ИНСТИТУТ СОЛНЕЧНО-ЗЕМНОЙ ФИЗИКИ
СИБИРСКОГО ОТДЕЛЕНИЯ РОССИЙСКОЙ АКАДЕМИИ НАУК

The new radio spectropolarimeters for solar activity observations

Ivanov E. F., Lesovoi S. V.

eugenessrt@gmail.com

THE 15TH RUSSIAN-CHINESE WORKSHOP
ON SPACE WEATHER
September 9–13, 2024, Irkutsk, Russia

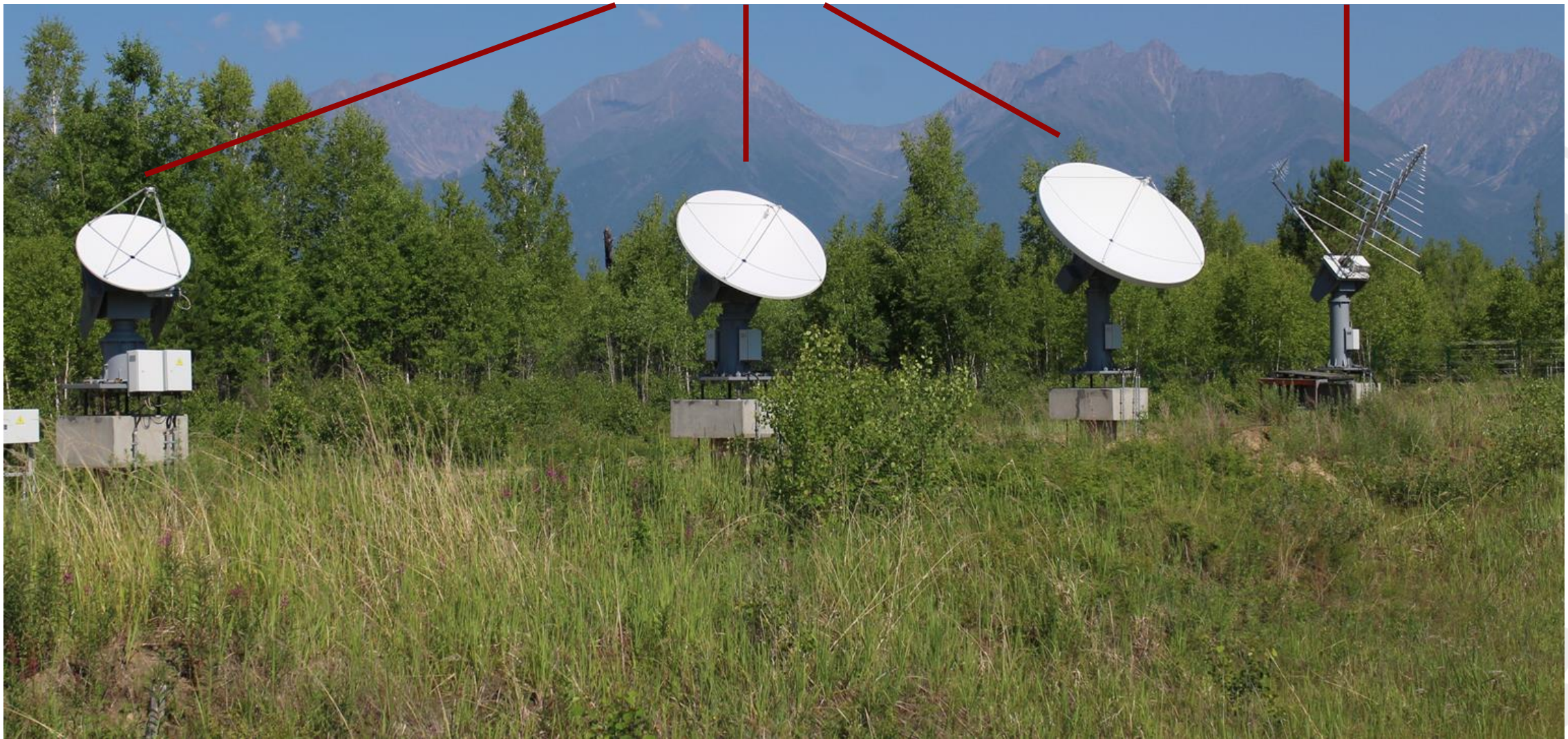
In December 2023 the Siberian Radioheliograph (SRH) started its operation

Three T-shaped arrays: 3-6, 6-12, 12-24 GHz

SRH have auxiliary instruments - SOLAr Radio SPEctro poLarimeters (SOLARSPEL)

