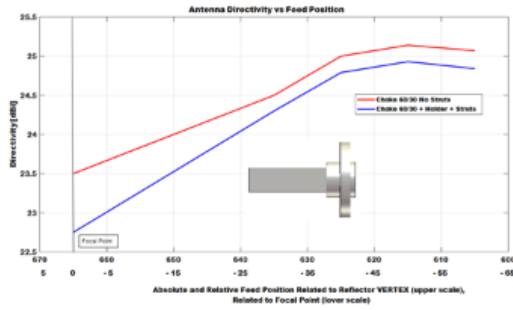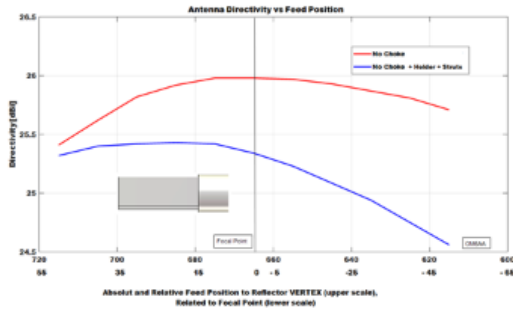# SIMULATION HIGHLIGHTS
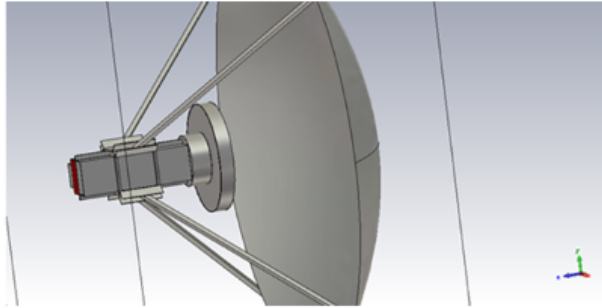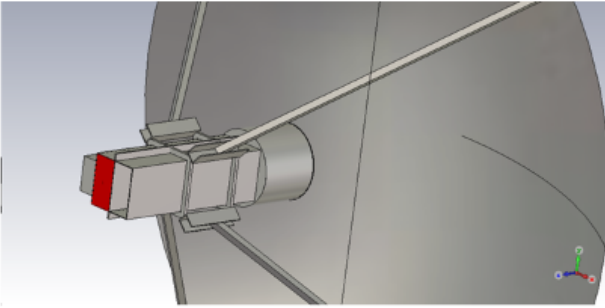
- Performance more sensitive to feed position with choke.

- Focus point +10 mm <u>outside</u> aperture without choke, -50 mm <u>inside</u> aperture with choke.

- With choke, -30 mm for best RX, -50 mm for best TX.

- Without choke, +10 mm for best RX, +10 mm for best TX.

- If invisible struts and holder, No Choke has about 1 dB more TX but 2 dB less RX.

- Struts and holder affect No Choke much more – nearly 2 dB on RX and 0.5 dB on Tx.
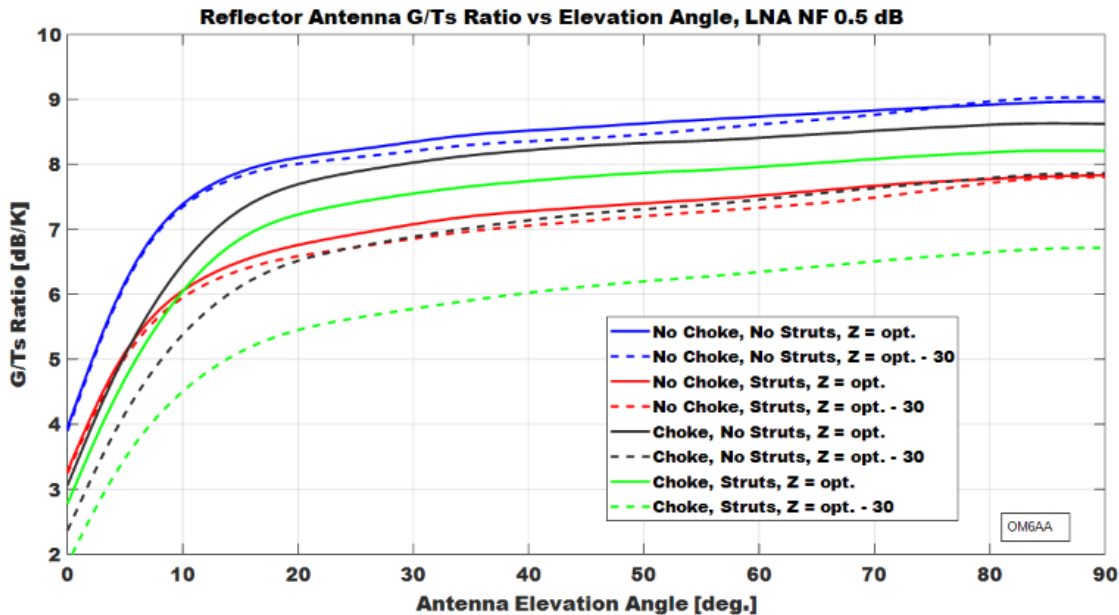
G/Ts, NF = 0.25dB

Added noise from a typical LNA @ 23 cm lowers the advantage of Choke vs No Choke

With metal struts, Choke still > 1 dB better than No Choke

Reflector Antenna G/Ts Ratio vs Elevation Angle, LNA NF 0.25 dB

Legend:
- No Choke, No Struts, Z = opt.
- No Choke, No Struts, Z = opt. - 30
- No Choke, Struts, Z = opt.
- No Choke, Struts, Z = opt. - 30
- Choke, No Struts, Z = opt.
- Choke, No Struts, Z = opt. - 30
- Choke, Struts, Z = opt.
- Choke, Struts, Z = opt. - 30

OM6AA
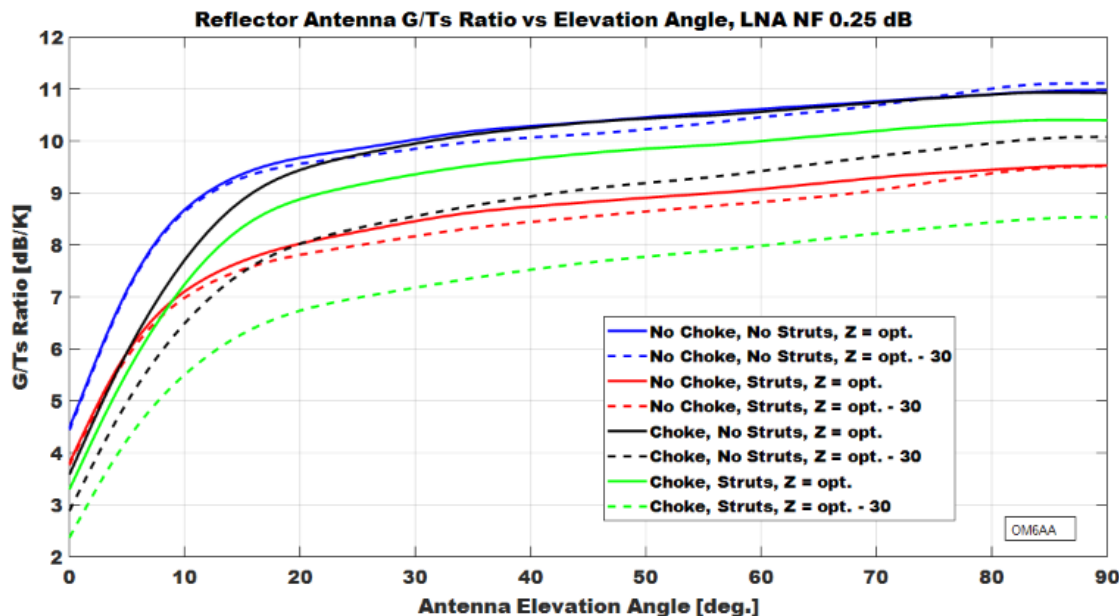
G/Ts, NF = 0.50dB

Higher NF reduces Choke advantage to < 1 dB

Reflector Antenna G/Ts Ratio vs Elevation Angle, LNA NF 0.5 dB

Legend:
- No Choke, No Struts, Z = opt.
- No Choke, No Struts, Z = opt. - 30
- No Choke, Struts, Z = opt.
- No Choke, Struts, Z = opt. - 30
- Choke, No Struts, Z = opt.
- Choke, No Struts, Z = opt. - 30
- Choke, Struts, Z = opt.
- Choke, Struts, Z = opt. - 30

OM6AA

Feed + Dish
With/Without Choke
Summary 2 of 3

- Added LNA noise starts to mask advantage of choke and fiberglass struts.

- With LNA NF = 0.25 dB and fiberglass struts, No Choke can <u>slightly</u> outperform choke on RX.

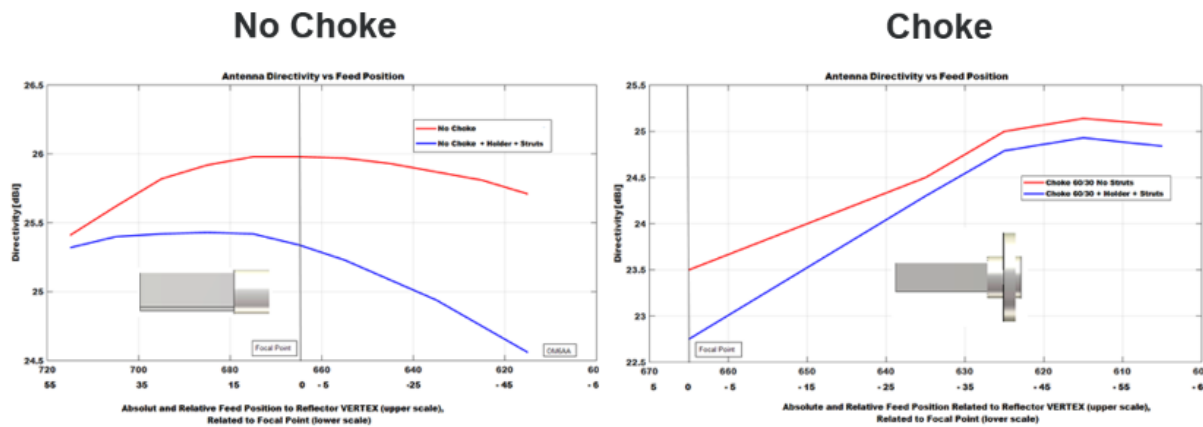- *This indicates an RA3AQ-type feed with fiberglass struts may be best with no choke.*

Feed + Dish
With/Without Choke
Summary 3 of 3

Gain (G)

