Presentation to the UC-ATF

13 May 2011

TMT

- TMT was started in 1999 by UC and Caltech
- $25M gift to UC by the G&B Moore Foundation funded Design Development Phase
- $100M pledge to UC for construction ($22.5M released through 2011
- G&BMF confidence in UC was based on extremely successful Keck Obs design, construction and operation, UC-produced Keck instruments and UC success in AO development and implementation
- $100M construction gift had $50M matching requirement

TMT Background cont.

- In 2004 CELT became TMT with UC, Caltech, ACURA and AURA as equal partners: each contributed $17.5M to the DDP. This was an excellent strategy which should have led to NSF partnership and MREFC funding based on 2000 decadal survey before Astro2010 started.
- Current partners: UC, Caltech, Japan, Canada, India, China

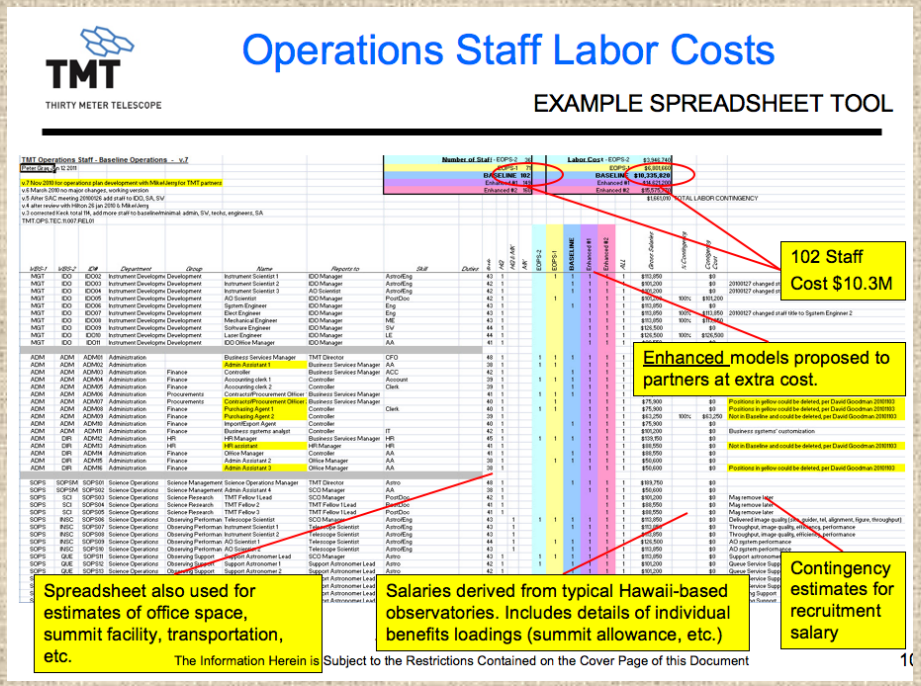
TMT Cost

- Project has had several detailed reviews:
  - Conceptual Design, May 2006
  - Cost Review, Sept 2006
  - Revised CDR and construction proposal review, June 2007
  - External Advisory Panel Review Sept 2008
  - NSF GSMT Community Assessment Review, May 2009
  - External advisory Panel Review, May 2010
  - TMT Cost Review, Jan 2011
- The above listed reviews were extensive and invasive. Four days, external panel drawn from world-wide observatory and major science project community. Many additional review of major subsystems.

TMT Costs

- Capital cost: $1.152B (FY2011)
  - 26.2% contingency
  - Includes Jan 2011 Cost Review recommendations
  - Uses detailed schedule and OBM escalators (same as specific BoC escalators)
- Operations costs: $24.8M/yr
- New capabilities costs: $21M/yr
  - “SRD” instrument suite
  - AM2
  - 85nm WFE AO upgrade

TMT Operations



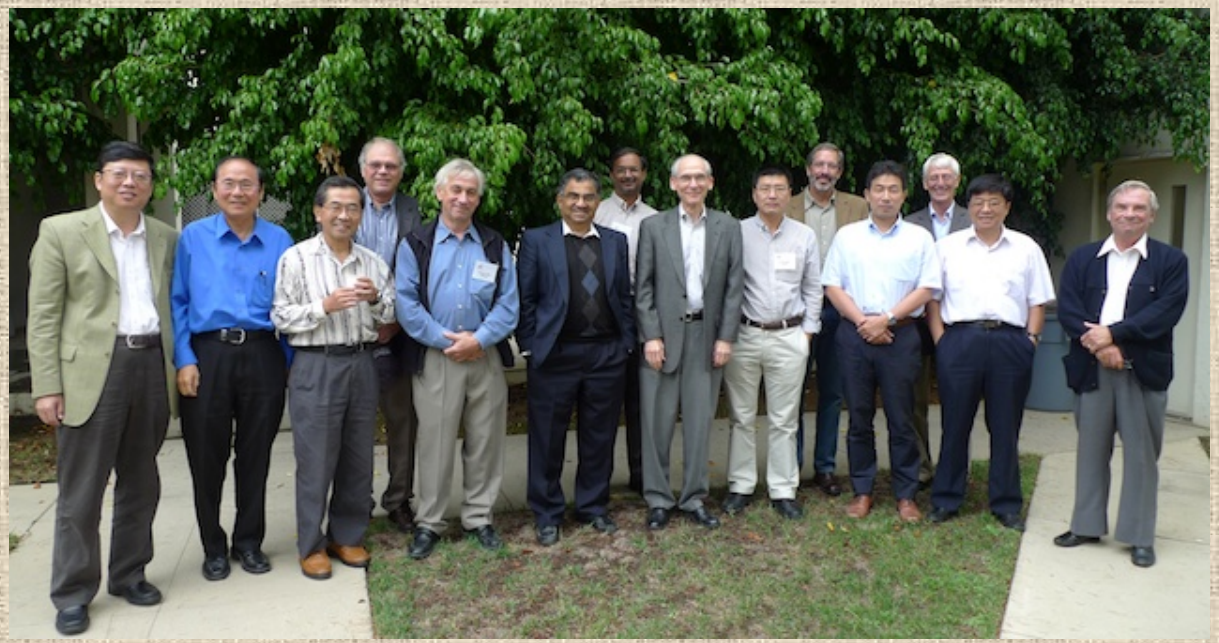
- Initial operations based on "enhanced", "corrected" Keck model
  - Task-by-task, person-by-person comparison with Keck
  - Enhanced services for science operations
  - Corrected for shortcomings in Keck model
- Bottom-up estimate coming in very close to Keck comparison
- Major review June 27-29
- What about 10% rule of thumb?

