Steward Observatory

- Part of University of Arizona (UA)
- Serves Scientists at UA, ASU, NAU
  UMinn, UVa
- Operates telescopes on Mt. Graham, Mt. Hopkins, Kitt Peak and Mt Lemmon

Steward Observatory

- Strongly supports TS approach for US astronomy because:
- Over 80% of collecting area is operated by independents.
- TSIP resources will improve instrumental capability and community access.
- TS permits NSF to leverage large non-federal investments in astronomy.

Major SO O/IR Telescopes

- **MMT (Mt. Hopkins)**
  Partner: Smithsonian; Director: Faith Vilas
  6.5m f/1.25 BSH primary; f/5, secondaries f/9 and AO f/15. Arizona share: 50%

- **Magellan (Las Campanas)**
  Two 6.5m telescopes; f/1.25 BSH primaries; operated by OCIW. Partners: Carnegie, Harvard, MIT, Michigan, Arizona (10%). Discussed by OCIW representative.

- **Large Binocular Telescope (Mt Graham)**
  Partners: Italy (INAF); Germany (LBTB), Ohio (OSU); Research Corp. (UMin, UVa, NDU); Director: Richard Green; Arizona share 25%;

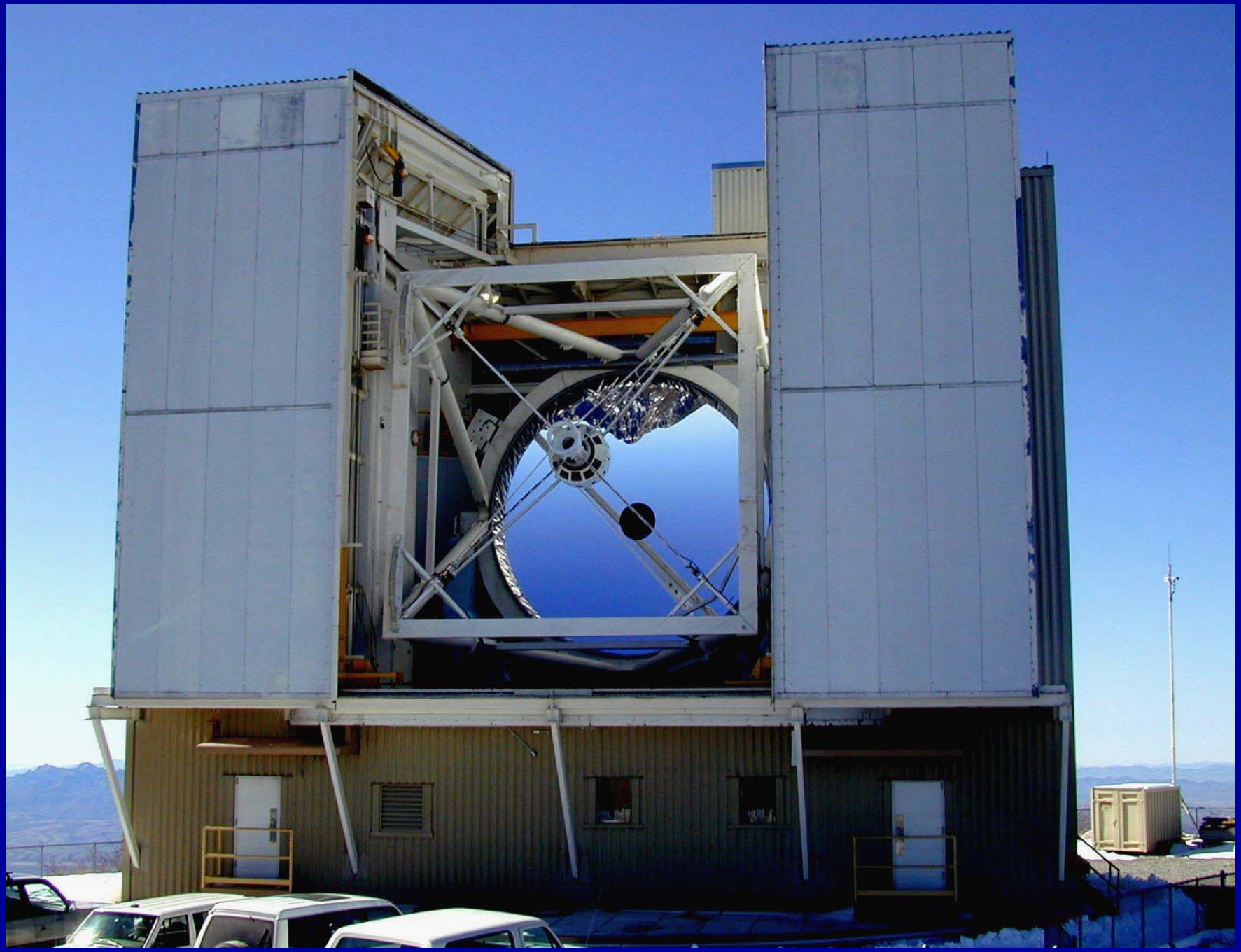
  All available through TSIP

Smaller SO Telescopes

- Bok 2.3m -- 90Prime (1 degree field)
  -- B+C Spectrometer
- VATT 1.8m -- 4Kx4K CCD Imager (25%)
- Kuiper 1.5m -- 4Kx4K CCD Imager
- ML 1.5m -- PI Instruments

All available for System Use: PI instruments welcome.