With no struts,
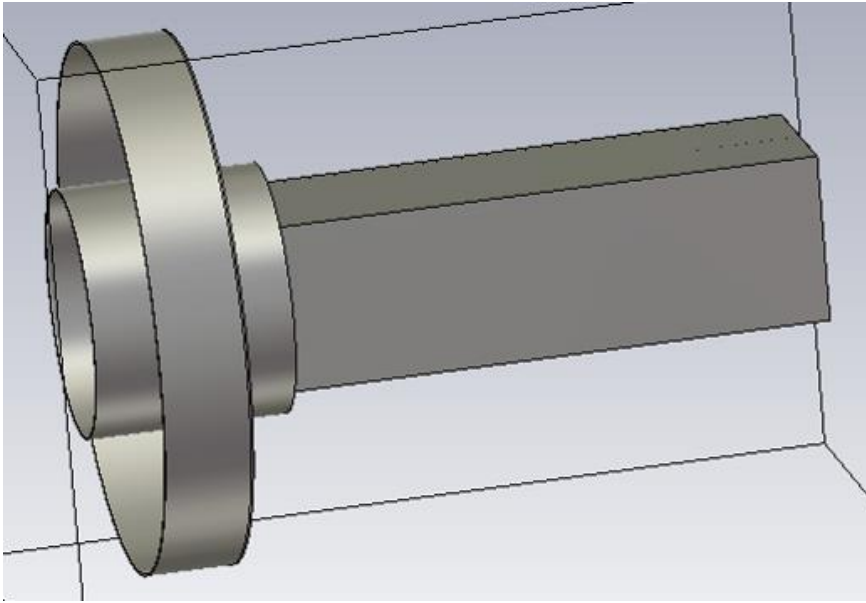No Choke has
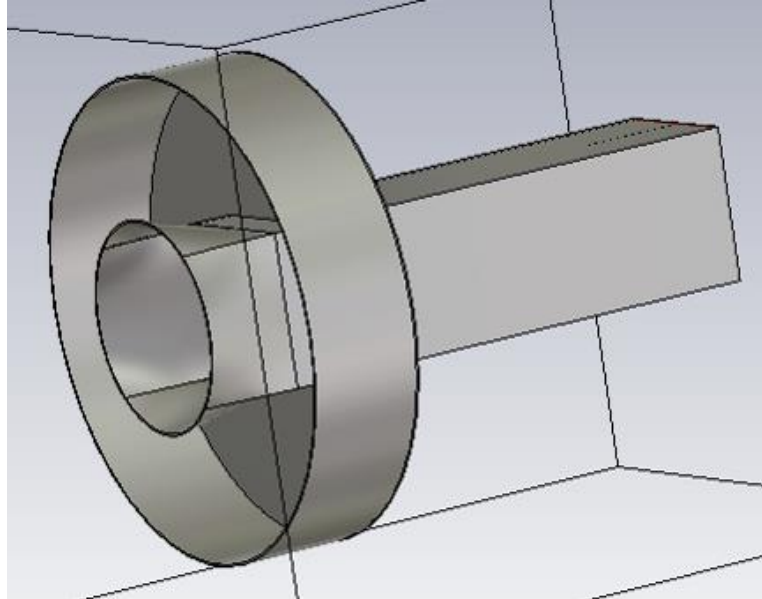0.8 dB higher
gain

With struts,
No Choke has
0.5 dB higher
gain

No Choke

Choke

- RA3AQ-type feed without Choke also has better TX.

RA3AQ-type

Better?

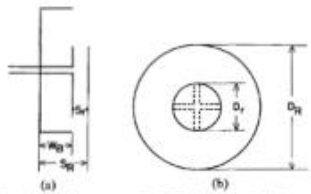CAN WE IMPROVE AN RA3AQ-TYPE FEED FOR A 1.9M F/D = 0.35 DISH?

Fig. 1. Two views of a conventional SBF antenna. (a) Front. (b) Cross section.

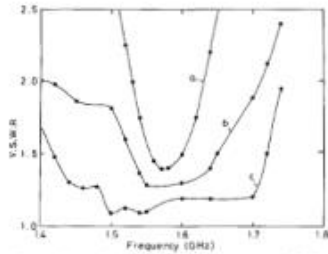Fig. 2. Radiation pattern of a conventional SBF antenna for 1540 MHz.

Fig. 3. Characteristics of input VSWR of three types of SBF antennas. a: Conventional SBF antenna with flat large reflector. b: Improved SBF antenna with conical large reflector. c: Improved SBF antenna with conical large reflector and second small reflector.
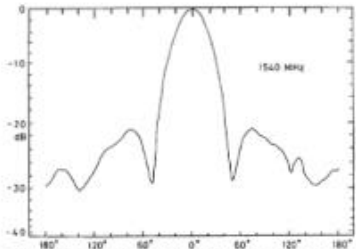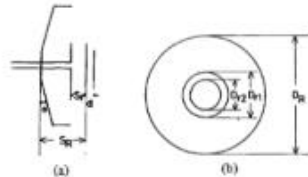
Fig. 4. Two views of improved SBF antenna. (a) Front. (b) Cross section.

SHORT BACKFIRE BEHAVIOR

- Simulations find the dish + feed combination provided two optimal focal points. This hints that the system may be operating as a Short Backfire Antenna (SBF).

- With a SBF, the choke + dish form a resonating cavity **with reduced sidelobes**. This helps negate the choke obstruction.

- Based on 1983 IEEE paper, an SBF antenna benefits with a Lamba/4 dish collar ring (58 mm).

- > 1 dB G/Ta simulated RX improvement with > 0.5 dB measured sun to cold sky improvement.
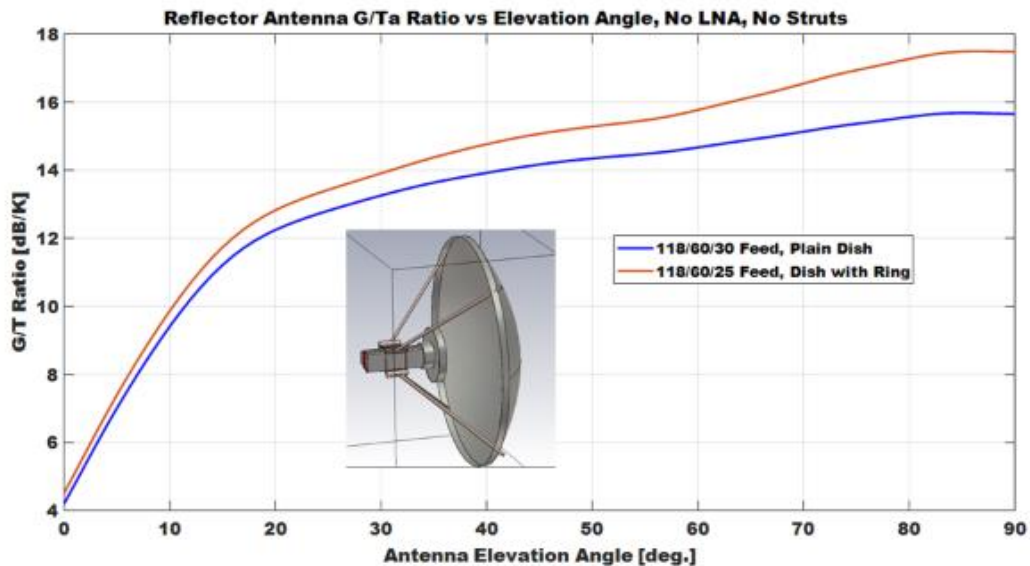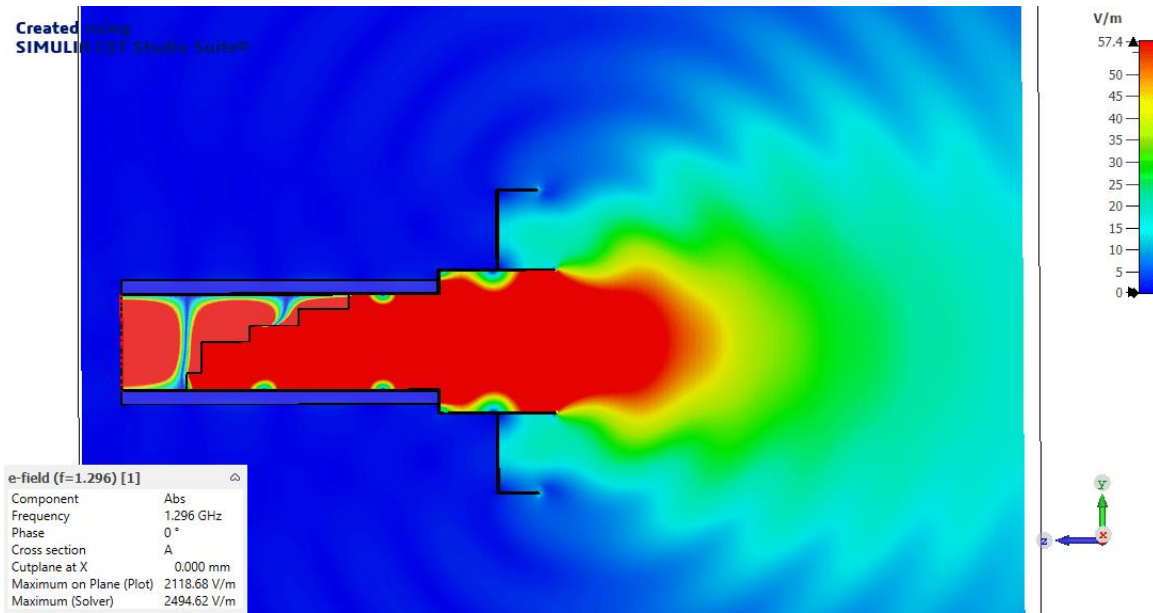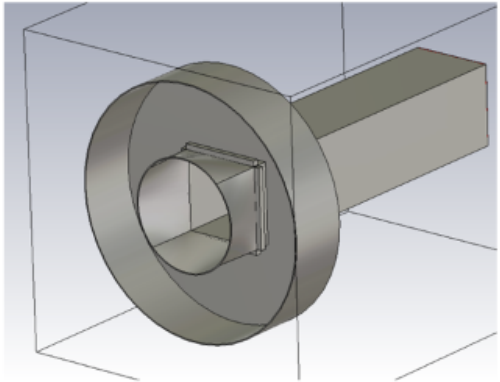
RESONANT WAVES

- With feed alone, choke fills with the E field.

- When dish added, three partially stationary waves form between dish vertex and feed. These are resonant waves.

- Choke fills with the waves reflected off the dish. **Reversed waves folding on choke rim combine with reflected waves to help reduce sidelobes with collar ring**.

- Disadvantage is S12 reduced from 30 dB to only 14 dB due to dish reflection.
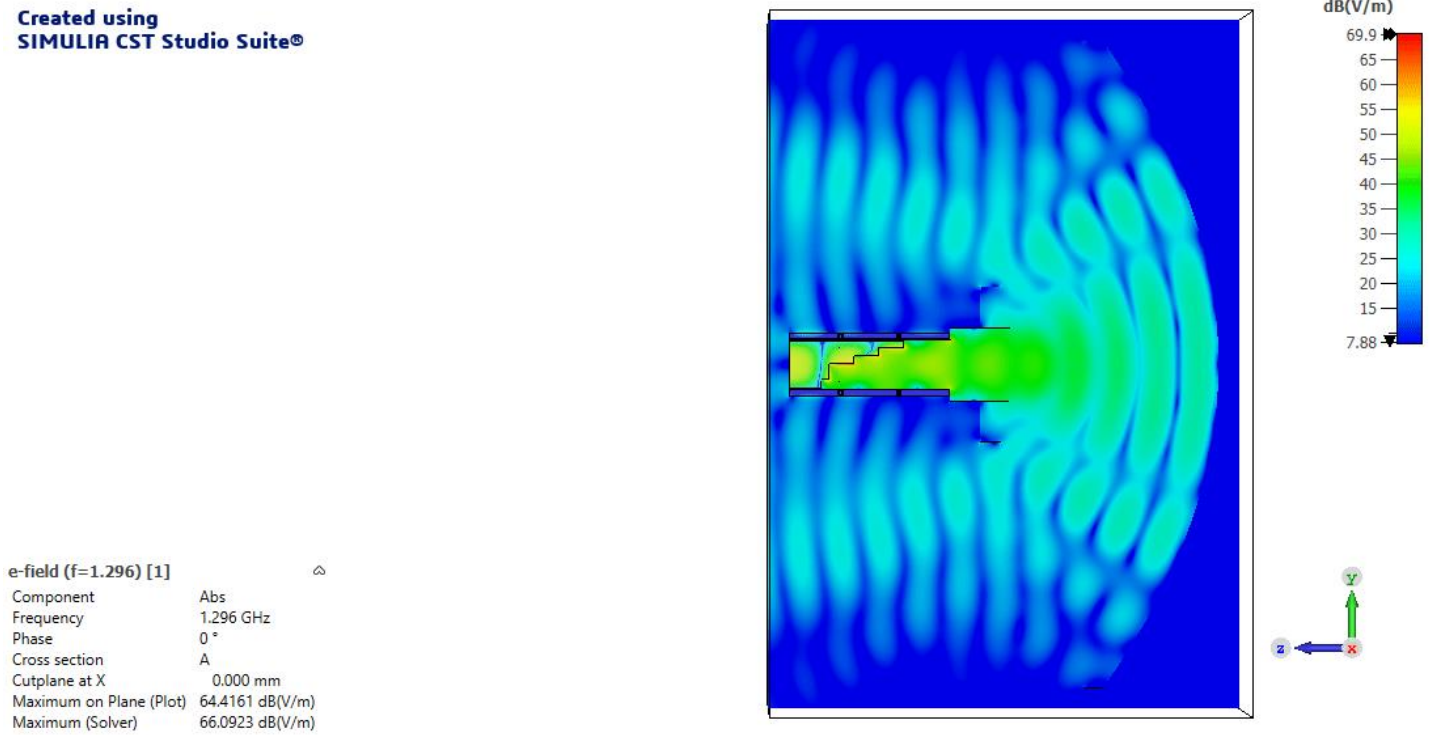
Square to Round Taper

