



radiojove.gsfc.nasa.gov

The Radio Jove Project

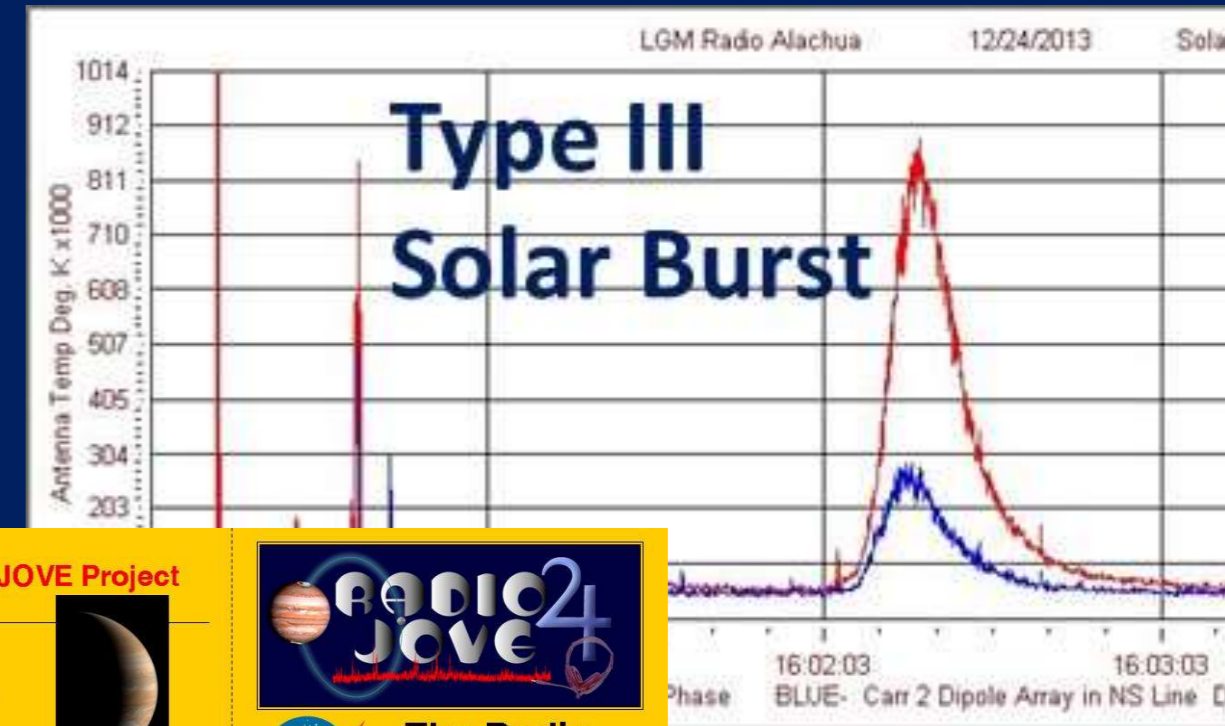


Chuck Higgins

Middle Tennessee State University, Murfreesboro, TN

Goals:

- Citizen Science via radio astronomy and space physics
- Science literacy with NASA education partners (NSSEC) doing outreach, lessons, and projects
- Provide a hands-on experience in radio astronomy
- Enable access to Online observatories and real data
- Facilitate the exchange of data and ideas



The Radio JOVE Project

JOVE Team

- NASA
- Raytheon
- University of Florida
- RF Associates
- The INSPIRE Project, Inc.
- Radio-Sky Publishing
- U. of Hawaii, Windward Community College
- Kochi National College of Technology

For More Information

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

<p>Dr. Jim Thieman NASA-GSFC Code 690.1 Greenbelt Maryland 20771 (301) 286-9790 thieman@nssdc.gsfc.nasa.gov</p>	<p>Dr. Chuck Higgins Dept. of Physics & Astronomy Middle Tennessee State University, P.O. Box 71 Murfreesboro, TN 37132 (615) 898-5946 higgins@physics.mtsu.edu</p>
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The Radio JOVE Project

Learning Science by Observing and Analyzing Radio Signals from Jupiter, the Sun and our Galaxy

Radio JOVE Team

Conceived in 1997, began in 1999

Team Members

Jim Thieman (NASA Goddard Space Flight Center)
Chuck Higgins (Middle Tennessee State University)
Dick Flagg (RF Associates, LLC)
Jim Sky (Radio-Sky Publishing)
Leonard Garcia (QST, Inc., GSFC)
Jim Gass (Raytheon Corp.)
Francisco Reyes (U. of Florida)
Wes Greenman (U. of Florida, Retired)
Kazumasa Imai (Kochi National Coll. of Tech., Japan)
Jim Brown (HNRAO, Pennsylvania)
Larry Dodd (Jasper, GA)

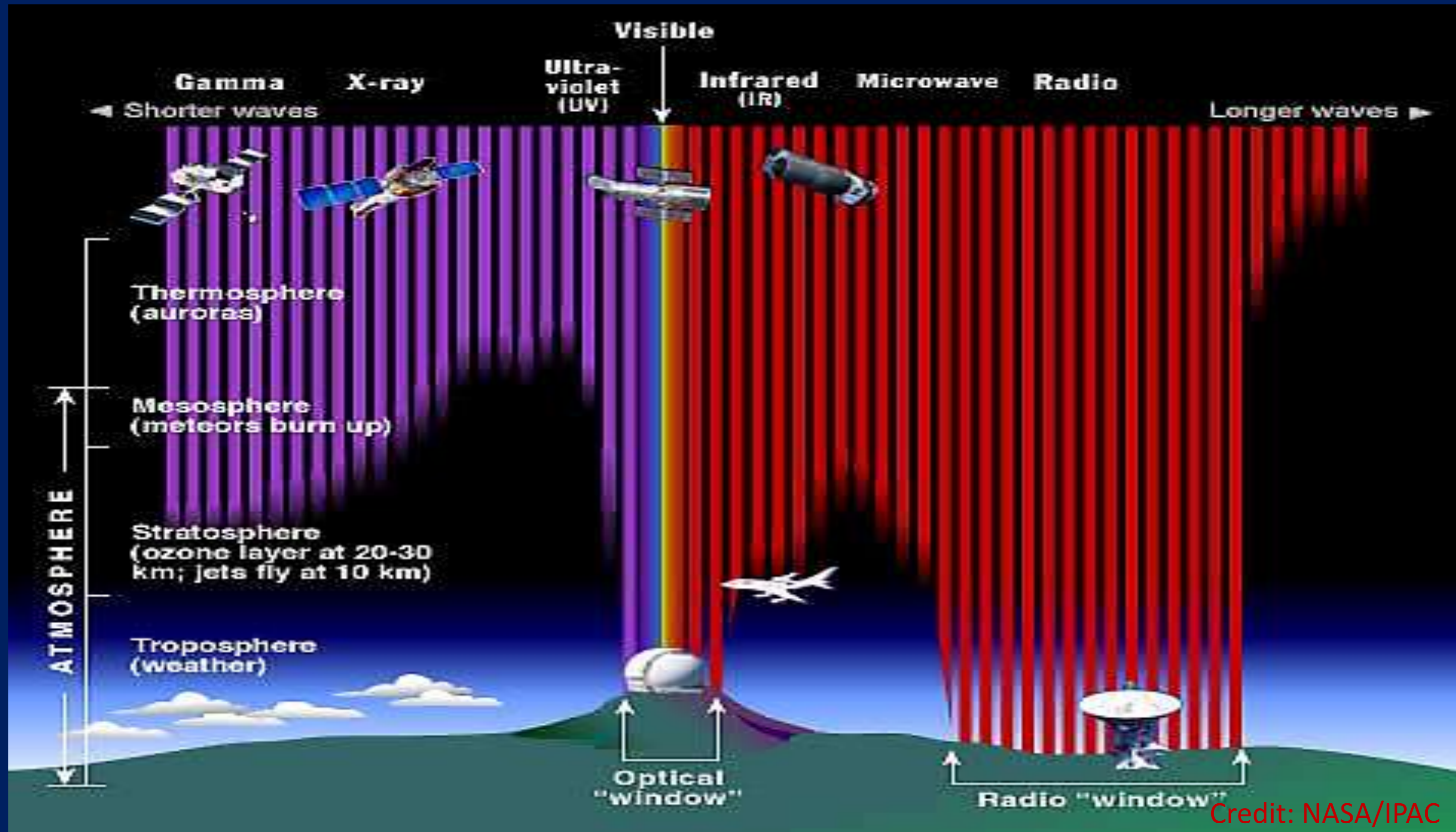
Society of Amateur Radio Observers (SARA)



NASA, GSFC, 1999

Radio Astronomy

– the study of radio waves originating outside Earth's atmosphere





Radio Jove Participants



- Citizen Scientists
- Interested amateurs
- High Schools
- Colleges & Universities



