Stage 1: 2013-2014

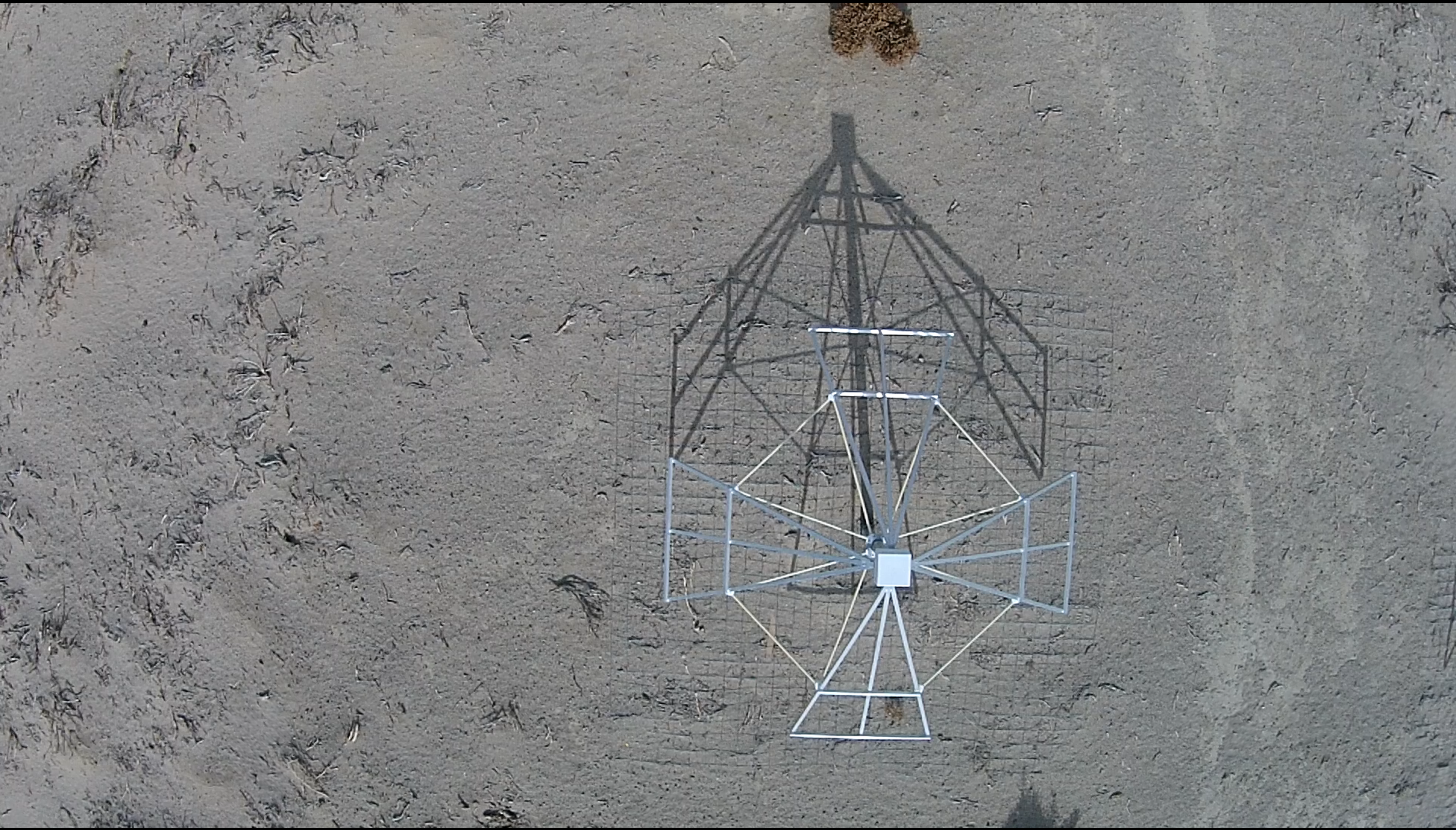
Custom built array for all-sky imaging

256 antennas
88 km of buried coaxial cable
1 km of fencing

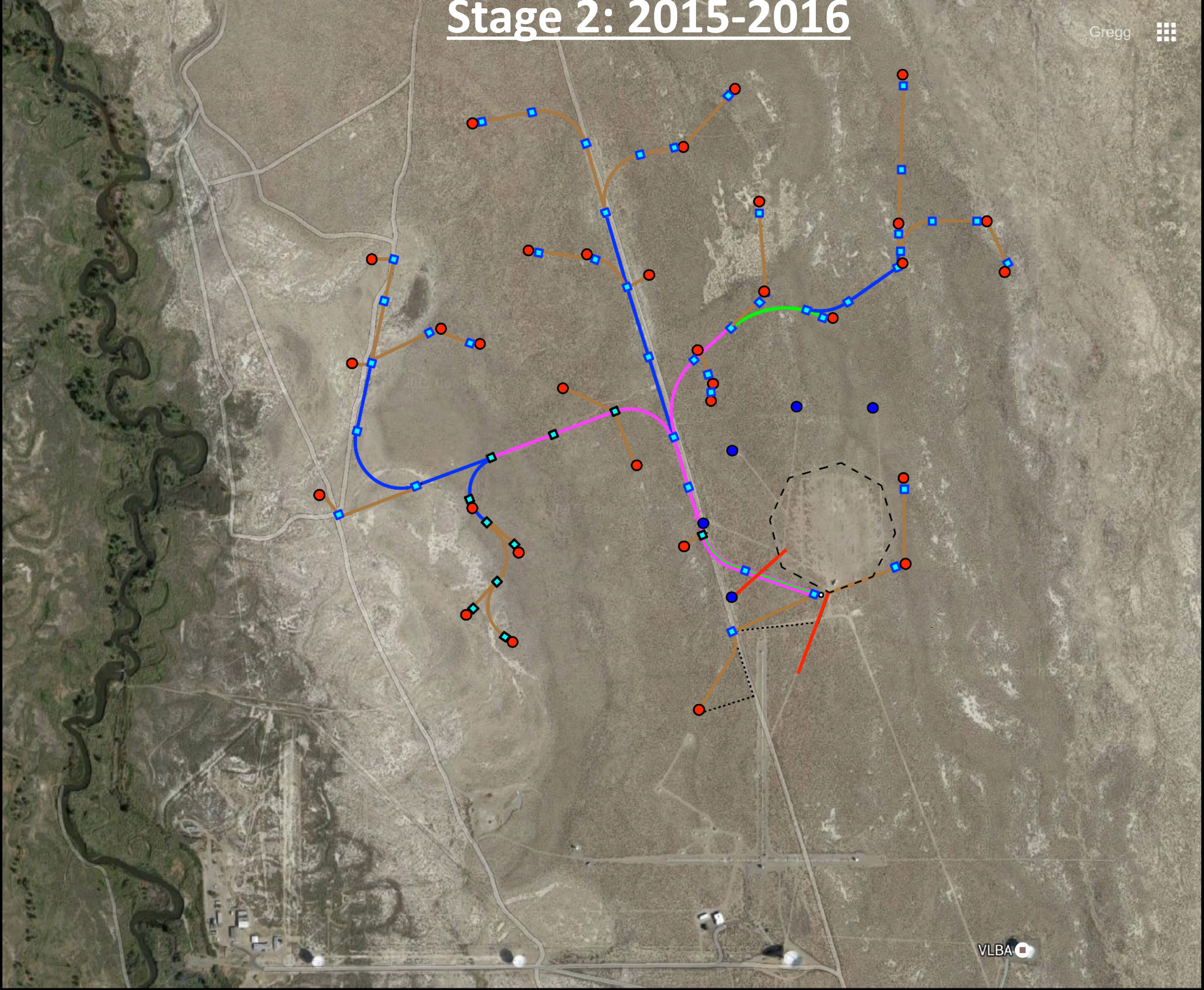
