# AKAMAI WORKFORCE INITIATIVE

# Summer Internship Symposium
# Project Abstracts

## *Pasadena* August 3, 2015
TMT Project Office

## *Hilo* August 5, 2015
Institute for Astronomy Hilo

## *Waimea* August 7, 2015
W.M. Keck Observatory Headquarters

## *Maui* August 10, 2015
Pacific Disaster Center

*Advancing Hawai'i college students into science and technology careers*

# 2015 Akamai Internship Program

The Akamai Workforce Initiative is a program of the
Institute for Scientist & Engineer Educators at University of California, Santa Cruz

## *Akamai = smart, clever*

The Akamai Internship Program is a unique program that supports Hawai'i 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, the students 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 Hawai'i and advance students from diverse backgrounds into science, technology, engineering and mathematics (STEM) careers. Interns receive college credit from UH Hilo.

## *2015 Host Organizations*

***~ Hilo ~***
Gemini Observatory
Smithsonian Submillimeter Array (SMA)
Subaru Telescope
Institute for Astronomy

***~ Kona ~***
Cellana, Inc.
Big Island Abalone Corporation (BIAC)
Natural Energy Laboratory of Hawai'i Authority (NELHA)

***~ Maui ~***
Akimeka LLC
Air Force Research Laboratory (AFRL)
Daniel K. Inouye Solar Telescope (DKIST)

***~ Pasadena ~***
Thirty Meter Telescope International Observatory (TMT)
California Institute of Technology Optical Observatories

***~ Waimea ~***
W.M. Keck Observatory
Canada-France-Hawai'i Telescope (CFHT)

# Akamai Workforce Initiative

## *Staff*

Lisa Hunter, Director - Univ. of California, Santa Cruz

Jerome Shaw, Associate Director - Univ. of California, Santa Cruz

Austin Barnes, Program Manager – Univ. of Hawai‘i at Mānoa

Michael Nassir, Communication Instructor – Univ. of Hawai‘i at Mānoa

Beth Walker, Assistant Director – Univ. of California, Santa Cruz

Nicole Mattacola, Program Coordinator – Univ. of California, Santa Cruz

## *2015 Akamai PREP Course Instructors*

David Harrington, Co-lead Instructor – UH Institute for Astronomy

Austin Barnes, Co-lead Instructor – Univ. of Hawai‘i at Mānoa

Christoph Baranec – Univ. of Hawai‘i at Mānoa, Institute for Astronomy

Sarah Beganskas, Team Leader – Univ. of California, Santa Cruz

Trevor Keiber – Univ. of California, Santa Cruz

Ehsan Kourkchi - University of Hawai‘i

Kevin Moore, Team Leader – Univ. of California, Santa Cruz

Jerome Shaw – Univ. of California, Santa Cruz

Sean Smith – Univ. of California, Santa Cruz

Laurel Stephenson Haskins – Univ. of California, Santa Cruz

## *2015 Communication Instructors*

Austin Barnes, Co-lead Instructor – Univ. of Hawai‘i at Mānoa

Michael Nassir, Co-lead Instructor - Univ. of Hawai‘i at Mānoa

Lisa Hunter – Univ. of California, Santa Cruz

Jerome Shaw – Univ. of California, Santa Cruz

# *Special Thanks . . .*

*There are many people and organizations that contribute to making the Akamai Workforce Initiative a success. We are grateful to everyone involved in prior years, and below we note those that played a role in the 2015 Internship Program:*

**Thank you for being a part of the 2015 Selection Committee**
Tim Minick (Gemini), Joseph Janni (Air Force), Mary Beth Laychak (CFHT), Bryan Berkowitz (KOA IT), LeEllen Phelps (NSO), Ryan Swindle (AFRL), Peter Konohia (Akimeka) and Rob Nelson (Akimeka), Ranjani Srinivasan (SMA), Lucio Ramos (Subaru)

**Air Force Research Laboratory**
Michael Werth, Jeremy Bos, Steven Griffin, Brandoch Calef and Ryan Swindle

**Akimeka LLC**
Rob Nelson, Desislava Iorgova, Peter Konohia III, Tad Dicks, Rob Bartlett and Jon Beck

**Big Island Abalone Corporation**
Cecilia Viljoen and Jay Booth

**Canada France Hawaii Telescope**
Greg Green, Gregory Barrick, Doug Simons and Tom Benedict

**Caltech Optical Observatories**
Richard Dekany, Roger Smith, Jeff Zolkower, John Henning, Michael Feeney and Rebecca Jensen-Clem. *Mahalo for hosting our weekly intern meetings!*

**Cellana Inc**.
Emily Knurek

**Daniel K. Inouye Solar Telescope**
Chriselle Galapon, LeEllen Phelps and Guillermo Montijo Jr. and Valentin Pillet. *Mahalo for hosting our weekly intern meetings!*

**Gemini Observatory**
Chas Cavedoni, Tim Minick, Peter Michaud and Markus Kissler-Patig and Adrienne Notley. *Mahalo for hosting our weekly intern meetings!*

**W. M. Keck Observatory**
Jason Chin, Ed Wetherell, Truman Wold and Hilton Lewis. *Mahalo for hosting our Symposium & our weekly intern meetings!*

**NELHA**
Pam Cotton, Keith Olson, Alex Leonard and Laurence Sombardier. *Mahalo for hosting our intern meetings!*

**Pacific Disaster Center – Kihei**
*Mahalo for hosting our annual Symposium!*

**Smithsonian Submillimeter Array**
Geoffrey Bower and Ranjani Srinivasan

**Subaru Telescope**
Russel Kackley, Lucio Ramos and Kiaina Schubert

**Thirty Meter Telescope International Observatory**
Amanda Cueto-Moll, Scott Roberts, Sandra Dawson, Holly Novack, Magnolia Ycasas and Warren Skidmore. *Mahalo for being a sponsoring partner!*

**University of Hawai‘i at Hilo**
Donald Straney. *Mahalo for providing housing for our interns and classrooms for the PREP course!*

**University of Hawai‘i at Mānoa - Institute for Astronomy**
Mark Chun, Günther Hasinger, Robert McLaren, Klaus Hodapp, Pamela Lau, Cristal Koki, Faye Uyehara, Laura Fiorentino and Johanna Estrella. *Mahalo for hosting our intern meetings!*

**University of Hawai‘i at Mānoa - College of Engineering**
A Zachary Trimble

# Mechanically Improving Dome Motion of the Zwicky Transient Facility Survey

**Racieli Andrada**
California State Polytechnic University, Pomona
Caltech Optical Observatories
*Mentors:* Richard Dekany and Roger Smith
*Collaborators:* Jeff Zolkower and John Henning

**Project Abstract:**
The Zwicky Transient Facility (ZTF) is a wide-field survey camera used to study the astrophysics of transient phenomena such as supernovae, variable stars, and solar system bodies. The wide field of view provided by the 48-inch (1.2-meter) Samuel Oschin Telescope allows scientists the opportunity to find rare transient phenomena by surveying the maximum volume of the universe per unit time with a preference for nearby objects bright enough to follow up with spectroscopy. To maximize the fraction of time spent observing, the time to slew between fields must be kept below the 10 seconds required to read out the image sensors for most slews. The purpose of this project was to determine the motor characteristics required to achieve this level of performance. Dome specifications, including dome weight and radius, motor speed and power, and gear ratios, were used to create a numerical model of the current drive system. The friction was inferred from the measured position versus time and the moment of inertia estimate. Motor torque could then be inferred from the top speed, since the net torque on the dome is zero when moving at that constant speed. A DC motor is known to have a linear dependence of torque on rotation rate. A finite difference model incorporating these performance parameters was created to predict the position versus time relationship. This prediction was then compared to measured dome position versus time when accelerating and running at final top speed. An analytical solution to the differential equation describing dome acceleration (based on Newton's third law) was shown to predict the same behavior as the finite difference model. The analytical solution was then used to predict the amount of time to make each slew. A list of the actual 48-inch telescope pointings over 81 nights of a similar sky survey was used to estimate the average excess above a 10 second slew time allowance. These tools can be used to confidently predict the reduction in observing overheads for proposed motor and gearbox upgrades so that a cost-benefit analysis can be performed for realistic observing scenarios.

