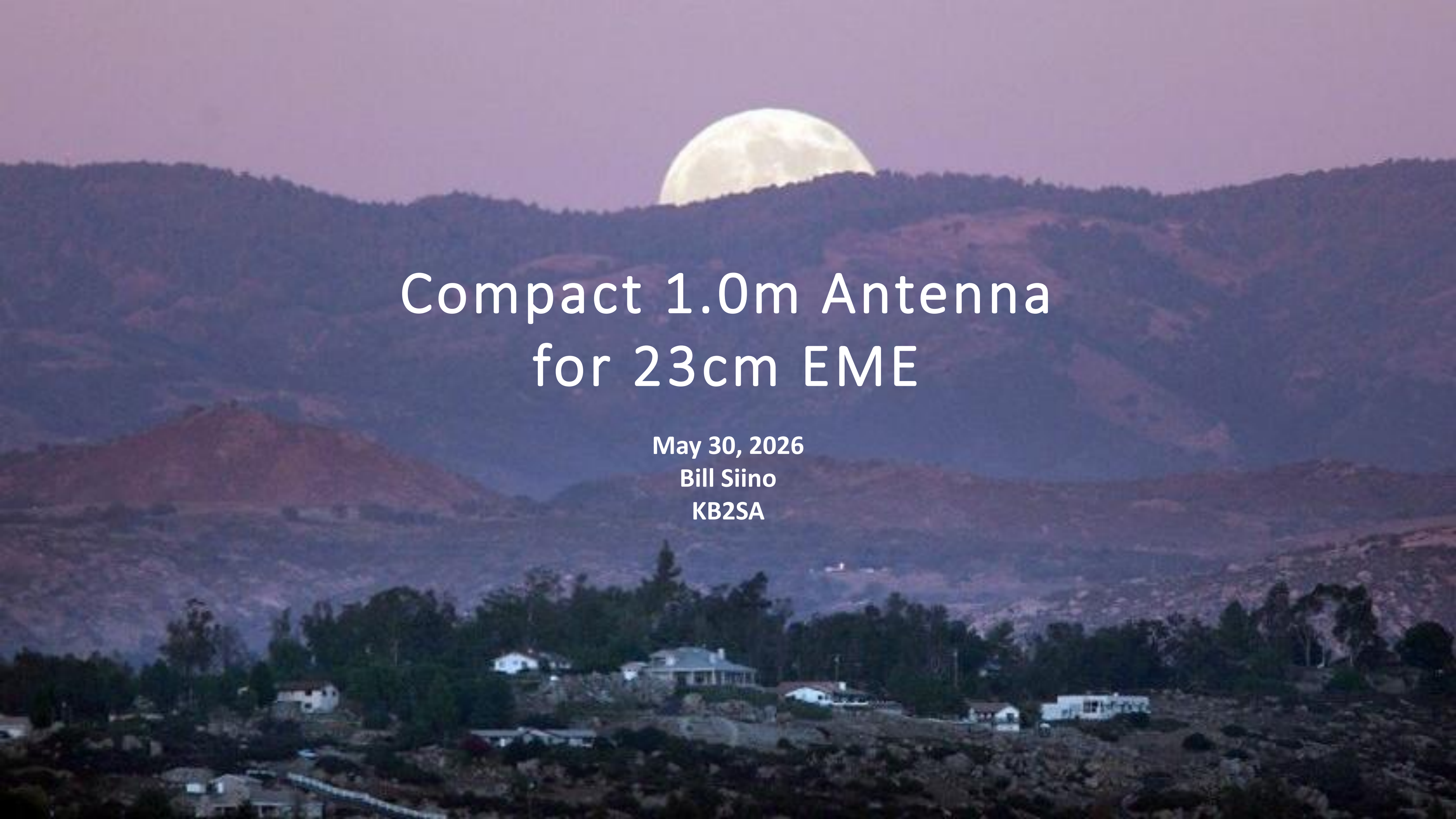


Compact 1.0m Antenna for 23cm EME

May 30, 2026

Bill Siino
KB2SA

AGENDA

- Introduction
- Acknowledgements
- What’s New?
- Simulation Highlights
  - Feed Performance
  - Dish + Feed Performance
  - Performance Sensitivity
- Sun to Cold Sky
- 23cm EME QSOs
- Build
- What’s Next?

INTRODUCTION

WHAT ARE WE DOING?

- Discussed here is a compact high-performance 1.0m mesh wire dish antenna for 23cm EME
- Selected as the most compact antenna that will accommodate digitally decoding the 1.5m “solar cooker”, 2.4m W2HRO folding fabric and larger yagi antennas
- QSOs with these smaller systems will require a minimum of 450W at the feed

ACKNOWLEDGEMENT

WHO HELPED

- Dassault Systèmes CST Studio Suite
- Clint Patton, Electromagnetics Senior Applications Engineer, GoEngineer
- Dave Fisher, KG0D for very detailed logs, testing, measurements and “out of the box” thinking

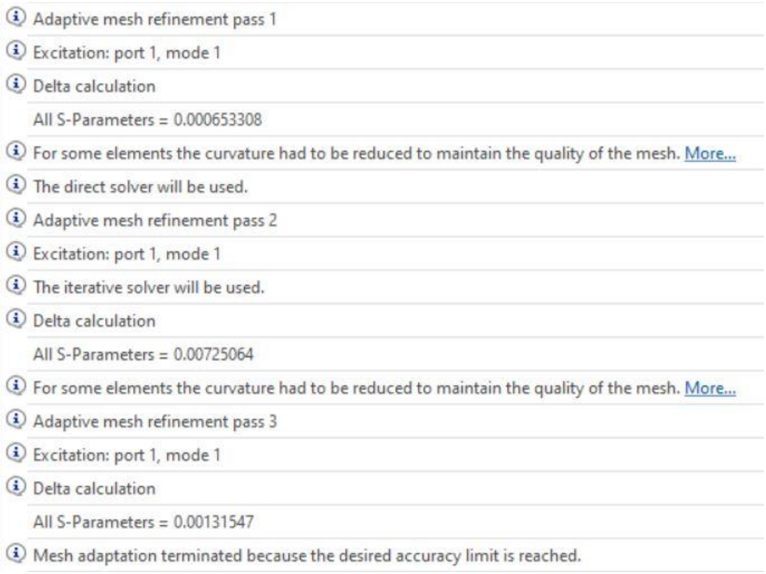
WHAT'S NEW?

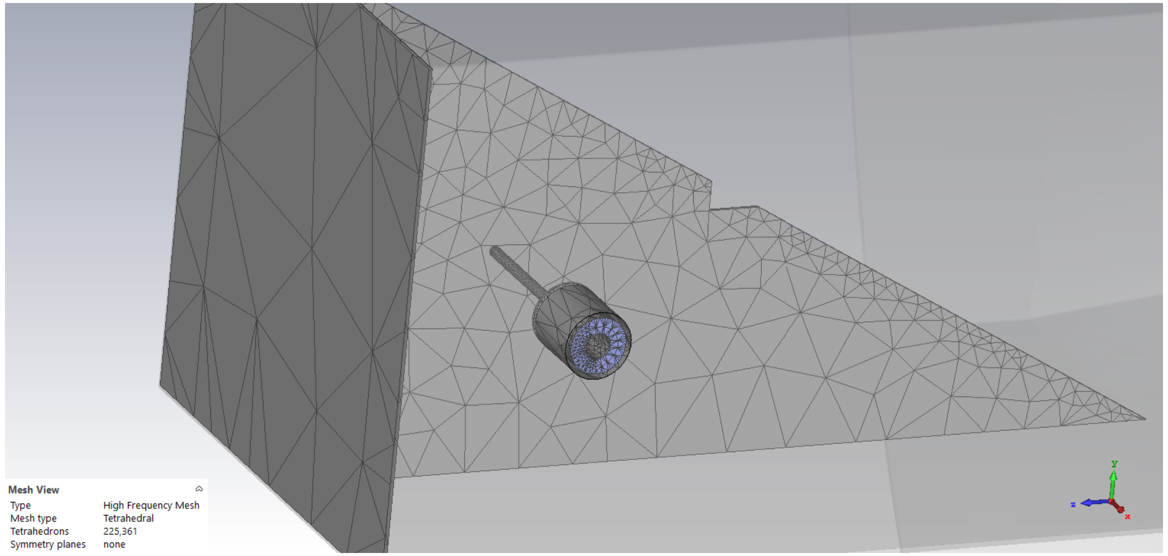
OPTIMAL 1.9M TO OPTIMAL 1.0M

- 2λ choke removed
- 200mm aperture reduced to 150mm
- 1λ cross dipole added
- S12 disk removed
- λ/4 "fence" increased to λ/2

SIMULATION HIGHLIGHTS

ADAPTIVE MESH REFINEMENT


Adaptive mesh refinement pass 1
Excitation: port 1, mode 1
Delta calculation
All S-Parameters = 0.000653308
For some elements the curvature had to be reduced to maintain the quality of the mesh. More...
The direct solver will be used.
Adaptive mesh refinement pass 2
Excitation: port 1, mode 1
The iterative solver will be used.
Delta calculation
All S-Parameters = 0.00725064
For some elements the curvature had to be reduced to maintain the quality of the mesh. More...
Adaptive mesh refinement pass 3
Excitation: port 1, mode 1
Delta calculation
All S-Parameters = 0.00131547
Mesh adaptation terminated because the desired accuracy limit is reached.

