

Hudson Valley Digital Network | www.hvdn.org /presentations

Radio Astronomy & L Band Spectrum

Presented to MHAA August 20th 2019

About Hudson Valley Digital Network (HVDN)

Subpart A—General Provisions

§ 97.1 Basis and purpose.

The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

(a) Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications.

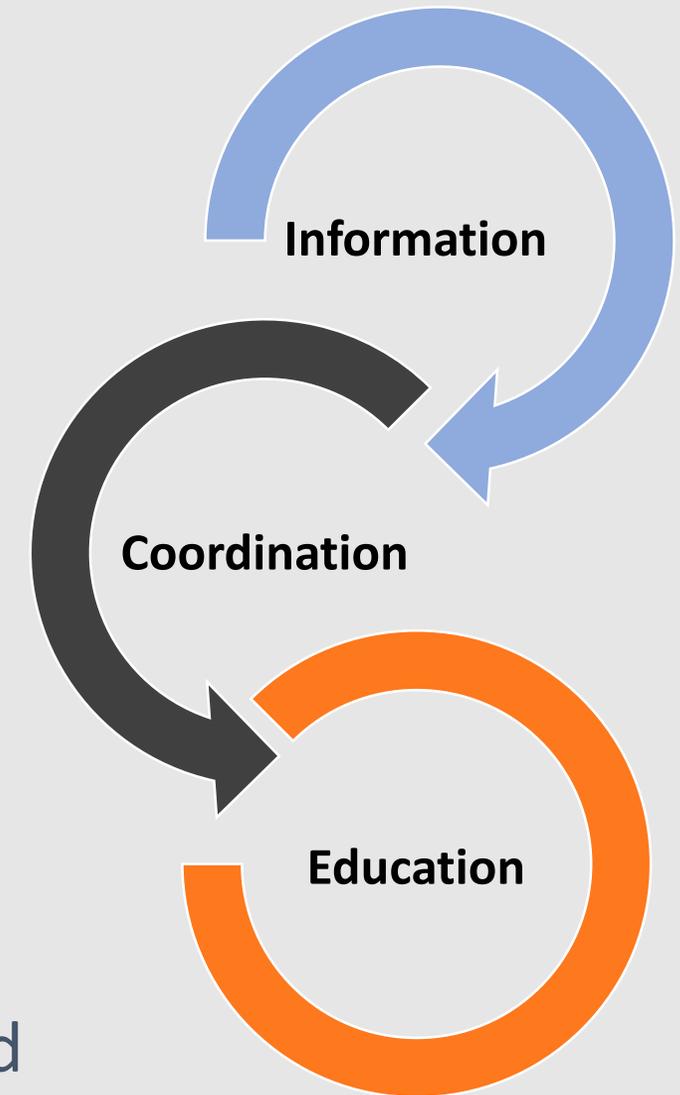
(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.

(c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.

(d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.

(e) Continuation and extension of the amateur's unique ability to enhance international goodwill.

- HVDN founded 2017
- Uphold FCC Part 97.1
- 3 pillar approach
- Deliberate modern & future focus
- Club call sign N2HVD
- Digital meets physical world



The “Biography” Slide....



Steve Bossert

K2GOG, Co-Founder HVVDN

Name:	Steve Bossert
First “Space Moment”:	9 Years Old
Amateur Radio License Since:	1998 (21 Years Ago)
Hobby Funding Source:	Informa PLC
Top 3 Hobby Interests:	Hiking, Photography, Travel
Fun Fact About Me:	Buried a tent. Forgot to remove watch.

Presentation Overview

- **Accidental Discovery**
- **Spectrum Analysis: Hydrogen Line Fun Facts**
- **MVS: L-Band Exploration**
- **Amateur Radio Astronomy Basics**
- **Getting started for about \$50 (USD)**
- **Interesting Project #1 (Pictor) & Demo (Maybe)**



