

M1: Naïve About Optics Team

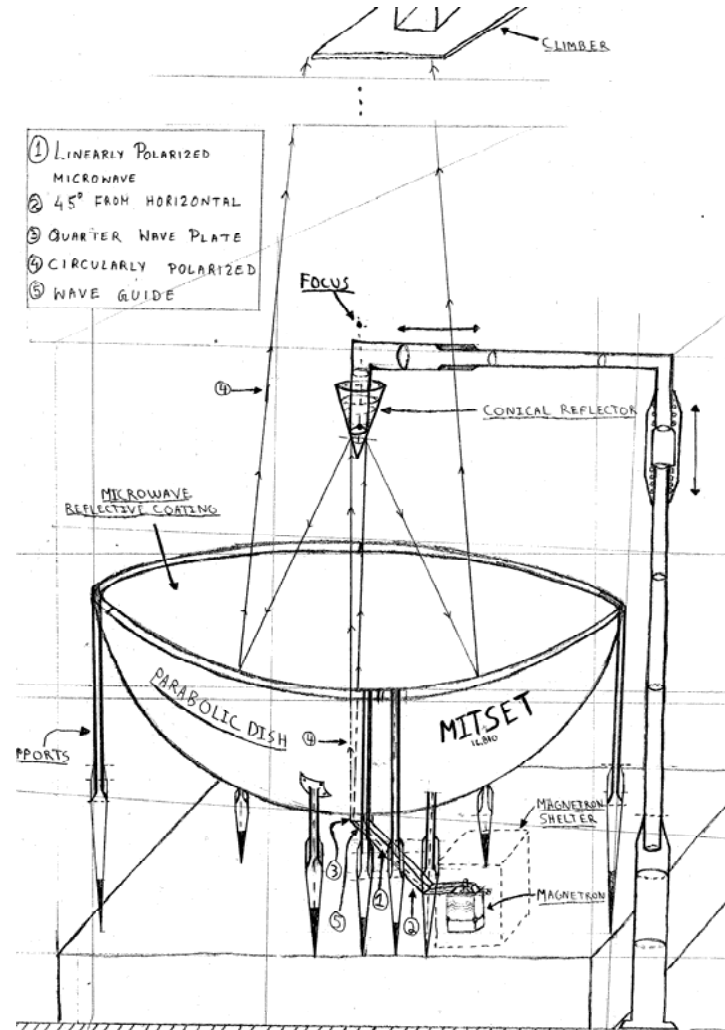
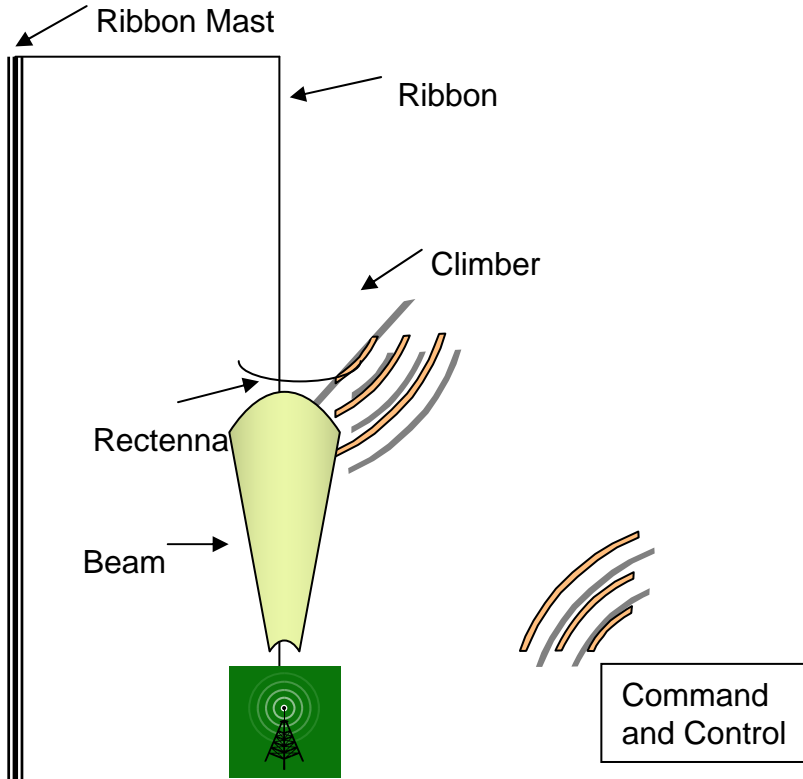
MITSET Power Beaming Competition