The feed only pattern with a square to round taper (KA1GT) is nearly the same as that from the "perfect" round septum feed (VE4MA/OM6AA)
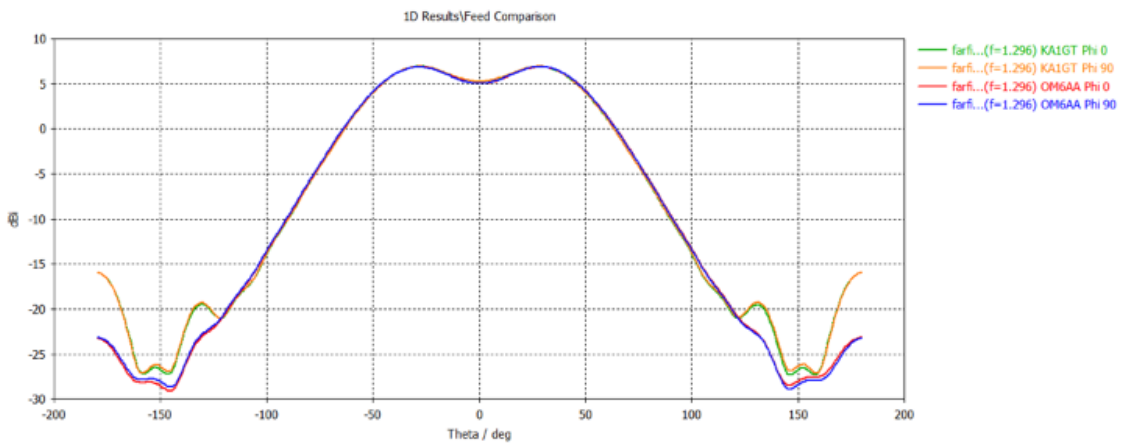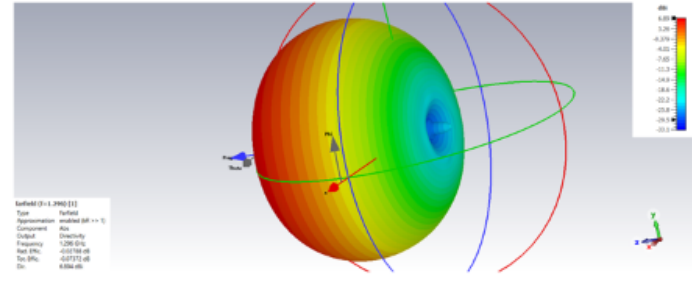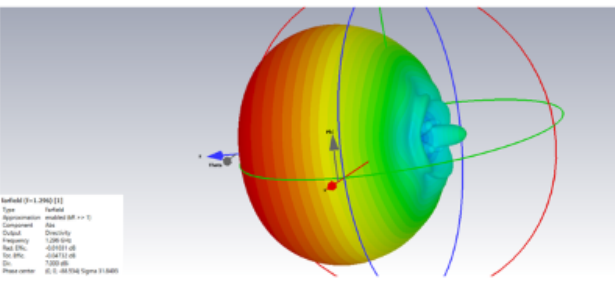
Square to Round Feed-only Pattern

Round Feed-only Pattern

1D Results\Feed Comparison

- farfi...(f=1.296) KA1GT Phi 0
- farfi...(f=1.296) KA1GT Phi 90
- farfi...(f=1.296) OM6AA Phi 0
- farfi...(f=1.296) OM6AA Phi 90

- Based on excellent RX performance observed by KA1GT, the abrupt square to round RA3AQ transition is replaced with a smooth square to round taper.

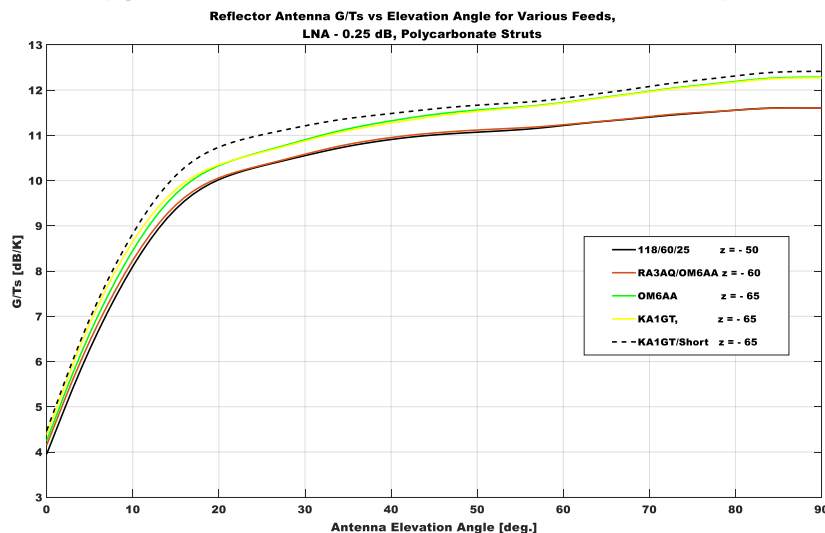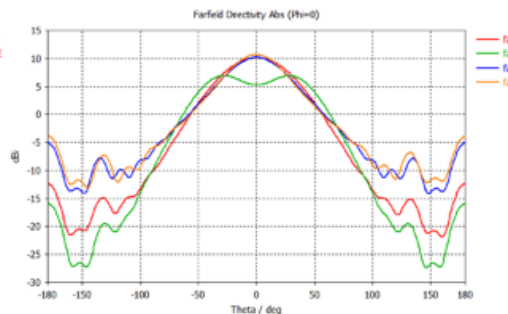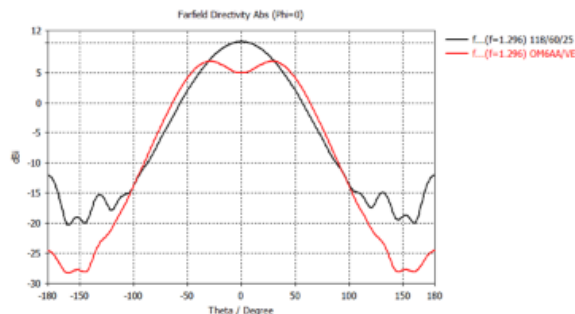- *Feed-only simulation indicates the pattern is nearly identical to a VE4MA/OM6AA round septum.*

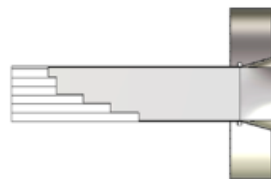## Comparing 3 "Best" Feeds

Extensive simulations at optimal focus and choke position yielded two feed competitors: OM6AA and KA1GT

OM6AA Round Septum w/ Super VE4MA Choke
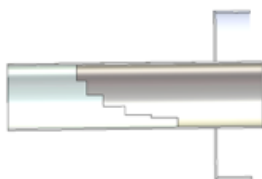
KA1GT Square to Round

Both feeds have a "fatter" pattern (fill the dish better) with lower sidelobes

Both feeds @ optimal focus provide similar RX performance that exceeds the optimized RA3AQ feed.

At the optimal RX focus, KA1GT feed provides the best TX performance and is the least sensitive to changes in the focal point

Reflector Antenna G/Ts vs Elevation Angle for Various Feeds, LNA - 0.25 dB, Polycarbonate Struts

FATTER PATTERN

Feed only & Feed + Dish Square to Round Taper Improvement 4 of 16

- Both the round septum and square to round taper show > 1 dB RX performance increase over the RA3AQ feed.

- Both feeds have a "fatter" pattern that fills the dish better with significantly lower sidelobes.

Antenna Directivity

When comparing the KA1GT system to the 118_60_30 RA3AQ system, we find the KA1GT system has significantly higher TX gain that is less dependent on feed position.
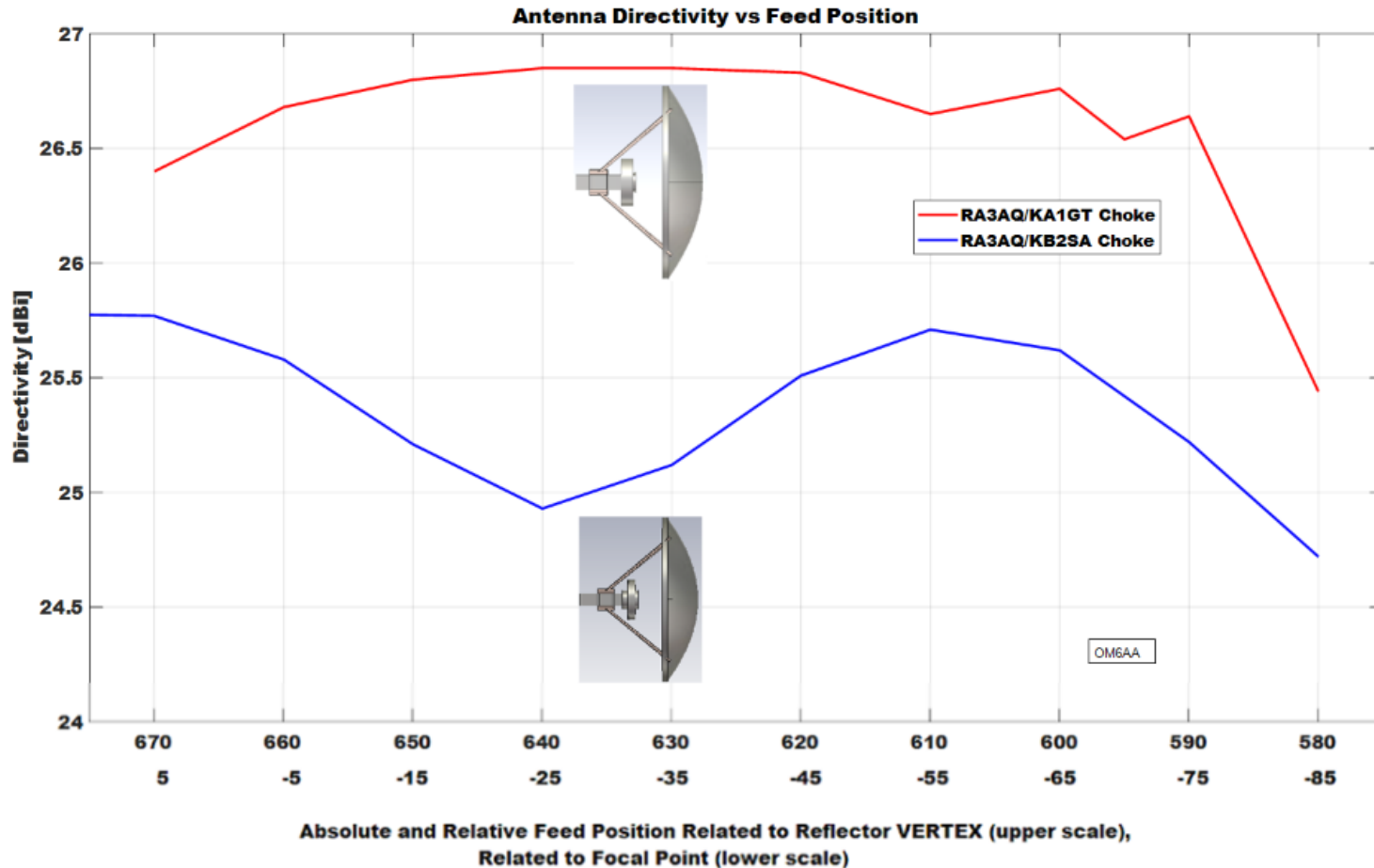

SAME TX AND RX POSITION

- The smooth square to round taper also shows a significant improvement over the abrupt square to round transition for TX gain.

