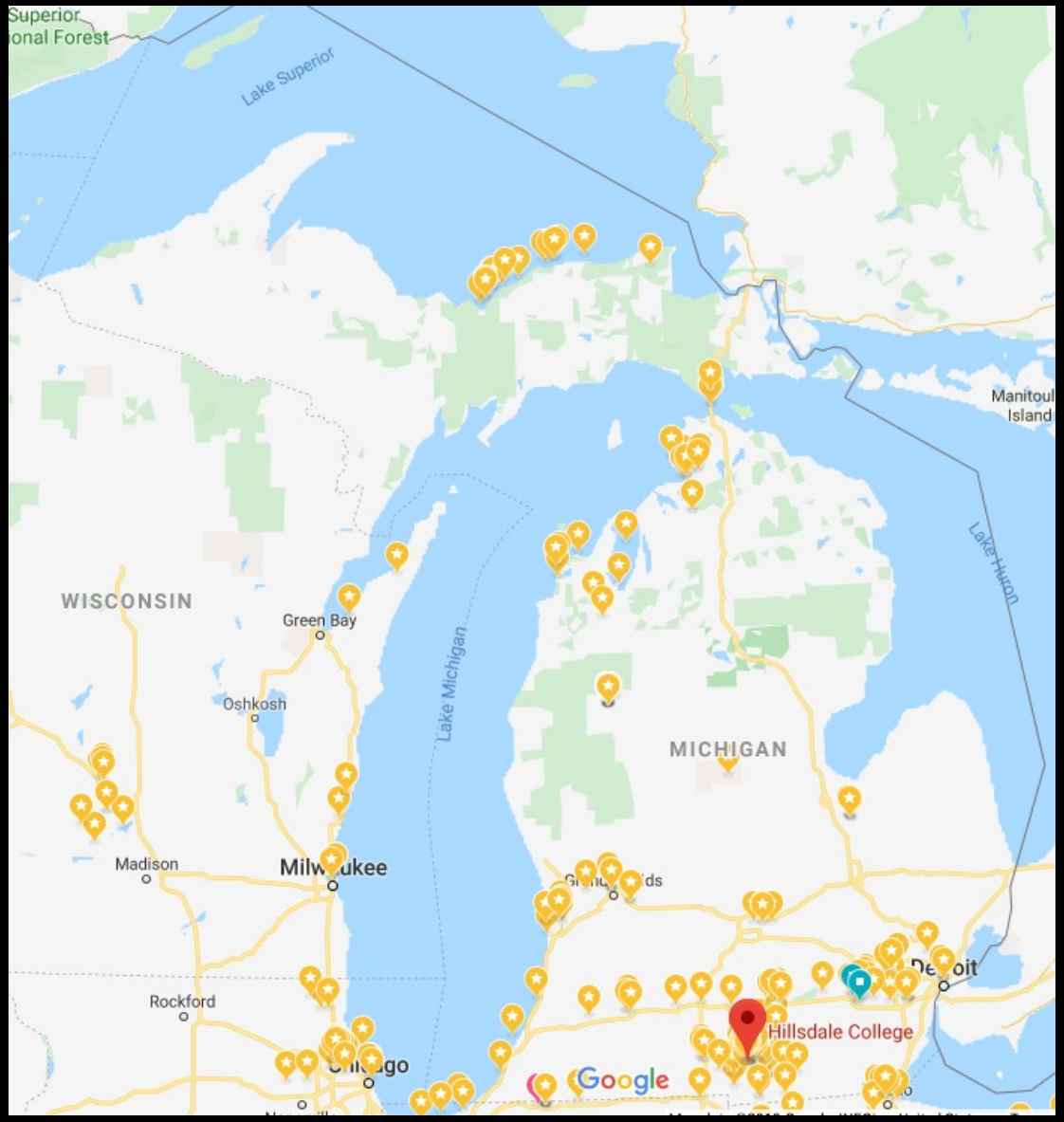
Observations at LWA Frequencies During the 2024 Total Solar Eclipse

Timothy Dolch[1,2], Jacob Agresta[1], Luke Avery[1], Louis Dartez[3], Alex Dulemba[1], Tom Hagen[4], Joe Helmboldt[5], Michael T. Lam[6], Sashabaw Niedbalski[1,7], Shane Smith[1], Sophia Sosa[8], Olivia Young[8]

[1]Hillsdale College, [2]Eureka Scientific, Inc., [3]Caltech, [4]SARA, [5]NRL, [6]SETI Institute, [7]Cornell, [8]RIT

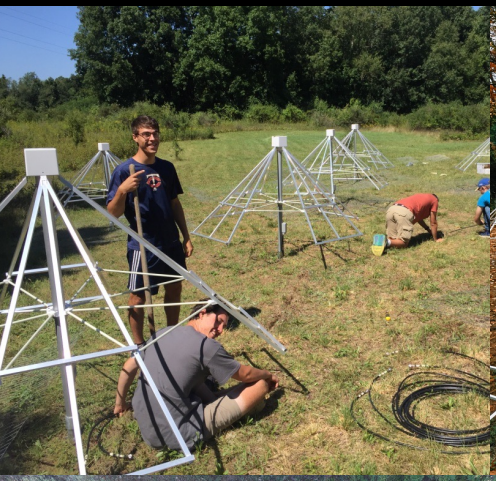
6/3/23

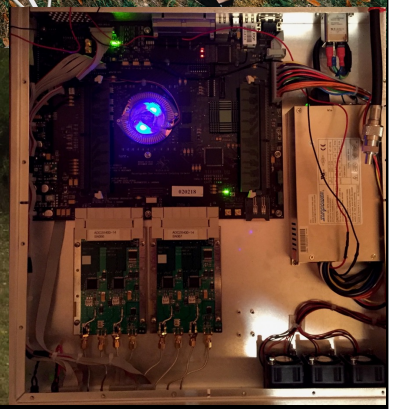
2023 LWA Users Meeting, UNM, Albuquerque, NM


Lake Superior
Manitoul
Island
Lake Huron
WISCONSIN
Green Bay
Oshkosh
Lake Michigan
MICHIGAN
Madison
Rockford
Hillsdale College
Google

An LWA-Swarm Pathfinder: The Low-Frequency All-sky Monitor

(Dolch et al. 2020; Dartez, Dolch et al. 2023 *in prep.*)



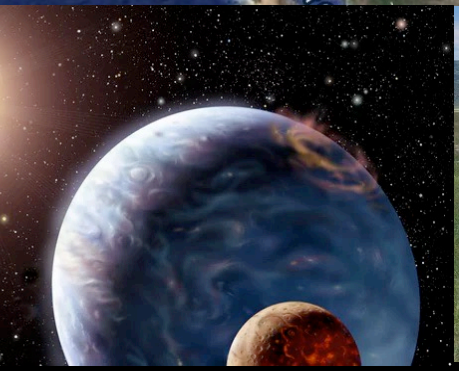


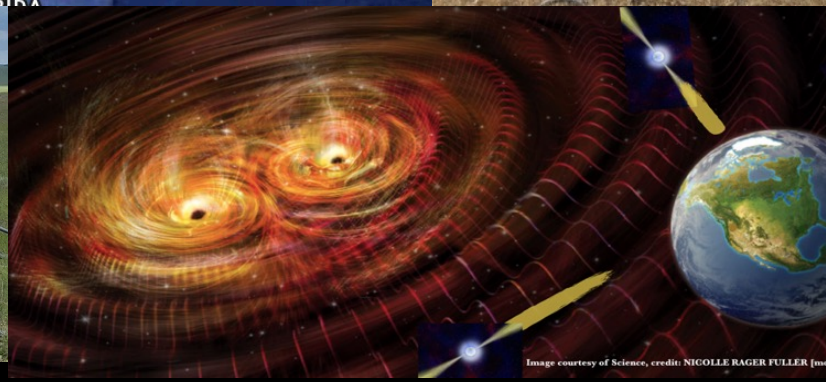
Hillsdale Students

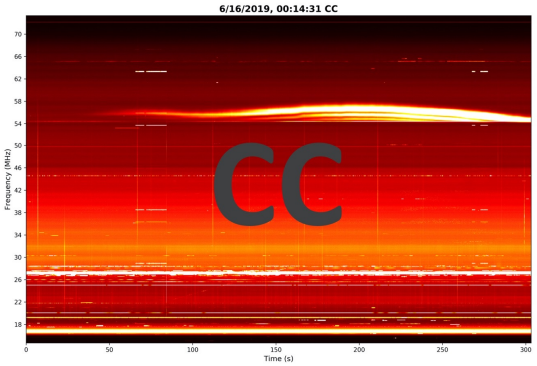
- **Shane Smith** (published SETI candidate in Nature Astronomy; now Aerospace Corporation)
- **Philip Andrews** (Notre Dame Aero. Eng. Ph. D. candidate)
- **Sasahabaw Niedbalski** (Cornell Astronomy Ph. D. candidate)
- **Caleb Ramette** (U. of Utah Materials Science Ph. D. candidate)
- **Laura Salo** (UMN Astrophysics Ph.D. candidate)
- **Jay Rose** (U of. Cincinnati Mech. Eng. M. Sc.)
- **Joseph Harvey** (data science with Aunyltics)
- **Nick West** (Applied Math graduate student at Oxford)
- **Evan Anthopoulos** (IRES radio astronomy student in Australia)
- **Alex Dulemba, Nathaniel Birzer, Konrad Ludwig**


202
204
204
178

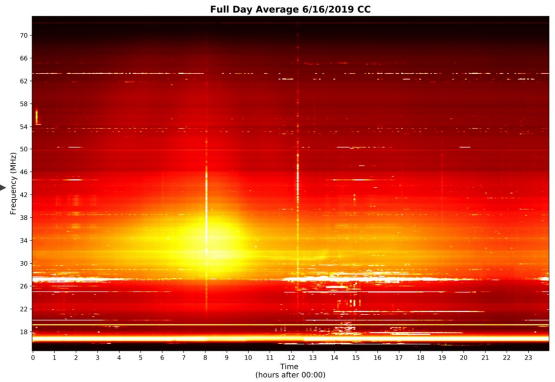
The LWA-Swarm: 64-antenna mini-stations
(G. B. Taylor… T. Dolch et al., 2019)