Original MMT on Mt. Hopkins
with six 1.8-m mirrors – Dec. 1981

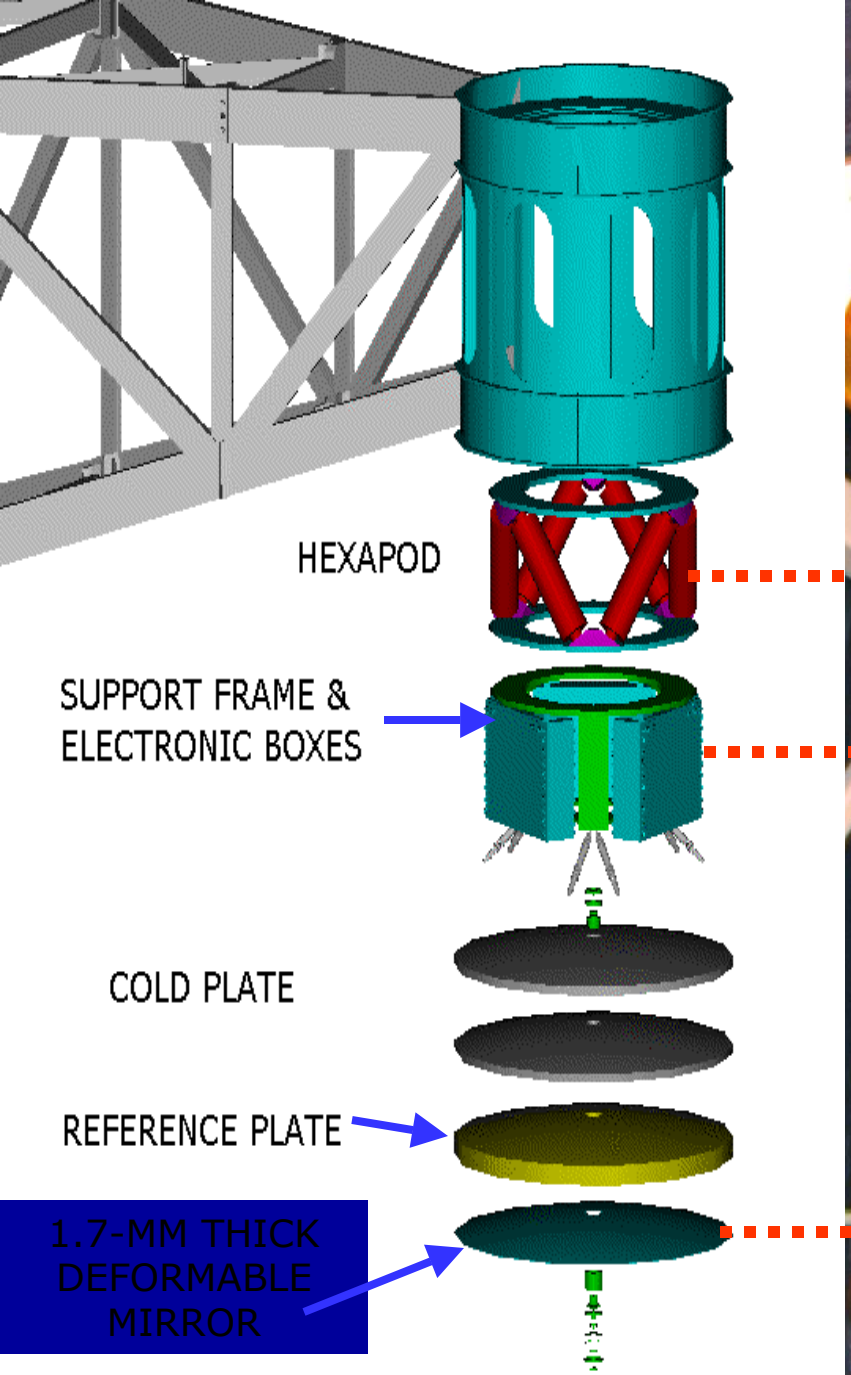


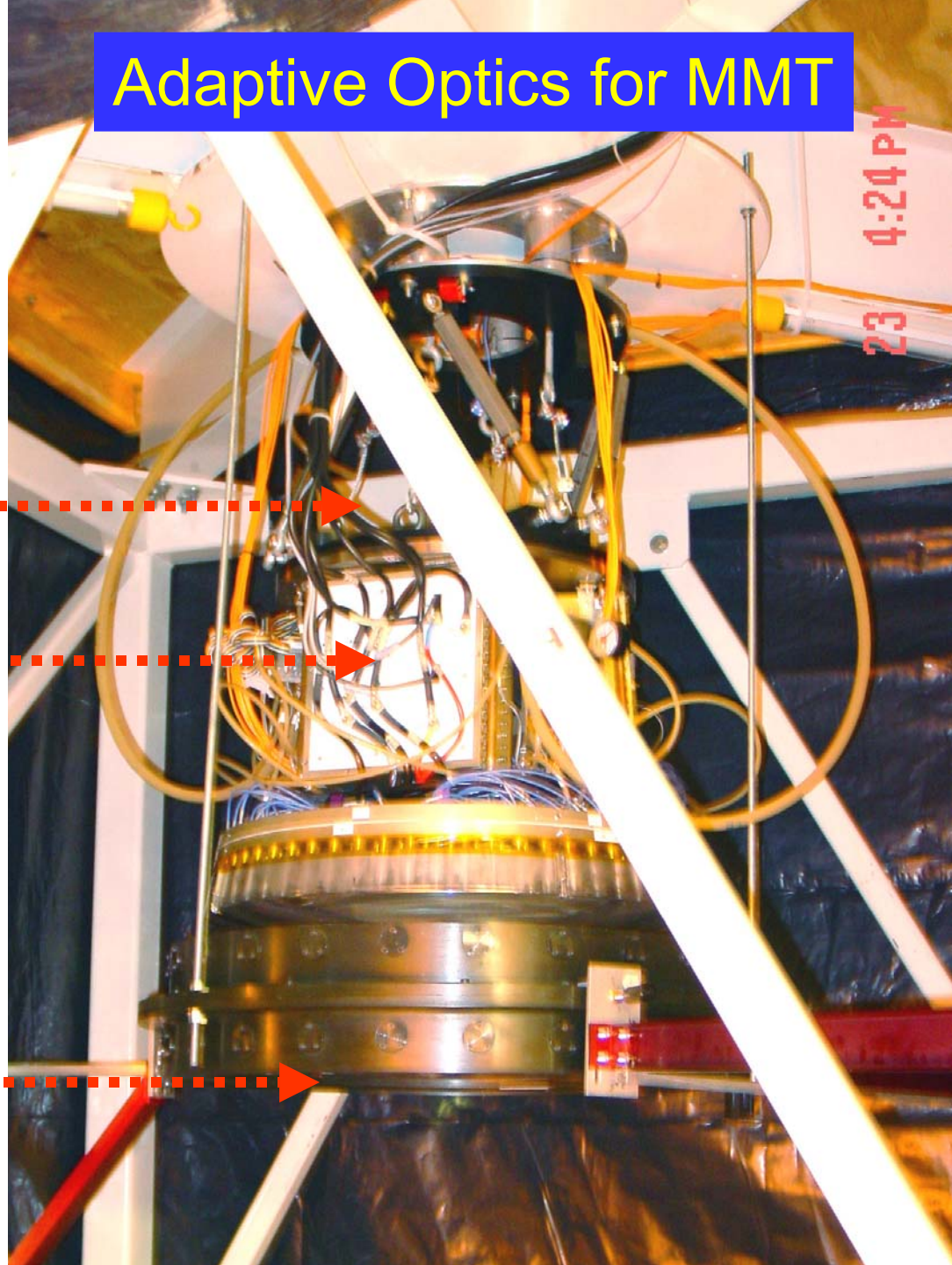
MMT Instrumentation

- **F/5** MegaCam; Hectospec; Hectochelle. *Maestro; Binospec.*
- **F/9** Dual Channel Spectrograph
- **F/15** Adaptive Secondary* (336 actuators) ARIES (Cam.); MIRAC; CLIO; *ARIES (Spectr); IRIS*

