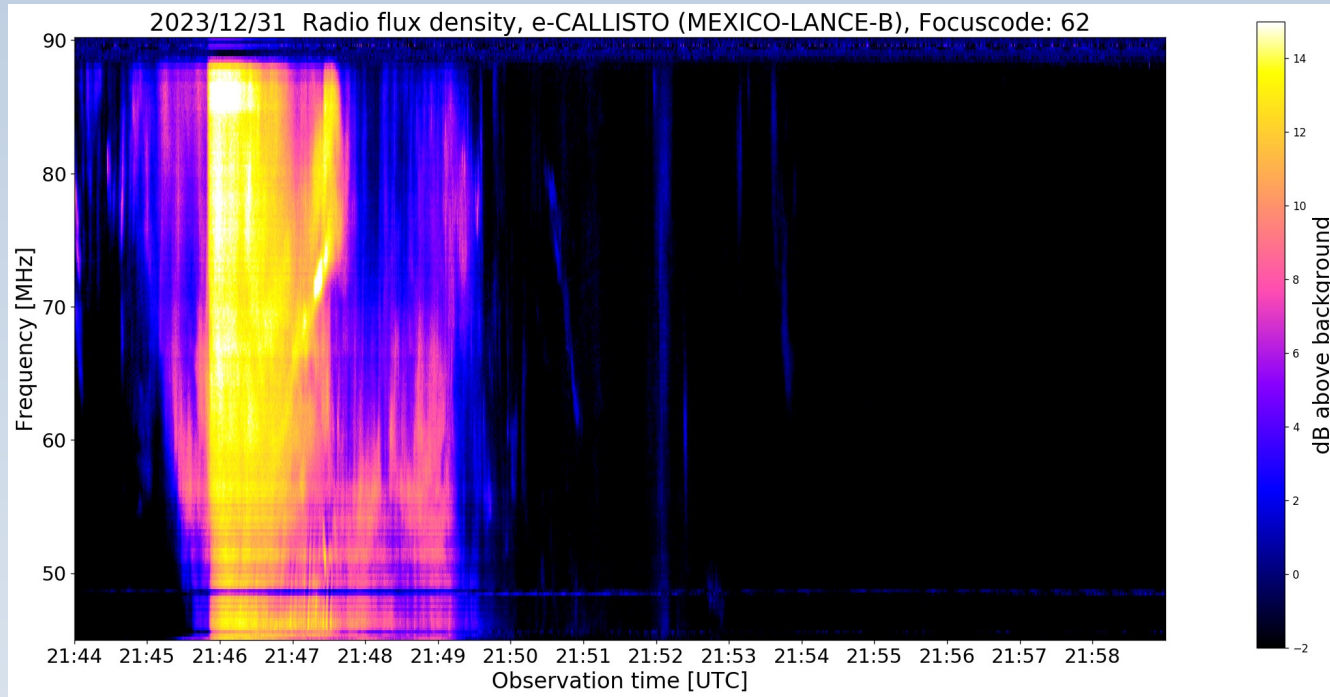


Deep Space Exploration Society Science Meeting



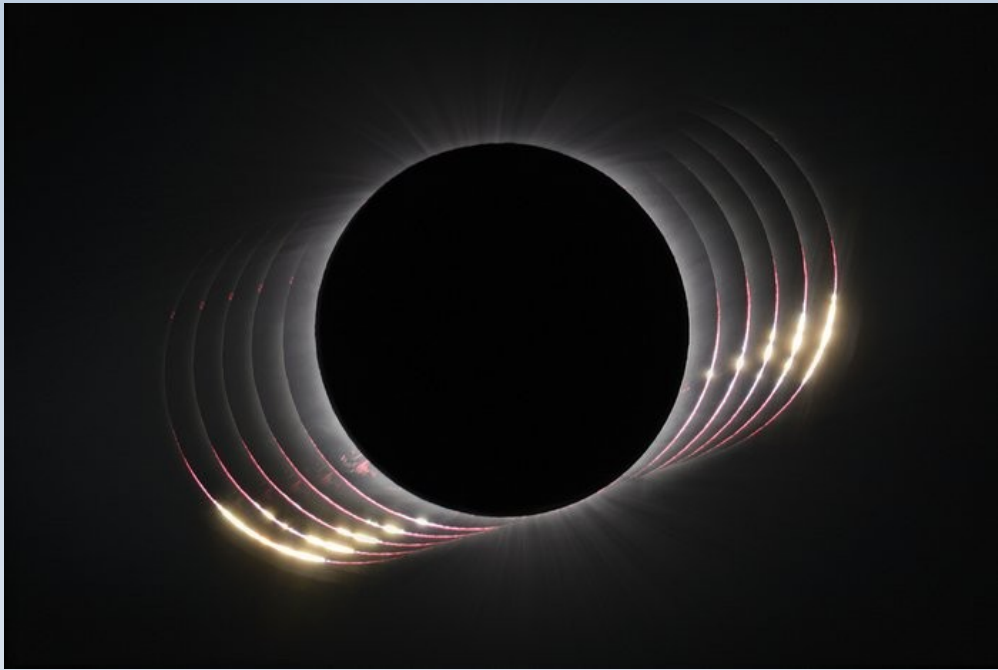
X4.8 solar flare, Dec. 31, 2023

January 22, 2024

Dan Layne

dses.science

Going to the Total Solar Eclipse? Take SunSketcher App



Baily's beads, ESO, July 2, 2019

- Citizen science project (WKU/NASA)
- Smartphone app will take pictures of Baily's beads before & after totality
- Goal: Improve accuracy of the size and shape of the sun
 - Collect millions of pictures (GPS time, location) along path of eclipse
 - Combine with accurate map of moon's surface (Lunar Reconnaissance Orbiter)

<https://sunsketcher.org/index.php>

<https://science.nasa.gov/eclipses/citizen-science/>

Upcoming Project Opportunities

- Feb. - Mar. (60' dish): Observe OH masers, pulsars & 21cm HI
- Feb. - Mar. (60' dish): Measure system temperature (T_{sys})
- Prepare new building for operations – Bill, Ray
- Install & configure three new online space weather instruments
 - Callisto solar spectrometer with VHF/UHF log periodic antenna
 - New Radio Jove with Moxon antenna
 - SAM III magnetometer
- Relocate 2nd interferometer dish – Ray

DSES Maser Status

- 1420 MHz feed has been modified to cover 1400 – 1800 MHz (new antenna probe, new LNA)
- 35 masers were added to System 1 radio source table
- Try SDRPlay at 5 MHz BW, 20 minutes with Virgo scripts
- Warm days coming: we can swap feeds and start masers
- Learning opportunities:
 - Help install and test new feed; observe masers
 - Can also observe 21 cm neutral hydrogen (HI) and pulsars

Circumstellar Hydroxyl (OH) Masers

- Shell of gas around late M stars (red giants) contains molecular OH produced by UV radiation on H₂O
- Strong infrared radiation excites OH to maser transitions at 1612, 1665, 1667, and 1720 MHz
- Often show double peak. VLSR-corrected Doppler shift blue (towards observer) or red (away)
- Often bright (> 100 Jy), but highly variable emission
- OH masers are large: 1,000 – 10,000 AU