**Biography:**
Racieli Andrada was born and raised in Kahului, Maui. She graduated from Maui High School in 2014 and is currently working towards a B.S. in Civil Engineering at California State Polytechnic University, Pomona. Her ultimate goal is to earn an M.S. in Structural or Environmental Engineering and return to Hawai'i to be a part of future development. Through Racieli's involvement with the Society of Women Engineers, American Society of Civil Engineers, Engineers Without Borders, and the College of Engineering as a Women in Engineering Ambassador, she has had the opportunity to surround herself with peers and professors who will be instrumental in her academic journey and success in engineering. In her spare time, Racieli enjoys being a freelance photographer for the school newspaper, going to Disneyland, and exploring Los Angeles.

**Comparison and Customization of Various Content and Workflow Management Systems**

**Paul B. Barnes**
University of Hawaii at Hilo
Thirty Meter Telescope
*Mentors*: Amanda Cueto-Moll, Scott Roberts and Hugh Thompson

**Project Abstract:**
Thirty Meter Telescope (TMT) does not currently utilize any software that automates workflow, which is a sequence of operations that are declared as the work of a person or a group. Different systems and subsystems within TMT rely on the workflow process for the revision, approval and publishing of a work product. TMT currently uses Xerox® DocuShare (DCC) as an Enterprise Content Management System (ECMS). DCC has a workflow management option, but this feature has not been deployed at TMT. Switching over from performing Configuration Management tasks, which are the identification, storage, change control, approval, and status reporting of selected work products during the life of a system, manually to automatically using software will increase TMT's efficiency. The purpose of this project was to assist TMT in increasing overall efficiency by automating the workflow management system. A publication of standards was used to form a basis of comparison to four software packages: DCC, Atlassian JIRA, Advantys WorkflowGen, and Cuteflow. The software's documentation were used to examine and gauge functionality. The trade study confirmed that three of the four tested software options fulfill the basic needs of TMT: the existing DCC, JIRA, and WorkflowGen. Although JIRA and WorkflowGen outperformed the existing DCC in the trade study, it is recommended that DCC's workflow should be implemented due to user familiarity of the existing DCC, the inertia required to transition to a new software package, and DCC's capability for upgrades. Since DCC is TMT's primary ECMS it should be further developed to accommodate all special needs that TMT may come across in the future.

**Biography:**
Paul Barnes was born and raised on the island of Hawai'i and graduated from Hilo High School. In 2009 he began his academic journey at the University of Hawai'i, Hawai'i Community College, earning his associate degree in Liberal Arts. He is currently attending the University of Hawai'i at Hilo and working towards his B.S. in Computer Science. After obtaining his bachelor's degree, Paul intends to continue his education and pursue a doctorate's degree in Computer or Software Engineering. In his free time, Paul enjoys going swimming, working out, going on random adventures around the island of Hawai'i, and spending time with family and friends.

## WavePy: Creating a Python Package for Wave Optics Researchers

**Celina Bekins**
Franklin W. Olin College of Engineering
Air Force Research Laboratory at the Maui High Performance Computing Center
*Mentors*: Jeremy Bos and Michael Werth

**Project Abstract:**
United States Air Force researchers are constantly trying to enhance images collected by ground-based telescopes of objects in space. Countless computer simulations have been performed to simulate images that have been corrupted by atmospheric turbulence for the purposes of testing new enhancement algorithms. However, these simulations have mostly been done in MATLAB, a proprietary software package, which is expensive and slow to incorporate new technology. This project aimed to make those simulations easier to run and share by using Python, a frequently updated open-source language, instead. Pre-existing MATLAB simulation code was translated into Python and this translation was benchmarked against the original. These fully translated and benchmarked functions were put into a new Python package called WavePy, which can easily be used by any researcher who downloads and imports it, similar to other popular Python packages. The benchmarking performed thus far shows the new Python code is as effective as the MATLAB code, running intensive algorithms in comparable amounts of time and producing the same results. Using WavePy, researchers will have a variety of wave optics functions readily available, rather than having to design and code entire simulations whenever they want to further their research. Moving forward, optimization might make WavePy's code run even faster and thereby more efficiently than the MATLAB code.

**Biography:**
Celina Bekins is a sophomore at Franklin W. Olin College of Engineering, where she is studying Mechanical Engineering with concentrations in Robotics and Sustainability. She grew up on Maui and has had to adjust to not seeing the sun all the time in Massachusetts, but she is extremely excited to have an internship at home for the 2015 summer. She is also immensely happy to be working at the Air Force Research Laboratory at the Maui High Performance Computing Center in Kihei. She attended Kihei Charter's STEM Academy Middle School for the first three years of its existence, where two of the classes were held at the MHPCC – you could say this internship is bringing her back to where her love for engineering began.

## Carbon Dioxide Utilization Efficiency in Microalgae Systems: Evaluating the Use of Flue Gas to Grow Microalgae

**Brittany Denzer**
Colorado College
Cellana
*Mentor*: Emily Knurek

**Project Abstract:**
One of the benefits of algae cultivation is the uptake of the greenhouse gas $CO_2$ through photosynthetic processes. Flue gas, exhaust from fossil fuel combustion, is an attractive source of $CO_2$ for algae cultivation because it is abundant, cheaper than conventional sources of pure $CO_2$, and allows for the recycling of $CO_2$ that would otherwise be emitted into the atmosphere. Cellana, a developer of algae-based nutraceuticals, animal feed and biodiesel, is researching and developing an on-site diesel flue gas $CO_2$-sourced system with commercial potential. A previous study showed the flue gas system met design goals, but does not deliver enough $CO_2$ to meet algae growth demand under standard pond inoculation density and duration. This project tested the efficacy of Cellana's flue gas delivery system supplemented with pure $CO_2$ and provided baseline measurements of $CO_2$ usage throughout the open pond growth cycle. A set of binary ponds were implemented to compare algae grown with flue gas supplemented with pure $CO_2$ to algae grown only with pure $CO_2$. Ponds were grown using Cellana's standard cultivation procedures. Growth rate, biomass productivity, biomass composition, nutrient use, pure $CO_2$ use, pH, and cost were analyzed for the two treatments. An evaluation of the flue gas system including an assessment of its efficacy will be presented. If the flue gas system reduces $CO_2$ requirements and produces quality algae with satisfactory growth performance, expansion of the system could possess commercial viability.

