Keck SSC Meeting Notes

2022 May 12-13
Meeting held via Zoom

Observatory Report

- Severe storms at summit in early May including lightning strike on or close to Keck
- No impact on the observatory operations due to COVID (locally in Hawaii there are no ICU cases)
- Welcoming observers back to VSQ, and summit tours are beginning again
- COVID recovery have resulted in rebalancing efforts (no cancellations), with main priorities being the KCRM and KPF projects
- Instrument updates:
  - DEIMOS: Pump controllers replaced leading to CCD5 back to nominal performance
  - NIRSPEC: new K-band filter installed (increase throughput) and 24x0.72 slit re-installed
  - KCWI: going off sky in June for KCRM
  - PyWFS: currently not available after some KPIC work (non nominal)
  - OSIRIS: issue with one imaging filter requiring servicing.
- DSI: 5/10 instruments pushing raw data to KOA, with all instruments expected to be ready by end of 2022. DEIMOS and KCWI now pipeline processing data during the night. New backend DDOI and frontend GUI prototypes of "observing planning" tool already developed.
- NASA CAN: renewal request sent on April 20. Expected results in August.

Observatory Report

- Major instrumentation:
  - KCRM:
    - Current projected costs are under the cost cap
    - KCRM will deliver in sep/2022, with KCWI is off sky in June/July
    - Pre-ship review in August, with commissioning planned for January
    - Detector system undergoing characterization and camera lens being assembled at Winlight (all lens met specifications)
  - KPF:
    - Current project costs are under cost cap
    - KPF expected to be delivered in July 2022, with commissioning in May/June for the FIU and November/February for the spectrograph
    - Open to the community in 2023A, pre-ship planned for June 15-16.
    - End-to-End testing is ongoing, with WMKO staff visited to participate on testing and software DSI development.
  - Laser Frequency Comb: IR Astro Comb
    - Project cost is under cost cap
    - WMKO is postponing deliver to Sep/Oct 2022 (intentionally delayed to accommodate other projects)
    - 95% of the equipment purchased, software under development

Observatory Report

- Major instrumentation:
  - SCALES
    - Budget is stable, with equipment purchases being delayed while funds are transferred. This will impact schedule
    - Imager arm holding a PDR review in June
    - Facility build out of integration facility is on-going. Imaging channel optical design with known performance. On target for final optical design.
  - DEIMOS Upgrade
    - CIT engineering labor funded and CCD contract completed (waiting to hear from NSF)
    - Schedule trigger for the start of project for the detectors in May. Then 2.5 years project
    - Development team selected Teledyne detectors.
  - HISPEC
    - Private funding supporting PDR. Team in PDR phase, then 4-5 years project
    - Considering changes to the KII AO bench.
  - KAPA
    - Continuing to integrate new real-time controller and OCAM2K camera
    - Completing laser tomography AO elements
    - Science team progressing (e.g., science meeting, exposure time calculator)
  - ORKID (ORCAS visible camera)
    - K2 AO fast visible camera, Nyquist sampled at 650 nm, 3.4x3.4 arcsec^2 at 189 Hz
    - To install in summit in Fall 2022

Maunakea Report

- 2021: working group tasked with exploring alternatives to UH for MK management.
- December 2021: working group released report “A New Day on Mauna a Wakea”.
- HB2024: using report as foundation, translated WG recommendations into a bill; passed House committee readings.
- SB2024: included some elements of HB2024, but with significant changes on issues related to UH telescope time, management authority membership, etc. Bill passed out of committee after two sets of amendments.
- Conference bill HB2024 CD1, passed conference committee unanimously. MK observatories provided testimony to committee.
- HB2024 CD1 passed on May 3, 2022. Now on the governor’s desk.

Maunakea (cont.)

