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(RESEARCH ARTICLE)

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Tracking extraterrestrial signals using the Super SID and Radio JOVE kits

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Abstract

A 20.1MHz dipole radio telescope was assembled, characterized and tested to detect extraterrestrial signals from planet Jupiter. Two element dipole arrays were built for the detection of 20.1MHz radio emission from the Jupiter-Io interaction, strong solar burst, the galactic background and the transit of the galactic center. Using the specifications and the layout, the dipole array was constructed. The block diagram, the schematic diagram built for NASA was used to solder together the radio frequency band pass filter, audio Preamplifier and audio amplifier to make the radio JOVE receiver. This was characterized, tested and tuned by setting the tuning knob to 20.0MHz. The dipole antenna was connected to the receiver and a variety of radio frequency emissions were detected. These signals were captured on a personal computer via the radio Jupiter Pro 3.8.3 and radio skypipe 2.6.5 software compatible with windows 7 OS and has python programme which converts data from the sod format to ASCII format to conveniently analyzed them. The data locally captured was correlated with other stations of the world. Specifically the analyzed chart of 14th July 2022 shows a lot of similarities with that captured by radio telescope UNIVERSUM shared with the global web repository.

Keywords: Dipole Antenna; Solar Burst; Galaxy; Radio-telescope; Sky pipe

1. Introduction

Radio signals from Jupiter and the sun are very weak - they produce less than a millionth of a volt (1 microvolt, 1µv) at the antenna terminals of the receiver [1]. These weak radio frequency (RF) signals must be amplified by the receiver and converted to audio signals of sufficient strength to drive headphones or a loudspeaker. The receiver also serves as a narrow filter, tuned to a specific frequency to hear Jupiter while at the same time blocking out strong earth based radio stations on other frequencies. The receiver and its accompanying antenna are designed to operate over a narrow range of short-wave frequencies centered on 20.1 MHz (megahertz). This frequency range is optimum for hearing Jupiter signals [2].

The antenna intercepts weak electromagnetic waves which have traveled some 500 million miles from Jupiter to the Earth. When these electromagnetic waves strike the wire antenna, a tiny RF voltage is developed at the antenna terminals. Signals from the antenna are delivered to the antenna terminals of the receiver by a coaxial transmission line [3, 4].

2. Materials, Assembling and Operation

2.1. Description of Antenna and Receiver-RADIO JOVE

The constructed Radio Jove kit consists of parts to assemble two half-wave dipole antennas, coaxial cable, parts to build a radio receiver, PC software, and a manual.

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- The Radio Jove antenna consists of wire, coaxial cable, insulators, connectors, and other parts. The kit consists of two identical half-wave dipole antennas, which was phased together with a feed line. Some soldering skills are required, as well as accurate measuring and cutting were employed to set up the antenna
- The receiver kit consists of 100 parts, including electronic components, solder, wiring, a circuit board, simple tools and a case. The receiver is "tuned" to a relatively narrow band of frequencies centered at 20.1MHz. It is powered by a 12V DC source, and outputs an amplified signal sufficient for listening over headphones or a powered speaker, and to provide a signal at the microphone input port on a personal computer.
- The receiver works by taking the weak signal from the antenna and filtering out frequencies outside of a narrow band around 20.1 MHz, converting the frequencies to the KHz audio spectrum, and amplifying the signal. Filtering was accomplished by pairing capacitors, which resist direct current but pass oscillating current, with inductors, which resist changing current. Capacitors store the energy of resistance as an electric field, and inductors store energy collected as a magnetic field. The properly "tuned", capacitors and inductors swap energy between their electric and magnetic fields at a specific frequency, or resonance. The receiver takes advantage of this capacitor-inductor resonance to augment signals at approximately 20.1 MHz and dampen other frequencies. The direct conversion of the MHz frequency to KHz is accomplished by subtracting the received signal from a reference signal generated by an oscillator in an integrated circuit, or IC. Two integrated circuits and two transistors amplify the output signal, and one JFET transistor amplifies the incoming signal.
- The Radio-Sky Pipe software provided in the kit was installed on a PC to record and store observations, provides visual feedback as to the strength of the signal being received on a real-time basis, and enables the research team share results with other observers over the internet.

3. Results

Constructed Dipole Antenna — The Radio JOVE Antenna assembled and connected

Figure 1 Startup Localised Spectograph by radio skypipe 2.6.5 in 2018

4. Discussions

The researchers conducted half-day sessions using the assembled kit, laptop computer and Radio-Sky Pipe software from 2018 to early 2020 before the COVID 19 lockdown led to the closure of the unit. The unit was however, opened in October after environmental bottlenecks were removed in October 2021. Using the program to conduct observations was reasonably simple, but requires much sensitivity.

The normal observing set-up included routing the antenna through a step-calibration device and an additional filter before being plugged into the receiver. One audio output was connected to a battery-powered speaker and the other was connected to the microphone input port of a laptop. A 12v power supply was connected to the receiver.

