

Keck SSC Meeting Notes

2020 November 11-12
Meeting held via Zoom

Introduction

- The SSC enthusiastically congratulates Andrea Ghez, her group, and the greater Keck team including Peter Wizinowich, Keith Matthews, and WMKO staff, on the Nobel Prize in Physics awarded for Galactic Center research.
- The SSC thanks Andrew Howard, Courtney Dressing, and Shelly Pelfrey for organizing a great 2020 Keck Science Meeting.
- The SSC welcomes Ryan Chornock, new Northwestern representative.
- The SSC welcomes Meagan O'Shea as the Keck Executive assistant.
- The SSC congratulates Leslie Kissner on her retirement and thanks her for 17 years of service at WMKO.
- The SSC commends the WMKO staff and management for its dedication & innovation in continuing high-quality operations despite significant COVID constraints and impacts.

Observatory report

- COVID status
 - No positive cases among WMKO employees or family members
 - Operating restrictions in place
 - Return to Site Initiative -- safely increase employee presence on summit and at HQ
 - Depends on conditions; goal to have preparations in place for initiative by January
 - WMKO will maintain 2 test approach to allow mainland contractors to come back on site
- Maunakea Update
 - IfA Director search on hold. Interim Director McLaren stepping down in Jan.
 - OMKM Director Nagata retiring. Loss of other staff and institutional knowledge
- Only 9% of allocated ToOs were used 2018B - 2020
- Observatory FY21 Plan is impacted by COVID
 - Project implementation is impacted and infrastructure projects delayed
 - No shutdowns planned, but will be revisited if COVID cases surge
 - Maintain staffing for externally funded projects
- Strategic Planning
 - Full Keck strategic plan dates to 2002; Science component last updated in 2016
 - Keck will remain the largest telescope in Northern Hemisphere for ~15+ years
 - Propose full update of strategic plan over next year; present to SSC and Board Nov 2021
 - SSC Endorses the concept
 - Will include all WMKO partners, with input from all stakeholders
 - Science, Community, and Infrastructure components
 - Science component to include Astro2020 and kick off March 2021
 - Summer 2021 workshop

Observatory report (2): Major Projects

- **KCRM**
 - On-track for Oct 2021 delivery, first light March 2022, available 2022B
 - Cryostat and detector housing received by UCO, gratings and other optics arriving
 - Camera optics (Winlight) and detector system are critical path items
- **LRIS Red**
 - Performance of current LRIS Red side continues to decline
 - Full new detector system to be delivered Feb 2021, commission during normal sky time
 - Detectors delivered, Det mount being fabricated, dewar ready
- **KPF**
 - Delivery in January 2022: matches NSF MSIP Schedule
 - Critical path has 7 weeks schedule slack until Assembly, Integration, and Test
 - Winlight camera optics on schedule but re-formatter optics are slipping
 - Zerodur bench is being machined at Schott
 - Detectors are now being processed and backside-thinned (U Az)
 - Vendor damaged collimator in polishing; new blank being cut
 - Interferometer hardware cleaned out of WMKO basement; preparing for KPF arrival
- **KAPA**
 - PDR/DDR to be held Nov 19 & 20
- **NIRSPEC / HISPEC Laser Frequency Comb**
 - Heising-Simons has awarded funding; Stephanie Leifer (JPL) is PI
 - Hardware to arrive Summer 2021; will then be integrated into NIRSPEC and KPIC
- **SSC impressed with good progress despite significant COVID impacts**

COVID impacts

Day operations: Summit Ops & HQ facilities staff are required to be on-site

- All CDC and state/county safety guidelines and mandates are being followed
- some tasks more difficult, some not being done (e.g. segment exchange)
- Daytime ops now on 7 days per week schedule, so larger group of summit staff on weekends & holidays compared to pre-COVID. Working well.

TDA science: no instrument switches allowed for ToO

KSM meeting was conducted on-line and had 425 participants, the largest ever.

Impacts to external projects (and similarly for internal projects) due to:

1. Restricted access to campus labs & shops
2. Persisting inefficiencies of working from home offices
3. Vendor inefficiencies
4. Process inefficiencies caused by lack of in-person meetings and discussion
5. Challenges in staff management, team continuity, hiring

Note: Assembly, Integration, and Testing will be affected for LRIS/KCRM/KPF

The SSC commends the WMKO staff and management for its dedication & innovation in continuing high-quality operations during these times.

