

SSC Meeting

Open Session Minutes
14-15 November 2018

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WMKO Highlights (Hilton Lewis Presentation)

- New Chief Scientist John O'Meara starts December 3
- Over half (45/84) of primary mirror segment repairs now done & most installed
- WMKO is proactively promoting Maunakea issues with HI government
- Keck science meeting had 161 participants
 - 10 breakout sessions, Decadal Survey discussion, 25th anniversary of Keck science, “Impossible Telescope” movie premier (story of Keck telescope development).
- 15 high priority current internal WMKO projects (FY 2019) spanning telescope infrastructure, segment repairs, K1 DM3, instruments & upgrades
- Three major AO projects:
 - Pyramid WFS and fiber injection / extraction units installed on K2; PWFS loop closed well
 - K2 Real-time controller passed PDR in September
 - KAPA Funded by NSF MSIP, started work in September
 - Four key science programs will be executed with OSIRIS when completed (~2023)
 - Starting design work on infrastructure for new K2 laser

WMKO Highlights (2)

- Minor telescope mount oil leaks have been investigated thoroughly
 - Outside consultant found small leakage, low environmental impact
 - HI agencies have been informed, and mitigation has been implemented
- WMKO Five Year Plan supports Strategic Plan goals:
 - Increase scientific output
 - Sustain the observatory: people, facility, mitigate risks, reduce operations costs
 - Invest in next generation science capabilities: instruments, AO
- WMKO is engaging HI Government officials proactively on Maunakea issues
 - Site tours and information to address incorrect rumors, hearsay, and perceptions
 - Coordinating with other observatories and UH
- Activel engagement in communications and outreach to local community, funders, fans, and WMKO staff
 - Impossible Telescope movie being shown to Keck community
 - Involved in program to give Hawaii high school students mentored observing experience
 - Exoplanet Imaginarium makes realistic science-based images of exoplanet scenes monthly
 - Seven high profile public astronomy science talks in 2018

Instrument reports

- Keck 2 has two more instruments (KCWI, NIRES) now than a year ago..
- New Support Astronomer: Elena Manjavacas
- Observing Assistant departures: Gary Puniwai (retired), Jason Macllroy

NIRSPEC upgrade

(presented by Emily Martin, Keck visiting scholar)

- Upgraded SPEC and SCAM detectors to H2RG
- Replaced transputers with upgraded electronics
- Final service mission completed in November; commissioning planned for December.
- New SCAM detector works out to 5 μm
- Internal temperature fluctuations reduced from 3 K to 0.3 K
- New SPEC detector increases number of accessible orders from 6 to 11 in H band and from 5 to 10 in K band

ESI

- Due to infrequent usage, ESI is now being operated in “campaign” mode and warmed between runs when off the telescope.

OSIRIS

- Imager detector upgrade is complete
 - Internal pupil misaligned with telescope pupil, requires service to fix
 - SSC recommends that a servicing mission be scheduled in early in 2019A.
- DRP update on flux misassignment in 100mas mode.
 - 5-7% of flux falls on wrong pixels
 - Causes ruled out: persistence in detectors, pupil misalignment
 - SSC requests update at the next SSC meeting, and that status be made clear on OSIRIS web site.

Adaptive optics operations

- Juan Carlos Guerra is WMKO's new AO Operations Scientist.
- Laser clearinghouse, which closes laser during satellite passes, updated their software. The recent high number of laser closures on Keck 2 now reduced to normal rate.
- Request update on the status of "sky tiles" program at next SSC meeting.

NIRES

- 2018 tasks:
 - Flexure compensation system: working, still being adjusted
 - Simple quick-look pipeline available for extractions
 - Working on guiding on the slit-viewing camera if a bright enough star is available
 - New observing GUIs working
 - FY19: study to investigate installing a cryocooler. Need cost estimate.
 - Flexure causes target drift between slit viewer and optical guider by a few pixels per hour. Working on tools for monitoring and calibration so that differential flexure can be removed in guider software (as implemented for MOSFIRE).
 - Optical guider shutter has expected lifetime of 6 months, will be replaced
 - Occasional issues: corrupted images, server crashes
 - Comparison of NIRES efficiency and S/N with other IR spectrographs: information on relative throughput of NIRSPEC low resolution mode, MOSFIRE, NIRES should be posted on instrument web sites.

LRIS

- Most requested instrument in 2018
- Status of LRIS tasks:
 - Replacing GUIs with web tools: in progress
 - Nightly throughput monitoring in progress, using Pypeit
 - Fix 5th grating port: not done yet, but anticipated to promote LRIS's TDA readiness
 - Blue shutter upgrade: new hardware being tested, purchase order submitted for new shutter
 - AUTOSLIT slit mask design being replaced with python-based program: full metadata and modern web-based interface, in progress
 - New spectroscopic focus GUI developed in python, in beta testing
- TDA readiness study:
 - Need to define a "TDA Configuration" that will always be available. Reaching out to user community to agree on common TDA setup.
 - Requires internal arcs and flats (can be done after observation) and 15 minute focus procedure.
- Future:
 - Pypelt will eventually be adopted as official DRP
 - Develop more informative FITS headers
 - Replace AUTOSLIT
 - Web-based configuration manager (as for KCWI)
 - CCD upgrade options for red side are being investigated.

