The Owens Valley LWA: Status & Future Plans

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RESEARCH CORPORATION for SCIENCE ADVANCEMENT

LEDA

JPL Jet Propulsion Laboratory California Institute of Technology

NJIT New Jersey Institute of Technology

LWA Long Wavelength Array

NSF

Concept

352 antennas spaced over ~2.6 km

Full cross-correlation = All-sky FOV

25-85 MHz (2400 channels)

5 arcminute resolution

Unmatched survey speed below 100 MHz

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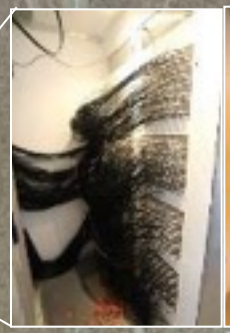
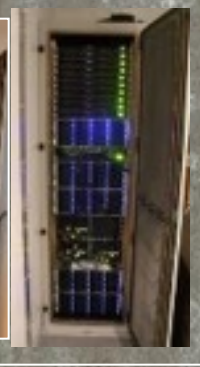
Stage 1: 2013-2014

Custom built array for all-sky imaging

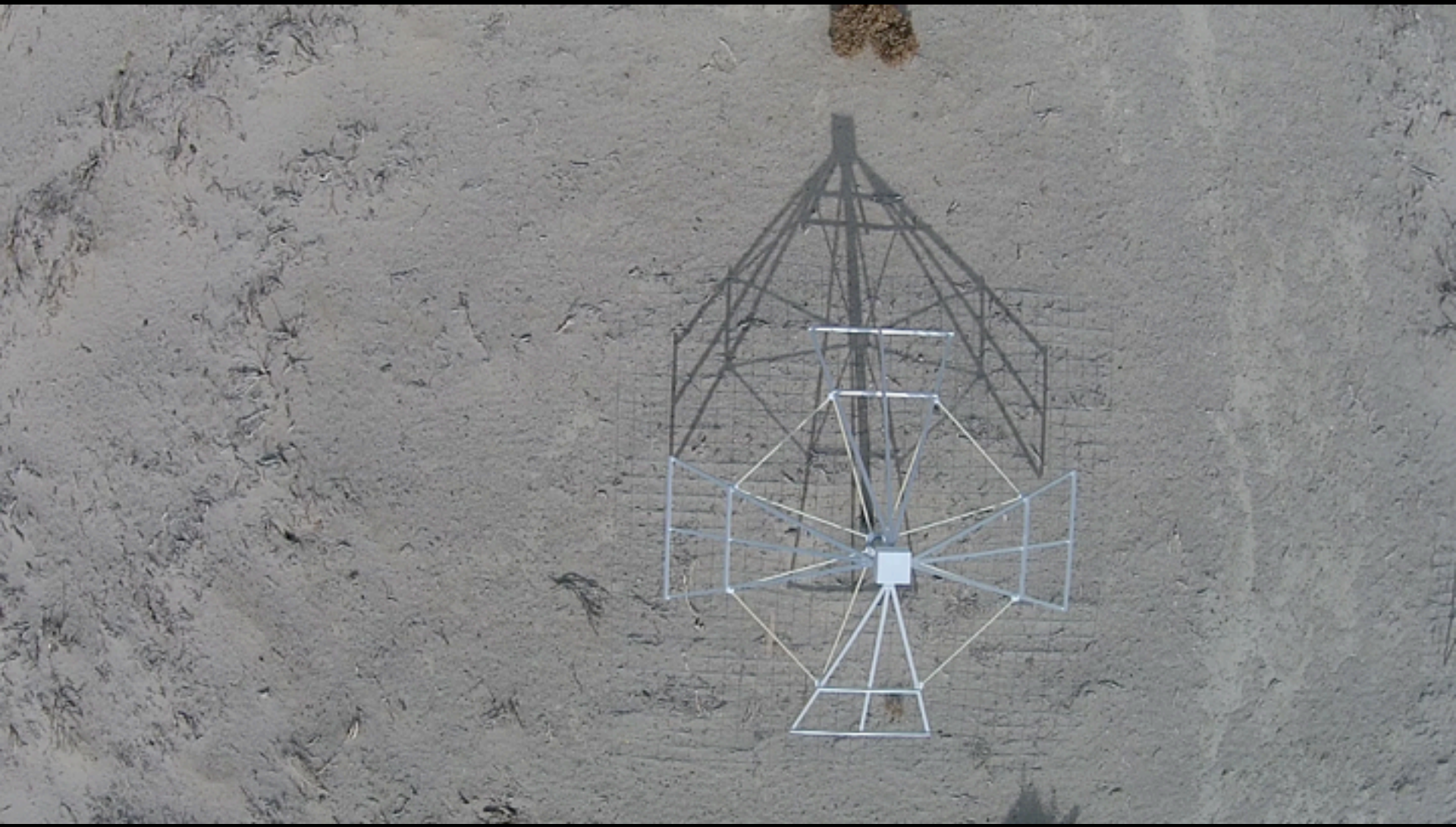
256 antennas
88 km of buried coaxial cable
1 km of fencing