SOLARSPEL 3 - 24 GHz

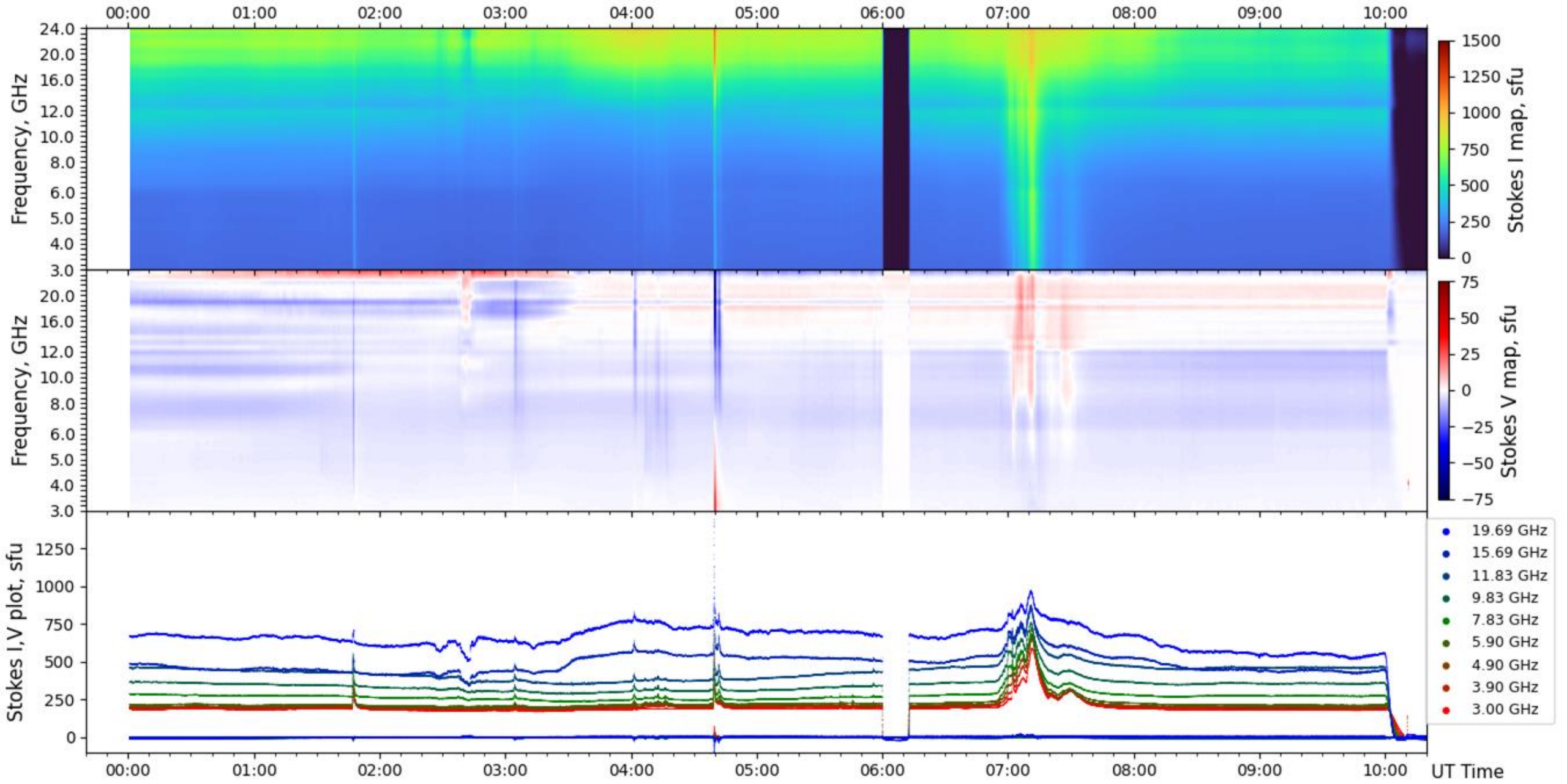
SOLARSPEL 50 - 3000 MHz



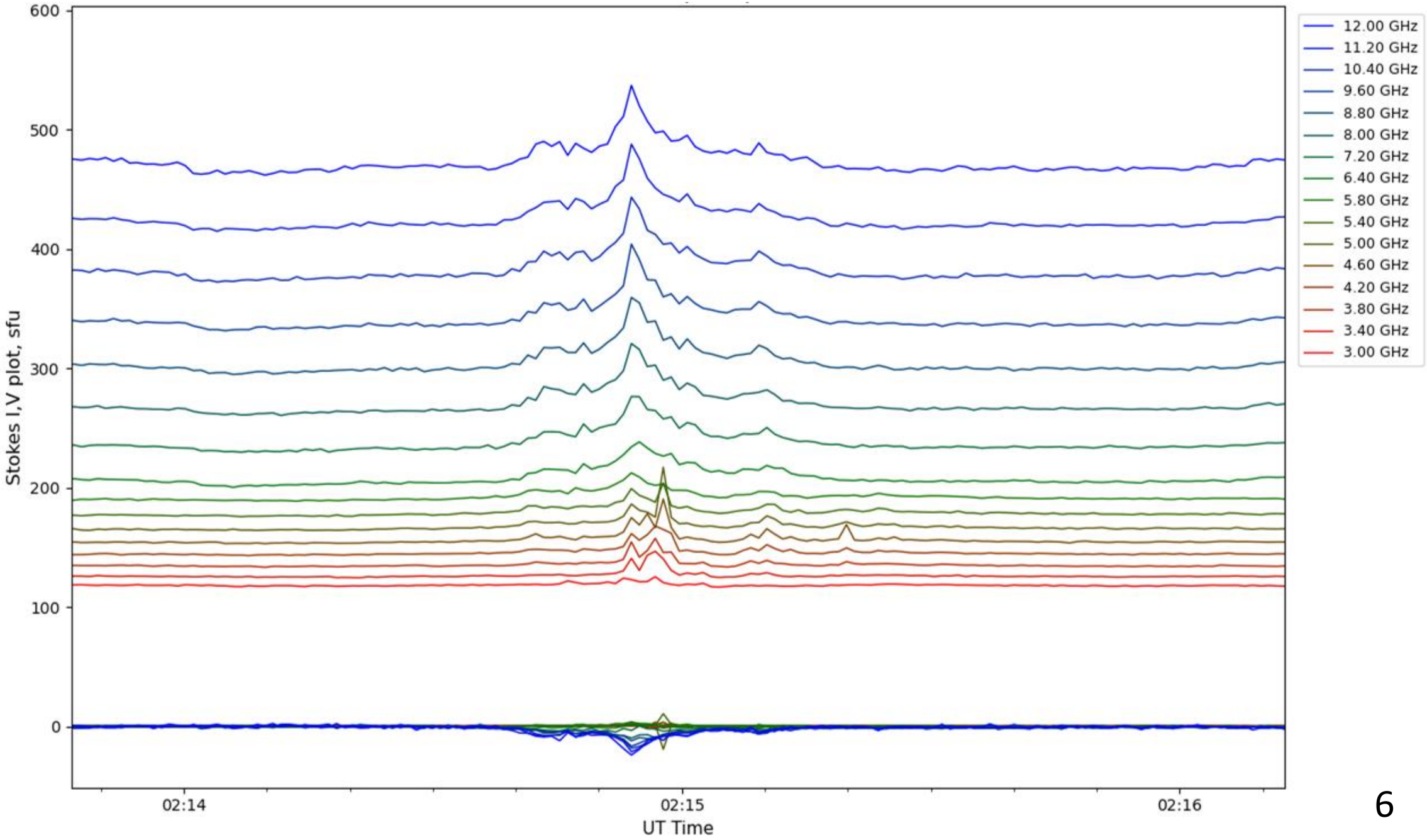
SOLARSPEL 3 - 24 GHz specifications

Antenna type	3m, 2m, 1m dish
Frequency range	3 - 24 GHz
Number of frequency channels	48
Channel bandwidth	10 MHz
Sample time	30 ms
Full sweep time	0,96 s
Polarization	RCP, LCP
Sensitivity	~1 s.f.u. at 3 GHz ~10 s.f.u. at 20 GHz
Daily observations time	0 - 10 UTC (summer) 2 - 8 UTC (winter)

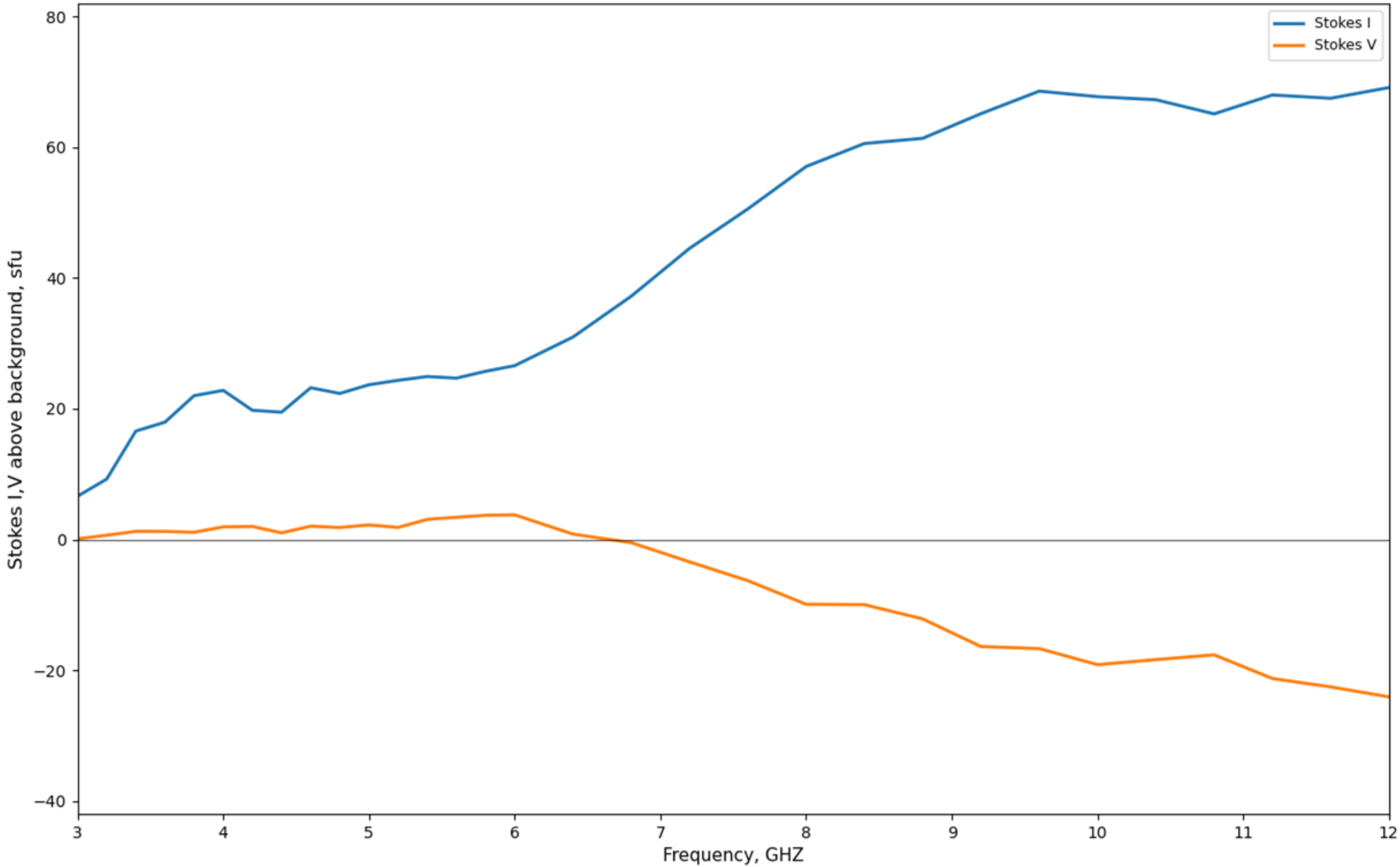
SOLARSPEL 3 - 24 GHz daily quick view (badary.iszf.irk.ru)



