AKAMAI WORKFORCE INITIATIVE

2022 Akamai Internship Symposium Project Abstracts

This booklet includes abstracts for Akamai interns presenting at four symposia:

July 29, 2022
Grand Naniloa Hotel, Hilo, Hawai‘i Island

Aug 1, 2022
W.M. Keck Observatory Headquarters, Waimea, Hawai‘i Island

Maui Aug 3, 2022
University of Hawaii Maui College, Kahului, Maui

Santa Cruz Aug 5, 2022
University of California, Santa Cruz

Presenters at each symposium are listed in symposia programs

Akamai is led by the Institute for Scientist & Engineer Educators at the University of California, Santa Cruz, in partnership with the University of California Observatories, University of Hawai‘i Institute for Astronomy (UH IfA) and University of Hawai‘i at Hilo (UH Hilo).

2022 Akamai Internship Program

Akamai = smart, clever

The Akamai Internship Program is a unique program that supports Hawaiʻi college students in completing an authentic science or technology project in a professional setting. Students are prepared through an intensive one-week short course, followed by seven weeks at an observatory or industry setting where they complete a project under the guidance of a mentor. Throughout the entire eight-week program, interns complete a communication course that begins in the short course and continues through weekly meetings and intensive coaching sessions. The Akamai program uses an internship model designed by the Center for Adaptive Optics (CfAO) originally funded by the National Science Foundation (NSF) Science and Technology Center. The goals of the Akamai program are to address the technical workforce needs in Hawaiʻi and advance students from diverse backgrounds into science, technology, engineering and mathematics (STEM) careers. Interns receive college credit from UH Hilo.

2022 Host Organizations

Hilo, Hawaiʻi Island

- Gemini Observatory
- Academia Sinica Institute of Astronomy and Astrophysics
- Subaru Telescope
- University of Hawaiʻi Institute for Astronomy

Waimea, Hawaiʻi Island

- W.M. Keck Observatory
- Canada-France-Hawaiʻi Telescope

Kona, Hawaiʻi Island

- Natural Energy Laboratory of Hawaiʻi Authority

Kihei, Maui

- KBR
- Odyssey Systems

Pukalani, Maui

- Daniel K. Inouye Solar Telescope

Santa Cruz, California

- University of California Observatories

Akamai Team 2022

Akamai is led by the Institute for Scientist & Engineer Educators (ISEE) at University of California, Santa Cruz (UC Santa Cruz), in partnership with University of California Observatories, the University of Hawaiʻi Institute for Astronomy (UH IfA) and University of Hawaiʻi at Hilo (UH Hilo). The following individuals were part of the 2022 Akamai team, and served in these roles:

Lisa Hunter UC Santa Cruz & UH IfA
Director, short course instructor, communication instructor

Jerome Shaw, UC Santa Cruz & UH IfA
Associate Director, short course instructor, communication instructor

Cynthia Nelly Carrión, UC Santa Cruz
Program Manager, short course instructor, communication co-lead instructor

Nicole Mattacola, UC Santa Cruz
Program & Event Coordinator

Mike Nassir, University of Hawaiʻi at Manoa
Short course instructor, communication co-lead instructor

Heather Kaluna, UH Hilo
Short course instructor, communication instructor

Stacey Sueoka, Daniel K. Inouye Solar Telescope
Short course instructor, communication instructor

Austin Barnes, UC San Diego
Short course instructor

David Harrington, Daniel K. Inouye Solar Telescope
Short course instructor

Mahalo

The Akamai team appreciates all the ways that people and organizations contribute to making Akamai a success. We extend a special mahalo to the following individuals who contributed to mentoring, fundraising, teaching, advising, coordinating logistics, and advocating for the program in many ways in 2022.

Akamai Mentor Council
Peter Konohia (Akimeka), Renate Kupke (UCO), Mary Beth Laychak (CFHT), Heather Marshall (DKIST), Keith Olson (NELHA), Lucio Ramos (Subaru), Chris Stark (Gemini), Marianne Takamiya (UH Hilo), Laura Ulibarri (KBR), Truman Wold (W.M. Keck).

Canada-France-Hawaii Telescope (CFHT)
Greg Barrick, Heather Flewelling, Mary Beth Laychak, Ivan Look, Billy Mahoney, Nadine Manset, and Raycen Wong.

Daniel K. Inouye Solar Telescope (DKIST)
David Harrington, Stacey Sueoka, Andre Fehlmann, Heather Marshall, Brialyn Onodera, Thomas Rimmele, Tom Schad, Sebastien Poupar, James Hoag, Paul Jeffers, Sarah Jaeggli, and Lucas Tarr.

Gemini Observatory
Andy Adamson, Chas Cavedoni, Emanuele Paolo Farina, Brian Lemaux, Jennifer Lotz, Zachary Hartman, André Nicolas Chené, Clara Martinez, Sebastian Raaphorst, Henry Roe, and Chris Stark.

University of Hawaii Institute for Astronomy
J.D. Armstrong, Christoph Baranec, Paul Barnes, Mark Chun, Johanna Estrella, Haosheng Lin, Luke McKay, Garry Nitta, James Ou, and Doug Simons.

Natural Energy Laboratory of Hawaii Authority (NELHA)
Keith Olson.

KBR
Greg Martin, Kurt Matillano, Ian McQuaid, Dylan Schwarzmeier, Danny Topp, and Laura Ulibarri.

Academia Sinica Institute of Astronomy and Astrophysics (ASIAA)
Geoffrey Bower, Ryan Chilson, and Derek Kubo.

Subaru Telescope
Wilfred Tyler Gee, Olivier Guyon, Eric Jeschke, Russell Kackley, Preethi Krishnamoorthy, Lucio Ramos, Kiaina Schubert, Ichi Tanaka.

University of California Observatories (UCO)
Daren Dillon, Renate Kupke, Christopher Ratliff, Connie Rockosi, Maureen Savage, and Kyle Westfall.

W. M. Keck Observatory
Caleb Bluesummers, Chien-Hsiu Lee, Hilton Lewis, Rich Matsuda, Jeannette Mundon, Joel Payne, Shelly Pelfrey, Sam Ragland, Paul Richards, Avinash Surendran, Kevin Tsuboda, and Truman Wold.

University of Hawaii Maui College
Jung Park.

University of Hawaii at Hilo
Kathy Cooksey, Bonnie Irwin, Heather Kaluna, and Marianne Takamiya.

Sam Adair
University of Hawaiʻi at Hilo

Site: W. M. Keck Observatory, Waimea HI
Mentor: Chien-Hsiu Lee

Determining the Distance to the M33 Galaxy Using Cepheid Variable Stars

Cepheids are pulsating variable stars that periodically increase and decrease in luminosity as their diameter regularly grows and shrinks over the span of a few days. The strong relationship between a Cepheid's pulsation period and its luminosity is well known, and it can therefore be used as a distance indicator. If a neighboring galaxy has enough known Cepheids, an estimated distance to that galaxy can be found by using the Cepheid period-luminosity relation. For this project, I analyzed archival data of M33 (the Triangulum Galaxy) taken by Hartman et al. using MegaCam at the Canada-France-Hawaiʻi Telescope, in *g*, *r*, and *i*-band filters. To determine the distance to M33, I created Python code that performed several analytical steps: first, the code read in light curves of variable sources from the archival data and used the Lomb-Scargle algorithm to find a period in each filter. Using these periods, I plotted phased light curves and manually identified 1989 variable stars. Since Cepheids occupy a specific region called the instability strip on the H-R diagram, I used that to differentiate Cepheids from other variables. This identified a sample of 1622 Cepheids, the largest Cepheid sample from M33 to date. I further classified these Cepheids into different sub-classes, then used fundamental-mode Cepheids to estimate the distance for M33 to be 898.26 kpc. This result is in agreement with past results from different methods.

Sam (Samuel) was born in Kanagawa prefecture in Japan but was raised in White Bear Lake, Minnesota. Currently pursuing a bachelor's degree in astronomy at University of Hawaiʻi at Hilo. After completing his bachelor's, he may pursue a doctorate. In his free time he likes to watch movies or play spike ball with his friends.

Michael Aquino
Honolulu Community College

Site: Subaru Telescope, Hilo HI
Mentor: Kiaina Schubert

Upgrading the GEN2 Observation Control System Network for Higher Network Speeds and a Failover System

The Subaru Telescope located in Hilo, Hawaiʻi needed an upgrade on their GEN2 Network. The purpose of the project was to upgrade the network from 10 Gbps to 20 Gbps for faster connection speed. The project also provided a fail-over environment for the GEN2 observation system to prevent server interruption and data loss. With the telescope's new instruments sending more data, higher network capabilities were necessary in order to avoid bottlenecking. For the upgrade, we implemented network switch replacement using high-speed switches, then used port aggregation and Multi-Chassis Link Aggregation Group (MLAG) protocols over multiple switches for the network upgrade. Link Aggregation Group (LAG) is a protocol which aggregates separate ports and combines them into one logical port, and MLAG is a type of LAG that provides redundancy in the event that one of the chassis fails. First, the switches were connected with MLAG. Next we made a topography of the network, then configured switches so that the data is routed from the MLAG-connected switches with aggregated ports that combined one port from each switch. Finally, we mounted the switches in the server rack, and we migrated equipment connections from the old switches to the new ones. With the network upgrade we implemented, we have increased network-speed capabilities and provided fail-over safety — in case a connection from one switch fails, the other switch will still send data. This project will be a great help to ensure data from the observatory will flow quickly and properly.

