

Keck Observatory Science Steering Committee

November 12-13, 2014

Caltech

Observatory Report

- Elements of strategic planning
- This year will produce a 4-Year plan instead of the usual 5-Year plan because we haven't yet completed the SP process. The plan will include
 - Operations cost savings
 - Cost-share for the NIRSPEC upgrade
 - Include a spare secondary mirror?
- Looking to hire a Chief Scientist for the observatory.
- New proposals include AO PSF reconstruction (ATI now) & NIRSPEC upgrade (MRI, Jan 2015)

Observatory Projects. Overview-1

- SSC likes overview chart of various projects and status.
- Segment repair— good technical progress. On track for test bed processing in January & starting pathfinder in June. Result should be known by end of 2015 November.
- NIRES---Re-commissioned KII visitor port. Delayed completion due to MUX problems. Possible ship in Jan with first light in Mar.
- TCS Upgrade --- 2 month slip in schedule. System integration underway. Full on-sky testing in Feb. on Keck II.
- Deployable Tertiary --- Successful PDR. 2 month slip in first light date with new baseline schedule of Oct 2016. PDR panel recommended increasing contingency to 20%.
- KCWI --- good technical progress. Some problems with CaF2 coatings & optical bench but resolved. Only 15% contingency remaining. First light, Oct 2015. SSC recommends observatory find way to purchase 3 de-scoped gratings (for \$45k).

Observatory Projects. Overview-2

- Keck II center-launch laser progressing; achieved 1.6" spot size compared to 2.2" with side-launch and relative to 1.0" spec in 0.5" seeing. Limited by beam quality of current dye laser. Need 2 nights of good weather for final commissioning in March.
- Near-IR tip-tilt AO good progress after 2 nights of good weather. Shared risk in February.
- Keck II Toptica laser on track. Plan to decommission original dye laser Sept 2015; review recommended. 4 month downtime with no LGS on KII until mid 2016B.
- Some Keck II opto-mechanical issues evidenced by AO PSF elongation not along guide star axis
- Initiated new image quality program – synergy with & help from TMT
- Keck II segment exchange completed for 2014. Measured 1.4%/yr reflectivity degradation. Degradation below 400nm possibly much more rapid.

Observatory Report. Other

- Emergency preparation sequences and procedures tested with several recent hurricanes. Generally satisfied with response.
- Some progress on DRPs, but
 - More work on OSIRIS calibration needed
 - More work on MOSFIRE graduated slit
 - More work on remote access to software at Keck
- slit mask design software
 - LRIS/Autoslit to be taken over soon
 - DEIMOS/dsimulator taken over in 2015

Time Domain Astronomy

- TDA Survey shows community support for TDA science
- WMKO committed to a TDA scheduling in K1DM3 proposal
- SSC recommends Directors draw up ToO cover sheet
 - How quickly must ToO be carried out?
 - Can an exposure sequence be interrupted?
 - Disrupt 'first on target' status?
 - What calibrations are required? When?
 - Etc.
- SSC recommends Directors add box to classical cover sheet
 - Request TDA immunity for specific reasons.
 - What calibrations are required?
- SSC recommends cross-institutional ToO program for 2015B
 1. ToO observations: ≤ 1 hour/night
 2. Number of ToO interrupts: ≤ 1 /night
 3. Number of cross-institutional ToOs limited to 20 (each direction)
 4. Cross-institutional conflicts for same target. First-call, first-served?
 5. TDA observations tracked to ensure equitable global institutional time allocations

Time Domain Astronomy

- SSC recommends trial Cadence program in 2015B
 - Encourages Observatory to schedule fractional nights
 - Encourages Observatory to propose 1 hour adjustments to institutional allocations (A gets 1 hour from B)
- SSC recommends trial Pool observing program (cross institutional)
- *SSC recommends that the Directors implement this trial program in a way that ensures community buy-in, in time for 2015B proposals. We propose that two semesters (2015B, 2016A) be executed with the trial program, and that results of these two semesters be reviewed at the Summer, 2016 SSC meeting.*

K1DM3

- Preliminary Design Review (PDR) held on October 24 at UCSC
 - Reviewers: A. Adamson (Gemini), T. Chylek (GMT), T. Nordin (WMKO), K. Seaman, Chair (JPL)
- Review outcomes
 - “Proceed as planned with the detailed design of the K1DM3”
 - The Review Board thanked the K1DM3 project team for a thorough and well presented review. Report demonstrated that the project understands the scope of the work and has developed a coherent plan to complete within the proposed budget and schedule.
 - Recommendations:
 - Perform a detailed thermal analysis of the mechanical design
 - Add further mitigation details to the risk analysis
 - Add detail to the schedule, esp. during the I&T phase
 - Current unallocated funds represent ~8% contingency on est. cost to complete which is too low, project should seek a 20% level
- Project status
 - Slip of PDR compared to schedule at project start is 5 months
 - DDR 1/2016; Pre-ship 9/2016; Commissioning Nov.2016
 - \$100k unallocated funds in budget at present (contingency)
- SSC supports recommendation for added contingency.