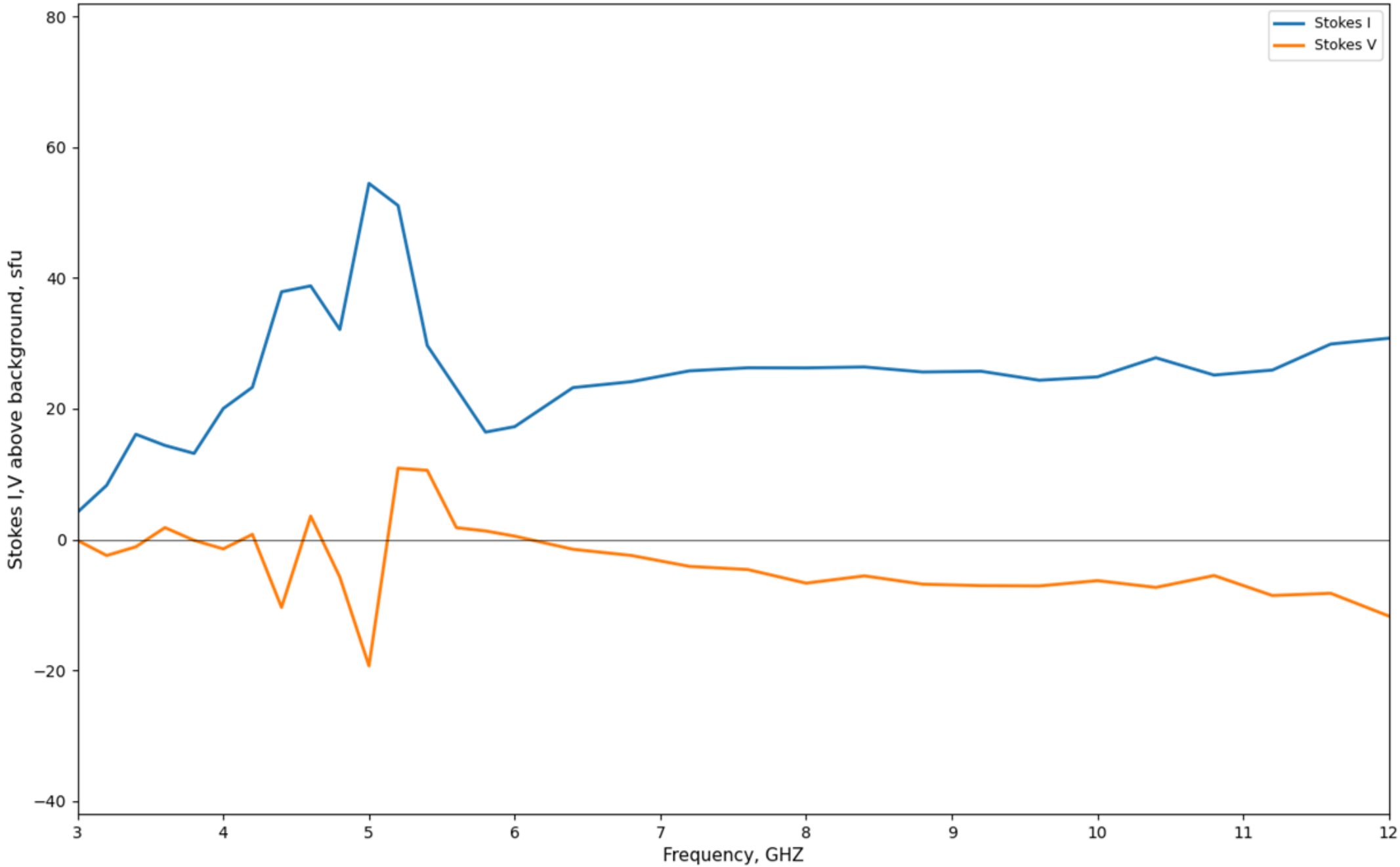
2023-03-19 2:12 flare



2023-03-19 2:12 spectrum at flare maximum



2023-03-19 2:12 spectrum at flare maximum + 4s

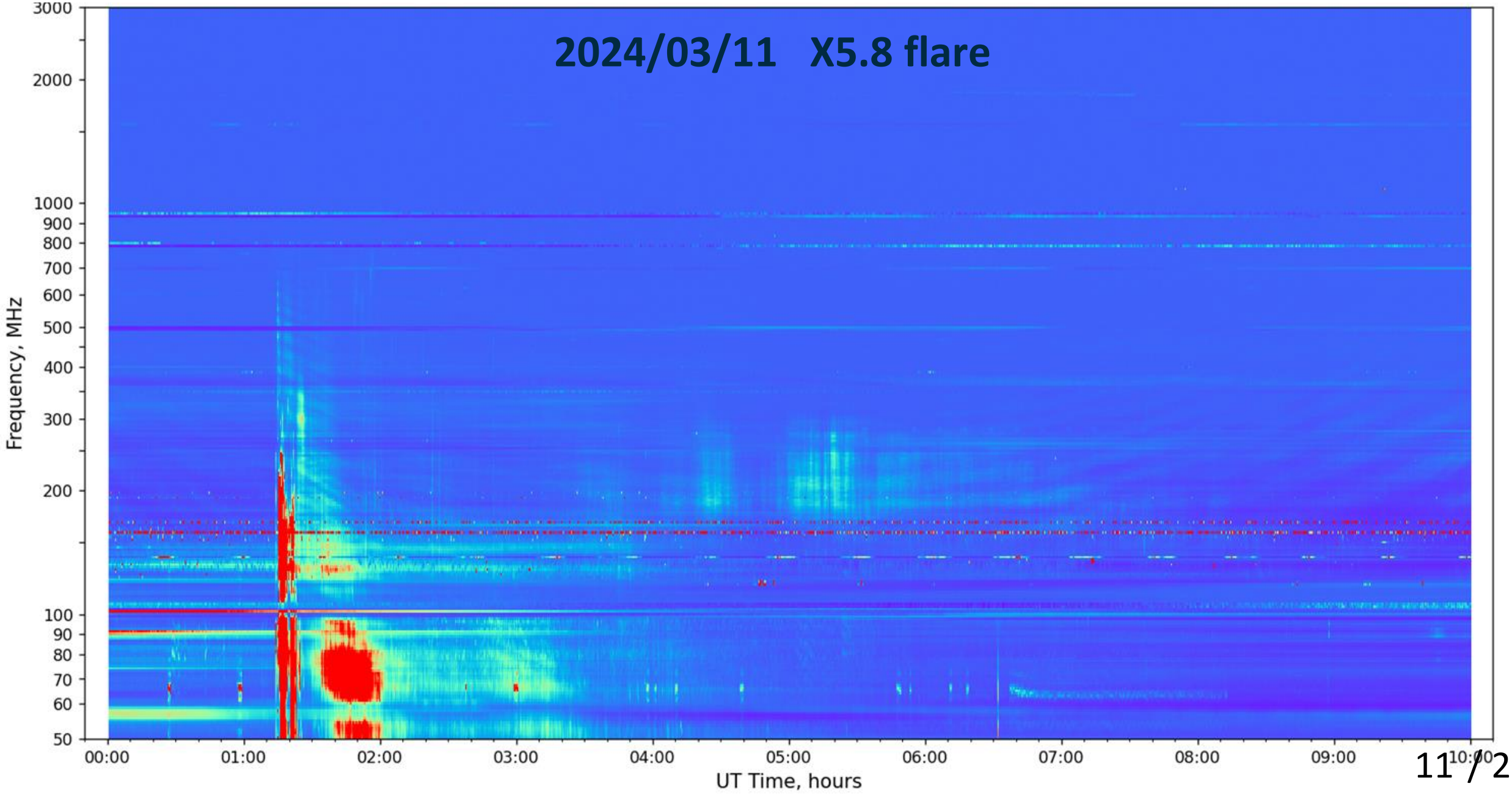


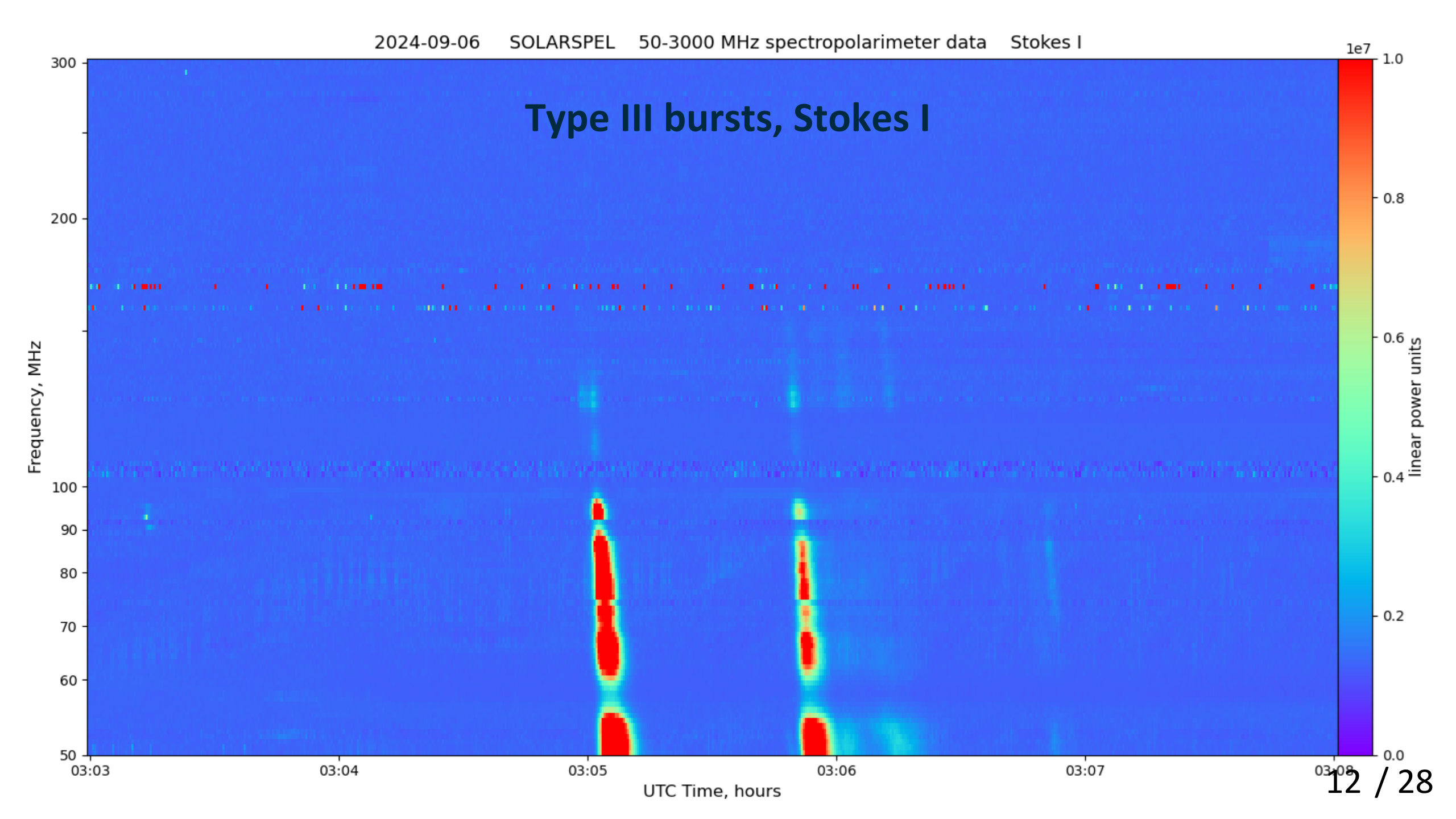
SOLARSPEL 50 - 3000 MHz spectropolarimeter