Pajama Mode observing and impacts on science

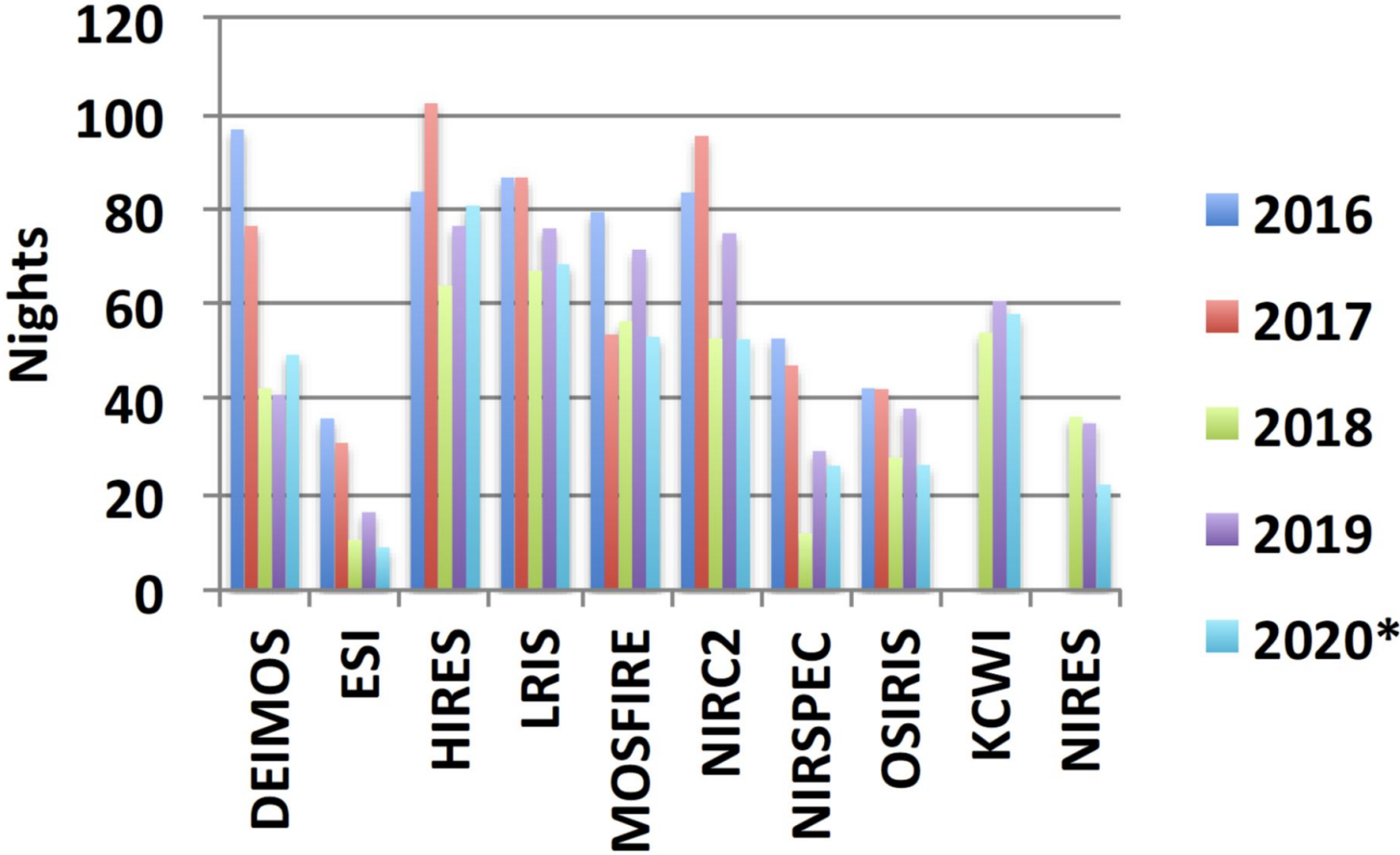
- Pajama Mode is now ~80% of observing; some observers able to use official sites.
- Positives:
 - Can get technical help readily from WMKO staff through the VNC
 - Facilitates engagement by larger portion of team, including people on different continents and more senior observers with significant daytime duties.
 - Boosts inclusivity, e.g. single parents & observers lacking travel funds
 - Improved observing efficiency from being able to bring in experts for a portion of the night (e.g. specialty observations & real-time debugging)
 - Facilitates involvement of collaborators, now all over the world.
 - Improved physical comfort compared to some Remote Observing rooms
- Negatives:
 - Reduced interactions with Keck staff: potential loss for both PIs & WMKO
 - Minor inefficiencies due to bad internet connections, poor microphones, lack of monitor real estate causing windows to be hidden
 - Potential loss of focus while observing from home
 - Added resource impact on WMKO staff

