



Update on the MROI

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On behalf of the MROI team

MROI Project Scientist

NMT Physics Professor



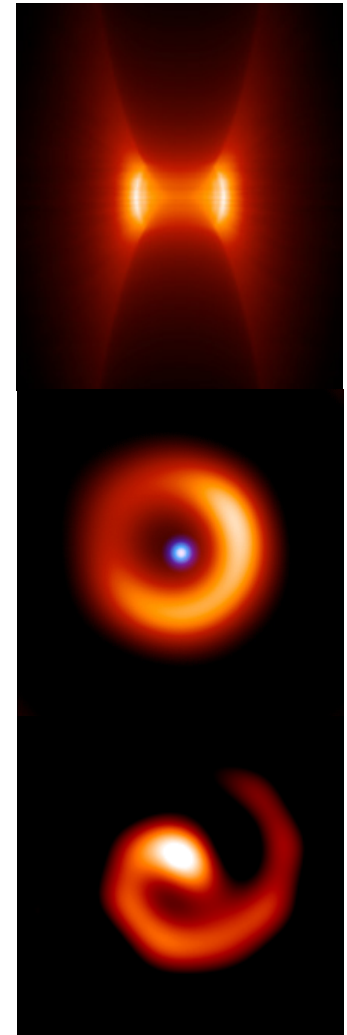
Overview of Talk

- General Introduction to MROI
- Progress in past Few Years
- Plans Associated with AFRL Funding



MRO Interferometer “Classical” Science Case

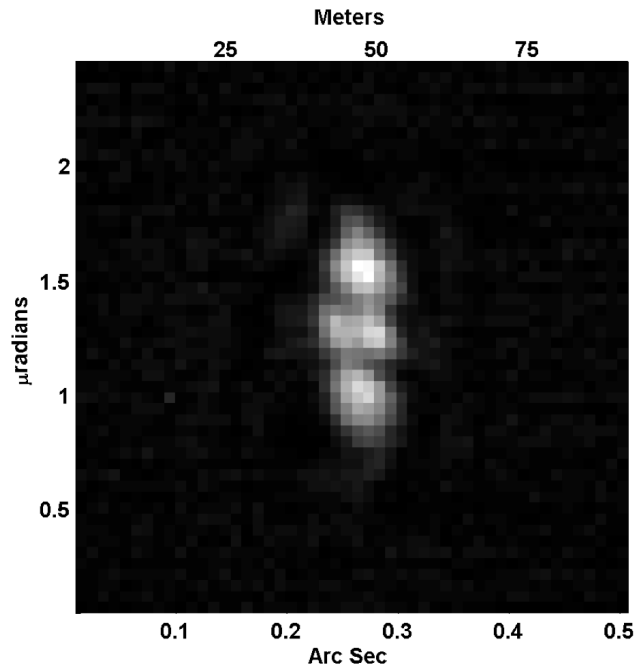
- AGN:
 - Verification of the unified model.
 - Determination of nature of nuclear/extra-nuclear starbursts.
 - H=14 gives >100 targets.
- Star and planet formation:
 - Protostellar accretion, imaging of dust disks, disk clearing as evidence for planet formation.
 - Emission line imaging of jets, outflows and magnetically channeled accretion.
 - Detection of sub-stellar companions.
- Stellar accretion and mass loss:
 - Convection, mass loss and mass transfer in single and multi-star systems.
 - Bipolarity and collimation of circumstellar material, wind and shock geometries.
 - Pulsations in Cepheids, Miras, RV Tauris, etc.