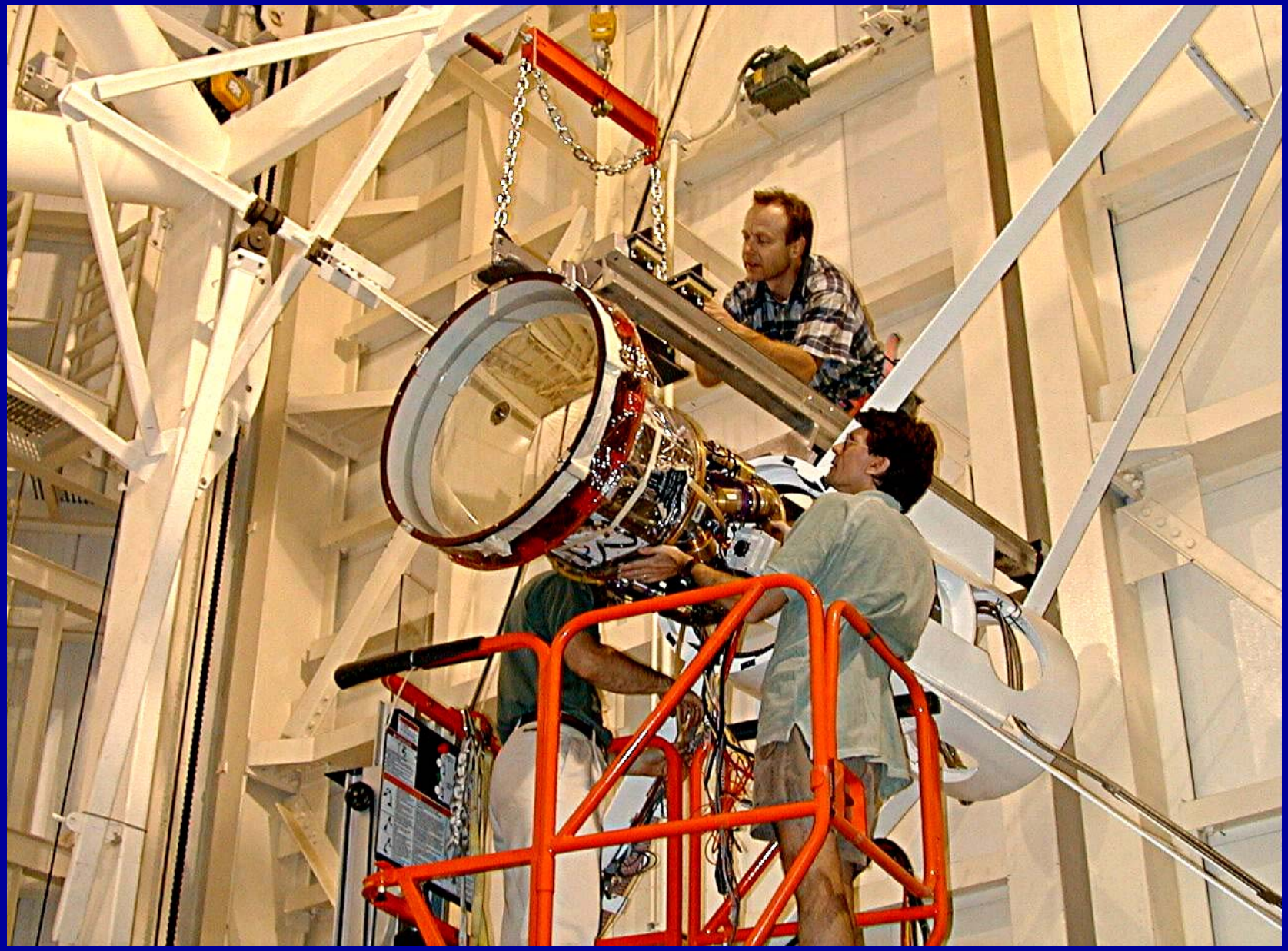
* *Unique capability*

Adaptive Optics for MMT

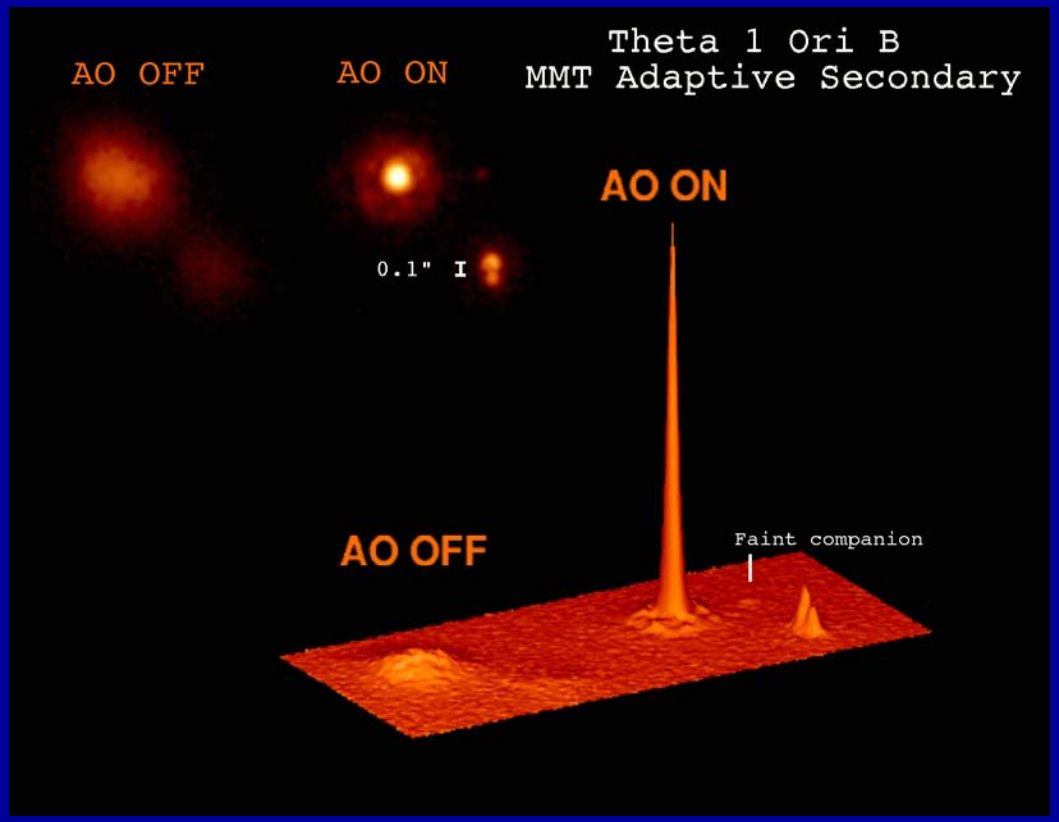


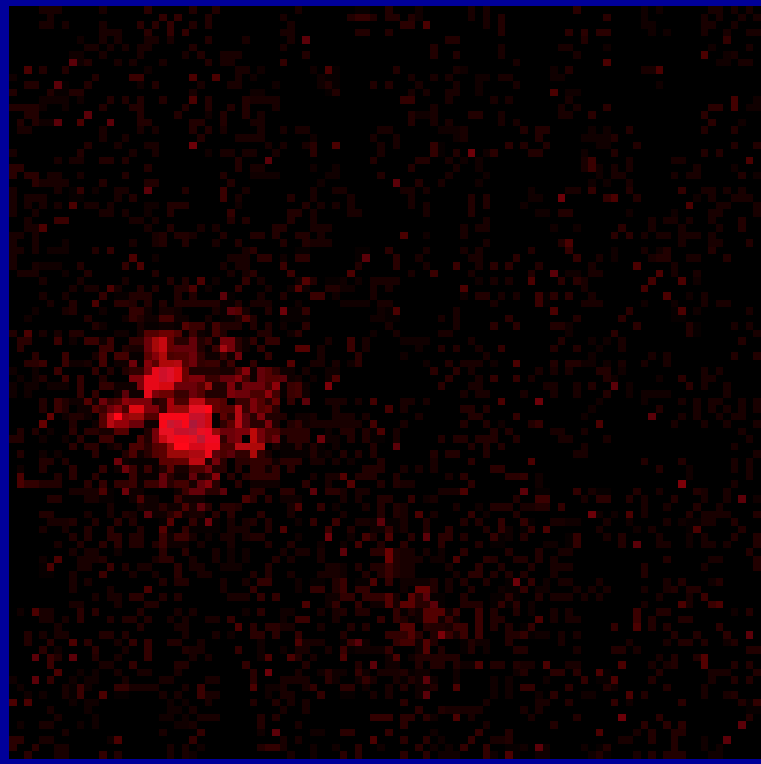


Final adjustments to AO by F. Wildi & L. Close…



