ANNUAL REPORT | FY 2015

PISCES
Pacific International Space Center for Exploration Systems

Hawai‘i to the Heavens

IN HAWAIIAN,
KA HUAKA‘I MEANS “THE VOYAGE.”

At the Pacific International Space Center for Exploration Systems, a voyage to other worlds is no longer a science fiction dream. We are actively navigating our way towards serving as Hawai‘i’s portal to space exploration, development, and utilization.

In our quest to reach other realms, we are also committed to giving back. Through planetary surface simulation testing, advanced manufacturing, and the development of advanced aerospace technologies, we aim to create 21st century jobs locally, educate our keiki (children) for careers in aeronautics and space, and both expand and diversify innovative economic development opportunities statewide.

This is our vision, and we welcome you to join us in our journey, our *huaka‘i*, as we continue Hawai‘i’s historic rendezvous with the stars.

PISCES

PISCES ANNUAL REPORT FY 15

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About the Pacific International Space Center for Exploration Systems

PISCES is a state-funded aeropace center strategically located in Hilo, Hawai`i. The Center is part of the state's Department of Business, Economic Development, and Tourism (DBEDT).

- We seek to educate, inspire, and offer unique opportunities to students in STEM (Science, Technology, Engineering, and Math) related fields.
- We work to develop the use of advanced technologies in space exploration that results in a direct benefit to our local communities.
- We utilize and facilitate testing of planetary robotics through our world-class planetary surface simulation testing sites.
- We research the next generation of additive manufacturing technology with practical *and* sustainable applications.
- We develop and execute collaborative efforts in the international community of aerospace, robotics, and technology, to further the collective human endeavor of space travel, utilization, and discovery.

LETTER FROM THE BOARD CHAIR

Henk Rogers

Dear PISCES supporters,

This could not have been a more frustrating good news, bad news year. It seems like we are taking one step forward and two steps back. Here are some things I know. Mankind will explore and colonize the planets that are within our reach today, if not in our lifetime, in the lifetimes of our children. Those who are a part of this effort have an opportunity, equal in size to the opportunity that existed when Columbus "discovered" the "New World." In other words, one that will change history. The Moon and Mars are sitting there waiting to be discovered. Those who are part of the effort will reap the rewards. The industry of space exploration will be huge. It's so big that it can one day be a cornerstone of the Hawaiʻi economy. We can board, or we can miss the boat. It's the same decision our ancestors made that brought mankind to the far corners of this world.

Hawaiʻi has been very unclear about whether or not it wants to become part of this history. We allocated $8.5 million to buy a property that could become the beginning of a cornerstone of the Space Exploration Industry in Hawaiʻi. At the same time, we all but pulled the plug on most of the projects which will become this industry in the future. Did we not make ourselves clear? Was there not enough money? Were we not loud enough? In the end, we were not even heard. I believe that we need to share our vision of the future with more people sooner so that we don't get "lost in space" like we did in the last legislative session. There is no more exciting future for the Hawaiian STEM based geniuses that brought us honor in national robotics championships than a career in space exploration/colonization. The choice is simple: either we are the ones who got on the boat, or we are the ones who were left behind.

This is the year when we have to make it clear to our government leaders. There is a future for Hawaiʻi beyond tourism, beyond construction and beyond military. The future is beyond Hawaiʻi, beyond this country, in fact beyond this planet. The future is in space exploration.

To do this, we need to mobilize ourselves early and start building our allies and telling our story. We have to show them that space exploration is within reach for our state.

The sooner we succeed in winning them over, the sooner we can claim a bigger piece of this pie for Hawaiʻi. The time is now. The prosperity of our children depends on it.

With Aloha,
Henk B. Rogers

LETTER FROM THE EXECUTIVE DIRECTOR

Rob Kelso

ALOHA!

Fiscal year (FY) 2015 (July 1, 2014 – June 30, 2015) was an incredible period of accomplishment for the Pacific International Space Center for Exploration Systems (PISCES), reaching heights well beyond what we imaged when the Center was conceived in 2007. PISCES continued its important focus of supporting the State of Hawaiʻi's need for high technology workforce and economic development, and continued growth in applied research for planetary surface systems.

Our committed goal within PISCES is to: *create economic development and hi-tech workforce opportunities in the State of Hawaiʻi, and provide research and development in planetary surface systems for maturing technologies for sustainable operations on the Moon, Mars and asteroids.*

As such, PISCES emplaced a "lunar sidewalk" made of Hawaiʻi volcanic basalt in Hilo, Hawaiʻi, replacing traditional cement with a sustainable alternative. A major accomplishment in FY15 was the introduction of an inspiring lunar flight program called Moon RIDERS, engaging two Hawaiʻi high schools in partnership with NASA's Kennedy Space Center to design and develop a lunar surface experiment for dust removal technology. To our knowledge, there has never been a high school experiment on the surface of the Moon!

PISCES has also led the way in creating the first cooperative education program at the University of Hawaiʻi at Hilo. The Co-op program will engage a university student in a work-study program within PISCES. In this regard, PISCES is extremely proud of its continued and growing relationship with the University of Hawaiʻi system. Looking to the future, we see PISCES being utilized in entirely new ways by NASA, the State, and the emerging commercial space/planetary resources sector, bringing innovation and new thinking to advanced technology development and supporting its respective mission needs.

PISCES exists and relies upon its business relationships and strategic partnerships. Thus, I extend my sincere thanks to the many supporting legislators, board members, academic advisors, cultural committee members and members of the business sector for their input, contributions, guidance and interest. I believe that FY16 will be one of the most important and productive years in the young history of PISCES. We, within the PISCES family, look forward with great anticipation and excitement for what is in store in the coming fiscal year.

With much aloha and grateful thanks,

Rob Kelso

EXECUTIVE SUMMARY

MOVING FORWARD | Return on Innovation

The Pacific International Space Center for Exploration Systems (PISCES) has successfully completed its second full year of operations, building on solid achievements during the last half of Fiscal Year (FY) 2014. These accomplishments drew various strategic partners from the federal government and private sector to request partnerships with PISCES in new, advanced technology research efforts.

Through these partnerships, PISCES engaged in research proposals, innovative robotics research in planetary construction, and designed a flight test program to operate technology on the surface of the Moon. It is with great pride that the PISCES ‘ohana continues to make strong progress in our mission to advance planetary surface systems technology and to improve economic returns to the State of Hawai‘i by focusing on three primary strategic initiatives: robotics, planetary basalt construction, and communications infrastructure.

In FY 2015, PISCES operated on-budget and on-schedule for new strategic initiatives planned for the year. The Center sustained 6.25 Full-Time Employees (FTE) in FY15, with our personnel providing invaluable leadership in engineering, project management, and robotics skills that proved to be critical to our success. PISCES continues to be increasingly recognized within the world-wide space community for its emerging research in planetary construction and robotics, and serves as a shining example of state-funded applied research.

In legislative matters, PISCES received no supplemental funding from the State for FY 2016, leaving only one-third of the budgetary request from its minimum operating budget allotted through the Governor’s budget. As such, PISCES is faced with financial challenges toward the end of FY 2016.

EXECUTIVE SUMMARY

FY 2015: KEY FINDINGS

• **Planetary Surface Systems Technology Development**. PISCES made significant advancements in planetary surface systems research and development:

o PISCES made substantial system upgrades to its 726 lb. ODG (Ontario Drive Gear) planetary rover from Canada. The upgrades included: software/avionics, instrumentation, navigation, camera/imaging systems, communications systems, mechanical systems and attitude determination technology. The rover, however, spent part of the year in repair after the encoders used to perform motor drive functions failed. After extensive troubleshooting with the manufacturer, the encoders were removed and replaced, restoring the rover to normal functionality. In addition, the rover was given a proper name by a second-grade Hawai‘i public charter school student: “Helelani,” or “Heavenly Travels.”

o Planetary Basalt Research - Under joint funding between PISCES and the County of Hawaii-R&D Department, PISCES led a collaborative research effort with NASA’s Kennedy Space Center (KSC) and the University of Hawai‘i at Mānoa to build the world’s first “lunar sidewalk” using basalt material in Hilo, Hawai‘i.

o Moon RIDERS (Research Investigating Dust Expulsion Removal Systems) – after 18-months of development, PISCES introduced the Moon RIDERS student lunar flight experiment program in August 2014. Moon RIDERS aims to develop, launch, fly and land on the moon a Hawai‘i High School student-built lunar surface experiment, in concert with technology from NASA KSC as a hosted payload on an upcoming Google Lunar X-Prize (GLXP) launch in early 2017.

‘Iolani School students participating in the Moon RIDERS program built a mock lunar lander and conducted field tests using NASA-built technology.

• **Federal / NASA Partnerships**. Formal working agreements between PISCES and NASA were completed, including two non-reimbursable space act agreements (nr-SAA). One SAA dealt with the Moon RIDERS lunar surface flight experiment. The other partnered with NASA KSC on a robotic space construction project to build a launch and landing pad out of volcanic basalt. PISCES was invited by NASA Headquarters to participate in the landing pad initiative through a Program Element Agreement (PEA). Further, PISCES was invited to be a key strategic partner with NASA AMES Research Center through NASA's BASALT (Biologic Analog Science Associated with Lava Terrains) research funding grant.

• **International Strategic Partners** - PISCES actively reached out to the international community to conduct joint research and testing opportunities.

o Japan – PISCES Executive Director Rob Kelso journeyed to Japan in October 2014 to begin discussion with Japan's national space program, JAXA, about collaborative research projects and joint lunar flight research opportunities.

o Germany – loaned a high-power laser to PISCES for 3D printing research with basalt material.

o Canada – provided long-term loan of a large planetary rover for research/testing in Hawai'i.

