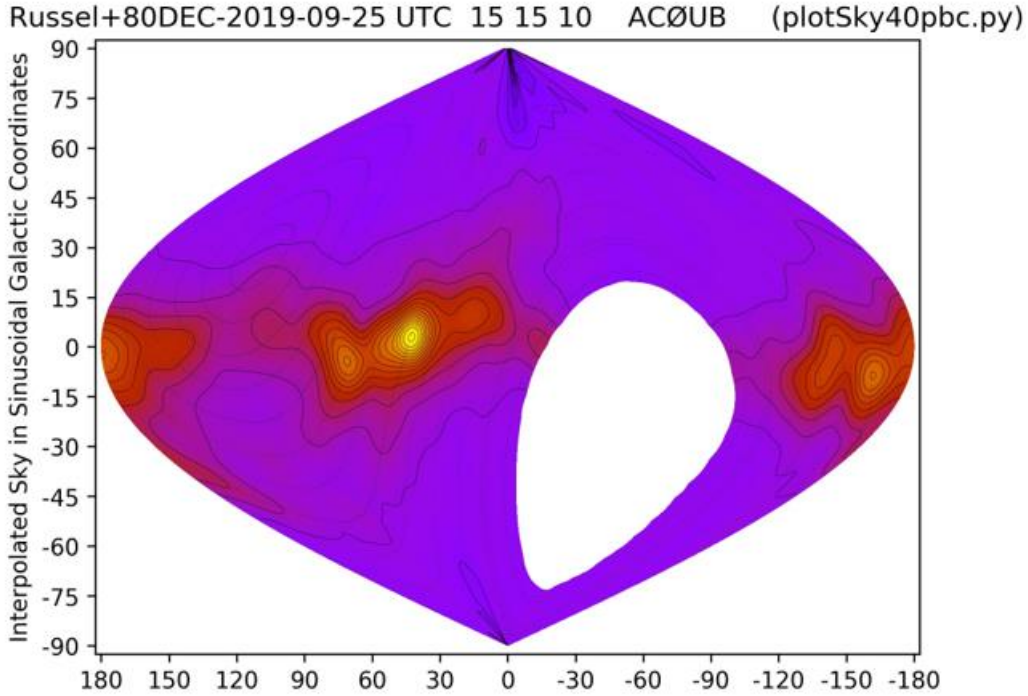
# Deep Space Exploration Society
# Science Meeting




Note the HI emission is along the Galactic equator, and is generally brighter toward the 0,0 Galactic center, Sagittarius A*.

Ted Cline, N0RQV, visualization of AC0UB HI Data

March 22, 2021

Dr. Richard Russel, AC0UB

DrRichRussel@netscape.net

DSES.science

# Information

- 9 ft Dish – Spectracyber running
- SuperSID – Working and porting data to Stanford
- Radio Jupiter – still need to get a new receiver and setup at site
- Pulsar – 408 MHz – Waiting on good weather
- Tropospheric transmission – 1296 MHz feed available
- EME systems – 1296 MHz feed available
- Moon Orbit determination using EME equipment

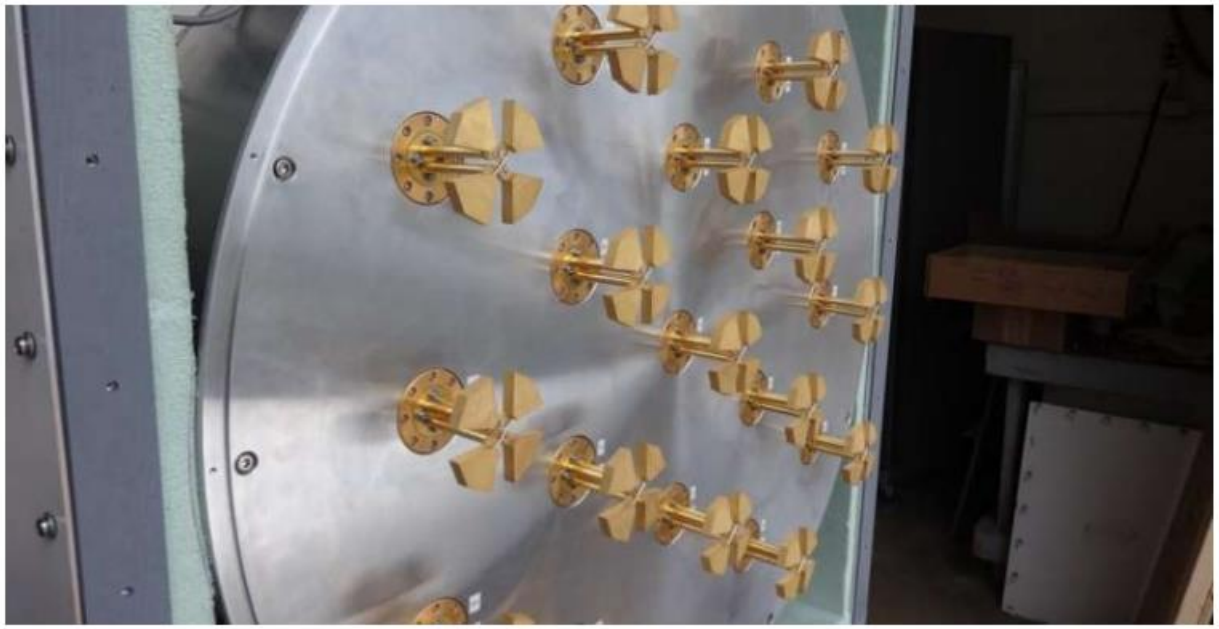
- Don Latham contact with 2$^{nd}$ 60 ft dish

