

Economic Development



Hawaii MoonBase Summit Forges Pathway to Lunar Settlement

Entrepreneur and PISCES Board Chair Henk Rogers (sitting center in white jacket) pictured with Apollo 11 astronaut Buzz Aldrin (directly behind) and attendees of the inaugural International MoonBase Summit held in Kona during the first week of October.

Since the humble beginnings of science fiction, humans have dreamed of establishing colonies beyond Earth. Last October, a group of people gathered on Hawaii Island for the first International MoonBase Summit (IMS) to figure out what it will take to make that vision a reality.

Led by serial entrepreneur and PISCES Board Chair Henk Rogers, a group of space scientists, engineers, architects, artists, students, academics, government officials and members of the private sector joined to explore concrete steps in the creation of a habitable lunar base. The project involves the construction of an Earth-based analog base for scientists and space agencies around the world to use for pre-mission studies, in addition to a real facility on

the surface of the Moon.

Through focused group work and discussion, summit attendees made three resolutions: build the terrestrial analog base (called "Mahina Lani") on Hawaii Island where terrain conditions closely mimic areas of the lunar surface; build the real Moon base near the lunar south pole where conditions resemble those found on Hawaii Island; and fund the Mahina Lani analog base through an innovative, self-sustaining business model.

Rogers, who hosted and sponsored the summit, lauded the effort as a great success. "The next great voyage of humankind has begun," he said.

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Message from the Program Director



Rodrigo Romo

Aloha Kakou!

Last month was highlighted by the inaugural International Moonbase Summit held here in Hawaii as well as several exciting outreach events supported by PISCES.

During the first week of October, I met with a diverse group of scientists, engineers, architects, artists and students for three days at the first Moonbase Summit held in Kona. In focused groups, we brainstormed and discussed the steps needed to build a prototype lunar base here on Hawaii Island as a trail project before building one on the Moon. It was exciting to be a part of this international effort to realize a vision that used to be only dreamed of.

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Workforce Development



Lawmakers Visit Shuttle Flight Simulator at Kea'au High School

Hawaii lawmakers from the Senate WAM committee pose with Kea'au High School faculty, students and PISCES staff in front of the Challenger Shuttle cockpit replica.

Lawmakers from the Hawaii State Senate Ways and Means (WAM) committee boarded an authentic replica of the Space Shuttle Challenger at Kea'au High School on Saturday, Oct. 28. The refurbished shuttle cockpit and flight simulator was a PISCES-facilitated project tackled by students at Kea'au High School and the Civil Air Patrol.

The group of senators included Donovan Dela Cruz, Gil Keith-Agaran, J. Kalani English, Brickwood Galuteria, Kai Kahele, Michelle Kidani, Gil Riviere, Maile Shimabukuro and Glenn Wakai. PISCES Director Rodrigo Romo led the introduction of the shuttle replica, illustrating its history and evolution.

Two teams of construction and automotive academy students redid the interior of the full-scale model, reinforcing the structure and repainting the body while installing wiring and displays for a working on-board flight simulator.

Since a grand unveiling of the replica in January 2016, the mock-up has sat outdoors beneath a tarp

awaiting a proper home. PISCES and school administrators sought support and guidance from WAM senators to overcome challenges associated with creating an on-campus building for the simulator.

The shuttle model originated from NASA in Florida and was procured by the Pacific Aviation Museum in Honolulu. After finding out about its presence in Hawaii, former PISCES Director and NASA Shuttle Flight Director Rob Kelso took interest in acquiring it as a student project and educational tool. The replica also pays homage to Hawaii's first astronaut, Ellison S. Onizuka, who was aboard the fated Space Shuttle Challenger that tragically exploded seconds after launch in 1986, killing all crew members aboard. Today, Onizuka's legacy and memory as an accomplished pilot and astronaut continue to inspire Hawaii youth through events like the annual Onizuka Day science fair.

The replica is currently provided through a long-term loan agreement, courtesy of PAM.

Throwback: Shuttle Simulator Debuts on Onizuka Day



Kea'au High School students worked on the Space Shuttle Challenger replica for nearly four months before unveiling it at an honorary Onizuka Day celebration at the school's campus in 2016. The shuttle was named "Kaho'omakahou," meaning "to learn" or "to inspire" in Hawaiian. The cockpit housing and controls are nearly identical to the real Space Shuttle Challenger's interior. Monitors were added to display an integrated flight simulator.