**Biography:**
Brittany Denzer was born and raised in Kona on the Big Island, where she developed a fascination with nature and ecological systems at a young age. She graduated from Kealakehe High School in 2012 and is currently a senior at Colorado College majoring in Organismal Biology and Ecology with a minor in Music. Brittany enjoys spending time outdoors, particularly in the ocean, and spent the last semester conducting research on a sailing voyage from New Zealand to Tahiti through the Sea Education Association. After graduating, she plans to attend graduate school to pursue a master's or Ph.D. degree in the biological sciences. Ultimately, she hopes to return to the Big Island to apply what she has learned to the challenges facing her island and state.

## Re-Structuring the Ten-MilliArcSecond Camera (TMAS)

**Jasmine Feliciano**
Worcester Polytechnic Institute
California Institute of Technology Optical Observatories
*Mentors*: Richard Dekany, Michael Feeney and Rebecca Jensen-Clem

**Project Abstract:**
The Ten-MilliArcSecond Camera (TMAS) is an optical wavelength camera system for use behind the PALM-3000 adaptive optics system on the 5-m telescope at Palomar Mountain. TMAS must be updated to be co-mounted with the near-infrared PHARO camera and have the capability of reading H-alpha and non H-alpha wavelengths. These two changes in the optical system will allow for new science cases such as exoplanet imaging that require simultaneous multi-wavelength data. The goal of this project was to mechanically and optically re-design TMAS to meet these two changes and to have an accessible interior. We used SolidWorks, a CAD program, and Zemax, a commercial optical design software, to create mechanical and optical designs. These designs were iterated with different methods of splitting the incoming light beam to achieve the necessary goals for TMAS. The final design that achieved the requirements of reading both H-alpha and non-H-alpha wavelengths within the space constraints imposed by co-mounting with PHARO included a dichroic mirror, an optic that separates two wavelengths by reflection. Since TMAS must be reduced to half of its current size and be accessible, it was best to use the dichroic mirror as a window into TMAS, mount all of the optical components to one wall, and have quick release side panels. This design concept allows for simplified human control over the optical components within the defined space constraints. This new model of TMAS is a good foundation for any future development and modifications.

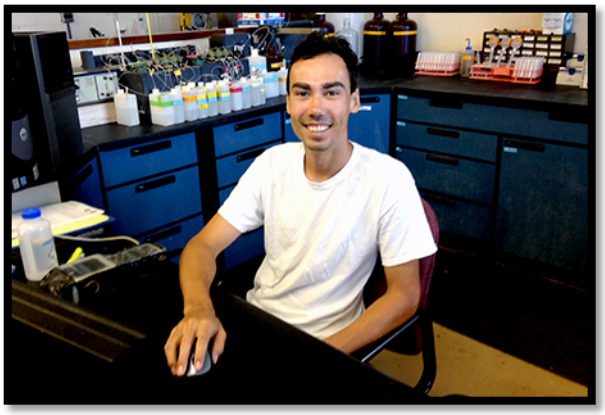
**Biography:**
Jasmine Feliciano is from Kahului, Maui and is a 2014 Maui High alumna. She has been involved in STEM programs and robotics throughout high school and middle school, which led to her desire of being an engineer. Currently, Jasmine is pursuing a bachelor's degree in Mechanical Engineering, with a focus in Robotics Engineering at Worcester Polytechnic Institute. Her goal is to work in the robotics or energy/sustainability field, and help increase STEM engagement and involvement of all ages, especially students. In her free time, Jasmine likes to volunteer at community events, especially STEM related events, ballroom dance, do outdoor activities such as hiking and biking, take photos, and spend time with family and friends.

## A Scope of The NELHA Anchialine Ponds

**Kapono Gaughen**
University of Hawai'i at Mānoa
Natural Energy Laboratory of Hawai'i Authority
*Mentors*: Pam Cotton and Keith Olson

**Project Abstract:**
Anchialine ponds are landlocked bodies of water with a direct subterranean connection to the ocean. These ponds host endemic and indigenous species found in no other habitat. The chemistry and biological makeup of the anchialine ponds present on the NELHA property have yet to be fully understood. Exotic biota is present in some of the ponds that is believed to stress and degrade the ponds' native species. The primary purpose of this experiment was to gather data on the relationship between tidal changes and the salinity of the anchialine ponds, which will allow for better understanding and future predictions about the behavior of the ponds. Secondly, the exotic biota present in the ponds was recorded, and measures were taken to remove the invasive species. To gather data on the salinity of the ponds, an in-situ CTD was placed in the ponds and recorded data once every 5 minutes over a large tidal fluctuation. This was repeated with the CTD moored to the bottom of the pond, and free floating at the surface. Two separate ponds were used for the sake of comparison. The invasive species were determined with visual observations, and traps were set up to remove them. With the gathered data on salinity and experimental trapping, recommendations will be made to NELHA on future practices to promote the health of native and endemic biota.

**Biography:**
Kapono Gaughen has recently graduated from the University of Hawai'i at Mānoa, gaining his bachelor's degree in Biology. Science has been a passion for Kapono from a young age. He also has an interest in politics and the political sciences. In the spring of 2012, he attended the Native American Political Science Program as one of the Native Hawaiian applicants, which was hosted by George Washington University in Washington, D.C. His career goals are to find a balance between science, politics, and the health field, which might allow him to help make a better life for those living here in Hawai'i.

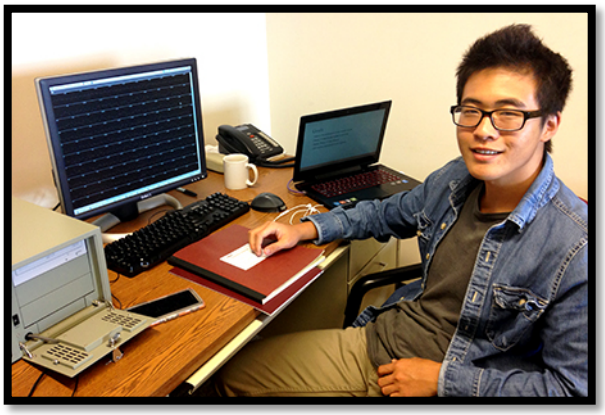


## Improving Real-Time Display of Multiple Datasets with User Interactions

**Tuan Giang**
University of Hawai‘i at Hilo
Smithsonian Submillimeter Array
*Mentors*: Geoffrey Bower and Ranjani Srinivasan

**Project Abstract:**
The YT Lee Array on Mauna Loa has seven radio dishes and each unique pairing of dishes generates one dataset. This creates 21 datasets requiring processing in real-time that need to be displayed for scientists and observers to analyze. The current graphing software displays multiple datasets as one figure on a single canvas which makes assessing the quality of the dataset cumbersome. A new graphing software was implemented using PyQtGraph with real-time updating capability for users to monitor incoming data on separate subplots on a single canvas and improve user interaction. The new software displays 21 datasets, each with its own independent figure on a single canvas. PyQtGraph has built-in user interaction functions such as panning along the x-axis and zooming in along specified x-axis intervals. Along with the built-in interactions, we were also able to implement a separate form application that allows users to take a detailed look at a dataset by selecting its baseline and starting timestamp. Some additional features such as toggling between plots of Amplitude vs. Time and Phase vs. Time, switching the display of data in terms of upper and lower sidebands, and changing the window size from fit to stretch were also implemented. The new software has enormously improved data quality inspection and integrated new interactive features with the data. However, further improvements can be made to the software by displaying more than 150 time integrations, optimizing its graphing performance to avoid lag when it is near the buffer limit, and implementing a rollback feature concurrent with the real-time updating.

