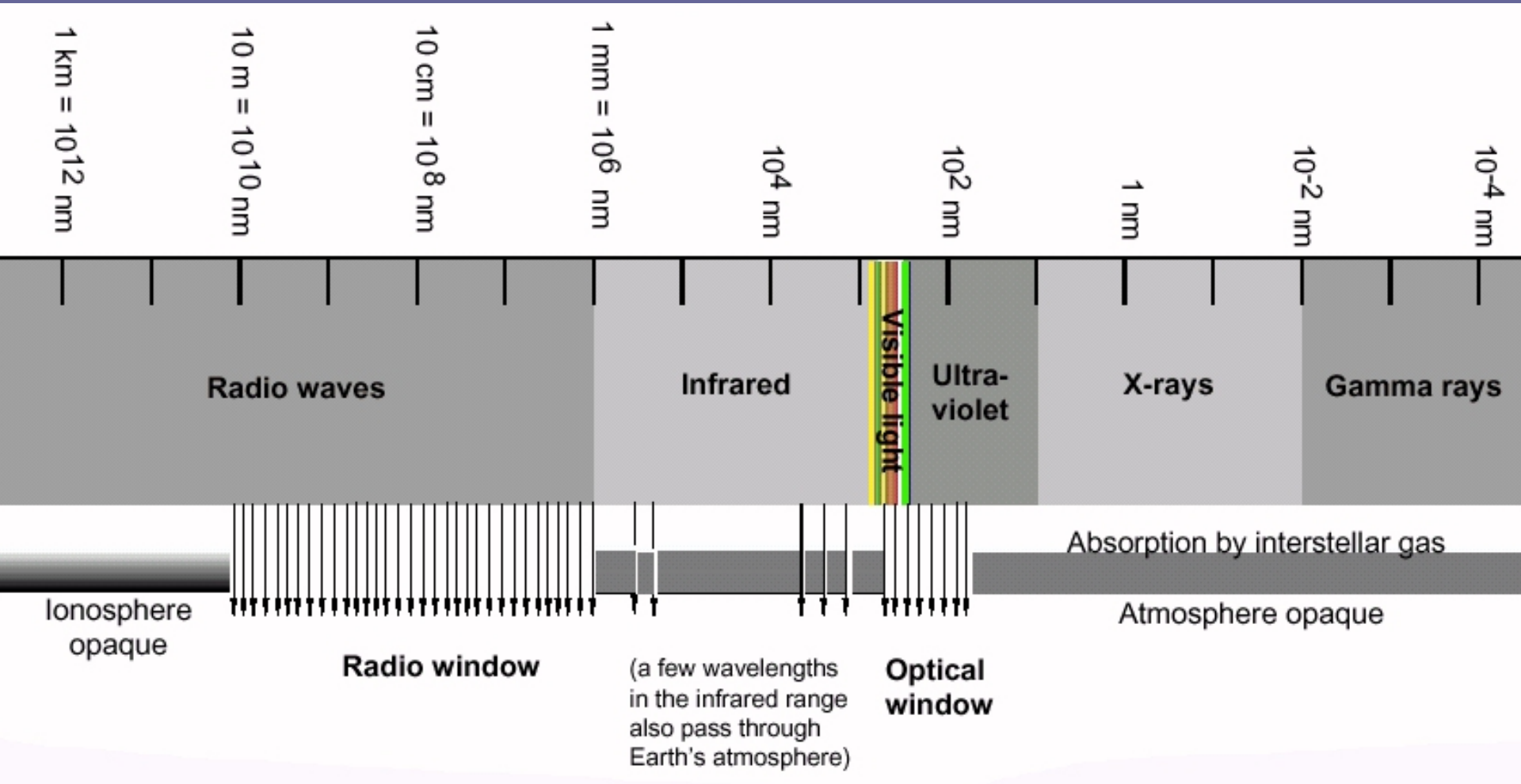
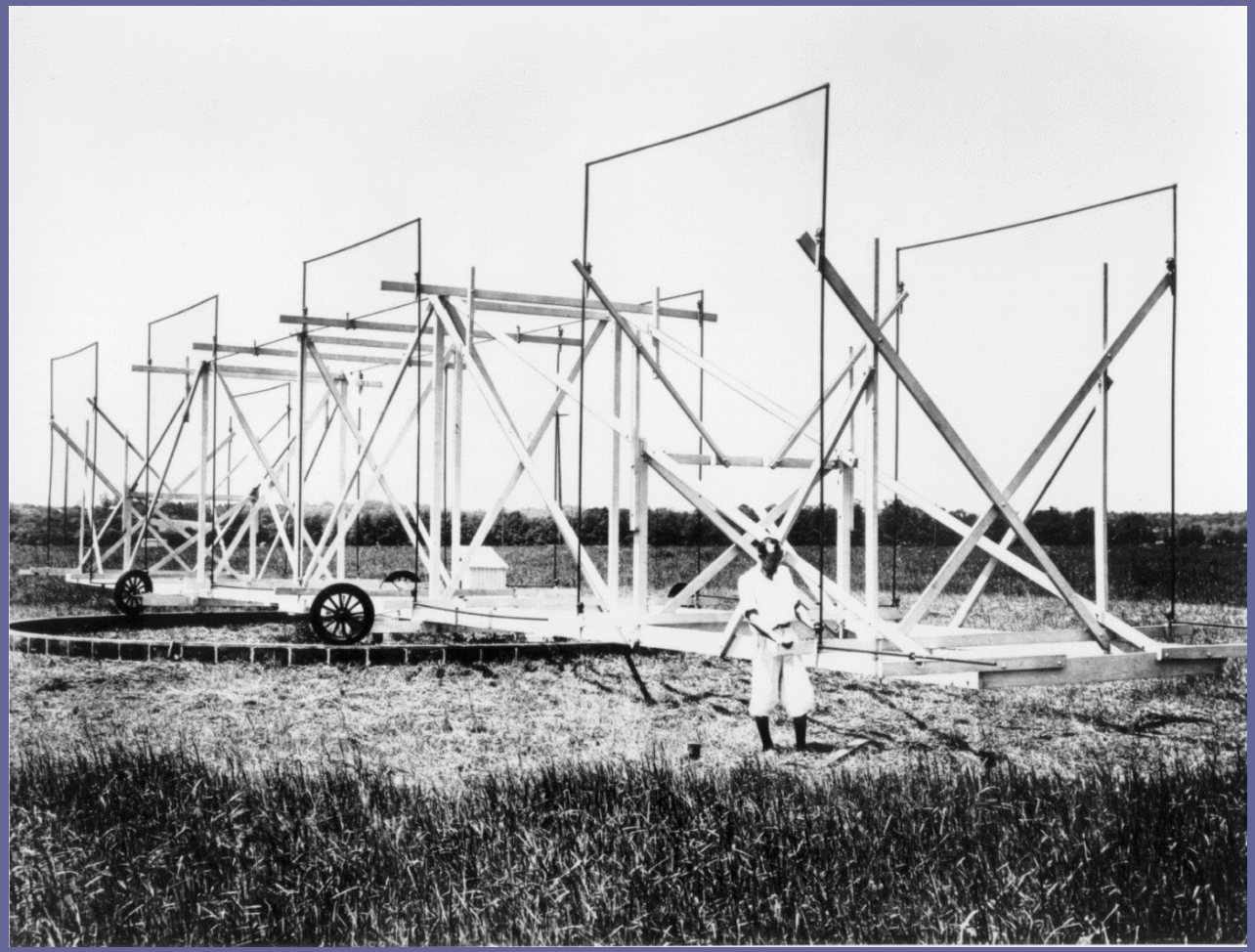
What can we detect from the ground?