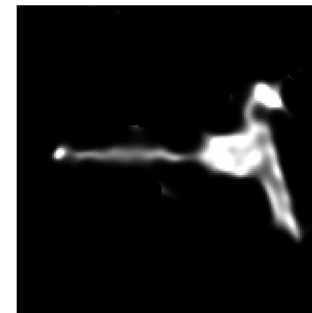
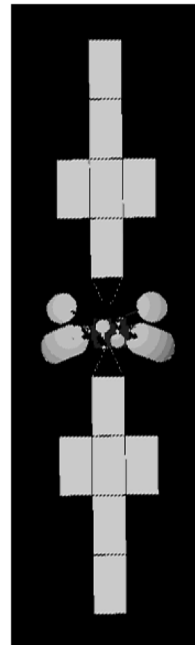


AFRL Geosynchronous Object

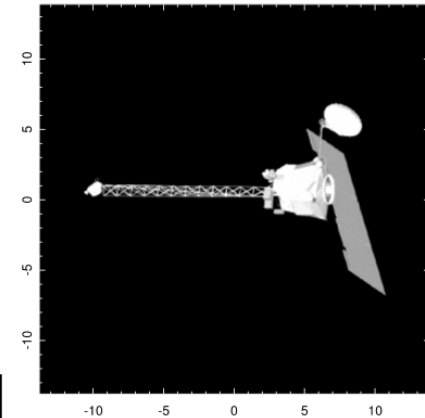
Goals



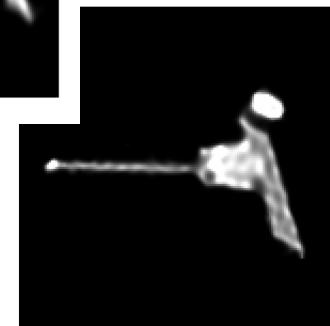
Drummond et al. (2010) on Keck II
with AO + deconvolution



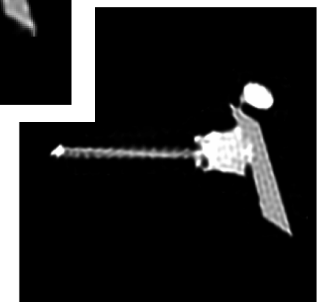
7 scopes



truth



10 scopes



19 scopes

MROI to
validate
technique and
sensitivity



Historical Progress

- Federally funded 2000-2011 (NRL), 2015-2020 (AFRL)
- Env. Impact Survey completed in 2003
- Two facilities at MRO
 - Fast-tracking 2.4m
 - NIR/Optical 10-element interferometer
 - Third site available
- MROI is 10 1.4m movable afocal telescopes in equilateral Y configuration
- Optical and near-IR operation
- Baselines from 7.8 to 347m
- Design optimized for imaging mission

Design Flow-Down

- Telescope diameter of 1.4 m
 - H magnitude = 14th for group delay tracking limit
- Spatial scales of 0.3 to 58 mas
 - Baselines from 7.8 to 347 m (for 0.6-2.4 microns)
- Moderate-to-high spectral resolutions
 - Separate fringe tracking and science cameras
- High throughput to achieve sensitivity limit
 - Fifteen reflections from primary to detectors
 - Optimized coatings for 0.6-2.4 microns
- Large number of telescopes rapidly combined
 - Optimized for model-independent imaging



