

The sky isn't the limit for UH space



The idea is as simple as the goal is audacious: become the only university in the world with dedicated rocket-launch capability. The University of Hawai'i at Mānoa's Hawai'i Space Flight Laboratory is well on its way to turning concept into reality.

"No other university will have the capability to fabricate satellites, make instruments, launch the satellites and have students operate the satellites in space," says Luke Flynn, a Hawai'i Institute of Geophysics and Planetology specialist who serves as director of the spaceflight laboratory. "We coordinate the whole project."

A multidisciplinary program supported by a congressional appropriation through the Low-Earth Orbit Nanosatellite Integrated Defense Autonomous System, Hawai'i Space Flight Laboratory aims to promote research for space missions; validate small spacecraft technologies; train workers to support unmanned space missions; and promote collaboration between government, academia and industry.

Flynn represents UH as prime contractor for the Operationally Responsive Space Office, a Department of Defense initiative focusing on smaller satellites and launch vehicles. UH will partner with NASA on small spacecraft design. UH scientists will develop instrumentation, partnering with local businesses and NASA centers when possible. The Navy's Pacific Missile Range Facility on Kaua'i and on-site contractor, Sandia National Laboratories' Kaua'i Test Facility will provide the launch vehicle and support. Staff and students at three UH campuses will participate in ground station and mission operation functions.

The first of two planned demonstration launches is a year and a half away. It will test SPARK (for space-borne payload assist rocket-Kaua'i) and its newly designed launch rail system. The payload will be *Kumu A'o* (Hawaiian for "source of learning"), a satellite being built by Hawai'i students of Lloyd French, an HIGP associate specialist and spaceflight mission manager formerly with NASA's Jet Propulsion Laboratory.

The second launch, slated for 2013, will deploy *Hawai'iSat-1*. "It will fly a lot of UH-developed technology," says Flynn. The UH designed satellite will carry instrumentation designed by HIGP's Paul Lucey (see page 5) and Robert Wright, who has experience with satellite-based monitoring of volcanoes in HIGP and ship tracking as part of the tri-university Center for Island, Maritime and Extreme Environment Security.

Students in UH Mānoa's College of Engineering and School of Ocean and Earth Science and Technology will be involved every step of the way. Hawai'i Space Flight Laboratory builds on a decade of experience in small satellite design. Engineering students have been designing and fabricating their version in the UH CubeSat Laboratory. CubeSat is a catchphrase for a miniature satellite—think Rubrik's Cube, a container about 10 centimeters on a side that fits in the palm of your hand. Working with Professor of Electrical Engineering Wayne Shiroma, students address all aspects of satellite design and function—structure, power, attitude control, command and data handling and telecommunication.

One of the keys to building a better satellite is to do more on-board processing in space, transmitting relevant answers instead of large data streams, Flynn says. "A lot

flight lab

by Cheryl Ernst

of satellites in orbit now have less capacity than your cell phone.” Another advantage of going small is agility in meeting the need for rapid deployment of instrumentation for crisis management or disaster mitigation, Shiroma adds. In 2009 he and a team developed a rocket payload for launch from New Mexico in a mere 45 days.

That year, UH was one of only 11 universities nationwide to receive a \$110,000 award from the Air Force Office of Scientific Research’s University Nanosat Program. About 20 electrical and mechanical engineering students are designing and fabricating a radar calibration CubeSat. Under a \$400,000 Office of Naval Research grant, students are developing novel antennas for a CubeSat.

The UH experience is reflected in *Emergence of Pico- and Nanosatellites for Atmospheric Research and Technology Testing*, an American Institute of Aeronautics and Astronautics book co-edited by Shiroma. Chapters on microthruster propulsion, mobile ground station design, retrodirective antenna systems and starting a university small satellite program have UH authors. Four of the nine student authors have since graduated to positions at Northrop Grumman Aerospace Systems. Tyler Tamashiro, a UH Regents Scholar and the 2008 Hawai’i Student Engineer of the Year, works on launch systems. Monte Watanabe, named one of the nation’s top five electrical engineering students in 2007, is designing satellite components.

Other graduates are working with Hawai’i Space Flight Laboratory. Lance Yoneshige is the small satellite structure and mechanisms engineer. Jeremy Chan, Zachary Lee-Ho, Reid Yamura and Michael Menendez are all on the *Hawai’iSat-1* engineering team. Miguel Nunes is designing mission operations with Trevor Sorensen, who was mission manager for the Clementine mission to the Moon.




Students build satellites. Far left: Mission coordinator Jeremy Chan, left, and electrical power systems engineer Reid Yamura with a model of the Hawai’iSat-1 they are readying for launch. Above: Zachary Lee-Ho tests the attitude control system. Below: Monica Umeda and Nick Fisher develop electrical systems for a CubeSat miniature satellite.

One of the goals of Hawai’i Space Flight Laboratory is to prepare students for careers in aerospace industry, says Flynn. As director of UH’s NASA-supported Hawai’i Space Grant Consortium, he fosters opportunities across the UH System, such as a planned telemetry project with Kaua’i Community College to involve students in data collection. “The Pacific Missile Range Facility has numerous job openings for telemetry engineers and technicians,” he observes. He is also working with Kaua’i Professor Francis Takahashi on a campus lab that will track satellites and Windward Community College Professor Joe Ciotti on outreach activities.

The collaboration also dovetails nicely with the university’s EPSCoR (Experimental Program to Stimulate Competitive Research) effort to boost educational activities that will make the United States more competitive in science, technology, engineering and mathematics. Together, Space Grant and EPSCoR bring about \$1 million a year to UH. Hawai’i Space Flight Laboratory adds another \$4 to \$5 million a year.

It’s an expensive business. The Hawai’i Space Flight Laboratory orbiters will cost \$2–\$3 million each and the launch itself about \$10 million. Still, that’s big savings over the bulky satellites and launch vehicles currently used by government and commercial operations. And the waiting list for a ride on those launches is long. Proving Hawai’i’s capability to do small satellite research and development and launch payloads could create a new state industry.

“We’re looking for opportunities for companies to come in and build components,” Flynn says. “We hope to be self-sustaining,” sharing the cost of future launches with research institutions and innovative companies who want to run experiments or test products in space. 

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