200m

Two powerful back-ends:

1) LEDA correlator
2) All-sky Transient Monitor



Stage 2: 2015-2016



Stage 3

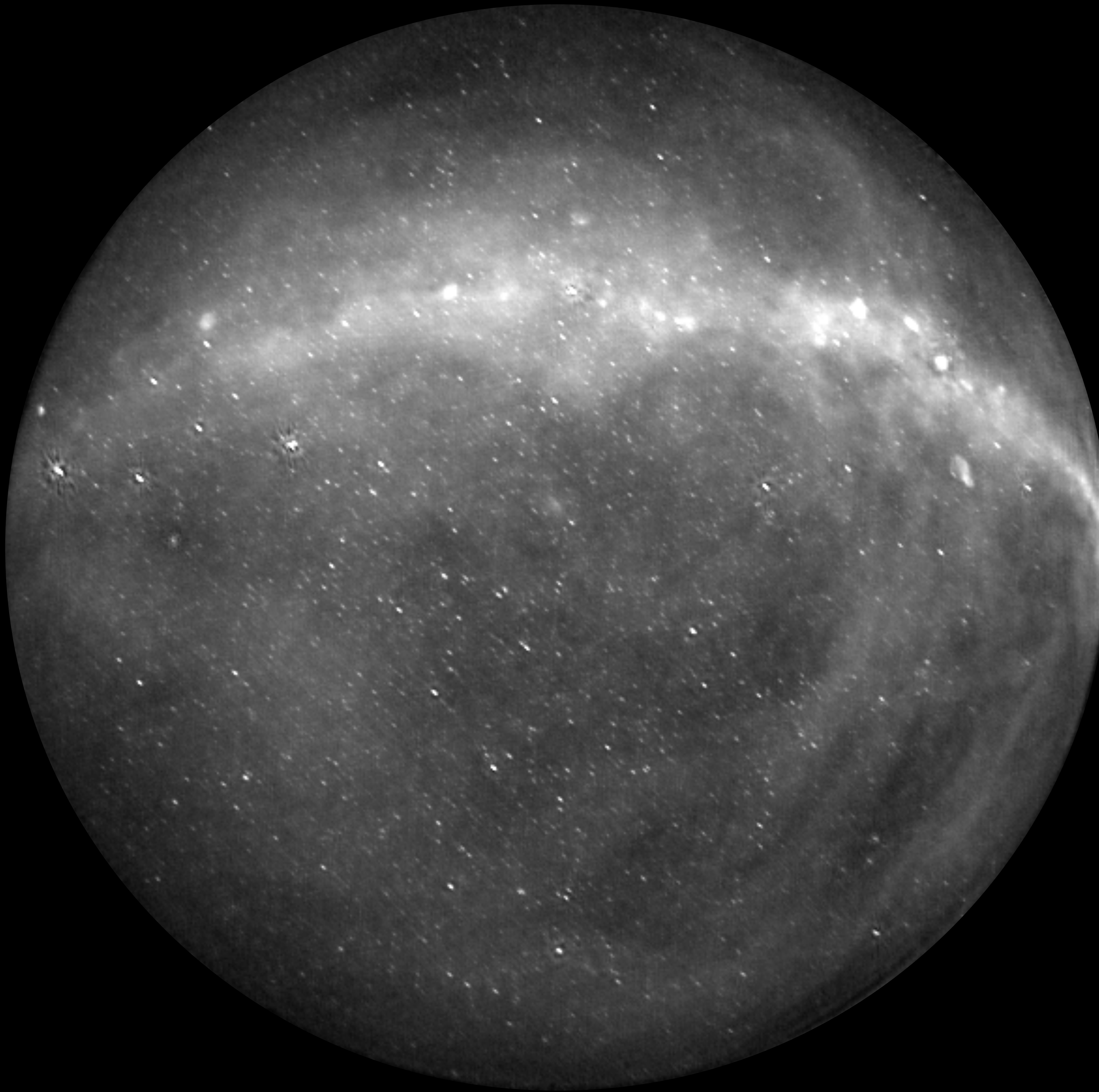
i) Complete remaining 64 antennas on long baselines

