HeRO:
Heliophysics Radio Observer

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HeRO: **He**liophysics **R**adio **O**bserver

Key Questions

- What are the shapes and properties of CME shock fronts?
- What are the sites and conditions for efficient particle acceleration in coronal and interplanetary shocks?
- What is the topology of magnetic fields from the sun into the heliosphere?

Tracking type II and type III radio bursts with high temporal and spatial resolution across a wide range of frequencies

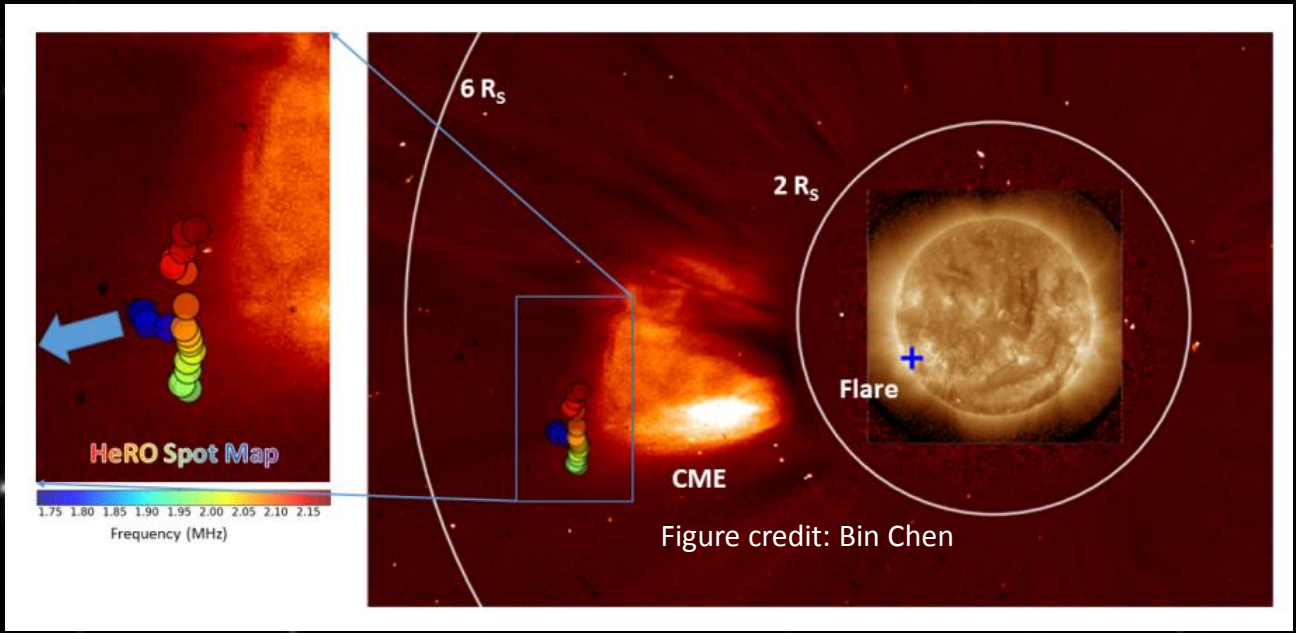
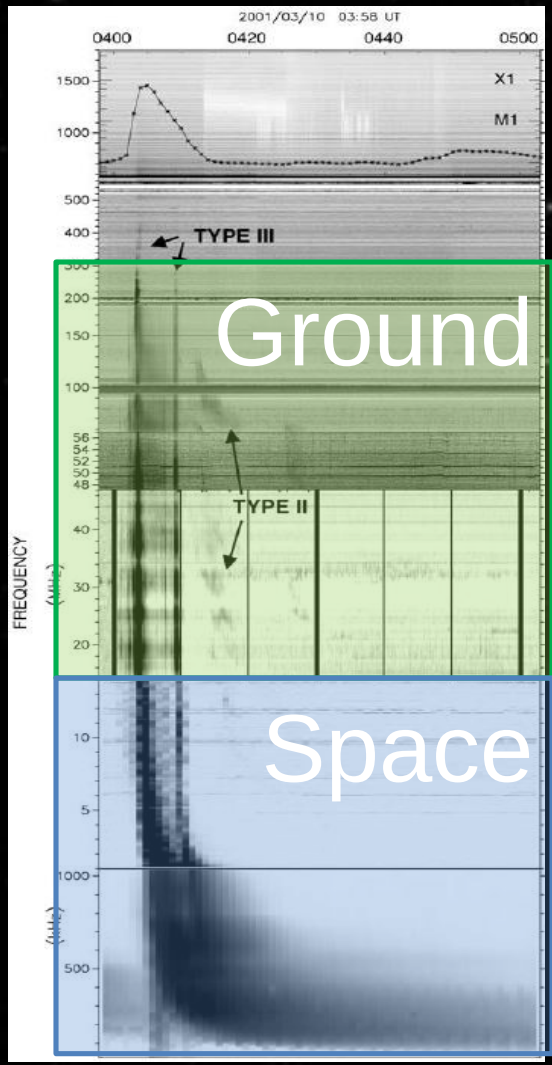


