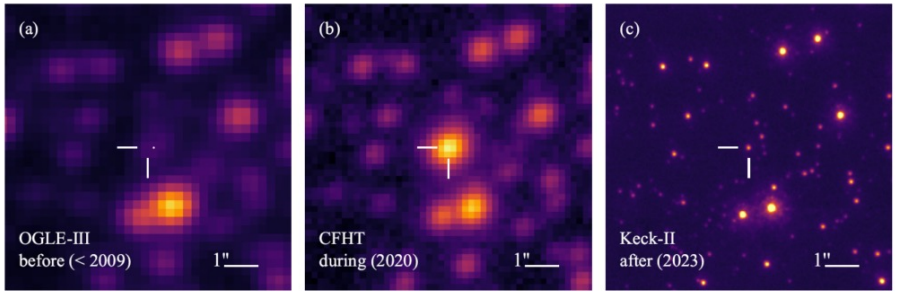
W. M. Keck Observatory Status and Plans 2025

January 29, 2025

Rich Matsuda, Observatory Director

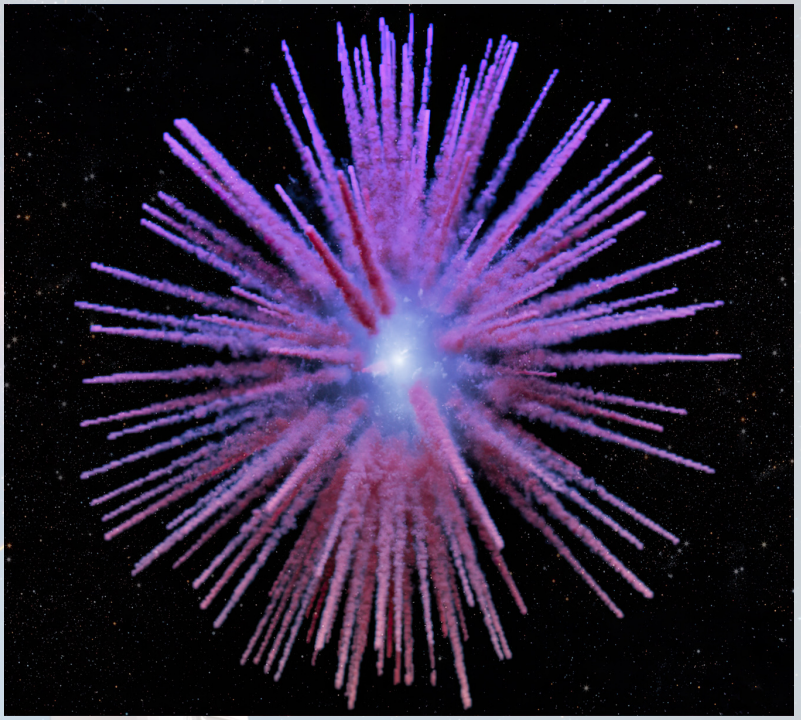
Earth’s Fate, Perhaps?



- Gravitational microlensing detection in 2020 using Korea Microlensing Telescope Network and CFHT concluded an earth-sized planet orbiting 1-2 AU from a host star half the mass of our sun about 4,000 light years away.
- Zhang (UCB/UCSD) et. al., followed up in 2023 on Keck using AO+NIRC2 to disambiguate the star.
- AO observation did not see anything there which led to conclusion that it is a white dwarf.
- What is interesting about this result is that this system looks like what earth’s fate may be 8 billion years from now when our sun evolves into a red giant and then a white dwarf. Earth will migrate to a larger orbit.

Dandelion Supernova in 3-D

- Type 1ax Supernova observed in 1181 in Cassiopeia including by Japanese astronomers.
- In 2013, the remnant nebula (Pa30) was found by amateur astronomer D. Patchick, using NASA -WISE data.
- Later, Fesen (Dartmouth) and Schaefer (LSU) discovered clumping, filaments in the remnants.
- Using the Keck Cosmic Web Imager‘s new red arm, Cunningham (CfA) and Calazzo (Caltech) et. al., including Chris Martin, PI of KCWI, mapped the filaments in 3 dimensions at unprecedented spatial, spectral sensitivity.



