SSC Report

November 20, 21
Waimea WMKO HQ
Jean Brodie and Chuck Steidel
SSC co-Chairs

The SSC Thanks the WMKO Staff

The SSC is extremely grateful to the Staff at WMKO for their commitment to the observatory during these challenging times. Their dedication to keeping science flowing is a source of pride and is what keeps WMKO at the forefront of ground based observing world wide.

The SSC Thanks Dave Cowley

The SSC thanks Dave Cowley for his many contributions to the success of WMKO and wishes him a happy, healthy and fulfilling retirement.

Observatory Report

- Segment repair on track to be complete by April 2020.
- Operations have been near normal since restarting, despite the ongoing blockade of access road.
  - Maunakea road blockade caused a 28-day shutdown in summer, largely during good weather.
- Science highlights:
  - Confirmation of GR at galactic center, pericenter of SO-2 (T. Do, A. Ghez)
  - HR 5183b, Jupiter-mass planet on extremely eccentric orbit (S. Blunt, A. Howard)
  - Rapid follow-up of galactic hosts of fast radio bursts (V. Ravi, J. X. Prochaska)
  - Microlensing anomaly caused by super-Neptune (T. Sumi, D. P. Bennett)
- Keck is the most productive ground-based optical/infrared observatory on a per-telescope basis, as quantified by publication impact.
- Top-level strategy goals:
  - Instrumentation: complete KCRM and KPF
  - Maintain a vigorous instrument development program
  - Data services: enhance archive, increase productivity and impact
  - Risk reduction: advocate for reliable Maunakea access, prepare for lease renewal
  - Facility upgrades: enhance reliability, address obsolescence

Data services initiative (DSI)

- The new motto is “On sky every night **with the best data**.” The data should be useful, usable, and quickly available.
- The goal is to have raw data ingested into the archive in real time, then have full reductions with observatory-supported pipelines shortly thereafter.
- The DSI is not just pipelines. It also involves standard observing recipes, standardized calibrations, archive ingestion, and better metadata.
- The data reduction pipeline (DRP) framework was codified in August 2019.
  - One of the most difficult aspects of writing DRPs is reverse-engineering the observing strategy. The DSI helps with that by standardizing observations and retaining metadata.
- Database-Driven Observing Infrastructure (DDOI)
  - User defines S/N, bandpass, etc., and it will return a recipe for calibrations.
  - This is **not** a queue.
  - The DDOI will not exclude the current method of operating instruments (e.g., command line), but both modes may not be supported in the future.
- In the near term, the DSI will need increased resources, integration of PypeIt and other pipelines, and DDOI development.

Proprietary period for calibrations

- Some reductions will benefit from calibration frames taken on other nights. Split nights and ToO observations using the same instrument setup will also benefit from shared calibrations.
- The Chief Scientist requests SSC endorse zero proprietary period on calibration frames taken in the afternoon and morning.
  - This would include calibrations such as dome flats, biases, arc lamps, etc.
  - Calibrations with target information (e.g., multislit masks) would be exempt from this policy.
- The SSC unanimously agreed to support this proposal.

Unattended night operation (UNO)

- UNO’s goal is to allow the telescopes to be operated safely and reliably without humans at the summit during nights.
- Benefits:
  - Reduced cost
  - Additional science time (40 hours/year/telescope) due to addressing existing inefficiencies in preparation for UNO
  - Improved safety and health of staff
- UNO development has been impacted by other recent pressing issues but WMKO is actively working now toward progress.

Segment repair

- 73/84 segments are repaired. 65 repaired segments are in telescopes, and K1 is fully populated with repaired segments.
- The repair project had no major issues.
- Project is expected to be complete in April 2020 on budget without dipping into contingency.

KPF update

- Project is on schedule to deliver in May 2022(?), operations in November 2022(?). However, very little slack is left in the schedule, and there will be a delay if remaining funding is not identified immediately.
- Major milestone: Zerodur disk has been machined successfully.