200m

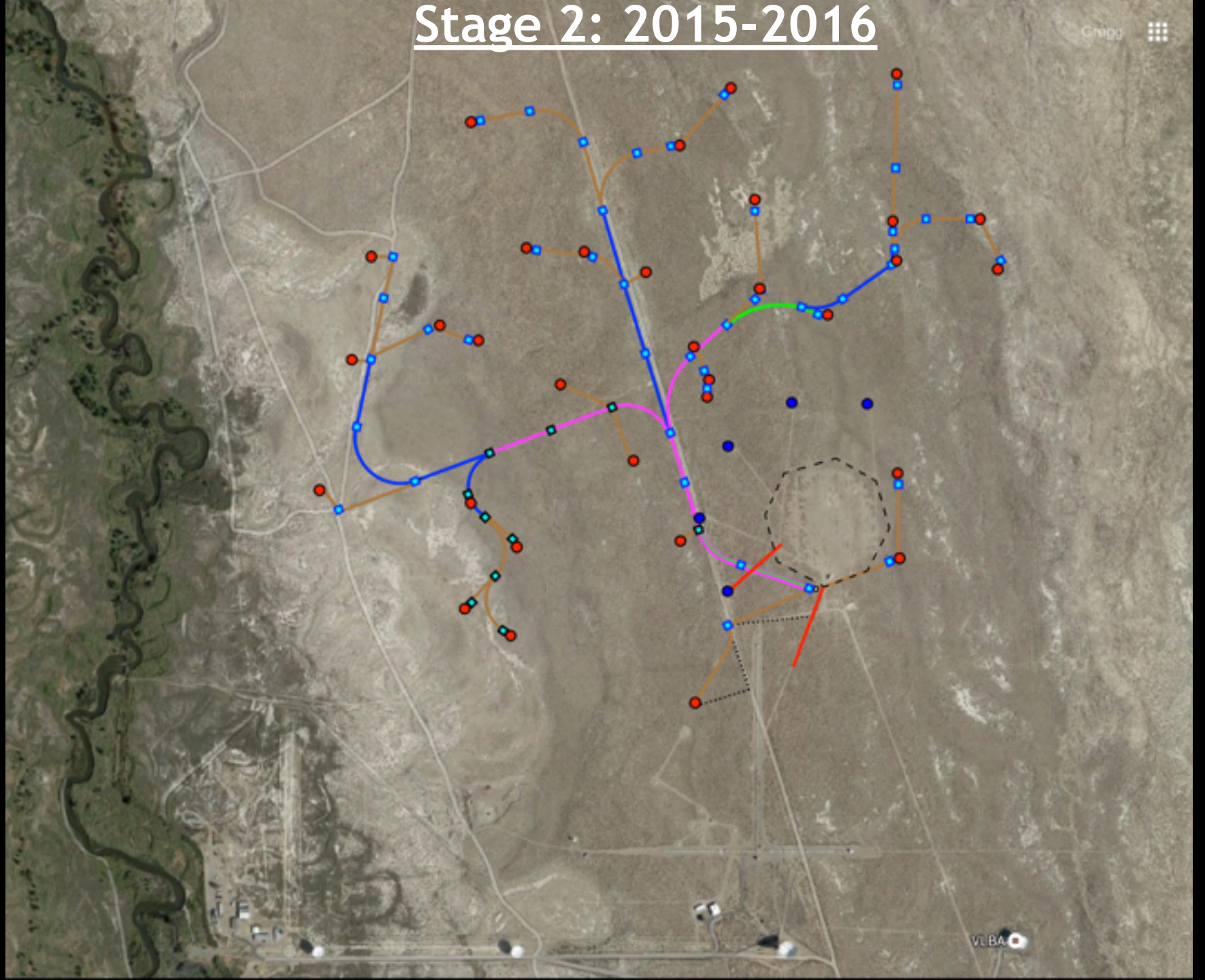


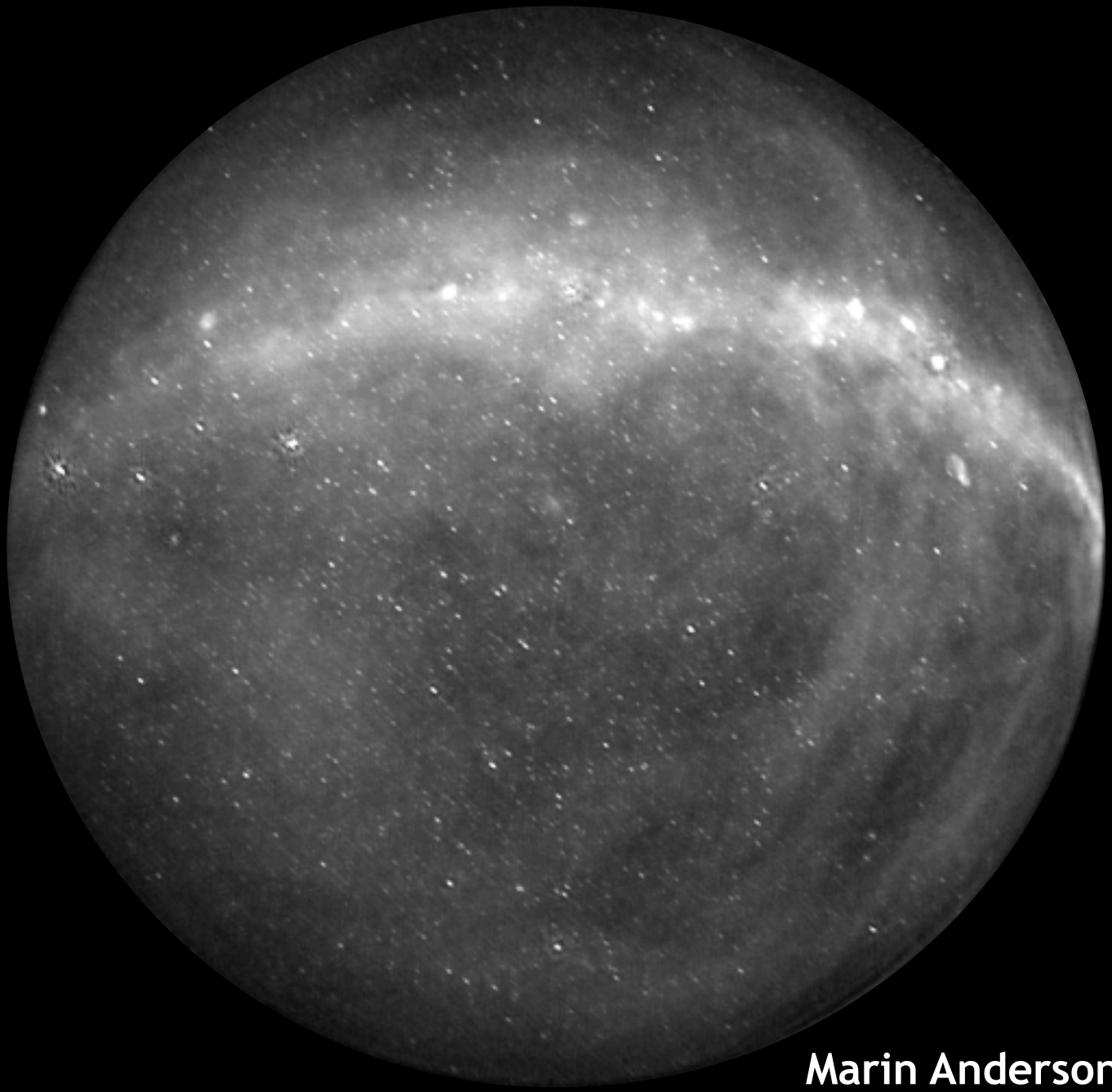


Two powerful back-ends:
1) LEDA correlator
2) All-sky Transient Monitor

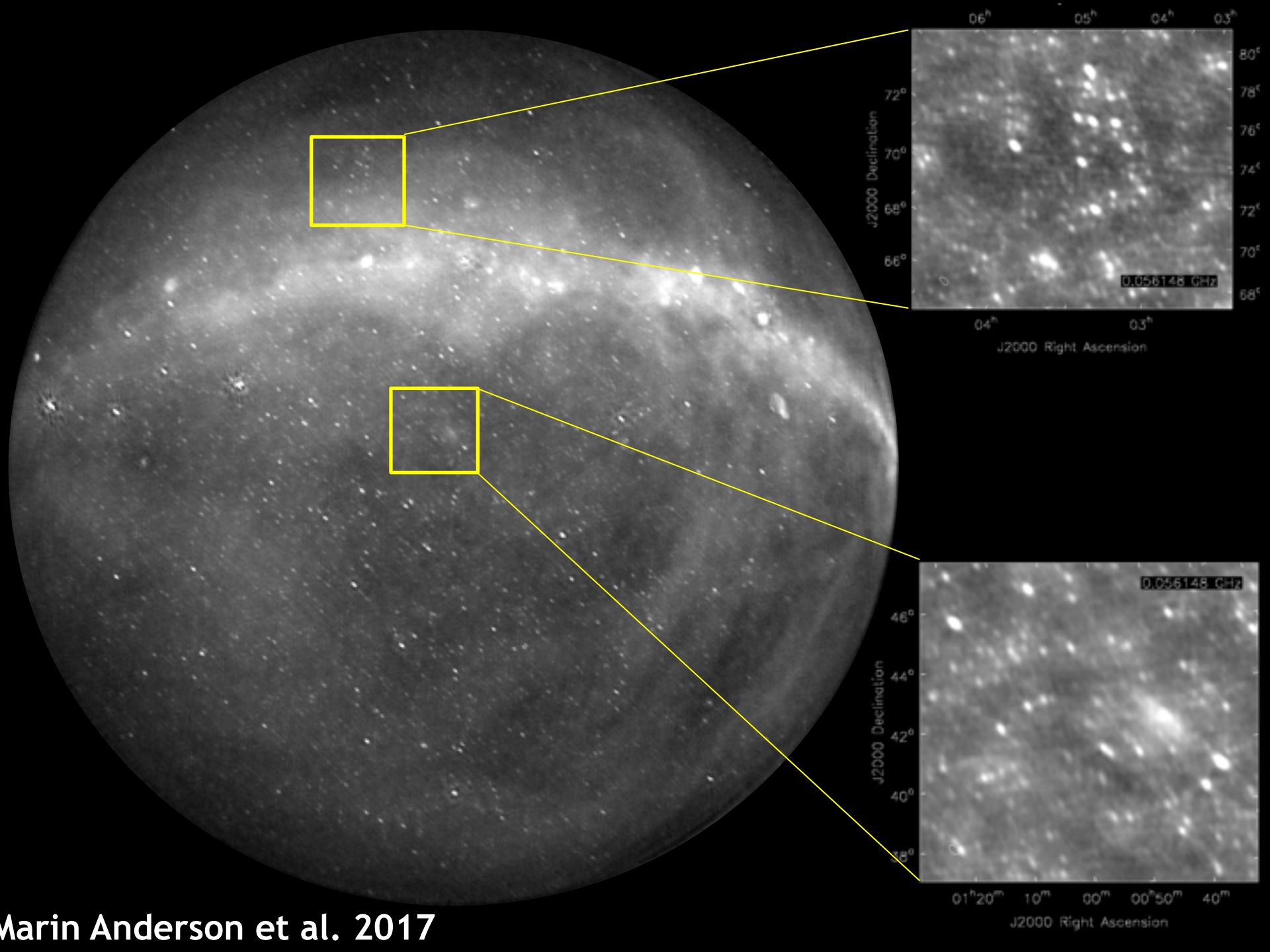


Stage 2: 2015-2016





Marin Anderson et al. 2017



