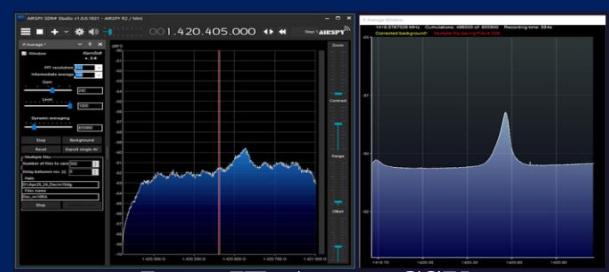
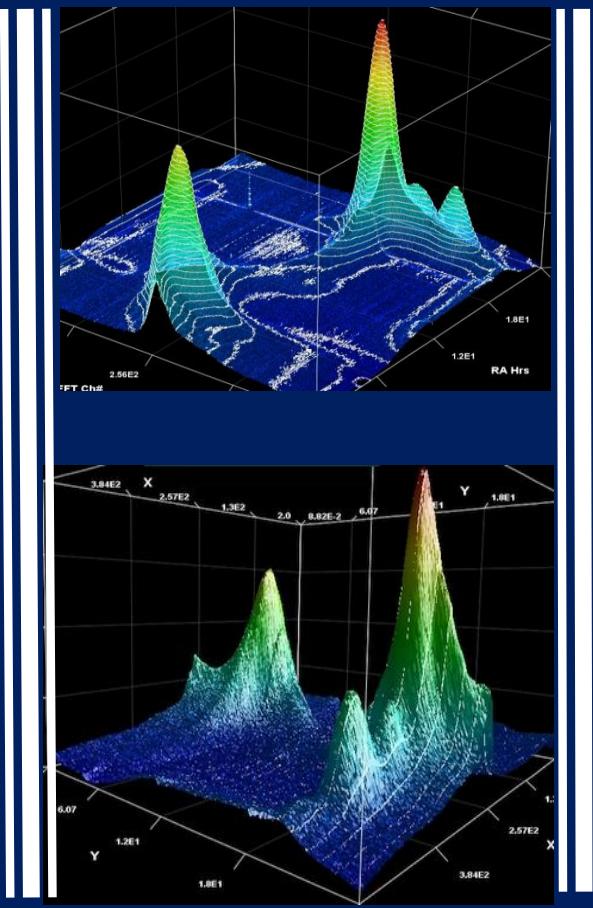
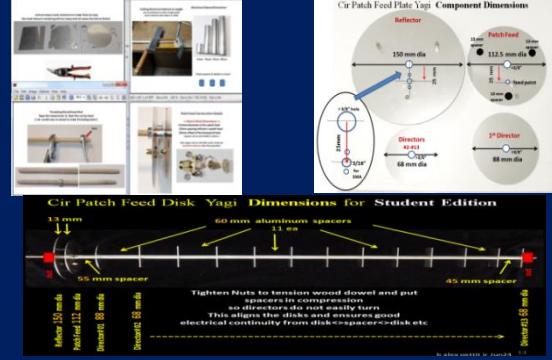
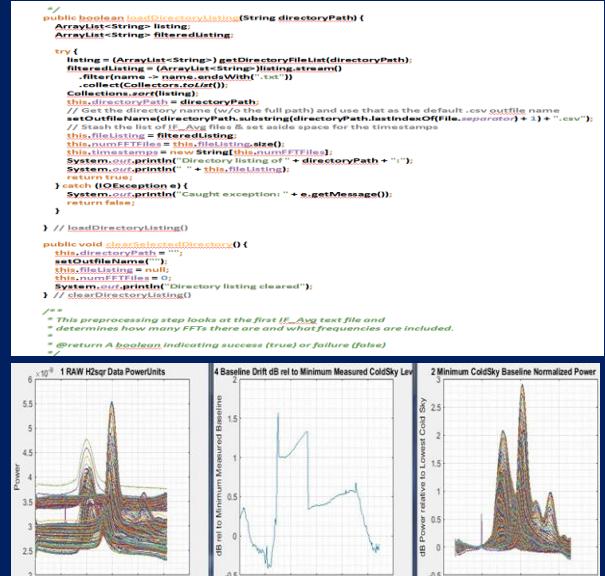


Project : H Line 3D

A Beginner's Guide to
Antenna Fabrication , Signal Reception, Recording, Processing , 3D Graphic Display
of the 21cm Wavelength Microwave Electro-Magnetic Emission Spectrum
from Neutral Hydrogen Clouds within Our Galaxy : The Milky Way



Java IF_Ave to CSV



21cm Wavelength Circular_Patch_Feed Disk Director Yagi Antenna

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

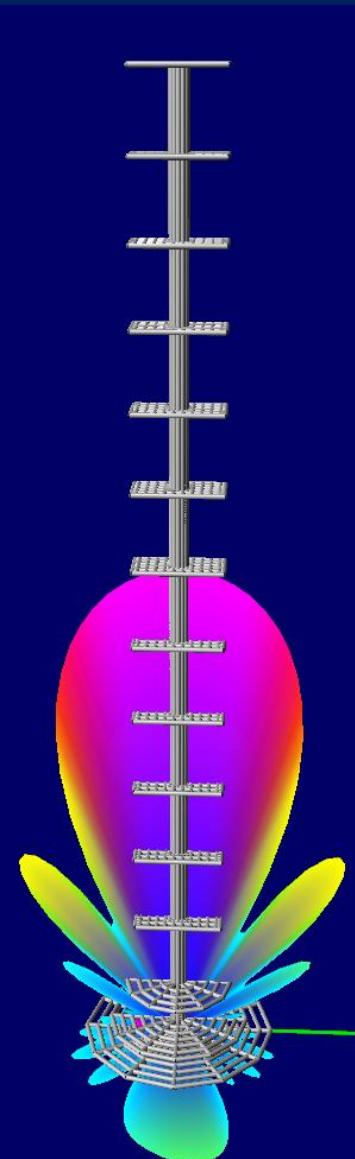
STUDENT EDITION

*** APEX revision ***
(All PEX spacers)

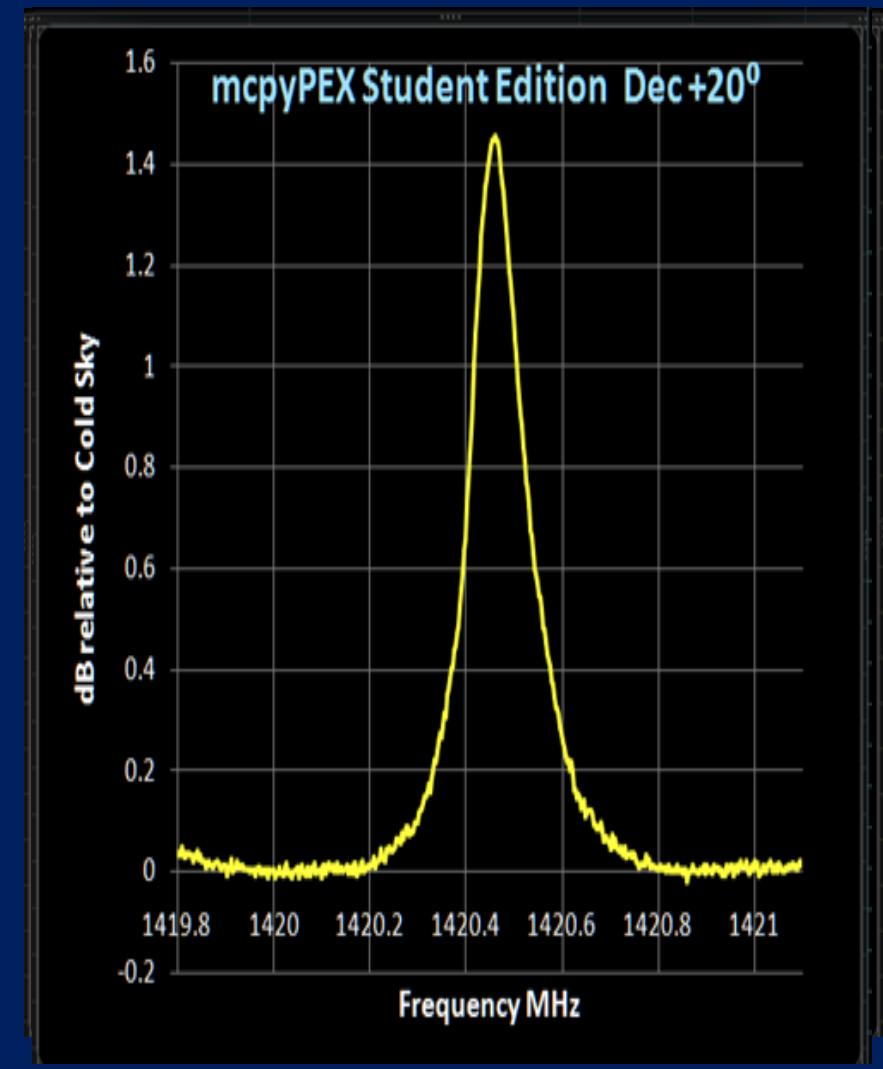
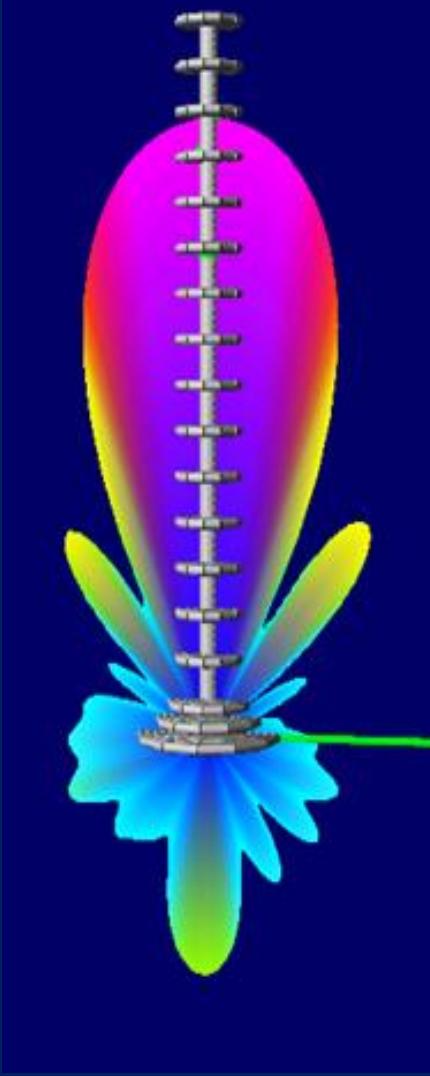
*If built carefully to correct dimensions
This antenna will have similar
performance to the original
&*

