

# Nā Hūakāi

THE VOYAGES

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## Big Achievements for Students Working on Small Satellites



Blaine Murakami

Wayne Shiroma, Associate Professor of Electrical Engineering

Providing undergraduates the opportunity to do research: is it primarily a charitable outreach effort, or does it really provide long-lasting benefits to the student? By the numbers, of the 12 HSGC undergraduate fellows and trainees that I have mentored since 1997, over half have gone on to graduate work (three are pursuing or have received their Ph.D. degrees and another four are pursuing or have received their M.S. degrees). Collectively, the 12 students have co-authored one book chapter, five journal papers, 22 conference papers, and three provisional patents.

But it's really the personal stories that convince me that HSGC undergraduate research is what helps nurture good students to become excellent students—even those that are nationally recognized. The University of Hawai'i's latest success story is **Blaine Murakami**, who received the 2005 **Alton B. Zerby and Carl T. Koerner Outstanding Electrical and Computer Engineering Student Award**, presented by the national electrical engineering honor society Eta Kappa Nu to recognize the most outstanding electrical engineering undergraduate student in the nation. In the past five years, UH students have won this award three times. **Kendall Ching** was the recipient in 2001 and **Aaron Ohta** was the recipient in 2003, and like Blaine, were both HSGC Undergraduate Fellows.

In just four years as an engineering undergraduate, Blaine has racked up an impressive list of achievements. He co-authored one book chapter and 13 conference papers, is a co-inventor on a pending patent, and was the student principal investigator on a \$100,000 extramural award. As a junior, Blaine co-founded a high-technology company which is developing self-steering antenna technology of which Blaine is a co-inventor.

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**UH engineering undergraduates at the Colorado Space Grant Consortium's 2002 Balloonsat launch site. (l-r) JUSTIN AKAGI, JASON AKAGI, BLAINE MURAKAMI, and AARON OHTA. Justin Akagi, currently a 2005 HSGC Fellow, will start his M.S. program at UH in January 2006 and will direct the fourth phase of UH's CubeSat Program. Jason Akagi, a 2002 HSGC Fellow, directed the Command and Data Handling Team of UH's first CubeSat and helped UH win a \$50,000 grant for its fourth CubeSat. Aaron Ohta, currently pursuing his Ph.D. at UC Berkeley, won the Zerby Award in 2003 and served as UH CubeSat Project Director from 2001–2003.**

Blaine started participating in space-related activities as a freshman through his involvement on the CubeSat Project, in which students design, build, and launch a small satellite into low-earth orbit. In the summer following his freshman year, he received a NASA Undergraduate Fellowship from HSGC. Blaine used this award to support his summer work on the CubeSat, which is awaiting a Russian launch later this year. That same summer, Blaine attended the Colorado Space Grant Consortium's Starting Student Space Hardware Programs: A How To Workshop, the first of an annual workshop under the excellent direction of Chris Koehler. Together with three other UH students, Blaine constructed a "balloonsat" that was launched on a weather balloon to 100,000 feet.

As a sophomore, Blaine, together with two other HSGC undergraduate fellows, wrote a proposal to the University Nanosat Program, sponsored by the Air Force Office of Scientific Research and administered by the Air Force Research Laboratories and NASA. We were delighted when UH was one of 13 universities selected nationwide to receive a \$100,000 grant.

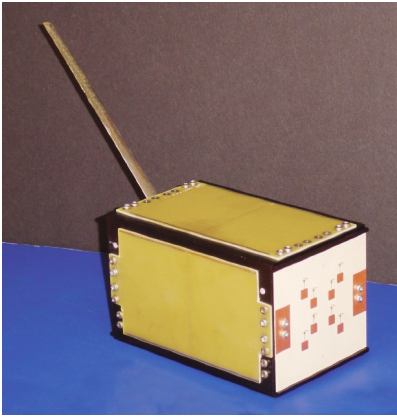
Blaine's impressive set of achievements aren't limited to just academics. As a junior, while enrolled in a graduate-level management course purely for his own interest, Blaine became aware of the UH Business Plan Competition, in which teams vie for \$70,000 in start-up seed money. Blaine teamed up with four others to write a business plan based on his patent-pending self-steering antenna technology. As part of the process, Blaine had to blend his technical knowledge with

that of financing, marketing, legal, and other commercialization-related issues. In the end, Blaine delivered the winning

presentation to a panel of venture capitalists, and the company, Pipeline Communications and Technology, Inc. took first place in this competition out of a field of 60 entries, winning \$45,000 in award money. Pipeline has since secured over \$250,000 in contract funding from the Office of Naval Research.

