Guam: Where Space Grant's Day Begins

By: Dr. Romina King, Associate Director of NASA Guam EPSCoR & Associate Professor of Geography

After many decades of inactivity, the University of Guam (UOG) is excited to be an active member of the Hawai`i Space Grant Consortium (HSGC). Last semester, UOG was proud to have two Space Grant Fellows, Allen Jake Aromin and John Tristan Palanca. Mr. Aromin is currently a senior, majoring in education. Mr. Palanca is also a senior, majoring in computer science and minoring in mathematics. They teamed up to informally undertake the Mars Ice Challenge, a very ambitious project considering that UOG does not have a robotics program or a mechanical or an electrical engineering program. The students were forced to find expertise outside UOG and tap into the private sector. Many mechanical and electrical engineers from Guam and abroad were more than eager to provide guidance on how to proceed.

Involvement with HSGC initially began in the late 1990s. The first HSGC Fellows from UOG were under the tutelage of Dr. Charles “Chip” Guard, a meteorologist at the National Weather Service (NWS), located in Tiyan Guam. After Dr. Guard, Dr. Mark Lander took the reins.

UOG students Allen Jake Aromin (left) and John Tristan Palanca at the HSGC Fellowship and Traineeship Symposium at UH Mānoa.
When UOG was awarded a NASA EPSCoR Research & Infrastructure Development (RID) grant, interest in HSGC was rekindled and Dr. John Peterson (Guam EPSCoR Co-Principal Investigator) approached Dr. Luke Flynn about becoming more involved. Upon receiving the green light and becoming the new Guam HSGC Associate Director, Dr. Peterson recruited Dr. Romina King to be the Guam HSGC Coordinator and to enlist undergraduates to avail themselves of this fantastic opportunity. Thus, with the recruitment of Mr. Palanca and Mr. Aromin, UOG entered into a new era of partnership with HSGC.

Guam's Storied History with NASA

Guam has played a special role in the history of NASA space exploration. The Guam Remote Ground Terminal (GRGT) currently serves as the heart of the Tracking and Data Relay Satellite System (TDRSS), along with facilities at the White Sands Complex and Goddard Space Flight Center.

The Guam Remote Ground Terminal (GRGT) was constructed in the 1990s to close the gap in coverage, or Zone of Exclusion, over the Indian Ocean for the Space Network (SN). GRGT allows Tracking and Data Relay Satellites (TDRS) to downlink and uplink data while not in line of sight of the White Sands Ground Terminal (WSGT) in New Mexico. The antennas are protected by radomes as frequent rainy weather interferes with operations.

Photo and caption from www.nasa.gov

Guam's TDRSS and its earlier version, the Guam Manned Space Flight Network (MSFN), have supported NASA space missions, including the International Space Shuttle, the Hubble Telescope, and the Apollo manned missions to the Moon. Built in 1966 to support the Apollo Program, the Guam MSFN facility is no longer inhabited and is currently being considered for listing on the National Register of Historic Places and recommended for the U.S. tentative list for World Heritage Sites. The facility is a significant part of the national space exploration program and was critical to the success of the Apollo missions. UOG has proposed that the facility be converted to an educational center to support Guam NASA EPSCoR and HSGC programs and activities. In addition to being an educational center housing permanent and seasonal displays, it could potentially also house the Guam Planetarium. It may also serve as a physical location for information technology training and a high technology research facility for visiting NSF and NASA scholars.

For future plans, UOG is striving to increase involvement in the HSGC in addition to pursuing the Guam MSFN renovation into an educational facility, implementing the NASA Guam RID, and being awarded a NASA Cooperative Agreement Notice (CAN). A fledgling UAV/robotics club has received funding, offering a fun, STEM-based organization to interest UOG students. We hope this club will eventually expand to offer outreach to elementary and middle school students regarding UAVs and robotics and organize educational events that promote STEM and NASA missions that involve Guam.

Acknowledgements: UOG is grateful to Dr. Luke Flynn and Ms. Mars Nii for their unwavering support.

This article's title is a reference to the U.S. island Territory's slogan, Guam: Where America's Day Begins.
The View from the Pipeline: "Robots to Rockets"

By: Amber Imai-Hong, Outreach Support/HSFL Engineer, UH Mānoa

Growing up on Hawai‘i Island, I loved the feeling I had while looking up at the stars. When life felt too chaotic, looking up at the Milky Way and finding constellations helped to put life into perspective; space was so large and beautiful that no problem seemed too big or scary, no matter how small I was. Naturally, I wanted to study space when I got older, though I never dreamed I would be able to work on satellites in Hawai‘i.

I was fortunate to learn about the Hawai‘i Space Grant Consortium (HSGC) at a young age. Although I could not afford to attend Future Flight, several of my friends tried to recreate the experiments they learned when they attended the week-long event. After eighth grade, I transferred from Keaau to Waiakea High School to join the newly established FIRST Robotics team, funded by NASA, HELCo, and HSGC. Before “robotics” was prevalent in Hawai‘i’s schools, keeping a team running while having to buy supplies and travel to the continental US for competitions was hard, and we as a team were very thankful for the support we received. Robotics opened so many doors for me and helped me to learn about time management and the importance of networking. In 2006, HSGC helped our team start the Hawai‘i Island Robotics Academy for student in grades 3-6. I loved getting to work with and learn from three of the Future Flight Hawai‘i teachers. Through robotics, I got my first internship at the Joint Astronomy Centre building a database program in Perl, which opened up the field of instrumentation engineering to me.

After graduating from Waiakea High, I moved to O‘ahu to attend the University of Hawai‘i at Mānoa, majoring in Electrical Engineering. I was hired as an HSGC student assistant in 2008 and primarily tasked with educational specialists Art and Rene Kimura with the K12 outreach activities, some of which I had participated in. Seeing familiar faces helped me to assimilate to life in the city. Volunteering at HSGC events gave me a deeper understanding and respect of how much work and manpower is needed to coordinate and execute the robotics tournaments I participated in.

In the summer of 2011, I was selected for a Space Grant sponsored internship at NovaSol, a private research firm in downtown Honolulu. I worked with engineers, technicians, and another intern on NovaSol’s optical communication system. While there, I was able to practice circuit analysis, circuit design, and participate in field tests. Thanks to my connection to HSGC and involvement in robotics, I was invited to join the student small satellite team during my first semester at UH Mānoa. I participated in a research and development team and in the Nanosat 6 program for about three and a half years. After a short break to focus on completing my degree after the Nanosat 6 project was over, I was invited to join the Hawai‘i Space Flight Laboratory (HSFL) to help with the HiakaSat project. After graduation, I have continued to work with HSFL as an Avionics Engineer. One highlight was seeing the Super Strypi launch in 2015 with the first satellite designed, fabricated, and tested in Hawai‘i, which was amazing, regardless of the outcome. Through HSFL, I have participated as a mentor to the Project IMUA RockSat team, which consisted of members from four UH Community Colleges, and the New Mexico Sounding Rocket (NMSR) team of freshman and sophomores at UH Mānoa.