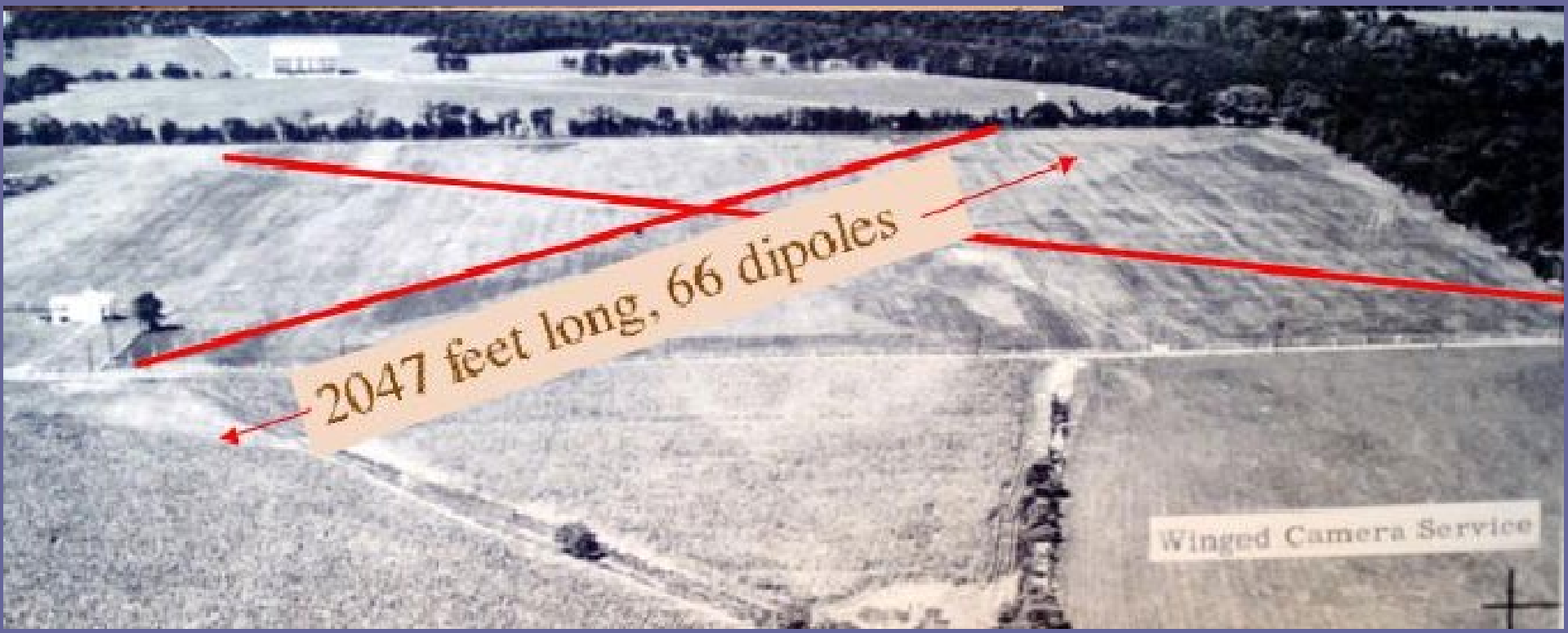
History

- Karl Jansky – detects radio waves from Milky Way in 1931 at 20.5 MHz



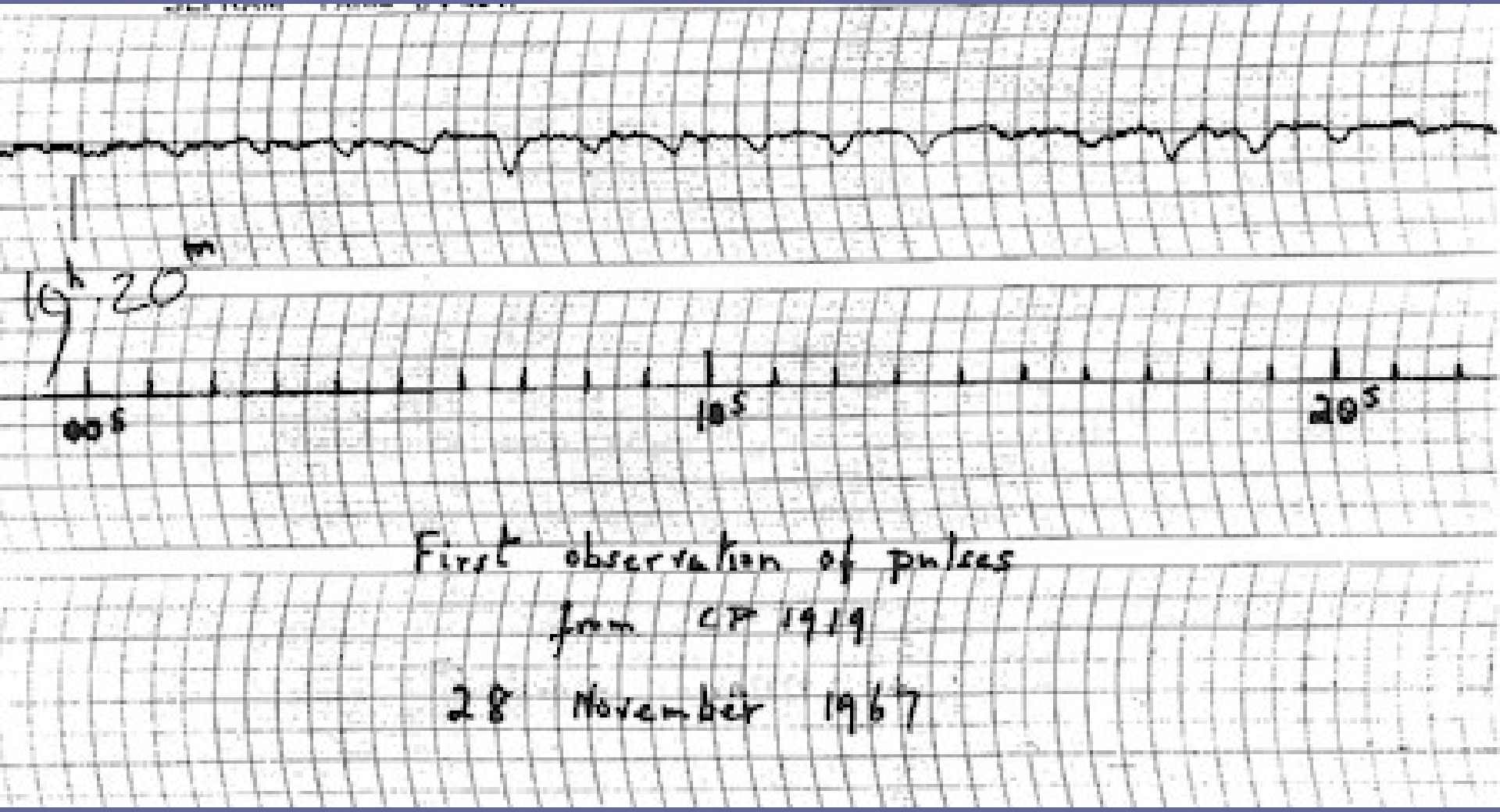
History

- First detection from Jupiter in 1955 near Washington DC at 22 MHz

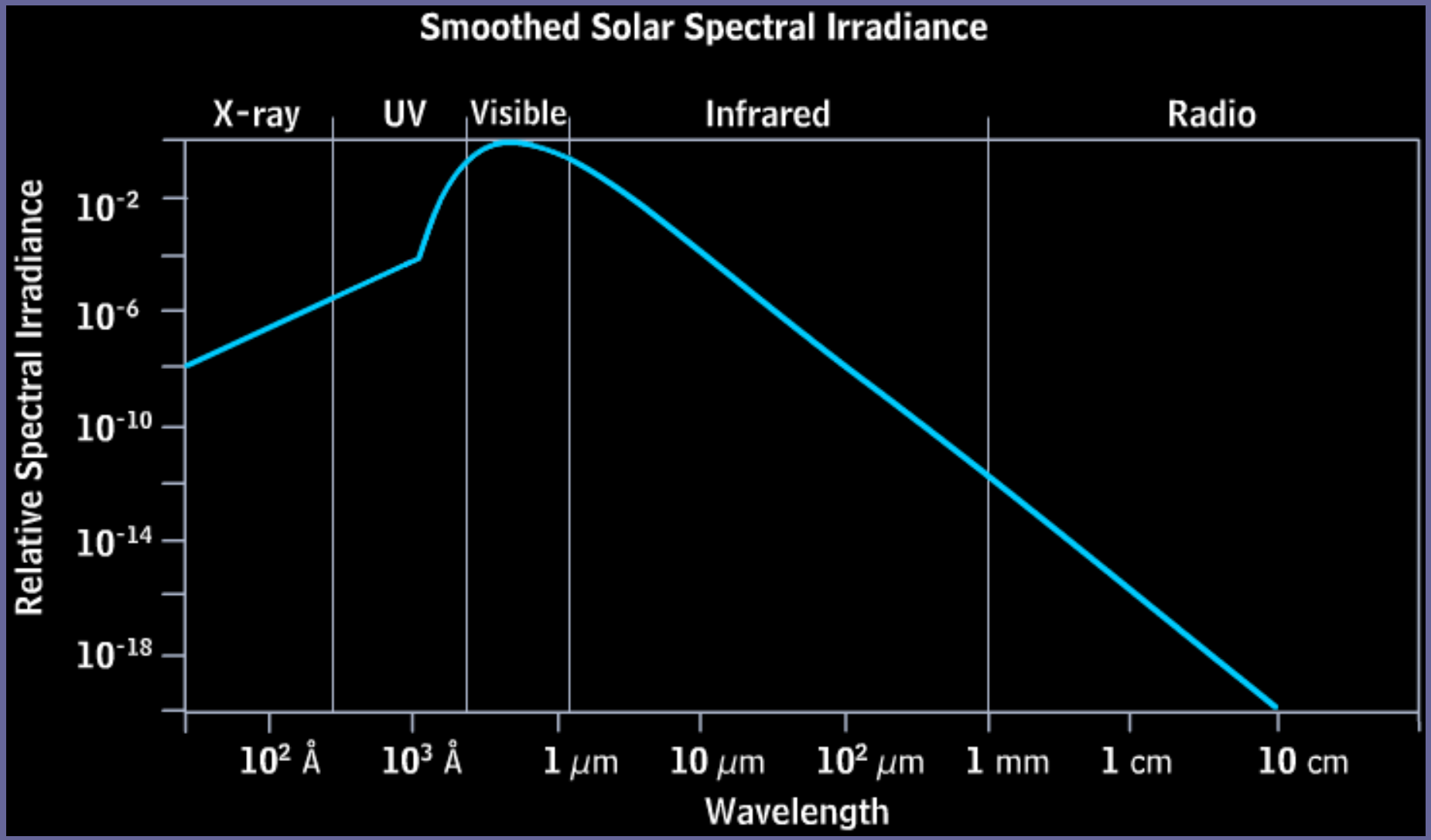


History

- First detection of a pulsar in 1967

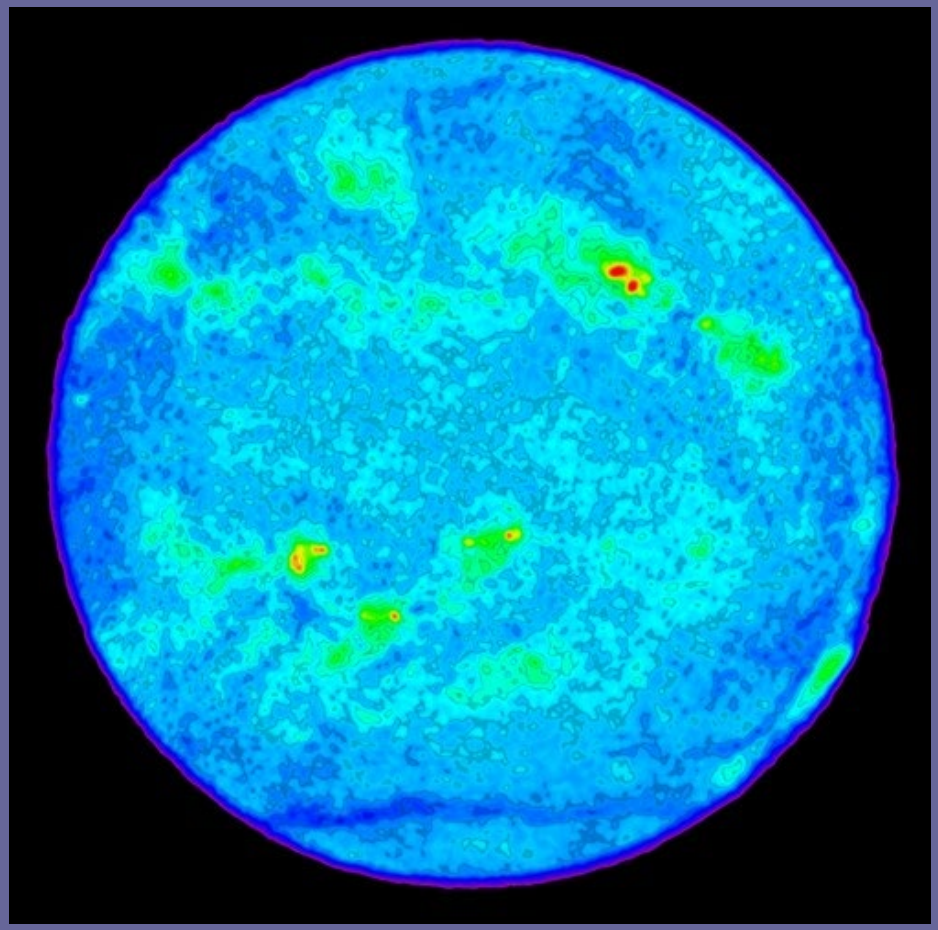


- Sun

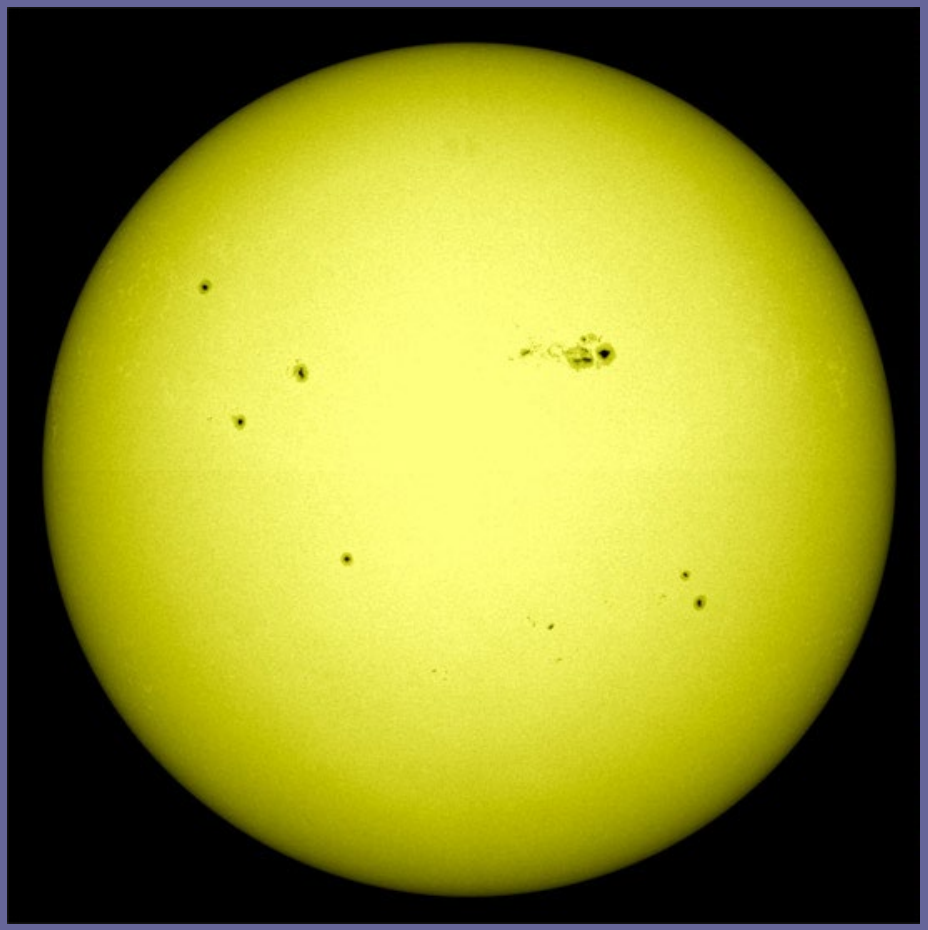

Smoothed Solar Spectral Irradiance
X-ray
UV
Visible
Infrared
Radio
Relative Spectral Irradiance
10-2
10-6
10-10
10-14
10-18
10² Å
10³ Å
1 μm
10 μm
10² μm
1 mm
1 cm
10 cm
Wavelength

- Sun

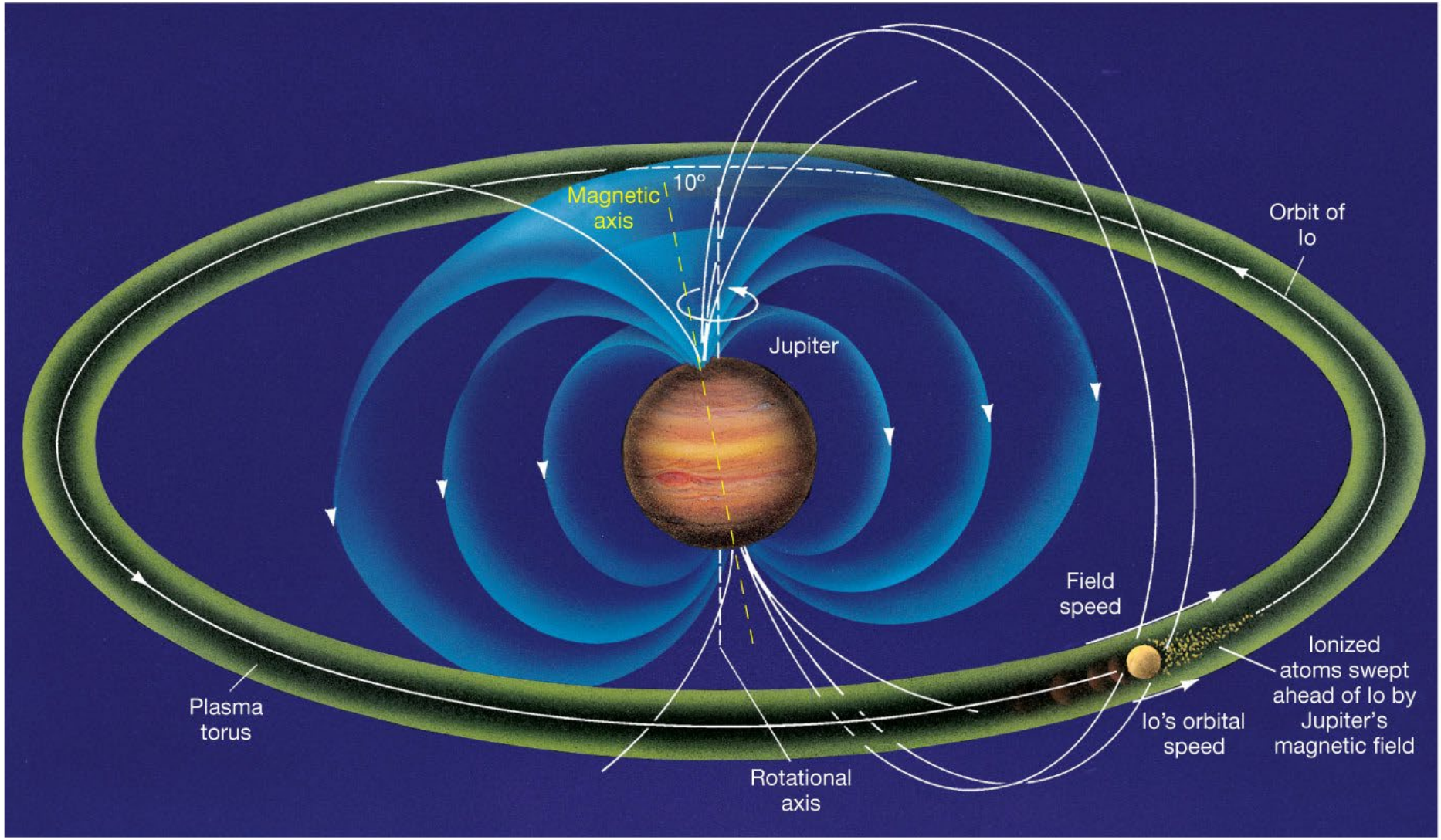
Radio



Visible



Jupiter and Io

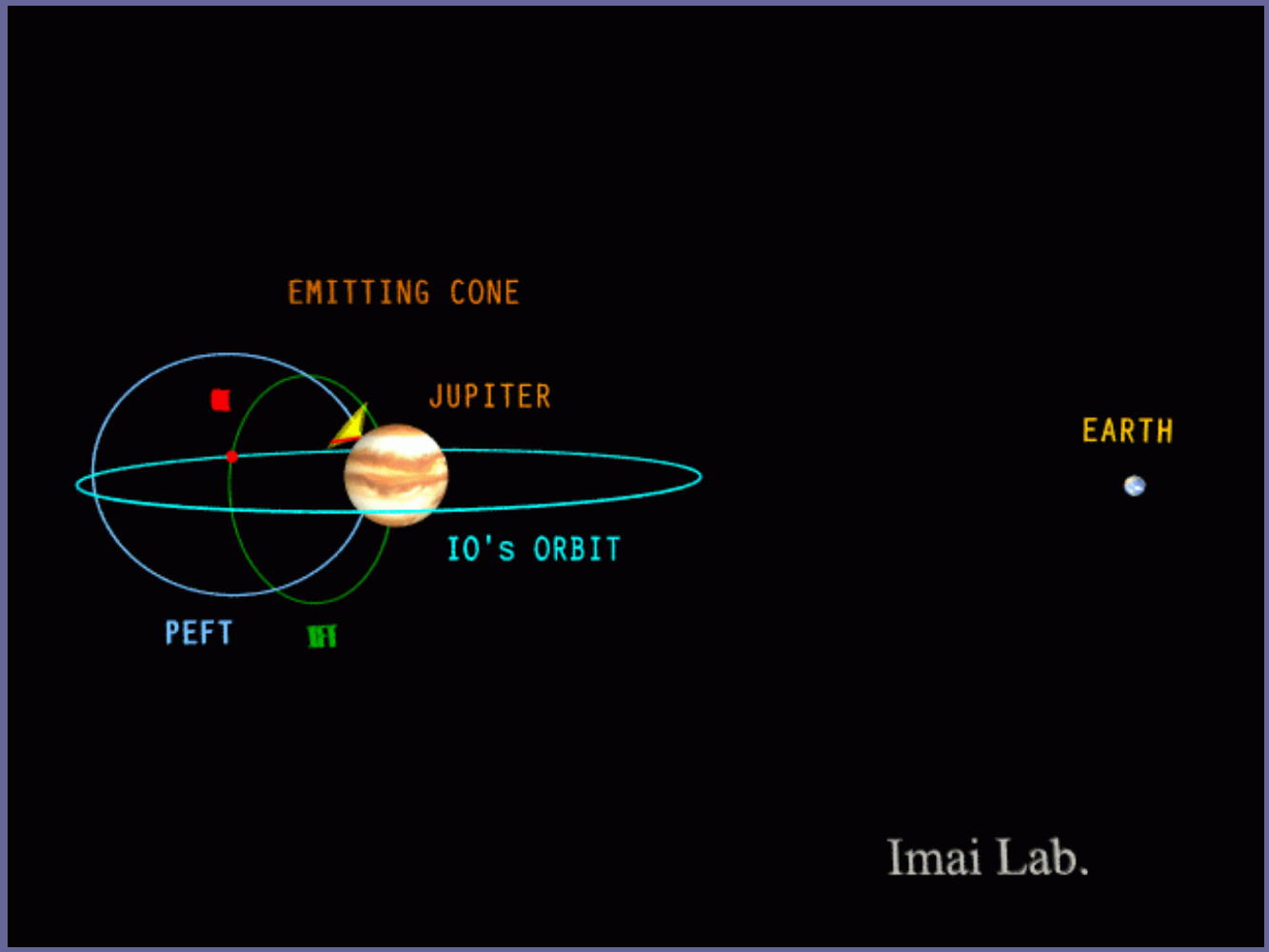


- Jupiter and Io

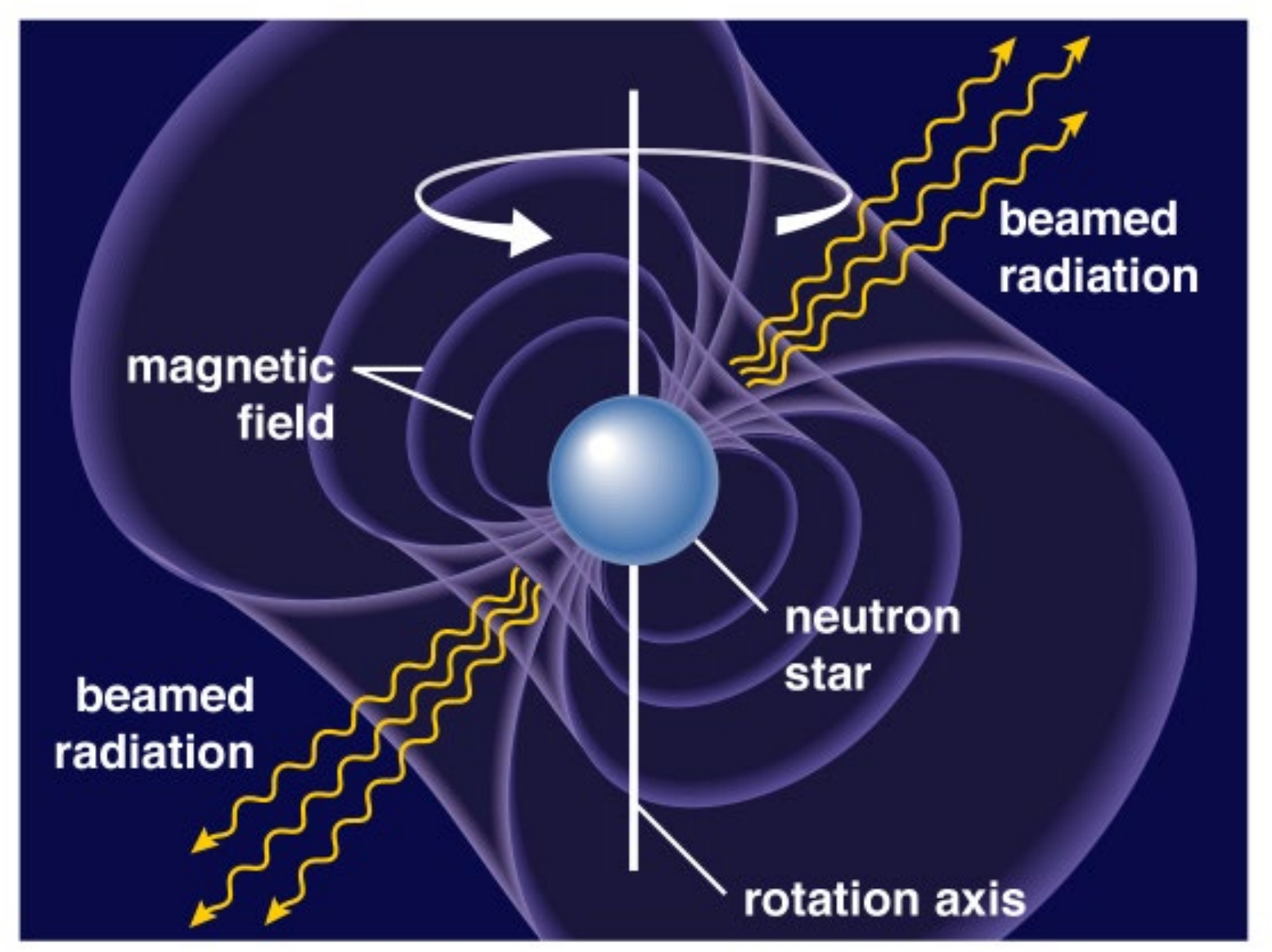
L – bursts

S – bursts (fast)