The sheer breadth and variety of experiences that Blaine has encountered during his four years in college also translates into a far-reaching network of contacts—one that is far more extensive than the average 22-year-old (and quite possibly more extensive than some 32- and 42-year-olds as well!). Blaine has interacted not only with his electrical engineering professors at UH, but many, many others: UH faculty from mechanical engineering, biosystems engineering, geology and geophysics, and accounting; the director of our university technology transfer office; a patent lawyer; program managers from the Air Force Research Laboratory Space Vehicles Directorate (Kirtland Air Force Base, Albuquerque, NM) and NASA Goddard (Greenbelt, MD); an aerospace engineering professor and his research group from CalPoly (San Luis Obispo, CA); managers from Boeing (Kihei, Maui), Northrop Grumman Space Technology (Redondo Beach, CA), and NovaSol (Honolulu, HI); an amateur radio operator (Fredonia, NY); the director of business development for a defense consulting firm (Tokyo, Japan); and the second-in-command of a USAF squadron providing direct nuclear command and control communications to the US President and Secretary of Defense (Offutt AFB, NE).

# Higher Education



One of two CubeSats that Blaine's team developed under the University Nanosat Program. The structure measures 10 x 10 x 15 cm. Solar cells (not shown) are on five of the faces, and a circularly polarized, two-dimensional self-steering antenna array is shown on the remaining face. The mission is to demonstrate novel self-steering crosslinks for CubeSat networks.

Blaine's story is indeed one of a most impressive young man: how early research experience gradually led to publications, extramural research funding, conference presentations, leadership skills, and entrepreneurship. I can think of no other 22-year-old who has developed such a wide-ranging breadth of experience. None of these achievements have jaded him, however. Anyone that knows Blaine also knows that he is a model of humility, helpfulness, and genuineness. The only closing thought I have is that if this is what we've seen of Blaine as an undergraduate, wait till he finishes graduate school and enters the workforce... we ain't seen nothing yet!

*Nā Hualakēi*

## Internship Program Receives Praise from Hawai'i Students

*The Hawai'i Space Grant Consortium awards undergraduate internships to students at the University of Hawai'i system.*

The goals of Hawai'i Space Grant Internship Program are to (1) help strengthen Hawai'i capabilities in STEM (Science, Technology, Engineering, and Mathematics) fields, (2) help prepare the future generation of scientists and engineers to replace retiring NASA and other highly-technically skilled employees, and (3) upgrade the overall technical capability of Hawai'i's workforce by encouraging on-the-job training and subsequent retention of undergraduate students here in Hawai'i. The awards are given for participation in a semester of STEM-related research at a Hawai'i company and provide a stipend of \$3000 for an initial semester to each recipient. Given a successful semester of work, the Hawai'i host company then provides at least one matching semester of support for the continued internship of the student.



During the Summer of 2004, the HSGC sponsored two interns, **Blaine Murakami** (Electrical Engineering) and **Howard "Chip" Richards** (Mechanical Engineering) at the high-tech engineering and remote sensing firm, NovaSol. Chip wrote the HSGC a letter about his experience: "The Space Grant Intern Program was set up to 'upgrade the overall technical capability of Hawai'i's workforce...' This is exactly what this program has done for me. NovaSol is a 21st century company, with a 21st century attitude, that has the resources to hire interns in Hawai'i. The group that I work with has helped me get up to speed quickly and I am learning new things every day... The exposure that I have gotten is priceless. I would highly recommend this program to any engineering student and I hope to see the program expanded. In my opinion, this program is the best opportunity for a Mechanical Engineering student at the University of Hawai'i."

After positive 2004 experiences with its first interns, the HSGC is working to formalize relationships with host companies which includes drafting a Memorandum of Understanding between the University of Hawai'i and potential host companies. Once the MOU is completed, interns may be placed in positions as early as Spring 2006.



# “Satellites” Spotted in Mānoa!

*Wonder what that thing is attached to a balloon flying by at low altitude? It may be CanSat!*

Five of our community college partners in the Hawai'i Space Grant Consortium have started engineering programs at their campuses where students get hands-on experience designing, building, and testing CanSats. A CanSat is a scientific experiment package that can fit into a soda can. Some of these experiments include retrieving photographic, temperature, pressure, and altitude data for near-Earth, low-atmosphere experiments.