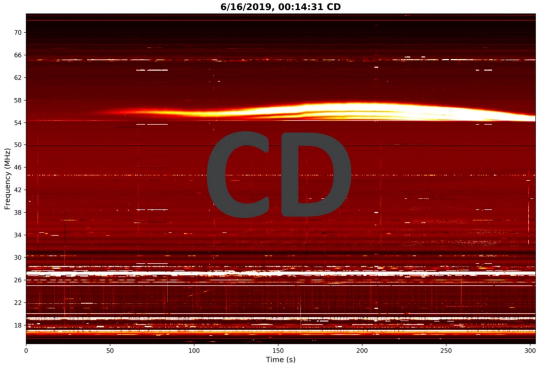


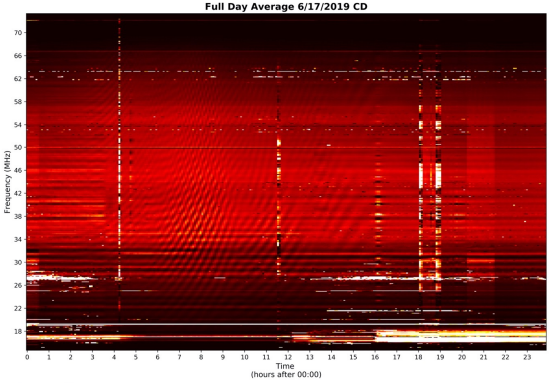


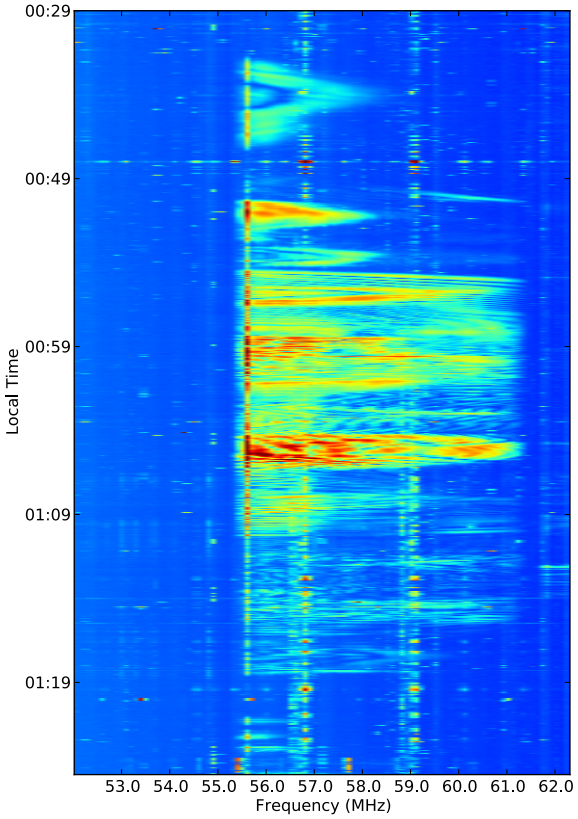
Two five-minute long LoFASM arrays, with 1024 frequency bins and 3615 time bins.



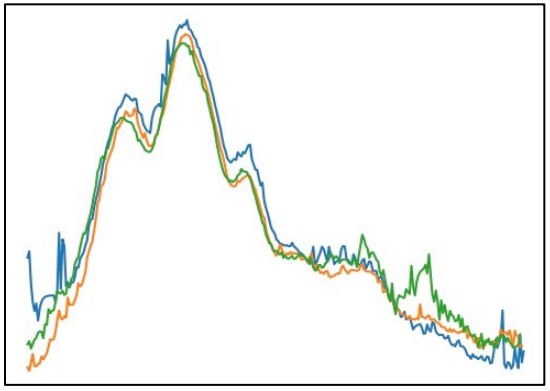
A full day of LoFASM data concatenated from 282 1d arrays, producing a 1024x282 array for channels CC and CD.

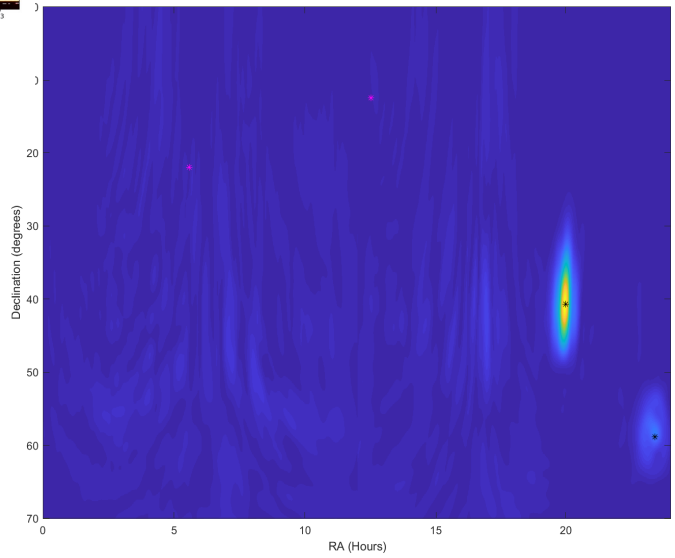




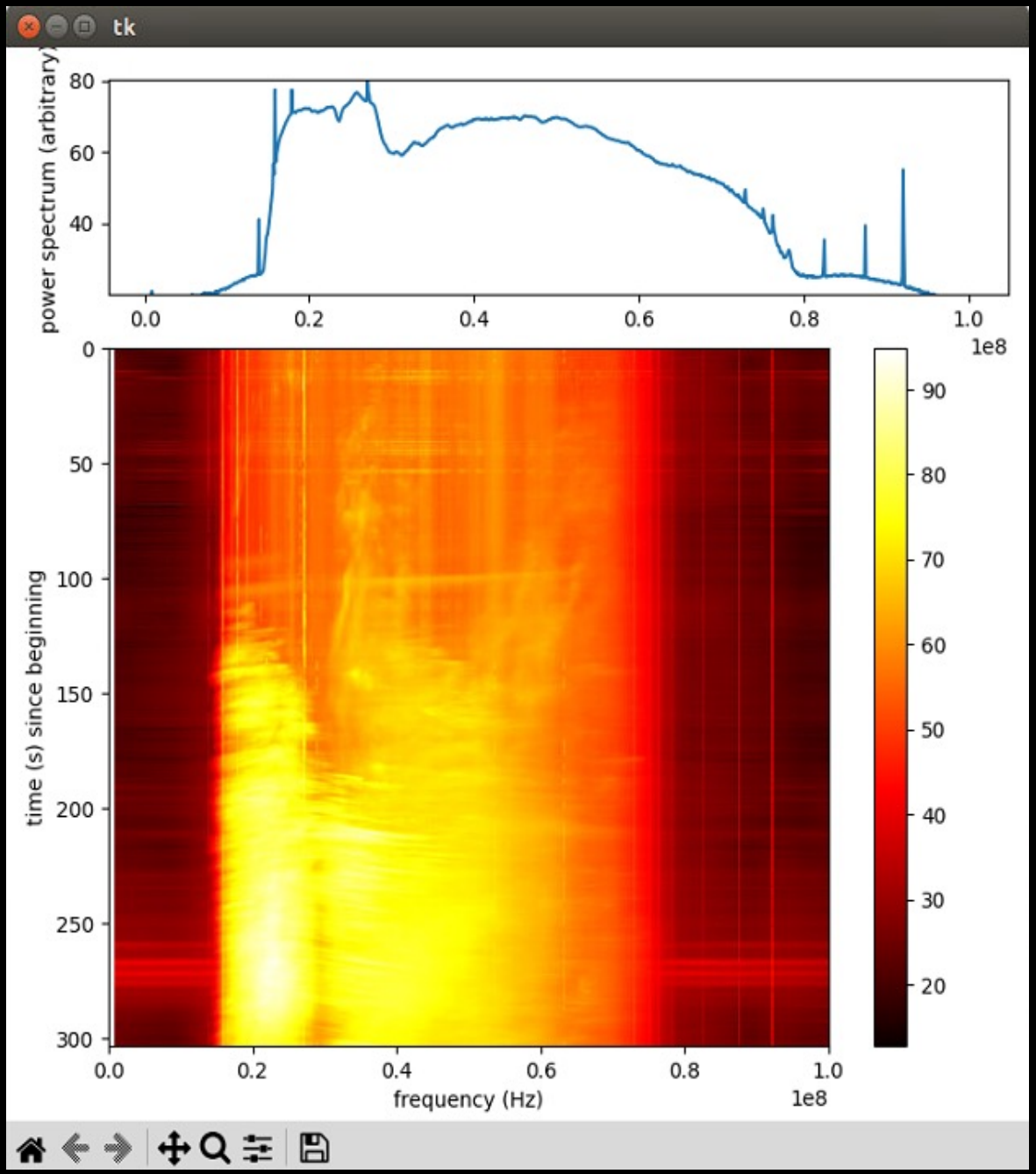


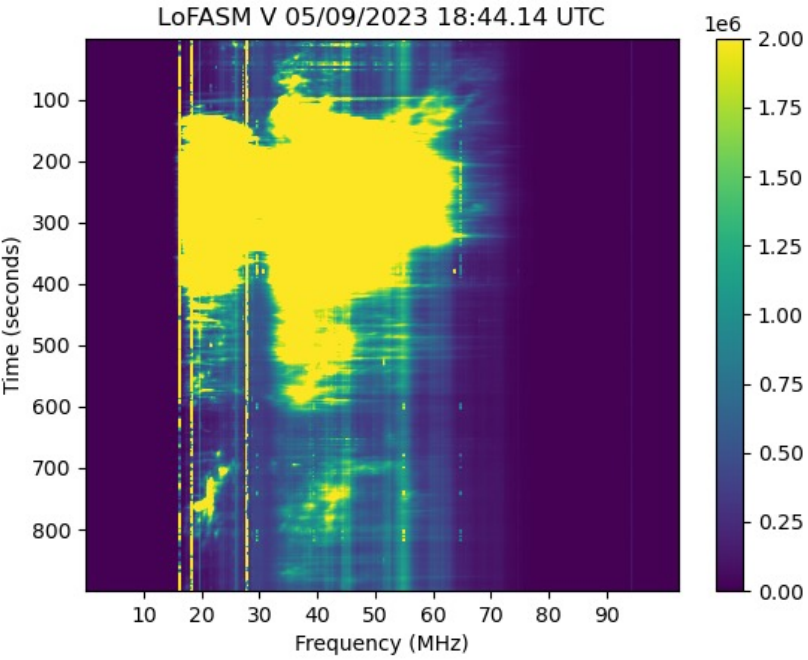
Arrays are averaged across the frequency bins to produce a 1d array, 1024 in length.