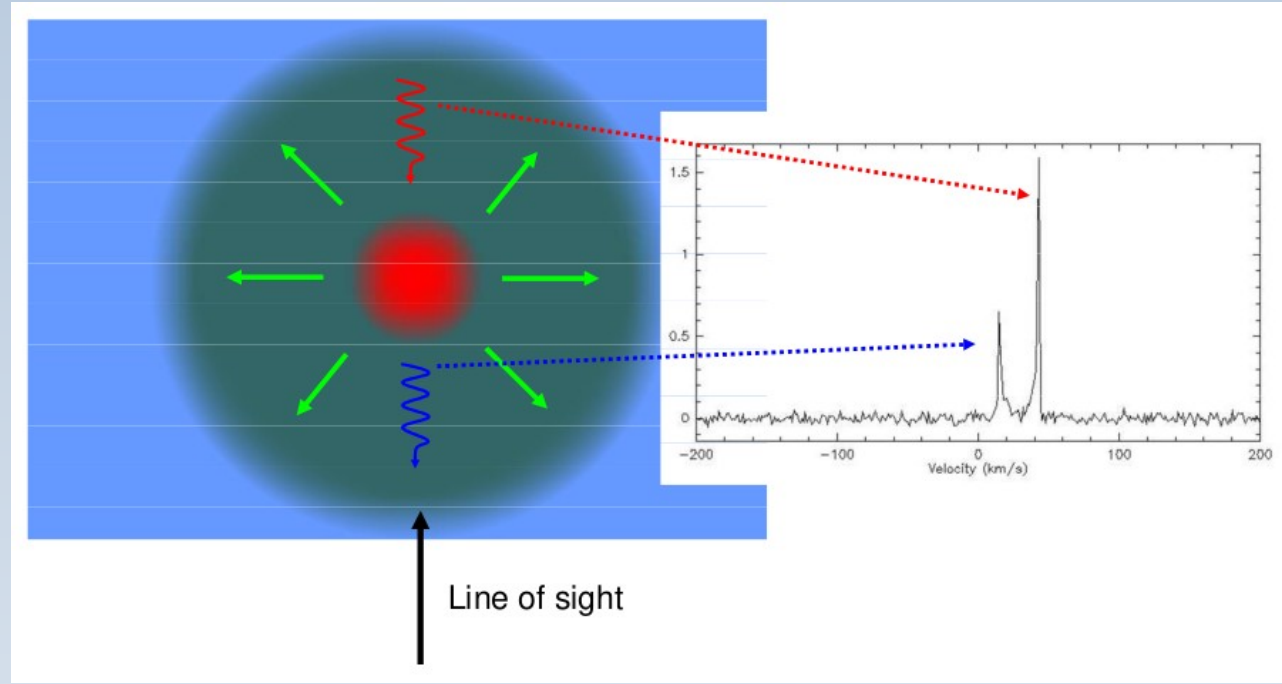
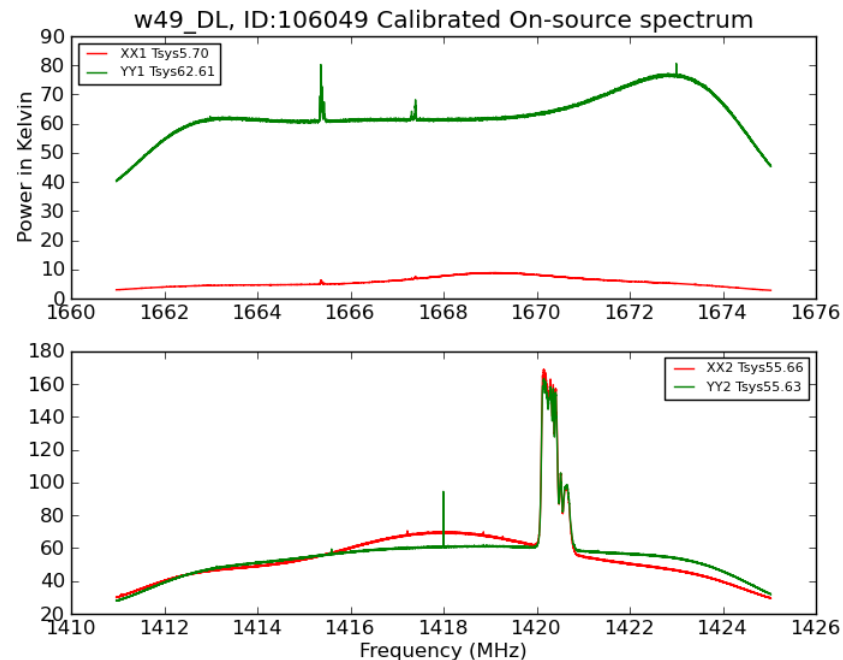
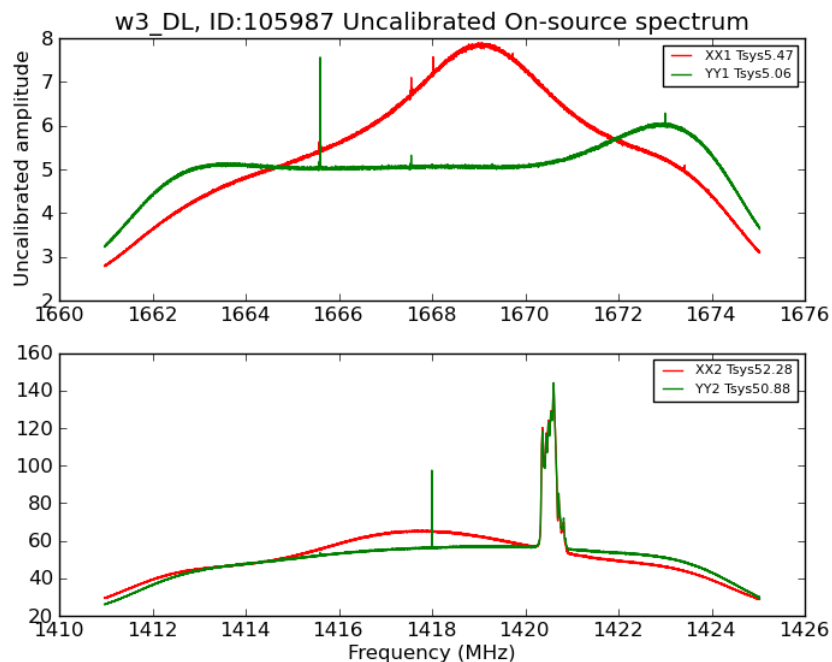