Adjusted configuration of the site-The Sc

Site_name = K&TRC_FPA
Longitude = 7.65
Latitude = 5.22
Utc_offset = +1
Time-zone = west central Africa
Monitor_ID = 0467
Audio_sanpling_rate = 96000
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Automatic_upload= yes
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number_of_stations = 6

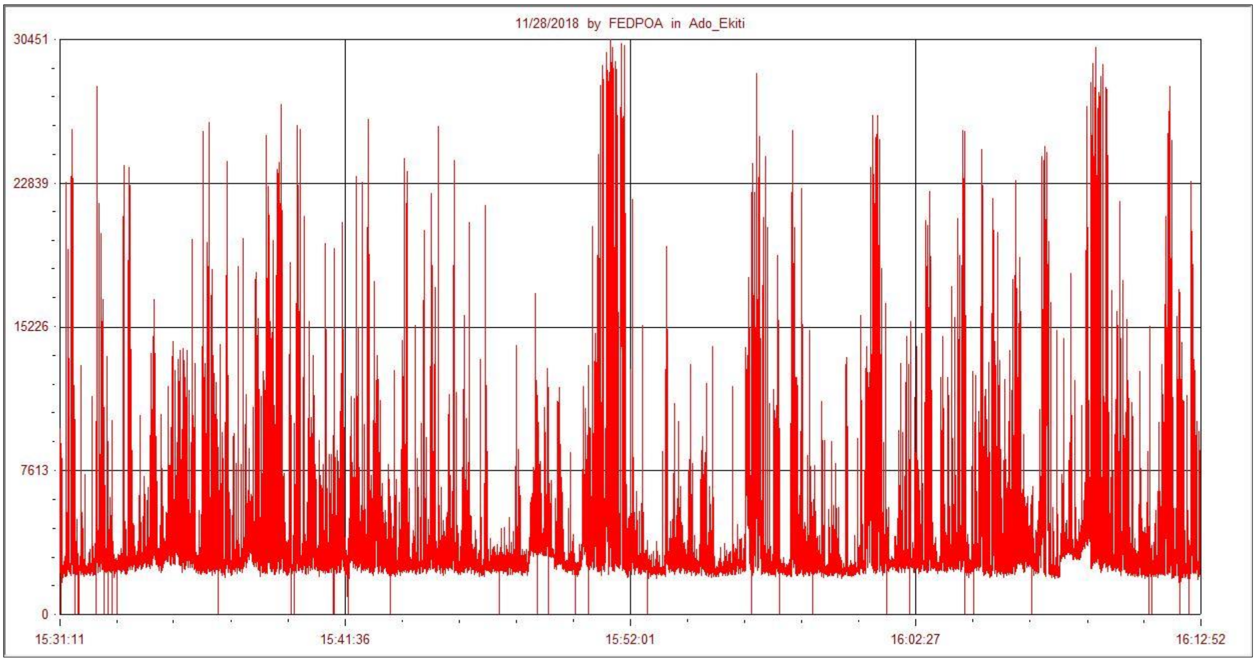


Figure 2 A graph of the Sun and Jupiter showing Altitude vs Azimuth Display

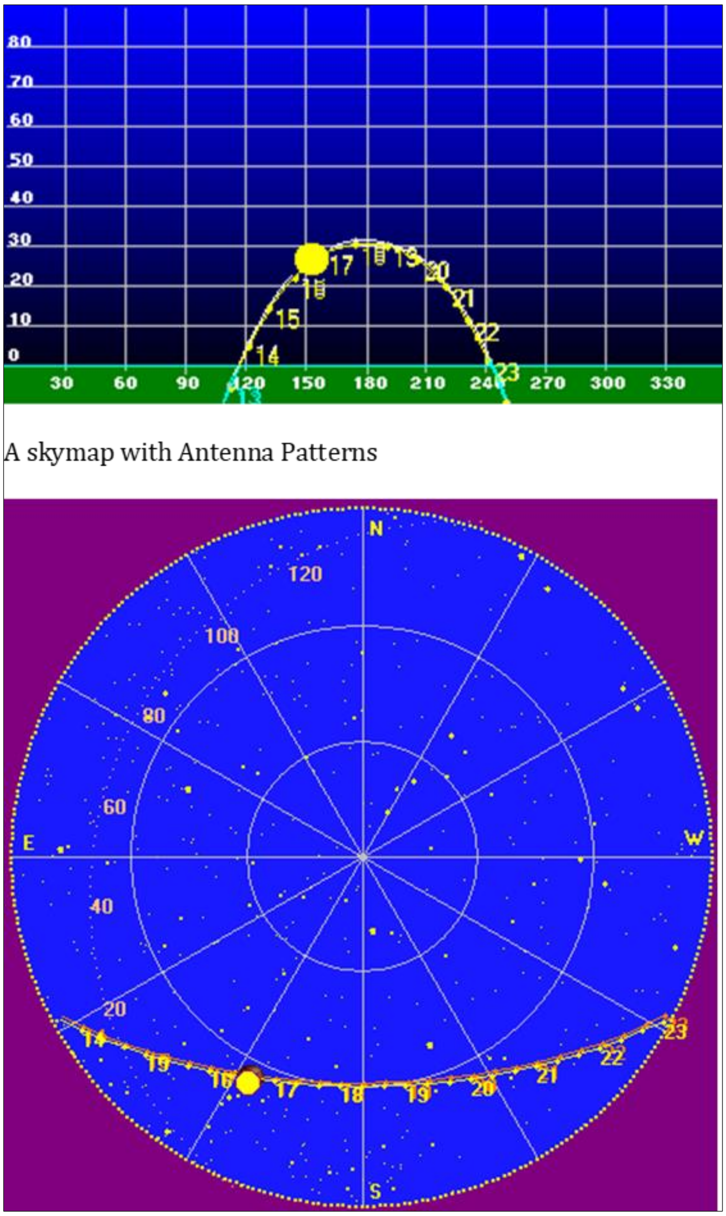


Figure 3 CML-Io Phase Plane at 2018/11/28

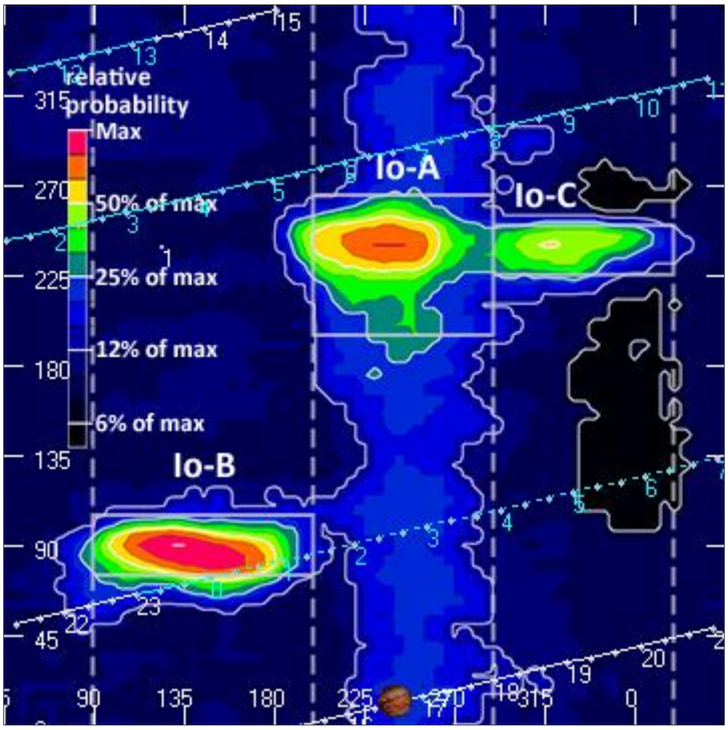


Figure 4 CML-Io Plane Probabilities

The probability of observing Jovian emissions is affected by many variables. Some of these are the observing frequency, transparency of the earth's ionosphere, duration of the observing session, antenna gain, receiver sensitivity, galactic background noise level, man-made noise level, position of Jupiter relative to the Sun, and the jovicentric declination of Earth.

For the reading generated by the local receiver, and correlated with this model; the software Radio Jupiter Pro CML = 240.3, Io Phase= 11.4. The relative probability is 90%

Table 1 Product: Solar Activity events.txt

: Created: 2019 Jul 26 0302 UT

: Date: 2019 07 26