- Explorebbx2d software can quickly look at LoFASM spectrograms, developed by Louis Dartez
- Luke Avery, Jacob Agresta (Hillsdale College students) doing LAUREATES summer research project on solar radio bursts
- More detailed views offline in matplotlib

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1.50
1.25
1.00
0.75
0.50
0.25
0.00
Time (seconds)
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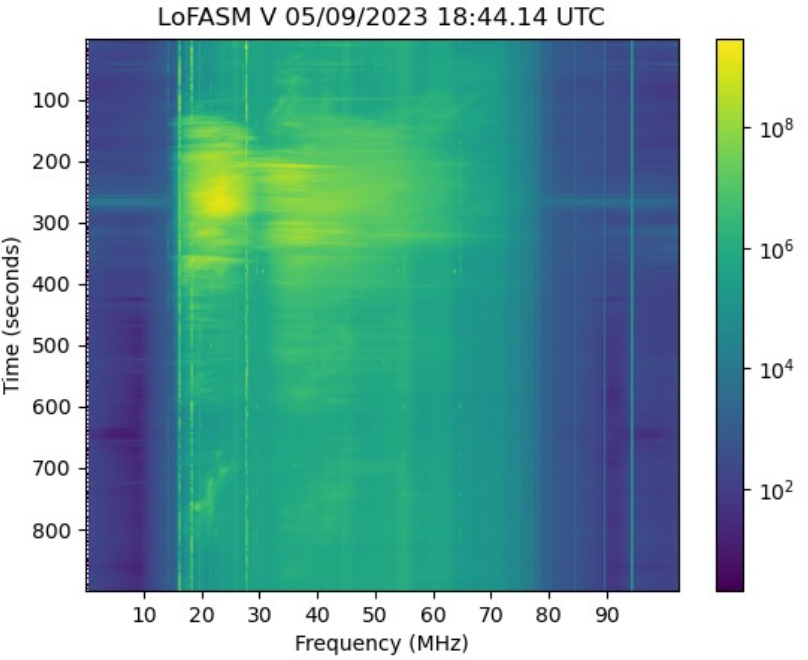
200
300
400
500
600
700
800
10
20
30
40
50
60
70
80
90
Frequency (MHz)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10^8
10^6
10^4
10^2
Time (seconds)
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300
400
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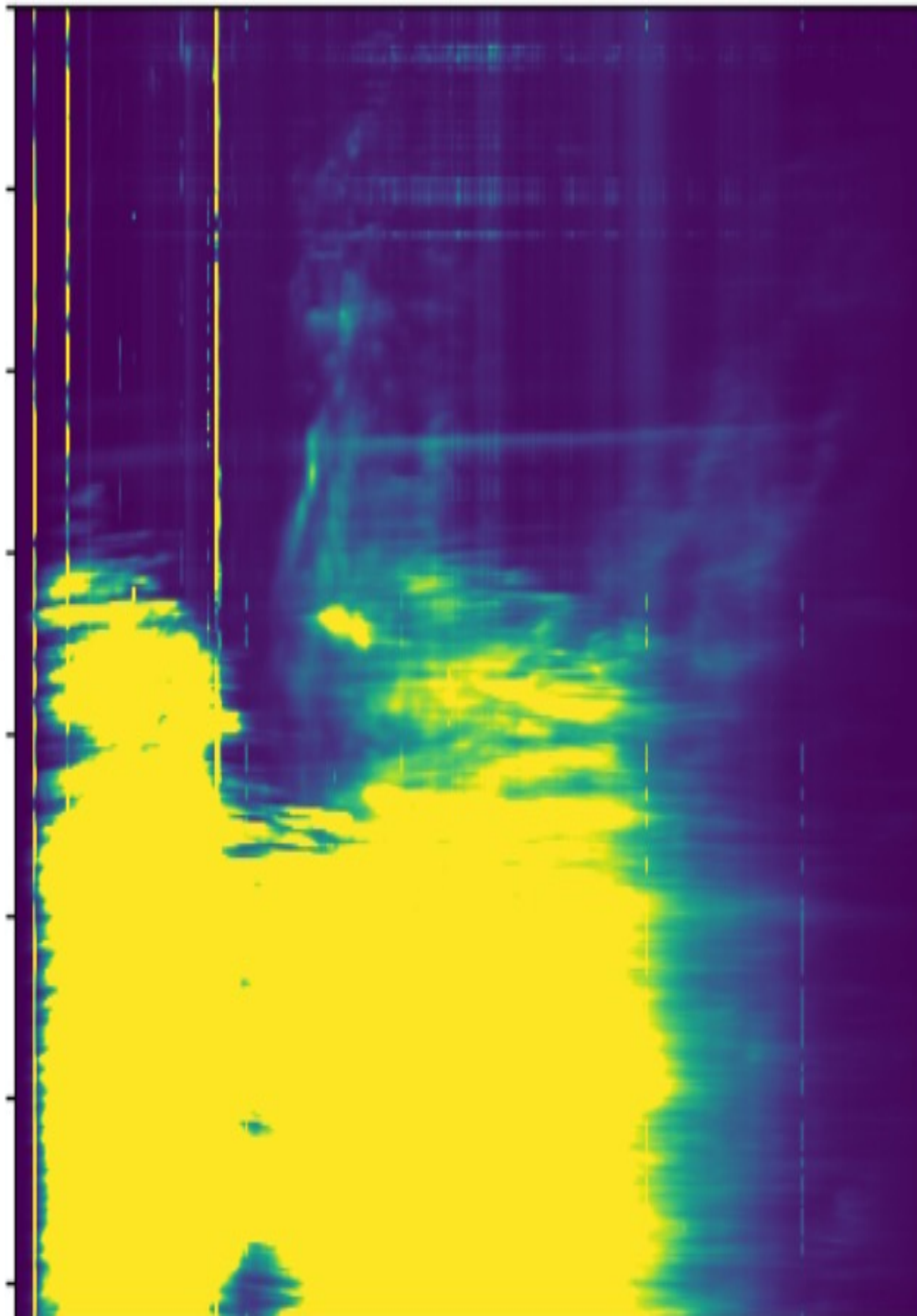
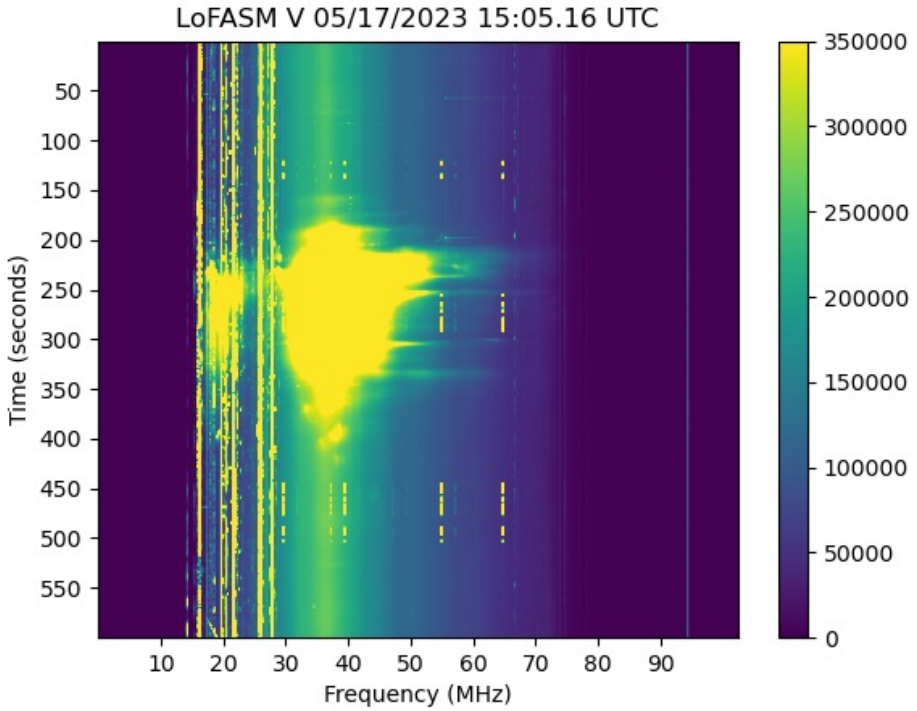
20
30
40
50
60
70
80
90
Frequency (MHz)