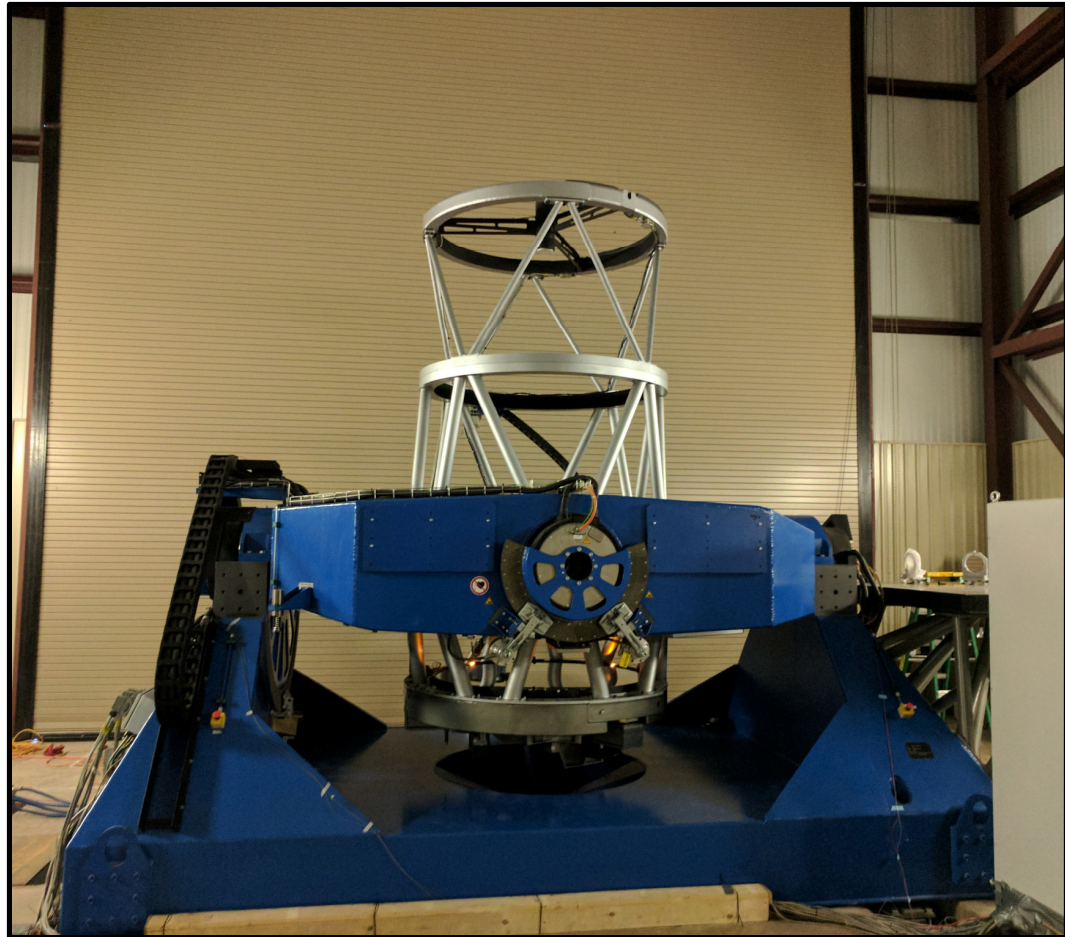
Recent Progress

- Telescopes
- Enclosures
- Delay Lines
- BRS/AAS
- Fringe Tracker



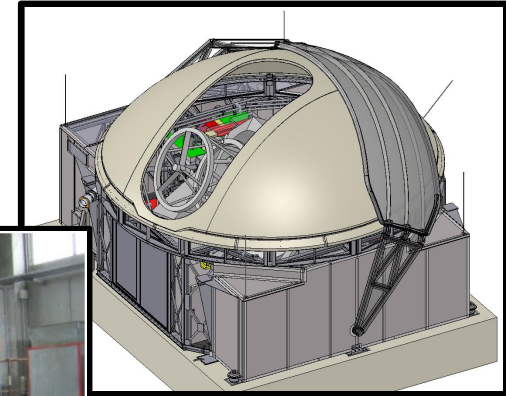
Unit Telescopes

- Alt-alt design 1.4m diameter primary
- Designed/built AMOS
- Wavefront 62 nm rms after 3 reflections
- First light Nov 29, 2016
- With present funding timeline UT#2 late '18



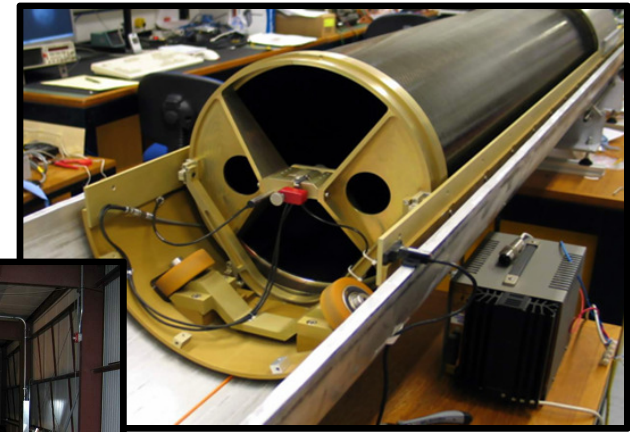
Telescope Enclosures

- Protects and transports telescope
- Designed and built by EIE
- Steel structure, fiberglass domes, carbon fiber shutters
- Partial FAT Dec '16
- Delivery expected May '17