KCWI

- **Task status:**
 - Pipeline released and installed at WMKO
 - Commissioning data released
 - 2 additional Support Astronomers trained to support KCWI
 - Pipeline conversion from IDL to Python: in progress
 - Working on end-to-end web-based data flow tools from planning to reduction and to enable scripting of complex observation sequences.
- **Generally very stable, but 2 hours were lost to rotator problems**
 - Cause: electronics too warm, causing rotator faults, encoders read wrong values; problem fixed (glycol flow).
 - Actions taken to mitigate problem: refined troubleshooting procedure, high temperature alarm
- **GUI improvements: developed simplified exposure control GUI**
 - Complicated engineering GUI won't be needed for regular use
- **Calibration scripts improved to reduce calibration time in afternoon**

DEIMOS

- Task status:
 - Upgrade polo and FCS software: in progress
 - New support astronomer trained
 - Migrate slit mask design software to Python and solve geometry issues: in progress
 - Rotator control system upgrade: started
- Detector issues:
 - Bad CCD channels with high noise during some observing runs (70 e- on CCD5)
 - 2 faulty channels fixed, one still bad
- Slitmask alignment tool problems: crashing and missing boxes
 - Fixed by changing background region
- Resolution of flexure issues: can now clamp grating at any rotator angle
- Server upgrade: replacing old Solaris machine with new Linux system
 - Need to solve software issues including bit arrangement, work in progress
 - Dashboard GUIs can't be migrated to Linux due to Tcl/Tk library and database changes
 - Will replace with a keyword-based GUI similar to NIRSPEC upgrade
 - New python+DS9 display tools being developed to replace figdisp
 - Pathfinding for other instruments with Solaris machines, such as NIRC2
- New slitmask design tool almost complete
 - Browser-based interface with python engine
- Rotator control system upgrade: approved FY19 project
- Throughput monitoring using archival data (Keck Visiting Scholar project)

NIRC2

- Task status:
 - New support astronomer trained
 - Support L-band vortex coronagraph in LGS mode: done
 - Study upgrade to high performance coronagraphy capabilities: started
- Issues:
 - Detector server crashes occur frequently. Only a small amount of time lost.
 - NIRC2 server is a 2001 Solaris machine, needs replacement
- Coronagraphy upgrade plans:
 - M-band optimized vector vortex coronagraph, new Lyot stop, low-res grism, Wollaston prism for spectropolarimetry, software upgrade for VVC
 - Need to decide which filter to remove to make room for Wollaston prism
 - Will require 3-5 week servicing for upgrades, probably late March

HIRES

- Task status:
 - Adopting a linux-based VNC server: in progress
 - Detector characterization and monitoring: stalled, other tasks are higher priority for now
 - PRV pipeline hosted by NexSci: in progress
 - WMKO will add documentation and observing scripts
- Recent incidents:
 - Motor control problems in September - fixed
 - Odd bias frames in Oct/Nov - traced to dirty/damaged fibers, problem addressed

MOSFIRE

- Task status:
 - Adopted linux VNC server: done
 - Confirm on-sky performance post-servicing mission: in progress
 - MAGMA slit configuration software update: stalled at present
 - Spare MACU (amplifier) electronics board was tested and non-functional: need replacement spare
 - CSU fatal error recovery software: a rare failure mode with very slow recovery (1.5 hours). Writing software to speed up the recovery process, in progress.
 - DRP updates: updates to 4 of 6 modules complete
- DRP updates:
 - Developing new mask to replace long2pos (longslit) to shift usage burden away from central slit bars. Requires major DRP update. In progress.
- Entrance window cleaned to remove artifacts seen in K-band images. Awaiting new imaging data to confirm problem solved.

Mainland Observing

- About 50% of nights are mainland-only. 70% are either mainland-only or eavesdrop observing. Similar numbers since about 2015.
- Mainland observing is supported by staff at UCO.
- Mainland observing is based on aging technologies: ISDN, polycom, VNC.
- Improvement project:
 - Updating software to make remote observing requests easier for observers
 - Update/replace VNC launch scripts, and use the new scripts at both WMKO and at mainland sites
 - Replace observing stations in Remote Ops and incorporate Zoom
- ISDN usage analysis (2014-17):
 - Longest connections: several connections lasted 200-800 minutes
 - Total 33 hours of downtime in 4 years. On average, 0.5 nights/year of ISDN usage.
- No replacement technology for ISDN exists that would fully solve the backup connection problem. WMKO is investigating options.