70 Countries have participated in Radio Jove
More than 2300 kits sold

Hardware and Software



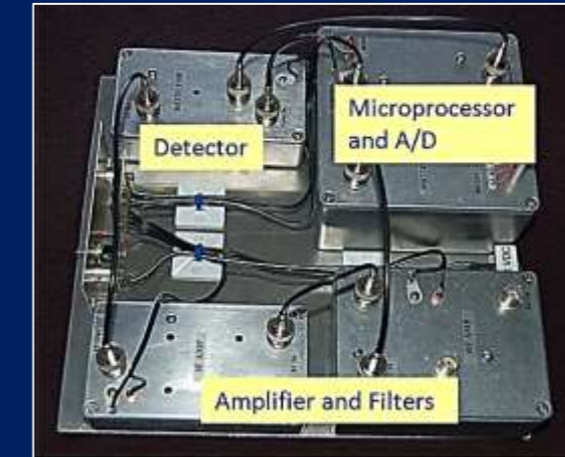
Radio Jove
20 MHz Receiver



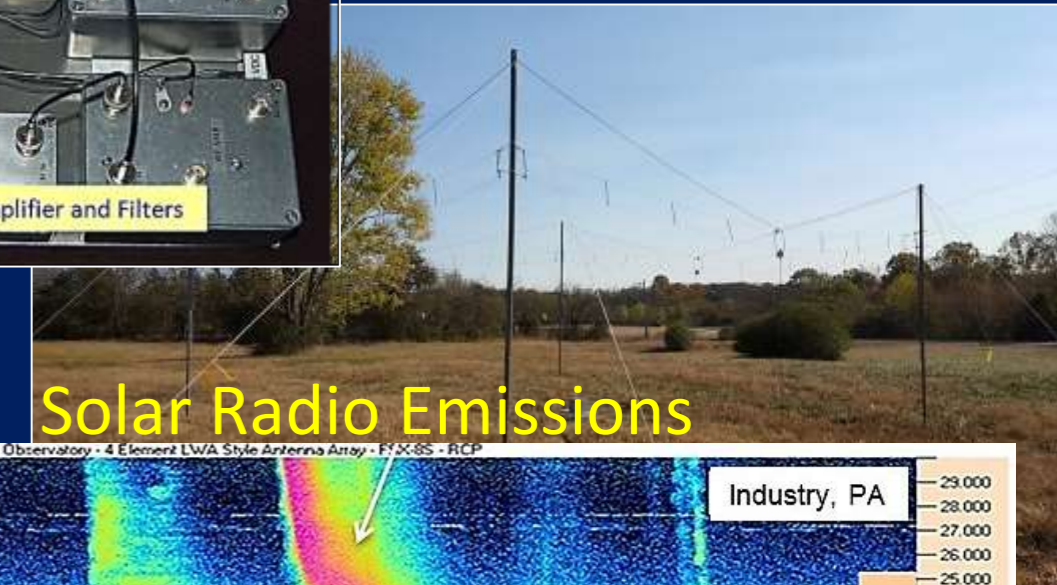
Dual Dipole
Antenna



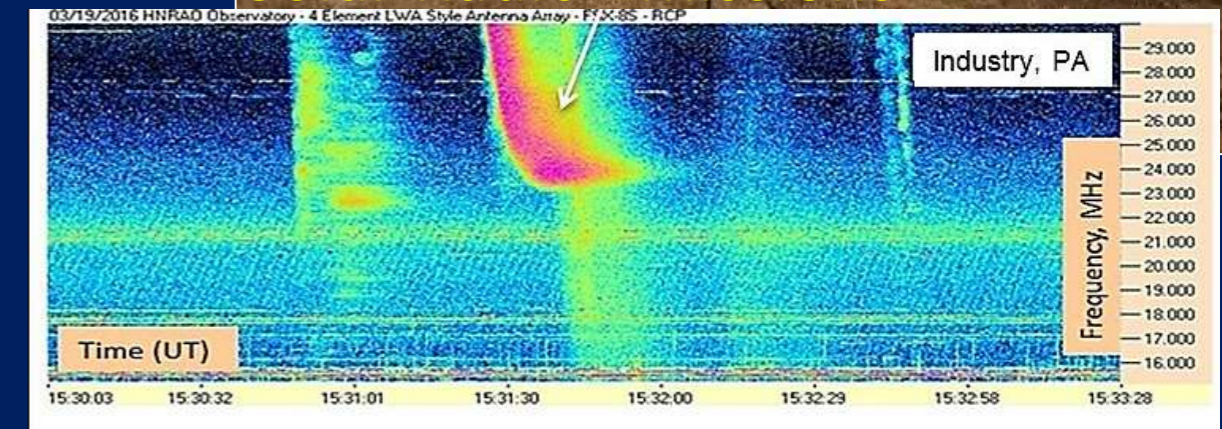
- You build it
- You operate it
- You collect data
- You analyze data
- You archive data
- You do science



Spectrograph and
Wide Band Antenna



Solar Radio Emissions

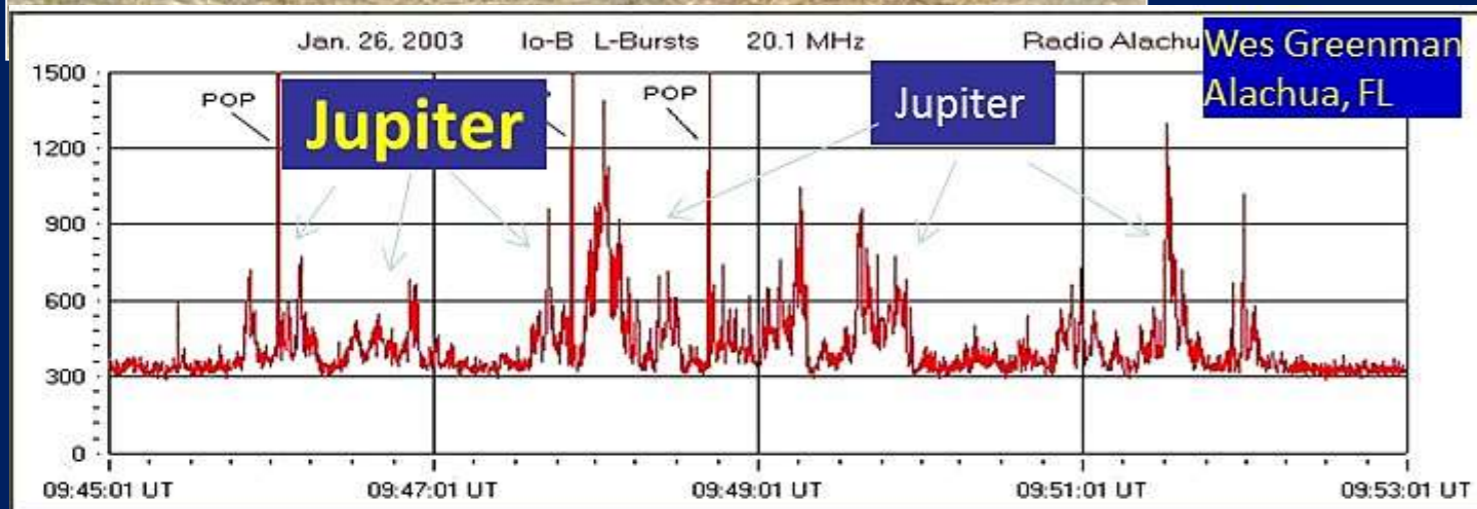


Basic System

- 20 MHz Receiver
- Dipole Antenna
- Recording and Analysis Software
- \$300 + computer

Observing Software from Radiosky.com Advanced Systems

- 15-30 MHz Radio Spectrograph
- Software Defined Radio (SDR)
- Wide band antenna
- Spectrograph Software
- \$2000 + computer



Observing Software from Radiosky.com



Space Science Education Partners



Partner #1. NASA Space Science Education Consortium (NSSEC)

- 26 Space Science Education Partners
- Collaborate in Education and Public Outreach

Partner #2. Citizen Scientists

- 11 spectrograph stations established in the USA
- Jupiter/Solar radio emissions, ionosphere, and space weather
- + Society of Amateur Radio Astronomers (SARA)



Partner #3. Juno Mission

- Support the Juno Mission with observations
- Collaborate with professional radio observatories



Partner #4. Worldwide Data Archives

- NASA-Planetary Data System (PDS)
- Virtual Wave Observatory (heliophysics wave data)
- VESPA – Virtual European Solar and Planetary Access

Radio JOVE Archive Calendar

Radio JOVE Homepage [Return to Welcome Page](#)

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[<-- previous month](#) [next month -->](#)

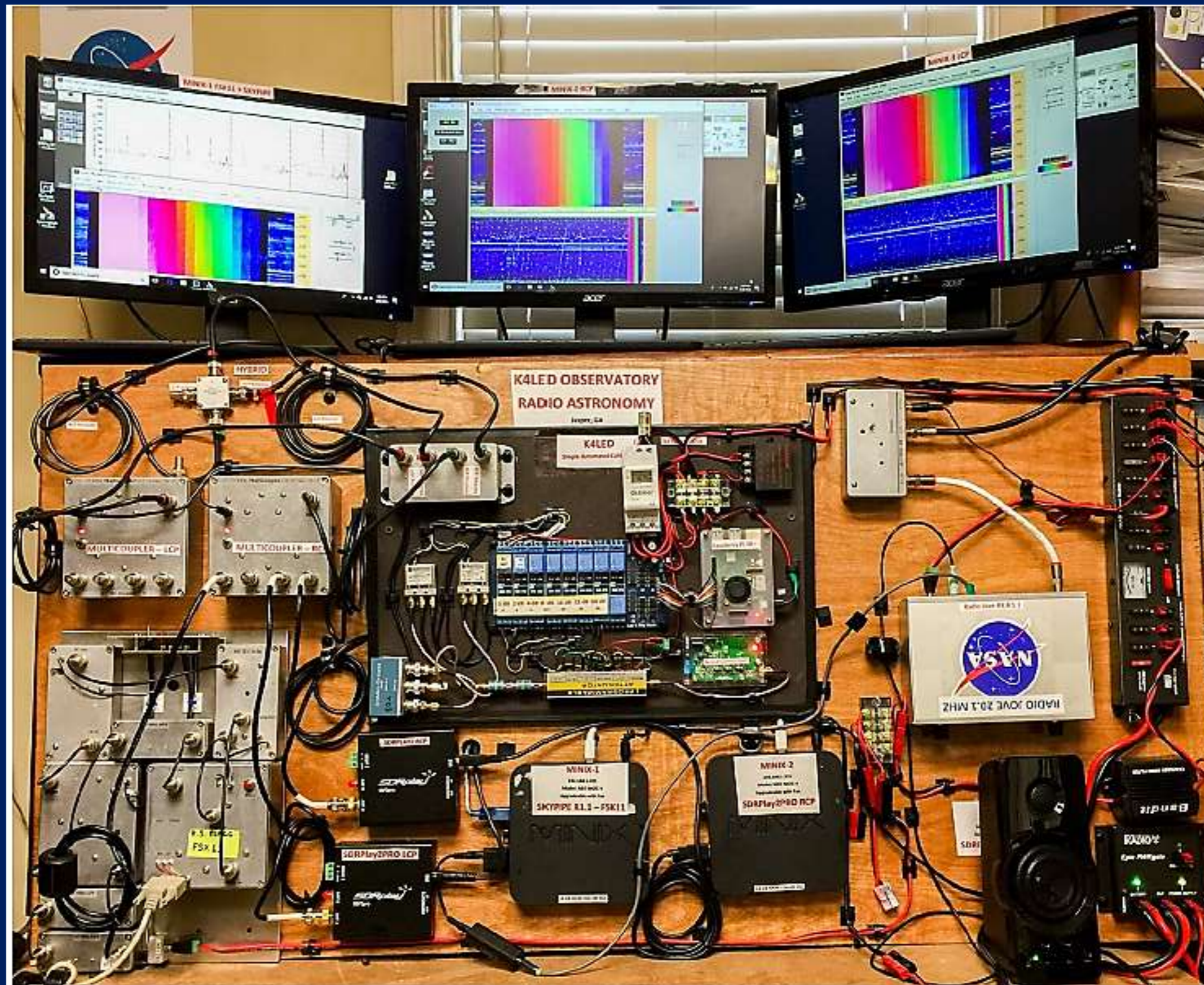
May 2019						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 ☀ Sun	2	3	4
5 ☿ Galactic Background	6 ☿ Galactic Background ☀ Sun	7 ☀ Sun	8	9	10 ☿ Galactic Background	11
12 ☿ Galactic Background	13	14	15	16	17	18
19	20	21	22	23 ♃ Jupiter	24	25
26	27	28	29 ☿ Galactic Background	30 ☿ Galactic Background ♃ Jupiter	31 ☿ Galactic Background	