- TX gain improved 1 dB and is less dependent on feed position.

- *The optimal feed position is also nearly the same for both RX and TX.*

RX Performance

When comparing the KA1GT system to the 118_60_30 system, we find the KA1GT system has significantly higher RX performance at the optimal focal point. KA1GT also less susceptible to focal point changes.
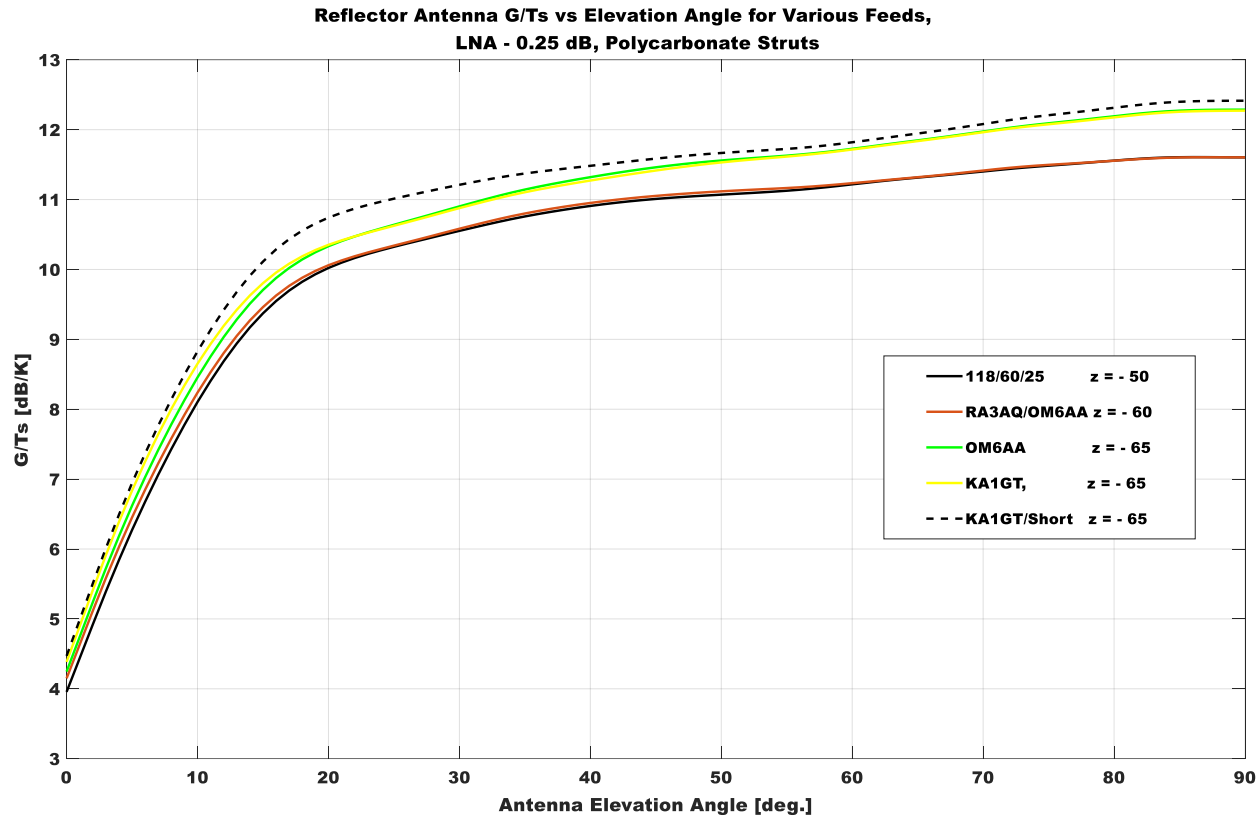

RA3AQ 118_60_30/No Choke Feed

KA1GT Feed
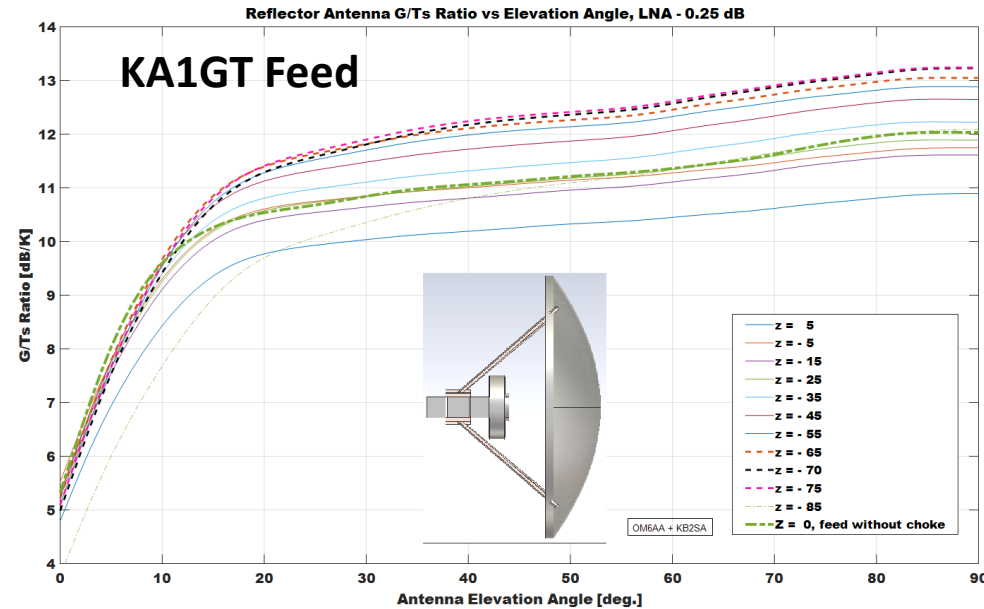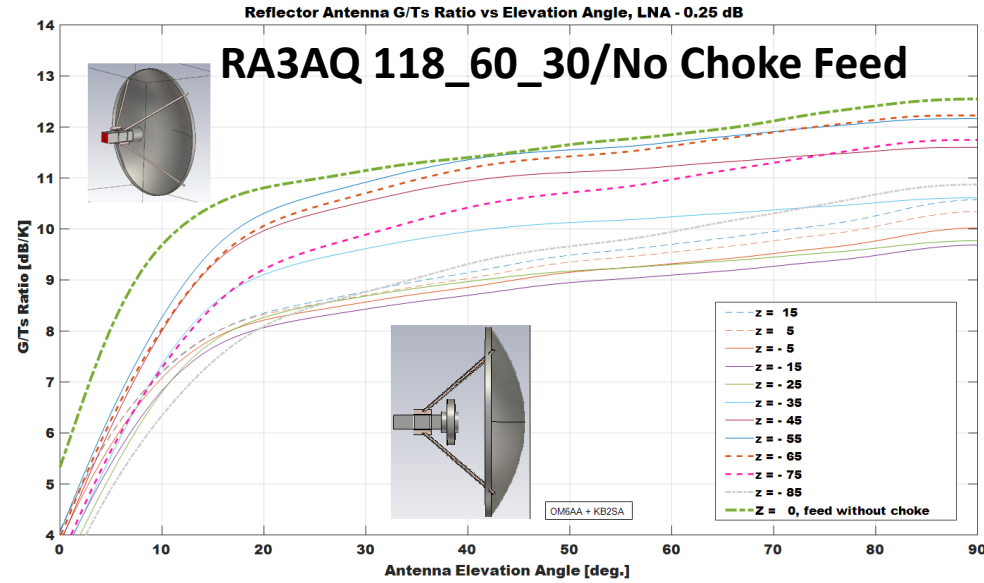
SQUARE TO ROUND TAPER!

**Feed + Dish
Square to Round Taper
Improvement 6 of 16**

- In summary, the smooth square to round taper has > 1 dB RX performance gain over the abrupt square to round transition.

- The RX performance is also less susceptible to feed position.

- *RA3AQ feed with No Choke better than Choke.*

Can we shorten the KA1GT feed?

To help lower feed weight, simulations were performed on a shortened KA1GT feed. G/Ts performance is not degraded, but S12 decreased from 20 to 18 dB.
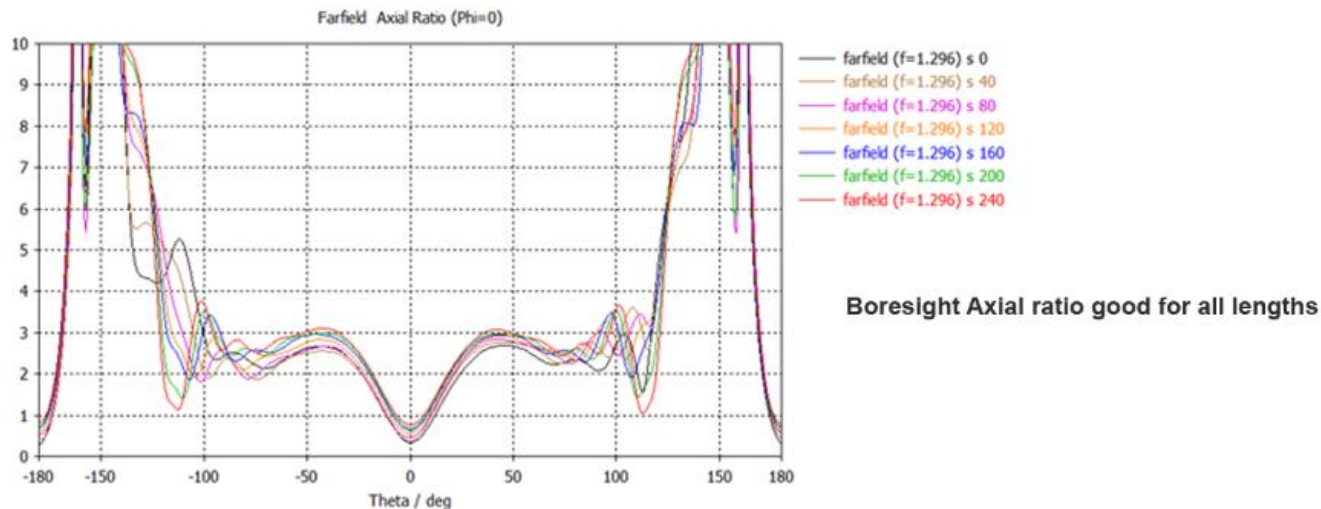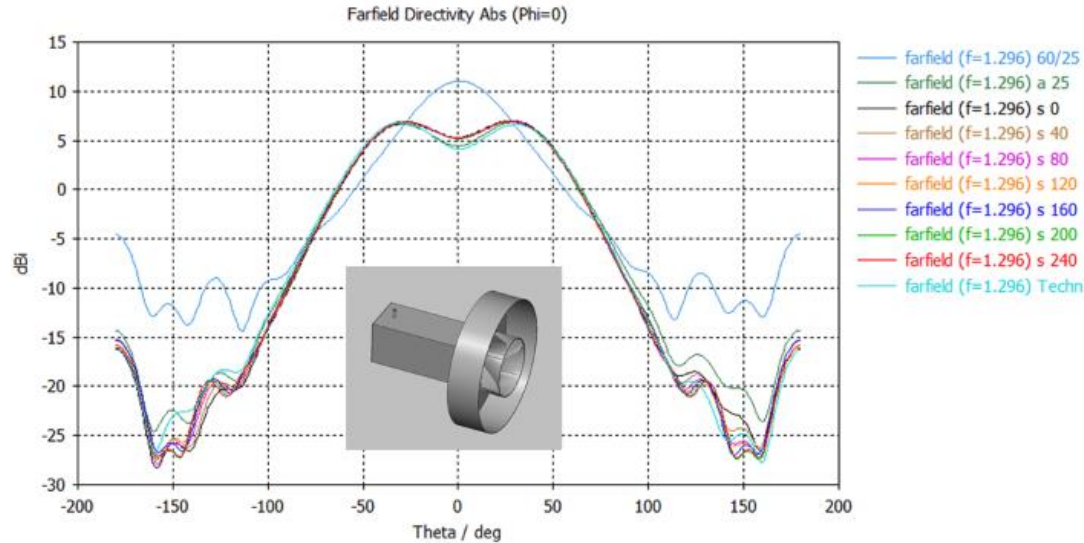
Reflector Antenna G/Ts vs Elevation Angle for Various Feeds, LNA - 0.25 dB, Polycarbonate Struts