Honolulu (**Ronald Takata**), Kapi'olani (**John Rand**), Leeward (**Roger Kwok**), Maui (**John Pye**), and Windward (**Joe Ciotti** and **Jake Hudson**) Community Colleges are taking part in the CanSat program and have students who are actively building small satellites. Teams are learning how to telemeter or send data from their balloon-borne satellites to the ground.



**Master's Apprentice LANCE YONISHIGE explains the functionality of a CubeSat, designed and built by UH-Mānoa students, during the Honolulu Community College CanSat Launch Day.**



**Members of the Honolulu Community College CanSat Team and the Honolulu Community College Administration preparing for launch on April 6, 2005. The event capped a morning of activities centered around CanSat.**

In addition to balloons, other modes of transportation for CanSats include parachutes (dropped from tall campus structures or possibly from airplanes) or rocket launches. Thus far, Honolulu (see photo above) and Kapi'olani Community Colleges have launched CanSats attached to weather balloons. Windward Community College is looking into the rocket-propelled CanSat and had a successful “drop” from the University of Hawai'i parking structure

during the Undergraduate Research Symposium in May, 2005.

Future plans for the CanSat program include inter-campus communication with multiple CanSats, construction of one multi-functional CanSat with each Community College building the separate components, and participation in the summer CanSat competition held each year in California.

# GG 460 Rocks!

*For the past five years, the Hawai'i Space Grant Consortium has sponsored the Geology and Geophysics 460: Geological Remote Sensing course.*

GG 460 was originally started as an in-service workforce development class designed to highlight NASA advances in remote sensing instrumentation and data products. The course, taught late in the afternoon, is popular with working professionals as well as undergraduate and graduate students at the University of Hawai'i at Mānoa. The former group of non-traditional students hails from many corners



**Intrepid GG 460 students from the 2004 class pick their paths carefully down Kīlauea's south flank while in search of active lava.**

of the workforce including State and local government, various military branches, and numerous high-tech businesses.

Remote sensing gurus **Scott Rowland** and **Robert Wright** teach a "packed to the rafters" course that is limited to 20 students every Spring semester. The course syllabus covers topics such as the physics of light and remote sensing, NASA remote sensing instruments and data, data processing, and geological applications of remote sensing data. The centerpiece of the course is a "hands-on, computers-on" weekly lab that plunges into image processing using ENVI software. The course culminates in a memorable final project in which all students must create a geologic map from remote sensing data and field observations collected on the Big Island over a three-day period. Day 1 of the



**The 2005 GG 460 class (lead by Robert Wright, far right) at the Mauna Iki site.**

fieldtrip centers on a search for active lava at Kīlauea Volcano in order to validate thermal remote sensing observations. Days 2 and 3 are focused on traversing the Mauna Iki field area to corroborate radar, visible-near-IR, and thermal image anomalies with features on the flow field.

## Undergraduate Symposium

Since 1999 Hawai'i Space Grant Consortium has partnered with the Honors Program at the University of Hawai'i at Mānoa to host an annual symposium dedicated to undergraduate research and creative projects. The coalition of sponsors has grown to also include the Marine Option Program, Global Environmental Science Program, College of Tropical Agriculture and Human Resources, the Marine Biology Program, Biology Program, Department of English, and the Office of the Mānoa Chancellor. Held at the end of Spring semester, the symposium is a celebration of the scholarly and creative work of our students above and beyond the classroom curricula.

The symposium held April 29 & 30, 2005, showcased the work of 90 students, including the 14 Space Grant Fellows and Trainees of the Spring 2005 semester. Abstracts from this year's symposium and from previous years are online at [undergradsymposium.higp.hawaii.edu](http://undergradsymposium.higp.hawaii.edu).

The next Symposium is scheduled for April 28 & 29, 2006.

*Na Hualakai*



# Undergraduate Fellowships and Traineeships: Fall 2005

## Fellowships

*Undergraduate Fellowships are awarded to full-time students at the University of Hawai'i campuses at Mānoa and Hilo. Awards are given for space-related research with a mentor and provide a stipend of \$3000 per semester to the student. Fellows are also eligible for travel and supply funds. In previous semesters, these funds have been used for activities including observing runs at the Mauna Kea telescopes, fieldwork to collect ground-truth information for interpreting satellite data of the Hawaiian Islands and other locations, and travel to meetings to present project results.*

### Mānoa Fellows

**Justin Akagi**, a senior in Electrical Engineering, is analyzing power budgets for energy production and consumption for small-satellite applications. Justin's project, titled "Power Generation and Distribution System Design for the LEONIDAS CubeSat Network" focuses on a low-Earth orbit nanosatellite cluster network, which is a joint venture of the Hawai'i Space Grant Consortium and the UH College of Engineering. **Dr. Wayne Shiroma** of the Department of Electrical Engineering serves as mentor.

