

21cm Wavelength Circular_Patch_Feed Disk Director Yagi Antenna

An
Efficient Low_Noise
Portable Economical
21cm Neutral Hydrogen
Radio Telescope Antenna

STUDENT EDITION

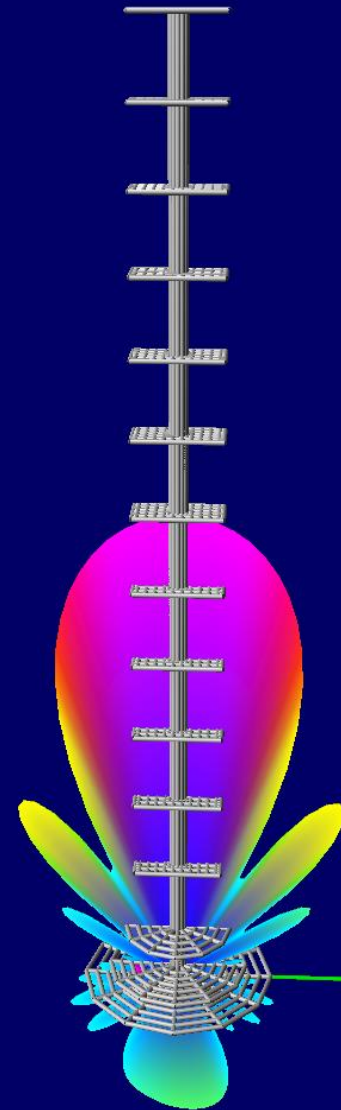
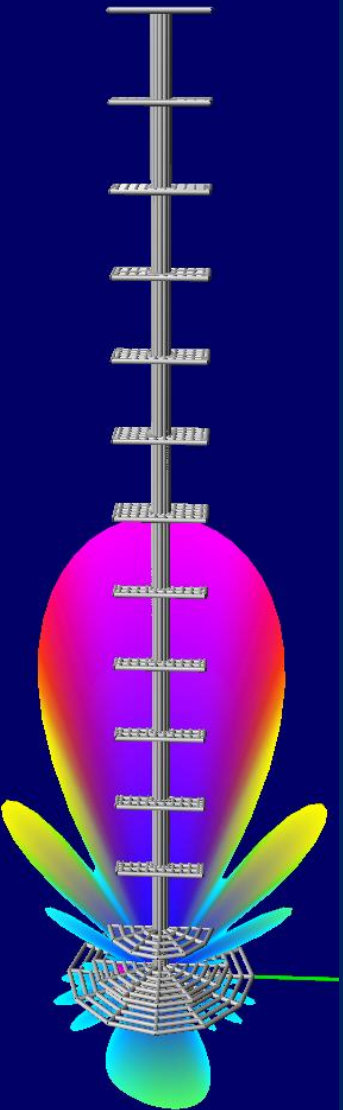
***Enhanced Reliability
Version***

*If built carefully to correct dimensions
This antenna will have similar
performance to the original*

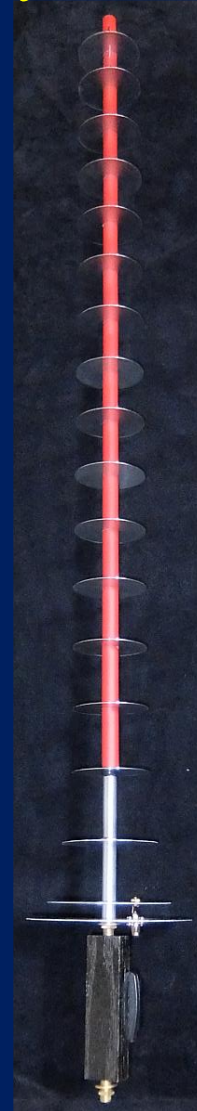
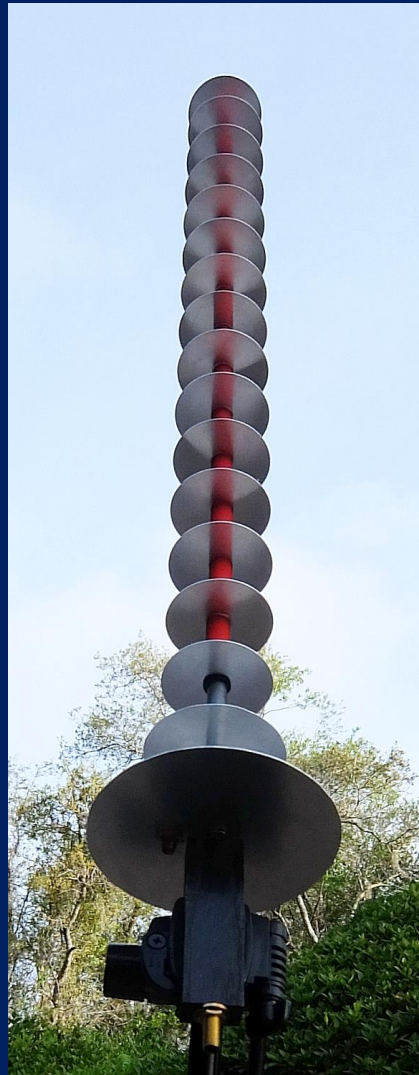
&

*It is light enough to be mounted on a
low cost photo tripod*

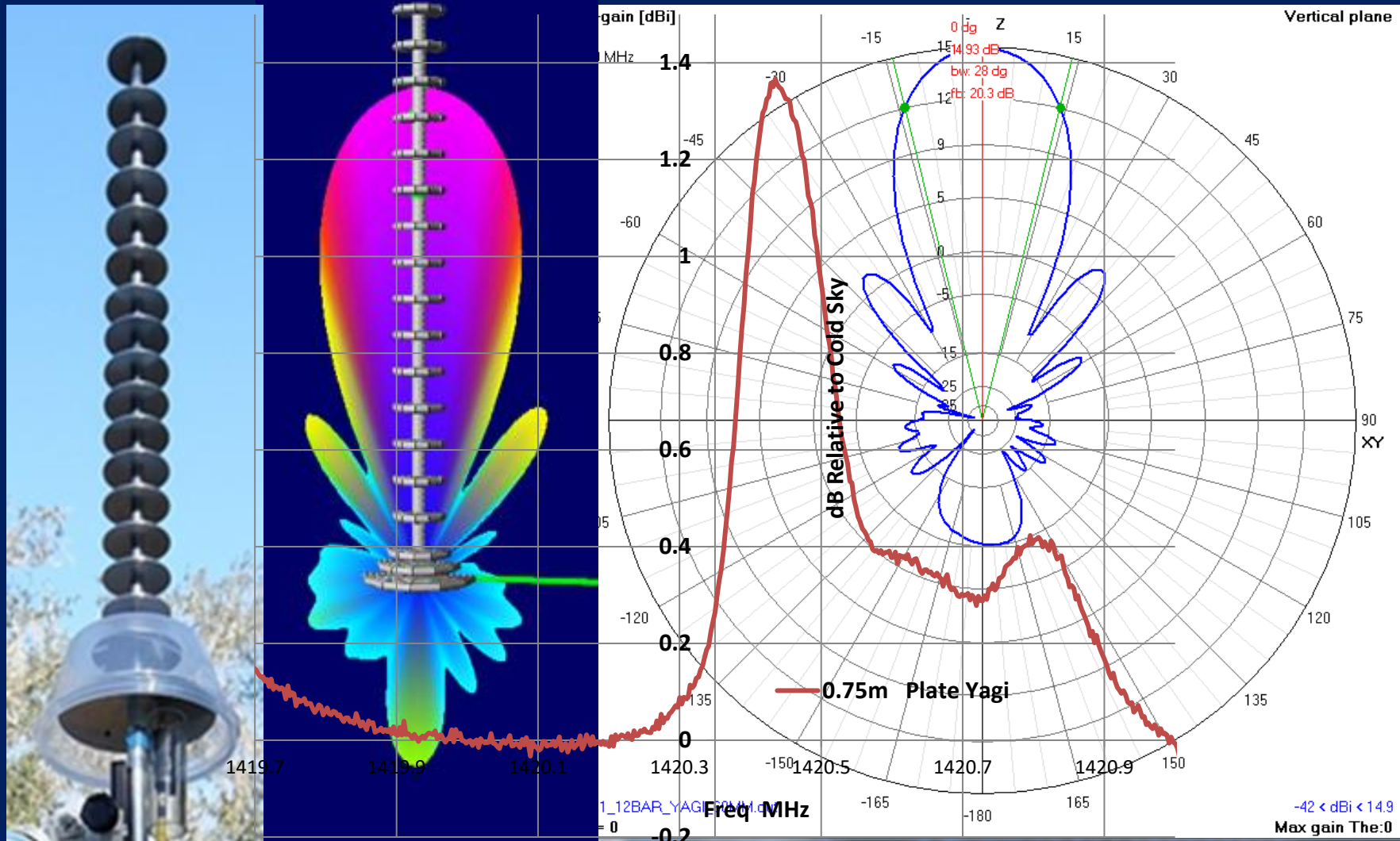
alex pettit jr April 2026



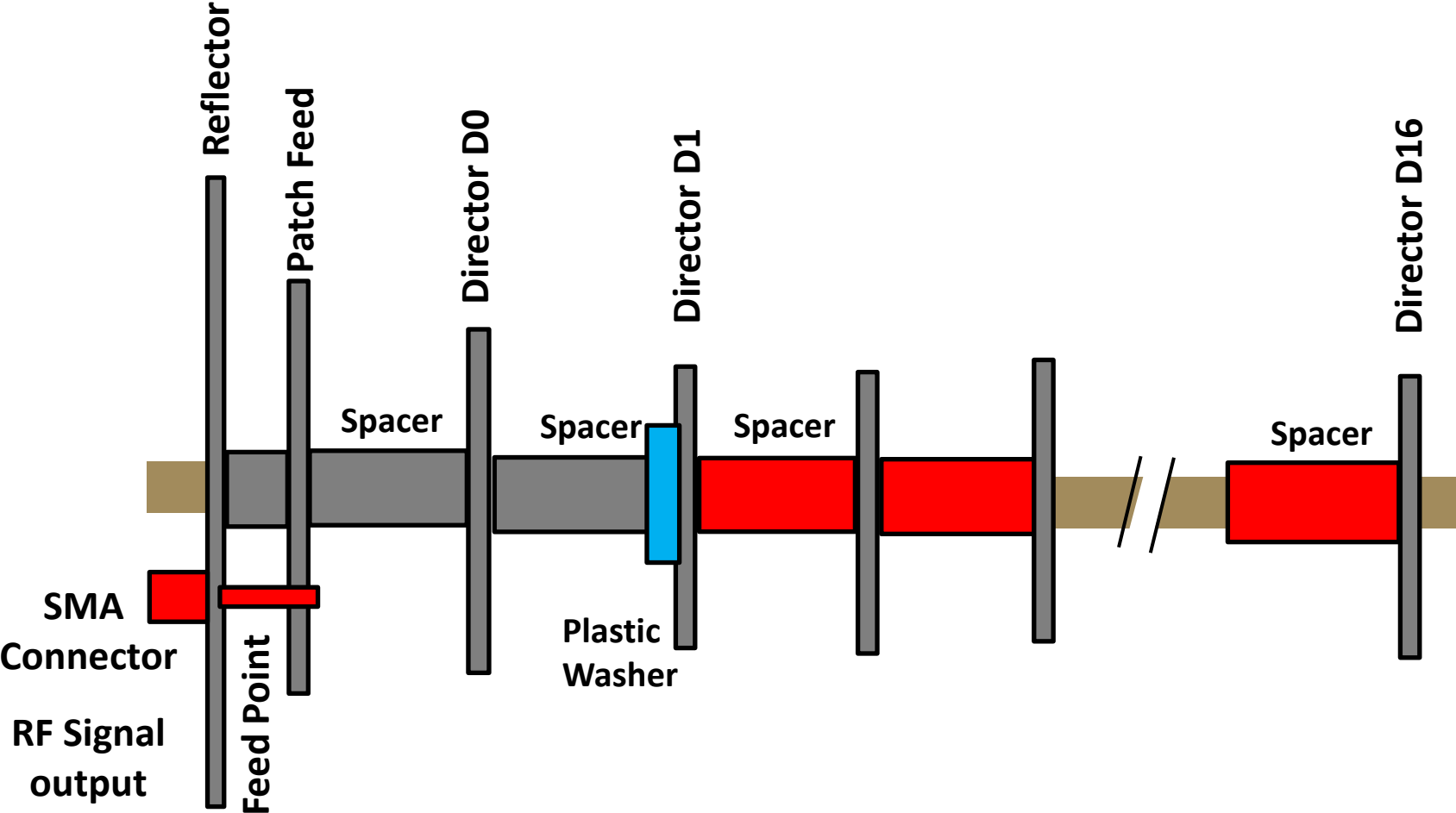
21cm Wavelength Circular_Patch_Feed Disk Director Yagi Antenna Student Enhanced Reliability Edition