Instrument Reports: General Metrics

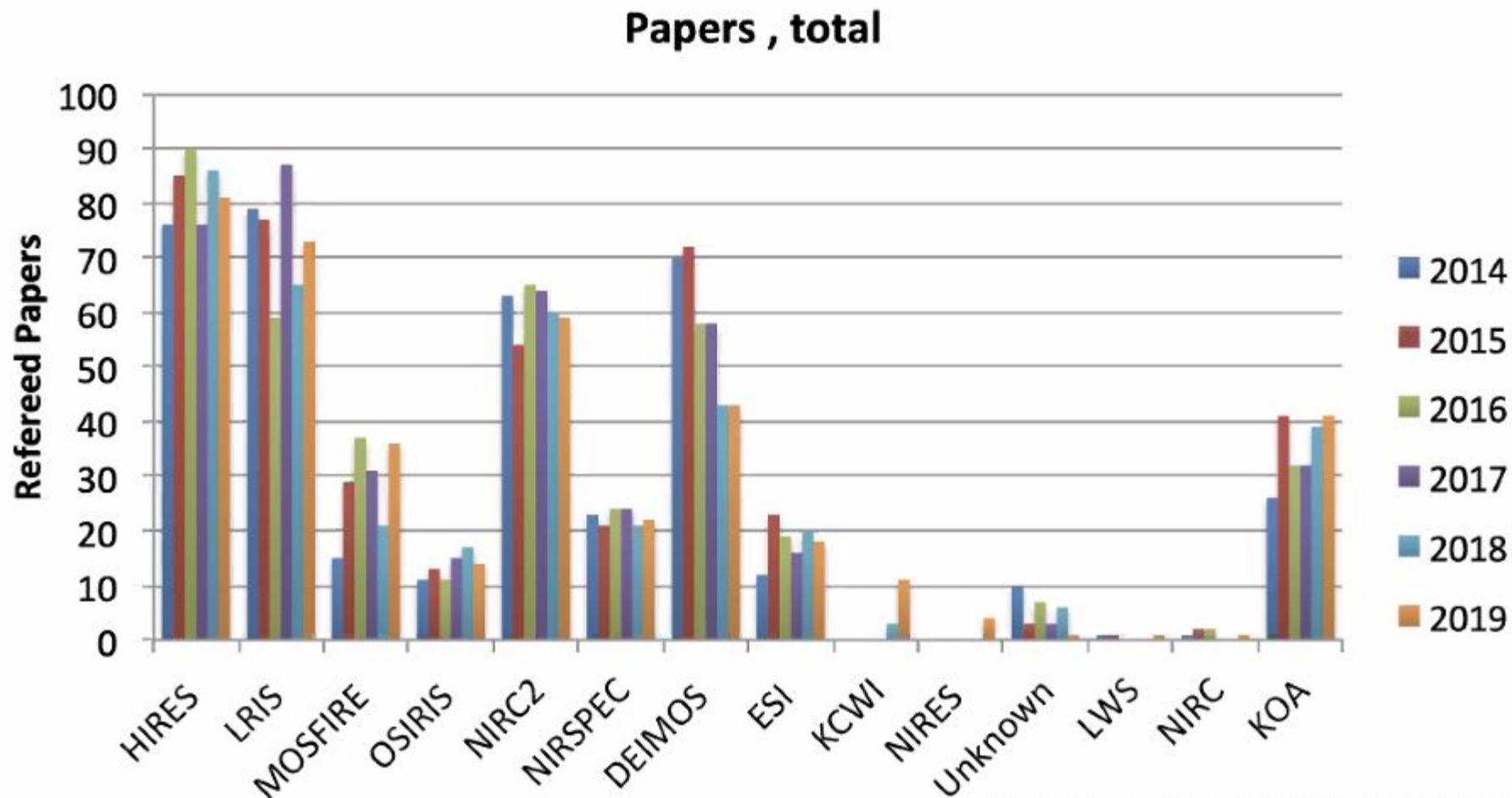
- Staffing: Elena Manjavacas has departed to work on *JWST*. Rosalie McGurk hired as a staff astronomer, starting in March. One SA position in recruitment.
- Consistent ~50% open-shutter science time over the past 6 years.
- Instrument use on-sky shown, some changes over time as KCWI and NIRES came online.
- Faults: KCWI and NIRES have decreased, NIRSPEC, OSIRIS, NIRC2 have increased a bit with new modes.
- Publication numbers per instrument largely consistent over time; new instruments still spinning up. KOA publication rate is tracked as well.
- Papers per night (using # nights of previous year) shown. Largely flat distribution. Differences in rates for instruments may be due to usage mode (survey+single object), pipeline maturity, and assumption of 1 year to publication.
- Instrument assessment includes 5x5 risk matrix (likelihood vs. impact)
- LN2-cooling impacts are both likely and impactful
 - 6 of 10 instruments have LN2 cryostats (soon to be 8/12)
 - Supply risk: 2 major interrupts in past year
 - Manufacturing plant down, also COVID shortages, summit access issues
 - Cryostat stability is risk to detectors and optics (through unintended thermal cycles)