**Matthew Bell**, a senior in Anthropology, will continue his work with mentor **Dr. Terry Hunt** of the Department of Anthropology on remote sensing techniques applied to archaeology and historic preservation. Matthew's project, titled "Archaeology on Easter Island" emphasizes the use of QuickBird satellite imagery and GIS mapping techniques to document monumental ceremonial platforms on Rapa Nui.



Matthew's work includes the development and field testing of a kite aerial photography rig.

**William Carrier**, a sophomore in Physics, will continue experiments under the guidance of mentor, **Dr. Ralf Kaiser** of the Department of Chemistry, to characterize infrared spectra of germanium-carrying molecules in low temperature ices. His project titled, "Chemistry of Germane and Methane in the Atmospheres of Jupiter and Saturn," will aid our understanding of the origin and evolution of the atmospheres of giant gas planets, and the data will be useful for future astronomical searches with infrared spectroscopy.

**David Gremminger**, a senior in Geology and Geophysics, will continue to use images from Viking Orbiter and Mars Orbiter Camera to study the surface of Mars; in particular, the physical characteristics and rates of formation and fading of slope streaks. Mentor **Dr. Norbert Schorghofer** of the Institute for Astronomy supervises David's project, titled "Decadal Variability in Slope Streak Activity on Mars."

**Tyson Kikugawa**, a junior in Electrical Engineering, is working on a project titled, "Systems Integration and Stabilization of a CubeSat" addressing the crucial aspects of overall configuration and stabilization of a satellite. This project is part of the larger UH Small-Satellite Program championed since 2001 by faculty and students in the UH College of Engineering. **Dr. Wayne Shiroma** of the Department of Electrical Engineering will serve as mentor.

**Kin Wai Leung**, a senior in Mechanical Engineering, will work with mentor **Dr. Beei-Huan Chao** of the Department of Mechanical Engineering to study the burning and extinction of diffusion flames in space through analytical and numerical modeling. Kin Wai's project is titled "A Theoretical Investigation of the Kinetic and Radiative Extinction of Spherical Diffusion Flames in Microgravity."

**Brandon Merz**, a senior in Physics, will work on instrumentation for ANITA (Antarctic Impulsive Transient Antenna), an experiment developed to search for ultra-high-energy neutrino interactions in the Antarctic ice cap using a cluster of balloon-borne antennas. Working under the guidance of mentor **Dr. Gray Varner** of the Department of Physics and

**Landsat image of the island of O'ahu, showing the location of the Mānoa campus of the University of Hawai'i.**

Astronomy, Brandon will study the triggering system in his project titled, “Development of a Trigger Unit for Radio Frequency Optimization for Neutrino Detector in Antarctica.”

**Shelly Migita**, a senior in Mechanical Engineering, will work with mentor **Dr. Marcelo Kobayashi** of the Department of Mechanical Engineering on a project titled, “Effects of Low Reynolds Numbers on the Aerodynamics of Micro-Air Vehicles.” Shelly’s interests in aeronautics are well suited for her study of computational fluid dynamics models of different wing geometries to better understand the aerodynamics of small, unpiloted aerial vehicles.

**Carolyn Parcheta**, a sophomore in Geology and Geophysics, will pursue her interests in planetary geophysics with a study of flow velocities and volume fluxes for lava flows on Olympus Mons, Mars. Using Mars Orbiter Camera data and THEMIS thermal remote sensing images, Carolyn will make use of digital image processing and analytical techniques in her project, titled “Estimating Effusion Rates for Olympus Mons, Mars.” **Dr. Sarah Fagents** of the Hawai’i Institute of Geophysics and Planetology will serve as mentor.

**Gabriel Wofford**, a senior in Global Environmental Science, will continue working with mentor **Dr. Terry Hunt** of the Department of Anthropology on a project titled, “Analysis of Satellite Imagery Documentation of Archeology on Rapa Nui.” Using QuickBird satellite imagery, image analysis, GIS spatial mapping, and ground-truth fieldwork, Gabriel’s project is helping to document prehistoric practices on Rapa Nui (Easter Island).

## Hilo Fellows

**Walter (Eli) Bressert**, a senior in Astronomy and Mathematics, will work with mentor **Dr. Michael West** of the Department of Physics and Astronomy on a project utilizing statis-



tical models with Hubble Space Telescope data of globular clusters. Eli’s project, titled “Reconstruction of the Evolution of Galaxies using the Extended-Press-Schechter Model with Globular Clusters” will provide quantitative constraints on the merger histories of individual galaxies.