**Biography:**
Tuan Giai Giang was born in Vietnam on February 16th, 1995. He immigrated to O‘ahu in 2003 with his mom. Tuan is a graduate of Kaiser High School, class of 2013. After graduating high school, he enrolled at the University of Hawai‘i at Hilo where he is currently pursuing his bachelor’s degree in Computer Science and a minor in Mathematics. When he graduates from college, he hopes to pursue an engineering position at one of the telescopes in Hawai‘i or either Google or Microsoft in California and Washington, respectively. The most influential people in his life are his parents and friends. When he has free time, Tuan likes to run and play Super Smash Brothers Melee and basketball.



## Cooling a Solar Telescope: Plate Coil Thermal Analysis

**Michael Gorman**
Syracuse University
Daniel K. Inouye Solar Telescope (DKIST)
*Mentor*: Chriselle Galapon
*Co-Mentors*: LeEllen Phelps and Guillermo Montijo Jr.

**Project Abstract:**
The extreme climate of Haleakalā requires the observatories to actively adapt in order to produce the best possible images. The telescope structure needs to be close to ambient temperature or the images become blurred and unusable. The Daniel K. Inouye Solar Telescope is a unique observatory as it will be actively observing during the day. This means that it will not only need to keep a constant temperature during the day, but also during the night so as not to radiate stored heat to the other telescopes while they are in use. To accomplish this feat, plate coil panels will be installed on the DKIST enclosure that are designed to keep the temperature close to that ambient temperature (between +0°C and -4°C). To ensure this, a test rig has been installed at the summit of Haleakalā. The project's purpose was to verify that the plate coil panels are capable of maintaining this temperature and involved collecting data sets of various variables including pressures, temperatures, flows of coolant, solar radiations and wind velocities during typical operating hours. Using MATLAB, a script was written to observe the plate coil's thermal performance. The plate coil did not perform as expected, achieving a surface temperature that was generally 2°C *above* ambient temperature, which indicates that the coolant pumped through the plate coil may not be set to a low enough temperature at this time. Calculated heat depositions from the model were within 25% of the measured design data, a reasonable agreement given the fact that many simplifying assumptions were used in the model. It is recommended to do additional tests at later hours in the day for completeness and to use a larger chiller for the plate coil or to set the coolant flowing through the plate coil to a lower temperature to achieve the desired cooling.

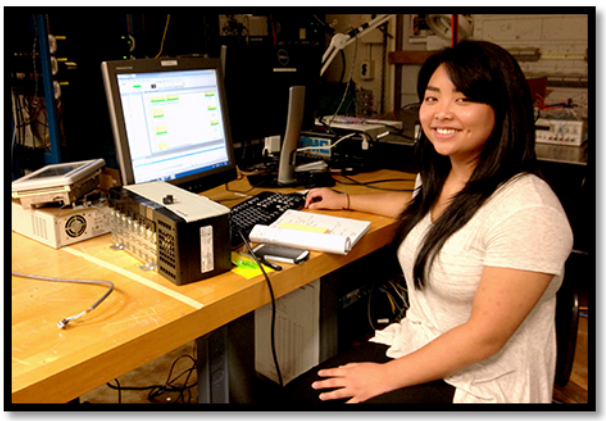
**Biography:**
Michael Gorman is a senior as a Mechanical Engineering major at Syracuse University. He is originally from Maui, but has lived in New Zealand and Florida, in addition to traveling to over 35 countries. He is very interested in innovation and design and would one day like to design something of his own. He has a primary interest in the space program and has been passionate about it since he was a kid. He hopes to work with a company that actively designs products or create his own business. In his free time, Michael enjoys working with computers, watching movies, playing sports, and hanging out with friends.

## Integration of the Next Generation Laser Subsystems at W.M. Keck Observatory

**Mickie Hirata**
University of Redlands
W. M. Keck Observatory
*Mentors*: Jason Chin and Ed Wetherell

**Project Abstract:**
The W.M. Keck Observatory plans to upgrade the Laser Guide Star Adaptive Optics (LGSAO) System with a Next Generation Laser (NGL) for the Keck II telescope located on the summit of Mauna Kea in October 2015. Since laser adaptive optics observations are in high demand, downtime during the replacement of the laser system must be minimized. To ensure a seamless transition during the integration phase, Keck engineered and built subsystems that were installed and tested on the telescope prior to the laser installation itself. Proper testing and calibration of these subsystems had to be verified for requirements compliance prior to delivery to the summit. Specifically, the Laser Safety System (LSS) will ensure safety for personnel and equipment; a Thin Film Polarizer (TFP) motor will control the laser beam intensity for alignment and calibration; and thermal coupled temperature sensors will ensure the laser is operating at their operating temperatures. These subsystems were assembled, calibrated, tested and documented at headquarters (HQ). After HQ testing was complete, the subsystems were transferred and integrated at the summit with further testing in the operational environment.

**Biography:**
Mickie Hirata was born in Hilo and raised in Waimea on the Big Island. After graduating from Hawai'i Preparatory Academy, Mickie currently attends the University of Redlands in Southern California. She will be a sophomore this fall and is pursuing the engineering 3-2 program to receive a B.A. degree in Physics, a minor in Mathematics, and a B.S. degree in Electrical Engineering. Although not completely sure until she gets there, she will possibly want to pursue a master's degree in a specific subject within physics. Mickie hopes to be involved in the discovery of new things as a career. Besides learning new things, she likes to play video games, watch shows and hang out with friends.



## Creating an Integrated SolidWorks Model of the Canada France Hawai'i Telescope

**William K Kaeo III**
University of Hawai'i at Mānoa
Canada France Hawai'i Telescope
*Mentor:* Greg Green

**Project Abstract:**
The Canada France Hawai'i Telescope (CFHT) has been in operation since 1979 and is currently investigating upgrading its optics and dome enclosure from a 3.6-meter optical/infrared telescope to a 10-meter class telescope. An accurate computer automated drawing in SolidWorks of the lower cement and steel structure of the current CFHT observatory is needed as the foundation for all future engineering work. The purpose of this project was to create an accurate model of the existing observatory building and its features for the engineers working on the new remodeled design of the CFHT to give a greater idea of new instrument fitment and possible design constraints as well as a model on which to base FEA studies. An accurate model of the observatory was created by converting a current semi-complete Autodesk Inventor model into SolidWorks and matching it to the existing architectural drawings along with measurements taken from the as-built structure. Because some of the features that exist in the current observatory building do not match the architectural drawing, many of them needed to be checked and documented in-person on the summit in order to ensure an accurate representation of the observatory building. This model will be used as the core structural component in the final design of the Mauna Kea Spectroscopic Explorer, which will be a 10-meter class telescope designed to take around 7 million spectra each year to excel at galactic archaeology of the Milky Way.