- Astronomy is declared the “policy of the state” consistent with the mutual stewardship paradigm.
- 11 members: BLNR chair, Hawaii County mayor, UH Regents chair, land resource expert, education expert, MKO rep, business/finance expert, lineal descendant of MK practitioner, recognized cultural practitioner, House-appointed member, Senate- appointed member, and UH-Hilo Chancellor (non-voting).
- Board members are appointed by the governor, ratified by the state senate.
- 5-year transition to be completed 2028
- During that time, UH will continue to manage day-to-day preparing for the handoff to the new Authority.
- Floor for UH observing time is 7%, with priority for programs involving Hawaii students
- Subject to land-use and admin laws of the state
- New lease negotiations postponed until 2028-2033.
- HB2024 meets the “core principles of the observatories”, and is consistent with Astro 2020 “State of the Profession” recommendations.
- There is a collection of public testimony, public statements by Keck and other MKOs here:

https://keckobservatory.org.hb2024

White Papers: 2022 Call

- 2022 deadline is 22 June.

- SSC reviewed updated language in the call with specific emphasis on highly multiplexed/sensitive spectroscopy, high contrast imaging, new instrumentation and AO concepts. Replacements and upgrades to current instrumentation are also encouraged. Discussion centered around how to attract attention of community to priorities in the call.

- Templates have been developed to assist proposal creation and evaluation. For Phase-A proposals, if information expands beyond the 7-page template it now can be provided in an appendix/supplementary document.

FOBOS Proposal Discussion

- Science motivation: (1) Cosmic ecosystem across all scales; (2) Dark sector
- This science area (cosmic ecosystems) + instrumentation (high-multiplex spectroscopy) identified as top-level priorities in Astro2020.
  - FOBOS mentioned several times in the report.
- FOBOS will serve as strong link/bridge to new capabilities
  - JWST+ELTs: z>2 galaxies, wl > 1 micron spectroscopy, samples of ~100's
  - Rubin+Roman: z< 2 galaxies, imaging, enormous samples
  - FOBOS: z~2 galaxies (peak of formation epoch), very large spectroscopic samples
- Successful CDR in July 2021.

Recent developments:

- FOBOS requires telescope to be focused slightly farther back than norm, to produce the flat focal plane needed for fiber positioning system (Starbugs).
  - First-order on-telescope test has been successfully conducted with DEIMOS, showing that rephased configuration produces similar FWHM (with larger PSF wings). Retires significant technical risk.
- Observing planning software written: ETC, fiber positioning tool.
- Active prototyping of IFUs underway: 37-fiber bundle, 5" hexagonal FOV
- Prototyping fused-silica etched (FSE) grating for UV channel (VPH not suitable)

HISPEC Update

- Key Science Programs (KPPs):
  - 1. Atmospheric characterization of close-in planets. Simulations show sensitivity to transits and eclipses of hot Jupiters and low-mass planets (especially around late-type stars). Very high resolution is key.
  - 2. Chemodynamics studies of resolved substellar companions with direct spectroscopy.
  - 3. Dynamical mass and orbit measurements using NIR RVs. Complements KPF with superior performance for HISPEC for late M-dwarfs. KPF+HISPEC RVs will give 0.45-2.45 micron range for stellar activity precision.
  - 4. Galactic center – measure RVs of stars orbiting Sag A* with high precision.
- Key specifications: 0.96-2.45 microns simultaneous (y-K), R=100k, three single-mode fibers (object, background, cal), 30 cm/s instrument stability, SNR=30 in 1 hr on 14-15 mag point source.
- HISPEC blue arm is important for studies of exoplanet/brown dwarf variability, atmospheric escape (Y band, He 10830 at Angstroms), RV information content is high in Y band.
- KPIC precursor observations with single-mode fibers have demonstrated excellent injection from Keck AO, line spread function stability, couple (~40%), throughput (3% end-to-end at peak-of-blaze, compared to 3.4% with NIRSPAO), blind offsetting, and new science.