**Sarah Knights**, a senior in Astronomy, is continuing her project on star formation using Hubble Space Telescope data to analyze the number and dynamics of young binary star systems. Sarah’s project, titled “Determining the Distribution of Young Binaries in the Orion Nebula Cluster” also includes observing time at the UH 88-inch telescope at Mauna Kea. **Dr. Bo Reipurth** of the Institute for Astronomy is serving as mentor for this research.

## Traineeships

*Undergraduate Traineeships are awarded to full-time students at the University of Hawai’i campuses at Mānoa and Hilo, University of Hawai’i Community Colleges, and at the University of Guam. The awards provide laboratory training and practical experience with a mentor in any space-related field of science, technology, engineering or math. Trainees receive a stipend of up to \$1000 per semester and may be eligible for additional supply funds.*

### Mānoa Trainee

**Tyler Tamashiro**, a junior in Electrical Engineering, will work with mentor **Dr. Wayne Shiroma** of the Department of Electrical Engineering on a project titled, “Intersatellite Communication Network for Picosatellite Clusters.” Tyler will study various networking methods and applications for a cluster of picosatellites. This project is part of the larger UH Small-Satellite Program championed since 2001 by faculty and students in the UH College of Engineering.

## Application Deadlines

Application deadlines for undergraduate fellowship and traineeship are **December 1 for Spring** semester and **June 15 for Fall** semester.

Download fillable application forms and get additional information at our web site at [www.spacegrant.hawaii.edu/fellowships.html](http://www.spacegrant.hawaii.edu/fellowships.html).

*Nā Huakāi*

Landsat image of the “Big Island” of Hawai’i, showing the location of the Hilo campus of the University of Hawai’i.

**Luke Flynn**, *Hawai'i Space Grant Director*, summarizes research opportunities that are helping to chart new directions of exploration at the University of Hawai'i—a thriving research institution, especially in the sciences. The Institute for Astronomy (IFA) and the School of Ocean and Earth Sciences and Technology (SOEST), the two units most concerned with space science, are world-renowned and bring in \$70 million in research grants every year. The Hawai'i Institute of Geophysics and Planetology, which is part of SOEST and is the parent organization for Space Grant, is awarded almost \$10 million in grants a year.

The Hawai'i Space Grant program facilitates research by providing development funds for opportunities that would not otherwise be available. HSGC also plays an active role in promoting research at UH Hilo and the Community Colleges. Primarily, HSGC supports research in four ways:

- **Undergraduate Fellowships and Traineeships:** the core of HSGC programs, these offer exciting NASA-related research opportunities for undergraduate students.
- **Workforce Internships:** offer undergraduate students research experience in the work place.
- **Master's Apprenticeships:** a research and workforce development program for graduate students. Currently, HSGC is supporting two students in small satellite construction, but we will soon be adding (January, 2006) a student interested in thermal remote sensing of volcanoes. Master's Apprentices can also be supported to complete a Master's thesis at one of Hawai'i's many high tech companies.
- **Faculty Seed Grants:** On occasion, HSGC will grant faculty seed grants of up to \$10,000 to jump-start new research initiatives. These seed grants are given with three caveats: (a) The NASA-related research should be in a new or growing field that is likely to lead to future funding. (b) The research should involve undergraduate students as active participants. (c) The work must lead to a proposal to NASA or an extramural funding agency.

## Current Research Foci

HSGC research focuses on three categories that are important to NASA's interests; (1) Small satellite design, (2) Terrestrial remote sensing, and (3) Space science.

### Small Satellite Design

Our interactions with the College of Engineering have created many research opportunities for undergraduates. The centerpiece of this is the CubeSat small satellite program started here in 2001 (*see cover story*). CubeSat is partially sponsored by HSGC workforce development funds. This remarkable program is mentored by **Carlos Coimbra** (Mechanical Engineering, HSGC Associate Director for Aerospace Engineering) and **Wayne Shiroma** (Electrical Engineering), and is driven by undergraduate engineering students. Fifty-four students formed 6 design teams to work on the project. This is a challenging project that will require careful organization, project management, and fund raising. The students were successful in obtaining a \$100,000 NASA/Air Force grant to build a similar Nanosat satellite. As a result of CubeSat success, HSGC sponsors related CanSat projects at the Community Colleges.

