

# 2024 IEEE EMC Maker Event

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# Thanks to today's sponsors



# Today's Maker Activity

- Today we are making a 2m Yagi type antenna
- The design is based on videos with modifications

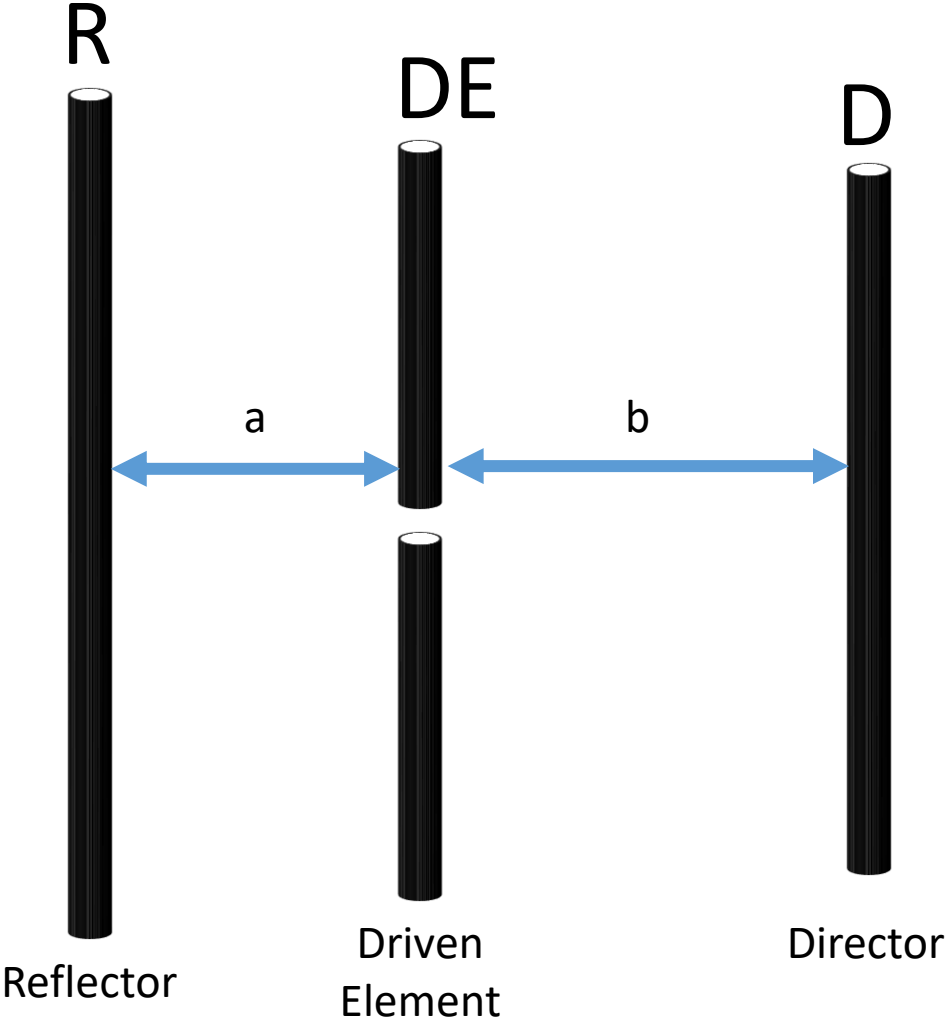
<https://www.youtube.com/watch?v=hh9beU335s4>

<https://www.youtube.com/watch?v=BmHoQrDfw-0&t=53s>

<https://www.youtube.com/watch?v=FbYfShh-OAU>

# Yagi-Uda Antenna

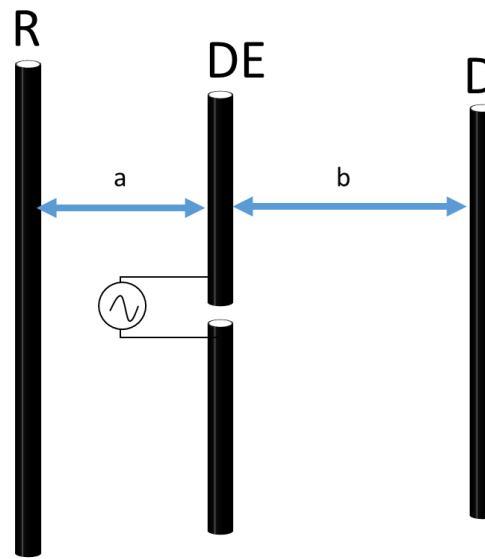
Transmission in Forward Direction or Reception from Forward Direction has higher gain than from opposite direction