# Greenbank Phased Array feed

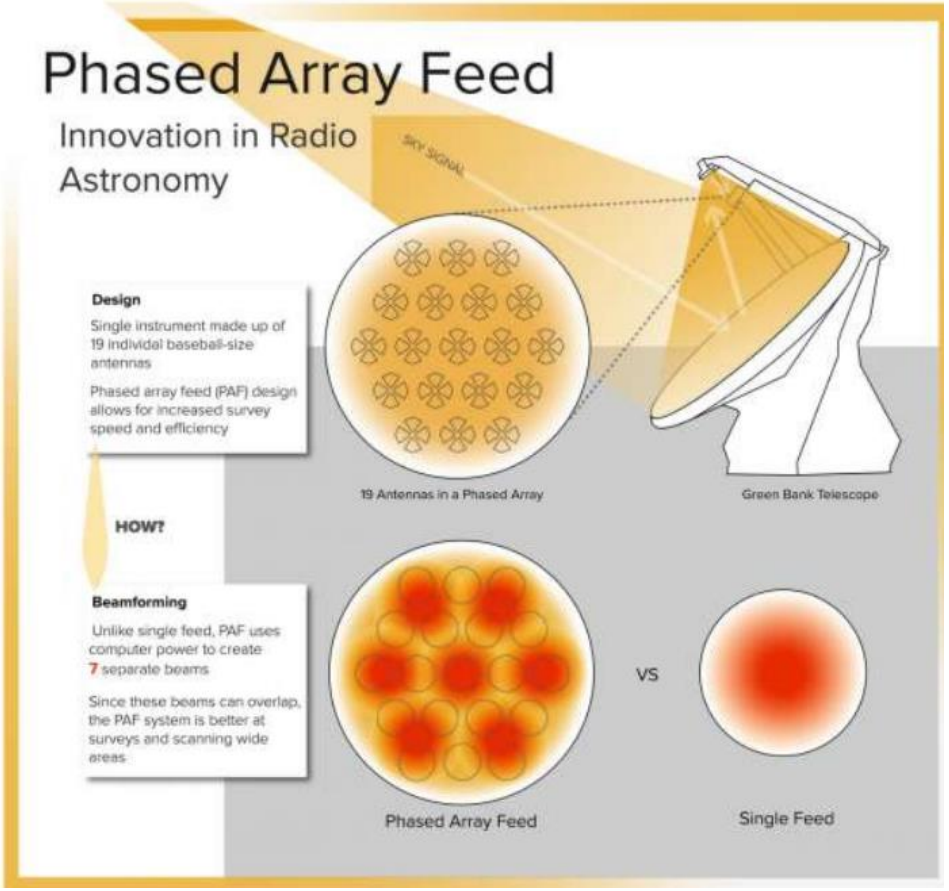
MAY 1, 2018

## Phased array feed imaging system broadens vision for radio astronomy

by National Radio Astronomy Observatory



The 19-element phased array feed developed by the NRAO CDL. Credit: NRAO/AUI/NSF




Source: [www.Phys.org](www.Phys.org)

# Online Radio Astronomy

**There is an intro-level course on radio astronomy**.
https://www.edx.org/course/radio-sky-1

**Also, an intro-level course on plasma physics.**
https://www.edx.org/course/plasma-physics-introduction

**Deep Space Object Astrophotography Part 1** -- ORION 2021 02 17. George Sradnov
https://www.youtube.com/watch?v=Pm_Rs17KIyQ

**A New Radio Telescope for Mexico** - ORION 2021 01 20. Dr. Stan Kurtz
https://www.youtube.com/watch?v=Q9aBWr1aBVc

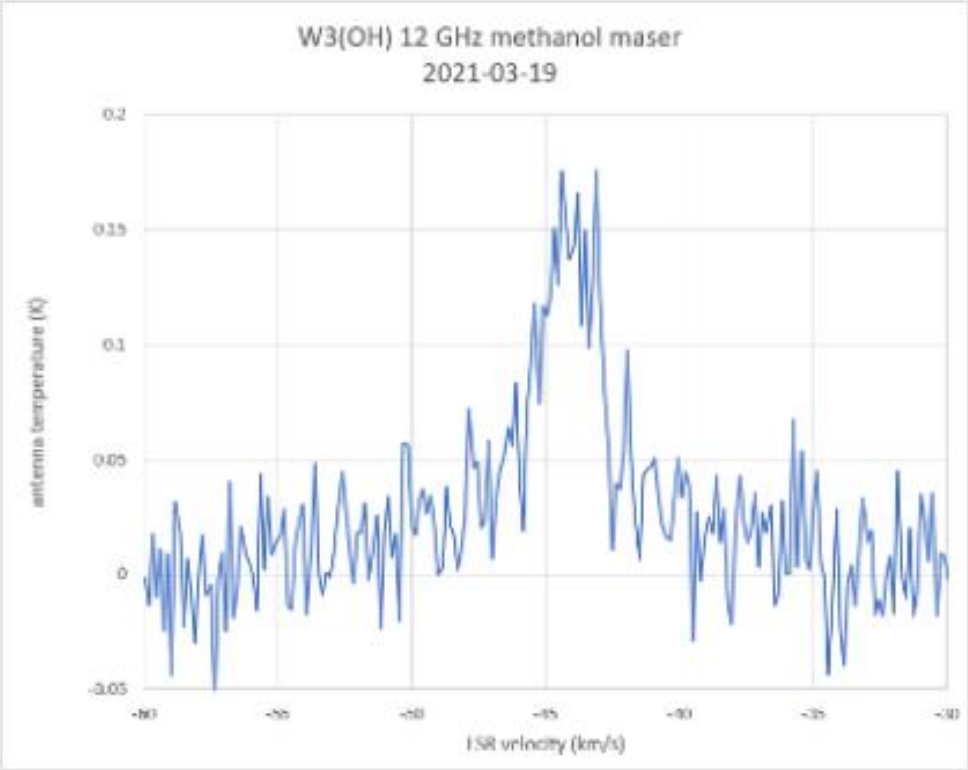
**The Arecibo Radio Telescope; It's History, Collapse, and Future** - ORION 2020.12.16.
Dr. Stan Kurtz, Dr. David Fields
https://www.youtube.com/watch?v=rBZlPOLNX9E

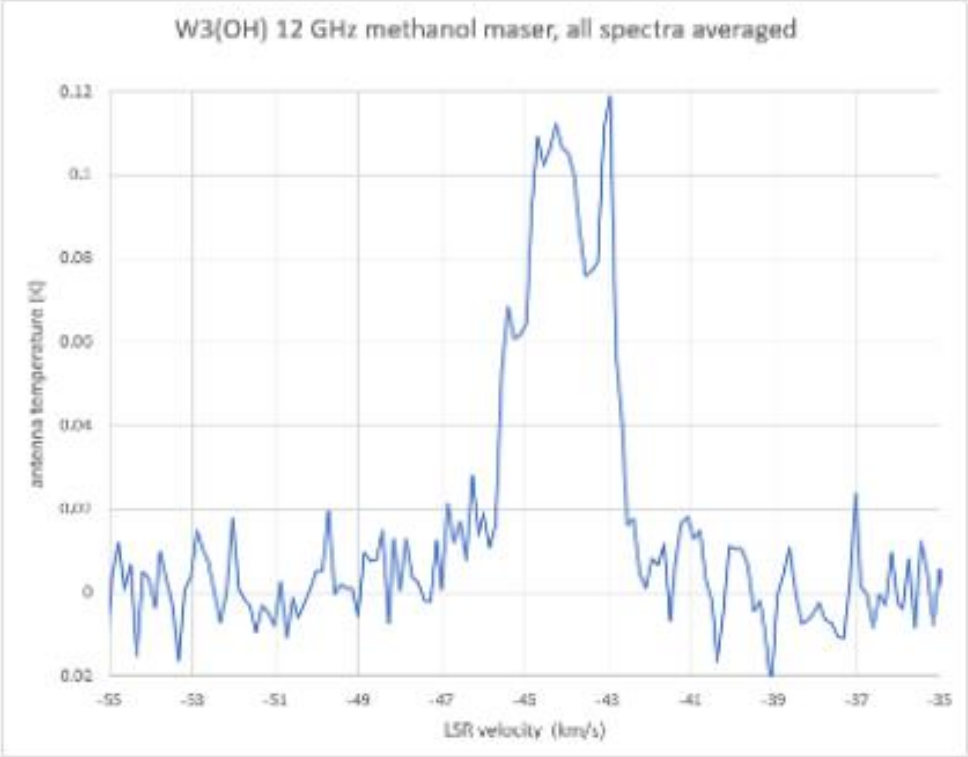
**Exotic Ions and Molecules in Interstellar Space --** ORION 2020 10 21. Dr. Bob Compton
https://www.youtube.com/watch?v=r6cKhp23SUo&t=5s