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

alex pettit jr May 2025

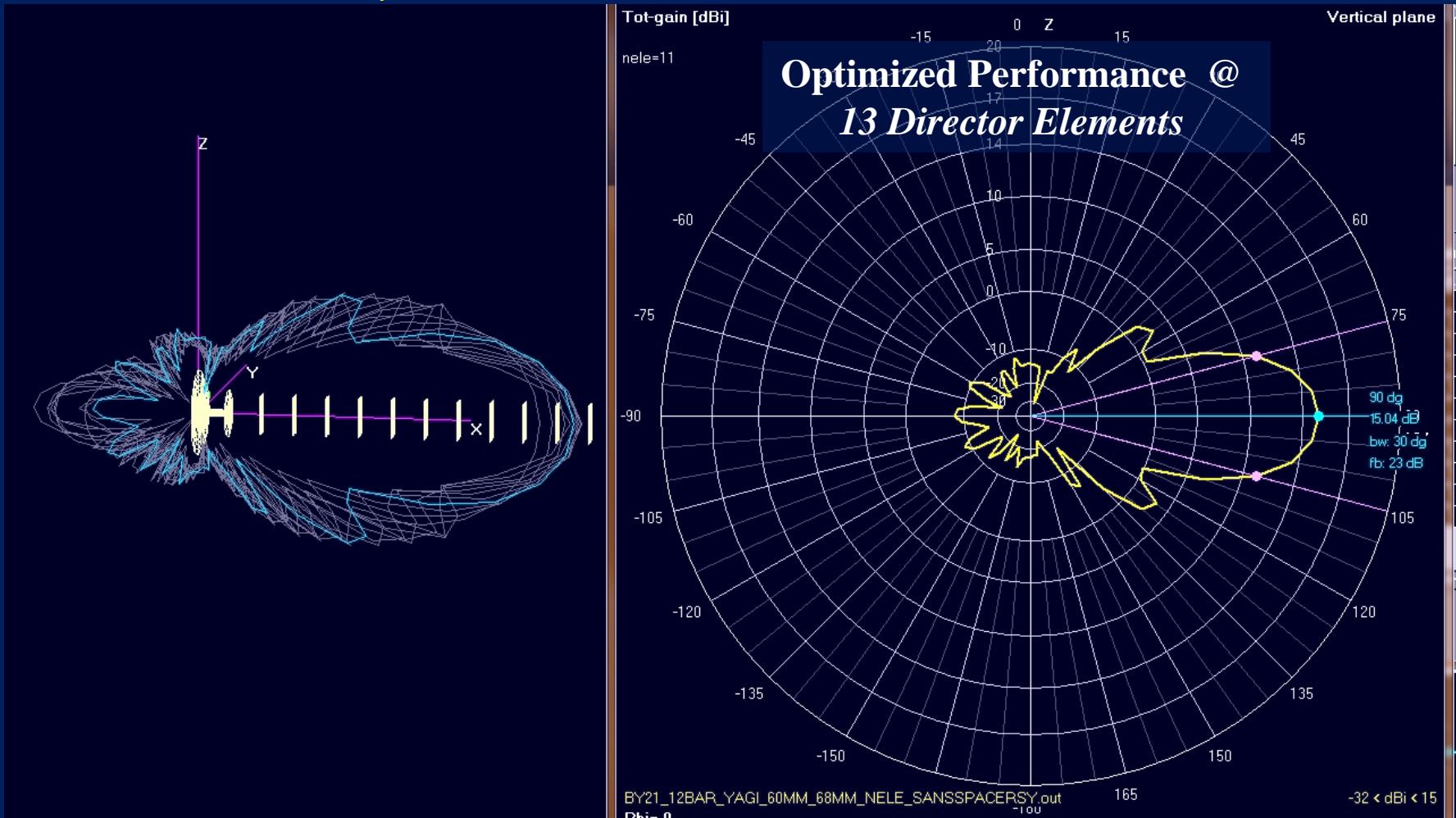


Performance Characteristics

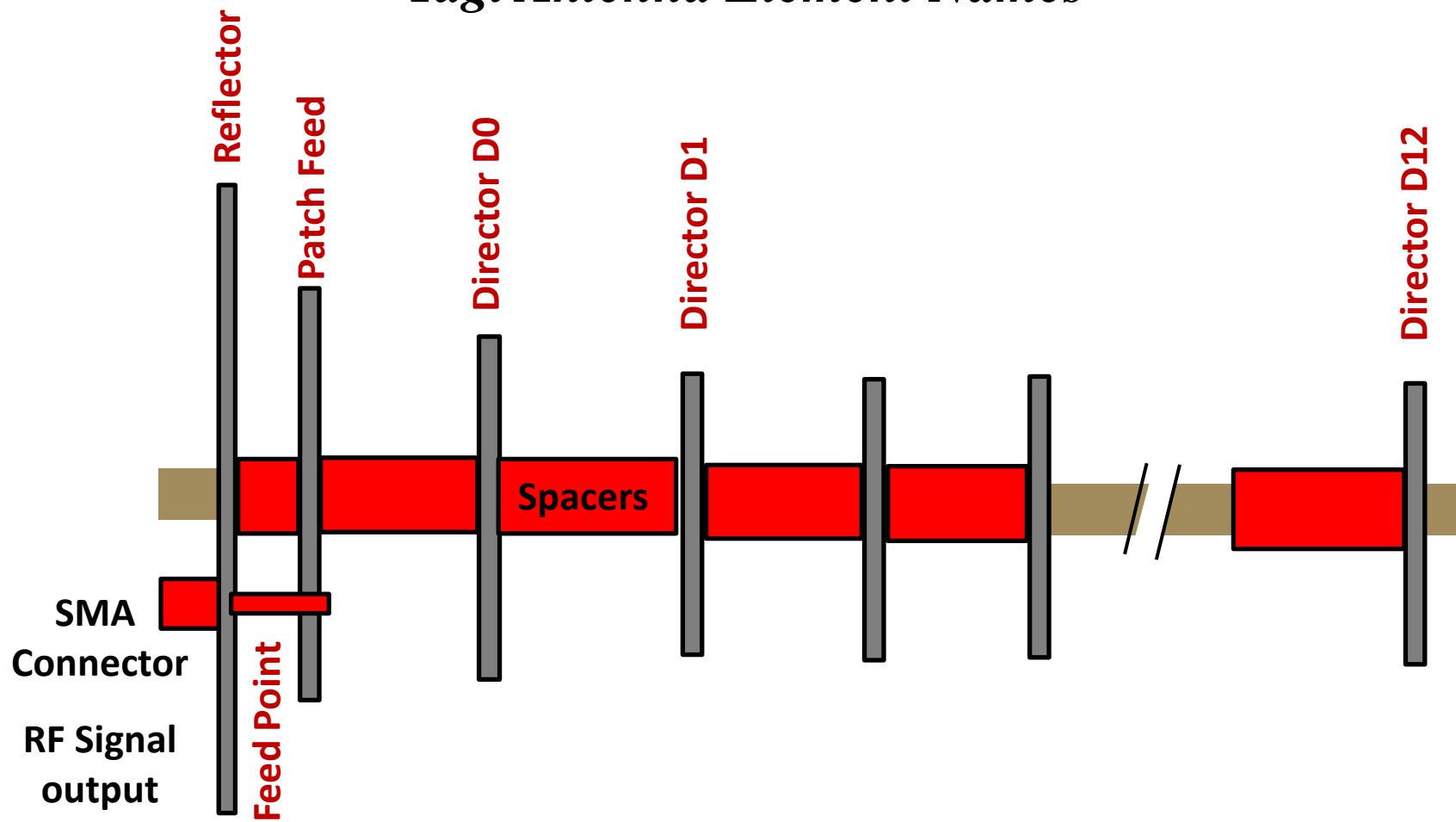


Performance Characteristics

Analysis : Number of Director Elements



Yagi Antenna Element Names



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

REMOVE BLUE FILM

1 set = 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 sets = 4 sheets 0.020"
for 13 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 10-ft Red PEX-B Pipe

\$4.28



Antenna Components

misc Purchase at Local Hardware Store

3/8"-16 tpi Stainless Steel Nuts 2 ea



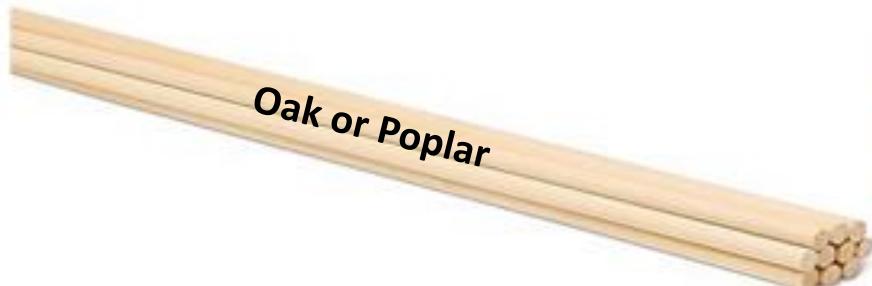
#6-32 x 1/4" screw & nut



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



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



\$3.28

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)



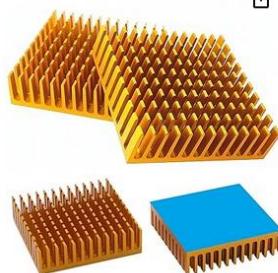
NooElec NESDR Smart XTR SDR - Premium RTL-SDR w/Extended Tuning Range, Aluminum Enclosure, 0.5PPM TCXO, SMA Input. RTL2832U & E4000-Based Software Defined Radio

[Visit the NooElec Store](#)

4.3 ★★★★★ 189 ratings | [Search this page](#)

\$43⁹⁵

prime Two-Day
FREE Returns



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



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

\$5⁶⁰ (\$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)

a petit jr Aug24

Hand Tools

cutting

<< Pick One >>

cutting

PEX tube to length

SharkBite 1/4-in to 1-in Pex Cutter

Item #2590607 | Model #U701

[Shop SharkBite](#)

[Shop the Collection](#)



\$9.55



PEX tube to length



Olson Saw 35-241 Fine
Kerf Saw 35-550 42 tpi
with Aluminum Thin Slot
Miter Box, Slot Size .014-
Inch, Slot Angles 45, 60,
90, Cutting Depth 7/8-
Inch, Pack of 1

Brand: ZONA

4.3 ★★★★☆ 1,806 ratings
200+ bought in past month

-10% \$21.62



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

\$9.99

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

cutting 0.02"sheet into 4 pcs
for Directors (will not cut 0.03")



Aviation Tin Snips 8 Inch Heavy
Duty Metal Cutter, Straight
Shears with Stainless Steel
Blade & Comfort Grips,
Multifunction Cutting of
Branches, Cable Wires, Thin
Iron, Cardboard etc..