- Primary focus of competition is power beaming
- Microwave energy chosen for efficiency and scalability
- Needs to supply an adequate power supply to rectennas
- Needed a system that could easily be assembled/disassembled
- High efficiency and cost effectiveness are the primary targets of project

Design divided into three subsystems

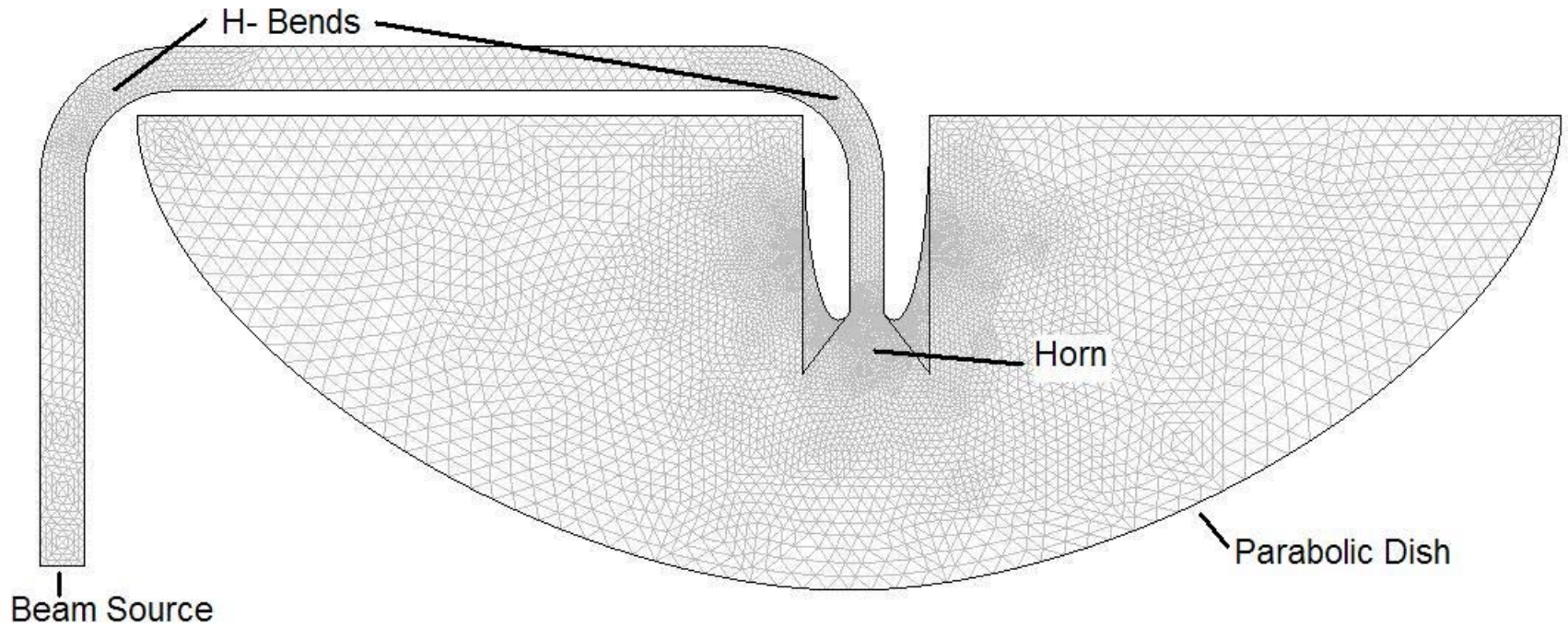
- Dish
 - Utilizes a pre-made satellite dish for simplicity and cost effectiveness
 - Needed to collimate the microwave energy
 - Needs to be fast and easy to assemble around the ribbon
 - Needs to be stable as well as level
- Microwave horn support
 - Designed to hold the microwave horn over the center of the dish
 - Has an adjustable height to allow for an adjustable focus
 - Has to be rigid enough to support magnetron and horn and precisely place them over the dish