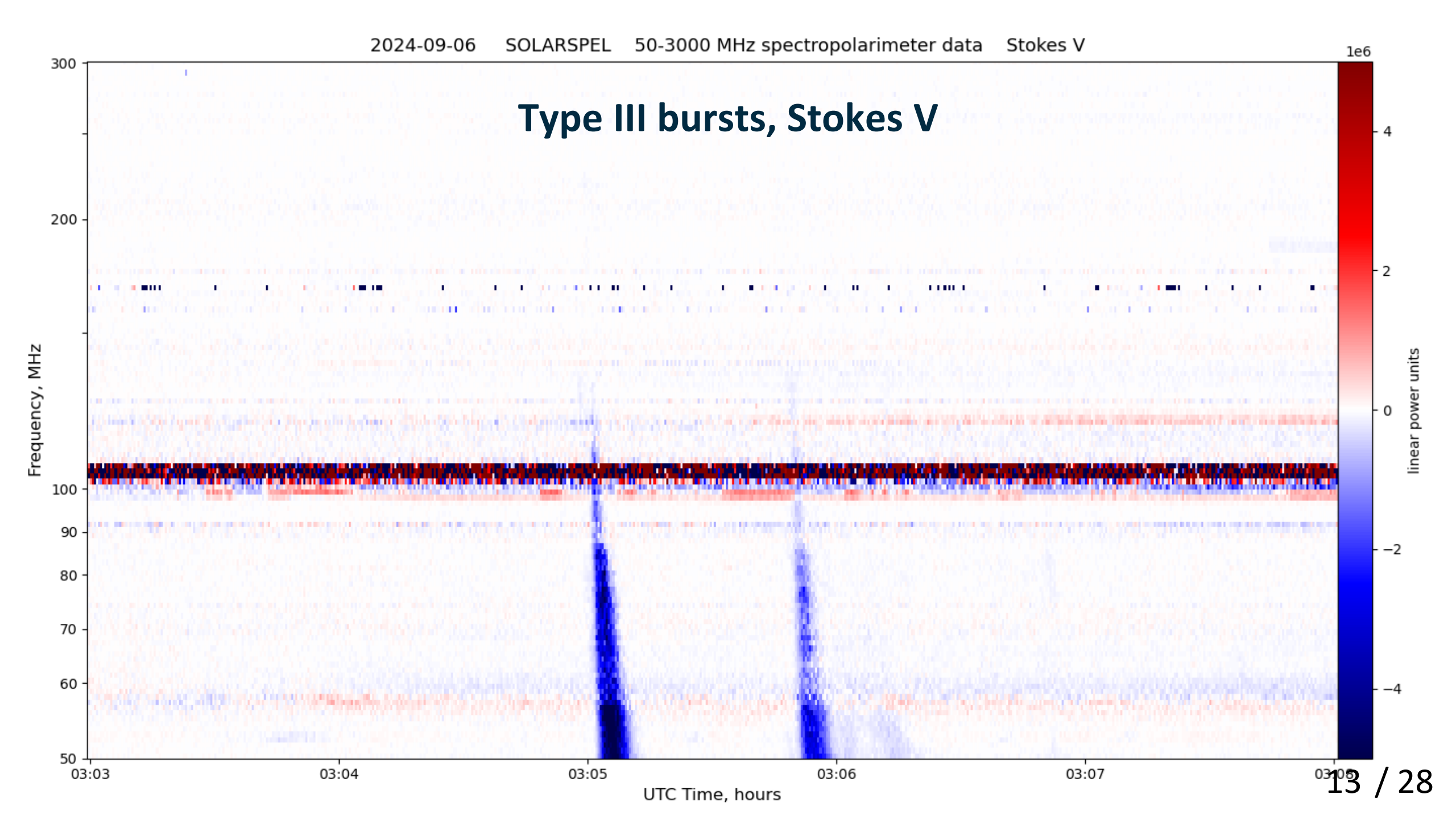
SOLARSPEL 50 - 3000 MHz specifications

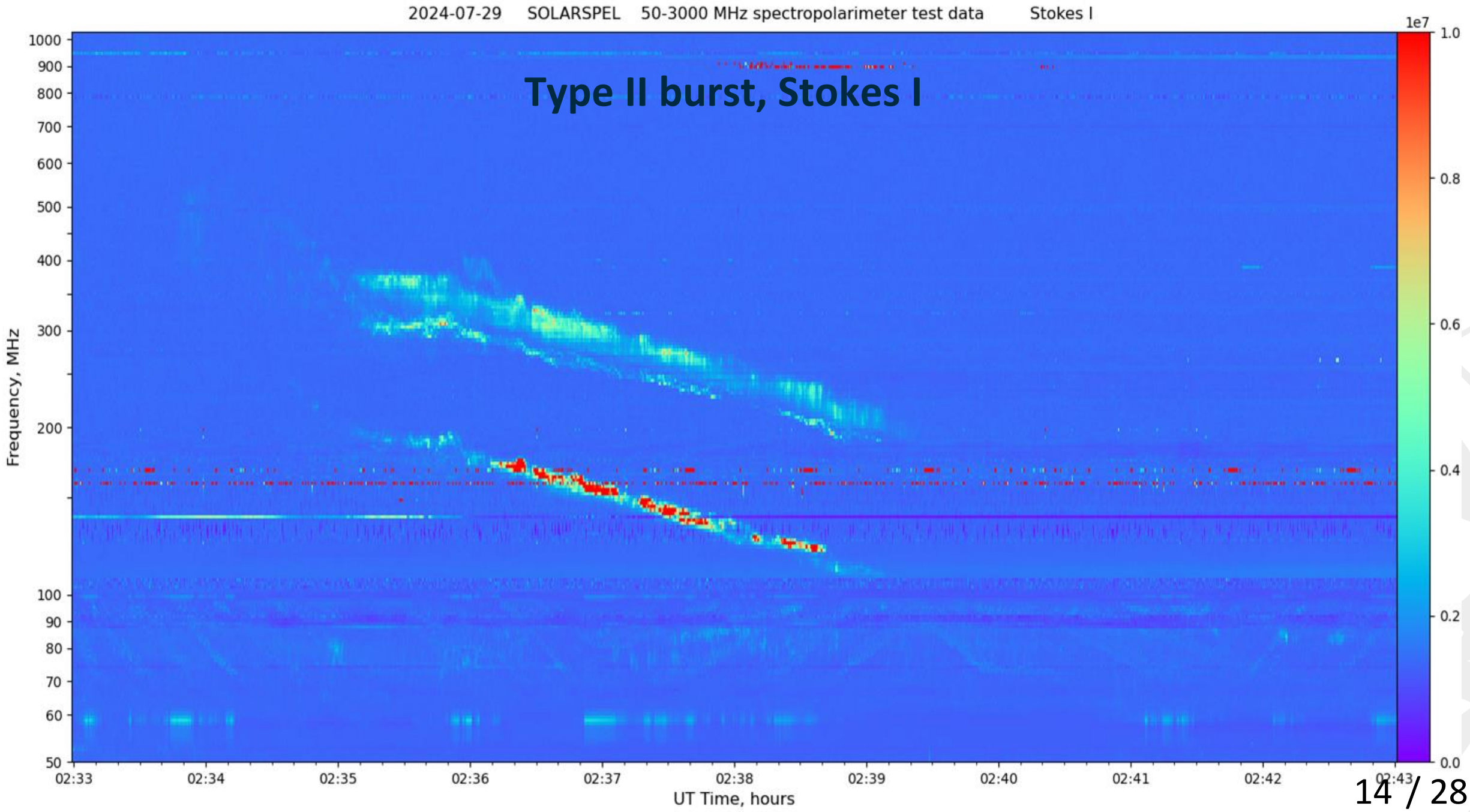
Antenna type	4x crossed LPDA (2x HF, 2xLF)
Frequency range	50 - 3000 MHz
Number of frequency channels	296
Channel bandwidth	1 MHz
Time resolution	0.2 s
Stokes parameters	I, V
Dynamic range, not less than	40 dB
Daily observations time	0 - 10 UTC

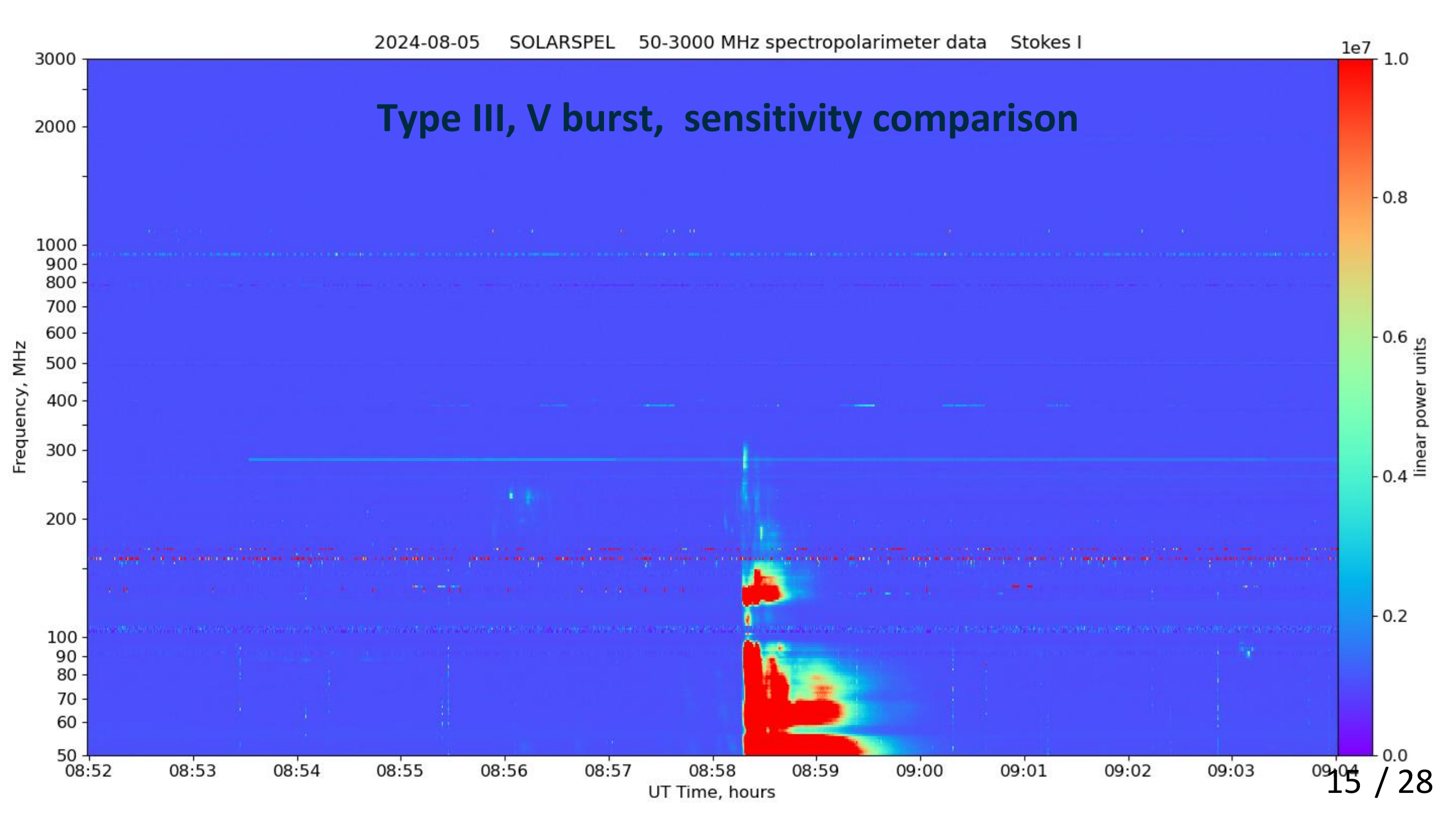
SOLARSPEL 50 - 3000 MHz daily quick view (badary.iszf.irk.ru)