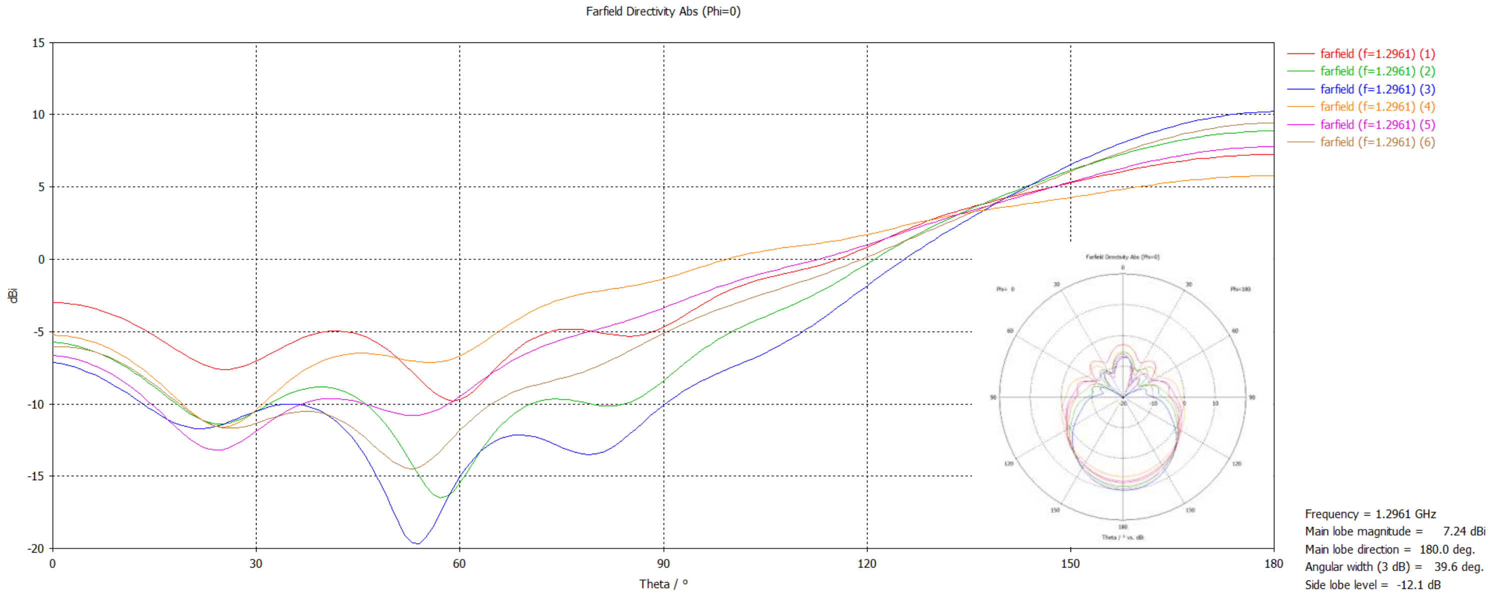


- CST MWS Frequency Domain Solver best for resonant narrowband structures
- Adaptive tetrahedral mesh refinement based on S-Parameter delta calculations

Slope septum notch from cutting RFHAMDESIGN stepped septum

Simulation Run	1λ Cross Dipole?	Aperture Diameter	-10dB Half Beamwidth
1	No	150mm	83°
2	No	200mm	63°
3	No	250mm	54°
4	Yes	150mm	111°
5	Yes	200mm	84°
6	Yes	250mm	64°

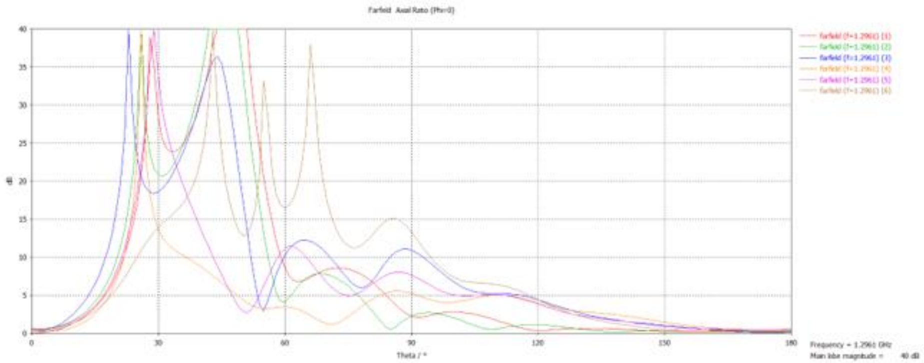
-10 dB Half Beamwidth
1λ cross dipole 90mm in front of aperture



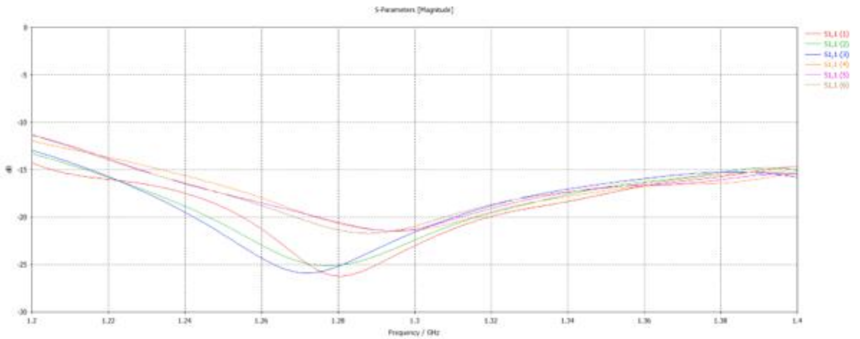
FEED PERFORMANCE

NO DISH BEAMWIDTH

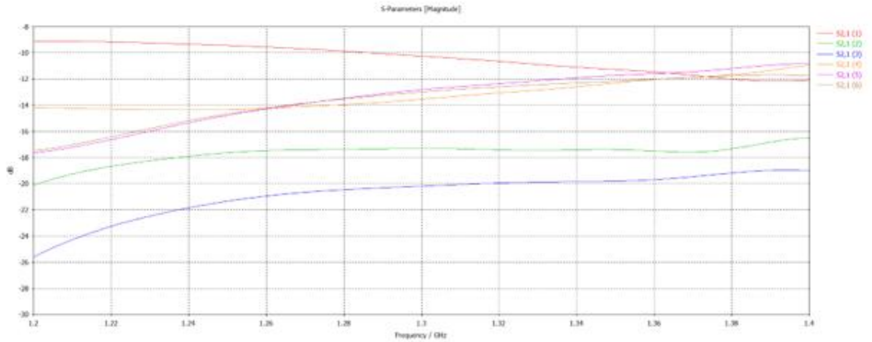
- A 1λ cross dipole is initially placed 90mm in front of the flare opening. This position provided the highest G/T when the dish is added
- As expected, the -10dB Half Beamwidth increases as the flare opening decreases
- *With the added dipole, the -10dB Half Beamwidth increases dramatically*
- Compare the **red** and **orange** curves for 150mm flare with (111°) and without (83°) dipole



Feed Axial Ratio



Feed S11



Feed S12

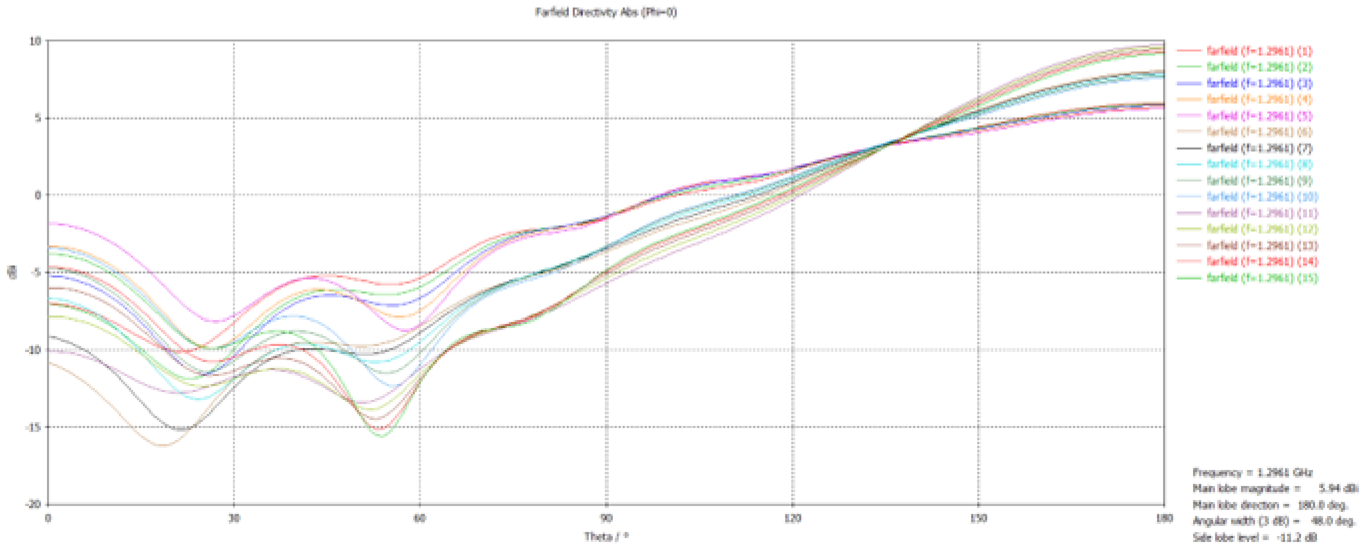
FEED PERFORMANCE

NO DISH Axial Ratio, S11 and S12

- Axial Ratio with and without flare with different flare openings remains excellent near boresight as this is primarily a function of the fixed septum slope
- S11 varies slightly near 1.3Ghz
- S12 varies widely, especially with and without the dipole’s added reflections
- *We’ll use both the dipole and feed position, much like the S12 disk, to tune S12 when the dish is added*