Future instrumentation under consideration

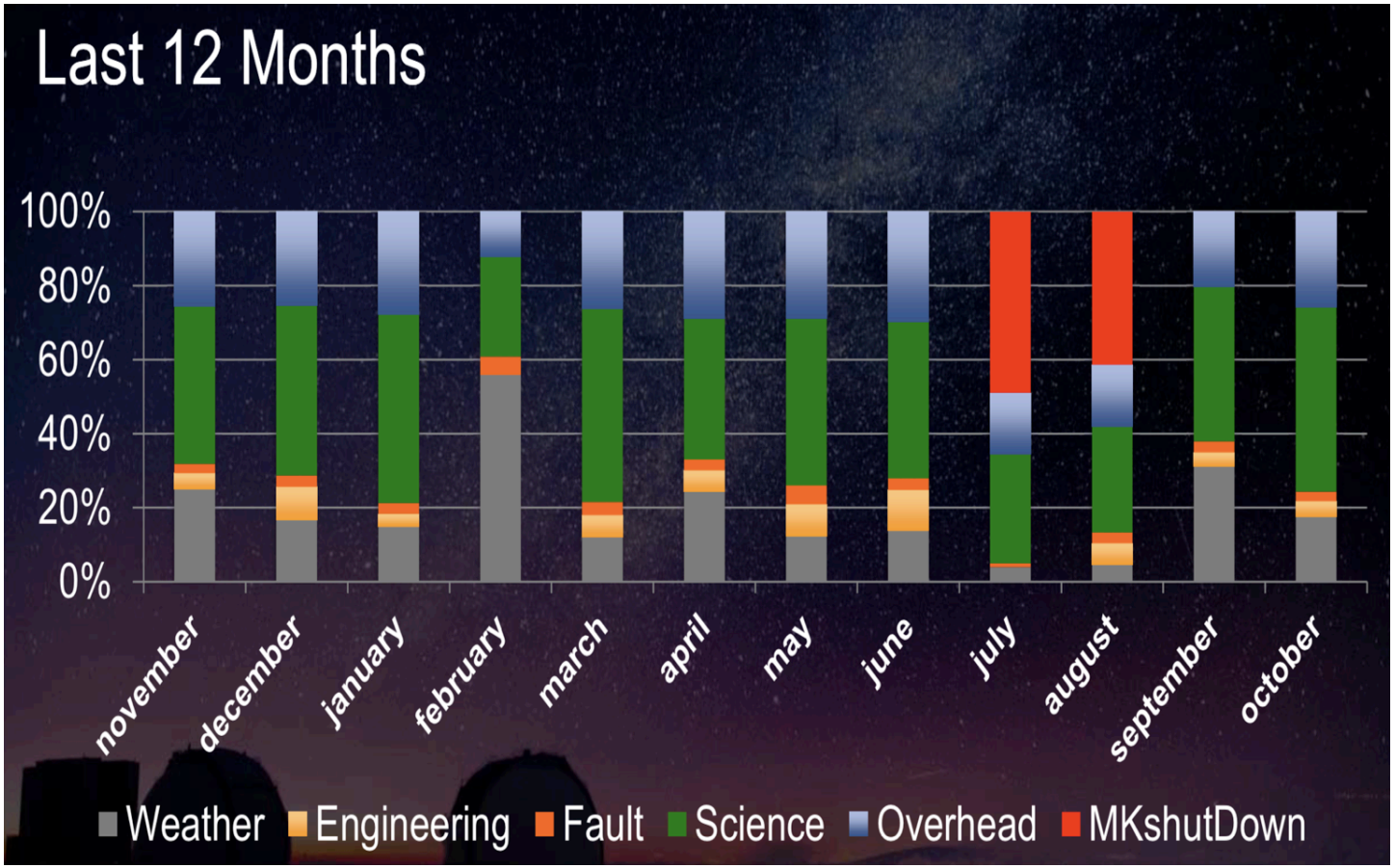
- Instruments and AO capabilities currently under consideration:
  - FOBOS
  - SCALES
  - LIGER
  - HISPEC
  - NIRSPEC laser comb
  - BIRES
  - KWFI
  - GLAO