Prepared by the U.S. Dept. of Commerce, NOAA, Space Environment Center for SLT FPA

please send comments and suggestions to sec@sec.noaa.gov

Missing data: ////

Updated every 30 minutes.

Edited Events for 2019 Jul 26

#Event		Begin	Max	End	Obs	Q	Type	Loc/Frq	Particulars		Reg#
1910	+	1529	1537	1545	G12	5	XRA	1-8A	B8.1	6.3E-04	0424
1910		1533	1534	1553	HOL	3	FLA	S17E71	SF		0424
1920		1604	1609	1617	HOL	3	FLA	S18E70	SF		0424
1930		1625	1650	1726	HOL	3	FLA	S18E68	SF		0424
1930	+	1637	1642	1650	G12	5	XRA	1-8A	C1.1	7.6E-04	0424
1940	+	1653	1653	1655	SAG	G	RBR	245	100		
1950		1713	1714	1714	PAL	G	RBR	245	87		
1960	+	1727	1736	1744	G12	5	XRA	1-8A	C4.5	3.1E-03	0424
1960		1730	1734	1759	HOL	3	FLA	S17E68	1F		0424
1960		1733	1733	1734	PAL	G	RBR	245	56		0424
1970		1839	1839	1839	PAL	G	RBR	245	110		
1980	+	1905	1918	1925	G12	5	XRA	1-8A	B7.1	7.5E-04	0424
1980		1917	1936	2005	HOL	3	FLA	S17E67	SF		0424
1990	+	1930	1946	1954	G12	5	XRA	1-8A	C5.9	5.9E-03	0424
2000	+	2112	2134	2140	G12	5	XRA	1-8A	C3.8	3.1E-03	0424
2000	+	2115	2115	2115	PAL	G	RBR	245	270		0424
2000		2116	2132	2156	HOL	3	FLA	S17E66	SF		0424
2020	+	2249	2256	2303	G12	5	XRA	1-8A	B9.0	5.9E-04	0424
2040	+	2341	2354	0002	G12	5	XRA	1-8A	M1.3	8.5E-03	0424
2040	+	2345	2351	0031	LEA	3	FLA	S17E63	1F	ERU	0424

