



Pacific International Space Center for Exploration Systems NEWSLETTER



www.pacificspacecenter.com

June 2019 | Issue 6 Vol. 7

WORKFORCE DEVELOPMENT



PISCES Summer STEM Program Awarded \$15,000

Above: Students and staff pose with the Helelani planetary rover outside HI-SEAS on Mauna Loa during the 2018 Women's STARS Program organized by PISCES.

The PISCES Women's STARS (STEM Aerospace Research Scholars) Program has received a generous boost this year of \$15,000 in grant and sponsorship awards to encourage and support Hawaii's young women in STEM.

The contributions were generously provided by two donors. Hawaii Community Foundation awarded a \$5,000 grant through its Career Connected Learning Program. The additional \$10,000 was donated by a major heavy equipment manufacturer who will also support STARS with volunteer staff.

The funding awards will provide a more in-depth and enriching learning experience to participating students, adding an additional day to the program and covering the costs of on-island transportation, meals and overnight accommodations.

"We are honored and very appreciative to receive these generous contributions for the STARS Program from Hawaii Community Foundation and our partners in the heavy equipment manufacturing industry," said Chris Yoakum, STARS program coordinator. "With a fully funded program, we can focus on the important task of giving Hawaii's young women an enriching and inspiring summer experience that we hope will benefit them for the rest of their lives."

This year, PISCES has partnered with Hawaii Science and Technology Museum (HSTM)—a Hawaii Island nonprofit dedicated to STEM outreach and education—to manage the funding for STARS. As fiscal sponsor, HSTM has been instrumental in managing and dispersing the \$15,000 in funding.

(Continued on pg. 4)

Message from the Program Director



Rodrigo Romo

Aloha Kakou,

The summer is upon us and we're getting ready for a busy couple of months. In a few weeks we will welcome four new student interns who will work with PISCES during the summer. Two interns will be sponsored by the Akamai program and two will be direct PISCES interns. Their work will involve programming and development for the Helelani planetary analog rover and structural testing of the sintered basalt samples we've been manufacturing as part of our Materials Science research.

In other summer events, our annual Women's STARS (STEM Aerospace Research Scholars) program in June promises to be the longest and most comprehensive STEM camp we've held yet. During the application period, we received a record number of students interested in attending and the selection process was difficult.

(Continued on pg. 4)

FOLLOW US ONLINE



@PISCES_HAWAII

GUEST SPOTLIGHT

Innovating Extraterrestrial Habitats

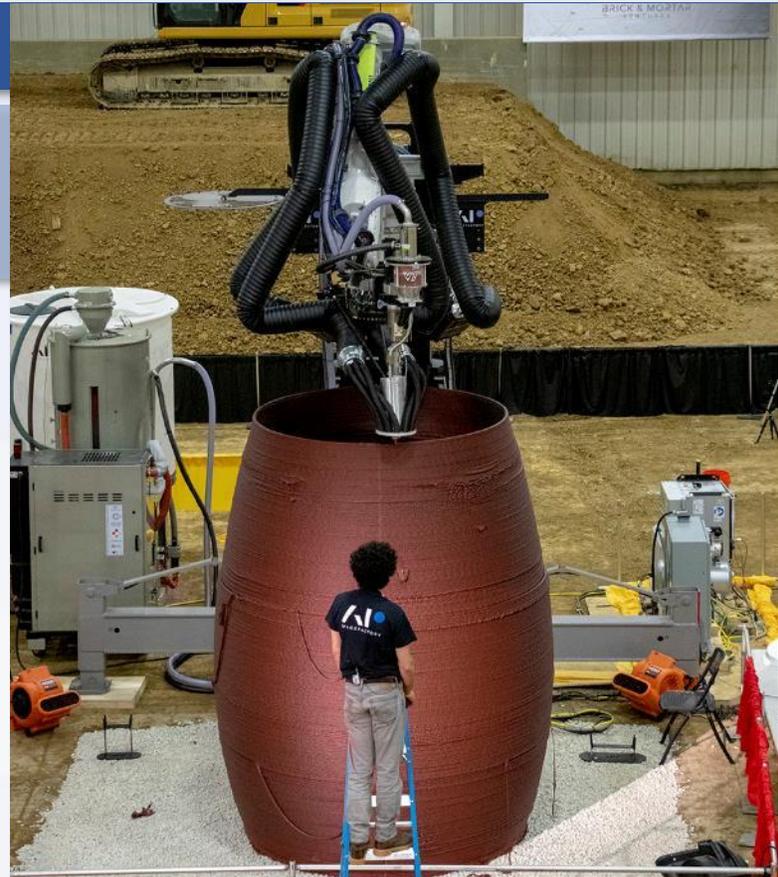
By: Jeffrey Montes

Habitat Systems Design Lead, AI Space Factory

Four years ago, NASA kicked off an influential open competition called the 3D Printed Habitat Challenge. It was designed to advance the state of the art in additive construction, autonomy and architectural concepts that integrate structure, layout and construction processes. On May 4th (yes, May the Fourth), after three phases and \$1.6 million awarded, the Challenge came to a dramatic conclusion at Caterpillar's demonstration facility in Peoria, Illinois. The team I led at New York-based "multiplanetary architecture" startup AI SpaceFactory won the grand finale of the Challenge (and \$500,000) by successfully printing our novel egg-shaped habitat design called *Marsha*.

