

Noelo

DELVE ▶ SEEK OUT ▶ VERIFY



RESEARCH AND INNOVATION AT THE UNIVERSITY OF HAWAI'I - 2016



UNIVERSITY of HAWAI'I®
SYSTEM

(COVER)
*Innovator-class
CyberCANOE at
UH Mānoa's Laboratory
for Advanced
Visualization and
Applications (LAVA)*

CONTENTS

INNOVATION

- 2 **The Hawai'i Innovation Initiative**
UH Research's Role in Diversifying the Hawai'i Economy
- 5 **XLR8UH**
Accelerating UH's Research Commercialization Success
- 6 **UH i-Lab**
A New Hub for Creativity, Innovation and Entrepreneurship
- 7 **Recipe for Success**
The Maui Food Innovation Center

BIG DATA AND CYBERSECURITY

- 8 **UH CyberCANOE**
A Picture is Worth a Thousand Words
- 11 **ITWorks**
A First-of-Its-Kind IT Apprenticeship Program

OCEAN AND CLIMATE SCIENCES

- 12 **C-MORE**
Unlocking the Secrets and Importance of
Marine Microbes
- 14 **Ocean Station ALOHA**
A Milestones in Microbiology Site
- 16 **A Race Against Time**
UH Spearheads Coral Bleaching and
Climate Change Research

SUSTAINABLE AGRICULTURE

- 19 **UH's "Supercool" Professor**
An Innovation that Could Transform the Food Industry

SPACE EXPLORATION AND ASTRONOMY

- 20 **UH AMS-02 Group**
Helping NASA Get to Mars and Beyond
- 22 **Lofty Goals and High Aspirations**
Space Programs at UH

HEALTH SCIENCES AND WELLNESS

- 26 **The Daniel K. Inouye College of Pharmacy**
- 28 **Pharm2Pharm**
Redefining the Role of Pharmacists in Tracking
High-Risk Patients
- 29 **Hope on the Horizon**
UH's Role in the Fight Against Bladder Cancer

RENEWABLE ENERGY RESEARCH

- 30 **Hawai'i Natural Energy Institute**
Guiding the State Toward Energy Independence

SOCIAL SCIENCES

- 32 **Social Sciences Research Institute**
Generating Innovative Solutions on Critical Social,
Behavioral, Economic and Environmental Issues

University of Hawai'i System

David Lassner, PhD
President

Vassilis L. Syrmos, PhD
*Vice President for Research
and Innovation*

NOELO, WHICH MEANS
"TO DELVE, SEEK OUT OR
VERIFY" IN HAWAIIAN, IS
THE RESEARCH REVIEW
OF THE UNIVERSITY OF
HAWAII SYSTEM PUBLISHED
ANNUALLY BY THE OFFICE
OF THE VICE PRESIDENT
FOR RESEARCH
AND INNOVATION.

PROJECT MANAGER
EDITOR

Eric R. Matsunaga
*Director, Research and
Administrative Operations
Office of the Vice President
for Research and Innovation*

LAYOUT AND DESIGN
Oshiro Design, LLC

For more information, contact:

Eric R. Matsunaga
Office of the Vice President
for Research and Innovation
University of Hawai'i
2425 Campus Road, Sinclair 10
Honolulu, HI 96822
(808) 956-5588
uhovpri@hawaii.edu
www.hawaii.edu/research/

*The University of Hawai'i is an
equal opportunity/affirmative
action institution.*

A Message from the Vice President

We are pleased to bring you the inaugural edition of Noelo, the research review of the University of Hawai'i (UH) System.

*Noelo, which means to “delve, seek out or verify” in the Hawaiian language, appropriately captures the *mana* or “spirit” of the ancient Hawaiian scientists and explorers that helped guide them in their pursuit of knowledge, understanding and purpose. Today, that spirit remains alive and well in the research conducted throughout the ten campuses of the University of Hawai'i.*

Leading the way, is our flagship campus—the University of Hawai'i at Mānoa (UH Mānoa). Classified by The Carnegie Foundation as producing “very high” research activity, UH Mānoa is ranked in the top 50 public universities for research expenditures by the National Science Foundation—securing \$425 million in extramural research funding in 2015. UH Mānoa's election to the Association of Pacific Rim Universities in 2013, a leading consortium of 45 premiere research universities that encompasses 16 economies in one of the most dynamic and diverse regions in the world, remains as a source of pride for us.

As one of a handful of land, sea and space-grant universities in the nation, we are fortunate to have a geographic diversity that is unmatched by anywhere else in the world—erupting volcanoes, frozen summits, tropical rain forests and the deep ocean. As a result, UH research is equally as diverse with our world-renowned research programs in astronomy, medicine, oceanography, genetics and tropical agriculture, with growing strengths in sustainable energy and big data/cybersecurity.

Cutting edge research facilities like the Daniel K. Inouye Center for Microbial Oceanography: Research & Education (C-MORE) Hale, Institute for Biogenesis Research, John A. Burns School of Medicine, UH Cancer Center, Laboratory for Advance Visualization and Applications, and the soon to be constructed Daniel K. Inouye College of Pharmacy at UH Hilo—provide our researchers with the necessary tools to conduct competitive research in science, technology and innovation.

Recently, UH has taken on a greater role to help revitalize the state's economy through the Hawai'i Innovation Initiative. We have partnered with the Hawai'i business community to help rejuvenate the state's economy by leveraging UH research to create and attract new companies, cultivate talent for a knowledge-based economy and to encourage the development of future technologies. Our shared goal is to build a \$1 billion research enterprise that will be driven by the growth of new industries in Hawai'i and fueled by UH's plans to employ and develop top researchers in several innovation focus areas over the next decade.

As we introduce you to some of the fascinating work being conducted by our researchers on the following pages, we hope that you'll enjoy your front-row seat and share in the same excitement and *mana* that makes research at the University of Hawai'i—like no place else on Earth.



A handwritten signature in black ink, appearing to read 'V. Syrmos', written over a faint dotted line.

Vassilis L. Syrmos, PhD
Vice President for Research and Innovation
University of Hawai'i System

How will we build innovation communities for the future?

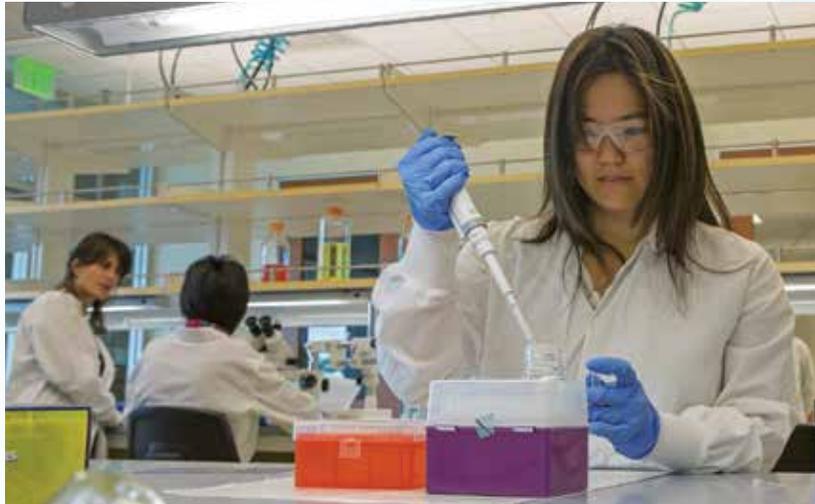


The Hawai'i Innovation Initiative UH Research's Role in Diversifying Hawai'i's Economy

The news of the shutdown of Hawai'i's last sugar operation on Maui earlier this year marked the final chapter of a once booming plantation agricultural industry spearheaded by pineapple and sugar.

With the decline of big agriculture, the Hawai'i economy has become increasingly dependent on the tourism sector and on military spending. However, Hawai'i is now facing increased competition from other world vacation destinations, while the large military presence and related spending in the state is significantly impacted by policy and budget decisions in Washington, D.C.

San Diego faced a similar situation in the 1960s, as it found economic and job growth constrained by an economy primarily based on tourism and the military. However, by bringing together the private sector, government and academia, and by leveraging UC San Diego research in the 1980s, the city was able to create a thriving tech-based economy that has produced a gross domestic product that currently hovers around



(LEFT, L-R) Hank Wuh of Skai Ventures, Tim Dick of Startup Capital Ventures, Luis Salaveria of DBEDT, Javier Saade of SBA and Omar Sultan of XLR8UH discuss innovation at last year's Future Focus Conference

\$218 billion—of which about 12 percent is attributed to its research and technology industries. Comparatively, Hawai'i's related industries account for only about three percent of the economy.

Recognizing that a similar economic turnaround is vital for Hawai'i and buoyed by San Diego's success, the University of Hawai'i (UH) and the Hawai'i business community have partnered on the Hawai'i Innovation Initiative—a bold and proactive effort to help diversify the state's economy by building a thriving \$1 billion innovation, research, education and training enterprise by 2025. As the largest research enterprise in the state, bringing in \$425 million in extramural research funding last year, UH is essential to achieving his goal.

To do so, UH is currently engaged in number of focused efforts to aggressively commercialize its research, including accelerator programs, creating new innovation infrastructure, streamlining its research operations and employing top researchers in several innovation focus areas. On point for the university on this initiative is UH Vice President for Research and Innovation Vassilis L. Syrmos.

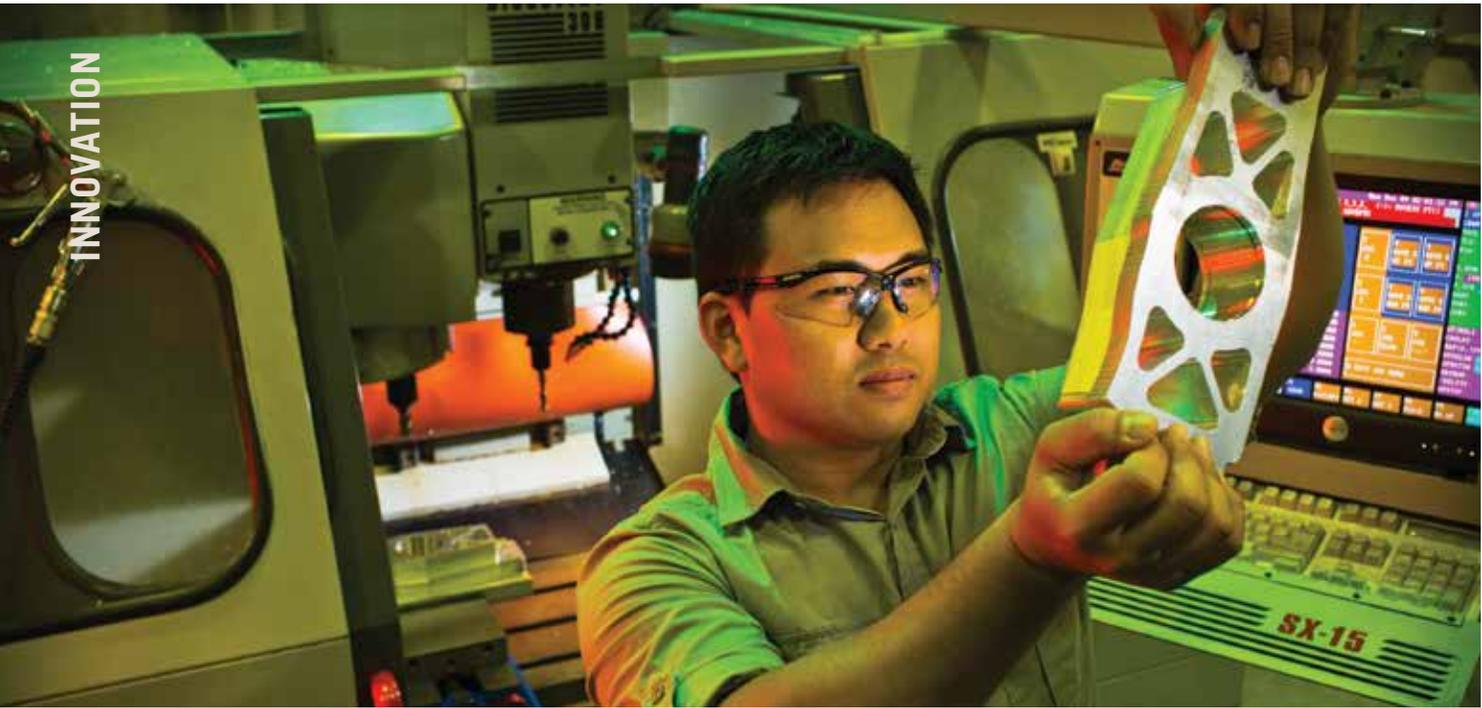
"The University of Hawai'i has always been known for its world-class research," said Syrmos. "Now, what we are doing differently is educating our faculty and students on entrepreneurship, providing them with the necessary tools and created an entrepreneurial ecosystem to help bring those technologies and break-through innovations to market."