Marin Anderson et al. 2017

Stage 3 Array (Final Construction)

64 more antennas – maximum baselines of 2.6 km

Next-gen Correlator

PI: Jonathon Kocz

Snap board and Pascal GPU-based

704-input correlator (20-85 MHz)

16 independent beams running parallel to correlator

Commensal solar mode (high time-res interferometry)

Real-time detection of power-line RFI

Real-time detection of cosmic rays

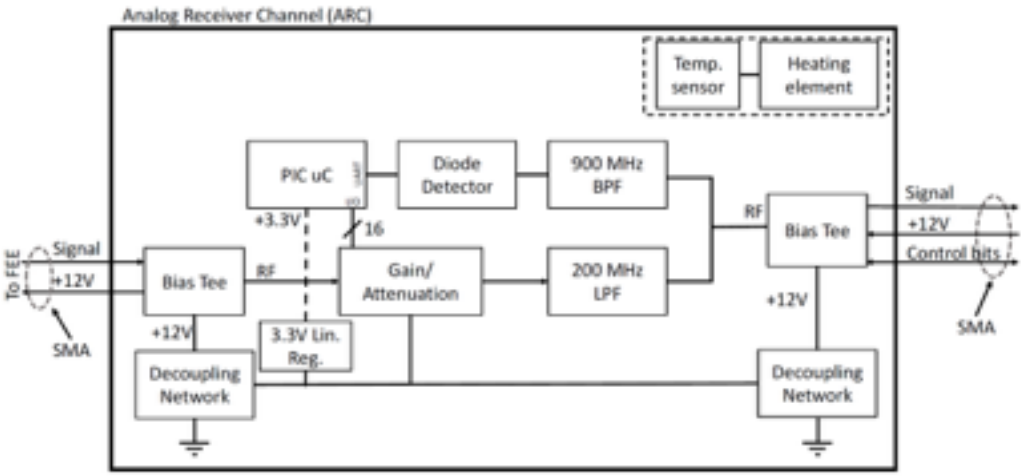
Accompanied by greatly increased compute and storage capacity

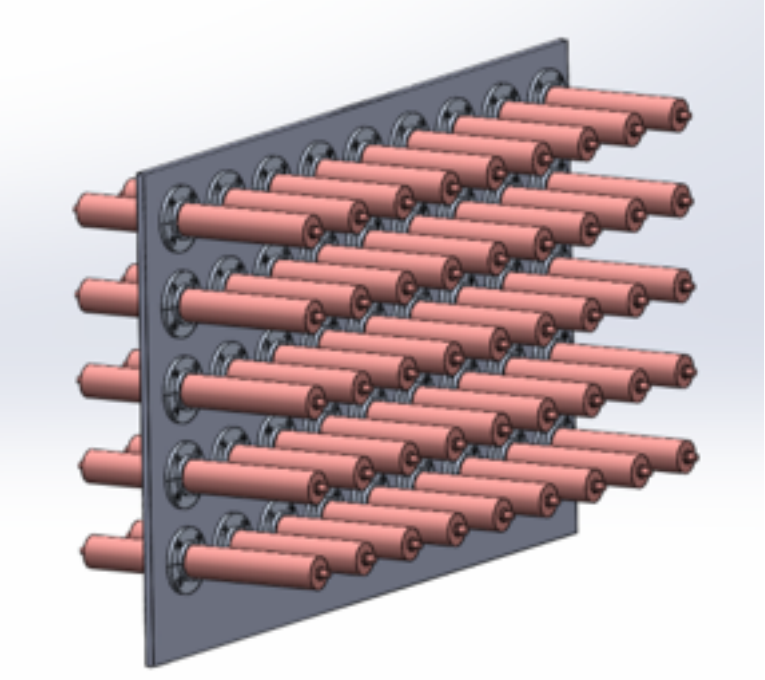
(6 PB)