Michael Aquino was born and raised in Kalihi from the island of Oʻahu. Michael graduated from Farrington High School. He now is currently pursuing a degree in Computing, Security, and Networking Technology from Honolulu Community College. He is one of the Officers of the HCC Hats Club and competes in Capture the Flag competitions regularly with the team. Recently he competed in the AFKEA and National Cyber League CTF competitions. He is excited about the Akamai Internship because he enjoys applying himself to new challenges. In his free time, Michael enjoys going to the beach, hiking and graphic design. He hopes one day to have a career as a network security analyst or auditor.

Nicholas Barrick
Embry-Riddle Aeronautical University

Site: KBR, Kihei HI
Mentors: Laura Ulibarri and Danny Topp

Model Based Systems Engineering to Describe a Telescope

Model Based Systems Engineering(MBSE) is a new approach in the field that seeks to address and improve upon the existing concepts of systems engineering. In MBSE, systems are broken into a number of representations, usually components, behaviors, requirements, and use cases. The aim of this project is to construct a digital model of a satellite tracking telescope utilizing the concepts of MBSE. This project utilizes the software Cameo Systems Modeler to construct the representations of the system. In order to complete this project, the system is broken up into individual components. The system is also assigned actions and behaviors. The interactions between components and behaviors within the model describe the system's function. The expected end result of this project will be a model that can accurately describe the components, behaviors, and constraints of the system. This model will ideally also have some capability to simulate how data will flow through the system, from the initial inputs to form a full tracking solution. The end goal is that the model created for this project can be used to provide a framework or stepping off point of KBR Maui's future construction projects. As of now, the model consists of three packages consisting of structure, behavior, and requirements. The structure package involves representations of the physical and software components of the system. The behavior package represents the actions and interfaces the system will make. The requirements package describes the physical constraints and necessary actions for the system to take. As of yet, this system does not have any simulation capabilities, but I am hopeful that this capability can be easily integrated by a future intern.

Nicholas Barrick was born and raised on the Big Island of Hawaiʻi. He graduated from Hawaiʻi Preparatory Academy in 2021 and has just finished his first year of college at Embry-Riddle Aeronautical University. In the past year, he was involved in the American Institute of Aeronautics and Astronautics' Design Build Fly competition, where he assisted in the design, construction, and flight of a UAS designed to complete a mission set out by the AIAA. After finishing his bachelor's he hopes to go directly into industry, to continue his learning, and to continue building the field of aerospace. His hobbies include flying RC aircraft and video games.

Jenny Brown
Kapiʻolani Community College

Site: Subaru Telescope, Hilo HI
Mentor: Lucio Ramos

Setup and Analysis of Proposed Data Loggers Used in Telemetry for the Prime Focus Spectrograph

The Subaru Telescope, located on the summit of Mauna Kea in Hawaiʻi, uses an instrument called the 'Prime Focus Spectrograph (PFS).' Within the telemetry system of the spectrograph, data loggers monitor temperature, coolant flow, and pressure to control environmental conditions. Due to the demands of the telescope instrumentation, the life cycle of current data loggers, 34972A Switch Unit, and its module, 34901A, are scheduled to be updated with the DAQ970A Switch Unit and module, DAQM90, from the same manufacturer, Keysight. They will serve as on site spares and eventually be phased in as replacements. Serving to minimize the downtime during installation for Subaru technicians, the project's aims were the following; to confirm the presence of required features, test under controlled conditions, set up preliminary configurations, and create user documentation. Equipment was set up and configured under controlled lab conditions. To compare if the technology was within their respective error range, temperature was recorded with J type thermocouples. When compared to a multimeter's findings, both models were within range. Further review found the updated technology differed in the following ways: the removal of the GPIB (General Purpose Interface Bus), the addition of a USB port, LCD, condensed wiring layout of terminals, optimized integrated circuit chips, ten times faster scans (5000 versus 500 per second), twice the memory (100,000 versus 50,000 scans), as well two extra scan channels and an auto-calibration feature. The updated switch unit and module were found to have the required features. Additionally, the project's documentation and preliminary configurations will be available as a reference to relevant parties for smoother integration into the current telemetry system at the Subaru Telescope.

Jenny was born in Honolulu, Hawaiʻi and as of 2022, attends Kapiʻolani Community College. She plans on continuing her education at University Of Manoa to complete her B.S. in Electrical Engineering. Jenny values the collaboration and the interdisciplinary aspects of engineering, and plans to use her education and work experience to improve the quality of life for her community. In her free time, she enjoys being highly involved in school through Ecology Club and Student Congress but also takes the time to enjoy the little things with her friends through treating herself whether that be through matcha soft serve to going on a hike.

Christopher Chock
Gonzaga University

Site: Subaru Telescope, Hilo HI
Mentors: Olivier Guyon, Preethi Krishnamoorthy, Wilfred Tyler Gee and Ichi Tanaka

Deployment of a Highly Sensitive Video Camera for Astronomical Observations

The objective of this project was to deploy a video system that transfers uncompressed RAW data with a resolution of 3840 x 2160 (4K resolution), 10-bit 4:2:2 video, and up to 60 fps into two systems: a Next Unit of Computing (NUC) computer for live streaming and a remote computer for data analysis. The Asahi Shinbun Camera system atop Maunakea provides a continuous live stream in 1920 x 1080 resolution. Although the system is well positioned to gather data, the data quality is insufficient for analysis, such as estimating a meteor's 3D trajectory. To build the higher-resolution system, the Panoptic Astronomical Networked Observatories for a Public Transiting Exoplanets Survey (PANOPTES) project coordinated with the Asahi Shinbun Camera system. The PANOPTES system captured the desired uncompressed data by connecting a USB Capture Card (Magewell 4K Plus), computer, and Sony α (alpha) 7s iii camera. This capture card allowed the streaming computer to receive data in 4K at 30 fps. We analyzed the camera's settings and utilized OBS Studio to confirm that raw data was received. Next, I led the mechanical design phase to deploy our system. The camera, capture card, and computer were assembled in a weatherproofed box and mounted at the Mauna Loa observatory. Inside, a thermal-sensing fan and surge-proof power source were included to maintain temperature and power. Additionally, the capture card contains a secondary HDMI-passthrough output that can send data up to 4K resolution at 60 fps. In the future, the PANOPTES project will send the camera's high-quality, raw data to an external computer for scientific analysis.

Christopher Chock was born and raised on the Big Island of Hawaiʻi. After graduating from Hawaiʻi Preparatory Academy in 2019, he attended Gonzaga University and is currently pursuing a major in Electrical Engineering and a minor in Physics. After college, he plans to enter the workforce in Hawaiʻi and give back to his hometown. In his spare time, Christopher enjoys indoor climbing, soccer, volleyball, and piano.

James Cobb
UH Maui College

Site: KBR, Kihei HI
Mentors: Kurt Matillano and Dylan Schwarzmeier

Developing and Prototyping a Sky Monitoring System for Capturing, Displaying, and Archiving Data

Monitoring the sky is an important aspect for the success of the telescope operations team at KBR. Unforeseen cloud cover can interfere with ongoing projects, sometimes causing delays in schedule and unnecessary labor costs for KBR and their partners. KBR presently has no system in place to monitor and record operational conditions at their facility in Kihei. To add this capability, a ground-up system was developed to capture images of the sky using a wide-angle camera and upload them to a website for secure viewing purposes. This website is only accessible on KBR's internal network. The hardware utilized for this project consisted of a Raspberry Pi (small-scale computer) and a fisheye-lens camera - with an enclosure designed to be weatherproof. Python scripts were developed to access the camera, name the images with timestamps, and upload them to a date-named folder. An additional script compressed and stored the previous day's folder on a KBR network drive. Using Nodejs, a web application was created for users to view images taken each day. Nodejs allows the server-side of the application to access Python scripts and images located in the Raspberry Pi, while maintaining a client-side website user interface. These aspects form a sky monitoring system accessible only to KBR's telescope operations personnel. The website allows for real-time updates of the operational conditions in Kihei by capturing an image of the sky every 30 minutes, or an on-demand capture button which captures an image when pressed. Available access to archived data allows researchers to retrieve information from previous dates. This system is modular and has the potential to be scaled horizontally by placing similar systems at various locations. In the future, all data could be collected and compiled on one server allowing for ease of access.

James was raised in Kihei, Maui since he was a child. He graduated from Kihei Charter High School and is currently pursuing an associate degree in Electronic & Computer Engineering Technology. James enjoys working on his car, playing piano, and playing video games in his free time. Once he graduates, he plans to find a job in the electronics field that can challenge him and satisfy his pursuit of knowledge.

Ethan Covello
Montana State University

Site: Canada–France–Hawaiʻi Telescope, Waimea HI
Mentors: Ivan Look and Raycen Wong

Developing a Diesel Fuel Release Detection Procedure while Upgrading to an Above-Ground Storage Tank at the CFHT

To combat any loss of electrical power at the Canada-France-Hawaiʻi Telescope (CFHT) summit facility, a diesel generator, fueled by a 5,000-gallon underground storage tank (UST), is used to power all critical systems and transition the observatory to a safe state. However, potential leaks from USTs pose a risk to the soil and aquifers on and surrounding Mauna Kea. Coupled with the difficult maintenance of USTs, this prompted the need for CFHT to both decommission its existing UST and upgrade to an above-ground storage tank (AST). This project aimed to assist in both processes. For the decommissioning phase of this project, we developed a procedure to follow if a release of diesel fuel was detected from the UST during sampling of the surrounding soil. This procedure outlined the specific state and federal organizations that would need to be notified, as well as the required forms to be completed and actions taken to mitigate the leak. For the upgrade to a new AST, the main issues to be addressed were storage capacity and tank location. To determine the proper storage capacity, we consulted with several CFHT operations and instrumentation engineers to establish which critical systems required power and the amount of time necessary to restore the observatory to a safe state. From these meetings, it was determined that the generator needed to operate for a minimum of 24 hours. The generator consumes a maximum of 14 gallons of diesel fuel per hour, therefore a 300-gallon AST was chosen to partner with the 75-gallon day tank, for a run-time without refill of about 26.8 hours. In order to integrate the AST into the day tank and generator configuration, a programmable logic controller (PLC) was programmed to create an automatic pumping system between the AST and day tank to feed the generator. After contracting with the vendor, the final step is to create a detailed installation procedure for CFHT and the vendor, and to prepare the location for installation.