Instrument Reports: General Metrics

Useable on-sky time



Instrument Reports: General Metrics



*Some papers use more than one instrument

LRIS

- Most productive Keck instrument (along with HIRES)
- Aging is causing problems mechanically and with detectors
- Risk matrix
 - Probable/major: Red CCD failure before replacement
 - Mechanical problems can be probable/minor, possible/serious, or unlikely/major
- Current problems:
 - Red side CCD: 4 amplifiers: 2 are dead, 3rd is unstable
 - Several mechanisms are unreliable (have to be moved several times)
 - Worn-out parts: grinding noises, broken cables
 - Software incompatibility with modern Linux (affects keyword history and DSI)
 - Ongoing mitigation
 - Continuous problems causes strain on summit crew. Often requires interventions at beginning of each run
- Ongoing activities:
 - GUI upgrade to support binning/windowing complete
 - Mechanism software upgrade to support keyword history complete
 - Cost analysis for overhaul not yet started
 - LRIS Pypelt module not yet started
 - Red-side upgrade scheduled for March
- Polarimeter damage
 - Beamsplitter e-ray prism has detached from o-ray prism, and calcite crystal is chipped
 - Looking into sending back to Karl Lambrecht Co. for assessment of repair/replacement

HIRES

- Risk matrix
 - possible/major: CCD dewar warm up. Specialized procedure, O2 soak. Procedure is not known. Hasn't warmed up in 16 years.
 - unlikely/major: CCD crate failure, solaris server failure
 - Very unlikely/major: motor crate failure
 - unlikely/serious: CCD shutter failure
- Stable operations in all of 2020. Linux upgrade for user interface (vm-hires)
- Compact HIRES mechanism GUI replaces old XHIRES GUI
 - Some desire for retaining old view of light path expressed
- K1 dome leak caused water to pool on HIRES enclosure. Crack in instrument enclosure caused a small amount of water to leak inside.
 - No water contact with dewar or optics. After elevated humidity, returned to normal after 2 days.
 - No evidence of water in data at 1% level
 - Roof re-sealed

OSIRIS

- Risk matrix
 - Very likely/serious: mechanism
 - Very likely/negligible: IMAG Fell filter bad image quality
 - Very likely/minor: AO faults
 - Probable/moderate: data reduction challenges
 - Unlikely/serious: Windows detector server failure
 - Very likely/serious: mechanism failure
- Updates from last year
 - Updated quicklook tool for correct orientation
 - Improved image sharpening for both spectrograph and imager
 - Provided NIRC2-like scripts for image (e.g. igoi, bxy3)
 - Migrated control software, scripts, VNCs from solaris to linux
 - Installed new Holographic Aperture Mask (HAM)
 - Realigned imager pupil mask
 - Fixed recmat issues, recalculated named positions for lenslet mask stage
- Lenslet mask stage failure
 - Troubleshooting: re-homing, service restart, driving motor steps (no sound), power cycling controllers, swapping control cables
 - Next step is to service in November. Warming up currently.
- Community-driven tasks
 - Wavelength calibration error study with UCLA
 - Differences in pupil with image scale
 - Imager DRP, with UCB KAPA group