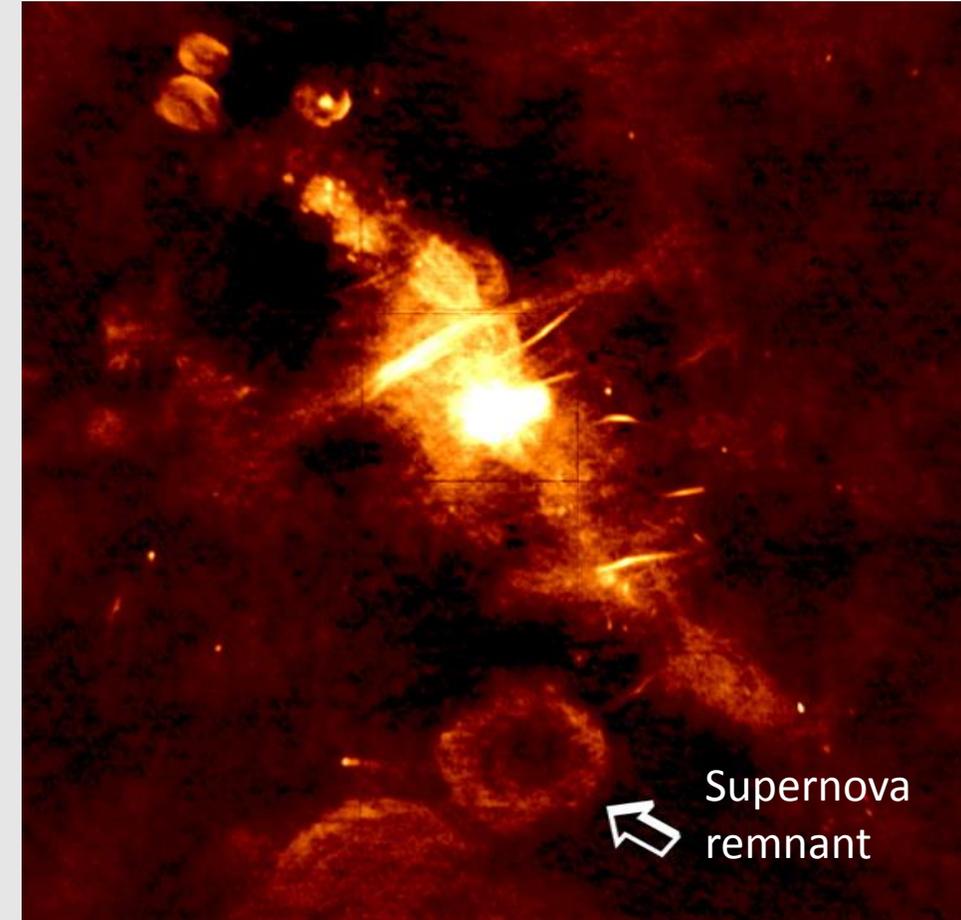
Presentation Goal

Scratch the surface on additional methods of observing far and near earth natural and man made objects through the use of radio assisted astronomy.

Accidental Discovery

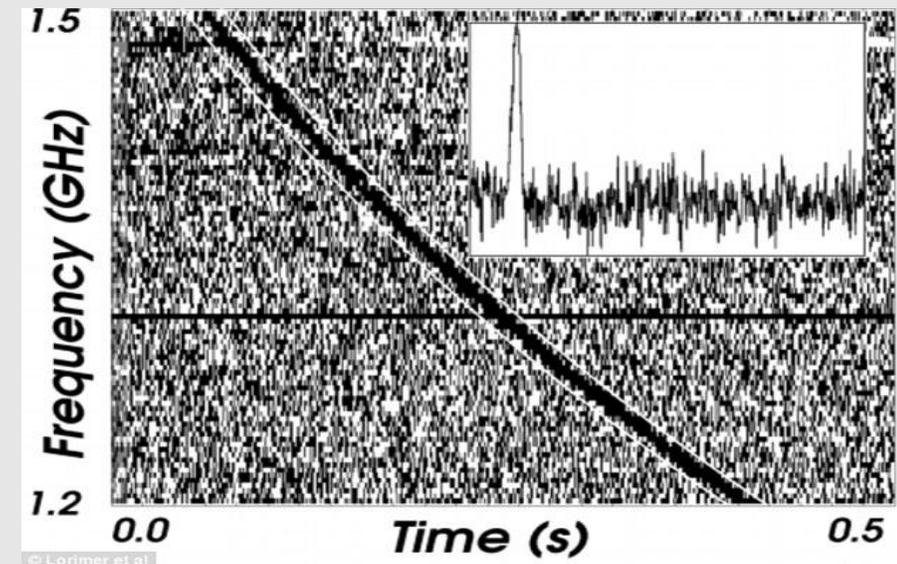
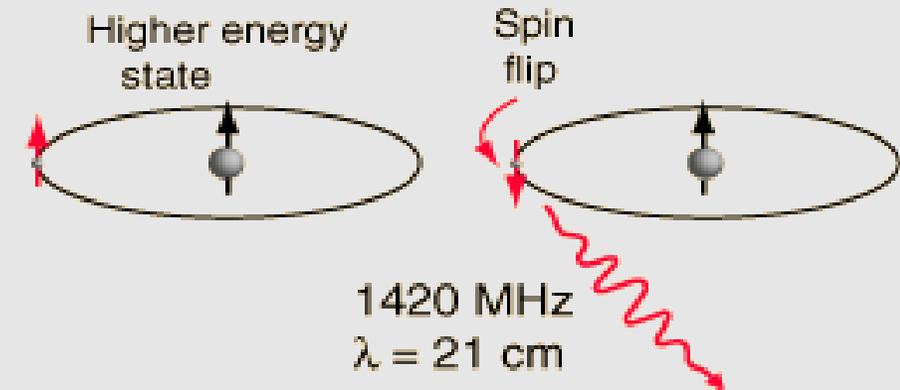
When was “radio astronomy” discovered?

- Speculations about this as early as 1860, but not proved until 70 years later
- Karl Jansky of Bell Telephone Laboratories noticed RF radiation coming from the Milky Way in 1932
- Jansky’s discovery was by accident. Looking for interference source affecting shortwave (HF, 2-30 MHz) communications
- 1945 H C van de Hulst suggested 21cm (1420 MHz) theory
- 1951 E M Purcell first detected it at Harvard University using a 1.3m by 17m aperture horn antenna some 3.2m long
- Proper term is “Radio Interferometry”