Ethan is from Honolulu, Hawaiʻi, and graduated from Henry J. Kaiser High School in 2020. He is currently a sophomore studying Mechanical Engineering at Montana State University in Bozeman, MT. Ethan's career interests lie in the field of aerospace technology as well as the engineering of mountain bikes and other outdoor equipment. In his free time, he is an avid skier, surfer, and mountain biker.

Ryan Foley
University of Hawaiʻi at Hilo

Site: Gemini Observatory, Hilo HI
Mentors: Emanuele Paolo Farina and Brian Lemaux

Detecting and Isolating Lyman-alpha Emission Surrounding Supermassive Black Holes using 3D Data from MUSE

Utilizing data provided by the Multi Unit Spectroscopic Explorer (MUSE) mounted on the Very Large Telescope, we aimed to create a flexible Python package able to analyze the close galactic environment of supermassive black holes (SMBHs). As part of the Reionization Epoch Quasar Investigation with MUSE (REQUIEM) survey, the scientific goal is to conduct further analysis on Lyα emission extending from the first quasars forming during the end of the age of reionization. A major caveat to studying these quasi-stellar objects (QSOs) is how faint their extended Lyα halos are, despite deep observation provided by current technology; however, they provide vital information about understanding the formation of SMBHs. Pycube is an object-oriented freeware package designed to allow the user data exploration (not limited to MUSE data cubes) and the ability to pass selective functions, which assist in isolating regions near these high-redshift QSOs. Being an aid to REQUIEM, much of the code of pycube was drafted but was not object oriented or easily accessible. The scope of the project was to design a module tailored for 3D MUSE data and implement three main data reduction functions: background subtraction, subtraction of a point-spread function (PSF), and halo-finding by detecting significant residual emissions. The first two functions worked to minimize sky residuals and infer accurate background noise using SEP, a Python descendant of SourceXtractor, and performed a subtraction of the QSO point-source emission to isolate the halo. The third function performs pixel analysis surrounding the reduced source. An accurate isolation of this region yields itself to further analysis by the REQUIEM survey to better understand the environment in which SMBHs formed in early cosmic times.

Ryan grew up on the Big Island of Hawaiʻi and graduated from Hilo High School. He is a senior at the University of Hawaiʻi at Hilo pursuing degrees in astronomy and physics while also getting a certification in data science. He is planning to pursue a career in astronomy research or operations and in STEM education.

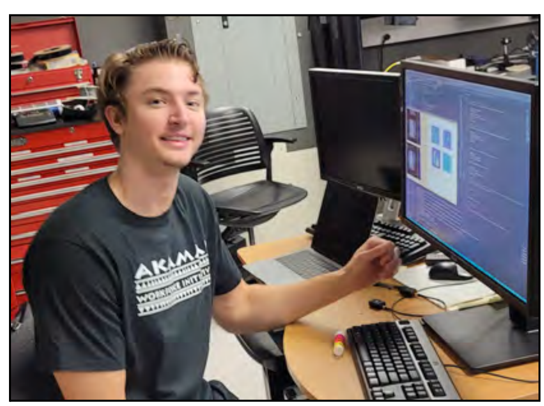
Aidan Griffin
Washington State University

Site: University of California Observatories, Santa Cruz CA
Mentors: Reni Kupke and Daren Dillon

Automating the Remote Control of Optical Shutters in a Benchtop Quadrature Polarization Interferometer

The Laboratory for Adaptive Optics at the University of California, Santa Cruz includes a benchtop Quadrature Polarization Interferometer that is used to characterize the shape of optical devices by measuring the phase difference created by dividing a source of light into separate paths. The output light beams are captured by a pair of polarization imaging cameras at the rear of the setup. Before each digital image can be analyzed, it must be flat-fielded to remove optical imperfections (dust specks, stray or scattered light, etc.) in the system. Flip-mounted shutters are used to block or admit each individual light path, allowing the creation of normalized and flat-fielded calibration images. Currently, these shutters must be operated manually via electronic switches, a process that is slow and sometimes prone to human error. This project transforms the opening and closing of the shutters into an automatic process performed remotely using Linux command-line executables. These commands have been integrated into existing imaging software, allowing for rapid and accurate shutter operation during the imaging process. This calls for a retooled GUI that integrates an image evaluation pipeline with improved real-time polarized-light image displays.

Aidan Griffin is entering his fourth year at Washington State University, pursuing a B.S. in computer science. He grew up on Maui, attending Kihei Charter High School. Aidan constantly strives to grow in the field of computer science. At school, he is eager to lead and contribute in team activities. He is a Voiland College peer mentor and participates in the Association for Computing Machinery and Cougs in Space. In his free time, Aidan enjoys playing pickup basketball and working on technical projects.



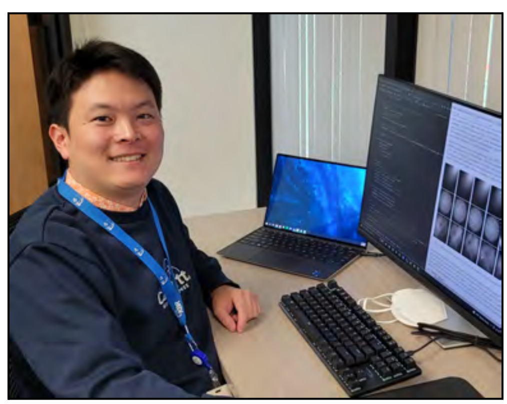
Marc Hayashi
Kapiʻolani Community College

Site: KBR, Kihei HI
Mentor: Greg Martin

Bayesian Deep Learning: MultiSWAG Uncertainty Estimation for Satellite Object Detection

Neural Networks can be trained to classify and/or locate objects in an image. Multiple Stochastic Weighted Average Gaussian (mSWAG) applies a Bayesian methodology to a neural network and has been shown to improve the accuracy and reliably measure the uncertainty on deep neural networks that classify images. One advantage of mSWAG is that it does not require modification of the previously trained neural network and is therefore relatively easy to implement. Also, mSWAG works well on rather large neural networks where other Bayesian methods don't perform well. mSWAG has also been shown to work well on multiple image classification networks (LeNet, VGG, ResNet, etc.) on a variety of different datasets (MNIST, CIFAR100, etc.). The original mSWAG implementation was written using a PyTorch Framework and to the best of our knowledge, mSWAG had not yet been evaluated on deep neural networks that perform object detection and localization. This project focused on implementing and evaluating mSWAG for the SatNet object detection and localization model. To accomplish this, we first needed to test the performance of mSWAG. My task was to modify the PyTorch implementation of an object detection model called YOLOv3 to be able to train/test it on the SatNet dataset. I then had to modify the original PyTorch-YOLOv3 configuration file to take in the ground truth parameters and image data from the SatNet dataset. From there, we tested the improvement of the model using the mSWAG method on the COCO and SatNet datasets. The ultimate goal is to eventually convert the mSWAG implementation from PyTorch to TensorFlow.

Marc Hayashi was born in Tokyo, Japan and grew up in Honolulu, HI. He is currently a student at Kapiʻolani Community College and is working towards a Bachelor's degree in Computer Science at UH Manoa. Marc's goal is to have a career in software engineering and development for Machine Learning. His hobbies include playing tennis, listening to music, and hiking.



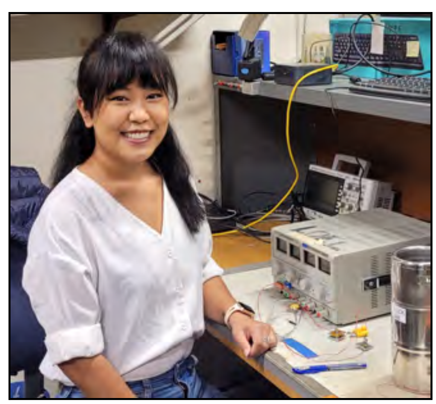
Deborah Higa
University of Hawaiʻi at Mānoa

Site: University of California Observatories, Santa Cruz CA
Mentors: Christopher Ratliff and Dale Sandford

Position Characterization and Testing of a Cryogenic Rotary Stage Assembly for SCALES

The University of California Observatories (UCO) is developing the Santa Cruz Array of Lenslets for Exoplanets Spectroscopy (SCALES), an infrared, integral-field spectrometer and imager. SCALES will be installed on W.M. Keck Observatory's Keck-II adaptive optics system to detect and characterize colder and lower-mass exoplanets than previous instruments. The fore-optics of SCALES contain a Lyot-stop selector, consisting of a rotary mechanism at the pupil plane that holds 15 selectable Lyot masks. The Lyot masks must have an *xy*-positioning accuracy of 70 μm and *xy*-positioning precision of approximately 3.5 to 30 μm. Due to the tight positioning requirements and the need for a passive mechanism that does not generate heat, a spring-loaded detent follower wheel was implemented. To verify that the detent mechanism precisely positions the Lyot wheel, Hall sensors were selected to serve as position sensors on the wheel due to their durability and non-contact capability, but their positional uncertainty at cryogenic temperatures was initially unknown. To characterize the repeatability and precision of the sensors, testing was completed in two stages. Preliminary testing showed that the sensors are functional at cryogenic temperatures, a voltage versus distance relationship was established, and some sensor-to-sensor repeatability data looks promising. The second stage of testing is in process and requires modification of an existing coronagraph slide to accommodate the sensors for signal characterization and repeatability at warm and cryogenic temperatures. It is suggested that UCO test the sensors in the modified coronagraph slide at cryogenic temperatures and continue testing to determine the optimal trip distance.