Normally a Yagi antenna would have more director elements

# Yagi-Uda Antenna

- Reflector and Director are “Passive” conductors
- Driven element is connected to transmitter OR receiver
- Spacing and length of elements is determined empirically or by simulation
- Optimization is used to improve forward gain, difference forward/backward gain, other parameters
- Bandwidth is limited



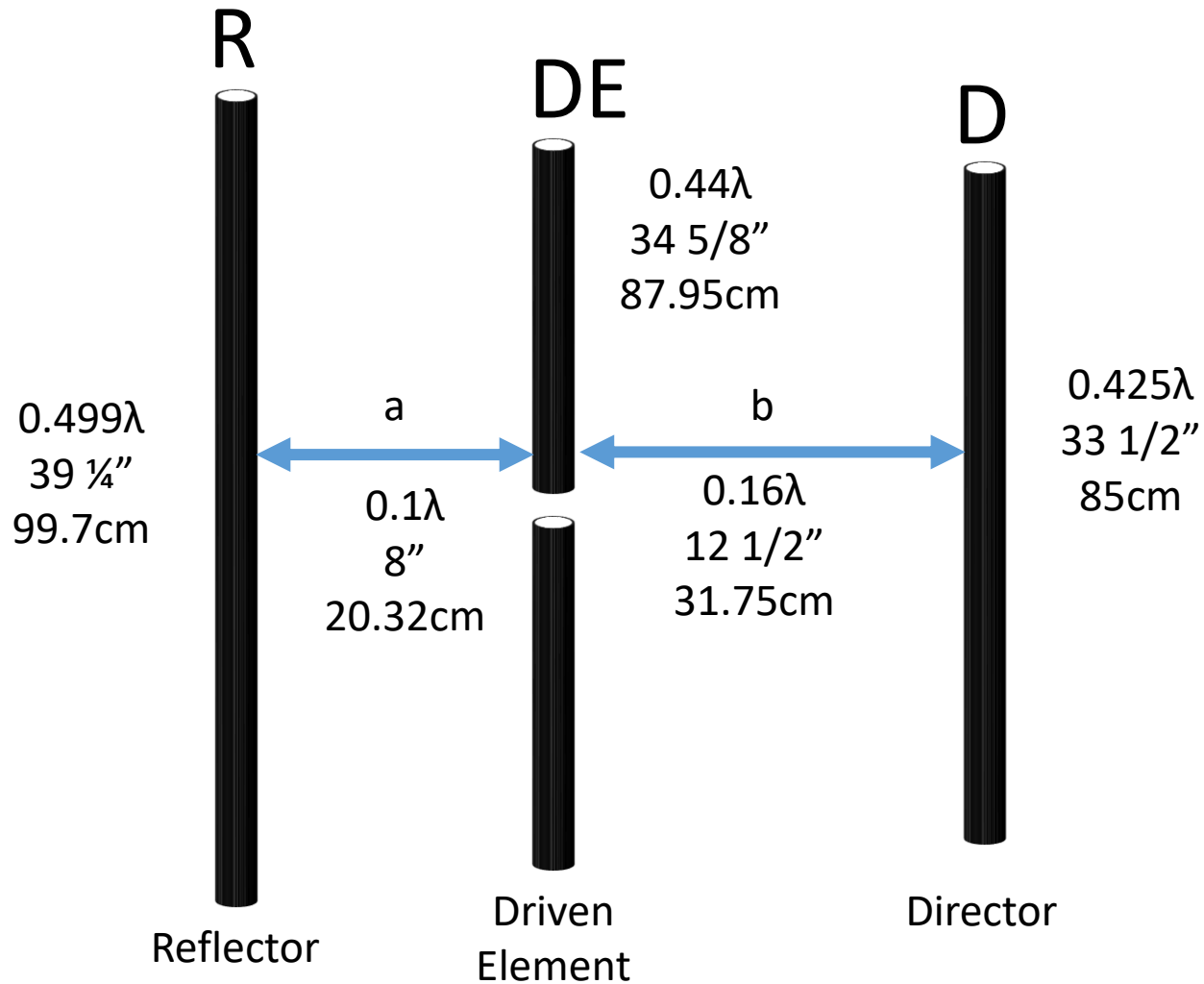
# Design guidelines for Yagi-Uda antenna