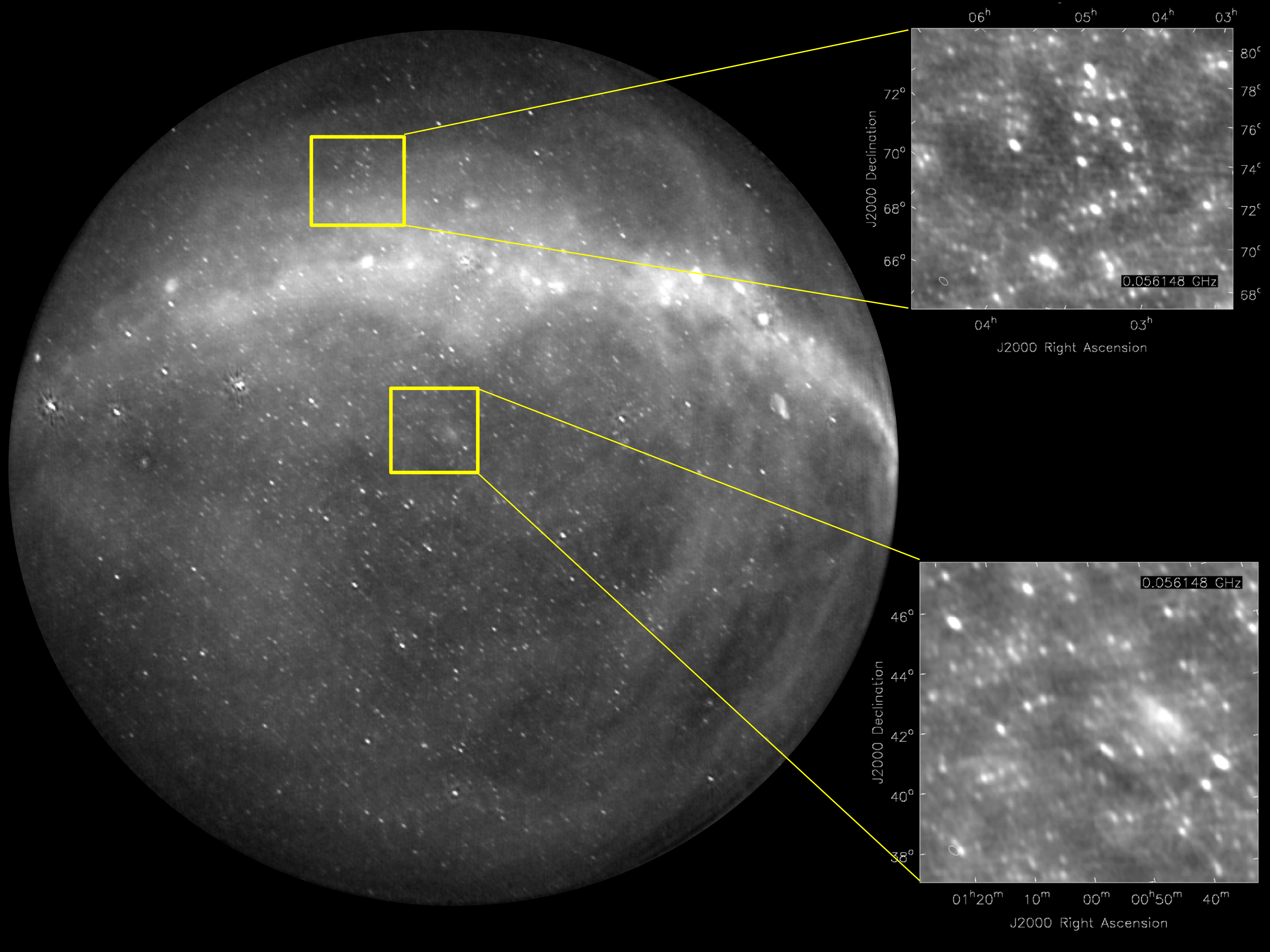
ii) Install new correlator with double the existing capacity

iii) Install a 1.35 PB system to allow 3000 hour integrations

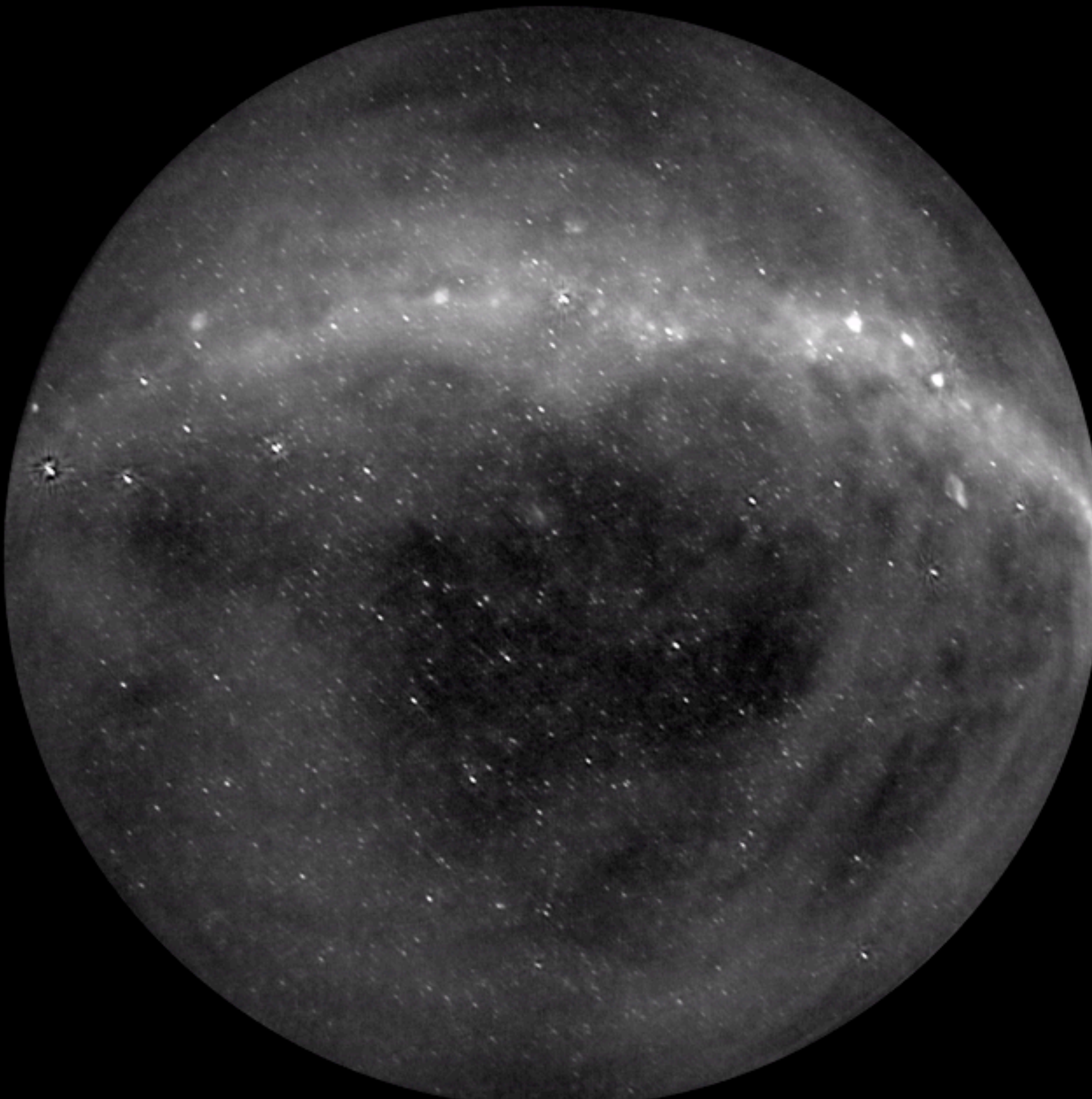
iv) Replace all receiver boards with next-gen models [underway]