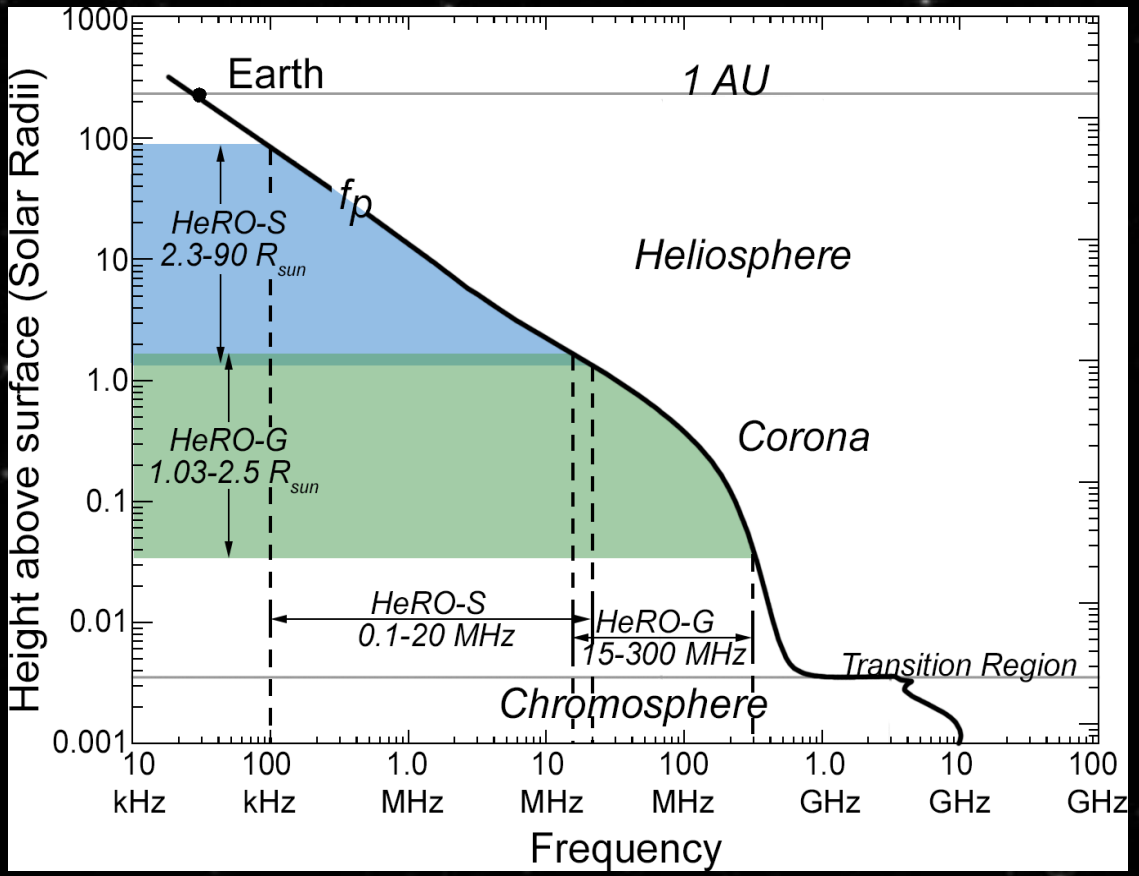
Figure credit: Bin Chen

A Hybrid Instrument
Space + Ground



300 MHz

100 kHz



Cane H V et. al. 2002 Solar flares, type III radio bursts, coronal mass ejections, and energetic particles *J. Geophys. Res.* **107** 1315