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Frequency (MHz)
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300000
250000
200000
150000
100000
50000
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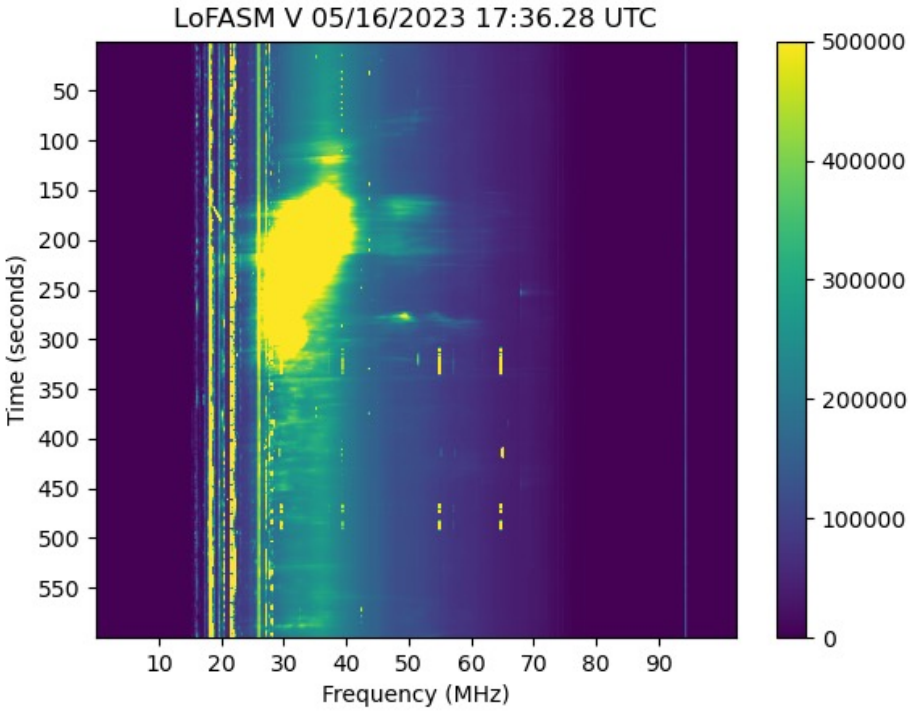
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Frequency (MHz)
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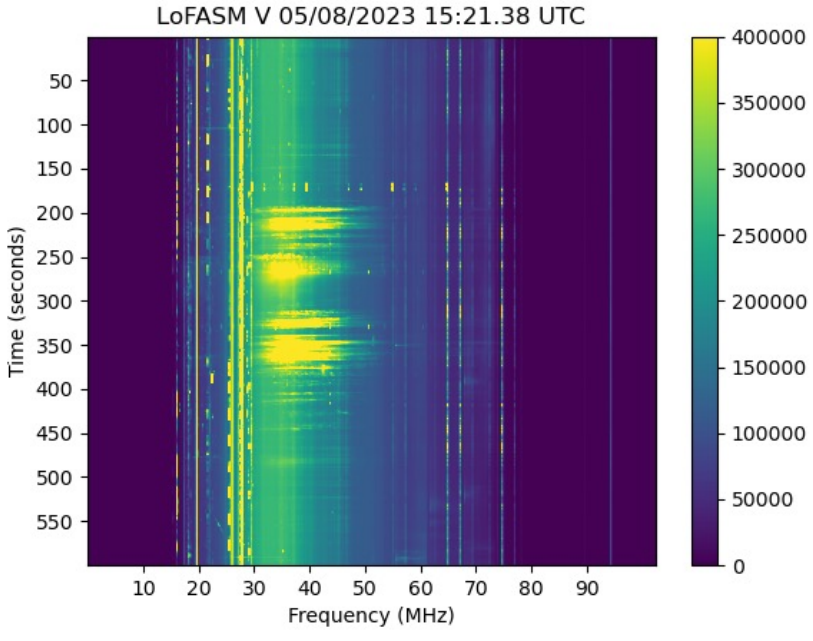
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Frequency (MHz)
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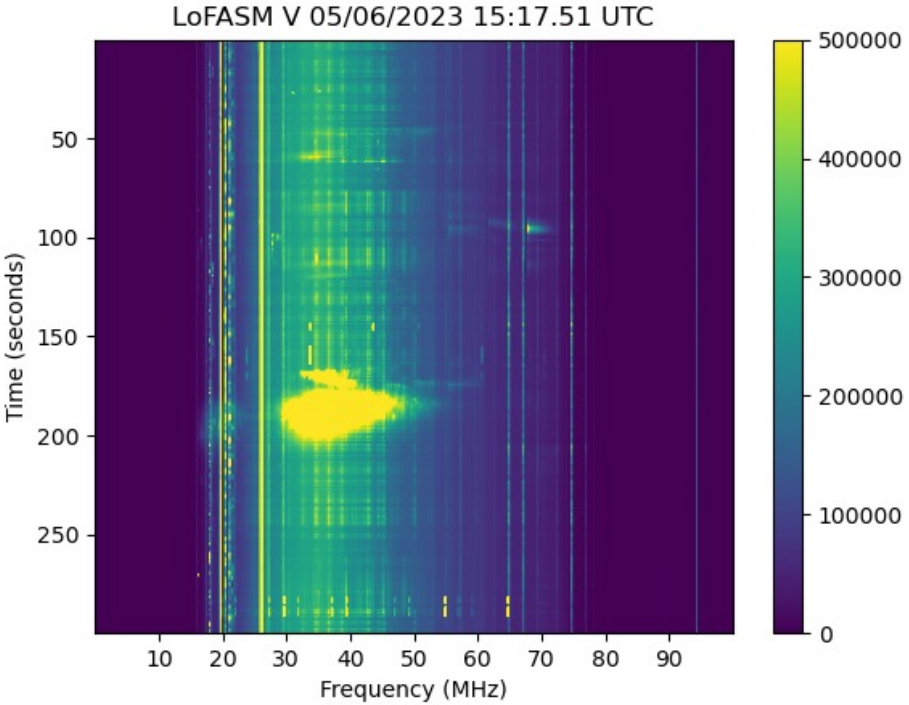
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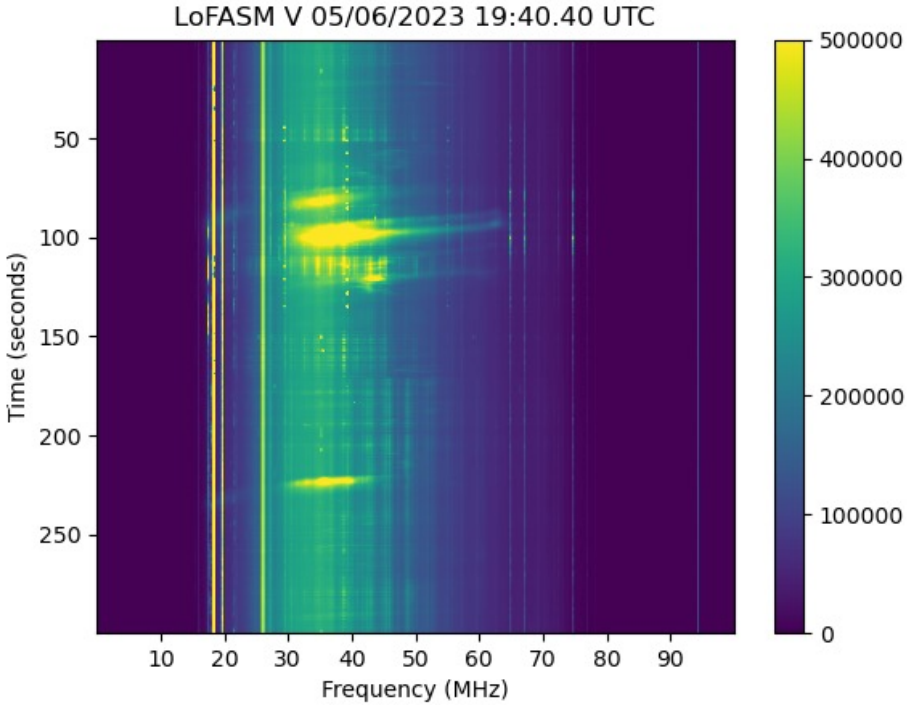
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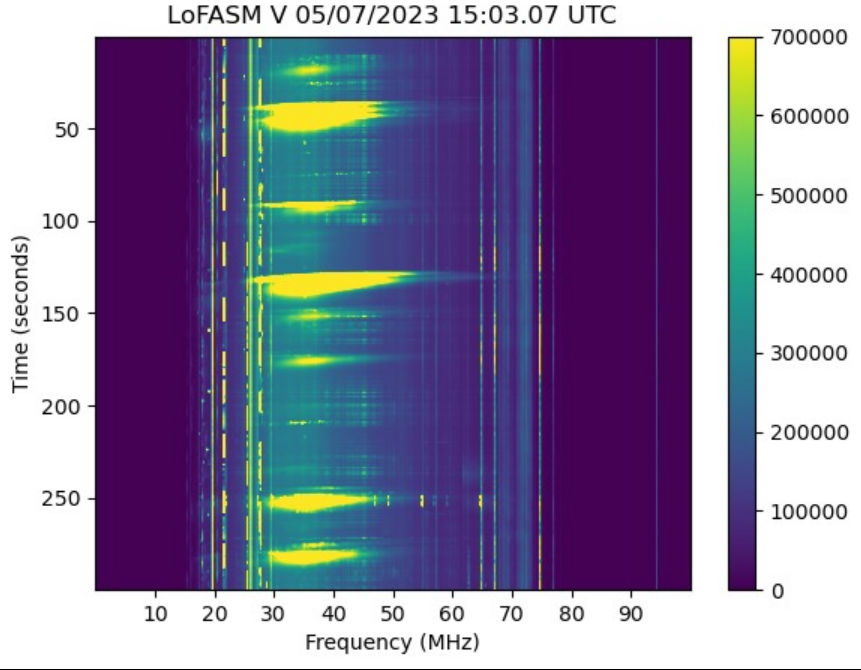
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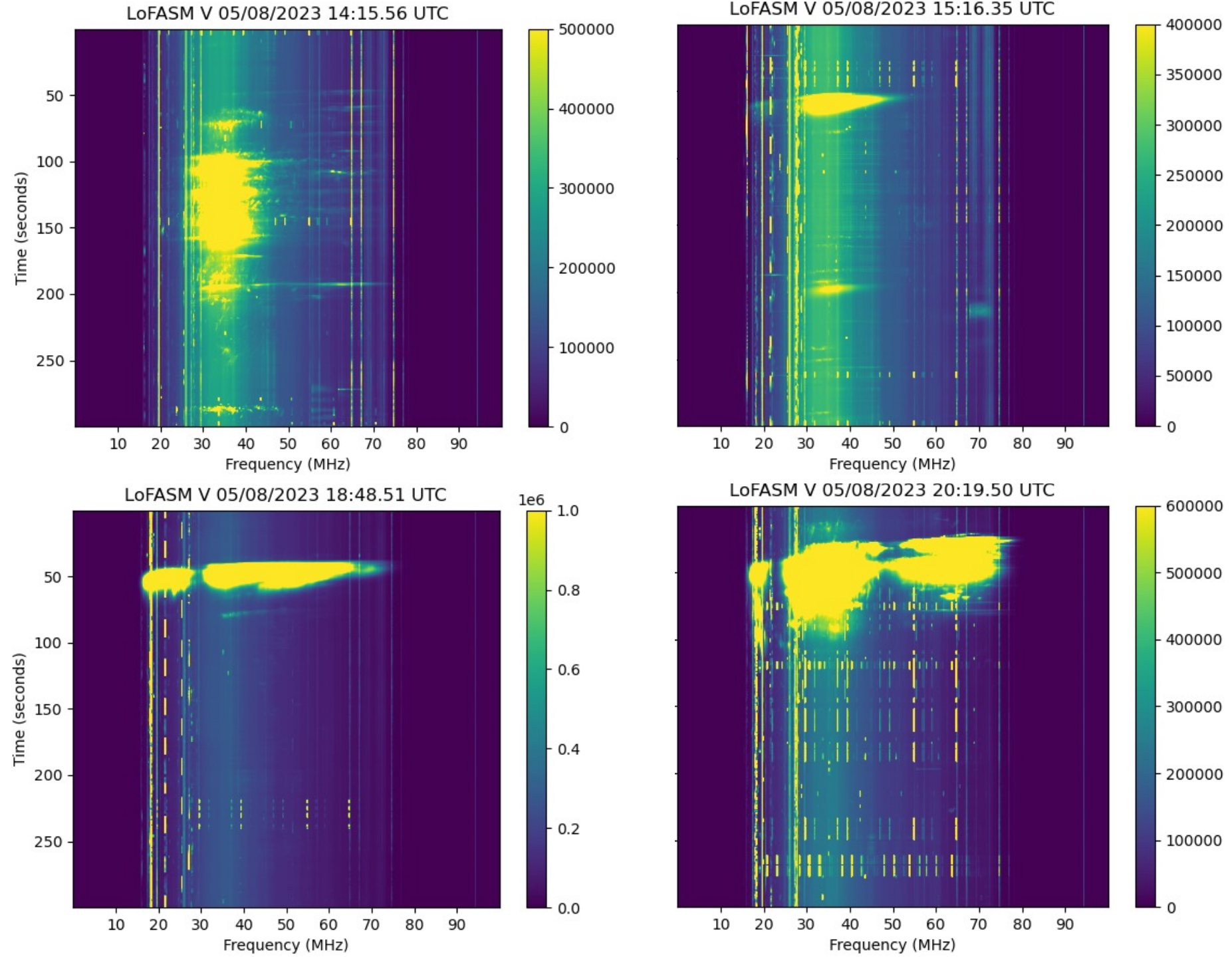
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LoFASM V 05/08/2023 15:16.35 UTC
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LoFASM V 05/08/2023 20:19.50 UTC
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Frequency (MHz)