Presenting at and volunteering for the Astronaut days in Hilo and Honolulu is action-packed and fun. Volunteering at robotics events reconnects me with friends, new and old, many of whom were either volunteers when I was a student, or were students that have all grown up. Feeling the excitement and being a part of the Future Flight Ohana is something I hope I never forget. Working with the HSFL undergraduate students who I’ve seen grow and mature through robotics is inspiring. I am so grateful for the many experiences that HSGC has brought me.
"Bringing the Islands to Virginia: My NASA Langley Experience"

By: John Tristan Palanca, Fellow, Spring 2017, University of Guam

This summer I had the opportunity to intern at NASA Langley Research Center (LaRC) in Hampton, Virginia. I had applied on a whim, knowing that many of the positions were engineering-heavy, whereas I was only a computer science major with a desire for hands-on experience, but no opportunities to pursue engineering at the University of Guam. This is where my experience as an HSGC fellow came into play. I hoped that my fellowship research project designing a drilling system for subsurface planetary ice would validate my determination to pursue a summer engineering position at NASA. Much to my surprise, I received an interview offer and was eventually selected for an internship at NASA LaRC.

Prior to this internship, I have never had any education in electrical engineering, and my circuit design experience was limited. With the help of the multitude of experts around me, I gained a respectable proficiency in electrical design in a matter of weeks, which is an accomplishment I can truly be proud of. Who else can say they got their first taste of EE at NASA? Furthermore, I applied my knowledge in computer science to designing the printing system’s firmware, which was mostly written from scratch, by expanding on existing 3D printing firmware such as Marlin.

Working at NASA LaRC has given me opportunities to learn and see beyond what I could never have imagined. I’ve met some of the greatest minds our nation has to offer, shared the summer with students from around the country spanning a vast range of disciplines, and most importantly, I was able to spread and share my island culture with everyone I’ve encountered. I got to tour NASA LaRC’s massive hangar, visit the Virginia Air and Space Center, and participate in events celebrating NASA Langley’s 100 year anniversary, such as the centennial gala. Perhaps one of the most memorable highlights was the opportunity to watch the Mars Ice Challenge in person at the hangar, since it was that very challenge that inspired my Space Grant ice drill project in the first place!

My task this summer was to explore the applications of Carbon Nanotubes (CNT), a high aspect ratio nanomaterial, for use as a sensor. Specifically, this work revolved around the fairly modern method of additive manufacturing, otherwise known as 3D printing. My partner and I sought to design and optimize a system for printing with CNT, working in a fast-paced, multidisciplinary environment. I was presented with a number of engineering challenges, most especially with my specific duties in electrical design.

It’s easy to say I won’t ever forget my experience at LaRC, and I owe it to the knowledge I gained as an HSGC fellow. I’m excited to return home to Guam and back to Hawai‘i and share the knowledge I’ve gained and continue to utilize it in my career to come and, hopefully, inspire others like me.
Justin Bergonio  (Fellow, Fall ’11 - Spr ’13)

"I have been fortunate to participate in two HSGC research projects at UH Mānoa. Following my success as a Space Grant Fellow I obtained a summer research opportunity funded by the National Science Foundation at Northern Arizona University’s ice lab. I assisted in carrying out several spectral experiments on methane-nitrogen ice mixtures that would allow scientists to remotely determine surface compositions of several icy planetary bodies. Thanks to the NASA Space Grant program, I have developed a passion for the scientific perspective that has compelled me to become a high school science teacher where I hope to awaken the same awe and wonder of the universe as my mentors instilled in me."

Michelle Bradley  (Fellow, 2006-2007)

"Through my experiences and contacts with HSGC I have been able to launch my teaching career. Following my graduation from UH Mānoa in the Spring of 2007 I began working for Island Pacific Academy (IPA) as a part-time substitute and resource teacher. Because of my degree and the experience and knowledge I gained from my Space Grant Fellowship I was hired full time for the next academic year. I have been a teacher at IPA ever since. During the 2009-2010 academic year, IPA asked me to pilot an integrated math and science class called Astronaut Academy. This opportunity would not have presented itself without the experience and knowledge that I gained through my Space Grant Fellowship. Most recently I was asked to develop an 8th grade science class that brings environmental science and the Hawai`ian culture together in a relevant and place-centered class. I owe a great deal to HSGC. Without my mentor Dr. Barbara Bruno and the other amazing people who run the program at UH Mānoa who believed in me and my vision of how to make education relevant, I would not be where I am today."

Current Occupation:
- Middle Years Program Coordinator,
- Science Dept. Chair
- Science Fair Coordinator for Island Pacific Academy
Fellowships are awarded to U.S. citizens who are full-time students at the University of Hawai‘i campuses at Mānoa and Hilo. Awards are given for space-related research with a mentor and provide a stipend of up to $4,000 per semester to the student. Fellows are also eligible for travel and supply funds. In previous semesters, these funds have been used for activities including observing runs at Mauna Kea telescopes, fieldwork to collect ground-truth information for interpreting satellite data of the Hawaiian Islands and other locations, and travel to meetings to present project results.

Yosef Ben Gershom, a junior in Mechanical Engineering, is working with mentor Dr. Weilin Qu of the Department of Mechanical Engineering on a project to improve spacecraft thermal control that includes Fellow Brialyn Onodera and builds on work by former Space Grant Fellows. Yosef plans to design and build a new dynamic testing apparatus as part of his project, "Simulation of Microgravity Conditions through Dynamic Testing of a Two-Phase Microchannel Heat Sink Cooling Loop for Spacecraft Thermal Control."

Kaimi Kahihikolo, a sophomore Astrophysics and Mathematics double major, is working with mentor Dr. Geoffrey Mathews of the Department of Physics and Astronomy on a project titled "Thieving Stars Caught by Kepler: A Search for Intermittent Accretors in Kepler Binary Systems." Kaimi will use data from the 2.0m Faulkes telescope on Haleakala to study three binary star systems to test his hypothesis that brightening events detected by the Kepler telescope are due to two stars accreting. This work supports efforts to better understand mechanisms of Type Ia supernovae and the theory of dark energy accelerating the expansion of the universe.

Lauren Mathews, a senior in Global Environmental Science, continues to work with mentor Dr. Craig Nelson of the Department of Oceanography on laboratory experiments to study the interacting effects of changes in water temperature and food nutrient-quality on zooplankton growth, survival, grazing rate, and stoichiometry over a whole life cycle. Lauren’s project “Nutrition and Elemental Stoichiometry of Zooplankton Life Stages in Warming Tropical Oceans” is relevant to future modeling of oceanic carbon storage and carbon exchange among the ocean, atmosphere, and biosphere.

Brialyn Onodera, a junior in Mechanical Engineering, is working with the "Construction and Implementation of a Two-Phase Microchannel Heat Sink in a Cooling Loop for Spacecraft Thermal Control." This study is in partnership with work by former Space Grant Fellows and builds on the mentorship of Dr. Weilin Qu of the Department of Mechanical Engineering. Brialyn aims to improve the design and test the components of a prototype cooling loop for maximum efficiency.

Heather Situ, a junior in Mechanical Engineering, is working on the "Investigation of Ultralight Carbon Nanomaterials for Space-Related Applications." Her mentors are Dr. Klaus Sattler of the Department of Physics and Astronomy and Dr. Murli Manghnani of the Hawai‘i Institute of Geophysics and Planetology (HIGP). Heather is investigating the physical and chemical properties of synthesized carbon nanofoams using Fourier Transform Infrared spectrometry.