Performance Characteristics



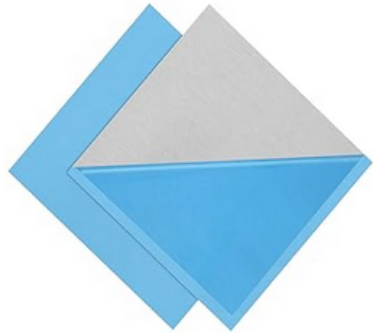
Yagi Antenna Element Names



Antenna Components *Using 0.020" & 0.030" Aluminum Sheet*

REMOVE BLUE FILM

**1 pack = 2 sheets 0.030"
for Reflector and Patch Feed**



2Pack 6061 T651 Aluminum Sheet Metal 6 x 6 x 1/32 (0.0315") Inch Flat Plain Aluminum Plate Covered with Protective Film, Heat Treatable Rectangle Aluminum Metal Plate for Crafting, DIY, 0.8mm Thick

Brand: Lswteiz
4.7 ★★★★★ 231 ratings | [Search this page](#)

\$7⁹⁹ (\$4.00 / Item)

**2 packs = 4 sheets 0.020"
for 16 Directors**



2 Pieces 6061 T651 Aluminum Sheet Metal 6X 6x0.02(24Gauge) Inch Rectangle Metal Plate, 0.5mm Aluminum Sheet, Plate for Crafting, Industry

Brand: iteshuai
4.7 ★★★★★ 112 ratings | [Search this page](#)

Amazon's Choice
in Aluminum Sheets & Plates by iteshuai

200+ bought in past month

\$5⁹⁹ (\$3.00 / Item)

Roll over image to zoom in

SharkBite

1/2-in x 5-ft White PEX-B Pipe

\$3.28



K & S Precision Metals
83035 Round Aluminum Tube, 1/2" OD x 0.035" Wall Thickness x 12" Length, 0.5 in OD, 1 pc, Made in USA

Visit the K&S Store
4.5 ★★★★★ 239 ratings

\$6⁹⁹

✓prime Two-Day

Antenna Components for Enhanced Reliability version

Purchase dowels and screws at Local Hardware Store

PRODUCT SIZE

Antique Brass Lamp Repair Hardware Kit - 5 Sizes, 60 Pieces, Includes Pipe Nipples, Lock Nuts, Washers, Perfect for Lamp Assembly & DIY

Brand: QVQCWD

4.6 ★★★★★ (214) | [Search this page](#)

300+ bought in past month

\$7⁹⁹ [Price history](#)

Item	Dimensions	Quantity
Pipe Nipple	20mm/0.87"	2Pcs
Pipe Nipple	100mm/3.94"	2Pcs
Pipe Nipple	50mm/1.97"	2Pcs
Pipe Nipple	40mm/1.57"	2Pcs
Pipe Nipple	20mm/0.79"	2Pcs
Lock Nut	9mm/0.35"	20Pcs
Lock Nut	13.5mm/0.54"	10Pcs
Lock Nut	19.5mm/0.77"	10Pcs
Lock Nut	17.5mm/0.69"	10Pcs
Washer	10mm/0.39"	10Pcs
Washer	10mm/0.39"	10Pcs



Dowel Rods Wood Sticks
Wooden Dowel Rods - 3/8
x 36 Inch Unfinished

**#6-32 x 1/4" screw & nut
for Patch Feed**



**#2-56 x 1/4" screws & nuts
(2.5mm x 6mm if you can find them)
for attaching SMA connector**



Electronic Components



🔗 Nooelec SAWbird+ H1 - Premium Saw Filter & Cascaded Ultra-Low Noise Amplifier (LNA) Module for Hydrogen Line (21cm) Applications. 1420MHz Center Frequency. Designed for Software Defined Radio (SDR)

[Visit the Nooelec Store](#)

4.4 ★★★★★ 62 ratings | [Search this page](#)

\$44⁹⁵ (\$89.90 / 100 g)



NooElec NESDR

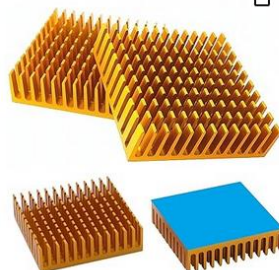
SMARTEE XTR SDR

Premium RTL-SDR w/ Extended Tuning Range, Aluminum Enclosure, Bias Tee, 0.5PPM TCXO, SMA Input. RTL2832U & E4000-Based Software Defined Radio

[Visit the Nooelec Store](#)

4.2 ★★★★★ (364) | [Search this page](#)

\$47⁹⁵



🔗 WWZMDiB 4Pcs 40mm Heatsink Back Side Thermal Conductive Tape 40mm x 40mm x 11mm Heat Sink

[Visit the WWZMDiB Store](#)

4.7 ★★★★★ 11 ratings | [Search this page](#)

\$5⁹⁹ (\$1.50 / Item)

✓prime
FREE Returns

Did you know? There's no annual fee for Prime Visa. **Get a \$100 Amazon Gift Card instantly upon approval.** [Learn more](#)

Brand

WWZMDiB



🔗 SMA Male to SMA Male Coaxial Cable 50 ohm KMR240 Coax Cable Ultra Low Loss Antenna Extension Cable with SMA Connector for 3G/4G/5G/LTE Network Equipment, GPS, RF Radio to Antenna (25FT)

[Visit the MOOKEERF Store](#)

4.5 ★★★★★ 77 ratings | [Search this page](#)

\$23⁹⁹ (\$0.96 / Foot)

✓prime One-Day



Roll over image to zoom in

🔗 USB 3.0 Extension Cable 1 ft, Yeung Qee High Speed USB 3.0 A Male to A Female Extension Cord for Data Transfer USB Flash Drive, Keyboard, Mouse, Playstation, Xbox, Card Reader, Printer etc (1ft/0.3M)

Brand: Yeung Qee

4.5 ★★★★★ 113 ratings | [Search this page](#)

\$5⁷⁹



DHT Electronics RF coaxial connector adapter SMA male coaxial Termination Loads 1W DC- 3.0GHz 50 ohm Pack of 2

Brand: DHT Electronics
4.4 ★★★★★ 215 ratings | [Search this page](#)

[Amazon's Choice](#)

50+ bought in past month

\$5⁵⁰ (\$2.75 / Count)

✓prime
FREE Returns
30-day refund/replacement

Specific personal



🔗 onelinkmore SMA Panel Mount Connector SMA Male 2-Hole Panel Chassis Mount Flange Solder Post Plug Connector Mounting Panel Post Straight Insulator PCB Coaxial Converter Pack of 5

[Visit the onelinkmore Store](#)

5.0 ★★★★★ 3 ratings | [Search this page](#)

\$6⁹⁸ (\$1.40 / Count)

Hand Tools

Cutting Aluminum & PEX tube to length



HAUTMEC 6inch Mini Hacksaw With Miter Box Set and 1pcs Bi-Metal Blade Small Miter Saw With Adjustable 6 Cutting Angles Professional Hack Saw for Metal、Crafts、Wood、Plastic Cutting

[Visit the HAUTMEC Store](#)

4.0 ★★★★★ 1,934 ratings

200+ bought in past month

\$8⁵⁸

Drill for Tripod mounting block



Cutting aluminum sheet into disks



Sponsored ⓘ

10" Left Cut Aviation Snip - Left Cut Offset Stainless Steel Cutting Shears with Forged Blade & Power Comfort Grips Aviation...

★★★★★ 10

\$9⁹⁹

(optional) Hand Tools

marking disk diameter
cutting lines on aluminum sheets



2pcs Compass for Geometry, Professional Drawing
Compass,Metal Compass, Circle Compass Drawing
Tool for Geometry, Math, Drafting, Drawing,
Measuring, School & Office Supplies by CUALORK

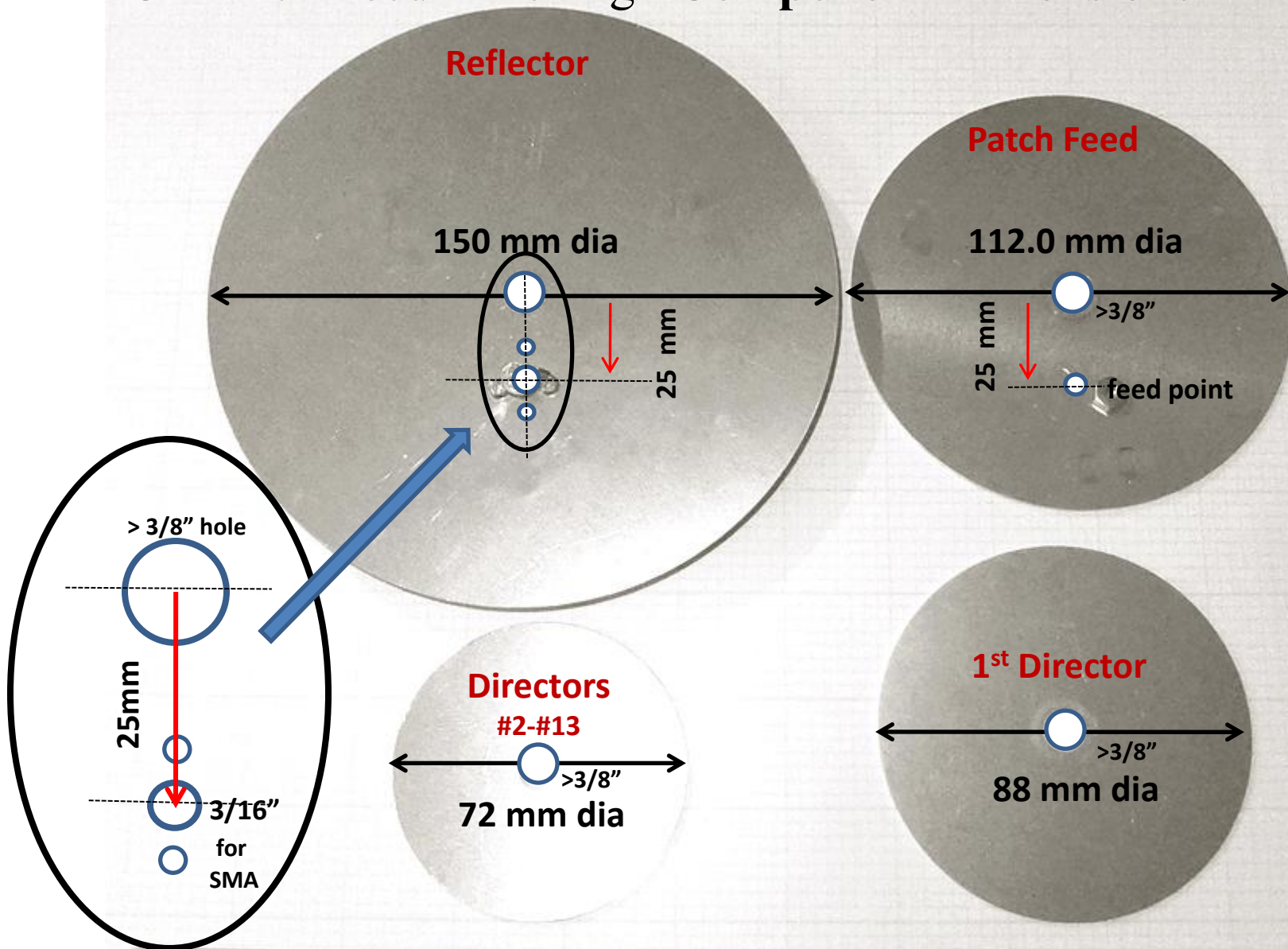
Brand: Cualork

4.5 ★★★★★ 253 ratings | [Search this page](#)