**The Radio JOVE Project & NASA Citizen Science** – ORION 2020.6.17. Dr. Chuck Higgins
https://www.youtube.com/watch?v=s6eWAxJywp8&t=5s

**Digital Signal Processsing using GNURadio - Fourier Analysis and Radio Astronomy**
Digital Signal Processsing using GNURadio - Fourier Analysis and Radio Astronomy – Digital Signal Processing in Radio Astronomy - Lessons Portal (wvurail.org)

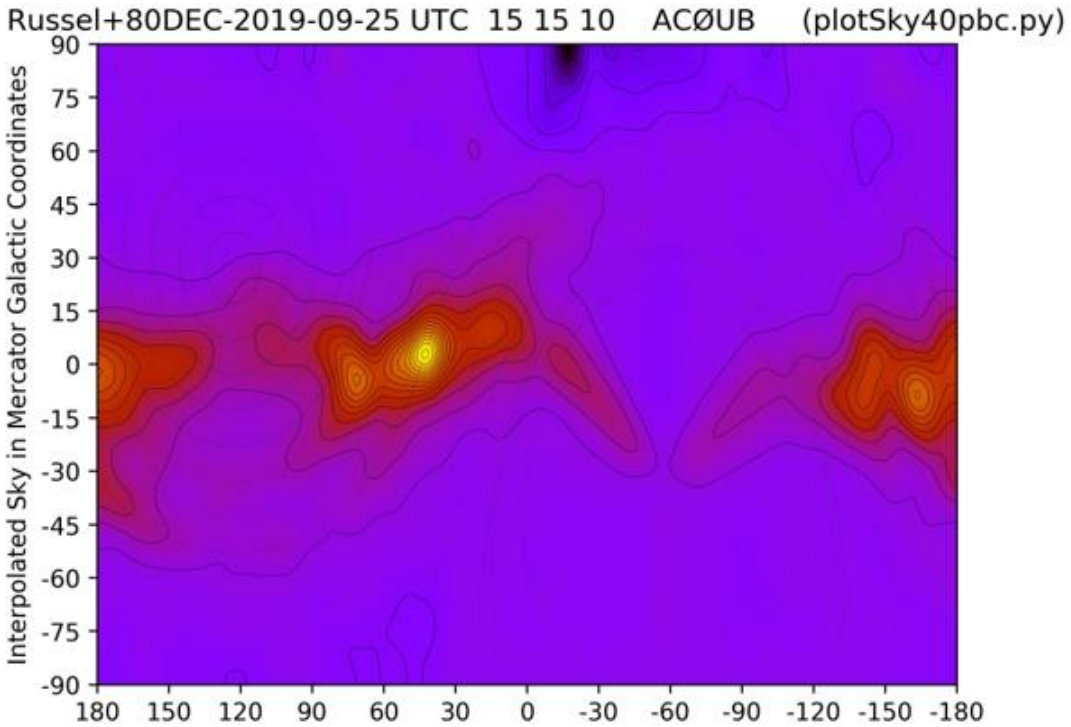
# Observing  a Methanol Maser with a 1.1 m Dish



