Progress at the Magdalena Ridge Observatory Interferometer

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New Mexico Tech – MROI Proj. Scientist
On behalf of the NMT and Cambridge Teams
- Federally funded since 2000
- 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
- 75% NASA/DoD funded

Magdalena Ridge Observatory

- MROI is 10 1.4m movable afocal telescopes in equilateral Y configuration
- Optical and near-IR operation
- Baselines from 7.5 to 340m
- Minimized reflections
- 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.
Requirements Flowdown

- Telescope diameter of 1.4 m
  - H magnitude = 14 for group delay tracking limit
- Spatial scales of 0.3 to 30 mas
  - Baselines from 8 to 350 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
  - Optimized for model-independent imaging
Walk through the Optical Path

1.4m Unit Telescope and enclosure

Beam Transport Lines
- Enhanced silver, 30 deg incidence in air

Vacuum Delay Lines
- "Cat's-Eye" retro-reflecting telescope carried on moving cart in vacuum

Beam Turning Area
- Enhanced silver, 30 deg incidence in vacuum
- 10cm beam dia
- 2 mirrors comprising Mersene 6.66 x Beam reducing telescope

Beam Combining Area
- 15 deg incidence, dichroic mirrors for selective reflection of different wavelengths
- Alignment Laser for back propagating alignment beam
- Metal Film Mirror

Beam Combing Facility
- Visible
- J Band
- H Band
- K Band

These outputs to switchyard and beam Combiner

Low Noise Detector

Beam Combiner
Unit Telescopes

- Designed/built by AMOS
  - 1.4m aperture
  - afocal alt-alt design
  - polarization preserving
  - 62 nm rms wavefront
  - UT1 completed factory acceptance testing
  - UT2-3 ordered
UT Enclosures

- Designed by EIE
- Build in “award”
- Houses and transports UTs
- Allows close-packed configuration to 30 deg elevation without vignetting for 6 hour tracks
Foundations and Beam Transport

- Designed M3 and built by MRO
- Supports 3 UTs per beamline with 0.5 mbarr vacuum from UT to BCA
- Install for piers for inner array began this past summer
- Houses all components of automated alignment system
Inner Array Install
Automated Alignment System

Designed and built by MRO

End-to-end alignment of tilt and shear

Enclosed in a "Magical Optical Box"

Custom quad cells and beam injection via fibers
Beam Combining Facilities

- Thermal & vibrational stability
- Supports full array
- Single-pass DL section 190 m long
- Equipment install started 2010
Delay Lines

- Designed/built Cambridge
- Innovative approach
- Inductive pick-up & wireless communications
- Install begins this month
Fringe Tracker

FIRST FRINGES!!
Science Instrument

- MRO conceptual design
- SIRCUS – J,H,K with $R \sim 30$ and 300
- 4-way image plane combination with fast-switching to combine 6 beams in $\sim 100$ sec

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**Performance:**
SNR per spectral channel in 100 sec at $R \sim 30$ with 0.7” seeing and RN=5e-
Scientific Schedule for MROI

- Technical Phase – Key observations that quickly demonstrate technical competencies
- Science Phase – Scientific observations that produce transformational changes to understanding of astrophysical phenomena
- Open Time Phase – Release of facility to broader community through public funding

Array Activities Timeline

- Initial Observations
- Transformational Science
- Open Time

T1 T2 T3 T4 T5 T6

2012

T7 T8 T9 T10

Effort

1.0

0.5

Technical

Science

Open Time
Interferometry Workshop in NM

- MRO/NOAO/LANL/USIC co-sponsors
- March 28-31, 2011 in Socorro
- Wide variety of science topics presented and discussed over 4 days
  - Invited speakers including:
  - Poster sessions, tour of MROI, Conference Proceedings
  - Website: www.mro.nmt.edu/workshop
Thank you for your attention!

- **PI:** Van Romero
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