Research and Projects

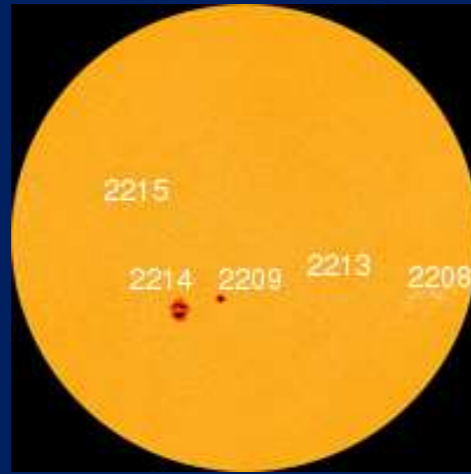


Larry Dodd
K4LED
Georgia Amateur Radio
Astronomy Observatory
Location: Lat. 34.42322 N,
Lon. -84.49413 W
Jasper, GA 30143

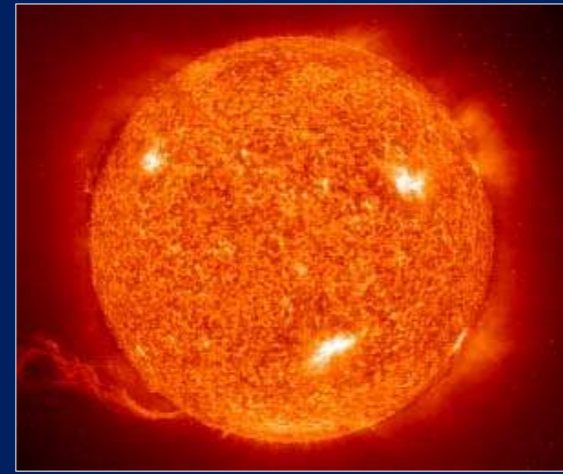


Radio Sun

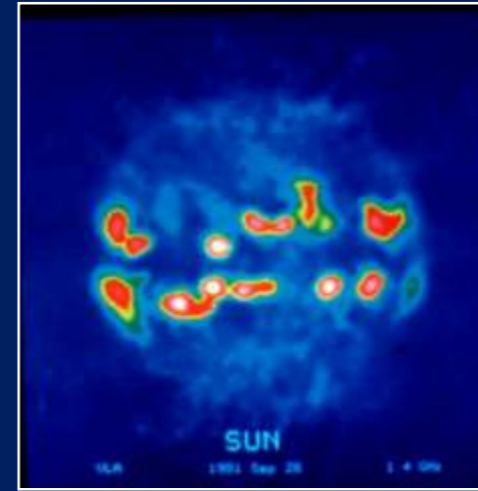
Optical



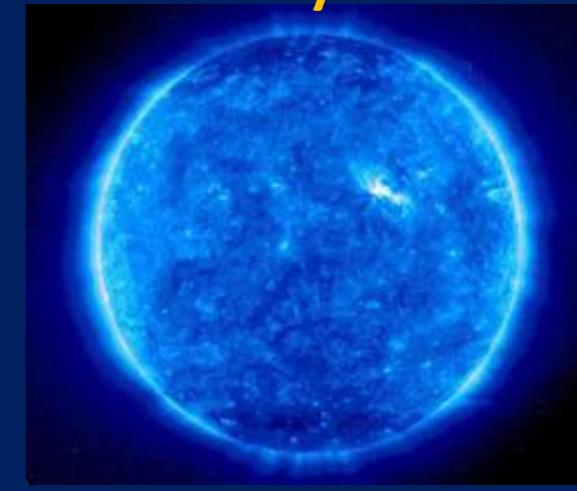
H-alpha



Radio



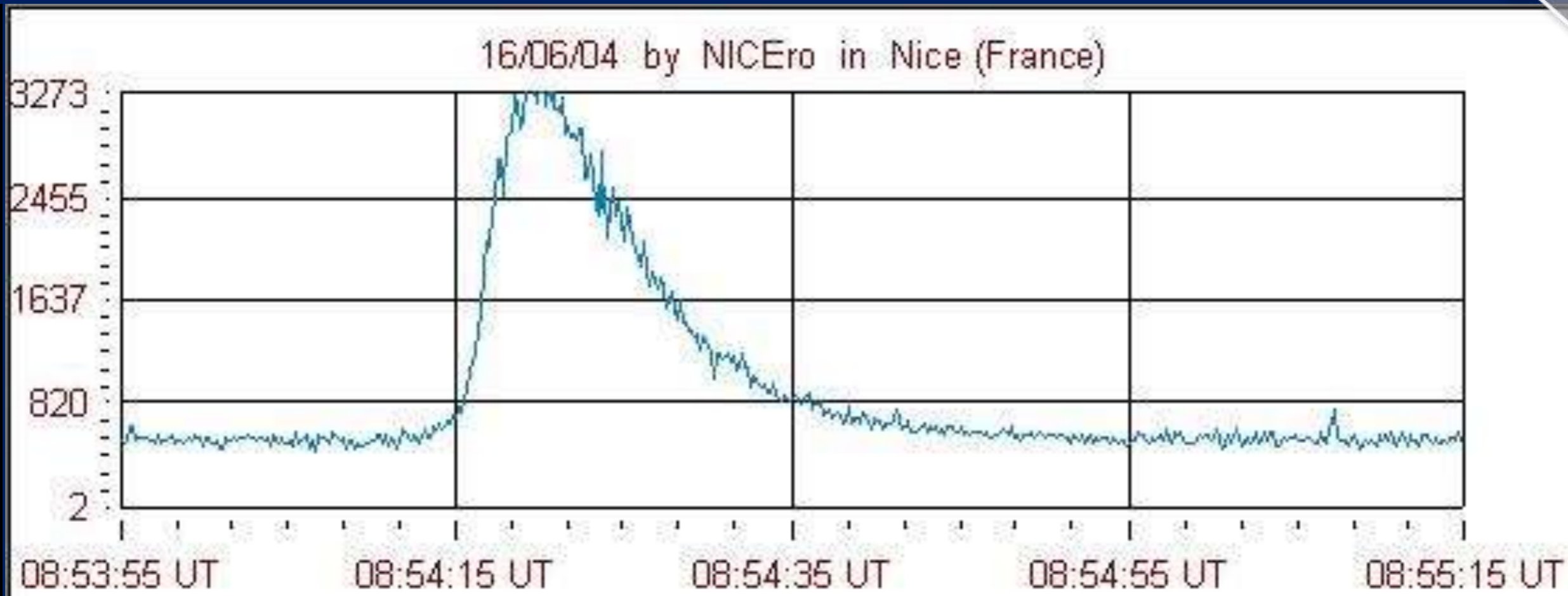
X-ray



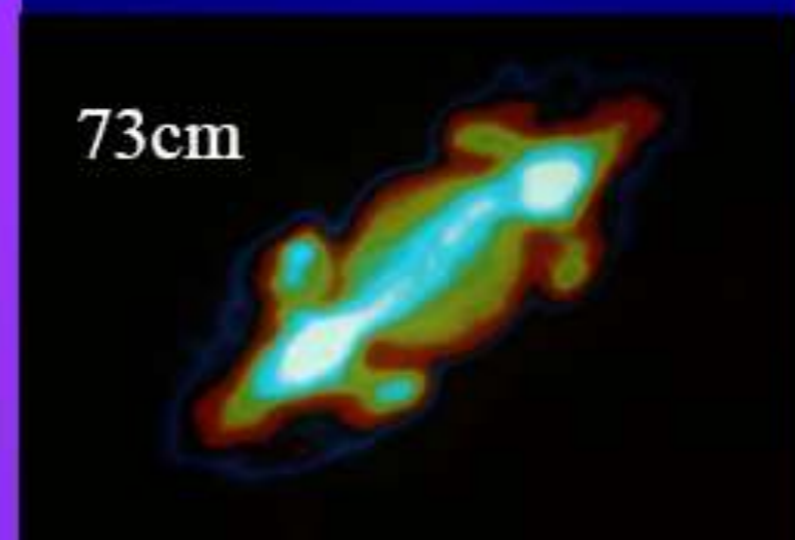
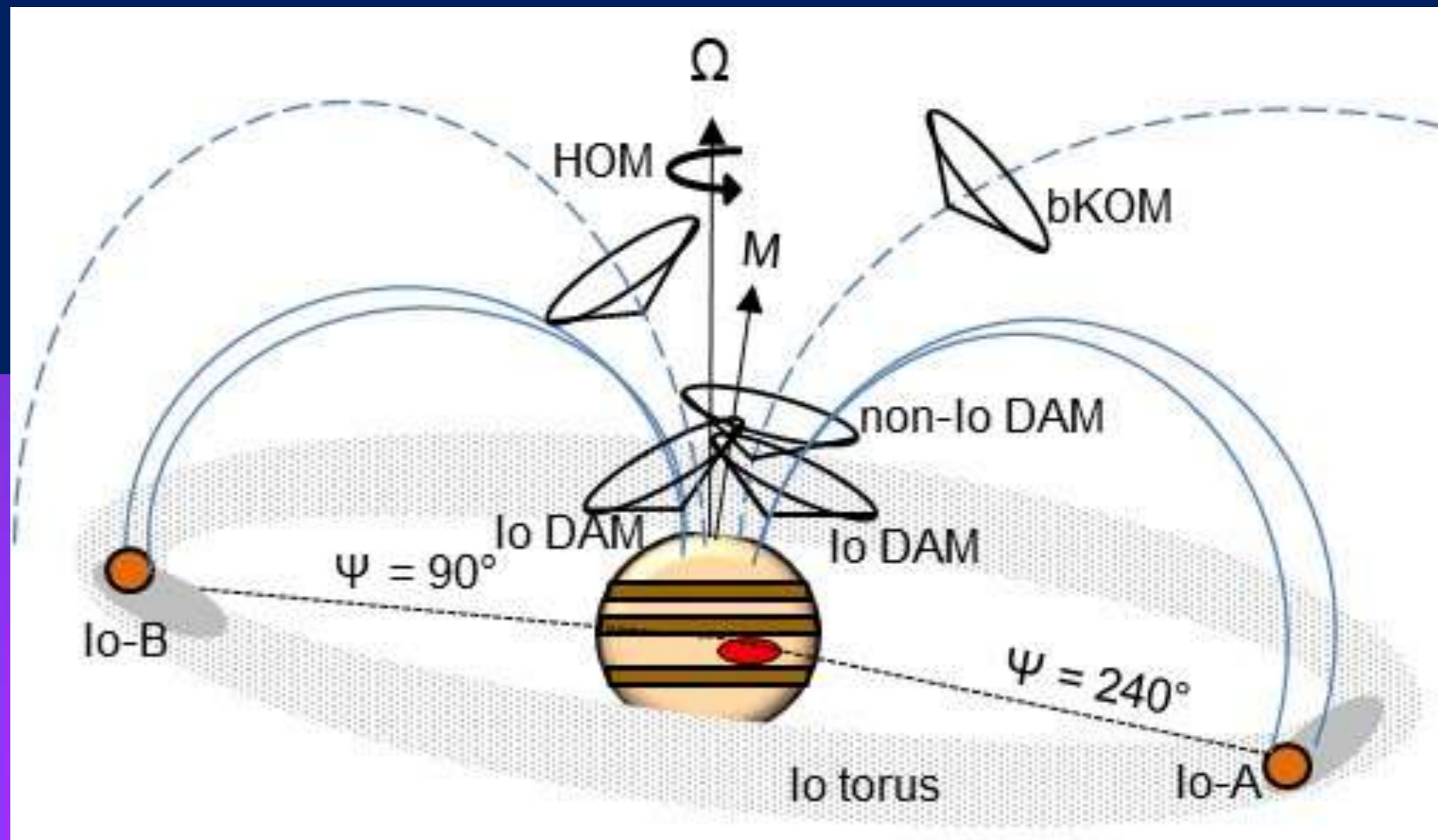
Solar Radio Burst – notice the sharp rise and the gradual decline of the burst. This is typical of Type III solar bursts.



