

# The Magdalena Ridge Observatory Interferometer – A Status Update and Plans for 2014

M. J. Creech-Eakman  
New Mexico Tech – MROI Proj. Scientist  
On behalf of the NMT and Cambridge Teams



# Magdalena Ridge Observatory

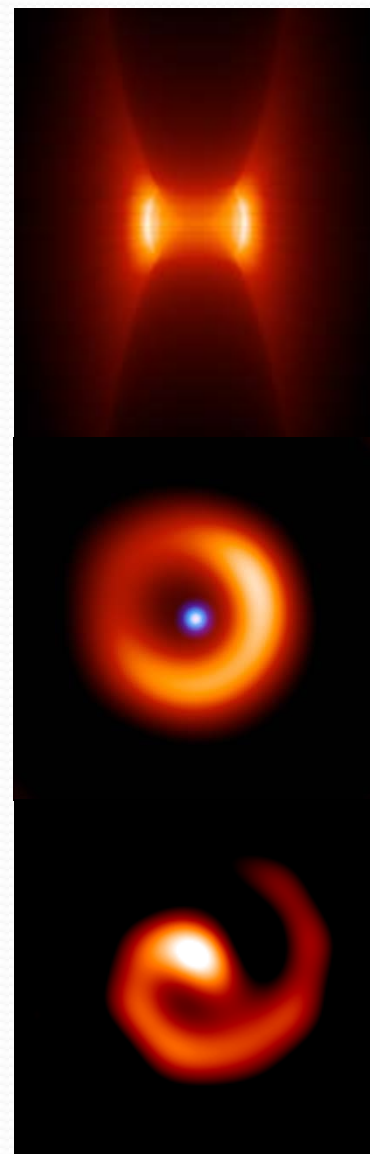
- Federally funded 2000-2011, 2014
- EIS completed in 2003
- Two facilities at MRO
  - Fast-tracking 2.4m
  - NIR/Optical 10-element interferometer
- 2.4m scope started full operations Aug, 2008
- Primarily NASA/DoD funded

- MROI is 10 1.4m movable afocal telescopes in equilateral Y configuration
- Optical and near-IR operation
- Baselines from 7.8 to 340m
- Design optimized for imaging mission



# MROI Key Science Mission

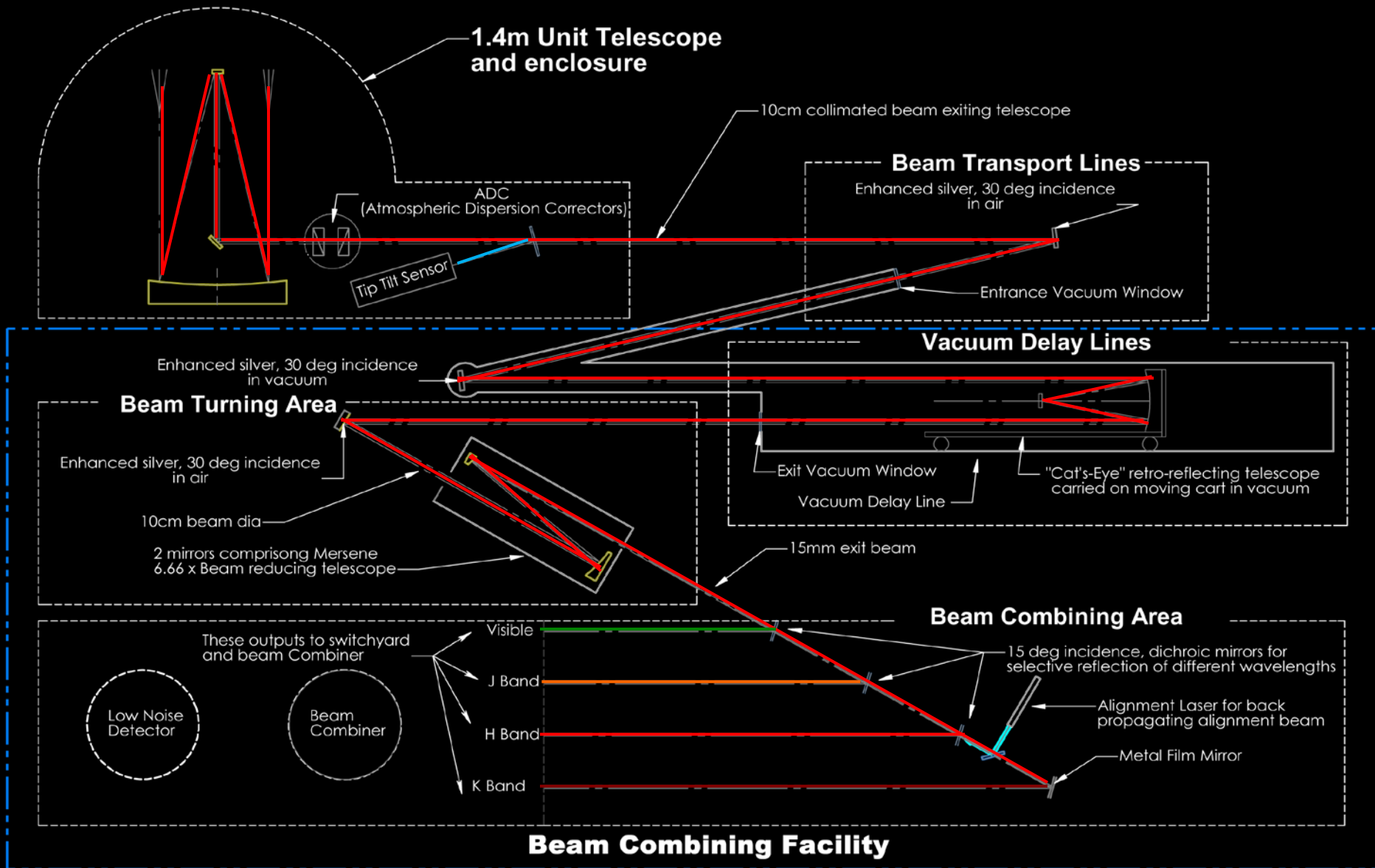
- AGN:
  - Verification of the unified model.
  - Determination of nature of nuclear/extra-nuclear starbursts.
  - $H = 14$  gives >100 targets.
- Star and planet formation:
  - Protostellar accretion, imaging of dust disks, disk clearing as evidence for planet formation.
  - Emission line imaging of 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.