KCWI

- No major problems in 2020.
- Risk matrix:
 - Extended loss of power may cause overcooling of detector
 - Recurrent problems: major dewar leak
 - Integration of KCRM will be a major operation and entails risk
- A new pipeline has been developed and is now complete (e.g., real time, event driven, python based); released in January. Deployed in December and integrated in DSI. Will run automatically while observing.
- A new automatic startup (which is ready to accommodate KCRM) and autofill procedures have been developed. Autofill upgrade: moved outside of instrument; shared with DEIMOS.
- Dewar fix, new BH1 grating will be implemented once the KCWR integration is done. The polarimeter and deployment of the new pipeline and DSI prototype in December.
- The problem of the excessive charge injected in detector after binning switch still needs to be fixed.

DEIMOS

- Risk matrix:
 - Serious problems with CCDs.
 - Rotator drive and optomechanical components are of concern. Mechanisms get stuck and have to be solved manually. Easy fix though.
 - Cryogenics: spontaneous soft vacuum event, detector dewar. Detector warmed up.
- Detector problems: not sensitive, not responding, striping, gradients, etc. Fixing is risky and complicated.
- Rotator drive degraded performance: high servo error while moving. Harmonic drive was replaced last year and again this month. A new rotator control system upgrade was also completed with new computer moved to Keck II computer room.
- Instrument host upgrade has been completed. Upgrade has incorporated new mechanism/instrument control and new data viewer scripts.
- Autofill upgrade completed: commonality with KCWI autofill.
- Pre-observing: Slitmask database migration pending; bring to Keck, eliminate dependency on UCO/Lick. New slitmask design tool in testing phase.
- Throughput upgrade: CCDs, detector dewar, flexure compensation mechanism. Major overhaul needed.

NIRC2

- Coronagraphy one of the most popular observing modes nowadays
- Risk matrix:
 - A high risk item is the instrument host, which is quite obsolete (Solaris based).
 - Detector electronics: certain components reaching high obsolescence.
 - Detector transputers: Aladdin detector, old transputers. Haven't failed recently, but limited spares available.
- Issues:
 - Detector server crashes almost every night, but recovery is fast.
 - NIRC2 host suffered spontaneous reboots; seems solved by partial hardware replacement.
 - Low efficiency of operations with the Vortex Coronagraphy (VVC), upgrades suggested.
- Improvements: update image writing software (fix header problems / add PyWFS keywords); PyWFS monitoring GUIs now available on NIRC2 VNCs.
- For some imaging science cases, more modern OSIRIS could be used instead of NIRC2, achieving better detector performances and wider FOV.

ESI

- Risk matrix
 - Risk of disruption to cryo supply
 - Detector system failure associated with obsolescence.
 - Guider failure: issues with an encoder in the mechanism
- Issue with poor rotator tracking: instrument was shaking. Missed lubrication test during shutdown. This has been fixed and other updates to the rotator amplifiers.
- Guider had a failure and was replaced with the spare. A new spare is now developed based on other instrument spares.

NIRSPEC

- New detector installed in 2018 for both Spec and Scam.
- Now has AO-fed fiber injection mode, which has had recent science verification use (successful).
- Risks: CCR cold heads may fail; Echelle grating mechanism failure
- Servicing mission in Feb. 2020: rotator worm gear replaced, new pupil stop added to filter wheel, new CaF2 dewar window; SPEC detector made more light-tight; water removed with warming/pumping.
- Failure modes at present: Galil motion for internal stages, apparently due to high current draw (rotator and/or echelle grating mechanism). Power cycling helps, with re-initialization of mech.
- Upcoming service mission Feb 2021, replacing both CCR cold heads; replace failed pressure sensor; will pump for ~1 week to remove accumulated water.
- Work to reduce detector overheads (Keck Visiting Scholar student work involved)

MOSFIRE

- Has survived power interruptions over last 28 months during shutdowns.
- Guider repair complete - replaced guider CCD
- Situation with spares has improved - spare MACU board modified by summit staff, works in instrument. Spare FCS controller acquired, needs to have zero points (during daytime).