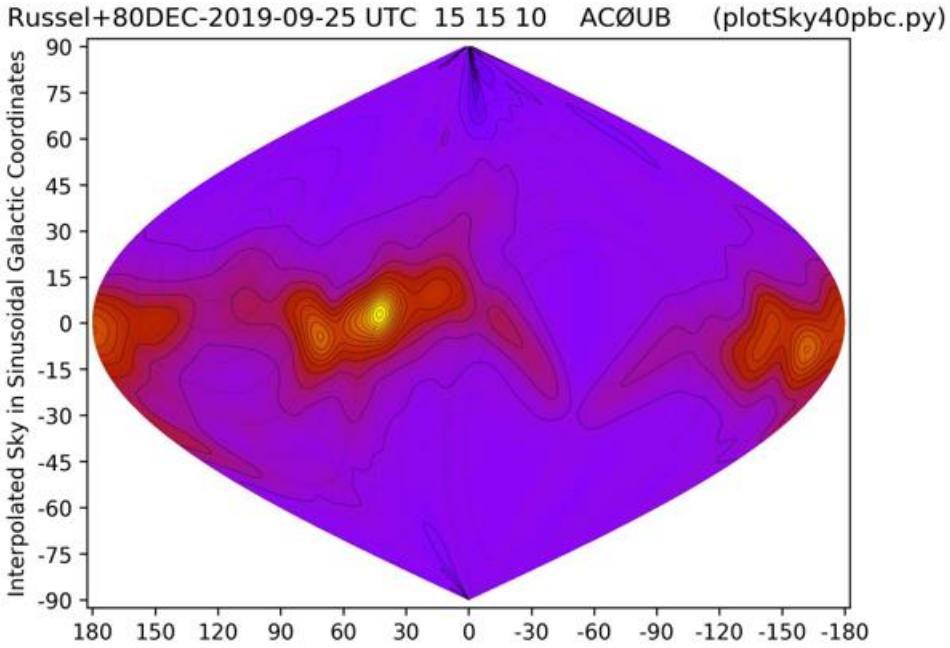




**Eduard Mol** (eddiemol2000@gmail.com)

# Ted Cline (N0RQV) Analysis of HI data

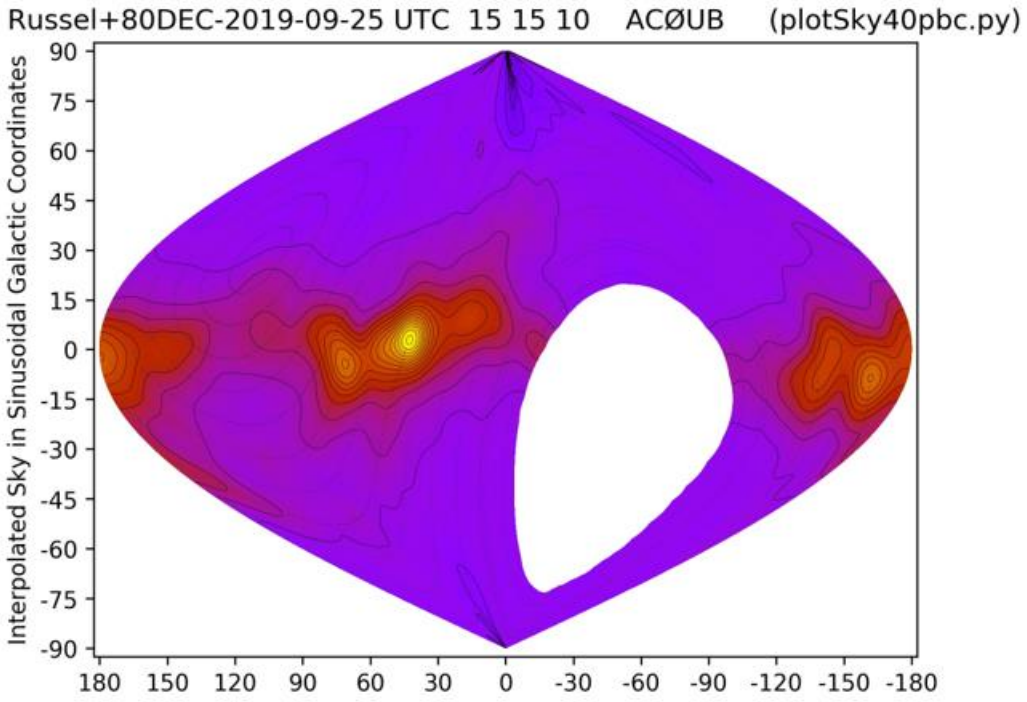



Here is the same (average AntB) data plotted onto a Galactic Sinusoidal Projection,

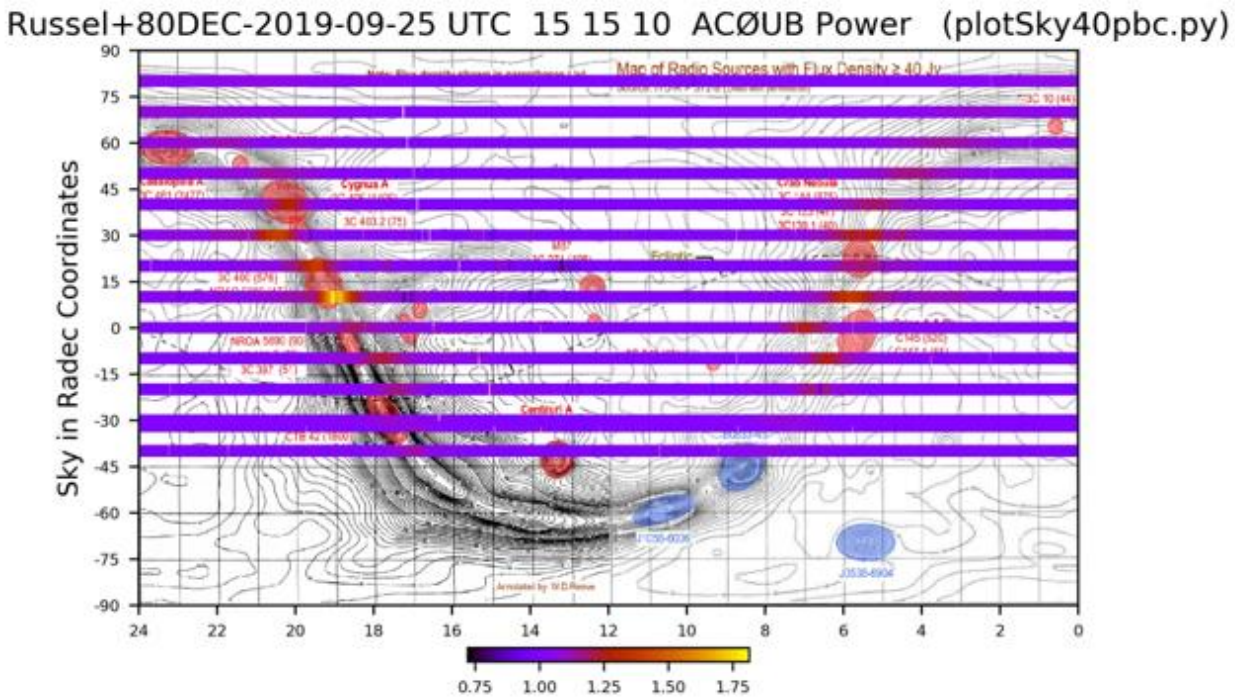



But the AC0UB dish can not see all of the southern sky from its location on earth, at +38.85 degrees latitude. Assuming a level horizon, the dish pointing south can only see down to +38.85 - 90 = -51.15 degrees Declination.