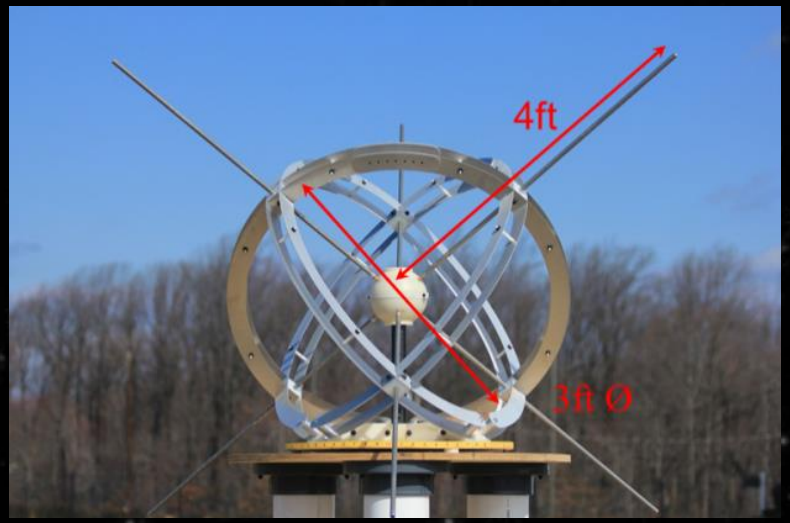
HeRO-G

- Based on RAPID
  - **R**adio **A**rray of **P**ortable **I**nterferometric **D**etectors
- 15 – 300 MHz
- Self-contained units with antenna, amps, receiver, data storage, power
- 25 units per HeRO-G station (300 baselines)
- 2 HeRO-G stations widely separated in longitude for > 60% temporal coverage

HeRO-S

- 6 CubeSats (6U) – 15 baselines
- 100 kHz – 20 MHz
- Baselines 500 m – 10 km
- Near-geosynchronous orbit
- Voltage data stored in ring buffer onboard, correlated and post-processed on the ground

Vector Sensing

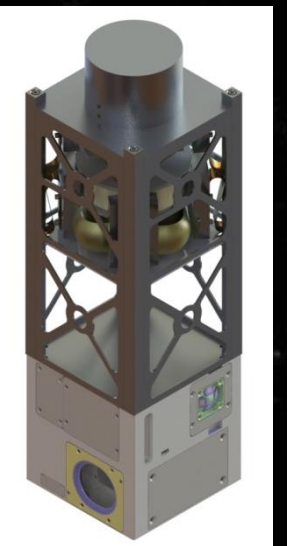


The vector sensor enables <u>nulling</u> of interfering sources

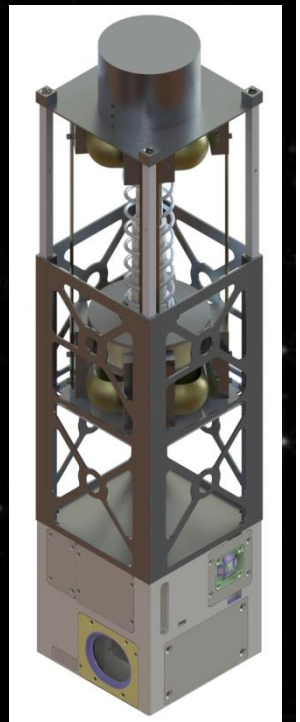
- 3 dipoles + 3 loops (electrically small)
- Measures full E and B field vectors, ExB = S (Poynting vector)
- Determines sources' intensity, direction and polarization in single snapshot
- Typically used for finding direction of strong sources
- Additional degrees of freedom when compared to triad/tripole
- **More sensitive (≥2x), capable element than tripole for interferometric arrays**