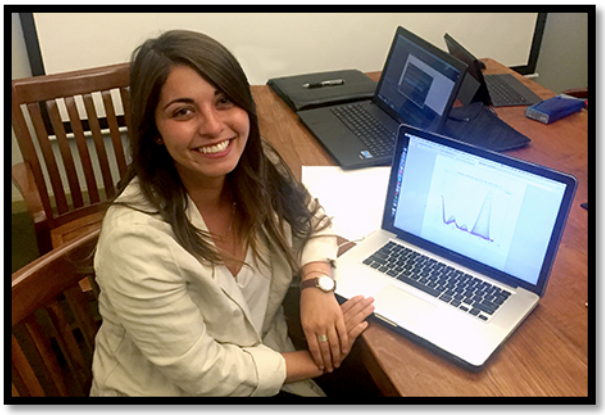
**Biography:**
After graduating from Nanakuli High & Intermediate School, William Kaeo III received his Associate of Science in Natural Science: Pre Engineering at Kapi'olani Community College (KCC). At KCC, William participated in and became a peer mentor for the KCC STEM program. William is a member of the Engineers for a Sustainable World, University of Hawai'i branch and participated in building the club's solar cart for Earth Day. For the upcoming Fall 2015 semester, William will transfer to the University of Hawai'i at Mānoa, where he will be pursuing a Bachelor of Science degree in Mechanical Engineering. At the University of Hawai'i at Mānoa, he hopes to obtain a master's degree in Mechanical Engineering and to work in the aerospace or automotive industry. In his free time, William enjoys spending time with his family, stand up paddling, playing with his dogs, and working on cars with his father.

## Determining the Behavior of Piezo-Ceramic Actuators and Finding Errors in Mirror Configurations for an Aperture Partitioning Optic

**Kourtney Kehr**
University of Colorado at Boulder
Air Force Research Laboratory
*Mentors:* Dr. Jeremy Bos, Dr. Steven Griffin, and Dr. Brandoch Calef

**Project Abstract:**
Atmospheric turbulence and sky brightness degrade satellite imagery collected during daytime telescope observations. To improve image quality, an aperture partitioning optic is being developed by The Boeing Company. The device consists of four articulating mirrors whose positions are adjusted by controlling the voltages applied to piezo-ceramic actuators positioned behind each mirror. The purpose of this project was to first determine the behavior of the actuators and then to develop a solution for detecting error in the mirror configurations. Using a high voltage amplifier, voltage was applied to a piezo-ceramic stack whose deformation or displacement was measured using a laser displacement sensor. The data collected in this experiment, using a CoCo signal analyzer, was then plotted in Octave in order to determine and observe the behavior of the piezo-ceramic actuators. They behaved according to a hysteresis loop, as expected. The hysteresis loop can now be characterized, and from this characterization, control voltages for each desired displacement can be attained. The method of characterizing the hysteresis loop is more complicated than closed loop positioning but has better resolution. Octave was used to simulate the image produced by the separate mirrors in order to determine piston error in the mirror configurations. It was observed that the piston error could be measured using the focal plane data so that it can then be corrected by adjusting the actuators. With the behavior of the piezo ceramic actuators determined and a method found for detecting error in the mirror configurations, the optic device can be used effectively and efficiently to improve the quality of daylight imagery of satellites.

**Biography:**
Kourtney Kehr was born in Kahului, Maui and will be a junior studying Mechanical Engineering in the fall at the University of Colorado Boulder. Her academic interests include space travel and she hopes to become an astronaut one day in the future. She currently works in the physics lab on campus where she is able to put her engineering knowledge to practical use. In the lab, she is in charge of improving demos and fixing any other issues that may arise. She is a member of the American Society of Mechanical Engineers and the Society for Women Engineers. Kourtney enjoys being outdoors, whether she is snowboarding, hiking, or just lounging outside with her dog, Tater.



## Using the Daylight Object Restoration Algorithm (DORA) to Mitigate Aberrations from a Low-Quality Primary Mirror

**Saxon Paul Knight**
University of Hawai'i Maui College
Air Force Research Laboratory
*Mentor*: Dr. Ryan Swindle

**Project Abstract:**
Professional grade telescopy for ground-based satellite imaging has mostly relied on cumbersome and expensive primary mirrors. The high cost and time required to adequately polish a primary is a severely limiting factor in production and deployment of telescopes, but new, cost-effective alternatives to the highest-quality mirror approach are being researched. One such alternative is the Flexible-replicated Large Optical Post-Processing Investigation (FLOPPI) concept, which combines poor quality optics (e.g. carbon fiber-reinforced polymer, CFRP) with image post-processing algorithms using peripheral sensor data to restore imagery to a high-quality-mirror equivalent. To investigate the viability of a low-cost, poor-optical-quality telescope concept in satellite detection and imaging, trade studies were desired on varying CFRP optical quality, atmospheric turbulence, peripheral sensor specifications, and satellite brightness. To facilitate these studies, the Daylight Object Restoration Algorithm (DORA) was used to restore images with and without modeling the static aberrations imposed by a poor-quality primary's surface. A color-map digitizer was also developed in Python to extract and convert data from surface-figure image files that would be used with DORA and, to ensure its accuracy in digitizing other images, was tested against the only available surface-data color-map-image pair via visualized differencing and a root-mean-square error (RMSE). The results were found to have a high visual correspondence and a low RMSE of 0.274 radians. An initial comparison of restored, simulated, ground-based images of the Hubble Space Telescope (HST), including cases where static aberrations from the observing telescope primary's surface were both modeled and neglected, as well as for two different Shack-Hartmann lenslet densities of 14x14 and 28x28, revealed a better restoration was possible in higher turbulence conditions and with lower-quality optics when the static aberrations of the primary were modeled as opposed to neglected. It is concluded that the FLOPPI concept at 0.8-m apertures and a wavelength of 800 nm is thus far viable in median turbulence conditions and is a favorable approach for lowering production costs and ultimately promoting vastly increased mobility of high-visual-quality imaging systems. It is also suggested that the FLOPPI concept would be a good complement to other technologies with the same goals in mind.

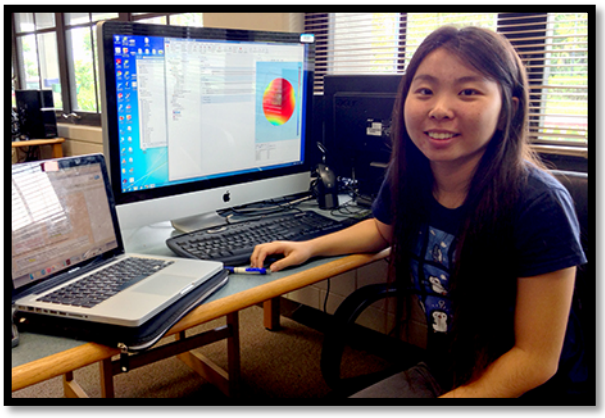
**Biography:**
By age thirteen, Saxon Knight had been to six different public schools and transitioned through private school into home-based autodidacticism. He and his mother moved at least twice a year, so he turned to the internet for socialization and began to indulge in the hobbies (programming, 3D modeling, and math) that would later lead him to go to school for engineering. Saxon has been attending the University of Hawai'i Maui College, taking higher math and physics courses and working as a math and science tutor with the goal of obtaining a bachelor's degree in Mechanical Engineering and a master's in Aerospace Engineering. His career goals are to work for an engineering-based company such as Boeing, SpaceX, or NASA in either advanced weapons systems or specialized-vehicle transport systems.