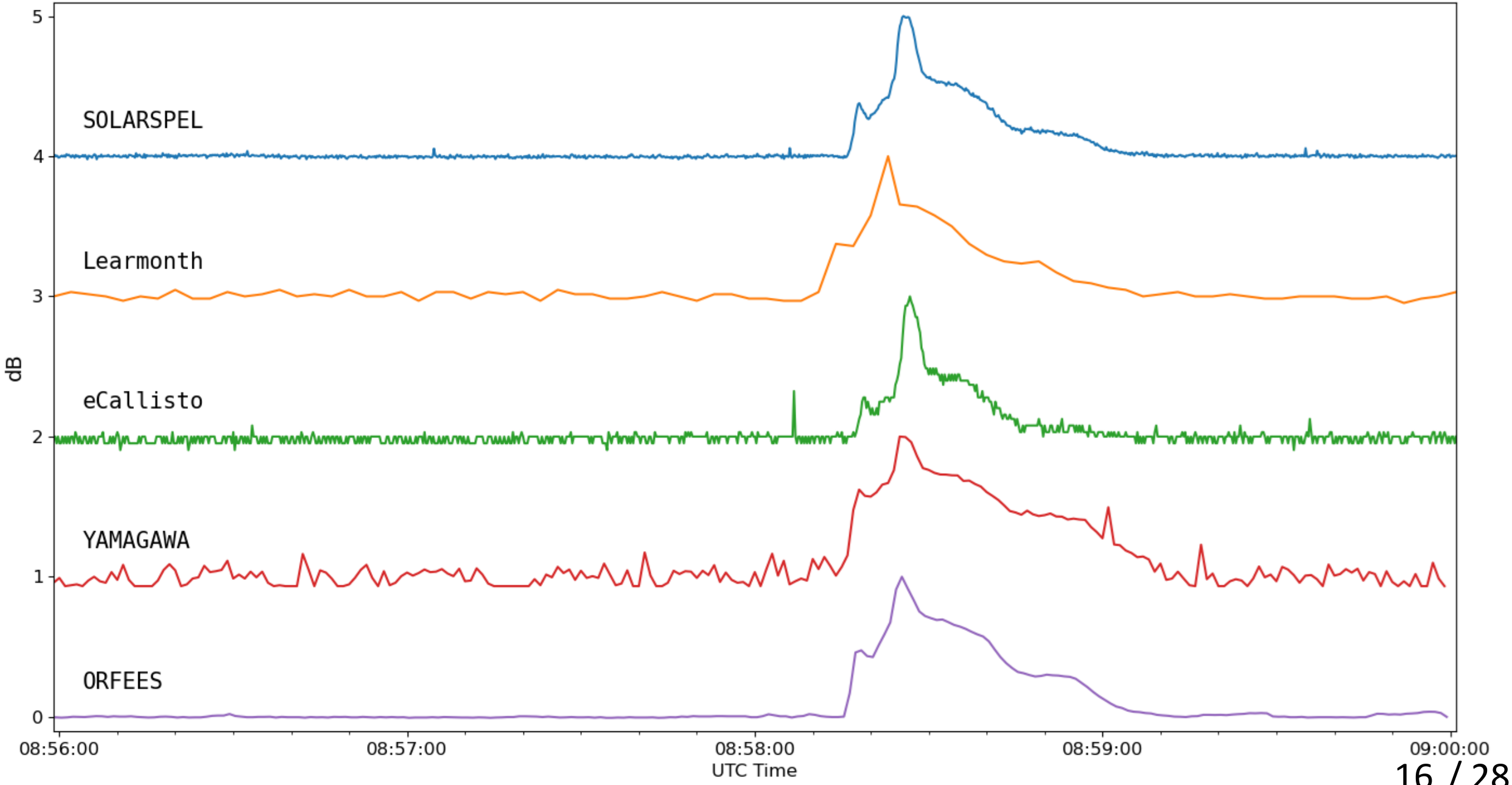

2024-09-06 SOLARSPEL 50-3000 MHz spectropolarimeter data Stokes I
Type III bursts, Stokes I
Frequency, MHz
300
200
100
90
80
70
60
50
UTC Time, hours
03:03
03:04
03:05
03:06
03:07
03:08
1e7
1.0
0.8
0.6
0.4
0.2
0.0
linear power units


2024-09-06 SOLARSPEL 50-3000 MHz spectropolarimeter data Stokes V
Type III bursts, Stokes V
Frequency, MHz
300
200
100
90
80
70
60
50
03:03
03:04
03:05
03:06
03:07
UTC Time, hours
1e6
4
2
0
−2
−4
linear power units

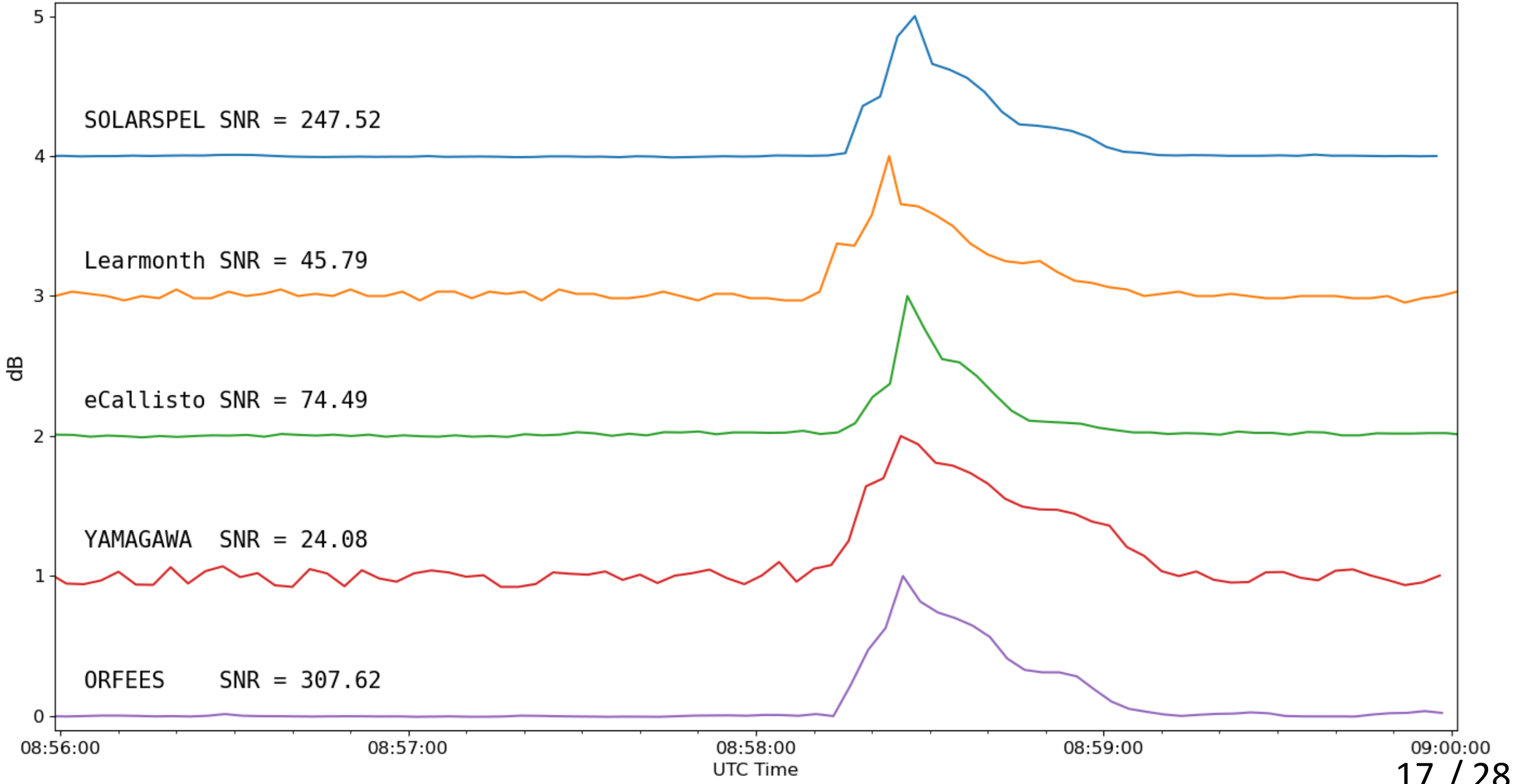

2024-07-29 SOLARSPEL 50-3000 MHz spectropolarimeter test data Stokes I
Type II burst, Stokes I
Frequency, MHz
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
02:33
02:34
02:35
02:36
02:37
02:38
02:39
02:40
02:41
02:42
02:43
UT Time, hours
1e7
1.0
0.8
0.6
0.4
0.2
0.0


2024-08-05 SOLARSPEL 50-3000 MHz spectropolarimeter data Stokes I
Type III, V burst, sensitivity comparison
Frequency, MHz
UT Time, hours
linear power units
1e7

