The Magdalena Ridge Observatory Interferometer: a new path to first light

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On behalf of the MROI project team

The Magdalena Ridge Observatory

MAGDALENA RIDGE OBSERVATORY

NEW MEXICO TECH

- Federally funded program 2000-2010 at NMT
  - Fast tracking 2.4m telescope
  - 10-element imaging interferometer

- Hiatus in deployment over the past few years
- Successful bid for additional funding in 2015

Original high-level goals for the MROI

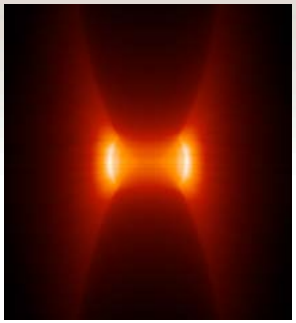
- Demonstrate high fidelity imaging of faint astronomical targets

> ×100 sensitivity of the current best
>
> Model-independent "snapshot" capability
>
> Multiple images/night

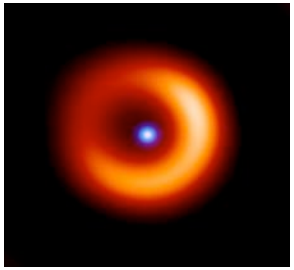
- Required "turnkey" capability, then not commonplace
- Aimed to build on best practice/implementations

Principal scientific missions

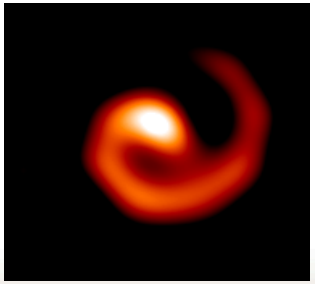
- AGN:
  - Validation of unified model
  - H=14 goal for >100 targets



- Star and planet formation:
  - Discs, clearing
  - Magnetically channeled accretion
  - Sub-stellar companions



- Stellar accretion and mass loss:
  - Mass loss and transfer
  - Convection and surface structure
  - Stellar pulsation



Conceptual design implications

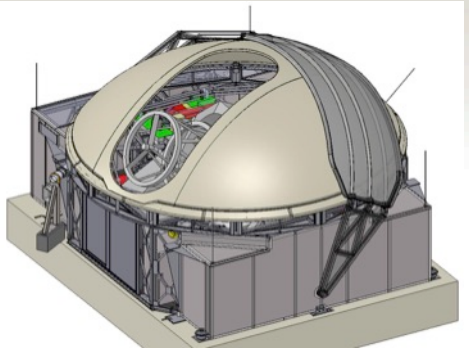
MAGDALENA RIDGE OBSERVATORY

NEW MEXICO TECH

Evolution of status since March 2015

Then

- Most subsystems designed, some prototyped
- First "unit" of many subsystems shipped
- Some key long-lead items on hold
- Goal to test first unit tel (UT) in maintenance facility in 2015
- Application for AFRL funding in Jan 2015