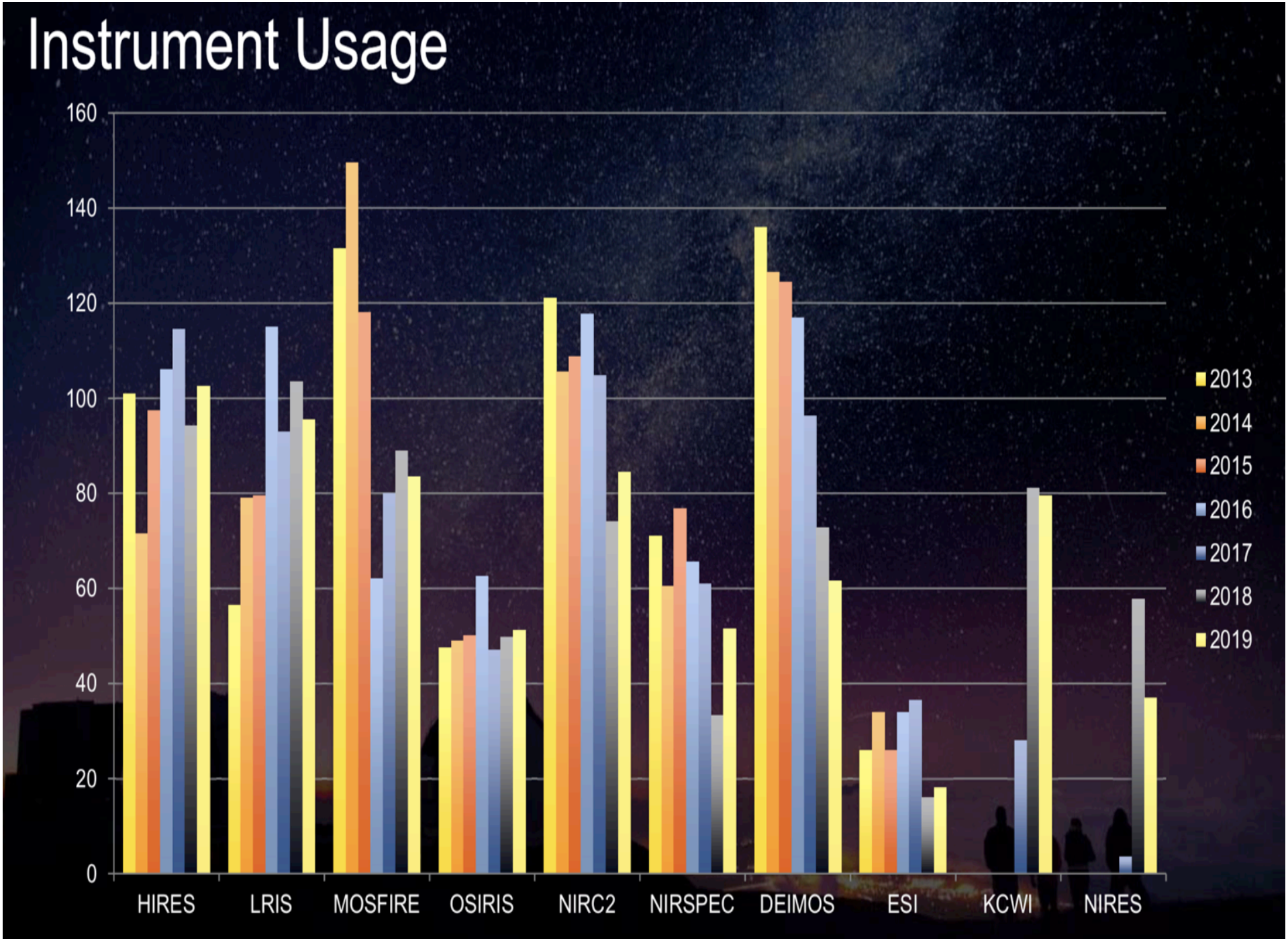
KCRM Update

- Integrated master schedule updated.
- New plan maintains schedule for commissioning in 2022A and science starting in 2022B.
- Detector subsystem on critical path in full scale development phase.
- Science detectors from LBNL have been acquired.
- Project manager being hired at COO, taking over from Marc Kassis who has been serving as project manager in an interim capacity.
    - **The SSC thanks Marc Kassis for his enormous investment of effort and outstanding work in this role**.
- CIT/JPL has been providing management guidance and system engineering.
- PDR chair Fengchuan Liu (TMT) continues to provide guidance.

WMKO Instrument Metrics

- All instruments are all being used and producing publications
- All instruments lost < 5% of observing time each averaged over past 5 years
- WMKO is assessing risks of failure for each instrument (likelihood & impact)




Instrument Usage
160
140
120
100
80
60
40
20
0
HIRES
LRIS
MOSFIRE
OSIRIS
NIRC2
NIRSPEC
DEIMOS
ESI
KCWI
NIRES
2013
2014
2015
2016
2017
2018
2019

Instrument report

- **Keck 1 instruments**: HIRES, LRIS, MOSFIRE, OSIRIS
- **Keck 2 instruments**: ESI, DEIMOS, KCWI, NIRSPEC, NIRES, NIRC2

- **Commonly repeated themes**:
  - Successful transitions from SunOS to Linux-based hosts
  - Lack of availability of spare parts
  - Aging mechanisms, with increasing frequency of failures