NIRES

- Work on slit-viewing camera guiding - successfully tested, soon to be operational.
- Slit-guider flexure - has now been measured, with max. Delta~1". Correction for this is in development.
- Working with Pypelt team to have a real time quick-look display.
- Risks: Leach boards ; optical guider shutter.
- FCS: controlling the FCS (slit to science detector) needs calibration
- Guider shutter is problematic, needs replacing.

Remote Observing

- Pre-COVID changes - new software for launching VNCs complete; testing video conference hardware stalled due to COVID.
- Pajama Mode observing implemented due to COVID. Remote ops software under rapid development. 400 SSH keys in system now. New ticket tracking system to set up remote ops.
- Remote observing sites can now be set up with much greater ease.
- ISDN lines no longer used.
- Risks: network interruption at observer home (having multiple observers at different sites mitigates this issue)

KOA

- Numerous projects (12 listed) - all on schedule
- Data will be ingested in real time
- Data available through Table Access Protocol and PyKOA (now available for HIRES)

AO Operations

- Biggest likely AO risk is DM electronics failure due to age
- Have had some laser failures but no downtime due to using laser spare
- Working on reducing WFS pickup noise to reduce jumps, also DM Elex cooling
- TRICK IR TT sensor still requires visible TT star, limited to $H/K < \sim 14$ mag
- Excellent image quality but may be insufficient for KAPA
- 76 AO nights on K1 and 163 nights on K2, including 16 PyWFS, over past 12 months
- Continuing AO infrastructure work, characterizing low bandwidth WFS (MAGIQ ~ 1 mag less sensitive), deploying new aoserver computers, upgrade projects

AO Development / KAPA

- Projects: RTC, KAPA, FIU coronagraph, precitive WFC, PyWFS, AO refurbishment, ORCAS mission study, High-contrast imaging, Advanced WFS& control
- KAPA adds laser tomography and expands IR TT beyond current TRICK
 - Concerned that LBWFS will limit sky coverage (R~18 mag); transfer to TRICK?
 - Several students involved at WMKO, UC, Caltech (UH?)
- Multiple KAPA subsystem PDRs and DDRs underway
- Significant KAPA developments in FY21: LMCT laser removal, RTC implementation / commissioning, laser tomography testing, fabricate asterism generator, complete other components (TRICK, PSF-R)
- Approaching monthly KAPA science meetings:
 - 4 key science themes: GC; dark matter / energy; young exoplanets; lensed galaxies
 - KAPA science tools being developed

AO Development: PyWFS + KPIC + demos

- Good performance with several NIRC2 + PyWFS papers already published
- PyWFS is providing correction for KPIC
- KPIC Phase 1 is now producing science results
 - Throughput has been improved by a factor of 10 (on NIRSPEC) since first implementation; still improving
 - KPIC being implemented for NIRC2 and NIRSPEC
 - KPIC Phase 2 planned for 2021
- High contrast AO demos being done with predictive WFC, speckle nulling, electric field conjugation, faster correction, telescope segment phasing

Future AO Advances

- Future AO Study Group (WMKO / UH / Caltech / UC) is prioritizing improvements
 - Working on high-order DM and post-dawn AO studies / proposals with SSC endorsement
 - High order DM helps with bright objects and PyWFS gives sky coverage
 - Post-dawn AO: seeing does not deteriorate until ~2 hr past dawn
- Continuing collaboration with NASA Goddard on ORCAS LGS satellite
 - Potential for significantly improved sky coverage over initial estimate
 - Mission concept reviews in late November and then January for Feb 2022 proposal
 - Would be 3 year mission launched in 2025
- Adaptive secondary mirror study continues
 - P. Hinz white paper and multiple meetings since July SSC

DSI - Data Services Initiative (1)