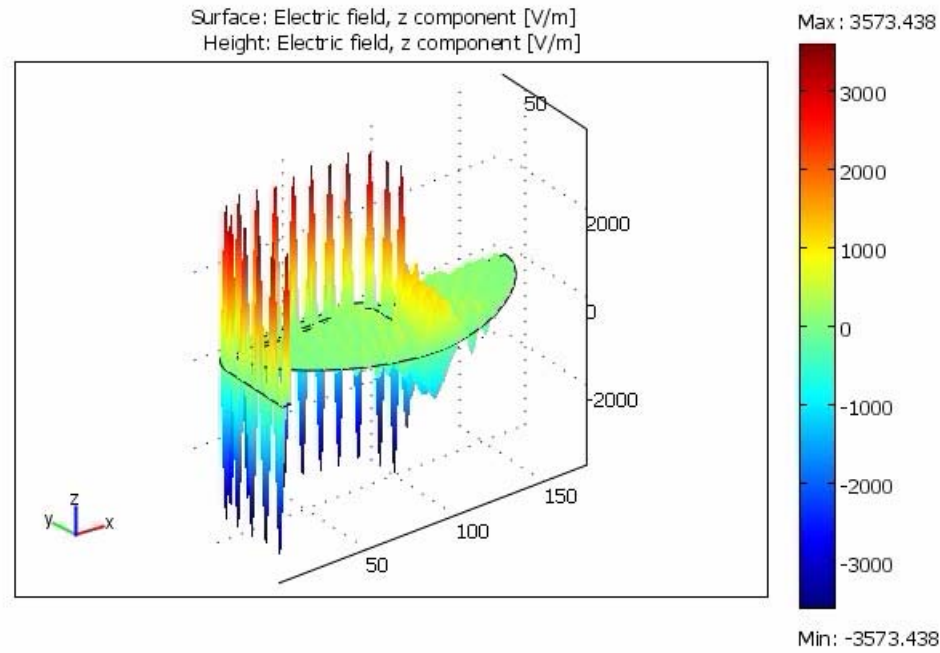
- Microwave Circuit
 - Provides microwave energy for climber
 - Circularly polarizes the microwave energy
 - Transfers to Climber
 - Needs to be as efficient as possible
 - Uses a magnetron mated with a polarizer, and a horn to project energy

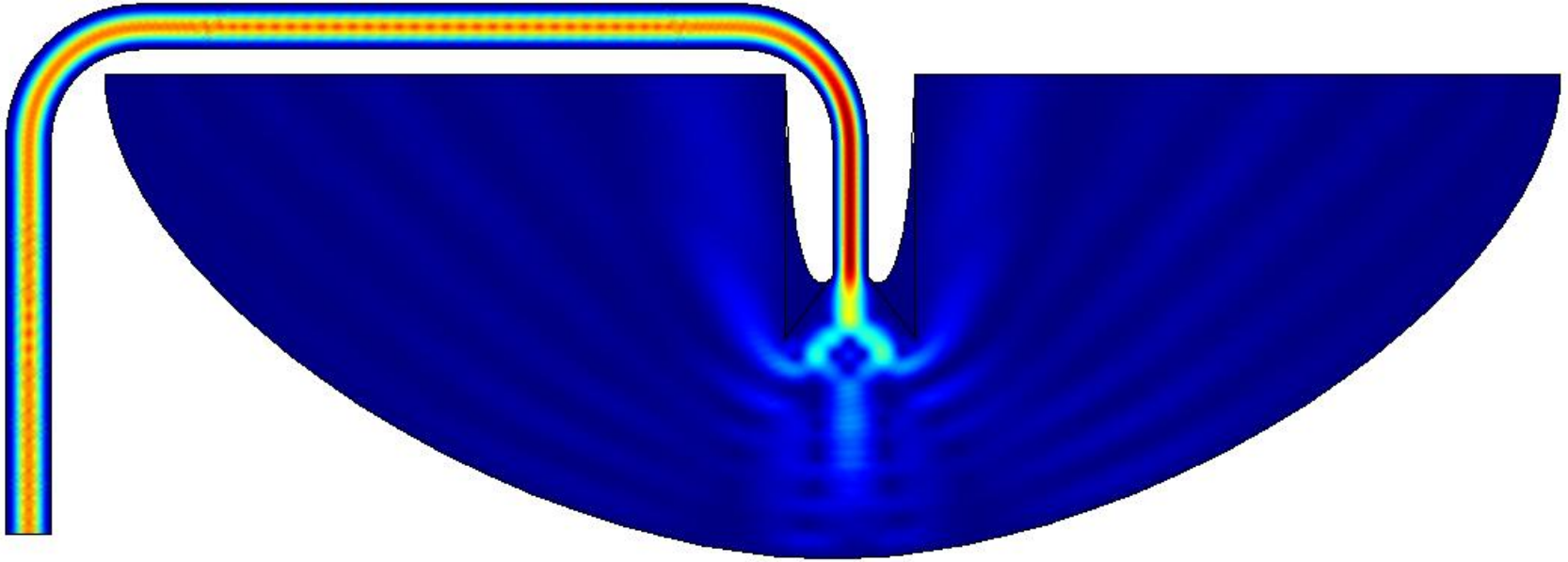


- Us optimists had two levels...
- Functional:
 - Transferred power amount (400W), duration (50s), destination (10 to 60m)
 - Components on climber weight (<8.5kg) and more (rulebook)
- Constraints
 - Transferred power polarization (circular)
 - Safety regulations
 - Laws of physics
- Interface
 - Power Source
 - Climber ribbon anchor
 - Spectator and operator distances
 - Storage size
 - Assembly time
- Optimization variables: Cost, Output Power