200+ bought in past month

\$5⁶⁸

Cir Patch Feed Plate Yagi Component Dimensions



Fabrication Details

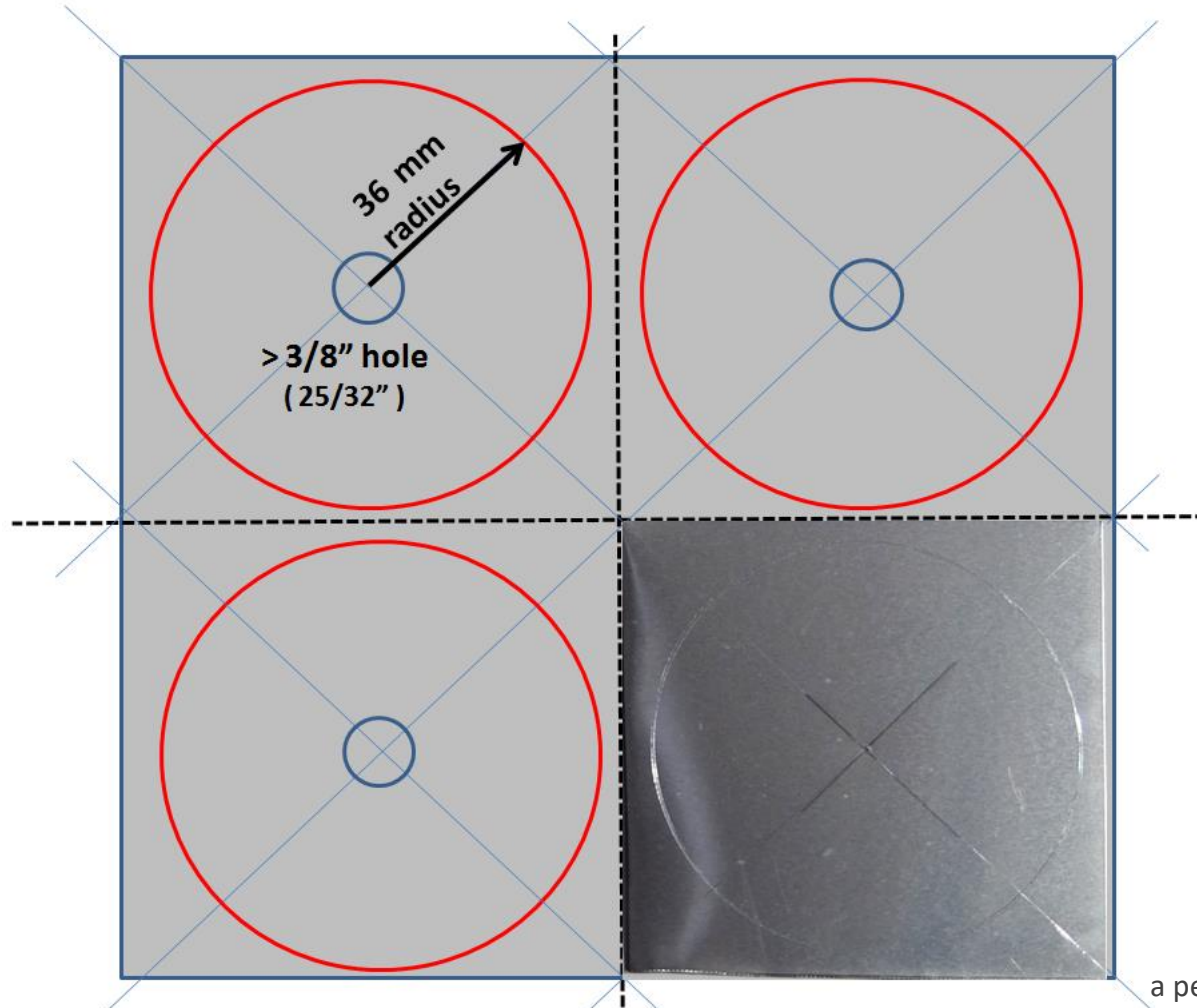
72 mm diameter Director Layout

it may be easier to drill all 4 dowel rod holes before cutting sheet into small pieces

indent centers w/ punch or sharp nail

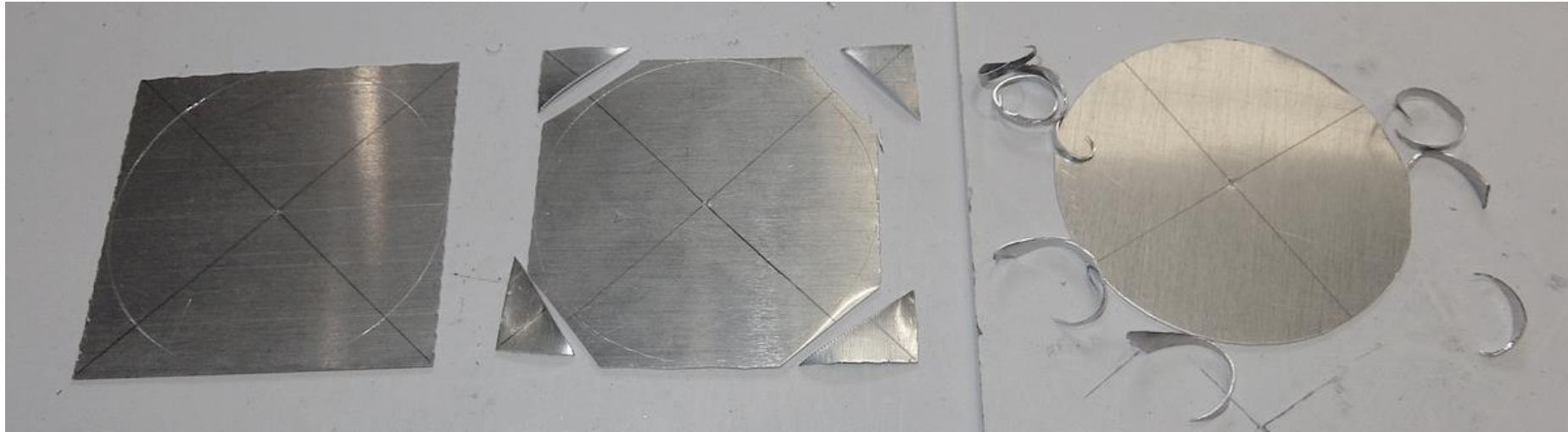
Start with a 1/8" drill bit and work progressively in 3 or 4 steps to 3/8"+ (25/64")

(OR cut out all circles , stack, clamp properly, and drill all 72mm disks at one time



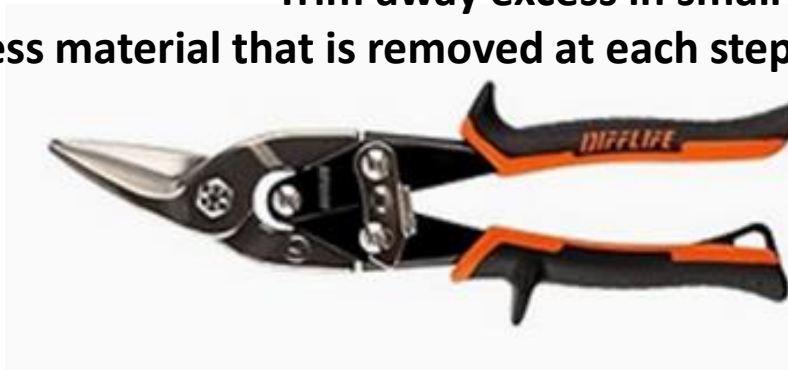
Fabrication Details

**Remove excess outer aluminum in stages to make final cut easier
the small amount remaining will curl away and not cause the disk to distort**



**Because of the amount of aluminum that must be cut away and the 0.030”
thickness of the 112.5mm Patch Feed disk, It is the Most Difficult
Trim away excess in small steps..**

The less material that is removed at each step , the easier each is to cut.



Left Cut Aviation Shears
(for a right handed person)

Fabrication Details

Cutting Spacers to Length

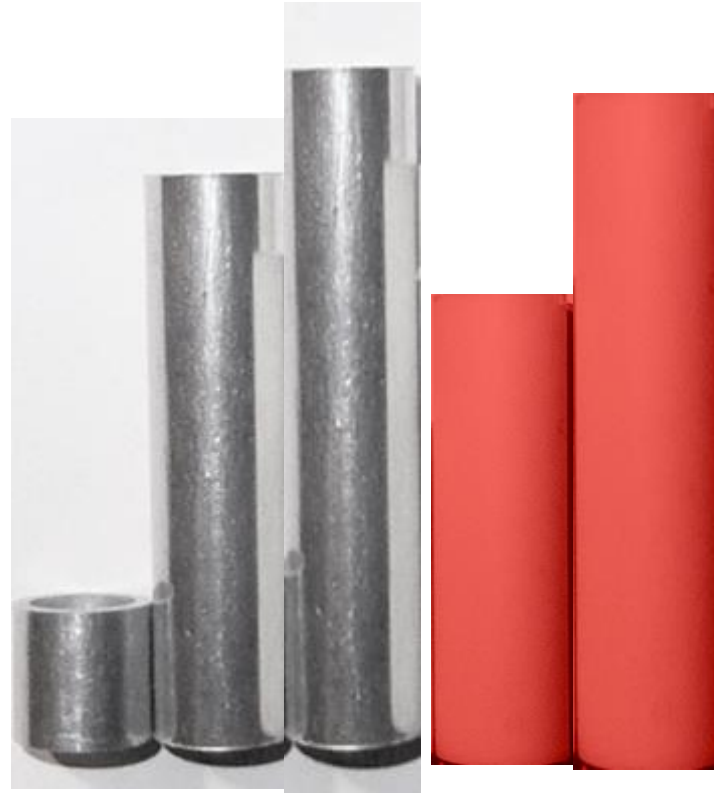
use a C-clamped wood block as both a length guide
and to hold the miter block to a table



Spacer Sleeve Dimensions

Aluminum

PEX



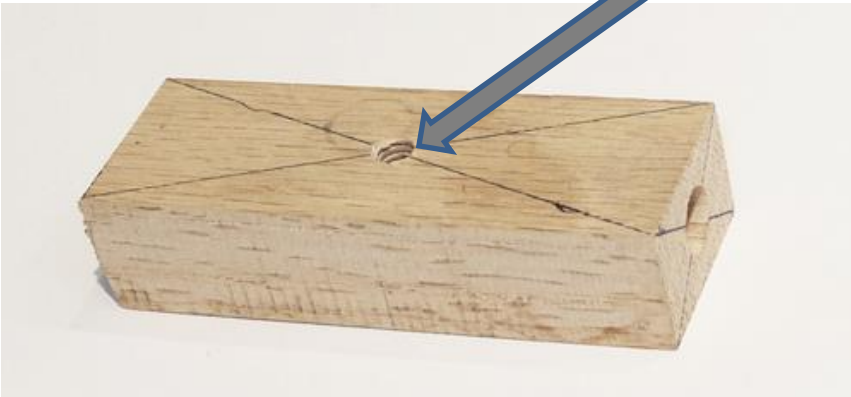
13.5mm 50mm 60mm

40mm 60mm

Fabrication Details

Use Wood Block for Base for attachment to Tripod Shoe

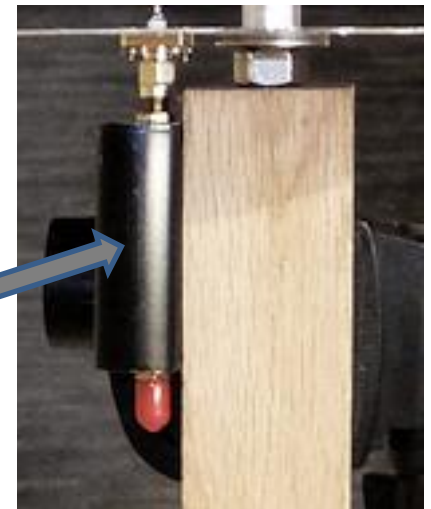
for **Tripod Mount** capability :
Drill $7/16''$ hole and make a thread pattern
with a $1/4'' \times 20$ tpi screw to match **Tripod Shoe**