Artist conception:
W. M. Keck Observatory/Adam Makarenko

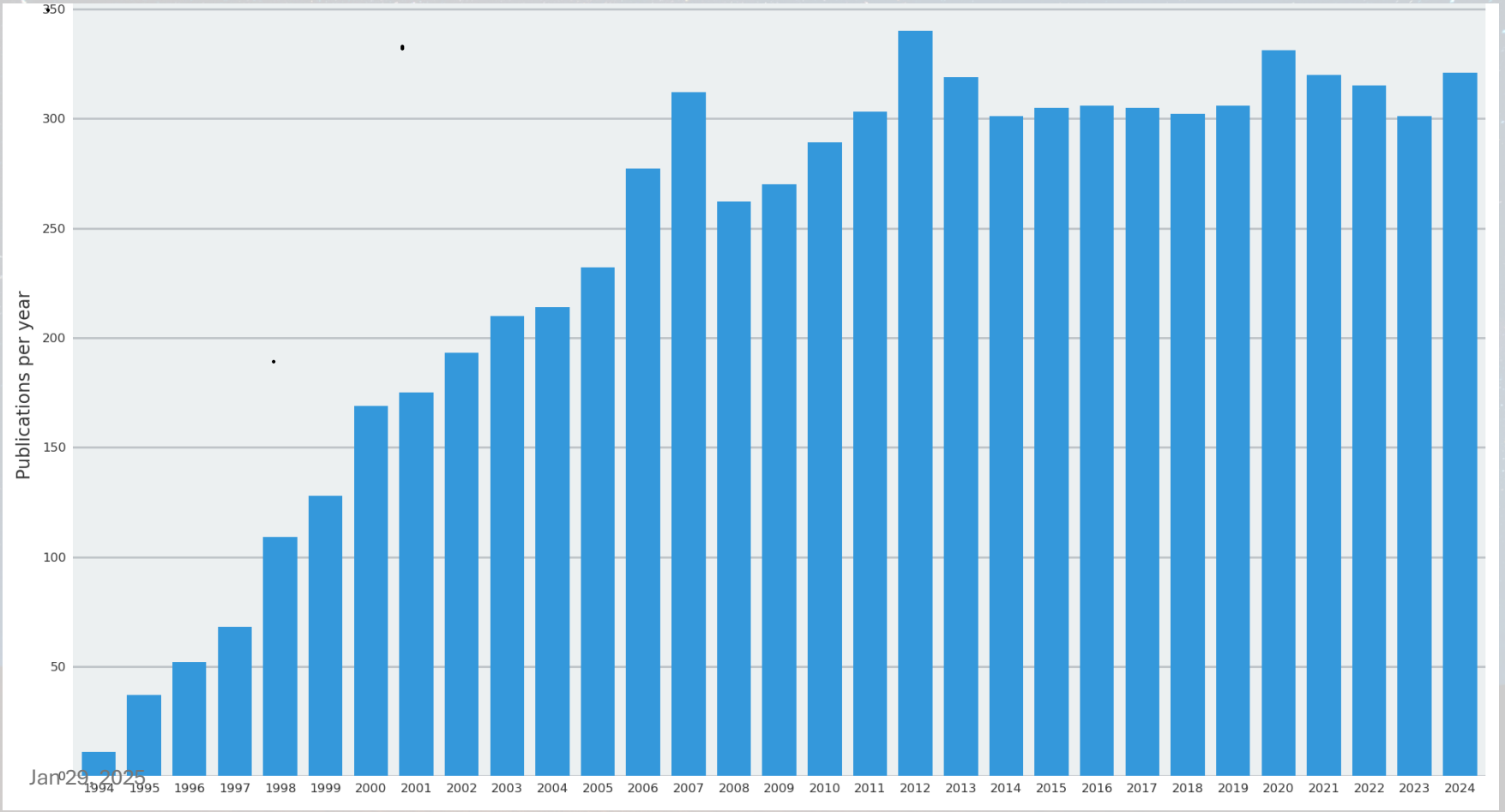
Keck 2035 Strategic Plan

Jan 29, 2025

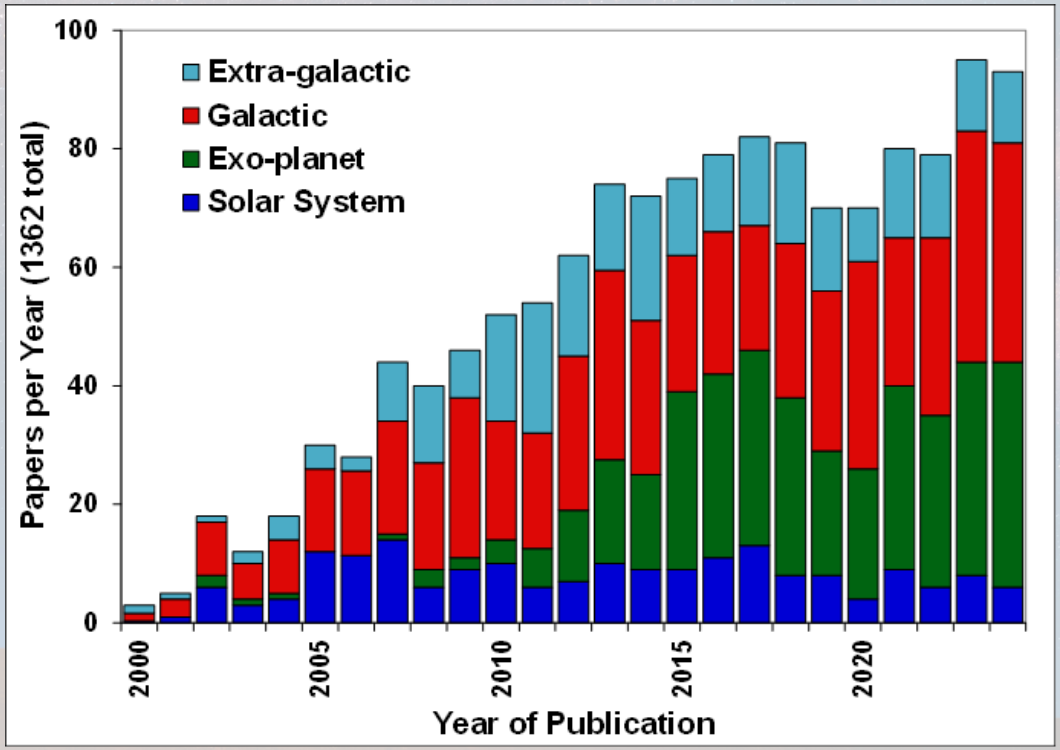
Science

Jan 29, 2025

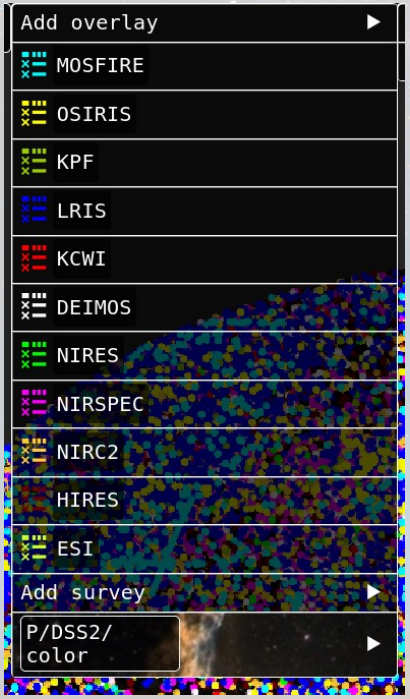
Scientific Productivity

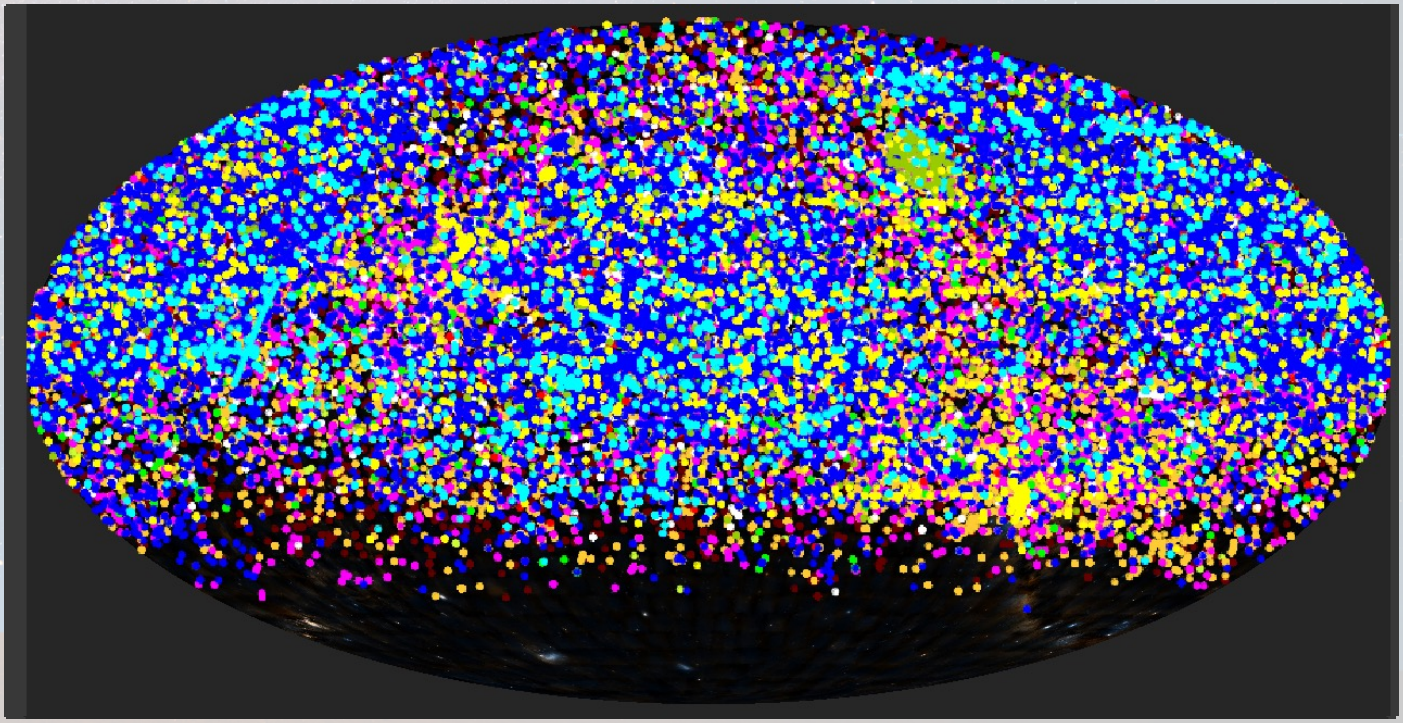


Adaptive Optics Science Papers



KOA Sky Map





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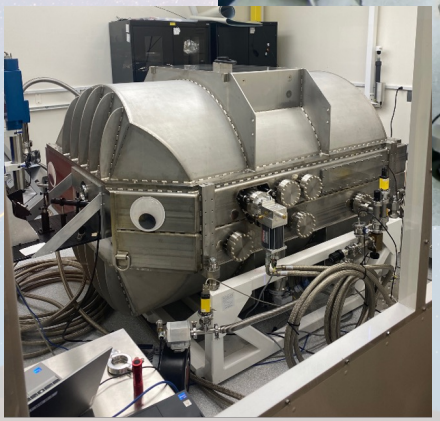
Major Instrumentation Project Summary

- **KPF**: Thermal stability improvements including cryocooler installation.
- **KCWI (new red arm):** Stable operations - Cryocooler upgrade in progress.
- **DEIMOS Upgrade**: Commissioning in FY25.
- **SCALES**: In assembly and test. Delivery late CY2025.
- **HISPEC**: In final design. Delivery in 2026.
- **LRIS-2**: Preliminary design review April 2025.
- **Liger**: Seeking funding for full construction.
- **WFI**: Seeking funding for preliminary design.