# Ted Cline (N0RQV) Analysis of HI data

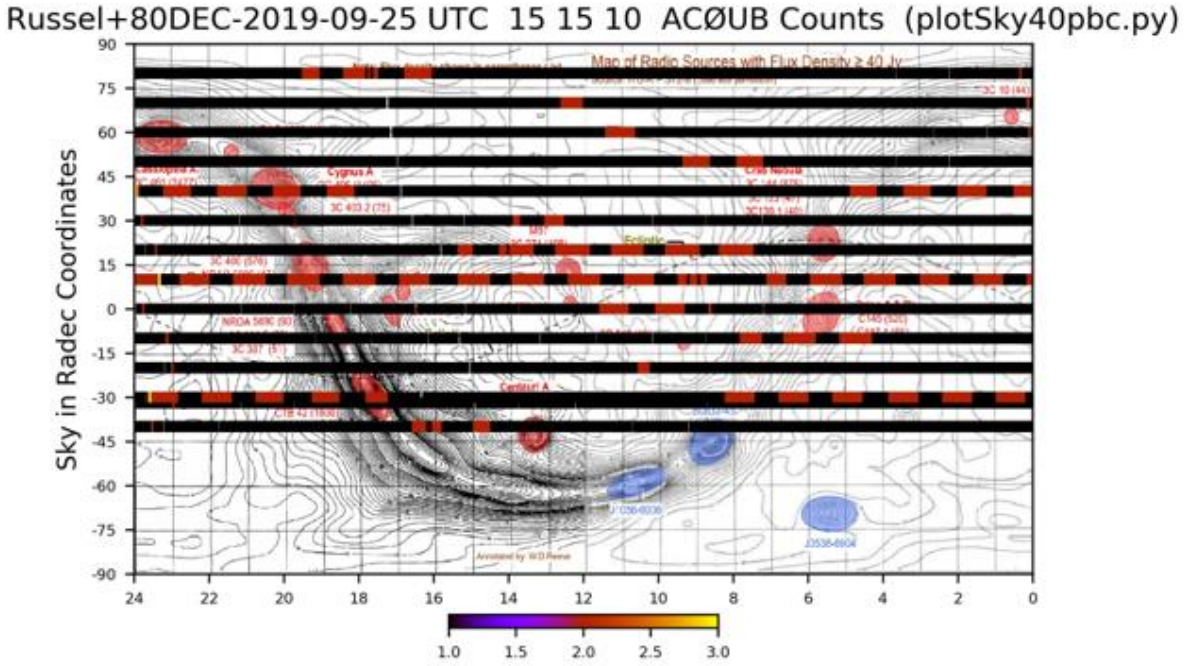



Note the HI emission is along the Galactic equator, and is generally brighter toward the 0,0 Galactic center, Sagittarius A*.

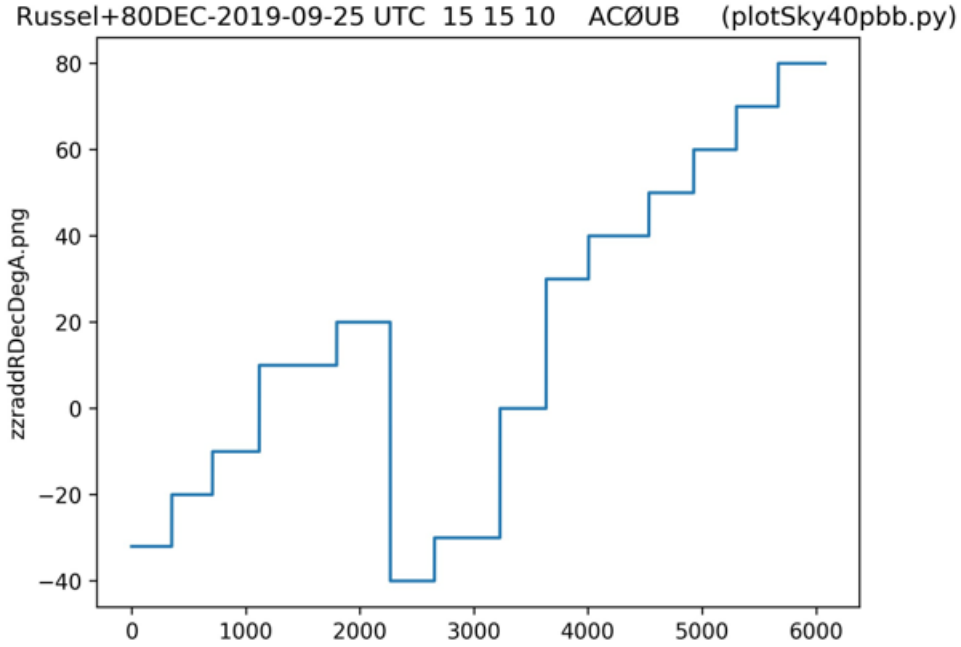



More data is usually better. More data helps to average out the signal noise. Averaging 15 samples is good.

# Ted Cline (N0RQV) Analysis of HI data

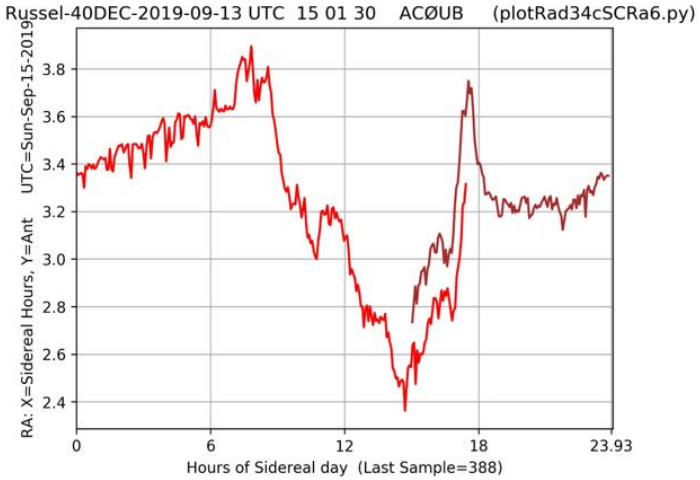


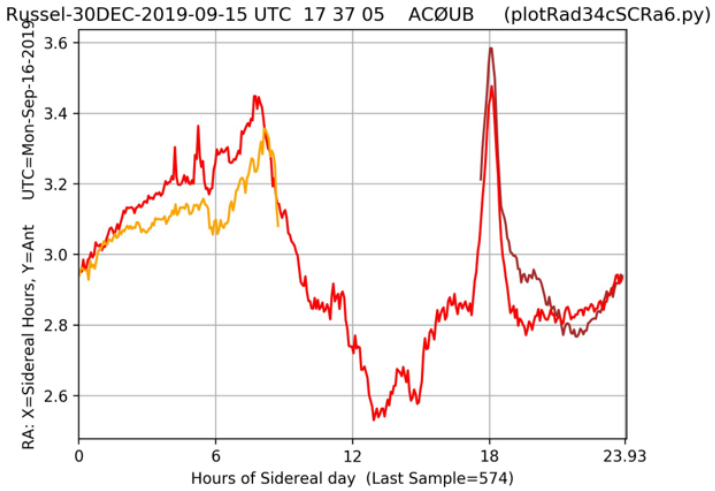

Here is the same data plotted onto RaDec coordinates. The driftscans are represented by horizontal very thin black lines. A Python program interpolates between the driftscan data,