- Design Options:
 - Source:
 - Helical
 - Magnetron
 - Transmission:
 - Coax
 - Waveguides
 - Polarisation:
 - Fresnel/Moony Rhomb
 - Quarter Wave Plate
 - Quadrature Coupler
 - Variable Length Branching
 - Beam widening:
 - Horn
 - Helical
 - Calvin Feed
 - Reflection
 - Offset
 - Cassegrain
 - Conical
 - Direct
 - Collimation
 - Field Choice
 - Forward/Backward
 - Beam Broadening
 - Boundary mitigation:
 - Crystals
 - Dielectrics
 - Diffuse beam

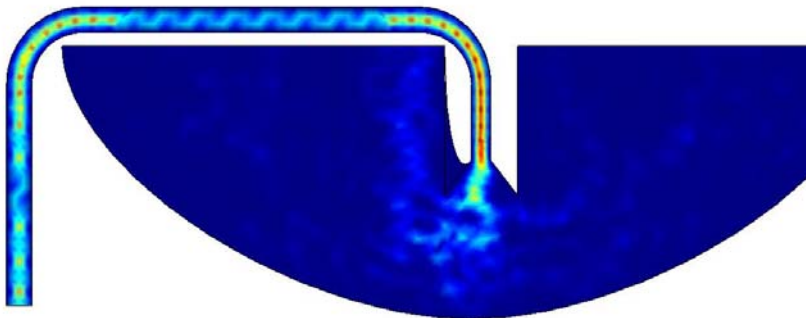


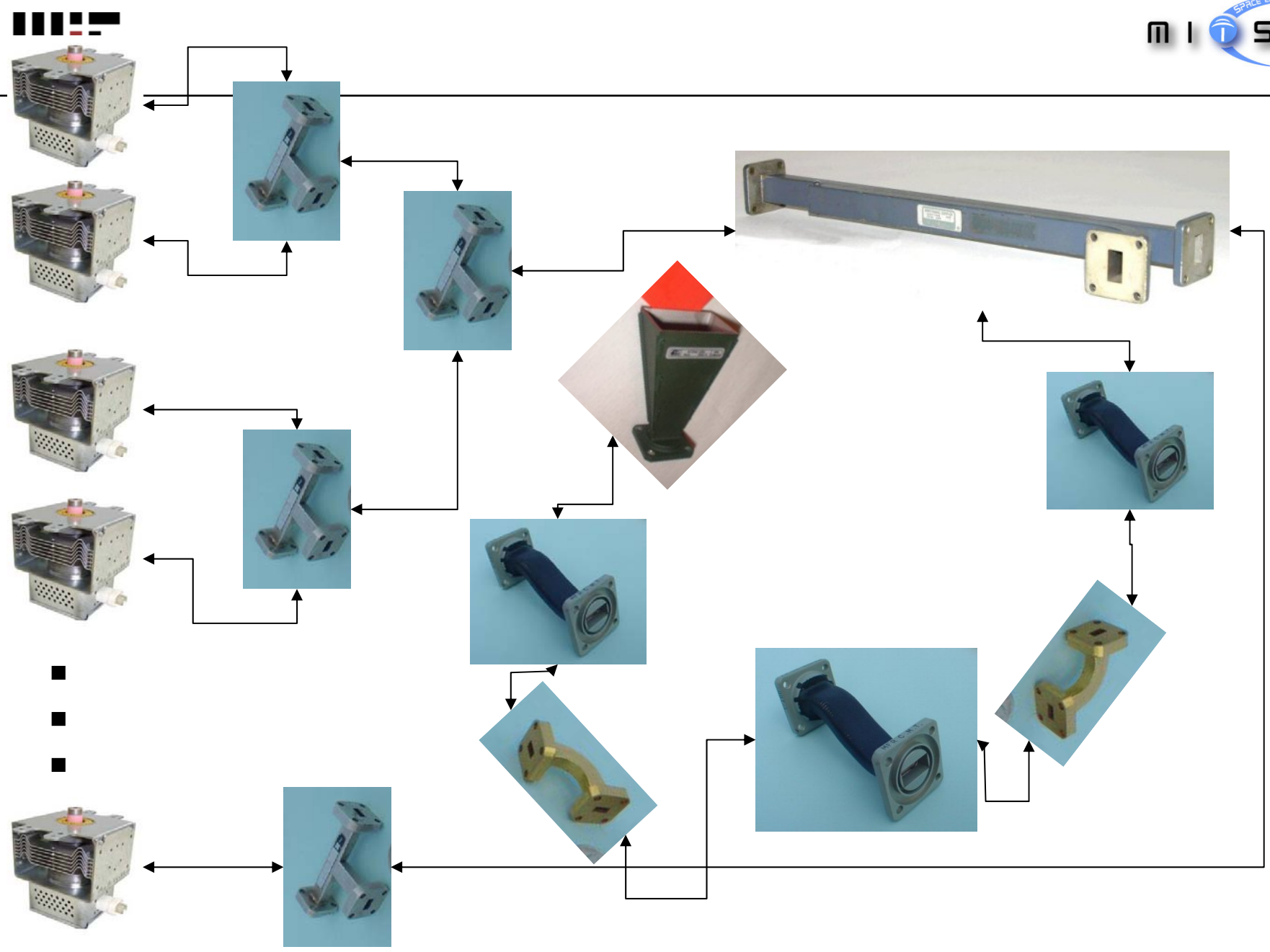


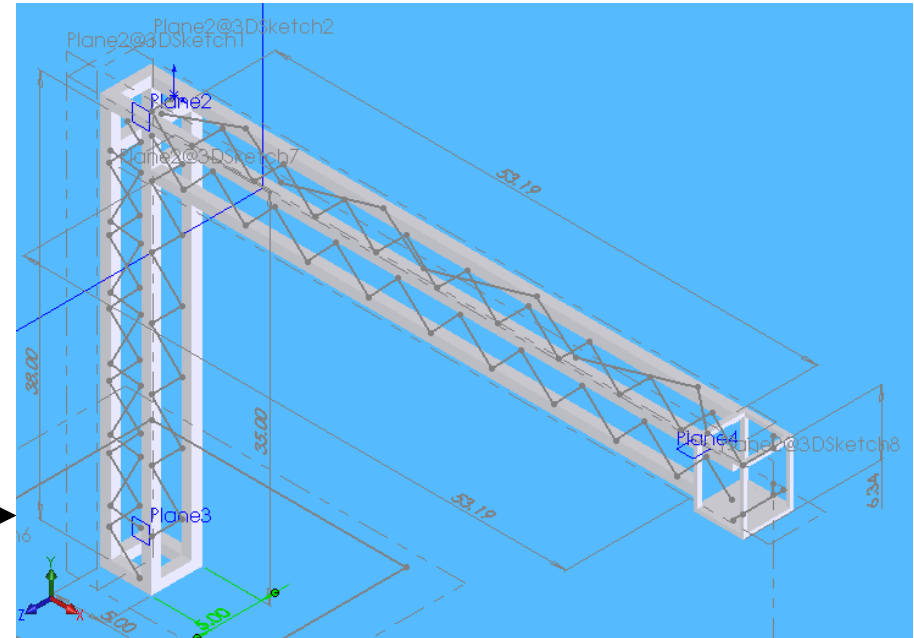
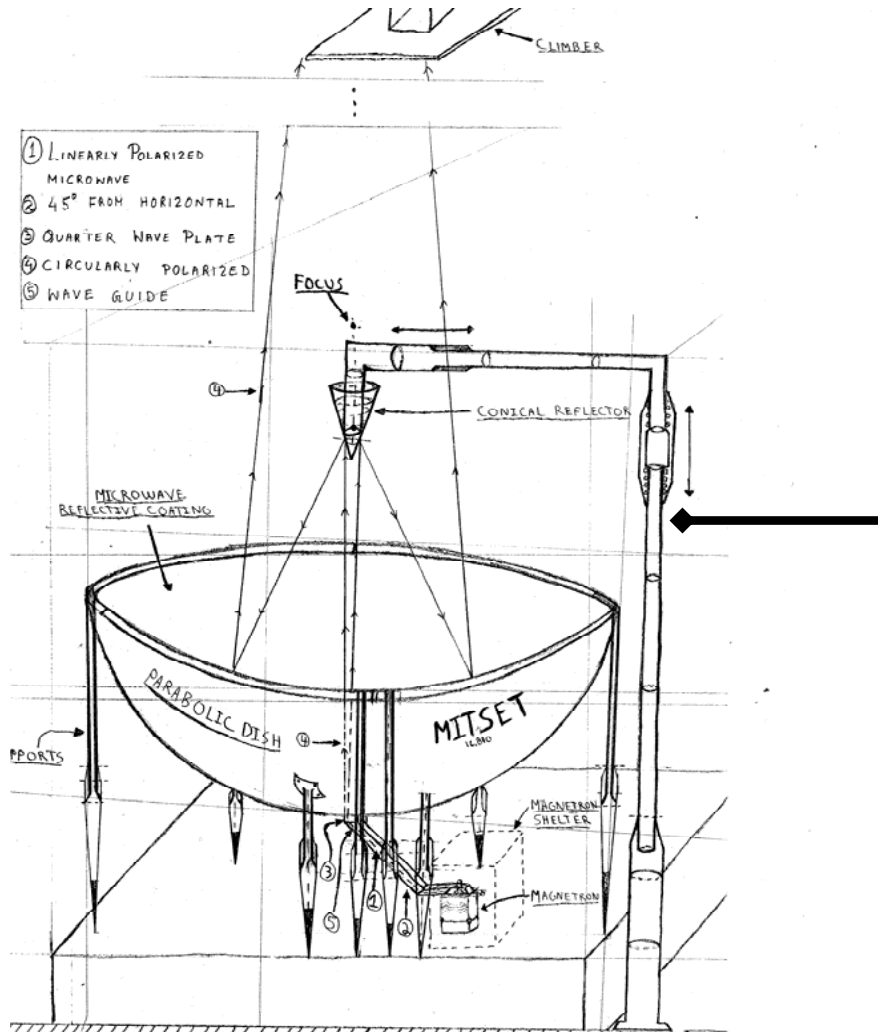