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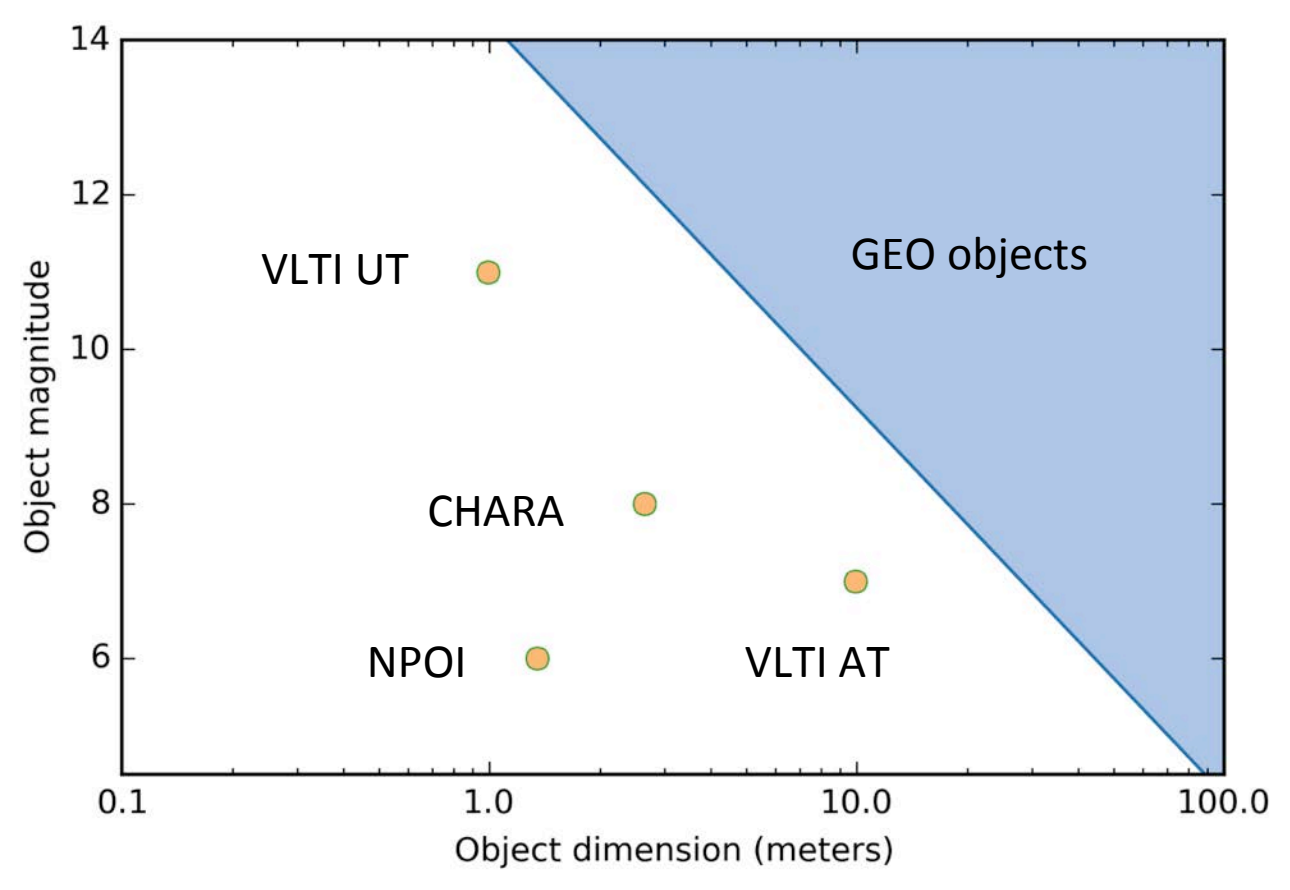
Now

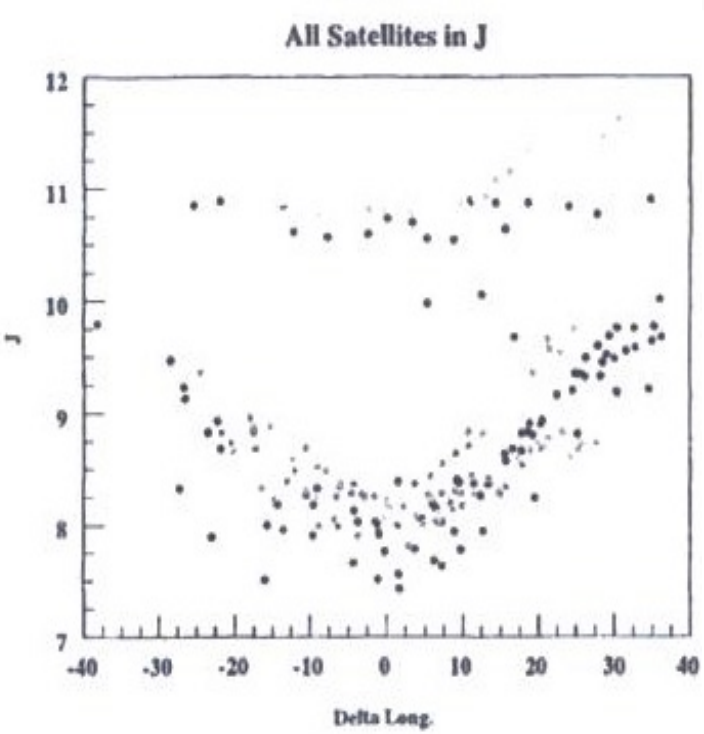
- Bid for Federal funding successful
- New Cooperative Agreement with AFRL for 2015-2020:
  - "Imaging of Geosynchronous Satellites"
- Collaboration between:
  - NMT, Cambridge
  - NRAO, Lockheed Martin, ATA, tOSC
- Funding in yearly tranches of approx $5M for 5 years