Wood Block Dimensions

$3/4'' \times 1 1/4'' \times 3''$ (not critical ... ***Except***, the Optimal Orientation of the Antenna's Beam Pattern is such that the Feed Point is East <> West.
Meaning : The Width of the block needs to accommodate the SMA connector & LNA amp unit)

$>3/8''$ hole for Threaded Rod (drill from each end)



Fabrication Details

Aluminum Spacers

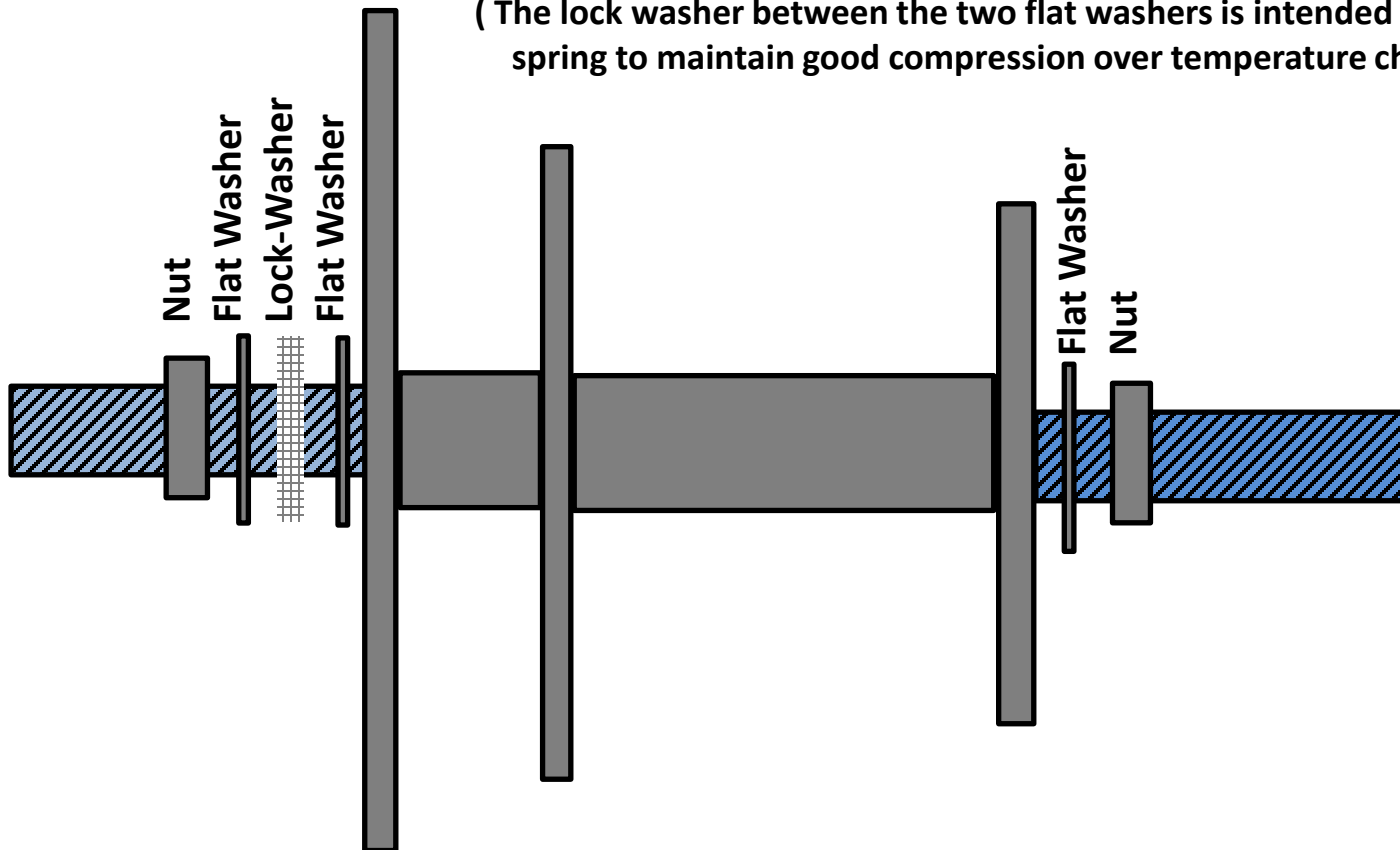
It is important that good physical and electrical contact exist between each Disk and Spacer

The goal is to have smooth right angles on each Spacer end.

Saw Carefully, Clean Disks & Spacers, Assemble.

Use 2 wrenches to tighten the nuts and compress these 5 components.

(The lock washer between the two flat washers is intended to create a spring to maintain good compression over temperature changes)



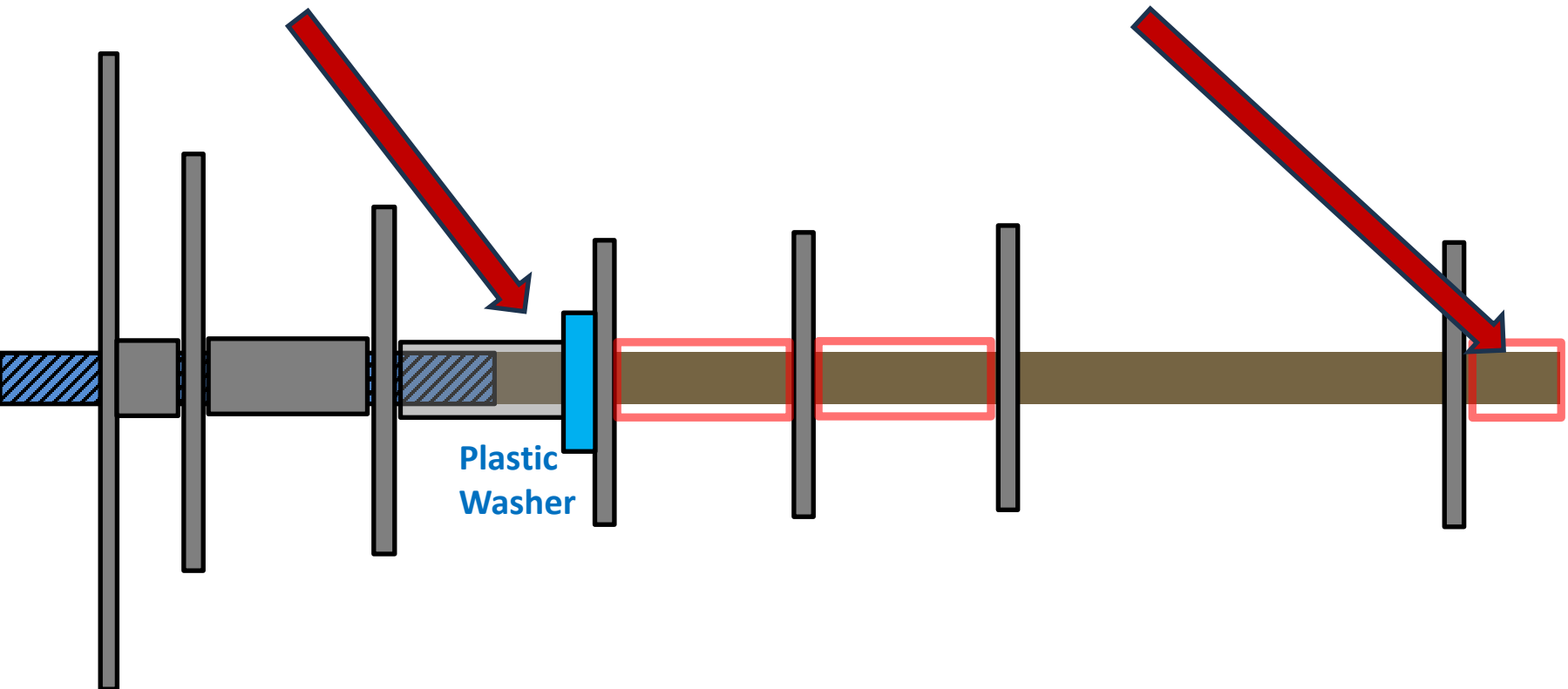
Fabrication Details

Assemble Antenna Array

Use the Lamp Tubing Kit Threaded Rod for Reflector, Feed, 1st Director then transition to the 36" Oak wood dowel for the balance of Directors.

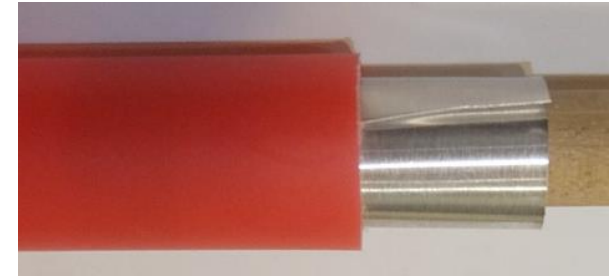
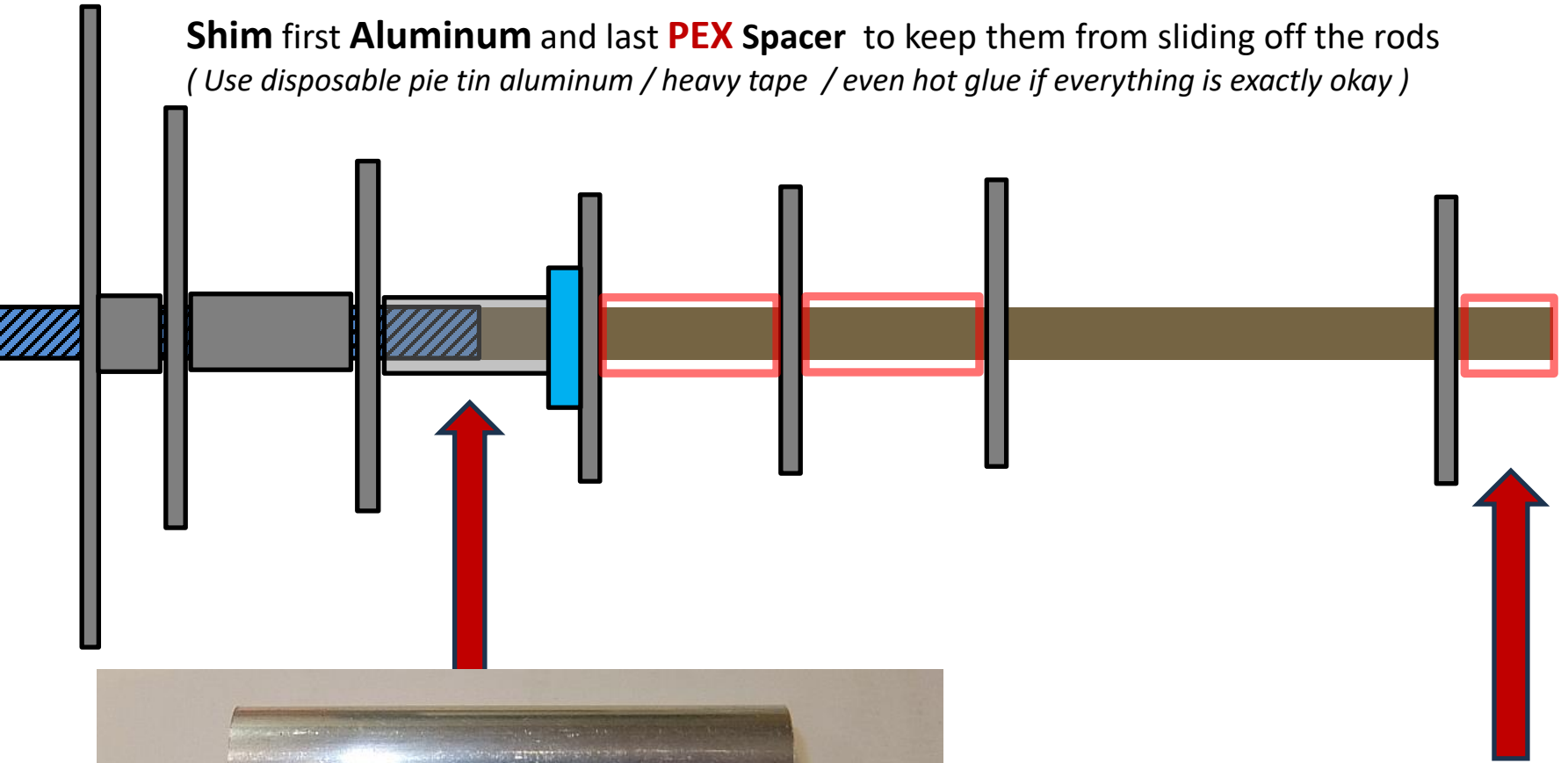
>> Add a bit of weather resistance, **Spray Paint** the Wood Dowel