• **Public Information Outreach** - PISCES made significant progress in implementing critical outreach tools that enhanced the dissemination of information about PISCES' progress and achievements:

o PISCES website – a regularly updated website (PISCES.HAWAII.GOV) continues to provide space-related news and events, in concert with social media networks; PISCES' monthly four-page newsletter relays the latest Center news to a distribution list of over 800 subscribers.

o PISCES produced and aired a "Space News" radio broadcast highlighting PISCES and local aerospace news to the local community.

o Major outreach events were planned and executed including presentations at the Pacific Aviation Museum in Honolulu, the State Capitol, schools, malls and planetariums statewide.

o PISCES conducted the first STARS (STEM Aerospace Research Scholars) workshop aimed at inspiring high school women in space careers and STEM-related fields.

EXECUTIVE SUMMARY

• **Planetary Surface Simulation Test Sites** - PISCES continued to improve its planetary surface simulation testing site with the addition of new infrastructure:

o Time Delay Emulator: provides the flight communications network of PISCES with the ability to simulate time delays for the Moon, Mars and asteroids.

o PISCES continued to investigate high-quality lava tubes and skylights.

o PISCES continued the development of a database for field-site data on planetary surface simulation testing sites.

The landscape of Pu'u Haiwahine, a PISCES planetary surface simulation test site, presents a world-class analogue for places like the moon and Mars.

• **Workforce Development / University Involvement**

o PISCES became a critical participant in the County of Hawai'i Workforce Development organization. The Center developed a workforce development proposal, MMADE-in-Hawai'i, which will provide in-state labor for out-sourced projects from the science and space community in the fields of light manufacturing and software and instrument processing. This could eventually lead to an aerospace research technology park on Hawai'i Island.

o PISCES launched the first cooperative education program at the University of Hawai'i at Hilo. This program will bring a university student into PISCES on alternating semesters to work side-by-side with PISCES senior engineers. The student will work on real-world research programs to complement curricula provided in the classroom. The program officially begins in the fall of 2015.

PISCES Interns from the Summer of 2014 characterized new planetary surface simulation test sites on Hawai'i Island and presented their findings to distinguished members of the community in public and private sectors.

o PISCES supported seven interns and volunteers during the summer of 2014 in various PISCES projects and initiatives. Students represented the University of Hawai'i at Hilo, the University of Hawai'i at Mānoa, the University of Hawai'i Maui College, Western Washington University, and the University of Rochester in New York.

o A former PISCES intern was awarded a 2015 summer internship at NASA's Marshall Space Flight Center (MSFC) in Huntsville, AL., working on an international humanitarian project.

• **Grants** – PISCES was awarded two grants during FY15:

o $10,000 grant from the Hawaii Community Foundation's THINK Fund for Moon RIDERS to integrate operations of the flight experiment into the lunar lander spacecraft.

o A four-year, $170,000 NASA grant for the BASALT research project.

As prudent financial stewards, the PISCES staff has invested in strategic programs that deliver value. We controlled expenses and carefully managed our state-funding, allowing us to further advance Hawai'i's support for planetary surface/space technology development, as well as to provide our customers with high-quality technical, educational and professional resources. Our achievements in FY15 have positioned us well for even greater advances in our strategic initiatives. Thank you to the PISCES staff, volunteers, and strategic partners for your roles in making these successes a reality.

Robert M. Kelso

***Executive Director*, PISCES**

TECHNOLOGY DEVELOPMENT

A. Planetary Surface Systems

PISCES' Helelani planetary rover traverses the rugged slopes of Hawai'i Island's Mauna Loa volcano.

Helelani Planetary Rover

PISCES' Helelani planetary rover provides a mobile platform for payload experimentation. Its open payload deck allows for extreme flexibility in design.

Over the last year, Helelani underwent major upgrades and improvements. The summer of 2014 concluded with the successful remote operation of the Helelani using a Graphics User Interface (GUI) and control system developed in-house. The systems allowed for the remote control of the rover from anywhere in the world using the internet. These tests, while successful, revealed limitations in the system design's capabilities. With these findings, the PISCES Robotics Team returned to the drawing board to completely redesign the control, communication, command, navigation and visual imaging systems on the rover to meet the demands of future Design Reference Missions involving third-party payloads, communications systems and software.

Helelani's upgrades now include:

- Two avionics boxes housing a powerful onboard computer, power converters, internet switches, sensors, relays and other electronics and hardware.
- Upgraded imaging system with Pan and Tilt controls for the situational camera, enabling the rover's navigator to optically explore the surrounding terrain without altering the rover's position.
- Infrared LED illuminator with a field depth of 300 feet, providing night time navigation capability.
- New and improved 9-axis IMU (Inertial Measurement Unit) with an accelerometer, magnetometer and gyroscope, as well as a higher-quality GPS tracking system.
- Weather sensors to monitor temperature, altitude, barometric pressure and wind-speed.

Under Development:

- Multiscreen GUI: allows different users to interact with the rover on separate monitors and stations. The interface includes: a navigation screen for operation, telemetry screen showing data collected by the rover (being developed using software created by NASA AMES Research Center), and a guest payload screen from which any third-party payload can operate the rover. The system will feature semiautonomous navigation, allowing multiple sequential commands to be programmed into the rover.
- Time Delay Emulator (TDE): Currently being integrated and tested, the TDE will simulate time delay conditions experienced on the Moon and Mars. Working with NASA, the communications protocol will incorporate a Disturbance Tolerant Network system to prevent data loss if communications with the rover are interrupted.
- Robotic Construction: Helelani has being outfitted with a mounting frame to integrate different mechanical systems including a levelling blade, roller/compactor, and a Paver Deployment Mechanism (PDM). The system will play a key role in a robotic basalt construction project (known as ACME) in partnership with NASA Kennedy Space Center's (KSC) SwampWorks.

Upcoming Testing:

The systems under development on the Helelani will be tested during three trials in the summer and fall of 2015. The first will be conducted at the PISCES Robotics Lab and at the Planetary Surface Simulation Test Site on the slopes of Mauna Kea, and will assess the upgraded capabilities of the rover. The second will be done in conjunction with NASA AMES to test long distance remote navigation capabilities using the TDE. The third will involve a robotic basalt construction project in partnership with NASA KSC's SwampWorks.

Helelani shown with a levelling blade to assist in the robotic construction of a lunar landing pad.

TECHNOLOGY DEVELOPMENT

B. Planetary Basalt Research

PISCES' "Laser Lava Lab" is home to additive manufacturing and basalt sintering research projects.

Basalt Fabrication and Construction

The addition of a galvanometer enables detailed print capabilities like the one shown above - the word "PISCES" sintered into a mound of Martian dust simulant.

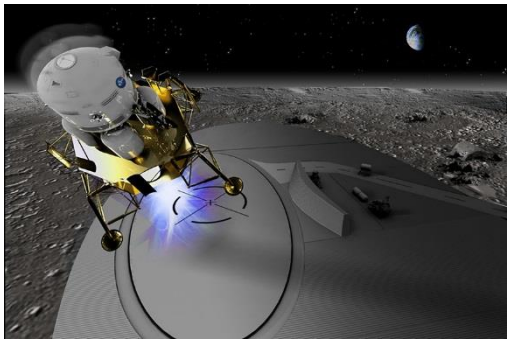
i. 3D Laser Printing

PISCES' Laser Lava Lab operates in the University of Hawai'i at Hilo's Science and Technology Building. The lab is outfitted with a Jenoptik GmBh, 400-watt fiber optic laser. The instrument was offered to PISCES in November 2013 as a long-term loan for use in PISCES' basalt additive manufacturing project.

In June 2014, PISCES began characterizing basalt melting techniques using the laser. To increase capabilities, PISCES purchased a mirrored galvonometer system in September from Nutfield Technology. The "galvo" allows the laser beam to be steered over the "print" area via computer commands without moving the laser head.

PISCES has successfully melted and "printed" basalt rock from basalt fines. With the installation of the Nutfield galvo, PISCES is developing its 3D basalt printing capability and optimizing its ability to "print" 2D basalt structures.

ii. Additive Construction for Mobile Emplacement (ACME)



The ACME project aims to robotically build a vertical lift off and landing pad (VTVL) on Hawai‘i Island using volcanic basalt. The PISCES Helelani rover plays a fundamental role in the construction process. It will be the tool used to provide site preparation (grading, leveling and compaction) and to transport the mechanism that will build the landing pad. The PISCES Robotics team is working hard to insure all necessary preparations are made to begin the ambitious project in late fall. Helelani is being equipped with a mounting frame that will allow for the integration of different mechanical systems required for the task: a leveling blade, a roller/compactor and a Paver Deployment Mechanism (PDM).

iii. Microwave Sintering

In March 2015, PISCES tested its microwave sintering prototype in the field with mixed results. The primary goal of sintering (heating to form a mass of material without complete melting) basalt regolith was not achieved, but microwave extraction of water to a depth of 30 cm was successful.

PISCES’ analysis of the March field-test results led to the development and modification of a second microwave sintering prototype. The second prototype was completed and successfully tested in May. The microwave sinterer successfully melted basalt fines and rock in under 30 seconds at full power. PISCES is now incorporating this technology from the second prototype to design and build a microwave extruder

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ECONOMIC DEVELOPMENT

A. Planetary Surface Simulation Test Sites

Pu'u Haiwahine Valley sits at roughly 9,000 feet on the slopes of Mauna Kea, and serves as one of PISCES' primary testing sites for planetary surface systems.

Overview

GLXP Team Puli's innovative rover on Mauna Kea.