Delay Lines

- Sidereal and atmospheric correction
- Completely new design – Cambridge
- Compliant wheels run on inside of vacuum pipe, inductive pick-up, wireless communication
- SAT of DL#1 completed, FAT of DL#2 underway



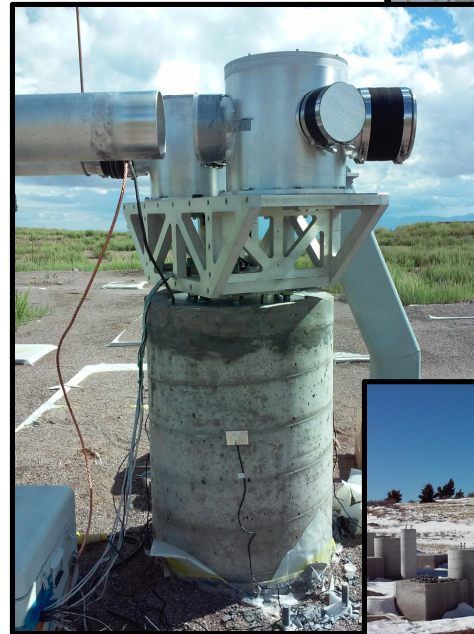
DL#1 and MROI 100m pipe



DL#2 FAT at COAST

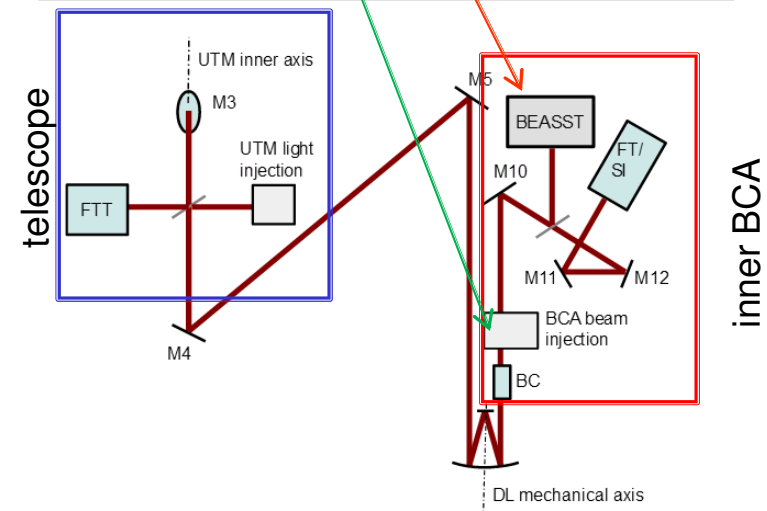
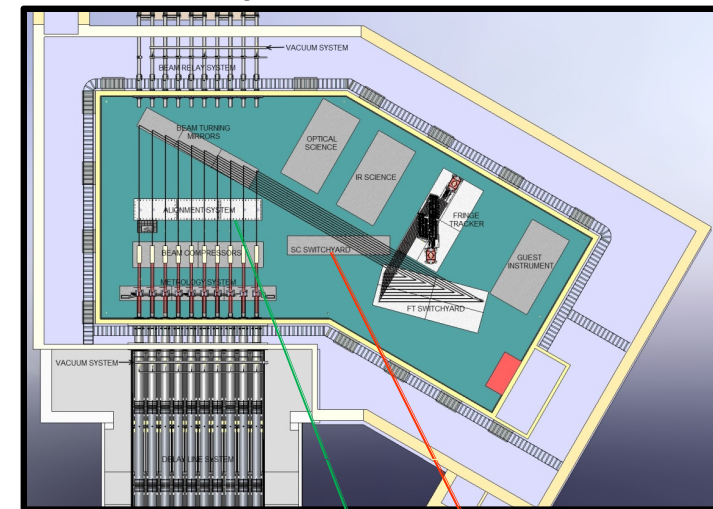
Beam Relay System (BRS)

- Single, double and triple can vacuum systems along 28 stations to direct light to DL out to 190m
- Testing diurnal motion of beams
 - Dominated by solar insolation
 - Adding insulation/shade