Although UH is a primary driver of the initiative, it joined forces with the Hawai'i Business Roundtable (HBR) to help it leverage vital support from the public and private sectors to help link investors, entrepreneurs and companies with resources to develop UH innovations and technologies into viable businesses. The Hawai'i Business Roundtable is statewide public policy organization made up of CEOs and senior executive of companies headquartered or maintaining significant operations in Hawai'i.

"The local business community has long recognized that research and innovation need to be a part of Hawai'i's future," said Gary Kai, executive director of the Hawai'i Business Roundtable. "We believe that the Hawai'i Innovation Initiative can be successful because of our great university and the quality of its cutting-edge research in many different areas."

The Hawai'i Innovation Initiative is beginning to taking root at University of Hawai'i and within the Hawai'i business community. Initial success stories include:

- **XLR8UH** Launched in 2014, XLR8UH is one of the first public university investment programs in the nation, revolutionizing the way innovation is commercialized at universities. The UH proof of concept center/venture accelerator has developed 15 companies that employ



currently 67 individuals, generated over \$600,000 in revenue and raised \$7.8 million in total funding.

- MAUI FOOD INNOVATION CENTER** A program of UH Maui College, the Maui Food Innovation Center (MFIC) provides business and technological expertise to food and agricultural entrepreneurs across the state. MFIC assists farmers and food manufacturers increase profitability through the development of new value-added food products, reduces the state's dependence on imports and contributes to the sustainability of Hawai'i-based agriculture.
- SBA RECOGNITION** Last October, XLR8UH and MFIC were both recognized by the U.S. Small Business Administration as two of the nation's elite programs in their annual Growth Accelerator Fund Competition. Both were awarded \$50,000.
- FUTURE FOCUS: UH/HBR INNOVATION AND TECHNOLOGY CONFERENCE** Last September, the Hawai'i Innovation Initiative held its inaugural conference that focused on energy, cybersecurity and entrepreneurship that featured some of the nation's top experts in those fields. Over 200 participants were in attendance, including representatives from the local government, business, innovation and research communities. Future conferences are expected to feature other areas of UH research and innovation excellence.
- UH i-LAB** Launched in February at UH Mānoa, the i-Lab design is inspired by elements of Stanford's D.School and provides a cutting-edge workspace for students in multiple disciplines to turn design concepts into working models.
- 2016 AUTM WESTERN REGION MEETING** The University of Hawai'i was successful in its efforts to bring the 2016 Association of University Technology Managers (AUTM) Western Region Meeting to Honolulu this November. AUTM's primary mission is to support and advance academic technology transfer globally, and its 3,200 members represent managers of intellectual property from more than 300 universities,

research institutions, teaching hospitals and a number of business and government organizations. UH's Office of Technology Transfer and Economic Development (OTTED) will be working closely with the AUTM organizers on the four-day conference.

- STRATEGIC HIRES** In 2014, UH recruited Edward DeLong as its first hire of the Hawai'i Innovation Initiative. DeLong, a member of the National Academy of Sciences and a former professor of biological engineering at MIT, is co-director and research coordinator at the world-renowned C-MORE at UH Mānoa. In the same year, UH and the Hawai'i Innovation Initiative received another boost with the hiring of Jason Leigh, a visualization expert and professor of computer science. Leigh, who was the director of the Electronic Visualization Lab and Software Technologies Research Center at the University of Illinois at Chicago, recently established the Laboratory for Advance Visualization and Applications (LAVA) at UH Mānoa and is currently working to develop the best data visualization system in the U.S.—known as the Cyber-enabled Collaboration Analysis Navigation and Observation Environment (CyberCANOE). Creating synergies in this area, UH Information Technology Services recruited its first Director of Cyberinfrastructure, Gwen Jacobs, to lead support activities of high performance computing and related “big data” techniques for researchers. She is already a PI and co-PI on several large grants and was recently named to the National Science Foundation's Advisory Committee for Cyberinfrastructure.

“This economy right now is dependent on two sectors that are largely outside of our control: tourism and military spending,” said David Lassner, UH president. “There is now a real appreciation around the state of the need to develop a third, strong economic sector around innovation and research. We need to be the anchor, but we must also work hand in hand with the local business community and government to ensure the sector can flourish to create economic dynamism and great jobs across Hawai'i.”



Accelerating UH's research commercialization success

Although it may sound like a car vanity license plate belonging to Robert Downey, Jr.'s *Iron Man* alter ego, multi-billionaire industrialist Tony Stark; there is nothing vain in the purpose of XLR8UH—the University of Hawai'i's first proof of concept center (POCC) launched in fall 2014.

The University of Hawai'i is aggressively pursuing the successful growth of its research enterprise and increased commercialization of its innovations to help diversify the state's economy. As a partner in the Hawai'i Innovation Initiative with the Hawai'i business community, UH's proof of concept center venture accelerator is vital to helping turn its research success into entrepreneurial success as well.

With XLR8UH, UH now joins a growing movement of universities around the country that are creating POCCs or turning to other new approaches to commercialize its research and to prevent innovative ideas from slipping through the cracks and suffering slow and obscure deaths. Unlike traditional business incubators that offer seed money to established companies, the POCC concept looks to harvest promising research and identify investors and businesses interested in the further development and exploration of its commercial viability. Georgia Tech, University of Utah, UC San Diego and the University of Southern California lead the list of success stories utilizing this novel approach.

"The University of Hawai'i is world-renowned for its research in oceanography, astronomy, agriculture, medicine, cancer research and genetics," said UH Vice President for Research and Innovation Vassilis L. Syrmos. "However, the crossover to commercialization is expensive and for many scientists, including our own, success without the proper ecosystem that a POCC provides often results in the proverbial 'valley of death'."

The "valley of death" that Syrmos refers to is a term used to refer to the vast chasm that often separates a great idea from the individuals that will invest in it to create a successful business that brings the idea into usage in the community. Over the last decade, decreasing interest in initial public offerings has left even less available capital for early-stage companies.

To help bridge this gap and stimulate innovation in the U.S., the White House began allocating millions of dollars in federal funding to support POCCs through competitive grants administered by organizations like the National Science Foundation (NSF), the National Institutes of Health (NIH) and the Economic Development Administration (EDA). The initiative represents a shift in administration policy from monetary support for the discovery of scientific and technological breakthroughs to one that focuses on its commercialization.

Earlier this year, XLR8UH was awarded a \$500,000 grant from the EDA's i6 Challenge, a cutting edge federal program that supports initiatives to spur innovation commercialization, entrepreneurship and job creation on the local level. With matching funds from UH, XLR8UH plans to expand its program statewide, including the underserved, rural neighbor island communities—by introducing new stimulus activities to assist in the growth of regionally developed intellectual property, entrepreneurs and startups.

"The establishment of XLR8UH represents an exciting new initiative and has received strong support from the community," said Managing Director Omar Sultan. "The center has become an integral part of accelerating the development of University of Hawai'i intellectual property and facilitating the commercialization pathway."

The University of Hawai'i is not just writing out blank checks to any would-be entrepreneur



from its ranks. Before receiving any funding, all faculty and student cohorts accepted to XLR8UH must first successfully complete an entrepreneurial/commercialization education program conducted by the Pacific Asian Center for Entrepreneurship (PACE). PACE, which has been instrumental in encouraging and promoting entrepreneurial activity to UH students and faculty through a multitude of programs, will provide cohorts with the necessary education, guidance and resources to nurture the development of UH's synergistic and integrated entrepreneurship ecosystem.

To date, the XLR8UH program has developed 15 companies that currently employ 67 individuals. These startups have generated over \$600,000 in revenue and have raised \$7.8 million in total funding. Last October, XLR8UH was recognized by the SBA as one of the nation's elite programs in their annual Growth Accelerator Fund Competition.

"The early successes and accolades for our XLR8UH program indicate that we are proceeding down the right path to increase commercialization," said UH President David Lassner. "Now our innovative researchers have an easier road to follow to get their cutting edge ideas and technologies to the community, and that is a core objective of the Hawai'i Innovation Initiative."



UH i-Lab

A New Hub for Creativity, Innovation and Entrepreneurship

Inspired by Stanford University’s Hasso Plattner Institute of Design, also known as the D.School, the University of Hawai‘i has created a lab based on those same principles of exposing students to experiences that get them involved with innovation and entrepreneurship.

“Our visit to Stanford’s famed D.School served as a tremendous source of inspiration for us to create something similar here for our students,” said Vassilis L. Syrmos, UH vice president for research and innovation. “We look forward to it becoming a vibrant hub on the UH Mānoa campus brimming with students and faculty working in collaboration to solve real-world problems with real-world innovative and entrepreneurial solutions.”

The i-Lab features floating whiteboards, chairs and tables that can be moved anywhere and most importantly, an absence of walls—all of which will help foster the free-flow of thought and sharing of ideas across multiple disciplines. The reconfigurable space is also equipped with rapid prototyping equipment like 3-D printers and laser cutters that allow students to turn design concepts into working models. The i-Lab is already being used for classes, workshops, lectures, and in the future, will play host to events like start-up weeks and innovation challenges.

“Many academic and nonacademic units as well as individuals within UH have pulled together magnificently to deliver the UH i-Lab,” said Peter Crouch, UH Mānoa College of Engineering dean who spearheaded the i-Lab effort. “The i-Lab will be the hub for activities that help students from all over the UH Mānoa campus and the wider community explore notions such as creativity, innovation and eventually entrepreneurship in interdisciplinary groups by grappling with a myriad of challenges and competitions.”

UH Mānoa schools and colleges already participating in activities through the i-Lab, include the School of Architecture, College of Arts & Humanities, Shidler College of Business, College of Engineering, College of Natural Sciences and College of Tropical Agriculture and Human Resources.

“The i-Lab represents another facet of our aggressive and comprehensive efforts to develop and build a thriving innovation, research, education and training enterprise at UH,” said David Lassner, UH president. “By developing talented entrepreneurs from among our faculty and students and fortifying the innovation ecosystem at UH, we are playing a key role in Hawai‘i’s efforts to diversify our economy, create high-quality jobs and build the foundation for new revenue sources through the Hawai‘i Innovation Initiative.”