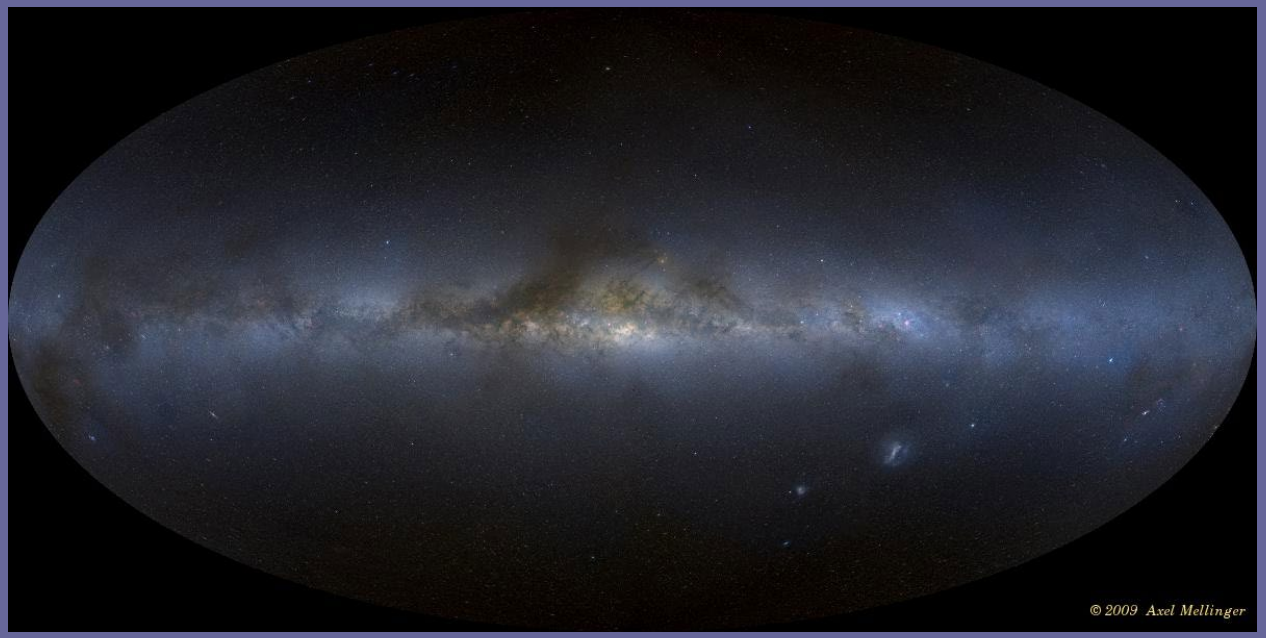
S – bursts (slow)



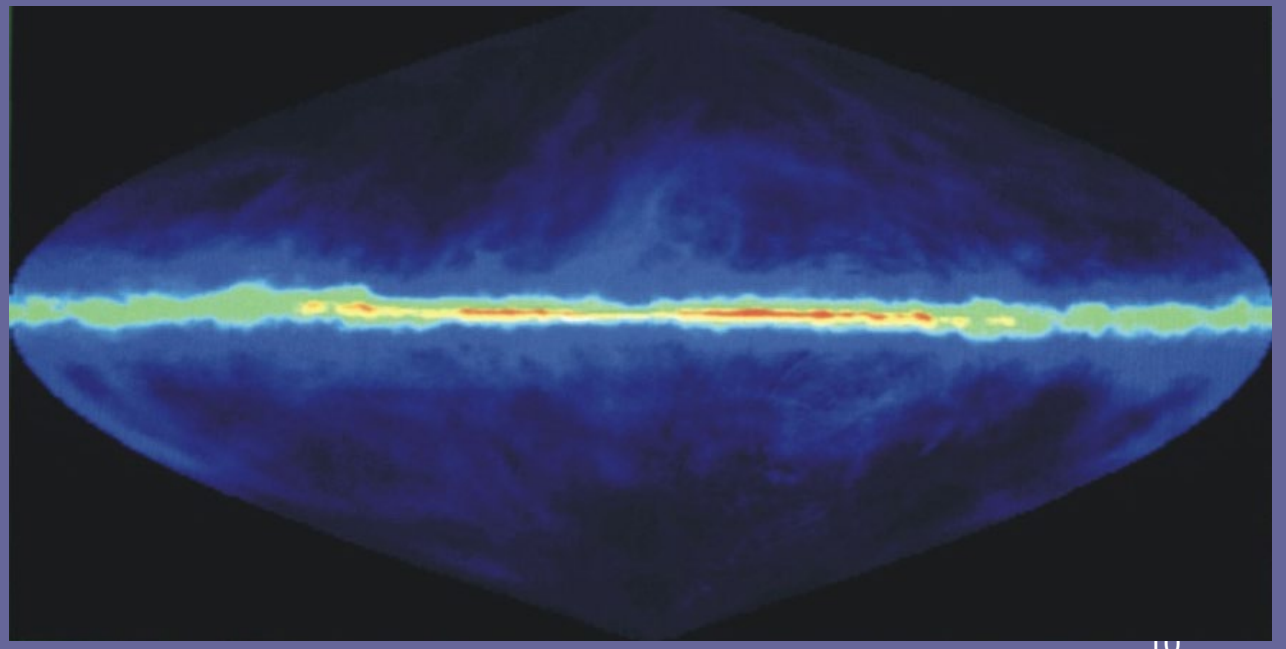
- Pulsars


beamed
radiation
magnetic
field
neutron
star
beamed
radiation
rotation axis

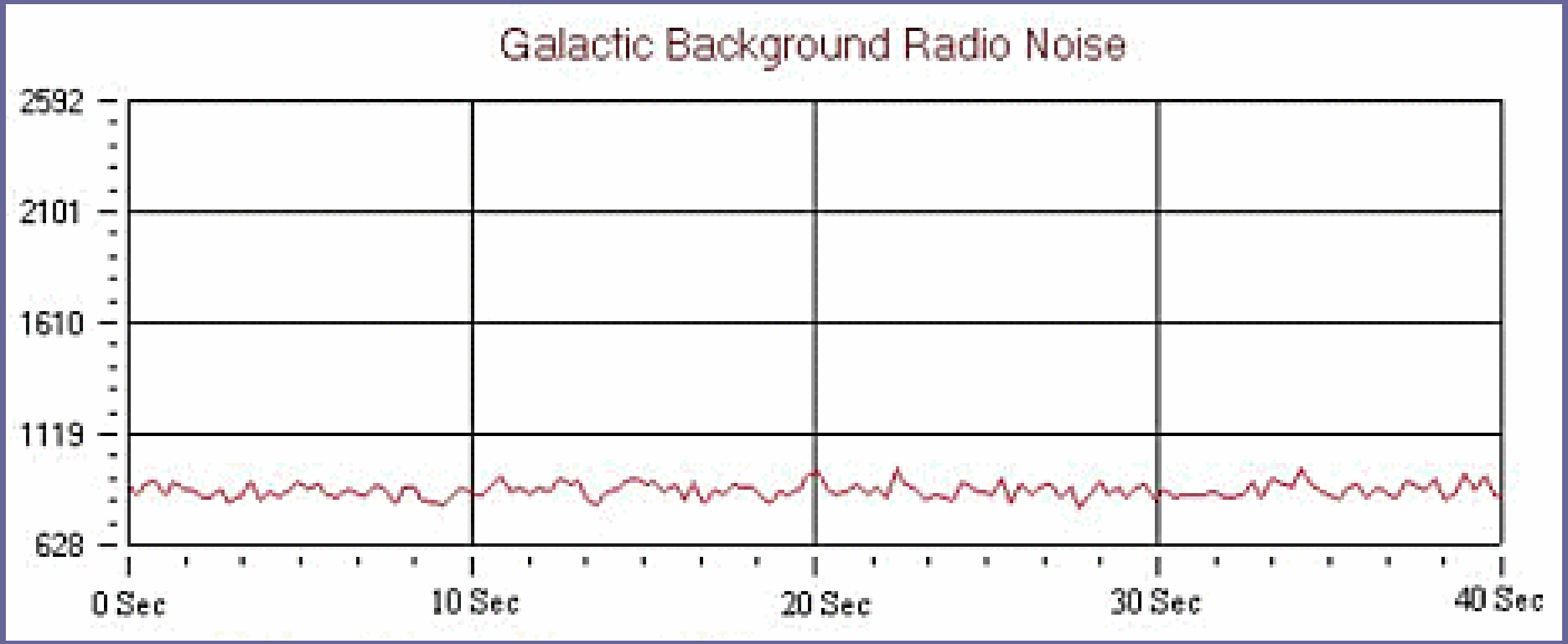
- Milky Way
  - Visible



  - Radio



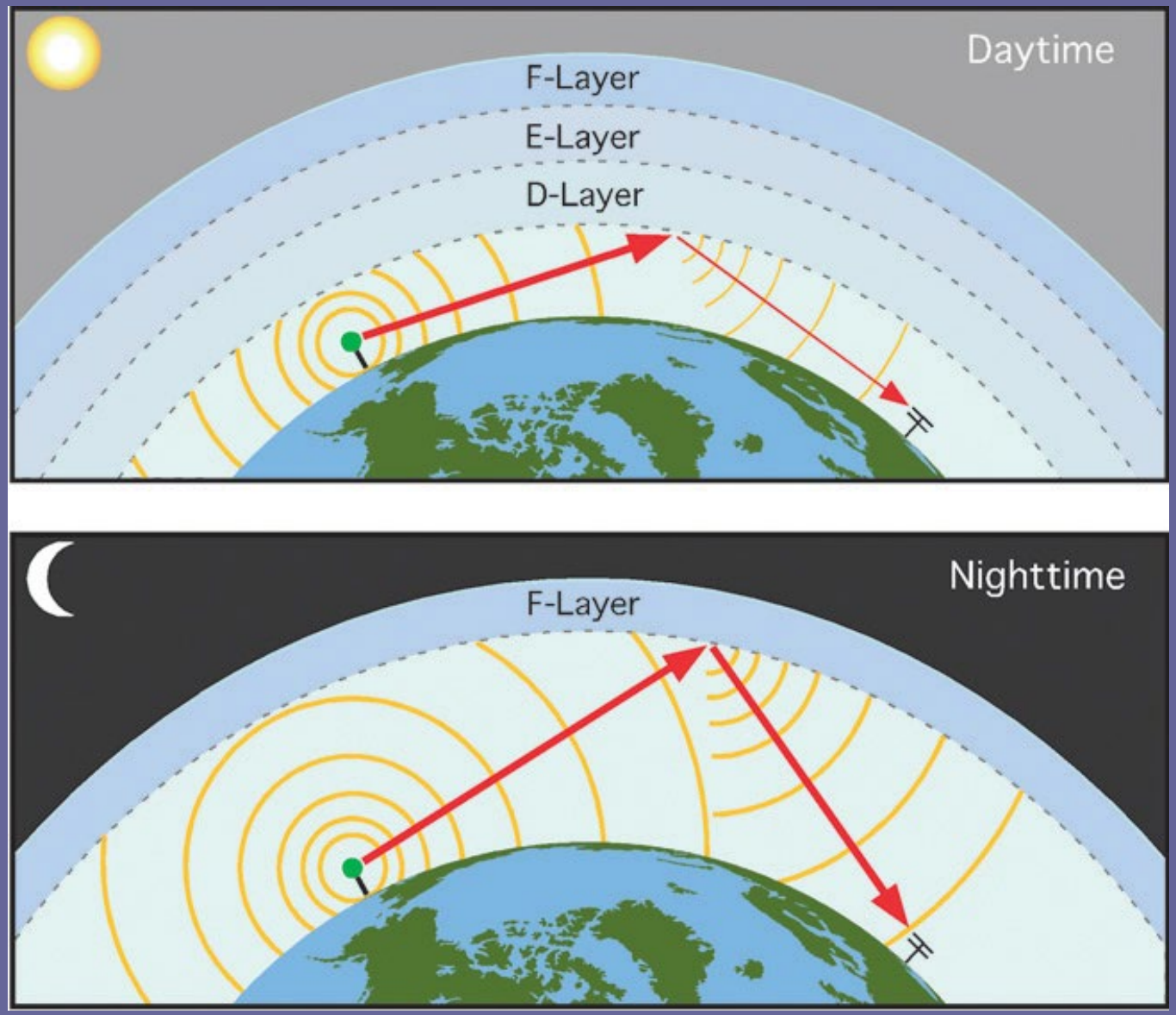
- Galactic Background
  - Steady “hiss” due to electrons in galactic magnetic field



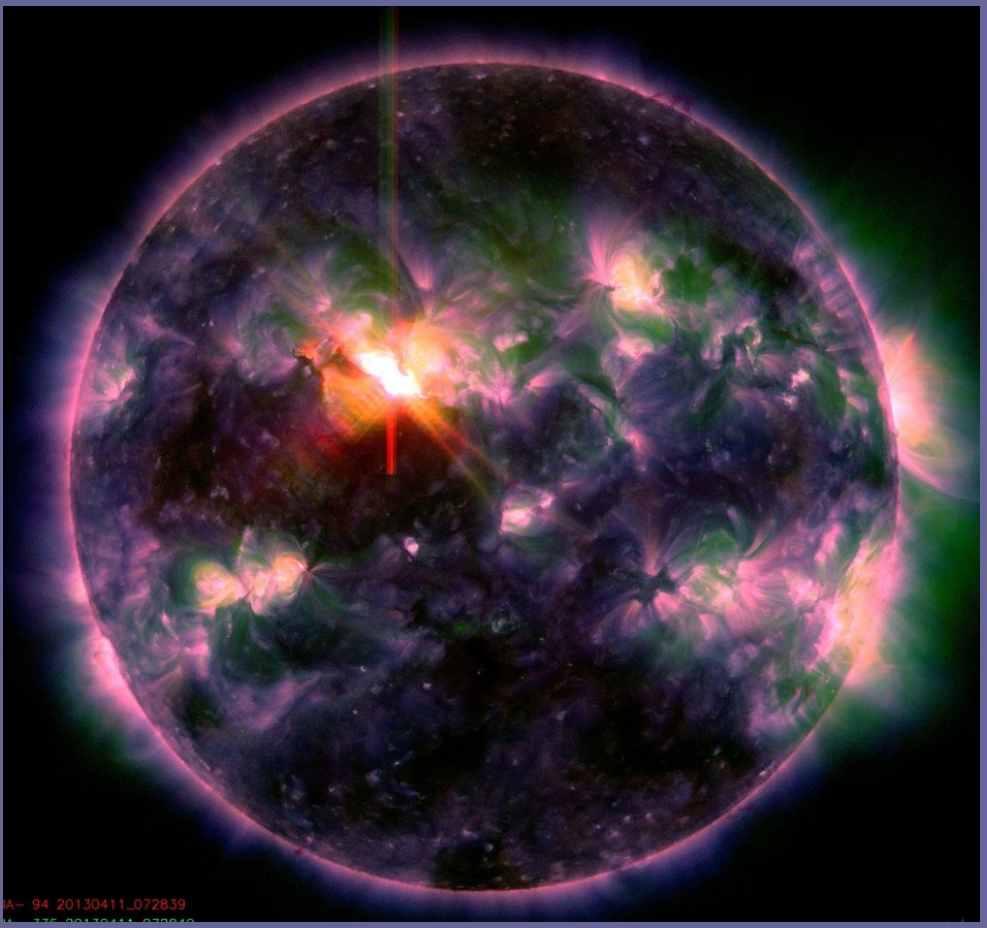
Current Projects

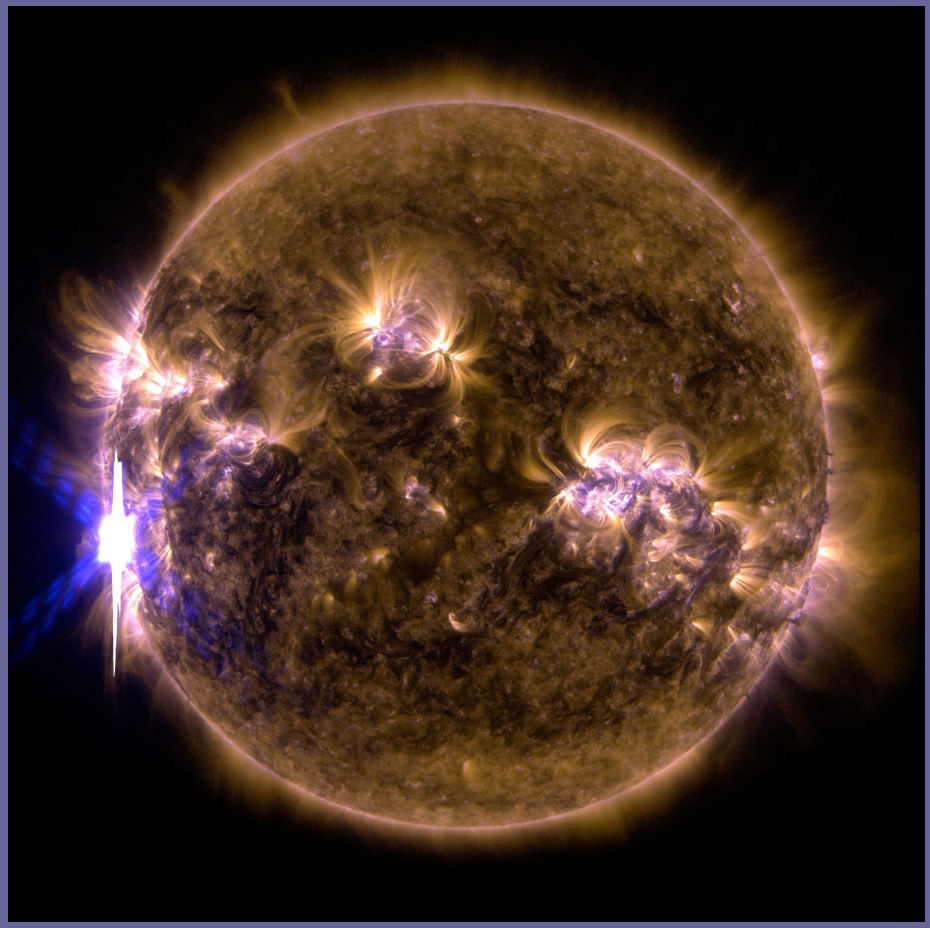
- SuperSID
  - Detection of solar X-ray flares, gamma ray bursts, earthquake precursors
- Radio JOVE
  - Detects signals from the Sun and Jupiter
- Meteor detection
- Galactic Hydrogen Emission