Visit the [TOOLMAK Store](#)

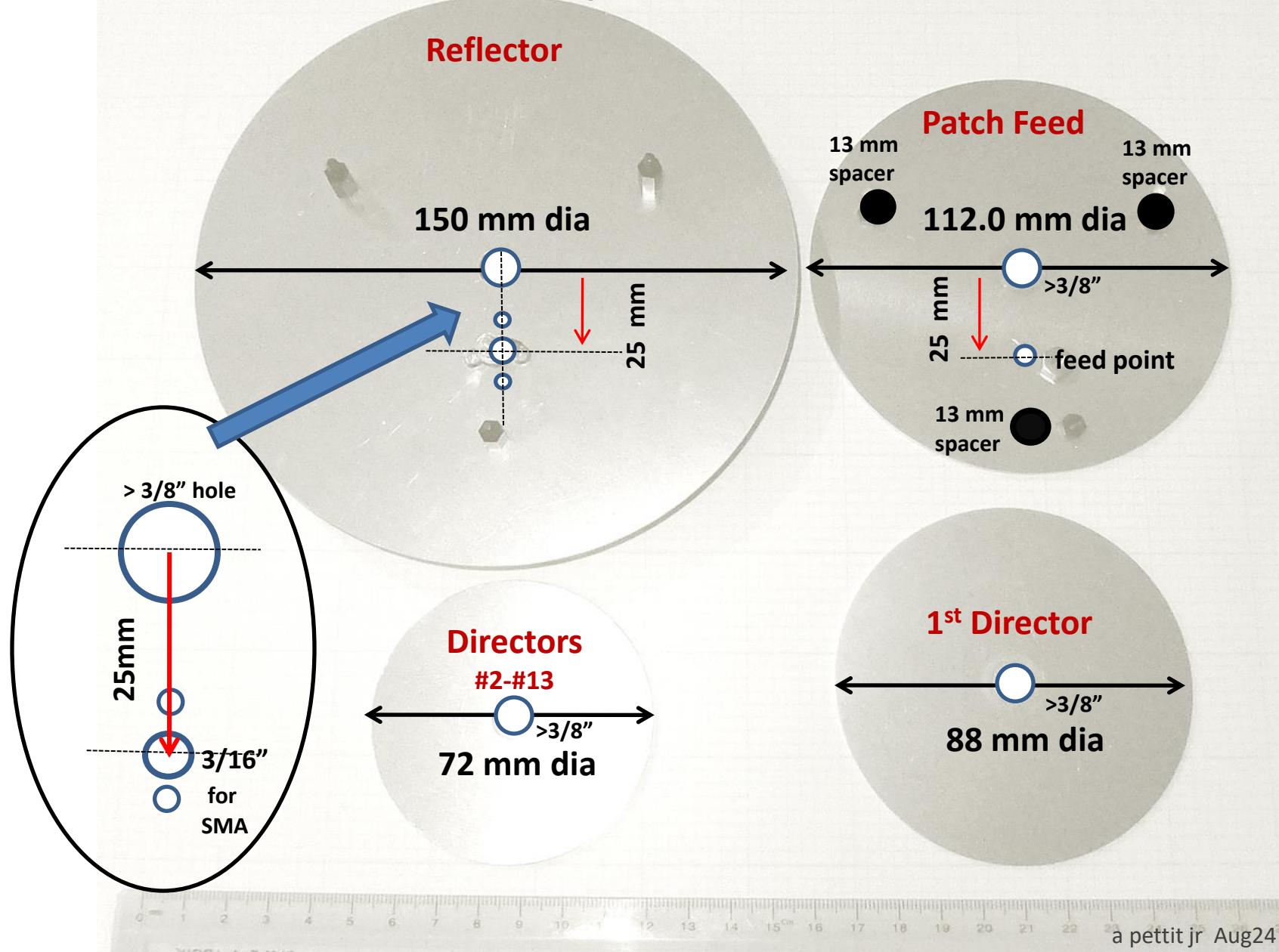
4.5 ★★★★☆ ✓ 258 ratings

600+ bought in past month

-17% \$9⁹⁹

a petit jr Aug24

Cir Patch Feed Plate Yagi Component Dimensions



Fabrication Details

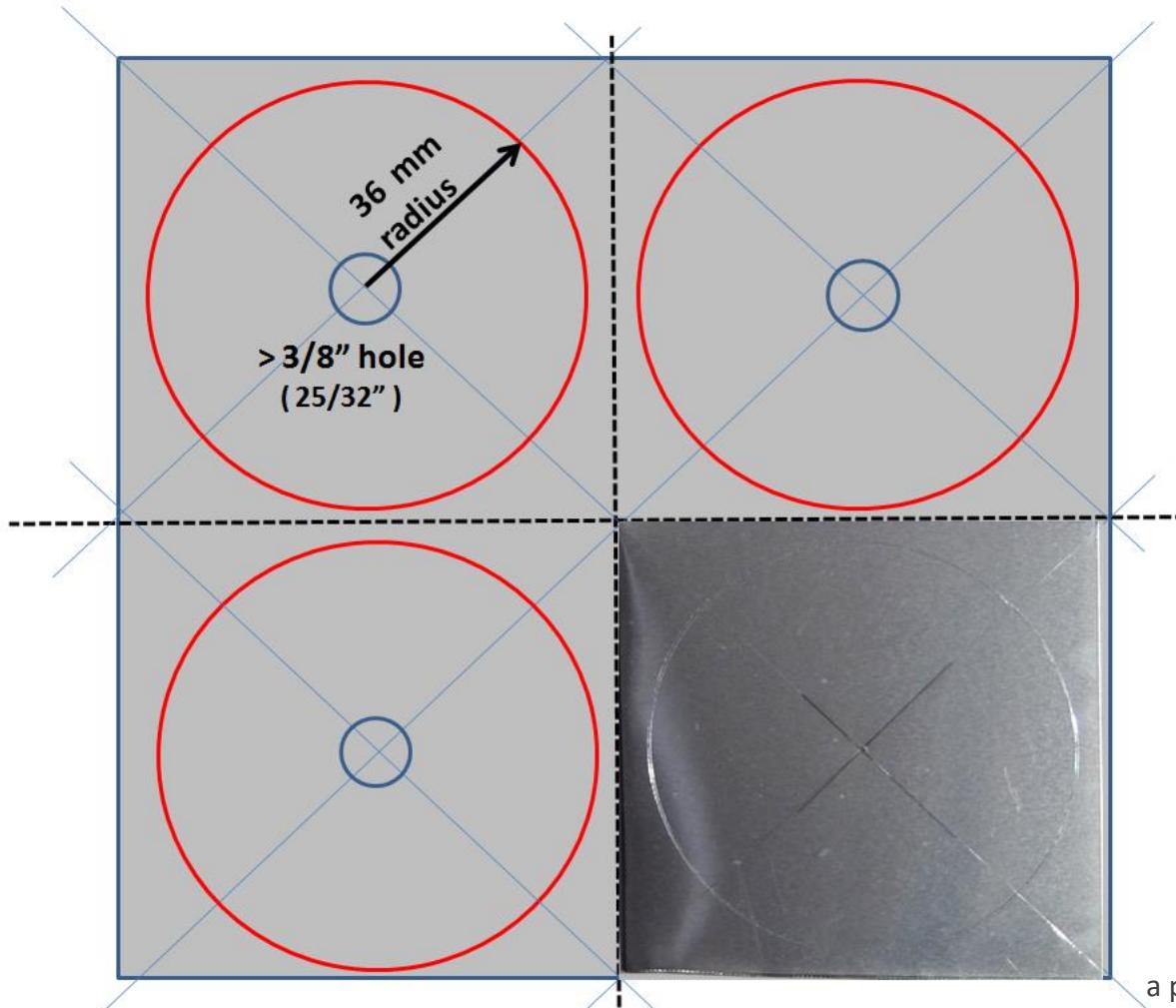
72 mm diameter Director Layout

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

indent centers w/ punch or sharp nail

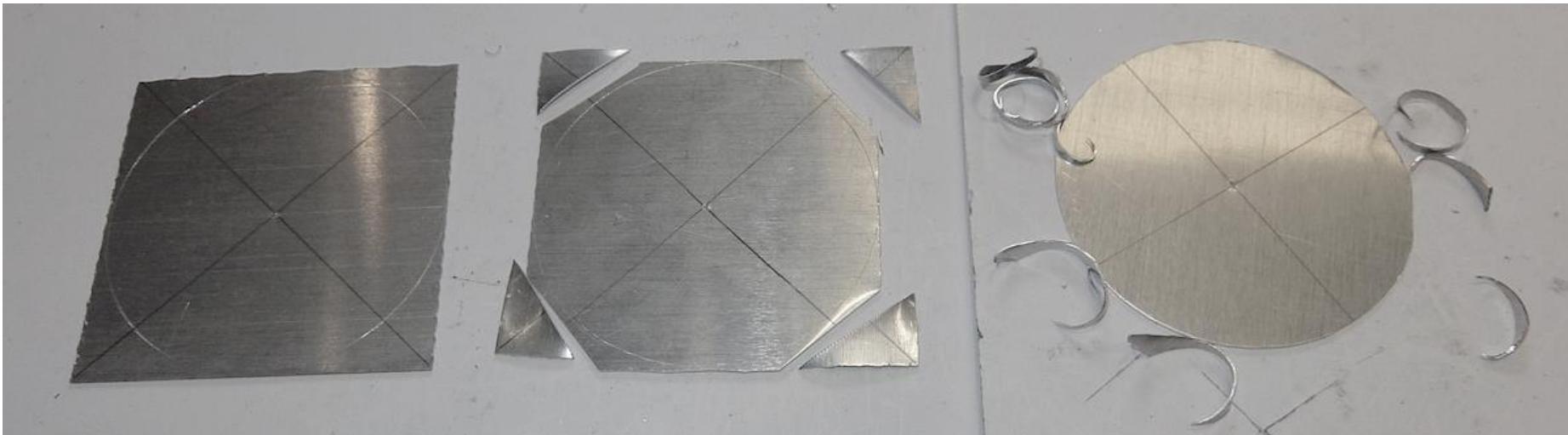
Start with a 1/16" drill bit and work progressively in 3 or 4 steps to 3/8"+ (25/64")