UC Share in TMT

- Current partnership principle regarding shares is based on:
  - Contributions to capital
  - Contributions to operations for first 20 years
  - Contributions to new capabilities for first 20 years
  - Early funding premium factor ("Founder's Shares")
- 18-19% is the current UC share for the first 20 years assuming:
  - $175M capital contribution
  - $6.5M/year operations [Keck "savings" post 2018]
  - 5% premium factor
- May also have community access if NSF becomes a partner

Partnership

- UC: 18%
- CIT: 18% (operations?)
- Canada: 25%
- Japan: 25%
- China 10%
- India 10% Total: 116% based on aspirations



Overruns?

- Look at trends in contingency vs fraction completed and TMT is on the conservative extreme of the envelope
- June 16th meeting will give perspective
- Government partners deep pockets (at expense of UC shares)
- Additional private contributions
- Descopes (real and value engineering)
- Keck 1: 7% overrun; Keck 2: 19% underrun

TMT GCAR comments (Apr 2009)

Executive summary

The TMT project has made outstanding progress during its design and development phase, and is now poised to begin construction. The TMT team is top notch in both technical and managerial skills, leaving them well-qualified to address the remaining challenges ahead. The committee found that the design presented for the TMT is sound in almost all areas and has completed their design and development stage successfully, essentially placing them at a PDR level consistent with the NSF MFREC process. There are a few specific areas for design confirmation (enclosure, wind buffeting or secondary mirror/top end) which are suggested in the main report. The management and systems engineering approach are world-class and built in from the beginning allowing for an easy transition to NSF participation from the expectations of managing large projects. Management structure, tools, processes, and staffing is essentially complete. Their WBS, schedule and costing approach is complete and very detailed, with a good tie into their risk management process. The systems engineering approach is complete, well staffed and includes excellent flow down of requirements, many trades complete or nearing completion, initial planning for integration test and commissioning and inclusion of instrumentation as part of the system with only a small hole to plug in one instruments error budget approach. This is an exciting project that will make great contributions to OIR astronomy, and participation by the broader community needs to be facilitated. We strongly encourage the project and the NSF to seek opportunities for collaboration as soon as possible.

GCAR comments II

Management

The panel commends the TMT Board and project office for assembling an outstanding project team that has all of the skills and prior experience needed to make this project successful. Project management planning, team coordination, PM controls, cost estimating, risk management, forecasting, scheduling, and documentation configuration control are all exemplary. The TMT project manager is doing an outstanding job of running the project. The cost estimation efforts are particularly commendable; the complete integration of system engineering practices and risk management leads to an overall contingency estimate that appears appropriate for the project at this stage (29.9%). The project schedule is estimated to be 80% complete, with over 4400 activities. Major and minor schedule interactions and links are well understood and have been captured in the schedule. Critical paths have been identified, and mitigations generated when possible.

GCAR comments 3

3. Are the current and/or proposed project management processes and business plan adequate for the project of this scope? If not, what are the deficiencies and how might they be remedied?

The project management processes being used reflect the best practices available in the community, and the project manager and team are all highly experienced in these approaches. The cost estimation approach is particularly commended. The panel was extremely impressed with the project information presented at the review.