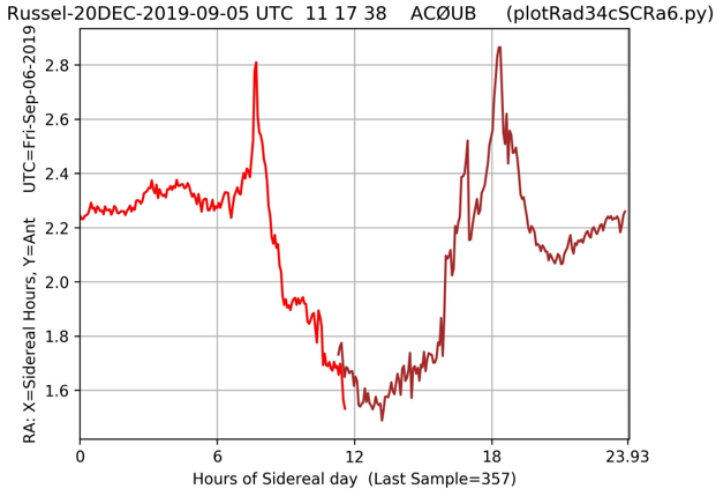


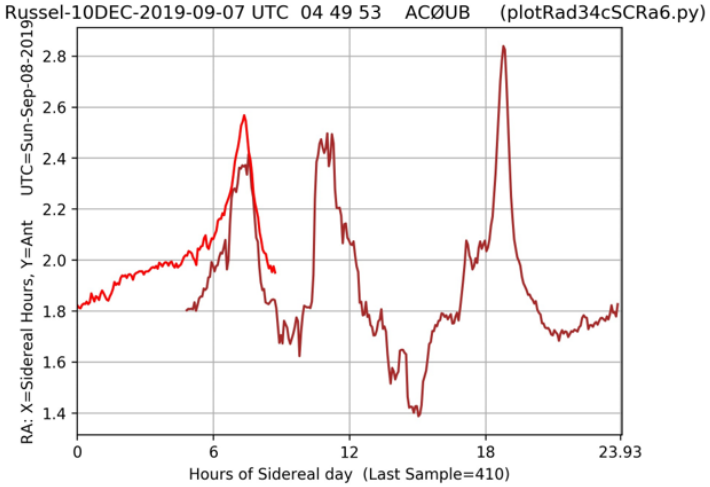

The 6078 sample spectra values varied greatly, but generally the spectrum averages show the rhythm of inner and (weaker) outer Galactic arms passing,