This work is leading to numerous other opportunities that will come to fruition in the next five years. We have submitted supplementary proposals for small satellite fabrication. We are also building support for a much larger endeavor to launch 110 nanosats into low Earth orbit as part of the LEONIDAS (Low Earth Orbit Nanosat-Integrated Defense Autonomous System). **Lloyd French** has joined forces with HSGC to help with the small satellite effort, a student-run Mars orbiter program, as well as the CanSat program. Lloyd brings to our team his expertise in mission development.

### Terrestrial Remote Sensing Program

Remote sensing is one of the great strengths of the University of Hawai'i at Mānoa. With Space Grant funding, **Luke Flynn** and **Scott Rowland** developed and taught a senior-level course in remote sensing (*see GG460 article on page 5*). The course is taught each Spring by Rowland and **Robert Wright**. It has spawned many research ideas and influenced both graduate and undergraduate students to consider remote sensing projects. While there are many different projects that HSGC has supported, our primary interest is thermal remote sensing of active volcanoes. HSGC has helped to support both field-based and remote monitoring efforts. Funds from the HSGC supports





Graduate students **LEON GESCHWIND** and **STEVE SAHETAPY-ENGEL** perform temperature measurements to determine cooling rates of active lava flows. These data are then compared with remote sensing observations from NASA's Landsat 7, Hyperion, and MODIS instruments.

the MODIS and GOES Thermal Alert web sites ([modis.higp.hawaii.edu](http://modis.higp.hawaii.edu) and [goes.higp.hawaii.edu](http://goes.higp.hawaii.edu), respectively). These real-time volcano monitoring sites provide updates of activity to volcanologists worldwide. In January, HSGC will support a thermal remote sensing student through the Master's Apprenticeship Program to work with data from the GOES and MODIS sites. HSGC also supports the development of future thermal remote sensing instruments that will serve as the data gathering tools for the LEONIDAS small satellite program.

## General Space Science Overview

During the coming years, space science research will focus on understanding the geochemistry of the Moon and Mars (HSGC Associate Director **Jeff Taylor** is on the Mars Odyssey Gamma Ray Spectrometer Team.) Part of his Mars research involves understanding the role of water in the evolution of the Martian crust, a central theme of the Hawai'i NASA Astrobiology Institute (Taylor is a Co-Investigator.) HSGC collaboration with the Astrobiology Institute will lead to numerous opportunities for undergraduate and graduate education, teacher training, and public outreach. Taylor is also involved in four instrument proposals for the 2009 Mars Science Laboratory mission.

Another focus for HSGC is future human and robotic space exploration. During the next five years this will be a central part of the work Jeff Taylor will do, along with students funded separately. This work falls into two major

Continued on page 10

*A variety of K-12 education projects bring hands-on experiments, gadgets, and the excitement of space exploration to thousands of students and parents alike. Here is a sampling of what's happening this year.*

## Space Explorers FESTIVAL

*(FEST=Families Exploring Science Together)*



At a Space Explorers FESTIVAL, children and their parents are partners in a night of discovery and hands-on science experiences. According to program directors Art and Rene Kimura, "We wanted to make science more of a family event, rather than the kids coming home from school to talk about it." The excitement and fun are obvious during these busy, fast-paced

FESTIVALS that feature not only science demonstrations and hands-on activities, but also information about NASA-supported educational opportunities, such as SHARP, Botball robotics, NASA Explorer Schools, and Future Flight Hawai'i. The free programs, offered to schools statewide during the academic year, are enjoyed by four thousand participants annually.

## Future Flight Hawai'i

Future Flight Hawai'i is a space-themed, summer educational program designed to catalyze a child's interest in science, technology, and the future. Over the past 15 years, more than 6,000 student and parent participants have voyaged on journeys of exploration to the Moon, Mars, and our own planet, Earth. During the summer of 2005 Hilo and Lihue hosted the five-day Day Exploration program, Hilo and Kihei hosted the five-day RoboTech program, and Honolulu hosted a weekend Family program. Perhaps the ongoing success of these summer programs is best expressed by



one of its students, "Next year, my family is going to Disneyland. I would rather come back to Future Flight." More information can be found online at [www.higp.hawaii.edu/futureflight/](http://www.higp.hawaii.edu/futureflight/).

## Hawai'i Botball Robotics Regional Tournament

2005 marked the second year that Hawai'i students were able to participate in Botball, the



energetic robotics program where students learn practical applications of science, technology, engineering, and math. Hawai'i Space Grant Consortium, the UH College of Engineering, Hawai'i Convention Center, and the Hawaiian Electric Company were partners in hosting the second annual Hawai'i Botball Regional program during the Spring term. Hawai'i Space Grant provided funding and in-kind support for a local two-day workshop for mentors and the tournament.