The Ionosphere

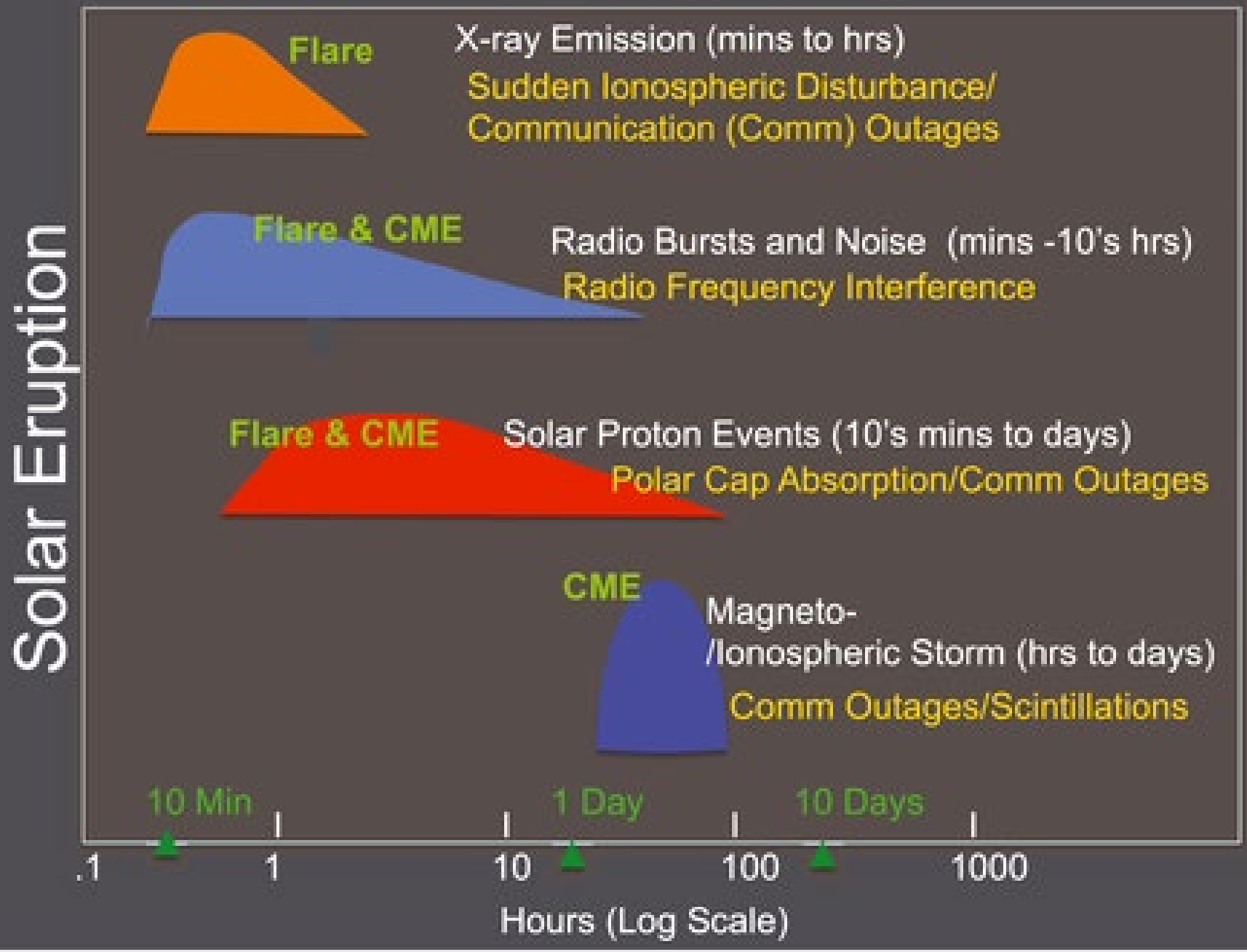


- Sun
  - X ray flares

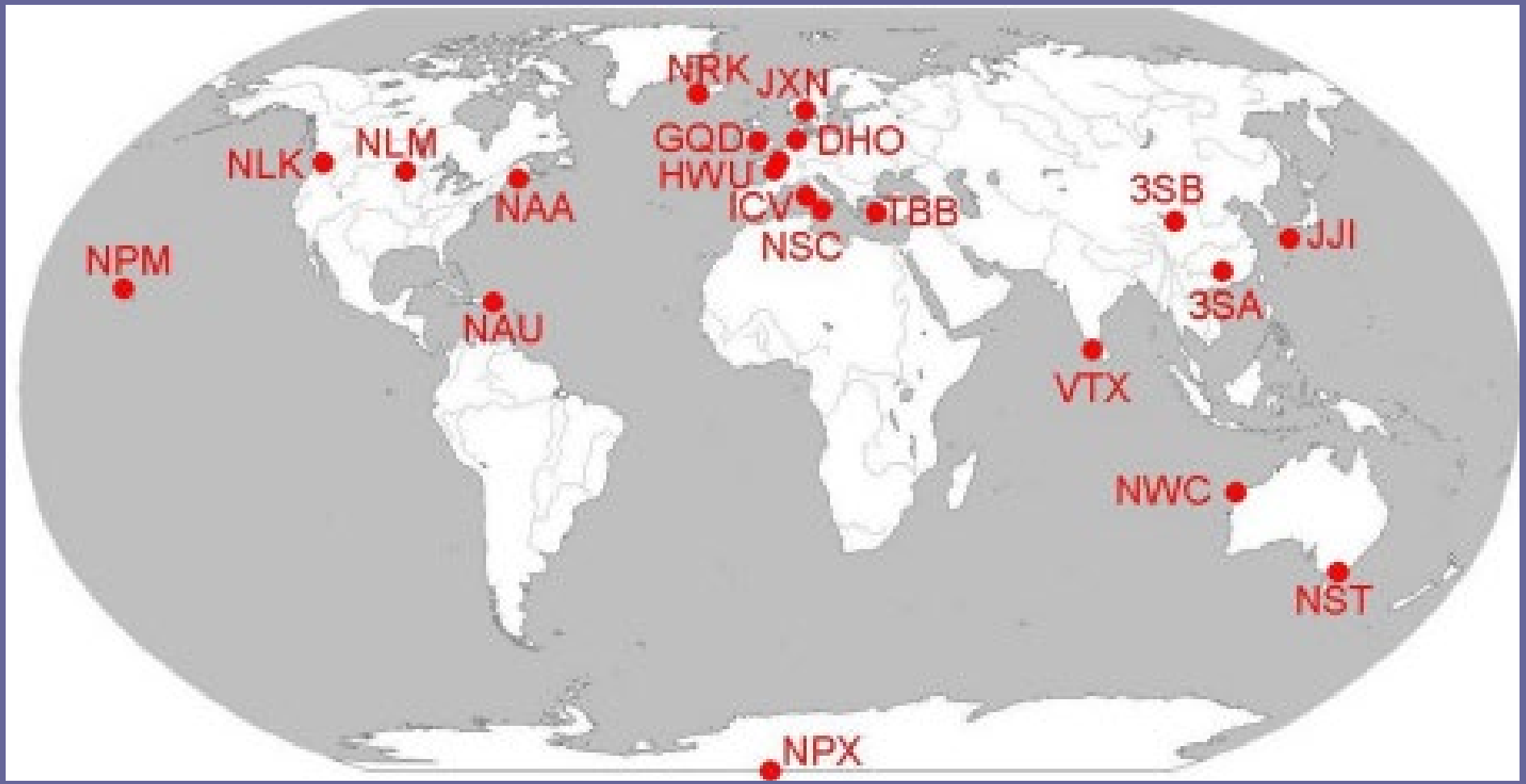




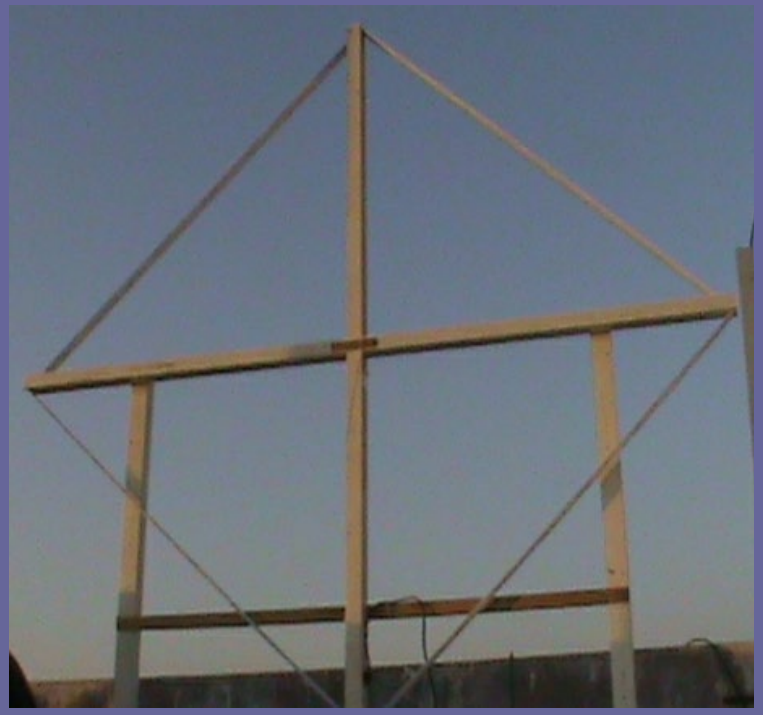
Radio Disturbance Sources and Timing

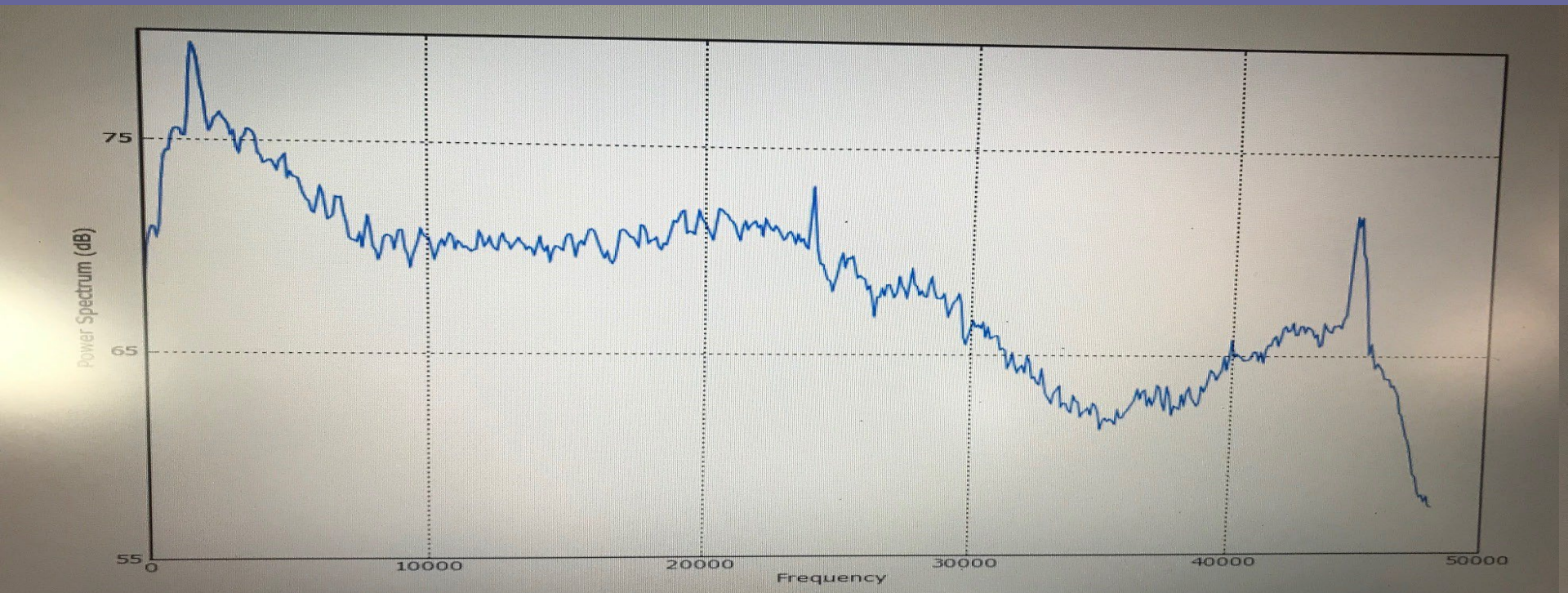


- Detection of a SID
  - Recording intensity variation from Naval VLF transmitters