Legend:
- 118/60/25   z = - 50
- RA3AQ/OM6AA z = - 60
- OM6AA   z = - 65
- KA1GT,   z = - 65
- KA1GT/Short   z = - 65

CAN WE SHORTEN FEED?

- There has been interest in a high-performance lightweight feed for portable operations.

- *An overall feed length of 470 mm outperforms 710 mm.*

- Shorter feed only looses 2 dB S12. We will fix this.

Feed length vs pattern

1. Plot "60/25" is a 60 mm deep choke 25 mm behind the aperture. This is not an optimal pattern.
2. Plot "a 25" is a 110 mm deep choke 25 mm behind the aperture.
3. Plots "s 0" to "s 240" are a 110 m deep choke 15 mm behind the aperture.
4. "s 240" = overall 710 mm feed length. "s 0" = 470 mm overall feed length. Note little effect on pattern.
5. A choke depth of lambda/2 widens the pattern by reversing the phase of the reflected field.

Farfield Directivity Abs (Phi=0)

- farfield (f=1.296) 60/25
- farfield (f=1.296) a 25
- farfield (f=1.296) s 0
- farfield (f=1.296) s 40
- farfield (f=1.296) s 80
- farfield (f=1.296) s 120
- farfield (f=1.296) s 160
- farfield (f=1.296) s 200
- farfield (f=1.296) s 240
- farfield (f=1.296) Techn

Farfield Axial Ratio (Phi=0)

- farfield (f=1.296) s 0
- farfield (f=1.296) s 40
- farfield (f=1.296) s 80
- farfield (f=1.296) s 120
- farfield (f=1.296) s 160
- farfield (f=1.296) s 200
- farfield (f=1.296) s 240
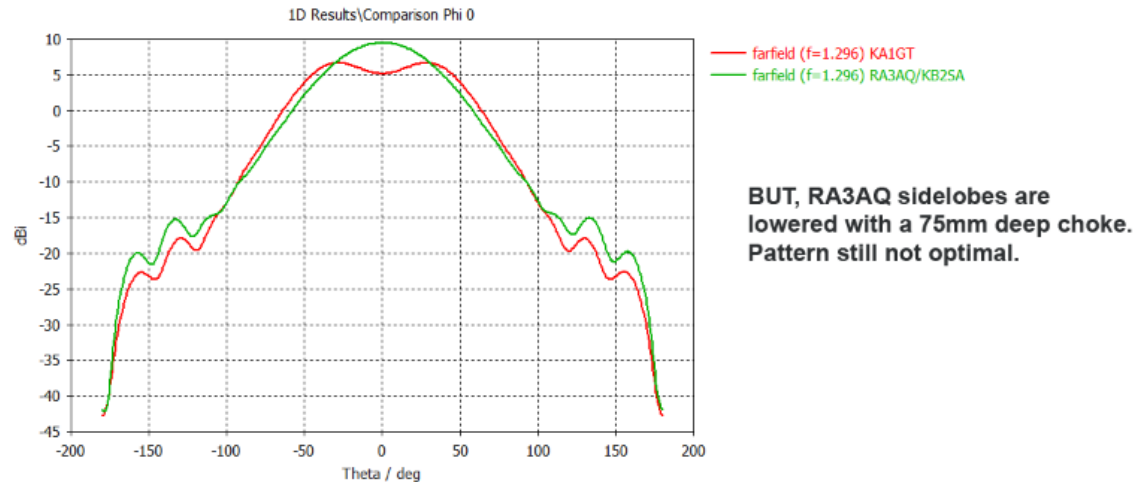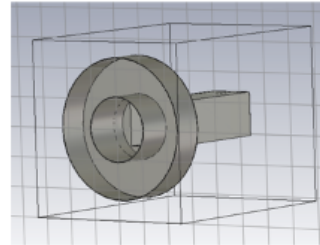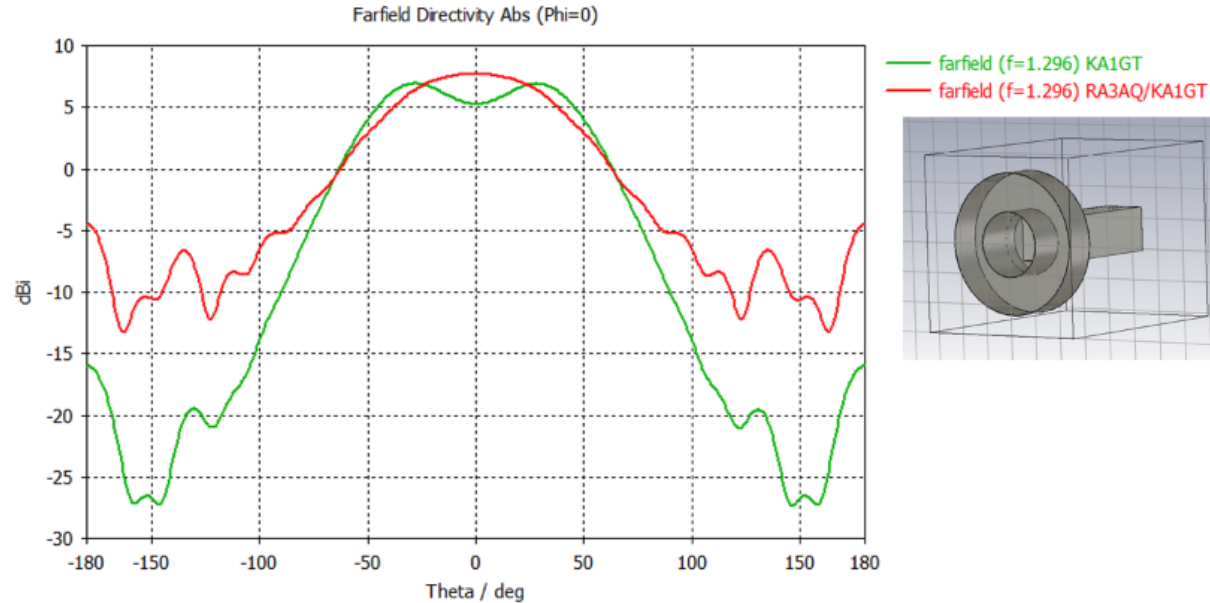
Boresight Axial ratio good for all lengths

LENGTH & CHOKE DEPTH

Feed only
Square to Round Taper
Improvement 8 of 16

- Extensive simulation confirms feed pattern is nearly identical for overall feed lengths between 710 mm and 470 mm.

- The more critical dimension is the choke depth.

- *A choke depth near lambda/2 (110 mm) creates a desirable wide pattern due to resonating choke structure.*

Can a deep (110mm choke) improve the RA3AQ performance?

Adding a 110mm deep choke to the RA3AQ feed with an abrupt square to round transition does not improve the feed pattern. There is a waveguide discontinuity between the square and round sections that is not present with the smooth square to round transition.

Farfield Directivity Abs (Phi=0)

— farfield (f=1.296) KA1GT
— farfield (f=1.296) RA3AQ/KA1GT

1D Results\Comparison Phi 0

— farfield (f=1.296) KA1GT
— farfield (f=1.296) RA3AQ/KB2SA

BUT, RA3AQ sidelobes are lowered with a 75mm deep choke. Pattern still not optimal.

DEEP CHOKE ON RA3AQ?

- Can a lambda/2 (110 mm) deep choke improve the RA3AQ feed performance?

- The "fat" pattern cannot be realized. A "waveguide discontinuity" occurs. This is not seen with the square to round taper.

- A 75 mm deep choke does lower sidelobes, but the pattern is still not optimal.

How does the feed pattern vary with choke depth?

Here we show the feed pattern as we vary the choke depth on the KA1GT feed. Each example has the choke set back 25 mm compared with the original KA1GT feed with 110 mm choke set back 15 mm.

Note how a shallow choke depth (80 mm) creates an undesirable pattern. A 100 mm deep choke appears optimal.
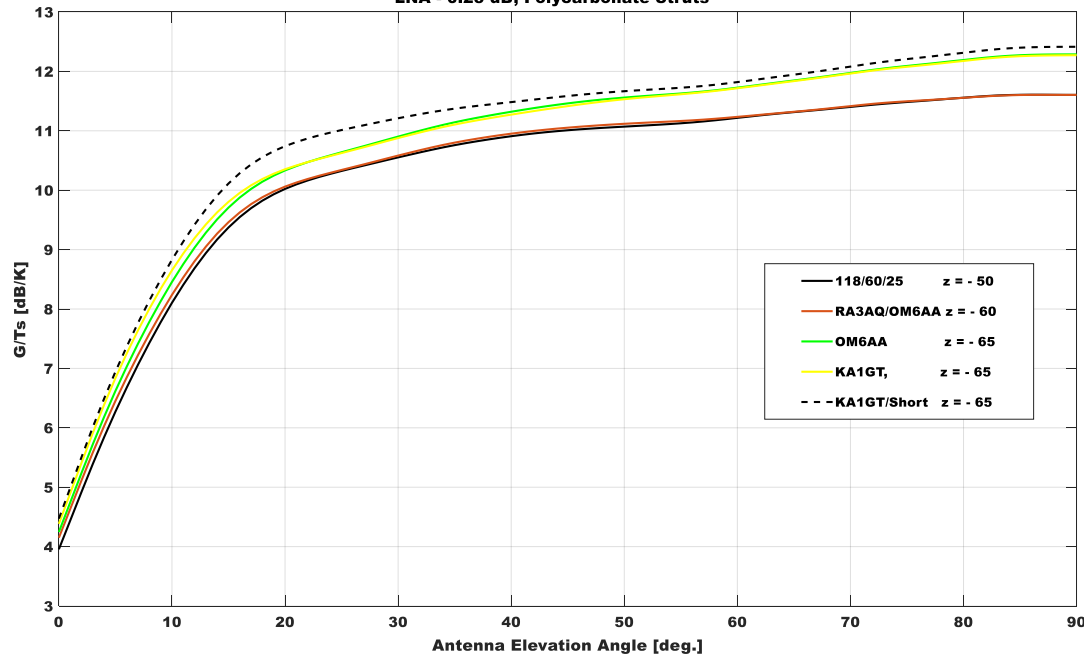
This is with the short (470 mm) KA1GT feed variant.