FEED PERFORMANCE

NO DISH BEAMWIDTH VS FLARE and DIPOLE

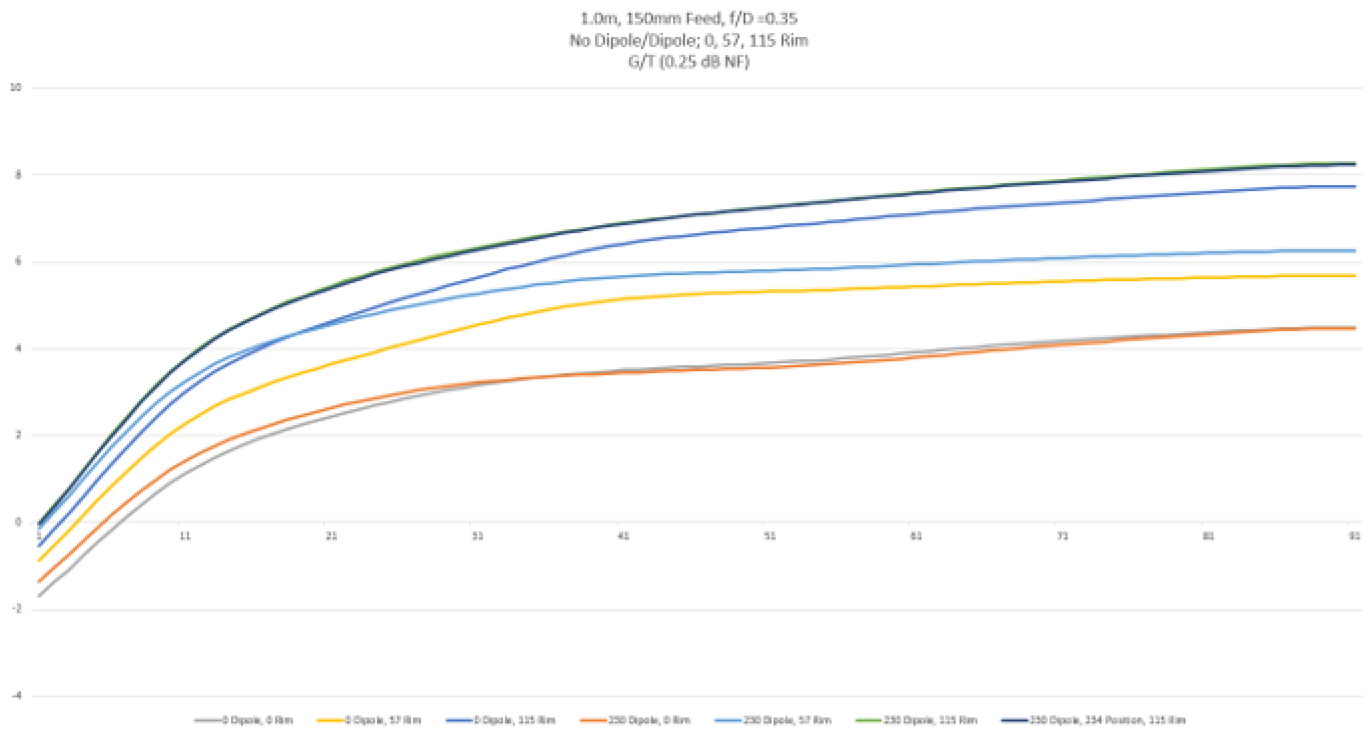


Feed Beamwidth vs 1λ Cross Dipole Position (86 - 94mm)
150, 200, 250 mm Aperture Diameter

- To prepare for in-dish tuning, we analyze the -10dB Half Beamwidth as a function of flare opening diameter and dipole position
- Beamwidth is more dependent on flare opening then dipole position
- *We'll take advantage of this behavior to tune S12 in dish with little change to G/T, S11 and Axial Ratio*

DISH+ FEED PERFORMANCE

START WITH G/T

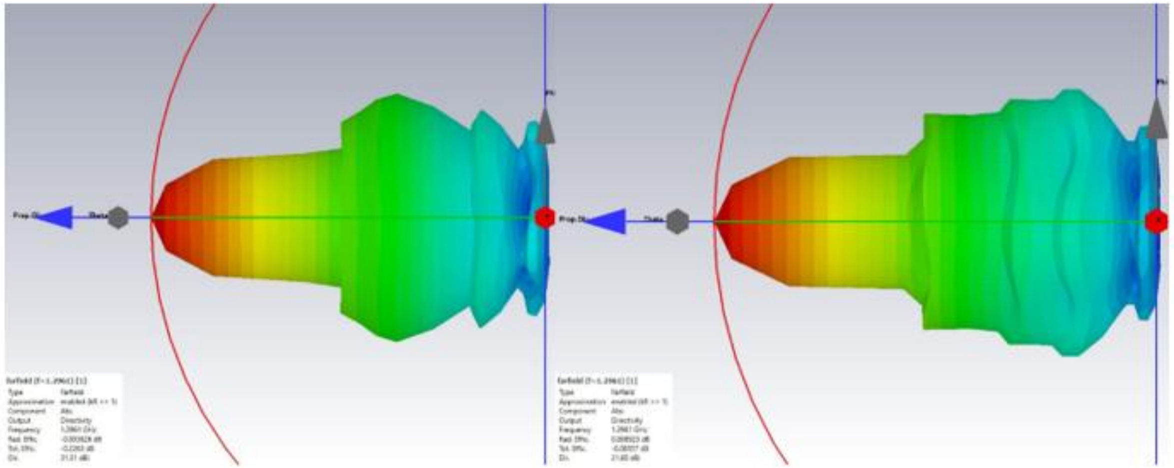


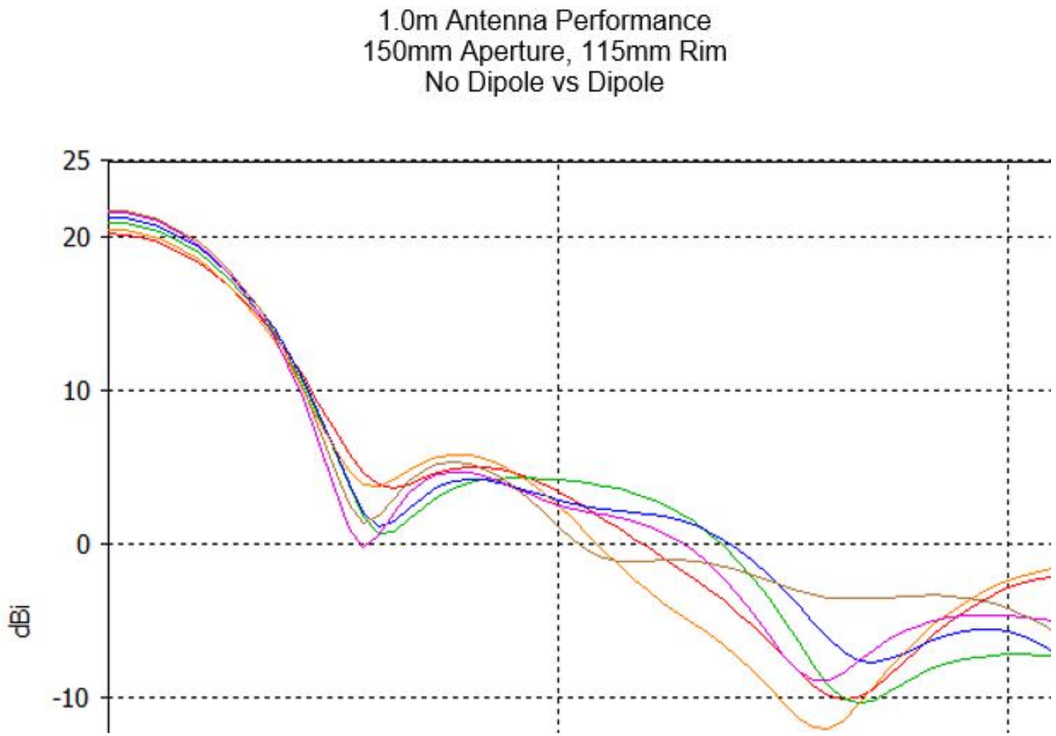
1.0m Antenna G/T

- Starting with G/T, the **gray** and **orange** curves show nearly the same performance with and without dipole and no dish "fence"
- The **yellow** and **light blue** curves show the added dipole improvement with a λ/4 fence
- The **dark blue** and **green** curves show the added dipole improvement with a λ/2 fence. Fence > λ/2 has small improvement.
- *The **black** curve shows moving the dipole slightly to tune S12 has very little effect on the **best** G/T*