# Technical Requirements Flowdown

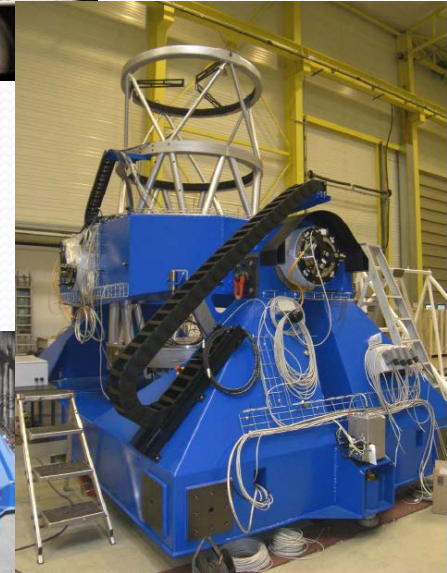
- Telescope diameter of 1.4 m
  - H magnitude = 14th for group delay tracking limit
- Spatial scales of 0.3 to 30 mas
  - Baselines from 7.8 to 340 m (for 0.6-2.4 microns)
- Moderate-to-high spectral resolutions
  - Separate fringe tracking and science cameras
- High throughput to achieve sensitivity 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

# Walk through the Optical Path



# Unit Telescopes

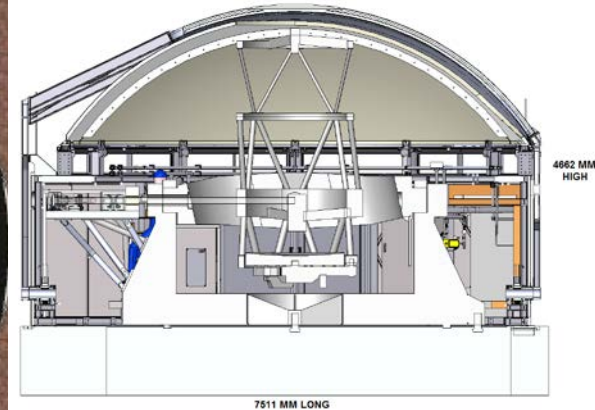