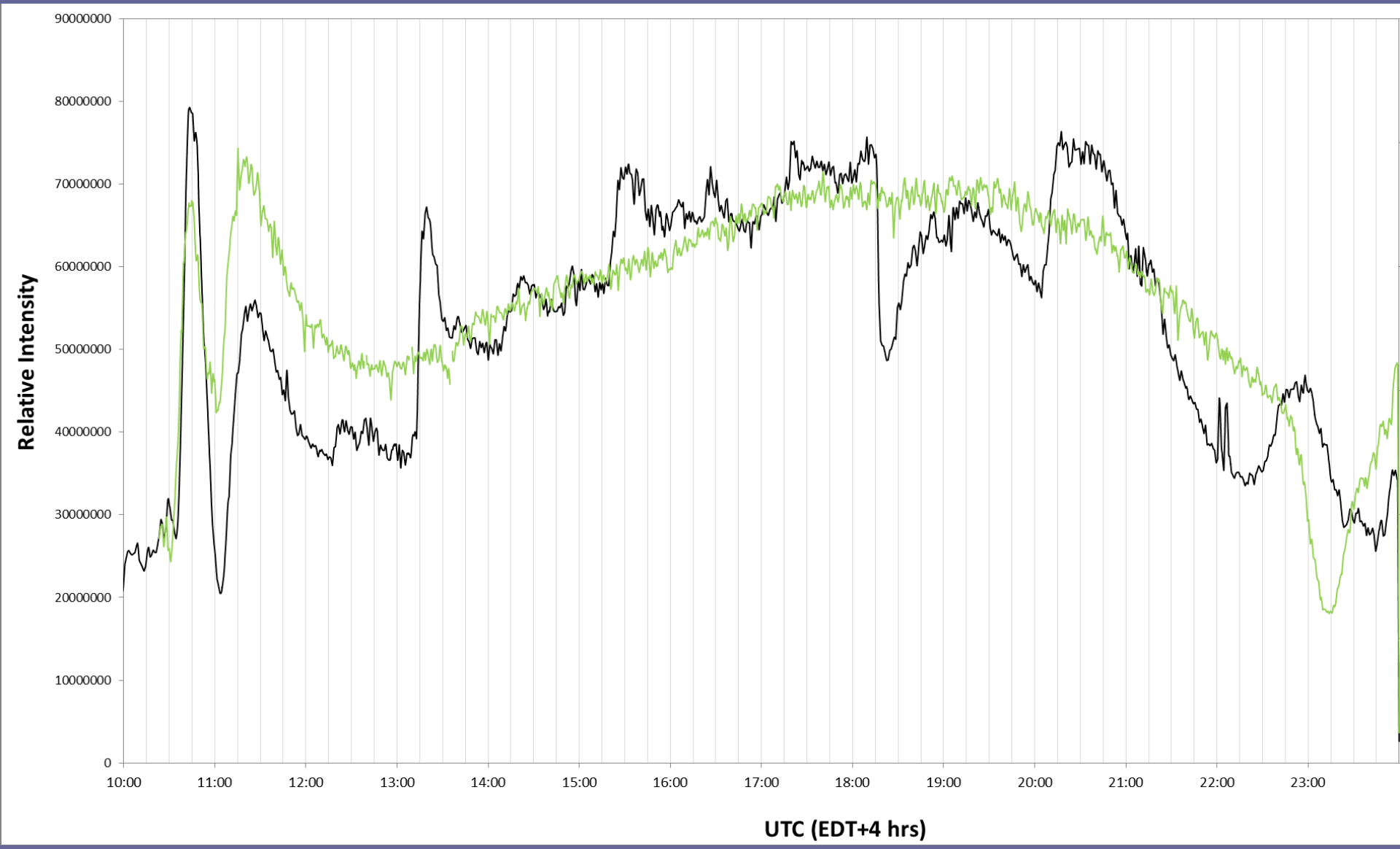


- SuperSID
  - Started at Stanford Univ.
  - Simple loop antenna





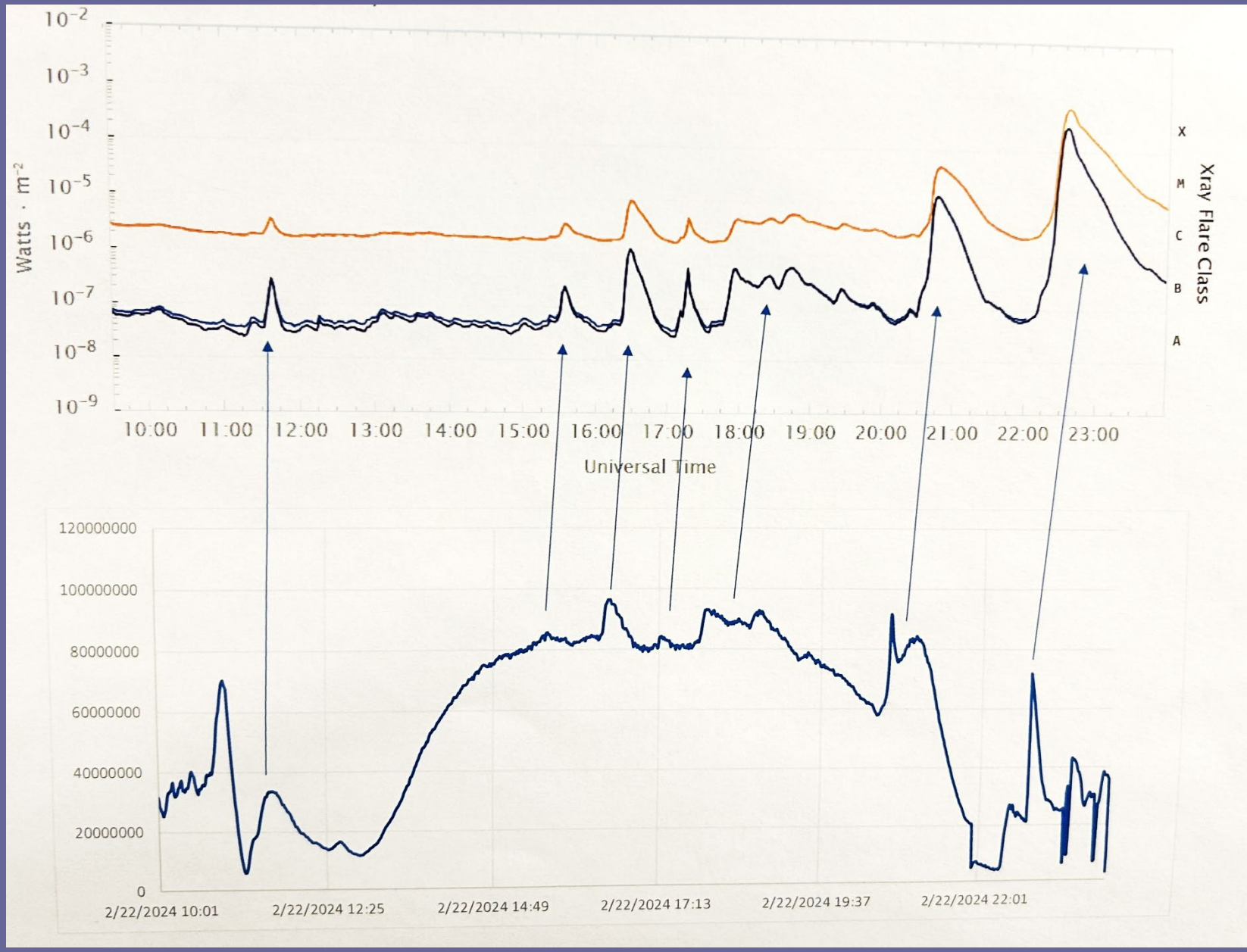
SuperSID


90000000
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
Relative Intensity
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
UTC (EDT+4 hrs)

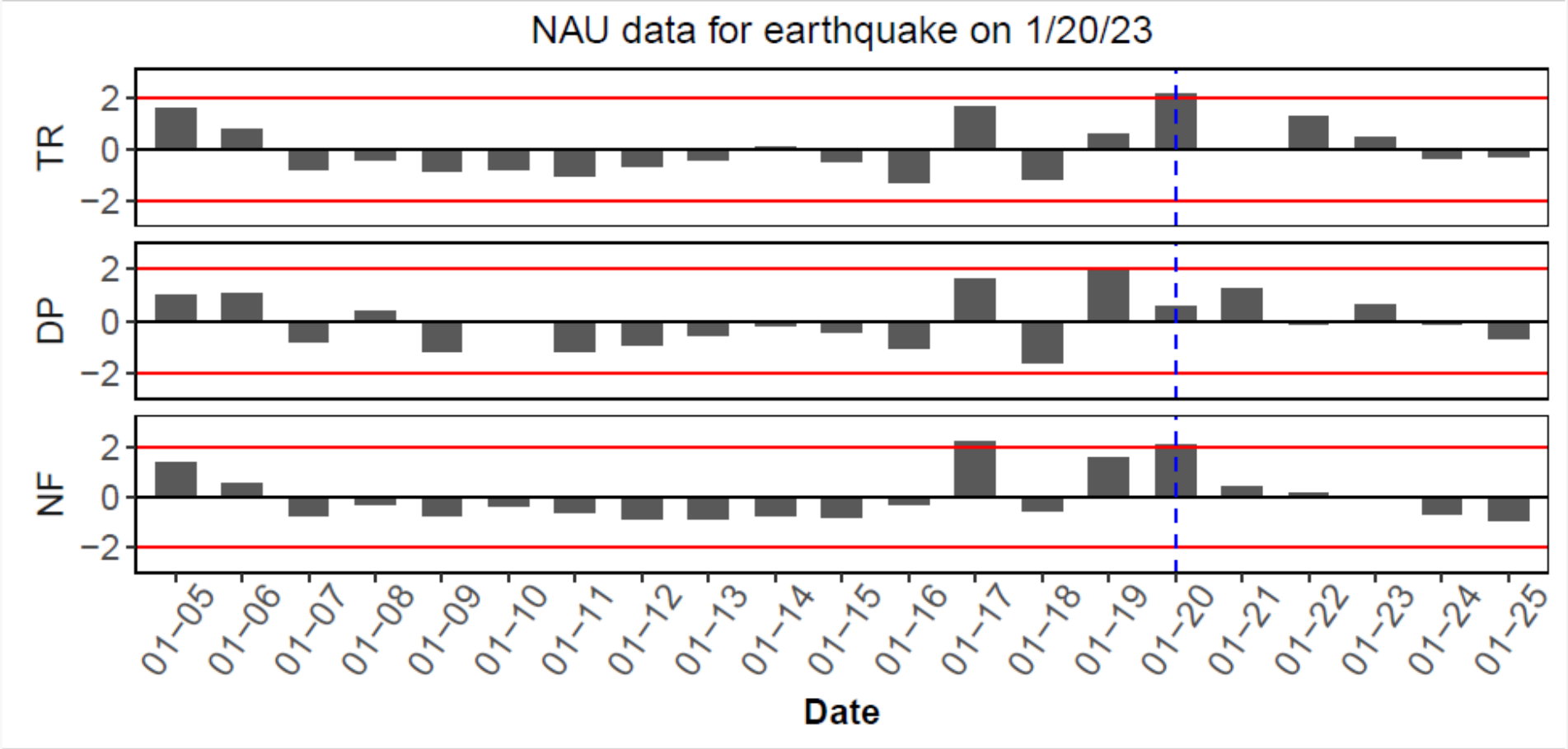
- SuperSID

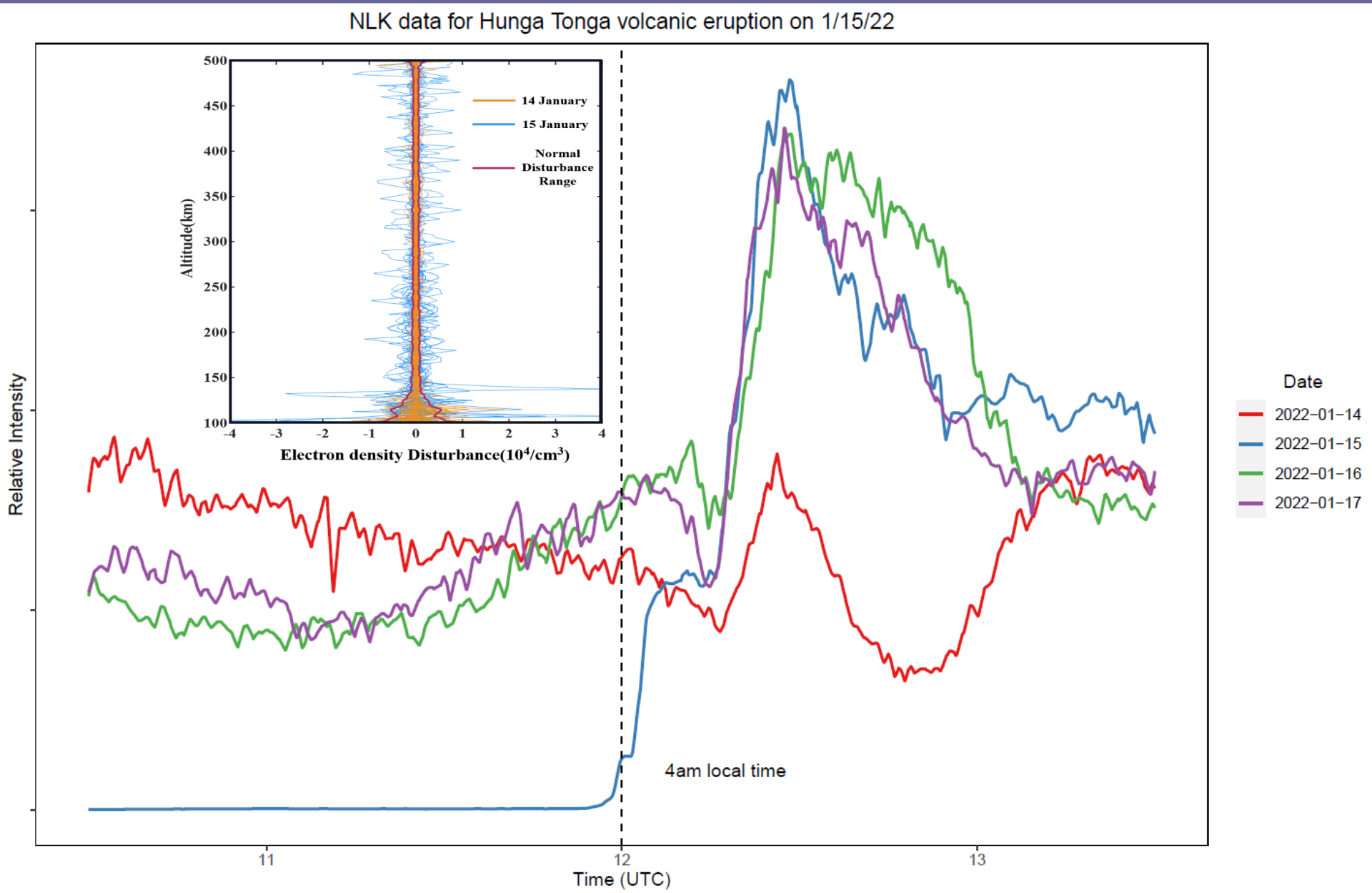
NASA

USCA

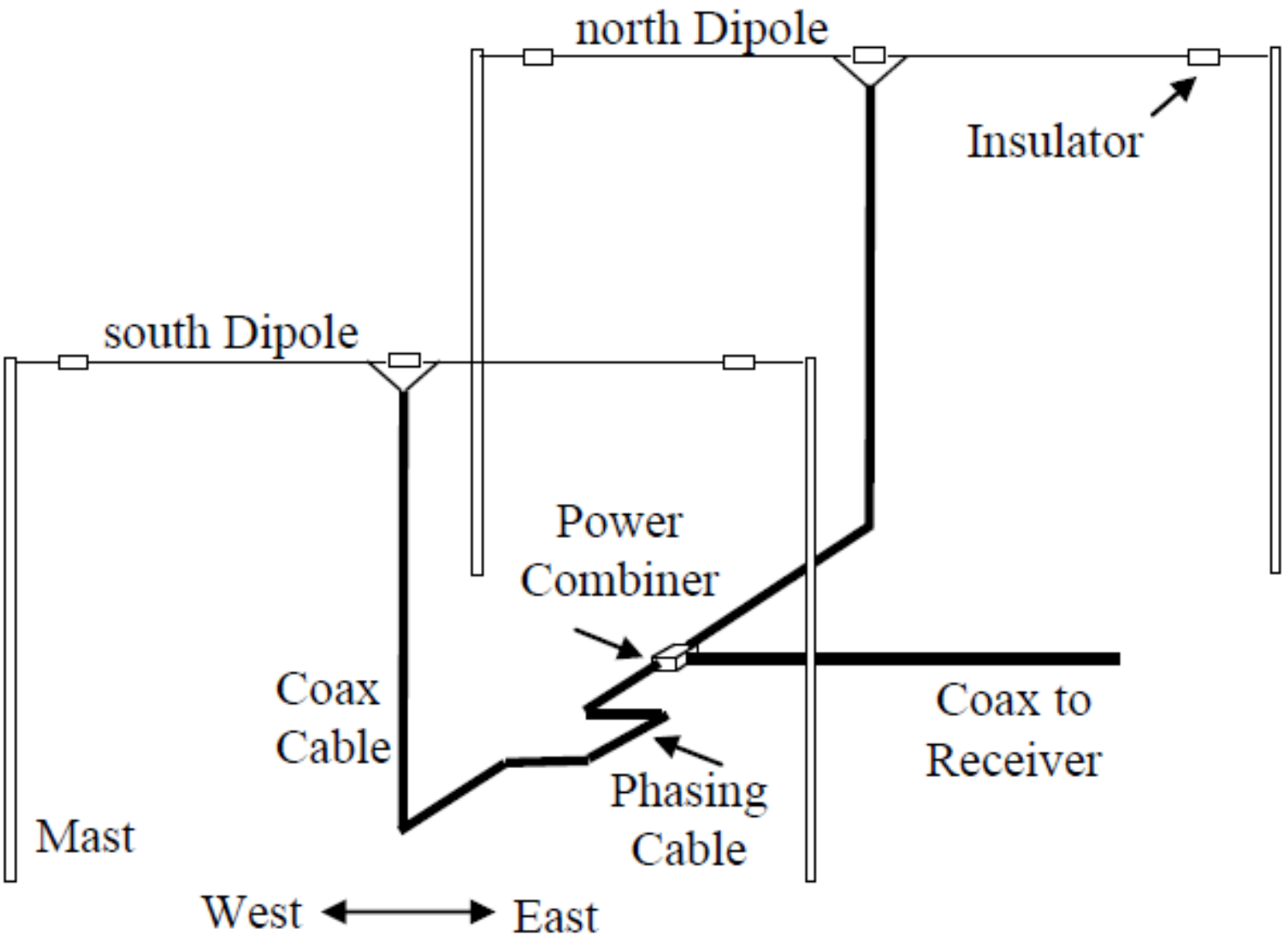


Mag. 6.1 that occurred 344 miles SE of Puerto Rico

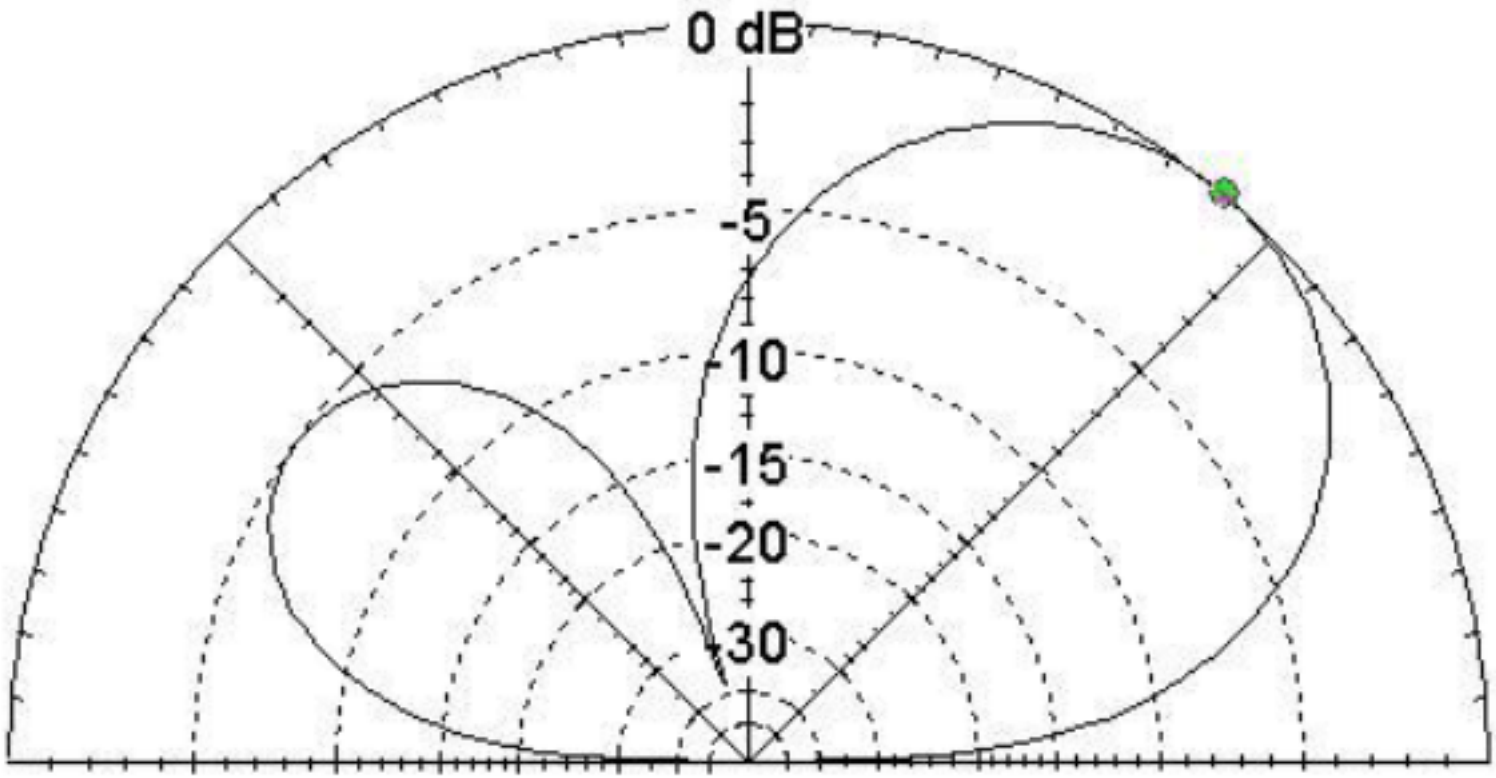



NLK data for Hunga Tonga volcanic eruption on 1/15/22
Relative Intensity
Time (UTC)
11
12
13
4am local time
Date
2022-01-14
2022-01-15
2022-01-16
2022-01-17
Altitude(km)
Electron density Disturbance(10^4/cm^3)
14 January
15 January
Normal Disturbance Range