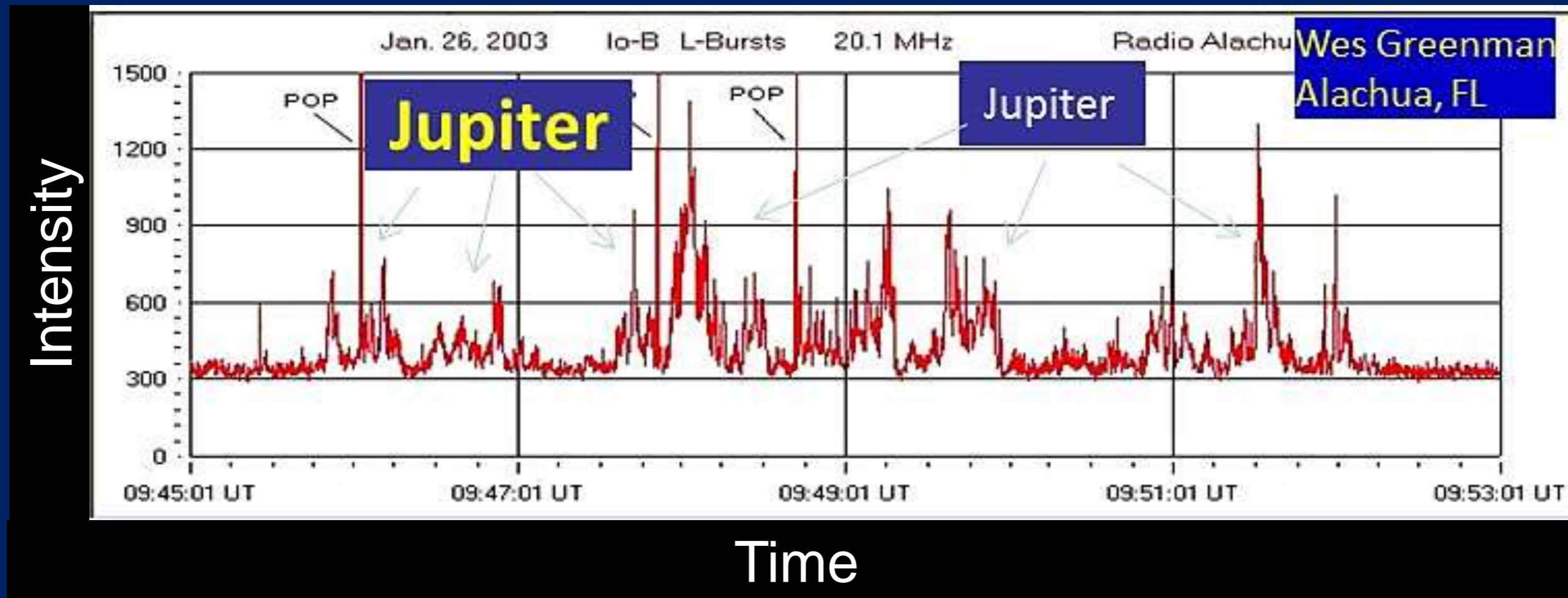
Intensity



Jupiter



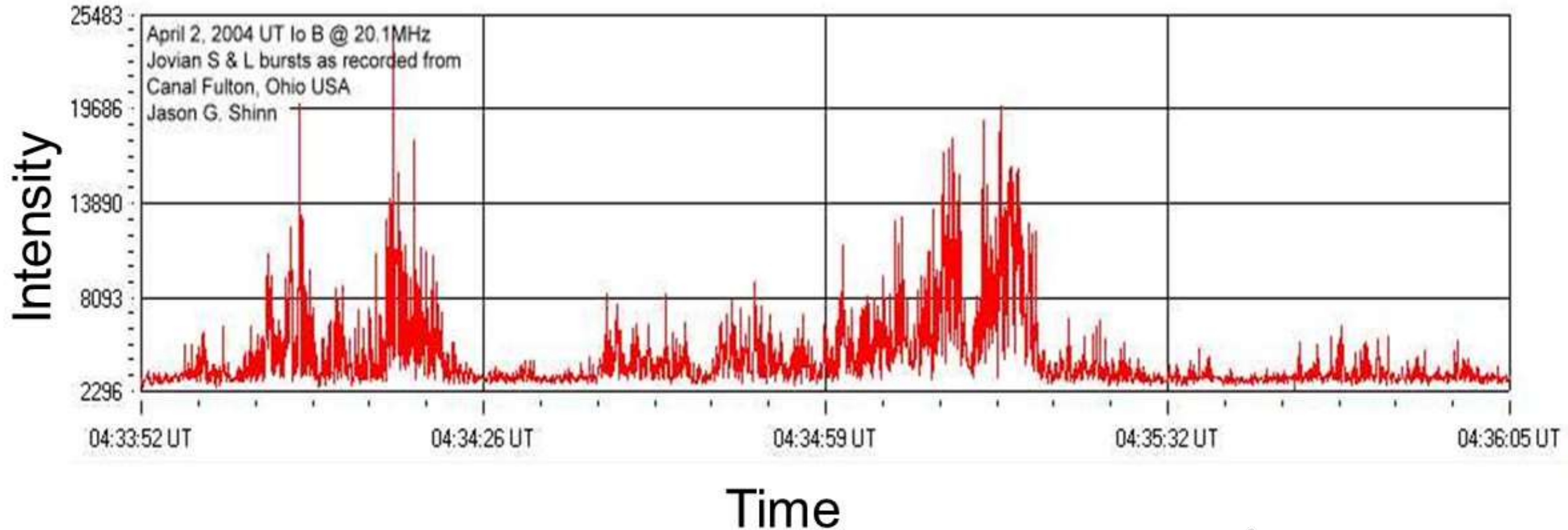
Jupiter L-bursts are radio emission that sounds like ocean waves crashing onto the shore



Jupiter L-bursts



Jupiter S-bursts are the short popcorn popping sounds in this Io-B storm



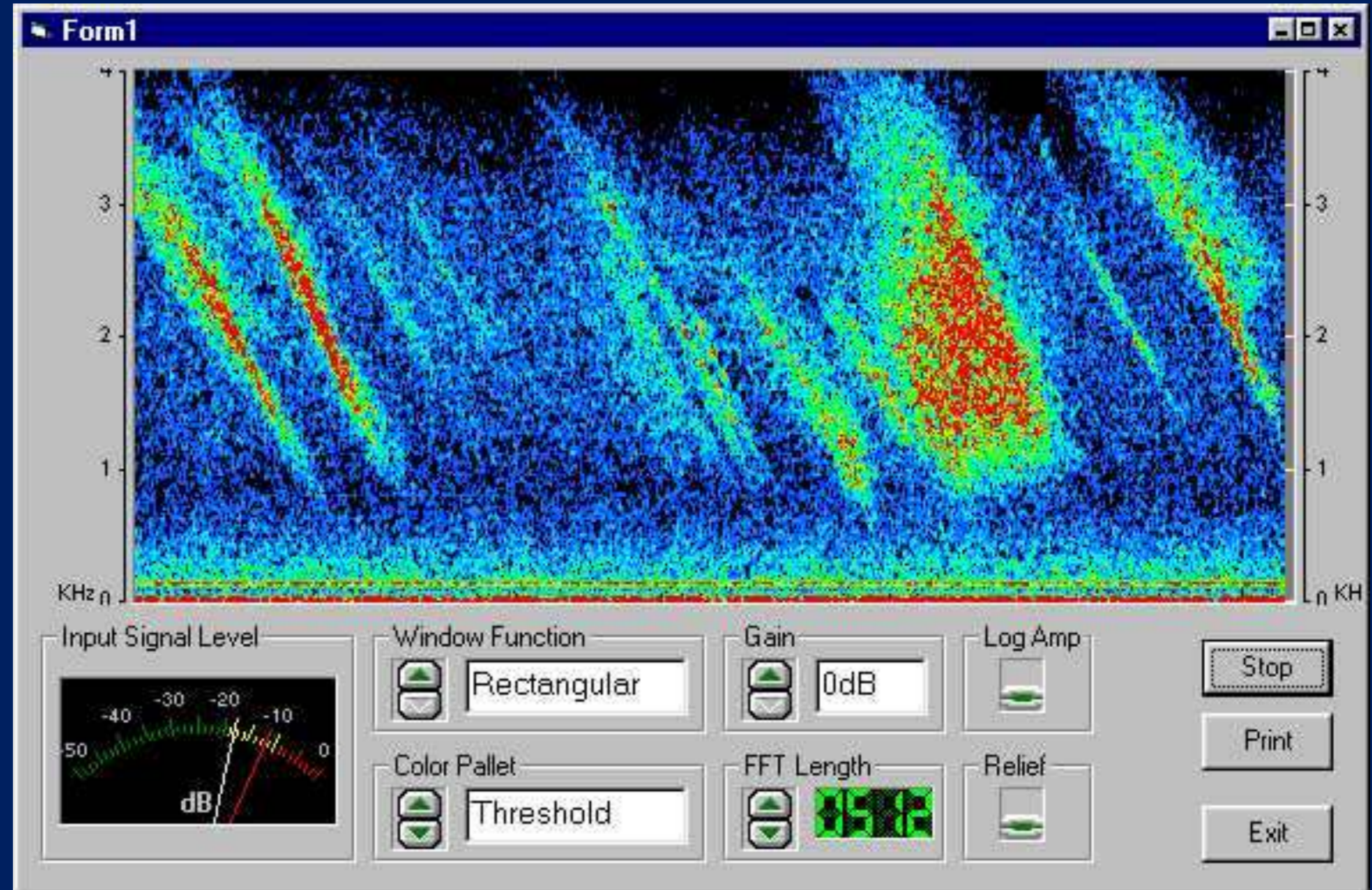
Jupiter S-bursts



Jupiter S-bursts sounds slowed down



These are recordings of the same bursts, except that the second file played 128 times slower.