SCALES – Slicer Combined with Array of Lenselets for Exoplanet Spectroscopy

- PI Andy Skemer at UCSC
- Keck 2, AO - Designed for direct imaging and integral field spectroscopy of exoplanets
- 2-5μm, R = 50 (low res), ~4,000 (med res)
- Cryostat delivered - good vacuum
- First cool down successfully completed
- A series of cooldowns to test mechanism operation at temperature and under vacuum are scheduled.
- Preship review Fall 2025.
- Shipment and install end-2025.
- arXiv:2208.10721v1



HISPEC – High-resolution Infrared Spectrograph for Exoplanet Characterization

- Fiber-fed high-resolution spectrograph fed by HAKA AO in Keck II
- 1-2.5μm, R=100,000
- Designed for TMT (MODHIS)
- Detailed designs for the spectrograph opto-mechanical mechanisms complete
- Detector selection in progress
- Data reduction pipeline and calibration plan is a major focus
- Have secured all funding with 30% contingency
- Delivery in 2026

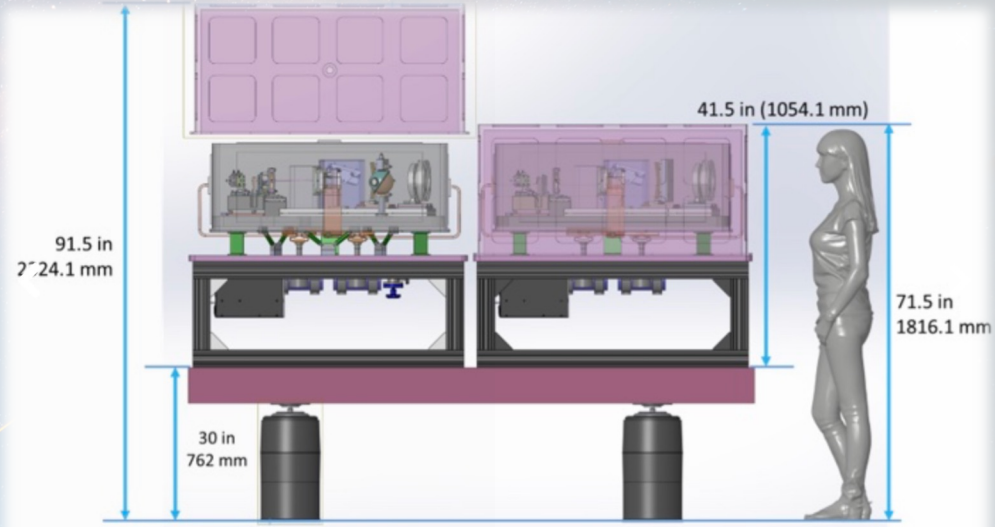


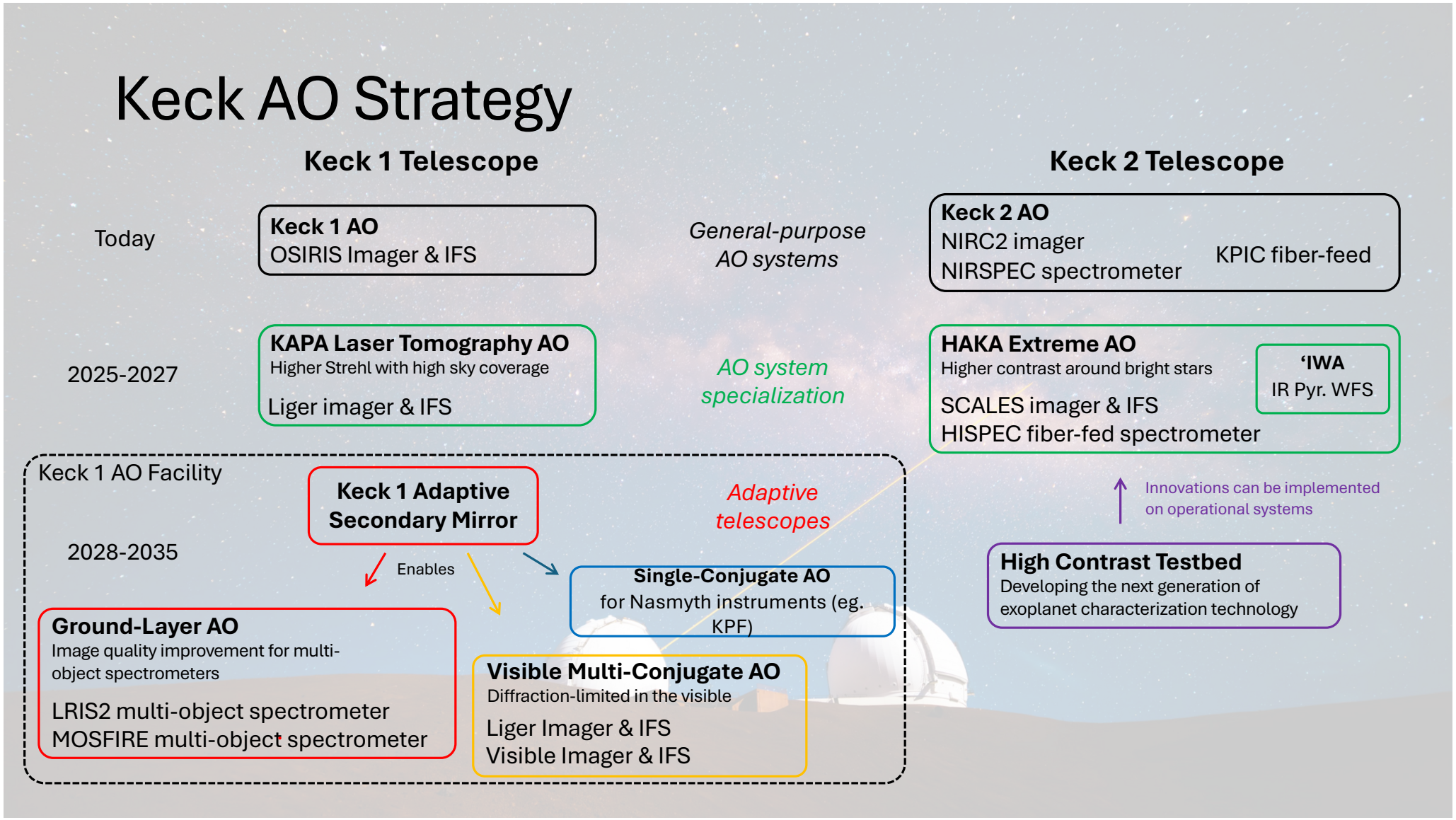
Figure: The two HISPEC cryostats housing the blue spectrograph (0.98-1.33um) and red spectrograph (1.49-2.46um).