Diagram credit: Wolfgang Herrmann, SARA

Comparison Masers via GBO 20 m

W3 peaks at 1665, 1667

W49 peaks at 1665, 1667



(Bottom chart is 2nd receiver at 1420 MHz. 1612 MHz is not available at Green Bank due to RFI)

OH Maser Planning

Maser	RA / DEC	Constellation	Feb. Viewing	Frequency
W3	2.45 / 61.87	Cassiopeia	Circumpolar	1612, 1665/67
W49	19.17 / 9.10	Aquila	7am - 2pm	1665, 1665/67, 1720
Vy Cma	7.38 / -25.77	Canis Major	7pm - 11pm	1612, 1665/67
V669 Cass	1.56 / 62.45	Cassiopeia	Circumpolar	1612, 1667
Nml Cyg	20.77 / 40.12	Cygnus	4am - 4pm	1612
OH 026.5 + 0.6 IRAS 18348-0526	18.35 / -5.26	Scutum	5am - 1pm	1612

System (noise) Temperature (T_{sys})

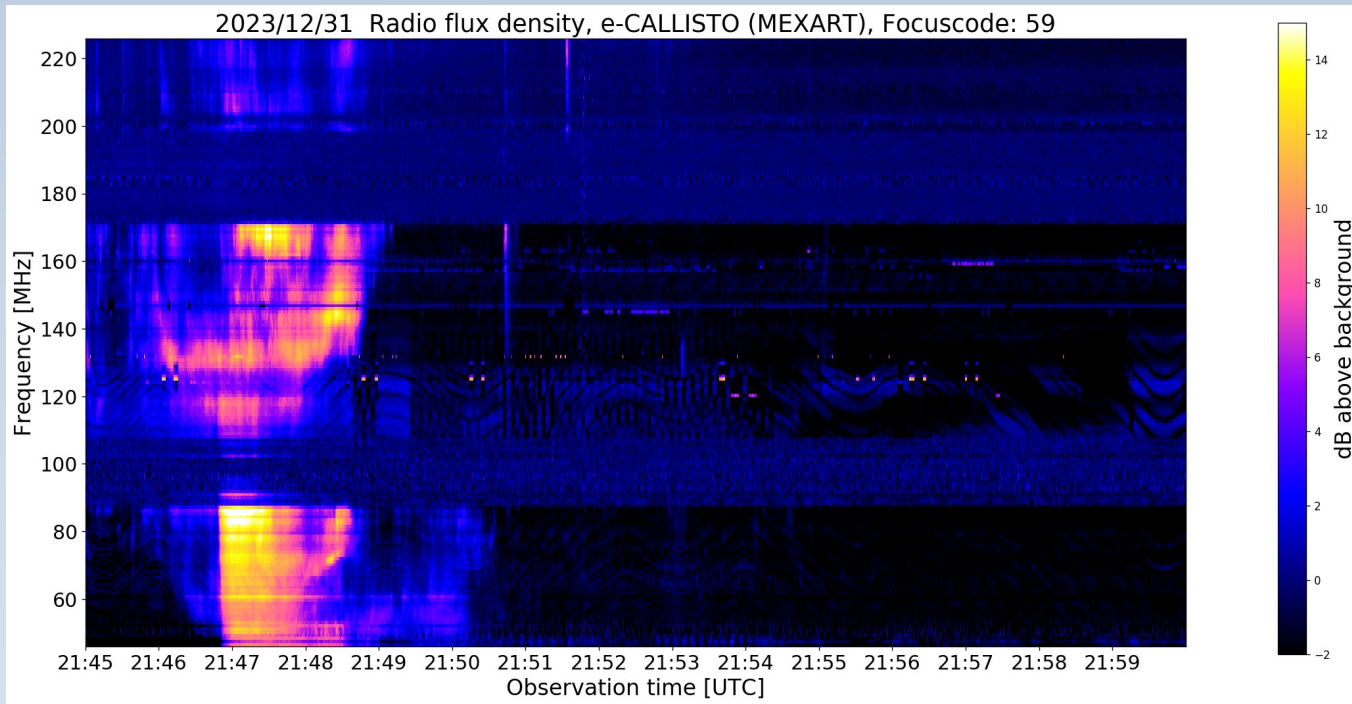
- The new 1420 MHz feed has a directional coupler allowing (calibrated) noise injection
- Point dish to blank sky, then switch noise source on/off
 - Method 1: Y-factor via calibrated power meter (dBm)
 - Method 2: Switched power measurement via oscilloscope (V_{rms})*
- Eventually automate T_{sys} measurements
- Learning opportunities:
 - Help install and test new feed; measure T_{sys}