Next-gen Receiver Boards

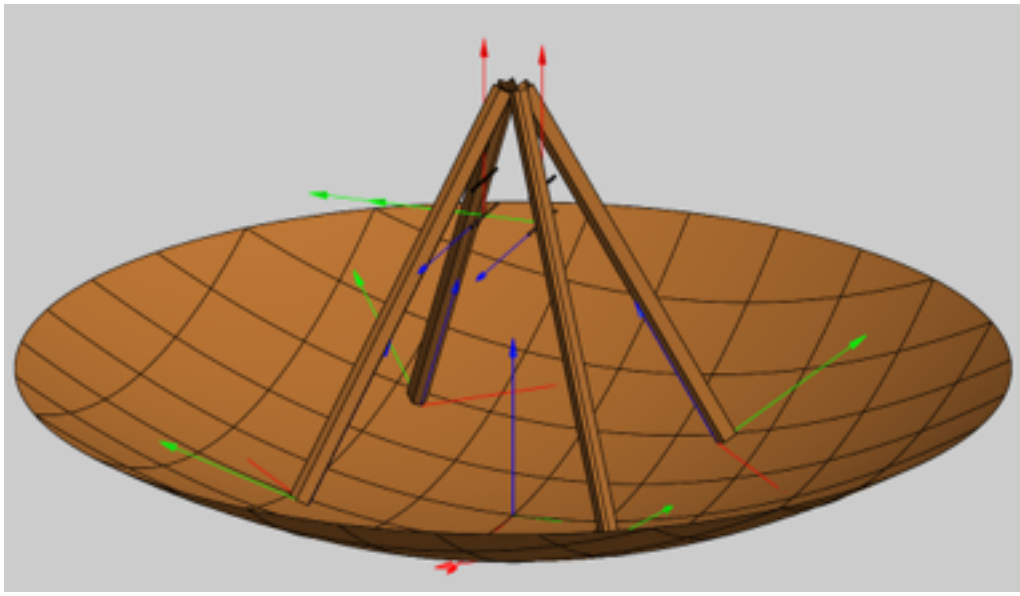
Design Team: Sandy Weinreb, Larry D'Addario, Devin Cody

Goal of 80 dB isolation





Holography of Antenna Beams



Science requires exquisite knowledge of the polarized beam of each dipole

Holography of each dipole antenna with nearby 40 m antenna (goal ~1%)

Initially use bright sources – transition to gated pulsars

Science with All-sky FoV

Transients (Stellar CMES and Extrasolar Planets)

21-cm Cosmology: Cosmic Dawn

Monitoring of the Sun and Jovian System

Detection of Cosmic Rays

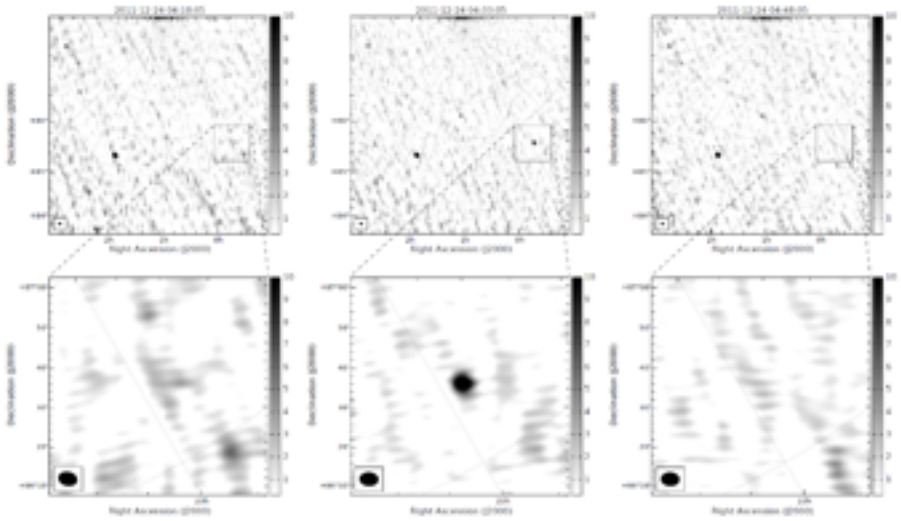
Extrasolar Space Weather

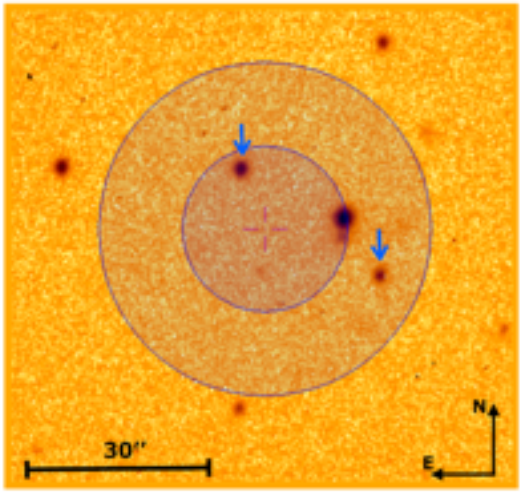
Marin Anderson's talk on Friday

OVRO-LWA will monitor the nearest 4000 stellar systems (radio and optical) for stellar CMES and exoplanet radio emission