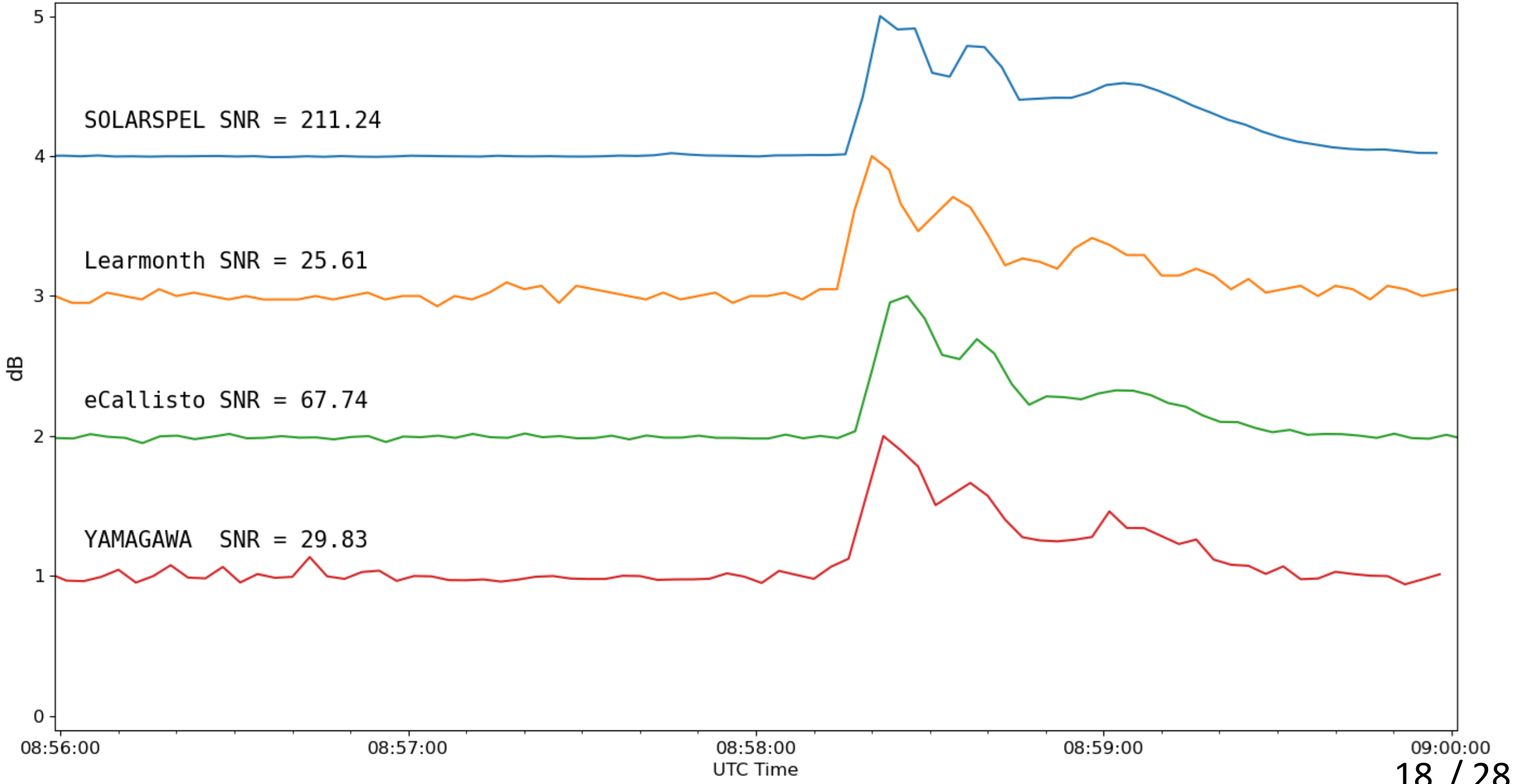
2024/08/05 event at 142 MHz



2024/08/05 event at 142 MHz, downsampled to 3s

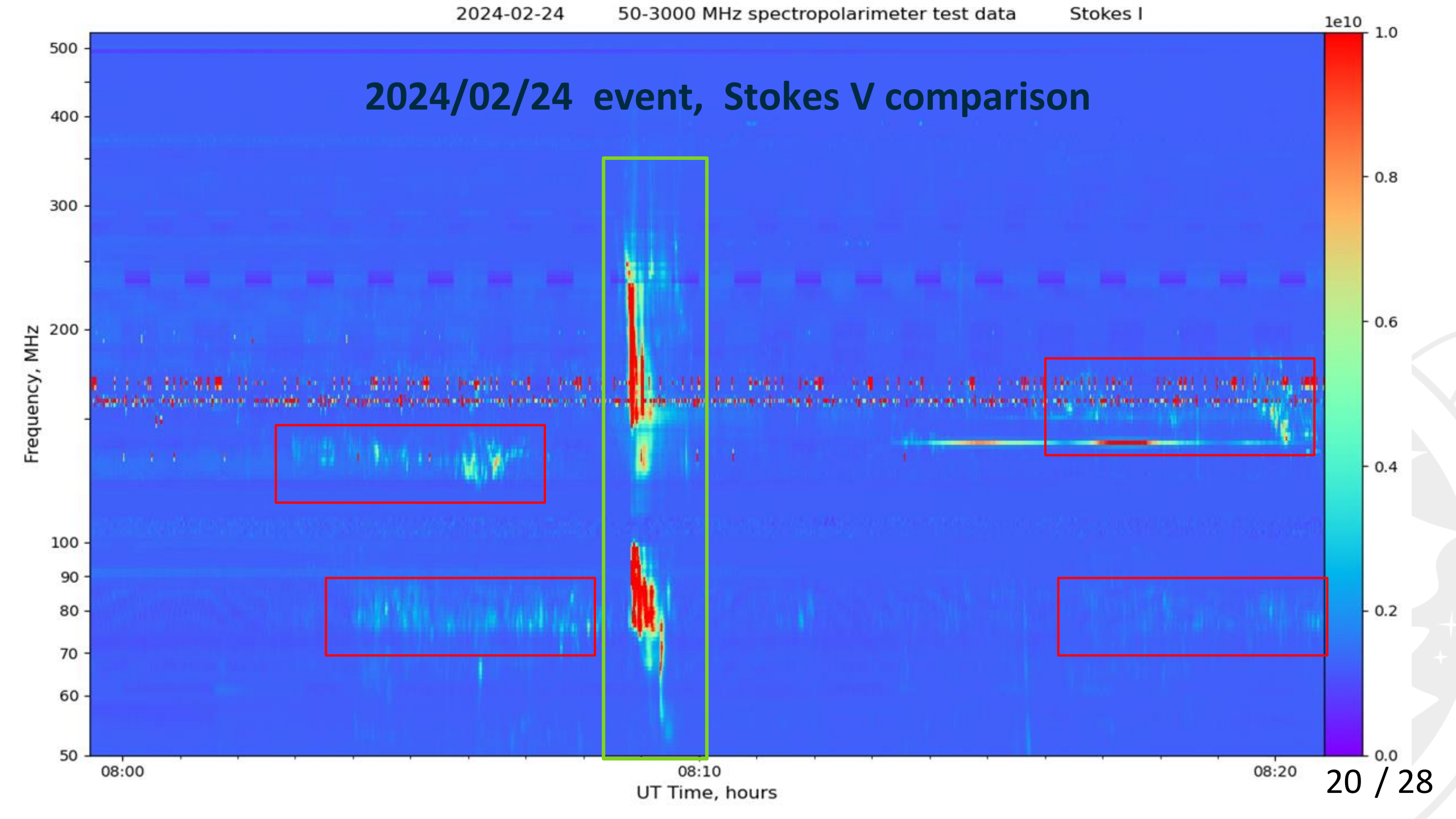


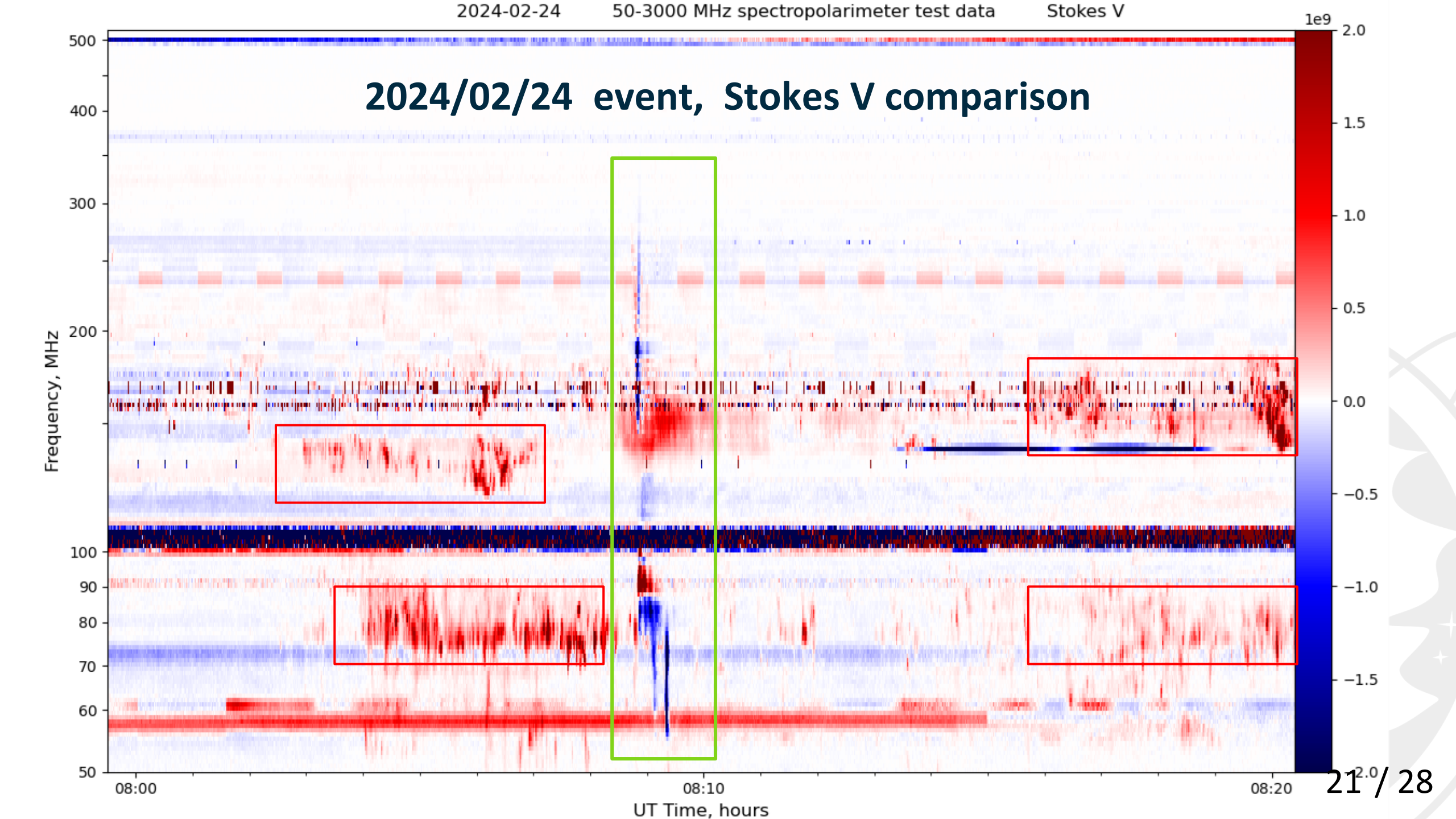
2024/08/05 event at 72 MHz , downsampled to 3s