First NIR AO science from the adaptive secondary: TheTheta Ori B mini-cluster

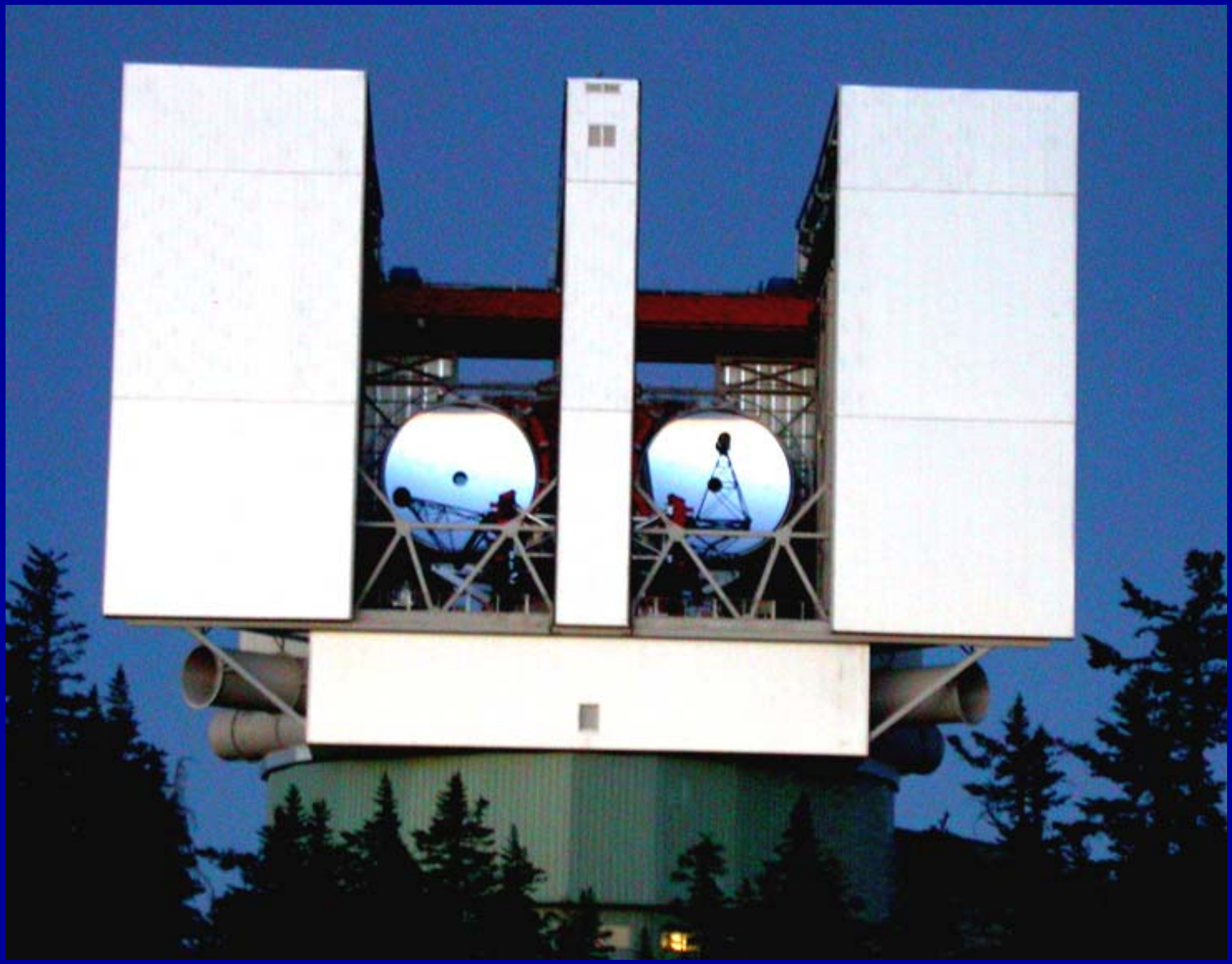




Close et al. 2003

Large Binocular Telescope

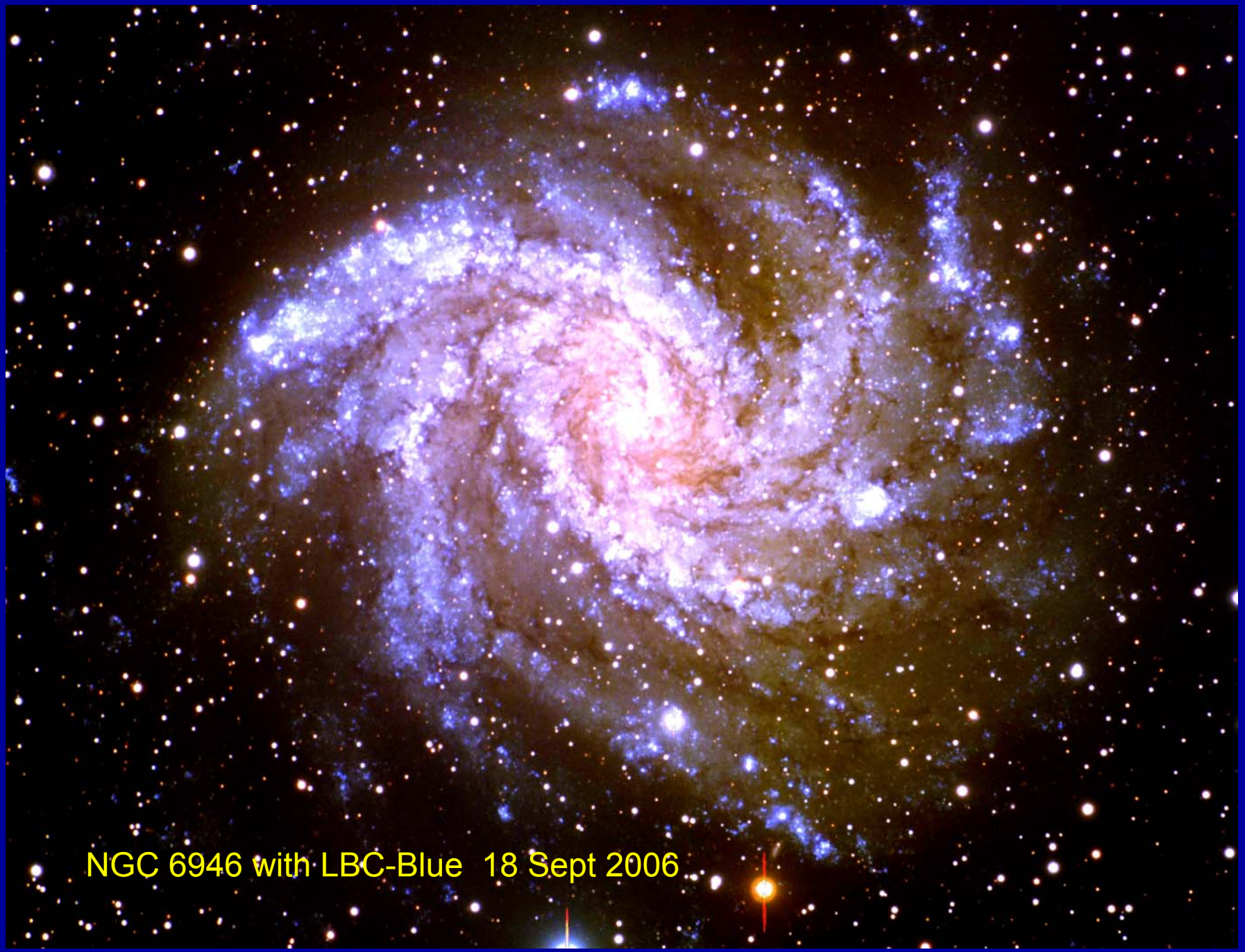
- Binocular: Two 8.4-meter mirrors, f/1.14
- Equivalent circular aperture: 11.8 m (39 ft)
- Interferometric baseline: 22.8 m (76 ft)
- Angular Resolution: 0.010 arc sec at λ~1 μ
- F/15 Adaptive Secondaries
- First light: October 2005
- Dual mirror operation expected: Fall 2006