DISH+ FEED PERFORMANCE

BEAM PATTERN

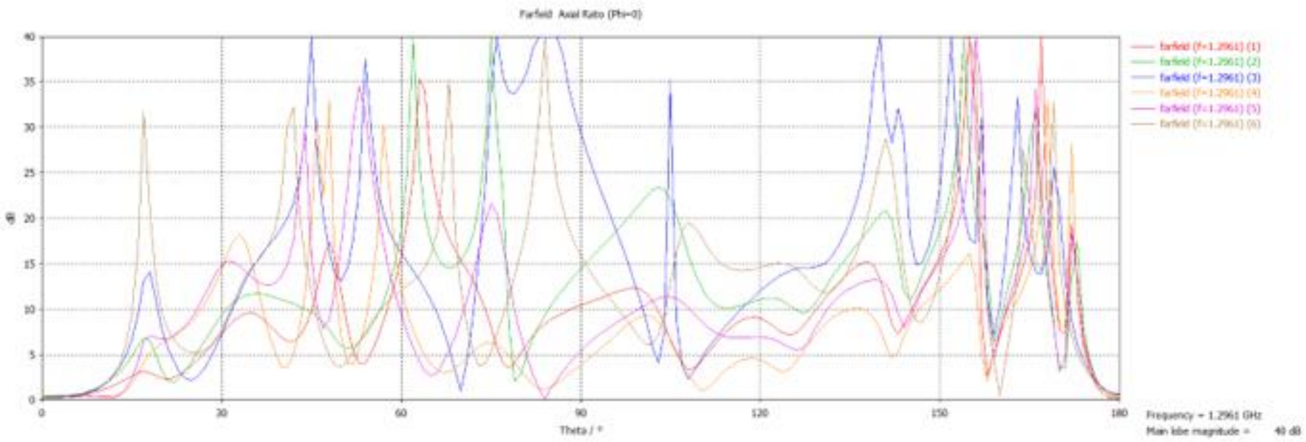




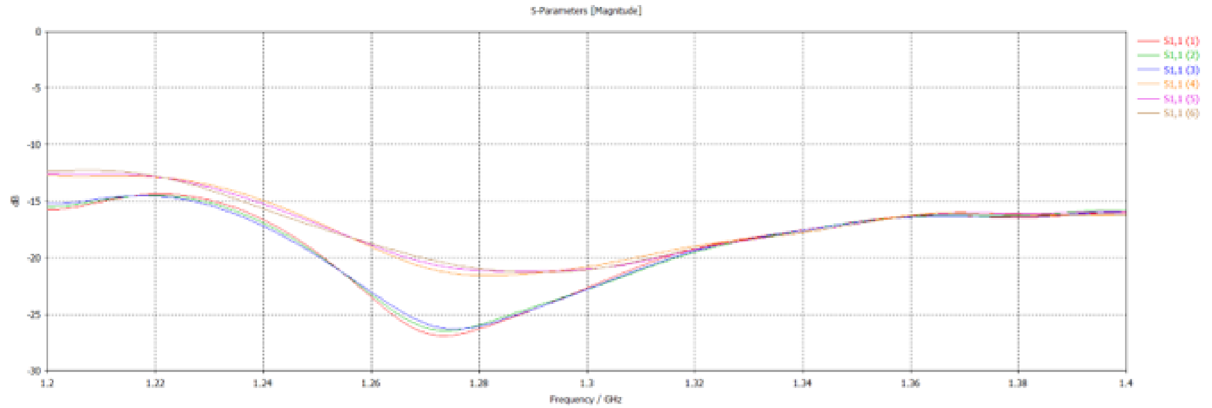
- Now focus on beam pattern. With 2λ fence and 150mm flare, the dipole increases G from **21.3 dB** to **21.8** dB.
- The **blue** (no dipole) vs **brown** (dipole) show the lower sidelobes closer to boresight that contribute to G/T
- The 2D diagram provides a "feeling". Integrating the 3D pattern in space for G/T vs elevation is the ultimate performance

DISH+ FEED PERFORMANCE

AXIAL RATIO and S11

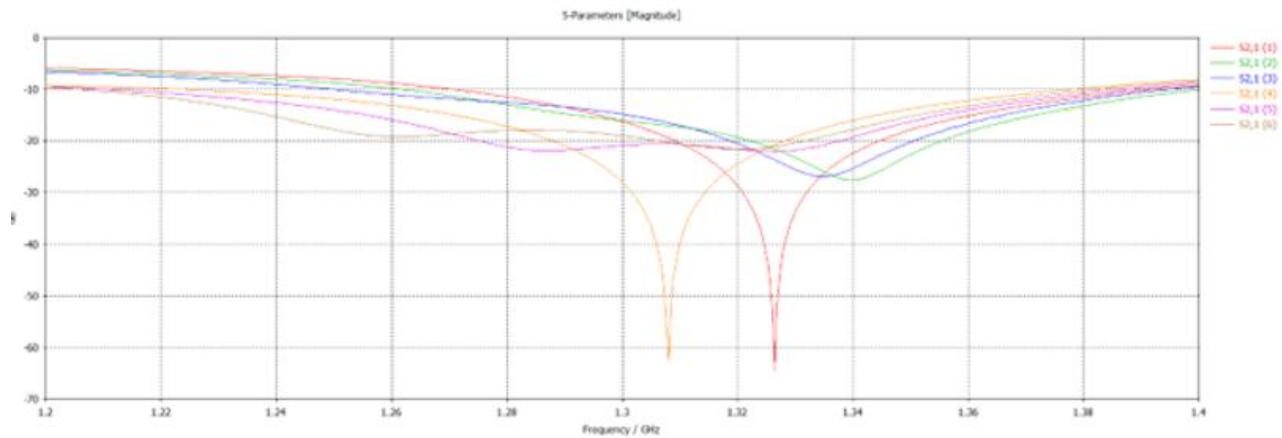


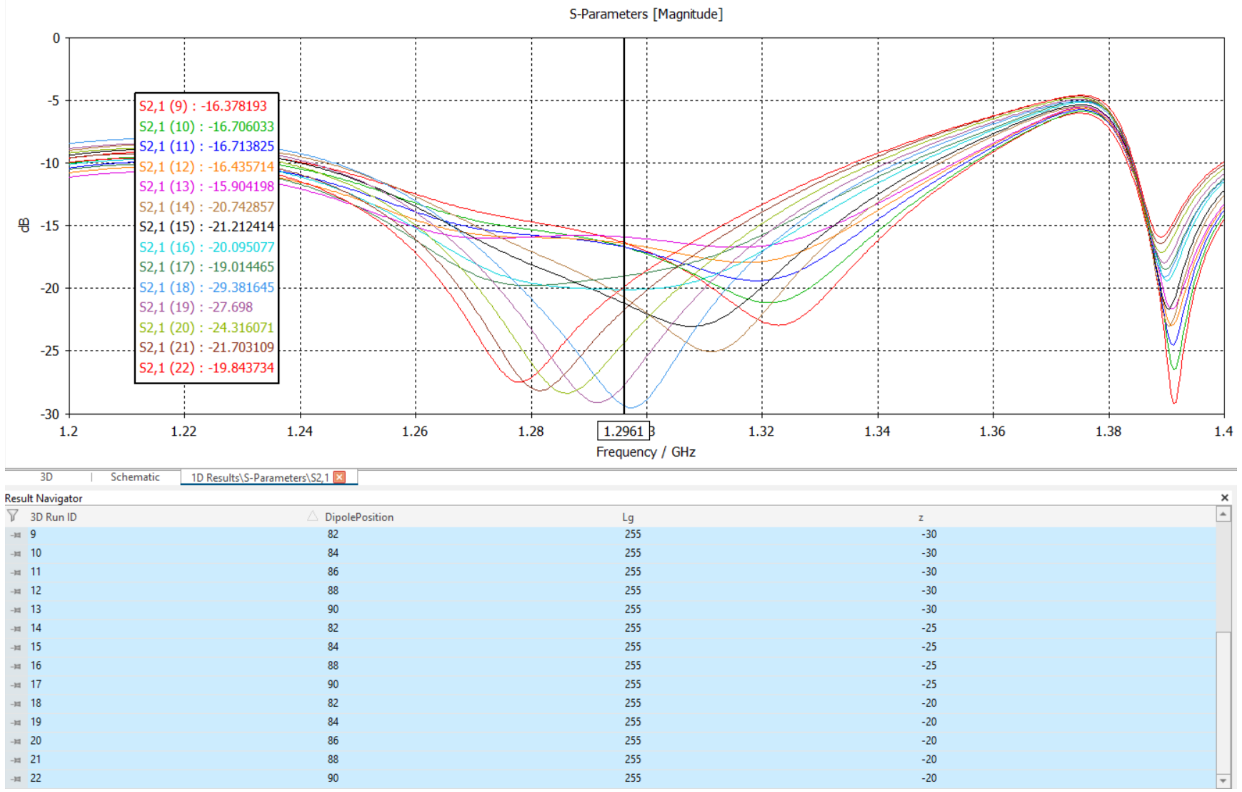
1.0m Antenna Axial Ratio



1.0m Antenna S11

- Axial Ratio and S11 are good as expected
- S11 can be tuned by varying the probe length and distance to the rear wall
- Actual measured S11 (7/16 DIN) and S22 (SMA) is -19dB and -17dB with a Superleggera 350 feed