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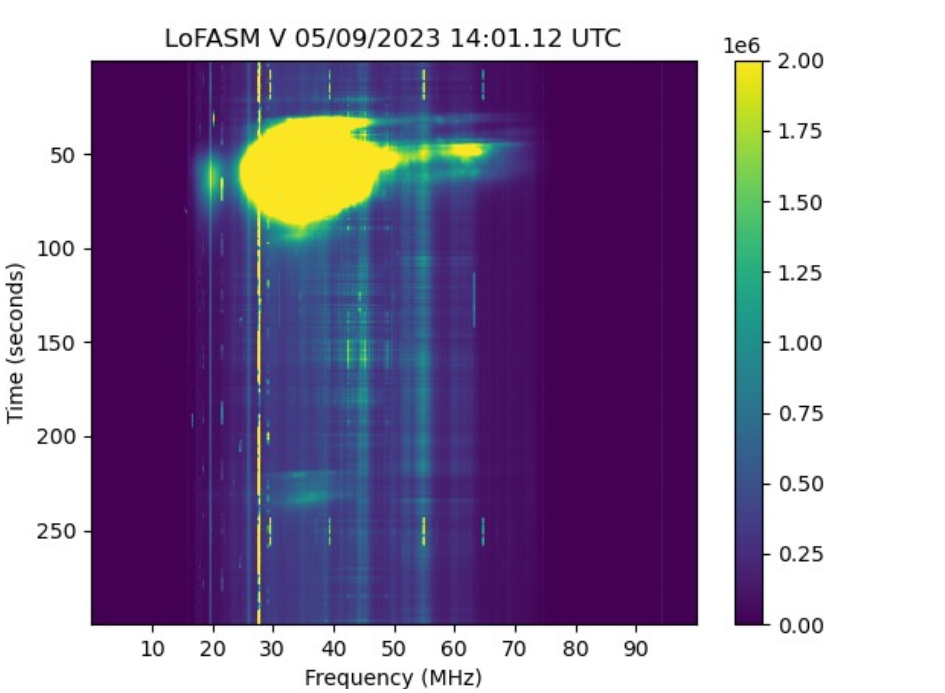
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1.00
0.75
0.50
0.25
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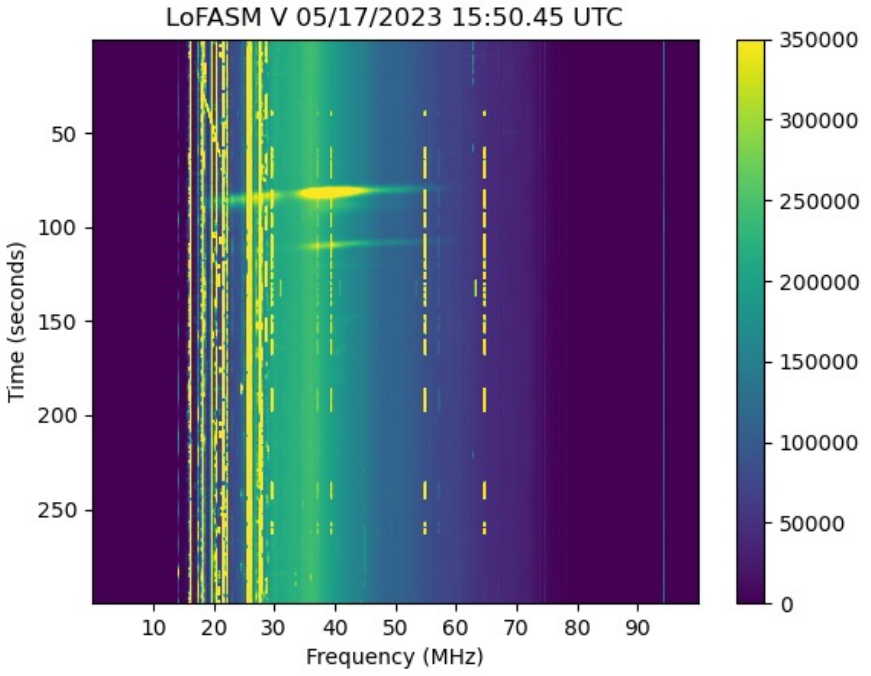
40
50
60
70
80
90
Frequency (MHz)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80
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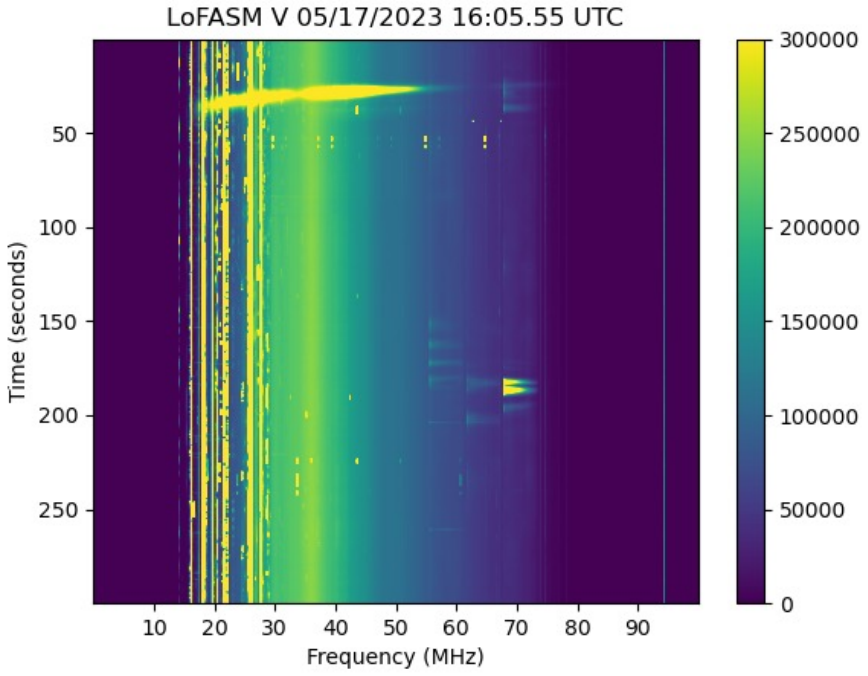
Frequency (MHz)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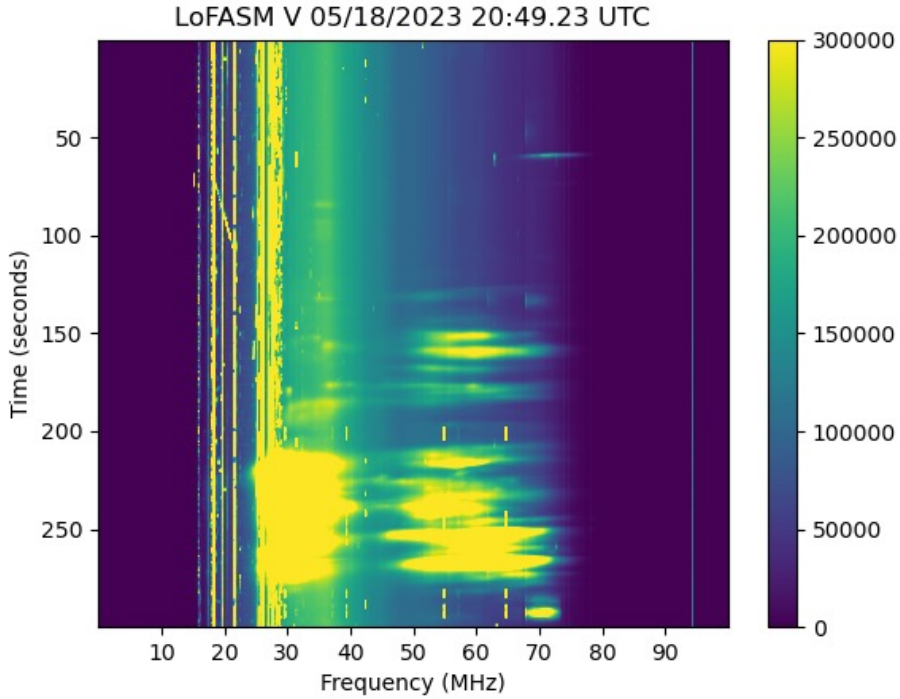
Frequency (MHz)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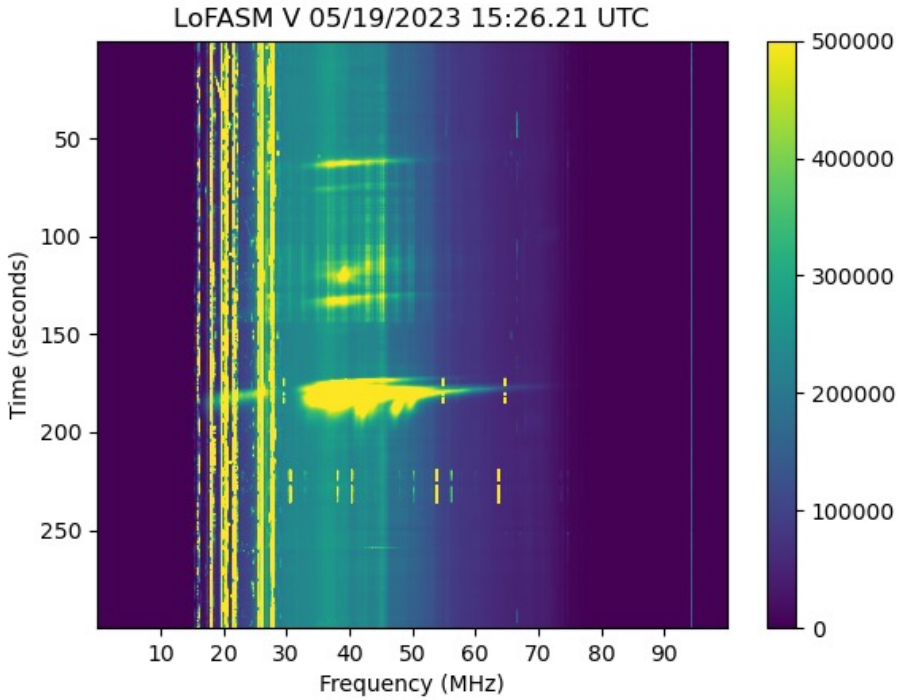
LoFASM V 05/19/2023 15:26.21 UTC
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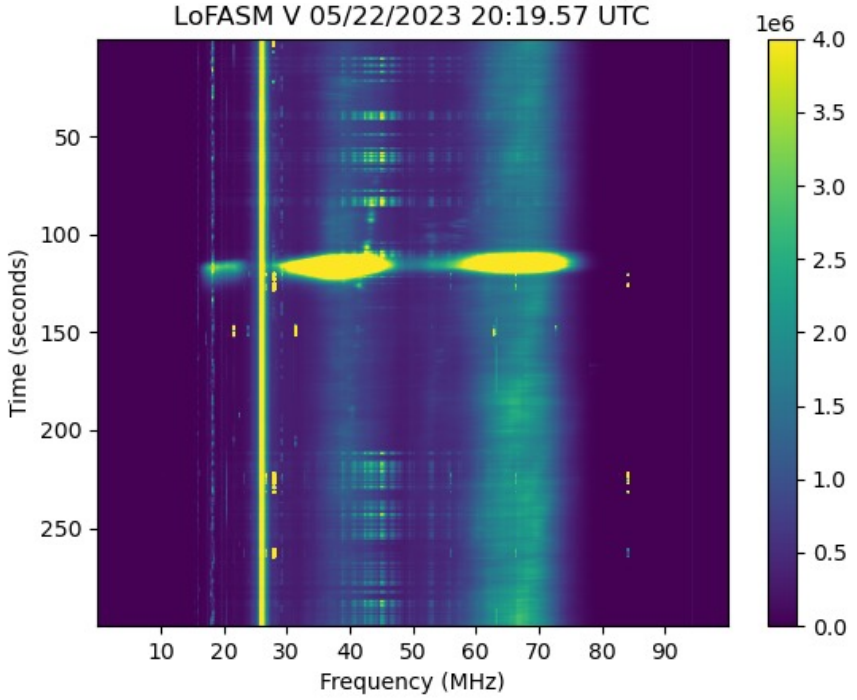
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3.0
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2.0
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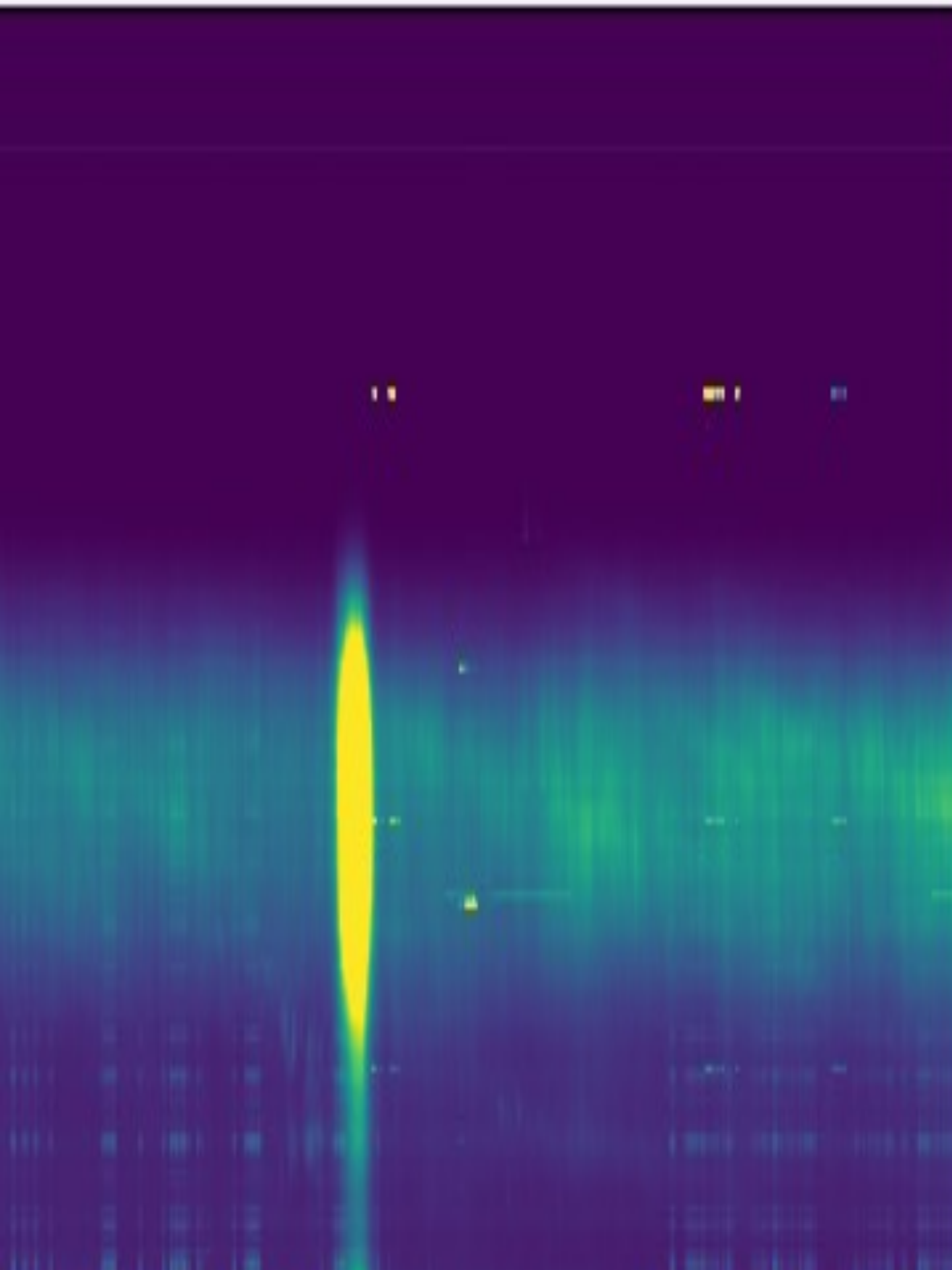
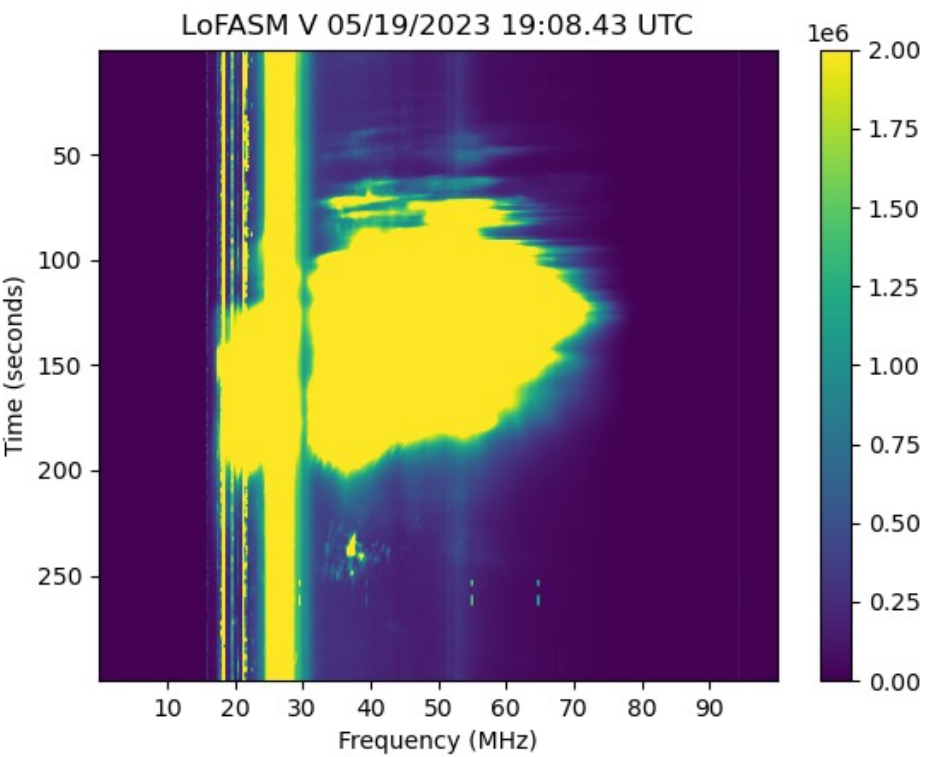
0.0