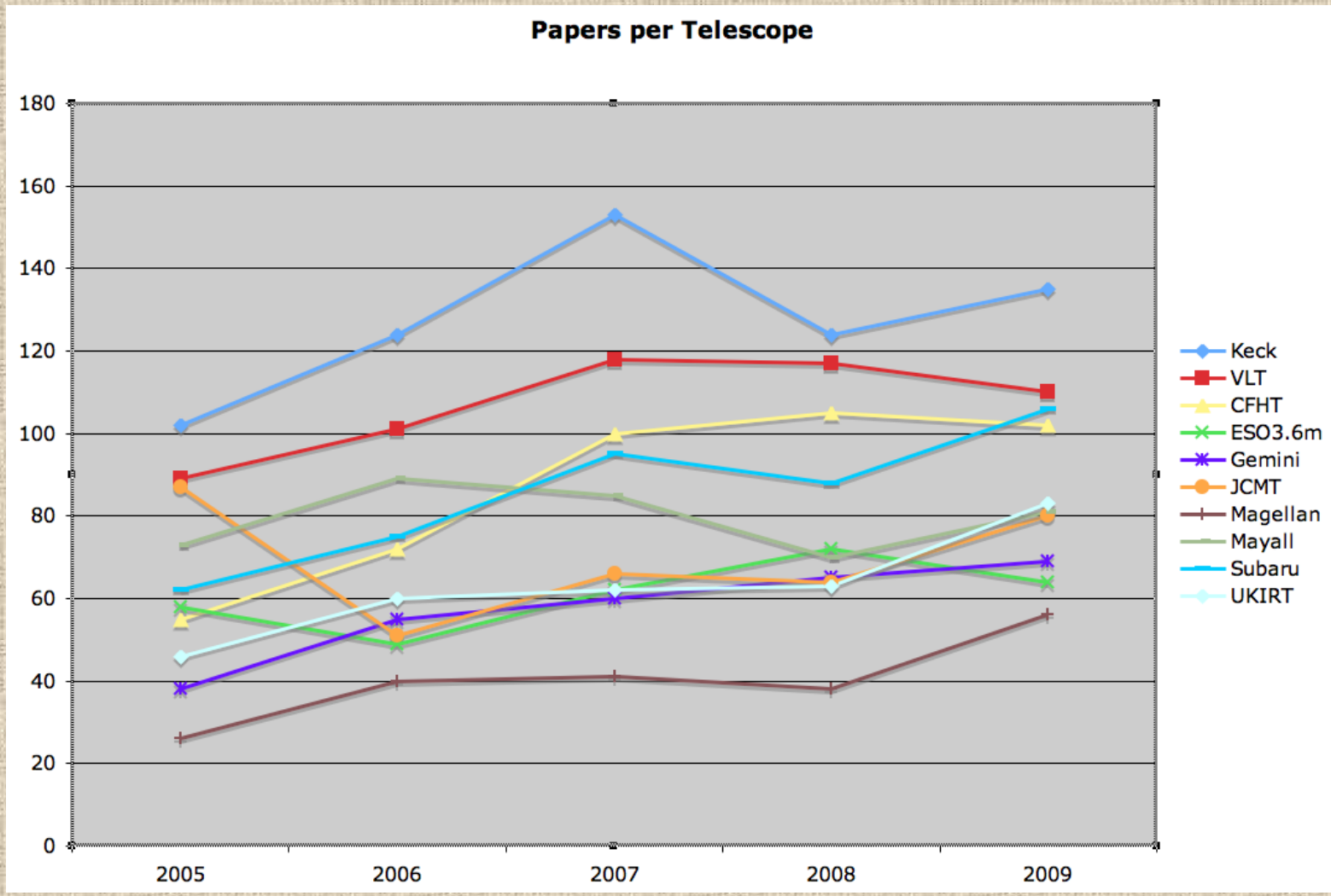
Keck Observatory

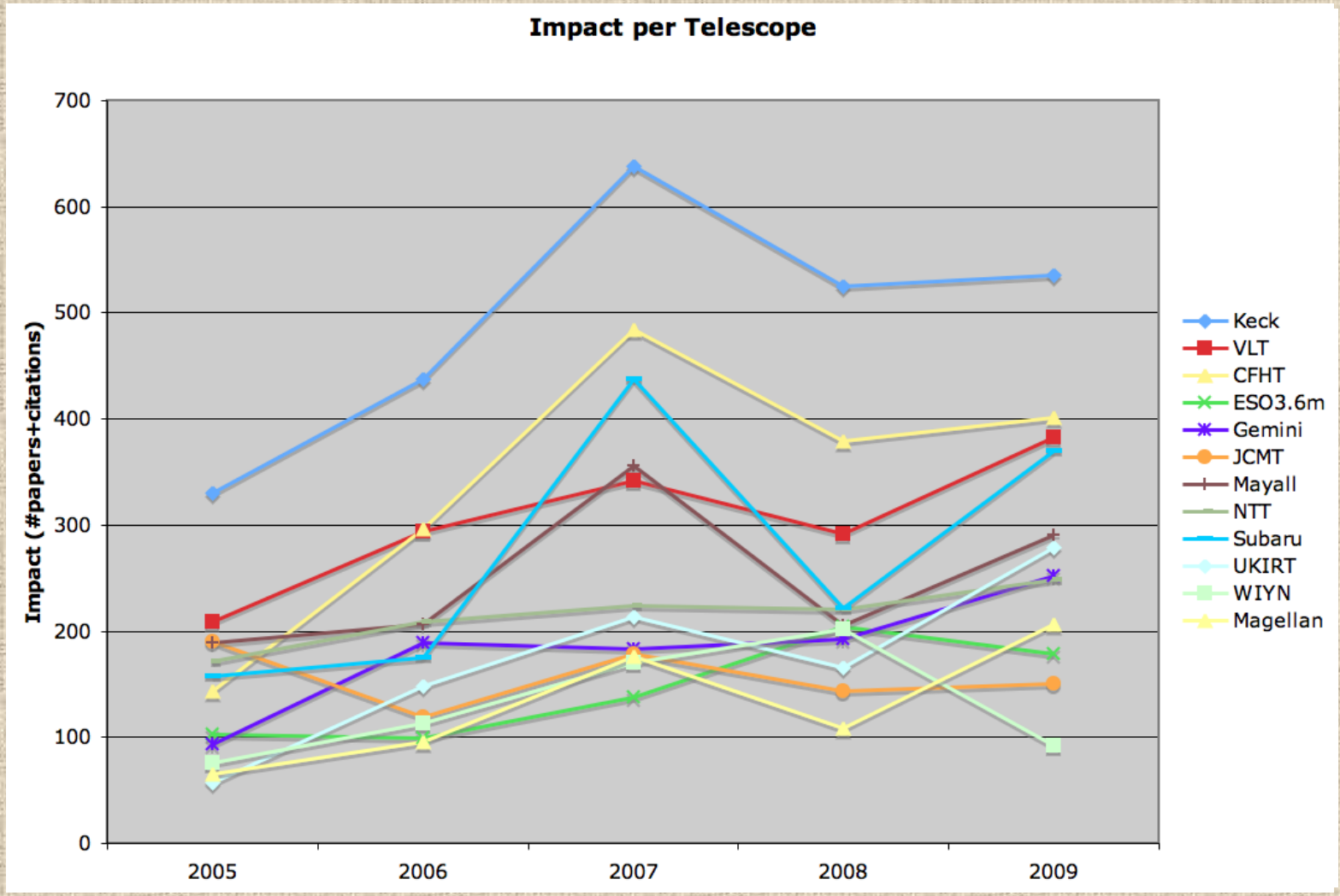
- UC-Caltech agreement regarding Keck does not "expire" in 2018

"5. Term of Agreement. This Agreement shall begin as of the Effective Date and shall continue until it is terminated (i) pursuant to paragraph 15 as a result of the default of the Institutions, or (ii) by mutual agreement of the Institutions. The Institutions expect that this or any successor Agreement shall continue as long as the W. M. Keck Observatory is useful for astronomical purposes."

"6.1 UC Contributions and Obligations

6.1.3.2 Post-March 31, 2018 Obligations. UC shall contribute to CARA, 50% of all W. M. Keck Observatory Net Expenses incurred by CARA after March 31, 2018. ("Net Expenses" means the total of CARAs Capital Expenses and Operating Expenses, after they are offset by all non-UC and non-Caltech contributions applied to pay for or reimburse for such expenses.)"


Papers per Telescope
180
160
140
120
100
80
60
40
20
0
2005
2006
2007
2008
2009
Keck
VLT
CFHT
ESO3.6m
Gemini
JCMT
Magellan
Mayall
Subaru
UKIRT


Impact per Telescope
Impact (#papers+citations)
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
Keck
VLT
CFHT
ESO3.6m
Gemini
JCMT
Mayall
NTT
Subaru
UKIRT
WIYN
Magellan