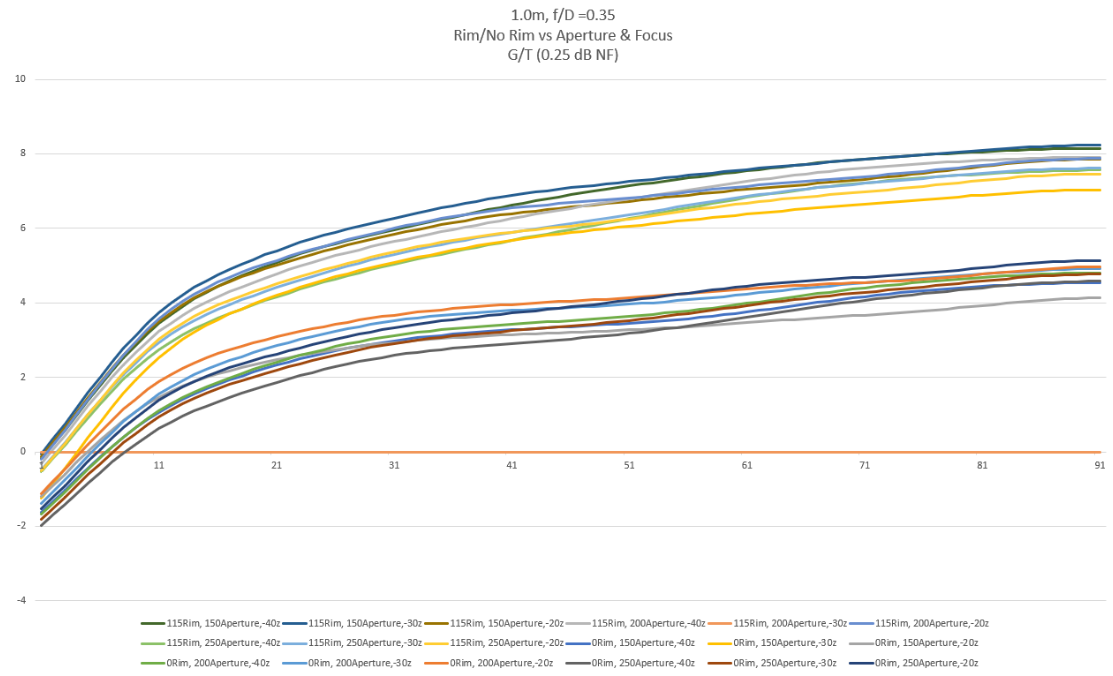


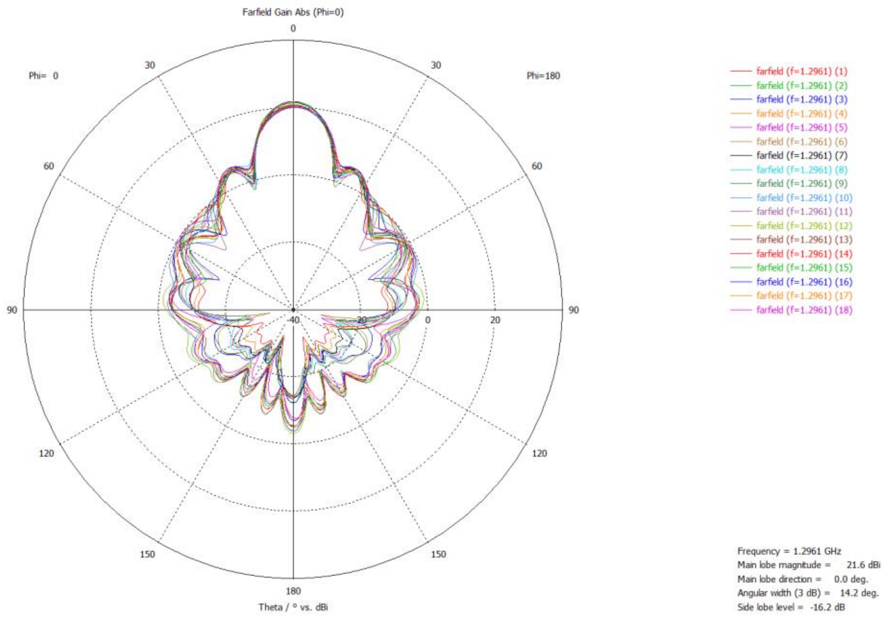


DISH+ FEED PERFORMANCE

S12

- S12 is the tricky one. This varies considerably with the fence and dipole with a fixed 150mm flare
- The top **brown** curve is with both the dipole and λ/2 fence in place
- Slight movement around the optimal feed and dipole position allow significant S12 tuning
- ***Actual measured S12 with a Superleggera 350 feed is -38 dB !***





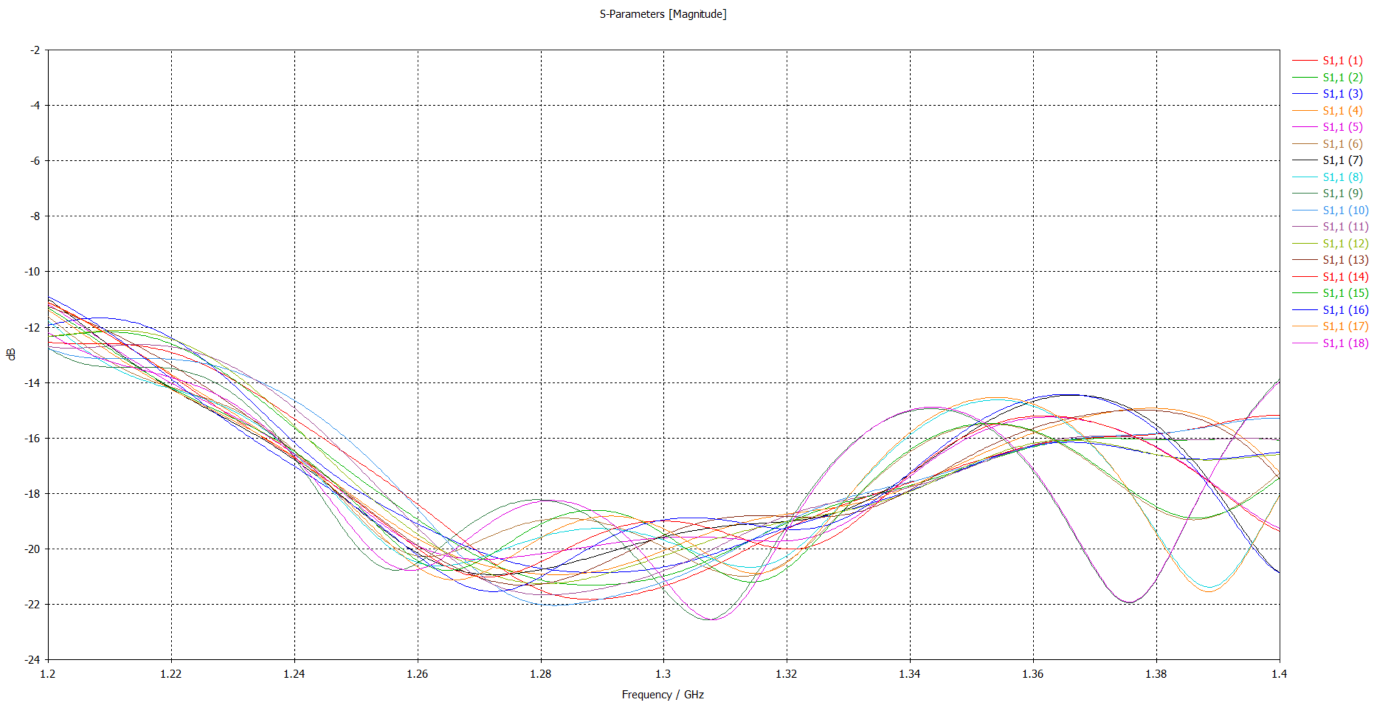
PERFORMANCE SENSITIVITY

G/T VS FENCE, FLARE AND FOCUS

- G/T varies 1 dB with 150/200/250mm flare and -40/-30/-20mm feed position relative to dish focus
- *G/T jumps 3 dB with λ/2 (115mm) fence*