Radio Jove - Developed by NASA in 1998



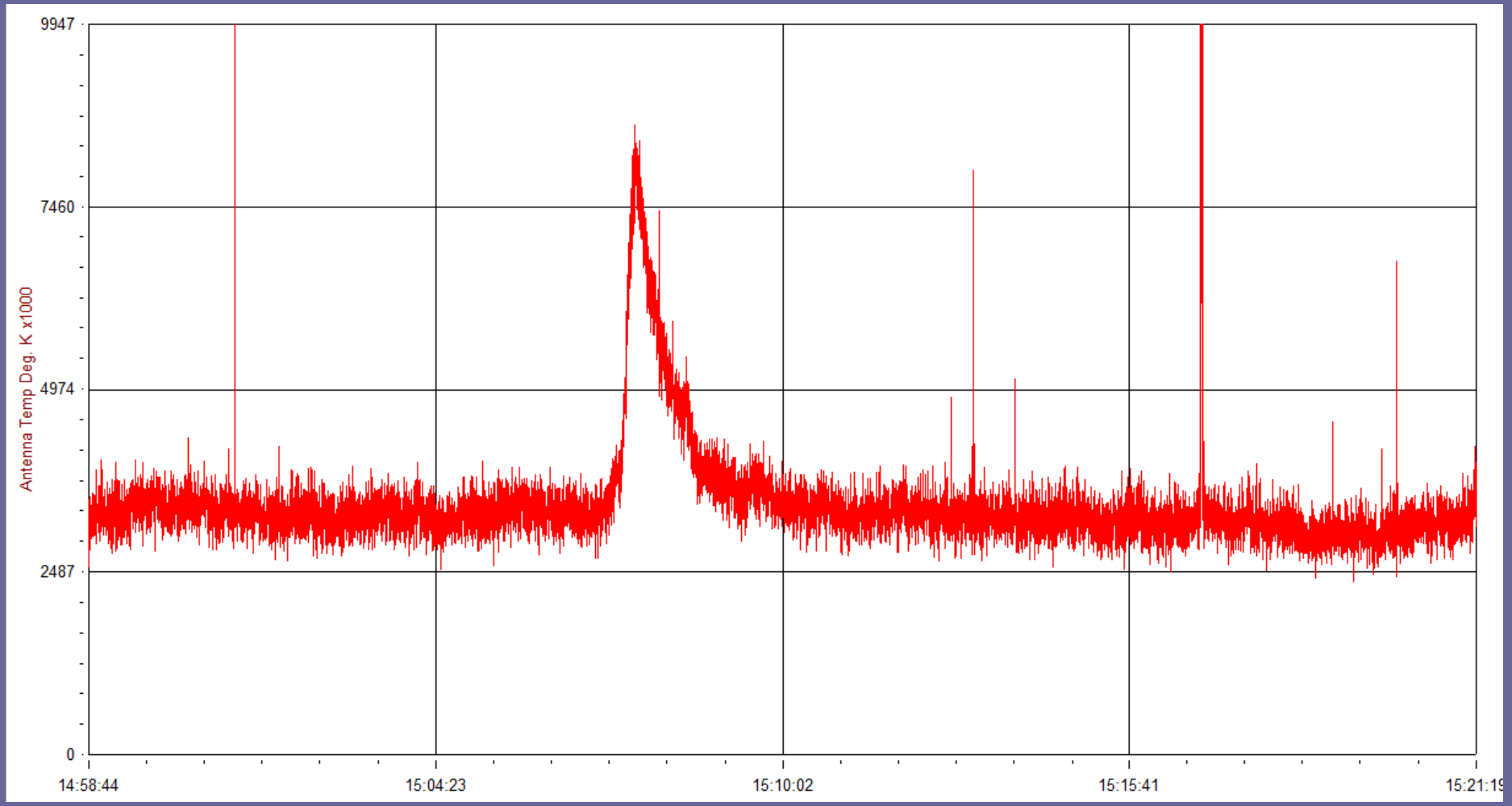
- Radio Jove
  - Elevation Beam Pattern



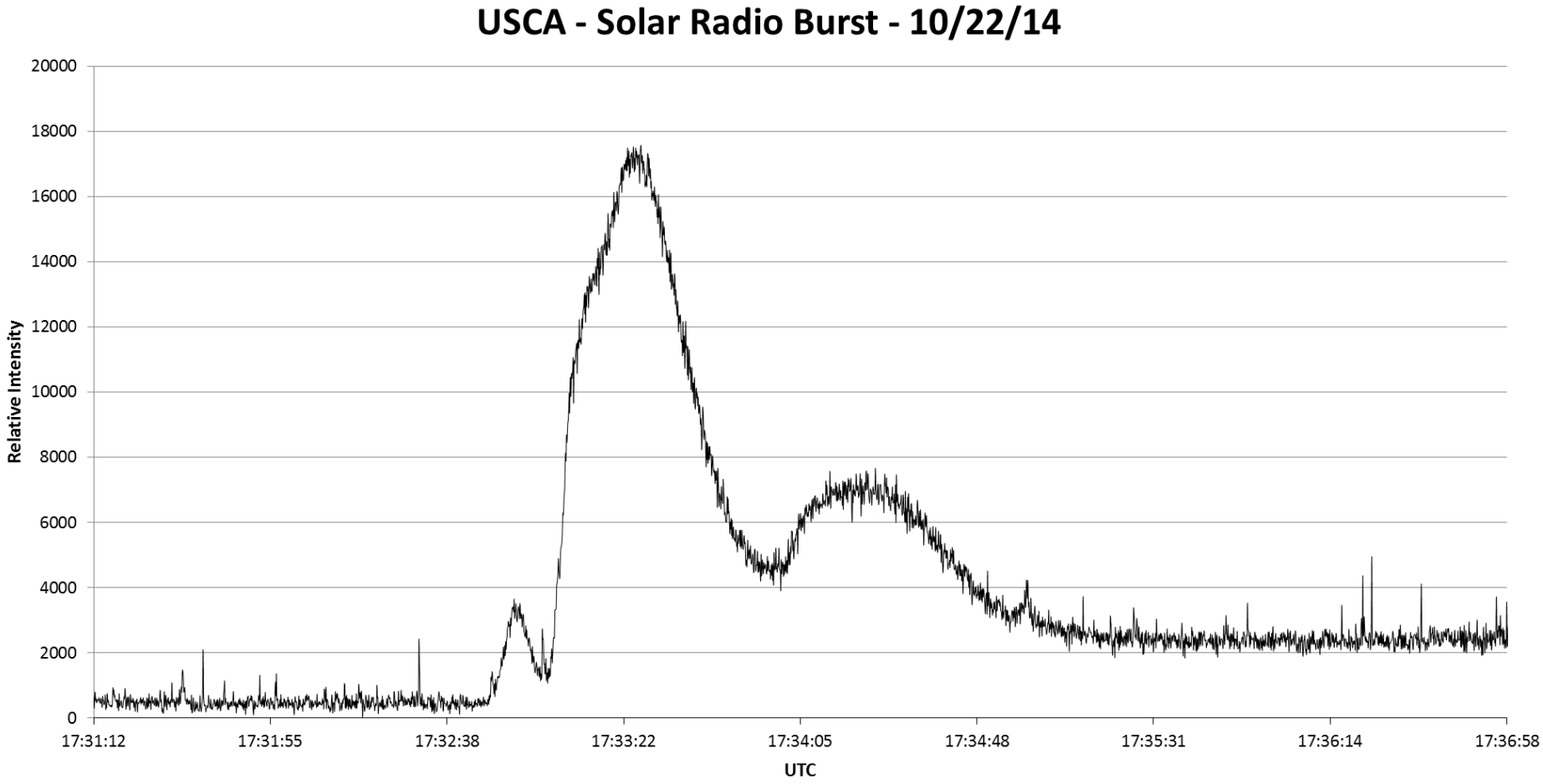
Dual dipole, 10 ft, 135 deg phasing, gain = 8.5 dBi at el = 50

Radio Jove

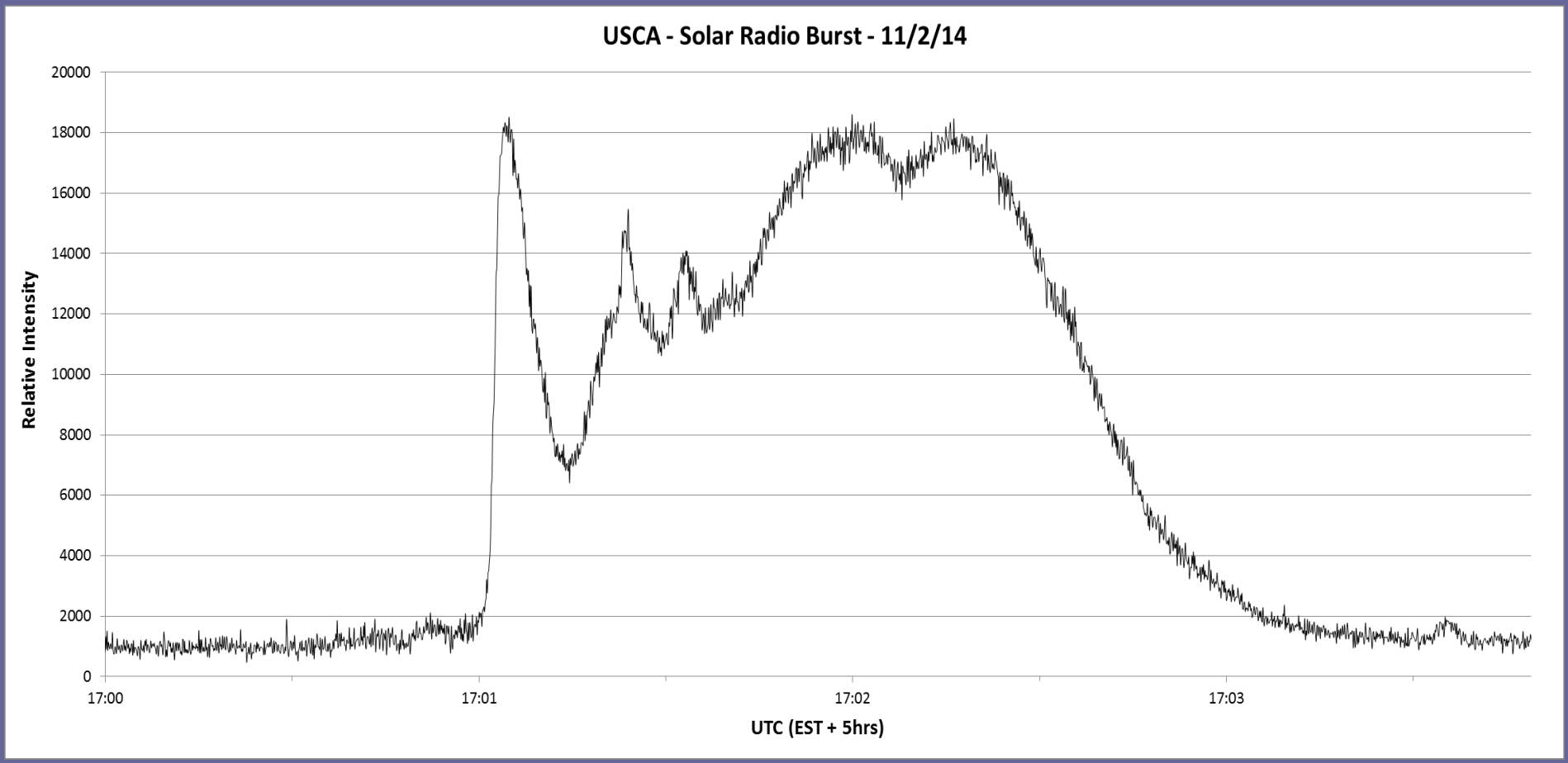
- Solar detection at 20 MHz (or 15 m)



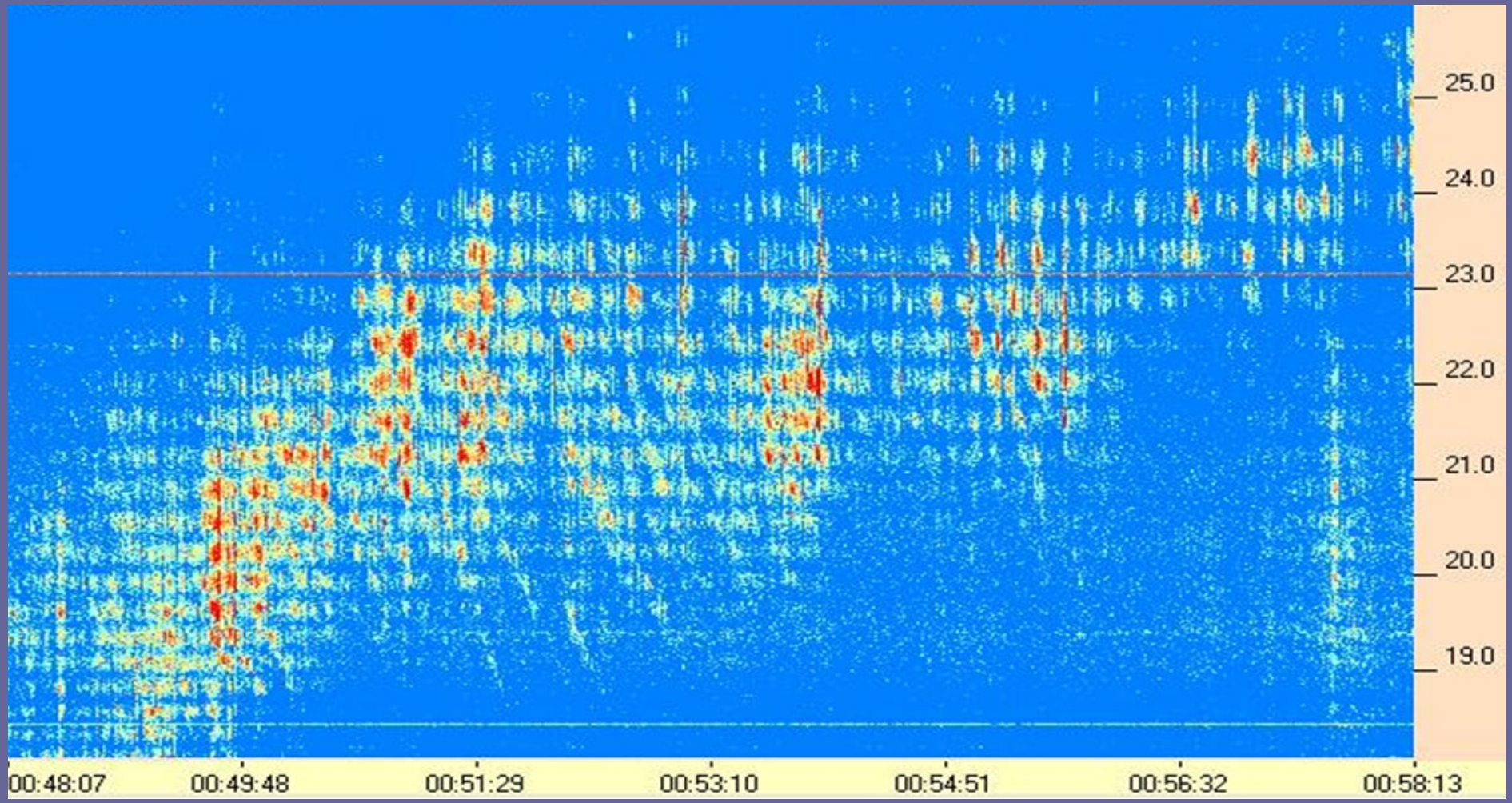
Radio Jove


USCA - Solar Radio Burst - 10/22/14
Relative Intensity
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
17:31:12
17:31:55
17:32:38
17:33:22
17:34:05
17:34:48
17:35:31
17:36:14
17:36:58
UTC