Twenty-seven teams from twenty-five schools (middle and high schools) participated in the seven-week program of designing, building, and programming mobile robots with customized, \$1000 Lego robot kits with sensors, cameras, and programming software. Students also maintained a web site to document their robot-building process before meeting at the Regional Tournament at the Hawai'i Convention Center held April 16, 2005. Overall Tournament winners were 1st: Maryknoll High School; 2nd: Waiakea High School #194; 3rd: East Hawai'i Homebots, and 4th: Takamatsu Kogei High School, Japan. This exciting program will happen again in Spring 2006. More information can be found online at [www.botball.org](http://www.botball.org).

## Astronaut Ellison Onizuka Science Day and Astronaut Lacy Veach Day of Discovery

Hawai'i's first two astronauts, **Ellison Onizuka** and **Charles Lacy Veach**, are honored each year with special programs that pay tribute to their legacies of exploration and service. Each full-day event attracts six hundred participants to its science workshops, demonstrations, displays, and keynote speakers. One hundred fifty volunteers and facilitators help each event to run smoothly.

The 6th annual Astronaut Ellison Onizuka Science Day will be held at the University of Hawai'i Hilo campus on



January 28, 2006. For students in grades 4 and above, parents, and teachers, the day remembers Astronaut Onizuka who was a crew member of STS 51-L, *Challenger*. The Science Day is a collabora-

tion of the Hawai'i Space Grant Consortium, Onizuka Memorial Committee, the Astronaut Ellison Onizuka Space Center in Kona, and the University of Hawai'i at Hilo, with the financial support of American Savings Bank. More information and online registration can be found at [www.spacegrant.hawaii.edu/OnizukaDay](http://www.spacegrant.hawaii.edu/OnizukaDay).

The 4th annual Astronaut Lacy Veach Day of Discovery will be held at Punahou School, Honolulu on October 29, 2005. The day gathers students in grades 4 and above, parents, and teachers for an inspirational look at voyages of the past, present, and future. The keynote speaker this year is **Nainoa Thompson**, the noteworthy navigator of Polynesian voyaging canoes and a close friend of Lacy Veach. This day is a collaboration of the Hawai'i Space Grant Consortium, Punahou School, and the Hawaiian Electric Company. More information and online registration can be found on our web site at [www.spacegrant.hawaii.edu/Day-of-discovery](http://www.spacegrant.hawaii.edu/Day-of-discovery).



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### Research (from page 9)

categories: lunar and Martian resource development and planning for the human and robotic return to the Moon and then to Mars (see the "Strategic Planning" article on the next page). Taylor is involved with several research projects to explore for space resources and to extract and process them for useful mission products, especially propellant.

Space science research is highlighted in one of our most visible outreach activities, the online journal called "Planetary Science Research Discoveries." The articles focus on and explain the exciting discoveries being made by cosmochemists and other planetary scientists. Our objectives are to improve public understanding and appreciation of science. The website is at [www.psrđ.hawaii.edu](http://www.psrđ.hawaii.edu).

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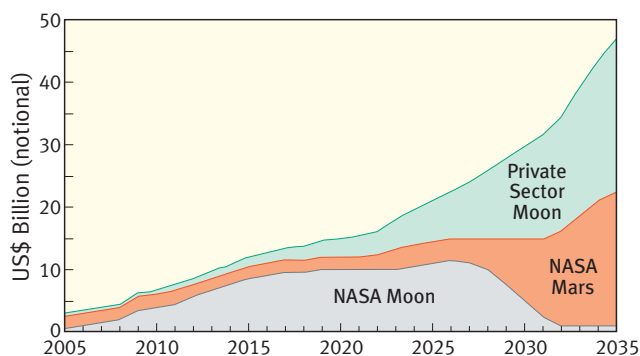
# Strategic Planning

## HSGC Associate Director Helps NASA Make Roadmaps to the Moon, Mars, and Beyond

**JEFF TAYLOR**, *Hawai'i Space Grant Associate Director for Space Science*, spent the first half of this year serving on two NASA committees developing roadmaps to implement President Bush's Vision for Space Exploration. One group developed an overall strategy for exploring the Moon; the other focused on identifying what technologies were needed for human systems and mobility in space exploration. He was also appointed the first chair of the Lunar Exploration Analysis Group (LEAG), a community-based, interdisciplinary forum. Taylor earned countless frequent flyer miles attending these meetings.