PERFORMANCE SENSITIVITY

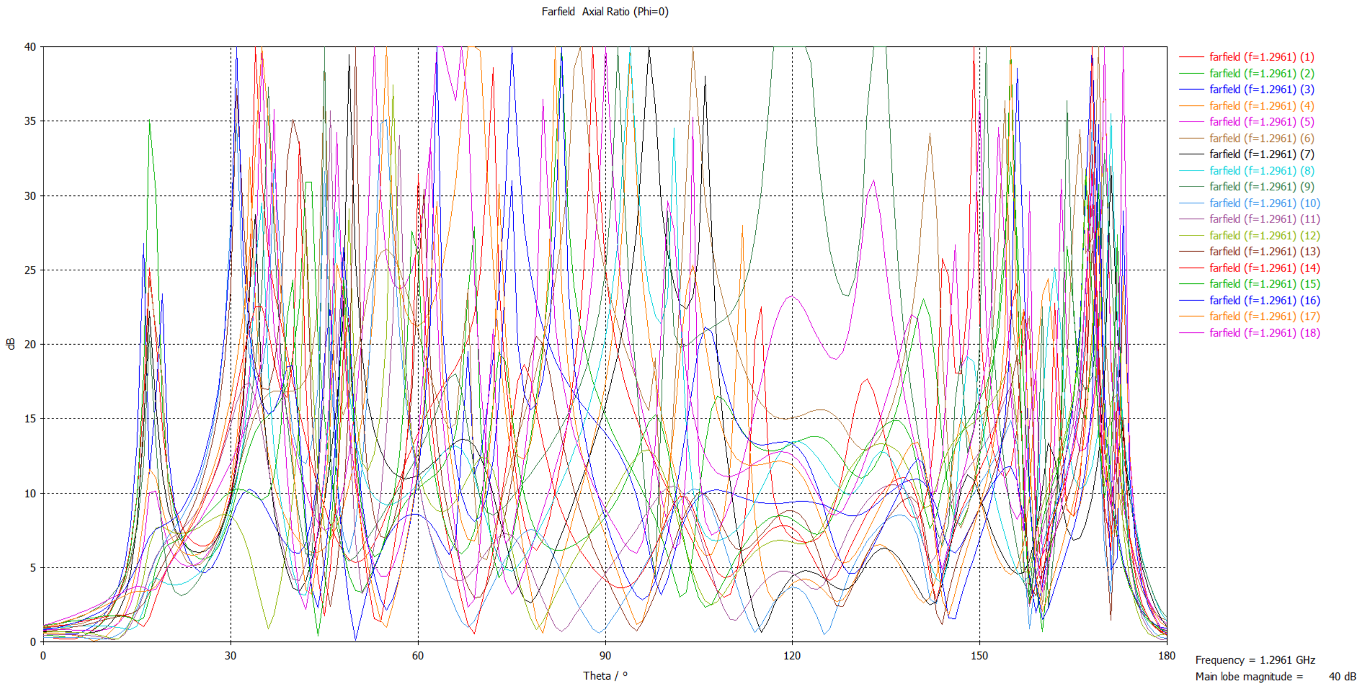
S11 VS FENCE, FLARE AND FOCUS



- S11 near -20 dB is relatively immune to fence, flare and feed position

PERFORMANCE SENSITIVITY

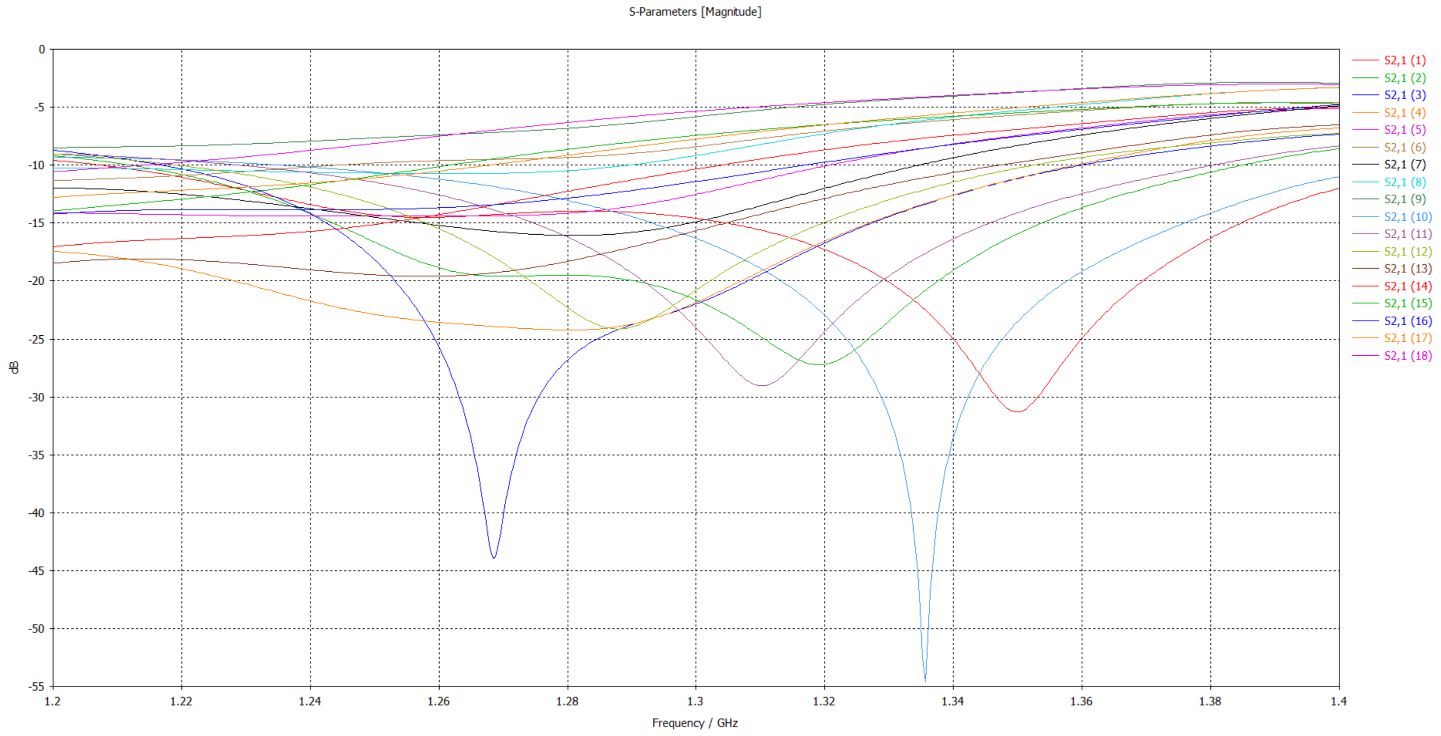
AXIAL RATIO VS FENCE, FLARE AND FOCUS



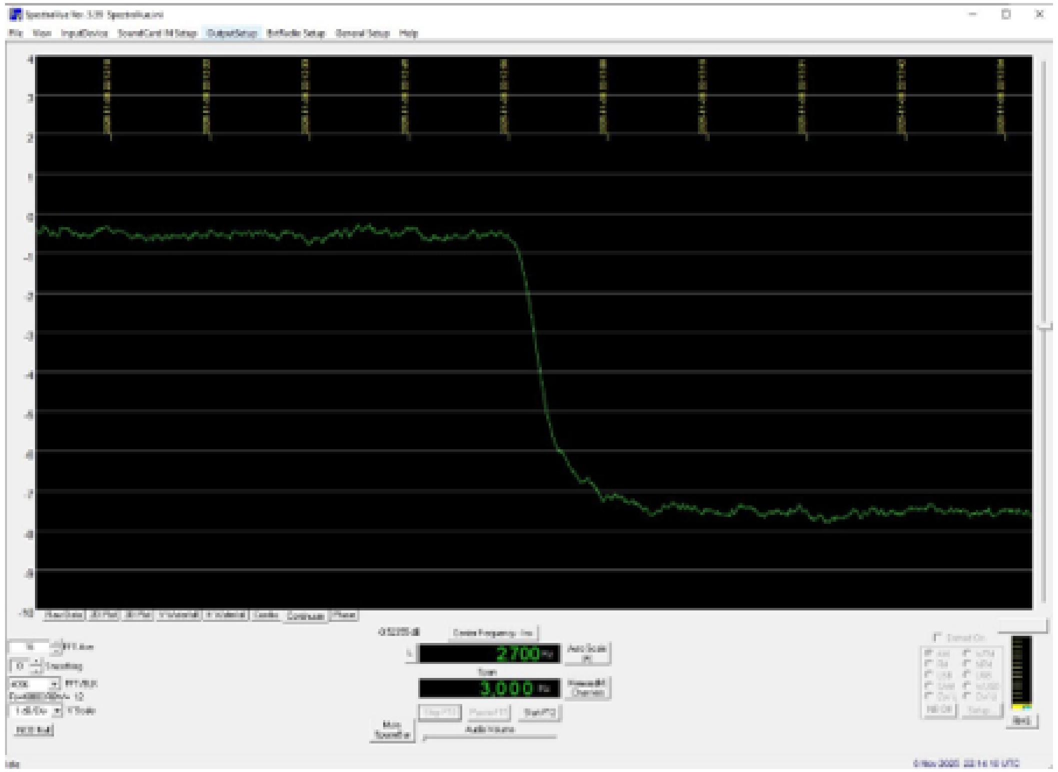
- Axial Ratio < 1 dB is relatively immune to fence, flare and feed position