(ABOVE, LEFT) UH i-Lab students “pitch” their innovative app to attendees at the grand opening event



Recipe for Success

The Maui Food Innovation Center (MFIC) at the University of Hawai'i Maui College (UHMC) recently awarded a total of \$5,000 to three emerging food producers on Maui for winning the "investor pitch" competition through its Maui Accelerator Program (MAP).

The awardees were chosen from MAP's first cohort of twelve Maui-based businesses and the winning products included a natural raw energy bar, cultured macadamia nut hummus and uniquely flavored cookies.

The Maui Accelerator Program provides support to value-added food businesses and entrepreneurs in the form of training, community resources, and access to a certified commercial kitchen at UHMC. The program provides an overview of business planning and marketing, good manufacturing practices, industry trends, packaging, and food industry requirements required for wholesale, retail and export markets.

"It is extremely rewarding to work with and develop Maui's talented food entrepreneurs through the Maui Food Innovation Center's Maui Accelerator Program that offering mentoring and formal training in food industry issues and business development to help these young businesses succeed," said Chris Speere, site coordinator for MFIC. "Our MAP participants learn to improve productivity, gain financial efficiency and increase revenue growth through persistence, desire and a commitment to excellence in the products they produce."



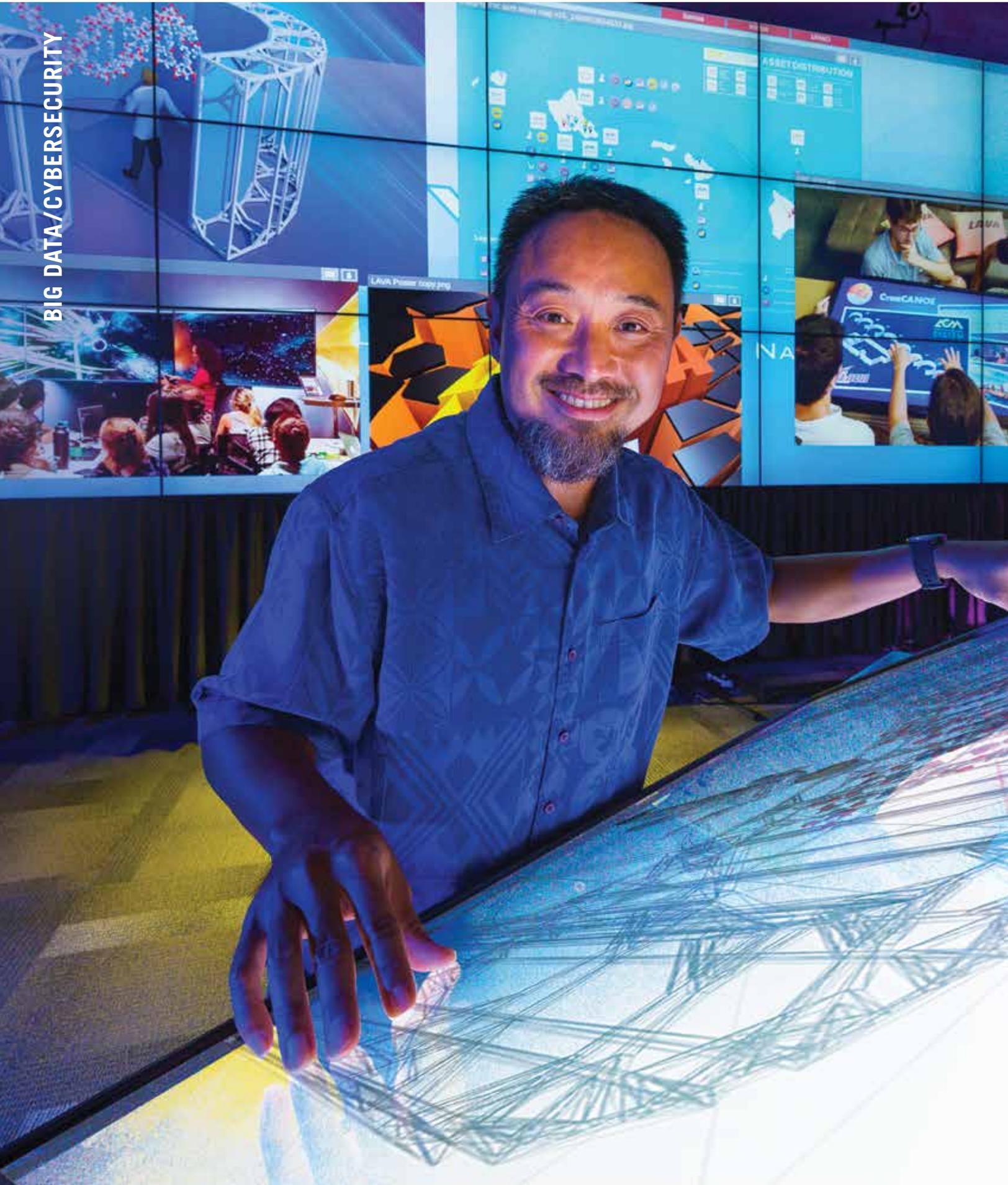
The Maui Food Innovation Center utilizes existing programs and services to best serve its clients, avoid duplication and create partnerships to make efficient and effective use of funding and resources. Partnerships include shared referrals, in-kind services, space sharing and other shared resources.

Last year, MFIC was a winner of the 2015 U.S. Small Business Administration's Growth Accelerator Fund Competition. The \$50,000 award was used to support MAP, which targets women and minority owned enterprises, including Native Hawaiian-led businesses.

"The Maui Food Innovation Center is an important program that will offer both the training and facilities needed by local food entrepreneurs to build a small business," said Lui Hokoana, chancellor of UHMC. "We're excited the project has been recognized nationally, and this additional award will increase learning opportunities for students."

(ABOVE, L-R) SBA check presentation: UH President David Lassner, VP for Community Colleges John Morton, Congressman Mark Takai, SBA Administrator Maria Contreras-Sweet, MFIC Site Coordinator Chris Speer and U.S. Senator Mazie Hirono

BIG DATA/CYBERSECURITY





UH CyberCANOE

A Picture is Worth a Thousand Words

“A picture is worth a thousand words” is an old adage. But with the help of technologies developed by visualization experts like University of Hawai‘i at Mānoa Information and Computer Sciences Professor Jason Leigh, pictures are now worth a whole lot more.

As researchers around the world begin to work more closely with each other to solve complex problems, collaborative scientific visualization environments comprised of ultra-resolution tiled display walls interconnected by optical networks, are becoming vital for data sharing and analysis.

Now, thanks to a major infrastructure grant from the National Science Foundation and funding from the UH System’s Academy for Creative Media (ACM System), UH Mānoa will be home to the best data visualization system in the U.S. Known as the Cyber-enabled Collaboration Analysis Navigation and Observation Environment or CyberCANOE, it represents the culmination of over two decades of experience and expertise for Leigh, who is also the founder and director of UH Mānoa’s Laboratory for Advanced Visualization and Applications (LAVA).

The UH CyberCANOE will provide an alternate approach to constructing ultra-resolution display environments by using new and completely seamless direct view light emitting diode displays, rather than traditional projection technologies or liquid crystal displays. New 2D and 3D stereoscopic display environment with almost 50 megapixels of resolution will provide researchers with powerful and easy-to-use, information-rich instrumentation in support of cyberinfrastructure-enabled, data-intensive scientific discovery. The net effect is a visual instrument that exceeds the capabilities and overcomes the limitations of the current best-in-class systems at other U.S. universities.

This virtual environment is provided by SAGE (Scalable Adaptive Graphics Environment), a software system developed by Leigh,

then director of the prestigious Electronic Visualization Lab and Software Technologies Research Center at the University of Illinois at Chicago. It enables users to access, display and share a variety of data-intensive information, in a variety of resolutions and formats, from multiple sources, on tiled display walls. Information displayed can be digital-cinema animations, high-resolution images, high-definition video conferences, presentation slides, documents and spreadsheets. The SAGE software is the National Science Foundation’s de facto standard for driving ultra-high resolution display walls and is currently in use by over 200 top research and industrial organizations worldwide, including Monsanto and Japan’s NTT.

Building on the highly successful CAVE (CAVE Automatic Virtual Audio Visual Experience), Leigh’s recent CAVE2 is the next generation, large-scale, virtual-reality system that allows researchers to completely immerse themselves in a seamless 2D/3D environment of visual information.

“The CAVE2 technology helps to bring science to the big screen,” said Leigh. “It allows the study of worlds too small, too large, too dangerous or too complex to be viewed otherwise, like the hostile surface of a distant planet or the intricate system of arteries in the human body.”

Leigh’s technologies have already being utilized by UH researchers including Karen Meech at the Institute for Astronomy and by world-renowned oceanographer David Karl at the Center for Microbial Oceanography: Research and Education (C-MORE).

“Jason Leigh has been a terrific addition to UH,” said Karl, the director of C-MORE. “We

(CONTINUED)



“... UH Mānoa will be home to the best data visualization system in the U.S.” –Jason Leigh



already have plans for a meaningful collaboration between his new visualization team and C-MORE scientists, who will soon be able to display our marine microbial genomics and biogeochemical datasets in vivid 3-D.”

Currently, there are smaller CyberCANOE deployed at UH Mānoa’s LAVA and i-Lab, UH West O’ahu’s Roy and Hilda Takeyama and Hilda Creative Media Lab and at UH Hilo’s ‘Imiloa Astronomy Center. In addition to two more planned locations at UH Hilo, Leigh’s group is working with the State Energy Office and Kamehameha Schools to have CyberCANOE installed at their facilities.

Last year, students at UH Mānoa and UH West O’ahu participated in UH’s first joint video game development class made possible by the CyberCANOE. Funding for the multi-screened computer environments was funded by UH System ACM. This year, the newest CyberCANOE at UH Hilo/‘Imiloa is being used to teach a joint class in data visualization between UH Mānoa and UH Hilo.

At least 46 researchers, 28 postdocs, 833 undergraduates and 45 graduate students spanning disciplines that include oceanography, astrobiology, mathematics, computer science, electrical engineering, biomedical research, archeology and computational media are poised to use the UH CyberCANOE for their large-scale data visualization needs. The UH CyberCANOE will also open up new opportunities in computer science research at the intersection of data-intensive analysis and visualization, human-computer interaction and virtual reality.

“We are thrilled to be able to continue our support of Jason Leigh and his team in securing the NSF grant,” said Chris Lee, founder and director of ACM System and a co-principal investigator on the grant. “The new CyberCANOE will build upon the capabilities of the two earlier ‘mini’ versions and help to transcend ACM System into an industry catalyst. ACM System is dedicated to collaboration between programs and campuses throughout UH and already the CyberCANOE has allowed new, innovative courses where students from UH Mānoa, UH West O’ahu and UH Hilo work together.”

The UH CyberCANOE, which is expected to be built in about three years, will enable



Leigh's advanced visualization laboratory to provide scientific communities with highly integrated, visually rich collaboration environments; to work with industry to facilitate the creation of new technologies for the advancement of science and engineering; and to continue ongoing partnerships with many of the world's best scientists in academia and industry. With the UH CyberCANOE, the lab will also support the country's leadership position in high-performance computing and in contributing advancements to complex global issues, such as the environment, health and the economy.

"This comes at the best time for the University of Hawai'i as the number of students interested in information and computer science is skyrocketing. Last year about 170 freshman computer science students entered the program, this year we will receive 270," said Leigh. "The UH CyberCANOE will give these students access to better technology than what will be available on the continent."