PISCES' Planetary Surface Simulation Testing Sites serve as world-class testing grounds for planetary surface systems. The volcanic basalt found on Hawai'i Island is geochemically almost identical to the regolith found on places like the Moon and Mars, offering an ideal environment for aerospace organizations to test their equipment prior to spaceflight.

The main simulation site is located in Pu'u Haiwahine Valley on the lower slopes of Mauna Kea volcano, and has hosted several high profile tests including Hungarian Google Lunar XPRIZE Team Puli in December 2013, and as well a joint ISRU (in-situ resource utilization) mission with NASA and the Canadian Space Agency in 2012. The site is also home to PISCES' annual PRISM Competition.

Facility User's Guide

PISCES developed a planetary surface simulation testing site user's guide to market and advertise various test sites and their unique capabilities. This document, along with a customer questionnaire for test requirements, has been distributed to customers such as the Google Lunar XPRIZE teams.

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Development

The Pu‘u Haiwahine Valley test site is supported by a portable, solar-powered Wi-Fi relay linking the remote area with the Ellison S. Onizuka Center for International Astronomy.

PISCES’ 2015 summer interns are compiling a web-accessible database to categorize simulation site data gathered over the last two years. The database will enable future test-site customers to match their field-test objectives with an appropriate location on Hawai‘i Island. The data will include location characteristics, access and civil data, communications access, weather and photo documentation with tagged geologic samples, as well as matching X-Ray Fluorescence Spectroscopy (XRF) data supplied by the University of Hawai‘i at Hilo Geology laboratory.

Several high-demand value sites are slated for assessment to expand PISCES’ planetary surface simulation testing sites to include environments for a variety of science objectives. These include multi-terrain roving, lava tubes, and higher altitude cinder sites mimicking planetary regolith.

PISCES’ characterization of skylights and lava tubes on Hawai‘i Island will provide additional high-value planetary surface simulation testing sites for robotic surface systems.

Surface Simulation Test Site Operations

PISCES is preparing to host teams from the Google Lunar XPRIZE competition in the fall of 2015. Japanese Team Hakuto and Florida-based Team Earthrise are both expected to conduct testing on Hawai‘i Island, prior to launch to the surface of the Moon. Team Hakuto was awarded with a GLXP Milestone prize in January 2015 at the California Academy of Sciences, an event attended by PISCES Logistics/EPO Manager John Hamilton. Earthrise is finalizing the design of its “Sagan” rover for testing in conjunction with PISCES’ second Moon RIDERS field test.

Google LUNAR XPRIZE

ECONOMIC DEVELOPMENT

B. PSTARS BASALT Grant Research

PISCES is one of several partners that has been selected to complete a four-year, $4.2 million Mars research project designed to help prepare for future human and robotic missions to the Red Planet. Called Biologic Analog Science Associated with Lava Terrains (BASALT), this project is spearheaded by the NASA AMES Research Center, in collaboration with PISCES, NASA Goddard Space Flight Center, NASA Kennedy Space Center, BAER Institute, Wyle Engineering, Massachusetts Institute of Technology (MIT), Purdue University, Leiden Measurement Technology, Idaho State University (ISU), Cornell University, Arizona State University (ASU), and the University of Hawai‘i at Hilo.

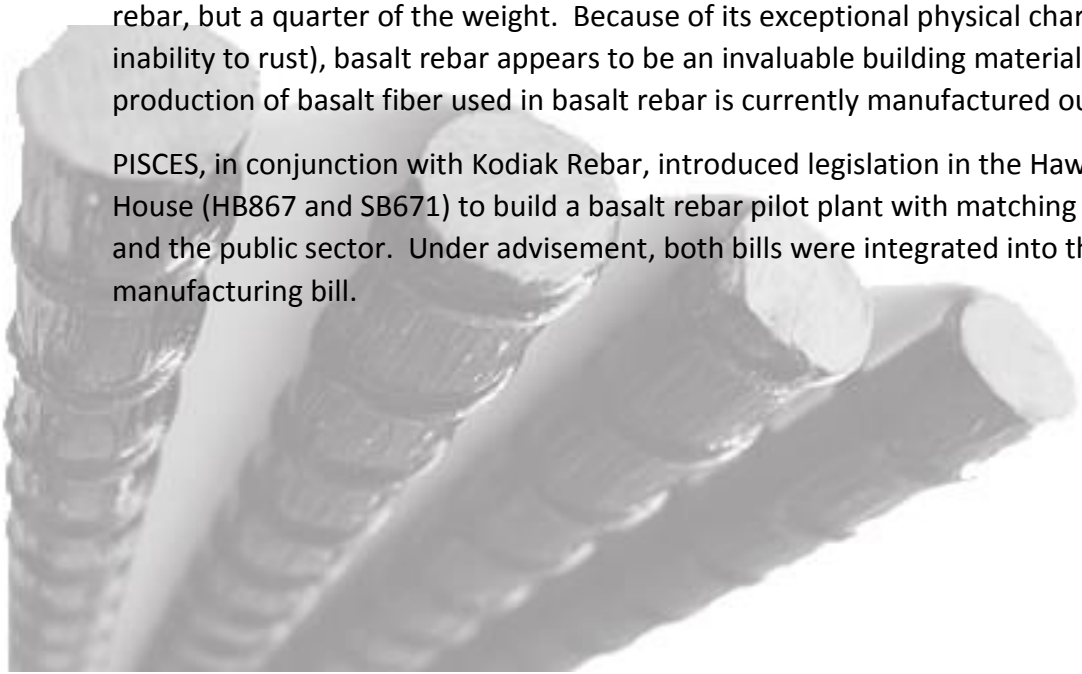
Out of 47 proposals received nationwide, this elite team of researchers is one of only seven grant applicants chosen by NASA’s highly competitive Planetary Science and Technology Through Analog Research (PSTAR) program.

BASALT crew comprised of scientists - both senior researchers and students - operations experts, and active astronauts, will investigate volcanic terrains and lava flows on the Big Island of Hawai‘i and in Idaho, both of which serve as Mars analogues. Numerous studies show the Red Planet’s past was filled with volcanic activity, with Hawai‘i’s lava terrain having similarities to early Mars, and Idaho’s flows resembling present-day Mars. Researchers will compare and contrast their geochemical properties to rocks on the Red Planet and evaluate microbial communities to understand the habitability potential of Mars.

C. Basalt Rebar Initiative

As part of PISCES’ Lunar Sidewalk initiative with the County of Hawai‘i, PISCES incorporated a commercially available rebar made from basalt. Basalt rebar has twice the tensile strength of steel rebar, but a quarter of the weight. Because of its exceptional physical characteristics (including its inability to rust), basalt rebar appears to be an invaluable building material in Hawai‘i. Commercial production of basalt fiber used in basalt rebar is currently manufactured outside of the U.S.

PISCES, in conjunction with Kodiak Rebar, introduced legislation in the Hawai‘i State Senate and House (HB867 and SB671) to build a basalt rebar pilot plant with matching funds between the State and the public sector. Under advisement, both bills were integrated into the State’s Omnibus manufacturing bill.



D. Multi-purpose Manufacturing and Advanced Development Enterprise (MMADE)

The Multi-purpose Manufacturing and Advanced Development Enterprise (MMADE) is a PISCES concept to act as a catalyst for workforce, education and economic opportunities. MMADE intends to provide space, training, and facilities needed to manufacture and service high-tech equipment. MMADE aims to provide infrastructure to supplant presently out-sourced services from the user communities of Hawaiʻi. The concept provides a full-service, state-of-the-art facility configured to serve a variety of high-tech projects, offering an alternative option for product processing. PISCES' request of $8.5 million in FY2016 for MMADE infrastructure was granted under Labor-Workforce Development in HB 500 (under the name multi-purpose processing facility).

E. Conferences

The Next Giant Leap Aerospace Conference

PISCES participated in the Next Giant Leap Aerospace Conference held in Waikoloa on Hawaiʻi Island in November 2014. The multinational event was a joint effort between PISCES, the ASA (Aerospace States Association) and the State of Hawaiʻi. PISCES Executive Director Rob Kelso served as an invited panelist and also moderated a briefing to the attendees on Moon RIDERS presented by Kealakehe High School students.

HI-WEDO

PISCES has been an ongoing participant with the Hawaii Island Workforce Education Development Organization (HI-WEDO) chaired by former Hawaiʻi State Department of Labor Director Dwight Takamine. These meetings have focused on how to develop High-Tech opportunities in the fields of aerospace and astronomy throughout the state. PISCES paneled the forum, "Spawning a Hi-Tech Community" in November, which focused on strategies to lower Hawaiʻi's energy costs and cultivate STEM education in the interest of 21st century workforce development.

PISCES Staff paneled the HI-WEDO conference in Waikoloa in November.

ECONOMIC DEVELOPMENT

E. Strategic Partnerships

i. Space Act Agreements with NASA

PISCES has three space act agreements (SAA) with NASA's Kennedy Space Center (KSC):

1. Reimbursable SAA – flight communications architecture for the PISCES planetary surface simulation test site.
2. Non-reimbursable SAA – an educational agreement establishing a contractual agreement between PISCES and KSC for the Moon RIDERS lunar surface flight experiment in collaboration with two Hawaiʻi high schools.
3. Non-reimbursable SAA – a technical agreement describing the collaborative research between PISCES and KSC regarding the robotic construction of a vertical takeoff/vertical landing (VTVL) launch and landing pad using basalt material in Hawaiʻi.

ii. NASA Centers: AMES Research Center, JSC, KSC

PISCES engaged in strategic discussion with several NASA Centers as well as NASA Headquarters in Washington D.C.