PERFORMANCE SENSITIVITY

S12 VS FENCE, FLARE AND FOCUS



- S12 varies considerably with fence, flare and feed position
- -5 dB with no fence, 250mm flare and -20mm focus
- -22 dB with fence, 150mm flare and -20mm focus
- The desired 150mm flare offers the best S12 regardless of fence and focus
- *No S12 disk needed*



7 dB cold sky to sun noise using SpectraVue™ with sun SFU = 164

SUN TO COLD SKY

SEVERAL READINGS

- Several sun to cold sky measurements were performed during October 2025.
- Sun to cold sky was measured at **6.4 dB** with **SFU = 121**.
- Sun to cold sky was measured at **7.0 dB** on two different days with **SFU = 160 and 164**

23CM QSOS

2025 EME COMPETITION

CALL	GRIDSQUARE	RST_SENT	RST_RCVD	QSO_DATE	FREQ
9H1BN	JM75	-24	-16	20251108	1296.1415
AA6I	DM06	-18	-13	20251011	1296.1315
AC2AC	EL96	-21	-21	20251011	1296.1315
DF2VJ	JN39	-18	-20	20251109	1296.0595
DF3RU	JN59	-19	-13	20251108	1296.091
DF7KB	JO30	-19	-10	20251012	1296.134
DK3EE	JO41	-15	-17	20251108	1296.077
DK3WG	JO72	-23	-18	20251011	1296.067
DL0SHF	JO54	-4	-10	20251011	1296.119
DL1HUH	JO61	-18	-15	20251108	1296.109
DL1SUZ	JO53	-25	-18	20251011	1296.1315
DL3EBJ	JO31	-16	-10	20251011	1296.122
DL3WDG	JN68	-24	-17	20251109	1296.1415
DL3WDG	JN68	-22	-17	20251109	1296.141
DL4DTU	JO61	-17	-13	20251108	1296.074
DL7UDA	JO62	-16	-11	20251109	1296.1415
ES3RF	KO29	-19	-16	20251011	1296.1315
F5JWF	JN26	-19	-15	20251012	1296.1315
G0LBK	JO03	-18	-14	20251109	1296.059
G7TZZ	IO92	-22	-16	20251109	1296.104
GM0PJD	IO85	-21	-16	20251011	1296.072
GM0PJD	IO85	-16	-13	20251109	1296.0595
HB9Q	JN47	-6	-5	20251011	1296.097
HL2/LY3UM	PM37	-23	-22	20251012	1296.102
I2FAK	JN45	-21	-16	20251108	1296.062
IK3COJ	JN65	-18	-12	20251109	1296.122
IK5VLS	JN53	-21	-16	20251011	1296.102
IK7EZN	JN90	-14	-15	20251011	1296.1315
IQ2DB	JN45	-24	-21	20251011	1296.057
JH3AZC	PM85	-25	-22	20251012	1296.1315
JJ3JHP	PM75	-16	-15	20251011	1296.079
JQ3JWF	PM75	-20	-16	20251011	1296.0765
JQ3JWF	PM75	-21	-13	20251108	1296.147
K0PRT	DM88	-13	-14	20251011	1296.105
K3SK	FM07	-22	-17	20251011	1296.1315
K5N	EM31	-15	-14	20251011	1296.088

ARRL International EME Contest Go

2025 Single Operator, All Mode, 1.2 GHz Go

☐ Show Operators ☐ Show Club

❮❮First ❮Prev Page 1 of 1 Next❯ Last❯❯

Rank	Category	Call Sign	QTH	Year	Score	QSOs	Mults	Hours	Operators
1	SO-1.2G	RD4D	UA	2025	2,507,100	183	137	23.4	
2	SO-1.2G	DL3EBJ	DL	2025	1,872,400	151	124	23.6	
3	SO-1.2G	ES3RF	ES	2025	1,731,600	148	117	20.6	
4	SO-1.2G	IQ2DB	I	2025	1,696,500	145	117	20.8	I2SVA
5	SO-1.2G	UA9FAD	UA	2025	1,500,800	134	112	22.1	
6	SO-1.2G	OK1USW	OK	2025	1,471,500	135	109	23.3	
7	SO-1.2G	DL0SHF	DL	2025	1,441,000	131	110	16.2	DF9CY
8	SO-1.2G	PA0TBR	PA	2025	1,380,300	129	107	24.8	
9	SO-1.2G	I2FAK	I	2025	1,360,800	126	108	4.4	
10	SO-1.2G	JJ3JHP	JA	2025	1,317,600	122	108	10.6	
11	SO-1.2G	OK1KKD	OK	2025	1,222,100	121	101	17.5	OK1FAQ
12	SO-1.2G	AA6I		2025	1,046,400	109	96	14.3	
13	SO-1.2G	UA1ALD	UA	2025	991,900	109	91	17.9	
14	SO-1.2G	IK2DDR	I	2025	967,200	104	93	13.4	
15	SO-1.2G	KB2SA		2025	875,500	103	85	14.6	

- The 1.0m antenna was thoroughly tested during the 2025 ARRL EME competition in October and November.
- **114 QSOs** were completed over four days with 900W at the feed
- Nearly all QSOs used Q65-30B with Q65-60C for a handful of very small stations.
- A QSO with KA1GT used the fast Q65-15A mode.
- ***1.0m antenna placed 15/68 for 2025 Single operator, All Mode, 1.2 Ghz operating from San Diego, CA***

23CM QSOS

900W to 450W

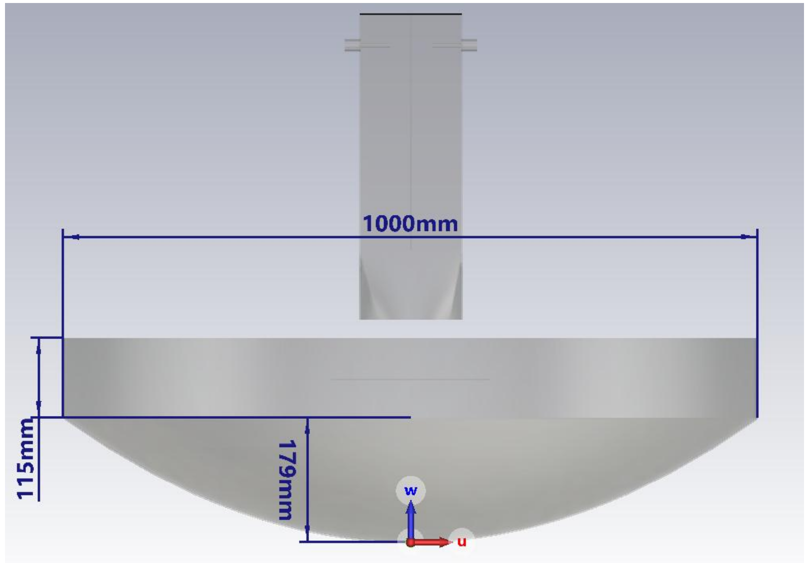
CALL	GRIDSQUARE	RST_RCVD	Dish
I2FAK	JN45	-28	4m
N0AKC	EN44	-28	3m
YL2GD	KO37ML	-28	6m
PY0FBS	HI36	-25	2.4m folding
N5BF	DM04	-24	2.4m folding
W3TI	FN20	-24	2.4m folding
OZ5TG	JO45	-23	4.3m
PA3EXV	JO32	-23	3.55m
W3HZU	FN10	-23	4.5m
W4UNU	EL98	-23	2.4m folding
HL2/LY3UM	PM37	-22	
JH3AZC	PM85	-22	
LU8ENU	GF05	-22	
N0LWF	EN10	-22	
NY1V	EM69	-22	
OE3JPC	JN87	-22	
SO5AZ	KO02	-22	
W3IPA	EN91	-22	
AC2AC	EL96	-21	
IQ2DB	JN45	-21	
SM6PGP	JO67	-21	

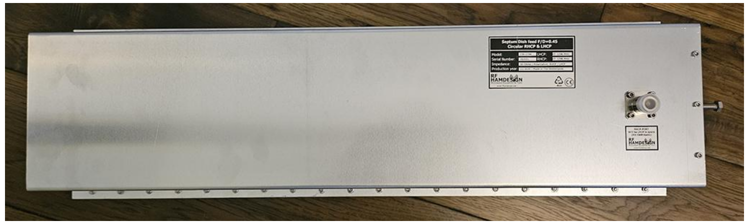
- Based on signal reports and dish sizes during the 2025 EME contest, only 4 stations may not decode the 1.0m with 450W (-3 dB)
- These stations all use a 2.4m folding dish
- QSO are likely possible with these stations using Q65-60C or Q65-120D

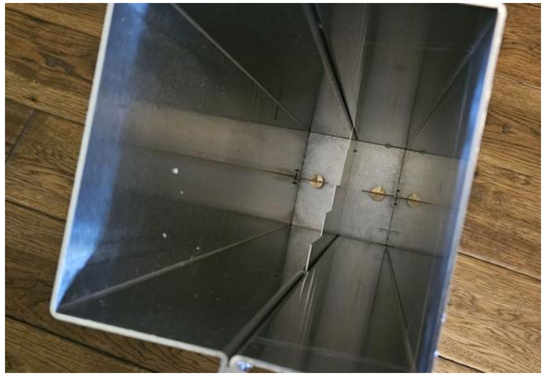
BUILD

CUSTOM DISH AND MODIFIED FEED

- The 1.0m f/D = 0.35 mesh wire dish used for this project was custom built by RFHAMDESIGN
- The feed started with a 23cm square waveguide with stepped septum from RFHAMDESIGN
- The long waveguide was cut down to 255mm with the stepped septum trimmed to a sloped septum of the same length
- A 150 x 100 mm sheet aluminum flare was fitted with the 1λ cross dipole suspended with polycarbonate rods