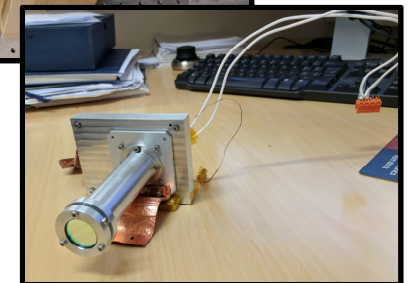
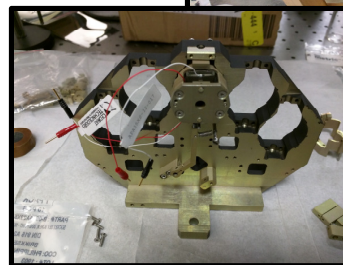
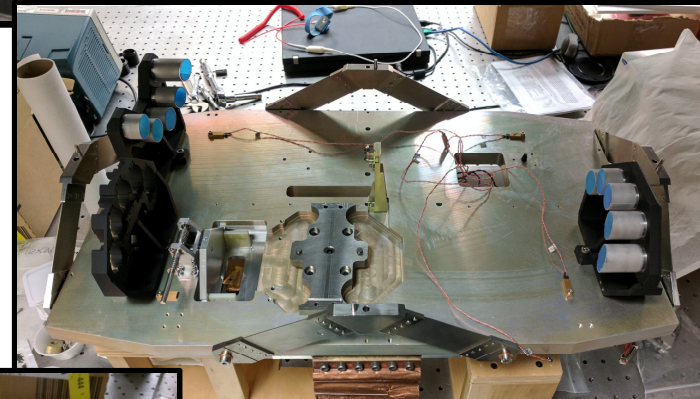
Automated Alignment System (AAS)

- Conceptual/Preliminary Redesign Underway
 - Beacons in lab and at telescope Nasmyth (UTLIS and MOB)
 - Shack-Hartmann Sensor in lab (BEASST)
 - Pop-up mirrors in beam cans
 - Capacitive Sensors for mirror steering



Fringe Tracker (ICoNN)

- H and K_s nearest-neighbors tracker
- Tested in the lab for 6 beams with beam combiner as well as fast readout
- Upgrading to Saphira detector for first light
- Expect to move to Ridge in ~1 year





Milestones with AFRL Funding

- Initial Cooperative Agreement is \$5M/year
- Need is for sloped funding profile to bring on hardware sooner
- Expectation is to demonstrate fringe tracking on geo object fainter than 10th magnitude in IR
- Year 2 – Deploy UT#1 on array; order UTM & UTE #2 and primaries
- Year 3 – Receive & install hardware, move FT to Ridge; order UTM & UTE #3
- Year 4 – Fringes and initial sensitivity demo
- Year 5 – Baseline bootstrapping demo



Shameless Plugs

- JOSA Special Issue – Imaging Interferometry – May 2017
- SPIE 2018 – Astronomical Telescopes and Instrumentation – Interferometry Session
 - Need SOC members and lots of papers!
 - Call will come out in November
- 2020 Astrophysics Decadal
 - CHARA, NPOI and MROI leads are trying to get community to ramp up
 - If you want to help (we need lots of help – white papers, nominations for committees, etc.) – talk to Theo, Gerard, Tom Armstrong or myself



Thank you for your attention!

- PI: Van Romero
- Program Director: Ifan Payne
- System Architects: David Buscher and Chris Haniff
- Project Scientist: Michelle Creech-Eakman
- Project Engineer: Fernando Santoro
- Lead Mech. Eng.: Andres Olivares
- Lead Software Eng.: Allen Farris
- NMT Staff: Chuck Dahl, Dylan Etscorn, Louis Jencka, Perry Johnson, Sonora Kameron, Rob Kelly, Dan Klinglesmith, Heidi Love, Danielle Ochoa, Juan Pino, Chris Salcido plus new students joining recently
- Cambridge Staff: Martin Fisher, Bodie Seneta, Xiwei Sun, John Young plus new students joining recently

**Your name
here?**



Thanks to our sponsors at AFRL and NMT.



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Observatoire
de la COTE d'AZUR

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