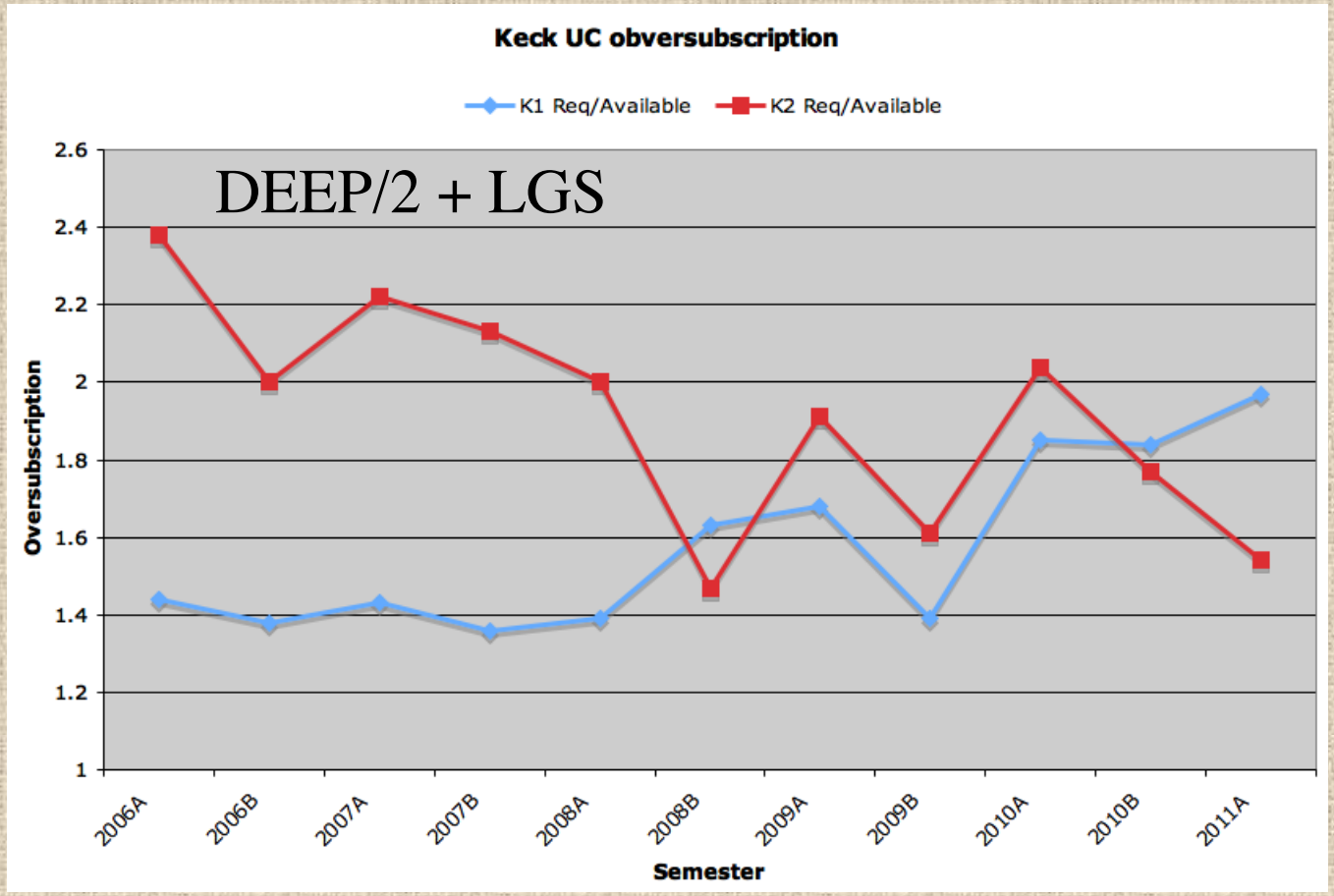
Keck Observatory

- In the early years, UC (5/6) and NASA (1/6) annual contributions were split between operations and new instrumentation (21.5% of the total). $11.9M in 1996, corrected for inflation to $15.2M in 2011.
- As instruments were added, operations costs increased and eventually the firewall between ops and development came down and most of the $15.2M/year from UC and NASA in 2011 will be used for operations
- New capabilities are funded through federal grants, sale of telescope time through TSIP, and by private gifts

Keck Observatory cont.

- TSIP limit has been set through discussion with UCOAC to 12 nights/year and we have more-or-less sold nights at $100k/night at this limit since 2003
- Keck instrumentation investment is ~$80M through 2010
- Future funding of new capabilities is via the same channels as the last five years: NSF MRI, ATI and mid-scale, NASA, and private philanthropy

UC Keck Oversubscription



- UC Keck oversubscription is self-limiting

UCO Keck in-kind contributions

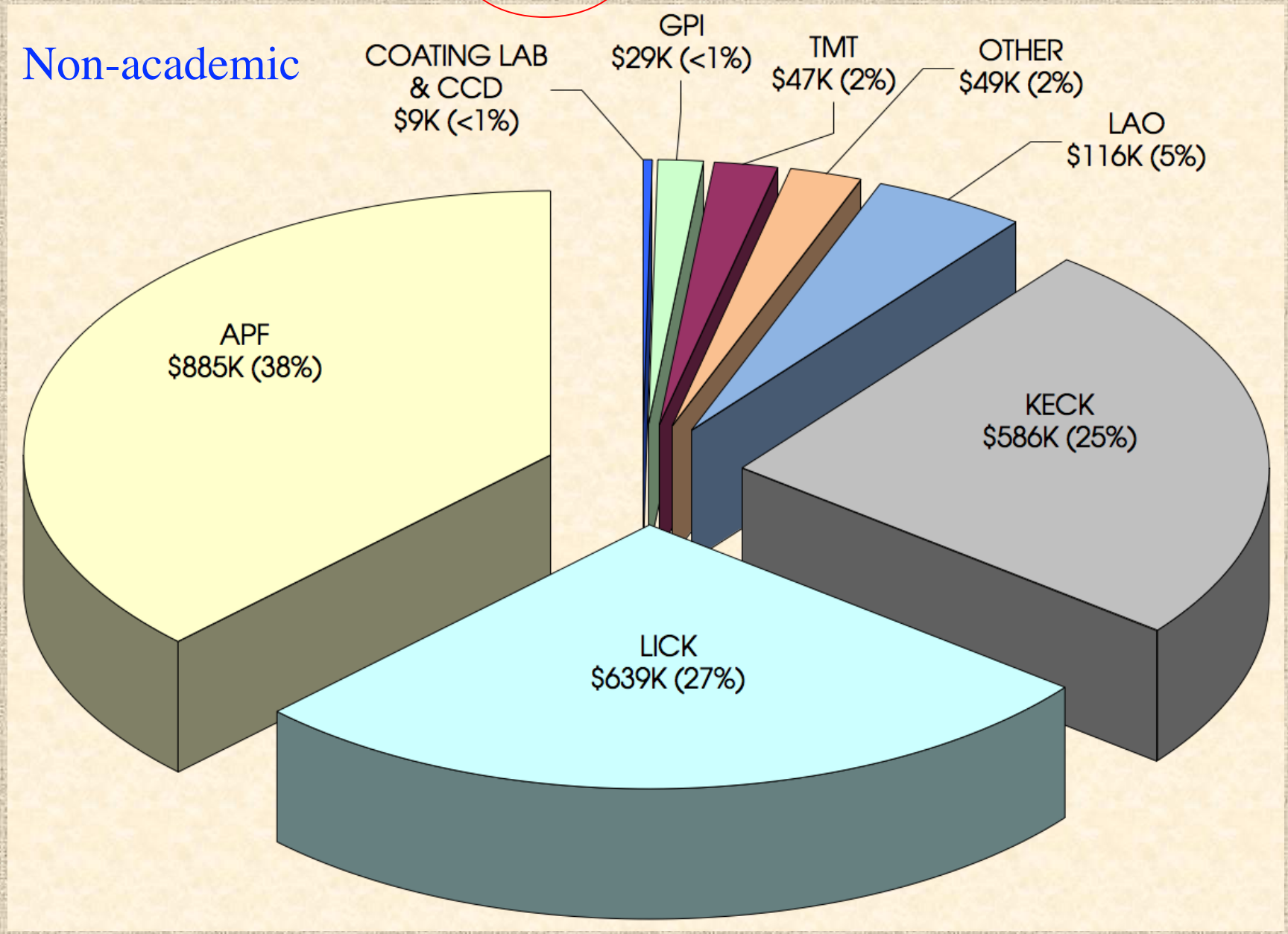
- Classes of contributions
  - Academic staff and faculty do not charge time to Keck projects
  - "warranty" on UCO-delivered instruments with associated support*
  - Reviews
  - Cost-capped projects
  - Proposal preparation support
- Time card data is easy to generate and accurate, other level-of-effort estimates less accurate FY10 example