- Currently in design stage and initial prototyping.
- Partly funded by NASA award.
- Philosophy: create data that's useful, usable, and quick.
- Why: increase productivity, user base, and utility; be ready for new instruments; align with NASA priorities and requirements and NSF data availability.
- DSI will add a different layer that can access keywords to drive/read hardware.
- Four pillars of DSI: Prepare, Execute, Reduce, Archive, which are coordinated as operational blocks and layers in the DSI architecture.
- Database Driven Observing Interface
- Plan: started in FY21, major milestones before Feb. 2023; Pypelt in development for DEIMOS/MOSFIRE
- First prototypes of DSI will be KCWI, NIRES
- WMKO resources: 2 new hires, several staff/SAs, Kassis (PM), O'Meara (PI)

DSI - Data Services Initiative (2)

- ODT (Observing Definition Tool) Workflow:
 - Observer adds target(s) to the Observing Definition Tool (ODT). The tool will be capable of ingesting non-sidereal objects, even automatically from JPL/Horizons.
 - Observer sets instrument configuration(s) in ODT
 - Observer sets observing sequence (dithers, nod/shuffle, co-ads, etc.)
 - User creates the observing block (OB)
- Above steps can be done any time prior to execution.
- At execution, the OB begins, but can be paused/stopped/altered.
- DSI will include quicklook tools: the team is working with Pypelt, with the ultimate goal to produce reduce data in realtime (<1 minute).
- Calibration: each ODT config will generate calibration set by pipeline needs; additional cals can be added; archival cals can also be used
- Observation: complete when cals and linked observations complete; incomplete observations flagged; validation checks
- DSI is not Gemini Phase 2 system (lessons learned from their system)
- ETC and planning tools are now being converted to python and online compatible with DSI. They will be vetted against archival data.