v) Measure each antenna beam to 1% [underway]

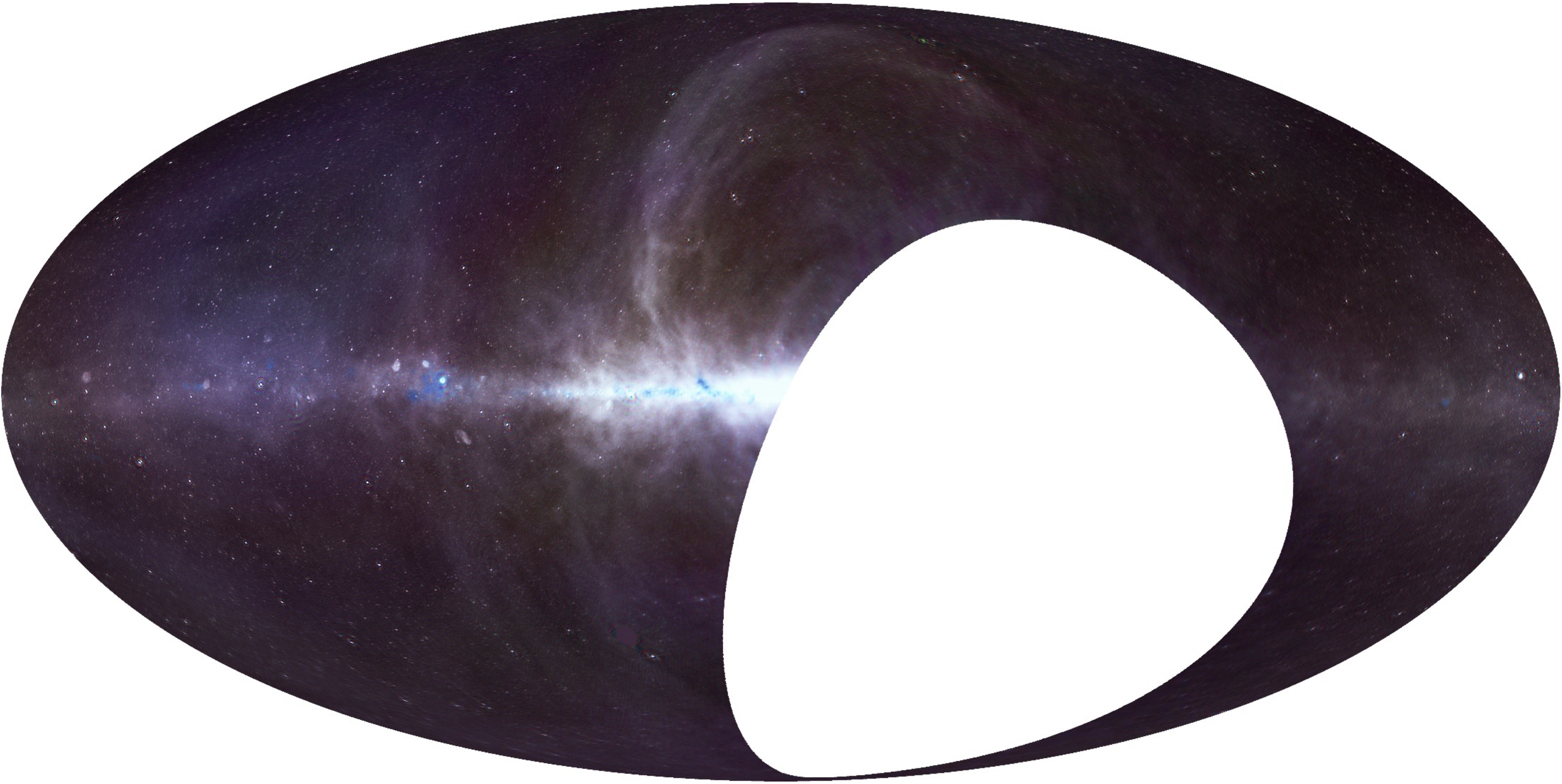




06h
05h
04h
03h
80°
78°
76°
74°
72°
70°
68°
72°
70°
68°
66°
J2000 Declination
0.056148 GHz
04h
03h
J2000 Right Ascension
0.056148 GHz
46°
44°
42°
40°
38°
J2000 Declination
01h20m
10m
00m
00h50m
40m
J2000 Right Ascension



Eastwood et al. 2017 – in prep.