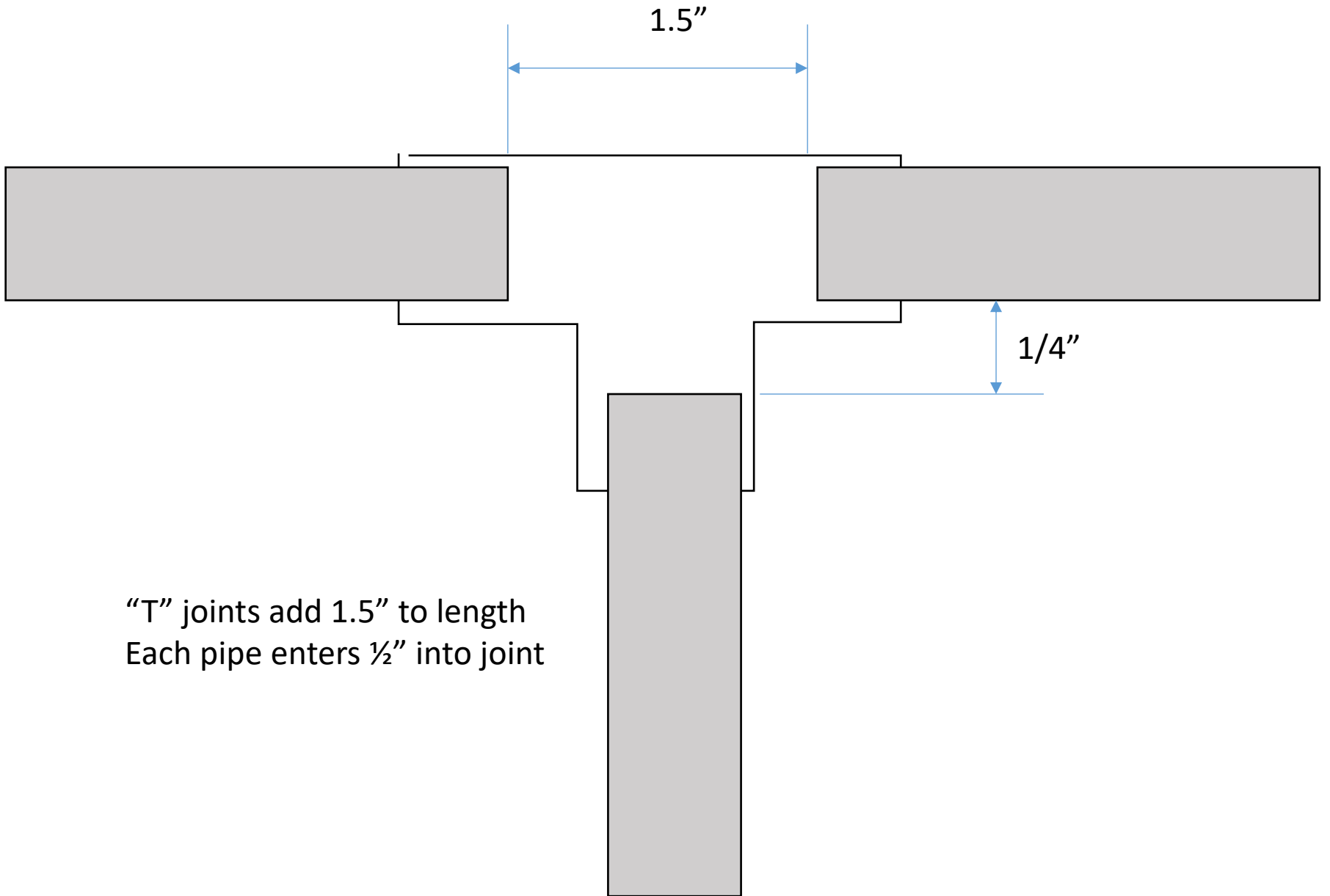
1. Director elements are shorter than feed (driven) element ( $0.4$  to  $0.45\lambda$ )
2. Driven element is less than  $\frac{1}{2}$  wavelength ( $0.45$ - $0.49 \lambda$ )
3. Reflector length longer than driven element
4. Distance from driven element to director  $\sim 0.3 \lambda$  (gain is lost if too long)
5. Distance from driven element to reflector  $\sim 0.25 \lambda$