KCWI

- Significant progress on construction and assembly
 - Two of four key mechanisms now tested and ready for integration
 - Several key risks retired: coatings on large optics, coatings on blue camera, mounting of large optics (barrel is essentially complete)
 - Optical bench delivered delaminated, new vendor selected and ordered (delivery 12/2014-1/2015). Marks beginning of system level integration.
 - Most of K mirror parts arriving; two gratings in fab; IFU delivery 2/15; bonded M1 and M2; all large mirrors coated
 - Winlight completed two of slicers and given go-ahead for rest (completed 1/2015)
 - Slicers coated at ZeCoat with multilayer Ag; Also Ag on FM1 and COL (min 93.2%; avg 96.7%)
 - Optical bonding of FMD complete
- Watch list
 - Tight camera tolerances-construction moving ahead. Scattered light risk retired by measurement
 - IFU complex optical element: Non-sequential simulation using Winlight-delivered models. Analysis of thermal performance and vignetting. Integration of as-built data into models.
 - Mechanisms: working ,but thermal tests recommended
 - Ag coatings: ZeCoat
 - Camera-first four and last two lenses are assemble; Remaining are being tested. Coatings from ECI program produced good results.

KCWI

- Resulting costs & schedule extension creates pressure on budget & contingency
 - Expecting a 1 month slip in first light to 10/2015
 - Cost savings plan has helped, but currently CIT labor is over cost savings target by \approx \$70k
 - Project wants to purchase three remaining gratings but this is not supported by level of contingency vs. remaining expenditures
- Management
 - Schedule & resources remain tight

Strategic Science Planning Follow Up on Oxnard Retreat

- Task Forces
 - Science Partnerships (Directors)
 - Science Opportunities (SSC and Directors)
 - Instrumentation (SSC)
- Plan to present results of task force deliberations at June 24-25 SSC Meeting and June 26th CARA Board Meeting
- Full written document will follow.

Strategic Science Planning

Science Partnerships & *Resources*

- NASA & Keck
 - Shri/Claire to visit Mather & Gardner to engage them in real needs of JWST. Limited mission lifetime presents need for ground-based selection of fields and follow-up studies (higher spectral resolution).
 - Identify NASA interests in Keck
- Keck in the TMT Era
 - Consult TMT SAC to develop synergies
 - Don't forget other ELTs
 - Plan now for future large programs
- Other Scientific Partners
 - Board-level discussion.

Strategic Science Planning

Science Opportunities

- Keck & JWST
 - Preparation & Follow Up at Keck for JWST
 - Involve larger community in thinking
 - KCWI & OSIRIS as precursor to JWST IFUs
- Keck & Synoptic Surveys
- High resolution/precision spectroscopy
- Wide field capabilities
 - Workshop on future wide-field imaging (Shri)
 - Medium wide fields & spectroscopy

Strategic Science Planning Instrumentation

- Evolutionary paths for AO
 - Which existing instruments could take WFS and interface with GLAO?
 - What is timescale, cost, reliability of an adaptive secondary?
 - Phased approach to narrow field, high precision AO
- New technology / Visitor instruments
 - How would it be implemented?
 - What types of instruments are desired?
 - E.g., MKIDS, polarimetry, etc.