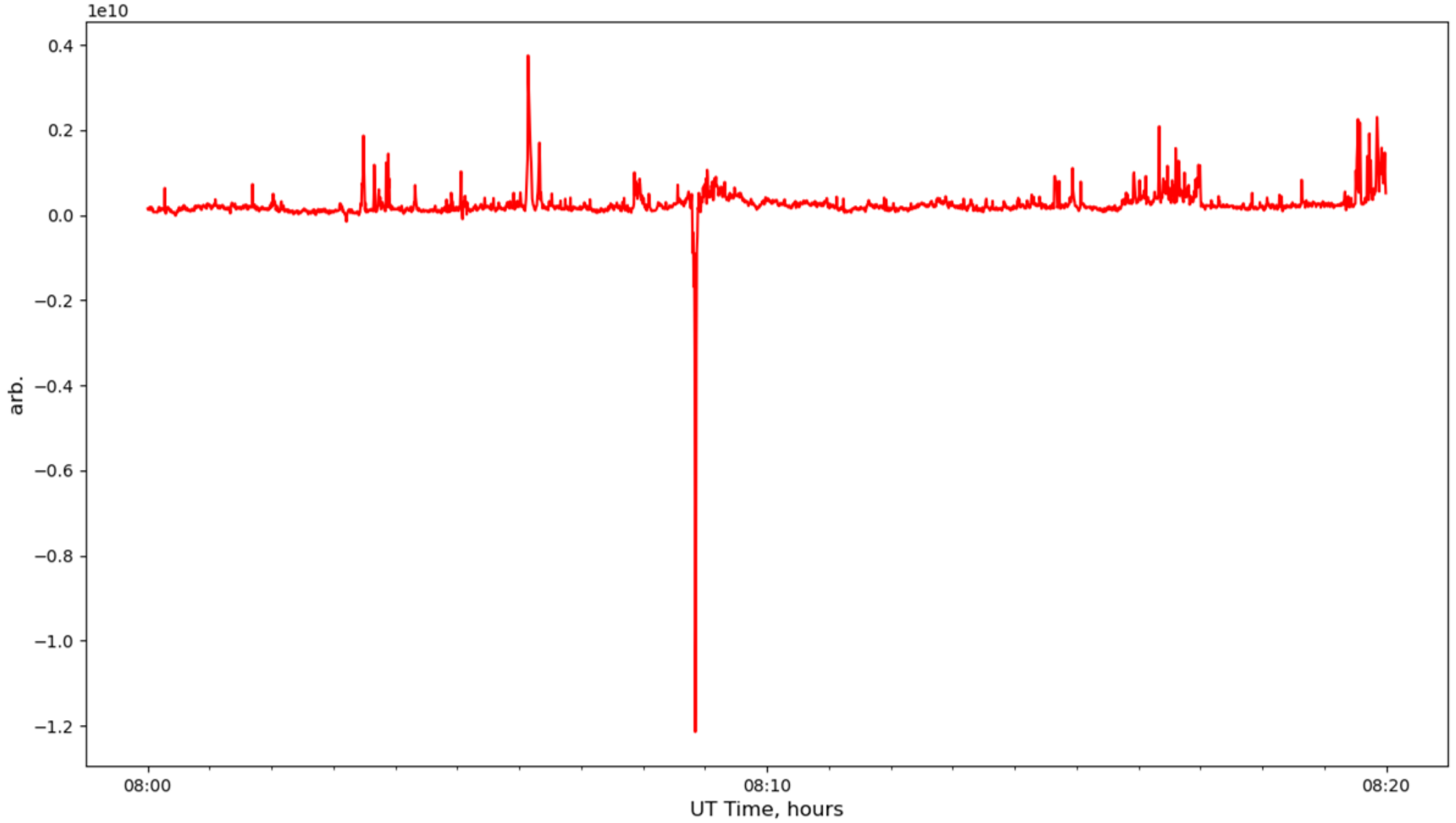
2024/08/05 event, SNR estimation

Observatory	SNR at 72 MHz	SNR at 142 MHz
ORFEES		307
SOLARSPEL	211	247
eCallisto (SSRT)	68	74
YAMAGAWA	30	24
Learmonth	26	46

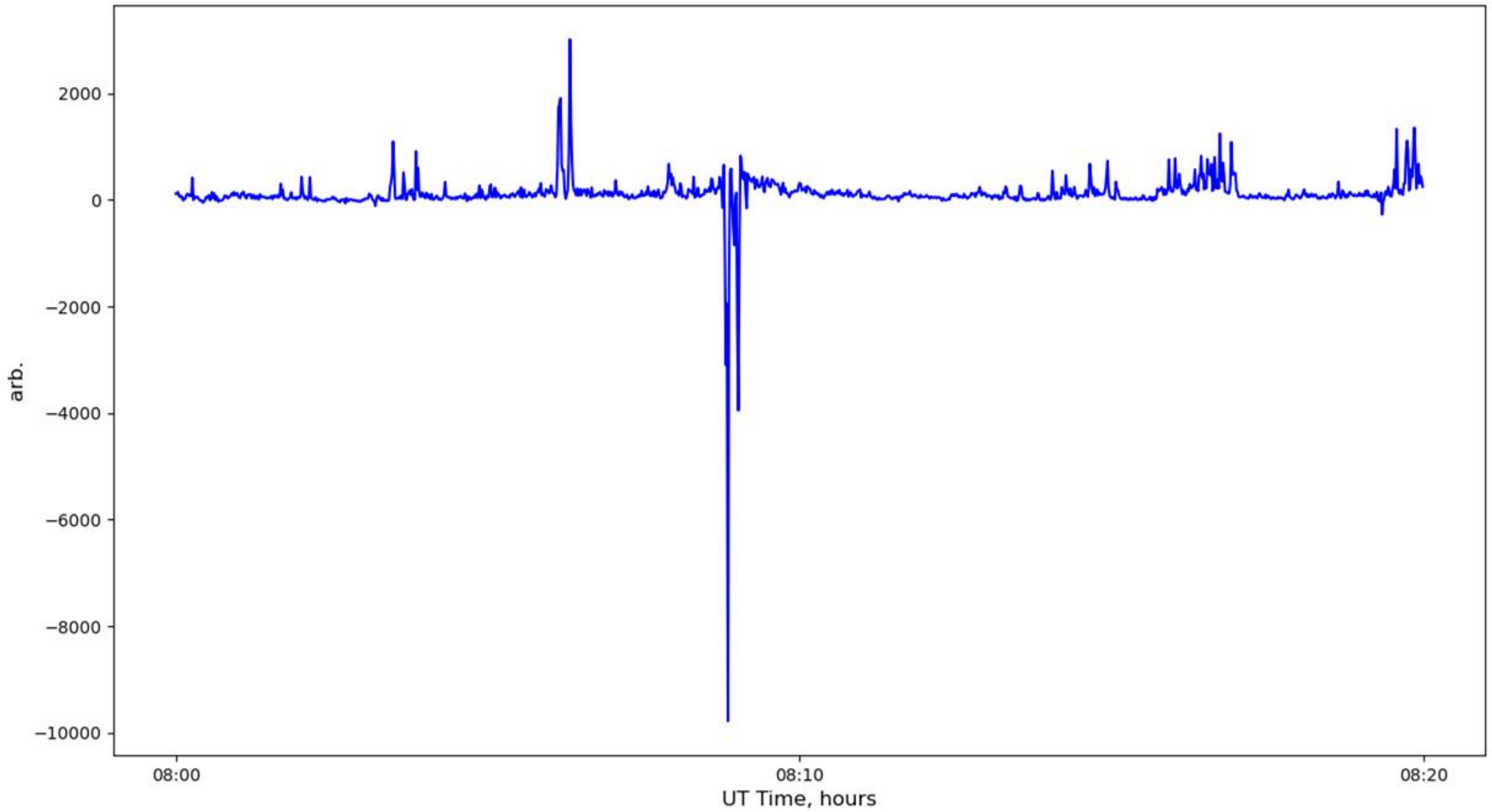

2024-02-24 50-3000 MHz spectropolarimeter test data Stokes I
2024/02/24 event, Stokes V comparison
Frequency, MHz
500
400
300
200
100
90
80
70
60
50
1e10
1.0
0.8
0.6
0.4
0.2
0.0
08:00
08:10
08:20
UT Time, hours