Target Sensitivity

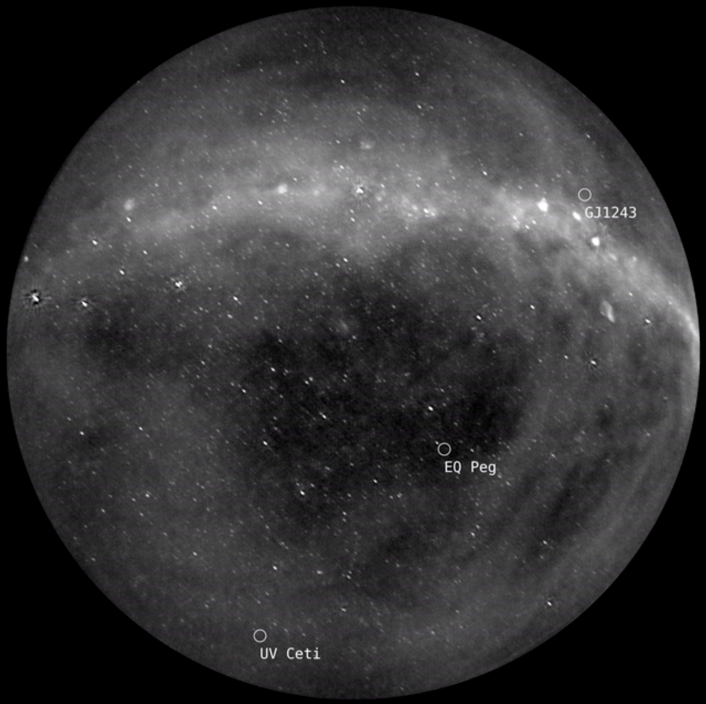
Every 10 seconds, full hemisphere to 150 mJy

Every hour, full hemisphere to 10 mJy

Every day, full sky to 3 mJy (Stokes V)

1000 hours, full sky to 500 μJy (Stokes V)

Extrasolar Space Weather Monitoring



OVRO-LWA: 352 antennas

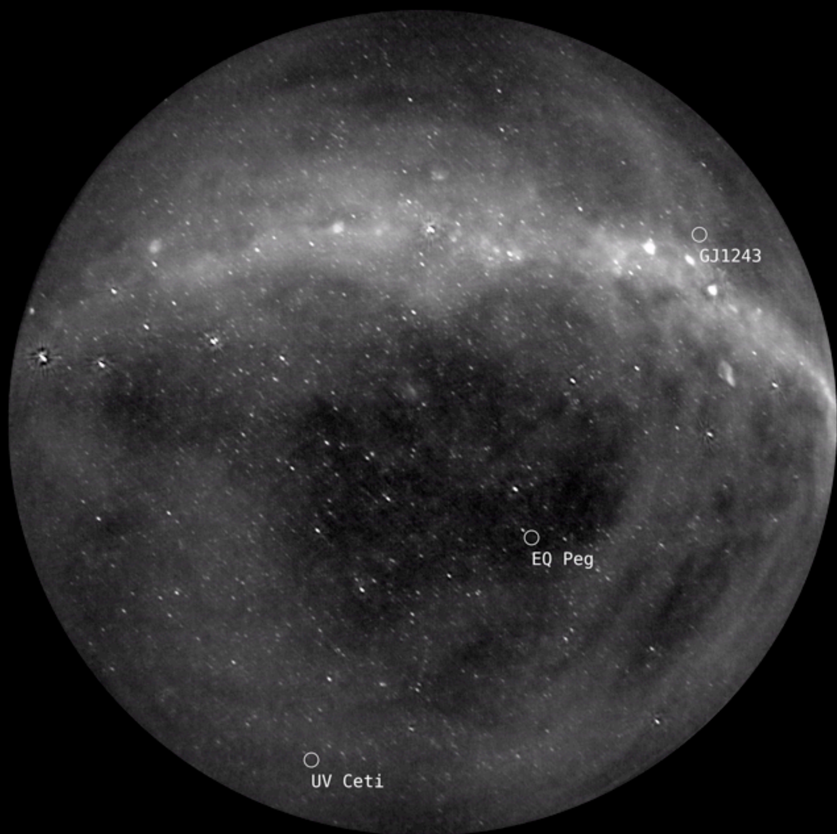
Evryscope: 24 x 61 mm-aperture telescopes

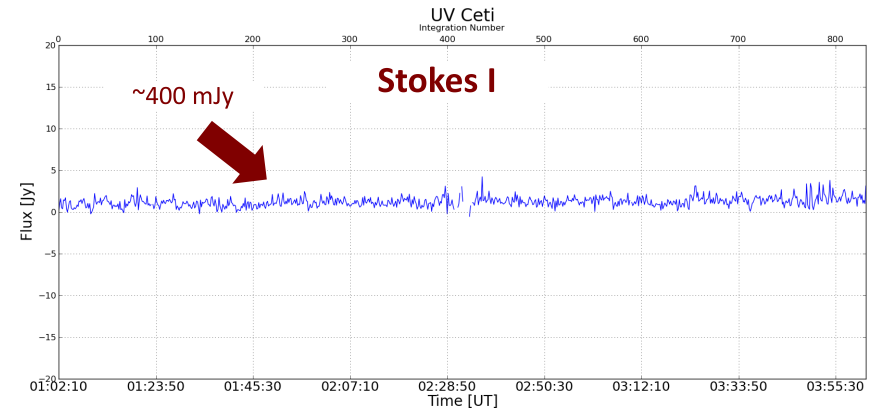
Nicholas Law and Robert Quimby

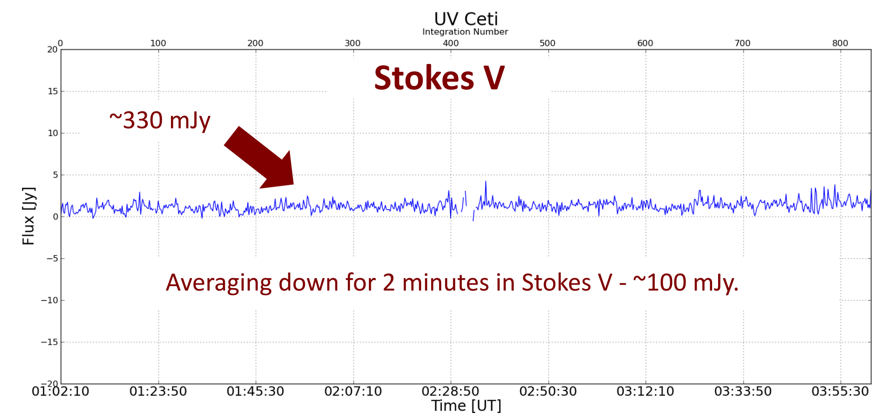
Both telescopes will continuously monitor ~4000 stars out to 25 pc