Research and Projects

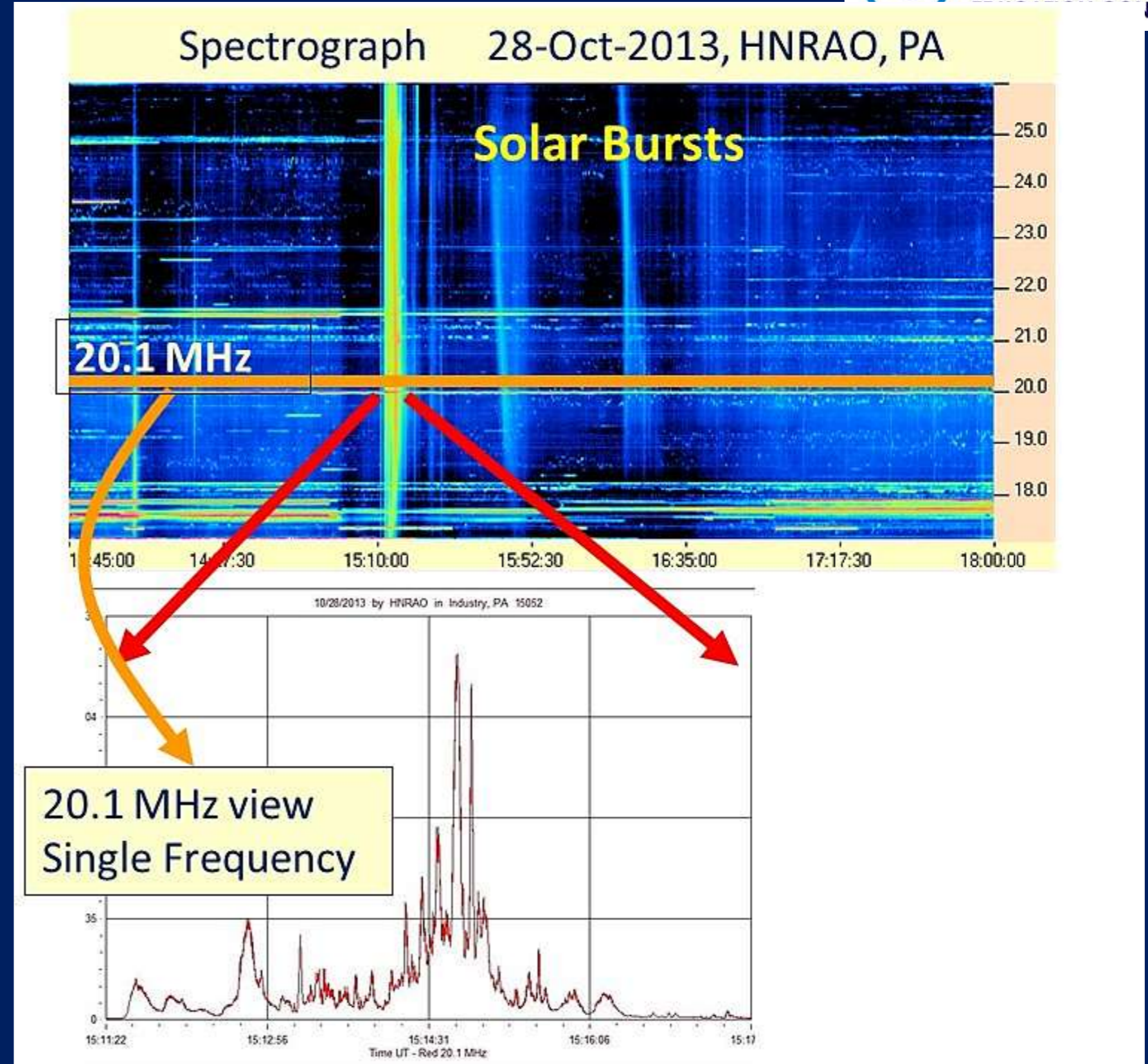


Research Interests

- Jupiter Radio Emission Structure
- Solar Radio Emissions
- Ionosphere Radio Wave Propagation
- Milky Way Galaxy

Projects

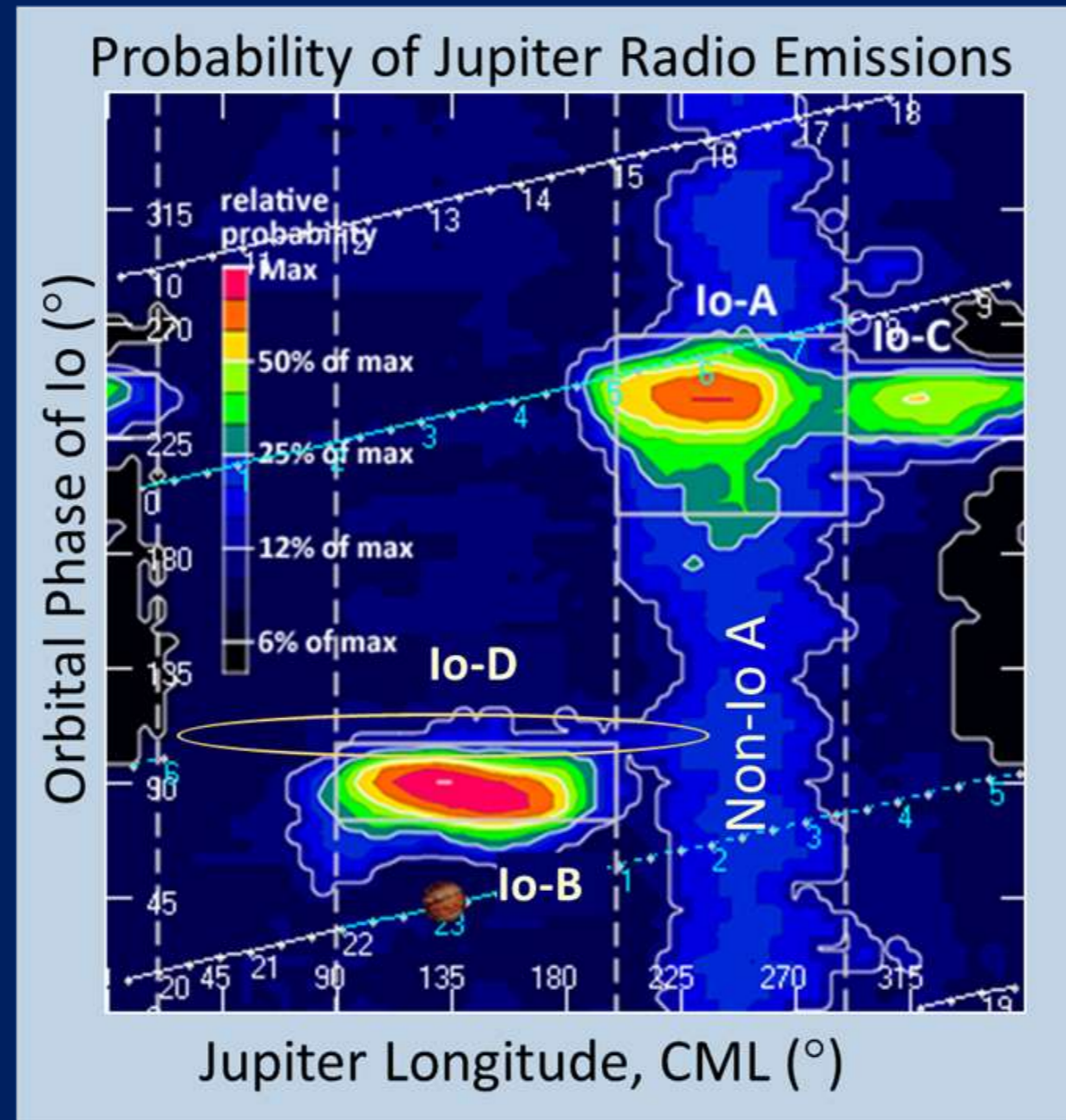
- Build a system and Make Observations
- Analyze, Compare, and Share Data
- Archive data for science investigations
- Join coordinated observations
- Advanced Projects (spectrographs, ionosphere, long-term studies)



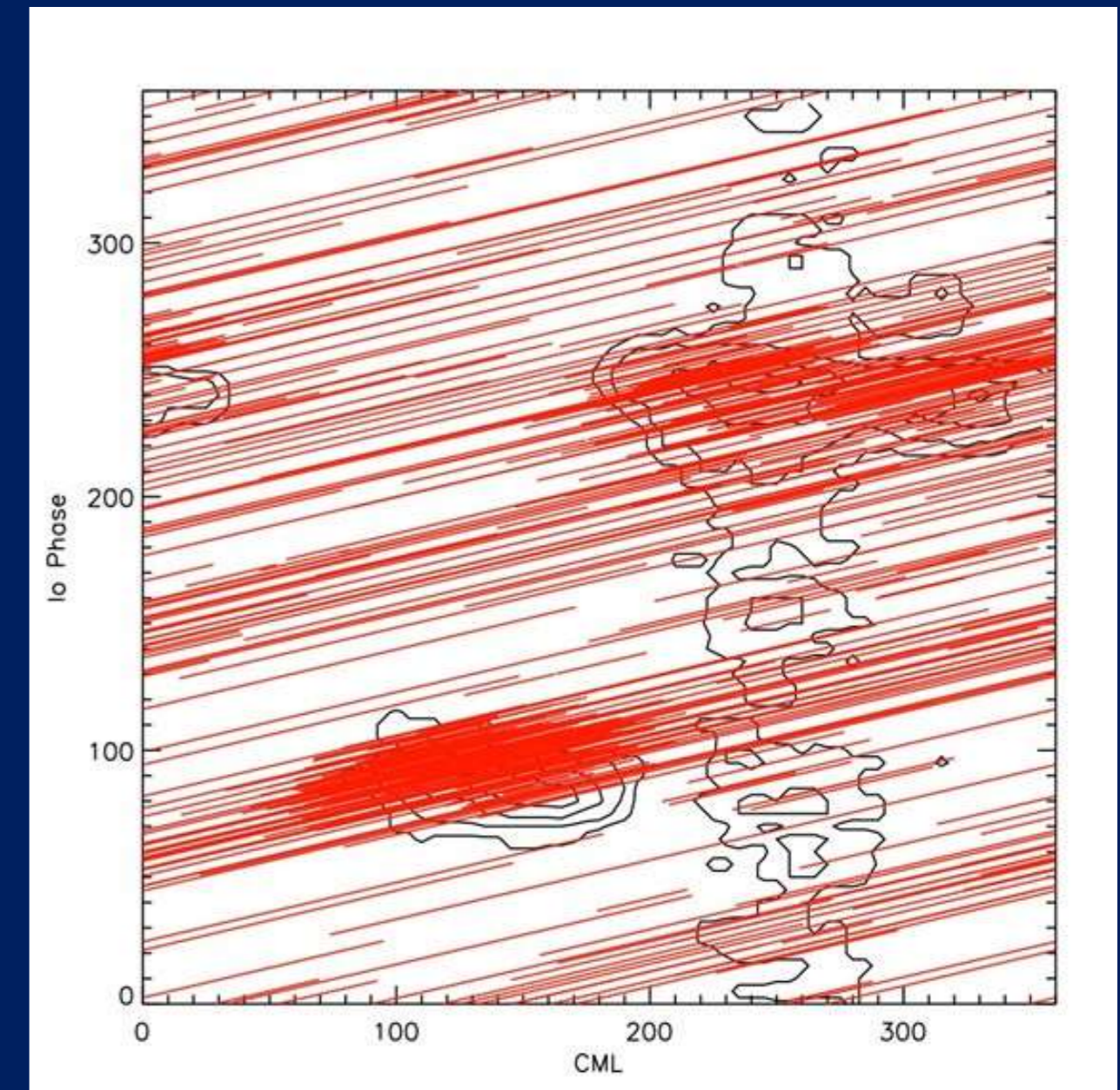
Comparison observations with a spectrograph (top) and a single frequency receiver (bottom). [Data from J. Brown]