Existing arrays are unable to image GEO assets

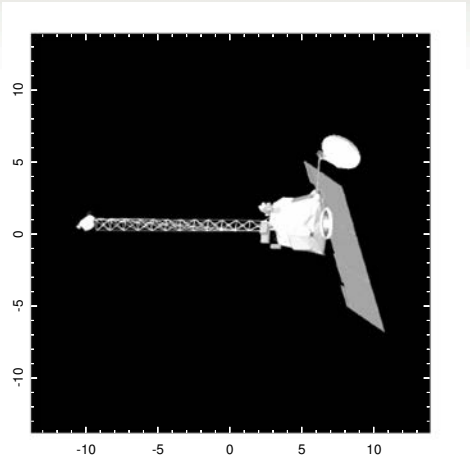


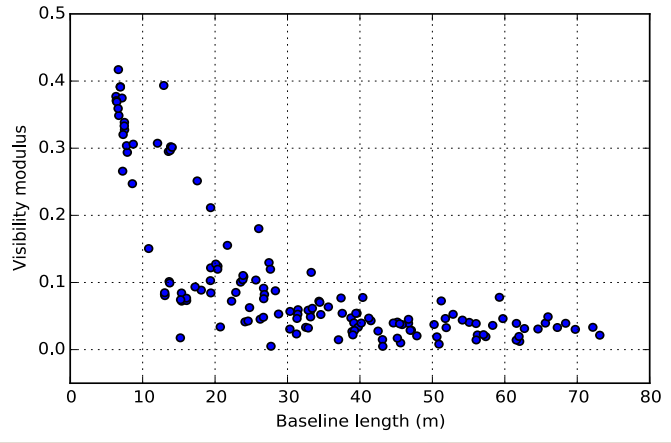
Two main technical challenges

Targets are faint by existing standards



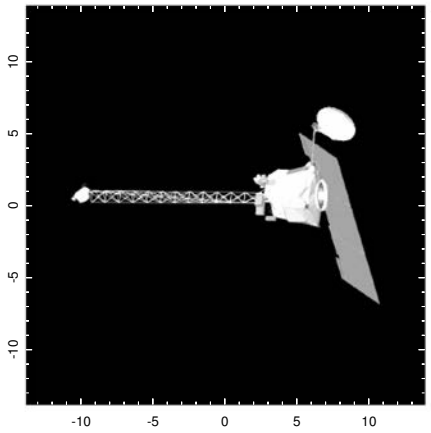
Targets are large by existing standards



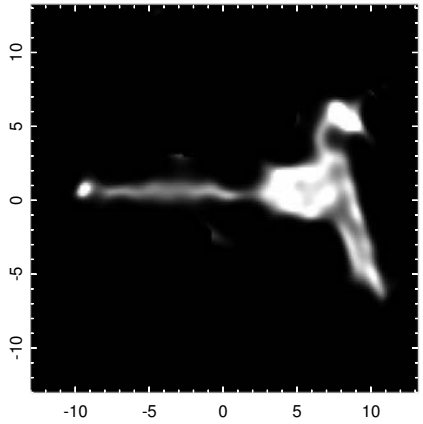


MROI architecture is well matched to this role

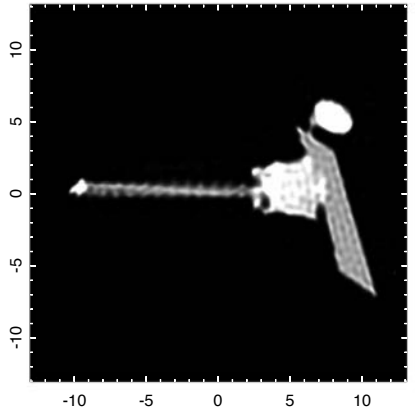
- Compact “core” array
- Good fringe-tracking sensitivity:
  - baseline bootstrapping
  - separate fringe tracking and science correlators
- Snapshot imaging capability



“Truth”



7 telescopes



19 telescopes

AFRL supported program has SSA focus

Principal foci

- Mitigate key technical risks for a 25cm ground-based imaging array:
  - Performance of unit telescopes
  - Delivery of light to beam combining lab
  - Stable fringes from GEO targets
  - Bootstrapping, closure phases from GEO targets
- Three technical studies:
  - Imaging capability
  - Radio data fusion
  - Transition to space

Proposed schedule

- Y1: First UT tested in maintenance facility
- Y2: Fast tip-tilt system validated, fringe tracker tested at GEO sensitivity in lab
- Y3: Light from first UT delivered to beam combiner lab, beam quality validated
- Y4: Second UT deployed, 1st fringes from GEO assets
- Y5: Third UT deployed, boot-strapping, co-phasing, closure phases

Conclusions

- AFRL Co-operative Agreement now in place
  - Supports program for next 5 years
  - NMT and Cambridge leading effort
- Near-term goals:
  - First light for first UT first pre-this year's SPIE meeting
  - First light in beam combiner lab 2017
- Project office seeking:
  - Technical staff, collaborators, partners
  - Additional funding to accelerate program
    - DARPA
    - Other sponsors