Deborah Higa is from the island of Oʻahu and is pursuing a Bachelor of Science in Mechanical Engineering at the University of Hawaiʻi at Mānoa. She is the president of the Society of Women Engineers (SWE) UH Mānoa collegiate chapter and is a strong advocate for gender inclusivity, particularly in the STEM field. She is also the Project Manager for Team RoSE, a Mars rover project at UH Mānoa and is aiming to compete in the University Rover Challenge, an international competition hosted by The Mars Society, during the Summer of 2023. Through this internship opportunity, Deborah hopes to expand her knowledge and experience in mechanical engineering and aerospace technologies and learn more about their practical applications. Her interests lie in project management, additive manufacturing, and system level design and integration.



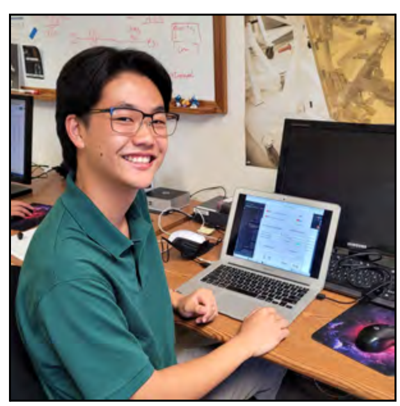
Preston Ito
Davidson College

Site: W. M. Keck Observatory, Waimea HI
Mentors: Avinash Surendran and Sam Ragland

Creating an Engineering GUI for the KAPA Telescope Simulator

The Keck All-sky Precision Adaptive-optics (KAPA) project will be a next-generation tomographic laser adaptive optics (AO) system, projected to begin operation at the W.M. Keck Observatory in 2024. To test their AO algorithm, Keck has built a Telescope Simulator that simulates the KAPA system on a smaller scale and more controlled environment. The KAPA Telescope Simulator is being further modified to include a turbulence simulator, which uses a glass phase screen to simulate typical atmospheric turbulence at various altitudes and wind speeds. This 2-D simulator moves via two high-precision linear stages. The turbulence simulator requires control from a GUI that adjusts different parameters necessary for the AO simulator's function. This GUI would also control some AO parameters, such as the wavefront sensor's gain and frame rate, as well as have the ability to invoke other AO operational GUIs. The ultimate goal of this project was to create intuitive software that could be used by astronomers and engineers alike. The first mockups of the GUI were designed in Pencil Project. Once the finalized widgets and layout were translated to Qt Designer, the GUI code was implemented in Python with the PyQt5 graphics library. Throughout the development process, feedback from engineers and scientists was employed to guide the several iterations of the GUI. This constant collaboration with engineers and scientists was essential to create software that was intuitive, efficient, and met all the needs to fit within the KAPA project.

Preston Ito was born and raised on Maui, and is currently pursuing his undergraduate degree at Davidson College in North Carolina. Finishing up his third-year, Preston is a physics major, but enjoys learning about computer science and has taken several coding classes throughout his undergraduate career. After Davidson, he hopes to continue his education at Washington University in St. Louis to get his Master's Degree in Aerospace Engineering. He loves using math and science to model and solve real world problems, and highly values hands-on project experience.



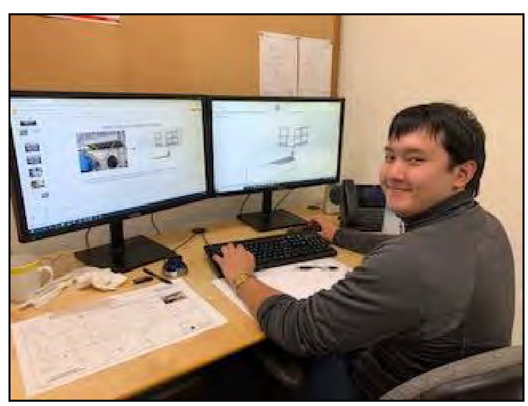
Cole Jamila
University of Hawaiʻi at Manoa

Site: W. M. Keck Observatory, Waimea HI
Mentor: Joel Payne

Redesign of Keck II Survey Platform to Address Instrument Clearance and Safety

Within the Keck II observatory dome, there are four Survey Platforms used to provide proper working areas for theodolites, surveyor's devices that are used to measure angles and distance. In 1998, an oversized instrument was installed onto Keck II directly under a survey platform on the right bent cassegrain elevation ring. However the platform's left support strut interfered with the location of this instrument, and was therefore cut in order to install the instrument. The survey platform was then deemed hazardous and taped off to restrict access. The current platform with its cut support has been modeled using Solid Works, and a finite element analysis study was completed to determine existing strength, confirming that the current survey platform was not safe for use. Three possible solutions were explored and assessed: first, to leave the survey platform as-is and restrict access; second, to install an in-situ welded support; and third, create an entirely new survey platform design. The first and second recommendations have been modeled and analyzed to accommodate for instrument clearance and to provide a safe walking platform that can support 500 lbs on a 1-ft circle.

Cole Jamila is from Oʻahu, where he graduated from Mid-Pacific Highschool in 2018. He is in his senior year at the University of Hawaiʻi at Manoa majoring in Mechanical Engineering. Cole is currently the chief engineer of the UH Drone Technologies lab and has been a member since he was a freshman. In his free time Cole enjoys old school film photography, and 3D printing.



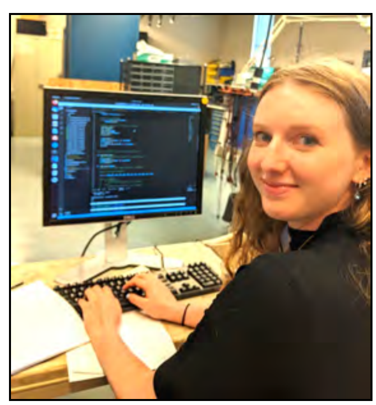
Momi Jeschke
Swarthmore College

Site: Academia Sinica Institute of Astronomy and Astrophysics, Hilo HI
Mentors: Geoffrey Bower, Derek Kubo and Ryan Chilson

Phase Stabilization of a Fiber-Optic System Using a Line Stretcher

The Academia Sinica Institute for Astronomy and Astrophysics (ASIAA) is a partner in the Event Horizon Telescope, a collaborative array of 11 radio telescopes around the world used to observe and synthesize images of supermassive black holes using interferometry. To accomplish this, the combined beam-size of the array must be extremely small (20 microarcseconds), which is achieved by aligning and synchronizing the individual telescope beams with a high degree of accuracy. However, temperature fluctuations and mechanical stressors on the fiber-optic cables that carry signals to and from the telescopes can create time delays, causing the signals to fall out of phase with each other. Our solution was to introduce a controllable line stretcher — a device that uses piezoelectric crystals to physically expand or contract fiber-optic cables — to counteract any phase changes induced by movement or temperature. We built and tested a laboratory-based prototype system, intended for future implementation at the Greenland Telescope (GLT) in Thule Air Base, Greenland. We developed a control system for the line stretcher, which included creating an algorithm for reading phase error, and stretching or contracting the line stretcher using a software PID controller. Allan variance analyses were used to measure and improve the effectiveness of the algorithm, and to compare data taken with the lab-based prototype system to data collected from the GLT. The final software servo control system adjusts the line stretcher to correct for phase drift once per second, allowing it to effectively correct for thermal and mechanical phase changes, which can change on time scales of tens of seconds.

Momi is a current senior at Swarthmore College, where she majors in Engineering and minors in Environmental Studies. Momi was born and raised in Hilo, Hawai'i, where she developed a passion for the protection of her beautiful ʻāina - environment and native ecosystems. She wants to become an electrical engineer, where she can design sustainable systems, machines, and devices, combining her passion for electronics with her dedication to the environment.



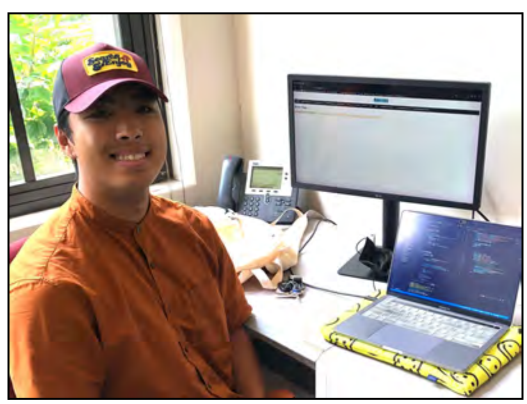
Ryan Liu
University of Hawaiʻi at Hilo

Site: Institute for Astronomy, Hilo HI
Mentors: James Ou and Christoph Baranec

Creating a System Status Monitoring Interface for Robo-AO 2

The Institute for Astronomy at the University of Hawaiʻi (UH) is currently developing Robo-AO 2, a next-generation robotic adaptive-optics instrument that will soon be deployed on the UH 88-inch telescope on Maunakea. In order to support the development, testing, and operation of Robo-AO 2, we created a dynamic system-status monitoring website. To provide real-time information, the dynamic website needs to provide continuous and reliable communication between the web server and browser. Using Node.js as a runtime environment, we selected a server-side framework called Express and the Pug templating engine for the client side. Socket.IO was used to enhance client-server connectivity by providing robust event-based communications. Since Robo-AO 2 is still under development, one of the goals of the project was to design and implement a modular application that supports the addition of future components. The result is a webpage that contains sections for each instrument component. Each section provides real-time telemetry, plus camera imagery and/or analytic tools, depending on the component.