Shim first **Aluminum** and last **PEX Spacer** to keep them from sliding off the rods
(Use disposable pie tin aluminum / heavy tape / even hot glue if everything is exactly okay)

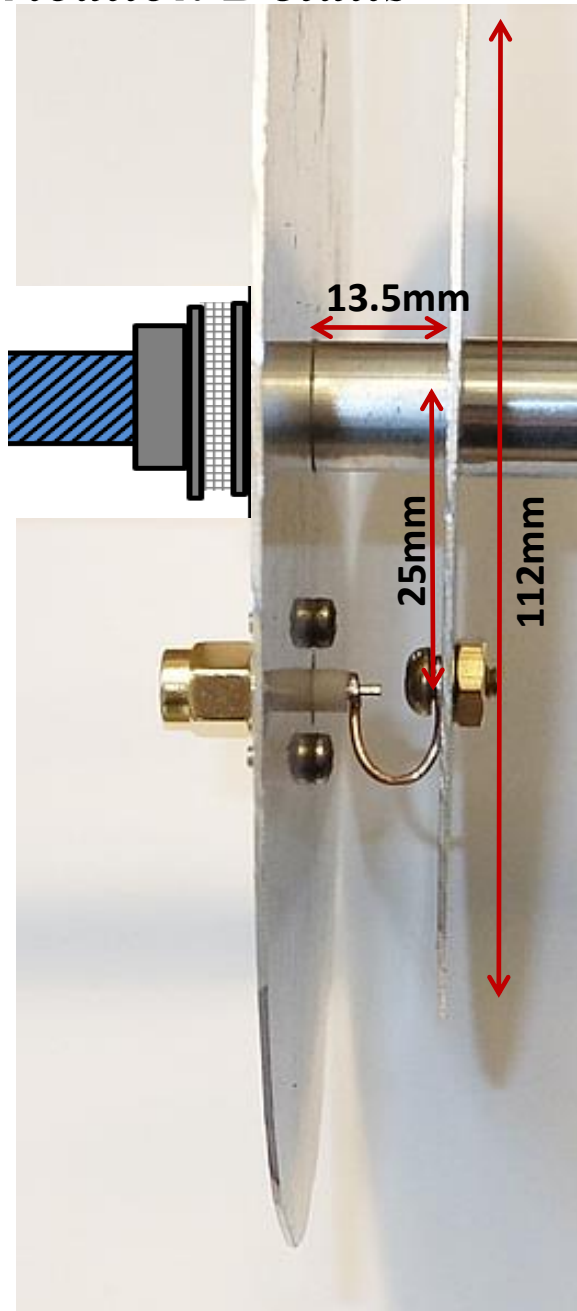


Fabrication Details

Shim first **Aluminum** and last **PEX Spacer** to keep them from sliding off the rods
(Use disposable pie tin aluminum / heavy tape / even hot glue if everything is exactly okay)



Fabrication Details



Patch Feed Construction Details

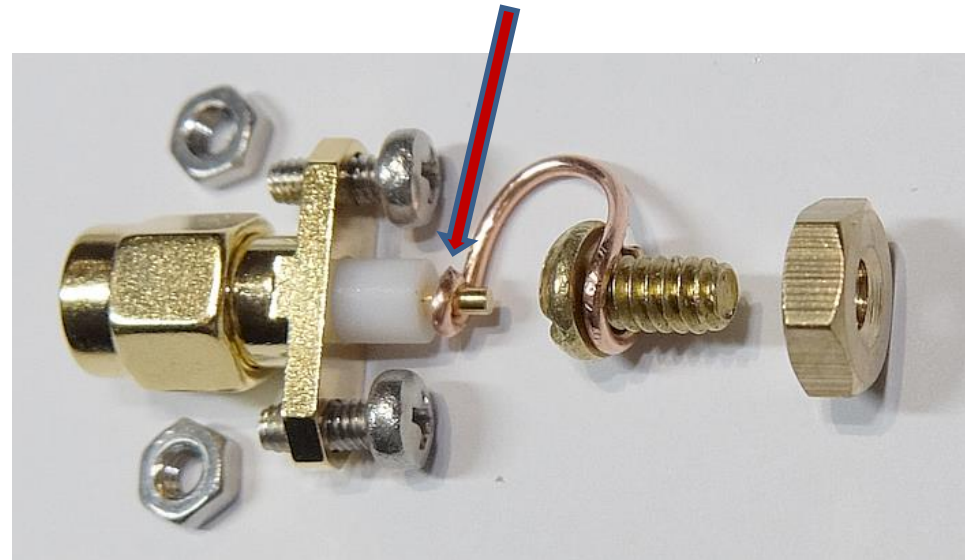
>> Most Critical Dimensions <<

112 mm Diameter of the patch feed

13.5 mm spacer Thickness reflector<>patch feed

25 mm Radius of the Feed Point

(copper wire loop on the SMA center conductor pin
Should Be Soldered
after SMA connector is installed on Reflector Disk)

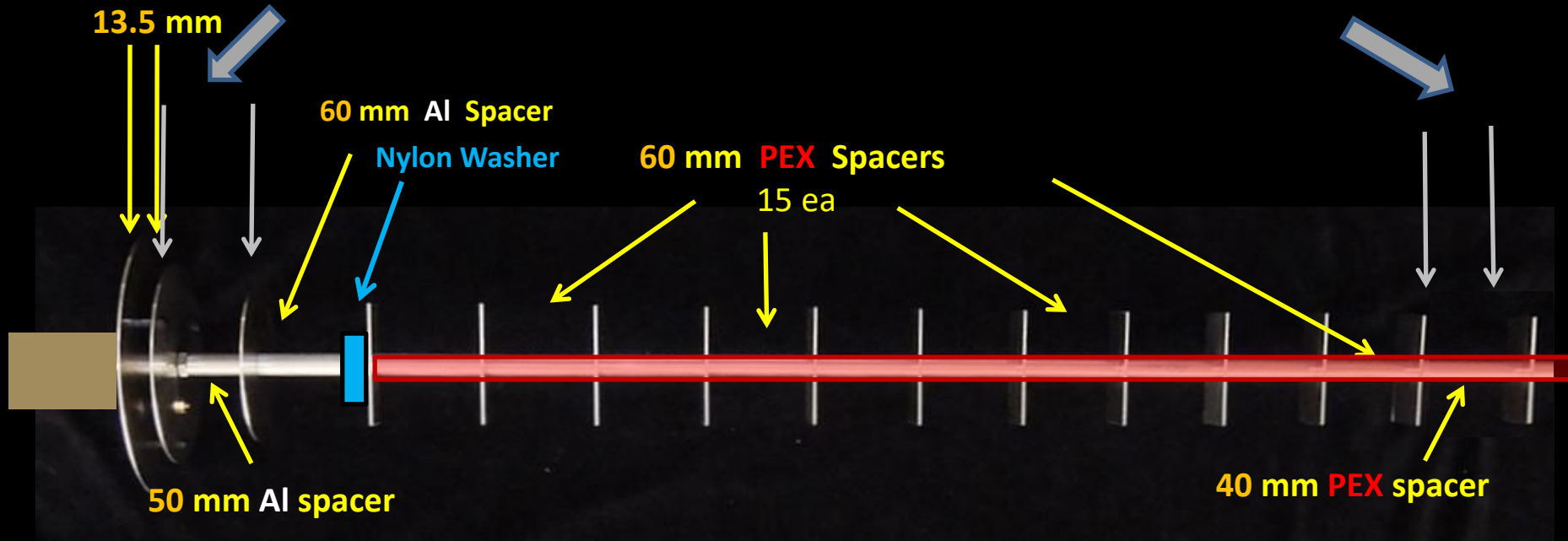


>> Clean Parts for good Electrical Contact <<

Cir Patch Feed Disk Yagi Dimensions for SE Enhanced Rel

optional : VNA required
(adjust for $F_n = 1420 \text{ MHz}$)

optional: VNA required
(adjust for $Z = 50 + j0 \Omega$)



Reflector 150 mm dia

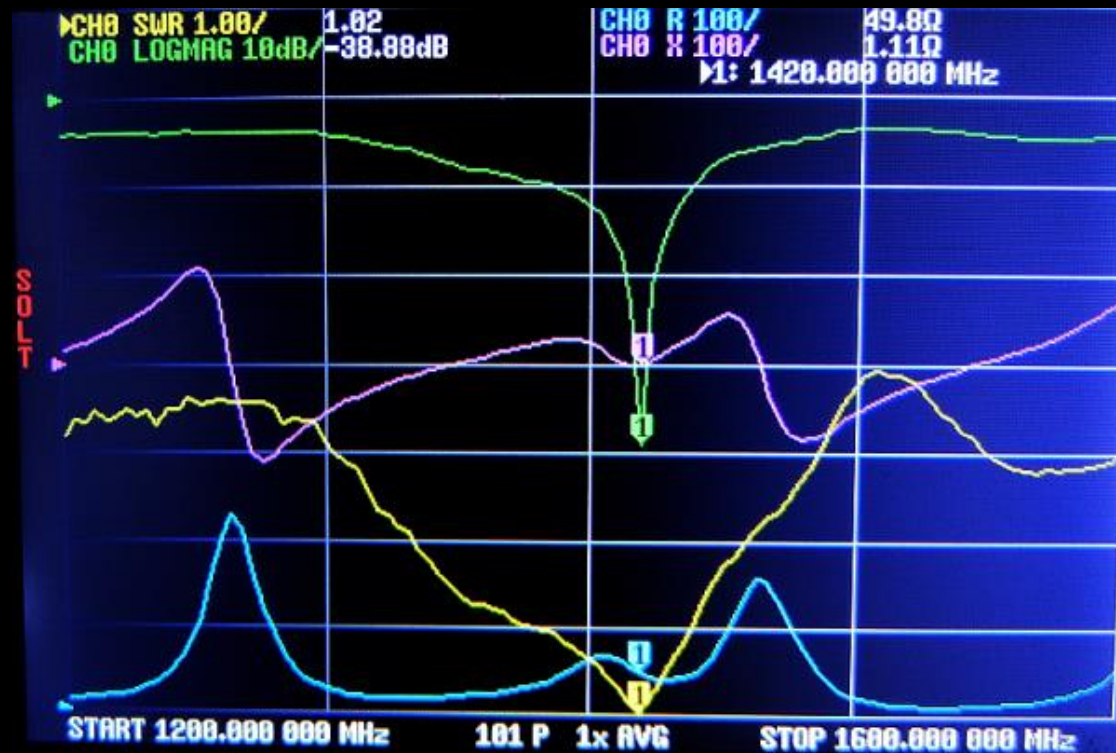
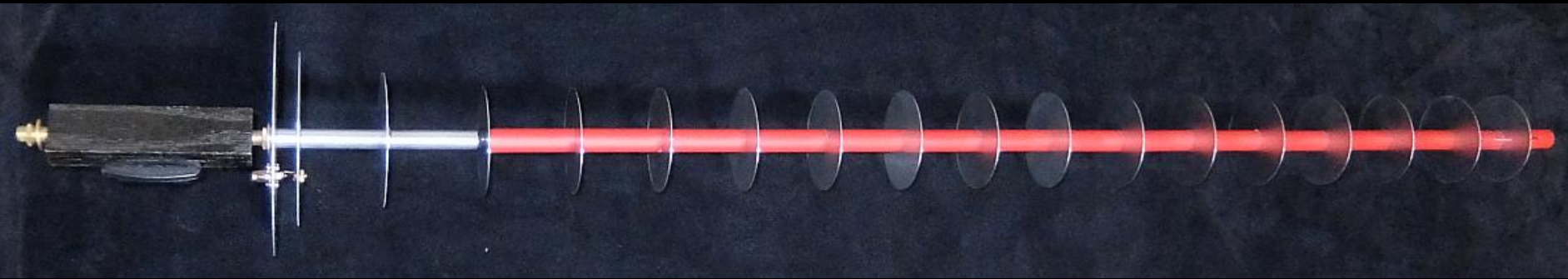
Patch Feed 112 mm dia