These values seem too large by factor of 2

Design from KB9RLW

<https://www.youtube.com/watch?v=hh9beU335s4>

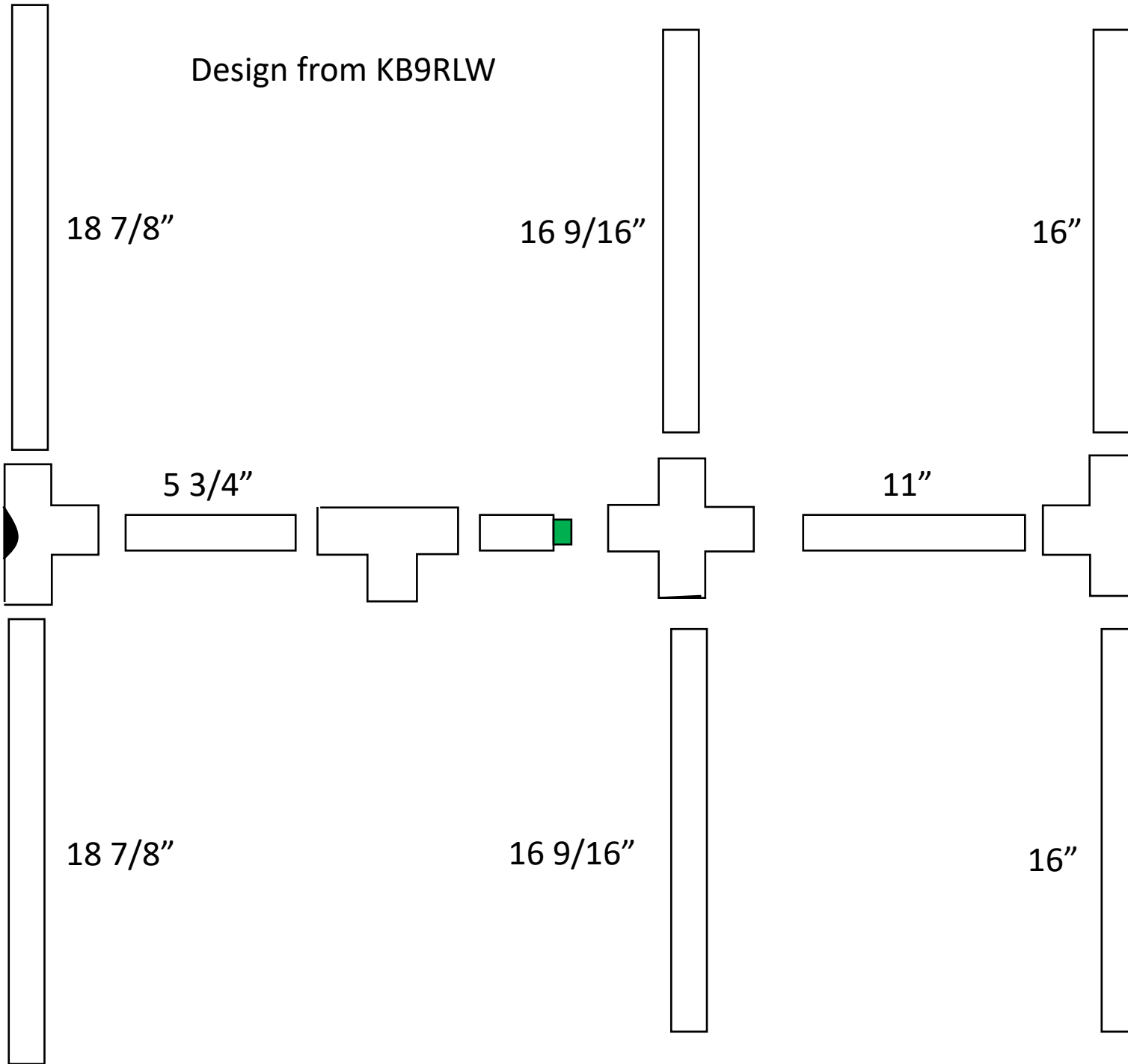




“T” joints add 1.5” to length  
Each pipe enters 1/2” into joint



Design from KB9RLW



# Check the design using 4NEC2

Main [V5.9.3] (F2)