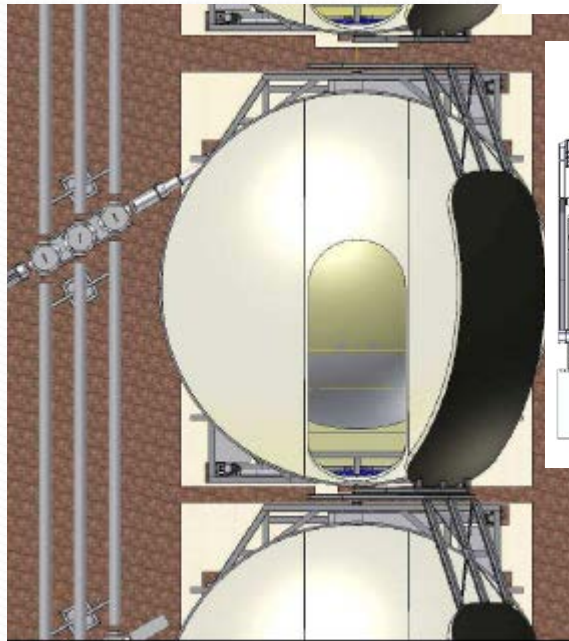
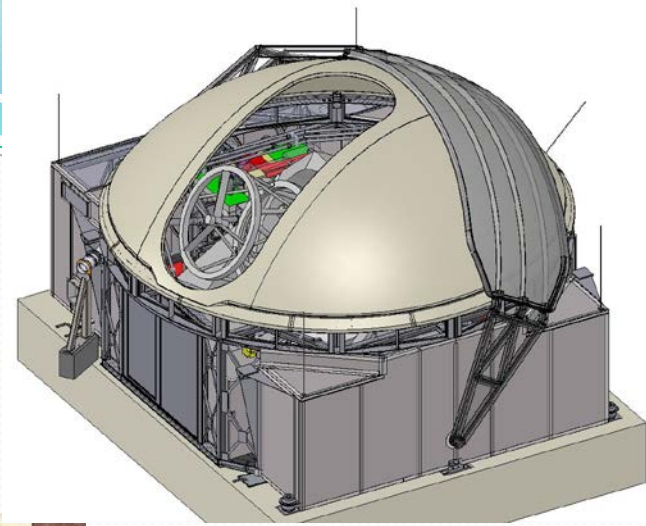
- Designed/built by AMOS
  - 1.4m aperture
  - afocal alt-alt design
  - polarization preserving
  - 62 nm rms wavefront after three reflections
  - UT1 is on campus!
  - UT2-3 long-lead items ordered and being assembled





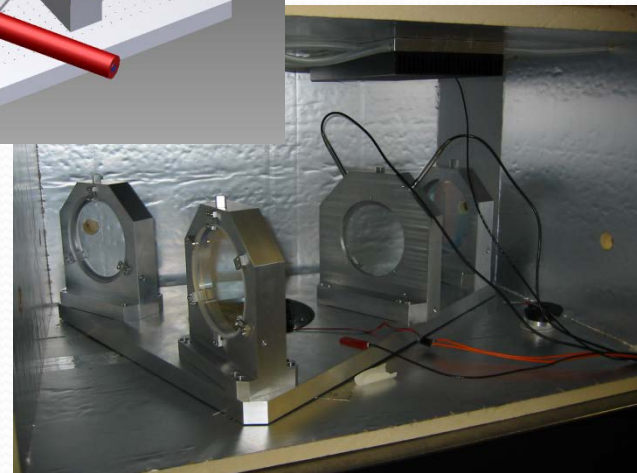
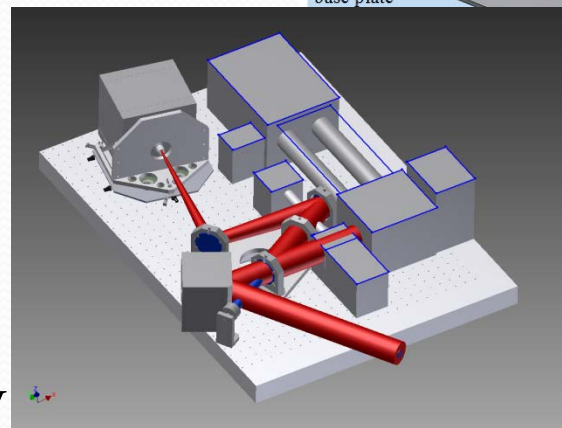
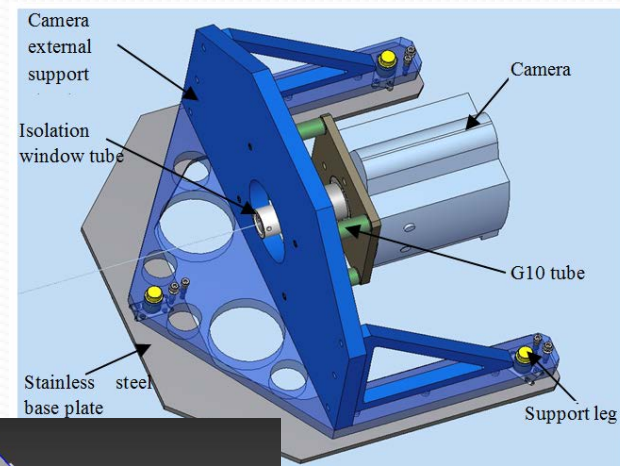
# Optics & UT Enclosures