Ryan was born and raised on the Big Island in Hilo. He graduated from Hilo High School in 2018 and is currently studying at University of Hawaiʻi at Hilo. Ryan is majoring in computer science, minoring in mathematics and pursuing a data science certificate. After graduating, he hopes to pursue a career with a focus in artificial intelligence. His hobbies include playing tennis, traveling and trying new foods.



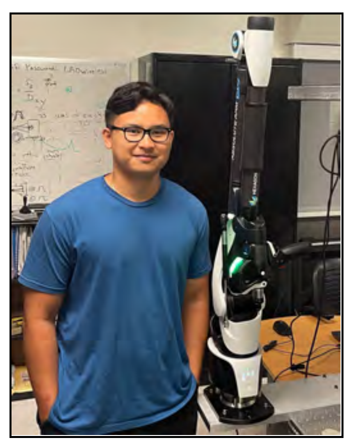
Jose Macabante
University of Hawaiʻi at Manoa

Site: University of California Observatories, Santa Cruz CA
Mentor: Daren Dillon

Precision Alignment of Optics/Mounts Utilizing Hexagon Absolute 7-Axis Arm

The Laboratory for Adaptive Optics (LAO) researches and develops adaptive-optics systems for high-resolution astronomy instrumentation for the broader University of California astronomy community, including the Keck, Gemini, and Lick Observatories. With astronomy instrumentation becoming more complex over time, the process of setting up and aligning the optical systems has become both tedious and time consuming. This is due to the level of precision required to fully align the optics and mounts, which can be difficult when done by hand. In an effort to minimize the amount of time needed during the alignment phase, the lab recently acquired a Hexagon Absolute 7-Axis arm, a high-precision articulating measuring arm, to set up and align optical layouts for the ongoing projects. Previously, there was no alignment procedure set for the arm, so one was created. The newly created procedure set consists of a measurement routine in the arm's software, PC-DMIS, that compares the optical layout's nominal measurements to the actual physical positions in a three-dimensional Cartesian coordinate system. Due to arm measurement limitations, the optical setup must be aligned further using a wavefront sensor at different areas of the layout to ensure overall high wavefront quality. This procedure set was applied to a simple optical layout multiple times to ensure consistency in setup and wavefront readings. The wavefront quality was tested immediately after setup using the arm, and then after adjusting further using the wavefront sensor readings. The arm successfully aligned the layout to 150 nanometers RMS, then was further aligned to 5–10 nm using the wavefront sensor, with a majority of the adjustments dealing with slight position changes due to arm measurement limitations.

Jose (Joselito) is a third year Mechanical Engineering student at University of Hawaiʻi at Manoa after attending Kapiolani Community College and graduating from Moanalua High School. He was born on Oʻahu, where he currently lives. After graduating, Jose hopes to be working for the Department of Defense. During his free time, he enjoys working out, playing video games, and hanging out with his friends.



Taggart Nakamoto
Brigham Young University

Site: Institute for Astronomy, Hilo HI
Mentor: Luke McKay

Environmental Monitoring for UH88 Telescope Maintenance

The UH 2.2m telescope (UH88) has long been used by scientists to investigate objects within and far beyond our solar system. A key to maintaining this instrument has been monitoring environmental factors that could harm the UH88, including temperature extremes, humidity, direct sunlight, and particles or gasses in the air. Recent advances in microcontrollers–small, cost-effective electronics that have become popular in the last decade–have created the perfect opportunity to upgrade the sensor system. These electronics are less expensive than typical astronomical instruments and their common use in “do it yourself'' (DIY) projects make them perfect for quick implementation. My project integrated these off-the-shelf microcontrollers and modular sensors using a programming language called CircuitPython, and packaged them into a compact array that logs sensor data via ethernet for later analysis. These sensors were then tested to increase stability, accuracy, and precision. Running these sensors on the UH88 revealed that memory leaks and power surges could cause errors, but these issues were rectified with scheduled resets and memory cleanup. For temperature sensors, freezing and boiling points were used as references to ensure thermometer accuracy. Testing gas sensors with known concentrations of evaporated isopropyl alcohol similarly allowed for higher accuracy. Data collected so far has already revealed previously unknown fluctuations in carbon dioxide and water vapor concentrations, aiding the work of scientists down the mountain. We predict that further data collection will yield more insights and help improve the UH88.

Taggart Nakamoto was born and raised in Kealakekua on the Big Island of Hawaiʻi. He graduated as a valedictorian and class treasurer from Konawaena High School in 2018. Taggart is now pursuing a Bachelor’s degree in Chemical Engineering with a minor in Computer Science at Brigham Young University. While pursuing his studies Taggart also acts as a research assistant studying molecular simulations of polymer structures. Outside of school Taggart enjoys skimboarding at the beach, hiking in the mountains, and solving puzzles, especially escape rooms.

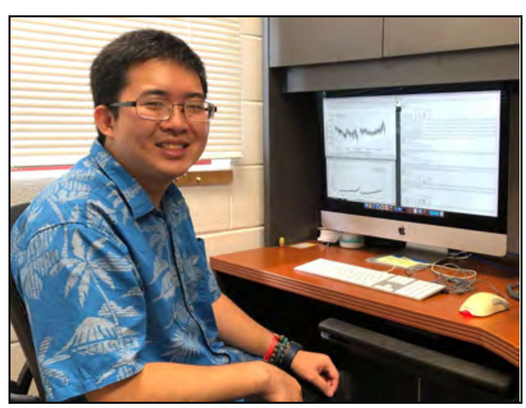
Tyler Ogawa
University of Hawaiʻi at Hilo

Site: Gemini Observatory, Hilo HI
Mentor: Zachary Hartman

Looking for Unresolved Companions of Low-Mass Wide Binaries in TESS Light Curves

Binary star systems consist of two stars that are gravitationally bound to one another, whether they are close binaries with separations smaller than 1 AU, or wide systems with separations of 10,000 AU or more. Yet sometimes, one of the components in these systems is a binary itself with an unresolved companion, making the system a higher-order multiple, i.e. a system that contains three or more stars. For solar-type wide binaries, the higher-order multiplicity fraction is roughly 50%. However, the value of this fraction is not well known for low-mass wide binaries. The goal of this project is to compare the higher-order multiplicity of low-mass wide binaries to solar-type wide binaries. To do this, I examined the primary components of 8082 low-mass wide binary systems to find evidence of eclipsing binaries and fast rotation. I used the LightKurve package to plot light curves from the TESS Quick Look-up Pipeline (QLP), then visually search for evidence of variability. In this sample, I found 4939 components with light curves available from the QLP, from which I identified numerous eclipsing binaries, fast rotators, and variable systems. I also plotted their locations on a classical H-R diagram, as well as examined where these systems fall on the "Lobster" diagram, a plot that compares the overluminosities of the primary and secondary components of the wide binary. Finally, I compared my lower limit for higher-order multiplicity to previous results for K+K wide binary systems and for solar-type wide binaries.

Tyler was born and raised in Hilo, and graduated from Waiakea High School in 2019. He is currently attending the University of Hawaiʻi at Hilo and is pursuing a degree in Astronomy. Tyler was always interested in science and astronomy as a child, and hoped to one day work for the observatories on Mauna Kea. In the future, he hopes to attend grad school and study electrical engineering, and continue to work for the observatories on Mauna Kea. In his free time, Tyler takes part in taiko drumming, community service, playing Nintendo games, and karaoke with his friends.



Hopena Paekukui
Grand Canyon University

Site: W. M. Keck Observatory, Waimea HI
Mentor: Truman Wold

Designing a Universal Instrument Transportation Cart For Nasmyth and Cassegrain Instruments

The W.M. Keck Observatory atop the summit of Maunakea consists of two domes, each housing a telescope. Instruments are installed on each telescope to observe the night sky. These instruments can weigh up to 6 tons, with average dimensions of 8 ft in height and 8 ft in width. A clean room in the Keck-I dome is used to perform maintenance on the instruments every 5–15 years. However, instruments in the Keck-II dome must be craned down three stories to the dome floor and onto carts specifically made for each instrument, before traveling to the clean room across the observatory. With 10 instruments split between both domes, and each instrument having its own unique cart, storage space becomes slim. Thus a singular, universal cart used for all instruments would optimize storage and transportation. The goal of this project was to design a cart that would transport both Nasmyth and Cassegrain instruments across the dome floors and hallway to the clean room. The cart would need to support up to 12,000 lb and fit within the observatory hallway. Fortunately, a common feature among all instruments are their crane points. Thus, the recommended design for the universal instrument cart consisted of a jib crane at each corner of the cart frame that would suspend the instrument above ground during transportation. Stress analysis and finite element analysis were performed on the cart cranes, frame, wheels, and the rail system the cart will travel along, with a factor-of-safety of 3 for yield and 5 for ultimate strength being considered.