1. NASA Headquarters – discussions on strategic activities in tele-robotic operations involving laser communications (NASA Advanced Exploration Systems), robotic construction of a launch/landing pad in Hawaiʻi for testing planetary construction technologies (Space Technology Mission Directorate), and planetary test sites/technology testing on the lunar surface (NASA Advanced Exploration Systems).
2. NASA Kennedy Space Center – planetary robotics, planetary construction technology, and Moon RIDERS for the testing of planetary surface systems technology on the lunar surface.
3. NASA AMES – strategic discussions on commercial space for Hawaiʻi with the AMES Space Portal, planetary robotic technologies, and the use of PISCES test sites/robotics in support of the NASA Resource Prospector mission.
4. NASA Johnson Space Center – fuel cell technology for robotics and in-situ resource utilization (ISRU).

iii. University of Hawai‘i

PISCES has entered an agreement with the University of Hawai`i at Hilo to establish the first Cooperative Internship in collaboration with the Applied Learning EXperience (ALEX) program. A candidate student will inaugurate the program this fall by working full-time on robotics, then returning to full-time college classes in the spring 2016 semester. Ethan Paguirigan is a pre-Engineering major who will continue at UH-Hilo as a Physics major with a Computer Science minor. The Cooperative program alternates full-time work experience with college attendance, and allows students to apply and reinforce their classroom learning.

iv. Memorandums of Understanding

PISCES has signed 3 Memorandums of Understanding (MoU) over FY15 with several strategic partners.

1. University of Houston Center for Advanced Materials, July 2014: allows for joint research on planetary regolith resource extraction and utilization.

2. NASA KSC SwampWorks, November 2014: enables collaborative work on sustainable, basalt-based concretes, 3D printing and additive construction.

3. Google Lunar XPRIZE, February 2015: facilitates cooperation on enabling emerging commercial space enterprises and education using GLXP Lego “MoonBots.”

STRATEGIC PARTNERSHIPS

2014–2015

Jenoptik
GERMANY
International Space Exploration Research Institute
HANYANG UNIVERSITY, KOREA
Australian Centre for Space Engineering Research
UNIVERSITY OF NEW SOUTH WALES

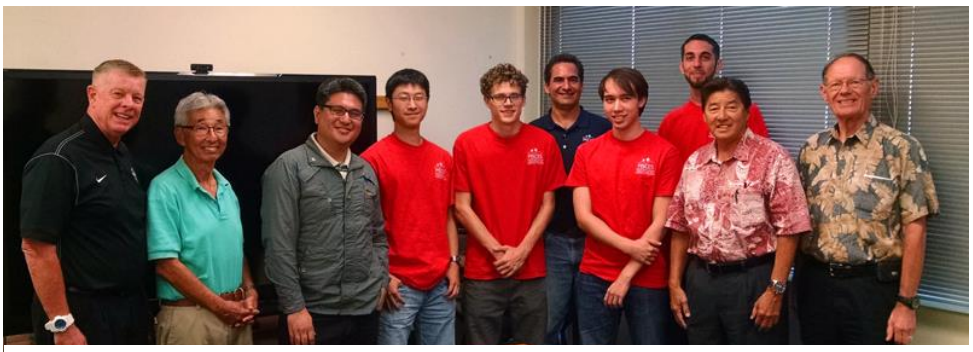
WORKFORCE DEVELOPMENT

A. Internships

PISCES' summer internship program offers a unique opportunity for college-level students involved in STEM (science, technology, engineering, and math) related study and career fields. The Center's hands-on program gives participants a real-world experience in applied engineering, geology, computer programming, and other fields, and cultivates skills for students to thrive in the 21st century economy. Over the last two years, 88% of participating interns have been students with a Hawai'i connection.

Summer 2014

Last summer, PISCES employed six interns and two volunteers, forming two teams that worked on planetary surface simulation test site characterization and development of the Helelani planetary rover. The characterization team successfully identified three testing sites and researched the value of volcanic basalt on Hawai'i Island as a test bed for planetary surface systems. The robotics team equipped the Helelani with remote navigation through the internet, enabling it to be controlled from anywhere in the world. The rover was successfully operated atop Mauna Kea by students from Gemini Observatory headquarters in Hilo.



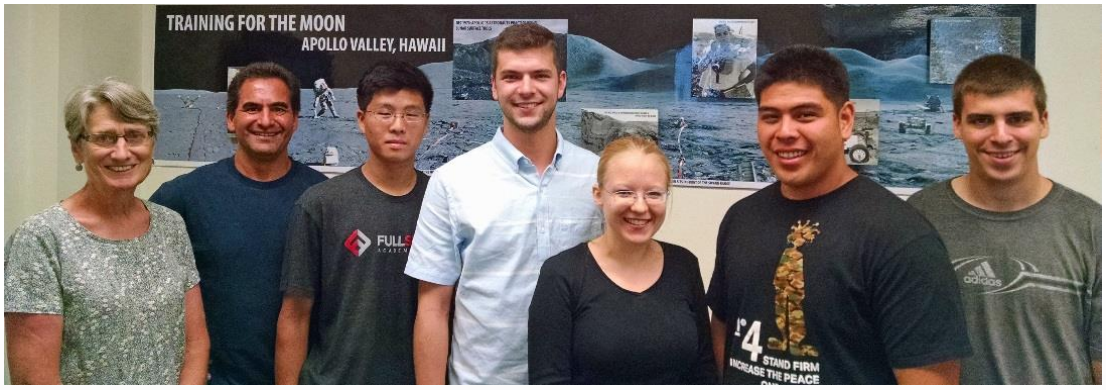
PISCES interns on the Robotics Team (red shirts) pose with distinguished members of the private and public sectors, following a presentation on their work with the Helelani rover.

The 2014 interns included Christina Cauley, Kyla DeFore, and Colin Milovsoroff of UH-Hilo; Nasre Manasrah and Lindsay Komai of UH-Maui College; Leila Olivar of UH-Manoa. PISCES' volunteers included Matt Takemoto of Western Washington University, and Tracee Fukunaga of the University of Rochester, NY.

PISCES

Summer 2015

This summer, PISCES is continuing its planetary surface simulation test site characterization and robotics development with two teams including six interns and two volunteers. The goal of this year's characterization work is to compile a web accessible database of data collected over the last two years, as well as assess new potential sites. Preliminary work will also be done for the two Mars simulation sites specified for the NASA BASALT grant in Hawai'i Volcanoes National Park. The robotics team is tasked with integrating the Helelani's new systems, and designing and integrating mechanical subsystems for the ACME project.



PISCES' 2015 Summer interns pose with PISCES Staff at the Hilo-based headquarters.

The interns include:

- Colin Milovsoroff of UH-Hilo: Geology
- Valerie Wasser of UH-Hilo: Geology
- Eric Boucher of Guelph University, Ontario: Physics and Canadian LORAN Scholar
- Amy Lowe, UH-Manoa: Moon RIDERS project participant, CAD Design
- Karlin Yeh, Cooper Union, NY: Mechanical Engineering
- Ernesto Esparza: UH-Manoa: Mechanical Engineering

Volunteers:

- Nicolette Thomas, UH-Hilo, Astrobiology
- Sam Fishman, Oregon State University: Mechanical Engineering

WORKFORCE DEVELOPMENT

B. Moon RIDERS Student Lunar Flight Experiment

Overview

Moon RIDERS students put their mock lunar landers to the test in March using NASA-built technology.

In 2014, PISCES initiated 'Moon RIDERS' (Research Investigating Dust Emulsion Removal Systems) - a one-of-a-kind STEM (Science, Technology, Education, Math) project in partnership with NASA KSC and two Hawai`i high schools. In the spirit of discovery and education, this program is designed to immerse and inspire Hawai`i high school students in the development and execution of a real-life lunar surface flight experiment, while simultaneously conducting critical flight testing and validation of a NASA-developed spacecraft systems technology. This project is the first of its kind, and involves a unique partnership of federal, state and academic partners to fly an experiment to the surface of the Moon aboard a GLXP spacecraft in 2017.

Since the spring of 2014, NASA KSC and PISCES have initiated a "program-start" on this project, adding two participating Hawai`i high schools within the engineering project to flight test NASA's spacecraft technology called the 'Electrodynamic Dust Shield' (EDS) – a system designed to address the problematic surface dust found on places like Mars and the Moon. The participating schools are 'Iolani School and Kealakehe High School. Moon RIDERS is fully-funded to design, develop, test, evaluate, (DDTE) and deliver a certified flight unit for a lunar landing.

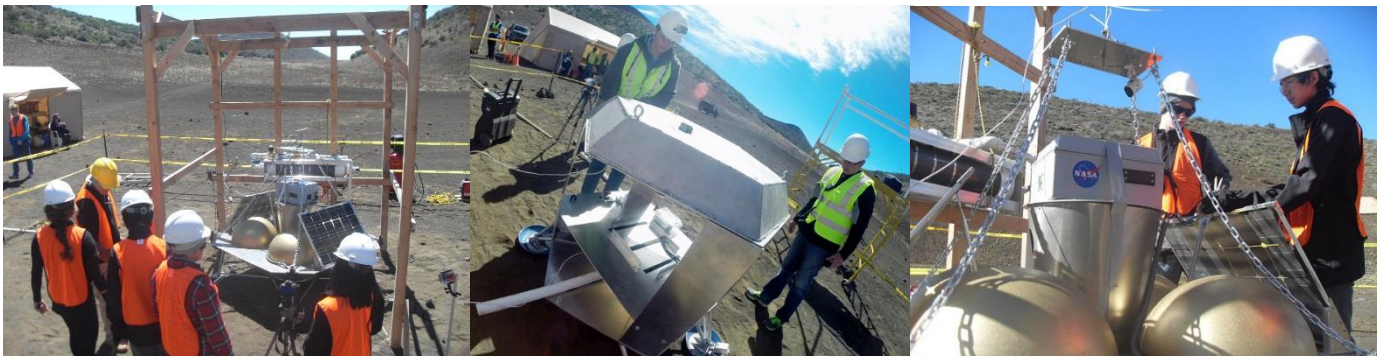
Field Testing

During mid-March, PISCES led a 10-day trial on Mauna Kea to field test the dust shield in lunar-like conditions. The two high school teams provided large-scale lunar lander mockups and integrated the EDS hardware. The objectives of these tests were to:

1. Test the EDS in a high-quality lunar simulation environment using lunar lander test articles
2. Assess locations and mounting of the EDS to the lander

3. Assess imaging of the EDS using various camera systems and radius distances
4. Develop imaging analysis and processing techniques that could be used for the mission
5. Determine optimal configurations for the EDS and camera systems for flight

The engineering field test yielded successful results. Data collected was analyzed and presented to the NASA KSC team in June. The next field test will be performed in the fall of 2015 to verify flight configuration for the EDS and camera imaging systems for flight to the Moon.