Notes on Observatory Strategic Plan

- How to coordinate with TESS, JWST (also relevant for TMT), WFIRST/AFTA? Finite lifetime (5-10 yr) drives extreme constraints on observing efficiency needing ground based input.
 - Meetings with Mather & Gardner
- Mega instruments & mega alliances (Keck + Subaru 30-60 night exchange)
 - How do we get access to HSC archive?
 - Subaru wants access to DEIMOS and MOSFIRE
- Australian interest—SWINCAM (w/blue emphasis) for access to large field instrument
- What is the demand for wide field imaging? Do you really care?
 - Narrow band imaging/U-band?
 - How much does the community really want this? 10, 30, 60-night projects?
 - Stimulate people to think about preparing for JW, TMT, &c.
- Workshops/taskforce/&c.
 - Need to get people in the same room to generate new ideas
 - AAS topics session?
 - Judy volunteers to organize Caltech observer's long-term imaging needs
 - Ken C. (IfA), Raja (UCO), Shri (Caltech). Crystal (UCSB) will host a 1-hour telecon to discuss wide field imaging and report back to SSC in ~ 1 month.
 - NASA/Keck discussion will be led by Claire & Shri
- Strategic attitude regarding TMT (and other ELTs)
 - TMT SAC is the group to work with—who has been putting time into TMT science? Good topic to coordinate
- Other scientific partners (TMT partners, e.g., China & India)?
 - Discuss with Board. Not a working group yet.
 - What's new is the strategic goals, not just near term.

Notes on Observatory Strategic Plan

- Personnel exchanges
 - NSF/PIRE program? TMT could apply in next round. Effort is the same as needed for a NSF Science and Technology Center.
- New instrumentation
 - Balance between upgrades and new instruments? What are the opportunities? How do we inject new technologies?
 - Visitor instrument with new technology (get new technology cheap)
 - New ideas out there: MKIDS, PRV-dream machine
 - AO evolutionary paths/GLAO? Adaptive secondary?
 - Adaptive secondary has broad implications for wide and narrow field AO
 - Which existing instruments would benefit from GLAO
 - Large format detectors/viewer field of view?
 - Upgrades—NIRSPEC (already agreed), ESI (blue sensitivity not feasible), DEIMOS (blue channel)

SHREK

- Headed towards System Design Review in late April/early May 2015
- Focus on
 - Bottoms-up cost estimate, comprehensive Doppler error budget, & engineering and project management
- Current activity
 - Sensitivity analysis
 - Camera design
 - Throughput
 - In house octagonal fiber test
 - Prototype fiber scrambler
 - Assessment of beam combining room
 - Design of slicer
 - Hired two engineers
- Camera based on DESI camera
 - Optimized for SHREK-spot sizes in the 6-12 μ m range
- Fiber testing ramped up
 - In SSL fiber lab see near field uniformity of 1% from single fiber.
 - Need to demonstrate pupil uniformity to 10,000:1 (from double fiber scrambler).
- Expect cost estimate at SDR
 - Project has retired some risks (camera design).

ATI/MRI

- NIRSPEC MRI

- ATI Nov 2013 -- highly reviewed, 3xE, 1 VG/G, 1xG: Joint panel --> "Worthy of funding" but cost too high, viewed as inappropriate for an ATI grant.
- MRI 2015 Baseline proposal
 - New detector for spectrograph, 5 um H2RG
 - New slit viewing optics and detector (5 um cutoff)
 - New readout and control electronics and s/w
 - Upgrade to grating tilt mechanism (improved stability)
 - Total cost perhaps \$1.8M, NSF \$1.27M, with cost-sharing \$0.54M (30%) including \$60K WMKO and the balance from UCO/UCLA
 - Requires WMKO MRI slot and constrains NSF funding to UCLA to 20% of NSF total
 - 24% contingency built into budget
- Future MRI Augmented proposal
 - 1. upgrade to grating tilt mechanism for better stability (100K) (perhaps in 2015 proposal)
 - 2. addition of PRV capability
 - Existing RV limited to ~50 m/s due to lack of wavelength standard
 - Upgrade would include:
 - » 1. new H2RG detector (yes)
 - » 2. slightly higher res from smaller pixels
 - » 3. fiber stabilized slit illumination
 - » 4. gas cell with ~1 m/s stability over 250 nm in K band
 - » 5. laser comb wavelength reference with <1 m/s stability over 100 nm in H band

ATI/MRI

- PSF Reconstruction Facility ATI
 - Based on 2 other development efforts:
 - 1. On-axis PSF-R (ATI funded)
 - 2. UCLA Galactic Center Group: Off-axis PSF methodology
 - These efforts complete Sep 2015. The results of these developments will be combined into a WMKO data pipeline facility for routine PSF reconstruction
 - Science case
 - kinematics of galaxies -- sig errors w/o PSF reconstruction
 - binary reconstruction -- x10 improvement
 - Cost: 700K
 - Goal is PSF recovered routinely 1 day after observations