(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



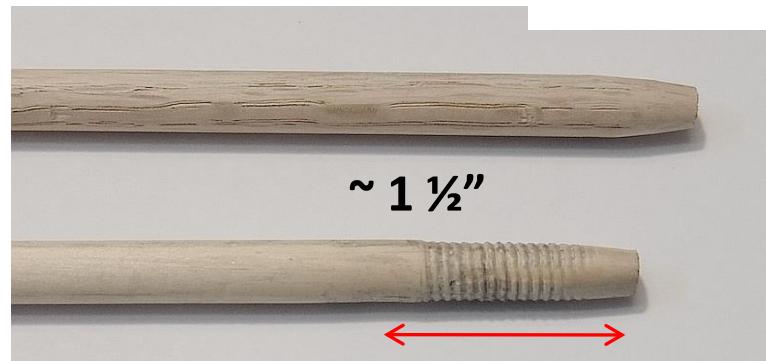
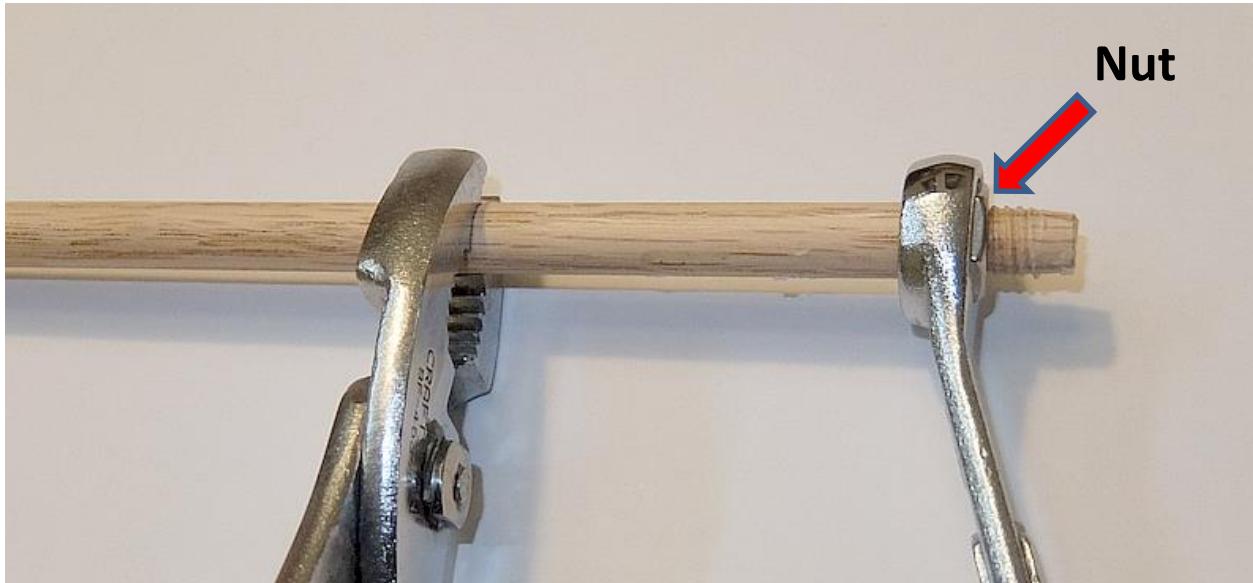
11mm 50mm 40mm 60mm

(Optional 11 mm spacers of plastic or wood)



Fabrication Details

Threading Wood Dowel Rod
Taper the dowel ends & Start the nut by hand
(rub candle wax on dowel to make threading easier)



Fabrication Details

Use Wood Block for Base

Glue / Screw Wood Block

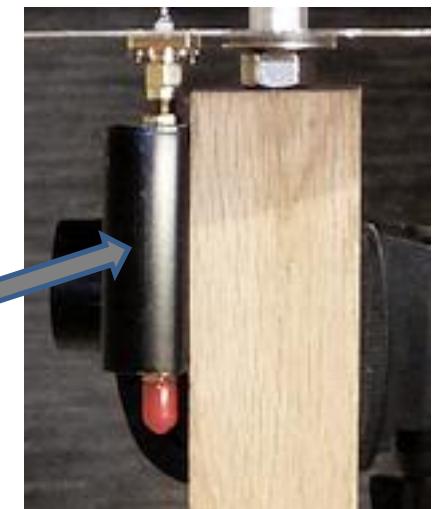
for **Tripod Mount** capability :
Drill 7/16" hole and make a thread pattern
with a 1/4"x 20tpi screw to match **Tripod Shoe**



Wood Block Dimensions

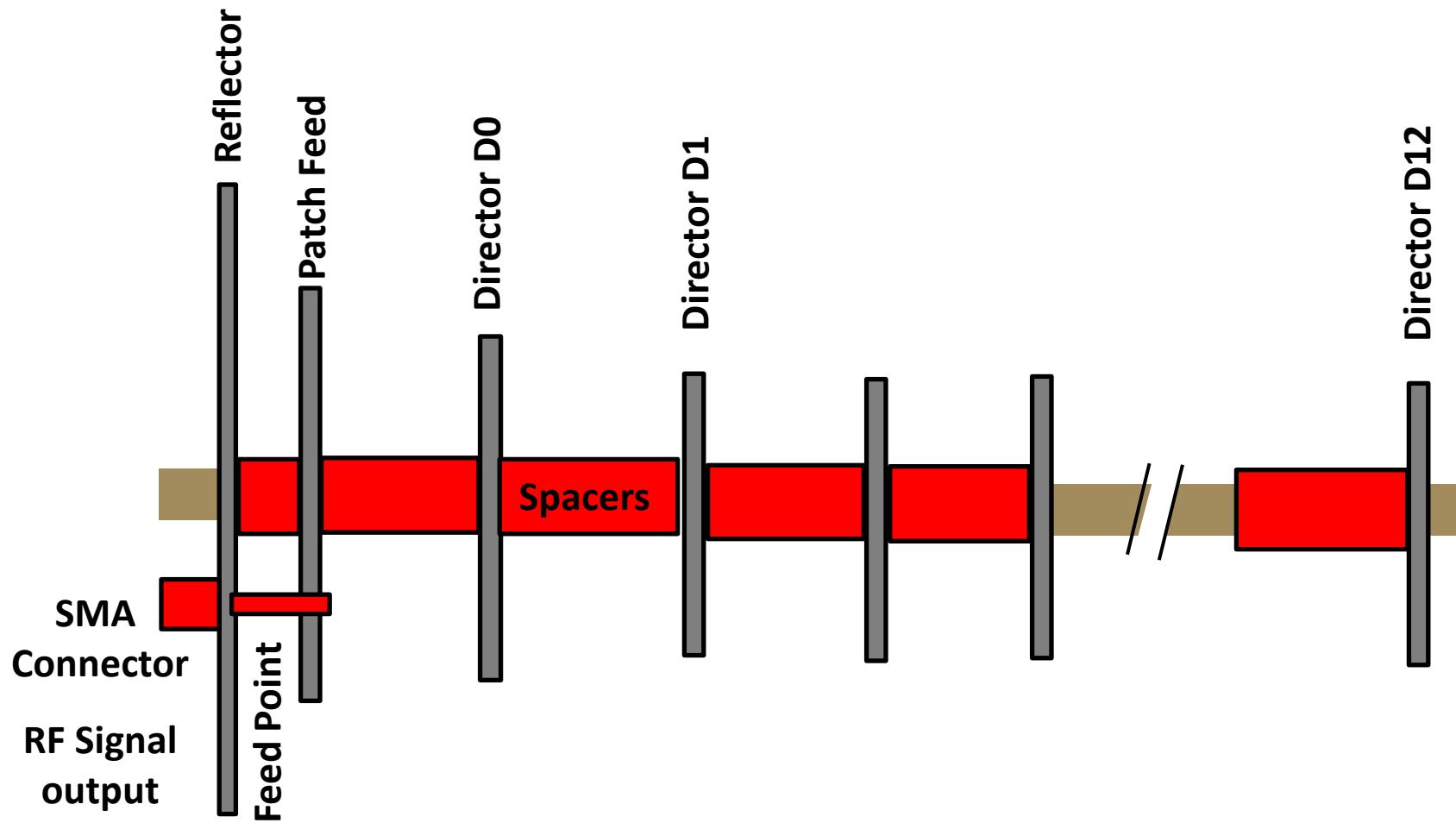
$\frac{3}{4}'' \times 1\frac{1}{4}'' \times 3''$ (not critical ... *Except*, the Optimal Orientation of the Antenna's Beam Pattern is such that the Feed Point is East <> West.
Meaning : The Width of the block needs to accommodate the SMA connector & LNA amp unit)

3/8" hole for Dowel (drill from each end)

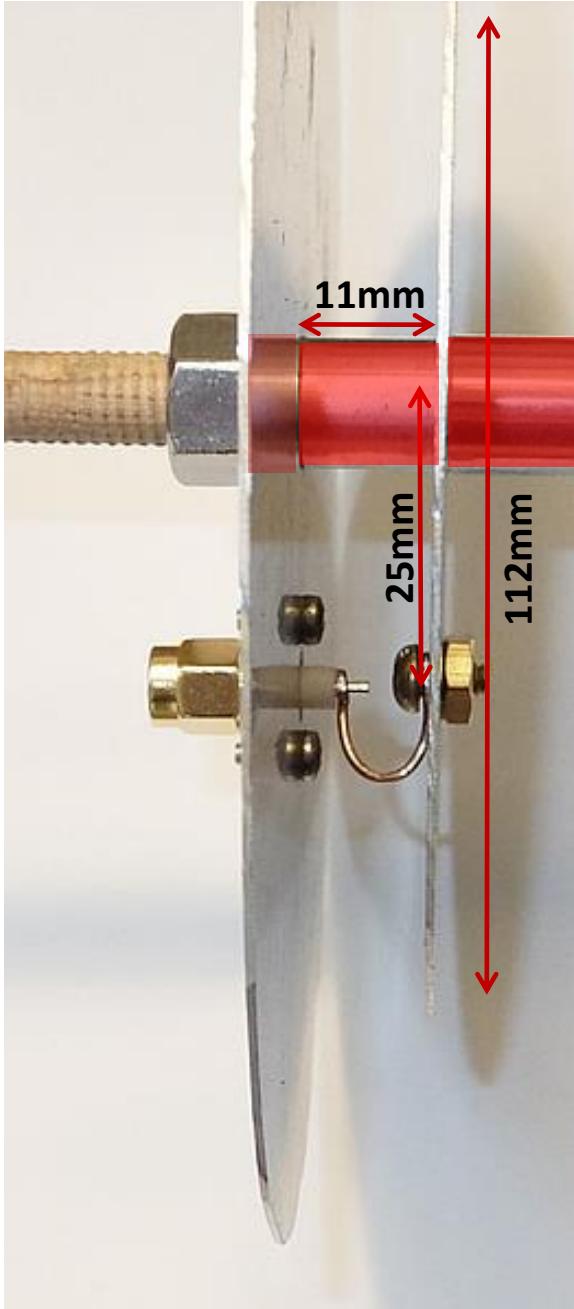


Fabrication Details

Assemble array on wood dowel from Reflector to Directors.