Farfield Directivity Abs (Phi=0)

— farfield (f=1.296) 110/ a 15
— farfield (f=1.296) Choke 80
— farfield (f=1.296) Choke 90
— farfield (f=1.296) Choke 100
— farfield (f=1.296) Choke 110

Feed only
Square to Round Taper
Improvement 10 of 16

- Feed shows the desirable "fat" pattern as choke depth increases.

- Pattern flattens noticeably @ 90 mm.

- As choke depth increases, pattern stays flat and sidelobes decrease and then start rising.

Differs slightly from KA1GT feed as shown
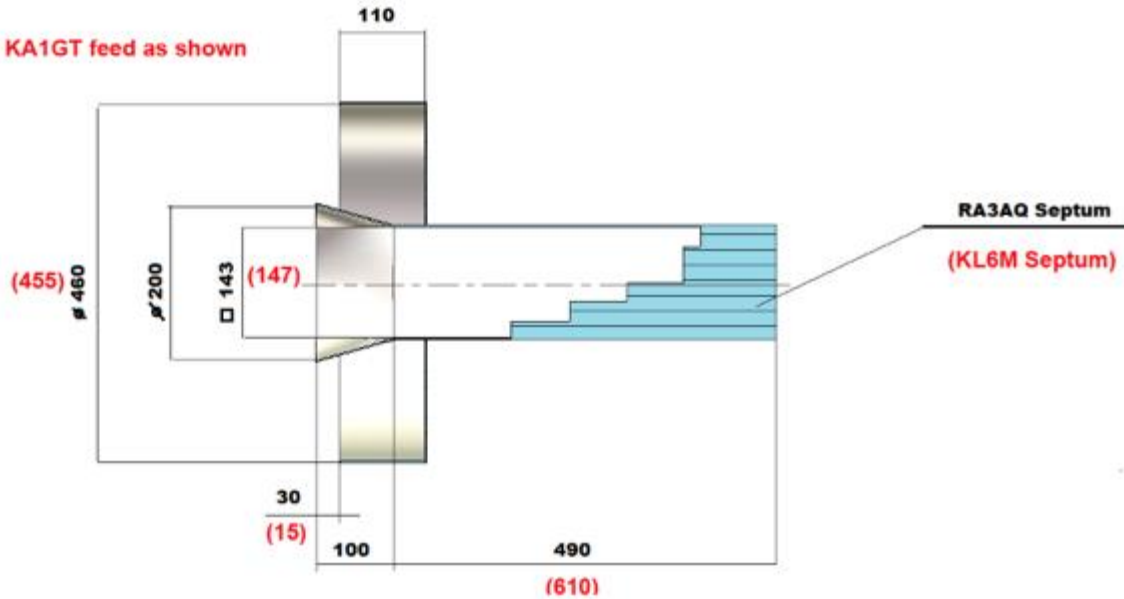
RA3AQ Septum
(KL6M Septum)

Reflector Antenna G/Ts vs Elevation Angle for Various Feeds,
LNA - 0.25 dB, Polycarbonate Struts

Line	Label	z value
——	118/60/25	z = - 50
——	RA3AQ/OM6AA	z = - 60
——	OM6AA	z = - 65
——	KA1GT,	z = - 65
- - -	KA1GT/Short	z = - 65

LET'S SUMMARIZE

- A very high-performance 23cm feed for a 1.9m f/d = 0.35 dish starts with an RA3AQ septum and adds a 110 mm deep choke and square to round taper.

- Optimal dimensions are very similar to that found experimentally by KA1GT (choke setback tuned to f/d).

- *A total feed length of 470 mm is noticeably better than 710 mm* (590 mm shown in the figure).

- Optimal focal point is approximately 65 mm <u>inside</u> the feed.

MEASURED:

85º F ambient (300K)
LNA NF = 0.25 dB

S12 = 14 dB
Relay + connector loss = 0.1 dB

- RX noise from TX port = 300 / 10^(14/10) = **12K**
- Equivalent LNA noise = 300 * (10^((0.25+0.1)/10) − 1) = **25K**
- Antenna noise @ 30º elevation = **12K**

Total noise = **12K** + **25K** + **12K** = **49K**

If we can remove the **12K** noise from the TX port we can realize
10 * LOG [49/(49-12)] = **1.2 dB increased RX sensitivity.**

WHAT ABOUT S12?

Feed + Dish
Square to Round Taper
Improvement 12 of 16

- Earlier we saw that the isolation between the RX and TX port (S12) was significantly reduced when the dish is present with a square to round taper (14 dB measured).

- Assuming 85º F (300K) ambient and .25 dB LNA NF, RX sensitivity is reduced 1.2 dB due to 300K noise on the TX port from 50-ohm termination.

S12 is significantly degraded with the addition of the flare. -14 dB was measured. -15dB seen in simulation and varies with focal point.

With degraded S12, noise on the TX port appears at the RX port. This increased the RX noise floor nearly 1 dB. A 50mm disk centered 45mm inside the flare lowered this TX noise. Dimensions selected by experimentation.
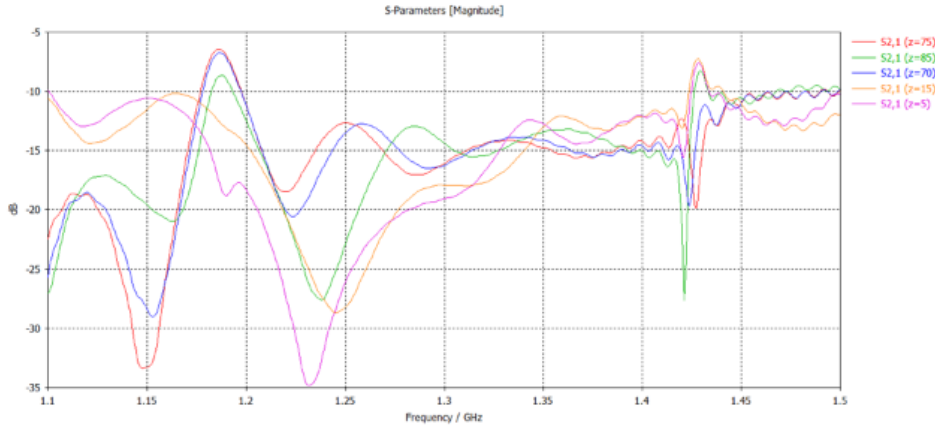
RECOVER S12 WITH DISK

Feed + Dish
Square to Round taper
Improvement 13 of 16
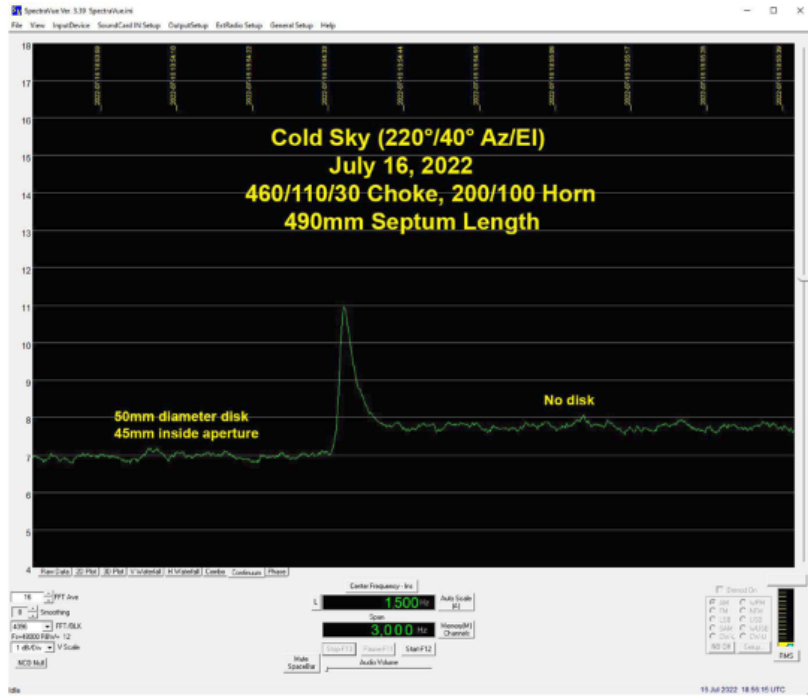
- A 50 mm metal disk centered 45 mm inside the taper increases S12 enough to eliminate the TX port noise on the RX port.

- RX sensitivity increased nearly 1 dB.

Simulations varied the disk diameter and placement to help characterize the behavior.

Simulation found the disk placement and diameter did not change the overall G/Ts.

S12?

Z	1	2
65	45	50
65	45	45
65	45	55
65	40	45
65	40	50
65	40	55
65	50	45
65	50	50
65	50	55
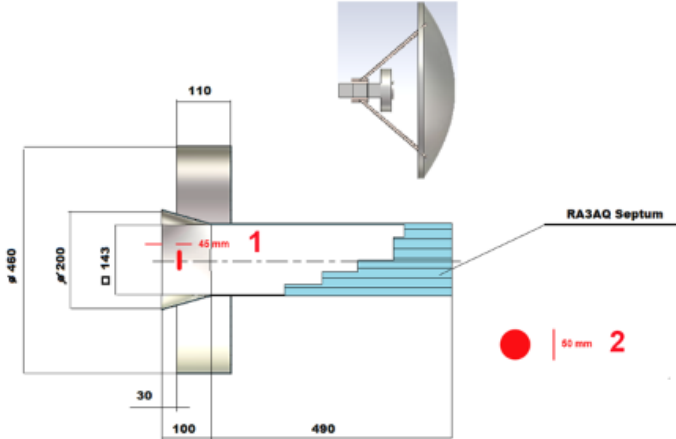
DISK NO EFFECT ON G/T

Feed + Dish
Square to Round taper
Improvement 14 of 16

- Disk diameter between 45 and 55 mm placed 40 to 50 mm inside taper has no effect on G/Ts.
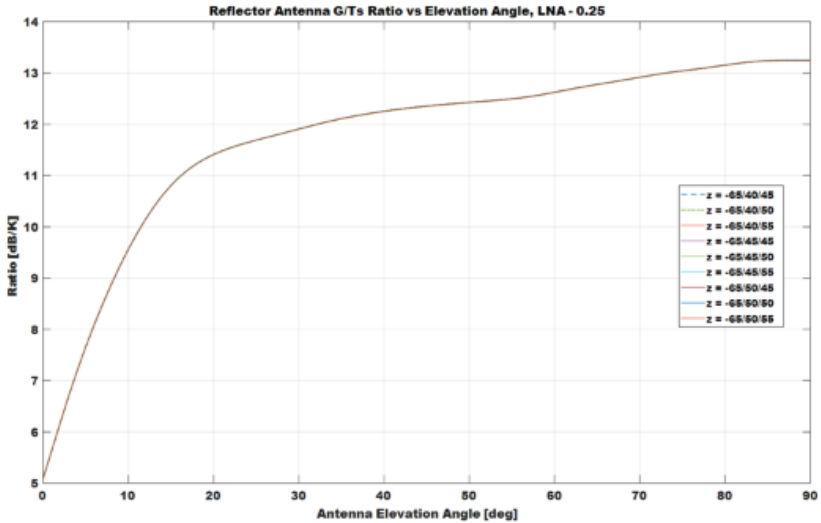
Simulations confirmed the 50mm disk 45mm inside the flare (45i/50d) is very good (-30dB), with 45i/45d and 50i/50d possibly being slightly better (-32dB)