Radio Jove

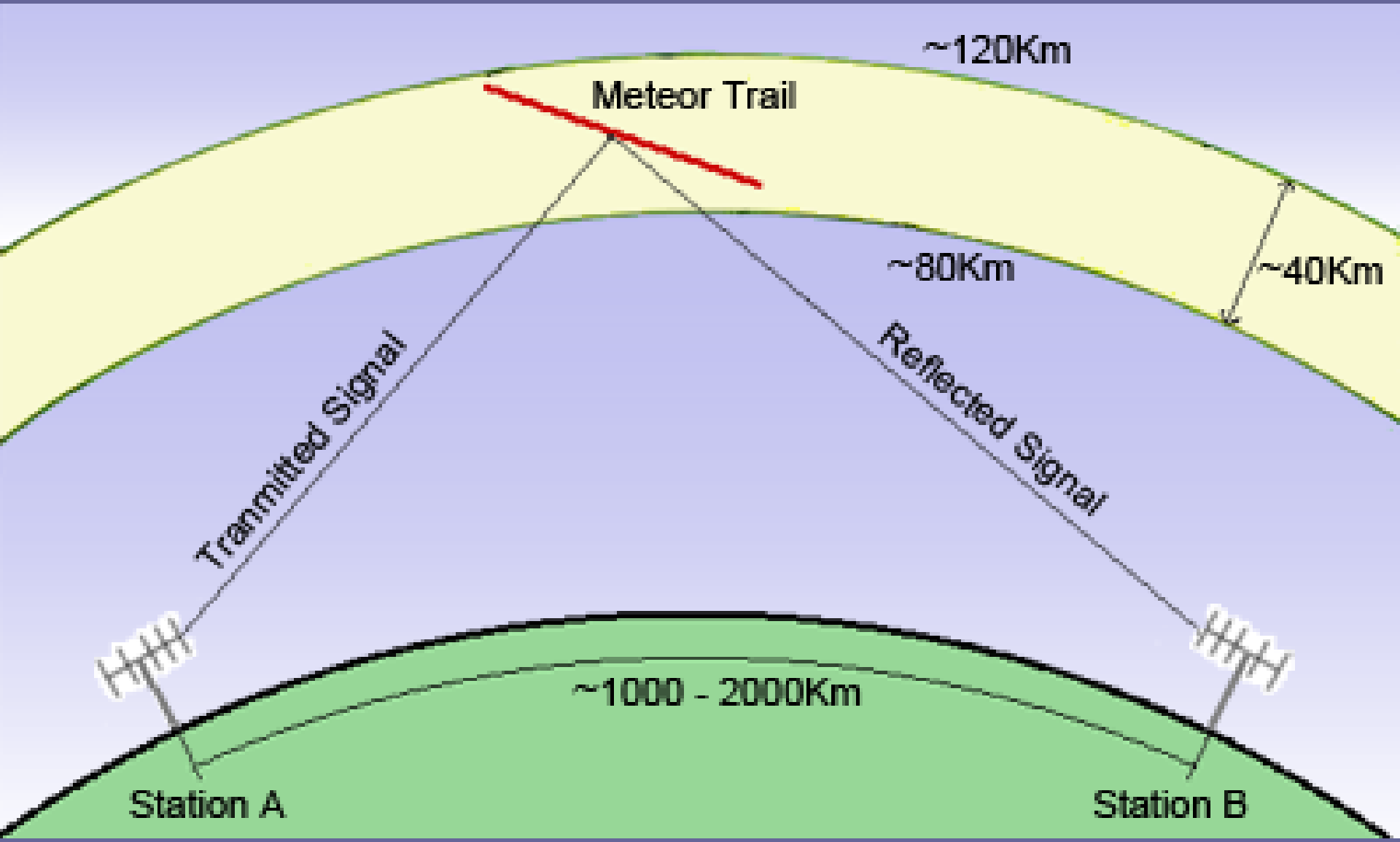

USCA - Solar Radio Burst - 11/2/14
Relative Intensity
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
17:00
17:01
17:02
17:03
UTC (EST + 5hrs)

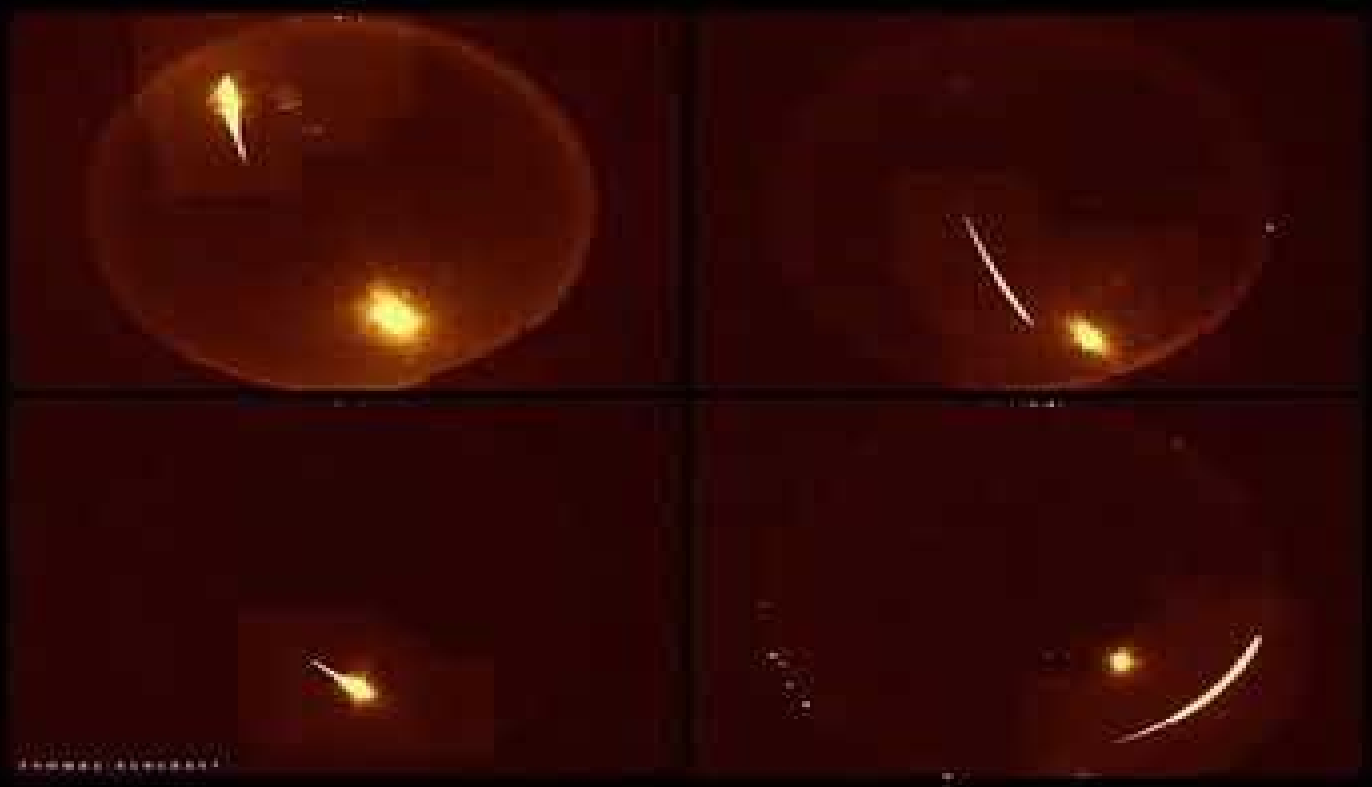
- Radio Jove
  - Upgrade to a SDR for spectrum data



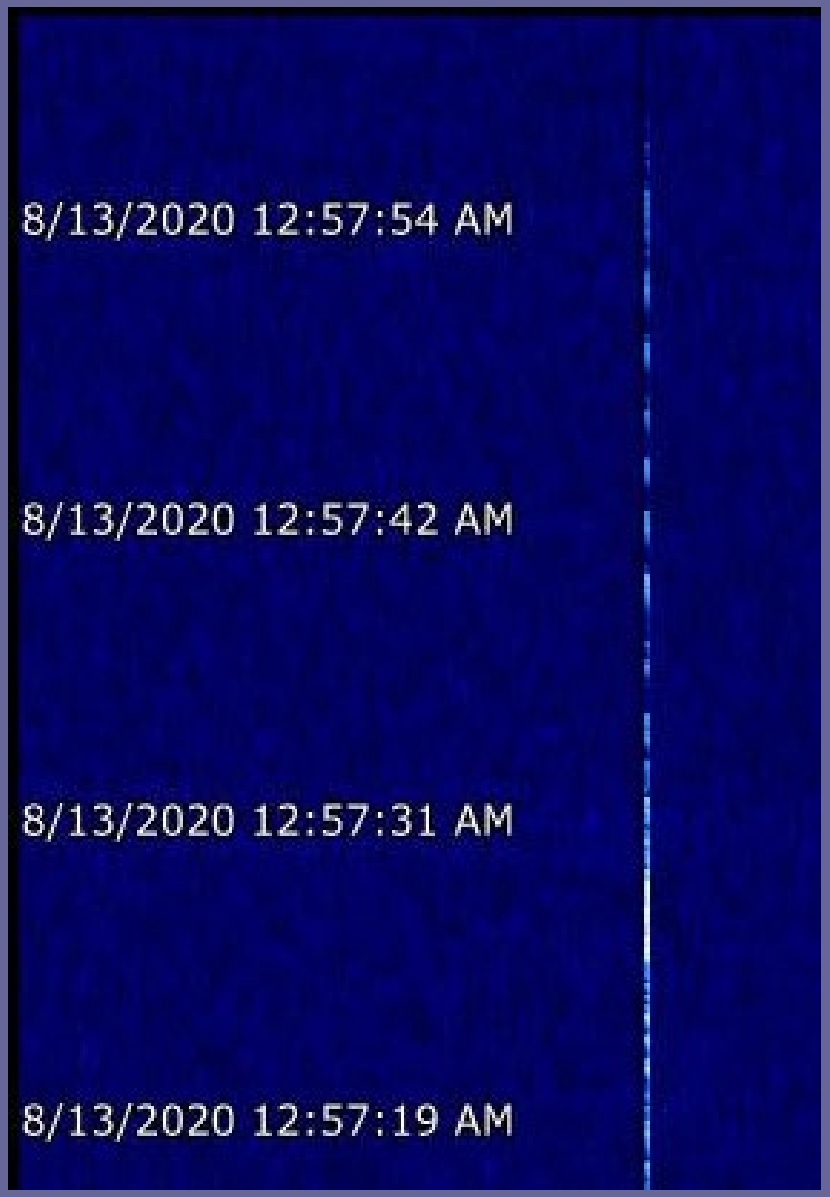
Meteor Detection

- Reflection of terrestrial signals
  - FM stations – tough to get a distant one
  - Digital TV Ch 2 - 6 (54 - 82 MHz)

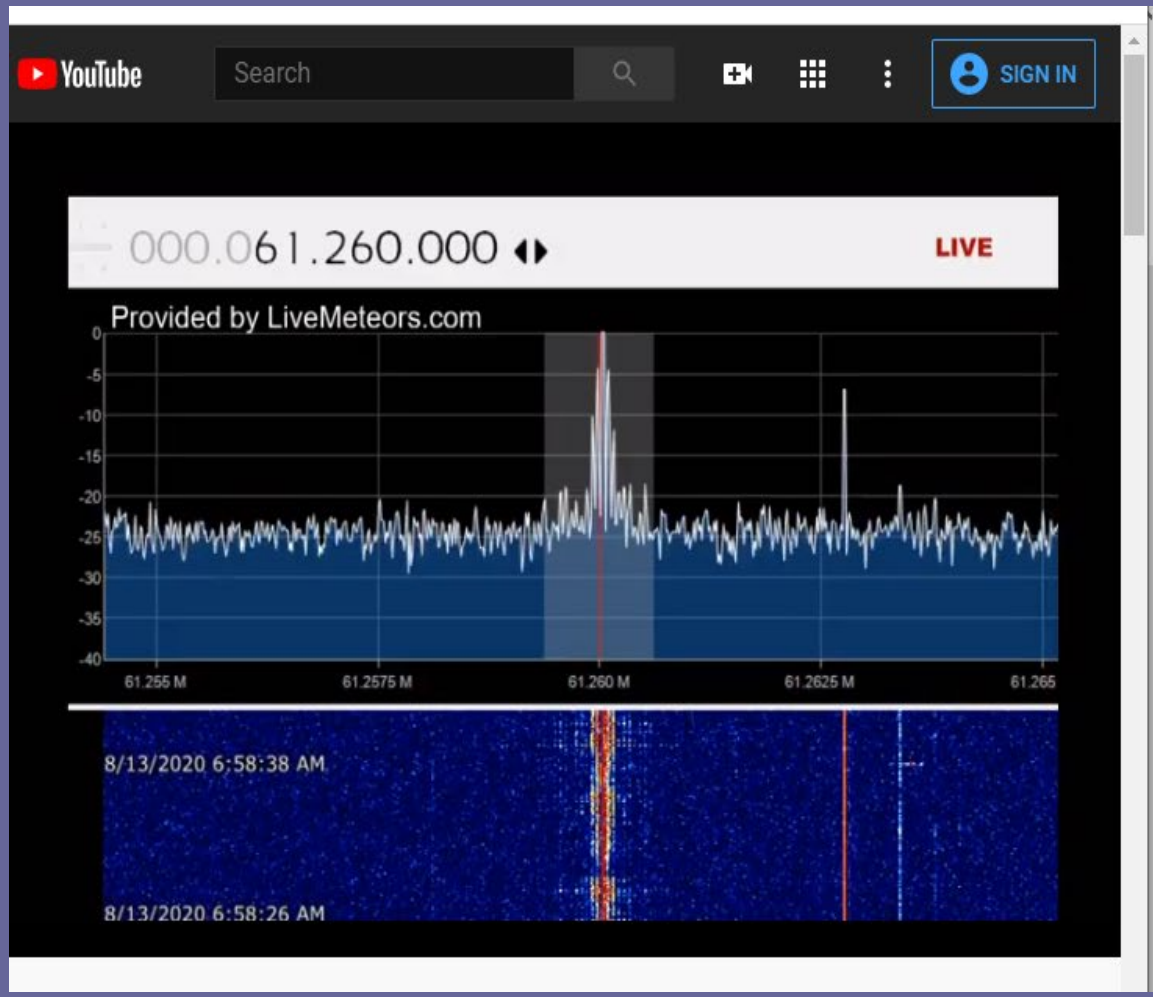

~120Km
Meteor Trail
~80Km
~40Km
Tranmitted Signal
Reflected Signal
~1000 - 2000Km
Station A
Station B