- Enclosures Designed by EIE
- Houses and transports UTs
- Allows close-packed configuration to 30 deg elevation without vignetting for 6 hour tracks
- 6 full sets of optics in warehouse
  - All M2's and M3's completed
  - First 3 M1's in various states of completion



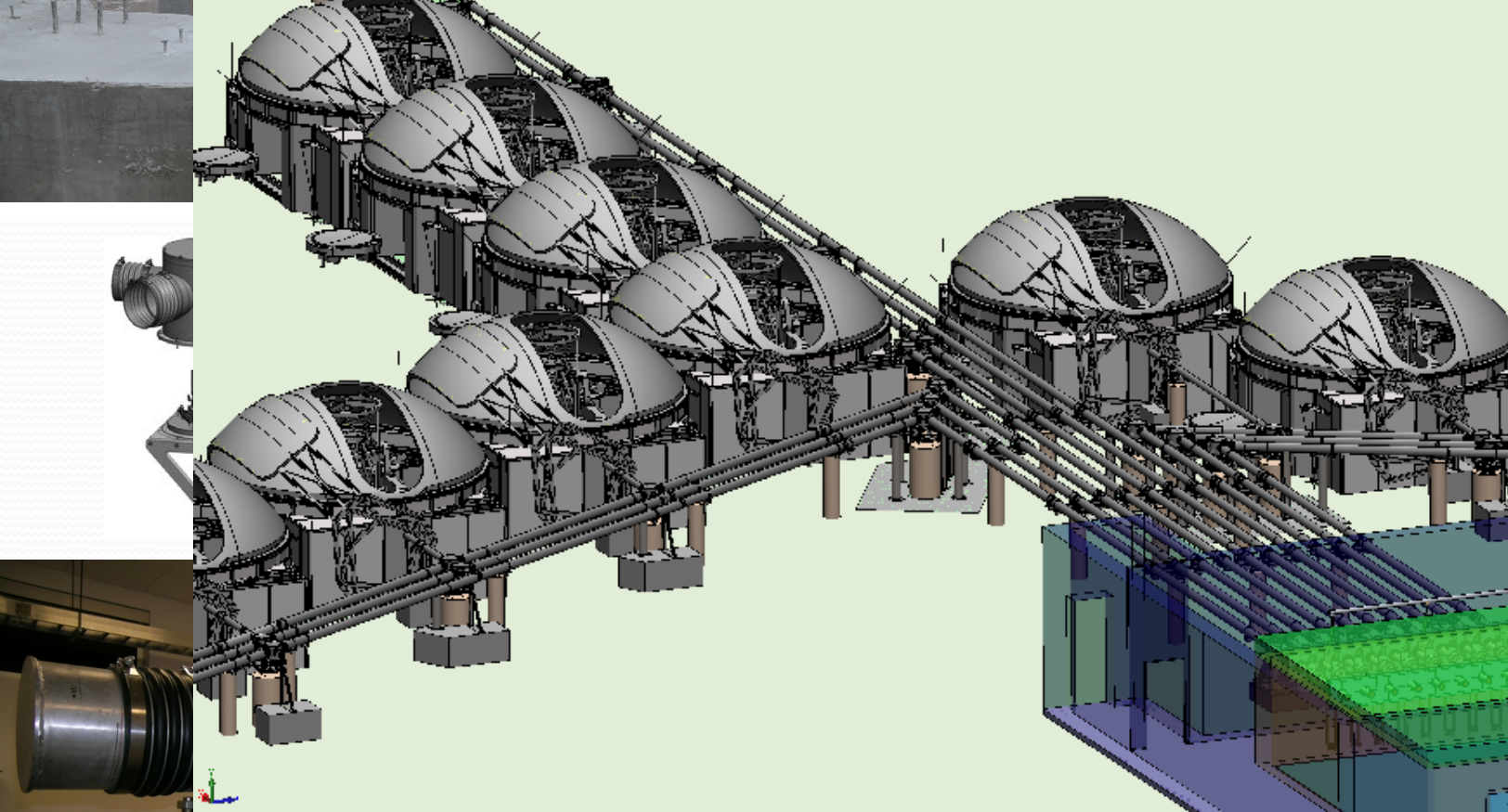
# Fast Tip-tilt & Acquisition System

- Nearing completion at Cambridge:
  - Full-scale prototype under test
  - Majority of software complete
- Uses Andor EM CCD head
- Transmissive optics
  - High throughput and relaxed tolerances