Our victory involved putting together a robotic system that would print a large structure with as little human intervention as possible, mimicking the realities of actual space construction and using a material that is manufacturable on Mars. Reaching a height of 15 feet, *Marsha* stood as the tallest ever polymer-based continuous 3D print! The material, developed with Techmer PM and informally dubbed "Marsha Matter," is far stronger than concrete and does not require rebar. Because we had only 30 hours to complete the structure—which was required to be a 1:3 scale of the true Mars design—our habitat was an empty shell at an average thickness of 1.5 layers (1.125 inches). But it nonetheless bested Caterpillar's 90-ton excavator, causing its treads to lift off the ground during the final crush test and shocking the crowd.

I'm a space architect, which means I have the ludicrous job of designing spaces and structures for people to live where we cannot normally live. We take for granted the importance of architecture on Earth because we have the option of leaving the building. Outside this planet, however, we depend on buildings to keep us alive and well. Furthermore, the environments are so different from Earth that construction and materials must be entirely rethought. Structures must be resilient and interior layouts must be tuned to mission demands while fostering sustained social and mental health, which are also mission-critical. Extraterrestrial habitats must be designed to be rich, useful and interesting worlds unto themselves. With *Marsha*, I wanted to show that that world, that design object, could be both visionary and credible. I wanted to challenge the conventional image of "space age" domes by focusing on the



Montes watches on as a massive 3D printer builds Marsha—an egg-shaped, extraterrestrial habitat made using sustainable materials—at Caterpillar's demo facility in Peoria, Illinois.

creation of spaces tuned to both known and anticipated physical constraints and psychological demands.

AI SpaceFactory is already testing these technologies on Earth in the form of habitats anyone can stay in. We're printing a family of structures called TERA (TERrestrial Analog) which will initially be direct descendants of *Marsha* and its technology. The first one is slated to begin construction this year in upstate New York and each TERA will build on the last until we achieve highly autonomous, structurally performing human-rated habitats. Just like *Marsha* informed TERA, the reverse will be true with all knowledge we gain feeding back into extraterrestrial design and construction, which will continue to be a major focus for us.

We are taking a bold Earth & Space approach to our business whereby both streams bootstrap each other so that we can get to Mars and advance sustainable ways of living on Earth. What good is it to work so hard to make new worlds possible when you have the best world right under your feet and the imperative to improve it?

Team Marsha consisted of (in alphabetical order): Christopher James Botham, James Coleman, James Earle, David Malott, Jeffrey Montes, David Riedel, Sima Shahverdi with support from our consortium partners: Autodesk Technology Center Boston and Virginia Tech.

HAWAII AEROSPACE NEWS

UH Planetary Scientist Joins 'Blue Moon' Advisory Board



Dr. G. Jeffrey Taylor has researched lunar samples since 1970, concentrating on the chemical composition and geological evolution of the Moon. He is particularly interested in the use of lunar resources to establish a permanent human settlement on the Moon.

A University of Hawaii planetary scientist has been appointed to the scientific advisory board for the Blue Origin lunar lander project, Blue Moon.

Dr. G. Jeffrey Taylor of the Hawaii Institute of Geophysics and Planetology (HIGP) at the University of Hawaii at Mānoa, will provide feedback to the Blue Origin lander's team about potential moon landing sites, lunar surface composition, the lander's design, resource exploration and other mission goals.

"Being a member of the science advisory board for the Blue Moon project is an exciting opportunity to help advance the dream many of us have had since Apollo—the settlement of space," Dr. Taylor said. "It gives the board members the chance to use our knowledge of

the Moon to help plan the path to using its resources for the benefit of people on Earth. It is an exciting time!"

Dr. Taylor is a researcher emeritus at UH Manoa who has also advised PISCES' Materials Science team on lunar regolith as part of the agency's basalt sintering research. He is among six scientists appointed to the advisory board for Blue Moon.

Unveiled in May 2019, the Blue Moon lander is a robotic spacecraft designed to carry various cargo payloads to the Moon. Its first mission is slated for 2024. According to Blue Origins' website, Blue Moon aims to "provide precise and soft landings and will enable a sustained human presence on the Moon."

OUTREACH & EDUCATION



2019 AstroDay Highlights: Science, Sci-Fi and Robots

Top left (L-R): PISCES' staff members Rodrigo Romo, Kyla Edison and Kye Harford shared PISCES' research in basalt sintering during AstroDay. Middle: The infamous Storm Trooper of Star Wars was a hit. Right: Keiki play w/ VexIQ robots at the PISCES table, one of 85 booths at the event.

The 18th annual AstroDay in East Hawaii on May 4th (now recognized by the adage, "May the Fourth be with you") was a soaring success. Sponsored by the Maunakea Observatories and coordinated by the University of Hawaii Institute for Astronomy (IfA), the event was supported by some 200 volunteers from observatories on Maunakea, Mauna Loa and Haleakala, as well as other science and education organizations.