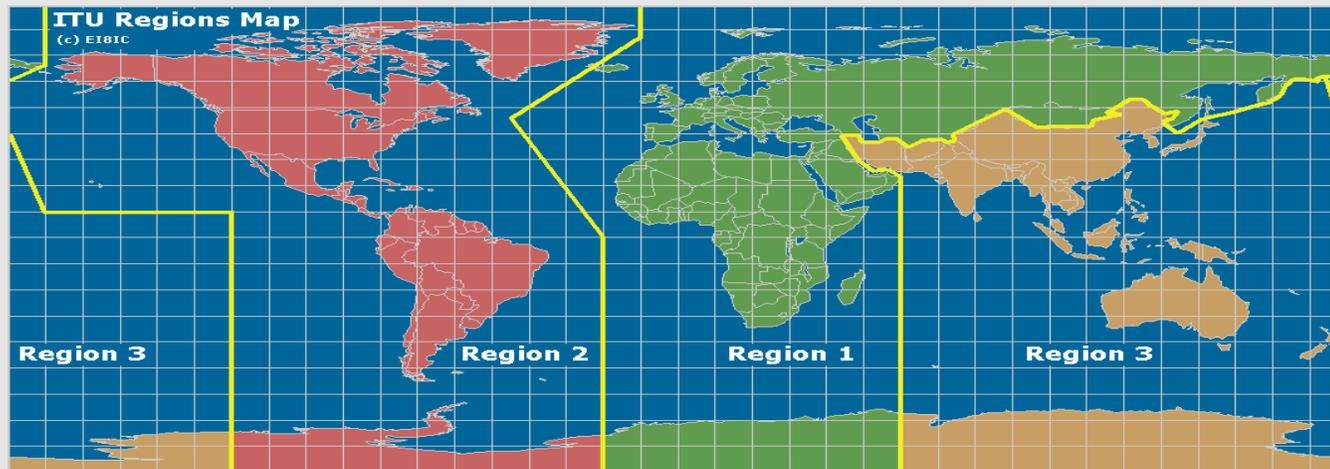
Spectrum Analysis: Hydrogen Line Fun Facts

- Lets talk about SETI and Hydrogen line (Put on your tin foil hat)
- All atoms radiate natural RF radiation (among other things...)
- Hydrogen atoms emit RF energy at exactly 1420.40575 MHz
- Atoms move and can be tracked (Can you say Doppler shift?)
- Hydroxyl (OH) emits RF energy between 1612 and 1720 MHz
- Hydrogen plus hydroxyl (H₂O) is water. Water does not like RF communications. Its called the “Water Hole”.
- 2.4 GHz Wi-Fi has a reason. It wont go very far because of H₂O.
- Microwave ovens use 2.4 GHz. Water molecules “hate 2.4 GHz”



MVS: L Band

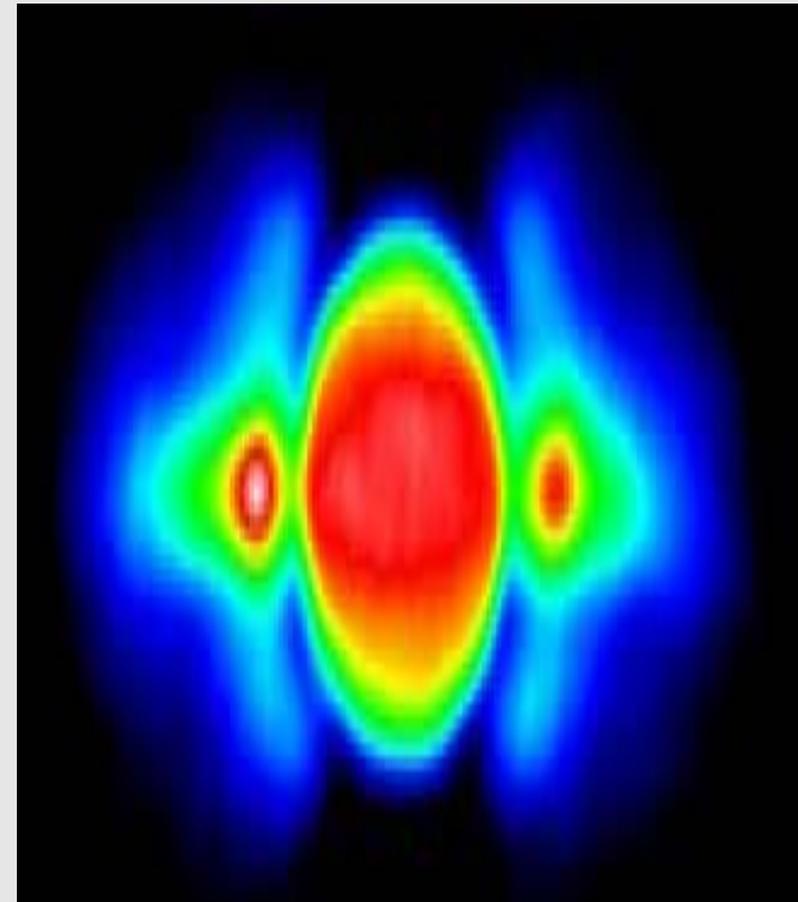
- IEEE standard definition of “L-Band” is 1,000 to 2,000 MHz
- L Band laughs at water. Cuts through it like.....
- Lots of commercial and “other” equipment can be repurposed for hobbyist “unintended” use



Use Cases	L-Band Frequencies (MHz)
Aircraft Tracking	1090 (Also 978, 1030)
GPS	1176.45, 1227.60, 1381.05, 1575.42
Amateur Radio	1240 to 1300 (Way underutilized)
Astronomy	~1420
InMarSat	1520 to 1550 (Multiple frequencies)
Weather	1698, 1701, 1704
Your phone	1700 -1900