- Fully passive opto-mechanical design:
  - No actuation to meet stability requirements
- V-band sensitivity of 16 at MROI:
  - Good match to reddest targets





# Foundations, Beam Relay & Inner Array



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# Visitor's Center

View from N



View from S



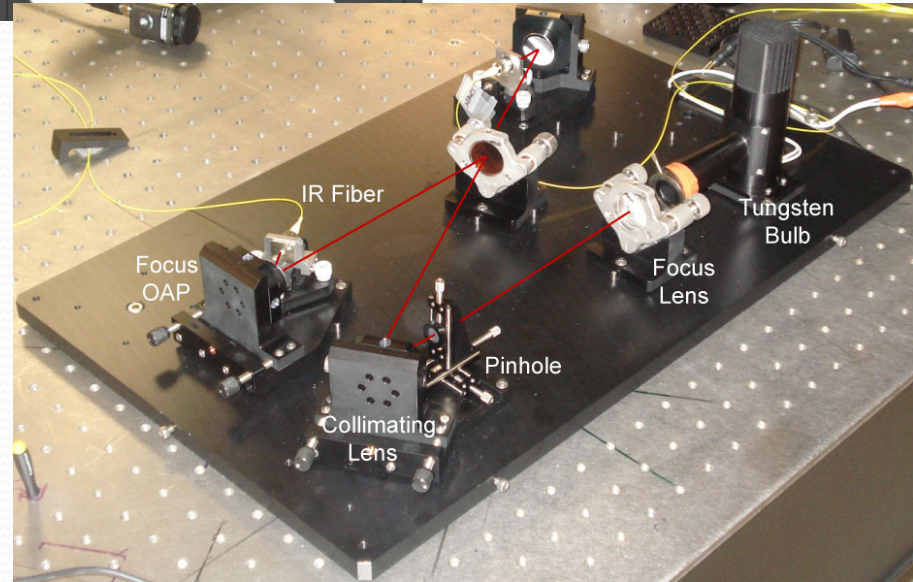
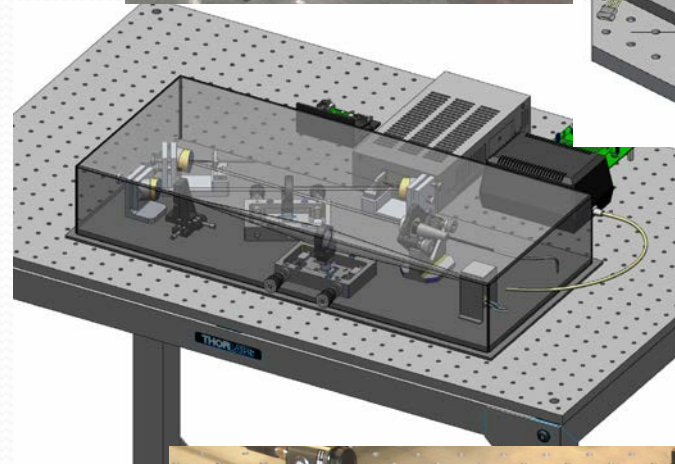
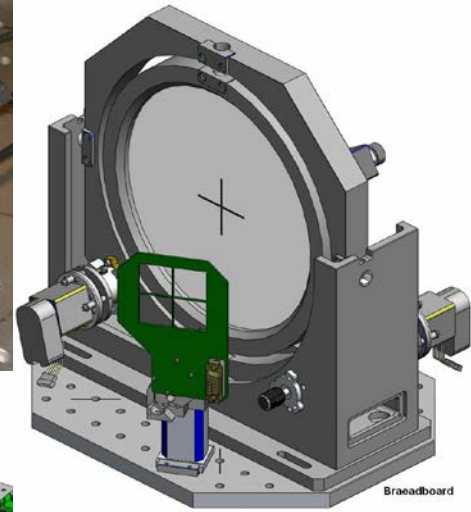
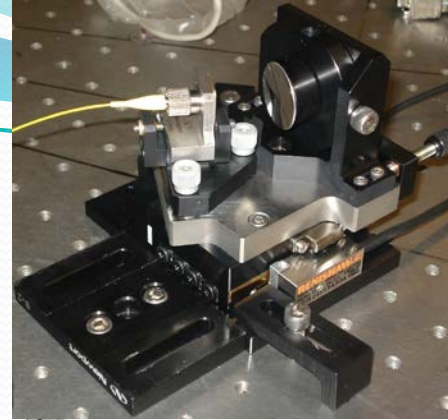
Looking out toward the N - view from telescope