* “Fundamentals of Radio Astronomy: Observational Methods,”
Marr, Snell, and Kurtz. CRC Press, 2020. Page 130

Online Space Weather Sensors

- Install and test 3 online space weather instruments when new building is ready
 - Solar spectrometer, Radio Jove, magnetometer
- Each project needs a Principal Investigator to oversee installation, configuration, & reporting
 - Learning the software and testing can start now
 - Well documented, well supported

Callisto: Dec. 31 X4.8 Flare

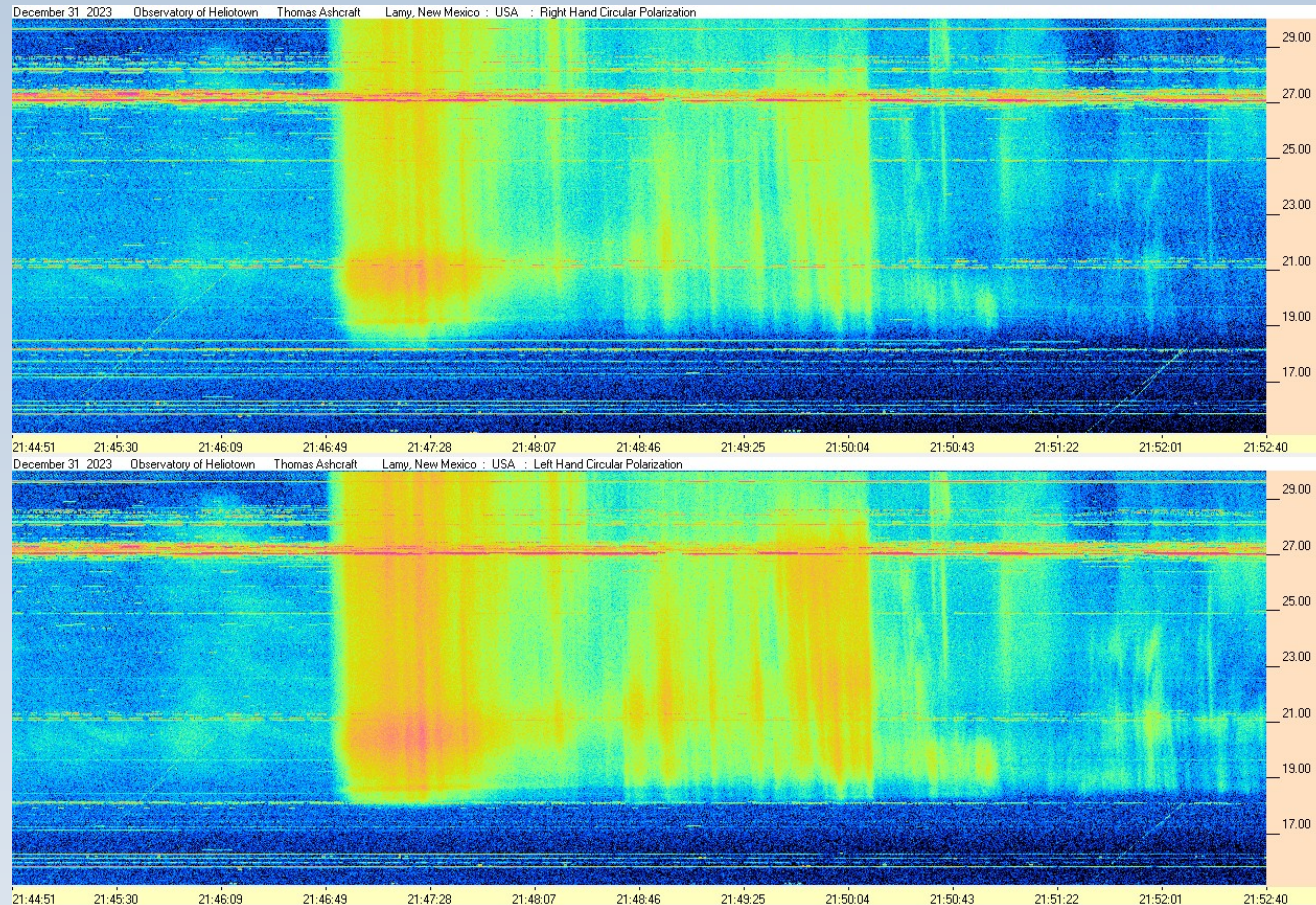


Showing e-Callisto plot from Mexico 50-225 MHz (plot on cover is 45-90 MHz)

DSES plans to install:

- 50-1300 MHz log-periodic antenna with LNA (+bias tee)
- Callisto wideband receiver
- Software (Windows, linux, RPi)
- Ftp data to e-Callisto server
- Extensive documentation
- TeamViewer for remote access