The bulk of this test was oriented toward the Astrobotic flight configuration, locating the EDS on the mock-up lander's 1-foot landing pad, and working with the Andy Rover imaging configuration as a data acquisition tool for observing EDS performance after landing.

NASA AMES Research Center Visit

Moon RIDERS students from Kealakehe High School travelled to NASA's AMES Research Center in California during the spring of 2015 to perform additional EDS testing operations using the Center's Regolith Test Bed. Results from this additional test were incorporated into the engineering field test data gathered during the spring testing on Mauna Kea.

Outreach

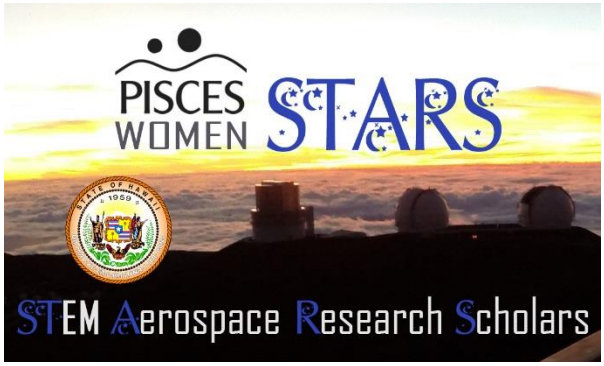
Outreach is an important aspect of the Moon RIDERS program. As such, both Kealakehe High School and 'Iolani School made public appearances to provide technical briefings on the Moon RIDERS program. These briefings included the State Capitol in Honolulu, 'Imiloa Astronomy Center during Onizuka Day, and the Mauna Kea Skies space lecture series.

WORKFORCE DEVELOPMENT

B. Women's STARS Program

Overview

PISCES' Women's STARS (STEM Aerospace Research Scholars) program is a hands-on aerospace workshop designed to encourage Hawai'i's young high school women to pursue a space career or other STEM (science, technology, engineering, mathematics) related field. The five-day summer program aims to show young women that a career in aerospace is an engaging, fun, and achievable dream within reach.



2014 Workshop

The inaugural STARS program kicked off in July 2014 with a trio of bright student cadets who ventured through the cosmos with a VIP backstage tour of several Mauna Kea observatories, presentations and lessons from Hawai'i's real-life space experts, hands-on experience with the Helelani rover, and an overview of Hawai'i's cultural relationship with the stars.

Students also conducted a lunar mission using the Google Lunar XPRIZE Lego MINDSTORMS robot from GLXP's MoonBots-In-A-Box program – PISCES is one of only 40 U.S. Science Centers that has this exclusive robotic kit. The grand finale was an overnight weekend adventure on 'Mars' at the HI-SEAS (Hawaii Space Exploration Analog and Simulation) Habitat on Mauna Loa.

STARS cadets spent a night on "Mars" at the HI-SEAS Mars simulation habitat (shown in background).

The inaugural STARS workshop included a test-drive of the Helelani rover.

2015 Workshop

The 2015 STARS cadets geared up for some off-planet activities in late June, staying overnight at the HI-SEAS habitat on Mauna Loa.

The STARS program more than tripled in 2015 with 10 Hawai‘i high school women participating in late June. The second-annual workshop engaged students in a mock robotic moon mining mission, a test drive of the Helelani rover, and a presentation on ISRU by PISCES Project Manager Rodrigo Romo. Because of restricted access to Mauna Kea, the summit observatory tour was cancelled. Students still had the opportunity to see PISCES' planetary surface simulation test site and stargaze on the slopes of Mauna Kea, following an "astronomer's dinner" at the Ellison S. Onizuka Center for International Astronomy.

The overnight stay at the HI-SEAS Mars-simulation habitat was complemented by the presence of former mission commander Martha Lenio, who completed an eight-month mission in the geodesic dome atop Mauna Loa. Lenio conducted a tour of the habitat for the students who later tried on simulated space suits and hiked the rugged volcanic terrain that resembles other planets.

STATE AEROSPACE LEGISLATION

Aerospace Development in Hawai‘i

Submissions

In early February 2015, PISCES submitted three legislative bills intended to advance the Center’s mission and project goals.

1. SB 672: appropriation of general funding for the Center to continue its planetary surface systems work enabling Hawai‘i to move to the forefront of the aerospace sector, as well as an additional appropriation for the acquisition of a central headquarters and testing facility.

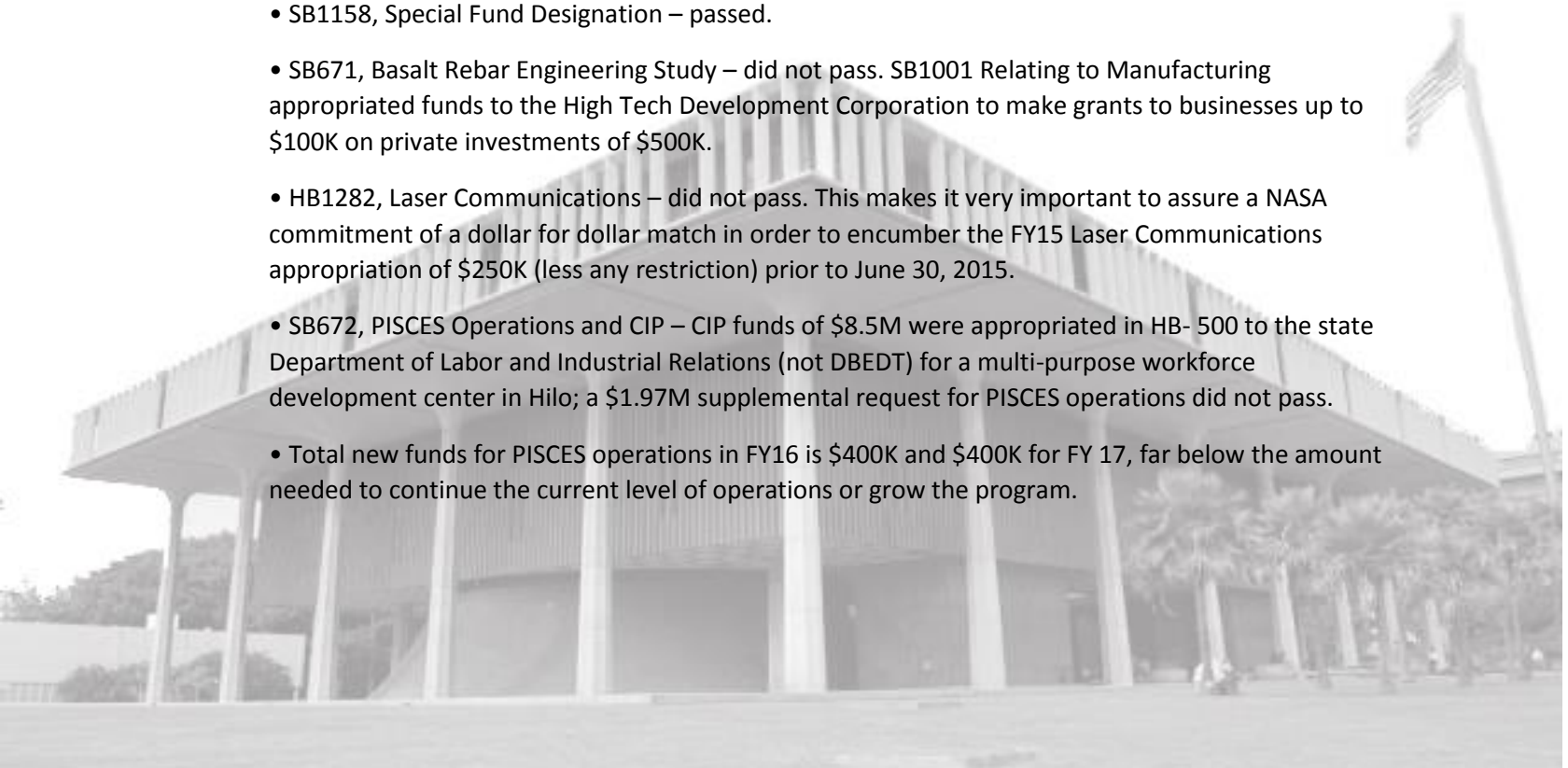
2. SB 671: a PISCES-led basalt rebar initiative requesting funds for an engineering study to determine how volcanic basalt can be used as an asset and potential new industry in the state of Hawaii. The study would assess if Hawai‘i’s basalt can be used as a material in manufacturing basalt rebar – a considerably lighter, and stronger alternative to steel rebar – while investigating the necessary energy support needed for production. The bill requested federal matching funds for the engineering study, to be conducted over a one-year period.