Bryan Yamashiro, a senior in Physics, is working with mentor Dr. Philip von Doetinchem of the Department of Physics and Astronomy on a project modeling cosmic-ray trajectories through Earth’s magnetic field. Utilizing data from the Alpha Magnetic Spectrometer installed on the International Space Station, Brian’s project, "Improving the Geomagnetic Cutoff Modeling for Cosmic-Ray Research," supports NASA’s efforts to better understand the high-energy universe.
Alexander Hedglen, a senior Astronomy and Physics double major, is working with mentor Dr. Mark Chun of the Institute for Astronomy on “Designing and Implementing an Adaptive Optics Demonstrator.” Following his previous Traineeships learning astronomical data reduction and processing, Alexander is now working on the opto-mechanical design and software applications for the new 0.7-meter-telescope adaptive optics system in the new UH Hilo Hoku Ke’a Observatory.

Nicolette Thomas, a junior Biology and Astrophysics double major, is working with mentor Dr. Michael Shintaku of the College of Agriculture, Forestry and Natural Resource Management on a plant study relevant to habitability and in-situ resource utilization on Mars. Nicolette is conducting transgenic plant work as part of her project “Metabolic Engineering of Plants for Detoxification of Martian Regolithic Perchlorate.”

Travis Thieme, a junior Astronomy and Physics double major, is researching “Small-Scale Physical Properties of Nebulae in Nearby Disk Galaxies” with mentor Dr. R. Pierre Martin of the Department of Physics and Astronomy. Travis is using data from an imaging spectrometer at the 3.6-meter Canada-France-Hawai’i telescope on Maunakea to study emission lines to better understand massive star formation and chemical enrichment processes in spirals.

Yosef Ben Gershom, a senior in Mechanical Engineering, is working with mentor Dr. Weilin Qu of the Department of Mechanical Engineering on a project to study possible improvements for spacecraft thermal control. This project, in collaboration with Fellow Brialyn Onodera, builds upon work by previous Space Grant Fellows. Yosef’s project involves simulating body forces experienced by spacecraft and satellites to study the “Effects of Body Forces on Flow Boiling Heat Transfer in Microchannels Through Dynamic Testing.”

Marielle Dela Cruz, a senior in Astrophysics, is working on “Analyzing Cometary Dust Tails using Finson-Probstein Modeling.” Her mentor is Dr. Karen Meech of the Institute for Astronomy. Marielle is using dust-dynamical modeling to investigate comet tails to better understand dust production rates, particle size distributions, and dust emission velocities, which are relevant to making predictions of the compositions of the volatile materials in comets.

Kaimi Kahihikolo, a sophomore Astrophysics and Mathematics double major, is working with mentor Dr. Geoffrey Mathews of the Department of Physics and Astronomy on a project titled “Thieving Stars Caught by Kepler: A Search For Intermittent Accretors in Kepler Binary Systems.” Kaimi is using data from the 2.0-meter Faulkes telescope on Haleakala to study three binary star systems. This work supports efforts to better understand mechanisms of Type Ia supernovae and the theory of dark energy accelerating the expansion of the universe.

Jeffrey Kleyner, a senior in Physics and Astrophysics, is working with mentor Dr. Geoffrey Mathews of the Department of Physics and Astronomy on modeling star ages in young stellar associations. Utilizing data from ESA’s Gaia satellite and new coding solutions, Jeffrey’s project, “Ages of Stars in Upper Scorpius Through Kinematic Motion,” supports NASA’s efforts to better understand the evolution of stars and protoplanetary disks.

Zachary Langdalen, a junior in Geology and Geophysics, is working on "Dispersal of Volcanic Ash on Mars: Ash Particle Shape Analysis" with mentor Dr. Sarah Fagents of the Hawai’i Institute of Geophysics and Planetology. Using terrestrial ash as Martian analogues, Zachary’s detailed 3D microscopy of the ash dimensions and shapes will be used in models of particle sedimentation in the Martian atmosphere.
Brialyn Onodera, a senior in Mechanical Engineering, is working on the "Body Force Effects on Flow Boiling Heat Transfer in Microchannels." This study is in collaboration with Fellow Yosef Ben Gershom and builds on work by former Space Grant Fellows under the mentorship of Dr. Weilin Qu of the Department of Mechanical Engineering. Brialyn aims to improve the design and test the components of a prototype cooling loop for maximum efficiency.

Lean Teodoro, a sophomore in Geology and Geophysics, is working with mentor Dr. Hope Ishii of the Hawai‘i Institute of Geophysics and Planetology on a laboratory project with interplanetary dust particles. Lean will be using multiple, high-resolution microscopy methods to identify the particles and compile compositional data in her project, "Assessment of New Extraterrestrial Particle Collections at Mauna Loa Observatory."

Jason Tremblay, a junior in Geology and Geophysics, is researching the "Topographic Influences on Emplacement Dynamics of Lava Flows on Mars" with mentor Dr. Sarah Fagents of the Hawai‘i Institute of Geophysics and Planetology. Jason will work with multiple image and topographic datasets of Mars to create a GIS database of detailed flow dimensions and shapes that will be used in numerical models to understand how topography affects the flow and emplacement of lava across the surface.

Travis Thieme, a senior Astronomy and Physics double major, is researching "Small-Scale Physical Properties of Nebulae in Nearby Disk Galaxies" with mentor Dr. R. Pierre Martin of the Department of Physics and Astronomy. Travis is using data from an imaging spectrometer at the 3.6-meter Canada-France-Hawai‘i telescope on Maunakea to study emission lines to better understand massive star formation and chemical enrichment processes in spirals.

University of Guam Fellows - Spring 2017

Allen Jake Aromin (left), a junior in Secondary Education, and John Tristan Palanca (right), a junior in Computer Science, are working with mentor Dr. Romina King of the College of Liberal Arts and Social Sciences on a robotics project. Their "Design, Fabrication, and Programming of a Drilling System for Water Extraction from Subsurface Planetary Ice," inspired by NASA’s Mars Ice Challenge, is a competition and demonstration project for improving in-situ resource utilization. Allen will concentrate on the fabrication and Tristan will concentrate on the programming, while both will be responsible for the robot’s electrical system, assembly, and testing on simulated Martian ice.

Brandon Watson, a junior in Mechanical Engineering, is working with mentor Dr. Robert Jedicke of the Institute for Astronomy on a project using automated telescopic surveys to discover and characterize near-Earth asteroids. In his project, "Finding the Ideal Asteroid for In Situ Resource Utilization and Human Missions," Brandon will gain experience with the moving object processing system of the Pan-STARRS telescope on Haleakala.

Daryl Albano, a junior in Computer Science, is working with mentor John Hamilton of the Department of Physics and Astronomy. Daryl’s project "Programming, Communications, and Robot Autonomy" is in support of the mining robot being constructed for a NASA competition at the Kennedy Space Center that fosters innovative robotic excavation concepts for future missions.
Traineeships are awarded to U.S. citizens who are full-time students at University of Hawai‘i Mānoa and Hilo campuses, Community Colleges, and the University of Guam. Awards provide lab training and practical experience with a mentor in any space-related field of science, technology, engineering or math. Trainees receive a stipend of up to $1,500 per semester and may be eligible for supply funds.