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Applied Research

Stage One of NASA-funded Project Nears Completion

Can we build infrastructure and draw crucial resources from other planets without transporting materials and resources from Earth? To answer this question, PISCES is experimenting with ISRU technology to find ways to transform Hawaii's volcanic basalt into usable materials.

Thanks to a NASA Phase 1 STTR grant awarded earlier this year, PISCES and Honeybee Robotics have partnered on researching an automated system that builds prototype construction blocks made entirely of volcanic basalt. The blocks are designed for horizontal and vertical construction applications.

Stage 1 of the project, now nearing

completion, involves collecting basalt samples from various quarries on Hawaii Island to analyze and compare their chemical compositions. The samples are being sintered into uniform blocks and sent out for structural analysis to identify any marked differences between sources.

Once a source with ideal characteristics is identified among the samples, PISCES will hone the sintering process to create a consistent material. Currently, the staff is exploring a new casting method—essentially recreating molten lava—using a forge, producing a stronger material with greater design flexibility.



Hawaii MoonBase Summit cont...

PISCES Director Rodrigo Romo said the summit brought back memories of his time spent in Biosphere 2.

"It reminded me of the daunting task that is bringing people from multiple disciplines together to work towards a common goal," said Romo. "PISCES will proudly participate in this exciting project and help Hawaii become a critical testing ground for

the future of space exploration and colonization."

Construction of the Mahina Lani simulation base could begin in about one year, according to Rogers. Mahina Lani would test life support systems and functions needed for human survival on the Moon, incorporating working dorms and labs designed to simulate and withstand the harsh lunar environment.

ISRU: "Living off the Land"



Photos above - 1: The volcanic basalt materials begins as a fine powdered dust sourced from local quarries on Hawaii Island. 2: Through a process of intense heat over a specific duration of time, the fines are melded into a solid material that can be molded into various shapes and forms. 3: PISCES technicians are now experimenting with various mold designs using a 3D printer to craft volcanic basalt into usable items like hand tools. The idea is based in ISRU, or *in-situ* resource utilization, which takes raw, natively sourced materials and transforms them into usable resources. The technology could be used to build shelters, launchpads and tools on places like Mars, while offering a sustainable building material for use here on Earth.

Outreach & Education

Program Director
Message *cont...*



In Pictures: STEM Community Outreach



Photos Above - 1: PISCES staff (including the Helelani rover) joined Pacific Aviation Museum's outreach team for the Discovery Your Future in Aviation event held at Ka'u High School on Oct. 23. 2: Students, parents and educators attended the STEM event highlighted by an inspiring talk by Nagin Cox, Spacecraft Engineer at NASA JPL. Cox shared her personal story of fulfilling a lifelong dream to work at JPL, and playing a crucial role in robotic space exploration. 3 & 4: PUEO hosted its annual Na Kilo Science & Culture Fair in Hilo on Oct. 21. Merging traditional Hawaiian wayfaring and scientific disciplines, the event included voyaging canoe rides in Hilo Bay and engaging STEM activities. PISCES brought its rover out to play in the field (3), piloted from a "mission control" beneath one of the canoe housings. Rodrigo Romo, PISCES Director, showed visitors the controls to pilot Helelani (4), capturing 3D images and mapping the area using the rover's new LiDAR system.

Working together, we can make Hawaii a premier destination for space agencies worldwide to test equipment and missions for space exploration.

Meanwhile at PISCES, we continue to prepare and inspire young minds for exciting prospects like the lunar base. Last month we participated in several outreach events geared towards inspiring youth in STEM including the PUEO Na Kilo Culture & Science Fair held at Palekai Bay in Hilo. We also attended Pacific Aviation Museum's Discover Your Future in Aviation event at Ka'u High School. Nagin Cox, a spacecraft engineer from NASA JPL gave an inspiring and entertaining talk at the Ka'u event about NASA's Mars rover missions including Spirit, Opportunity, Curiosity and the upcoming Mars 2020 mission.

The month ended with a visit by members of the Hawaii Senate Ways and Means committee at Kea'au High School. Lawmakers witnessed first-hand the work that students, teachers and the community did to restore the full-scale cockpit model of the Space Shuttle Challenger replica. We are now working with the school to develop an adequate storage and display facility for the shuttle cockpit to serve as an educational tool for students.

We are honored to support and collaborate in outreach events throughout the state. It is part of our mission to share the wonders and benefits of Space and Space Science with Hawaii's youth to inspire them to learn about STEM fields and perhaps pursue an exciting, lifelong career in one of them.

A hui hou,

R. Romo

Rodrigo Romo, PISCES Director

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(and designed by DREW LACROIX)

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