Fabrication Details



Patch Feed Construction Details

>> Most Critical Dimensions <<

112 mm Diameter of the patch feed

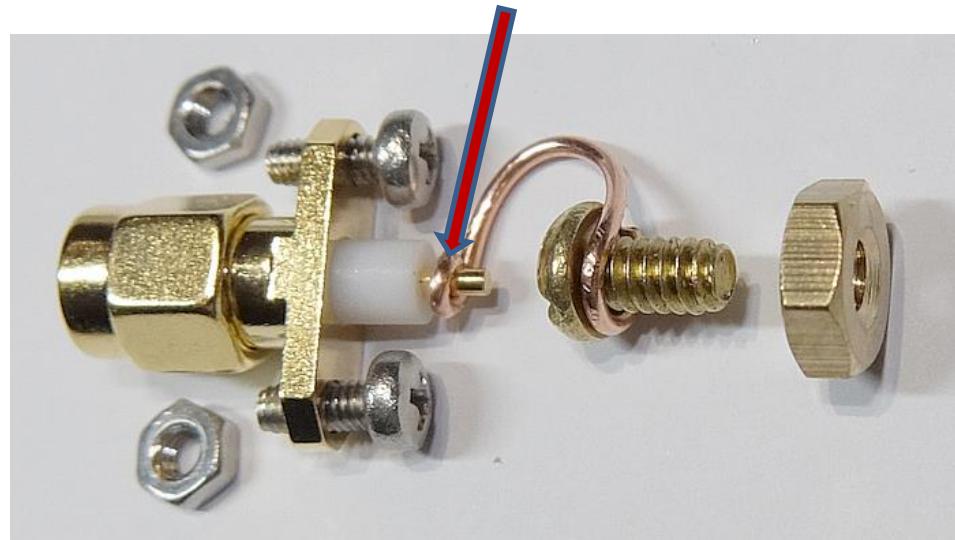
11 mm spacer Thickness reflector<>patch feed

25 mm Radius of the Feed Point

(plastic spacers not installed in photo)

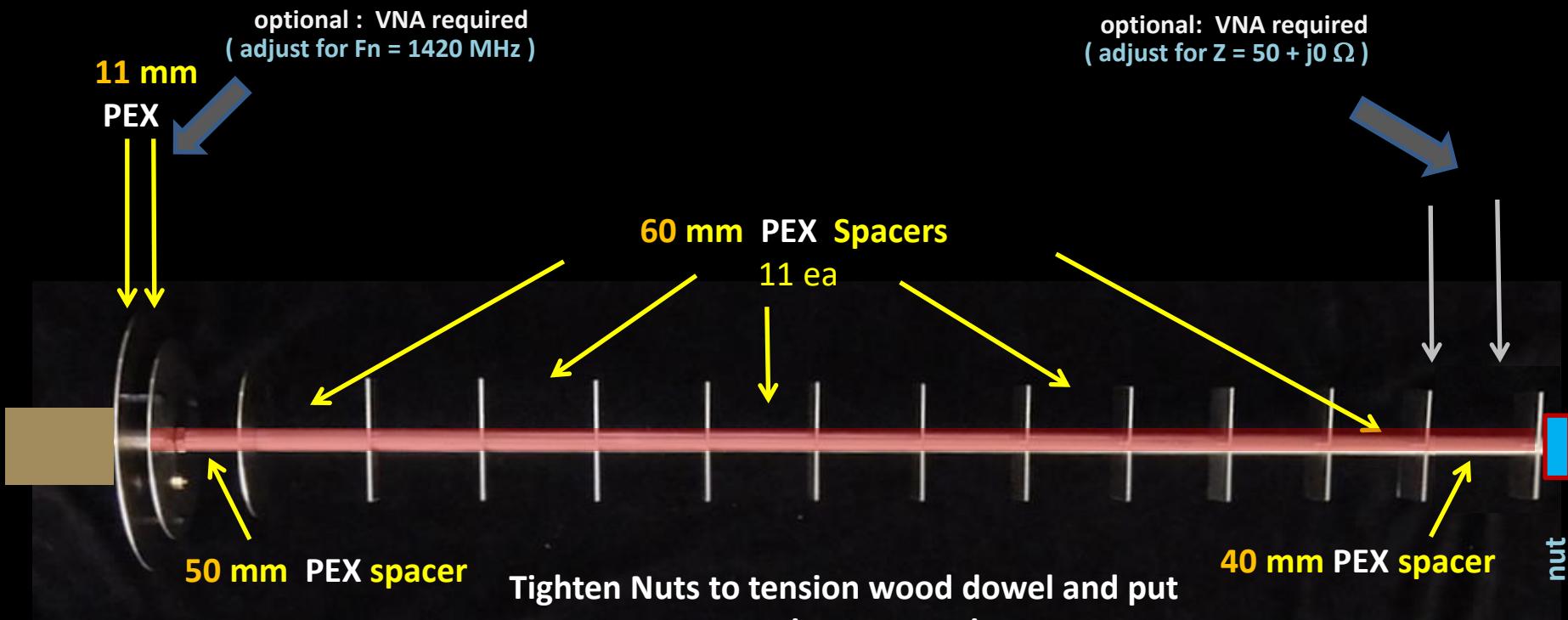
**(copper wire loop on the SMA center conductor pin
Should Be Soldered**

after SMA connector is installed on Reflector Disk)



>> Clean Parts for good Electrical Contact <<

Cir Patch Feed Disk Yagi Dimensions for Student Edition



Reflector 150 mm dia

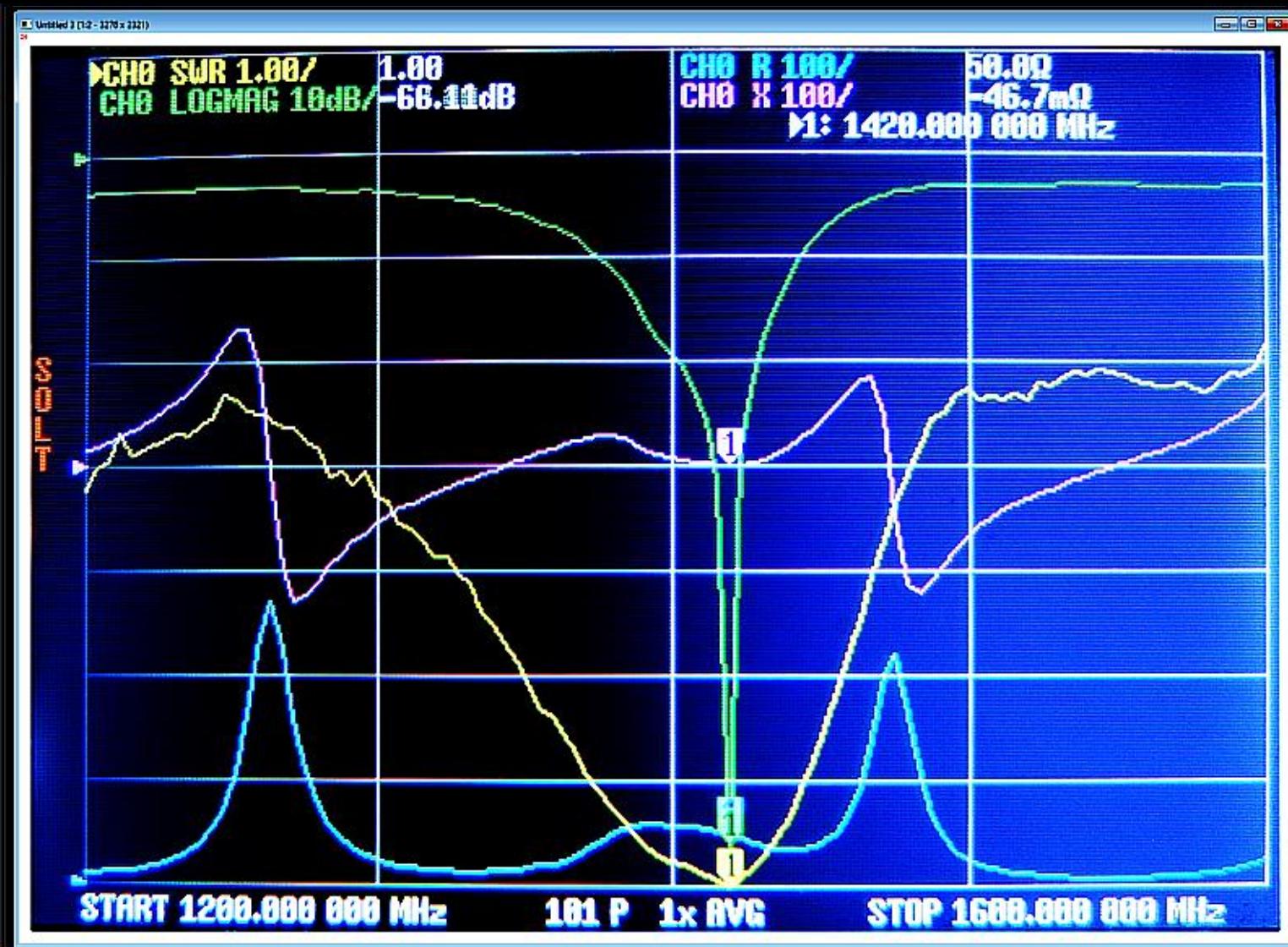
Patch Feed 112 mm dia

Director#01 88 mm dia

Director#02 72 mm dia

Director #13 72 mm dia

Antenna Tuning !