(ABOVE, LEFT) Professor Jason Leigh and ACM System Founder and Director Chris Lee

ITWorks

A First of Its Kind IT Apprenticeship Program

The Pacific Center for Advanced Technology Training (PCATT) in partnership with DevLeague and the State of Hawai'i Department of Labor and Industrial Relations (DLIR) will develop and deliver training for the first of its kind "ITWorks", a State of Hawai'i IT Apprenticeship Program. The purpose is to create a public-private partnership to broaden the use of American Apprenticeship Initiative grants in developing a highly skilled workforce able to meet the local information Technology (IT) needs, while also offering U.S. workers access to training and career advancement.

PCATT is a consortium of the University of Hawai'i Community Colleges responsible for collaborating with industry to develop and provide leadership and training in advanced technology which enhances educational and workforce development programs and initiatives in the State of Hawai'i and the Pacific Rim. The center, which also manages Honolulu Community College's continuing education and lifelong learning programs, collaborates with other UH System entities to develop non-credit activities that lead into credit pathways. DevLeague is Hawai'i's first and only web development coding academy.

In the Hawai'i IT Apprenticeship Program, the targeted occupations are computer programmer, computer systems analyst, database administrator, and data/science analyst. Targeted curriculum will be programming/coding, data sciences, and database administration.

"As technology and business requirements rapidly change, it is not only what you know that is important, but also how fast you can learn," said Steve Auerbach, director of PCATT. "The State of Hawai'i Department of Labor and Industrial Relations will utilize the innovation elements, identified by the U.S. Department of Labor, and best practices to create an ecosystem of technologists, strategies and resources for a new Registered IT Apprenticeship Program in Hawai'i."

Registered Apprenticeship is a unique, flexible training system that combines paid and on-the-job learning and related technical and theoretical instruction in a skilled occupation to enable employers to develop and apply industry standards to training programs that can increase productivity and improve the quality of the workforce.

The IT Apprenticeship Program, which targets the unemployed, incumbent workers and underrepresented populations, is expected to serve 300 apprentices, including 100 incumbent workers and 90 underrepresented participants.



Steve Auerbach
Director of PCATT

C-MORE:

Unlocking the Secrets and Importance of Marine Microbes



At less than a hundredth of the thickness of a strand of human hair, marine microorganisms are small in stature—but their impact on life is enormous in comparison.

“Marine microorganisms sustain planetary survival. They produce most of the oxygen we breathe,” said David M. Karl, director for the Center for Microbial Oceanography: Research and Education (C-MORE) at the University of Hawai‘i at Mānoa (UH Mānoa). “They capture solar energy, produce food and sequester carbon dioxide, yet we are largely ignorant about how they live and interact.”

It is this ignorance on the part of science that has led Karl to delve deeper into one of the ocean’s last remaining mysteries. Invisible to the naked eye, marine microbes produce nearly half of the Earth’s oxygen supply. They consume many pollutants of human activities and serve as the base of the marine food chain. Unlocking the secrets of these infinitesimal sea creatures and their roles in nature, will have a tremendous impact on the environment, marine industries and medicine.

A microbial biologist and oceanographer in UH Mānoa’s School of Ocean and Earth Science and Technology, Karl was instrumental in the establishment of an open ocean time-series station, known as HOT Station ALOHA, in the subtropical North Pacific as a sentinel for observing the effects of climate on the structure and function of microbial communities. He has participated in more than 100 major oceanographic cruises and submersible dives around the world to identify new microbes that live in harsh environments.

Since joining UH Mānoa in 1978, Karl has been principal investigator on more than 80 grants bringing over \$100 million in federal and foundation funds to the University. Additionally, he has brought in over \$50 million to support various research vessels and submersibles used in his own research.

In 2006, Karl was awarded a 10-year \$36.8 million National Science Foundation (NSF) grant that led to the establishment of C-MORE, one of only 17 NSF Science and Technology Centers in the nation. C-MORE is an interdisciplinary partnership led by UH Mānoa that includes the Massachusetts Institute of Technology (MIT), University of California at Santa Cruz, Woods Hole Oceanographic Institution, Oregon State University, Columbia University and the Monterey Bay Aquarium Research Institute.

In 2010, the center moved into its 27,000-square-foot permanent home located in UH Mānoa’s newest research facility, the Daniel K. Inouye C-MORE Hale, named after the late U.S. senator from Hawai‘i.

“Senator Inouye was a champion of C-MORE because he was impressed by UH’s world-class expertise in microbial oceanography,” said Vassilis L. Syrmos, vice president for Research and Innovation at the University of Hawai‘i. “He also understood the importance of this research, its significance to the environment and its future potential in healthcare and other industries.”

C-MORE investigators are recognized leaders in the field and their research has appeared in over 600 scientific papers and published in many leading journals. It is also home to four elected members of the National Academy of Sciences (NAS), including Karl, C-MORE Co-Director Edward DeLong, and MIT’s Sallie Chisholm and Ed Boyle. Karl, Chisholm and Woods Hole’s John Waterbury are also recipients of NAS medals of distinction. In 2013, President Barack Obama presented Chisholm with the National Medal of Science, the nation’s highest honor in science and engineering, for her research on the ocean phytoplankton *Prochlorococcus*—the world’s smallest, yet most abundant, photosynthetic organism.

In addition to its primary research function, C-MORE has taken an active role in increasing scientific literacy about microbial oceanography among the general population, as well as training microbial oceanographers. It offers undergraduate internships, a summer graduate training course, a Native Hawaiian outreach program and provides resources for K-12 educators, including training workshops, science kits, and a teacher-at-sea program.

“C-MORE was created to explore the enormous and mostly uncharted biodiversity in the sea,” added Karl. “But it is the dedicated efforts and accomplishments of our investigators and staff that garnered us international attention and helped us to establish the University of Hawai‘i as the world’s leading institution in microbial oceanography.”



A DROP OF SEAWATER collected from Station ALOHA as seen through a false color scanning microscope. The colors depict different groups of microorganisms, as determined by shape and size.



TRICHODESMIUM, a nitrogen-fixing microorganism, as seen through an epifluorescent microscope. Collected from Station ALOHA, this organism and others related to it are able to produce bioavailable nitrogen from the unlimited supply of nitrogen gas dissolved in seawater and are key to oceanic ecosystem sustainability.

Ocean Station ALOHA A Milestones in Microbiology site

Ocean Station ALOHA, the University of Hawai'i at Mānoa's research site 60 miles north of O'ahu has been designated a Milestones in Microbiology site by the American Society for Microbiology (ASM).

The ASM Milestones in Microbiology program recognizes institutions and scientists that have made significant contributions toward advancing the microbial sciences.

This open-ocean research station “has played a fundamental role in defining the discipline of microbial oceanography, developing a comprehensive understanding of the sea and educating the public about the critical role of marine microbes in global ecosystems,” ASM officials noted in their citation.

BIRTHPLACE OF MICROBIAL OCEANOGRAPHY

While microbial oceanography was emerging as a field of inquiry, scientists at the UH Mānoa School of Ocean and Earth Science and Technology (SOEST) proposed a bold new program—the Hawai'i Ocean Time-series (HOT) research program—and selected Station ALOHA (A Long-term Oligotrophic Habitat Assessment) as the deep ocean site representative of the vast North Pacific Sub-tropical Gyre, one of Earth's largest biomes. Since the program's inception in 1988, the National Science Foundation has been the major funding agency, with UH Mānoa and SOEST providing invaluable support including efficient operation of its oceanographic research vessels.

“It soon became a trans-disciplinary collaboration among individuals who traditionally did not interact (microbiologists, physical scientists, oceanographers, mathematicians and educators), and created unique opportunities for scientific discovery, knowledge transfer and outreach to society at large,” said David Karl, HOT co-founder, Victor and Peggy Brandstrom Pavel Professor of Ocean and Earth Science and director of the Daniel K.



Inouye Center for Microbial Oceanography: Research and Education (C-MORE). “Ocean Station ALOHA may be viewed as the birthplace of microbial oceanography.”

OCEAN MICROBES—SMALL BUT MIGHTY

Since 1988, teams of scientists have conducted pioneering research at Ocean Station ALOHA that has transformed the ecological understanding of the most abundant life forms in the sea—microorganisms. The teams have discovered complex microbial interactions, numerous novel microorganisms and unprecedented metabolic pathways; and have made significant contributions to the understanding of the impacts of climate change on marine ecosystems.

BUILDING ON SUCCESS

In 2006, the capacity of the HOT program was enhanced with the creation of the NSF-supported C-MORE, one of only 17 Science and Technology Centers in the nation. This multi-institutional collaboration was established to investigate the identities and impacts of microorganisms including their potential responses to climate change. In addition, C-MORE has an important education mission: to train a new breed of inter-disciplinary microbial oceanographers; to develop curricula at the undergraduate and graduate levels and to increase the number of students and teachers engaged in science and engineering, focusing on underrepresented groups, especially Native Hawaiians and Pacific Islanders.

A third research program, the Simons Collaboration on Ocean Processes and Ecology (SCOPE), was created in July 2014, to

complement the objectives of HOT and C-MORE. Discoveries await the SCOPE scientists who will investigate, in greater detail than ever before, the microbially-mediated processes that govern the flow of matter and energy at Ocean Station ALOHA.

EDUCATION AND RAISING PUBLIC AWARENESS

Through public and private partnerships with the NSF, the Gordon and Betty Moore Foundation and the Simons Foundation, Ocean Station ALOHA has increased public awareness of the science of microbial oceanography and its global importance.

“The value of Ocean Station ALOHA continues to increase with time: its initial beginnings as a place to quantify ocean change from shipboard sampling has steadily evolved to become the model site for integration of ocean research and education,” said Matt Church, SOEST oceanography professor and lead investigator of the HOT program. “Among the most successful examples of this integration is the international summer school developed as a partnership with the Agouron Institute in 2006. This school has trained more than 150 students in the growing discipline of microbial oceanography.”

(ABOVE, TOP) Water sampling operations at Station ALOHA. This device, termed a CTD-rosette, contains a suite of instruments to collect environmental data as well as a set of 24 water sampling bottles. This instrument is able to sample the water column properties and to return discrete water samples from the surface to the abyss. PHOTO: TARA CLEMENTE

(ABOVE, BOTTOM) R/V Kilo Moana

(BEHIND) PHOTO: TARA CLEMENTE

A Race Against Time

UH Spearheads Coral Bleaching and Climate Change Research



Ruth D. Gates and her team are on the clock. However, unlike *Jeopardy!* or *The Price Is Right*, this is not a game and the consequences of not having the correct answer will have global implications. That's because Gates, a marine biologist and director of the University of

Hawai'i at Mānoa's Hawai'i Institute of Marine Biology (HIMB), and her team of researchers are racing against time and climate change to breed and condition corals that can withstand future ocean stressors and be used to restore and build resilience in our reefs. Part of this work involves figuring out why some corals thrive and stay a healthy brown corals while those growing right next door that are exposed to the same environmental stress turn white or bleach—a clear sign of stress.

Coral bleaching is a primary threat to the persistence of coral reef ecosystems globally and is typically caused by a rise in water temperature. Coral deaths resulting from bleaching have already affected an estimated 30 percent of the world's reefs over the last 20 years. Coral turn white (bleach) when micro algae living in its tissue that give corals their characteristic brown color—leave during stressful environmental conditions. The coral will begin to deteriorate and die if unfavorable conditions persist or are too extreme, but a coral can bounce back if conditions improve.

"A bleached coral will either recover or die," said Gates. "It is as simple as that and we really don't know what that outcome will be until months after the bleaching event."