3. SB 1158: proposes the establishment of a special fund for the operation, maintenance, and management of all PISCES projects, facilities, services, and publications. The bill also provides the ability for the Center to accept outside revenue.

Approvals/Disapprovals

The following PISCES-related bills were passed/declined by the 28th Hawai‘i State Legislature:

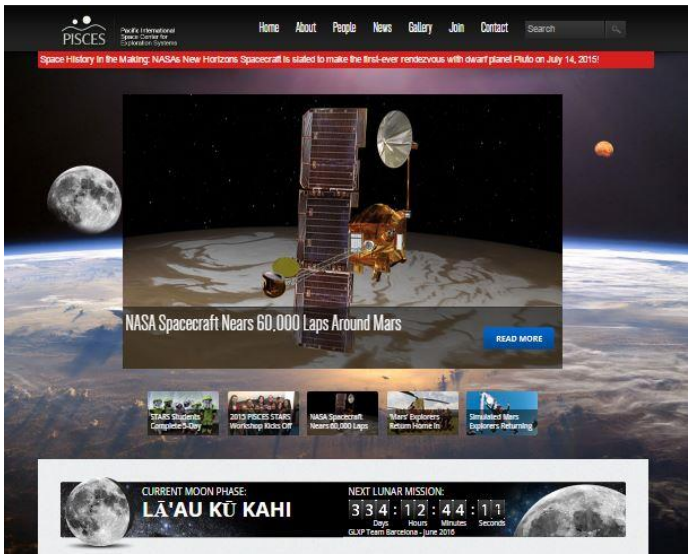
- SB1158, Special Fund Designation – passed.
- SB671, Basalt Rebar Engineering Study – did not pass. SB1001 Relating to Manufacturing appropriated funds to the High Tech Development Corporation to make grants to businesses up to $100K on private investments of $500K.
- HB1282, Laser Communications – did not pass. This makes it very important to assure a NASA commitment of a dollar for dollar match in order to encumber the FY15 Laser Communications appropriation of $250K (less any restriction) prior to June 30, 2015.
- SB672, PISCES Operations and CIP – CIP funds of $8.5M were appropriated in HB- 500 to the state Department of Labor and Industrial Relations (not DBEDT) for a multi-purpose workforce development center in Hilo; a $1.97M supplemental request for PISCES operations did not pass.
- Total new funds for PISCES operations in FY16 is $400K and $400K for FY 17, far below the amount needed to continue the current level of operations or grow the program.



PUBLIC INFORMATION & MEDIA

Website

Over the last year, PISCES' website has served as an indispensable portal for Center-related news, events and updates, as well as general aerospace news. Recently, front page links were added to provide visitors with a direct link to the STARS workshop, PRISM competition, and Moon RIDERS program. Website tabs were also expanded to include pages on press coverage, PISCES' "Space News" radio broadcasts, as well an educational Space 101 page outlining historic space missions.



Social Media

PISCES continues to employ Facebook, Twitter, and YouTube as networking and media sharing outlets, with followership growing substantially over the last year. The largest growth occurred during the PRISM competition, STARS workshop, and Hawai'i Five-0 rover debut. PISCES also utilizes Flickr, a photo and video hosting website, to archive images for public and media access.

News Blasts

PISCES issues "news blasts" to a distribution network of over 800 subscribers. These blasts average 2-3 per month, and continually result in positive media coverage including some two-dozen newspaper, television, and online news features during the last year. To date, PISCES has been featured in the Honolulu Star-Advertiser, Hawai'i's ABC, NBC, and CBS stations, SpaceNews, New York Times, Huffington Post, and SpaceFlight Insider, among other news journals.

PUBLIC INFORMATION & MEDIA

Newsletter

PISCES' monthly newsletter has kept the community up-to-date on the latest in PISCES news, aerospace news and events since July of 2013. The four-page reader is distributed to a subscriber list of over 800 and receives regular feedback from readers.

Radio

Beginning in October 2014, PISCES initiated a biweekly community news program through KWXX, a Hawai'i Island radio station broadcasting in Hilo and Kona. The 60-second spot, dubbed "Hawai'i Space News," relayed the latest in PISCES and Hawai'i aerospace stories covering technology, research, economic development, and STEM education. PISCES aired a total of 10 pre-recorded shows between October and December.

Television

To continue expanding education and media outreach, PISCES joined up with the Nā Leo 'O Hawai'i Community Access TV station in January 2015. Following a prerequisite course held at the station's headquarters, PISCES' Communications Specialist Chris Yoakum received certification as a producer, gaining access to the studio's camera and editing equipment. In March, the station aired PISCES' first 30-minute film highlighting the Moon RIDERS field test on Mauna Kea.

Hawai'i Five-O Rover Debut

In September, the Helelani rover landed a starring role in an episode of *Hawai'i Five-O.* Technicians from the production crew outfitted the rover with space props for the shoot, which took place at the HI-SEAS habitat on Hawai'i Island's Mauna Loa volcano. The event was documented with video and photos, and a behind-the-scenes film showing PISCES staff, the rover, production crews, and starring actors achieved the highest public reach to-date through the Center's social media outlets. The episode aired in December, titled "Ke Koho Mamao Aku."

Cameras capture the action during Helelani's Hollywood debut in an episode of Hawai'i Five-O.

EDUCATION & PUBLIC OUTREACH

A. Outreach Events

Moon RIDERS Press Conference

In February, PISCES announced the selection of the two Hawai‘i high schools participating in the Moon RIDERS student lunar flight experiment at a press conference held at Kealakehe High School in Kailua-Kona on Hawai‘i Island.

The event drew an audience of about 200 community members, faculty, students, and media, and announced the selection of ‘Iolani and Kealakehe High school to participate in the lunar experiment project. It was supported with videos from Hawai‘i Governor David Ige and U.S. Representative Tulsi Gabbard, as well as representative support from three Hawai‘i Lawmakers who attended.

Keynote speakers included PISCES Executive Director Rob Kelso, lead NASA scientist Dr. Carlos Calle, Department of Education Superintendent Kathy Matayoshi, Kealakehe Principal Wilfred Murakami, and ‘Iolani Head of School Dr. Timothy Cottrell.

Students from both schools presented impressive and inspiring talks detailing their work on Moon RIDERS. The respective schools were chosen for their merit as leading educational institutions in the public and private education sectors.

Rover Naming Contest Award Ceremony

PISCES held an award ceremony at Ka Umeke Ka Eo Hawai‘i public charter school May 22 to honor a 2nd-grade student who coined the spacecraft’s name. Her idea came about through a rover naming contest held by PISCES last fall at four local elementary schools. Some 100 students and faculty gathered for the event, which officially christened the rover as “Helelani,” or “Heavenly Travels.” Students were treated to an up-close look and Q&A on the rover (pictured right), and the winning student, Mahealani Lee, test drove the vehicle. The event was designed to inspire youth in STEM-related fields.

PISCES

Astronaut Ellison Onizuka Science Day

PISCES continued public outreach efforts in the community with an interactive booth at the annual Onizuka Science Day held on campus at UH-Hilo. The booth invited young students to take a picture with a spacecraft, while spreading the mission of PISCES and its summer STARS workshop. The event marked the 30th anniversary of Onizuka's first flight aboard STS-51C, the first NASA Shuttle flight mission to carry a secret payload for the Department of Defense. PISCES commemorated this milestone with an honorary article and news blast remembering Onizuka's first flight.

Hawaii Island Science and Engineering Fair

Held at 'Imiloa Astronomy Center in Hilo, this event drew the best and brightest students in STEM from around the Island. PISCES Logistics/EPO Manager John Hamilton attended the event as a judge, awarding 7th–grader Tierney Wold of Parker School with the PISCES Science Award. The young student, an aspiring aeronautical engineer, created an in-depth presentation called "Going Ballistics", which explained and demonstrated the functionality and aerodynamics of different rocket nose cones.

PISCES Science Awardee Tierney Wold with John Hamilton.

Journey Through the Universe

The Journey Through the Universe program soon followed with a week of classroom visits by PISCES Executive Director Rob Kelso, Project Manager Rodrigo Romo and Astronomer John Hamilton. Presentations were also done for the `Imiloa Astronomy Center's Science Day by Kelso and the Kealakehe High School Moon RIDRES students. PISCES also contributed an information booth alongside NASA AMES.

Astro-Day

The GLXP MoonBots activity proves to be a popular activity with children during PISCES outreach events.

Spring concluded with the annual Astro-Day Festival held at the Prince Kuhio Mall where PISCES displayed its planetary rover Helelani, engaged keiki with MoonBots, and interacted with the community via videos, displays and pamphlets along with lively discussions on the value of exploration and discovery to the human spirit and Hawaiian culture.

EDUCATION & PUBLIC OUTREACH

Team Incredibots Grand Prize Visit

In November, PISCES hosted the international GLXP Moonbots educational program winners with a grand prize visit to Hawai‘i. This year it was the “Incredibots” from Cincinnati Ohio. Their visit included educational excursions to Hawai‘i Volcanoes National Park, Mauna Kea Observatories and a mock robotic field test at PISCES’ planetary surface simulation testing site.