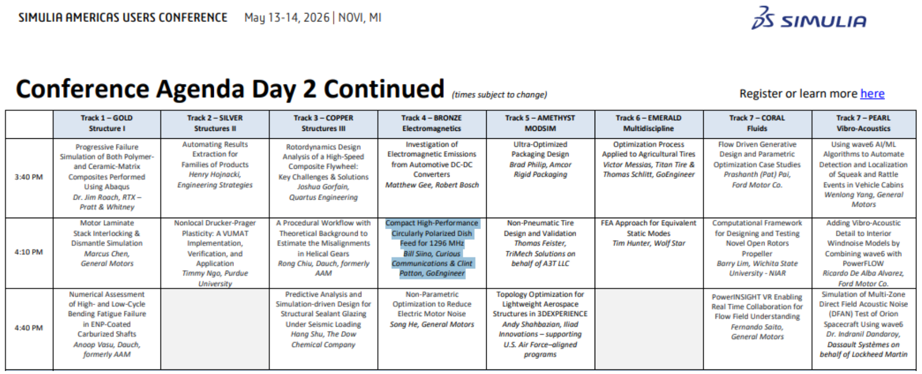






WHAT'S NEXT

HIGH PEFORMANCE 23CM FEED FOR SOLAR COOKER



SIMULIA AMERICAS USERS CONFERENCE May 13-14, 2026 | NOVI, MI

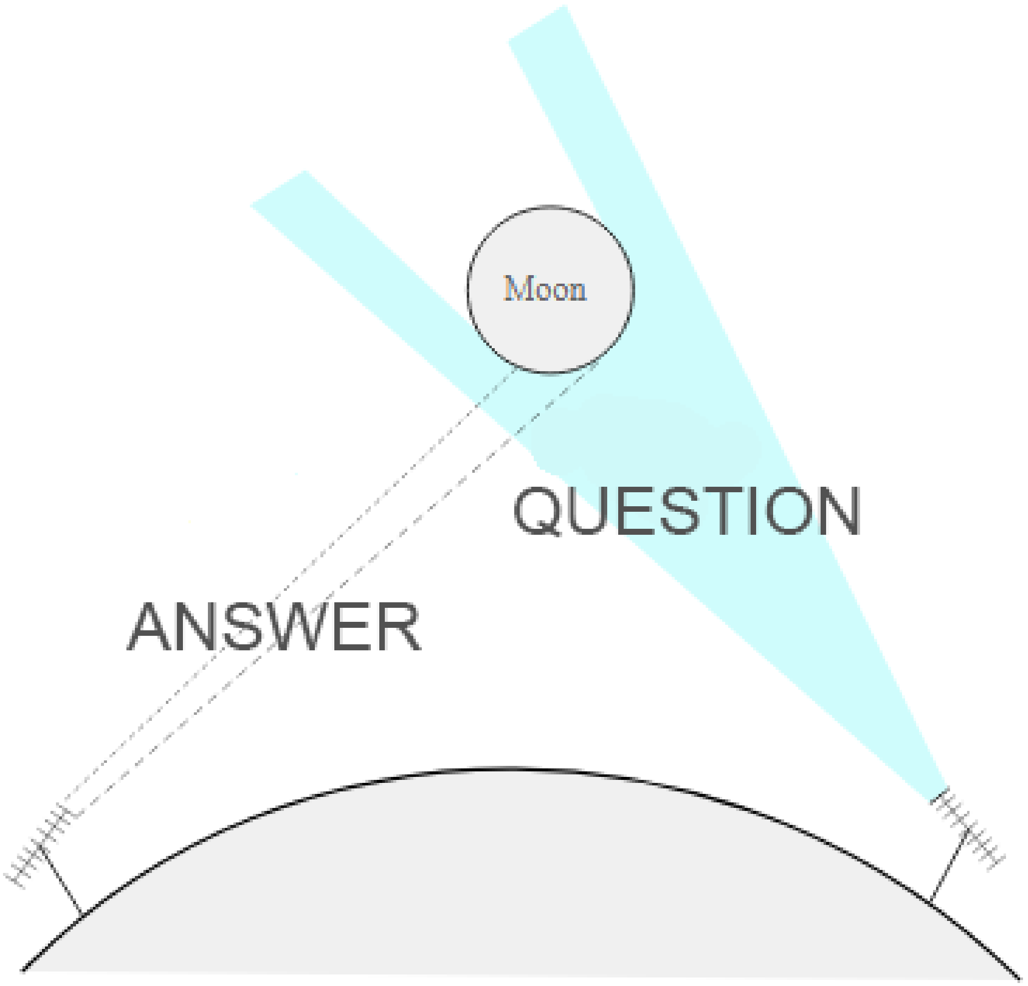
SIMULIA

Conference Agenda Day 2 Continued *(times subject to change)*

Register or learn more here

	Track 1 – GOLD Structure I	Track 2 – SILVER Structures II	Track 3 – COPPER Structures III	Track 4 – BRONZE Electromagnetics	Track 5 – AMETHYST MODSIM	Track 6 – EMERALD Multidiscipline	Track 7 – CORAL Fluids	Track 7 – PEARL Vibro-Acoustics
3:40 PM	Progressive Failure Simulation of Both Polymer- and Ceramic-Matrix Composites Performed Using Abaqus *Dr. Jim Roach, RTX – Pratt & Whitney*	Automating Results Extraction for Families of Products *Henry Hojnacki, Engineering Strategies*	Rotordynamics Design Analysis of a High-Speed Composite Flywheel: Key Challenges & Solutions *Joshua Gorfain, Quartus Engineering*	Investigation of Electromagnetic Emissions from Automotive DC-DC Converters *Matthew Gee, Robert Bosch*	Ultra-Optimized Packaging Design *Brad Philip, Amcor Rigid Packaging*	Optimization Process Applied to Agricultural Tires *Victor Messias, Titan Tire & Thomas Schlitt, GoEngineer*	Flow Driven Generative Design and Parametric Optimization Case Studies *Prashanth (Pat) Pai, Ford Motor Co.*	Using wave6 AI/ML Algorithms to Automate Detection and Localization of Squeak and Rattle Events in Vehicle Cabins *Wenlong Yang, General Motors*
4:10 PM	Motor Laminate Stack Interlocking & Dismantle Simulation *Marcus Chen, General Motors*	Nonlocal Drucker-Prager Plasticity: A VUMAT Implementation, Verification, and Application *Timmy Ngo, Purdue University*	A Procedural Workflow with Theoretical Background to Estimate the Misalignments in Helical Gears *Rong Chiu, Dauch, formerly AAM*	Compact High-Performance Circularly Polarized Dish Feed for 1296 MHz *Bill Siino, Curious Communications & Clint Patton, GoEngineer*	Non-Pneumatic Tire Design and Validation *Thomas Feister, TriMech Solutions on behalf of A3T LLC*	FEA Approach for Equivalent Static Modes *Tim Hunter, Wolf Star*	Computational Framework for Designing and Testing Novel Open Rotors Propeller *Barry Lim, Wichita State University - NIAR*	Adding Vibro-Acoustic Detail to Interior Windnoise Models by Combining wave6 with PowerFLOW *Ricardo De Alba Alvarez, Ford Motor Co.*
4:40 PM	Numerical Assessment of High- and Low-Cycle Bending Fatigue Failure in ENP-Coated Carburized Shafts *Anoop Vasu, Dauch, formerly AAM*		Predictive Analysis and Simulation-driven Design for Structural Sealant Glazing Under Seismic Loading *Hang Shu, The Dow Chemical Company*	Non-Parametric Optimization to Reduce Electric Motor Noise *Song He, General Motors*	Topology Optimization for Lightweight Aerospace Structures in 3DEXPERIENCE *Andy Shahbazian, Iliad Innovations – supporting U.S. Air Force–aligned programs*		PowerINSIGHT VR Enabling Real Time Collaboration for Flow Field Understanding *Fernando Saito, General Motors*	Simulation of Multi-Zone Direct Field Acoustic Noise (DFAN) Test of Orion Spacecraft Using wave6 *Dr. Indranil Dandaroy, Dassault Systèmes on behalf of Lockheed Martin*

- We know a patch feed with Beam Forming Ring (BFR) has potential based on testing performed by Dave Fisher, KG0D
- A 1000W version without a hybrid was presented at the Simulia Americas Users Conference on May 14
- Feed is built with testing forthcoming on a solar cooker dish



Q&A

YOU HAVE QUESTIONS
WE HAVE ANSWERS

- What’s New?
- Simulation Highlights
  - Feed Performance
  - Dish + Feed Performance
  - Performance Sensitivity
- Sun to Cold Sky
- 23cm EME QSOs
- Build
- What’s Next?


THANK YOU!