**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



a petit jr Aug24

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

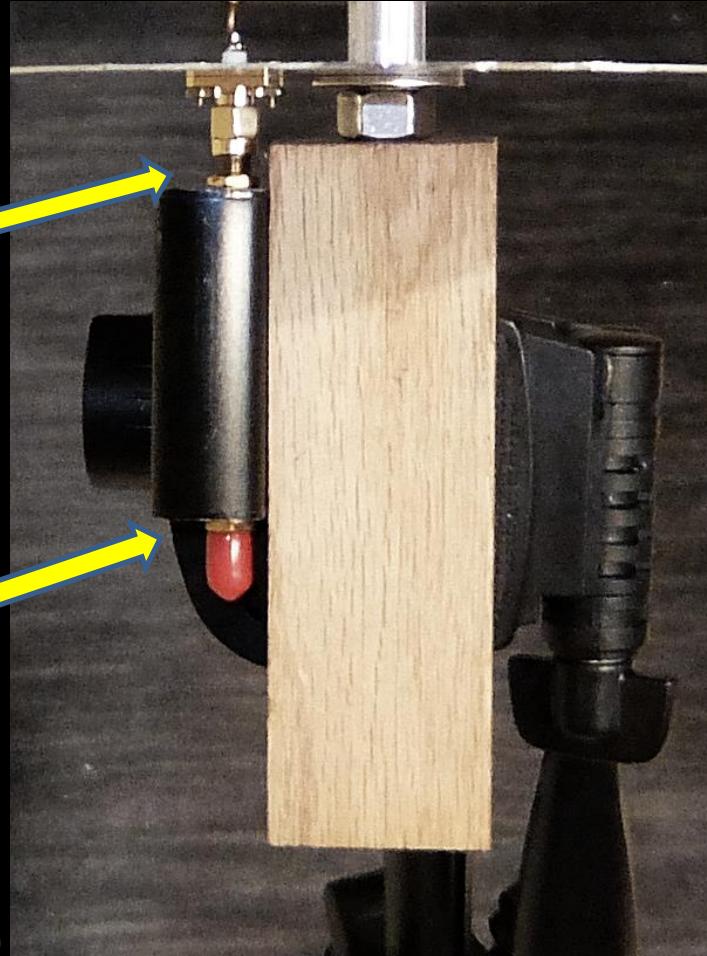
LNA : INPUT

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

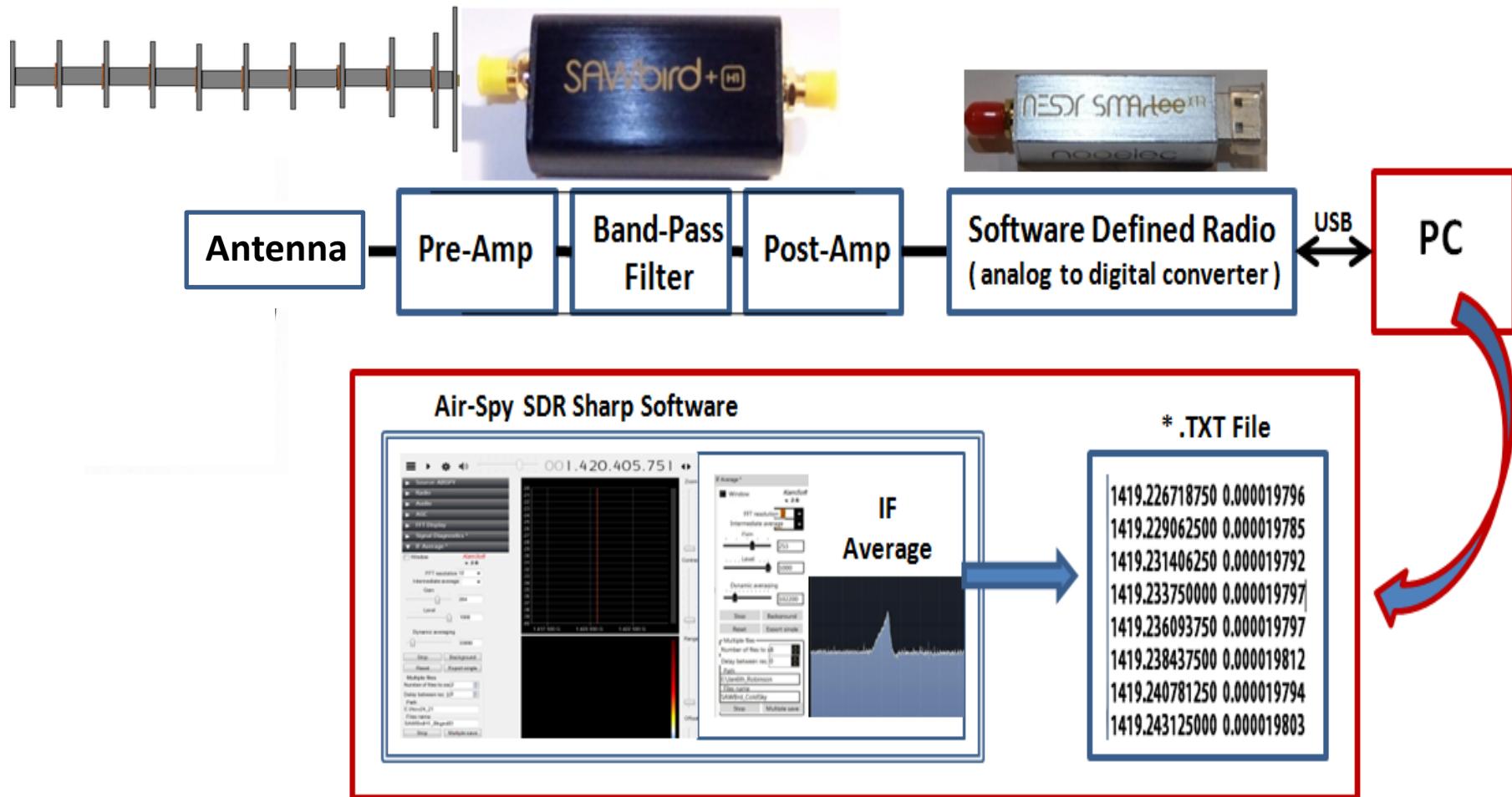


25

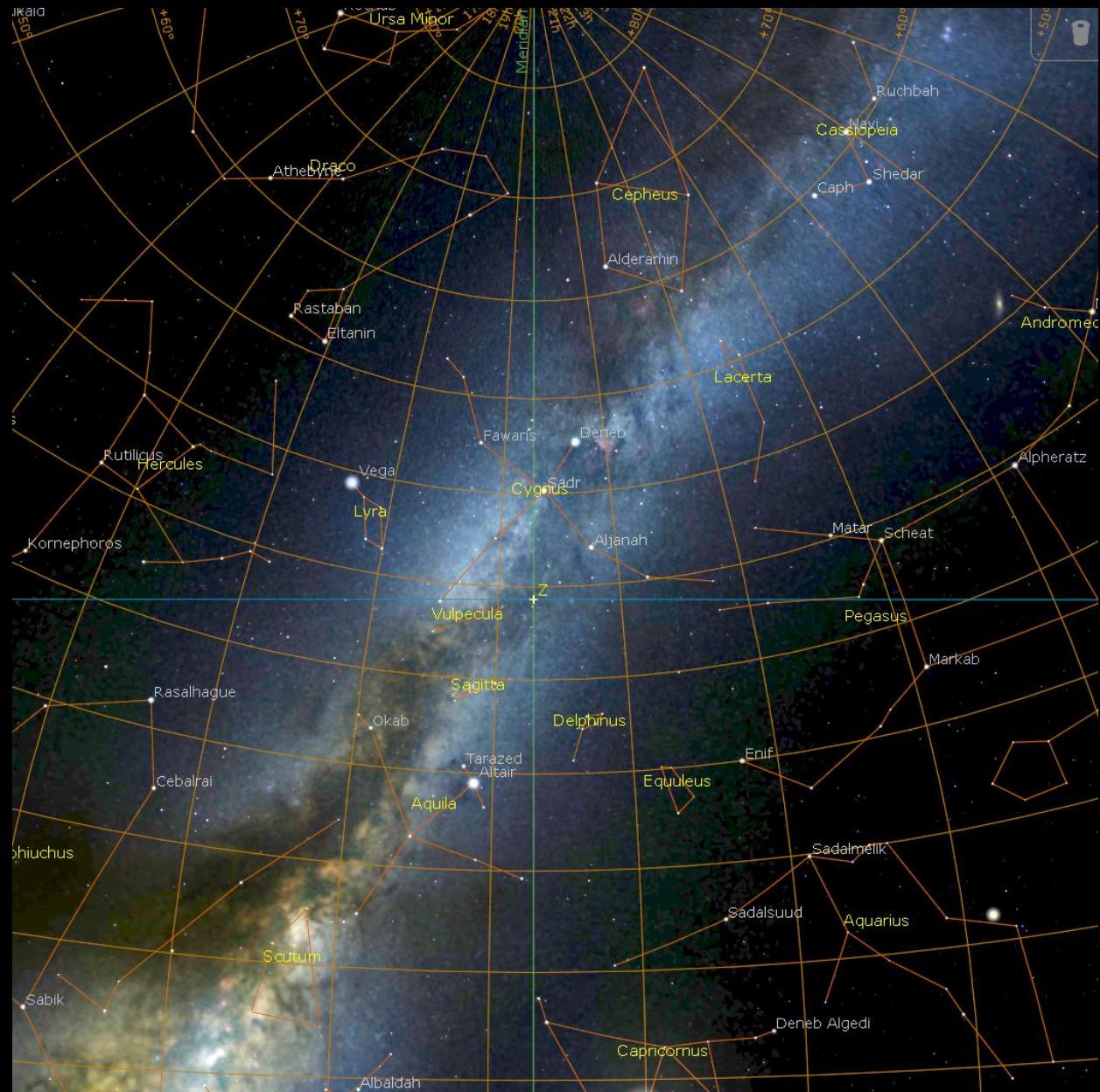
a petit jr Aug24

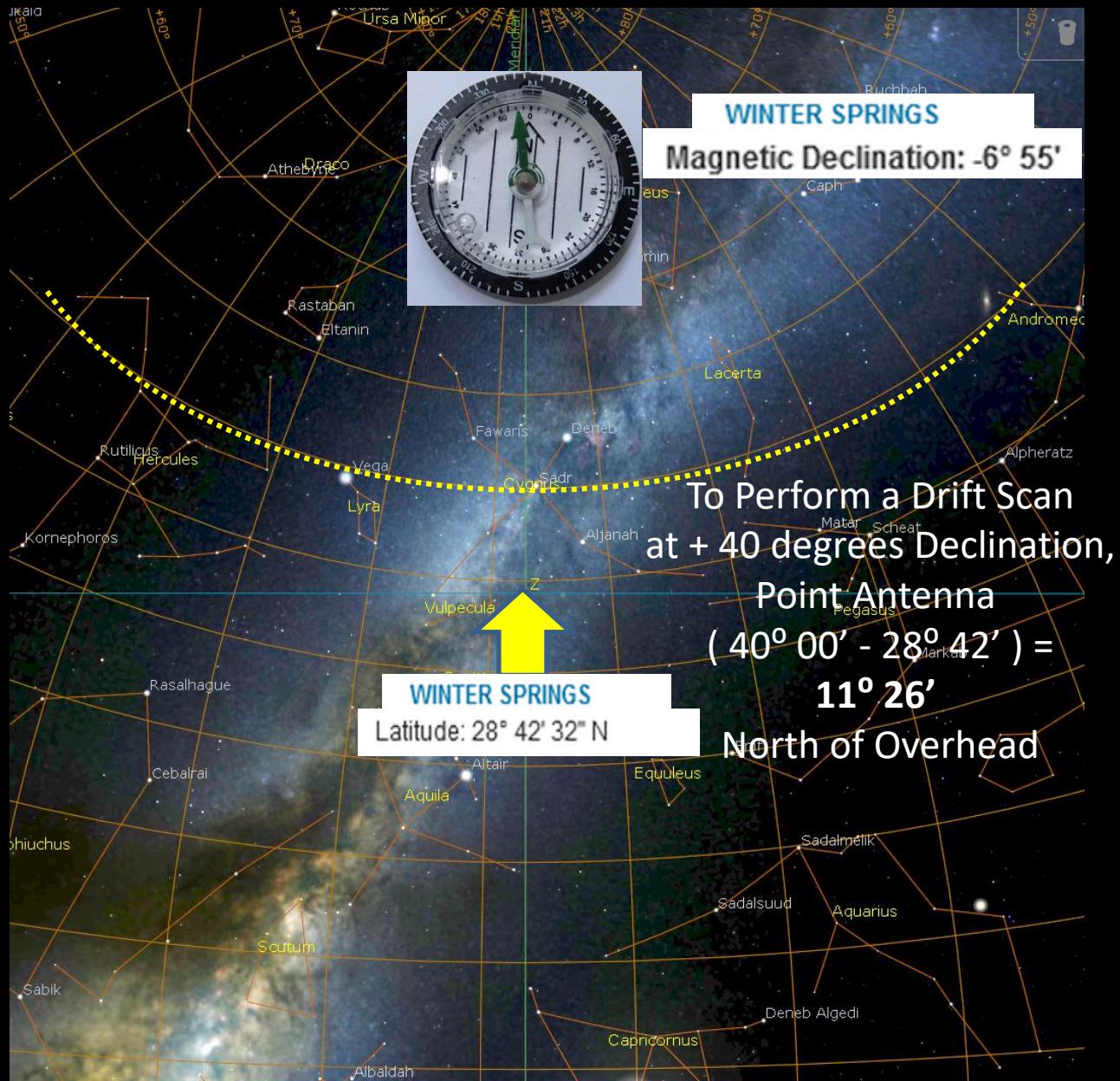
System Hardware and Software

Hardware & Software System Block Diagram