Projects

- Maps of the Jupiter Radio sources
- Jupiter Emission microstructure



Jupiter radio emission occurrence probability plotted as a function of orbital phase of Io and Jupiter longitude (CML). [J. Sky, radiosky.com]



About 750 Jupiter radio observations in the Radio Jove archive over an Io Phase vs Jupiter Longitude (CML) plot. The observations are most concentrated near Io-related Jupiter radio storms. [L. Garcia]

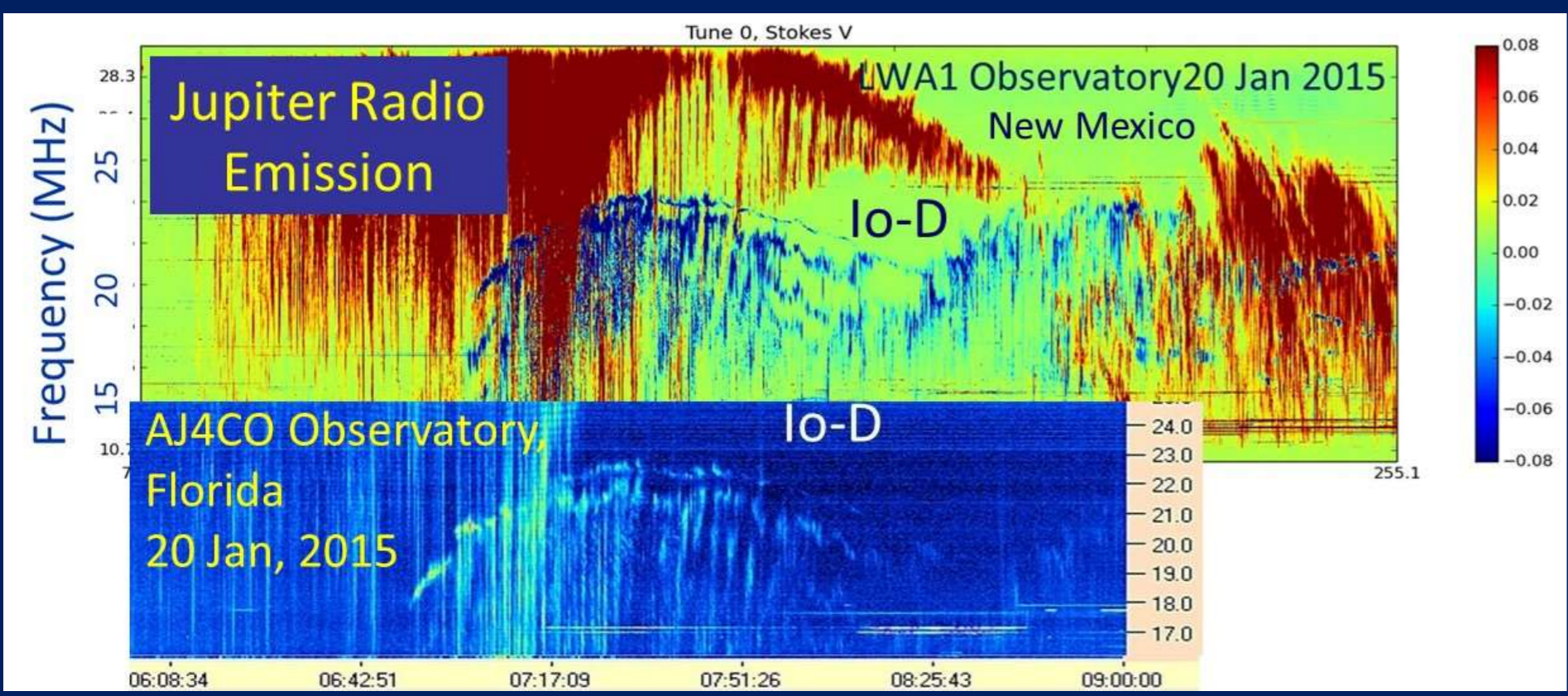
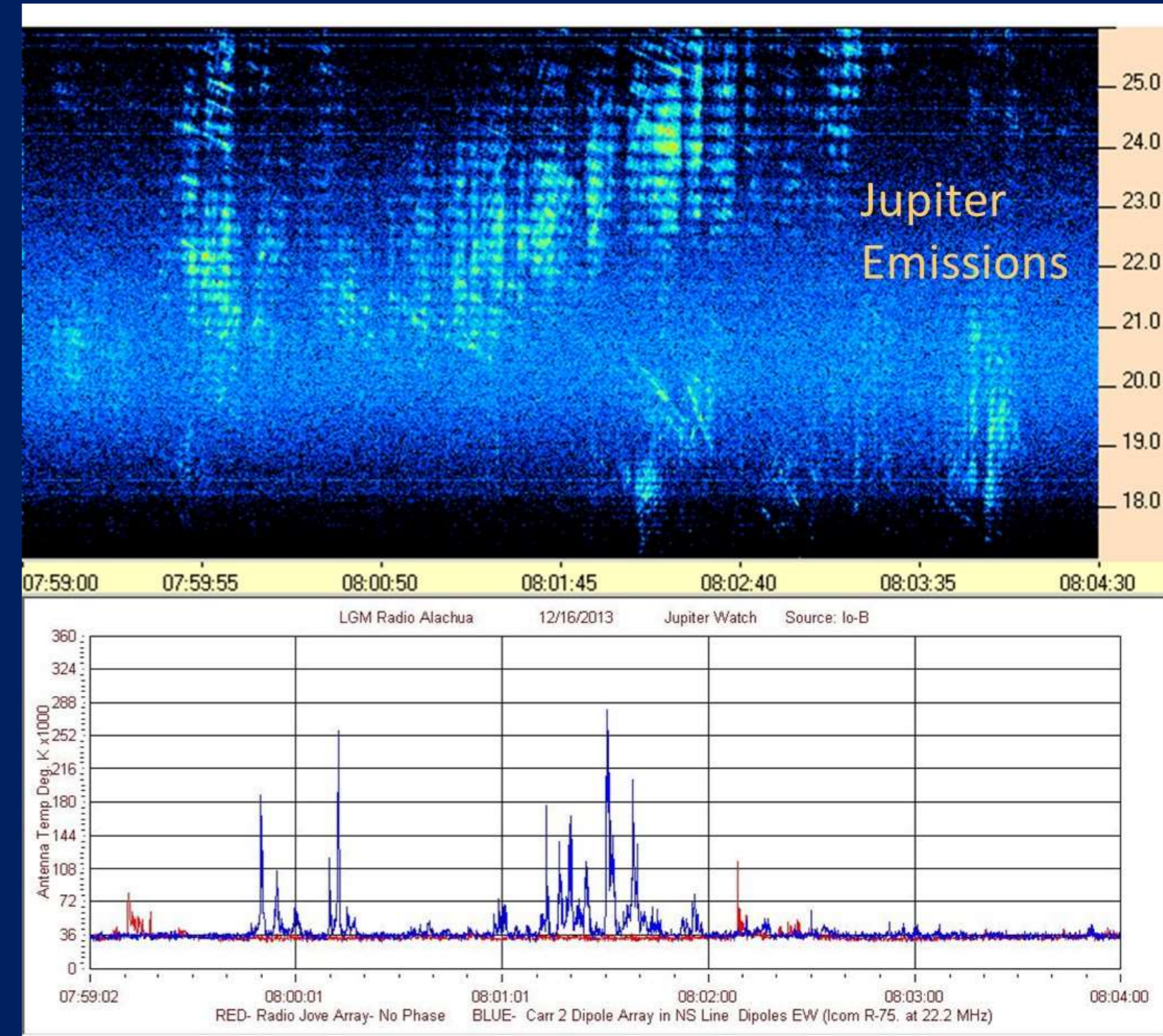


Research and Projects



Projects

- Maps of the Jupiter Radio sources
- Jupiter Emission microstructure



Polarized spectroscopic observations of Jupiter's spectral structure. [D. Typinski]

Jupiter observations with a spectrograph and a 20 MHz receiver. showing fine spectral structure such as modulation and Faraday lanes due to propagation effects. [J. Brown and W. Greenman]