Adaptive Optics Leadership

Dr. Peter Wizinowich
Retiring EMERITUS

Dr. Antonin Bouchez
New Head of AO Development

Keck AO Strategy



Organizational Health

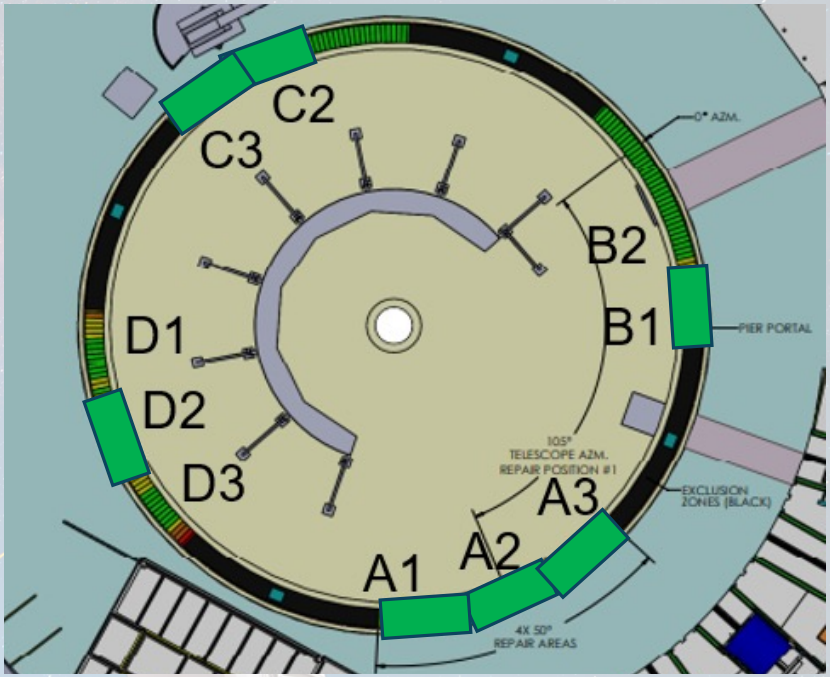
Jan 29, 2025

Pier Repair – 6.5 Week Shutdown, March 2025

Major initiative to address degradation of K1 pier

2 or more shutdowns planned

Keck II does not have same issue



Downtime #1 areas of repair

Hawai‘i Community Relations

Jan 29, 2025

New Governance of Maunakea

- Mauna Kea Stewardship and Oversight Authority (MKSOA) established by the State of Hawai‘i in 2022.
  - “Mauna Kea has come to symbolize a rigid dichotomy between culture and science, often leading to **polarization** between stakeholders on Mauna Kea and local communities.”
  - “…for the purpose of fostering a **mutual stewardship paradigm** in which ecology, the environment, natural resources, cultural practices, education, and science are in balance and synergy.”
  - “**support of astronomy** …is a policy of the state.”
- Authority will develop a management plan that balances astronomy development with other interests.
- Five-year transition ending in 2028 for MKSOA to assume stewardship responsibilities from the University of Hawai‘i and the State Dept. of Land and Natural Resources.
- Existing master and subleases remain in effect, expiring in 2033. MKSOA authorization will be required for observatories to operate beyond 2033.
- WMKO Director Matsuda is current astronomy representative on board –
  - Objective: build strong relationships and mutual understanding so that astronomy may work in close collaboration with MKSOA and local community on future of astronomy post-2033.

MKSOA Board

John Komeiji, Chair
Business/Finance

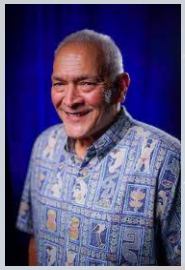
Neil Hannahs
Land Management

Kalehua Krug
Education

Rich Matsuda
Observatories

Pomai Bertelmann
Lineal Descendant

Lanakila Mangauil
Cultural Practitioner



Paul Horner
Senate Appt

Dr. Noe Noe Wong-Wilson
House Appt

Ryan Kanakaʻole
First Deputy, DLNR

Dr. Kimo Alameda
Mayor, Hawaii County

Benjamin Kudo
Former UH Regent

Dr. Bonnie Irwin
Chancellor, UH-Hilo
(non-voting member)

MUTUAL STEWARDSHIP

Authority Members presentation to A
Astronomical Society Meeting in Seat

PILINA (relationships)

First Nations Futures Program

WHEA Stu
with Leade

Food Truc

HAWAIʻI GROUNDED

ʻOli welcome
@ Keck Science Meeting

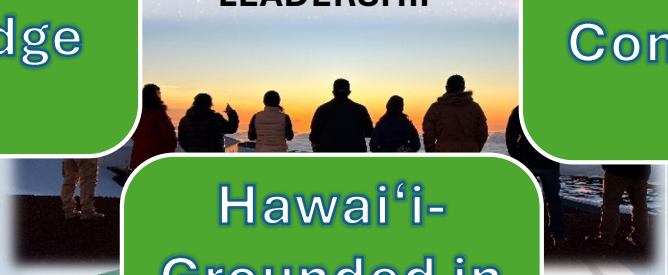
Keck Kalihiao
May Day 2023, Lei Making

MĀLAMA ʻĀINA (env.

West Hawaiʻi Beach Cleanup

Maunakea Forest Restoration Project

LEADERSHIP



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E ENGAGEMENT

West Hawaiʻi Explorations Academy Career Fair

Parker School Visit

Respect for Maunakea

Sharing of Knowledge

Fostering Connection

Hawaiʻi-Grounded in a Global Context

WMKO in 2035

Jan 29, 2025

Our Aim in 2035

- **We play a vibrant and essential role scientifically** in the era of the ELTs, JWST, Roman, Rubin and with future missions like the Habitable Worlds Observatory on the horizon.

- **We drive technological advancement** in instrumentation and AO, leveraging innovation of Caltech, UC, and our other scientific partners.

- **Keck nights are highly sought-after**. Superb conditions on Maunakea, Keck's unique capabilities, and great staff support enable leading-edge discoveries.

- **We have a strong relationships built on trust with the local community**, sustaining our long-term future on Maunakea. We have a new lease. The community views us as good stewards and a valuable community partner. There is a strong workforce pipeline for Hawai'i residents into jobs at Keck.

- **Our operations are highly effective and efficient**. We are financially sound, the facilities are well-maintained, and it is a highly desirable place to work. We havfe a great workplace culture.