## A Finite Element Study of the Self-Deflections in Large Mirrors Subject to Various Mounts

**Tina Li**
University of Hawai‘i at Mānoa
Institute for Astronomy
*Mentors*: Mark Chun and Zachary Trimble

**Project Abstract:**
The Institute for Astronomy is currently working on a project called ‘Imaka, which is a ground-layer adaptive optics (GLAO) system for the 2.2-meter telescope on Mauna Kea aiming for high resolution, high sensitivity, and a large field of view using relatively large mirrors. Due to the size and weight of large mirrors, gravity causes deflections in the mirror surface that will distort the output images. The design of a mount for large mirrors has to be carefully considered in order to support the mirror and reduce self-weight deflection. Mirror surface deflections were calculated using COMSOL, a finite element analysis (FEA) software, for various mounting designs. A simply-supported ring mount, a fixed ring mount, and a 3-point mount were modeled for a solid Borofloat33 glass mirror with a 400-mm diameter and 50-mm thickness. Model results were compared with analytical solutions to gain modeling skills and understanding of the software and the limitations of both the FEA and analytical models. For the ring mount, both simply-supported and fixed, there was a 3% difference between the FEA and analytical solutions (taking into account bending and shear stresses). As the aspect ratio of the mirror increases, bending stress dominates the deflection and shear stress becomes negligible for both the ring and 3-point mounts. Verification of basic mounts and understanding of FEA in COMSOL will facilitate the design and analysis of the more complex mounts that will be needed to support the ‘Imaka project’s mirrors.

**Biography:**
Tina Li was born and raised in Honolulu, where she graduated from President William McKinley High School. She currently attends the University of Hawai‘i at Mānoa, pursing a Bachelor of Science degree in Mechanical Engineering. After graduating, she would like to attend graduate school. One day she would like to work in the biomechanics industry. In her spare time, Tina enjoys watching movies, reading, eating, and spending time with family and friends.

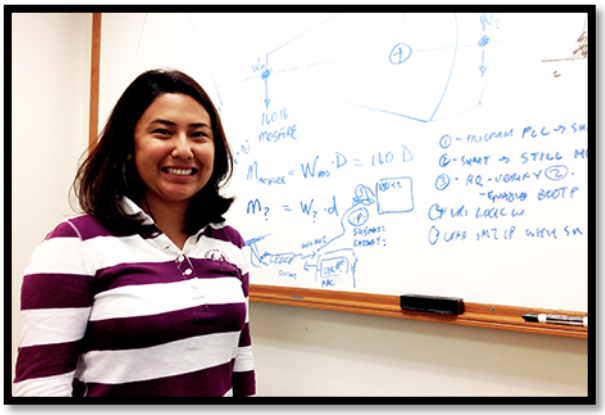


## Improving the Counter-Balance Systems for the Keck I and Keck II Telescopes

**Brialyn Onodera**
University of Hawai'i at Mānoa
W.M. Keck Observatory
*Mentor:* Truman Wold

**Project Abstract:**
The twin W.M. Keck Observatory telescopes are currently balanced by manually bolting steel plates to the telescopes. This method is time consuming and unsafe, prompting the need for a more efficient balancing system. Initial research was conducted on the balancing systems for Keck and other observatories to determine requirements of an improved system. Evaluating current balancing operations on the Keck telescopes led to three different scopes of weight adjustments: "fine-tuning" involves small weight changes to correct minor imbalances; "reconfiguration" addresses weight changes caused by instrument exchanges; "total telescope balancing" includes fine-tuning and reconfiguration but also fixed weight changes to counteract more permanent telescope fixtures. To address these scopes simultaneously, three feasible designs were conceptualized which include improving the current system, moving weight, and fluid transfer. Improving the current system could involve a mechanized method of moving and attaching weight. Moving weight and fluid transfer are both dynamic methods that controllably move metal plates or liquid, respectively, for rebalancing. Evaluating different design concepts demonstrated that a combination of moving weight and fluid transfer is recommended to address all three weight scopes. Small dynamic moving weights in both solid and fluid form would easily address the "fine-tuning" scope, while a slightly larger version would address the "reconfiguration" scope. The "total telescope balancing" scope would require the largest dynamic weight changes, but would still incorporate the use of static weights. Using these recommendations, Keck will be able to design a system that addresses the balancing needs of the telescope more efficiently and can support heavier instruments and weight changes in the future.

**Biography:**
Brialyn Onodera was born and raised on the Big Island of Hawai'i. A graduate of Kamehameha Schools, she attended the University of Hawai'i at Hilo for three years, then transferred to the University of Hawai'i at Mānoa in the fall of 2014. She is currently enrolled there, studying Mathematics and Mechanical Engineering. She intends to graduate with her bachelor's degree in both majors and plans to get her master's degree in Mechanical Engineering. After growing up in Hawai'i, where she gained a fascination for the ocean and the life it harbors, she would like to find a job building robots to be used for underwater research.



## The Most Overlooked Intangible Company Asset: Development of a Data Management System

**Kevin Ryan**
Honolulu Community College
Akimeka LLC
*Mentors*: Rob Nelson, Desislava Iorgova and Peter Konohia III

**Project Abstract:**
As we enter the "Big Data Era", professionals are relying on business intelligence tools and data management to quickly analyze high volumes of semi-structured data in order to make better business decisions. Akimeka is a software development firm that maintains systems for the Department of Defense (DoD) and enhances the software per requirements defined by the DoD. Akimeka expects to better serve its clients' needs by migrating from storing and managing requirements in MS Word Documents and MS Excel Spreadsheets to a Requirements Management System. Akimeka's new system aims to improve accessibility and analysis of functional, system, and design requirements for its stakeholders. The Requirements Management System needs to transform data from Excel spreadsheets to a database environment to improve requirements analysis, accuracy, and search capability for the Akimeka team. This project's effort was to research and design two possible solutions for data migration, conduct an analysis of alternatives, make a recommendation, and to implement, test, and document the chosen solution. The two possible solutions were writing Custom Java Code or using Pentaho's Data Integration (Kettle) software to provide Extract, Transform, and Loading (ETL) of the data into an Oracle database. Based upon research of both approaches, Pentaho's Data Integration (Kettle) is recommended because of its scalability, data change adaptability, and overall ease of use. Currently, the ETL design has been implemented, tested, and properly documented. It affords Akimeka's management the capabilities to ingest large amounts of data from multiple spreadsheets, transforms the semi-structured data into an accurate searchable structure, and loads the data into an Oracle database for business analytics. With the new Requirements Management System in place, Akimeka will more effectively and efficiently meet the government's requirements for these systems and ultimately enhance software services for military members and their families.

**Biography:**
Kevin Ryan was born and raised on the western part of O'ahu in our second city, Kapolei. He is a Honolulu Community College student completing an Associate of Science degree in the Computing Electronics Networking Technologies (CENT) program. Kevin's expected graduation is in the fall of 2015. He will be transferring to the University of Hawai'i - West O'ahu to double major in CENT and Information Security Assurance (ISA), also known as Cyber Security. After completing his degrees, Kevin plans to pursue a career revolving around Network Engineering and Security. When he is not studying for his next certification, Kevin enjoys spending quality time with friends and family, lifting heavy weights, driving fast cars, and eating delicious foods.