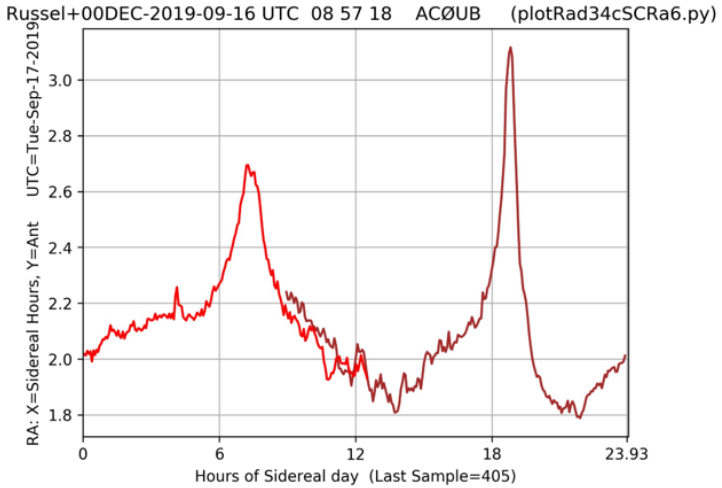
# Ted Cline (N0RQV) Analysis of HI data

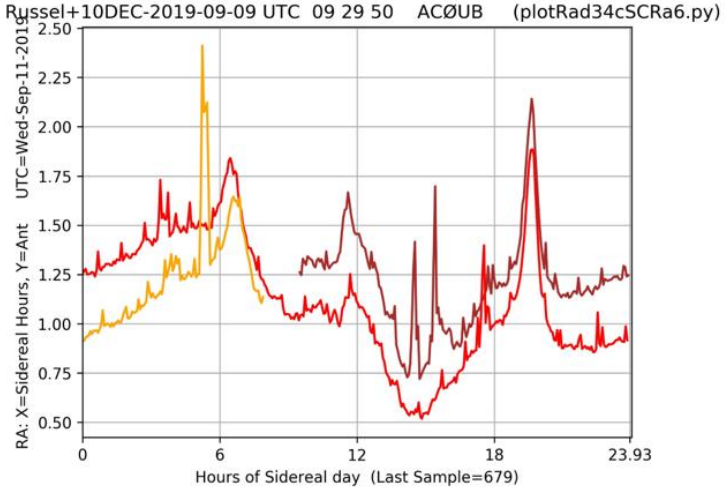


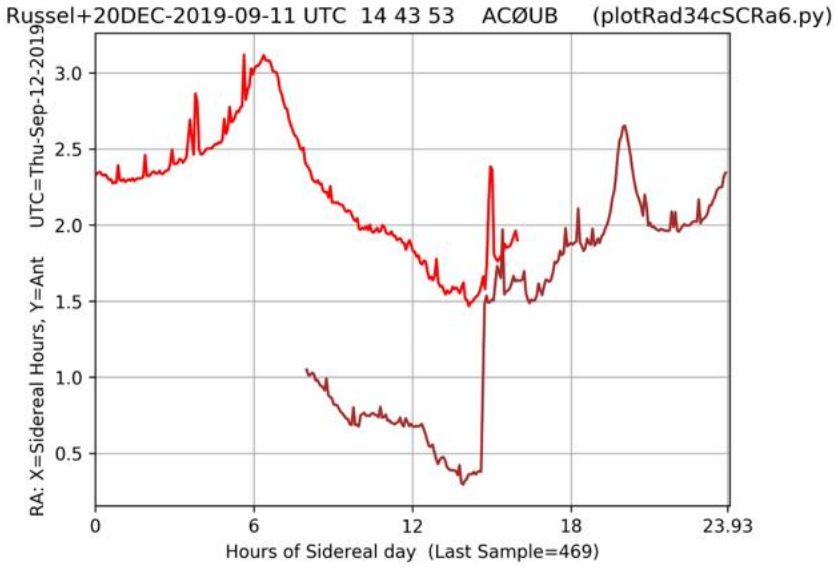



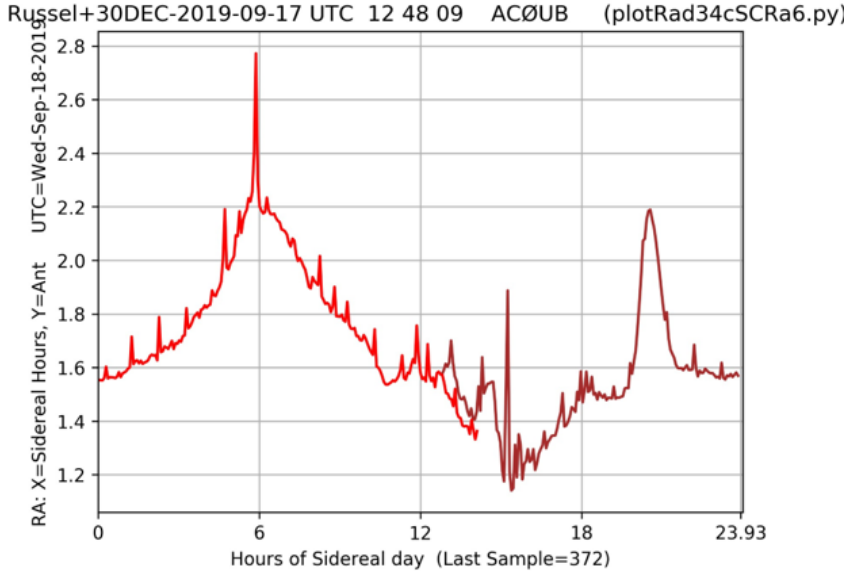



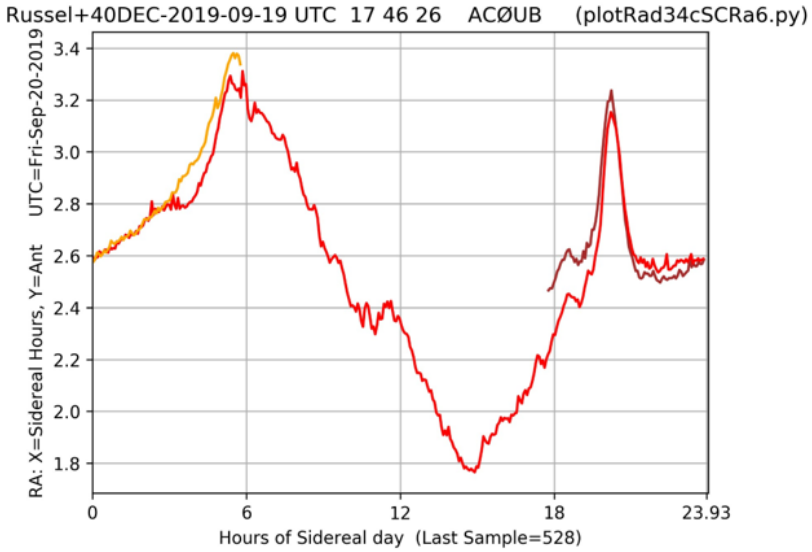



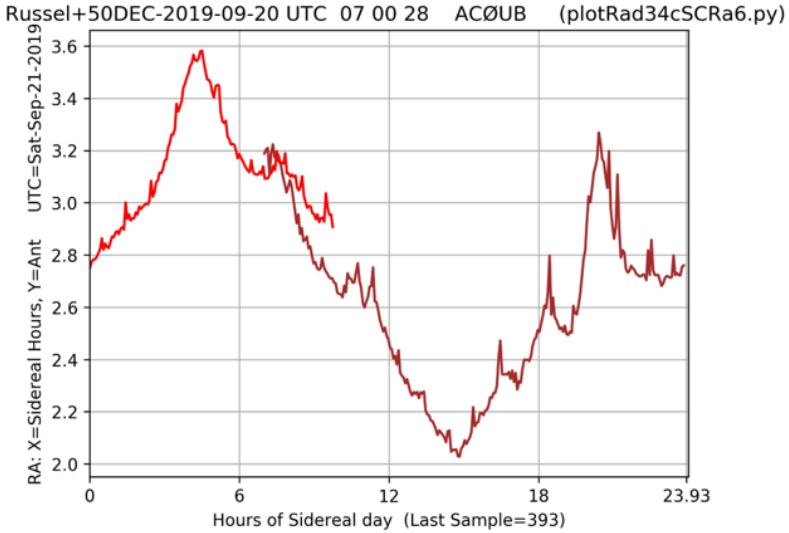



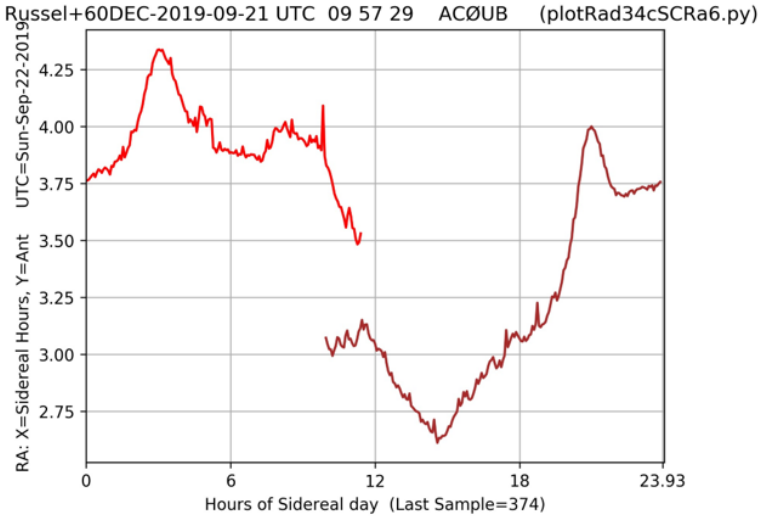
# Ted Cline (N0RQV) Analysis of HI data

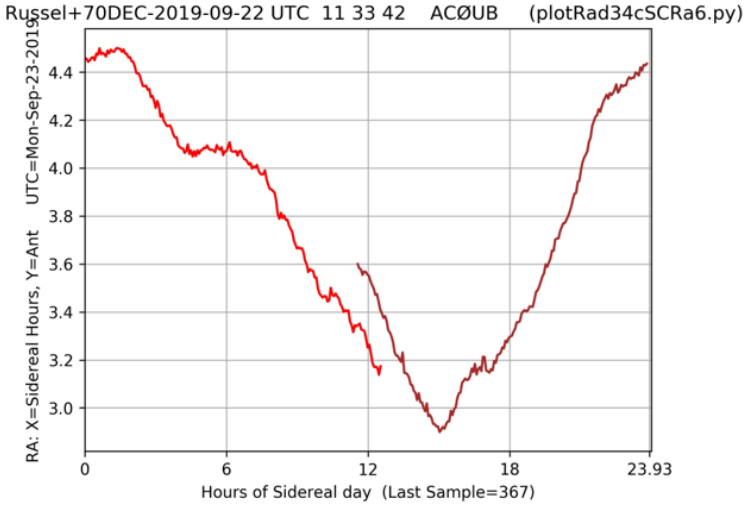


# HAMSCI Presentation

- HamSCI 2021 Program | HamSCI https://hamsci.org/about-hamsci
- RBN - Reverse Beacon Network http://beta.reversebeacon.net/main.php
- uscranton (iPosterSessions - an aMuze! Interactive system)