Big Island Aerospace Tour

PISCES staff conducted an all-day tour in November 2014 for space industry senior executives demonstrating the organization’s field activities on Hawai‘i Island. The event included a guided tour of a large lava tube/skylight in the Kona area, the HI-SEAS Mars-simulation habitat on Mauna Loa, PISCES’ planetary surface simulation test site, and the astronomy telescope facilities on the summit of Mauna Kea. Twenty-three participated in the tour led by senior PISCES staff, including Executive Director Rob Kelso, Operations Manager Christian Andersen, and Logistics/EPO Manager John Hamilton. The tour was offered in concert with the “Next Giant Leap” aerospace conference held in Waikoloa, Hawaii

Galaxy Forum

PISCES presented an extra-planetary look at Hawai‘i Island in November as part of the 2014 Galaxy Forum sponsored by ILOA (International Lunar Observatory Association) – a non-profit seeking to establish a lunar observatory and international Moon-base. The event was organized to foster 21st century education and enterprise in Hawai‘i, and offered an inside look at the important astronomical work being conducted on Hawai‘i Island. PISCES’ Surface Simulation Site Characterization specialist, Melissa Adams, presented her work on Mars analogue sites in Hawai‘i, identifying the unique nature and similarities of volcanic tephra compared with Martian regolith. Her research, conducted with Jacobs/NASA scientist Trevor Graff in the summer of 2013, earned her the prestigious Sally Ride internship at NASA’s Johnson Space Center.

EDUCATION & PUBLIC OUTREACH

Planetary & Terrestrial Mining Sciences Symposium

PISCES presented at the Planetary & Terrestrial Mining Sciences Symposium (PTMSS) and Space Resources Roundtable in Montreal, Canada in May 2015. This was held in conjunction with the annual Canadian Institute of Mining conference. John Hamilton presented an update and progress report on the PRISM Competition to an international forum of ISRU experts. Participants include NASA, the Canadian Space Agency, GLXP Team Hakuto, Lockheed Martin, and various universities, corporate aerospace contractors and off-world mining interests.

B. PRISM Competition

PRISM (PISCES Robotic International Space Mining competition) made its debut in Hawai‘i in July of 2014. Modeled on NASA’s highly successful Lunabotics (now called Robotic Mining Competition), this college level open-design contest challenges teams to robotically mine regolith at a planetary surface simulation site. PRISM takes NASA’s RMC one step further by taking the event outdoors, and inviting international participants. The volcanic tephra of the competition grounds is an excellent substitute for lunar dust and was determined to be geochemically identical to Mars in 2013. Since regolith is found on all of the inner planets (Mercury, Venus, Earth, Mars), some moons (like Saturn's Titan and our Moon) along with comets and asteroids, this competition forms the first step in the ISRU process of 'living off the land.” Six teams competed in the inaugural event with the University of West Virginia claiming victory. Other teams included Kapiolani Community College, University of Alabama, Iowa State University, University of Alaska and University of New Hampshire.

Due to the publicity and excitement of this event, UH-Hilo fielded its own student robotics team (Team Vulcan) to the 2015 NASA RMC competition and will be the home team for this year's PRISM event. PISCES Logistics/EPO Manager John Hamilton attended the RMC at Kennedy Space Center in May as an invited judge. This year's RMC grand champion, the University of Alabama, will be attending PRISM again. Several international judges have committed to attend, along with a NASA Communications expert.

The University of Alabama robotics team will join PRISM again in 2015, after claiming victory at NASA’s RMC this year.

OPERATIONS & MANAGEMENT

A. Overview of FY15 Funding

- Operations: Act 122, SLH2014 appropriated $400K and Act 169, SLH2014 appropriated $500K to PISCES operations for FY15 ($900K total). Due to budget rescissions, the amounts allocated and subsequently encumbered were lower, $346K and $475K respectively ($821K total). All allocated funds have been encumbered. The funds are made available for PISCES operations through an agreement between DBEDT and the Research Corporation of the University of Hawaii (RCUH). In addition to the $821K in FY15 funds, $421K of the FY14 allocation was carried in from FY14 and available for use in FY15. These FY14 funds carried PISCES through until the first FY15 funds were available for expenditure in November 2014. See the chart below for a summary of funds available for FY15 operations and expenditures during the year.

Source of Funds	Total Funds Available	Funds Expended in FY15	Outstanding POs as of 6/30/2015	Total Expended & Committed	Available Balance
FY14 Ops Funds carried into FY15	$ 420,638	$ 420,638	$ -	$ 420,638	$ -
FY15 Ops Allocation	$ 821,311	$ 352,443	$ 19,336	$ 371,768	$ 449,543
Totals	$ 1,241,949	$773,071	$ 19,336	$ 792,406	$ 449,543

The available balance of FY15 funds shown in the table above will be used to cover early FY16 operations until FY16 funds are available for use. Based on experience from prior years, PISCES FY16 funds are likely to become available in November 2016.

- Laser Communications Ground Station Initiative: Act 171, SLH2014 appropriated $250K to provide funding for an engineering assessment of the proposal to establish a laser optical ground station in Hawaii. The study is to be conducted in partnership with NASA. $237.5K of these funds were allocated at the very end of FY15, were encumbered and are carried into FY16. PISCES will coordinate these activities in FY16.

B. Statement of Assets, Liabilities, Revenues and Expenses for FY15

PISCES owns three capital assets (value of $5K or more).

- A 2006 Chevrolet Silverado K1500 pick-up truck. For practical reasons, this truck remains assigned to the University of Hawaii for use by PISCES. PISCES pays for the operation, maintenance and care of this truck.

- A Nutfield Technology galvanometer.
- An Olympic FL27 kiln.

Non-labor liabilities as of June 30, 2015 are low, totaling less than $500. June 30, 2015 payroll expenses outstanding were $32.5K and were paid on July 7, 2015.

PISCES was unable to access FY15 operations funds until late in November of 2014. The FY14 allocation carried into FY15 paid for operations until the FY15 funds were available, and were fully expended by December 2014. Likewise, PISCES has carried FY15 operating funds into FY16, and they will pay for operations expenditures until FY16 funds are available for expenditure.

The table on this page shows the budget, expenditures, commitments and balance of State of Hawaii funds remaining as of June 30, 2015.

COST CATEGORY	Total Funds Available	Expended Thru 6/30/2015	Outstanding Purchase Orders	Total Expended & Committed	Available Balance
Labor	$ 865,000	$579,975		$579,975	$285,025
Facility Costs	$ 62,000	$47,585	$15,999	$63,584	($1,584)
Equip & Supplies	$ 179,950	$47,998	$370	$48,368	$131,582
Travel	$ 55,000	$48,645		$48,645	$6,355
Other Non-Labor	$ 38,000	$22,725	$2,967	$25,692	$12,308
Indirect Costs	$ 41,999	$26,143		$26,143	$15,856
Totals	$ 1,241,949	$773,071	$19,336	$792,406	$449,543

Expenditures in FY15 totaled $773K, with 75% of the funds being spent on labor costs. Facility, equipment/supplies, and travel categories each represented about 6.2% of the costs, while other non-labor costs and indirect costs represented 2.9% and 3.4% respectively.

The apparent over-expenditure in the facility costs category occurs because the total facility funds available were planned to cover the project through October 2015. However, outstanding purchase orders for rental space will cover expenditures on PISCES offices through December 2015 and for the high bay facility through September 2015, resulting in the slightly negative available balance. Spending in the facility category are on track.

The positive available balance in the other cost categories will cover anticipated expenses through October 31, 2015, as planned. Labor and non-labor expenditures overall are within the planned parameters.

OFFICE AND RESEARCH LOCATIONS

Office

PISCES leases 1,012 square feet of office space at 99 Aupuni Street in Hilo that serves as the Center's headquarters. The space contains a conference room and six work stations for seven PISCES staff (5.2 FTE) and summer interns to use when they are not working in the off-site labs or elsewhere in the field.

PISCES' Aupuni Street office building located in Hilo is home base for PISCES staff and all administrative functions for the Center.

Laser Lab

Since January 2014, PISCES has had use of an empty machine shop in UH-Hilo's Science and Technology Building. It is outfitted for class IV laser work and houses an Olympic FL27 kiln used for baking basalt paver blocks.

Robotics Lab

In May 2014, PISCES leased a 40' x 20' High Bay at the Shipman Business Center located about 15 minutes from PISCES headquarters. All work on the PISCES rover is done in this work space. It also houses the microwave and inductive coil basalt sintering operations.

Home of the "Helelani" planetary rover, the PISCES high-bay and robotics lab facilitates the Center's planetary robotics development and programming team.

PISCES

Future Location:

Wainaku Executive Center

PISCES evaluated the Wainaku Executive Center in Hilo as a possible site for headquarters and an associated aerospace technology park. The location offers office facilities, two high bays, conference rooms, and several areas that could facilitate robotics testing and checkout activities. The facility also affords space where PISCES could rent offices to technology start-up companies as a collaborative effort with the County of Hawai‘i for facilitating and supporting high technology job creation.

PISCES participated with the County Workforce Development office, local businesses, the Chamber of Commerce and State legislators on due-diligence of this facility for a potential aerospace technology park. This effort of collaboration led to the appropriation of $8.5M in CIP funding for the State Dept. of Labor and Industrial Relations for the creation of a multi-purpose processing facility. PISCES is continuing to work with the State and County to determine how the designated funds can be utilized by PISCES for the acquisition of the Wainaku property for use as an aerospace technology park.

The Wainaku Executive Center sits just minutes outside of downtown Hilo, facing Hilo bay. The building is a two-story, 12,000 square-foot facility, and could house all of PISCES' operations in a single location.

MANAGEMENT & GOVERNANCE

PISCES Board of Directors

In November 2012, the PISCES Board of Directors was formed following the guidelines set forth in Act 169 SLH2012. The Board members are:

- Henk B. Rogers, PISCES Board Chair
- Rob Kelso, Executive Director, PISCES, Vice Chair, Ex-Officio
- The Honorable George R. Ariyoshi, Vice Chair
- Hoyt Davidson, Near-Earth LLC
- Galen Ho, President Galen Enterprise
- Luis Salaveria, Director of DBEDT (or designated representative), Ex-Officio
- Chancellor Donald Straney (representing the President of the University of Hawaii), Ex-Officio
- Dr. Daniel J. Rasky, NASA-Ames, Ex-Officio, Non-Voting

There are two vacancies on the Board of Directors as of June 30, 2015.