Efficiency: 8%

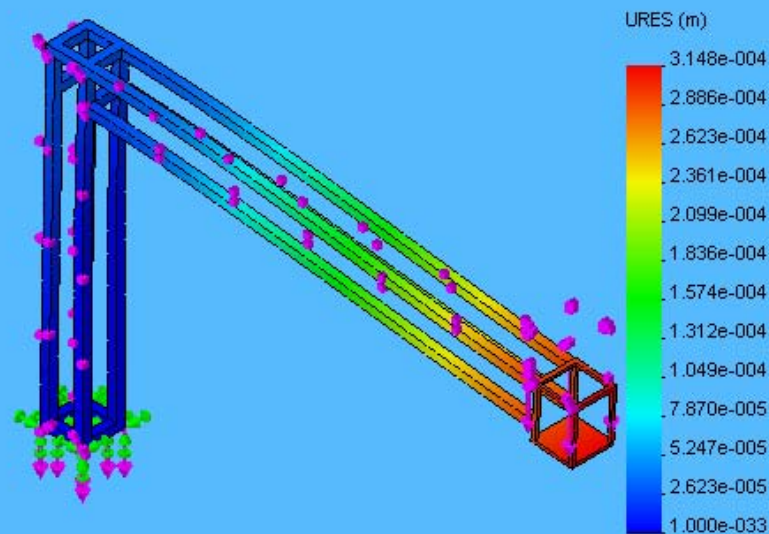
(back of the envelope: 14%)







Wigi-wigi technology...
Proves to be pretty stable.