**Traineeships**

**UH Mānoa Trainee - Spring 2017**

Cameron Asaoka, a freshman in Electrical Engineering, is working with mentor Dr. Jeffrey Gillis-Davis of the Hawai‘i Institute of Geophysics and Planetology to collect reflectance data on soils of different porosities in a project relevant to understanding the polar regions on the Moon. In his project, “Examining Why Lunar Permanently Shadowed Regions Appear Dark in the Ultraviolet,” Cameron will gain experience with laboratory techniques and with reflectance data obtained from instruments on NASA’s Lunar Reconnaissance Orbiter.

**UH Hilo Trainees - Spring 2017**

Daryl Albano, a junior in Computer Science, is working with mentor John Hamilton of the Department of Physics and Astronomy. Daryl’s project “Programming, Communications, and Robot Autonomy” is in support of the mining robot being constructed for a NASA competition at the Kennedy Space Center that fosters innovative robotic excavation concepts for future missions.

**UH Maui College Trainee - Fall 2016**

Dutch Akana is working on a project titled “Digital Phasing System for Radio JOVE,” a NASA program to observe and analyze natural radio emissions of Jupiter, the Sun, and our galaxy.

**Windward Community College Trainees - Fall 2016**

Cale Mechler is working on the “ARLISS Competition,” a rocket launch for international student satellites.

Tianna Barber is working on a project “Matching Martian Topographic Features in Curiosity Panoramas with Orbital Images.”

**Carli Hand, a senior in Mathematics, is working on the “Electrical Setup and Control of a Mining Robot” with mentor Marc Roberts of the Department of Physics and Astronomy. Carli’s work on the electro-mechanical and communications Hoku Ke‘a Observatory.** Carli is working on the integration of software and hardware components of the new 0.7-meter telescope that will be used for education and outreach.

**Chantelle Kiessner, a sophomore Astronomy and Physics double major, is working with mentor Dr. Kathy Cooksey of the Department of Physics and Astronomy on “Profile Fitting Absorption-Line Spectra of Circumgalactic Gaseous Structure.” Chantelle will gain experience with the specialized software and programming needed to analyze spectra to characterize the extended gaseous halos of distant galaxies.**

**Callie Crowder, a senior Astronomy and Physics double major, is working with mentor Dr. R. Pierre Martin of the Department of Physics and Astronomy on a project titled “Integration and Commissioning of the new UH Hilo Hoku Ke‘a Observatory.” Callie is working on the integration of software and hardware components of the new 0.7-meter telescope that will be used for education and outreach.**

**UH Mānoa Trainee - Fall 2016**

Callie Crowder is working on the "Electrical Setup and Control of a Mining Robot" with mentor Marc Roberts of the Department of Physics and Astronomy. Callie is working on the integration of software and hardware components of the new 0.7-meter telescope that will be used for education and outreach.
Callie Crowder, a senior Astronomy and Physics, is working with mentor Dr. R. Pierre Martin of the Department of Physics and Astronomy on a project titled "Integration and Commissioning of the new UH Hilo Hoku Ke‘a Observatory." Callie is working on the integration of software and hardware components of the new 0.7-meter telescope that will be used for education and outreach.

**Kapi‘olani Community College Trainees - Spring 2017**

Brian Swilley is working on the project "Survey of Elliptical Galaxies in the Vicinity of the Biggest Super Massive Black Holes using the High Energy Astrophysics Science Archive Research Center."

Mattthan Mejia and Jason Salseg are working on the project "Toward the Design of an Underwater Remotely Operated Vehicle for Subsea Exploration on Europa."

**Kapi‘olani Community College Trainees - Spring 2017**

**Leeward Community College CanSat Trainees - Spring 2017**

"Team No Na Me‘e."

(l to r) Dr. Bryson Padasdao, Kainani Santos, Jeffrey Bareng, Jason Marcos, Joseph McConnell and Alejandro Ruck Vega.

**Windward Community College Trainee - Spring 2017**

Tianna Barber is working on the project "Identifying and Measuring Geological Features on Mars Photographed by Curiosity near the Bagnold Dunes."

**Project IMUA Mission 2 Trainees - Fall 2016**

**(Bottom to Top, Left to Right) Madori Rumpungworn, Darlene McLeod, Elena Barbour, Amber Imai-Hong, Keith Allard-Mahoney, Kaina Nakamatsu, Kala‘imoana Garcia, Cale Mechler, Jarren Dion Endrina, and Dr. Joseph Ciotti.**

**Project IMUA Mission 3 Trainees - Fall 2016, Spring 2017**

**(Bottom to Top, Left to Right) Nicholas Herrmann, Damien Apilando, Pingyang Liu, Cale Mechler, Mr. Robert Potter, Dr. Joseph Ciotti, Dr. Jacob Hudson, Mr. William Smith, Xiao Hua Li, Onkar Nerurkar, Cyrus Valdivia, and Ms. Helen Rapozo.**

Hawai‘i Space Grant Consortium
In high school, I was encouraged to apply for a NASA HSGC Fellowship by one of the Education Specialists in HSGC, Art Kimura, while participating in the 2015 Pacific Astronomy and Engineering Summit. Over the past year and a half, I’ve had the amazing opportunity to participate in two research projects within the field of astrophysics.

For my first research project (Spring 2016), I worked with Dr. Hsin-Yi Shih, of the Gemini-North Observatory, studying powerful radio jets produced by Active Galactic Nuclei (AGNs) in three young radio galaxies. The purpose of this project was to determine the impacts of radio-jet-driven outflows on host galaxy evolution. By analyzing the emission lines of these radio galaxies, we were able to determine the following: interaction between local gas clouds with the radio jets, the mass outflow rate, and the heavy element abundance in the gas outflow. With our findings, we hope to put constraints on the impacts these outflows have on their host galaxies. This experience helped me develop skill sets (i.e.; programming and public speaking) to apply in other fields of STEM, thereby creating more opportunities for me.

Moving onward, I worked on a research project with Dr. Geoff Matthews of the Institute of Astronomy (Fall 2016 - Spring 2017). Our content focused heavily on the mass transferring binary star systems within the Kepler field. The purpose of this project was to determine the existence of mass-transferring binary stars within the field observed by the Kepler telescope and I conducted this research utilizing two methods. First, by analyzing light curves, potential systems were identified by observing photometric variations such as intermittent brightening and dimming associated with material collision. Second, we studied the orbital period of binary stars over the course of the Kepler I mission to determine if a period change existed and to formulate theoretical models of current orbital periods. Using both methods, three potential systems were identified within the Kepler field and are currently being observed with various telescopes around the world associated with the LCOGT Network. While conducting the research, I presented my work at the AISES National Conference in November 2016 located in Minneapolis—which was funded by both NASA HSGC and the Institute for Astronomy. As a result, I placed 2nd overall for the undergraduate research presentations.

I am grateful for the experiences and skills developed through the HSGC Fellowships. They led to more opportunities including additional funding (i.e. Undergraduate Research Opportunities Program), as well as attending other conferences and internships.
**Summer 2017 Intern Experience**  
By: Melia Okura, HSGC Summer 2017 Intern

HSGC has given me an amazing amount of experience. I am studying to become a Social Studies teacher, but with my free time I do light metal work and I am currently working on a home project that would allow my household to run on solar power. For our Space Grant project, my partner Tristan and I planned to construct a drilling mechanism that would extract soil and ice. Guam does not have all the resources we needed at hand, so this project took a lot of research and planning. Tristan and I had a number of meetings discussing what would work best. Our sketches on the project were done multiple times until we were satisfied with the outcome.