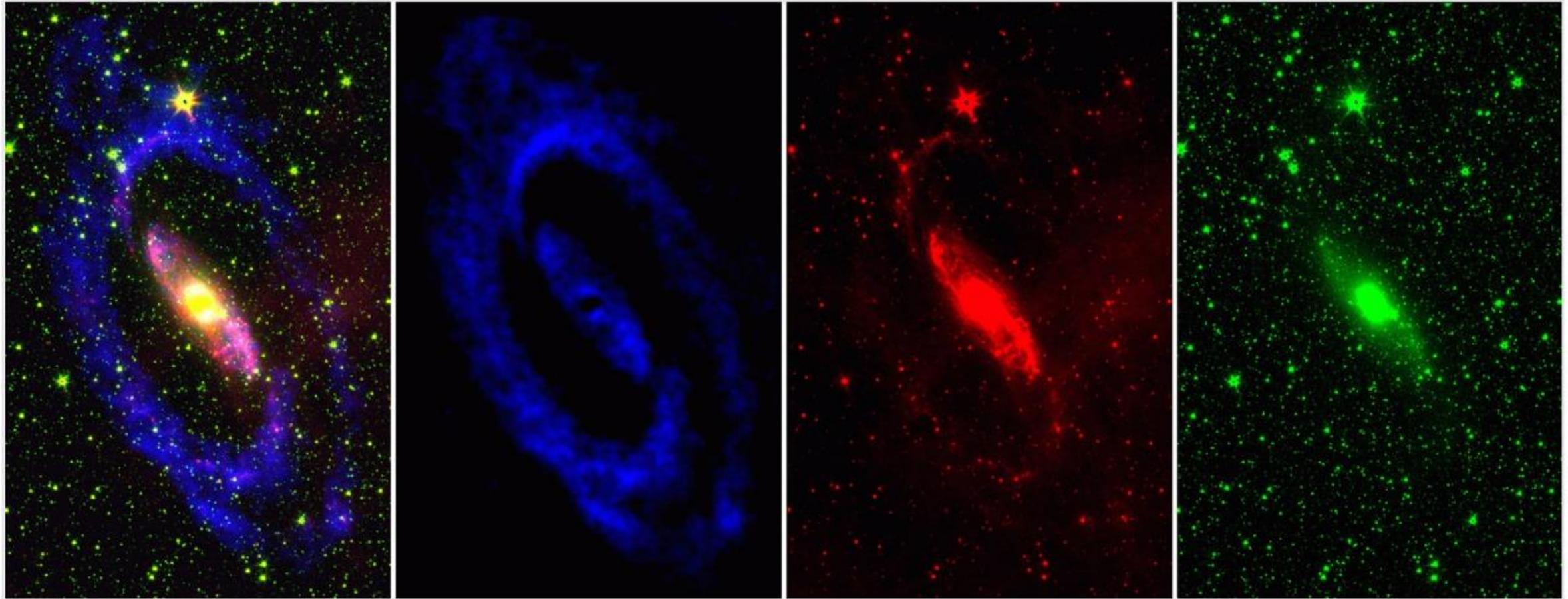
Amateur Radio Astronomy Basics

- Clear view of the sky (cloudy is FINE!)
 - Poll: How often is your viewing thwarted by overcast weather?
 - Largest or smallest aperture possible (Bigger is better?)
 - Antenna gain, SNR & receiver bandwidth important
 - How to crunch, record, view and decode from your radio telescope
 - Computers are our friends...
- Not just L-Band: Jupiter is can be found between 15 to 40 MHz



<https://radiojove.gsfc.nasa.gov/>

Amateur Radio Astronomy Basics



The Circinus galaxy as seen at different wavelengths: cold hydrogen gas (coloured blue), the fuel for star formation, was mapped using one of CSIRO's radio telescopes; the warm dust of space (coloured red) and stars (shown in green) were mapped using data from mid-infrared instruments. When combined, these three images reveal gas and stars in the inner disk and spiral arms of the galaxy. ©The Royal Astronomical Society (from For, Koribalski & Jarrett (2012))

Getting started for about \$50 (USD)

- Computer (You have one, right?)



- USB SDR (Avoid some...)



- LNA (Low Noise Amplifier)



Note: Power supply needed.
RTL-SDR V3 has it built in though

\$21.95

RTL-SDR Blog
R820T2 RTL2832U...

Amazon.com

- Antenna (Dish, Patch, Array, Horn, etc)