Coral bleaching and death can seriously impact a coastal area. As the structural foundation of reefs, coral play a critical role in providing protection from coastal erosion and a habitat for food fish and other sea life, while generating millions in tourism dollars in places like Hawai'i, the Caribbean or The Great Barrier Reef in Australia—places that are already being affected by coral bleaching.

Gates is a recipient of multi-million dollar support for her world-class research from a number of prominent sources, including a million-dollar donation from philanthropist Pam Omidyar to HIMB in 2009, Gates recently added Microsoft co-founder Paul

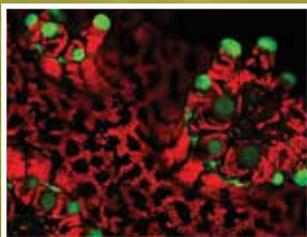
G. Allen to her impressive list of supporters. In 2013, Gates and Madeline van Oppen from the Australian Institute of Marine Science (AIMS) were winners of the Paul G. Allen Ocean Challenge, an international competition soliciting the best ideas for mitigating the impacts of ocean acidification in marine systems. They were awarded a \$10,000 grand prize and invited to submit a grant proposal for funding consideration. A nearly \$4-million, five-year project agreement was reached in June 2015. This research provides an unparalleled opportunity to study different coral species, environmental conditions and human factors and being conducted in both Hawai'i and Australia, generates stronger research conclusions than work at a single-site.

At HIMB on Coconut Island in Kāne'ohe Bay, Gates and her team are working with a set of corals that were both affected and unaffected by a 2014 and 2015 warming events that caused widespread bleaching throughout Hawai'i. These pairs of affected and resilient corals are being examined to identify the factors contributing to their contrasting responses, with a focus on coral genetics and algal symbionts. Age-old selective breeding techniques (similar to those used in the agriculture industry) will be used with the corals that perform well in these trials. The strong performers will also be pre-conditioned to survive in increasingly warmer and more acidic water through successively increasing exposures. Gates refers to conditioning as "training corals on environmental treadmills." The goal is to breed and induce greater resilience in the individual samples as well as in their offspring.

"Once we have a proof of concept, we'll build a bank of coral stocks that are preconditioned to withstand the warmer and more acidic ocean conditions of the future," said Gates. "Within the five-year grant period we should have a significant stockpile of highly resilient coral strains and a plan in place to use them to restore a completely denuded reef, as well as plant them on a partially damaged reef so they can reproduce with the existing corals and enhance the overall resilience of the vulnerable reef."

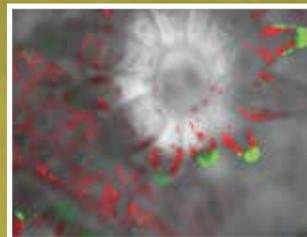
The Australian experiments are being conducted at the state-of-the-art National Sea Simulator (SeaSim) located on the campus of AIMS headquarters in Cape Ferguson. The SeaSim allows for tightly controlled environmental factors including temperature and water acidity during the selective breeding-style and conditioning

(CONTINUED)

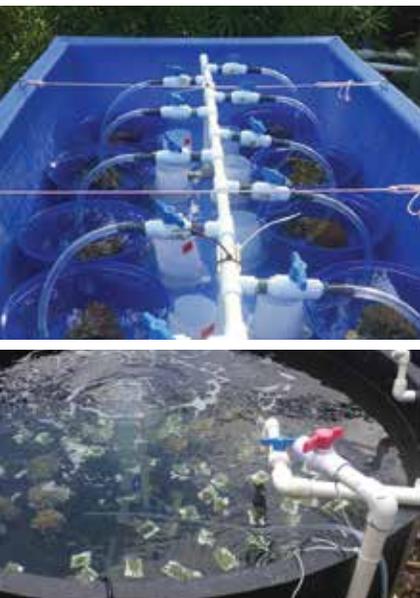


HEALTHY CORAL under a live imagine laser scanning confocal microscope—red shows the millions of algae inside the coral tissues and green the bettered of stinging cells in the coral itself.

PHOTO: KATIE BAROTT



BLEACHED CORAL under a live imagine laser scanning confocal microscope—red shows the reduced number of algae inside the coral tissues and green the bettered of stinging cells in the coral itself. *PHOTO: KATIE BAROTT*



activities. Both the Hawai'i and Australian components of the research are conducting work that falls under the umbrella term human-assisted evolution.

"Assisted evolution takes advantage of natural processes," said van Oppen. "It accelerates the evolution of coral and with the rapid decline of coral health worldwide, the development of tools to help protect corals from stress is urgent."

"Human-assisted evolution for corals is a radical departure from the conservation perspective traditionally applied in the field," said Gates. "It's often confused with GMO-type approaches in which foreign DNA is introduced, but in reality, we are proposing to

accelerate naturally occurring evolutionary processes."

One aspect of the research is already providing hopeful results. In 2015, a new study from Gates' team reveals that preconditioning adult corals to increased temperature and ocean acidification resulted in offspring that may be better able to handle those future environmental stressors. This rapid trans-generational acclimatization may be able to "buy time" for corals in the race against climate change.

In this study, featured in the *Journal of Experimental Biology*, Hollie Putnam, HIMB assistant researcher and lead author, and co-author Gates, exposed two groups of parental corals to either ambient ocean conditions or IPCC-predicted future ocean conditions—warmer and more acidic water. As expected, the harsher future conditions negatively affected the health of the parental coral—lowering photosynthesis and production to consumption ratios. Surprisingly, however, the offspring of parents who were exposed to future conditions appeared healthier when re-exposed to the harsher environment.

"By preconditioning the corals while the offspring are being brooded it may be possible to increase the offspring's potential to perform under stressful environmental conditions," said Putnam.

Corals have been suffering huge losses in diversity and abundance on reefs worldwide due to local stressors such as overfishing, coastal development, pollution and sedimentation. Additionally, corals exposed to ocean acidification can struggle to build their skeletons and reefs are undergoing bioerosion and dissolution.

"Together these local and global stressors are placing an unprecedented strain on coral reef ecosystems. It has even been predicted that some corals may go extinct and the reefs will not provide the same biological diversity and provisioning—goods and services valued at hundreds of billions of dollars annually," said Putnam.

It is thought genetic adaption is the primary option for corals to respond to climate change. With the rapid rate of environmental change, however, genetic adaptation may not be able to keep pace. Putnam and Gates were interested in the potential for other more rapid

response mechanisms like the acclimatization provided when adults provision their offspring based on their environmental experience. The researchers think epigenetics, or a change in the quantity and product of a gene without a change in DNA sequence, may be one such acclimatory mechanism that allows the organism to rapidly adjust to environmental change. Epigenetics and parental effects, they say, may help to buffer corals against the rapidly changing climate.

"Our work suggests that when we consider multiple life stages in connection and their environmental history, corals have resources to respond to climate change that we have not yet considered fully," said Putnam. "This may be good news for corals of the future."

In a new series of experiments, the researchers are expanding their analysis to more coral life stages by tracking the coral larvae from preconditioning in their parents until they settle and grow into juveniles. Their goal is to assess the "grandchildren" after three to four years, when the first offspring become reproductive. They are also comparing the response to temperature and ocean acidification simultaneously and separately to determine if one factor is more influential than another.

The overarching goal of the work of Gates and her team is to accelerate the natural processes by which corals adapt to environmental change and generate a stockpile of corals that can survive the warmer and more acidic waters of the future. As the clock ticks down, Gates and her research team are giving it their all to develop capacity that can be used to build resilience on, or restore damaged coral reefs and protect the essential diversity, goods, and services that reefs provide and that the world depends upon.

(LEFT, TOP) Corals in an experimental setting at HIMB PHOTO: HOLLIE PUTNAM

(LEFT, BOTTOM) Corals being conditioned to warmer and more acidic waters in experimental tanks at HIMB PHOTO: HOLLIE PUTNAM

(BELOW) Bleached and non-bleached coral side by side on the reef PHOTO: RAPHAEL RITSON-WILLIAMS



UH's "Supercool" Professor

An Innovation That Could Transform the Food Industry

Imagine reaching into the freezer to prepare a meal. The frozen chicken breast remains pliable and fresh, the frozen blueberries and strawberries for dessert thaws without turning mushy. Although it may sound like a futuristic scene from *Star Trek*, think again.

It's the Food Processing Laboratory at UH Mānoa's College of Tropical Agriculture and Human Resources (CTAHR) and the technology is a promising supercooling method—which combines pulsed electric and magnetic fields to reach subzero temperatures without turning liquids solid.

In 2013, Soojin Jun, an associate professor in CTAHR's Department of Human Nutrition, Food and Animal Sciences (HNFAS), received a three-year \$500,000 grant from the USDA to study a high-tech new way to preserve food for storage and shipping. Along with Co-Principal Investigator Peter Berkelman, an associate professor in the UH Mānoa College of Engineering, the duo embarked on a research project to address the loss of quality in food items due to freezing and thawing during storage and transportation, which leads to waste and a decrease in economic value.

During the freezing process, water crystallization can result in irreversible damage to tissue structures resulting in damage to a variety of foods. In contrast, Jun's project aimed to preserve food's original freshness by controlling the supercooling and ice crystallization of water using combined pulsed electric and magnetic fields. "Supercooling" refers to the process by which water temperature drops below the freezing point, but there is no transition to ice. "Imagine supercooled sashimi that tastes as fresh as it did out of the sea four weeks ago," said CTAHR's Associate Dean for Research Ken Grace.

A portion of the grant included the development of a prototype freezer equipped with pulsed electric field and oscillating magnetic field generators, designed and fabricated in the HNFAS lab. This technology has the potential to ensure food quality and freshness during storage, which would have an enormous impact on the food industry. It would specifically benefit Hawai'i and the Pacific Basin by ensuring food security and sustainability, as well as provide new export opportunities for local farms and entrepreneurs.

According to Grace, "supercooling isn't just applicable to the food industry either. The possible medical applications for organ transport and long-term blood storage are bringing attention to Dr. Jun's work too."

Last year, Jun's supercooling technology spinout (inventions developed from university research) Jun Innovations, was invited to present at the prestigious First Look LA showcase of university technologies at UCLA's California NanoSystems Institute. Over 250 investors and entrepreneurs were in attendance at the invitation-only event. Jun Innovations is a graduate of XLR8UH, UH's proof of concept center/venture accelerator program. Success continues to follow Jun Innovations, as the promising spinout was recently awarded with a USDA SBIR Phase 1 grant for \$100,000 on June 1, 2016.

Beyond the food industry, the supercooling technology has exciting possibilities for use in medical applications such as organ and tissue transplantation. It also just one of many technologies explored by Jun's Food Processing Laboratory.

His lab also developed a patented technology that combines ohmic heating by electric current (efficient for liquids) with microwave heating (good for solids). Current methods for foods such as soups require heating components separately, which is inefficient, or else overheating solids, which degrades quality and nutrition. He sees similar potential for companies processing local foods like poi and kava.

Supported by more than \$2.5 million in USDA, industry and international grants since 2008, Jun's team also researches pathogen-fighting technologies such as laser decontamination of fresh produce and nano-material coatings to reduce bacteria-promoting biofilm buildup on the surfaces that come in contact with food during processing. He would also like to explore biodegradable or edible films as waste-reducing packaging.

"I'm not a just foodie guy," Jun insists—an electrical/agricultural engineer at heart. "There are so many things you can do as an engineer."

(BELOW, L-R) Taiyoung Kang, Associate Professor Soojin Jun, Jae Young Her and Raymond Hoptowit in the HNFAS lab



SPACE EXPLORATION AND ASTRONOMY

It is the dawn of a new era in manned spaceflight. The period of Low-Earth Orbit missions serviced by the space shuttle has made way for a more aggressive push towards exploration, including a return to the Moon's lunar surface and long-duration manned space missions to Mars and beyond.