Our project took a lot of time and effort to put together and we both sought out different people to assist and guide us. In our individual research, we searched for hydraulics, what materials would work best for our project, electrical wiring, programming, and much more. We may not have used all of the information we gathered, but we did learn more about those different components.

Although I am not majoring in Science or Engineering, my Fellowship has given me the opportunity to explore these fields through my research, meet people that are in these fields, and it has also let me see a variety of projects that were done by students. Attending the HSGC Symposium allowed me to visit Hawai‘i for the first time and it was great. The people that put together the event, the other presenters, and even the members of the audience were friendly and welcoming. We were able to receive advice from professors and students as to what would help make our project function better and we look to incorporate it into the next part of our project. This entire experience has pushed me further and has allowed me to learn a lot.

At first, I did not think that the HSGC Fellowship would affect what I wanted to do for a living, but after everything that has happened, I plan on pursuing a degree in Science or in Engineering, and hopefully that would one day lead me to teaching Robotics in high school classrooms on Guam. Hearing the different Fellowship projects at the Symposium genuinely sparked my interest. I am very grateful for the opportunity to be a HSGC Fellow because it has showed me a few of the many different opportunities in the fields of Science and Engineering, and it also made me rethink what I wanted to have as my career.

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**University of Guam Fellow Experience**  
By: Allen Jake Aromin, Fellow, Spring 2017, University of Guam

I was very excited to return to Hawai‘i for summer vacation after completing my first year of college at Brown University. The first year of being away from home is always the toughest and I was ready to indulge in the warm island weather. However, my summer was not all rest and relaxation, I was presented with the awesome opportunity to intern with General Dynamics by HSGC. This would be my second year doing this internship and I was very excited to be returning to the GD office, especially with the $3,000 pay that was awarded to the interns.

This year I worked with fellow intern John Acoba on a project that used change detection techniques to study astrophotography using a Raspberry Pi. Our goal was to write a program that would be able to process a set of frames from a long-exposure video taken of the sky to determine which frames contained a shooting star, comet, or other space object. To go through all of the frames by hand would take too much time and effort, so our program would sift
through the images and pick out only the ones that had any potential of containing a space object for further inspection by a human operator. Our approach to this project was to use change detection to figure out which images were different from the rest, and thus containing an extra object. A majority of the long-exposure images are virtually identical, containing the usual stars, celestial bodies and other constant objects like trees and grass. This may seem like quite a difficult task for two interns working for six weeks, but we had a lot of guidance from the GD employees at the office. They were very knowledgeable and gave us plenty of information to make decisions pertaining to our project. One such example would be how to approach comparing one image to the next. To get the best results, we were advised not to compare raw images. The space objects that we are looking for in the images are very small, and extra objects in the images are very distracting. To streamline the image comparison process, we were advised that adding filters to the images would help flush out the distractions so that the computer could focus on looking for the space objects. In our final program we include three different filters that minimize the background noise of all the usual stars in the sky so we can focus on the brighter presence of the unusual space objects. In other cases, the workers at GD helped us learn the best ways to plan, test, and fix our program as well as looking towards ways to make it more user friendly using a Graphic User Interface (GUI).

In addition, we were also able to ask them all about their job and their career paths. I am currently majoring in computer science and am looking to find a career in the ever growing field. I know that there are varying paths that you can choose to follow within computer science and although I am looking to focus in cyber security it was definitely helpful to hear what sort of work and education the other employees at GD have experienced. Talking with the employees about what they studied and which classes they found worthwhile was the most helpful to me as I go into my sophomore year of college. Furthermore, several of the people at GD grew up and went to high school on Kauai just like I had and so hearing how they were able to find a job in computer science here on the island helped me map out a plan for myself so that I too may be able to live in paradise while working a job that I enjoy.

Overall, this Internship was invaluable. It gave me the opportunity to learn how to efficiently program while working on a real project and I was able to learn a great deal from those in the office who answered all of our computer science and career questions.

My HSGC Project Imua Traineeship Experience

By: Onkar Nerurukar, Project IMUA Mission 3 Trainee, Honolulu Community College

I currently attend both UH West Oahu and Honolulu Community College, and am enrolled in a bachelors degree in Information Security and Assurance. In spring 2016, I started to work on HSGC’s Project Imua at Honolulu Community College. My traineeship with Project Imua included working on Colorado Space Grant Consortium’s (COSGC) RockSat-X project. For Project Imua, college students develop a scientific payload, which is launched into suborbital space on a sounding rocket. My duties included developing and engineering a camera system to take video and photos of ScubeR, the main experiment of our payload. ScubeR is a small 3D printed rocket, which is launched from our payload at suborbital apogee. ScubeR contains the same chemical compound used in mothballs as the fuel to provide a very small thrust as it leaves our payload on the sounding rocket.

This was my first experience being part of a HSGC project and it was a fantastic learning experience in many ways. I got the opportunity to collaborate with multiple UH Community College campuses to design and build the scientific electronic payload that mounts into a two-stage suborbital rocket provided by COSGC.
As part of a multi-campus team, we had to prototype, develop and build subsystems that were subsequently tested and integrated together into a single payload. At Honolulu Community College, our responsibility was to build an onboard camera subsystem and a data controller. Students at Windward Community College built ScubeR, the flight computer, power conditioning board, and a laser range finder system. Kaua‘i Community College built a wifi enabled camera attached to ScubeR which collected imagery looking back at our payload. Collaboration and open communication were very important to make all these subsystems come together into a single, functioning payload. For example, a major tool we used to stay in touch was Google Core Apps to send group messages, text/video chat, and create/share documents for the team to see anytime.

Along with biannual HSGC student symposiums we also presented our work through telecon sessions that gave us the opportunity to show COSGC and NASA that our payload met the criteria and requirements. My first few telecons were nerve racking because I knew my contributions were crucial in determining if our payload would be selected to fly. As I became more experienced with the project and how the telecon worked, I felt more confident. Now I can say with confidence that presentations and telecons will be easier going forward.

Once the payload was complete we had the opportunity to visit NASA Wallops Flight Facility for a week of integration and testing. We had to learn and follow NASA protocol, and present our project to many high school and University students that were part of RockSat-X or other projects. At Wallops you feel like you are one of the engineers, and your knowledge and expertise are put to the test. When you are in the testing/development room, you are the expert of your experiment. If anything goes wrong or any questions come up, you must be ready to fix the problem or answer questions with confidence. My time at Wallops has been the best educational experience I have had yet.

My experience as a HSGC Trainee has greatly benefited my education and career goals. I have learned workplace skills such as communication, collaboration, and presentation skills. I have learned industry skills such as soldering, software and hardware development. But most importantly, I have learned how to be a team player on an engineering project. Thank you to HSGC for giving me the opportunity to be a part of COSGC’s RockSat-X (Project Imua).