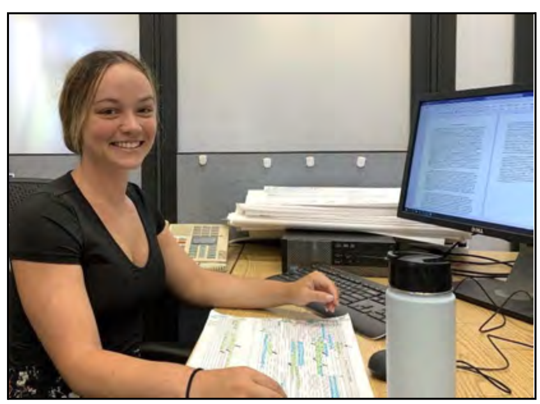
Hopena (Gabriel) was born on Oʻahu and grew up in Kaneohe, but moved to the Big Island to attend high school. He attends Grand Canyon University pursuing a mechanical engineering degree. His goals are to inspire people to do good by create machines that meaningfully contribute to humanity, especially the people of Hawaiʻi. In his free time, Gabriel enjoys 3D printing, playing Dungeons & Dragons with his friends, and designing and painting custom shoes.

Jenna Perry
Washington University

Site: Natural Energy Laboratory of Hawaiʻi Authority, Kona HI
Mentor: Keith Olson

NELHA Seawater Pumping System Infrastructure Risk Assessment Analysis

The Natural Energy Laboratory of Hawaiʻi Authority (NELHA) currently operates a 24/7/365 seawater pumping system that supplies pristine deep and surface seawater to approximately 55 clients within the Hawaiʻi Ocean Science and Technology (HOST) Park. The goal of this project is to identify small system changes that can be implemented routinely to eventually create lasting change pertaining to the reliability and readiness of the seawater pumping system. An initial list of vulnerabilities pertaining to the pumping network was created through collaboration with the NELHA operations team. Using the system's data collection and modeling software, SCADA, I was able to familiarize myself with the system using fluid dynamics concepts such as the pressure differences across the system. The vulnerabilities were then organized into five categories (pump system, sump system, electrical system, distribution system, and general) and given a frequency and severity score depending on the nature of the vulnerability. The identified vulnerabilities were then investigated further by utilizing NELHA's purchasing history, conducting on-site inspections of portions of the pumping system, and researching the mechanics of the pump parts. Using this information, we identified that the greatest risks within the system are the water quality, the potential for a localized grid outage, dependency on singular people for repair or installation procedures, and the lack of safety requirements for an open sump. A detailed list of action items and workarounds that would help the pumping system were summarized in a risk assessment containing a risk matrix, and a table containing recommended solutions for each vulnerability and the cost and time estimate that is associated with that project. From our findings, it is suggested that the electrical system for the Farm Compound and Research Campus should be reconstructed and combined. It was also advised that cross training workshops should occur regularly for critical tasks, and an SOP for an open sump should be created.



Jenna was born and raised in Kamuela on the island of Hawaiʻi where she graduated from Hawaiʻi Preparatory Academy in 2020. She is currently attending Washington University in St. Louis where she is studying Chemical Engineering with a minor in Energy Engineering. While in St. Louis, Jenna works as a peer tutor for the McKelvey School of Engineering and competes on the University's powerlifting team. At home, Jenna enjoys spending time at the beach, going on hikes, and playing with her dogs. She is very interested in the field of renewable energy and hopes to work in this industry after college.

Junyoung Shin
University of Hawaiʻi at Manoa

Site: Daniel K. Inouye Solar Telescope (NSO/DKIST), Pukalani, HI
Mentors: Brialyn Onodera and Sebastien Poupar

An Overview and Standardization of DKIST Vibration Procedures

The Daniel K. Inouye Solar Telescope, (DKIST) is the world's biggest solar telescope that functions by redirecting sunlight with an array of mirrors to sensitive optic equipment located throughout the coude lab. Vibration throughout DKIST creates displacements in these mirrors and optics, which limits DKIST's capability of capturing clean images. DKIST is conducting surveys to categorize and track the source of these vibrations, which is essential to limiting the effects of performance degradation. This process is done by utilizing accelerometers and various in-house MATLAB scripts. Standardizing and streamlining this procedure would enable more staff to collect data to test if vibration is the suspected cause of performance degradation. After conducting vibration tests and data analysis on my own, I produced several documents that detail the overall surveying process. Additionally, to further streamline the overall procedure, various small-scale tasks were completed such as modifying MATLAB scripts to be more user-friendly, troubleshooting the data acquisition computer and more. Tutorials have been verified by another intern within DKIST to be easy and clear to follow through. Once these documents are distributed among DKIST staff members, we hope to have everybody conducting their own vibration data collection and analysis.

Mark (Junyoung) Shin was born in Korea. He immigrated to the United States with his family when he was 13, and has lived in Hawaiʻi ever since. He graduated from Moanalua high school, and is currently studying Mechanical Engineering at University of Hawaiʻi at Manoa. After graduating, Junyoung hopes to give back to his community. When he's not busy with school, he enjoys spending time with his friends, swimming and playing guitar.

Alannah Shinde
University of Hawaiʻi at Hilo

Site: University of California Observatories, Santa Cruz CA
Mentor: Kyle Westfall

Measuring the Performance of Optical Fibers with Low Numerical Aperture for FOBOS

Led by the University of California Observatories, the Fiber-Optic Broadband Optical Spectrograph (FOBOS) is a new instrument in development for the W.M. Keck Observatory. FOBOS differentiates itself from Keck's previous multi-object spectrographs by its use of optical fibers. Additionally, FOBOS's fibers are unique in that they have a low numerical aperture (NA), a feature atypical of all other fiber-based spectrographs. Therefore, before the FOBOS team could confidently design prototypes of its fiber arrays, three main performance factors of the low-NA fibers needed to be tested and characterized. Specifically, we measured (1) the fraction of light that passes through the fiber; (2) the output focal ratio and illumination profile; and (3) the consistency of these properties over time. We built a Python program to measure and graphically visualize these properties for prototype FOBOS fibers using data collected at the Space Sciences Laboratory at UC Berkeley. We present our measurements and compare them to the performance requirements specified to meet FOBOS's science goals of 95% total throughput at 650 nm and an output focal ratio of 4.5.

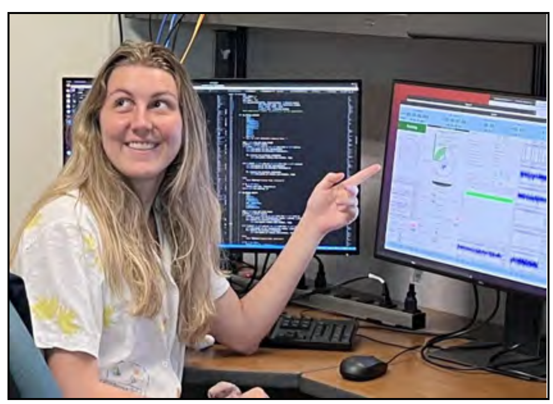
Alannah Shinde was born and raised on the Big Island which inspired her love of the stars and science at a young age. She is currently going into her third year at the University of Hawaiʻi at Hilo where she is pursuing a degree in computer science along with a minor in astronomy. In her free time, she loves to bake, play games with her friends, and help run her school's newspaper.

Katie Stevens
Gonzaga University

Site: Subaru Telescope, Hilo HI
Mentor: Russell Kackley and Eric Jeschke

Subaru Telescope System Simulator (TELSIM) Software Upgrade

The Telescope Control System for the Subaru Telescope on Mauna Kea was developed by a subcontractor and, at the time it was developed, there was no requirement for it to be able to run in simulation mode. The source code for this system is proprietary and is not accessible by Subaru software engineers. Actual telescope time is limited and expensive, so having a Telescope Control System Simulator such as TELSIM to test observation scripts is essential for conserving resources. Prior to this project, TELSIM was able to simulate basic functions of the telescope, including mount rotation, focus selection, instrument rotation, and basic tracking/auto-guiding. However, there were specific features that were lacking or which needed improvement, such as the TELSIM GUI application. For this upgrade project, I first created a cleaner, more user-friendly way to select a secondary-mirror/focal station configuration in the TELSIM GUI. The application was also modified to subscribe to the current status stream, so that, if the focal configuration is changed elsewhere, the TELSIM GUI will update itself in real-time. Another feature that needed improvement was the command system. To improve existing commands and to implement new ones, I first determined how the specific commands work on the actual telescope control system by examining the status data from observation logs of the telescope control system and correlating them to the original arguments of the command. I also communicated with telescope operators who were familiar with how the commands worked. I could then simulate the actions of the commands and update the internal status values. This suite of new features will allow TELSIM to return more meaningful and accurate results when observing scripts are tested, and it will also serve as a valuable training aid for new telescope operators.



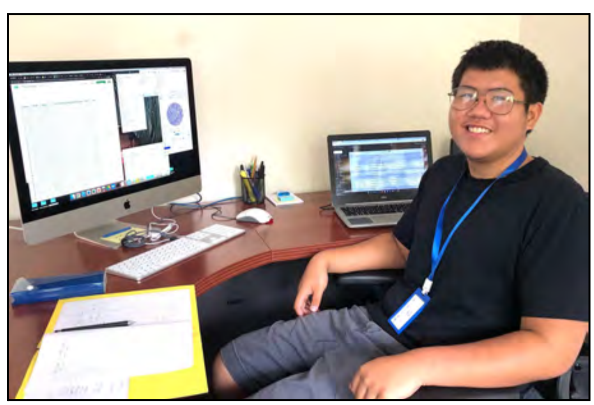
Katie (Katherine) was raised in Kihei, HI and graduated from Maui High School in 2019. Currently, she is entering her Senior year at Gonzaga University pursuing a Bachelor's degree in Computer Science. She is most interested in game design and data science but she likes to keep her mind open to learning about new topics and fields. In her free time, she plays music, video games, and goes out with friends.