* Examples: CCD support, DEIMOS, flexure compensation system, slitmask software, remote diagnosis of all hardware/software problems including upgrades, split cost for many repair missions (Keck hard costs, UCO salary costs)

UCO Keck

- Major UCO contracts in the last decade are for:
  - ESI
  - DEIMOS
  - OSIRIS
  - HIRES detector upgrade
  - LRIS-R detector upgrade
  - K1 ADC
  - MOSFIRE
  - Total contracted values ~$40M
- For Santa Cruz instruments in-kind ranges from 15 - 20%
- Many small contracts
- Uncharged consultation, shop work ~$200k/year
- All in-kind work is through agreement between UCO Director and WMKO Director/Associate Director

FY2008–FY2010: TOTAL OF LABOR COST CONTRIBUTION—$2.36M



Lick Observatory

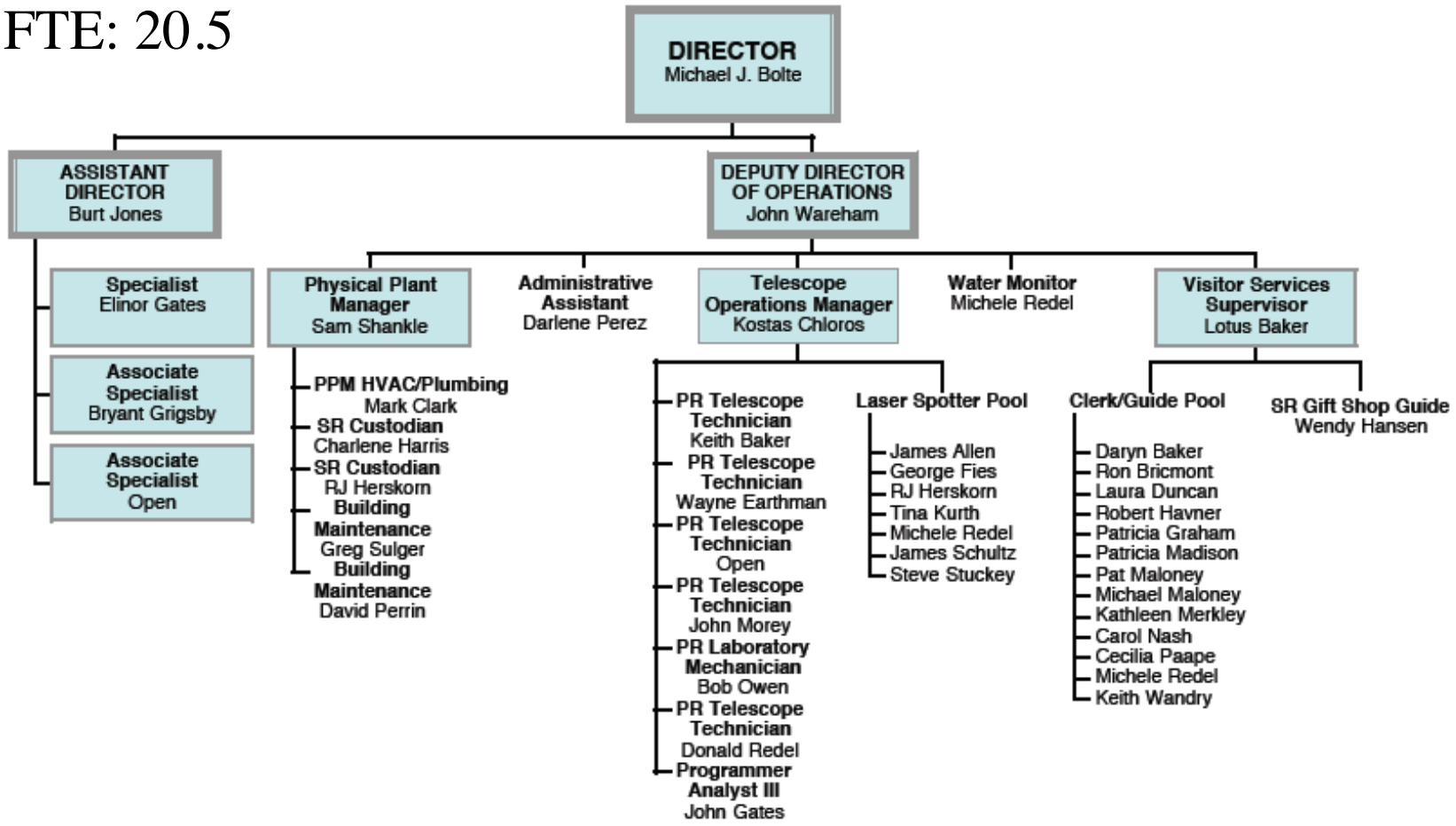
UNIVERSITY OF CALIFORNIA OBSERVATORIES

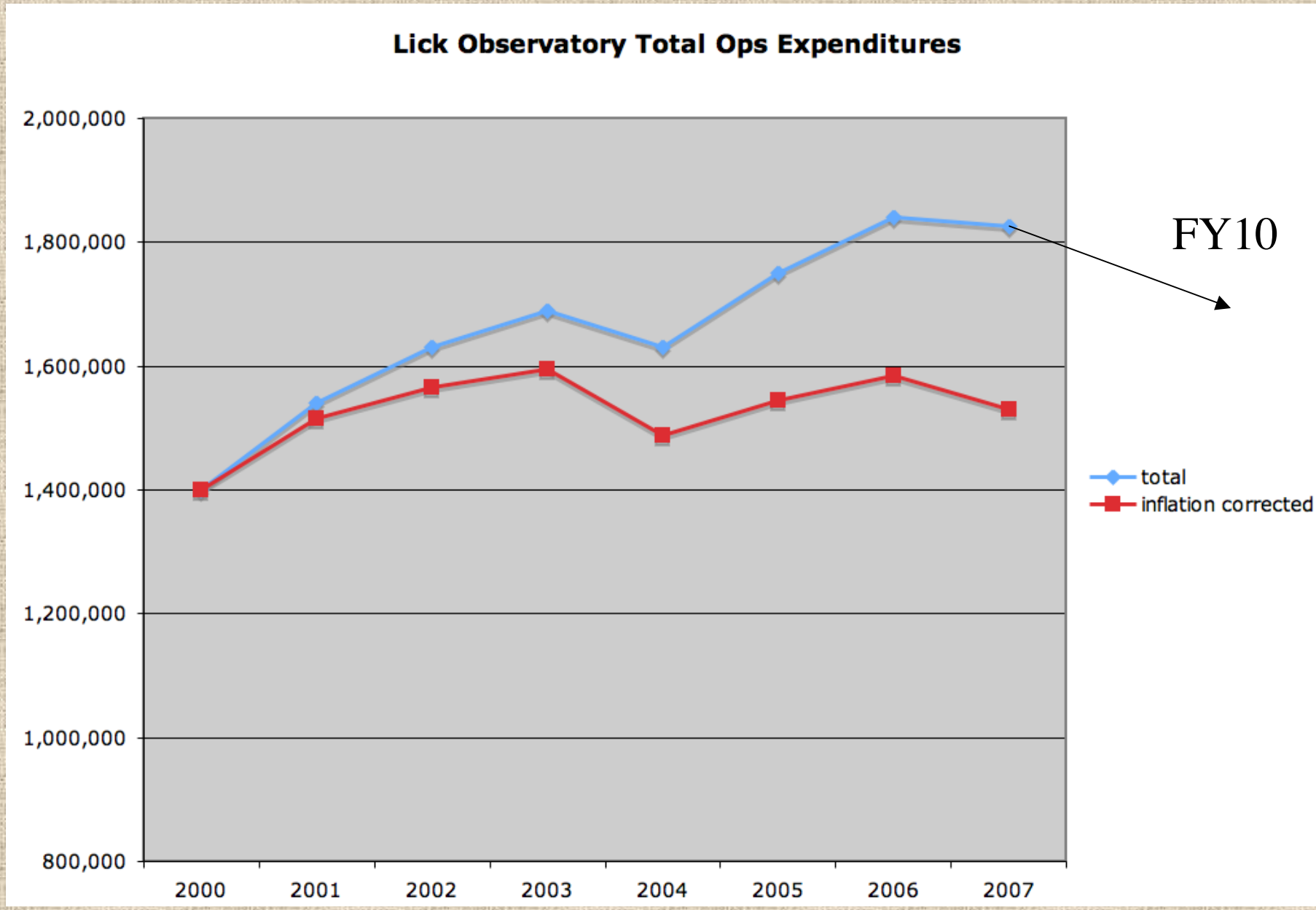
LICK OBSERVATORY

2010–2011

Employee count: ~40

FTE: 20.5




Lick Observatory Total Ops Expenditures
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
2000
2001
2002
2003
2004
2005
2006
2007
FY10
total
inflation corrected

Lick Observatory investments over last five years

- Operating expenses ~$1.7M/year (see previous slide)
- New projects including upgrades:
  - APF, APF spectrometer [$1M UCO, $9M external]
  - Kast CCD upgrade [$300k UCO, $52k external]
  - PFCam CCD upgrade [$100k UCO]
  - Remote operations [$50k UCO $50k external]
  - Hamilton slitroom automation, motor control upgrades [$250k UCO, $50k external]
  - 3m control room, kitchen, library renovations [$250k UCO, $35k external]
  - Shane AO [$240k UCO, $2M external]
  - Optics renovation [$100k UCO]