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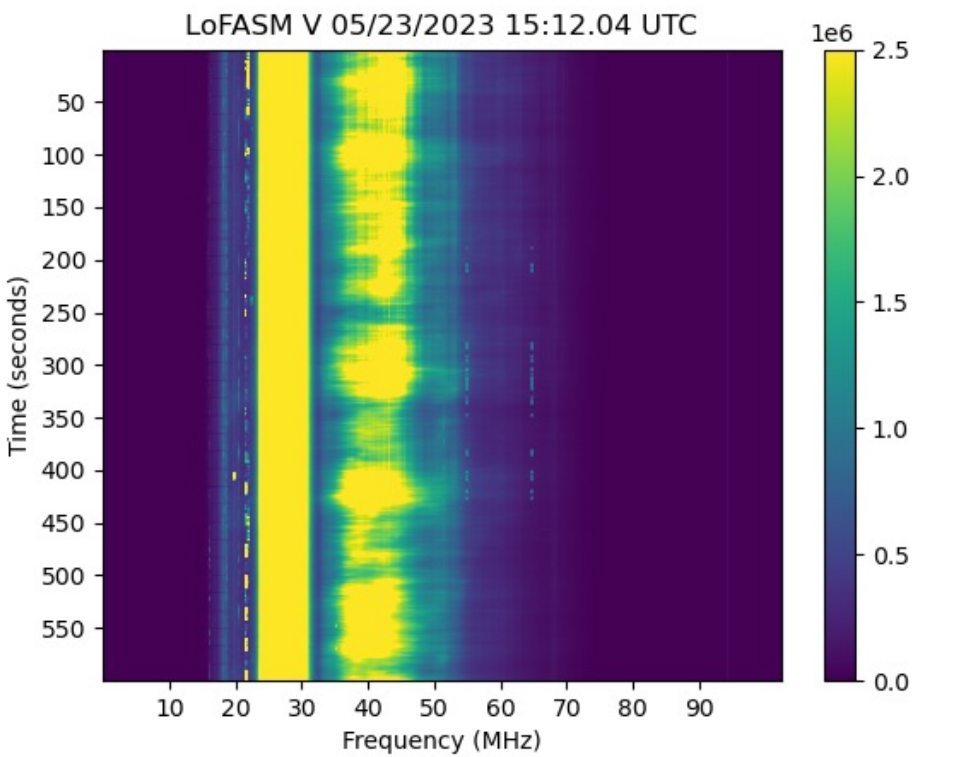
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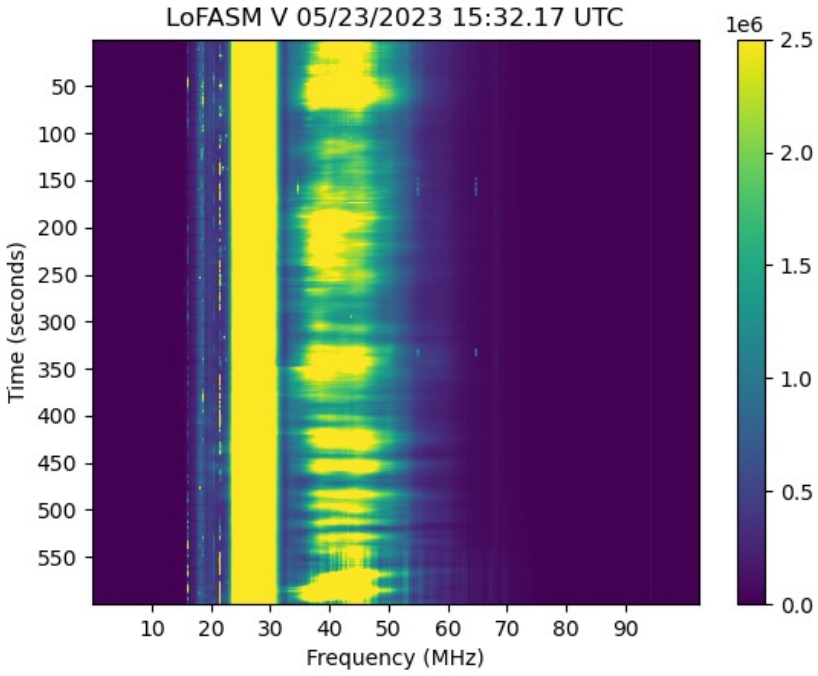
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Frequency (MHz)
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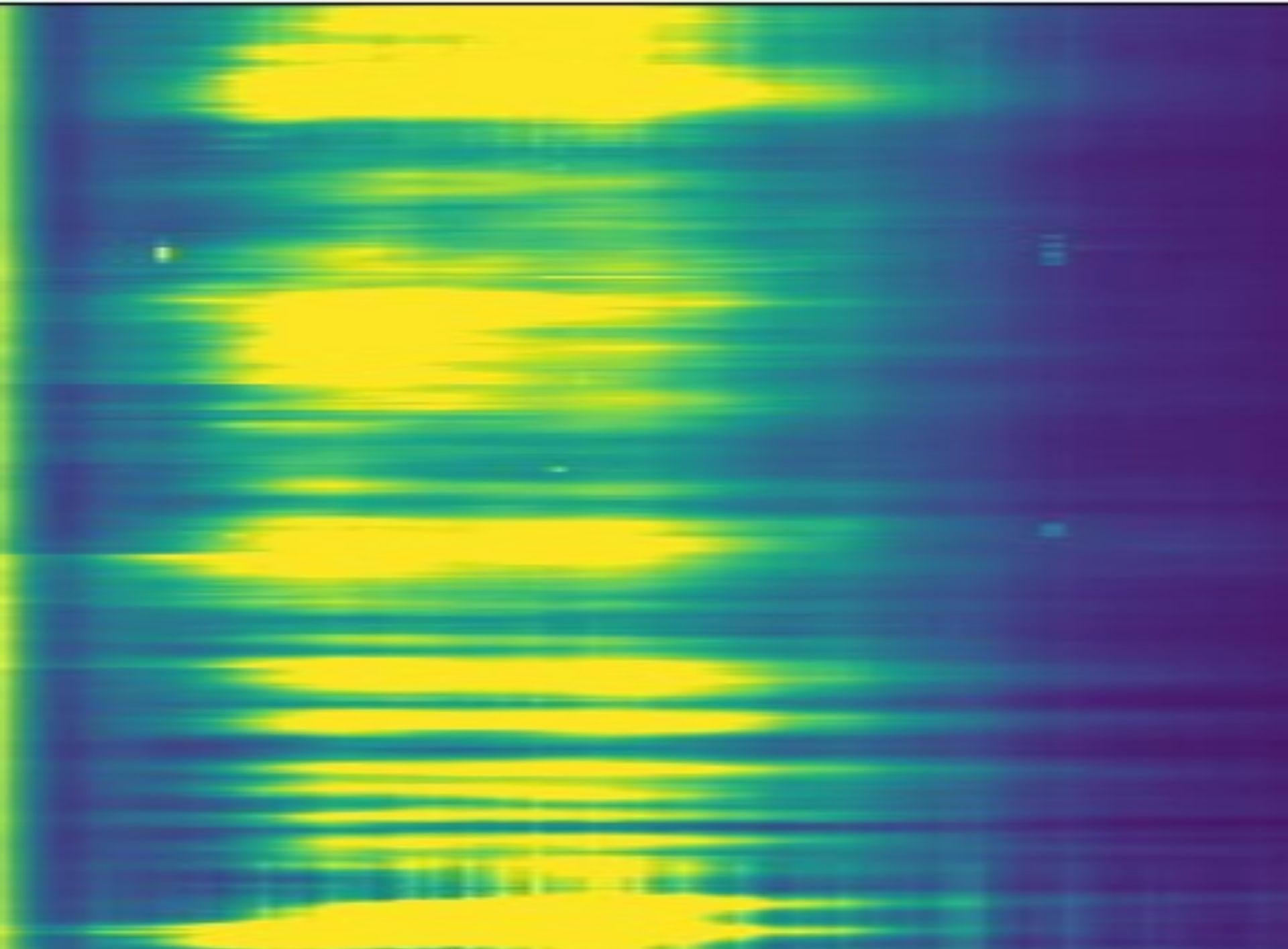