- State DOT funded
- Visitor's Center (red): giftshop, displays, observing window
- Maintenance facility (beige): small machine shop, control room, overhead crane, telescope pad + all facility needs
- UTM<sub>1</sub> SAT June 2014
- FOV to N:  $\sim 35^\circ \times 40^\circ$



# Automated Alignment System

- Designed and built by MRO
- End-to-end alignment of tilt and shear
- Enclosed in a “Magical Optical Box”
- Custom quad cell and beam injection via fibers
- Ongoing CLFE experiment
- First M.S!





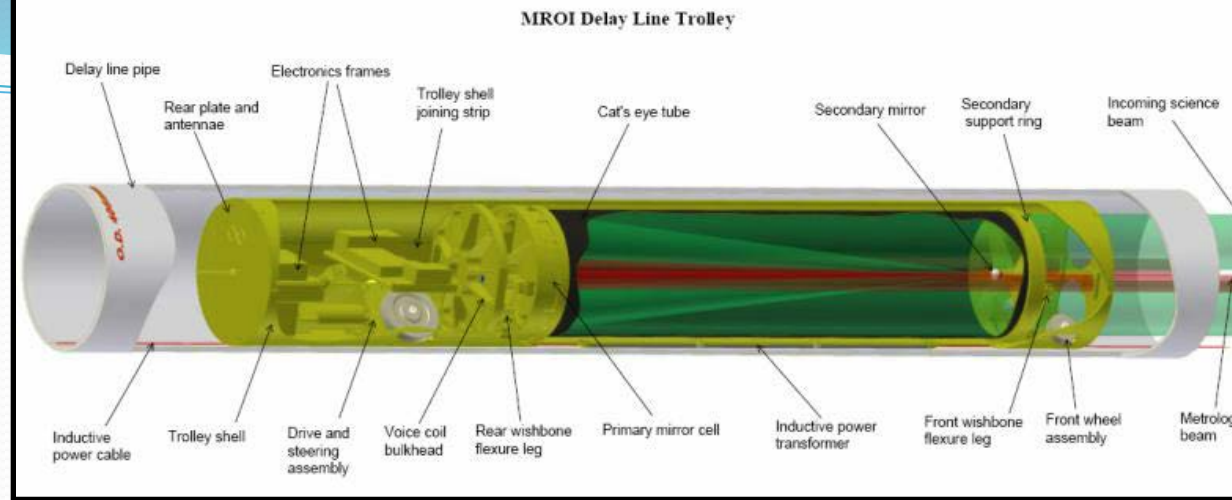
# Beam Combining Facilities

- Design by M<sub>3</sub>/built KL House – delivered in 2008
- Thermal & vibrational stability
- Supports full 10-telescope array
- Single-pass DL section 190 m long