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**RockOn! Workshop 2017**

June 17 - 22, 2017, NASA’s Wallops Flight Facility, VA

By: Derae Shibata, Lanz Ocampo, Engineering Technology, UH Maui College

The RockOn workshop is a hands-on opportunity for students to learn about and build sounding rocket payloads. Twenty-three teams, each consisting of two to four students, received a kit with all the components of the rocket payload and a deadline of three days to assemble and solder everything, including components onto the printed circuit board and sensors onto the shield.

On the first day, we headed to our workstations to receive our kit and safety briefings. The first part of the payload that was assembled was the Geiger counter. The function for this board is to count radiation. After all components were soldered onto the printed circuit board and tested for functionality of the electronic components, we applied a conformal coating to ensure protection of the electronic components.
The second day of the workshop consisted of building the shield. This was a crucial component of the payload because most of the sensors are on it and the Arduino was to be connected to it afterwards.

The shield consisted of an 8 GB SD memory card, 0 - 15 psi pressure and temperature sensor, 3-axis gyroscope, 3-axis acceleration in low and medium range, humidity sensor, and an 1-axis acceleration in high range. Surface mount components were used on this PCB so surface mount device (SMD) soldering was also taught.

The first thing that was put onto the PCB were the resistors and capacitors. This was the first time our team got a chance to do SMD soldering. As we kept doing it, it got easier. After soldering all the resistors and capacitors in, a power and ground test was done with the g-switch to ensure that there were no shortages between ground and power. A g-switch is a switch that will activate when an amount of g-force is placed upon it (2 gs in our case will activate it). The reasoning in using a g switch is because we want the electronics and sensors to turn on when the rocket launches. The amount of g-force that a rocket will produce will be well above 2 gs. After all the testing was completed, the sensors and Arduino were soldered into their places. This finalized the completion of the shield. All data seemed to be good except for the accelerometer. After trying to analyze where we went wrong, we noticed that the accelerometer chip given to us was broken. The helpers at the workshop had to give us a new one which solved our problem. Other than that, everything else went perfectly.

On the last day of building we did our final tests with the rocket’s payload. We combined the Geiger PCB and the shield together and uploaded the final version of the code which displayed the data from all sensors. After making sure everything was still working, we then mounted all the electronics onto a round piece of plexiglass. Then, we stacked our rocket payload with other teams’ payloads and then placed into a canister to be placed in the rocket provided by the Wallops Flight Facility.

The day of the launch was on the morning of June 22, 2017. Weather conditions were perfect and there were no delays for the launch. The rocket was a stage 2 rocket. The apogee of the rocket was unsure.

After recovering the rocket, we were given back the SD memory cards to analyze the data collected from the payload that we built. All data that was collected from the sensors were all reasonable. Before the launch, our team had a prediction that the temperature and pressure of the rocket would go down as it went up, but according to the data that was received, it turned out that we had predicted wrong. We were confused as to why pressure and temperature went up rather than down. After analyzing the issue, the reason temperature and pressure increased as the rocket went up was because we were not measuring outside pressure and temperature. The barometric pressure (BMP) sensor was located inside of the rocket. This sensor measured the various temperatures and pressures that were being used. As the rocket launched, the inside temperature and pressures rose. If the BMP sensor was placed outside the rocket, then we would probably would have seen a drop in pressure and temperature rather than it increasing. According to the data that was received back, we also assumed that the total flight time was about 10 minutes.

Overall, the RockOn workshop is a great workshop for those who want an introduction into sounding rocket payloads. The work days were very long but it was well worth it because we learned various new things that we will be using in our future studies and careers.

We would like to give a sincere thank you to the Hawai’i Space Grant Consortium, NASA Wallops Flight Facility, the Colorado Space Grant Consortium and especially Chris Koehler and his staff for giving us the opportunity to participate in an event like this. We hope to return to more events like this in the future.
"A variety of K-12 education projects bring hands-on experiments, tools, and the excitement of space exploration to thousands of participants."

- Arthur Kimura, HSGC Education Specialist

The 17th annual Astronaut Ellison Onizuka Science Day held on January 28, 2017, at the University of Hawai‘i-Hilo, featured keynote speaker, Astronaut Kjell Lindgren, who spent 141 days on the International Space Station during Expedition 44/45.

Children and parents attended two of the many hands on workshops, which included forensic science, paper circuits, flight simulators, DNA extraction, hardware science, virtual travel to Mars, blooming spices, satellite data analysis, light diffraction, racing brushbots, ocean analysis, and energy. In addition, there are 20 displays provided by schools and community organizations, the TMT VEX IQ Robotics tournament, and the closing diffraction of light activity. Sponsored by the Onizuka family, the Astronaut Onizuka Space Center, the University of Hawai‘i-Hilo, American Savings Bank and the Hawai‘i Space Grant Consortium, 600 participants and 250 volunteers joined together in honoring the legacy of Ellison Onizuka and the Challenger crew.
Astronaut Lacy Veach Day of Discovery
http://www.spacegrant.hawaii.edu/Day-of-Discovery

The 15th annual Astronaut Lacy Veach Day of Discovery, held in October at Punahou School, featured Nainoa Thompson, Polynesian Voyaging Society President and master navigator who shared inspiring global connections via the Malama Honua around the world voyage of Hokulea, which was the suggestion of Lacy Veach in 1992 (http://www.hokulea.com/honoring-lacys-legacy/), an 18 team VEX IQ robotics tournament, industry sponsored displays and workshops. Workshops included the Hawaiian Electric’s World of Electricity, Problem Solving with Science, Leaning Tower of Honolulu, cow eye dissection, squid dissection, Fun with Kinetic Energy, self-driving, line following robots, bottle rockets, looking at Hawai’i from space, parachute design, drones in Hawai’i and Dash and Dot robots.

The event was sponsored by the Hawaiian Electric Company, Punahou School, the family of Lacy Veach and HSGC. Two hundred volunteers supported the registration, workshops, and displays for the 600 registered students, parents, and teachers. The concluding afternoon assembly included the final VEX IQ Robotics competition matches, and a diffraction of light program.

VEX VRC and VEX IQ Scholastic Robotics
http://www.vexrobotics.com/vexiq

HSGC has been instrumental in the introduction, expansion and sustainability of VEX robotics in Hawai’i. VEX Robotics is the fastest growing scholastic robotics program in Hawai’i and around the world with over 16,000 teams including 355 VEX EDR and VEX IQ teams in Hawai’i. VEX IQ, introduced just four years ago, had an 88 percent growth in the number of teams in Hawai’i over the past year including a +100 team growth in one year, one of only 10 states to do so. Twenty-three qualifying tournaments and leagues were held on Oahu, Maui, Moloka’i, Kaua’i and the Big Island, with 145 teams advancing to the middle school and high school Hawai’i EDR championships and the elementary and middle school Hawai’i IQ Championships. The Pan Pacific VEX Championship was reinstituted and brought teams to Hawai’i from China, Canada, and Taiwan among the 100 teams that competed. From the state championships, 31 Hawai’i teams qualified for the World VEX Championships, held in Louisville, Kentucky in April 2017, among the 1,500 teams from 40 countries that participated. Two VEX IQ teams finished second in the world in their respective elementary and middle school divisions. Hawai’i sponsors included the Hawaiian Electric Companies, the aio Foundation, the Thirty Meter Telescope, the University of Hawai’i-Hilo, the County of Hawai’i, Okinawa Enetech, the Hawai’i Council of Engineering Societies, the Department of Labor and Industrial Relations and the NASA Robotics Alliance.
Science FESTival
(FEST = Families Exploring Science Together)

What is STEMFEST?
In the half-day, school-based program called STEMFEST, using a context of exploring Mars, students and parents learned about the NASA Mars exploration program, designed a wind energy device, raced rubber band and wind powered vehicles and built and programmed a robot in a challenge to rescue stranded astronauts on Mars. The kits used in the program were taken home by the students for further experimentation.