Director# 01 88 mm dia

Director# 02 72 mm dia

Director #16 72 mm dia

Cir Patch Feed Disk Yagi Overall View & Tuning Plots



Cir Patch Feed Disk
Yagi
Student Edition

Mounting Options

Interface Ideas

low cost lightweight Tripod



Roll over image to zoom in

JOILCAN Tripod for Camera, Camera Tripod 67" Heavy Duty Tripod, Phone Tripod for Video Recording Photo Vlog, Aluminum Camera Tripods with Holder & Travel Bag for Camera DSLR iPhone Projector Laser

[Visit the JOILCAN Store](#)

4.5 ★★★★★ 1,580 ratings

[Search this page](#)

300+ bought in past month

-24% \$27⁹⁹



LNA (low noise amplifier) Installation :
optimal orientation is for the feed point to be East-West

LNA : INPUT

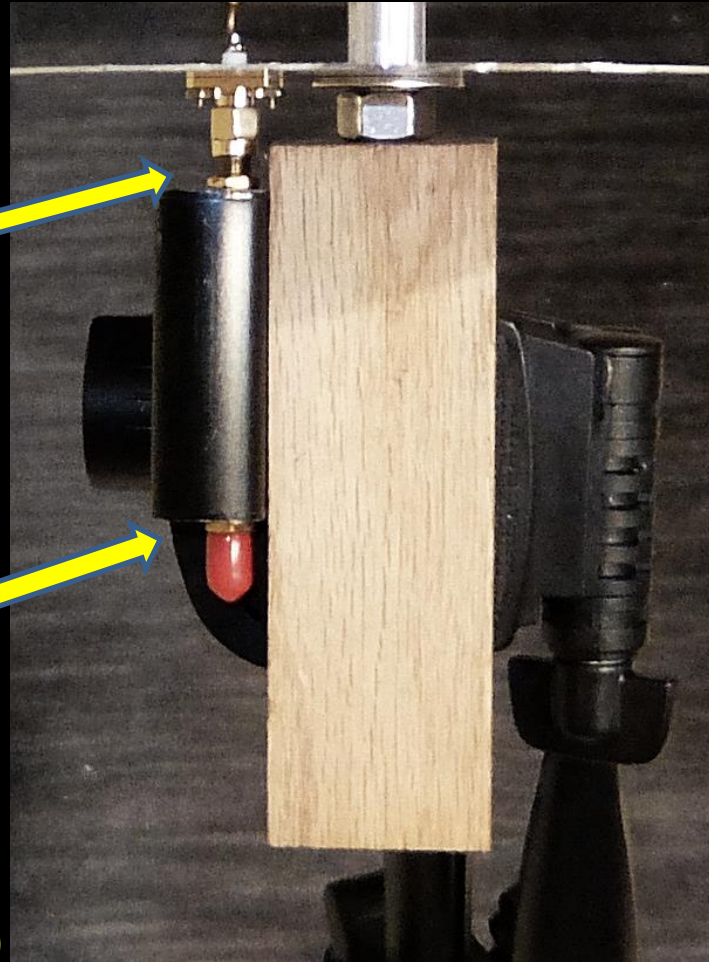
signal
from
antenna

LNA : OUTPUT

amplified signal
to
coaxial cable

(other end of
cable connects to
SDR

software defined radio)