http://www.sec.noaa.gov/ftpdir/indices/2019_events/20190716events.txt

Figure 5 Actual and projected solar activity events

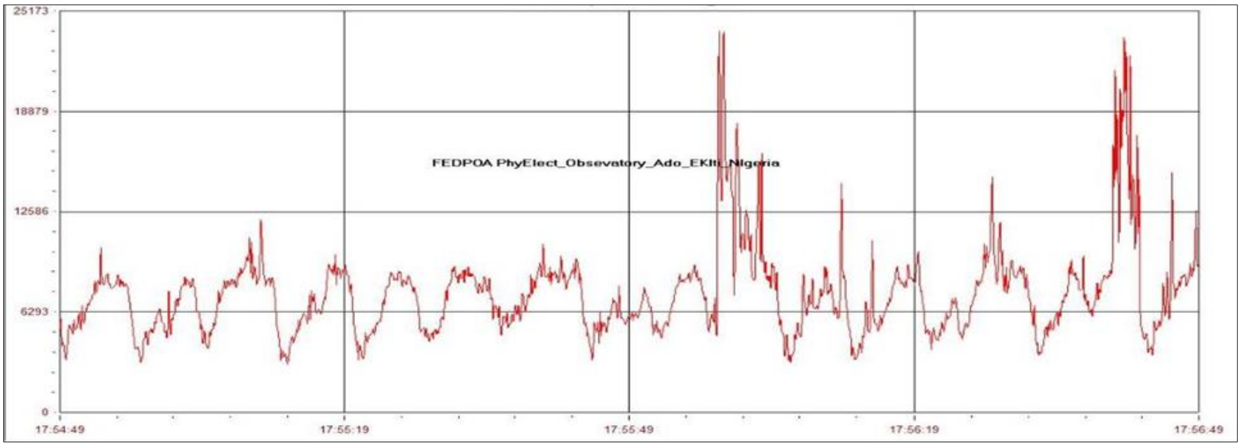


Figure 6 Solar bursts emission record for FEDPOA Observatory for July, 2019

The spectrograph of solar events as picked by the Radio Skypy software on the PC for this period are shown below:

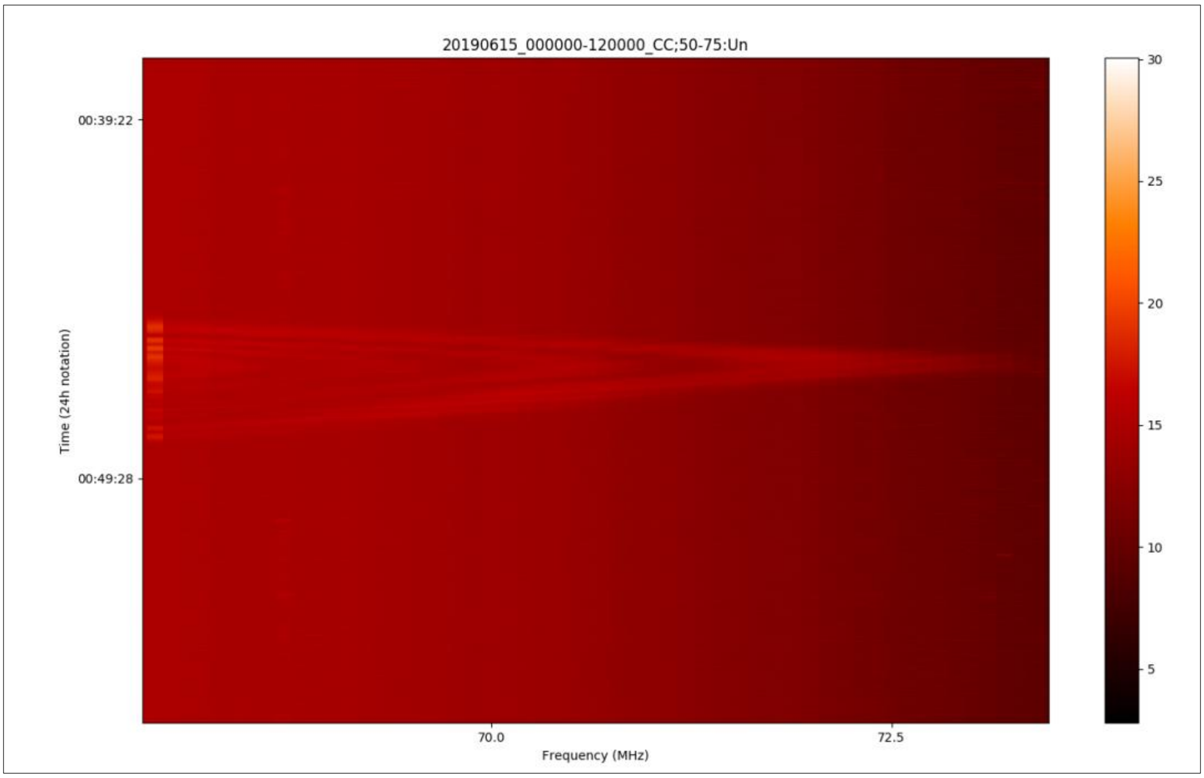


Figure 7 Solar bursts emission record for FEDPOA Observatory for July, 2019

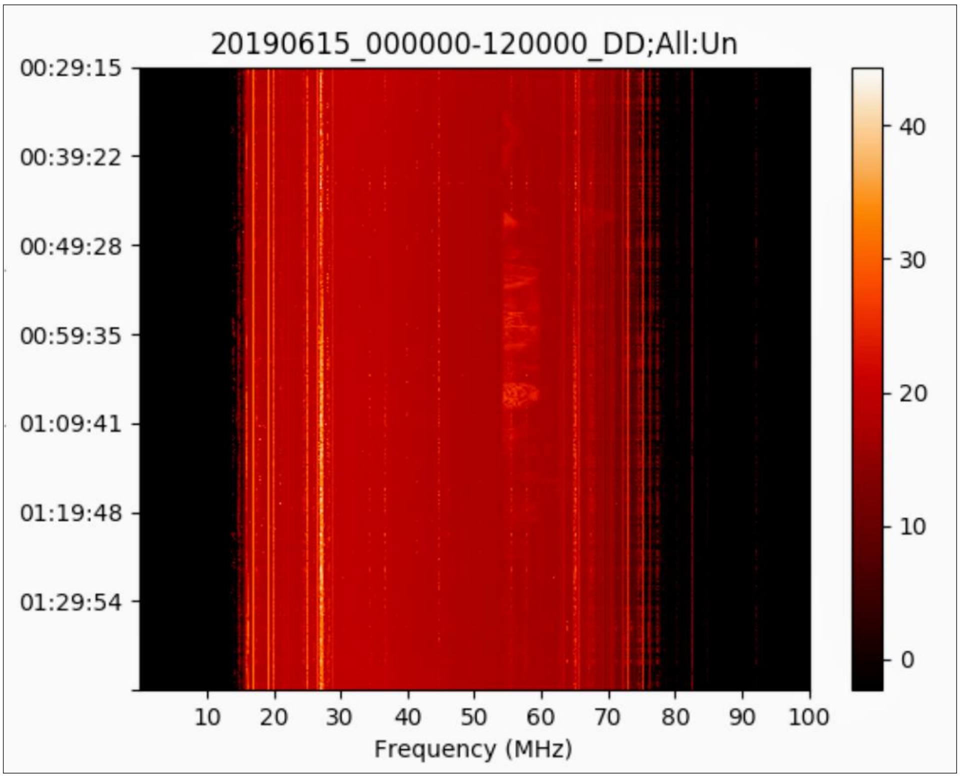


Figure 8 All day and Solar bursts emission record for FEDPOA Observatory for July, 2019

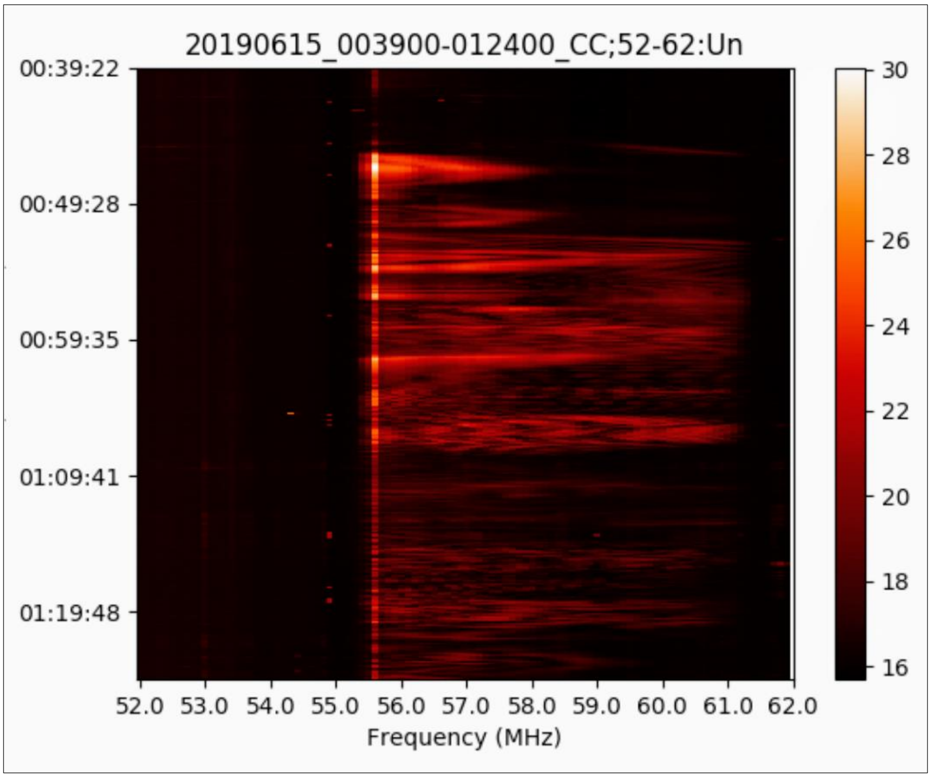


Figure 9a Nights Solar bursts emission record for FEDPOA Observatory for July, 2019