Xavier Tablit
University of Hawai'i at Hilo

Site: Gemini Observatory, Hilo HI
Mentors: André Nicolas Chené and Clara Martinez

A Brute-Force Strategy for Cataloging Members of Open Clusters

Open stellar clusters are young (generally one Gyr and younger) and coeval (formed in single events from a distinct molecular cloud) groups of stars that are gravitationally bound. Thus, they are among the best candidates for providing precise information on both the ages and chemical compositions at various spatial positions in the Milky Way disk. In addition, they play an integral part in the understanding of stellar evolution and assist us in ascertaining the history, structure, dynamics, and chemical evolution of the Milky Way. Recent work by Karla Peña Ramírez (U. of Antofagasta) led to the development of new analysis tools that allow for an increase up to 50% of known stellar members in open clusters located in the bulge and in the disk. This has a significant impact on the derived fundamental parameters, such as extinction and total mass. Motivated by this work, we studied a sample of two dozen open clusters using photometric and astrometric data from the Gaia Data Release 3 (DR3), complemented by near-infrared data from the Vista Variables in the Via Lactea Survey (VVV) and the Two-Micron All-Sky Survey (2MASS). The technique used was based on Gaussian mixture models and unsupervised machine-learning methods, which allowed us to identify the members of each cluster. We first performed a reanalysis of the membership in a previous study made by Peña Ramírez et al., in order to reproduce results and confirm adequate performance of the computer code used in our study. Alterations were then made to portions of code to broaden the extent of their collective cluster-cataloging ability. This approach to cluster-member selection allows for a large-scale evaluation of the Galactic plane, serving as a valuable tool for assessing cluster populations and testing of stellar evolutionary models.



Xavier was born and raised on the Big Island of Hawai'i. He graduated from Pahoa High School and is currently enrolled at the University of Hawai'i at Hilo pursuing degrees in Astronomy and Physics. Xavier intends to be an astrophysicist, study the cosmos and inspire others to do the same for the improvement of humanity.

Brock Taylor
Columbia University

Site: Canada–France–Hawai‘i Telescope, Waimea HI
Mentor: Billy Mahoney

Designing, Manufacturing, Programming, and Deploying Environmental Sensing Instruments using Visible and Infrared (IR) Cameras for the Mauna Kea Observatories (MKO) All-Sky Infrared & Visible Sky Analyzer (ASIVA)

The All-Sky Infrared & Visible Sky Analyzer (ASIVA), maintained and supported by Canada-France-Hawai‘i Telescope (CFHT) for the Mauna Kea Observatories (MKO), is a weather sensing instrument composed of an infrared (IR) camera, a visible-light camera, multiple temperature sensors, and a machine-learning system to automatically identify cloud conditions. Real-time cloud detection is essential for assessing sky quality and choosing appropriate observing programs, especially for the remote observatory operations of MKO. However, ASIVA's visible-light camera was no longer functional and in need of replacement. Additionally, the IR camera and computer were outdated. Finally, upgrading ASIVA's custom-made components to standard, well-documented equipment would allow for easier upkeep. This overall project was performed in two parallel stages: (1) replacement of the visible-light camera on the ASIVA instrument, and (2) development of a backup system to replace the IR camera in case of failure. First, to restore the visible camera functionality, a new, independent system was created using a commercially available all-sky visible camera and a small Linux microcontroller to collect, process, and send data to the CFHT network. A custom modular bracket system was designed and manufactured that allowed the new visible camera system to readily integrate into the ASIVA. A combination of a commercial IR camera with a specialized frame-grabber and custom software to integrate into the CFHT infrastructure provided the backup solution to the ASIVA IR camera. Additionally, the effort to renovate the ASIVA spawned the concept and design of a new, fully portable ASIVA-like instrument that could act as a backup for the entire original ASIVA, or which could be installed in other locations to supplement research and environmental sensing.

Brock was born in Idaho and raised on the Island of Hawai‘i from the age of two. He graduated from Kealakehe High School through their STEM Academy program, where he worked to receive his Associate's degree in liberal arts from Hawai‘i CC - Pālamanui during high school. He now attends Columbia University where he is pursuing a degree in mechanical engineering with a minor in computer science. Brock enjoys all aspects of engineering challenges and always looks to find new and exciting ways to tackle them.

Benny Trieu
University of Hawaiʻi at Manoa

Site: KBR, Kihei, Maui
Mentor: Ian McQuaid

Developing Web-server Features for the Deep Learning Team

Machine learning is a data-driven model which requires user-given features. Deep Learning improves on that by removing user-given requirements, allowing the algorithm to assign features to itself. Deep Learning models require a lot of computing power when trained and would need GPUs (Graphics Processing Unit) at the ready to train them. Users need a tool that they can use to check whether a GPU is available which is why the web server, "GPU status server", is created. Dash (Python framework for making dashboards) and Plotly (Graphic Engine of Dash) were used to develop the web server. The web server displays how many GPUs there are, checks whether they are available, and who is using them. It could also show additional information on specific analytics of the GPUs like memory, disk, and CPU (Central Processing Unit). These graphs give users more analytics on specific GPUs for their deep learning models. These graphs were implemented using Dash and Plotly as they allow fast and easy features on the web server. There have also been issues with users not appearing on the web server even though they are using the GPU. This bug was due to certain users having their names longer than eight characters. This was fixed by adding a new method in the code that accepts usernames longer than eight characters. In the future, an auto-refresh feature that does not need users to manually refresh the page, should be added. By adding additional features and bug fixes to the web server, the deep learning team is provided a more informational look at GPU availability for each server host.

Benny Trieu was born and raised in Honolulu, Hawaiʻi. He currently attends University of Hawaiʻi at Manoa. He enjoys playing a lot of video games growing up thus his choice on why he is aiming on getting a Bachelor's degree in Computer Science. In his spare time, he likes to stream video games alongside playing it with his friends, and participate in Game Dev at UHM. In the future, Benny hopes to either be a part of a video game company or be a part of a well-respected company.

Andrew Unger
University of Hawaiʻi at Hilo

Site: Canada–France–Hawaiʻi Telescope, Waimea HI
Mentors: Heather Flewelling and Nadine Manset

Studying the Presence of Satellites in MegaCam Images and Determining the Change over Time

MegaCam is a wide-field optical imager used on the Canada-France-Hawaiʻi Telescope. The images taken with this instrument are one square degree in size, a field-of-view roughly four times the size of the full moon. The usability of MegaCam data relies on the images being free of contamination, including light trails from artificial satellites. MegaCam is only used part-time as it requires the darkest possible nights of the month, when the moon's illumination is at its smallest. Recent increases in launches of artificial satellites for the Starlink megaconstellation (as well as those for other companies) have increased the chance of a satellite passing within the telescope's field-of-view during observations. What is the observational impact on MegaCam images due to the increased amount of Starlink satellites in orbit? A survey of historical images selected from MegaCam archives was conducted to measure the number of visible satellites, as well as how their frequency has changed over time. MegaCam has been online since 2003, continuing to operate to this day, with a total archive of over 300,000 images. A data-filtering program was implemented to select roughly 1000 images, spanning throughout the instrument's lifetime. We expected that an increase in satellite frequency would be found, especially for dates after 2020 when the Starlink megaconstellation satellites began launching. The population of known satellites doubled between the dates of 2012 and 2021, and we found that the frequency of streaks in MegaCam images reflects this increase.

Andrew Unger was born and raised on the Big Island of Hawaiʻi. He attends the University of Hawaiʻi at Hilo pursuing a degree in Astronomy. Andrew has been inspired by the study of space since his first viewing of the film Contact as a child. Outside of school, Andrew has been involved in the local Astronomy community as a member of the West Hawaiʻi Astronomy Club where he has participated in outreach events to share his love of space with others. Andrew enjoys stargazing, road trips, reading, and is most happy when spending time with his family.

George Villanueva
Oregon State University

Site: Daniel K. Inouye Solar Telescope (NSO/DKIST), Pukalani HI
Mentors: James Hoag and Paul Jeffers

Developing Concepts for the DKIST Enclosure Entrance Aperture Mechanism Fall Brakes

The entrance aperture of the Daniel K. Inouye Solar Telescope (DKIST) is currently operated by a chain drive system. The aperture was initially operated by gears but was converted to a chain drive system due to issues regarding inconsistent gear meshing and flexing. However, in its current design, if chain failure were to occur, the motor brakes would be ineffective, leading the aperture to collide with its end-of-travel shock absorbers. To combat this, an additional brake concept is to be explored for integration that will slow down and potentially stop the aperture prior to engaging the end stops in the event of chain failure. Brake concept development began with brainstorming and familiarization with existing drive designs. Existing designs, SolidWorks models, and calculations were analyzed, to calculate the constraints and specifications required for sourcing commercial brake component options. Finite element analysis was also performed on the end stops using ANSYS to quantify the need for and inform the requirements for the brake. Multiple brake concepts were then drafted, reviewed, and modified, leading to the selection of three final brake concepts for possible implementation. These concepts included a caliper brake and flat bar concept, and two centrifugal brake and gears concepts, where one incorporates pre-existing elements from the original design and the other a modified version. Furthermore, these presented concepts act as proof of concept that a fall brake system is feasible. Additionally, it will serve as the foundation for a design that will be further refined and worked on in future years.