Educational Version. For Instructional Use Only

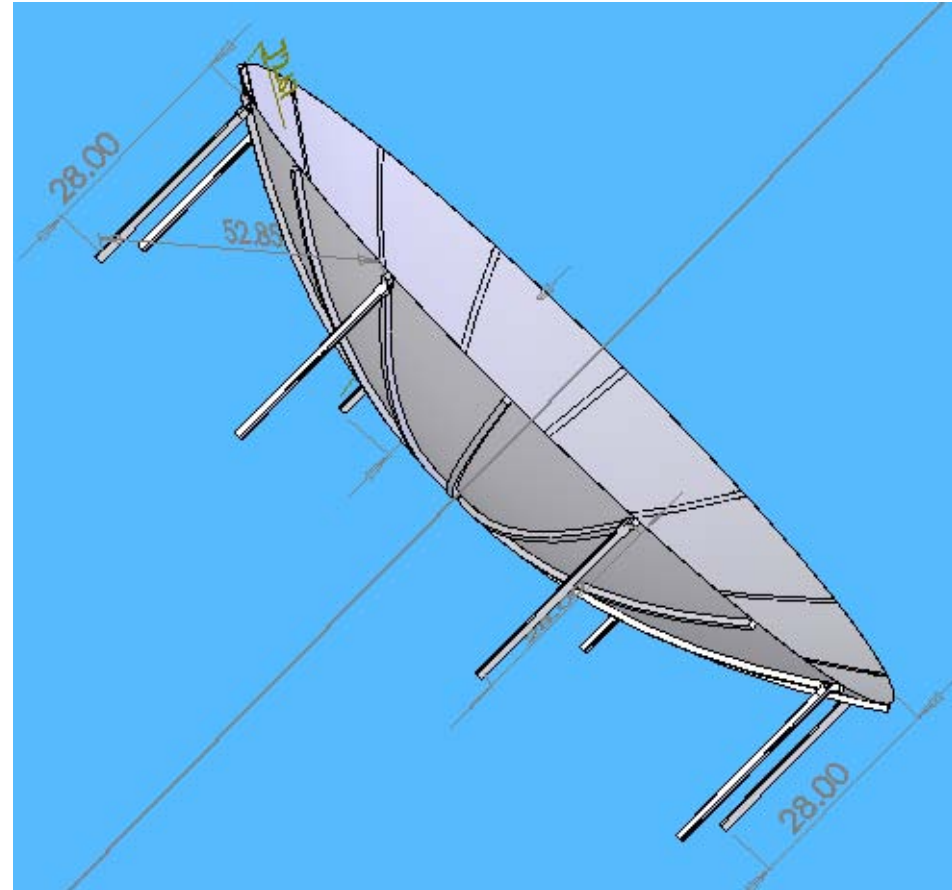
Positive sides:

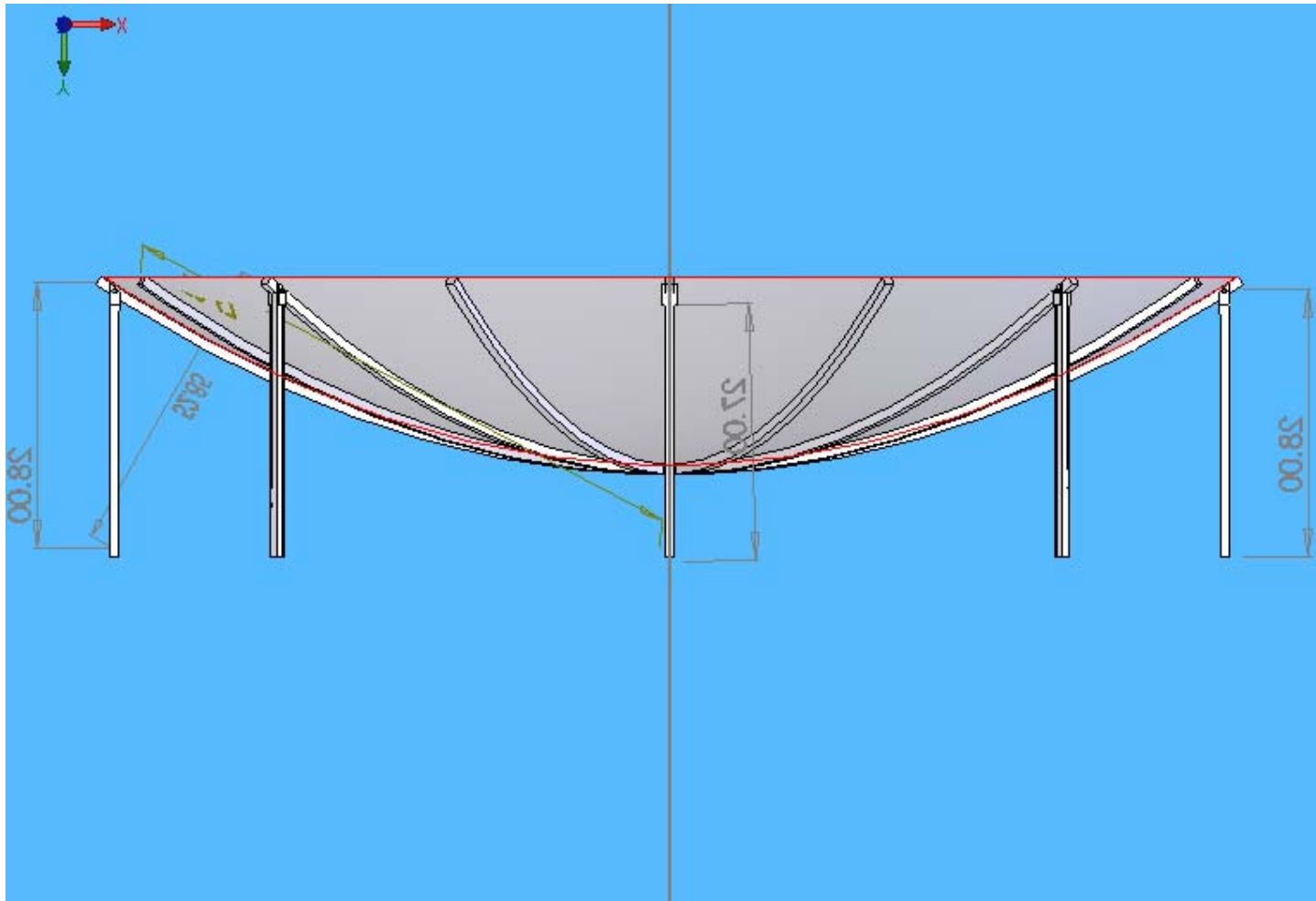
- 1) Very light weight.
- 2) Greater stability
- 3) Can be put together pretty fast.
- 4) Minimal air resistance.
- 5) Easy to make, and cheap.