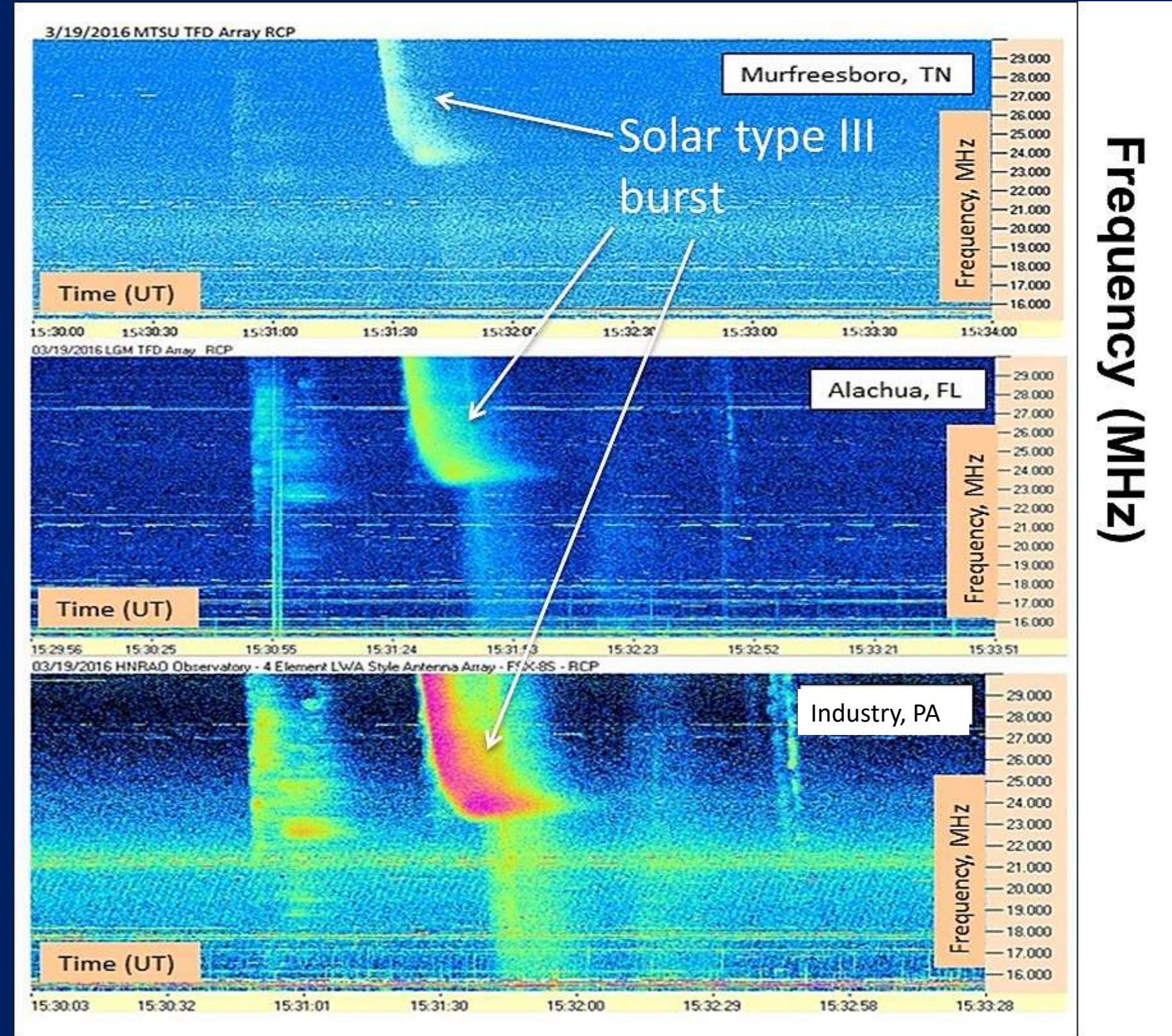
Research Interests

- Solar Radio Emissions
- Ionosphere Radio Wave Propagation
- Milky Way Galaxy

Frequency-time spectrogram comparison observations of solar radio bursts seen by different observers.

Differences in observed spectra result from difference ionospheric conditions and the angular spectrum of solar radio emissions. Horizontal bands represent radio interference.

[C. Higgins, W. Greenman, and J. Brown]



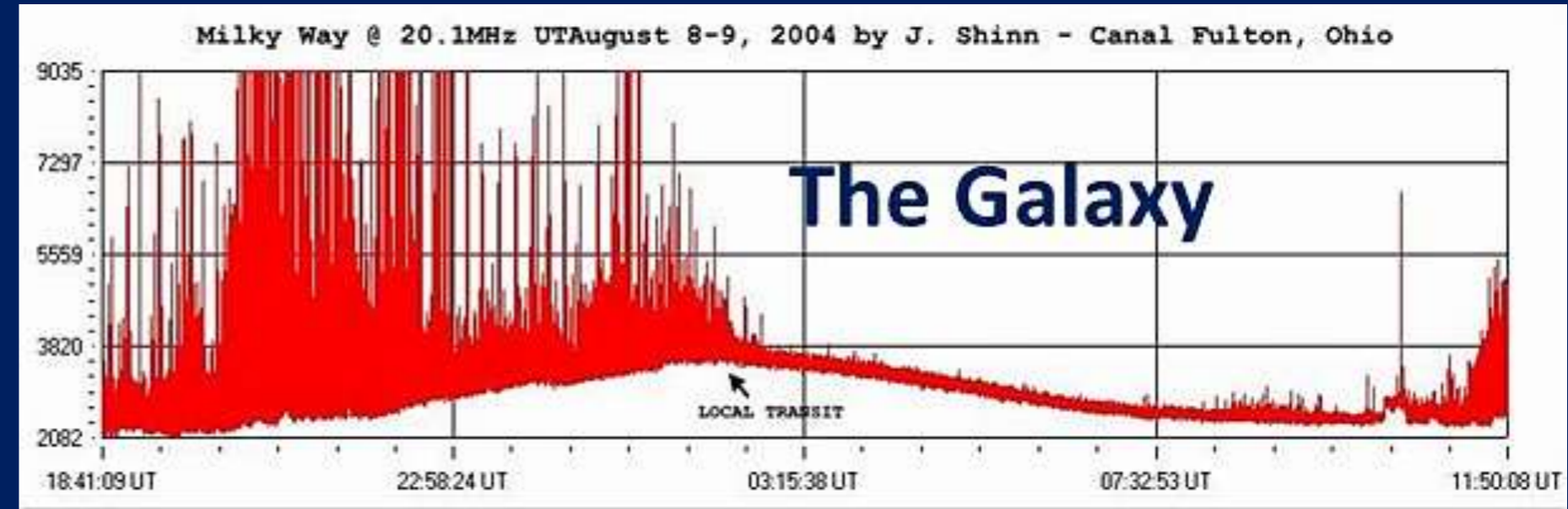


Research and Projects

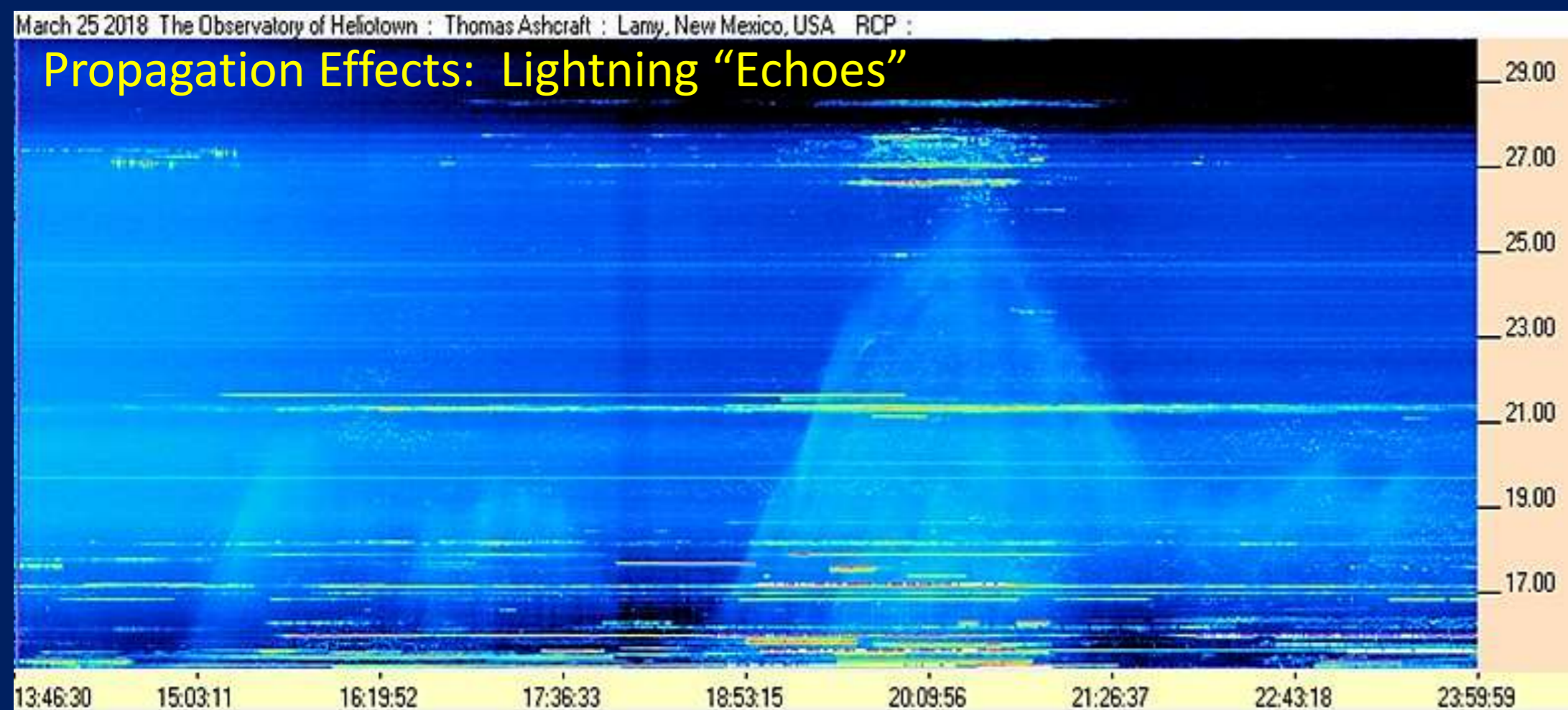


Research Interests

- Jupiter Radio Emission Structure
- Solar Radio Emissions
- Ionosphere Radio Wave Propagation
- Milky Way Galaxy



24-hr intensity-time radio emission showing the Galaxy [J. Shinn]



Frequency-time data of lightning reflection and propagation in Earth's ionosphere [T. Ashcraft]



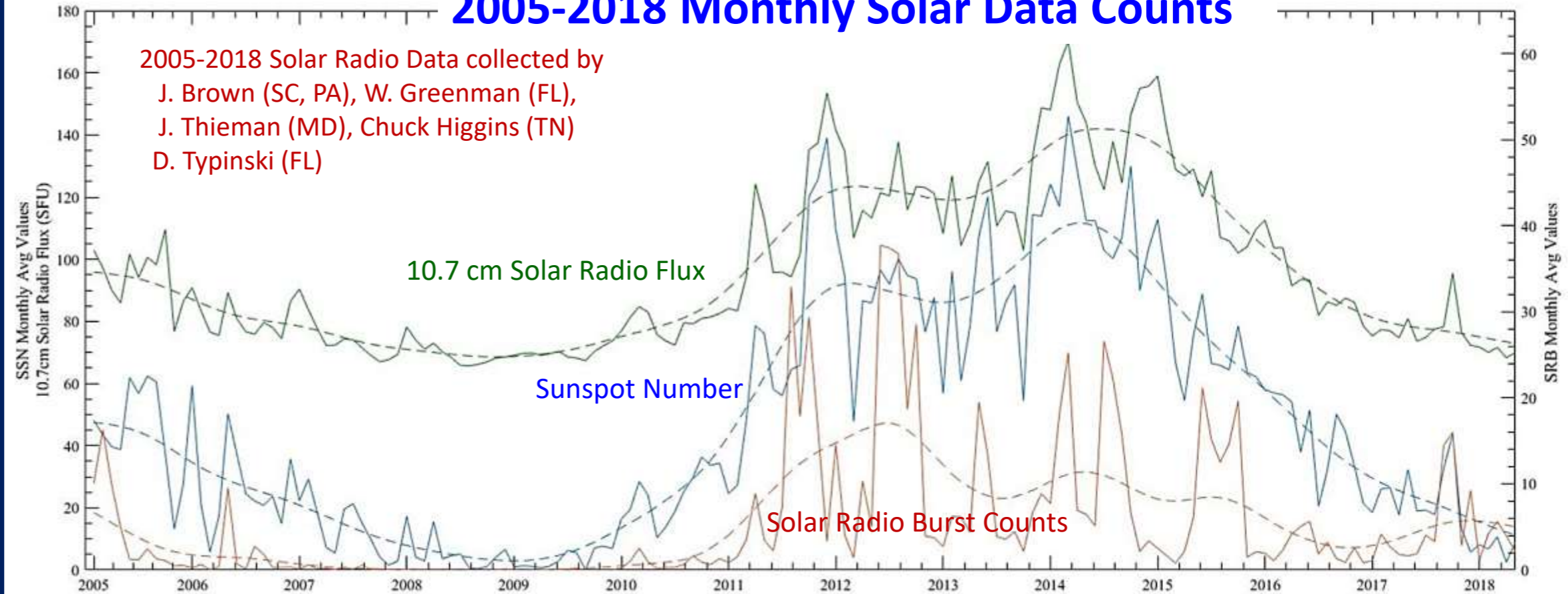
Solar Radio Education Activity



Solar Radio Burst Counts

1. Observe the Sun with a Radio Jove telescope
2. Count daily solar bursts
3. Compute average for 1 month
4. Send Data to Radio Jove
5. Your name added to a graph