File Edit Settings Calculate Window Show Run Help

Filename: yagi3wire.out

Frequency: 150 Mhz  
Wavelength: 1.999 mtr

Voltage: 74.2 + j0 V  
Current: 1.35 - j 3.85 A

Impedance: 6.01 + j17.2  
Parallel form: 55 // j19.3

S.W.R.50: 9.31  
Efficiency: 100 %  
Radiat-eff.: 290.2 %  
RDF [dB]: 8.34

Series comp.: 61.83 pF  
Parallel comp.: 55.07 pF

Input power: 100 W  
Structure loss: 0 uW  
Network loss: 0 uW  
Radiat-power: 100 W

Environment:  Loads  Polar  
FREE SPACE

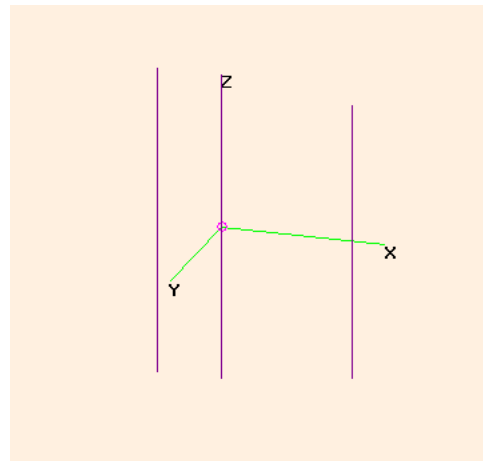
Comment:  
Length X1 = 0.005  
Length X2 = 0.005  
Length Y = 0.005  
X sections = 6  
Y sections = 6  
Rotate X, Y, Z = 0, 0, 0  
Move X, Y, Z = 0, 0, 0

Seg's/patches: 51  
Pattern lines: 5329  
Freq/Eval steps: 1  
Calculation time: 0.063 s

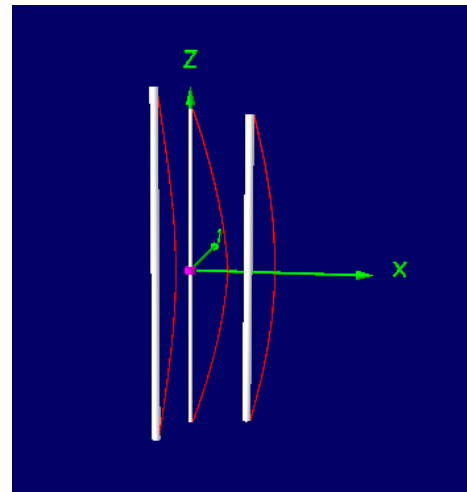
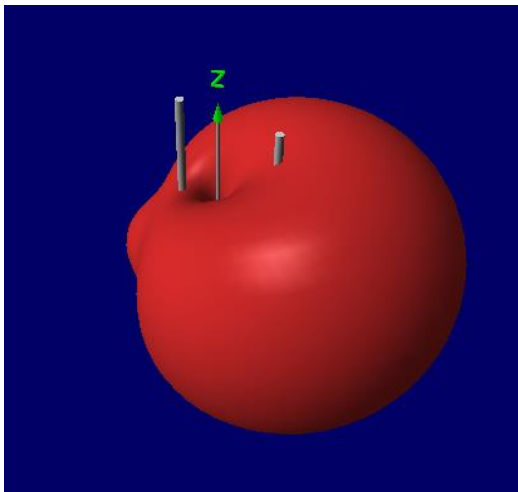
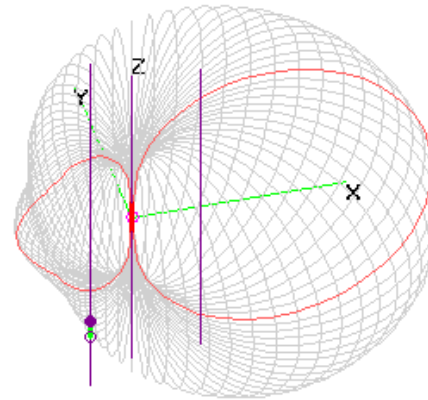
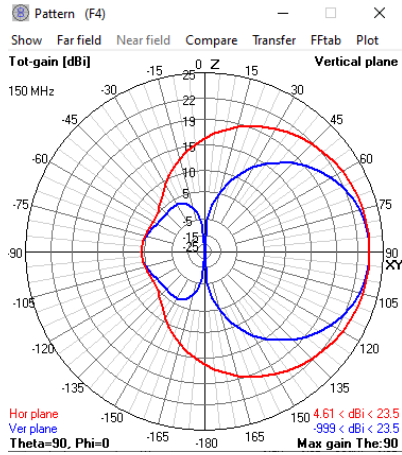
	start	stop	count	step
Theta	-180	180	73	5
Phi	0	360	73	5