LBT Instruments

Individual Focus Instrument Pairs

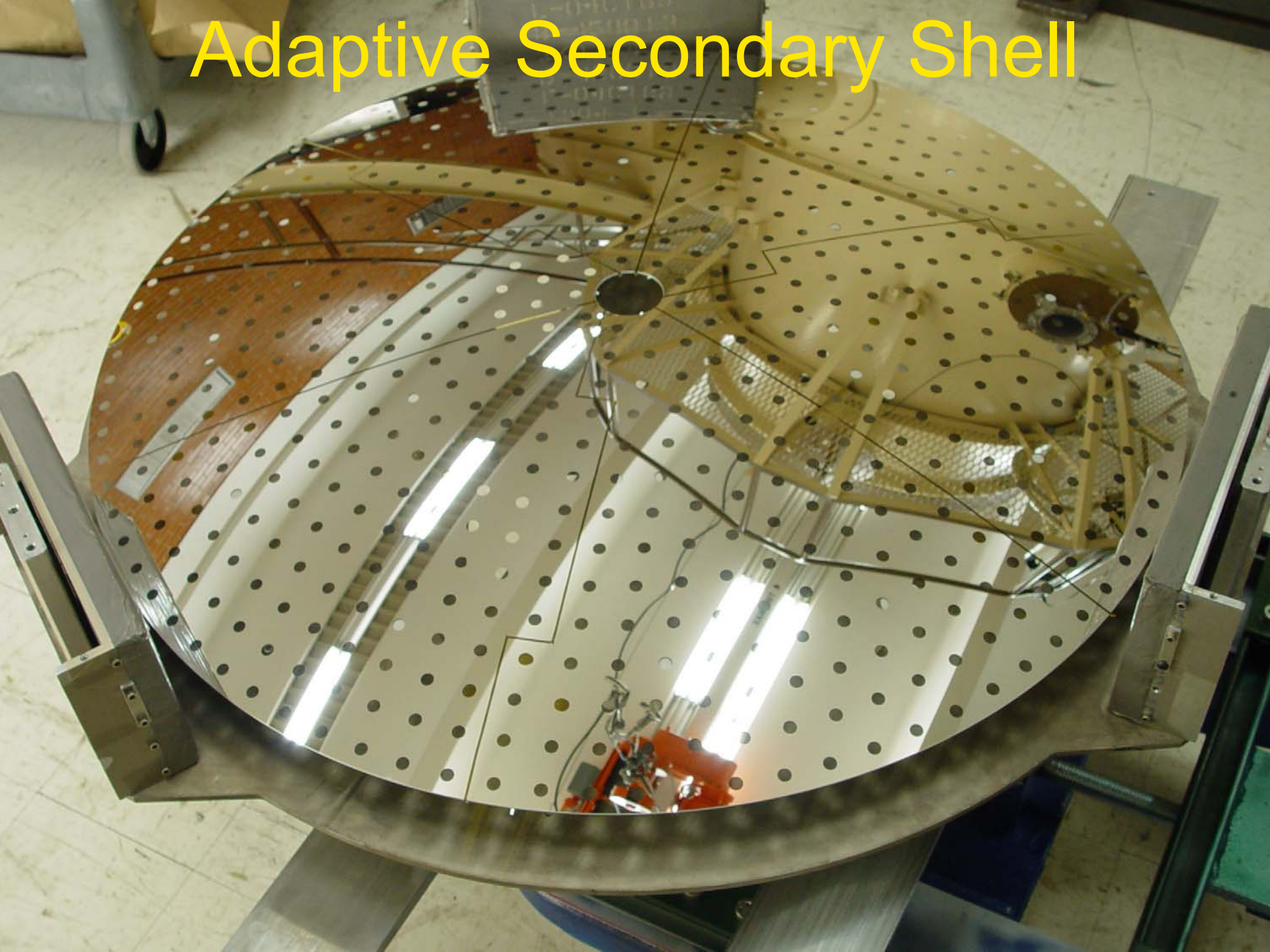
LBC	Red/Blue Optimized Prime Focus Cameras (Italy)
MODS	Optical Multi-object Spectrometers Each with red/blue optimized channels (Ohio)
Lucifer	NIR Seeing/Diffraction Limited Imager/Spectrometers with multi-object capability (Germany)


NGC 6946 with LBC-Blue 18 Sept 2006

LBT Adaptive Optics

- Prototype implemented at MMT with 336 actuators.
- LBT adaptive secondaries f/15, 911 mm diameter, 1.6 mm thickness.
- 672 voice-coil actuators, operating at kHz rates
- Engineering shell delivered to Italy August 2005. First scientific shell figured, thinned, deblocked.
- Processing, integration and test plan calls for return to Mt. Graham in late 2007.
- 2007/8 will see the installation of first Gregorian instruments.

Adaptive Secondary Shell



LBT Instruments (cont.)