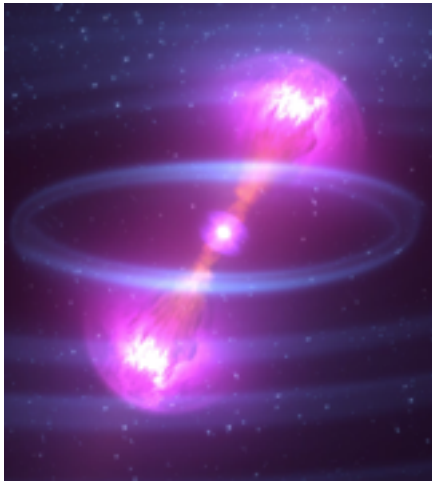
Transients and Compact Object Mergers

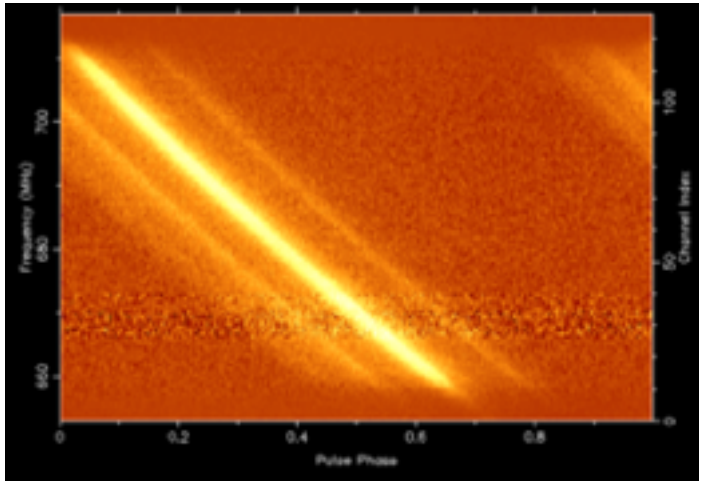
See talk by Marin Anderson on Friday





Detected at 60 MHz in 400 hours of data from the LOFAR MSSS survey (Stewart et al. 2016)