# About HAMSCI

## Motivation

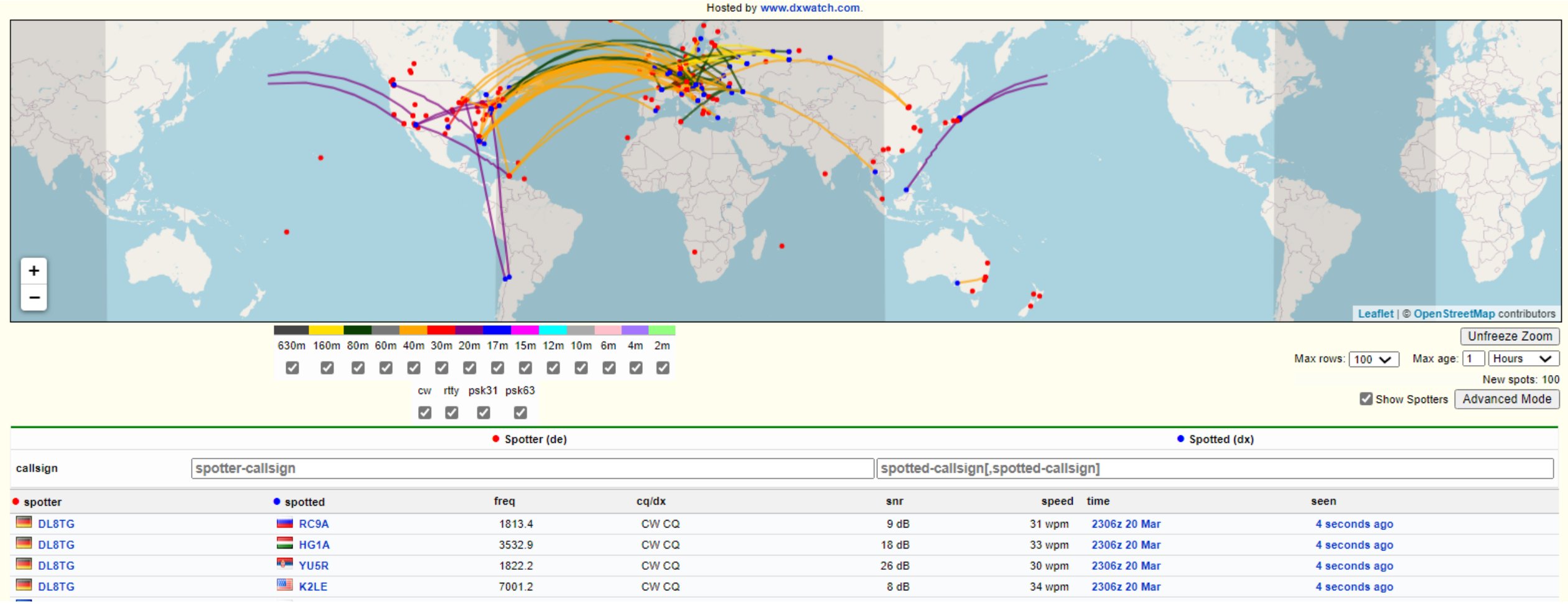
Since the beginning of the United States amateur radio service in 1912, amateur radio operators have made significant contributions to radio technology and the understanding of radio science. This work must be continued today, as Part 97 of the FCC rules states that a primary purpose of the amateur radio service is the "Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art." Recent advances in the fields of computing, software defined radio, and signal processing provide unprecedented opportunities to meet this mandate, specifically in the field of radio science. These opportunities are already beginning to be realized with the advent of systems such as the **Reverse Beacon Network** (RBN), the **Weak Signal Propagation Reporting Network** (WSPRNet), and **PSKReporter**. In addition, enabling amateurs to make and contribute legitimate scientific observations will expose amateur radio to a wider community of people interested in science around the world.

## What is HamSCI?

HamSCI, the Ham Radio Science Citizen Investigation, is a platform for the publicity and promotion of projects that are consistent with the following objectives:

- Advance scientific research and understanding through amateur radio activities.
- Encourage the development of new technologies to support this research.
- Provide educational opportunities for the amateur community and the general public.

# Reverse Beacon Network




http://beta.reversebeacon.net/main.php

# HAMSCI Poster Session 3-20-21

## The use of the Sudden Ionospheric Disturbance Radio Telescope to predict the signal and observe the North American 2017 Total Solar Eclipse

Richard A. Russel
AC0UB
Society of Amateur Radio Astronomers
Deep Space Exploration Society

### SuperSID Solar Flare Detections

Author's SuperSID System

The sudden ionospheric disturbance (SuperSID) monitor measures the signal strength of a very low frequency (VLF) broadcast station after its signal is reflected off of the ionosphere. The characteristics of the signal strength is highly dependent on the local night and day. The Sun's energy ionizes

OPEN

### North American 2017 Solar Eclipse

The North American 2017 Eclipse was going to pass between the authors SuperSID station and the VLF transmitter.

### Predicting the SuperSID Eclipse Response

The following analysis was conducted before the eclipse.

A geometric analysis was conducted to determine the effect of the moon transitting the sun.

Sun and Moon Eclipse Geometry


For the eclipse, a close approximation can be made that the apparent diameter of the Sun and Moon are the same.

The area of A1 is the area of arc segment abc with the triangle abc removed. The formulas for these are shown below.

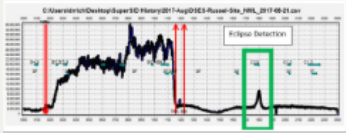
$$Area\ Arc\ abc = \frac{\theta}{360}\pi r_m^2$$

The basic geometry is shown using the following triangle.

### Eclipse Measurement Results and Review Questions

The eclipse was measured with the author's SuperSID radio telescope.

August 21, 2017 SuperSID Eclipse Measurement

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### Summary

- An eclipse can be measured using the variation of ionospheric changes that are similar to the normal sunrise and sunset variations.
- The SuperSID radio telescope is sensitive enough to observe an eclipse if the geometry of the transmitter - receiver and the eclipse path is favorable
- An eclipse signal can be predicted using basic geometry and historic sunrise and sunset historical data.

### Prediction Summary

- The beginning of the eclipse has a slow increase in signal rate until full eclipse – both models correspond to the rise
- The historic data model assumes the end of the eclipse equates to the

https://hamsci2021-uscranton.ipostersessions.com/?s=49-22-13-0F-3A-3B-0A-84-E0-67-13-10-47-91-30-7C

# 2021 Observation/ Feed Schedule

- March 2021
  - 408 MHZ Feed for pulsar observations
  - 1296 MHz if EME team wants it
- April 2021
  - 408 MHZ Feed for pulsar observations
  - 1296 MHz if EME team wants it
- May 2021
  - 1st 2 week Skip Crilly Feed Science
  - 408 MHZ Feed for pulsar observations
  - 1296 MHz if EME team wants it

# Questions?