## 911- Emergency Mobile App for People with Disabilities

**Derae Shibata**
University of Hawai'i Maui College
Akimeka LLC
*Mentors:* Tad Dicks & Rob Bartlett
*Co-Mentor: Jon Beck*

**Project Abstract:**
Out of the 63 million people with disabilities in the United States, 28 million are deaf or hard of hearing and thus have difficulty with conventional 911 services. The purpose of the project was to create an emergency mobile app prototype for users with either a permanent or temporary hearing disability. The app allows the user to send an automated text to 911 that includes the user's pertinent information: disability, GPS coordinates, and nature of the emergency. The prototype was built using Apache Cordova, a platform for creating native mobile apps with HTML, CSS, and JavaScript. Little or no code needs to be changed when deploying Apache Cordova apps to different mobile devices. The next steps will be to implement Accessible Rich Internet Applications (ARIA) specifications, which defines a way such as a screen reader to make web content applications more accessible to people with disabilities, and publishing the app in both Google Play and Apple App Stores.

**Biography:**
Derae Shibata is from Makawao, Maui. She is a sophomore at the University of Hawai'i Maui College majoring in Electronic & Computer Engineering Technology (ECET). She plans on graduating with her Associate of Science degree in May 2016, followed by her Bachelor of Applied Science degree in Engineering Technology. She plans on furthering her education by leaving her home town and continuing to get a Master of Science degree at the University of Washington. Upon graduation, she plans on returning to her beloved Maui and using her acquired knowledge to help the people of Hawai'i through technological innovation and local production in renewable energy and/or sustainability. In her free-time she enjoys going to the beach and spending quality time with her friends and family.

## MOIRCS Focusing Program Upgrade

**Hannah Twigg-Smith**
Franklin W. Olin College of Engineering
Subaru Telescope
*Mentor*: Russell Kackley

**Project Abstract:**
One of the Subaru Telescope's instruments, the Multi-Object InfraRed Camera and Spectrograph (MOIRCS), utilizes a number of hard-to-maintain computer programs to determine the best-fit focus configuration. The purpose of this project was to rewrite the MOIRCS best-fit focusing programs in Python in order to make them less confusing and easier to maintain, and to also integrate the programs into the existing Gen2 system, which is the software used to control the telescope. To do this, the original programs were analyzed and the base functionality was translated to Python while excluding parts deemed unnecessary. The new programs make use of Python libraries such as Astropy, MatPlotLib, and SewPy, which allow them to achieve the same result as the original programs faster and to produce cleaner-looking graphs. The best-fit focusing programs were reduced from nine scripts to two scripts, using one intermediate pickle file to store data. After being rewritten, the programs were formatted in such a way that they could interface with the Gen2 system directly in the form of a plug-in, using the format of existing plug-ins as a framework. Integration of the MOIRCS focusing programs into the Gen2 system allows astronomers easier access to the plug-in that ultimately returns a best-fit focus suggestion that helps astronomers decide what value to use to focus the telescope.

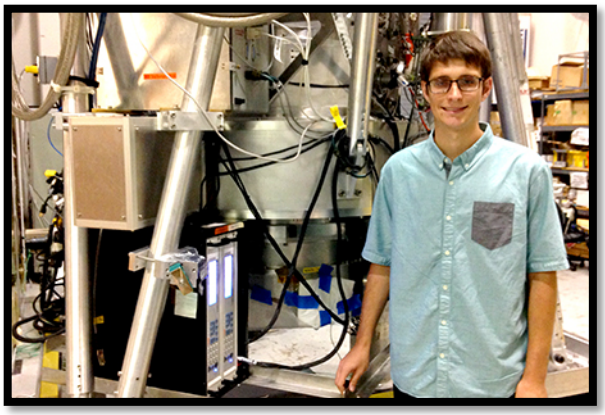
**Biography:**
Hannah Twigg-Smith was born in Kainaliu, Hawai'i, and raised in both Kona and Waimea. She graduated from Hawai'i Preparatory Academy in 2014 and is currently a member of the Franklin W. Olin College of Engineering class of 2018. Hannah is pursuing a degree in Engineering with Computing with a specialization in Human-Computer Interaction. After graduation, she plans to continue her education and pursue a master's degree in Computer Engineering. In her spare time, Hannah enjoys reading, photography, and video games.

## Design and Implementation of a New Temperature Control System for MOIRCS

**Luke van der Spoel**
Rice University
Subaru Telescope
*Mentor*: Lucio Ramos

**Project Abstract:**
One of the primary instruments in use at the Subaru Telescope is the Multi-Object InfraRed Camera and Spectrograph (MOIRCS); currently MOIRCS is at the Subaru base facility where modifications and repairs are being made. These modifications include the updating of the temperature control system, which keeps the instrument at 77 degrees Kelvin. The purpose of this project was to assist in the designing and implementation of this new temperature control system. The principal component of the new system is the Lakeshore 336 Temperature Controller; Subaru has acquired two of these for use in MOIRCS. The Lakeshore 336s have a built in proportional-integral-derivative controller, but must be integrated into and configured to work with the rest of the system, including the sensors, external power supplies, heating resistors, and existing wiring within MOIRCS. The old temperature controllers had completely different connectors and wiring to the Lakeshore 336s so new cabling was designed and constructed; adapters between the existing sensor wiring and the new system were also implemented. By themselves, the Lakeshore 336s are unable to provide enough power for the heater resistors, which necessitated the integration of two external power supplies. These power supplies were programmed to vary their output with the information coming from the Lakeshores' analog outputs. Comprehensive documentation on the new set up was completed to ease the way for future upgrades and modifications. The new temperature control system will allow for sensor readouts and power usage data to be accessed remotely through the Subaru Network. Additional sensor ports and sensors have been added, providing for holistic monitoring of MOIRCS. The implementation of the external power supplies will reduce the power usage of the temperature controllers themselves, which were previously operating at maximum capacity, and will result in a safer and more reliable control system.

**Biography:**
Luke van der Spoel was born in South Africa and has lived on the Big Island of Hawai'i since his fifth birthday. He graduated from Kealakehe High School in Kailua-Kona in 2013. He is currently a sophomore at Rice University in Houston, Texas, pursuing a Bachelor of Science degree in Electrical and Computer Engineering. Luke's degree focus is systems engineering and signal processing. After graduation, he plans to attend graduate school with the hope to work as a design engineer in industry.

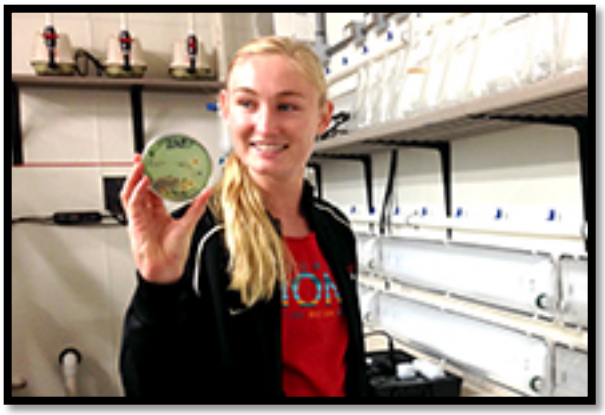


## Determining the Cause of Abalone Mortality

**Alexandra Van Pernis**
Brown University
Big Island Abalone Corporation
*Mentor*: Cecilia Viljoen

**Project Abstract:**
Big Island Abalone Corporation (BIAC) is a commercial aquafarm that grows abalone on the Big Island of Hawai'i and sells it locally, in Canada, in Japan, and in the western United States. BIAC has seen periodic high mortality in their juvenile abalone (4-5 months old) mostly around the full moon of each month. This project's purpose was to determine the cause of the abalone mortality and, if found, to devise an effective treatment method. An experiment with two methods of approach was designed. The first method was weekly sampling of tanks containing juvenile abalone to determine if any changes could be detected in the water and tanks. Dissolved oxygen, pH and cell counts from the incoming seawater were recorded, and bacteria from test tanks were cultured. This determined baseline values and determined if mortality correlated to a deviation in these values. The second approach was to test tanks and abalone that experienced mortality. Abalone mortality was observed on July 13th, 2015, and abalone were sampled and observed under a microscope. Organisms resembling the parasite *Labyrinthuloides haliotidis* were seen in wet mounts, but samples must be sent to an off-site laboratory for histopathology and PCR. If a parasite is confirmed as the possible cause of mortality, experiments to test treatment options will be conducted.