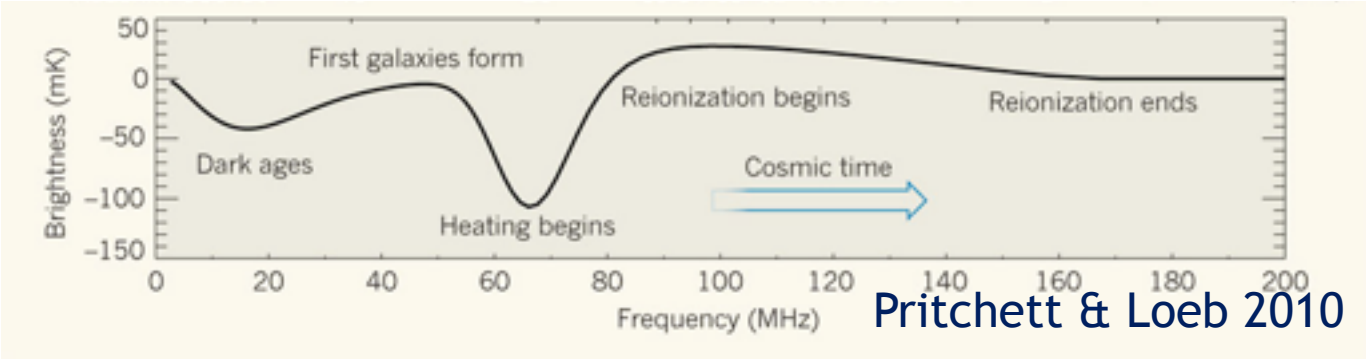




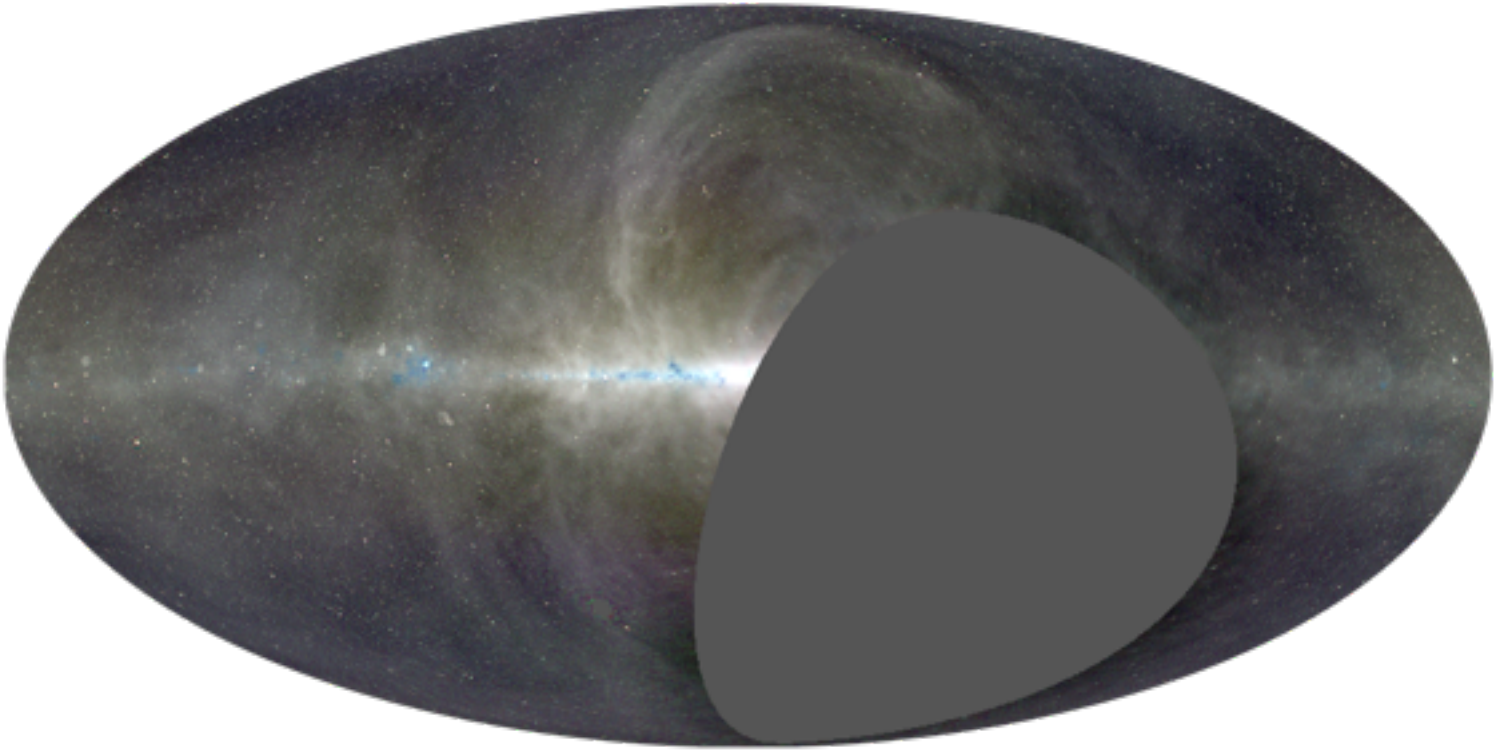
Prompt or precursor pulse to compact object mergers
Hansen and Lyutikov 2001, Lyutikov 2013, Pshirkov & Postnov 2010