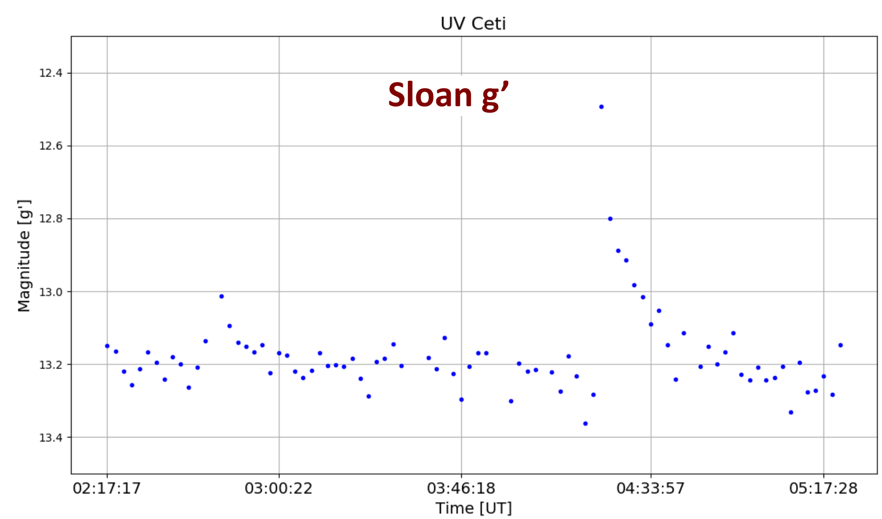
NSF Career AST 1654815 (Hallinan)
NSF Career AST 1555175 (Law)

RESEARCH CORPORATION *for* SCIENCE ADVANCEMENT


GJ1243
EQ Peg
UV Ceti


UV Ceti
Integration Number
Stokes I
~400 mJy
Flux [Jy]
Time [UT]
01:02:10
01:23:50
01:45:30
02:07:10
02:28:50
02:50:30
03:12:10
03:33:50
03:55:30


UV Ceti
Integration Number
Stokes V
~330 mJy
Averaging down for 2 minutes in Stokes V - ~100 mJy.
Flux [Jy]
Time [UT]
01:02:10
01:23:50
01:45:30
02:07:10
02:28:50
02:50:30
03:12:10
03:33:50
03:55:30


UV Ceti
Sloan g'
Magnitude [g']
Time [UT]
02:17:17
03:00:22
03:46:18
04:33:57
05:17:28

Scientific Goals

Establish flare and CME rates across a wide range of mass and age

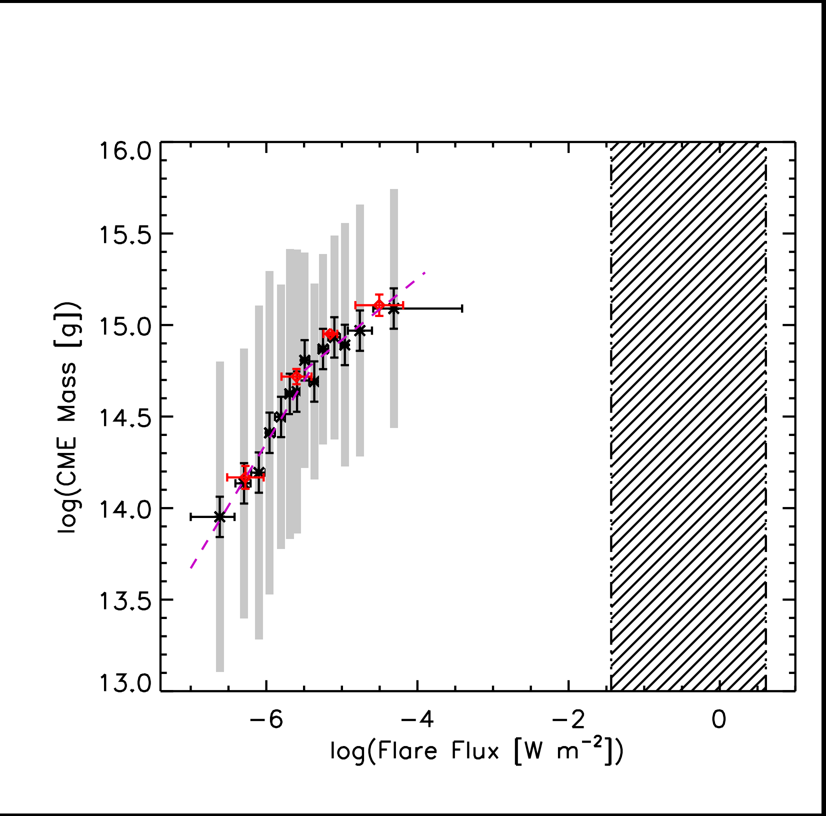
Investigate the relationship between flare energy and CME kinetic energies for low mass stars