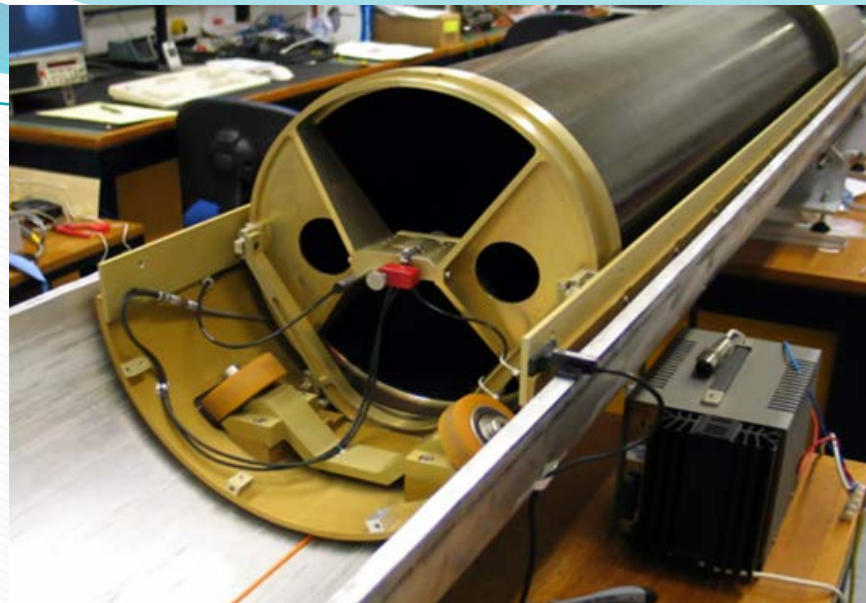
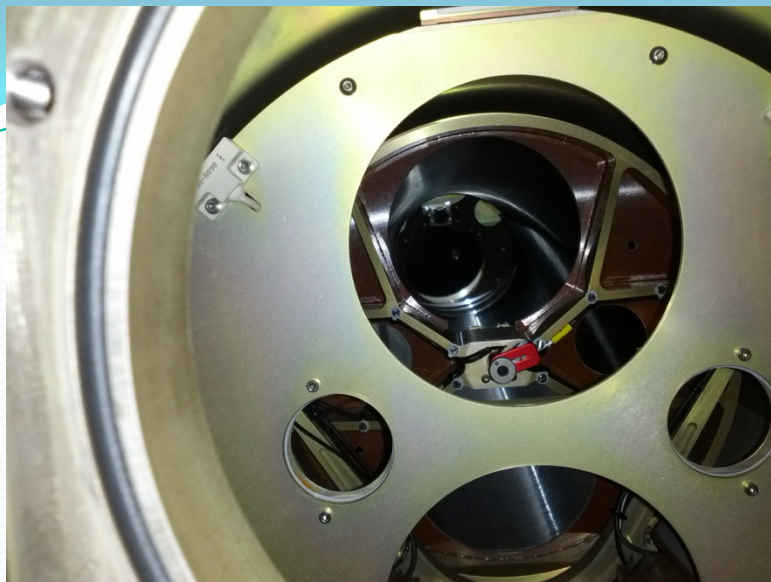


# Delay Lines

- Designed/built Cambridge
- Inductive pick-up & wireless communications
- DL<sub>1</sub> install to about 100m
- DL<sub>1</sub> Site Acceptance Testing underway in Delay Line Facility