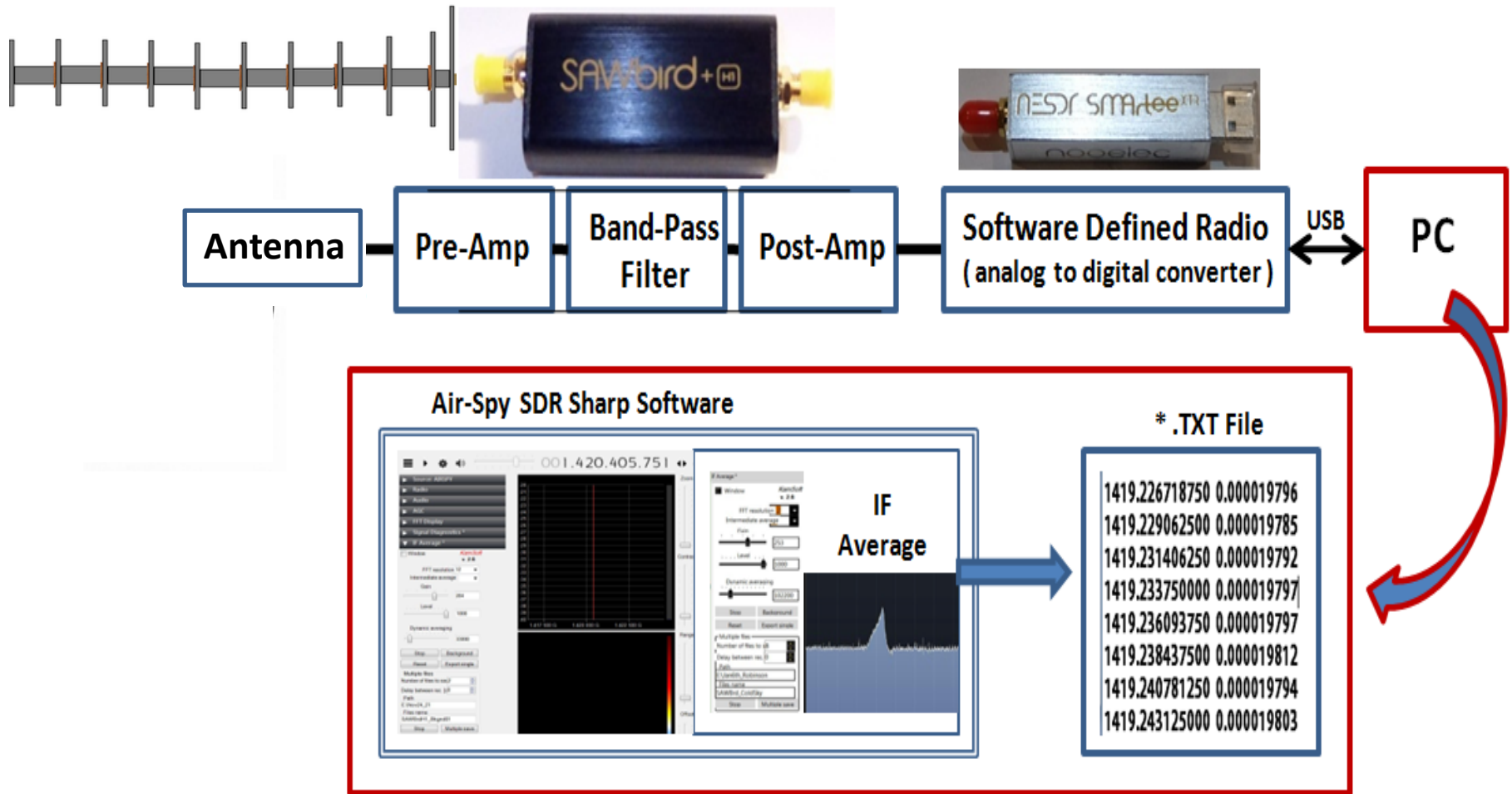
**** Improving Weather Resistance ****

Overnight Dew Shield : use a plastic polyethylene container

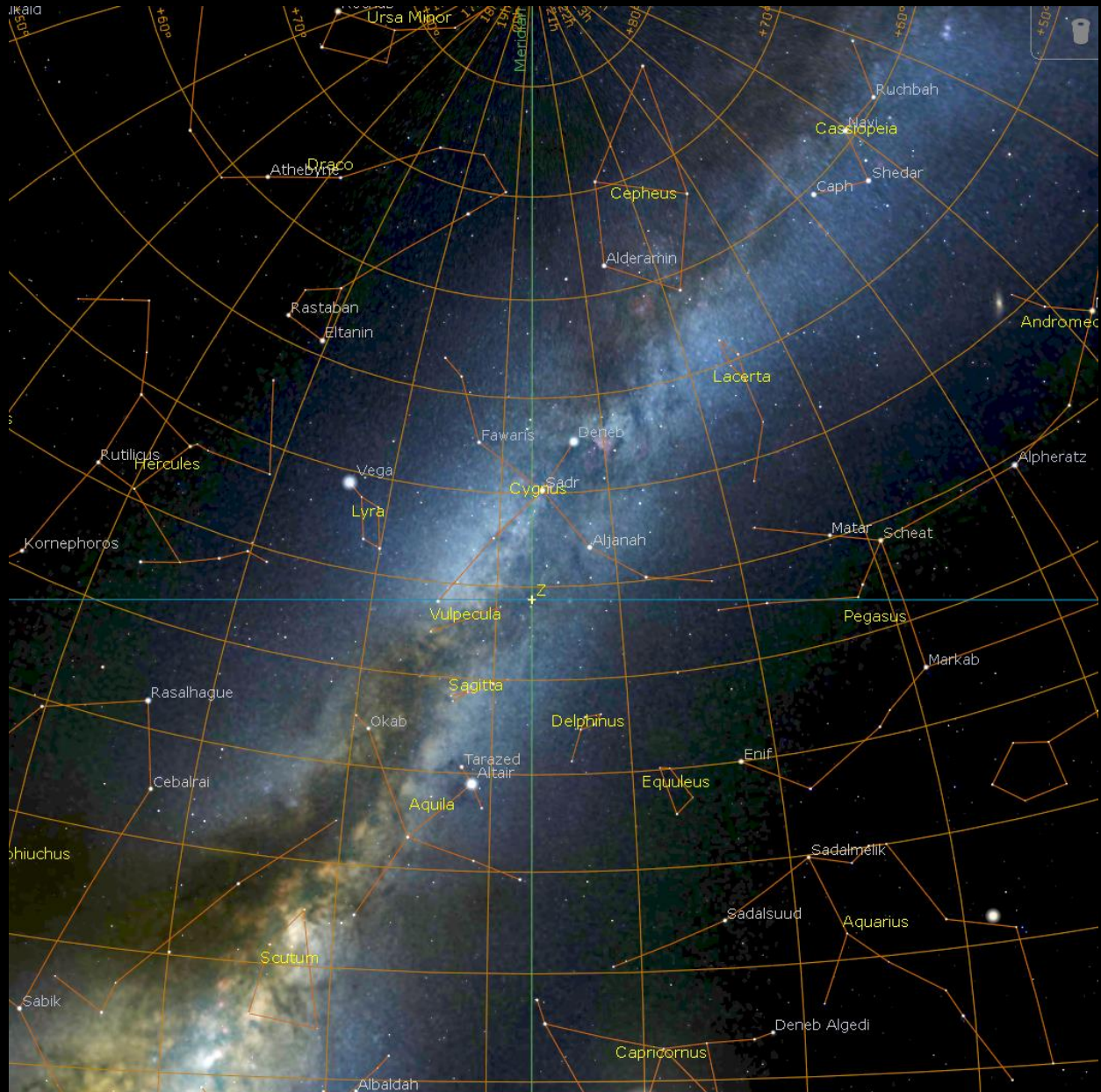


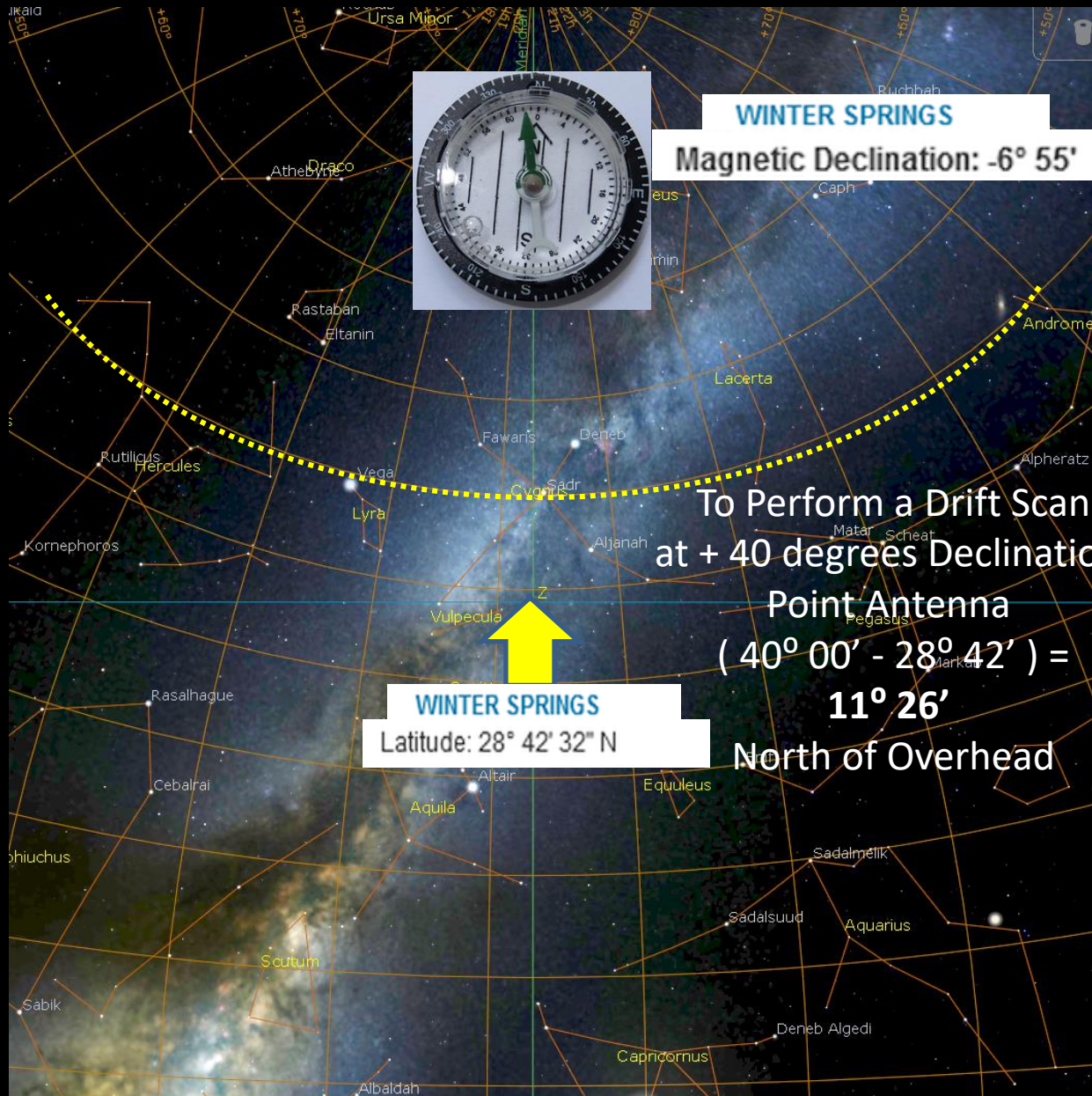
System Hardware and Software

Hardware & Software System Block Diagram



Stellarium Planetarium Software





WINTER SPRINGS

Magnetic Declination: $-6^{\circ} 55'$

To Perform a Drift Scan
at $+40$ degrees Declination,

Point Antenna

$(40^{\circ} 00' - 28^{\circ} 42') =$

$11^{\circ} 26'$

North of Overhead

WINTER SPRINGS

Latitude: $28^{\circ} 42' 32''$ N

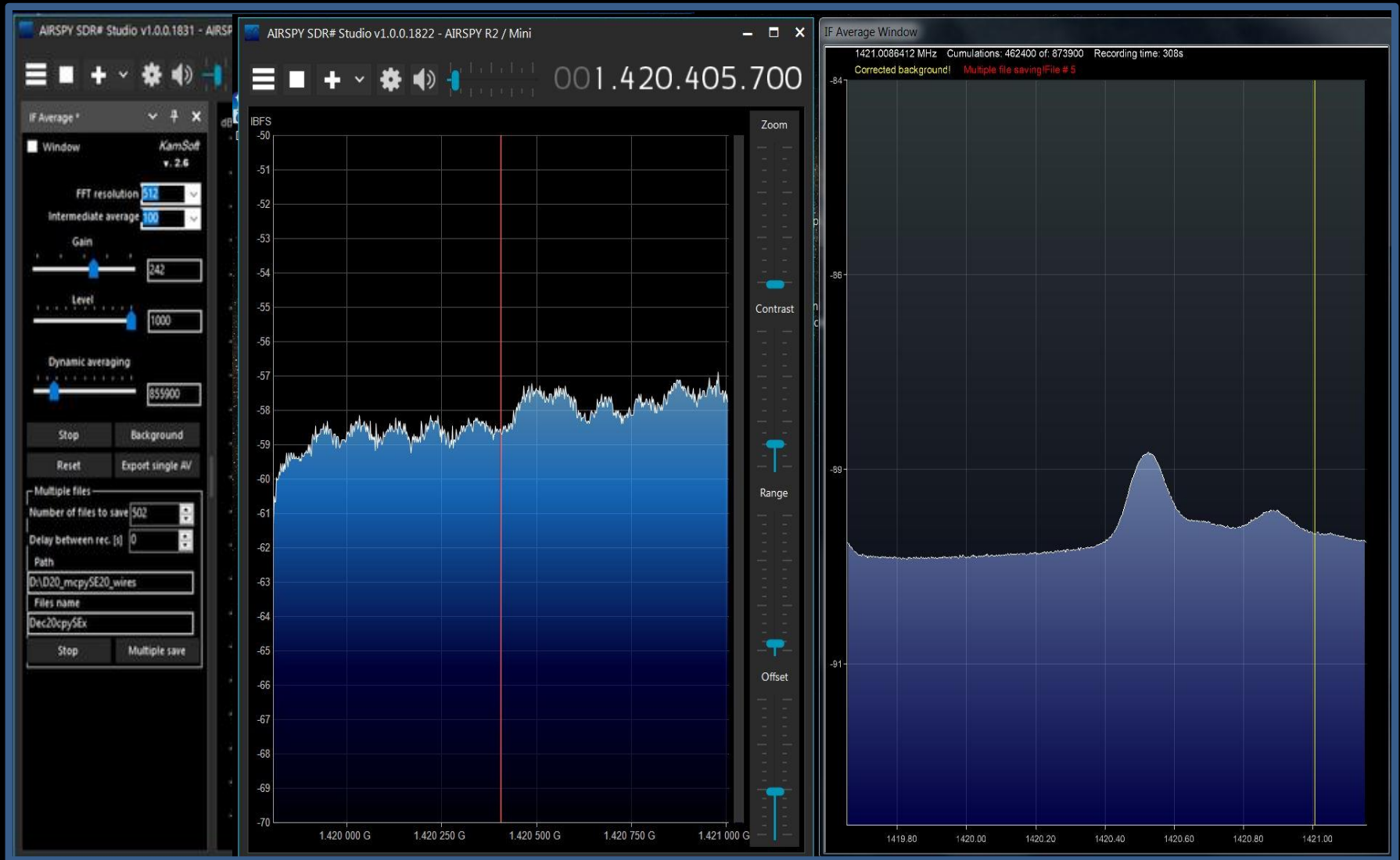


To Perform a Drift Scan
at + 40 degrees Declination,
Point Antenna
($40^{\circ} 00' - 28^{\circ} 42'$) =
 $11^{\circ} 26'$ towards
North of Overhead

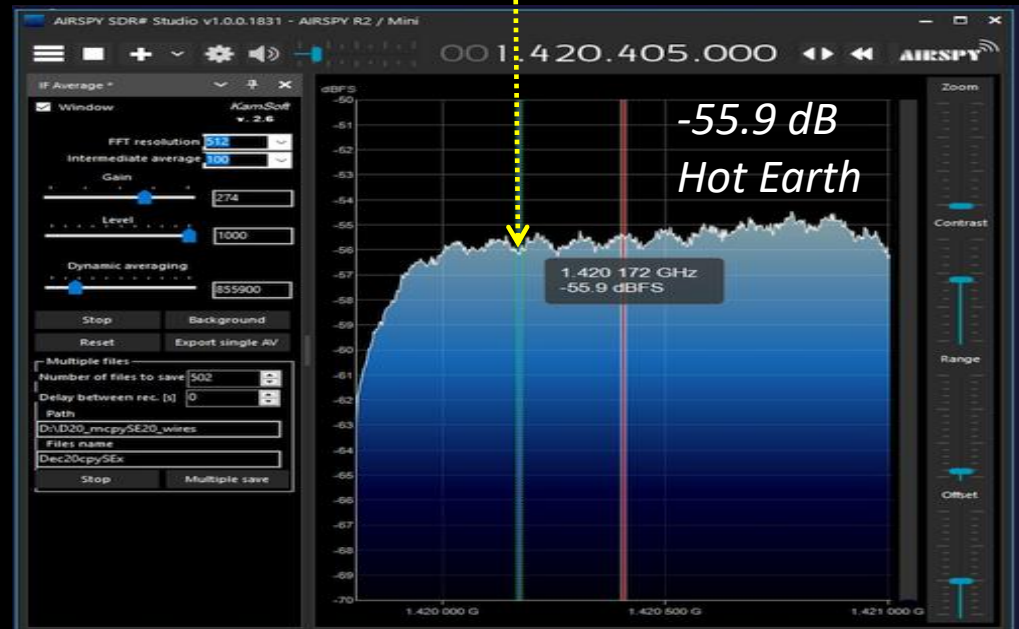
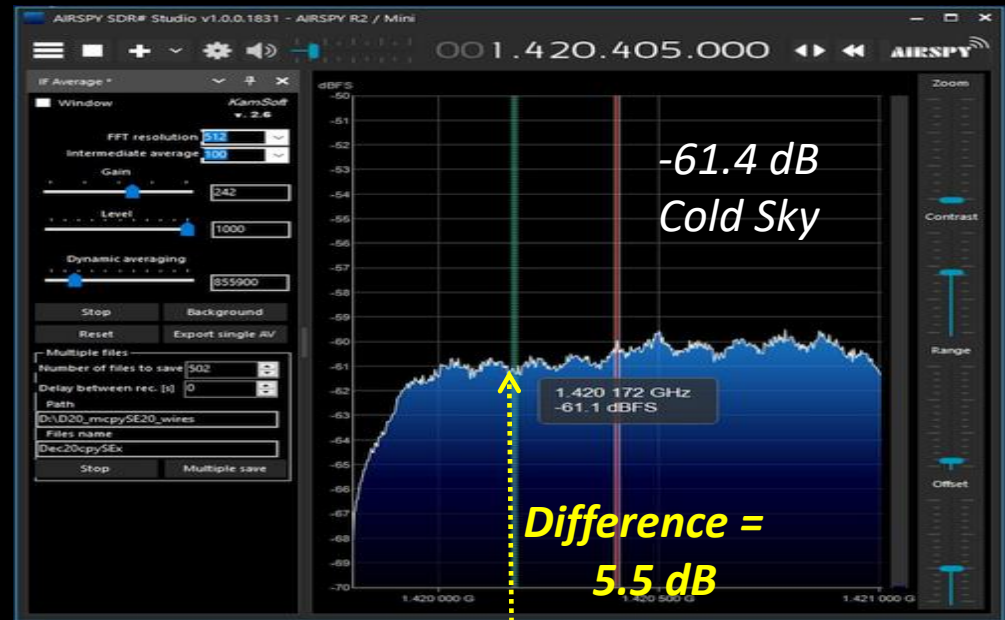