Next Slide

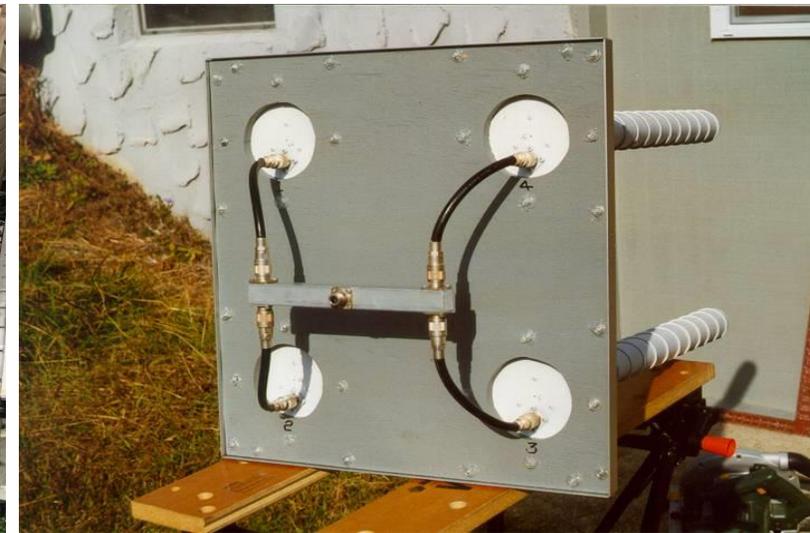
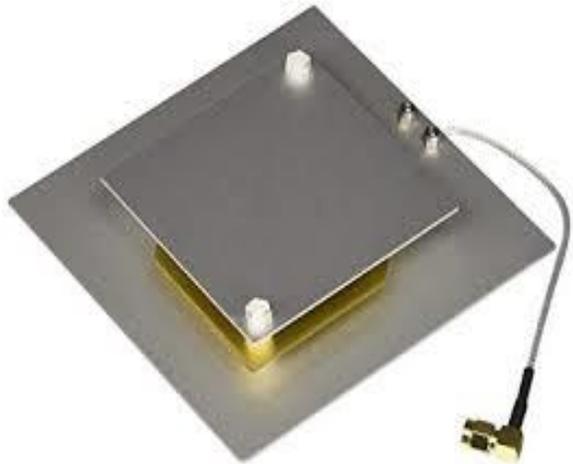
Getting started for < \$50 (USD)



We made it!

- Dish
- Patch
- Horn
- Helix

■ **Array!!!**



Interesting Project #1

PICTORTELESCOPE

— ● Home

○ About

○ Specifications

○ Observe

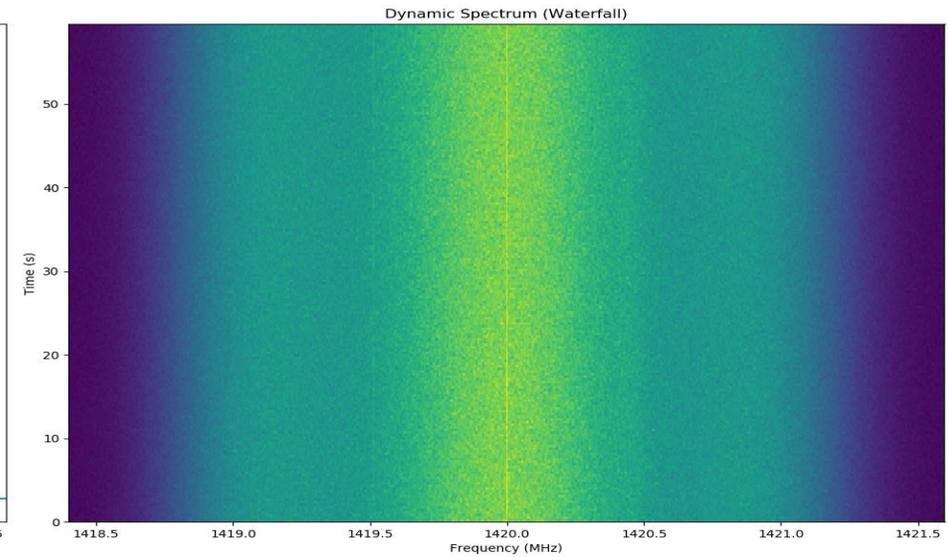
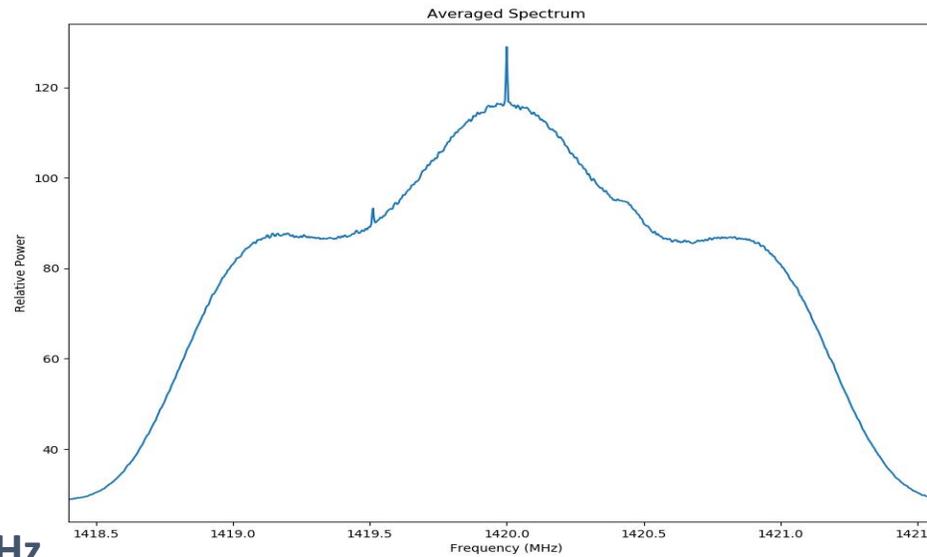
○ Contact