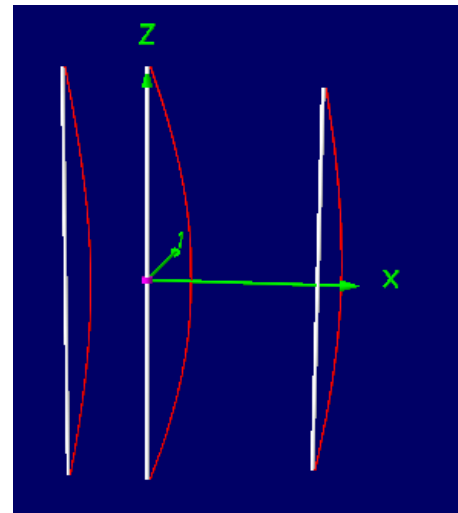
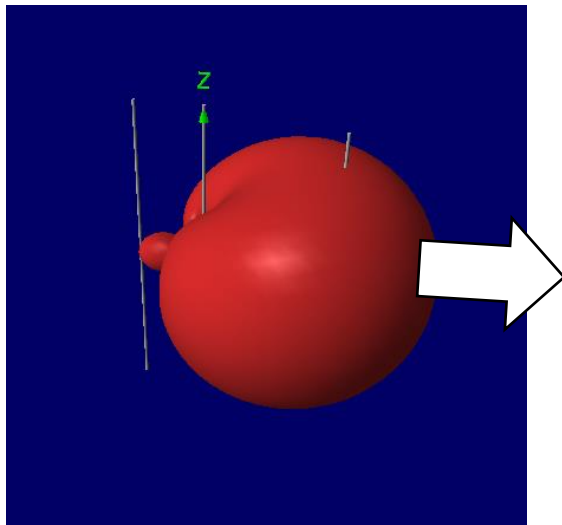
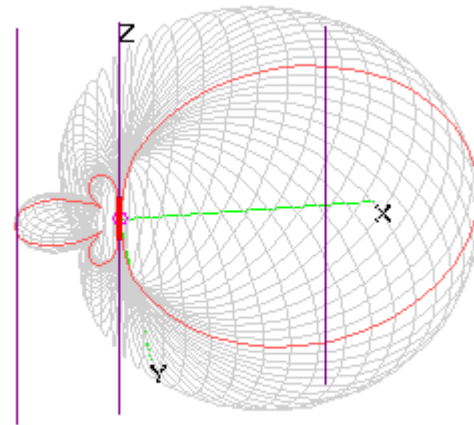
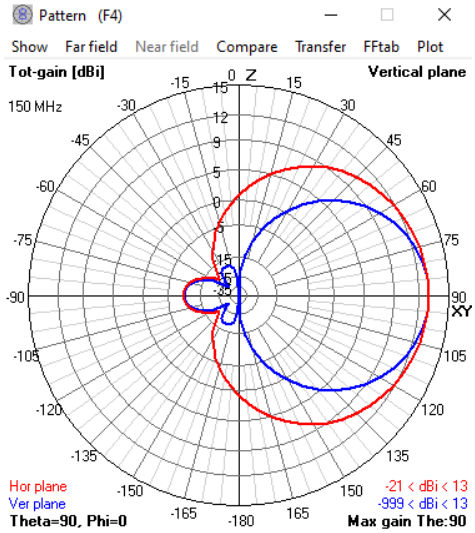
## Symbols