**Biography:**
Alexandra Van Pernis was born and raised in Kailua-Kona, on the Big Island of Hawai'i, and graduated from Hawai'i Preparatory Academy in 2014. She currently attends Brown University in Providence, Rhode Island and will be a sophomore in the fall. She plans to graduate with a Bachelor of Science degree in Environmental Science. Alexandra also runs on the varsity cross country and track and field teams at Brown and is having fun exploring the city she lives in!



## Optimizing the Glycol Pumping System at the Gemini North Observatory

**Darren Wong**
University of Hawai'i at Mānoa
Gemini North Observatory
*Mentor*: Chas Cavedoni

**Project Abstract:**
Gemini Observatory consists of twin 8.1-meter telescopes, providing its international partners with full coverage of both the northern and southern skies. In 2012, the United Kingdom withdrew from the partnership with Gemini resulting in a 25% reduction in funding. To cope with the loss of funds while still maintaining peak observatory performance, Gemini seeks to renovate and upgrade the existing glycol cooling systems with a goal of reducing energy use by 25%. The proposed upgrade to the glycol cooling systems requires significant revisions to the existing plumbing arrangement and system pumps. To optimize the plumbing and pumping arrangement, the hydraulic performance of the existing glycol cooling system was modeled using the application software PIPE-FLO Professional. PIPE- FLO Professional modeled and simulated incompressible fluid flow throughout the system with additional functions to calculate and optimize pump brake horsepower along with all the other hydraulic engineering parameters. The existing glycol cooling system simulation model was then validated with on-site measurements to understand and refine its accuracy. The new glycol cooling system was simulated allowing the proposed plumbing and pumping arrangement to be optimized with confidence. Results of the optimization and final recommendations will be presented.

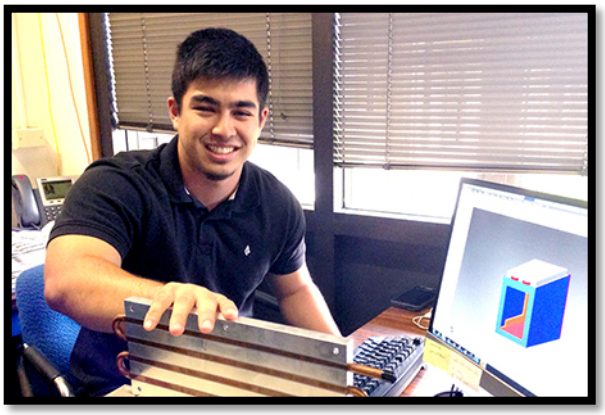
**Biography:**
Darren Wong was born in Honolulu, raised in Hong Kong, then moved back to Hawai'i at the age of seven. He graduated from President William McKinley High School in 2013 and is now attending the University of Hawai'i at Mānoa. He is pursuing a Bachelor of Science degree in Mechanical Engineering. His career goal is to create or innovate something that will impact the world. In his free time, Darren likes to relax and sleep.

## Heat Mitigation in Canada France Hawaii Telescope's Wide Field Infrared Camera

**Raycen Scott Wong**
University of Hawai'i at Mānoa
Canada France Hawai'i Telescope
*Mentors:* Gregory Barrick and Tom Benedict

**Project Abstract:**
Heat produced by the Canada France Hawaii Telescope's (CFHT) Wide Field Infrared Camera (WIRCam) causes decreased image quality. WIRCam contains two detector controllers that produce heat. The total heat generation of WIRCam was estimated using radiation and convective heat transfer equations and resulted in roughly 830 Watts of heat. The purpose of this project was to mitigate the heat produced by WIRCam and decrease the overall temperature of the instrument. To dissipate some of the heat being produced, a cooling system was designed for the WIRCam controllers. The cooling system extracts the produced heat via heat exchangers and transfers the heat into the cooling fluid. The placement of the provided heat exchangers was crucial to maximize the efficiency of cooling. The decision to mount the heat exchangers on the top of the controllers was made based on the fact that heat rises due to density changes of the air related to increased temperature. The prevalence of near freezing temperatures on the summit resulted in the selection of a glycol-water mixture as the cooling fluid due to its low freezing point. Adjustable flow valves were implemented in the design to manage the flow of each individual heat exchanger because the flow will take the least restrictive path into the heat exchangers. After a preliminary design review, modifications were made to ensure the safety and efficiency of the final design. The design was implemented to accommodate the clearance of the controllers to the outside shell, cool the system efficiently and increase the image quality. It is recommended that this system is tested off of the instrument to ensure clearance, zero leakage, efficiency and determination of the total amount of heat being mitigated.

**Biography:**
Raycen Scott Wong was born and raised on the Big Island of Hawai'i. He will be entering his senior year in Mechanical Engineering Program at the University of Hawai'i at Mānoa. During his free time he enjoys working on as well as racing cars, going fishing and camping, exercising, and playing sports. In the future, Raycen would like to find a job here in the state of Hawai'i, preferably on the Big Island. He finds the component design aspect of engineering most interesting. One of the goals he has set for himself would be to design something someone has never seen before that would make a change in society for the better.



# Akamai Workforce Initiative

The AWI advances Akamai (smart, clever) students into the Hawai‘i technical and scientific workforce. AWI partners with industry, observatories, government, educational institutions and community to meet workforce needs in astronomy, remote sensing and other science and technology industries in Hawai‘i. The Akamai Internship Program is one of the major programs of the Akamai Workforce Initiative, led by the Institute for Scientist & Engineer Educators (ISEE) at University of California, Santa Cruz (UCSC).

The 2015 Akamai Internship Program placed college students from Hawai‘i at the following organizations to complete a seven-week project:

- The Air Force Research Laboratory (AFRL)
- Akimeka LLC
- Big Island Abalone Corp (BIAC)
- California Institute of Technology Optical Observatories
- Canada-France-Hawaii Telescope (CFHT)
- Cellana, Inc.
- Daniel K. Inouye Solar Telescope (DKIST)
- Gemini Observatory
- W.M. Keck Observatory
- Institute for Astronomy
- Natural Energy Laboratory of Hawai‘i Authority (NELHA)
- Smithsonian Submillimeter Array (SMA)
- Subaru Telescope
- Thirty Meter Telescope International Observatory (*Pasadena facility*)

## The AWI currently receives funding from:

Thirty Meter Telescope International Observatory
THINK Fund at the Hawaii Community Foundation
University of Hawai‘i System
University of Hawai‘i at Hilo
National Science Foundation (AST#1347767)
National Solar Observatory

**For more information please contact:**

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**http://akamaihawaii.org**