

# Large Telescopes in the Ground-Based O/IR System

Todd Boroson  
NOAO

# Large Telescopes in the System

- Large Telescopes were the driver for the system paradigm because
  - There are more >6m telescopes than 3-5m telescopes (and there are as many institutions with access to them)
    - This is different than the relationship between 1.5-3m and 3-5m
    - There are not as many public nights on >6m telescopes, but within a factor of 2
  - Instruments are very expensive (and getting more so with each new generation)
  - The competition has 4 8m telescopes with an instrumentation program that doesn't have to duplicate capabilities

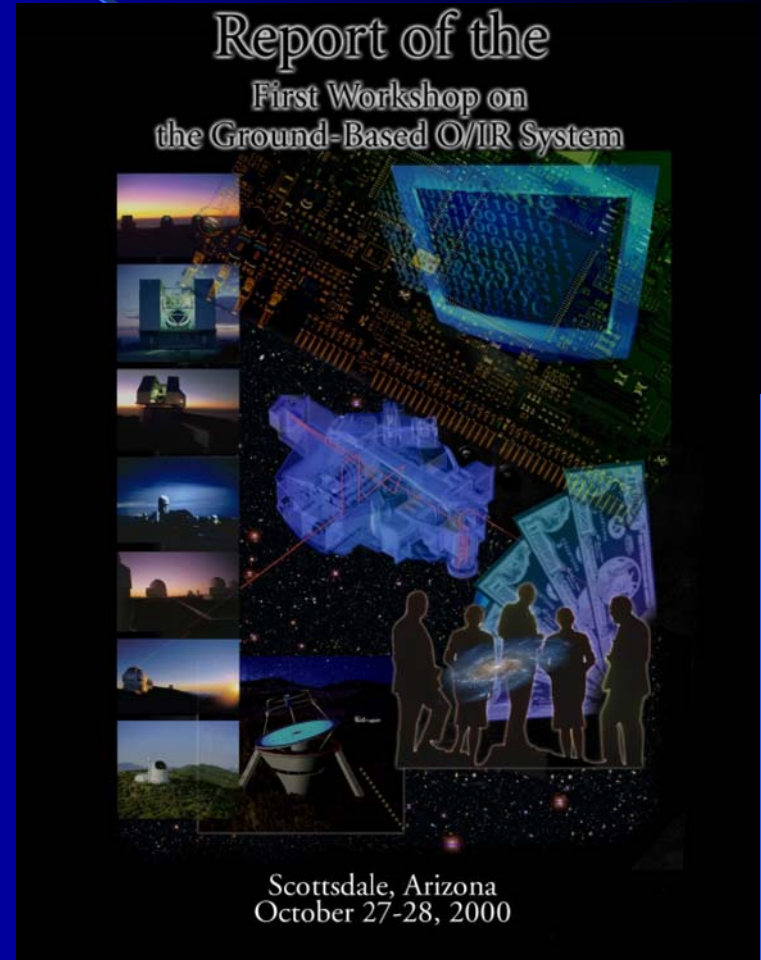
# Large Telescopes in the U.S. System

- **Keck** – 2 x 10m – Caltech, U. California, **NASA** (planetary), **NSF (TSIP)**
- **Hobby-Eberly** – 9.2m – U. Texas, Penn State U., Stanford U., German universities, **NSF(FIP)**
- **Gemini** – 2 x 8m – **NSF (~50%)**
- **Magellan** – 2 x 6.5m – OCIW, U. Arizona, Harvard U., U. Michigan, MIT, **NSF(TSIP)**
- **MMT** – 6.5m – U. Arizona, SAO, **NSF (FIP & TSIP)**
- **LBT** – 2 x 8.4m – U. Arizona, Ohio State U., Notre Dame U., U. Minnesota, U. Virginia, Italian universities, German universities, **NSF (TSIP)**
- **SALT** – 9.2m? – minor shares to Rutgers U., U. Wisconsin, Carnegie Mellon U., U. No. Carolina, Dartmouth College, HET partners

# We have made progress on the capabilities identified in the first workshop

- Instruments that have come on-line or begun development since 1<sup>st</sup> workshop