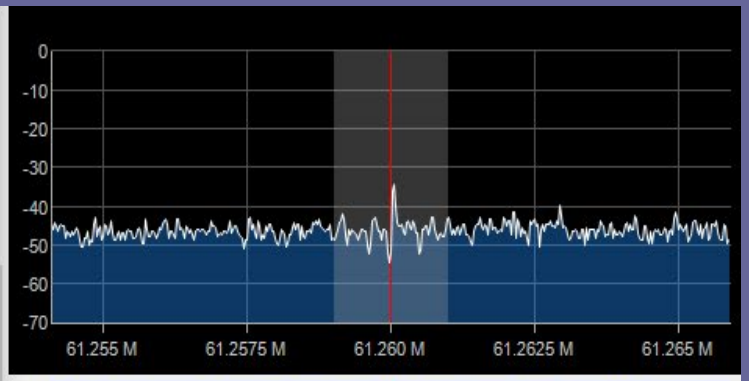


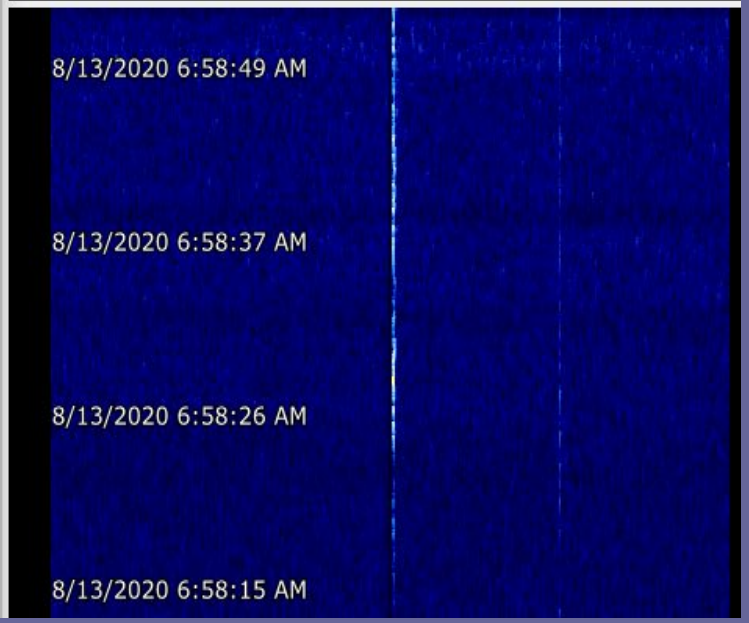
Perseid Meteor Shower - August 2020



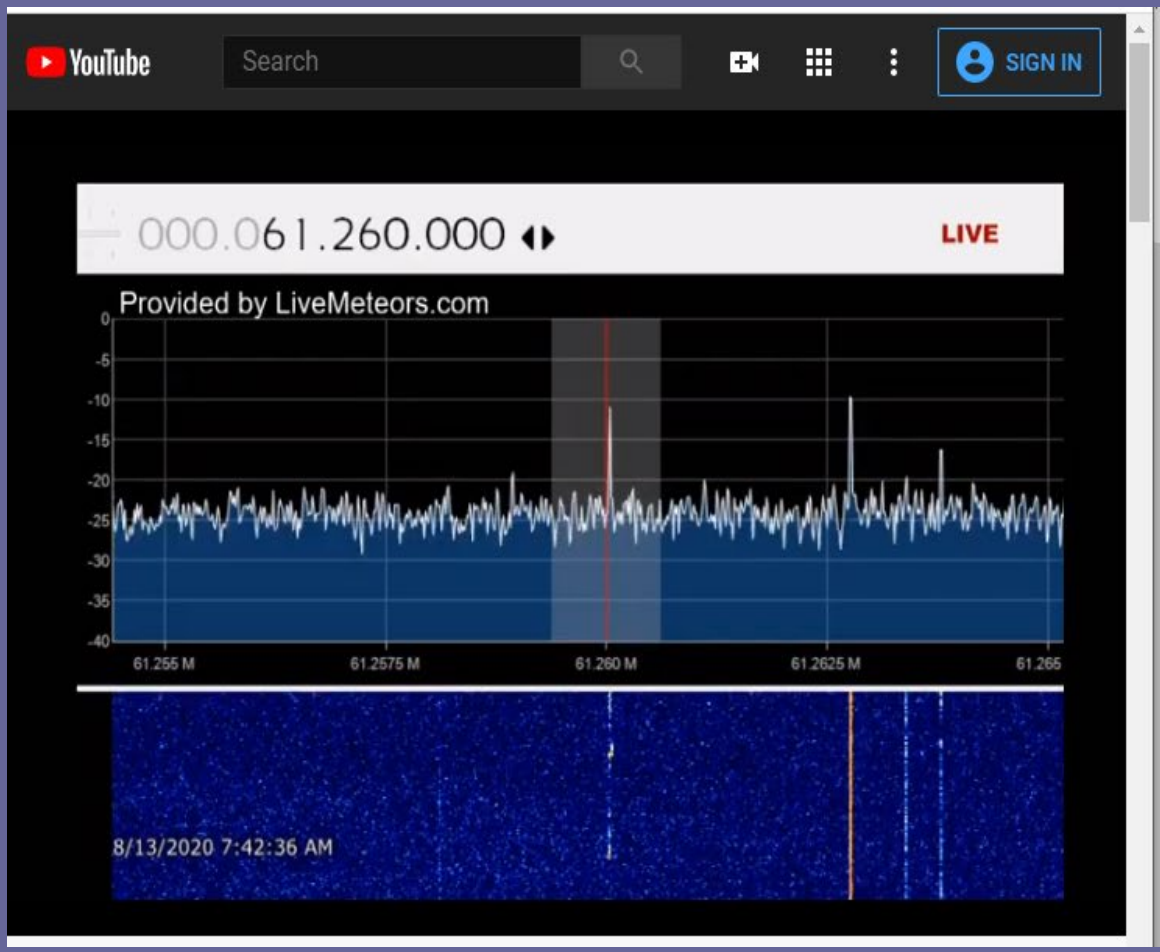
Perseid Meteor Shower - August 2020

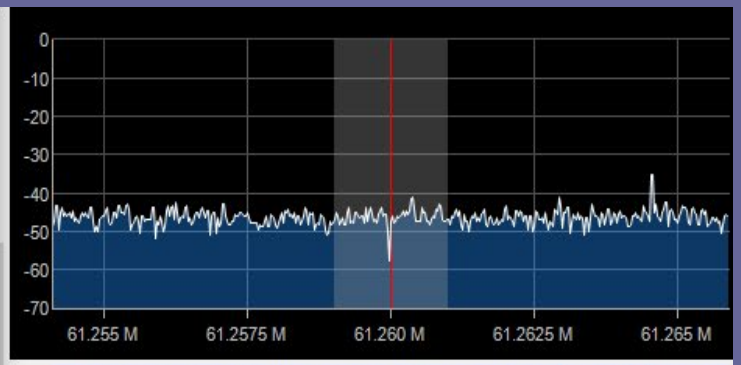


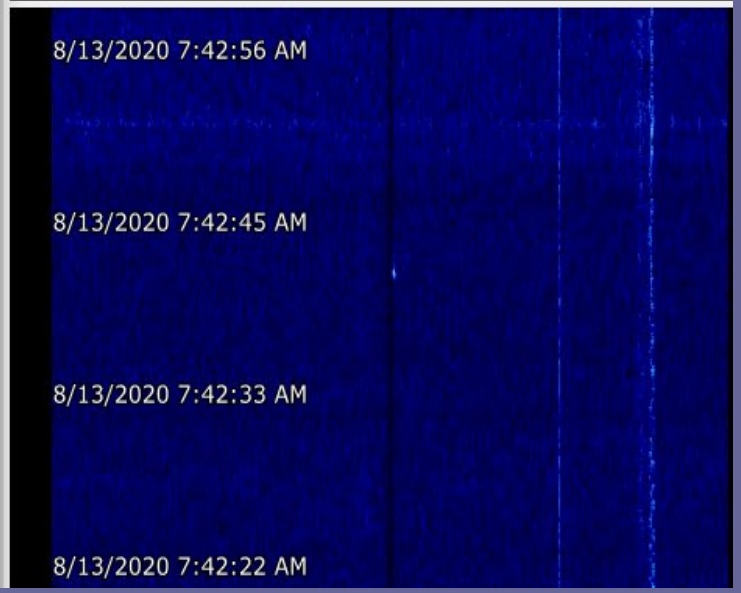




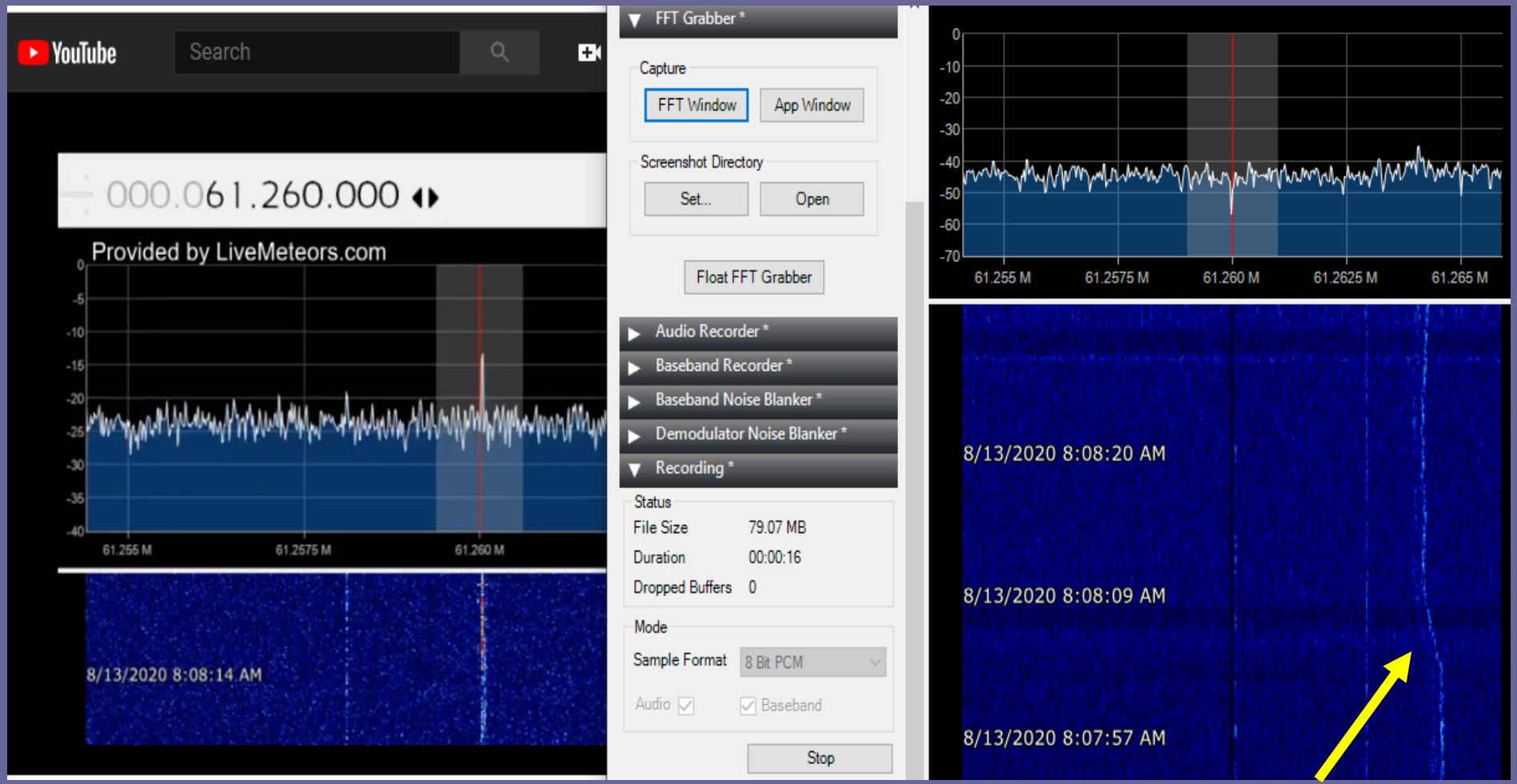
Perseid Meteor Shower - August 2020





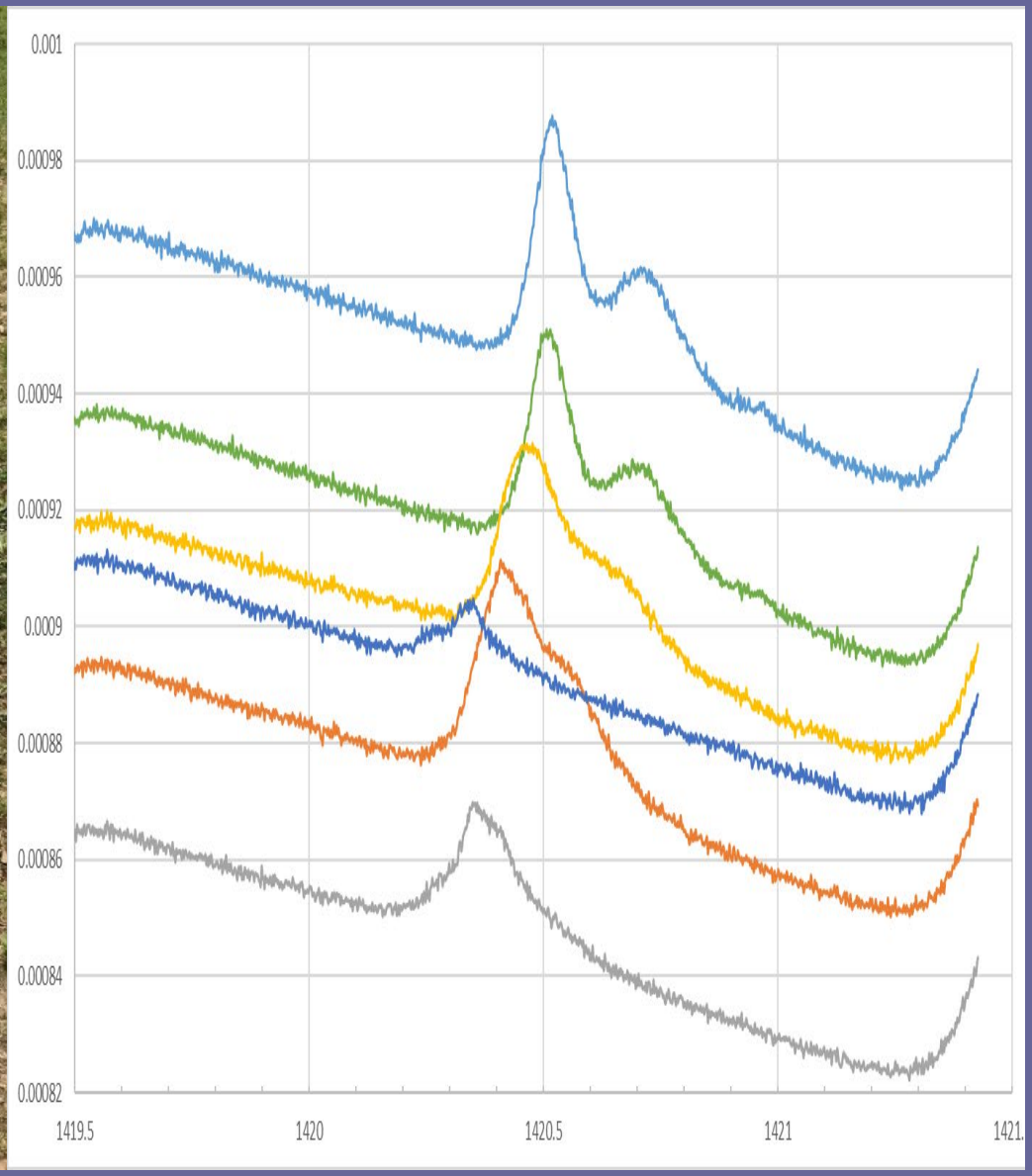


Perseid Meteor Shower - August 2020



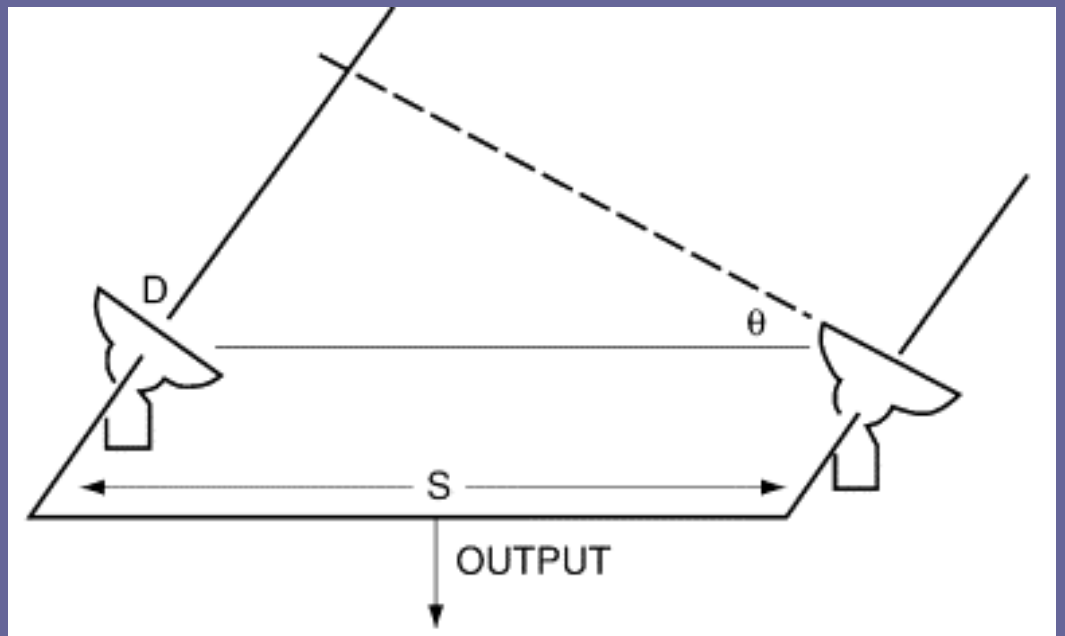
Doppler shift?

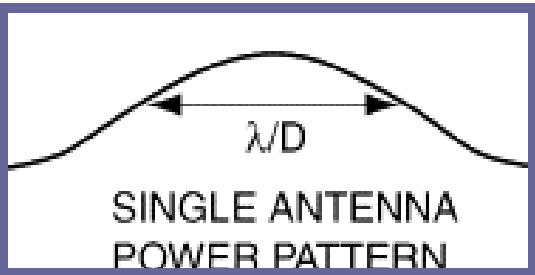
Hydrogen Emission at 1.42 GHz

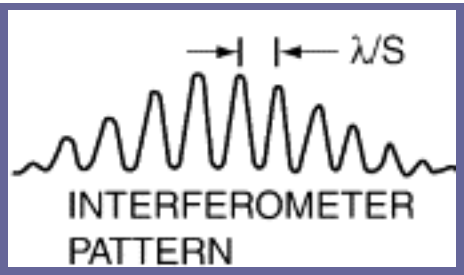


Future Projects

- Detecting pulsars
  - Single dish and interferometer







Getting Started

- Society of Amateur Radio Astronomers
  - https://www.radio-astronomy.org/
- Galactic Hydrogen Detection
  - https://www.rtl-sdr.com/a-talk-on-21cm-hydrogen-line-amateur-radio-astronomy/
- Meteor Detection
  - https://www.amsmeteors.org/ams-programs/radio-observing/