Signal Acquisition Software

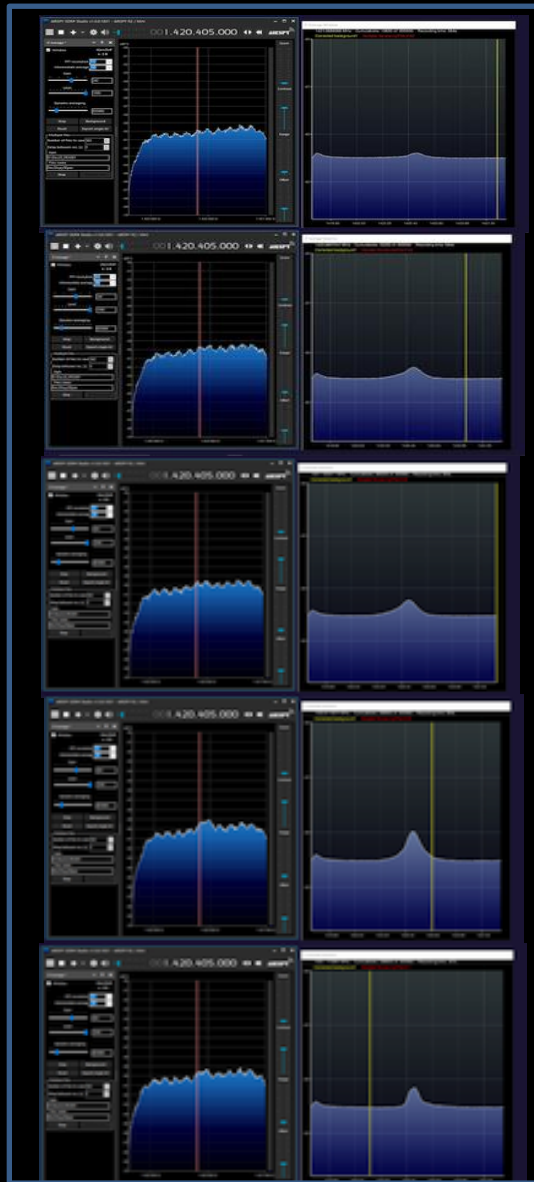
AirSpy SDR# Studio & Kaminski IF_Ave Plugin software



System Operational Verification Hot_Earth vs Cold_Sky

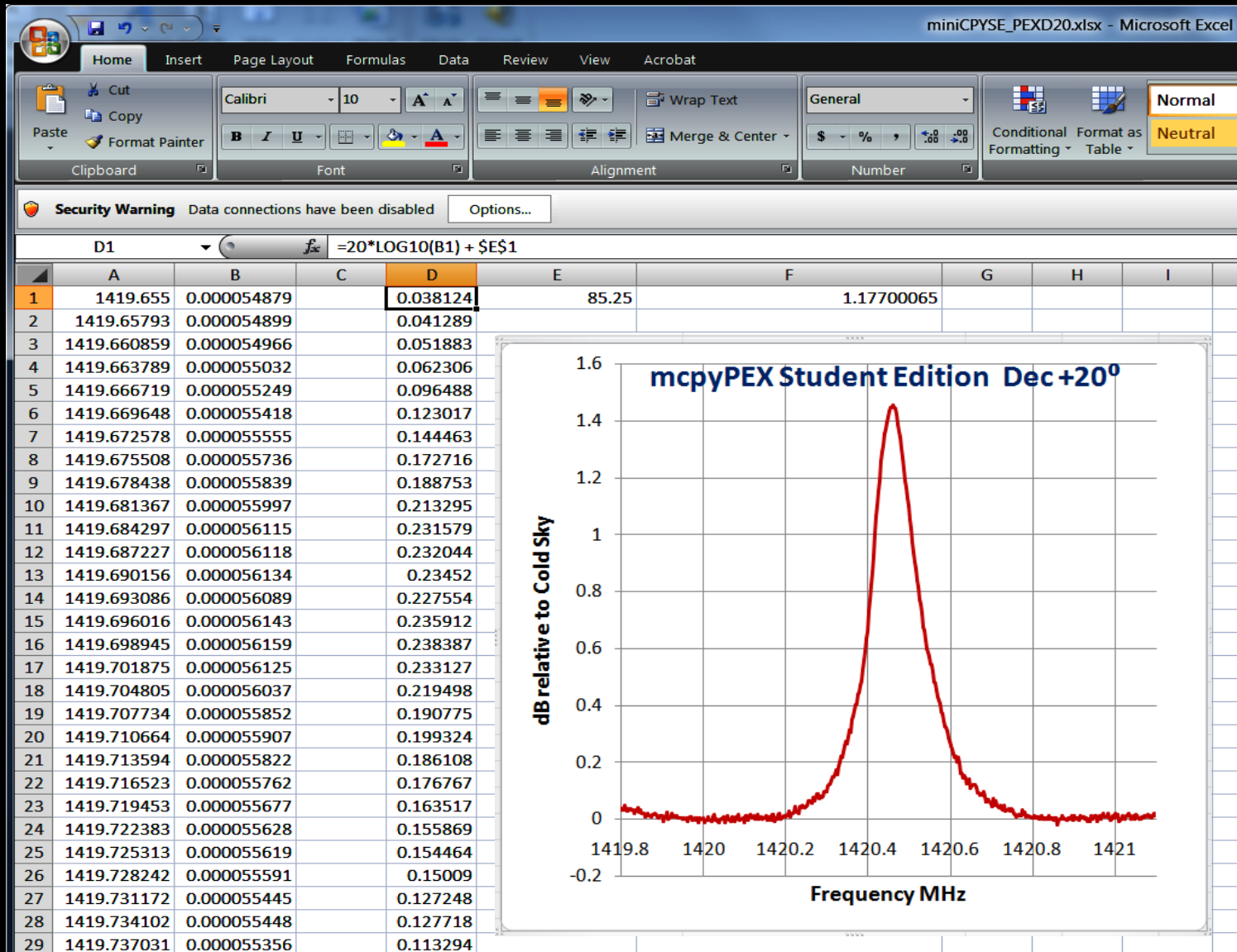


Perform a Drift Scan and Save a Data File Set

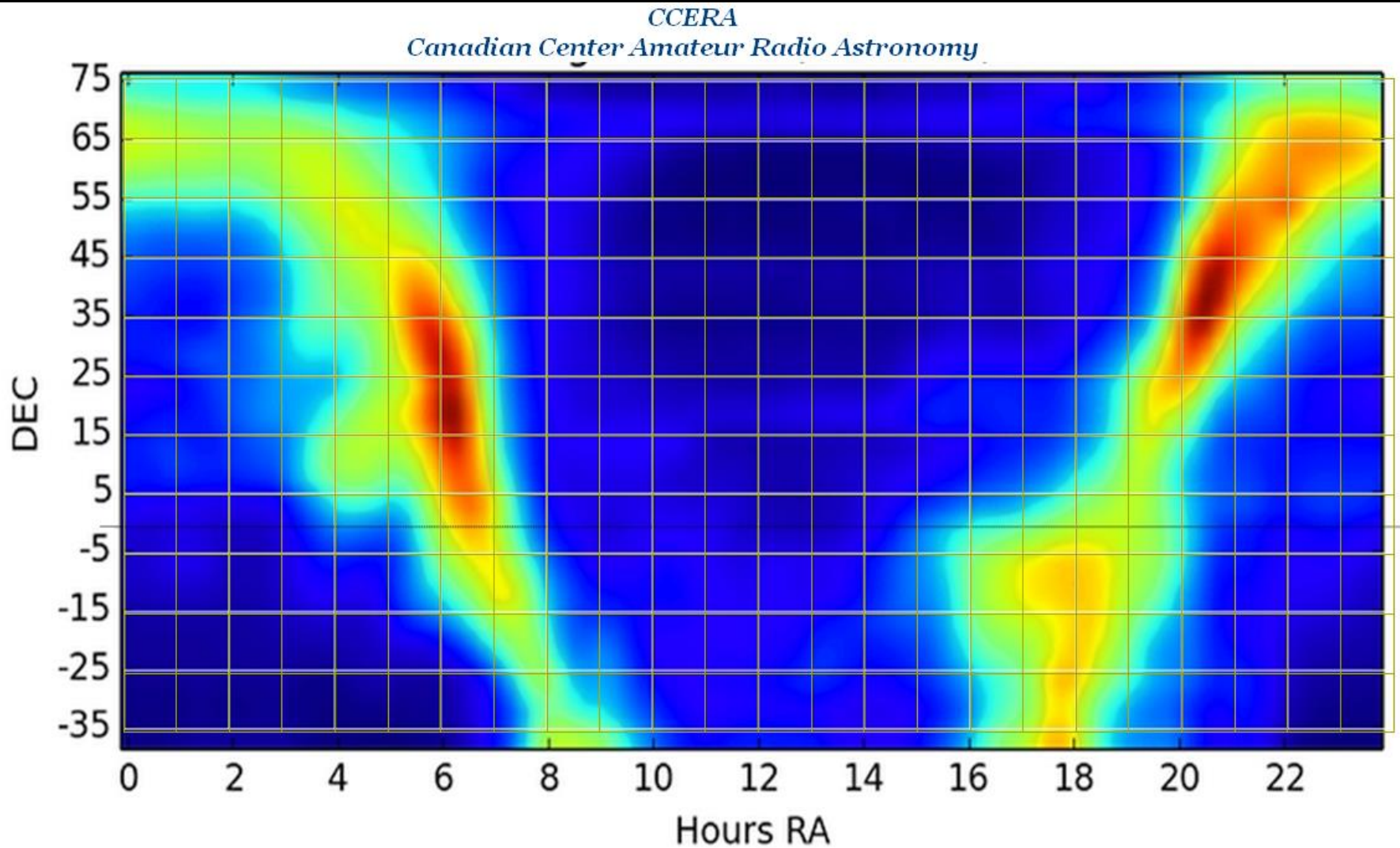


Dec40_cpy_SE01_0001.txt	8/18/2024 11:31 A...	Text Document	15 KB
Dec40_cpy_SE01_0002.txt	8/18/2024 11:36 A...	Text Document	15 KB
Dec40_cpy_SE01_0003.txt	8/18/2024 11:41 A...	Text Document	15 KB
Dec40_cpy_SE01_0004.txt	8/18/2024 11:46 A...	Text Document	15 KB
Dec40_cpy_SE01_0005.txt	8/18/2024 11:50 A...	Text Document	15 KB
Dec40_cpy_SE01_0006.txt	8/18/2024 11:55 A...	Text Document	15 KB
Dec40_cpy_SE01_0007.txt	8/18/2024 12:00 PM	Text Document	15 KB
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Dec40_cpy_SE01_0020.txt	8/18/2024 1:03 PM	Text Document	15 KB
Dec40_cpy_SE01_0021.txt	8/18/2024 1:08 PM	Text Document	15 KB
Dec40_cpy_SE01_0022.txt	8/18/2024 1:13 PM	Text Document	15 KB
Dec40_cpy_SE01_0023.txt	8/18/2024 1:18 PM	Text Document	15 KB

Plot Data via Excel (Open_Office_Calc)



Reference Chart MW neutral hydrogen distribution



Software

AirSpy SDR# Studio and Kaminski IF_Ave plug-in

<https://www.dropbox.com/scl/fi/2f67lyu6qgt2cp98rg9kp/SDR-2.ZIP?rlkey=y82yv6jzjyu7e92sap3x8ewm7&st=tcil7w3s&dl=0>

Stellarium planetarium software

<https://stellarium.org>

(Excel or Apache Open Office Calc)

<https://www.openoffice.org/product/calc.html>

Software

(HLine3D and Rinearn : Data Set Processing and 2D / 3D Graphics)