LRIS (Rizzi)

- LRIS is a 25 year old instrument with blue-side detector installed in 2002, red in 2010.
- The most important development was the installation of a new shutter (shutter used to fail once a year). Also updated from Solaris to Linux.
- The main issues are associated to aging mechanisms and lack of spare parts.
- A critical problem is now affecting the red detector (1 of 4 amplifiers not functional). Slower readouts with single amplifier still possible. Plan to update the detector in summer 2021.
- There is a probable risk of critical failure due to lack of parts and old software

HIRES (Manjavacas)

- HIRES was commissioned in 1993, with a detector upgrade in 2003
- A test of the detector characteristics (e.g., gain, read-noise) over time indicate practically no changes since the upgrade in 2003.
- A new GUI was deployed, and the instrument servers now operate in Linux (before in Solaris). Webpage updates.
- A high risk is having no access to the summit during a detector warning may impact greatly the sensitivities. Moderate risk in lack of spare parts.
- Another risk is likelihood of problems reproducing QE benefits of O2 backfill procedures in the event of a warm up

OSIRIS (Yeh)

- Detectors upgraded in 2016 and 2017. New characteristics quantified.
- Main improvements include a new quicklook tool and image sharpening (re-focused). The software is now being migrated from Solaris to Linux.
- There are issues with the rectification matrices due to lenslet masks losing steps. Also pupil misalignment in the imager.
- Tested twilight imaging program scripts
- Main risks include vacuum leak evidence and power outage (CCR loss).

MOSFIRE (Walawender)

- The detector uses a Windows driver, but it has been stable (installed in 2012).
- A KVSP performed a flexure analysis and automatic measuring tool.
- Software issues, including CSU fatal errors and during startup. FCS problem traced to a bad port, now fixed. An amplifier died, impacting half of the guider. This is inconvenient but not a show stopper for regular observing.
- There is no spare for the FCS piezo controller, yet parts are available and an order is being prepared. There is no spare guider. The spare for the Macu board will require re-development.

ESI (Lyke)

- The instrument has not been upgraded since its installation in 1999.
- Aging is the main risk with guider, motion control issues, and obsolescence of detector system.

DEIMOS (Alvarez)

- Installed in 2002, with MIT/Lincoln Labs CCDS (ARC-GenII controller).
- Upgrades to pre-observing software.
- The rotator control and host are being upgraded, to replace obsolete computers and controllers, and to fix several mechanical issues. On-sky testing now and new GUI developed.
- The slitmask software and simulator (dsimulator) are being rewritten (modern interface and programming language) and brought from UCO/Lick to Keck computers.
- Issues include: detector electronics, in particular bad readout on CCD5 (5x read noise), lost vacuum 4 times last year (once due to shutdown), glycol spill and rotator degraded performance (drive was replaced by spare).
- The main risks are associated with detector issues and with the cryogenics (lack of vacuum). Less critical risks include aging mechanical components and obsolete instrument host.

NIRC2 (Alvarez)

- First light in 2001, with original detector and old transputer controller.
- Hardware upgraded to provide modern coronagraphic capabilities (VVC, Lyot mask). Software migrated to Linux.
- The detector server crashes almost every night (yet the impact on time lost is minimal). The instrument host was also rebooting spontaneously and it was replaced. The cold head failed and it was replaced.
- The main risks are related to the obsolete detectors and host computer.

NIRSPEC (Doppmann)

- Major upgrade successfully implemented in 2018, new detector (2x larger format, 3x lower read noise), controller, and new SCAM detector. Stable operations (no server crashes), and increased thermal (3x) mechanical (5x) stability. **The SSC commends the team for such an impressive success.**
- SCAM guiding is now being implemented, after reducing readout times.
- Issues: long overheads for co-adds and occasionally missed slit nods.
- Main risk is related to aging mechanical parts (e.g., rotator and echelle).

NIRES (Gomez)

- The SCAM detector is a 2010-generation device
- Excessive persistence has been fixed
- Main issues include refining the flexure compensation system, SCAM guiding, and addressing quick look tool crashes.
- Cryocooler retrofit too expensive, now investigating rotating LN2 feed.
- The main risks include obsolete ARC (detector) and piezo-actuator controllers, an aging mechanical shutter, and general lack of spares.