Schools in Hawai‘i are hosting Future Flight Hawai‘i’s Space FESTivals. These free programs offered by HSGC feature science demonstrations, information about NASA-supported educational opportunities, and selected hands-on activities for students and parents. These evening, family science programs encourage children and parents to work together, foster home/school partnerships, engage parents and students in thinking and working scientifically, assist parents to encourage an interest in science in their child, and help students to learn through active engagement in educational experiences.

“Thank you (Mahalo - Mucho gracias - Arigatoo) soooo much for continuing to provide this type of activity. It was a wonderful experience not only for our students and their families but for our teachers as well. The energy and enthusiasm helped to ignite or re-ignite the passion for learning. The students were eager to tell their classmates and teacher who were not able to attend the event what they had learned.

- Kim Mukai-Otani, Kamalii Elementary School

“...the kids who attended SpaceFEST 2017 were excited and talking about their experiences the next day. Clearly, you made quite an impression on them! For me, seeing all the dads come to SpaceFEST still wearing their soldier uniforms was especially touching. It meant they didn’t even have time to change out of their work clothes before coming to spend the evening with their child. The parents had as much fun as their kids, and listening to the excitement in the students’ voices was heartwarming. Science is definitely a verb even if the dictionary says it’s a noun. We really appreciate your commitment to sharing your knowledge with the students and families.”

- Jan Iwase, Principal, Daniel K. Inouye Elementary School

“Thank you so much for providing such a fantastic parent night with our students. The students and parents had such a wonderful time and the feedback and evaluation we received from the parents were extremely positive and appreciative - many requested to have more opportunities provided to them such as the SpaceFEST. As for the teachers, they were not only impressed with you and Rene, they kept saying that it was so much fun - Your shirt and the talking cup said it best - “Science is Fun”.

- Stacy George, STEM resource teacher, Mauka Lani Elementary School
Earning an Educational Internship with HSGC

By: Lauren Kamei, Former HSGC Student Staff

The Spring 2017 Semester wraps up my two-year Master's of Education in Teaching (MEdT) program with the College of Education at the University of Hawai‘i at Mānoa. For this final semester, I did a K-12 Education Specialist Assistant internship with the HSGC. This opportunity gave me an understanding of what it is like to do cocurricular and extracurricular integrated Science, Technology, Engineering and Mathematics (STEM). A key mission of HSGC is to deliver K-12 STEM lessons related to NASA missions and programs. All missions of NASA have a STEM education component so that the community can gain and learn from them. As a K-12 Education Specialist Assistant, my position was to assist with preparing and running outreach activities, which are a key mission of this office.

This internship allowed me the opportunity to assist at Space Families Exploring Science Together (SpaceFEST) and Science, Technology, Engineering, Mathematics Families Exploring Science Together (STEMFEST) workshops at various schools on the island of Oahu. At these events students and their parents learn by doing hands-on STEM based projects. Through this internship I observed, assisted and reviewed professional materials from my mentors that I used to create my own curriculum packet.

Throughout this semester-long internship, under the mentorship of Rene and Arthur Kimura, I worked on a 5th Grade STEM Curriculum Plan called “Inquiry and Innovation with Robotics”. It consists of 5 strategic lessons that build up to a culminating project-based lesson where students apply what they learn by building and carrying out an open-ended engineering analysis and inquiry about what they are observing with their BrushBot. The purpose of this unit is to introduce students to technology, which helps humans solve problems in the real world. The unit focuses on students gaining valuable experiences designing robots using creative and innovative ideas, working collaboratively, solving problems efficiently, communicating effectively and thinking critically through designing robots. The goal the unit is to have students implement the three science concepts that they learned: open and closed circuits, center of gravity and friction, and apply the concepts when building and testing their BrushBot.

What I enjoyed most about my internship with HSGC was seeing the students that participate in our K-12 program find their strengths. Students learned that these strengths will help them succeed in any field. They were challenged, STEM skills were strengthened and students gained a sense of pride and confidence in themselves. This confidence is what will empower them to pursue a career pathway into a STEM Field.

A valuable experience was learning from great mentors: Arthur and Rene Kimura. They create experiences for students to learn and love science through active, hands-on and project-based learning activities to solve problems. Students do open-ended research, ask relevant questions, design problems, and then carry out investigations to overcome those problems. The students and myself learned a lot from this dynamic duo educator-team through the modeling with the educational toys, labs and activities all while laughing and having fun with science.

HSGC offers many students, like myself, educational opportunities and gives us valuable experiences to prepare us to enter STEM degree pathways and careers. The internships provided by HSGC give students real-world experiences to have inquiry and innovation at the college level. The internships here allows us to follow our passion.

Working as a student staff at HSGC helped me to grow as an individual and as an educator by reaching my goal of practicing engaging and integrated STEM lessons. I have been surrounded by many great scientists and researchers and resources at HSGC that have motivated me to continue to believe in myself and explore.
HONORIES

Honoring Dr. Ed Scott, former HSGC Associate Director for Fellowships, 1994-2017

Farewell to Dr. Edward Scott an Emeritus Professor in HIGP, but more importantly, a true member of NASA HSGC at UH Mānoa for 23 productive years. Ed began an active role as Associate Director with HSGC in 1994 and continued to serve in this position until his retirement with the program at the end of Spring 2017.

Luke Flynn writes, "I would like to thank Dr. Ed Scott for his years of service to the Space Grant Fellowship Program. Ed has been a very understanding and capable advocate for our Fellowship students while working to codify the HSGC rules regarding Fellowships. He has also done a spectacular job orchestrating the many Undergraduate Research Symposia during his tenure. Many thanks to Ed!"

Jeff Taylor writes, “Thanks for the memories during the 40 years we have worked together, Ed. Your excellent work with the Space Grant fellowship program is just one of many accomplishments. Linda and I are particularly impressed by the articles you have written for PSRD, the web’s most happenin’ site. You are our most prolific guest author. You are skilled at outreach and sharing your science, besides being a first-class man.”

Marcia Rei Nii “Mars” (HSGC Executive Director) will miss his intellect, his genuine easy-going personality and his perfectionism in letter writing but most of all his leadership and dedication to promoting the HSGC undergraduate programs. She will truly miss working with him and expresses her mahalo to Dr. Scott for his passion to help groom the STEM workforce and for his encouragement of students to do research. Congratulations Ed and enjoy your happiness with ‘ohana on finally, a real vacation as a retired faculty and former HSGC Associate Director!
There are several benchmarks in becoming a scientist. Undergraduates focus on obtaining experience with carrying out directed tasks and using various computer programs and instruments. Graduate school focuses on running an entire project and figuring out how to answer a particular hypothesis. After graduate school, it seems like the next benchmark is to put forward new ideas and hypotheses and write proposals to get these projects funded. This year, I was able to accomplish this benchmark by having my idea and proposal, titled, “Carbon Phases in Low Reflectance Material on Mercury” funded by NASA’s Discovery Data Analysis Program.