LoFASM BBX File Viewer

Welcome to LoFASM, dolcht

NEXT PLOT | SAVE ANOMALIES | File Number: 8 of 120

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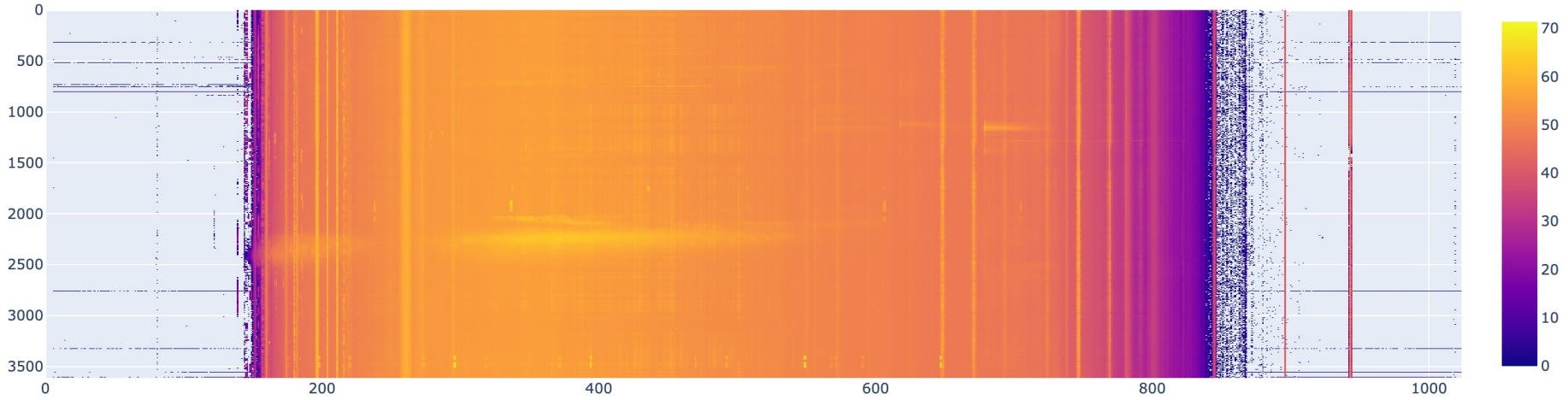


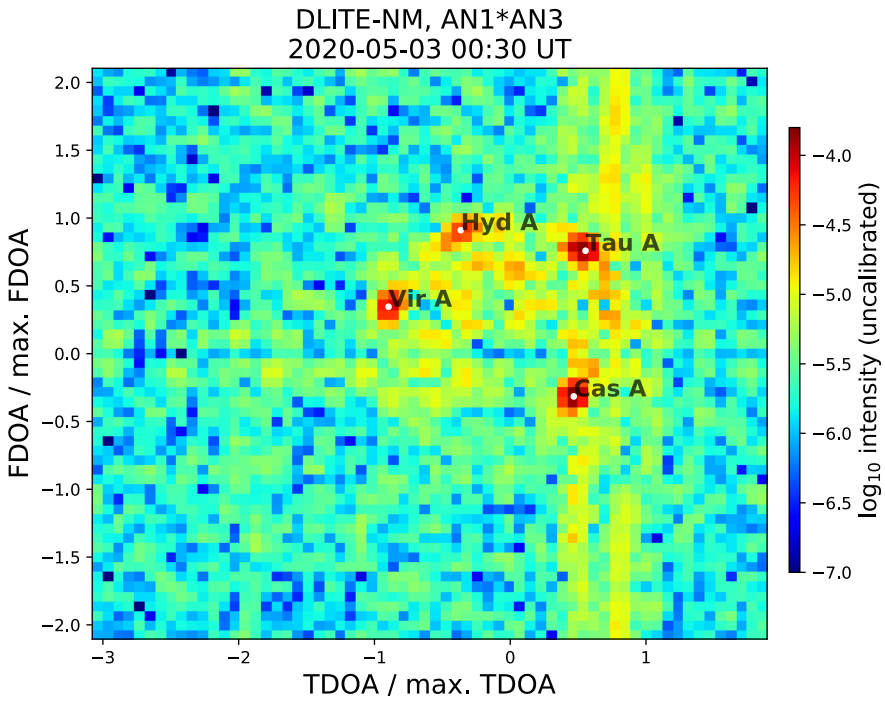
Anomaly List

Callbacks | 0 Errors | Server

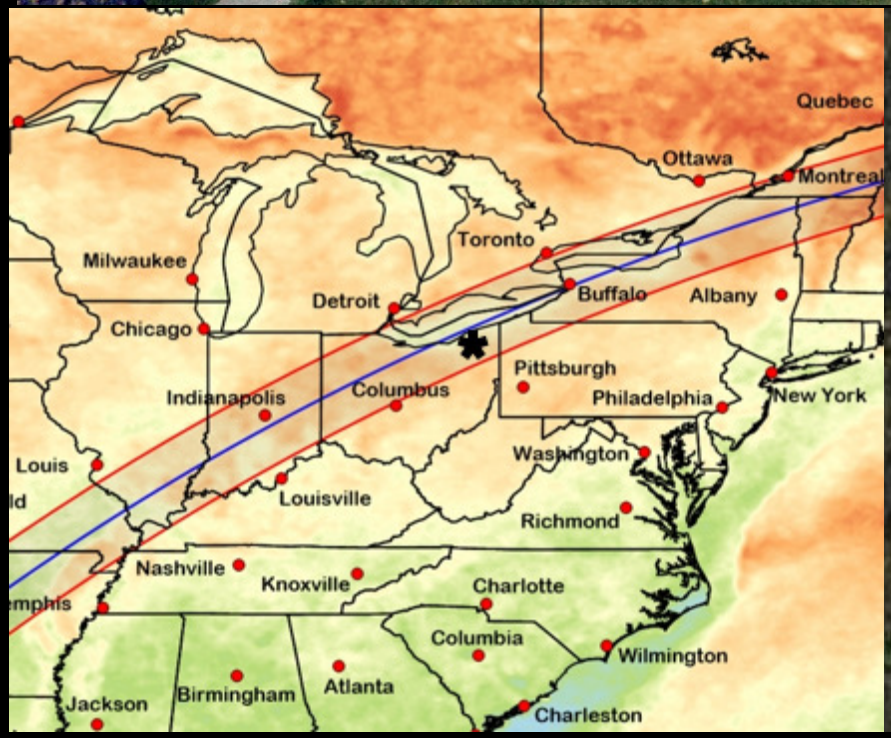
Online student viewer. Courtesy Tom Hagen, Society of Amateur Radio Astronomers