HISPEC Update (2)

- KPIC phase II will improve throughput to ~5% using high-order deformable mirror and a PIAA beam-forming optic, which should transfer to HISPEC.
- KPIC is space-constrained on the K2 AO bench. Considering modifying the layout to accommodate SCALES and HISPEC. Discussion of retiring NIRSPAO in 2025 to the accommodate HISPEC, SCALES, and PWFS front-end. The proposal is only retiring NIRSPAO, not NIRSPEC.
- A preliminary analysis by the HISPEC team suggests that most NIRSPAO use in the past 10 years (which is dominated by exoplanet science applications) can be accomplished by SCALES and HISPEC, which offer superior performance. One mode that would be lost is high-spectral resolution L+M spectroscopy.
- Optomechanical design has two cryostats (yJ and HK) each with three-mirror anastigmats (TMAs). Germanium grating prototypes.
- With HAKA upgrade to AO system, HISPEC throughput would be 4% to 10% (y-K)
- Laser frequency comb calibrator (yJ + HK) being developed for NIRSPEC/HISPEC.

NIRC2/SCALES Imager Discussion

- Comparative chart on next page.
- Community survey led by Carlos Alvarez, sent to all NIRC2 users over past 5 semesters. 12 questions, 39 responses.
  - Half of respondents self-identify as expert users, with > half being exoplanet researchers.
  - PSF knowledge identified as critical for achieving science goals for majority of respondents, with high contrast also important.
  - Near IR most important, followed by thermal IR and narrow-band imaging.
  - ~¾ require <1s integrations and ~⅓ desire <0.1s minimum integration time per coadd
  - Vast majority (95%) identified narrow camera of NIRC2.
  - Significant community interest in vector vortex and vertical angle modes.
  - Identified NIRC2 strengths, including stability/reliability/robustness, detector configuration (short exposures), thermal AO, and high contrast.
  - Also identified shortcomings, including detector performance, instrumental WFE, and unreliable operation with vortex alignment (QACITS).
- SCALES will go at K2 AO direct (NIRC2 current) or bent port. Prior direction from WMKO to team to design for bent port, but issues with NIRSPAO and KPIC FIU. Could move to NIRC2 position later.

	NIRC2	OSIRIS imager	SCALES imager	LIGER imager
Wavelength (μm)	0.9 – 5.3	0.9 – 2.5	1.0 – 5.3 (0.6 – 1.0 capable)	0.8 – 2.4
Coronagraphy	Yes	No	Possible (Yes for IFS)	No
Aperture masking	Yes	Yes	Possible (Yes for IFS)	Yes
Spectroscopy	Long-slit	Parallel IFS	Separate IFS	Parallel IFS
RMS WFE (nm)	<190	<50	<65	<50
Detector	1Kx1K Aladdin-3 InSb	2Kx2K Teledyne H2RG HgCdTe	2Kx2K Teledyne H2RG HgCdTe	2Kx2K Teledyne H2RG HgCdTe
Pixel scale (mas)	10, 20 and 40	10	6	10
FOV (arcsec^2)	10x10, 20x20, 40x40	20x20	12x12	20x20
Sub-windowing	Yes	No	Yes	Yes
Min texp (full frame)	0.2s	1.5s	1.0s	1.4s
CDS readout noise	60e-	23e-	8e-	8e-

Conclude that SCALES imager is better than NIRC2 for narrow field observations, and maintains the flexibility of NIRC2.

OSIRIS⇒Liger will be the wide-field (>20”) imager of choice.

Keck Science Meeting

- KSM planned for September 15-16 at Caltech with hybrid capability
- Co-chairs: Lynne Hillenbrand, Tuan Do
  - SOC membership TBD
- KAPA science meeting will be held during the 2 days prior
- Suggestions/questions for meeting planning:
  - Bring people together for visible AO discussion
  - Slack-based poster discussion has gone well in recent years
  - Important to have sufficient interaction/discussion time on the agenda
  - Important opportunity for SAs to engage with observer community
  - Opportunity to introduce DSI features and get feedback
  - Opportunity to discuss strategic plan, instruments in the pipeline
  - Consider sessions on synergy with JWST
  - Important to get good microphone coverage for hybrid discussion
  - May still have room capacity limitations in September
  - Consider KPF splinter meeting