KCWI (Rizzi)

- The most modern instrument, with a Teledyne detector and ARC-GenIII controller. No aging issues yet!
- New set of simplified GUIs and a configuration manager. Pipeline is being converted (80% done now) to Python (from IDL).
- The main issues include: sub-par flat-fielding (probably associated with the DRP), problems initializing the guider, and charge injection after a change in binning.
- The main risks are a dewar leak and accommodating (software and hardware) for KCRM integration, which will require dismantling the instrument and having it unavailable for a semester.

AO operations (Guerra)

- A large range of detectors and technologies
- The main activities on AO are K1: TRICK software, WFS noise source (pickup from FCS stage), TT actuator replaced, and new AOserver; while in K2: upgraded room cooling capacity and new AOserver.
- Main risks are related to aging systems and mechanisms, glycol leaks, TRICK software, cooling capacity, and labor resources.

Remote observing (Walawender)

- ISDN is no longer required. Observer bears the risk for loss of time due to internet/power outages.
- Evaluating transitioning to "Zoom rooms" instead of "Zoom Pro"
- A VNC launch script/app was developed - it is now in beta testing phase.
- New sites include Northwestern
- Risks include internet outages (e.g., recent fires in California), on-call support at the remote site varies, and summit/HQ depends on old polycom hardware.

Adaptive Optics Update

AO publication rate remains robust, e.g. Keck LGS continues to lead refereed papers.

IR pyramid WFS (UH led instrument) doing well in commissioning phase.

KAPA development continuing:
- SDR passed, PDR in July 2020 (6 months ahead of original schedule)
- new K1 LGS installation progressing through early 2020
- new RTC testing & installation in summer+fall 2020

KPIC developments: recent successful science run; NIRC2 upgrades (coronagraphy + polarimetry), new DM, new ADC, new fiber coupling optics

AO Future Study Group underway, preparation for June 2020 Keck SSC meeting

GLAO Report

‘imaka pathfinder experiment on UH 2.2m finds 2x increase in noise equivalent area (photometric sensitivity), uniform PSFs across 11’ field, ~sqrt(2) improved astrometry, relatively achromatic.

Keck GLAO feasibility study has been on pause after year 2. Scope to date has been to carry out initial performance simulations, instrument compatibility study, WFS feasibility study, and ASM technology survey.

Can existing instruments take advantage of GLAO?

LRIS: optical quality can take advantage of up to 0.3” in histogram of past performance. The seeing statistics could be biased because of telescope focus errors. Also has an ADC. But no flexure compensation, so that is the main problem.

DEIMOS: used pinhole mask to asses image quality. Looks good. No ADC

MOSFIRE: no ADC.

For Cass instruments, feasible WFS pickoff in tertiary tower.

KCWI, HIRES, NIRSPEC: not explored

Note improved PSF stability could help with HIRES. Free atmosphere is more stable than ground layer.

GLAO continued

Note update from AOF GLAO on VLT. Enclosed energy in a 0.2” spaxel. Improves dramatically with closed loop, more than 2x. Performance drops in blue. Note better gains in worse seeing.

FOBOS can potentially take advantage of GLAO feed. Fiber bundles could potentially be placed in center of field where there is GLAO correction. Reserving space for WFS. Question about sampling on spectrometer detector. Need to engage with team on GLAO potential. Plan is to have an ADC.

New DM technology from TNO, project for UH 2.2m for 2020-2021. Should solve many problems of existing mirrors (no glycol, no air gap). General optimism for new technology. The SSC supports the suggestion that Phil Hinz be engaged in further investigating these technologies.

SSC request a brief (~1-page) document summarizing issues and next steps.

ToOs and non-traditionally scheduled observing

- 11 Target of Opportunity interrupts executed in 2019A+B, well below limit
  - 50% required instrument change. Those had high overheads (focus, cals) and required > 1 hr
  - WMKO is looking at using fixed focus offsets to reduce instrument change overheads
- 4 twilight programs being executed on Keck 2 with NIRC2 NGS
- Investigating extending twilight observing to Keck 1 with OSIRIS imager NGS
- Queue observing is desired for Keck Planet Finder (KPF). SSC will charter a working group to provide advice on policies (limited to KPF PRV only).
- The SSC discussed a Fast Turnaround Proposal system (like Gemini FT):
  - 1 month cycle, regularly scheduled 0.5 nights / mo
  - Proposals and reviews would be managed by WMKO
  - Could also be used to allocate give-back science time (surrendered from engineering)
  - SSC does not endorse a Fast Turnaround Program at this juncture, but would like to study GEMINI fast-turnaround program before making any recommendation