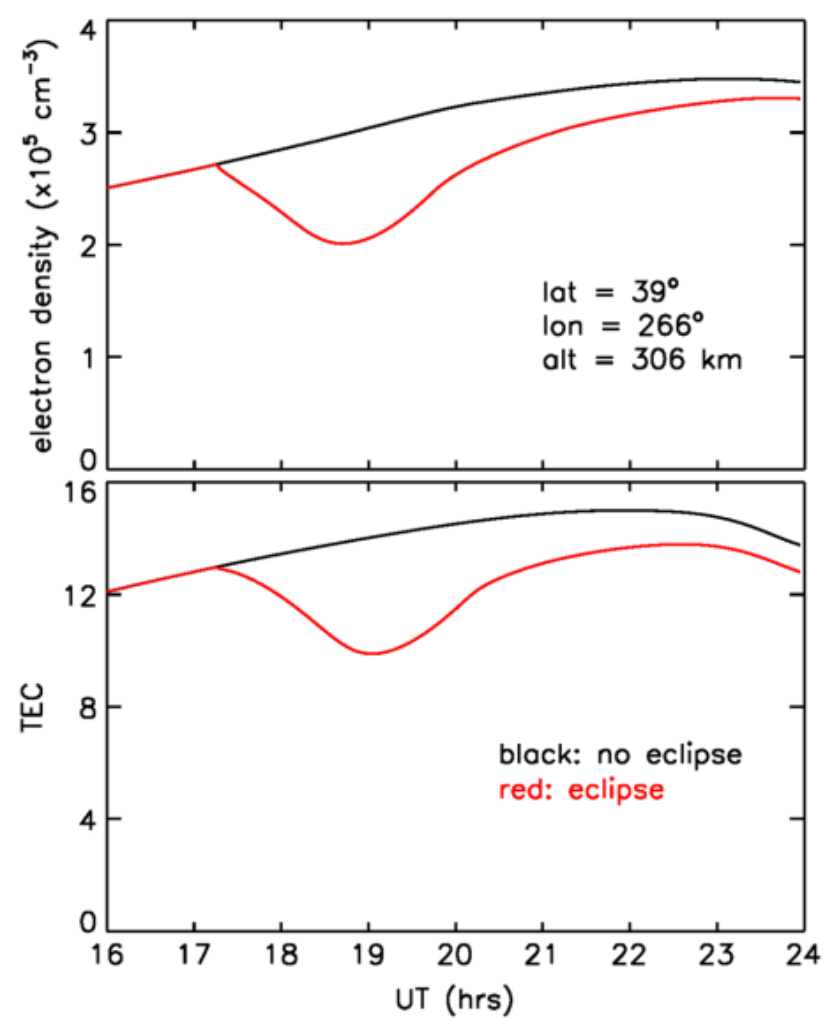
Deployable Low-Band Ionosphere and Transient Experiment (DLITE)

(Helmboldt et al. 2021)



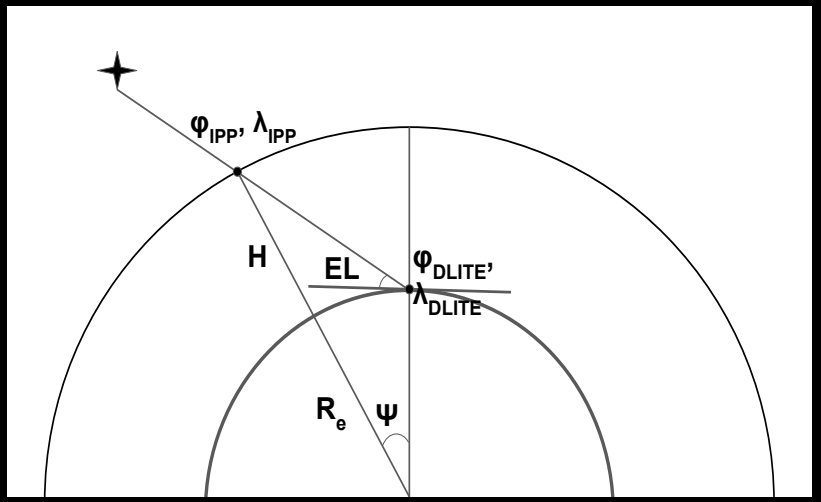
Observatory Park, Montville, OH (International Dark-Sky Association as a Silver Tier Dark Sky Park)



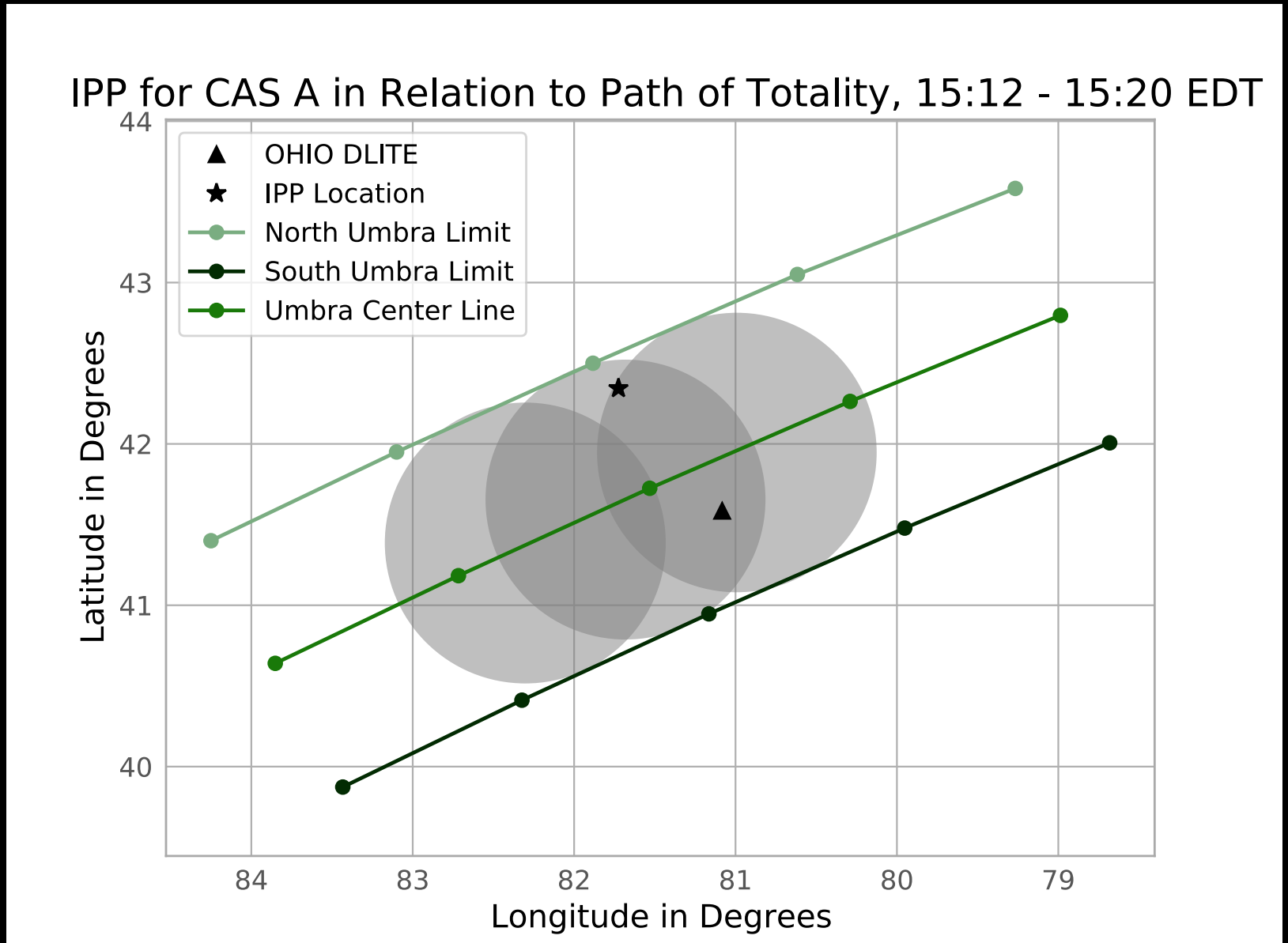


(Above) The electron density and the total electron content (TEC) as a function of time during the 2017 solar eclipse over the central United States in western Missouri (Huba & Drob 2017).

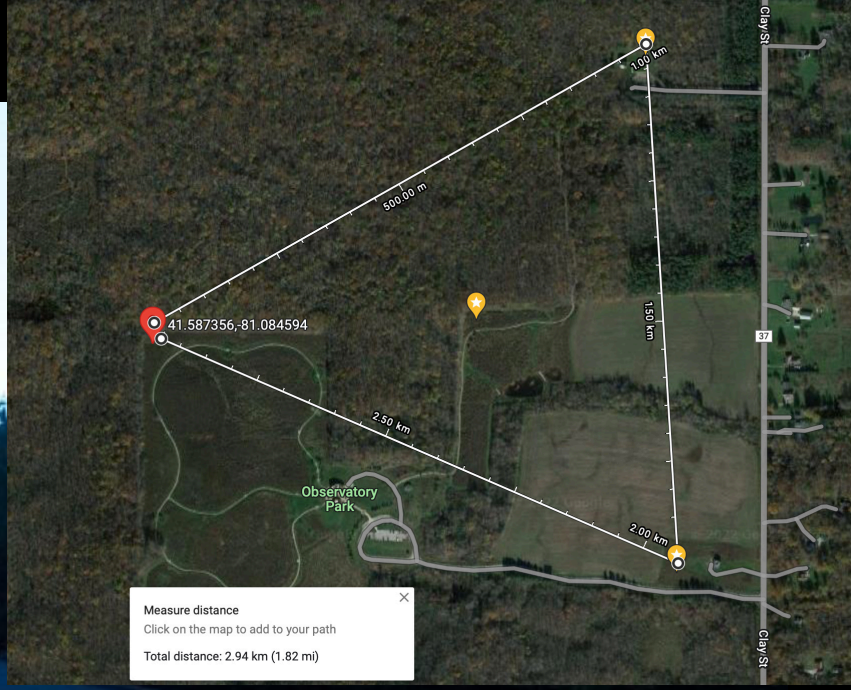
(Below) Configuration used to determine ionospheric pierce (IPPs) toward Cas A during totality (Sharma et al. 2018). An assumed airglow emission layer of 250 km was used to find the Cas A IPP location.



- Use A-team position changes to find TEC in totality ionosphere
- A-team scintillations to find density fluctuations during totality
- Image inner solar corona
- Solar radio bursts, sky background during eclipse? (LoFASM too)


IPP for CAS A in Relation to Path of Totality, 15:12 - 15:20 EDT
OHIO DLITE
IPP Location
North Umbra Limit
South Umbra Limit
Umbra Center Line
Latitude in Degrees
Longitude in Degrees
44
43
42
41
40
84
83
82
81
80
79


NASSAU


41.587356,-81.084594
500.00 m
1.00 km
1.50 km
2.50 km
2.00 km
Observatory Park
Clay St
37
Measure distance
Click on the map to add to your path
Total distance: 2.94 km (1.82 mi)