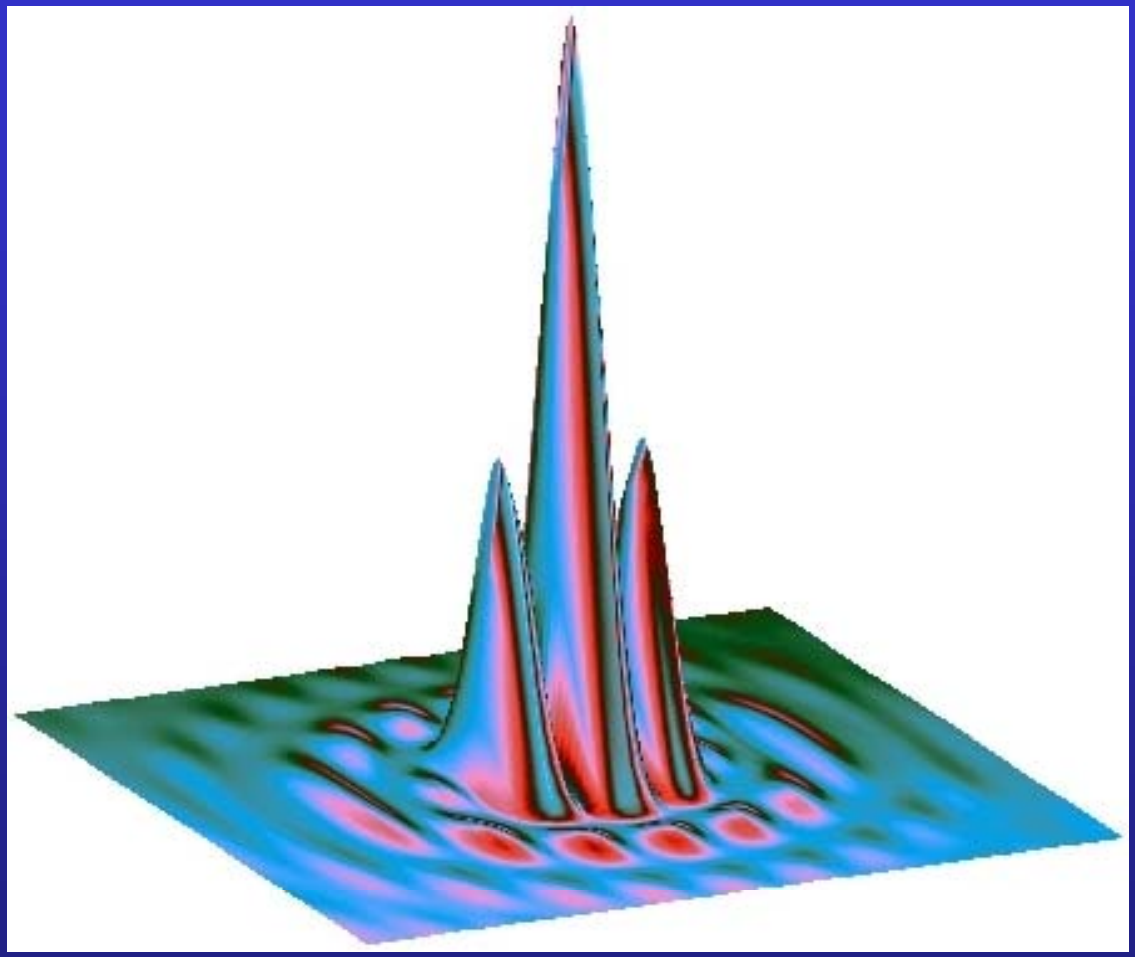
Combined Focus Instruments

- LBTI — Thermal IR (2-20 microns) with Fizeau imaging and Nulling capability. (Arizona, RC partners)
- LINC — Near IR (1-2 microns); extension to MCAO capability. (Germany, Italy)

PI Instrument

- PEPSI — High resolution fiber spectrometer (Potsdam)

LBT Point-Spread Function.

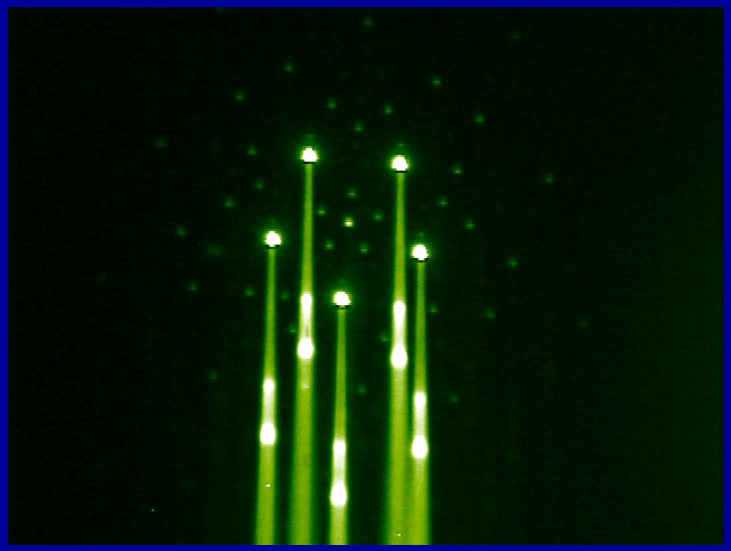


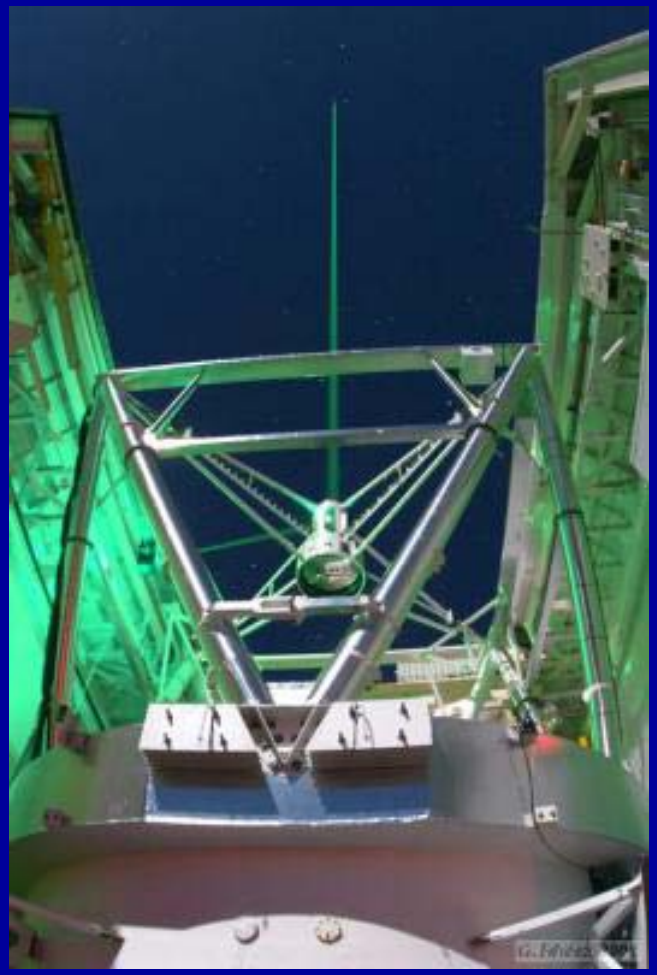
With 22.8-m aperture, res ~ 0.0088’ at λ = 1 μ

SO Instrument Plans

- Continue with partners to implement current instrument plan for MMT and LBT;
- Install adaptive secondary at Magellan;
- Further develop multi-beam Rayleigh laser systems and implement at the MMT and LBT.
- Avoid too many instruments on any single telescope. Not cost effective.