Associate Professor Veronica Bindi (center in black) and the AMS-02 collaboration lead by Nobel Laureate Samuel C.C. Ting (seated in white shirt) at NASA's Johnson Space Center (ACROSS) AMS-02 in orbit on the International Space Station PHOTOGRAPHY COURTESY NASA/AMS-2 COLLABORATION

UH AMS-02 Group Helping NASA Get to Mars and Beyond

However, interplanetary space is permeated by dangerous radiation from galactic cosmic rays, which are charged particles, like protons and ions (atoms that have lost their electrons like helium, carbon and iron), that travel at very high speeds close to the speed of light. Generated from inside the Milky Way and other galaxies, these particles travel long distances accelerated by extremely energetic environments, like supernova explosions, active galactic nuclei (AGN), colliding galaxies and black holes. Galactic cosmic rays remain as one of the most significant barriers involved in long-duration space exploration that extend beyond the natural protection of the Earth's atmosphere and its geomagnetic field.

As a result, the National Aeronautics and Space Administration (NASA) initiated the Human Research Program to discover the best methods and technologies to support safe space travel. To help them understand and quantify the health impacts of space radiation, one of the most important elements of the program, NASA is relying upon a group led by University of Hawai'i at Mānoa (UH Mānoa) Associate Professor of Physics Veronica Bindi.

Bindi, who joined the Department of Physics and Astronomy at UH Mānoa in 2012, is an experimental particle physicist and NSF Early CAREER Award recipient who previously worked for 10 years at the European Organization for Nuclear Research (CERN) in Switzerland as part of an international team led by Noble Laureate physicist Samuel Ting of the Massachusetts Institute of Technology. In response to budget cuts that cancelled a superconducting supercollider project that severely reduced the possibilities for experimental high-energy physics on Earth, Ting's team developed a proposal for a space-borne cosmic ray detector called an Alpha Magnetic Spectrometer (AMS). The prototype, known as AMS-01, was tested on a shuttle mission in 1998.

"Previously, the biological effects of space radiation were studied at particle accelerators on Earth delivering beams of particles to simulate space radiation," said Bindi. "Because AMS is space-based, it provides us with real and very accurate cosmic ray data, used to improve models essential to assess crew exposure during long missions."

(CONTINUED)

The main mission, AMS-02, was delivered to the International Space Station (ISS) in 2011. The state-of-the-art magnetic spectrometer onboard will operate until 2028 and is extremely accurate in the measurement of all types of cosmic rays (from 125 MeV to approximately 1 TeV), including solar energetic particles (SEP) emitted from the Sun during intense solar events, such as solar flares and coronal mass ejections.

Shortly after her arrival at UH Mānoa, Bindi quickly established a new group of two postdocs, two PhD students and several undergraduate students from UH and Europe to embark on a vigorous research program to analyze the AMS-02 data. With the full support of Professor Ting, Bindi and her University of Hawai'i AMS-02 (UH AMS-02) group are the only researchers in the AMS collaboration with a scientific partnership with NASA that is specialized and focused on the study of galactic cosmic rays.

Bindi was initially awarded a one-year start up grant by the NASA Space Radiation Analysis Group based at NASA's Johnson Space Center in Houston to study low energy galactic proton fluxes measured by AMS-02 and to develop a long-term proposal for future data collected. Impressed by the results, NASA decided to award Bindi and the UH AMS-02 group a \$1 million grant to extend the project for five years, to study the time variation of proton, helium and carbon fluxes in the energy range from 1 to 10 GeV, where radiation is expected to be the most harmful.

"In addition to improving the models to study the crew exposure during long missions to Mars, we also want to identify new materials that can be used for future spaceships to better protect astronauts and to predict the best time period for space travel from the solar activity point of view," added Bindi.

Through these projects, Bindi and the UH AMS-02 group have the opportunity to study the different types of cosmic rays in an energy range and at a precision that has never before been available. Currently, there is very little information about the behavior of cosmic rays inside our solar system, their modulation with the Sun and SEPs at such high energies. AMS-02 will measure cosmic rays and SEPs for several years and during a complete solar cycle. This proposed research program takes advantage of AMS-02's innovative technology and location above the atmosphere aboard the ISS to provide brand new information to the NASA community about cosmic rays and SEPs, which is currently unobtainable by any other means.

"AMS-02 will contribute to improving the understanding of galactic cosmic rays and solar energy particle physics and improve models, which will lead to better predictions and safer operations in space," said Bindi. "It is a unique opportunity for the NASA community, the AMS-02 collaboration and UH to contribute to science in an unanticipated way, as is often the case preceding new discoveries."



(BEHIND) The ORS-4 mission blasts off from PMRF carrying UH's HIAKA Satellite

(RIGHT, TOP) ORS-4 just after liftoff

(RIGHT, BOTTOM) An HSFL student at work on instrumentation

Lofty Goals and High Aspirations

Space Programs at UH

“Space is hard—but worth it...” is what British billionaire Richard Branson said after the loss of his Virgin Galactic SpaceShipTwo during a test flight in 2014.

Space is indeed hard as faculty and students of the University of Hawai‘i’s Hawai‘i Space Flight Laboratory (HSFL) experienced this first-hand during Hawai‘i’s first space launch last November. Shortly after liftoff, the experimental Super Strypi rocket experienced an anomaly that destroyed the spacecraft. Known as the ORS-4 mission, it was sponsored by the Operationally Responsive Space Office (ORS) in collaboration with UH and the Pacific Missile Range Facility at Barking Sands, Kaua‘i, and served as a test for a quick, low-cost rail-launched system for small satellites.

According to HSFL Director Luke Flynn, the University of Hawai‘i and the state are now considered players in the aerospace industry in spite of the unsuccessful launch.

“It proved that UH has the equipment and expertise to build and test small spacecraft,” said Flynn. “HSFL has clean-room facilities and small-satellite test equipment to fully train the next generation of small-satellite engineers.”

HSFL designed and constructed the primary payload for the mission, the hyperspectral imaging aeronautical kinematic analysis satellite, called HIKA— which also means “to recite legends or fabulous stories” in Hawaiian. More than 150 UH students gained real world experience building the sophisticated satellite that passed a rigorous NASA-based testing process before it was approved for a space launch.

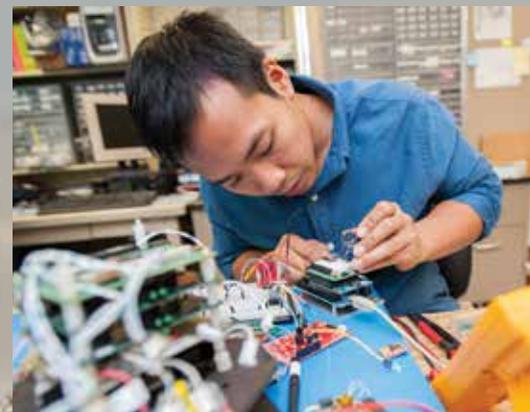
Because of this project, Hawai‘i now has a rocket launch pad and a rail launcher at PMRF that are critical assets for future space launches, as well as established satellite tracking stations in place at Kaua‘i Community College and Honolulu Community College that have been fielding requests from commercial agencies for data downlink services.

“HSFL received two commercial queries regarding use of the launcher (at PMRF) after the mission,” said Flynn, adding that private sector interest in deploying small satellites for lower costs is very high. “It’s been reported that SpaceX alone wants to send up 4,000 small communications satellites in the future. Certainly, the number of launches and launch sites in the U.S. and abroad will have to grow to meet this demand.”

Established in 2007 within the School of Ocean and Earth Science and Technology and the College of Engineering at the University of Hawai‘i at Mānoa, HSFL has received \$29 million in federal funding over the past seven years for the November 2015 launch attempt and invested \$2 million in university funds in equipment that is being used to support future small-satellite development across the UH System.

A group of HSFL students are currently working on a suborbital payload launch from New Mexico scheduled for summer 2016. The payload is a new on-board computing system that will be used in future HSFL small satellites.

HSFL is also working on two orbital satellites that will be launched as part of the NASA CubeSat Launch Initiative in 2017. The Neutron-1 satellite will detect neutrons that are incoming to the Earth from space. The GOSTE-1 satellite will measure atmospheric water. The NASA CubeSat Launch Initiative is particularly exciting for HSFL because the program offers free launch services for university CubeSats.



Project Imua

Last August, a rocket carrying a payload designed and built by students from Honolulu Community College, Kapi'olani Community College, Kaua'i Community College and Windward Community College was successfully launched from NASA's Wallops Flight Facility in Virginia into suborbital flight. The UH Community College team was the only community college whose payload was selected for this launch.



The multi-campus collaboration known as Project Imua (Hawaiian for “to move forward”) involved a joint faculty-student enterprise for designing, fabricating and testing payloads. Each Project Imua campus brought its unique expertise and skills to the table. Kaua'i CC was responsible for designing and building the payload's instrumentation. In close collaboration, Honolulu CC designed the payload's electronic circuitry for power and telemetry, while Kapi'olani CC designed the associated print circuit board. Windward CC was tasked with integrating all the components together and performing static tests on the payload. Both Windward CC and Kaua'i CC designed and constructed the payload's mechanical housing.

The scientific instrument that formed the main component of Project Imua's payload was a UV spectrometer that analyzed the intensity of the sun's ultraviolet radiation and its effects on the Earth's upper atmosphere and climate.

Project Imua is funded by a two-year \$500,000 grant awarded under the NASA Space Grant Competitive Opportunity for Partnerships with Community Colleges and

Technical Schools. Project Imua is supported by UH Mānoa, the main Hawai'i Space Grant Consortium campus, which provides technical assistance through Hawai'i Space Flight Laboratory's resources and personnel.

During Imua's two-year period, about 100 scholarships will be awarded to students at the four UH Community College campuses. These students will be provided training and hands-on experience in the design, construction and test phases involved in fabricating small payloads. Students also participate in periodic tele-conferences with the RockSat-X coordinators. These review sessions simulate that same procedures required by NASA contractors involved in space flight, thus providing students a unique experience with aerospace engineering protocols.

A second launch is scheduled for August 2016.

(BEHIND) The Project Imua payload lifts off from NASA's Wallops Flight Facility

(LEFT) Students from four UH Community Colleges test their scientific instrument in preparation for the launch





UH Mānoa Small-Satellite Lab

On November 19, 2013, a U.S. Air Force Minotaur 1 rocket blasted off into orbit from NASA's Wallops Flight Facility carrying a little bit of Aloha and a lot of history with it.

In the payload bay was a CubeSat called Ho'oponopono 2, or H2, constructed entirely by graduate and undergraduate engineering students at the UH Mānoa Small-Satellite Lab.

When it reached orbit, H2 became the first UH-built satellite to circle the Earth and joined an elite group of student-designed orbiters to reach space. It was also the culmination of over three years of design and construction by over 30 students in the cutting-edge program established at UH Mānoa by Electrical Engineering Professor Wayne Shiroma in 2001.

With dimensions comparable to a loaf of bread, H2's experimental mission was to perform radar calibration and performance monitoring for U.S. Department of Defense radar stations that track objects in space. That task was previously carried out for the past 20 years by RADCAL, a satellite that was 20 times larger and whose mission was 40 times more expensive than the \$220,000 cost of H2. A second CubeSat Ho'oponopono 3, is planned to incorporate lessons learned from the first

mission and will also be placed in a higher orbit.