Stellarium Planetarium Software





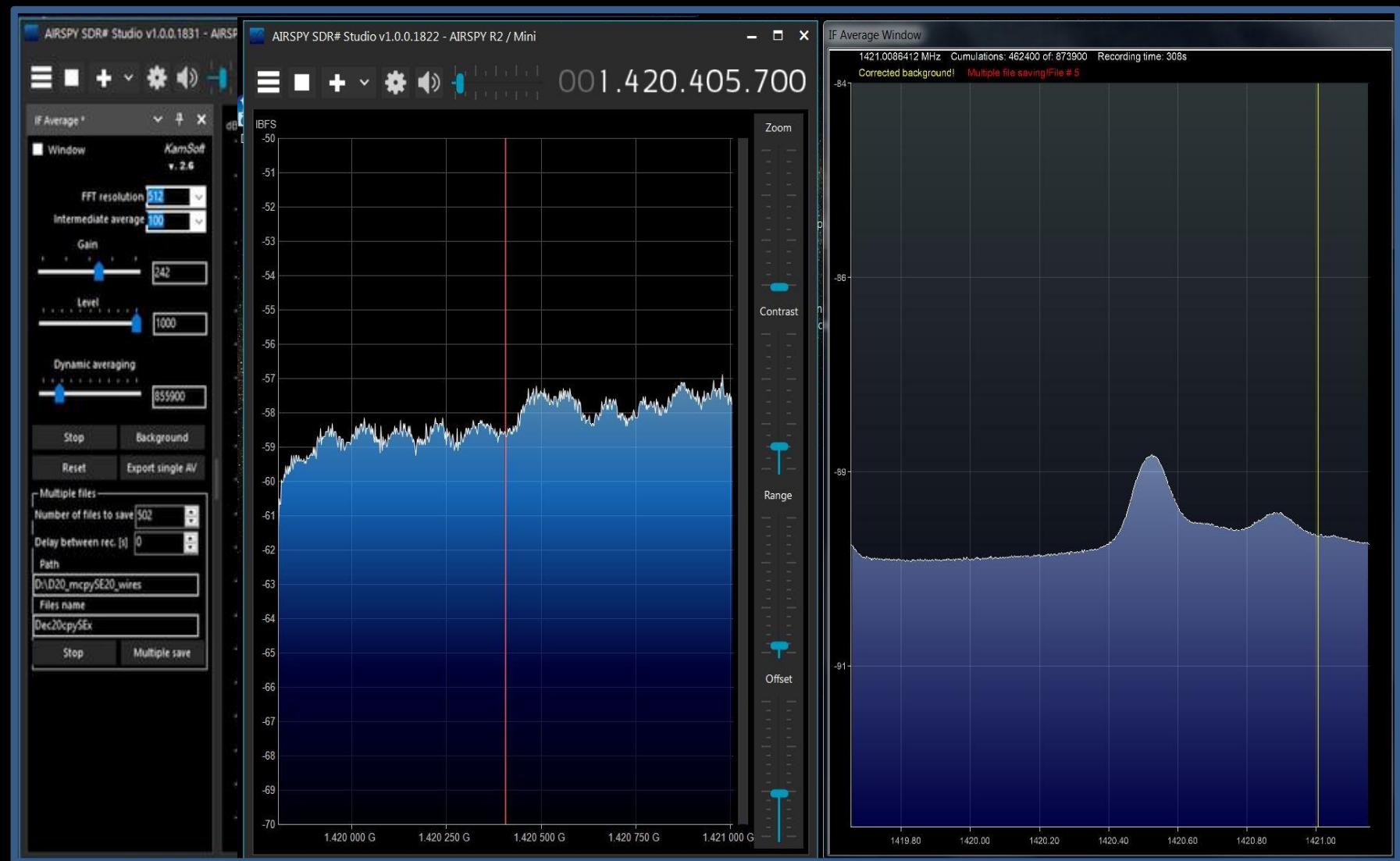


To Perform a Drift Scan
at + 40 degrees Declination,
Point Antenna
 $(40^\circ 00' - 28^\circ 42') =$
11° 26' towards
North of Overhead

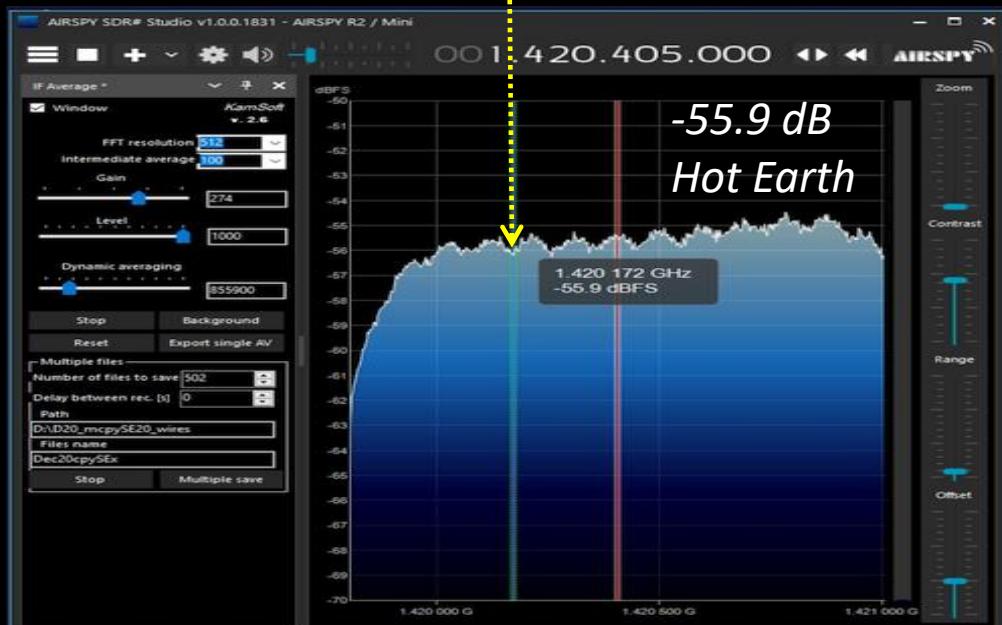
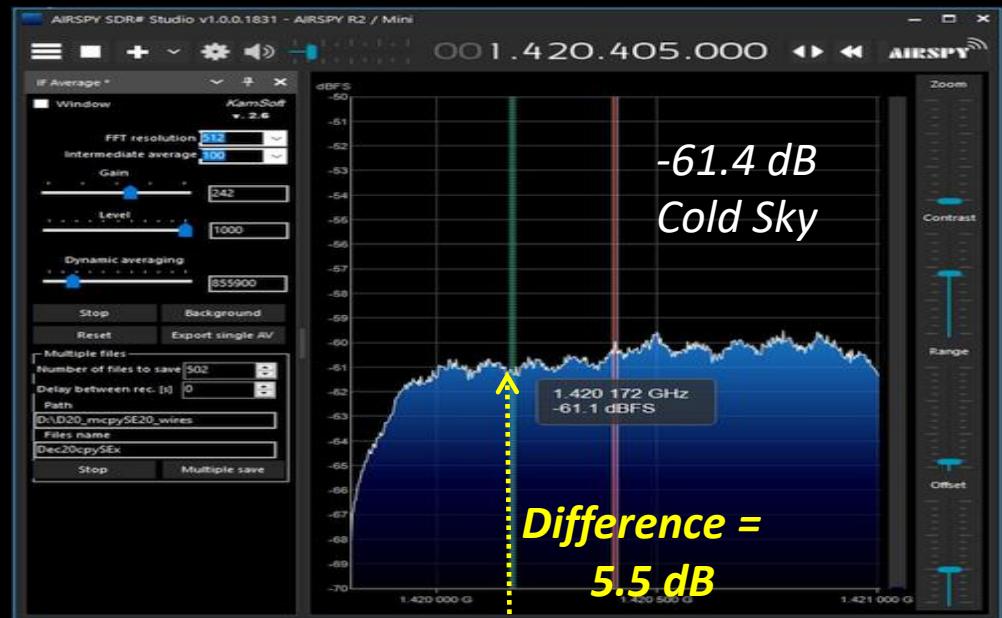


Signal Acquisition Software

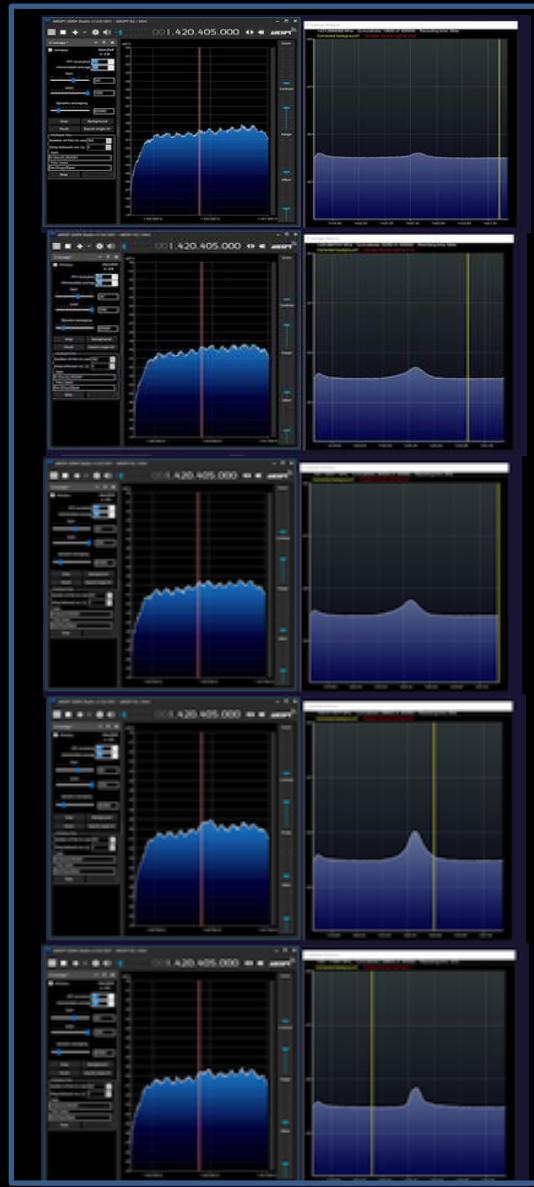
AirSpy SDR# Studio & Kaminski IF_Ave Plugin software