Data Reduction Pipelines

- DRP development is now a formal project at WMKO.
 - Will develop software requirements, pipeline infrastructure design, and start infrastructure development in FY2019
- WMKO will lead the effort in collaboration with instrument builders and existing pipeline development teams (Pypelt)
- Pipelines will be in a three-tier system:
 - Tier 1: Officially supported pipeline based on common infrastructure developed at WMKO
 - Tier 2: Externally developed pipeline meeting criteria and requirements set by data reduction working group. Tier 2 pipelines are potentially convertible to Tier 1.
 - Tier 3: Externally developed pipelines not meeting those criteria, but listed and recognized on WMKO web sites. Not convertible to Tier 1.
- Plan to have an open call to join pipeline DRWG
- KCWI pipeline to be converted to Python/Tier 2 by end of FY 2019
- Luca Rizzi and Jeff Mader are leading new “Scientific Software Coordination Group” to develop unified data flow architecture (DRPs, TDA, KOA)

PRV Landscape Review

Idea is to have guidance on where KPF fits into exoplanet/PRV landscape

Questions considered:

- What is most productive role for PRV on large telescopes?
- What is role for large telescope in big space mission/ELT era?
- What is the KPF science niche, how do those mesh with Keck community?
- How to go about optimizing science w/ KPF?
- How best complement other projects/missions?
- What about outside groups?
- How to maximize scientific output?
- What other RV opportunities exist beyond KPF on large telescopes?
- What strategies exist for cadence observing?

PRV Landscape Overview

Many high-power exoplanet folks on committee, incl. Scott Gaudi, NASA XRP reps.

- 2-day mtg. at Caltech in August 2018

Next frontiers in PRV science

- Current-gen PRV precision is 1-3 m/s, with some instruments pushing lower, sometimes with significant time investment
- Existence of “Fulton Gap” delineates goal of studying 1 R_E as a function of T_{eff} , spectral type, age, semimajor axis to understand formation/evolution (Fulton Gap around 1.5 R_E)
- 1 m/s -> Habitable Zone (HZ) Earths around M star (red/NIR)
- 10 cm/s -> HZ Earths around FGK stars in visible
- Masses and orbits (eccentricity, obliquity) for understanding formation/migration, ephemerides for scheduling JWST/ARIEL spectroscopic follow-up
- New PRV instruments will deliver HZ rocky planets (ESPRESSO, EXPRES, NEID)

Useful table of operational and planned vis/NIR PRV instruments in the PRV Landscape Working Group report.

PRV Landscape Review: KPF advantages

- Good longitudinal coverage, good seeing/low water vapor (tellurics)
- Good for faint targets compared to other instruments
- F5-M5 stars
- 380 nm channel for monitoring stellar activity
- Public access through NASA
- Kepler field requires northern access with large aperture (cannot be done with Espresso/VLT).
- Rossiter-McG. effect needs high SNR
- Complement NEID (WIYN telescope, Kitt Peak)
- Finding/characterizing HZ Earths for ELTs (M stars) and space missions (G stars)
- 100s of M stars

- Metric ($D^2 \Delta\lambda$) gives KPF an advantage, especially for later spectral types

PRV Landscape Review: KPF Science Niches

- Rossiter-McLaughlin effect requires instantaneous sensitivity.
- Masses for TESS targets, especially faint late-type host stars, good for JWST
- 100s of M stars out to M5-6, finding/characterizing HZ Earths
- NEID (WIYN) vs. KPF histograms for TESS/PLATO follow-up target numbers vs. spectral type shows a big advantage for KPF, especially for M dwarfs

Ancillary science

- Advantage of stable line-spread function for stellar physics, asteroseismology of dwarfs, fine structure constant and proton/electron mass ratio vs. redshift (latter cases need aperture, since they depend on QSOs)

PRV Landscape Review: Logistics

Challenges:

- Sharing a telescope..
 - HIRES uses an informal queue; Formal queue may be appropriate/needed for KPF to be deployed efficiently
- DRP development
- SSC needs to reach out to broader community to investigate non-PRV science that HIRES does that could be achieved with KPF
- Queue issues need further study.

Potential augmentations:

- Solar feed to assess performance
- Second fiber feed from Keck 2
- Replace etalon with laser frequency comb
- Collaborations with other groups/telescopes to enhance science return

Target of Opportunity (ToO) recommendations (#1)

- A committee made up of representatives from each partner with no direct link to gravity-wave (GW) investigations were established to update the ToO guidelines (Kirby/Caltech, Helfand/NASA, Liu/UH, Prochaska/UC, Campbell/WMKO)
 - Obtain the best-science and avoid multiple competing groups triggering simultaneously.
 - Provide follow-up opportunities.
- In the last two years, only 4 of 96 of the allocated partnership ToOs were triggered.
- LIGO's next observing run is scheduled to start in March/April 2019, which will likely lead to numerous ToO triggers at Keck.
- The committee started activities in June/2018, collected previous ToO statistics, and provided recommendations in Sep 2018. New ToO guidelines to be released in Nov 2018.

KCRM: Red channel of KCWI

- **KCRM:** PDR will be held Jan 17 - 18, 2019, at Caltech.

K1DM3

- Currently rotation only (M3 mode) during the night i.e., OSIRIS and HIRES exchanges, not yet retracting for Cass instruments
- Will be available for 2019A with full access as planned.