  - Villages [$300k UCO, $350k external]
- Almost all UCO contributions are in labor

Instrumentation and UCO

- New capabilities are required to stay out in front
- Building quality instruments for 10m telescopes is challenging
- Although infrastructure is increasingly dated, UCO has built a program that is first-rate at designing and delivering 10m instruments and major upgrades
- Lick Observatory is also remaining scientifically productive and a number of younger faculty are interested in pursuing new IR instruments

Instrumentation: Keck

- Keck Instrument Era peak was a few years back but it is not over:
  - KCWI: UCO doing red and blue camera design and build
  - Deployable tertiary for rapid deployment of instruments on K1 is next on the SSC priority list
  - SHREK
  - NGAO - UCO LAO is absolutely key
  - Major detector upgrades for IR and optical instruments
  - With MOSFIRE commissioned, NIRSPEC2: optimized for high-R 1-5μ work
  - Multi-object, wide-field R~15000 spectrometer
  - …? Lots of clever ideas in our community

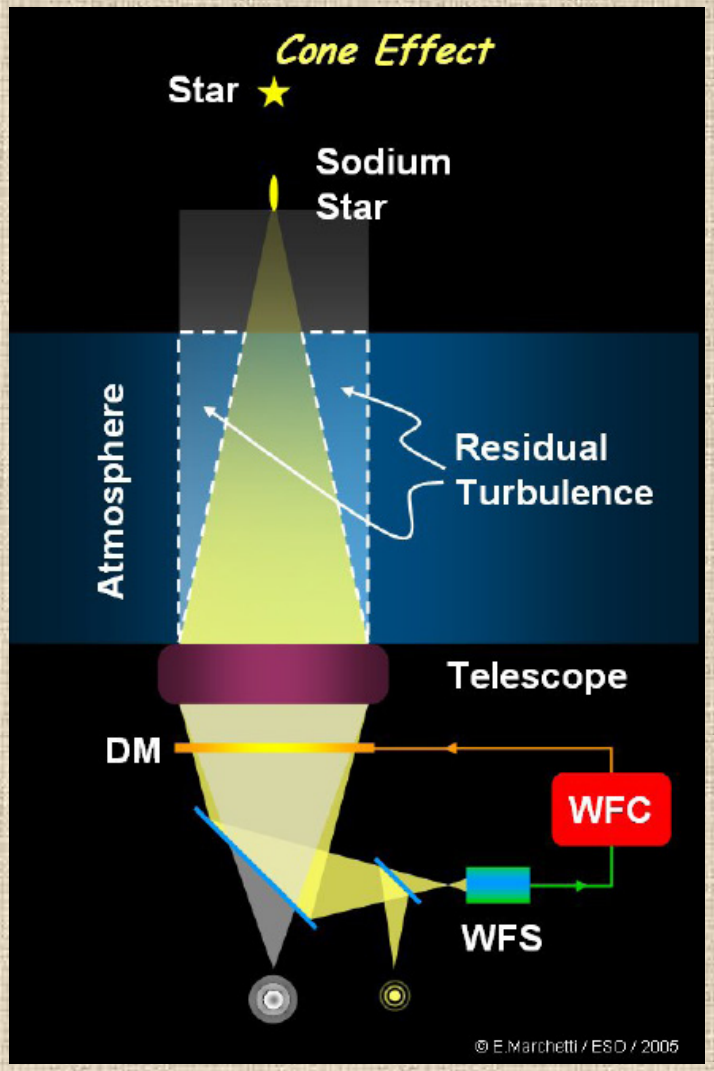
Instrumentation TMT

- With a significant effort and some expenditure of resources, two TMT first-light instruments are led out of UC.
- Total budget is $90M for WFOS and IRIS
- To date both projects have been very underfunded
- We are under-gunned to carry out the design and fabrication currently. TMT funding will solve the personnel problem, infrastructure updating is more difficult
- There will be intense competition among the partners for 2nd-generation instruments. Excellence and experience are a great place to compete from