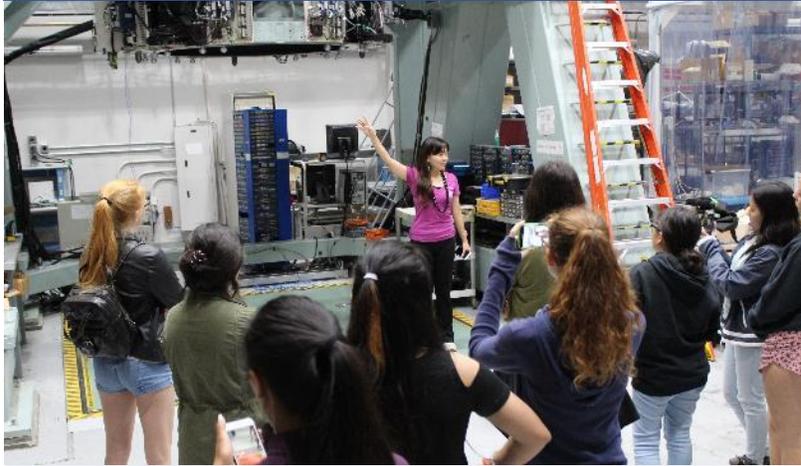
Volunteers engaged visitors of all ages with physics and astronomy activities, science demonstrations and robotics. Robots and technology were among the highlights this year, with

high school teams from Hilo and Keauau attending the event at Prince Kuhio Plaza (PKP) in Hilo.

The event also featured research talks by two local scientists who were recently highlighted in the news. Dr. Heather Fwelling of IfA spoke about a comet named after her; Dr. Jessica Dempsey of EA Observatory/JCMT described her role in the first-ever imaging of a black hole named Pōwehi.

"This is the largest crowd I've seen in years," said PKP Property Management Associate Makana Guillermo during the event. "There's so much energy here today!"

PISCES Women's STEM Program Awarded \$15K (continued...)



Students tour Subaru Telescope's instrument testing room with Outreach Specialist Yuku Kakazu during the 2018 STARS Program.

Now moving into its sixth year, the STARS Program offers a unique summer STEM experience to Hawaii high school girls including engaging presentations, behind-the-scenes tours, hands-on workshops and mentoring opportunities. The week-long camp engages students with women scientists and engineers working in astronomy, aerospace engineering, space settlement research, marine biology, conservation, geology and planetary science.

PISCES received a record-number of applicants for STARS this year from students around the state. Due to budget and facility limitations, the program in its current format only accommodates up to 12 students. PISCES is working to expand the program to offer more opportunities to eligible students.

Director's Message (continued...)

All the applicants were highly qualified and motivated young women interested in STEM. We are looking at alternative program schedules to expand the number of participants we can accept next year. First, we need to work out budget and logistical challenges, as well as the coordination necessary with our many generous partners who support the program.

For this year's STARS Program, we also had the fortune of receiving a grant award from Hawaii Community Foundation's (HCF) Career Connected Learning Program to help cover expenses. We also received a significant contribution from a major heavy equipment manufacturer. With these two sponsorships, the STARS program will be fully funded. I send my heartfelt appreciation to both HCF and our partners in the heavy equipment industry for their generous support.

Speaking of appreciation, this year we've partnered with Hawai'i Science and Technology Museum (HSTM) as our fiscal sponsor for STARS. Thanks to HSTM, we can utilize our supplemental funding with greater ease and efficiency. HSTM's support and collaboration with STARS is proving to be extremely valuable. We hope to continue growing this partnership and work together on future projects.

Looking ahead this summer, we will be attending several conferences including the National Space Society's International Space Development Conference in Arlington, Virginia where we will be participating in the "Bio-Requirements for Space Settlements" panel session. PISCES will also be presenting its latest sintered basalt research at the Space Resource Roundtable Conference in Golden,

Colorado. We hope to forge new partnerships and stoke new business opportunities to benefit Hawaii's economy during these events.

On behalf of the PISCES team, I want to congratulate Jeffrey Montes and the AI SpaceFactory team for their win at NASA's 3D Printed Mars Habitat Challenge this year. I had the pleasure of meeting Jeffrey (our featured guest author this month) at a conference last year and shared with him our basalt research. It is encouraging to see young engineers developing innovative technologies for habitats on other planets that can change the way we do construction here on Earth.

Lastly, I would like to welcome DBEDT's new deputy director, Randy Tanaka, to the DBEDT ohana. The PISCES staff had the pleasure of meeting Randy in person this month to discuss our research and development projects over the last few years, and how they align with DBEDT and the state's core objectives. It is exciting to be working with a new team at DBEDT and we are very appreciative to those who came before, specifically Luis Salaveria and Mary Alice Evans. Both provided strong support and shrewd guidance for the direction of PISCES' continuing programs and initiatives in Economic Development and Workforce Development.

As we head into summer, I look forward to meeting with research colleagues in the aerospace community and seeing the work that our interns produce.

A hui hou,

Rodrigo Romo
PISCES Program Director