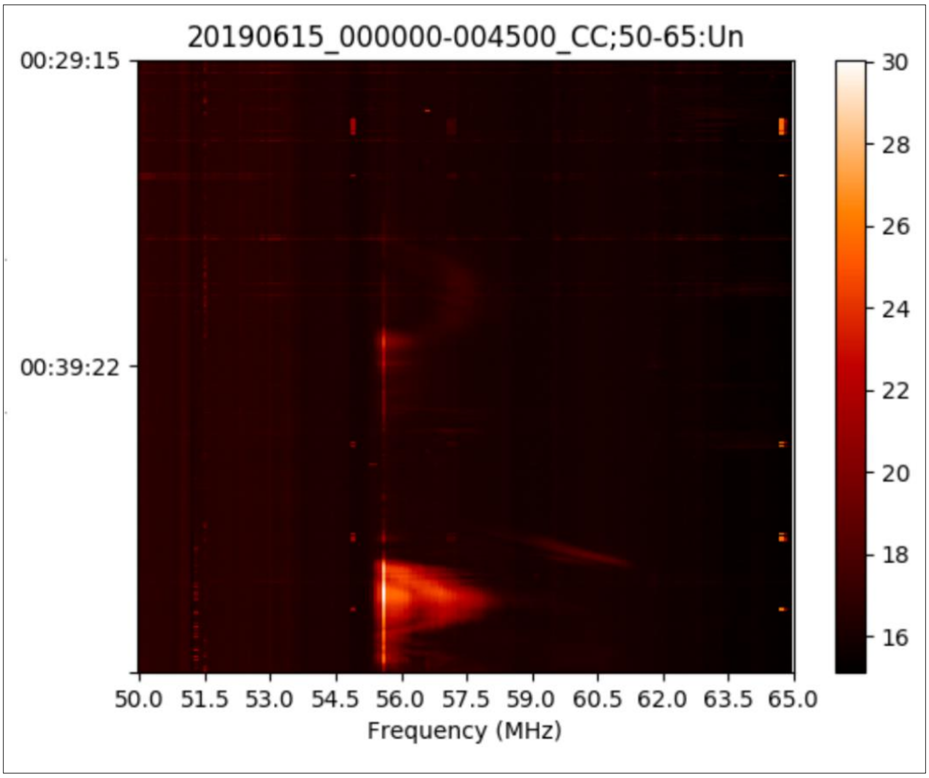


Figure 9b Nights Solar bursts emission record for FEDPOA Observatory for July, 2019

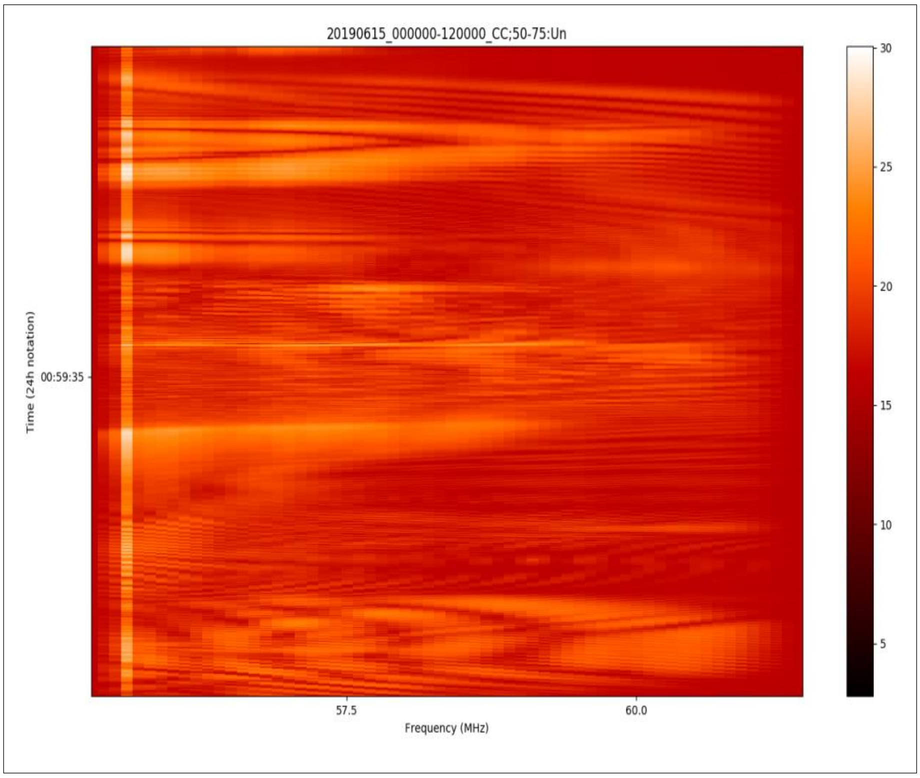


Figure 10a All-day Solar bursts emission record for FEDPOA Observatory for July, 2019