Feed + Dish
Square to Round taper
Improvement 15 of 16

- S12 increased from 14 dB to > 30 dB with 45 – 50 mm diameter disk placed 45 – 50 mm inside flare.
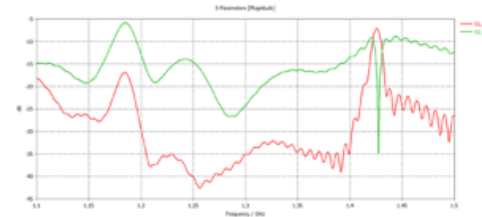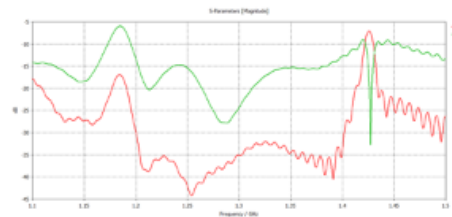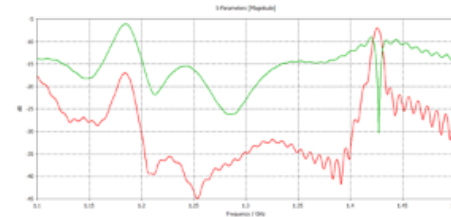
40i/45d   40i/50d   40i/55d
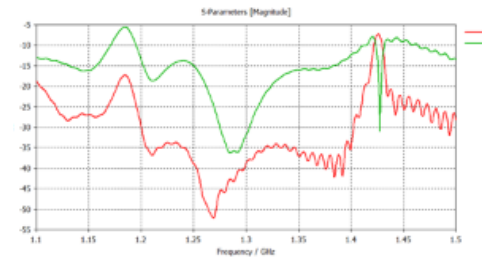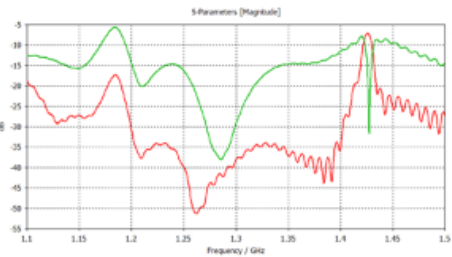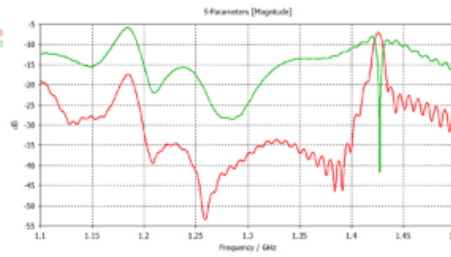
45i/45d   45i/50d   45i/55d

50i/45d   50i/50d   50i/55d

Reflector Antenna G/Ta Ratio vs Elevation Angle, No LNA
f/D = 0.33 Ratio, Choke Position 30 mm

Reflector Antenna G/Ta Ratio vs Elevation Angle, No LNA
f/D = 0.36 Ratio, Choke Position 30 mm
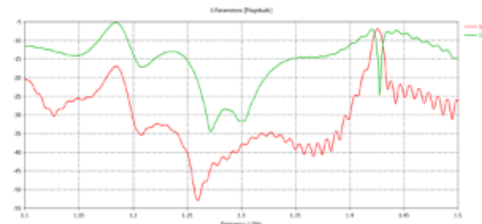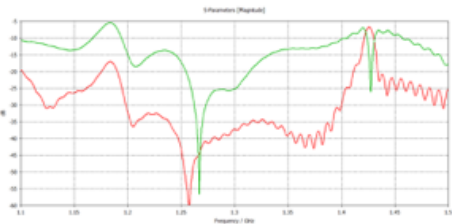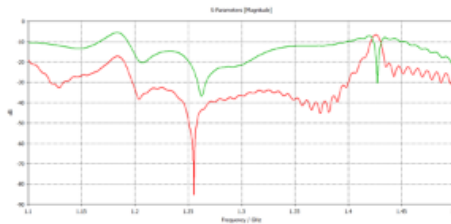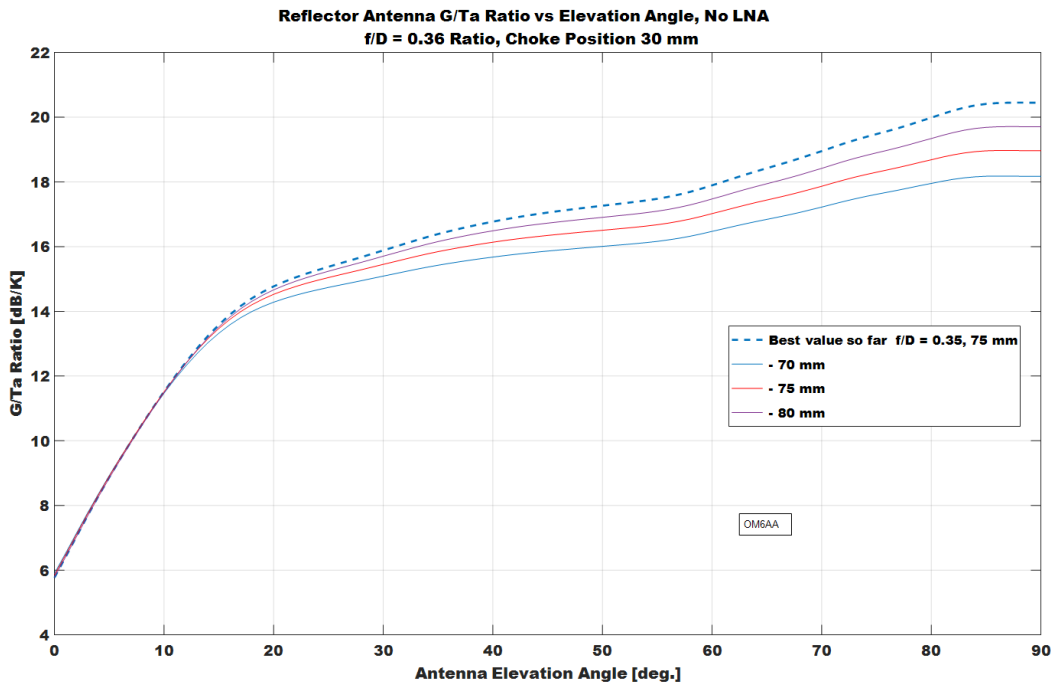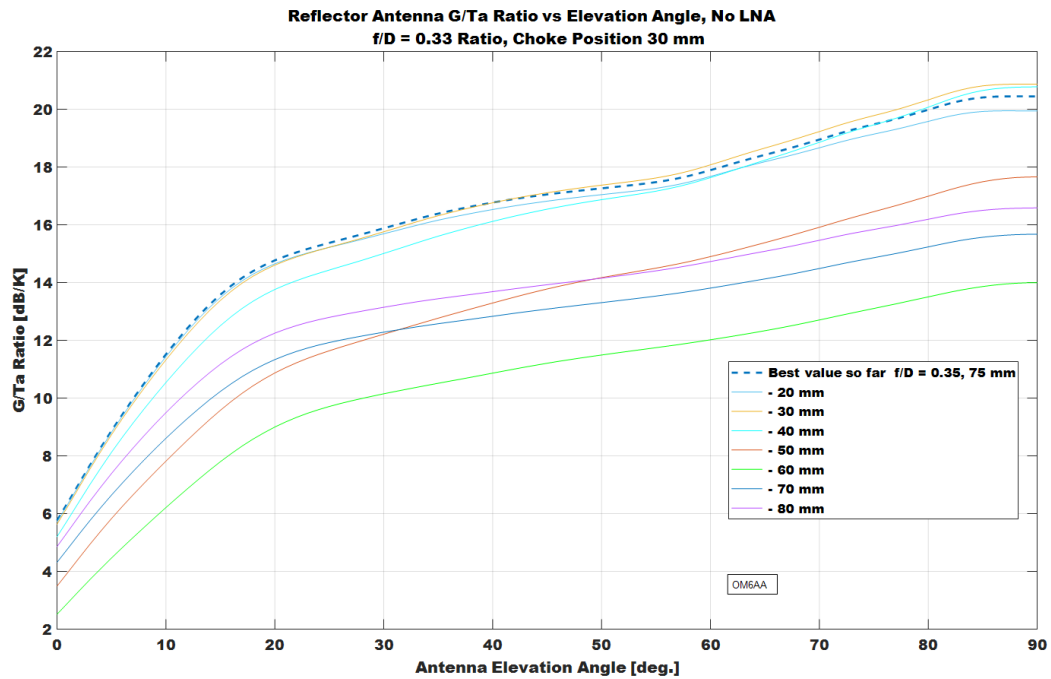
DIFFERENT F/D BETTER?

- f/d = 0.35 works well with this feed type. Might a different f/d work better?

- A "deeper" f/d = 0.33 dish is slightly better. Shallower dishes (e.g., f/d > 0.36) are noticeably worse.

- Varied choke position and focus to confirm behavior.

Fiberglass struts
58 mm collar ring

RA3AQ Septum

45 mm

50 mm

Measured with
SpectraVue

Sun SFU vs
Sun to Cold Sky (dB)

SUN TO COLD SKY

**Feed + Dish + S12 Disk
Actual Feed (590mm length)**

- Current KB2SA system (2023/2024).

- Sun to cold sky signal measured during 2023/2024 with 1.9m f/D = 0.35 mesh wire dish, collar ring, fiberglass struts, 0.25 dB NF LNA and S12 disk.

- *Adjust RF gain as needed so strongest and weakest signals are within the total RX system's linear response region (e.g., no sun saturation).*

- *AGC, Noise Reduction (NR) and Noise Blanking (NB) off. Sun > 40º.*

1.9M FEED ON 4.88M DISH

"KB2SA" feed radiation relatively uniform
in near, fresnel, and far field
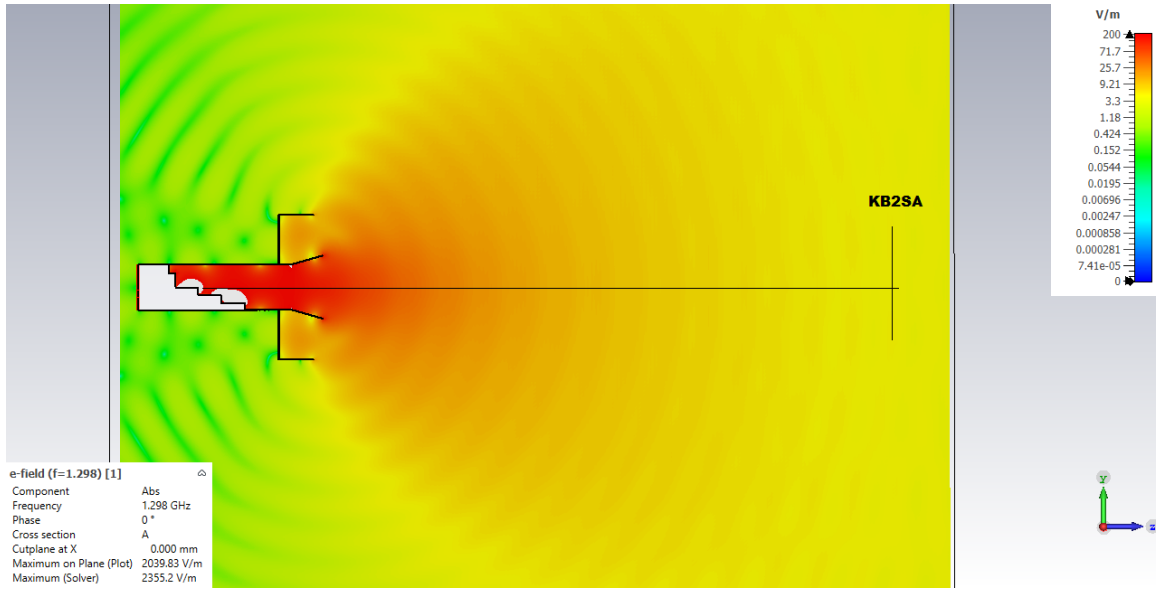
Mats made a
polycarbonate cover
for tunable S12 disk
and birds/insects

1.9M FEED ON 4.88M DISH

Mats Bengtsson, KD5FZX
4.88M Solid, F/D = 0.39
"KB2SA" Feed

- Mats, KD5FZX, expertly constructed the "KB2SA" feed with choke offset tuned to his 4.88M f/d = 0.39 dish.