2024-02-24 50-3000 MHz spectropolarimeter test data Stokes V
2024/02/24 event, Stokes V comparison
Frequency, MHz
UT Time, hours
1e9
08:00
08:10
08:20

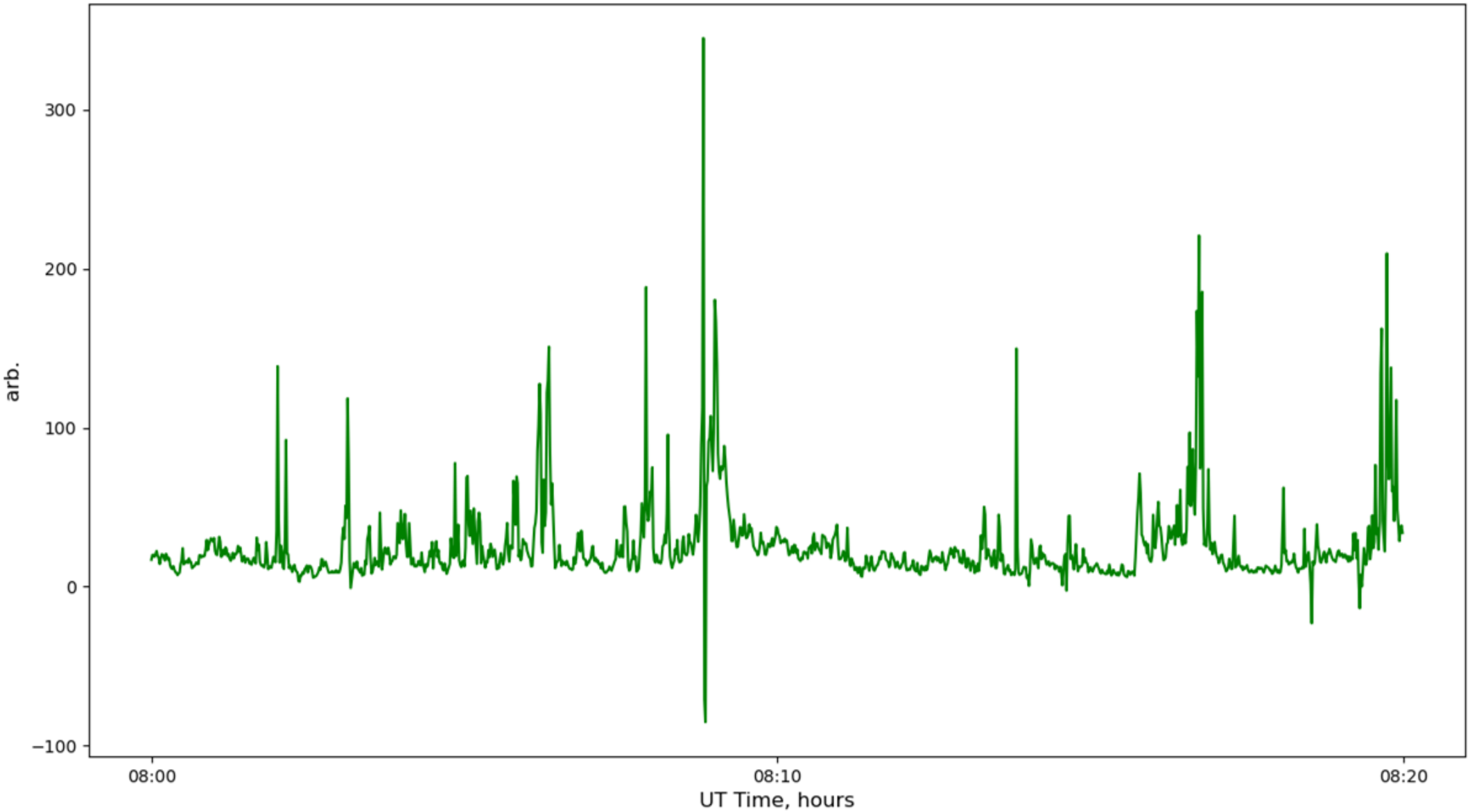
2024/02/24 event, 162 MHz, Stokes V, SOLARSPEL



2024/02/24 event, 162 MHz, Stokes V, YAMAGAWA



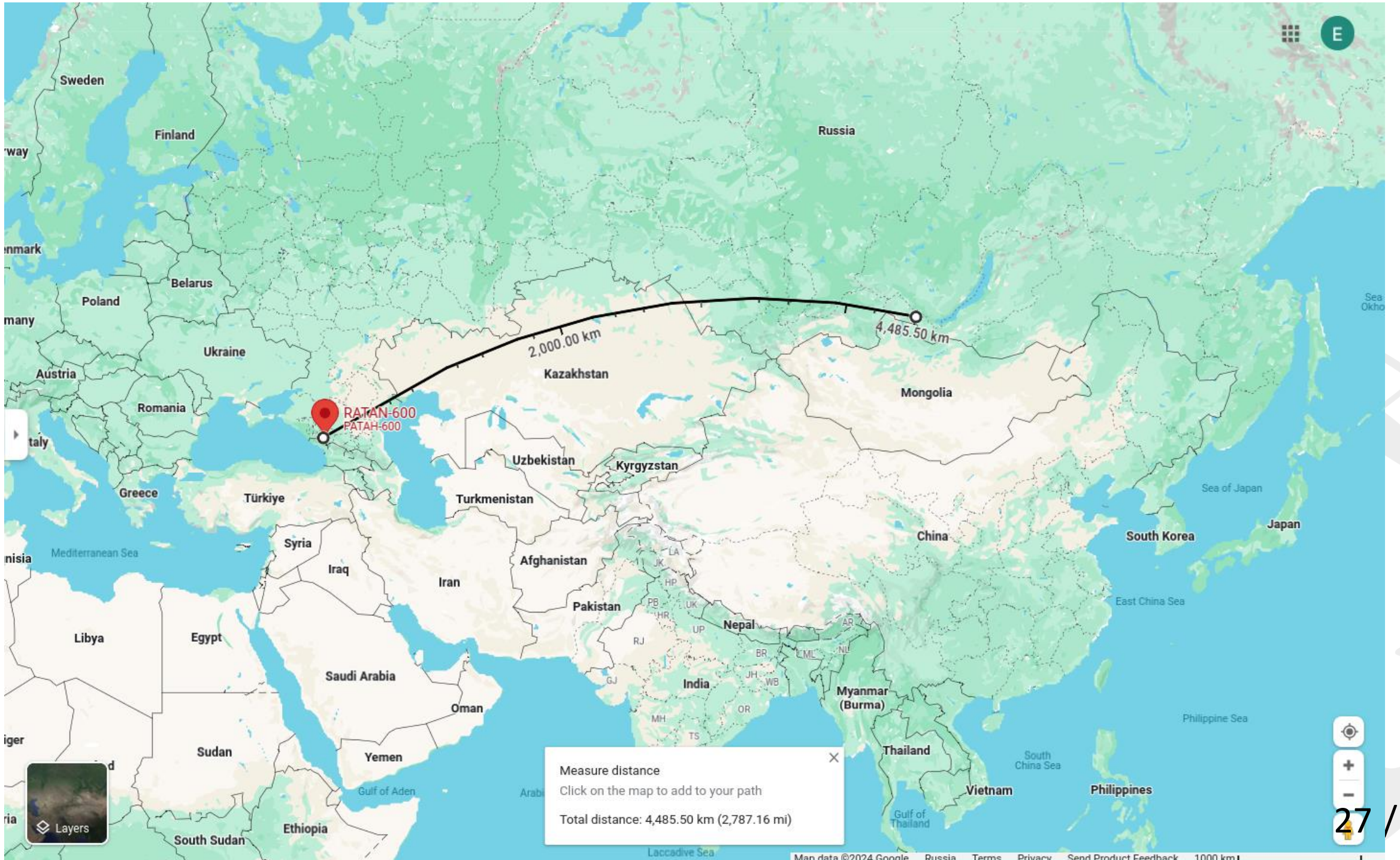
2024/02/24 event, 162 MHz, Stokes V, ORFEES



Conclusion

- The new radio spectropolarimeters for solar observations are launched
- Spectropolarimeters data can be used for space weather research purposes
- Test observations showed that the instruments have good potential for solar phenomena studies
- There will be more akin instruments soon, which will allow us to build the radio spectropolarimeters network

SPACE RESEARCH INSTITUTE RAS (iki.cosmos.ru)
RATAN - 600


Sweden
Finland
Russia
Belarus
Poland
Ukraine
Austria
Romania
Kazakhstan
Mongolia
Uzbekistan
Kyrgyzstan
Turkmenistan
Greece
Türkiye
Syria
Iraq
Iran
Afghanistan
Pakistan
China
South Korea
Japan
Sea of Japan
East China Sea
Mediterranean Sea
Libya
Egypt
Saudi Arabia
Oman
Yemen
Sudan
South Sudan
Ethiopia
Gulf of Aden
India
Nepal
Myanmar (Burma)
Thailand
Vietnam
Philippines
Philippine Sea
South China Sea
Gulf of Thailand
Laccadive Sea
RATAN-600
PATAH-600
2,000.00 km
4,485.50 km
Measure distance
Click on the map to add to your path
Total distance: 4,485.50 km (2,787.16 mi)
Layers
Map data ©2024 Google
Russia
Terms
Privacy
Send Product Feedback
1000 km

Conclusion

- The new radio spectropolarimeters for solar observations are launched
- Spectropolarimeters data can be used for space weather research purposes
- Test observations showed that the instruments have good potential for solar phenomena studies
- There will be more akin instruments soon, which will allow us to build the radio spectropolarimeters network

Eugene Ivanov eugenessrt@gmail.com