"Small satellites aren't just enablers of new technologies and systems," said Shiroma, who is also chair of the electrical engineering department. "They're enabling a whole new generation of students for whom traditional educational methods don't seem to work. These students find open-ended, discovery-based, group learning to be more effective than the traditional blackboard-and-textbook educational paradigm."

Shiroma's students have helped write proposals that have resulted in over \$1 million in extramural funding and four launches. They also contributed to numerous publications including the first book on educational CubeSats and have pursued advanced degrees and careers in the space industry.

Three of Shiroma's former students who served as leaders for the program—Aaron Ohta in 2003, Blaine Murakami in 2005, and Larry Martin in 2012—were recognized as the top electrical engineering seniors in the nation,



receiving the IEEE/HKN Alton B. Zerby and Carl T. Koerner Outstanding Electrical/Computer Engineering Student Award.

"Small-satellite project-based learning not only emphasizes the multidisciplinary aspect of engineering, but also integrates life experiences that result in a different kind of engineer that is more adaptable in today's rapidly changing work environment."

Space is hard—but the students and faculty at the University of Hawai'i's Hawai'i Space Flight Laboratory, UH Mānoa Small Satellite Lab and UH Community Colleges are not letting that get in the way of their lofty goals and high aspirations.

(ABOVE, LEFT) The Minotaur 1 rocket clears the tower with Ho'oponopono 2 onboard

(TOP, RIGHT) Professor Wayne Shiroma and his students watch the launch of the Air Force rocket carrying the satellite they helped build

(BOTTOM, RIGHT) A UH Mānoa Small-Satellite Lab student displays a CubeSat



The Daniel K. Inouye College of Pharmacy

“Build it and they will come” is often attributed to the famous baseball film *Field of Dreams*, but it also fittingly describes the remarkable story of the Daniel K. Inouye College of Pharmacy (DKICP) at the University of Hawai‘i at Hilo.

In the movie, the main character set out to build a baseball field in an Iowa cornfield. For UH Hilo, its protagonist was the late U.S. senator from Hawai‘i and his dream to establish a pharmacy school in Hilo.

“Building a high-quality college of pharmacy on Hawai‘i island was part of Senator Inouye’s vision to encourage better health care throughout the Pacific region and throughout the neighbor islands of Hawai‘i,” said Donald Straney, UH Hilo chancellor. “His vision was that each neighbor island would harbor a center of excellence, that every island should have its own specialty. The specialty for Hawai‘i

island envisioned by Senator Inouye was our own college of pharmacy.”

Opening its doors to an initial cohort of 90 students in August 2007, DKICP’s humble beginnings were literally and figuratively true. Spread across over five different locations, the administration was housed in a county building a few miles away that was built in 1920, research labs were located seven miles out of town in buildings constructed in the 1960s and temporary classrooms were located on the campus outskirts.

Despite these less than ideal arrangements, DKICP flourished to become one of the fastest growing programs in the UH System with enrollment reaching 360 students in its first five years of existence. In 2012, a year after graduating its inaugural class and in its first year of eligibility, the college was ranked as one of the top five new schools of pharmacy by *U.S. News & World Report*. Much of this



success can be attributed to the leadership of Dr. John Pezzuto, founding dean of DKICP.

“Despite the many challenges and hurdles that Dean Pezzuto and his staff have had to overcome in establishing a college of pharmacy from the ground up, they have successfully met every benchmark set,” said Matthew Platz, vice chancellor for academic affairs at UH Hilo. “His knowledge, leadership and vision made it very possible for us to set our sights on becoming one of the top 25 pharmacy schools in the nation.”

DKICP has added to its doctor of pharmacy program with a bachelor of arts in pharmacy studies, a master of science in clinical psychopharmacology and a doctor of philosophy in pharmaceutical sciences.

As the only college of pharmacy in the Pacific region accredited by the Accreditation Council for Pharmacy Education, DKICP is responsible for more than \$50 million of eco-

nomic activity per year in the state, according to an independent study by UH Hilo Economic Professor David Hammes. Also contributing to economic development is the work being done by faculty researchers to expand the state’s research capacity. UH Hilo’s researchers are working on drug development to fight malaria; ways to reverse the progression of cancerous tumors; understanding diseases of the central nervous system; the cellular process implicated in many diseases; disease tolerance in native Hawaiian bird populations; antitumor drug development; and drugs for use in tuberculosis and malaria. These projects, funded by the National Institutes of Health, allow UH Hilo to collaborate with UH Mānoa on biomedical research, strengthening research capacity not only for the DKICP but for the entire state.

DKICP is also working to save millions of dollars in Hawai’i health care costs. One of its

most successful programs is Pharm2Pharm, a pharmacist-care system established in 2012. The \$14.3 million federally funded program is designed to reduce medication-related hospitalizations and emergency room visits by establishing teamwork between hospital and community pharmacists in rural counties of Hawai’i Island, Maui and Kauai. The program, developed by Professor Karen Pellegrin, founding director of the Center for Rural Health Sciences, is expected to save over \$27 million across the state.

This past April, UH Hilo awarded a \$31 million contract to proceed with the construction of a permanent building to house the Daniel K. Inouye College of Pharmacy. The 45,000 square foot building is expected to be completed 20 months after construction begins.

Build it and they will come.

CLASSROOM AND EXTERIOR RENDERINGS BY WCIT ARCHITECTURE OF HONOLULU

Pharm2Pharm

Defining the Role of Pharmacists in Tracking High Risk Patients



Karen Pellegrin

The role of pharmacists in Hawai'i communities is being redefined in an innovative healthcare program administered by the University of Hawai'i at Hilo. Traditionally, pharmacists are isolated dispensers of medication, located in stationary storefronts. However, in the Pharm2Pharm program carried out over the past three years in select areas throughout the state, pharmacists play a much more integrated and proactive role in overseeing high risk patients' medication routines.

"Patients who are on a lot of medications or certain types of medications are at higher risk for problems that could land them in the hospital," said Karen Pellegrin, director of Continuing and Distance Education and Strategic Planning at the Daniel K. Inouye College of Pharmacy at UH Hilo and principal investigator of the Pharm2Pharm program.

"Through the Pharm2Pharm project, we've shown that consulting pharmacists—those who coordinate medications across prescribers and across dispensing pharmacies—can help make sure patients are on the right medications and are taking them properly," she said. "These pharmacists have made a difference statewide, but especially in our rural communities where physician shortages are most severe."

Problems with medication often arise for patients due to lack of coordination between prescribers, inadequate monitoring, and misunderstanding about how to take them properly. Consulting pharmacists in the program track patients' use of prescription medication as they transition from hospital to home—a high-risk period for medication problems.

The consulting pharmacists meet with patients regularly, and utilize secure computer software to monitor a patient's overall medication plan and network with others on the patient's healthcare team. This is the first time in Hawai'i that information technology has been implemented on a statewide basis for medication management. The Hawai'i Health Information Exchange is providing the IT infrastructure to support the program.

POSITIVE RESPONSES FROM PATIENTS

The feedback from patients is outstanding. Many patients participating in Pharm2Pharm report the services have helped keep them out of the hospital and improve their overall health and well-being.

"This program has changed my life," reports one patient. "I have returned to my old self; I can sleep at night, fear of never waking is gone. No more inhaler and wheezing. Not so many pills and knowing when or when not to take them also the security of knowing I have

someone to talk with when I have a question or problem. Thank you for my life back, and I really mean this."

Another patient said, "My pharmacist was extremely helpful beyond my expectations."

Pellegrin said the positive results are "what happens when pharmacists become part of the care team."

COLLABORATION

Hawai'i Community Pharmacists Association members have provided the outpatient services. Collaborating partners in Pharm2Pharm also include Hawai'i Pacific Health and Hawai'i Health Systems Corporation, who have enrolled patients several of their hospitals. In all, seven hospitals in the state have participated in Pharm2Pharm. Pellegrin said the final count of patients receiving Pharm2Pharm services is 2,570 statewide, most in rural areas.

The pharmacy college was awarded \$14.3 million in 2012 to develop the program to save health care costs, one of 107 awardees competing successfully against more than 3,000 other highly qualified applicants for the funding. The program is funded by the Centers for Medicare and Medicaid Services (CMS) Innovation Center.

Pharm2Pharm is now in its fourth and final no-cost extension year focusing on evaluation and sustainability.

Pellegrin said since the launch of UH Hilo's Daniel K. Inouye College of Pharmacy, the supply of pharmacists in Hawai'i has greatly improved. If wisely deployed, she said, this workforce can extend the short supply in physicians and add unique medication experts to the state's healthcare system.

"The Pharm2Pharm model program shows there is an opportunity to improve healthcare services to the people of Hawai'i by integrating pharmacists into patient care teams," she said.





Hope on the Horizon UH's Role in the Fight Against Bladder Cancer

For patients afflicted with bladder cancer, a new drug treatment could be around the corner thanks to a national clinical drug trial being conducted by the University of Hawai'i Cancer Center (UH Cancer Center).

Developing novel effective treatments for bladder cancer is important because it has a very high rate of recurrence, making it one of the most expensive cancers to treat on a per patient basis. Up to 70 percent of patients with non-muscle invasive bladder cancer may develop cancer recurrence, making it one of the most prevalent cancers in the U.S.

Nationally there are 74,000 new cases of bladder cancer and an estimated 16,000 deaths every year, according to the National Cancer Institute. It is ranked in the top five cancers for men in the U.S. The disease occurs more often in men than women.

"The medical community does not yet have an effective means of preventing bladder cancer from recurring with currently available treatments," said Dr. Charles J. Rosser, a UH Cancer Center urologist and principal investigator of the trial. "Finding an effective treatment would go a long way toward preventing more people from suffering from this disease."

At the center of attention is the drug ALT-803, an interleukin 15 superagonist complex, created by Florida-based Altor BioScience Corp. In early studies, ALT-803 showed strong potential to stimulate the body's immune system and create a protective and long-lasting

effect against tumors when paired with the immunotherapy drug Bacillus Calmette-Guérin (BCG), which is currently used for the treatment of bladder cancer.

Phase I of the study with about dozen participants was completed in summer 2015 and showed that the trial was well-tolerated and demonstrated the recommended dose to be tested in Phase II. At least 20 percent of the participants were expected to have a recurrence of bladder cancer by now, but so far, no patients have. Overall, bladder cancer has a high recurrence rate of more than 50 percent.

Phase II of the study, approved by the Institutional Review Board (IRB) and Food and Drug Administration (FDA), commenced on October 2015. With about 124 patients mostly from Hawai'i, the goal of this phase is to show improved outcomes for cancer patients and to move ALT-803 one step closer to FDA approval for use in the treatment of bladder cancer.

"The last time the FDA approved a drug for bladder cancer was almost two decades ago," said Rosser, director of the UH Cancer Center's Clinical Trials Office. "BCG has been the main drug used to treat the disease since the '80s, but we may finally be able to move the field forward and get better drugs to patients."

(ABOVE, LEFT) Charles J. Rosser, M.D.



Hawai'i Natural Energy Institute

Guiding the State Toward Energy Independence

With a deep blue ocean, gentle trade winds and endless sunshine—Hawai'i is a picture-perfect postcard paradise.

However, as the most geographically isolated population center on Earth and as the most petroleum dependent state in the United States, Hawai'i has the dubious distinction of owning the highest electricity rates in the country—at almost twice the national average. Fortunately for island residents, many of the natural resources that make Hawaii a tropical vacation destination—also serve as abundant sources of clean energy.