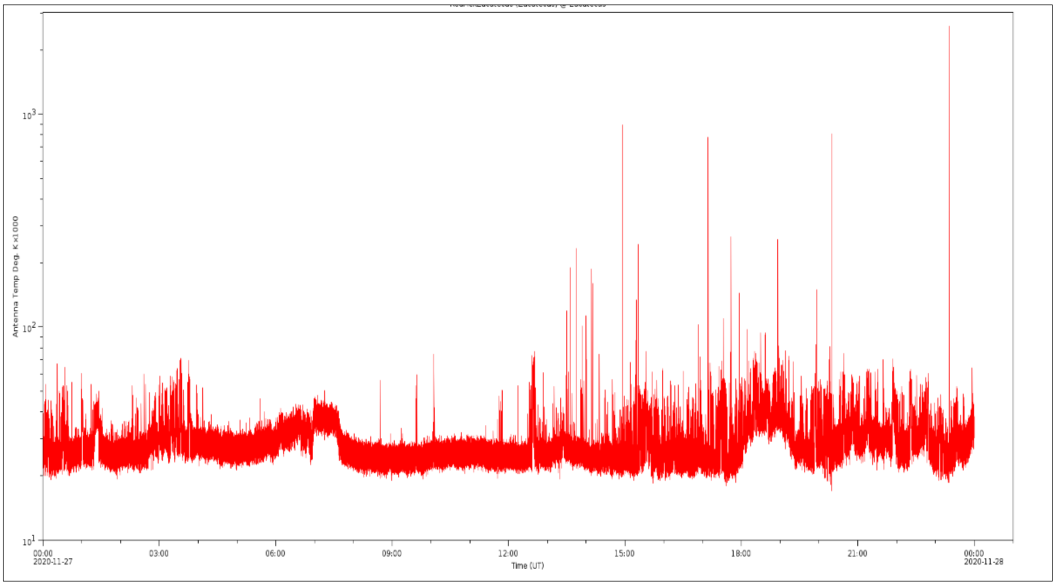


Figure 10b All-day Solar bursts emission record for FEDPOA Observatory for July, 2022

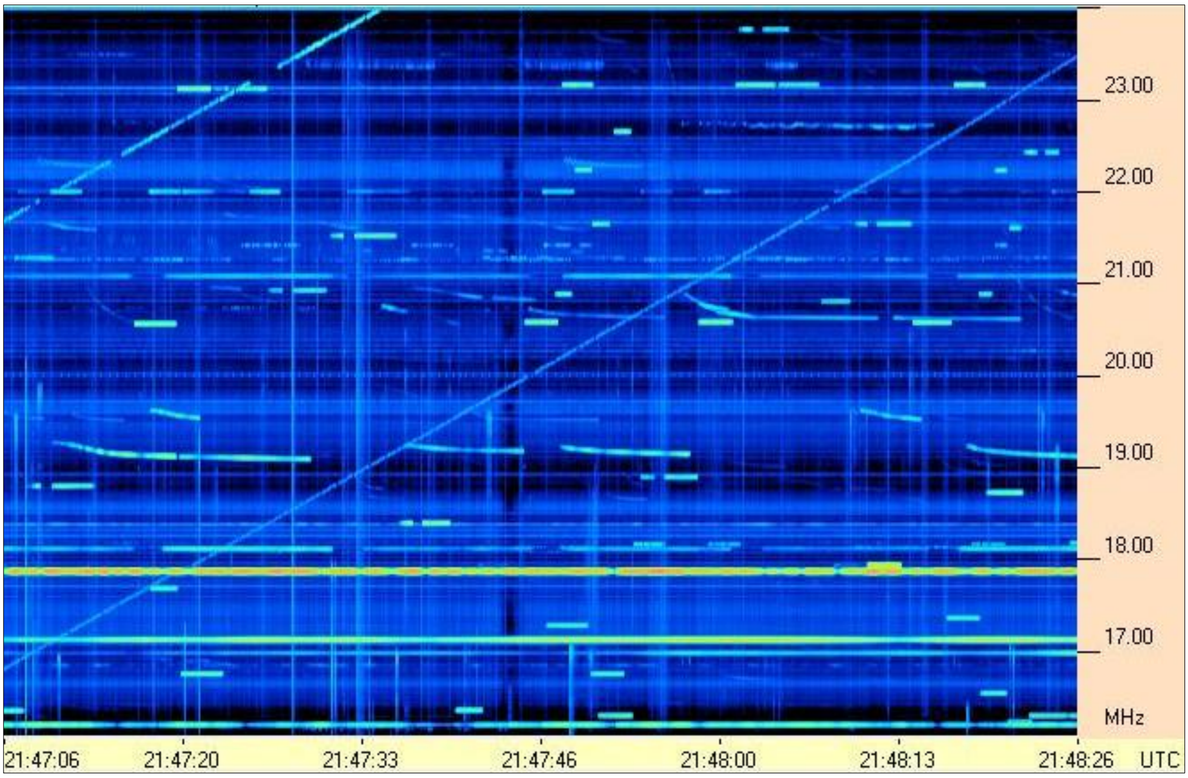
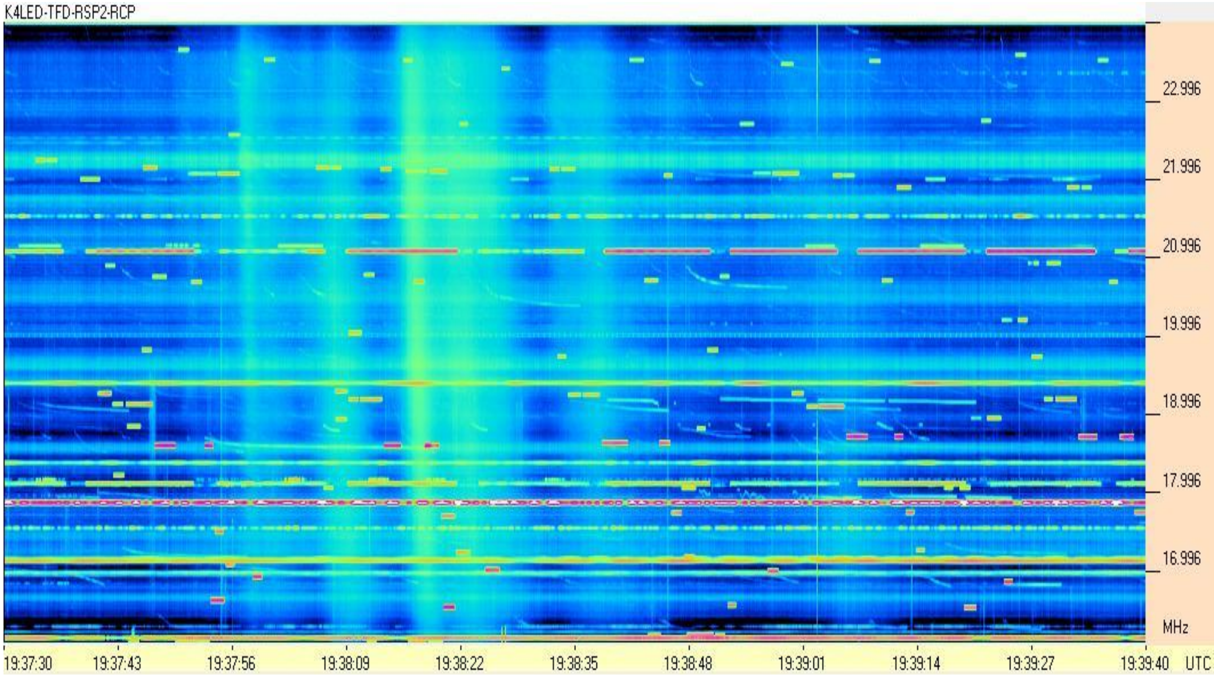