Correlate phenomenology with magnetic field strength and topology

Inform the community of extreme events

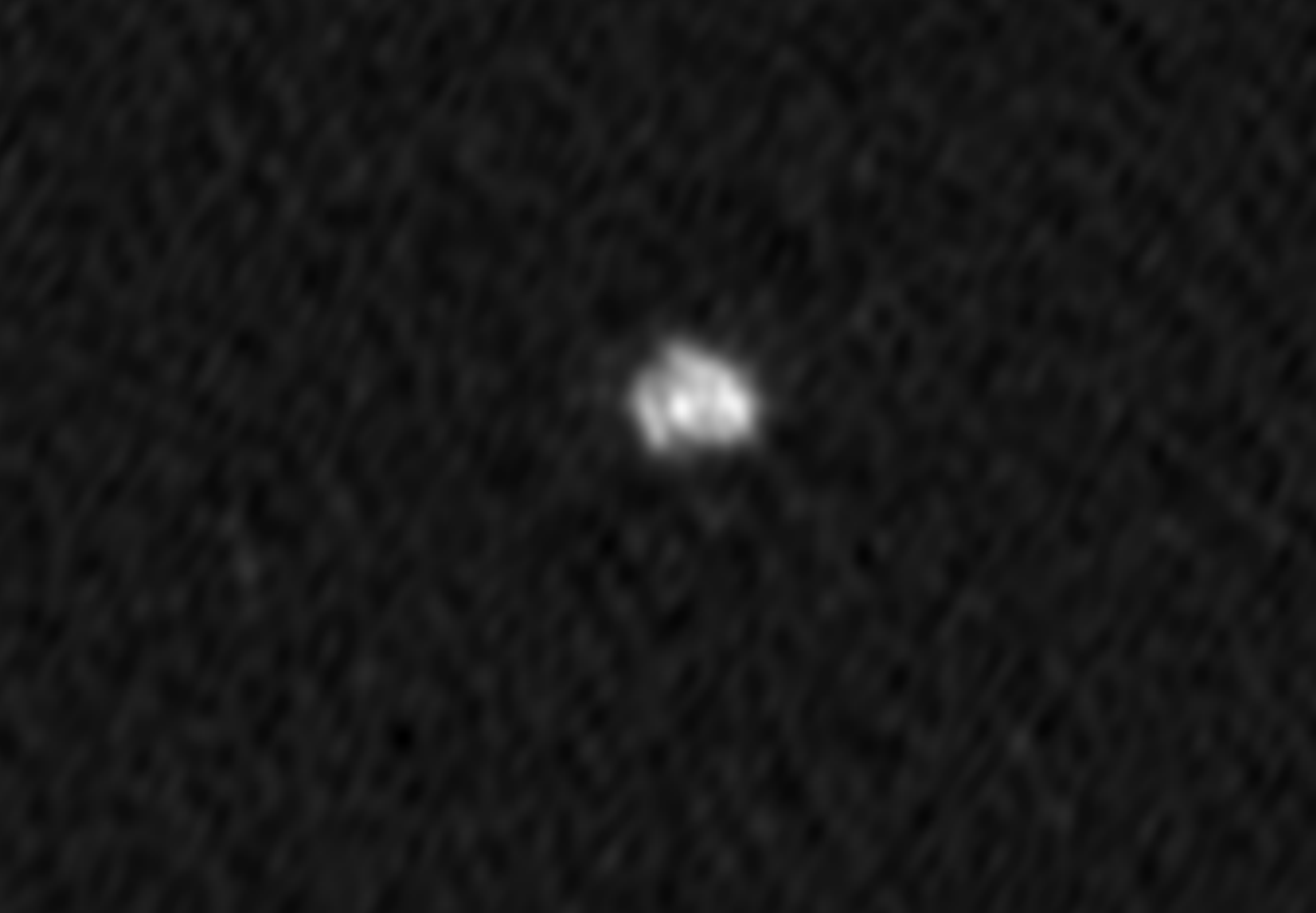
Receive triggers for highest energy events (e.g. *Swift* super-flares)

Provide the most meaningful constraints (or detections) of radio exoplanets!



Aarnio et al. 2010, Osten & Wolk 2015

Solar Coronal Mass Ejection



Summary

Understanding the impact of stellar activity and the presence of planetary magnetic fields is becoming increasingly important for defining planetary habitability

Low frequency radio observations are key

<u>The long-term future is from the lunar far-side</u>

352-antenna Owens Valley LWA is uniquely powerful in targeting for radio emission from stellar CMEs and exoplanets

Produces all-sky images every 13 seconds with ~5 arcminute resolution

Collaboration with Evryscope for simultaneous optical and radio

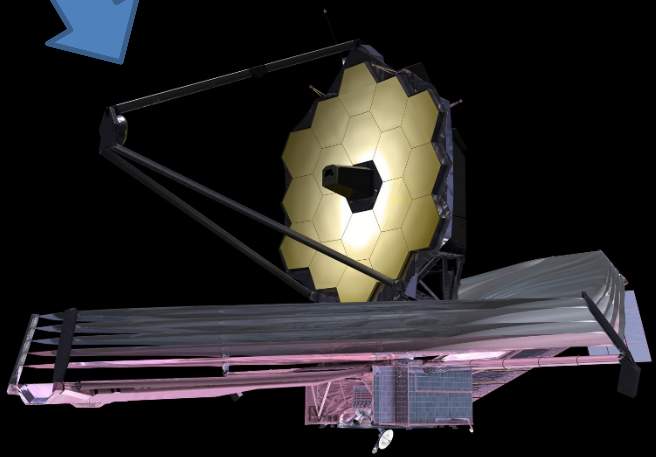
Array will be complete after final phase of construction (Stage 3)

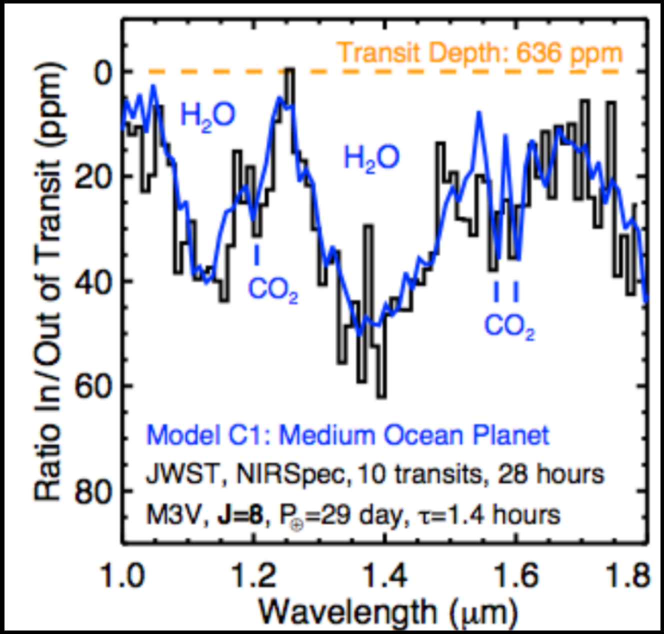
Early science underway – monitoring 4000 stellar systems

Valuable Data in the Search for Habitability

Provide data on the flare and CME rate for the nearby sample of TESS and RV (KPF; ESPRESSO) detected planets

Compare flare and CME rate (and possibly planetary magnetic field strength) with atmospheric properties determined via transmission spectroscopy





Triggered Spectroscopy?