Negative sides.

- 1) Still have to figure out a way to make the y-axis variable, as desired.
- 2) Unstable weight distribution (40" X 63")

- Used to collimate microwaves
- 120 inches in diameter
- 20 inches deep
- Pre-manufactured dish
- Divided into 4 sections
 - 3 legs per section
- Free standing sections
- Simple design for quick assembly





Deliverable D: Cost Estimate				
<i>M1 Team</i>		<i>Naive About Optics Team</i>		
Ethan Huwe				
Arka Dhar				
Chris Mandy				
Item	Price	Unit	Quantity	Cost
<i>Raw Materials</i>				
<i>Dish Support</i>				
Steel Tubing 1" square	5	\$/yard	12	60
Steel Plates	4.73	\$/sq. foot	2	9.46
Bolts	2	\$/25	1	2
Screws	6	\$/25	1	6
Fasteners	4.2	\$/100	1	4.2
<i>Horn Support</i>				
Tubing	5	\$/yard	13	65
Bolts	2.5	\$/25	8	20
Nuts	2	\$/25	8	16
Wigi-wigi wire	3	\$/yard	30	90
<i>Microwave Circuit</i>				
Magnetrons	1170	\$/unit	11	12870
Waveguide 41.41cm	131.44	\$/unit	1	131.44
Waveguide 62.74cm	172.65	\$/unit	1	172.65
Waveguide 14.22cm	41.23	\$/unit	1	41.23
H-Bend	210.2	\$/unit	2	420.4
Horn Copper	2.2	\$/sq. foot	1	2.2
Bolts	2	\$/25	2	4
Screws	6	\$/25	2	12
Horn Backplate	0	Scrap	1	0
Beam Combiner	301.5	\$/unit	10	3015
Quadrature Coupler	440	\$/unit	1	440
<i>Manufacturing</i>				
Welding	75	\$/hour	2	150
Cutting and Drilling	75	\$/hour	1	75
<i>Assembly</i>				
Assembly	75	\$/hour	4	300
<i>Testing</i>				
Not quite yet...				
Total				17906.58

- No level 2
- Functional:
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- ~~Interface~~
 - Power Source
 - Climber ribbon anchor
 - Spectator and operator distances
 - Storage size
 - Assembly time

- Polarization (Rectenna Related)
- Beam blockage losses
- Software use
- Beam source and signal type
- Beam directionality losses
- Beam Collimation: variable reflector height
- Play with the “wigi-wigi”, to figure out the optimum binding for perfect stability.
- Unstable weight distribution (40.3” X 63”)
- Improve stability, by proper load distribution (depends on new configuration)

- Redesign incorporating Mr. Willwerth's rather nice ideas
- Perform Thermal Analysis
- Comsol would be nice...
- Review design by fresh person before testing
- Test in sections before all up:
 - Magnetron alone
 - Waveguides + optimize
 - Waveguides + emitter
 - Reflector
 - Waveguides + reflector + optimize
 - Waveguides + receptor antennae
 - Reflector + receptor antennae

- Trust measurements over specs
- Don't trust specialists
- Trust specialists
- Simplest design works best
- There's plenty to know about microwaves. What actually matters for implementation is tiny, but it's hard to find out what it is.
- It's possible to do crazy things in one month. It's hard to do them right.