Figure 11a Recent Evening Localized Jupiter Signal data correlated with Location: High Springs, FL Lat/Lon: 29.8369/-82.621School: AJ4CO Observatory on 14th July, 2022



https://radiojove.net/archive/data/220714214706K4LED-TFD-RSP2-RCP.JPG

Figure 12 Recent Night Localized Jupiter Signal data correlated with Location: High Springs, FL Lat/Lon: 29.8369/-82.621School: AJ4CO Observatory on 14th July, 2022

5. Conclusion

The Super SID monitor and Radio JOVE installed and the antennas constructed have been confirmed to be working accurately as confirmed by comparisons with results from satellite data via GOES 13 and other ground base observatories particularly the event of 16th July, 2019 vis-avis the localised observation at the Federal Polytechnic, Ado-Ekiti till recent data of 14th July, 2022 The data collected showed sunrise and sunset signatures which are indications that the monitor is sensitive to changes in Ionospheric electron density. Hence, the installation of the Super SID monitor at the Federal Polytechnic, Ado-Ekiti has been working optimally.

The associated space weather phenomena which cause the Sudden Ionospheric Disturbance was not ascertained as the GOES 13 showed that similar signatures appeared in both Solar flare observatory and the Gamma Ray emissions observatory database on the same day.

The research involved a start-up investigation of extraterrestrial radio frequency signals. A very low frequency receiver called the radio JOVE receiver was assembled using the circuit schematics. A dipole antenna was also constructed, after all necessary testing have been completed, and the JOVE receiver was connected to the RGB coaxial cable of the dipole antenna. Softwares were used to capture the signals from about 500 million miles from the Jupiter and 93 million miles from the sun to our personal computer and outlined the strength and variations of these signals. The device was tested and confirmed working to amplify radio frequency signals from Jupiter.

Using the radio Jupiter pro3.8.3 and radio skypipe 2.6.5 softwares installed on the personal computer a graphical catalogue of the radio frequency signals was captured and plotted. The radiojove kit, with appropriate supervision, is an excellent educational tool. The kit constructed and successfully set up achieved among other things the following:

- The project students were educated about the basis of radio astronomy and the danger exposed, from the extraterrestrial bodies due to emissions, especially Jupiter and the Sun.
- Provided an opportunity to experience the scientific process,
- Created a link with a worldwide net of observers connected through the internet, and
- Facilitate the exchange of ideas between students and researchers at different locations

Compliance with ethical standards

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Disclosure of conflict of interest

There is no basis for any conflict of interest in the research work.

Statement of ethical approval

The research work meets all ethical considerations before submission.

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Authors short biography

Adesunloro Gbenga M. is the secretary of research meetings of the School of Science and Computer Studies; committee member, Centre for Research, Innovation and Development (CRID), member, E-Learning Committee of the School of Science and Computer Studies of the Federal Polytechnic, Ado-Ekiti and member of research seminar series of the department of Science Technology in the institution. He had supervised over 50 research students in groups and individually on various research areas. He is a professional member of the Nigeria Institute of Physics and the Society of Amateur Radio Astronomers. He is a mentor to many youth groups and organisations.