Radio Jove 2.0: Dec. 31 X4.8 Flare



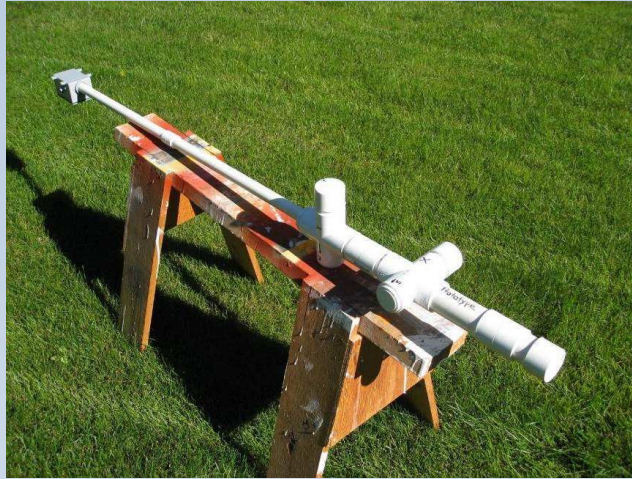
Showing wideband spectrograph from New Mexico

Besides detecting Jovian decameter radio storms, Radio Jove also detects solar radio bursts

DSES plans to install:

- Moxon antenna
- SDRPlay RSP1A
- Radio-Sky Spectrograph to record and review spectrograms (16-24 MHz)
- Windows only
- TeamViewer for remote access

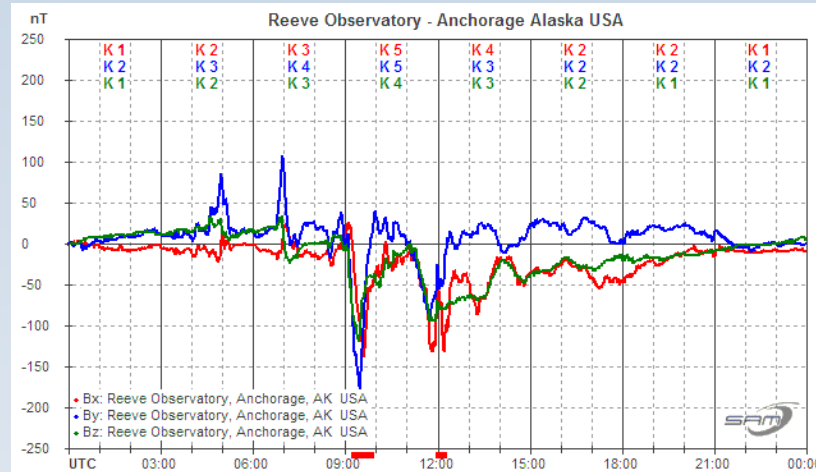
SAM III Magnetometer



Real-time sensing of geomagnetic field

DSES plans to install:

- 3 fluxgate sensors buried underground in weatherproof PVC housing
- SAM III microprocessor
- SAM_View software (Windows)
- Extensive documentation
- TeamViewer for remote access



Summary

- Feb. - Mar. (60' dish): Observe OH masers, pulsars & 21cm HI
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