A free-to-use Radio Telescope

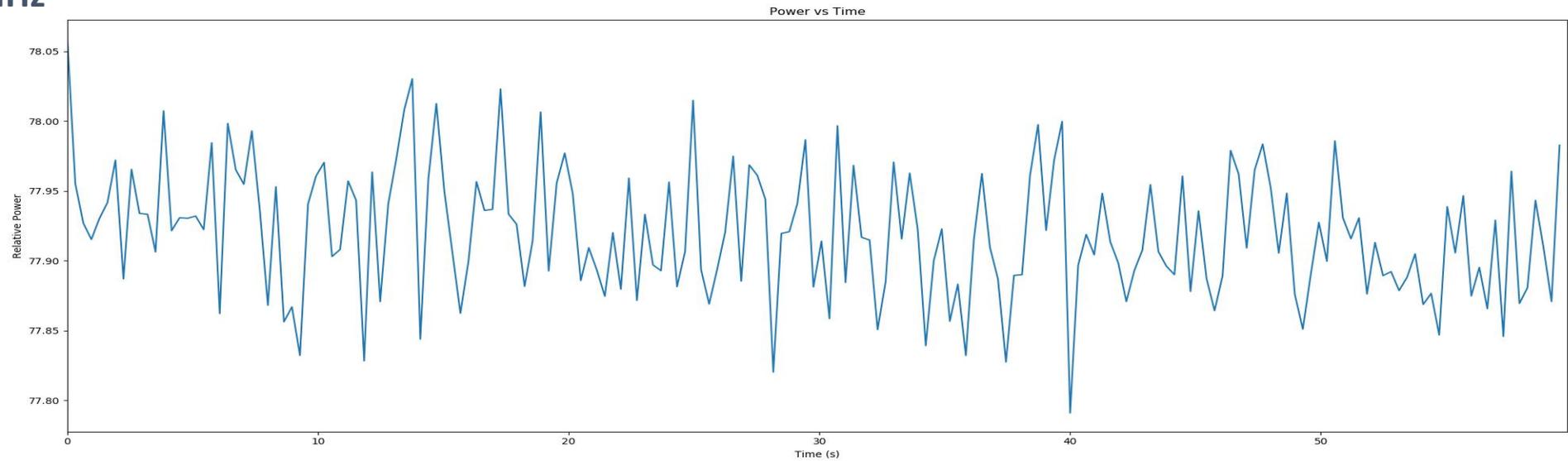
PICTOR is an open-source radio telescope that allows anyone to observe the radio sky, using its convenient web platform for free.