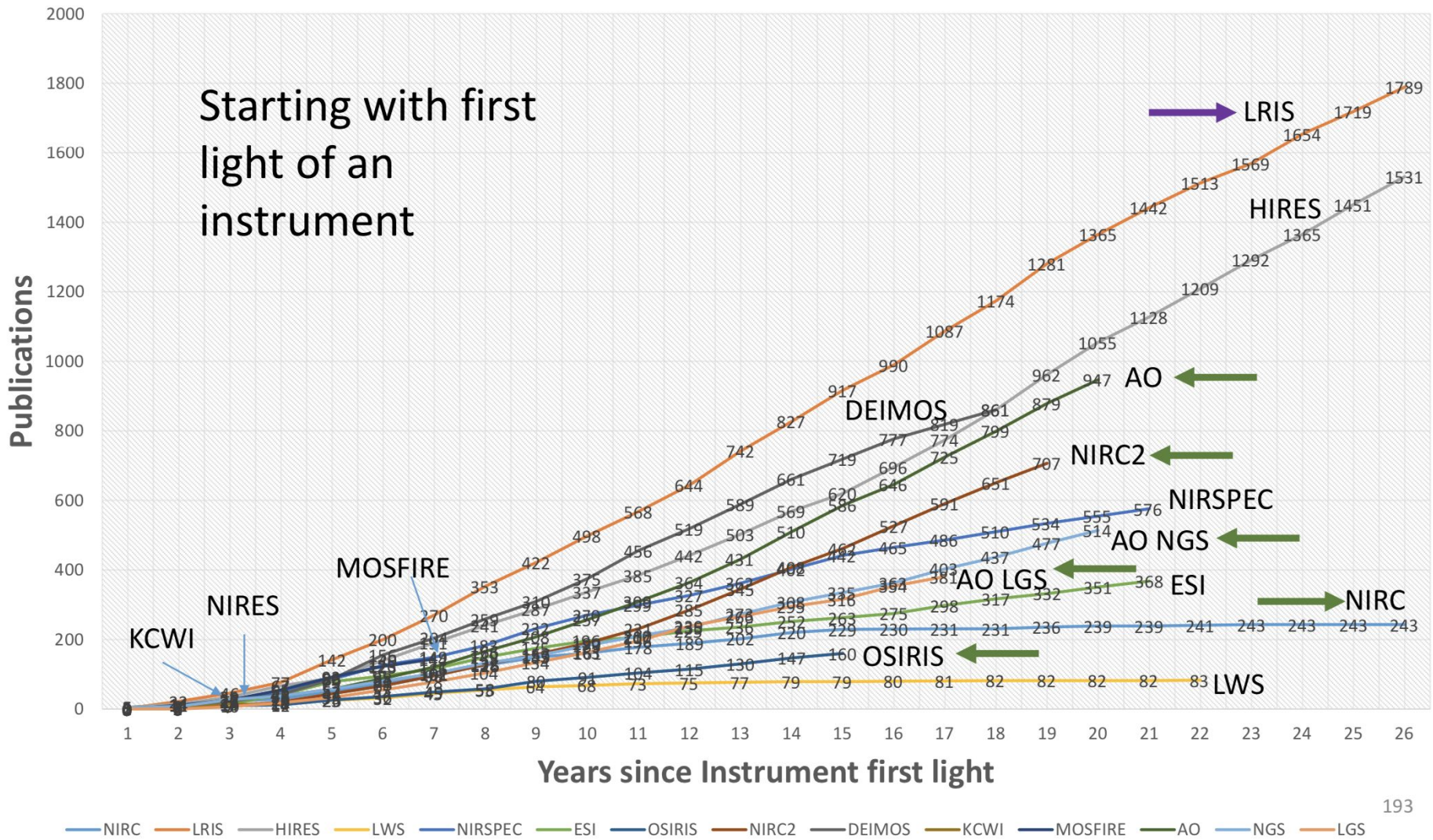
IR spectroscopy workshop planning

- Proposal for a community workshop on infrared spectroscopy, in advance of the strategic planning exercise. Idea is to assess community needs, including discussion of instruments we have heard about (HISPEC, SCALES, IGNIS) and any potential new ideas not yet on the table. Tom Greene is organizing.
- Survey will be send out to Keck community in the coming month.
- 1-day workshop in January 2021 for interested members of Keck community, including instrument PIs, Keck, SSC, etc.
 - Motivational science talks.
 - Community poll results.
 - Instrument concepts - (a) known, well-developed, (b) new, less-developed, (c) upgrades
 - Discussion of matching concepts.
- The workshop should yield a report to SSC/MMKO, which will inform the strategic plan. Goals are to enable prioritization and to identify gaps.
- Work needed before the survey is sent out includes data gathering on what is available at other observatories now, and planned in near future.
- Publicize e.g. at AAS meeting. Should reach out to solar system community.
- May be hard to get instrument team engagement given major proposal deadlines in same time period.

Retirement Metrics

- Historical note: instruments have been retired only when the location was needed for another instrument, either new or re-positioned.
- Possible metrics:
 - usage: allocated # of nights per year, and scheduling “frequency”
 - productivity : # of publications
 - citations: raw number and impact factor
 - “efficiency” or normalization by # of nights
 - needed level of instrument care+feeding (staff time converted to \$\$)
 - Other possible metrics brought up in discussion: science diversity, unique capabilities.
- Large set of graphs was presented on the above, by instrument and year.
- Optical spectrographs are the most productive, impactful & efficient
 - several have been upgraded but now could be replaced with 2nd-generation instruments
- Although efficient, ESI & NIRSPEC usage and impact have declined
- Existing instrumentation insufficient to make optimal use of KAPA and potentially GLAO
 - OSIRIS efficiency is low compared to other frequently used instruments
- Takes about 6 years to evaluate an instrument’s impact.
- WMKO’s next strategic plan should include a vision for future instrumentation (including retirements & upgrades for existing instruments).

Cumulative Publications Since Instrument First Light



Discussion: Instrument retirement

- What other metrics are needed for SSC to assess / discuss instrument retirements?
 - What spectral range and resolution would be lost? Could it be recovered via upgrades?
 - Should consider uniqueness of Keck capabilities
 - What science areas would be most impacted and to what degree?
 - What communities would be most impacted?
 - TAC rankings might provide useful information
 - What capabilities are always available (for ToOs)?
 - Resource cost of maintaining current instruments (daily ops/maintenance, instrument changes, in addition to failures/upgrades/servicing)
- SSC asked for clarification about whether any specific decisions need to be made soon
 - No immediate action needed
 - Planning is needed to manage physical constraints and phasing of future instruments
- What (& how many) foci options will be available for future instruments that have not been proposed yet?
- Discussed strategic relocations of instruments from K2 to K1
 - Smaller field instruments (HIRES, KCWI,...) on K1