Before this proposal, there have been several investigations trying to determine why the planet Mercury is so dark and what minerals are present on Mercury’s surface. These works have examined various minerals based on which mineral groups are naturally found together on Earth, the Moon, and in the laboratory. After sorting through various common groups and using data from NASA’s MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) spacecraft to Mercury, it was found from laboratory work that graphite is a very likely mineral to be present on Mercury’s surface that is causing it to be dark.

Building on previous work, our idea was to test whether graphite is the phase present on Mercury. Graphite consists of only carbon, but how the carbon is bonded to one another creates a different mineral. For example, both graphite and diamond are made of pure carbon, but they are different based on their crystal structure. In our funded project, we want to determine if the carbon is actually present in the form of graphite. In addition, because Mercury lacks an atmosphere, it experiences a process called space weathering, where the surface is constantly bombarded by grains smaller than a millimeter across and high energy particles from the Sun and beyond the Solar System. As a result, the grains on the surface of Mercury will change physically and chemically. From experiments, it is found that graphite actually becomes a type of glass, called amorphous carbon. This is another objective within our study, to determine if graphite on Mercury changes into glass-like carbon material as seen in our laboratory.
FACULTY PERSPECTIVE

The Sky is Falling: A New Cosmic Dust Collection at Mauna Loa Observatory

By: Dr. Hope Ishii, Mentor and Professor of Cosmochemistry, UH Mānoa

Approximately 30,000 to 40,000 metric tons of extraterrestrial dust particles arrive at Earth and fall down through the atmosphere each year. Most of this dust comes from small dust-producing bodies like asteroids and comets that have experienced limited processing since the formation of the Solar System, and we call it ‘cosmic dust’. Using a high volume air sampler at the Mauna Loa Observatory, we are now collecting samples on air filters to create a new, local, cosmic dust collection. Lean Teodoro, a 2017 HSGC Fellow at UH Mānoa, has been developing the methods to search for extraterrestrial candidates and analyze them.

The Long Duration Exposure Facility, a satellite that flew in low Earth orbit collecting extraterrestrial impacts, showed that the amount of cosmic dust arriving at Earth is about 100 times greater than that of larger meteorites, making dust the largest contribution to the extraterrestrial mass influx to Earth. Long- and broad-winged aircraft flying high in the stratosphere have been collecting cosmic dust since the 1980s with low contamination from terrestrial and manmade particles, but these flights are expensive and infrequent.

Near the end of the semester, Lean and I flew over to the Big Island for a trip up the mountain to exchange filters and discuss some future improvements to the collector. We were accompanied by a writer and a photographer from the Hawaiian Airlines in-flight magazine Hana Hou!, so the next time you fly, look for an article featuring the new Mauna Loa Observatory Cosmic Dust Collection and HSGC Fellow Lean Teodoro!

Our new collection at Mauna Loa Observatory (MLO) offers a unique opportunity to collect cosmic dust continuously and locally at far less cost. MLO is run by the National Oceanic and Atmospheric Administration’s Earth System Research Laboratory and has ideal conditions for its most famous measurements: monitoring the levels of CO₂ in the Earth’s atmosphere. MLO is located at 11,400 feet altitude near the summit of Mauna Loa on the Big Island. At nighttime, air flows down-mountain and brings clean air from the troposphere, the atmospheric layer above the planetary boundary layer, to the observatory. We take advantage of these atmospheric conditions to collect cosmic dust from the down-mountain flow of aerosol particles. Previous experiments at MLO have demonstrated that high percentages of extraterrestrial material can be collected, but those experiments destroyed the material in the process of measuring it. The MLO Cosmic Dust Collection uses a high volume air sampler that pulls large amounts of air through polymer air filters when the anemometer on top indicates correct wind direction and speed.
Lean Teodoro, a transfer student from Saipan and currently a sophomore in the Department of Geology and Geophysics at UH Mānoa, performed the first survey of the initial dust collection in the Advanced Electron Microscopy Center at UH Mānoa this semester. She was such a natural at learning to use the new UH Focused Ion Beam instrument to carry out scanning electron microscopy (SEM) imaging that Dr. John Bradley, who also mentored her, asked her what model of SEM she’d used in the past. Lean looked surprised and replied that she’d never used one before! Lean quickly learned to image particles and to characterize their elemental chemistry using brand new software that runs our energy dispersive x-ray detector. She is still teaching me little tricks to get the most out of the software.

Our research group focuses on studying early Solar System solids that have not altered much since their formation ~4.5 billion years ago, and one of the hallmarks of such cosmic dust is a chemical composition that is chondritic, or Sun-like. This is because dust that has not experienced heating and exposure to water has not differentiated: The heavy and light components are still mixed on a very fine scale. Lean demonstrated that we can use large area elemental mapping of MLO samples that have been pre-concentrated in the center of the filter to identify candidate cosmic dust by their chondritic, or Sun-like, compositions. She also developed a method for measuring the size distributions of the collected dust particles.

Lean will be continuing this project in the fall when we plan to prepare some candidate particles for transmission electron microscopy (TEM) using our state-of-the-art Titan microscope. We are excited about identifying our first bona fide cosmic dust particle from the new MLO Cosmic Dust Collection soon!
Hawai‘i Space Grant Consortium

Chartered under the National Space Grant College and Fellowship Program in 1990, the Hawai‘i Space Grant Consortium develops and runs interdisciplinary education, research, and public service programs related to space science, earth science, remote sensing, human exploration and development of space, small satellites, and aerospace technology. We accomplish this through a variety of projects: Undergraduate research fellowships and traineeships, innovative college courses, workshops for educators, educational web sites, public exhibitions, lectures, tours, primary school programs, space-themed evening programs, and much more.

HSGC AFFILIATES

UH Mānoa,
  Dr. Luke Flynn, Director
  Ms. Marcia Rei Nii, Program Coordinator
  Mr. Arthur Kimura, Education Specialist
  Ms. Rene Kimura, Education Specialist
  Dr. G. Jeffrey Taylor, Associate Director,
    Space Science and Fellowships
  Ms. Linda Martel, Webmaster/Communications
  Ms. Dora Nakafuki, Industry Affiliate (HECO)

UH Hilo
  Dr. Kenneth Hon, Associate Director

UH Maui College
  Dr. Jung Park, Associate Director

Hawai‘i Community College
  Dr. Joseph Wilcox, Associate Director

Honolulu Community College
  Dr. Shidong Kan, Interim Associate Director
  Mr. William Smith, Coordinator

Kapi‘olani Community College
  Dr. Radovan Milcinic, Associate Director
  Dr. Aaron Hanai, Liaison

Kaua‘i Community College
  Dr. Georgeanne Purvinis, Associate Director
  Mr. Stewart Burley, Liaison/Industry Affi. (STU, LLC)

Leeward Community College
  Dr. Bryson Padasdao, Associate Director

Windward Community College
  Dr. Joseph Ciotti, Associate Director
  Dr. Jacob Hudson, Rocketry Coordinator

University of Guam
  Dr. John Petersen, Associate Director
  Dr. Romina King, Coordinator