[Learn More](#)

Interesting Project #1 (Pictor)

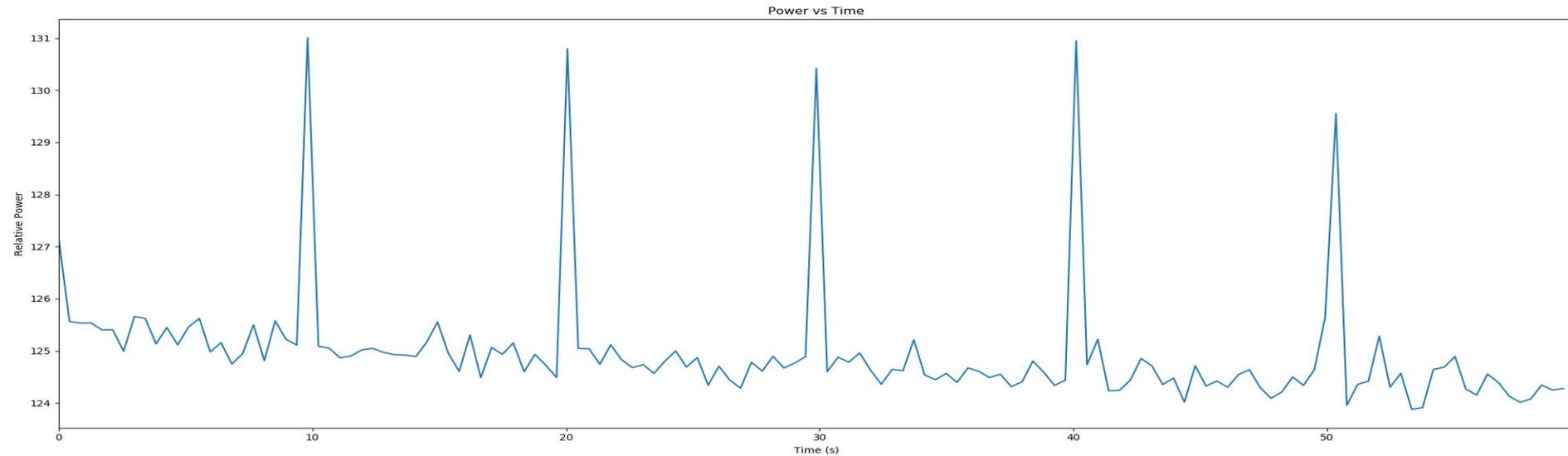
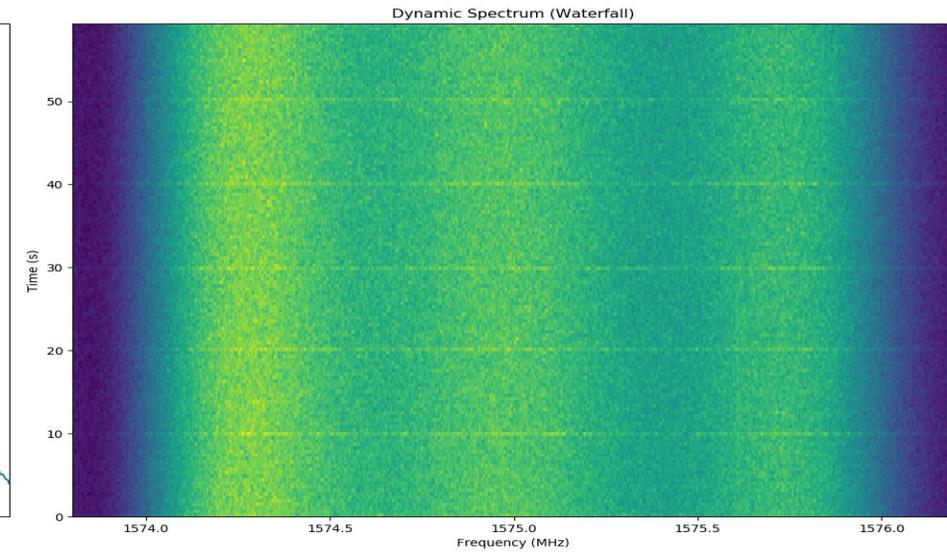
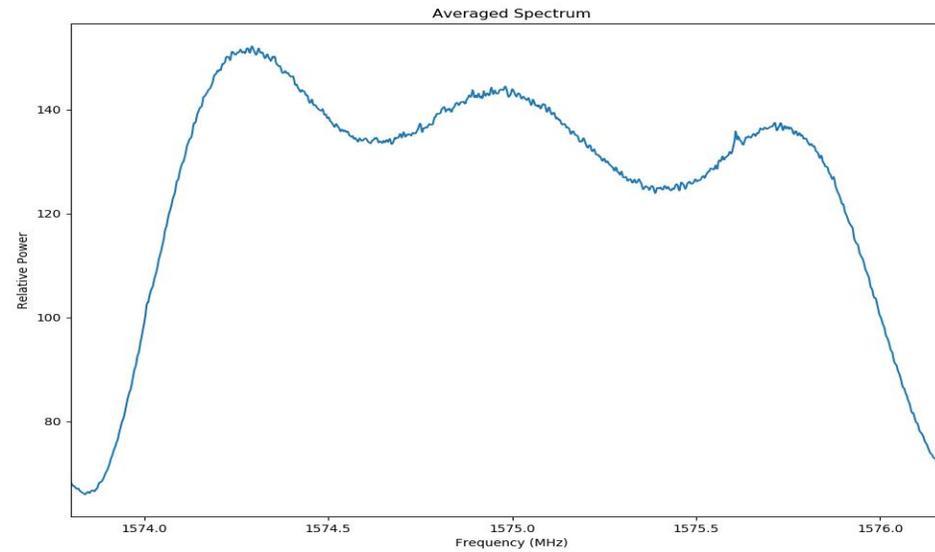