### Strategizing lunar exploration

The Robotic and Lunar Exploration Strategic Roadmapping Committee, chaired by then Associate Administrator for Exploration Systems Craig Steidel, did not complete its deliberations before NASA Administrator Mike Griffin halted all roadmapping activities. Nevertheless, the committee made substantial progress resulting in a useful set of recommendations. One of the most interesting was an emphasis on the importance of involving the private sector as a partner with government in lunar exploration and long-term settlement. This will allow management and funding to be gradually transferred to the private sector when NASA decreases



**Private investment in lunar and cis-lunar infrastructure eliminates need for continued NASA funding of lunar operations once a decision is made to proceed with human missions to Mars.**

its focus on the Moon and sends humans to Mars. Jeff Taylor organized much of the discussion of private sector involve-

ment in lunar exploration, tapping into the frontier space community. This is a classic Space Grant role: cooperation with industry.

### Human systems and mobility

Taylor co-chaired the Human Systems and Mobility Capabilities Roadmapping Team with Chris Culbert, an engineer at the Johnson Space Center. This team focused on a wide-ranging set of capabilities that support human exploration activities in space and on planetary surfaces. It includes capabilities to allow scientific observations, resource and site evaluation, instrument deployment, facility/spacecraft assembly and servicing, and efficient, affordable mission operations. This capability is divided into four major divisions:

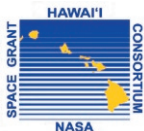
- **Crew-Centered Operations:** Enables local planning and control of operations without extensive ground support to provide safe, efficient, and cost-effective operations.
- **Human Exploration:** Enables efficient access to exploration targets, with in situ observations & analyses
- **Mobility:** Enables movement and transport of crew and equipment in space and on planetary surfaces.
- **Assembly, Deployment, & Servicing:** Enables construction and servicing in space and on planetary surfaces.

### In LEAG with NASA

In a moment of weakness, Taylor agreed to chair a committee designed to solicit ideas and opinion from the broad lunar exploration community. Called the Lunar Exploration Analysis Group (LEAG for short), it analyzes scientific, engineering, technology, and operational issues associated with lunar exploration to support the Vision for Space Exploration. It has had an active year and is co-organizing a Conference on Lunar Exploration to be held October 25–28, 2005, in Houston.

*Nā Huakāi*





# Hawai'i Space Grant Consortium Events

## 2005

### SEPTEMBER

- 1 & 2 Informative Fellowship & Traineeship meeting

### OCTOBER

- 14 & 15 HIGP/SOEST Open House (POST Building)
- 25 & 26 Space Explorers FESTivals (FEST=Families Exploring Science Together)
- 29 Astronaut Lacy Veach Day of Discovery (Punahou School, Honolulu)

### NOVEMBER

- 14-17 Space Explorers FESTivals
- 19 Fellowship & Traineeship Meeting/Associate Director's Meeting

### DECEMBER

- 1 Spring 2006 Fellowship & Traineeship Application Deadline
- 6-8 Space Explorers FESTivals
- 8 University of Hawai'i at Mānoa Fall session ends

## 2006

### JANUARY

- 9 University of Hawai'i at Mānoa Spring session begins
- 23-26 Space Explorers FESTivals
- 28 Astronaut Ellison Onizuka Science Day (UH Hilo, Hawai'i)

### FEBRUARY

- 13-17 Space Explorers FESTivals / Botball mentor workshop

### MARCH

- 7 Space Explorers FESTIVAL (Maui)

### APRIL

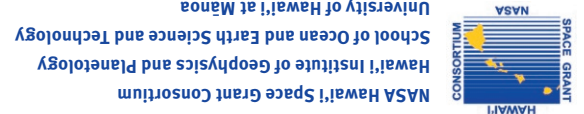
- 10-13 Space Explorers FESTivals
- 15 Botball Regional Tournament (Hawai'i Convention Center)
- 27 & 28 2006 FIRST Robotics Competition (In support of Hawai'i schools)
- 28 & 29 University of Hawai'i Undergraduate Research Symposium

### MAY

- 3 University of Hawai'i at Mānoa Spring session ends

### JUNE

- 15 Fall 2006 Fellowship & Traineeship Application Deadline



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### CONSORTIUM MEMBER CAMPUSES

University of Hawai'i, Mānoa

University of Hawai'i, Hilo

Hawai'i Community College

Honolulu Community College

Kap'olani Community College

Kaui Community College

Leeward Community College

Maui Community College

Windward Community College

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