Recognizing the importance of clean and renewable energy resources to the future of Hawai'i, the State of Hawai'i and the U.S. Department of Energy embarked on the Hawai'i Clean Energy Initiative (HCEI) in 2008—setting an ambitious goal to derive 70 percent its power from energy efficiency and renewable energy by 2030. In 2014, the target was reset to achieve a clean energy goal of 100 percent by 2045—making Hawai'i the first state to make such a bold commitment with a specific timeframe.

While this may seem like a daunting task for the state, there has been a research group diligently working behind-the-scenes toward the same goal. Established at the height of the energy crisis in the 1970s, the Hawai'i Natural Energy Institute (HNEI) based in the School of Ocean and Earth Sciences and Technology (SOEST) at the University of Hawai'i at Mānoa, was created to serve as a focal point for multidisciplinary research and education on the sustainable energy in Hawai'i. In 2007, the Hawai'i State Legislature created a statute for HNEI to coordinate and undertake in the development of Hawai'i's natural energy resources and in coordination with state and federal agencies—explore national and global energy solutions.

Last June, HNEI, in partnership with GE Energy Consulting, completed an analysis identifying various scenarios that would allow the islands of O'ahu and Maui to surpass Hawai'i's 2020 renewable energy targets while lowering electricity costs.

The study evaluated various mixes of renewable energy generation (primarily wind

and solar), different island-interconnection strategies, and changes to utility operations to identify cost-effective pathways to meet the state's Renewable Portfolio Standards (RPS) targets. Funding for the Hawai'i RPS Study was provided by the U.S. Department of Energy and the State of Hawai'i via the Energy Systems Development Special Fund that receives a portion of the State's barrel tax.

“This analysis shows that Hawai'i can cost-effectively achieve and even exceed the 30 percent goal for 2020 mandated by earlier legislation,” said John Cole, HNEI project leader. “For ACT 97, which requires 100 percent renewable electrical energy by 2045, this study provides a valuable tool to assess potential pathways to meet this aggressive goal while also maintaining a reliable system for everyone.”

Cole added, “The challenge with achieving 100 percent renewable energy has more to do with how to reliably store and distribute the electricity than with how the electricity is generated. The current grid isn't flexible enough to respond to rapid changes in energy supply



or demand, and energy storage is not yet cost effective. Intermittent sources like wind and solar are often ‘curtailed’ or purposely restricted, which is a waste of good energy.”

The study, which considered the islands of O’ahu and Maui, used the GE Multi-Area Production Simulation (MAPS) model to simulate the electric power system operation with varying amounts of utility-scale wind and solar, as well as increasing amounts of distributed rooftop solar photovoltaics (PV). The team coordinated with the local utility company to identify and model the generation mix expected to be in place by 2020.

A variety of utility operational changes including reduced minimums on thermal units, thermal unit cycling, demand response, alternate fuels (e.g. Liquefied Natural Gas or LNG) and adjustments to ancillary service procurement were evaluated in the analysis. Another GE model, the Multi-Area Reliability Simulation (MARS), was used to assess system reliability while operating with a significant contribution of intermittent wind and solar generation.

In addition to estimating production cost savings as reported in previous studies, this work also developed preliminary economic models to estimate the cost of additional power purchases, new grid equipment and

operational changes. This work, did not consider distribution level impacts or limitations, or the costs associated with changes to the distribution system.

“This modeling provides an independent look at the utility system and how changes to it and its operations can affect its costs and ability to accept additional renewables,” said Richard Rocheleau, director of HNEI. “The report and additional analyses that build upon it will provide regulators and other stakeholders with valuable information as we continue reducing our dependence on fossil fuels.”

Key findings of the study include:

- High levels of intermittent renewable energy generation with minimal curtailment can be achieved with modifications to electric system operations and infrastructure expected by 2020. With these changes, the islands of O’ahu and Maui can surpass the 2020 RPS goal while lowering electricity costs and increasing the reliability of the grid with or without island interconnection.
- Balanced growth of wind and utility-scale and distributed solar was shown to help reduce the aggregate variability and intermittency and the need for ancillary services on the grid relative to continued expansion of a single resource type.
- The use of natural gas as a transition fuel has the potential to substantially lower the cost of electricity, depending on cost projections for LNG and oil. The price will be dependent on the volume of LNG consumed, hence any cost benefit decreases as renewable penetration increases.
- Increased use of energy efficiency, demand response, and storage will be needed to maintain grid reliability with fewer thermal

generators on the system, as is projected by the utility.

- Inter-island transmission can facilitate more efficient use of resources, contribute to increased grid reliability, and enable increased renewable penetration by providing expanded siting options.

HNEI and GE are continuing this work, including analysis of frequency stability at both the system and distribution levels with larger amounts of wind and solar; a more detailed evaluation of the value (cost/benefit) of mitigation measures including advanced grid technologies such as storage, demand response and other ancillary services; an assessment of the impact of advanced transportation systems such as electric, and fuel-cell electric vehicles; and the risk of fuel price volatility. An initial report on the frequency stability of the Oahu grid with very high penetrations of rooftop solar was completed in April 2016, with additional reports to soon follow.

By harnessing its abundant natural energy resources, Hawai’i can end its reliance upon imported oil, help to reduce the effects of global warming and to help preserve its island paradise—thanks in part to the hard-working, behind-the-scenes researchers at the Hawai’i Natural Energy Institute.

(TOP, LEFT) An electric vehicle at the Fast-Fill hydrogen fueling station at Marine Corps Base Hawai’i
PHOTO: MITCH MCEWAN, HNEI

(ABOVE) A NWEI Azura wave energy conversion device deployed at the U.S. Navy’s Wave Energy Test Site (WETS) off Kāne’ohe, O’ahu. HNEI provides research support to the site.

Social Science Research Institute

Generating Innovative Solutions on Critical Social, Behavioral, Economic and Environmental Issues

"Hawai'i serves as a natural laboratory for social science research. With its multicultural population and unique geographical setting, it is an ideal location to conduct significant research and applied investigations that generate innovative solutions for critical social, behavioral, economic and environmental issues challenging Hawai'i and the Asia Pacific region," said Denise Eby Konan, dean of the College of Social Sciences at the University of Hawai'i at Mānoa (UH Mānoa).

The Social Science Research Institute (SSRI), housed within the College of Social Sciences, was established by UH Mānoa in 1961 in response to this opportunity. Today, SSRI's team of researchers, who collaborate across a broad range of disciplines, are leaders in the areas of health informatics, economics, environmental change, behavioral health and social innovation.



"SSRI is currently comprised of six major programs. These programs are great assets and provide unique social science perspectives in areas that play essential roles in the university's research efforts. One example is the TASI (Telecommunications and

Social Informatics) / PEACESAT Program of the Social Science Research Institute. Its overarching mission is to facilitate and conduct interdisciplinary and applied research in issues relating to health care disparities, including health care cost and value; health information technology; health care informatics; Information and Communication Technologies (ICT) and telecommunication services in underserved and rural locations," said Judith Inazu, acting director of SSRI.

Adds Inazu, "The United States and many other countries have initiated major transformations in the use of health information technology to improve patient safety, clinical care, healthcare system efficiency, bio-surveillance, public health reporting, and research in healthcare. With expertise in healthcare informatics policy, planning and technology systems, TASI is positioned to be a significant contributor in the use of emerging technologies to improve health outcomes."

SSRI's University of Hawai'i Economic Research Organization (UHERO) conducts rigorous, independent economic research on issues that are both central to Hawai'i and globally relevant. Its analyses are distributed widely to promote research-driven dialogue and inform public- and private-sector decision making in Hawai'i.

Since 1997, UHERO has established itself as the premier source for economic forecasts and analysis in the state. Its unique Data Portal provides access to a one-stop shop for local data and research on the visitor industry, income, employment, and other crucial indicators of Hawai'i's economy.

UHERO is also involved in research programs that address many of the key policy challenges facing Hawai'i and the Asia Pacific region. The Energy and Greenhouse Gas Solutions (EGGS) program is a



resource for individuals interested in issues of energy and greenhouse gas emission reduction. Utilizing a transdisciplinary approach to research, EGGS brings together economists, planners, engineers and system modeling experts to address issues related to energy, as well as climate change mitigation.

Project Environment applies formal economic analysis to the study of Hawai'i's key environmental issues, such as pollution control, water allocation and pricing, and control of invasive species.

The Hawai'i Coral Reef Initiative Research Program in SSRI supports research and monitoring to more effectively manage coral reef ecosystems in Hawai'i. It works with county, state and federal agencies and private organizations to: assess major threats to coral reef ecosystems; build management capability for more effective management; develop relevant database and information systems; conduct public awareness programs on threats to coral reef ecosystems; and implement education and training for coral reef scientists and managers.

The Hazards, Climate & Environment Program (HCEP) works with local and regional stakeholders and experts in physical and biological science, engineering, and social and cultural knowledge to assess risk



and vulnerability from hazards, climate change, and environmental degradation, and to develop risk reduction methods to build resilient communities.

SSRI's Office for Evaluation and Needs Assessment Services conducts program evaluation and needs assessment research primarily for public and private non-profit programs. The office provides continuing education and training, technical assistance and consultation, and opportunities to work with a multi-disciplinary team on complex public policy issues and programs.

Established in 1976 by the Hawai'i State Legislature, the Center for Oral History (COH) preserves the recollections of Hawai'i's people through oral interviews and disseminates oral history transcripts to researchers, students, and the general community. As a resource center for oral history materials, COH also develops books, articles, catalogs, brochures, photo displays, and videotapes.

The importance of the social sciences in solving today's complex problems is reflected in the growing research portfolio in the College of Social Sciences and its Social Science Research Institute. Since 2000, extramural funding levels have increased 284 percent, from just under \$4.3 million in 2000 to more than \$16.5 million in 2016.

University of Hawai'i

BOARD OF REGENTS

Randolph G. Moore
Chair

Jan Naoe Sullivan
Vice Chair

Eugene Bal III
Vice Chair

Simeon Acoba
Interim

Wayne S. Higaki
David Iha
Benjamin A. Kudo
Coralie Matayoshi
Michael T. McEnerney
Barry T. Mizuno
Jeffery Portnoy
Lee Putnam
Michelle Tagorda
Ernest K. Wilson
Stanford Yuen

SENIOR MANAGEMENT

David Lassner
President

Nainoa Thompson
Advisor on Hawaiian Affairs

Risa E. Dickson
*Vice President for Academic
Planning and Policy*

Jan Gouveia
*Vice President for
Administration*

Kalbert K. Young
*Vice President for Budget
and Finance/Chief
Financial Officer*

John F. Morton
*Vice President for
Community Colleges*

Garret Yoshimi
*Vice President for
Information Technology/
Chief Information Officer*

Carrie K. S. Okinaga
*Vice President for Legal
Affairs/University
General Counsel*

Vassilis L. Syrmos
*Vice President for Research
and Innovation*

CHANCELLORS

Robert Bley-Vroman
University of Hawai'i at Mānoa

Donald Straney
University of Hawai'i at Hilo

Doris Ching
*University of Hawai'i –
West O'ahu*

Rachel Solemsaas
Hawai'i Community College

Erika Lacro
Honolulu Community College

Louise Pagotto
Kapi'olani Community College

Helen Cox
Kaua'i Community College

Manuel Cabral
Leeward Community College

Lui Hokoana
*University of Hawai'i
Maui College*

Douglas Dykstra
Windward Community College

UH RESEARCH

From distant galaxies to the ocean depths ... and everywhere in between™



UNIVERSITY
of HAWAII®
SYSTEM

Office of the Vice President for Research and Innovation
2444 Dole Street, Bachman Hall 204, Honolulu, HI 96822
(808) 956-5006
www.hawaii.edu/research/