■ Hydrogen Line at 1420 MHz



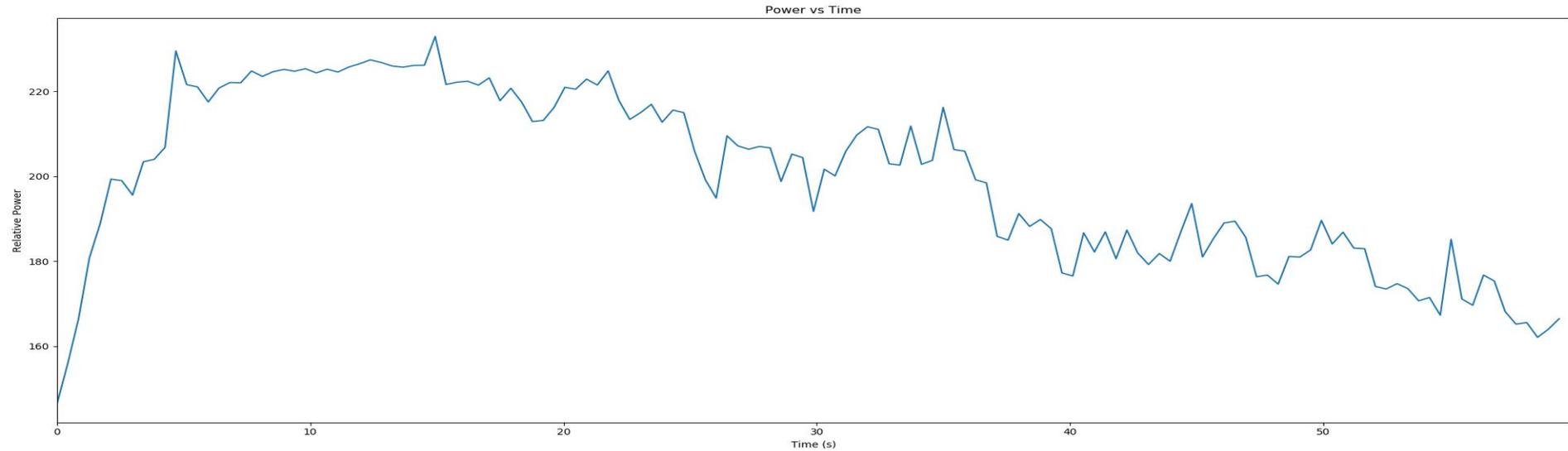
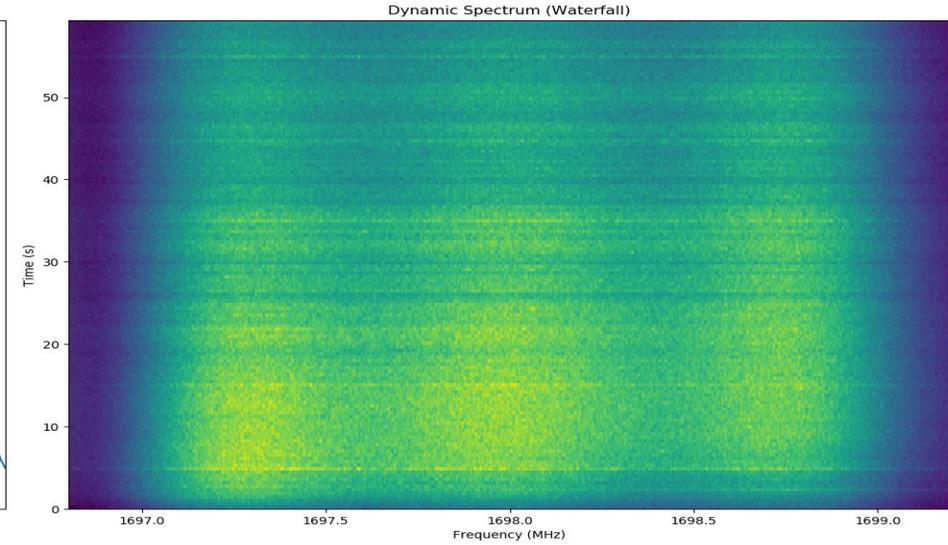
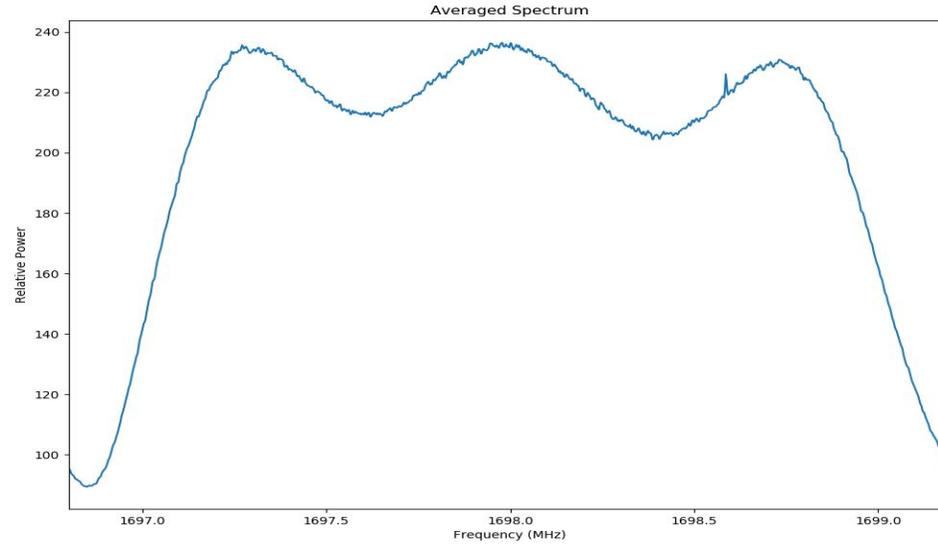
Interesting Project #1 (Pictor)

■ GPS at 1575 MHz



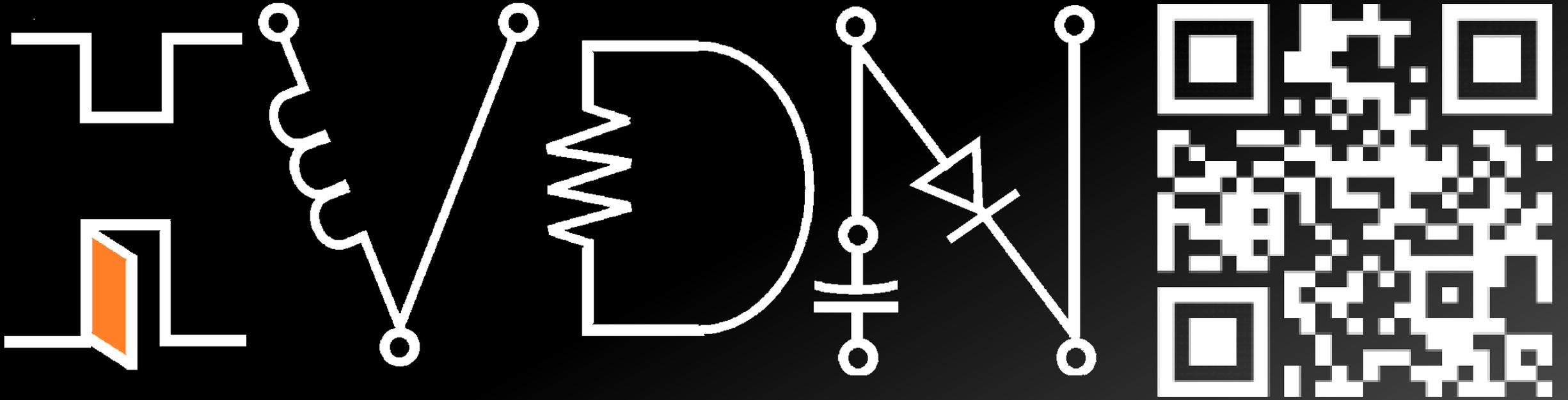
Interesting Project #1 (Pictor)

■ HRPT @ 1698 MHz



Why YOU can do & looking beyond

- Use it  Cheap & Easy....
- Cloudy weather?  Does not matter
- Something new  Applied knowledge
- Wishlist?  Create an RF Telescope Array?



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Radio Astronomy & L Band Spectrum