Nr	Symbols and equations	comment
1	$\text{Lambda}=2$	wavelength
2	$R=1/2*\text{Lambda}/2$	reflector half length
3	$F=1/2*\text{Lambda}/2$	Feed half length
4	$D=0.9/2*\text{Lambda}/2$	Director half length
5	$a=0.2*\text{Lambda}/2$	reflector to feed length
6	$b=0.4*\text{Lambda}/2$	feed to director length



# Characteristics of KB9RLW design



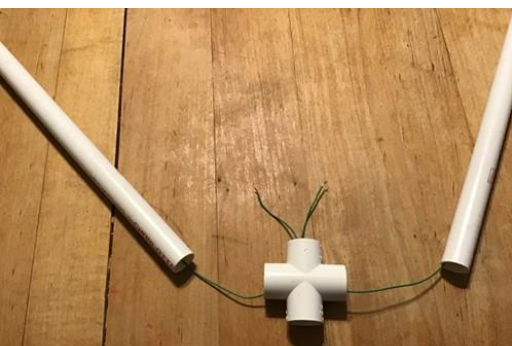




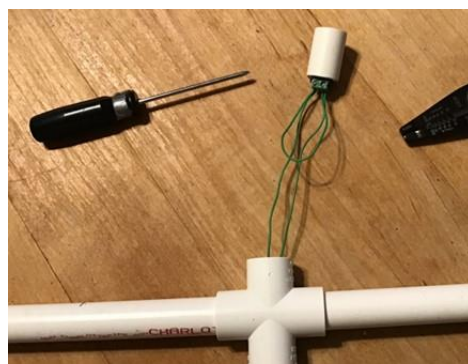
Cut 5 1/2 " of wire to use a stub



Cut remaining wire in half



Feed wire through driver pieces and cross piece

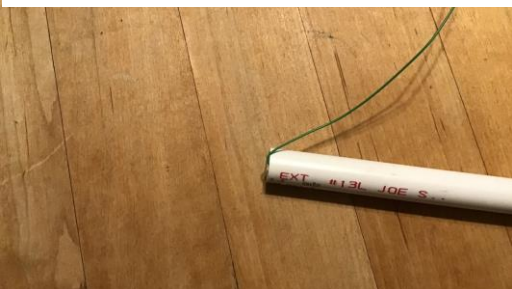


Attach wire to BNC and connect stub across terminals



Pull wires through tubes and push BNC into cross piece. Pull stub through cross piece

Pull the wires tight and bend over tube ends



Assemble T and tube onto BNC on reflector side

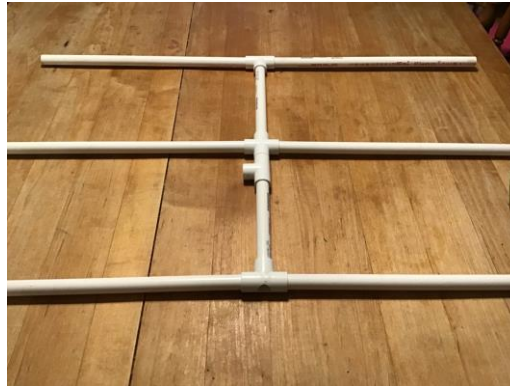


Put T with hole onto reflector side





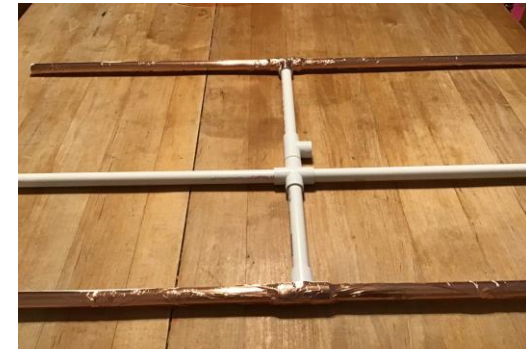
Assemble the remaining tubing



Add copper tape to reflector



Connect copper tape across the T joint



Put copper tape onto director



Secure wire to driver tube ends with hot glue and trim wire