System Operational Verification Hot_Earth vs Cold_Sky

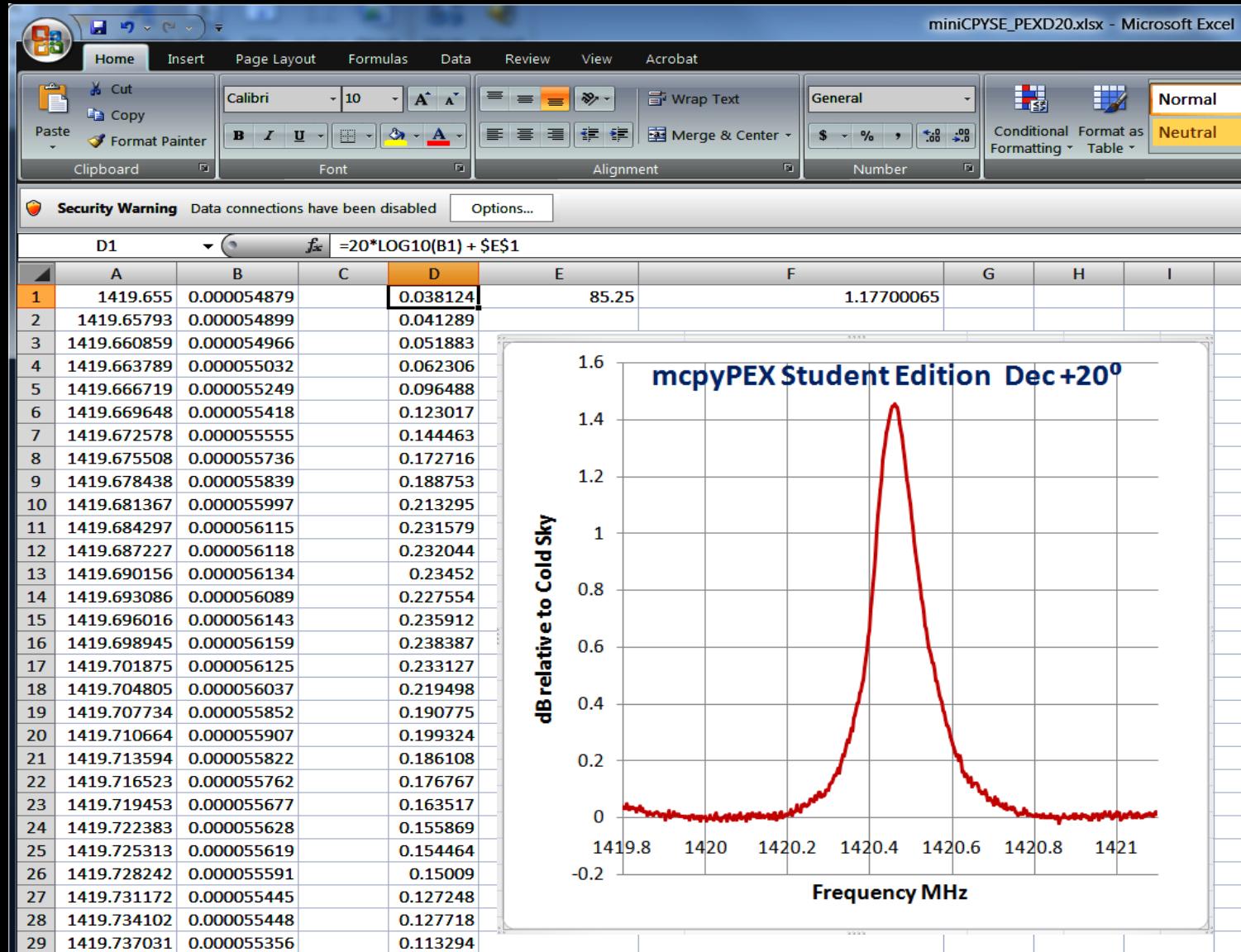


Perform a Drift Scan and Save a Data File Set

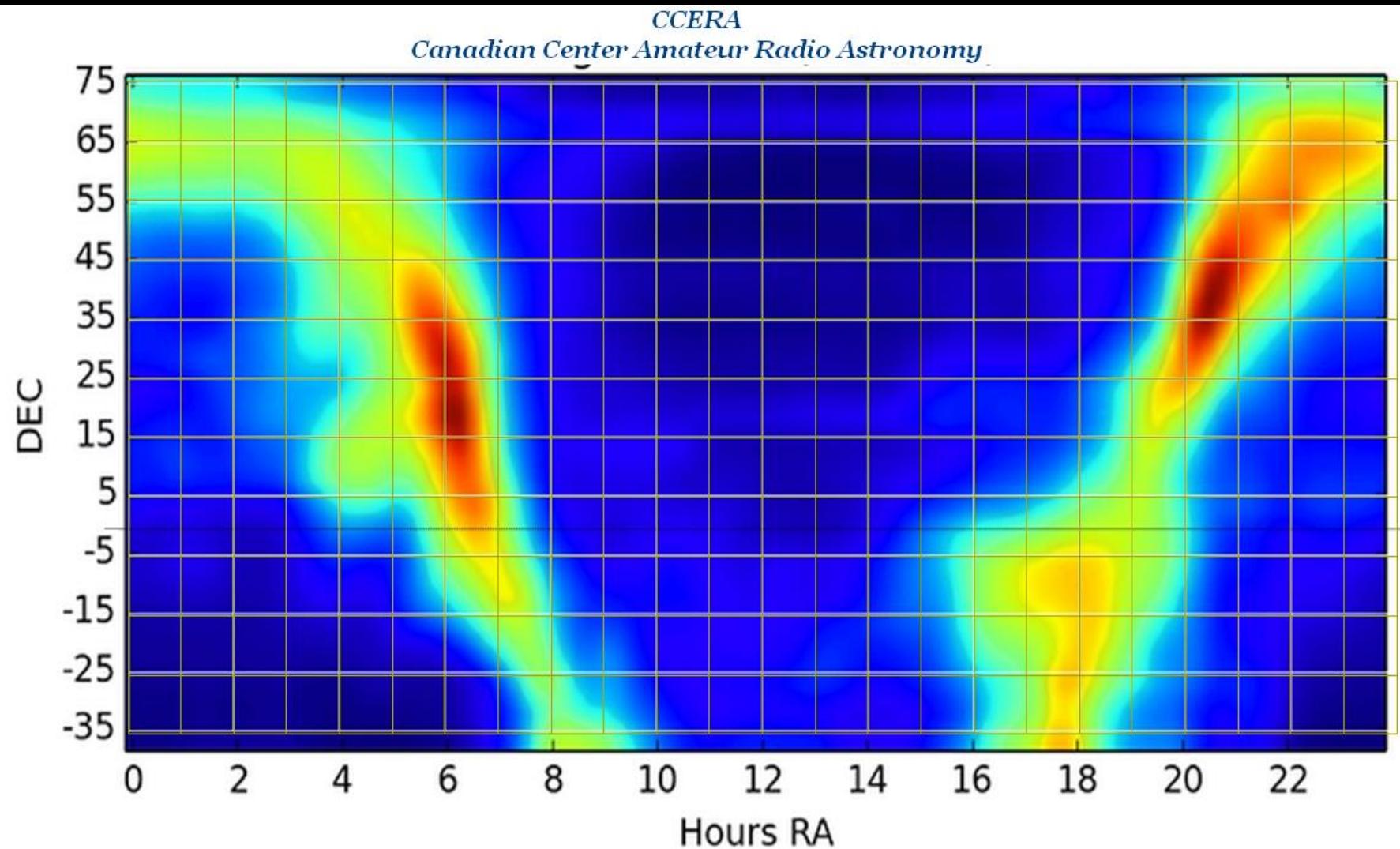


Dec40_cpy_SE01_0001.txt	8/18/2024 11:31 A...	Text Document	15 KB
Dec40_cpy_SE01_0002.txt	8/18/2024 11:36 A...	Text Document	15 KB
Dec40_cpy_SE01_0003.txt	8/18/2024 11:41 A...	Text Document	15 KB
Dec40_cpy_SE01_0004.txt	8/18/2024 11:46 A...	Text Document	15 KB
Dec40_cpy_SE01_0005.txt	8/18/2024 11:50 A...	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
Dec40_cpy_SE01_0008.txt	8/18/2024 12:05 PM	Text Document	15 KB
Dec40_cpy_SE01_0009.txt	8/18/2024 12:10 PM	Text Document	15 KB
Dec40_cpy_SE01_0010.txt	8/18/2024 12:15 PM	Text Document	15 KB
Dec40_cpy_SE01_0011.txt	8/18/2024 12:20 PM	Text Document	15 KB
Dec40_cpy_SE01_0012.txt	8/18/2024 12:24 PM	Text Document	15 KB
Dec40_cpy_SE01_0013.txt	8/18/2024 12:29 PM	Text Document	15 KB
Dec40_cpy_SE01_0014.txt	8/18/2024 12:34 PM	Text Document	15 KB
Dec40_cpy_SE01_0015.txt	8/18/2024 12:39 PM	Text Document	15 KB
Dec40_cpy_SE01_0016.txt	8/18/2024 12:44 PM	Text Document	15 KB
Dec40_cpy_SE01_0017.txt	8/18/2024 12:49 PM	Text Document	15 KB
Dec40_cpy_SE01_0018.txt	8/18/2024 12:54 PM	Text Document	15 KB
Dec40_cpy_SE01_0019.txt	8/18/2024 12:59 PM	Text Document	15 KB
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=tcl7w3s&dl=0>

Stellarium planetarium software

<https://stellarium.org>

(Excel or Apache Open Office Calc)

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

Software

(soon to be released : **2D Data Set Processing and 3D Graphics**)