The Board met six times in fiscal 2014: July 24, 2014; November 8, 2014; February 26, 2015; March 10, 2015; May 19, 2015 and June 26, 2015.

PISCES Staff and the Board of Directors convened for a meeting on the Center's progress and progression in November of 2014.

PISCES Cultural Advisory Committee

The Cultural Advisory Committee (Papa A'oa'o) was originally formed in 2007. This committee is composed principally of Native Hawaiian professionals and cultural practitioners and its role is to provide advice to PISCES management and staff on conducting operations in a culturally aware and sensitive manner. The members of the Cultural Advisory Committee are:

- Kalepa (Chad) Baybayan
- Nathan Chang
- Greg Chun
- Kamaka Gunderson
- Robert K. Lindsey, Jr.
- Kimo Pihana
- Koa Rice
- Dr. David Sing
- Frank Trusdell

PISCES

PISCES Staff

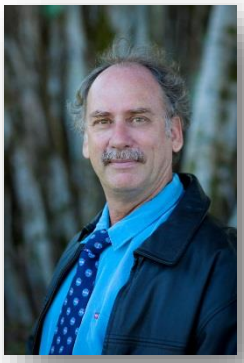
The PISCES staff has decreased from 6.25 FTE at the end of FY14 to 5.2 FTE at the end of FY15, eliminating the 0.5 FTE

Executive Director
Rob Kelso

Executive Administrator
Polly Roth

Operations Manager
Christian Andersen

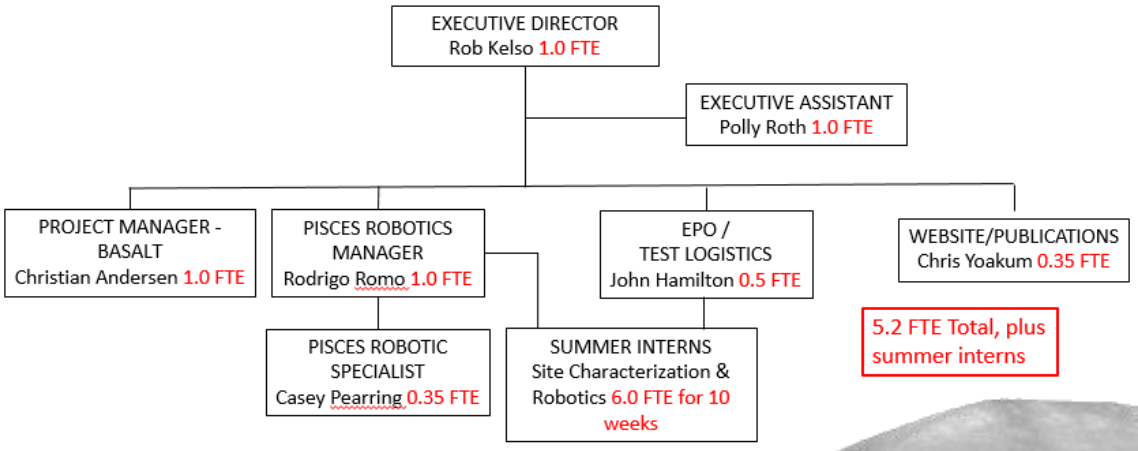
Project Manager
Rodrigo Romo

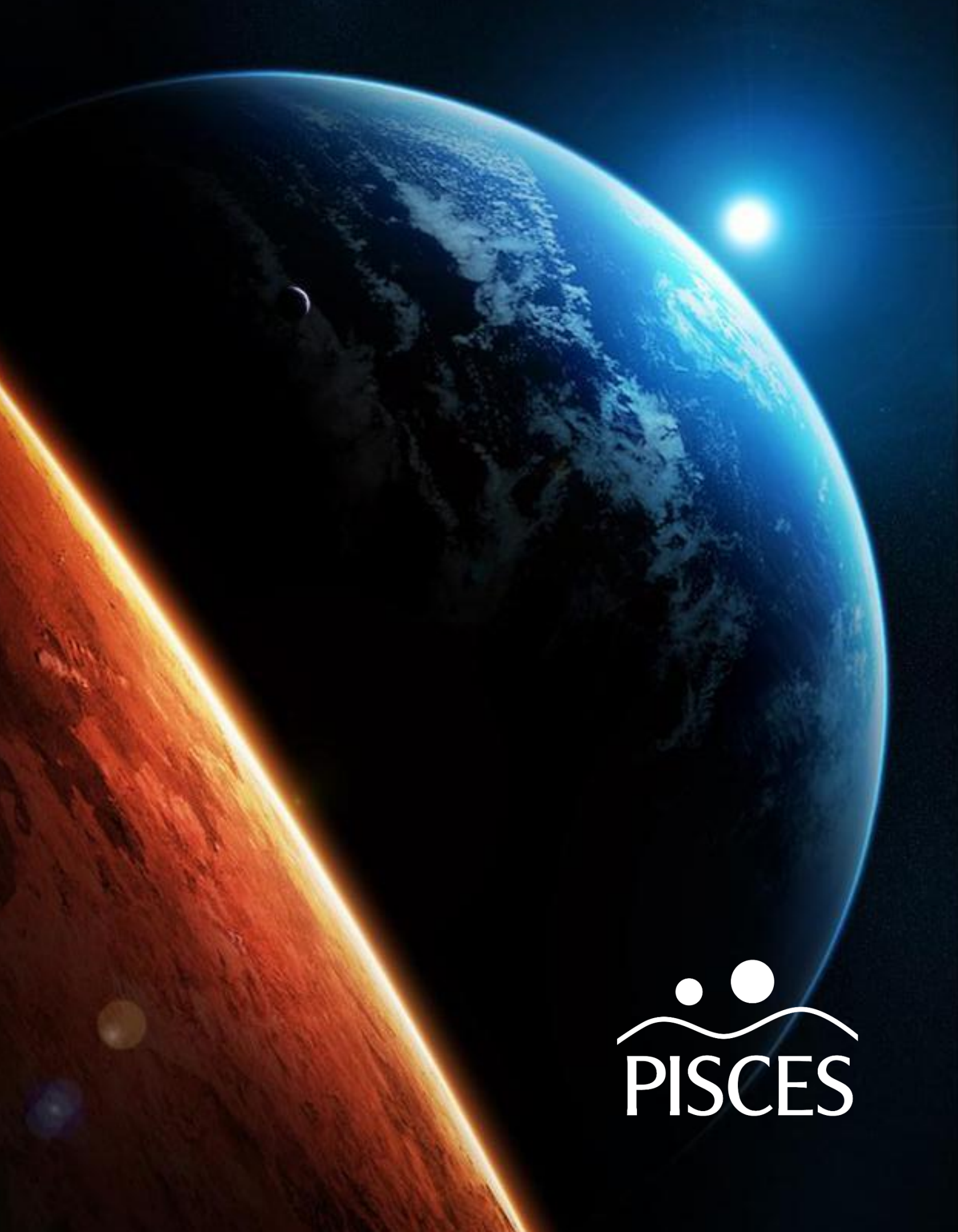


Logistics/EPO Manager
John Hamilton

Communications Specialist
Chris Yoakum

Robotics Technician
Casey Pearring

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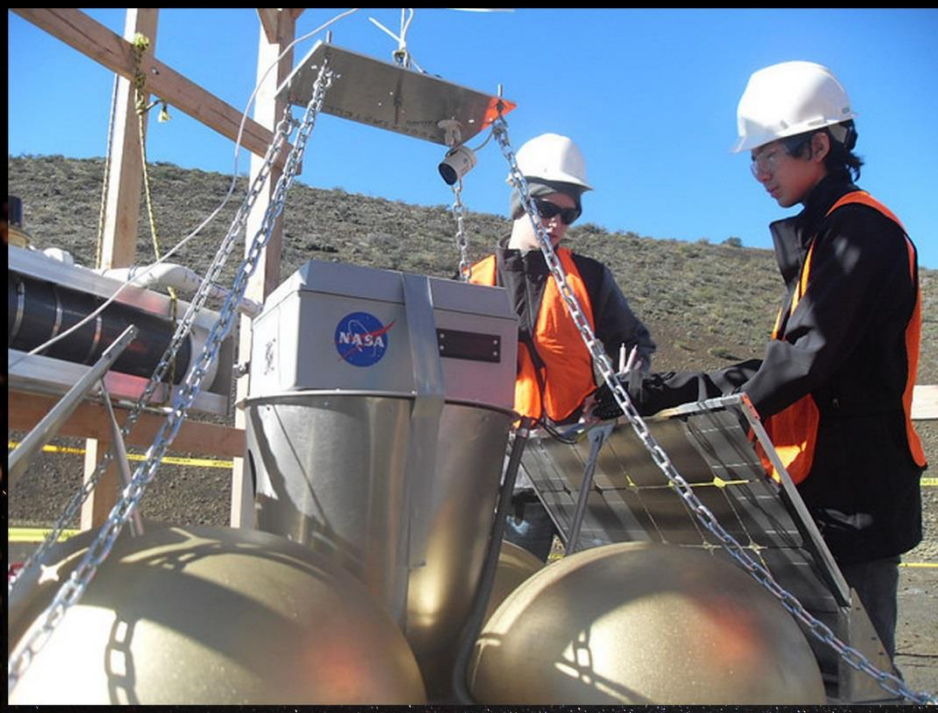
Pacific International
Space Center for
Exploration Systems

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