Governance

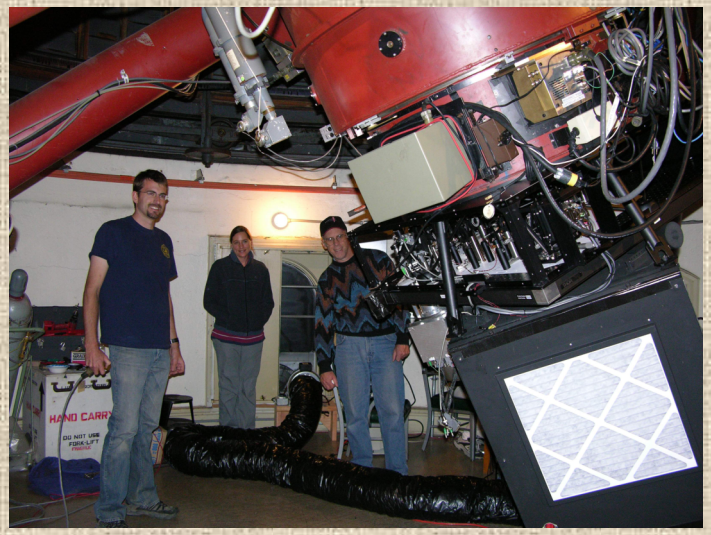
- Advisory committees are crucial to UCO and UC astronomy
  - Time Allocation Committees make the decisions regarding Lick and Keck time
  - Policy decisions are made by the UCOAC
  - Future directions are discussed in detail and extensively in the UCOAC
  - Keck SSC and TMT SAC are the deciding bodies for Keck and TMT scientific priorities and strategic plans
  - Ad hoc committees set up as required
- Director's office responsible for implementing consensus wishes of the community
- It is a good system

Keck-TMT Synergy



- Keck-TMT combo at Mauna Kea is extremely powerful: science programs, technology programs, workforce
- Pathfinder science and technologies at Keck
  - AO is the key example
- Complementary capabilities:
  - Wider-field science at Keck
  - Large programs at Keck
  - High-performance AO
- Timescale
  - TMT first light 2019
  - Fully instrumented 2029 (?)

Lick Observatory in the TMT era



Lick Observatory in the TMT Era

- Note: still 10 years out
- Find a partner or endowment for the public outreach and a K-12 program
- Barth et al. and Kepler programs demonstrate the potential science value of owning a facility
- Currently have four instrument demonstration programs underway
- Remote access and robotic facilities can be very cost effective for research and undergraduate/grad education programs

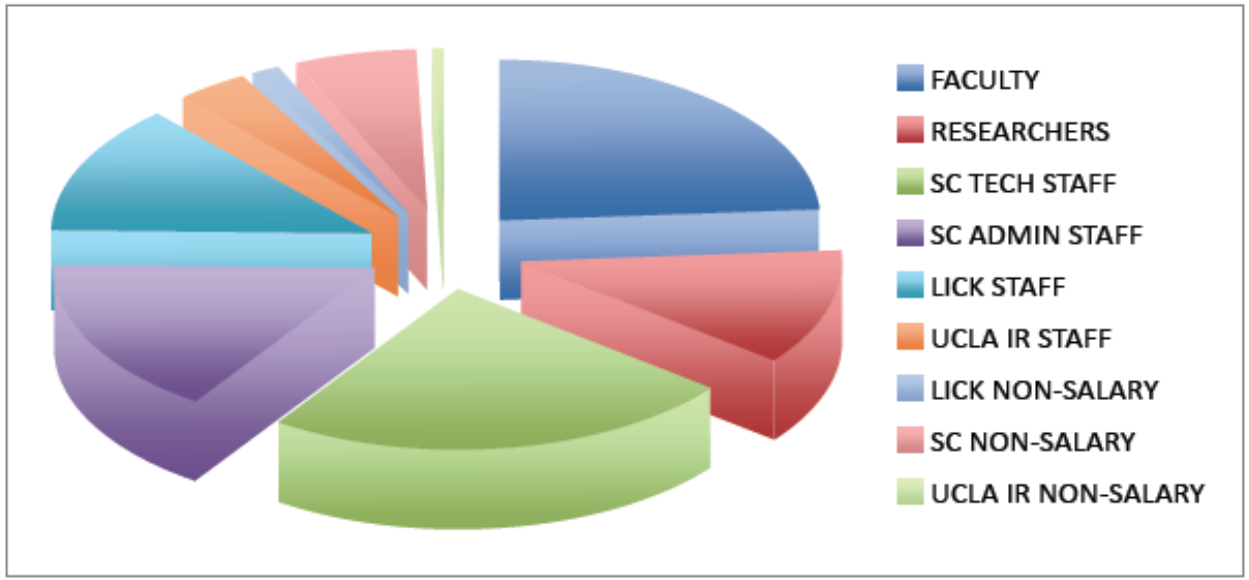
Budget

$7.48M UCOP, $0.56M UCSC facilities, $var contracts

FY 2010 EXPENDITURES
BREAKDOWN BY SALARIES/NON-SALARIES
including UCOP General Funds, Recharge funded staff

FACULTY	$ 1,942,082	24%	
RESEARCHERS	$ 964,039	12%	
SC TECH STAFF	$ 1,948,894	24%	
SC ADMIN STAFF	$ 1,290,340	16%	
LICK STAFF	$ 1,060,856	13%	
UCLA IR STAFF	$ 300,000	4%	92%
LICK NON-SALARY	$ 118,678	1%	
SC NON-SALARY	$ 506,620	6%	
UCLA IR NON-SALARY	$ 37,500	0%	8%
	$ 8,169,007		