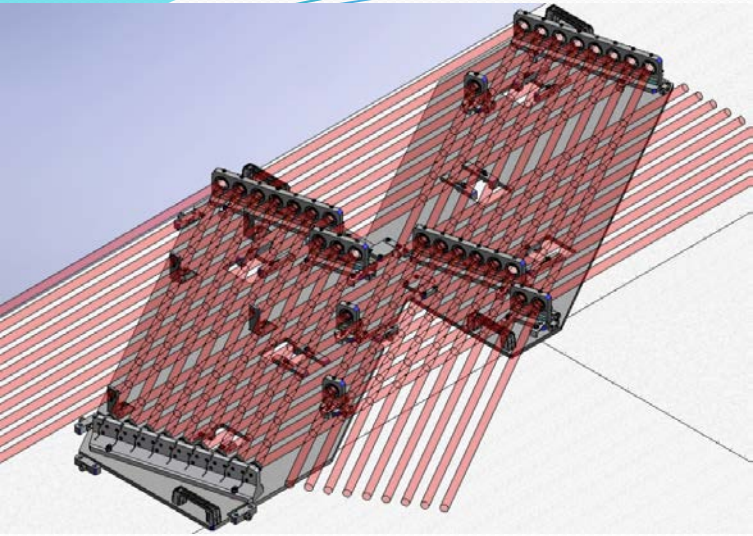




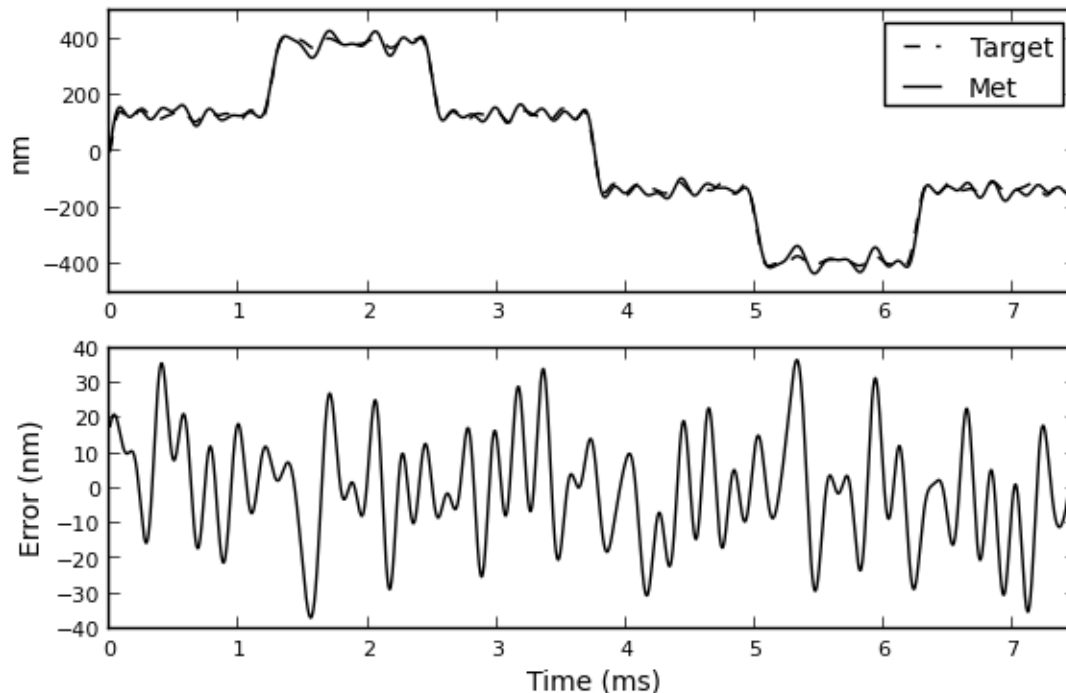
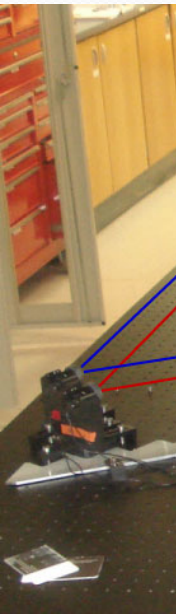




# Fringe Tracker - ICoNN



- Designed/built by MRO
- Operates H or Ks
- Uses nearest-neighbors combination
- Closed loop FT in the lab using step modulation
- First Ph.D.!



# Funding Issues...are improving

- Received \$4M two days ago in Omnibus FY14 thanks to support of our Congressional Delegation
- Need total \$14M over next 3 years to get to 'First Fringes'
- Need total \$93M from today to finish 10-telescope facility
- Plans to go for State Severance Bond in Jan 2014 Session
- Received pledge of Funding from Hilton for 1 UT
- Plans to pursue NSF Mid-Scale funding after first fringes
- **Looking for university or potential consortium partners**

# Thank you for your attention!

- PI: Van Romero
- Deputy PI: R. Cervantes
- Prog. Director: I. Payne
- System Architects: C. Haniff, D. Buscher
- Proj. Scientist: M. Creech-Eakman
- Visitor's Center: M. Stanley
- NMT Team: P. diBartolomeo, M. Edwards, A. Farris, D. Klinglesmith, M. LaGrave, A. Olivares, J. Pino, C. Salcido, L. Schmidt, J. Trueblood
- Students: M. Napolitano, J. Riker, S. Rochelle
- Cam. Team: R. Boysen, J. Coyne, M. Fisher, B. Seneta, D. Sun, D. Wilson, J. Young
- Recent Graduates: T. McCracken, A. Shtromberg
- Recent Departure: R. Selina