Cosmic Dawn

See talk by Michael Eastwood on Thursday



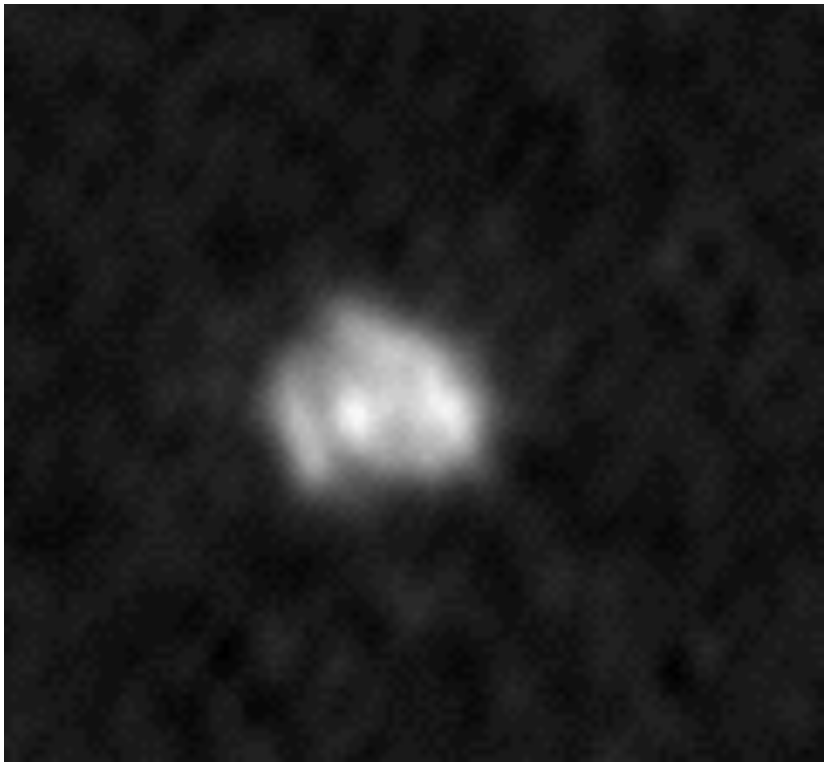
Pritchett & Loeb 2010

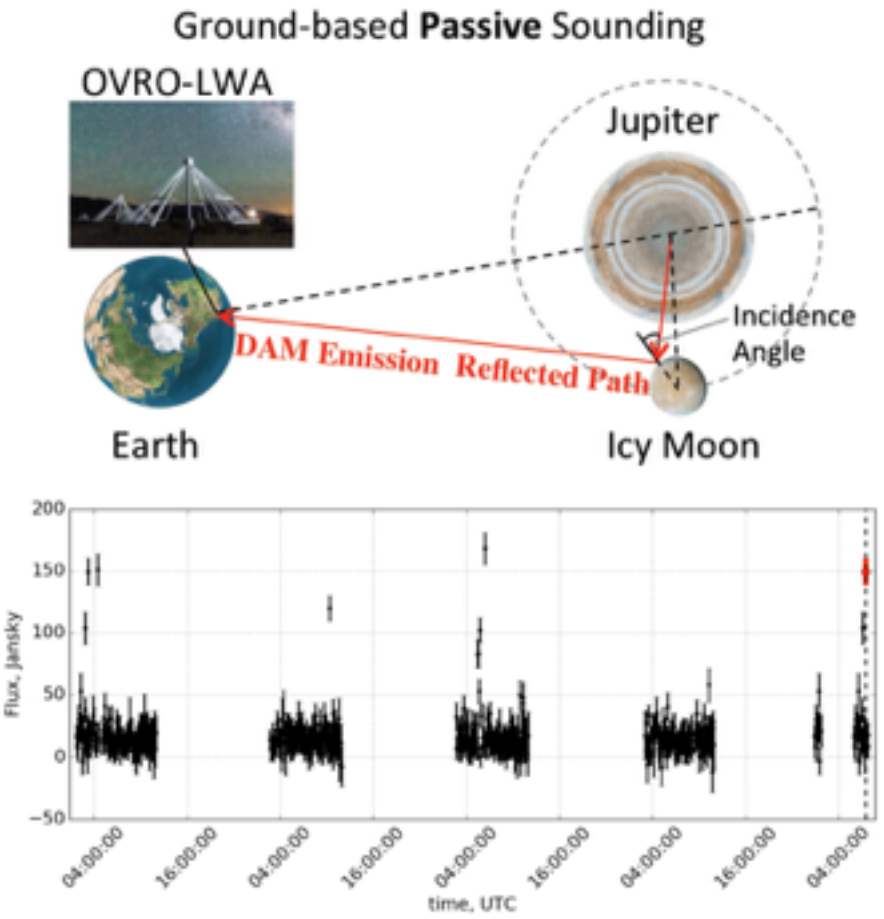


Eastwood et al. 2017 - Tihkonov regularized m-mode analysis

Price et al. 2017 - LEDA global 21-cm experiment

Monitoring the Sun and Jovian System



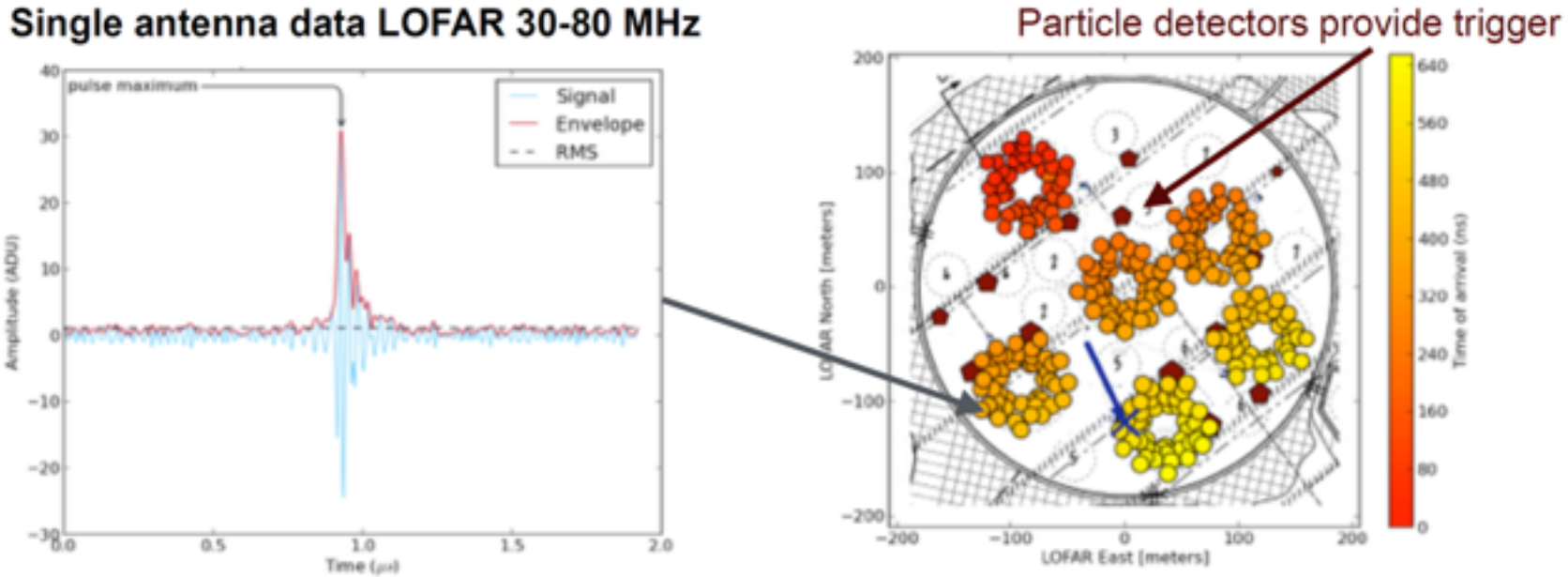


Resolved imaging of space weather events
Chhabra et al. in prep.

Probing the sub-surface of Galilean moons
Andrew Romero Wolf & Paul Ries

Real-time Detection of Cosmic Rays

See talk by Ryan Monroe on Friday



Buitink et al. 2017

Measuring the mass composition of high-energy cosmic rays

Direct detection greatly enhances capability

Summary

Stage 2 OVRO-LWA is constructed and early science is underway

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

Final array will be a 352-antenna array dedicated to extrasolar space weather, transient science, Cosmic Dawn, solar and Jovian monitoring and direct cosmic-ray detection