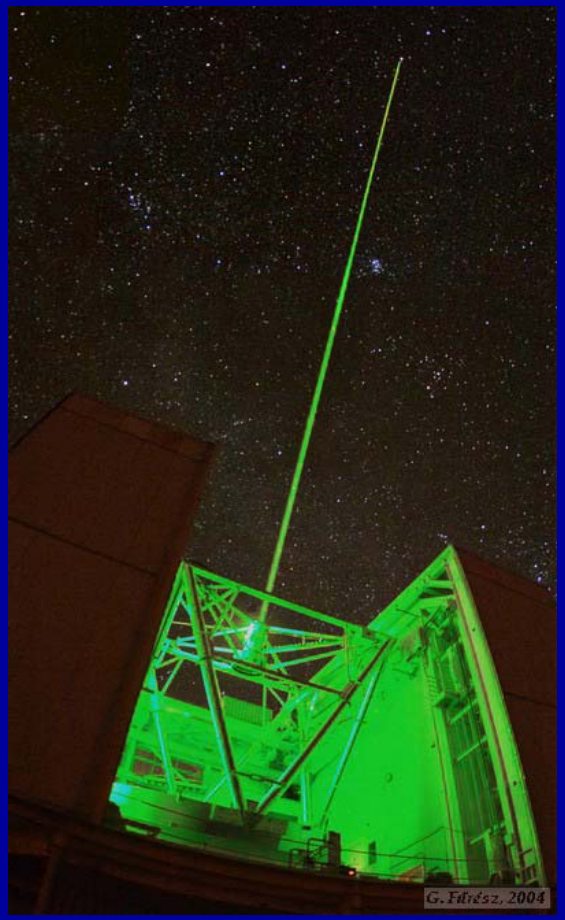
Multi-beam Rayleigh Lasers



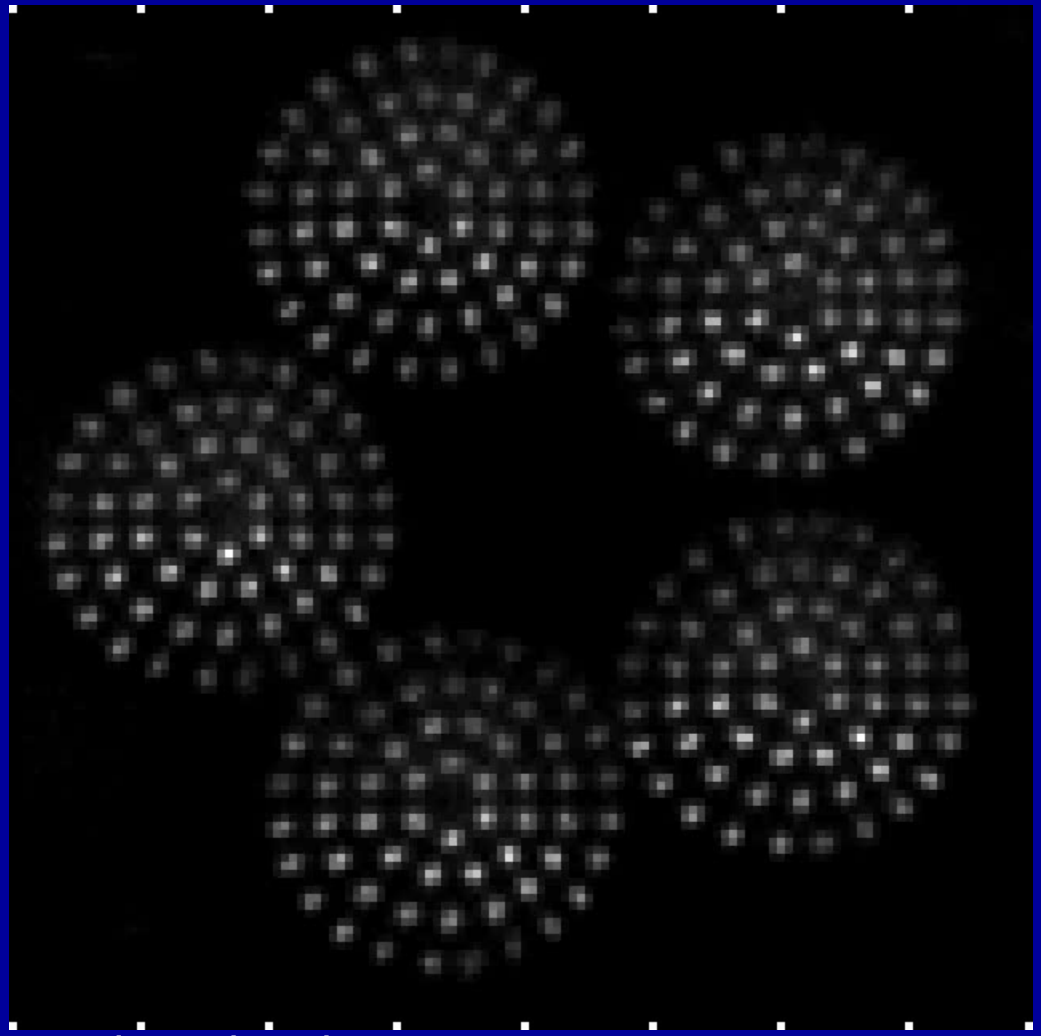


- (Above) Laser projected from 61 inch onto bottom of cloud. Note layers of sub-visible cirrus lit up and higher-order diffraction from hologram that splits one beam into 5 (80% of power goes into the “real” spots).
- (Right) 5 beams, 5 W each, projecting from MMT.

Five lasers at the MMT



The laser beams going up…



…and coming down.

Steward Observatory

- Participates in and supports the TS;
- Believes – along with the SR - that expanded funding is needed for TSIP (~$7M); AODP (~$5M); ATI (~$10M);
- Supports SR recommendation that smaller telescopes be incorporated in TS as needed;
- Recommends actions that stimulate continued private investment in US astronomy. Delicate balance for TS.