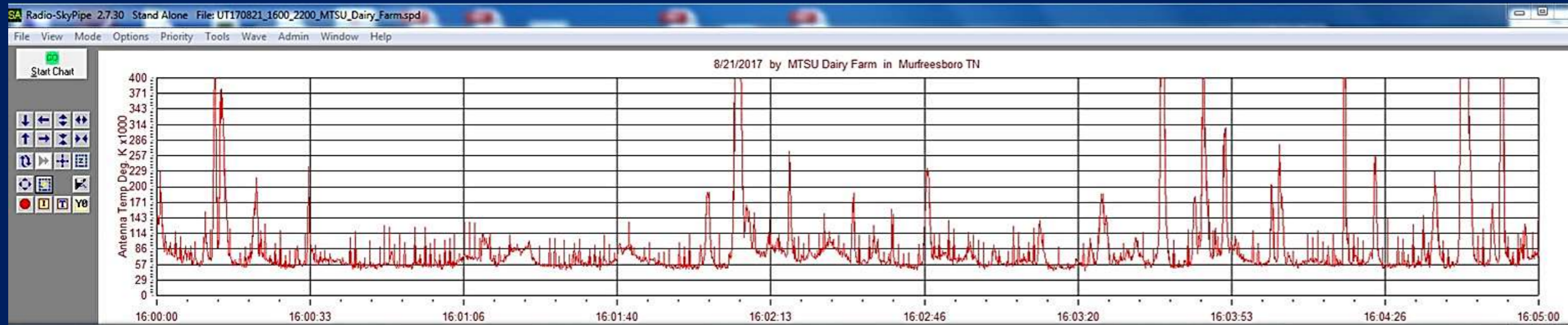
2005-2018 Monthly Solar Data Counts



MTSU Undergrads: Monica Villarreal, Jacob Burleson, Luke Garner, Courtney Gibson, Beverly Warner, Travis Marlow

2005 – 2018 Monthly Solar Radio Burst Counts (SRB) at 20 MHz correlate well with the visible Sunspot Number (SSN) and the 10.7 cm (2800 MHz) Radio Flux data. 20 MHz correlation with SSN is 67%.

Example Raw Radio Data with solar radio emissions





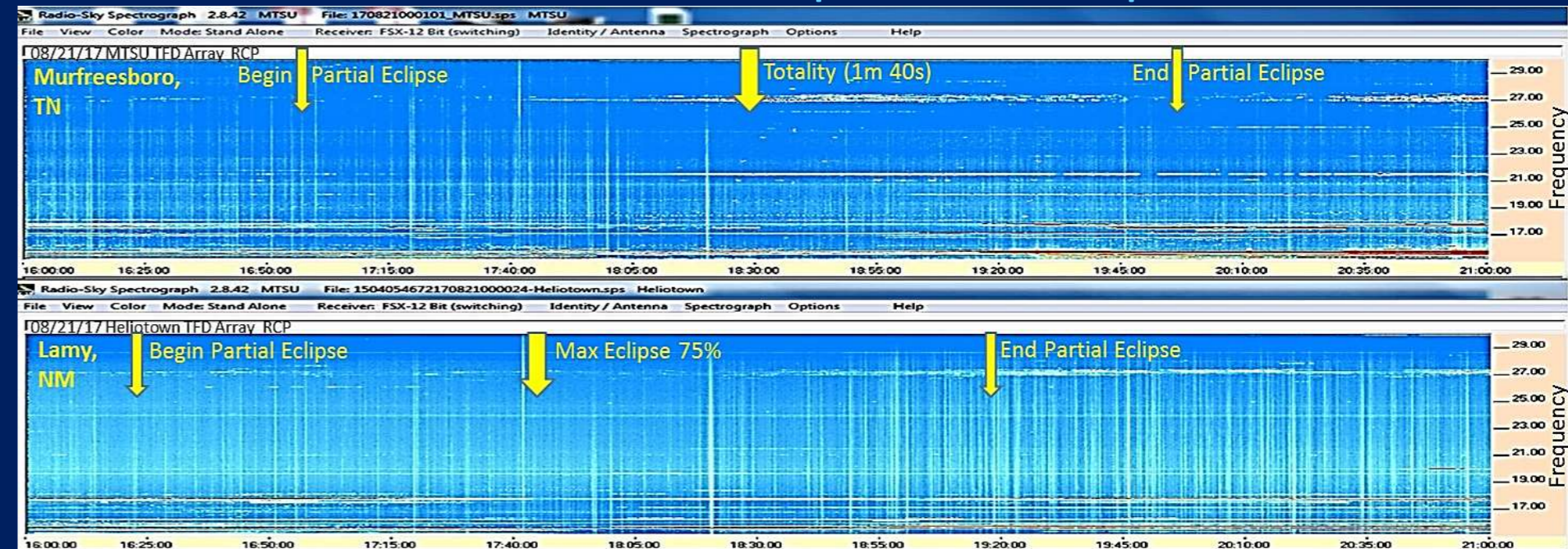
2017 Solar Eclipse



2017 Coordinated Activity

- 25 Radio Jove groups observed the solar eclipse
- Only 7-8 observers made science-quality observations
- Citizens Scientists → Large Learning Curve
- Two stations show evidence that the lunar shadow affected the received solar emissions

Example Solar Eclipse Observations



Twenty-five Radio Jove observers are shown on the map for the August 21, 2017 total eclipse. [Background: eclipse.gsfc.nasa.gov]

Frequency-Time spectrograph solar eclipse observations on August 21, 2017 from 16-21 UT at 15-30 MHz in TN (100% eclipse) and NM (75% eclipse). Radio burst intensity are reduced near the time of totality in the Murfreesboro, TN data as compared with the data from Lamy, NM.

**New effort for
2024 Solar Eclipse**

Data Archive

Welcome to the Radio JOVE Data Archive - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://jovearchive.gsfc.nasa.gov/

Most Visited Customize... http://www.mtsu.edu...

Welcome to the Radio JOVE Data Arc...

RADIO JOVE

Welcome to the Radio JOVE Data Archive

Radio JOVE homepage

View Calendar

View Current Data Archive

Submit New Data to the Archive (Password protected)

If you are a Radio JOVE observer and wish to submit data to the archive please send a request to [Leonard Garcia](#)

If you are making use of the data on this site for your own research please acknowledge the data submitters and the Radio JOVE education and outreach activity.

[Privacy Policy and Important Notices](#)

Curator: [Leonard Garcia](#), Wyle

Responsible NASA Official: [James Thieman](#) NASA/GSFC

- Submit your data to the Archive
- Use it for science/projects

Radio JOVE Archive Calendar

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May 2018

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																	
		1 Galactic Background	2 Galactic Background	3 Galactic Background	4 Galactic Background Jupiter	5 Galactic Background																																	
6 Galactic Background	7 Galactic Background	8 Galactic Background	9 Galactic Background	10 Galactic Background	11 Galactic Background Jupiter	12 Galactic Background																																	
13 Galactic Background	14 Galactic Background	15 Galactic Background	16 Galactic Background	17 Galactic Background	18 Galactic Background Jupiter	19 Jupiter																																	
20 Sun	Radio JOVE Data Archive Display Return to Welcome Page Return to Calendar Page																																						
27 Gal	Data Products Key Image File Available SkyPipe File Available Text File Available Sound File Available																																						
Bas	<table border="1"> <thead> <tr> <th>FIRST_NAME</th> <th>LAST_NAME</th> <th>SCHOOL/OBS</th> <th>START_DATE</th> <th>START_TIME</th> <th>STOP_DATE</th> <th>STOP_TIME</th> <th>OBJECT</th> <th>STORM_TYPE</th> <th>FREQUENCY</th> <th>DATA PRODUCTS</th> </tr> </thead> <tbody> <tr> <td>David</td> <td>León Salinas</td> <td>Red Mesa Prepa 7 "Lourdes Gómez" UNAM</td> <td>05/26/2018</td> <td>0846</td> <td>05/27/2018</td> <td>0158</td> <td>Sun</td> <td></td> <td>20.1</td> <td> </td> </tr> <tr> <td>Larry</td> <td>Dodd</td> <td>KALSD</td> <td>05/26/2018</td> <td>0608</td> <td>5/26/2018</td> <td>0359</td> <td>Sun</td> <td></td> <td>20.1</td> <td> </td> </tr> </tbody> </table>						FIRST_NAME	LAST_NAME	SCHOOL/OBS	START_DATE	START_TIME	STOP_DATE	STOP_TIME	OBJECT	STORM_TYPE	FREQUENCY	DATA PRODUCTS	David	León Salinas	Red Mesa Prepa 7 "Lourdes Gómez" UNAM	05/26/2018	0846	05/27/2018	0158	Sun		20.1		Larry	Dodd	KALSD	05/26/2018	0608	5/26/2018	0359	Sun		20.1	
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Radio JOVE Summary



radiojove.gsfc.nasa.gov

- Radio JOVE is an active citizen science project
- 4 Partnerships: NASA Education (NSSEC), Citizen Scientists, Juno Mission, and Data Archives
- Collaborate in Science, Education, and Public Outreach
- 11 active citizen scientists – looking to expand the network
- Continue to coordinate observations to support science
- Jupiter, Solar, Ionosphere research projects

Brochures available on request

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JOVE Team

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Voyager 1 Image
SOHO Image
NASA/GSFC Image