- Wide-field imaging (**Megacam, ODI, Dark Energy Camera, NEWFIRM**)
- Medium resolution optical & NIR spectrographs (**GNIRS, GMOS, MODS**)
- WF optical & NIR multi-obj spectrographs (**DEIMOS, IMACS, Hectospec, KIRMOS, Flamingos, MMIRS**)
- High-res optical & NIR spectrographs (**Hectochelle, MIKE**)
- DL imaging & IFU spectroscopy (**NIRC2, OSIRIS, NIRI**)



# TSIP has been an integral part of this progress

- TSIP has now run 3 years at \$4M/year
- Program funds can be carried over to encourage a long-term perspective
- Instrument capabilities funded:
  - OSIRIS – IFU-coupled NIR spectrograph behind AO on Keck (2 years – was at CDR)
  - Design of KIRMOS – large format NIR MOS for Keck (2 x 1 yr)
  - MMIRS – NIR imager/MOS for MMT and Magellan (3 yrs)
  - MODS (in negotiation) – Optical MOS for LBT (3 yrs)
- Telescope time for community
  - 53 nights on Keck
  - 26 nights on Magellan
  - 26 nights on MMT
  - 24 nights on LBT

# TSIP rules

- TSIP allows two types of proposals
  - Instrumentation proposals
    - Must be new facility instrument
    - No aperture restriction
    - Time to be made available equal in value to 50% of funds received
    - Evaluation criteria include relevance to community-stated priorities for new capabilities within system
  - Improvement proposals
    - Any other upgrade or facility improvement that allows more effective or efficient operation
    - Limited to >6m aperture telescopes
    - Time to be made available equal in value to 100% of funds received

# TSIP continued

- TSIP has depended on report from first system workshop as community's expression of priorities for capabilities
- All TSIP proposals (3 yrs; 7 proposals) have been instrumentation proposals
  - Each year have adjusted language in solicitation to encourage instrumentation proposals from telescopes <6m aperture (without changing rules).
- Program has generally been somewhat (but not very) oversubscribed
  - Remember that there is a very limited pool of proposers

# Large Telescope Issues - Instruments

- Facility instruments for big telescopes are expensive
  - First generation 6-10m instruments are \$4-10M
  - Next generation will take us to \$20M
  - Instruments for 20-30m telescopes will go beyond this.
- Even upgrades are expensive
  - Detectors, controllers, integration – a new focal plane array for a big instrument can cost \$500K - \$1M



# Large Telescope Issues - Instruments

- Total capacity of community to build instruments is small
  - While there are many groups that can build large PI-style instruments, there are few groups that have adapted to the more serious management level that very large/expensive instruments require.
    - Do instruments for space observatories provide a model?  
University-aerospace company partnerships?
  - The next scale increase of instruments will further challenge instrument-building groups and their resources.
  - Are the groups with this capability saturated?

# Large Telescope Issues – Resources

- Operations costs are high
  - Keck now puts all its funding into operations
  - Magellan is having trouble with lean operations model
- Delivery of facility AO systems has been limited by funding
  - The promise of AO has been a major factor in planning the evolution of current large telescopes and justifying the next step-up in aperture.
  - AODP was greatly oversubscribed in its first year – and has needed to focus its early funding on component development rather than systems for existing telescopes.

# Large Telescope Issues - Access

- TSIP does not return many large telescope nights to community
  - \$4M/yr buys about 40 nights/yr
- Model for next generation of extremely-large telescopes will have to be different
  - We will not have as many 20-30m telescopes as we have 6.5-10m telescopes
- Most of the data from these telescopes is not archived
  - Cost is not so high anymore; expertise is available
- For observers, performance metrics for similar capabilities are not easily available

# Questions for Discussion Here

- Is there a problem?
  - What should our access model be?
    - There is now broad access to 2 x 0.4 Gemini and a few nights on all the other >6m telescopes
    - Should we be reviewing proposals for this time with modified criteria?
  - Will more researchers be using archived data in the future, decreasing the need for telescope-nights?
  - Are instrument programs running at full speed?
    - Should they be?

# More Questions

- How should TSIP evolve?
  - (Make proposals for smaller telescopes viable)
  - Encourage proposals for AO systems
  - Allow upgrades at 50% discount rate
  - Preference for telescopes that are efficiently run
- Should federal funding for new instruments require them to archive data?
  - Archiving data badly is worse than not archiving at all