- The theoretical difference between 1.9m and 4.88m is about 8 dB.

- A 7-8 dB delta is confirmed on both TX and RX with hundreds of QSOs and echo tests.

- We suspect < 1dB loss due to non-optimal f/d = 0.39.

SSTV EME QSO (Scottie DX)
Martin 2 easily readable

NOTEWORTHY 1.9M 23CM QSOS

NOTEWORTHY 1.9M 23CM QSOS

Timing is everything

- BH1TSU w/36-element yagi
- ZL1NJR w/1.8m folding dish through trees
- ZC4RH w/67-element yagi
- KA1GT w/3.1m dish *and 5 watts*
- DK0TE w/70-element yagi (easy 60C and 30B QSOs)
- WAS #24. *Thank you Peter, KA6U and Gene, KB7Q!*
- 2,895+ QSOs on LoTW
- ARRL International EME Contest, SO-1.2G
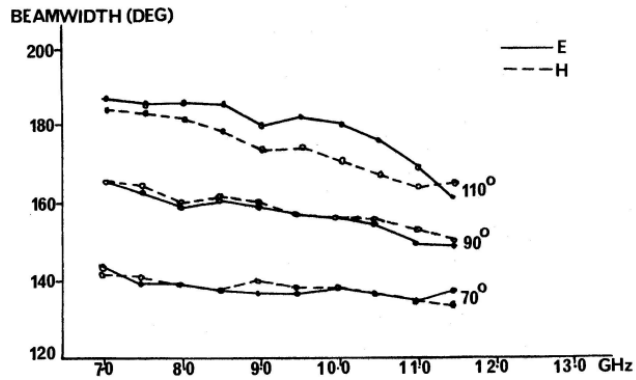   - 2023: **#11**/60
    - 2022: **#13**/43
    - 2021: **#16**/51
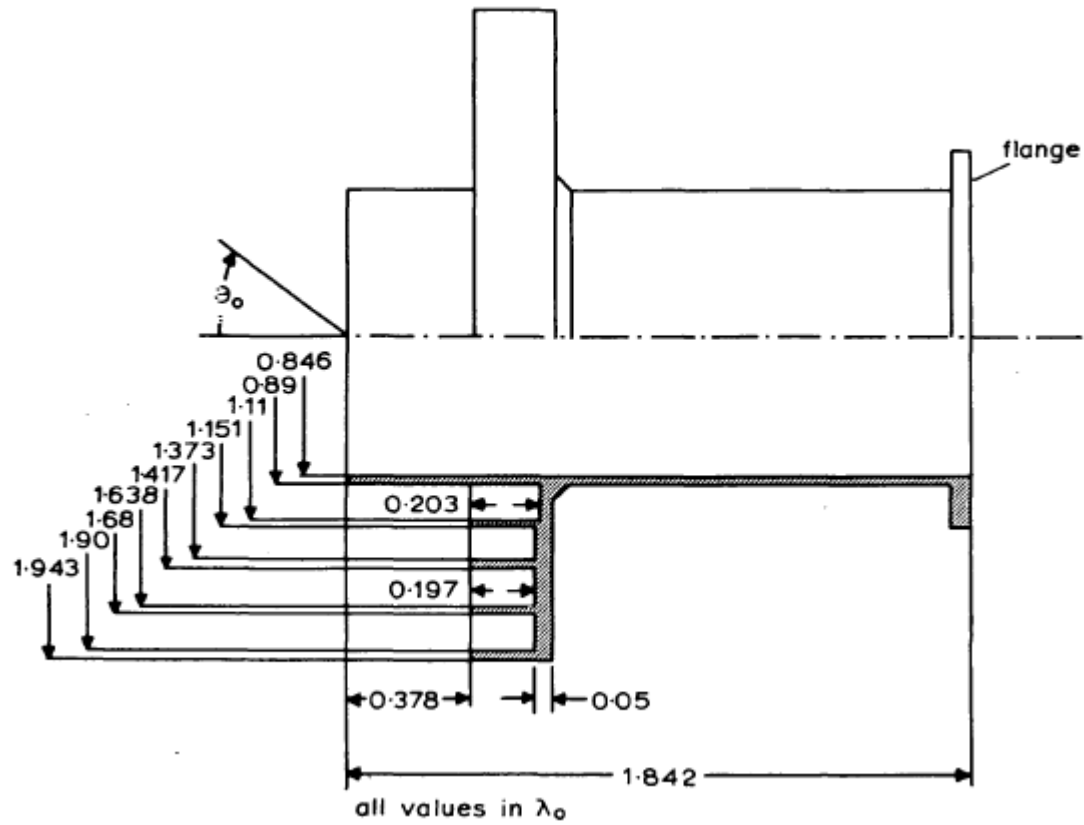
WHAT'S NEXT

LOOK BACK TO LOOK AHEAD
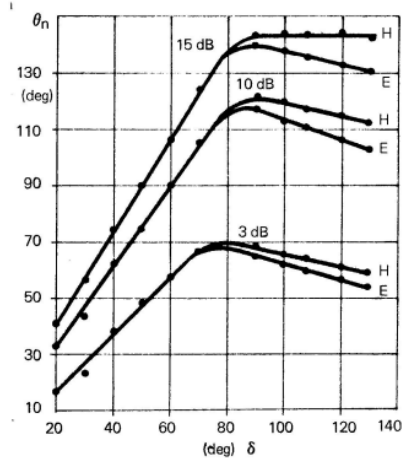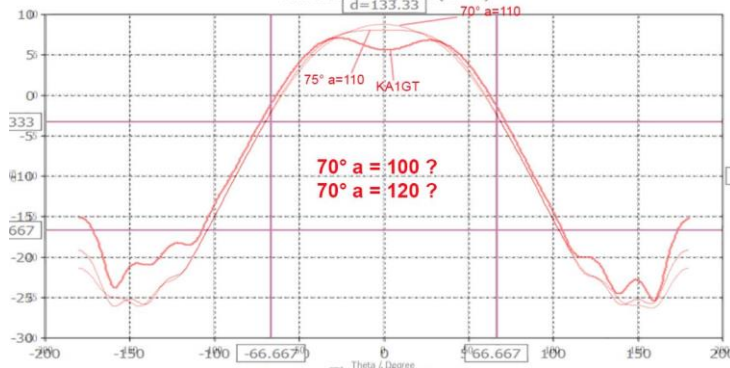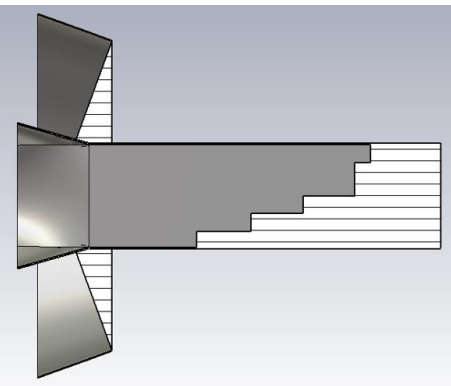
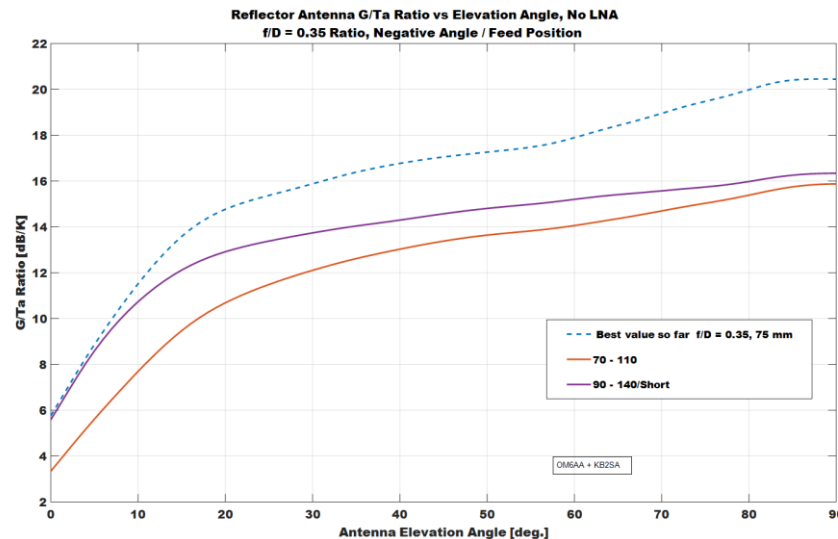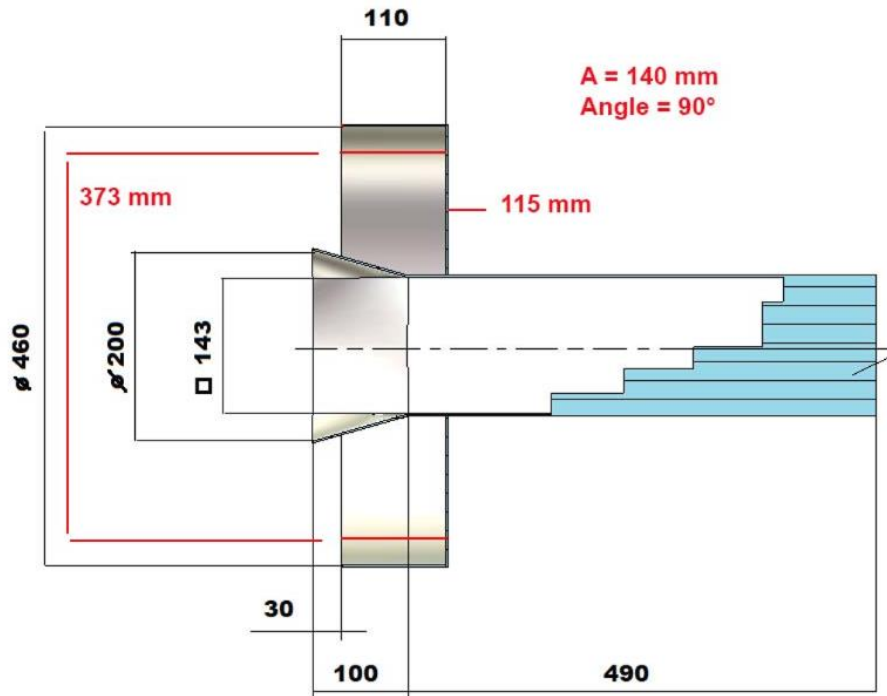# CONVEX CHOKE

1971

1980

2024

Does it improve G/Ts ?

- Experiments by McInnes and Booker in 1971 indicate a 110° choke flare may provide a "fatter" beam.

- A revisit by Pagana and Massaglia in 1980 indicate flares > 90° do not widen beamwidth.

- Simulation in 2024 confirm the 1980 results using different flare angles and choke setbacks. 110° and 105° flare with 110 mm setback shown here. No improvement in G/Ts.

SMALLER CHOKE

Does it improve G/Ts ?

- Might a smaller choke have less obstruction to overcome "non-resonant" losses?

- <u>Preliminary</u> results show no improvement. *More simulation is needed.*

- G/Ta shown here is best so far vs 110° flare with 110 mm setback and 90° flare with 140 mm setback and 373 mm diameter choke.

THANK YOU!

Bill Siino
KB2SA
San Diego, CA