CrossMark

The Pale Green Dot: A Method to Characterize Proxima Centauri b Using Exo-Aurorae

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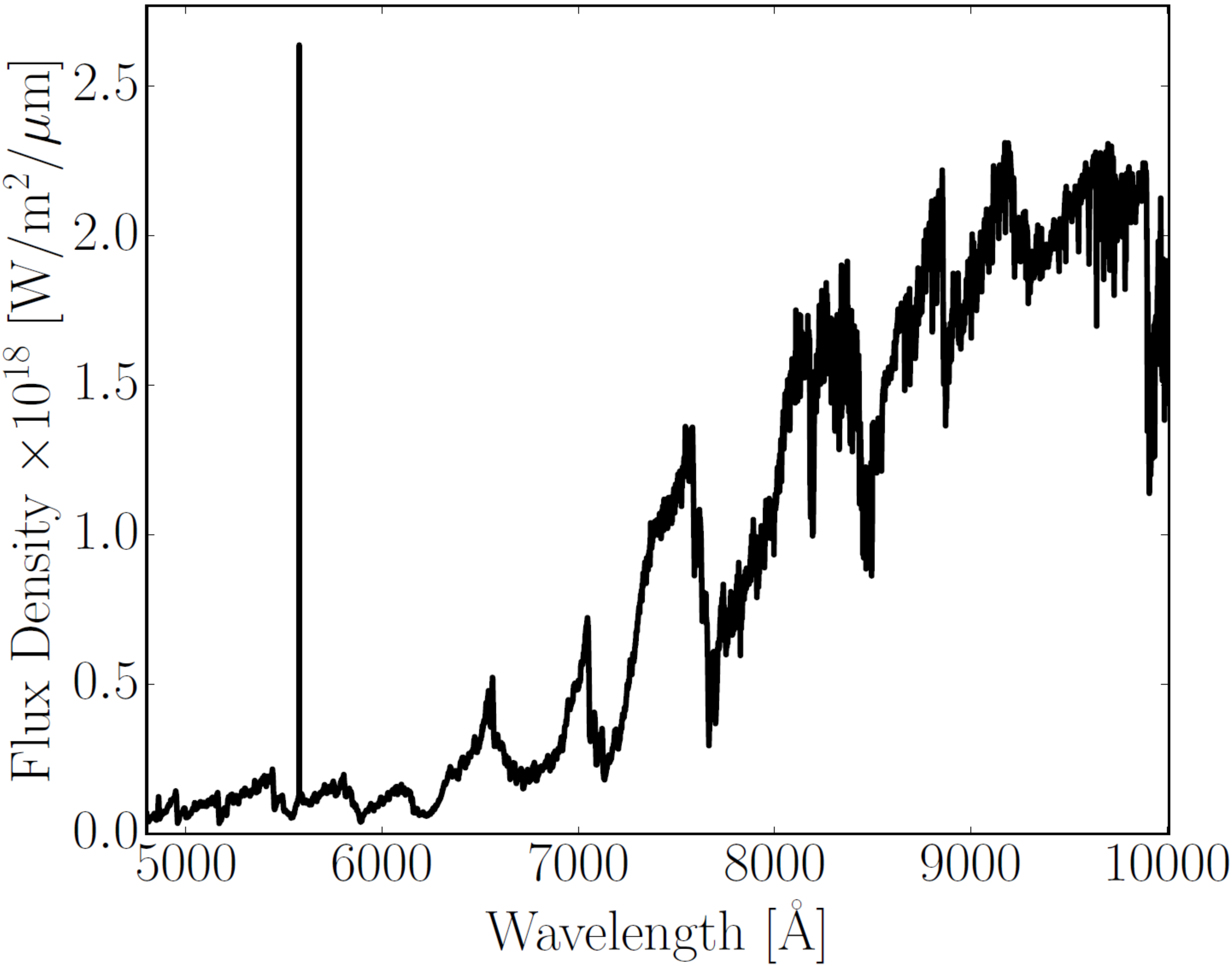
Abstract

We examine the feasibility of detecting auroral emission from the potentially habitable exoplanet Proxima Centauri b. Detection of aurorae would yield an independent confirmation of the planet's existence, constrain the presence and composition of its atmosphere, and determine the planet's eccentricity and inclination, thereby breaking the mass-inclination degeneracy. If Proxima Centauri b is a terrestrial world with an Earth-like atmosphere and magnetic field, we estimate that the power at the 5577 Å O I auroral line is on the order of 0.1 TW under steady-state stellar wind, or $\sim 100\times$ stronger than that on Earth. This corresponds to a planet–star contrast ratio of 10^{-6}–10^{-7} in a narrow band about the 5577 Å line, though higher contrast (10^{-4}–10^{-5}) may be possible during periods of strong magnetospheric disturbance (auroral power 1–10 TW). We searched the Proxima Centauri b HARPS data for the 5577 Å line and for other prominent oxygen and nitrogen lines, but find no signal, indicating that the O I auroral line contrast must be lower than 2×10^{-2} (with power $\lesssim 3000$ TW), consistent with our predictions. We find that observations of 0.1 TW auroral emission lines are likely infeasible with current and planned telescopes. However, future observations with a space-based coronagraphic telescope or a ground-based extremely large telescope (ELT) with a coronagraph could push sensitivity down to terawatt oxygen aurorae (contrast 7×10^{-6}) with exposure times of ~ 1 day. If a coronagraph design contrast of 10^{-7} can be achieved with negligible instrumental noise, a future concept ELT could observe steady-state auroral emission in a few nights.

Key words: planets and satellites: atmospheres – planets and satellites: aurorae – planets and satellites: detection – planets and satellites: terrestrial planets



Flux Density ×10^18 [W/m^2/μm]
2.5
2.0
1.5
1.0
0.5
0.0
5000
6000
7000
8000
9000
10000
Wavelength [Å]