George Villanueva was born and raised in Kahului, Maui, and graduated from Maui High School in 2019. He is an upcoming fourth year at Oregon State University majoring in Mechanical Engineering and pursuing a minor in Aerospace Engineering. He has an interest in CAD design, robotics, 3D printing, and aerospace technology. George is the Event Coordinator for OSU's Society of Asian Scientist and Engineers Chapter and is a member of the Design, Build, Fly (DBF) Team of OSU's AIAA Club. After graduation, George eventually plans to work for companies such as NASA, Lockheed Martin, SpaceX, or Boeing or return home to work in Hawai'i. In his free time, he enjoys spending time with friends, playing video games, watching anime, and graphic design.

David Welch Keliʻihoʻomalu
Seattle University

Site: Gemini Observatory, Hilo HI
Mentor: Sebastian Raaphorst

Developing a GraphQL Query Service to Retrieve Historical Environmental Data for Gemini's Automated Scheduler

Queue coordinators at Gemini telescope manually create observation plans for every possible set of weather conditions. To save time, this process is being automated through the development of a new program called the Automated Scheduler. The goal for this project was providing environmental data through a query service for the Collector stage of the Scheduler. Python is used to run the Scheduler and GraphQL is used to run the query service. To start off, a new class called "Env" was created in order to store the current collection method. This collection method passed in fixed values to accurately describe the weather for each site. Next, zipped data was then collected and filtered from the data folder to be used back in the Env class. This new environmental data was passed in the constructor of the Env class. The constructor allowed for the data to be read and processed into a Python dictionary indexed by observation site and night. Finally the environment file was formed into a GraphQL service. This service lets the Scheduler ask for certain environmental data based on a specific night and site. This section of the Scheduler is needed because it now provides the ability to compare the efficiency of creating observation plans between the Queue coordinators and the Automated Scheduler.

David Welch Keliʻihoʻomalu grew up in Kamuela on the island of Hawaiʻi. David is currently living in Seattle, Washington while he attends Seattle University pursuing a BS degree in Computer Science with a minor in Finance. He is excited to get some real working experience related to his field during his internship this summer. David enjoys playing volleyball, basketball, and video games. He also likes to review old coursework and concepts and solve coding problems.

Ryan Wong
University of Hawaiʻi at Manoa

Site: Odyssey Systems, Kihei HI
Mentor: Ryan Swindle

Mechanical Design, Assembly, and Testing of a Slitless Spectrograph for Satellite Characterization

Odyssey Consulting, the U.S. Space Force Space Systems Command (SSC), and the Air Force Maui Optical & Supercomputing site (AMOS) are researching a precise methodology to characterize artificial satellites and other near-Earth objects using low-operation-cost telescopes while maintaining good coverage of the spectrum. Previous research on slitless spectroscopy has suggested its usefulness for detecting and distinguishing classes of satellites. Following this model, they have sought to fabricate various instrument parts for the first light (first operation) ground-based telescopes for spectral data collection using slitless spectroscopy. First, individual parts that required design or redesign were identified: zero-tilt adaptor, spacer and sprocket for FLI CFW 9-5 filter wheel, optics holders, and adaptor for filter wheel to telecompressor tube interface. Second, all parts were rendered in Autodesk Inventor and Fusion 360. Finally, an initial 3D-printout was created for test fitting, and the entire spectrograph was assembled using the definitive version. The main component, the optics holders, consists of the various combinations of transmission grating and wedge prisms, all enclosed in its 3D-printed shell. The custom holders were tightly fitted into the FLI CFW 9-5 filter wheel slot, allowing all incoming light to diffract and redirect back to the center of the telescope's camera. Through successive iterations, various designs were adjusted and revised, due to the received product (filter wheel) varying from the CAD model obtained and the limited accuracy of the 3D printer. To preserve previous spatial dimensions, components required adjustment on-site, as the new installment will affect the overall telescope length. The final spectrograph will have its 3D-manufactured parts installed until more modifications or repurposing are needed.

Ryan Wong was born in Honolulu and educated in Hong Kong before returning to Hawaiʻi at the age of twelve. He graduated from President William McKinley High School in 2019 and is now attending the University of Hawaiʻi at Manoa to pursue a Bachelor of Science degree in Mechanical Engineering. His career goal is to develop wearable mechanics, such as an exoskeleton, that will improve user movement. Ryan likes to spend his free time playing computer games, eating nice cuisine, building plastic models, and napping.

Taylor Wong
University of Hawaiʻi at Manoa

Site: W. M. Keck Observatory, Waimea HI
Mentors: Caleb Bluesummers, Paul Richards and Kevin Tsuboda

An Audio Monitoring Interface for Nightly Telescope Operations at W.M. Keck Observatory

W. M. Keck Observatory is attempting to shift night time operations to a remote setting. The Unattended Night Operations (UNO) Remote Audio Monitoring project aims to allow operators to detect melting ice dripping,mechanical failures and a series of other dangers to the telescope through cameras within the facility. Cameras made by Axis Communications are connected to a Synology surveillance device which is accessible through their web-based API. Audio and video is accessed through real time streaming protocol (RTSP) streams which are obtained from the Synology web based API. Those streams are then processed and ordered using PyQt5 and VideoLAN Client's (VLC)s python media player. To ensure both audio and video streams were being transmitted, tests with various python libraries such as VLC, PyAudio, FFMPEG, and OpenCV were conducted. The results held that a RTSP stream from the Synology API would produce expected results. A graphical user interface created from PyQt5 with a VLC player as a widget and a dropdown menu, based off of Synology's API, produced the most desirable outcome. As a minor suggestion, W.M. Keck Observatory could deploy a dispatcher to check each camera to obtain the current status.

Taylor grew up on Oʻahu, Hawaiʻi. He graduated from Hawaiʻi Baptist Academy and has already completed a bachelor's in Marketing. A newly found love for statistics sprouted during his business courses and now he is pursuing a second degree in Computer Science with a focus in data science. He hopes to continuously grow his knowledge and passion through practical applications for the betterment of society.

Kevin Yim
Case Western Reserve University

Site: Daniel K. Inouye Solar Telescope (NSO/DKIST), Pukalani, HI
Mentors: Dave Harrington, Andre Fehlmann, Lucas Tarr, Tom Schad and Sarah Jaeggli

Enabling DKIST Coronal Observations by Measuring Sky Brightness and Polarization

The Daniel K. Inouye Solar Telescope (DKIST) on the summit of Maui's Haleakala is the flagship facility for ground-based solar observations in the world. DKIST is able to take high-resolution images of the Sun and measure light scattering in the Sun's outer atmosphere (corona). However, specific observation modes are only possible during certain terrestrial atmospheric conditions at the telescope. DKIST's recently purchased Cimel CE318-TP9 photometer is a way to measure these conditions in real time. The Cimel was a new and unfamiliar instrument, so the main stages of this project included performing the initial setup and configuration, determining the Cimel's most useful modes of data acquisition, analyzing its data formats and output, and integrating it into the observing system at DKIST. The Cimel measures sky radiance and sun irradiance through nine filters of different wavelengths, as well as three polarization states. It is capable of autonomous operation over a specified period of time via a customizable auto mode. Several preliminary sets of data were taken and analyzed via MATLAB and Python code to determine the level of accuracy and consistency of the photometer's output. With a full understanding of the Cimel's capabilities and a plan for its function as a DKIST sky-quality monitor, we plan for installation at the summit for real-time operation.

Born and raised on O'ahu, Kevin graduated from Punahou School in 2019 and is now studying mechanical engineering in his third year at Case Western Reserve University. He is still exploring potential areas of interest within engineering, but wants to learn more about renewable energy. After graduation, Kevin plans to find a job either on the mainland or in Hawaii, and eventually pursue a Masters degree. Outside of school he enjoys hiking, working out, and playing the French Horn in CWRU's symphony orchestra.

Akamai Internship Program

Akamai advances students into the Hawai‘i technical and scientific workforce. The program partners with industry, observatories, government, educational institutions, and the community to meet workforce needs in astronomy, remote sensing, and other science and technology industries in Hawai‘i. Akamai is led by the Institute for Scientist & Engineer Educators (ISEE) at University of California, Santa Cruz, in partnership with University of California Observatories, the University of Hawai‘i Institute for Astronomy and University of Hawai‘i at Hilo.

The 2022 Akamai Internship Program placed 32 college students from Hawai‘i at the following organizations to complete a seven-week project:

- Canada-France-Hawai‘i Telescope
- Daniel K. Inouye Solar Telescope
- Gemini Observatory
- KBR
- Natural Energy Laboratory of Hawai‘i Authority
- Odyssey Systems
- Academia Sinica Institute of Astronomy and Astrophysics
- Subaru Telescope
- University of California Observatories
- University of Hawai‘i Institute for Astronomy
- W.M. Keck Observatory

In 2022, Akamai interns were funded by:

- Hawai‘i Community Foundation Kukio Community Fund
- Daniel K. Inouye Solar Telescope (National Science Foundation)
- Gemini Observatory/NOIRLab (National Science Foundation)
- Keck Planet Finder project (National Science Foundation, AST#2034278)
- ISEE’s Advancing Inclusive Leaders in Astronomy project (National Science Foundation, AST#1743117)
- University of California Observatories
- KBR
- Maunakea Observatories
- Keck All Sky Precession AO project (National Science Foundation AST-1836015)
- Event Horizon Telescope (National Science Foundation AST#2034306)
- Canada-France-Hawai‘i Telescope

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