$7.4M state + $774k recharge



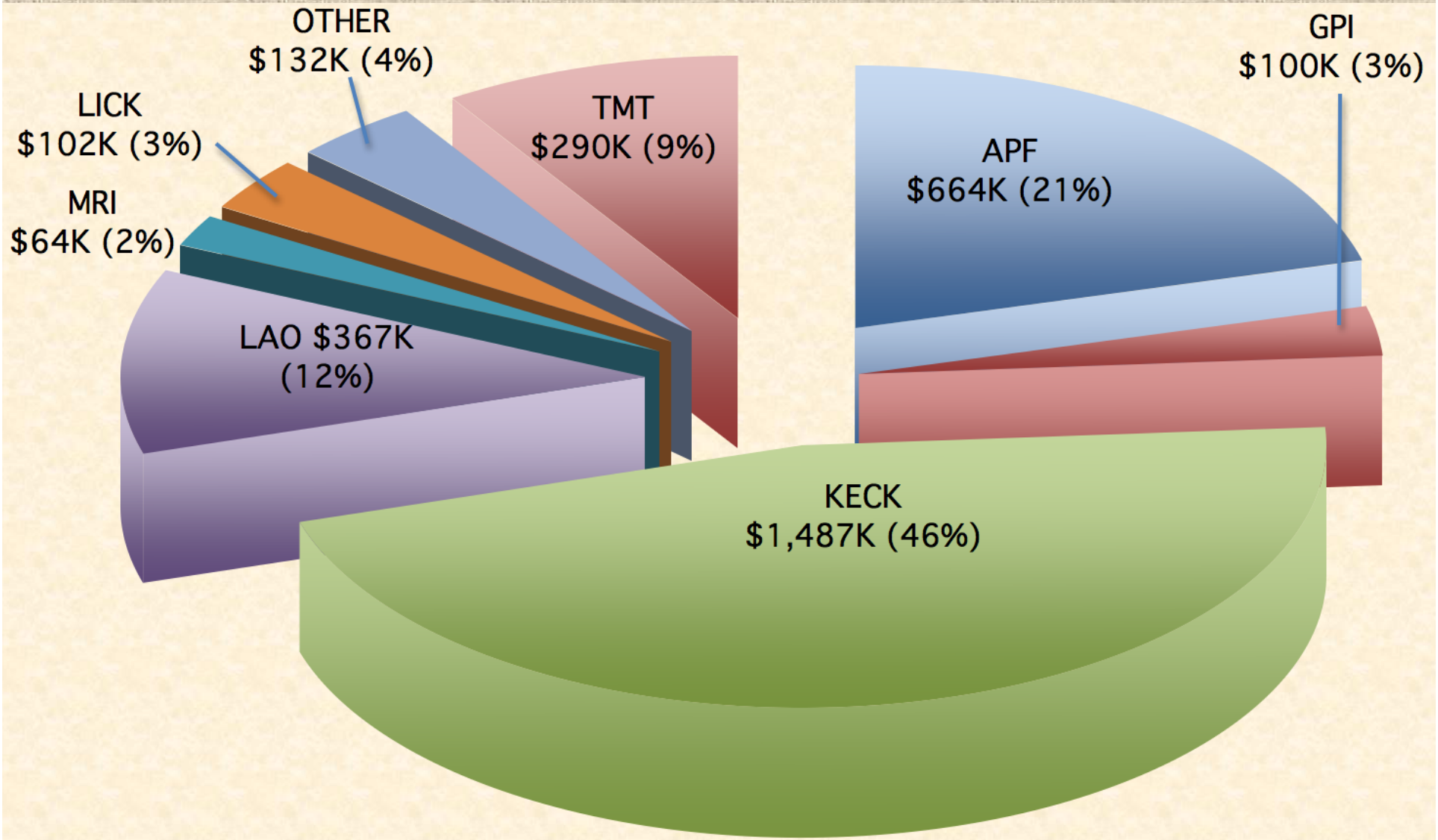
Example 3-year labor revenue

Three Year Comparison - Revenue Collected

Project Name	3 Year Total	FY10	FY09	FY08
APF	664,747	61,511	96,293	506,942
GPI	100,489	100,489	-	-
Keck	1,487,137	345,941	497,264	643,932
LAO	366,864	-	161,894	204,970
MRI	63,547	63,547	-	-
Mt Hamilton	102,361	-	101,607	754
Other*	131,554	103,612	12,607	15,336
TMT	289,809	96,243	117,404	76,161
Total Revenue Collected	**3,206,507**	**771,343**	**987,070**	**1,448,094**

- Labor only (hard costs generally pass through although requires UCO purchasing/management
- Nelson/Mast/Bigelow salary not included

FY2008-FY2010: Total of labor Revenue Collected—$3.2M



FY2008-FY2010
Expenditures by fund type

Sum of Amount		Fiscal Year				
Category	Fund Level 4	2008	2009	2010	Grand Total	NOTES
UCO Operating	GENERAL FUNDS	7,491,393	7,632,101	7,811,536	22,935,030	
	STATE UCLA IR	375,000	375,000	337,500	1,087,500	
	COURSE RELIEF	18,400	18,113	17,826	54,339	
	RECHARGE REVENUE	23,517	(61,207)	(322,244)	(359,934)	
	PRIVATE GRANTS	1,145,630	803,268	390,699	2,339,597	*Moore Fdn for LAO*
	PRIVATE CONTRACTS	107,905	71,553	1,443,362	1,622,820	*Keck, TMT, Caltech*
	PRIVATE GIFTS	644,592	220,823	110,060	975,475	*Kast, Levy*
	ENDOWMENTS	192,428	186,930	98,152	477,511	
	RESERVES	13,861		13,841	27,701	
	STATE AGENCIES	371,272	32,594	(25,417)	378,449	*FEMA vegetation management*
	FEDERAL CONTRACTS	204,244	895,463	102,238	1,201,945	*APF*
	FEDERAL GRANTS	1,047	(379)	147,140	147,808	
UCO Operating Total		**10,589,288**	**10,174,260**	**10,124,693**	**30,888,241**	
Faculty Research	GENERAL FUNDS	435,327	435,157	407,413	1,277,897	*Faculty Startup*
	PRIVATE GRANTS	199,737	301,758	352,980	854,475	
	PRIVATE CONTRACTS	1,536,540	1,760,364	1,667,014	4,963,918	
	PRIVATE GIFTS	41,685	3,794	17,903	63,382	
	ENDOWMENTS	20,294	14,025	28,500	62,819	
	OPPTY FUNDS	18,444	124,642	131,420	274,506	*UC research awards*
	EDUCATION FUNDS	293,093	301,322	79,956	674,370	*UC research awards*
	FEDERAL CONTRACTS	433,450	368,024	397,084	1,198,559	
	FEDERAL GRANTS	6,597,679	5,347,298	4,905,374	16,850,351	
	REVENUE/RECHARGE	60,755	(14,323)	13,617	60,049	
Faculty Research Total		**9,637,003**	**8,642,061**	**8,001,261**	**26,280,325**	
Grand Total		**20,226,291**	**18,816,322**	**18,125,954**	**57,168,567**	

Notes:

1 Except for 57962 Moore Foundation is under operating, all other funds associated with 444686 are under research section.

2 All STSI funds are under Research/Federal Grants.

3 APF, TMT, Keck, MRI projects are classified as operating rather than research as they support the organization and facilities.

4 GENERAL FUNDS, STATE UCLA IR and COURSE RELIEF are further analyzed in other sheets.

Some parting thoughts

- The Lick and Keck Observatories are the laboratory facilities for A&A in UC
  - Great efficiencies in centralizing the resource and by combining 10-campus resources can work at the world-class level
  - Centralization of A&A resources makes them stand out in a budgetary sense and reduces any one campus's ownership: puts a target on the back of UCO and A&A central funding and diminishes the apparent support for the endeavor
  - We have a great investment in physical and human capital and by all the standards usually applied to academic programs the payoff has been outstanding
  - "Make no small plans" - take the example of the Keck Observatory as a mode for the future