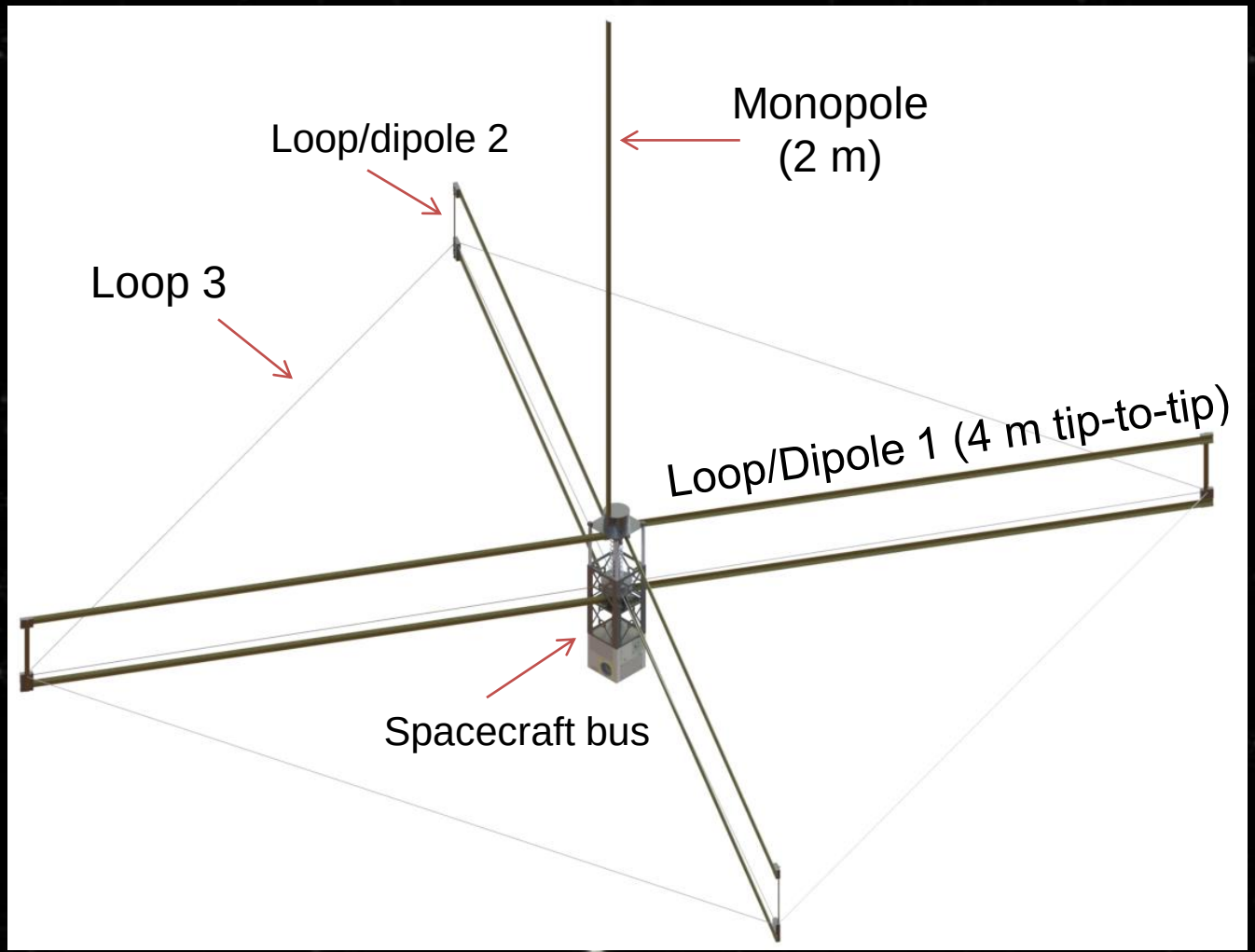
CubeSat Deployable Vector Sensor

Stowed

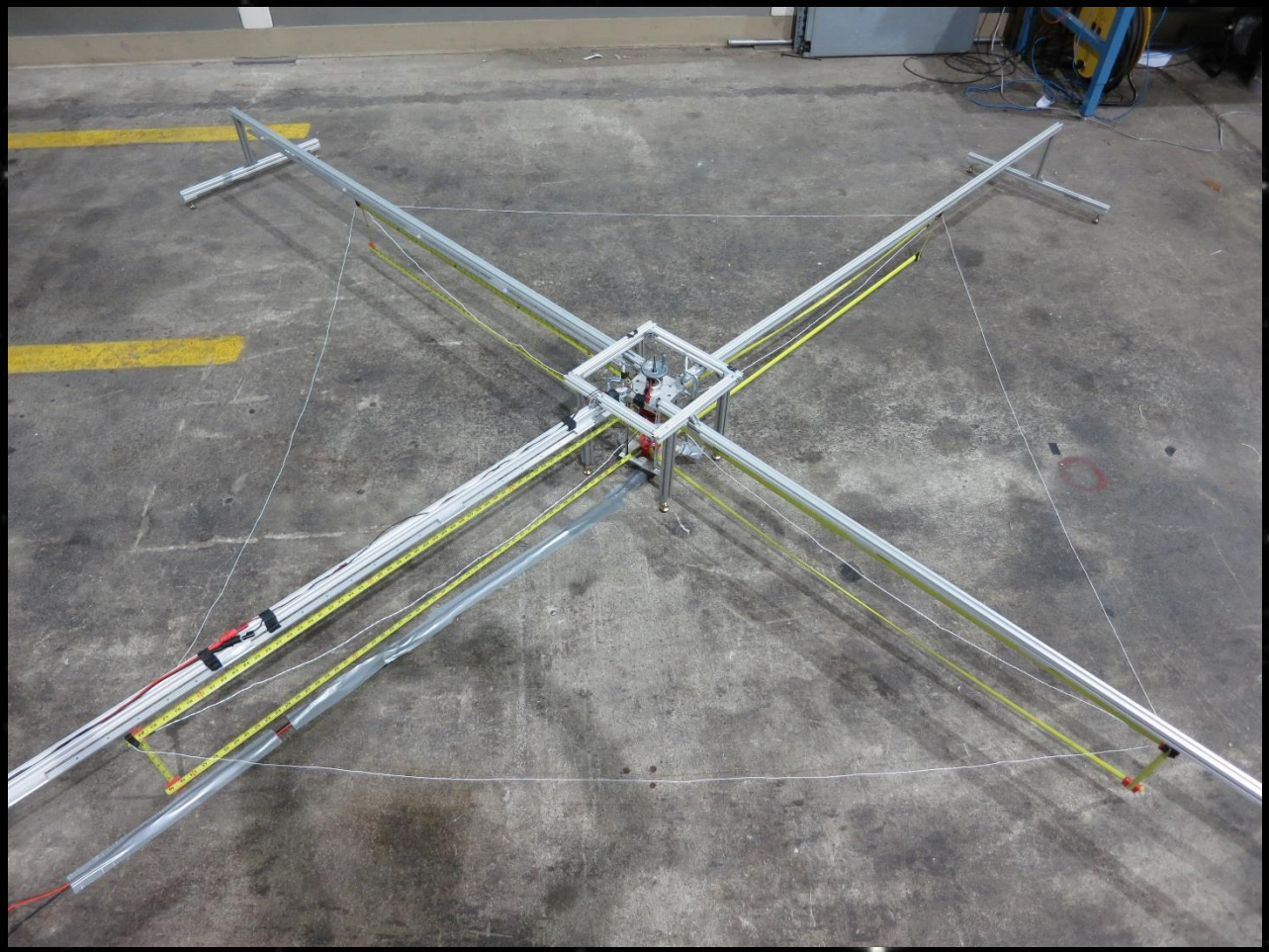


Telescoped



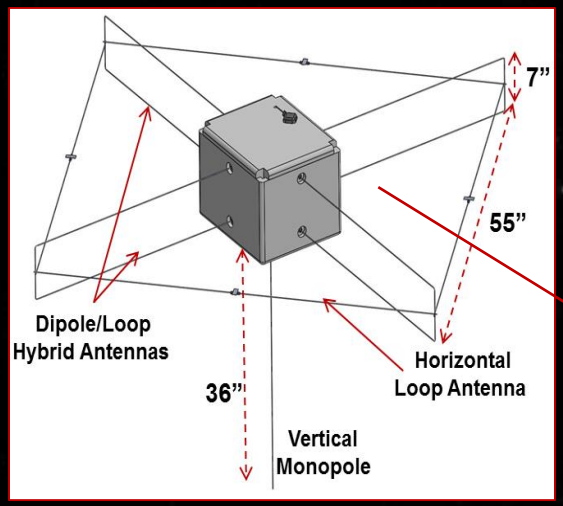


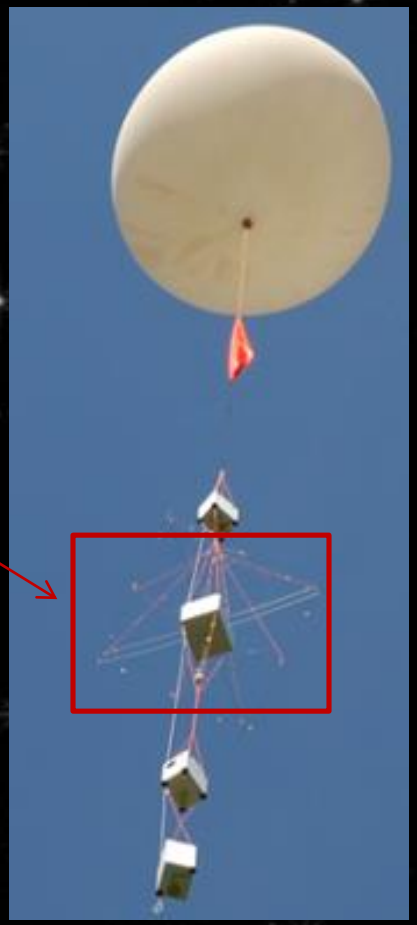
Deployable Vector Sensor Prototype



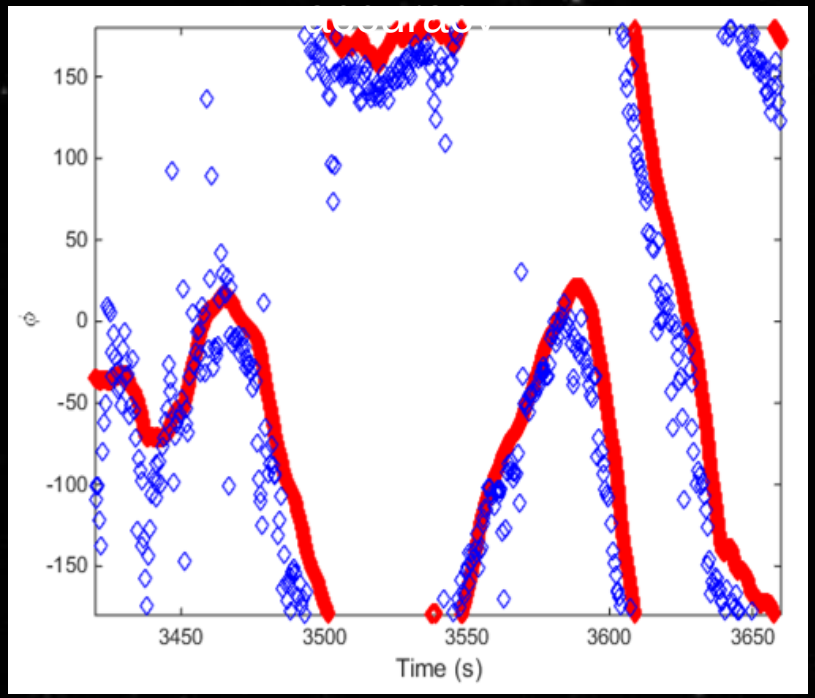
High Altitude Balloon Test (Single Vector Sensor)

Balloon-mounted vector sensor tracked angle of arrival of test beacon on the ground





Results: ~3° direction of arrival



Direction of arrival (azimuth) vs. time
Red: Truth
Blue: Vector sensor measurement

Summary

- HeRO is a hybrid space + ground heliophysics observatory
- HeRO will generate a rich multidimensional dataset on type II and III bursts
- High temporal, spatial, and frequency resolution and full polarization information
- Context measurements for upcoming solar missions (SPP, SO)
- Potential for discovery – a new way to look at the sun

Acknowledgements

HeRO collaboration:

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