

George R. Ariyoshi
999 Bishop Street, 23rd Floor
Honolulu, HI 96813

January 28, 2014

TESTIMONY IN SUPPORT OF SB2583 - RELATING TO THE PISCES AND NASA
LASER COMMUNICATIONS GROUND STATION INITIATIVE

Dear Members of the 27th State Legislature,

I strongly support the intent of this bill to provide matching state funding for an engineering assessment to enable the development of a laser optical communications ground station in Hawaii.

Since the beginning of the Space Age, NASA has communicated with its spacecraft through the use of Radio Frequency (RF) ground antennas. However, the ever increasing data rate requirements from more and more sophisticated instruments on future spacecraft will soon outstrip NASA's ability to support them with RF communications.

Space laser communications technology has the potential to provide 10 to 100 times higher data rates than traditional radio frequency systems for the same mass and power. Therefore, NASA has embarked on the development of technology for laser communications between its spacecraft and Earth. This new technology was successfully demonstrated in late 2013 with the Lunar Laser Communications Demonstration (LLCD) experiment aboard the Lunar Dust and Atmospheric Environment Explorer (LADEE) spacecraft, which is now orbiting the Moon.

NASA plans to introduce laser communication technologies with its next-generation spacecraft at the beginning of the next decade. In order to prepare for this new operational laser communication network, NASA has begun planning to establish a global network of laser communication ground stations.

As clouds present a major obstacle for laser communications in space, NASA recently conducted a sophisticated statistical analysis of weather patterns that resulted in a set of candidate locations in the US for its anchor ground station. This analysis indicated that of

all possible sites nationwide, Hawaii is the very best location for the first operational laser communication ground station. Therefore, NASA and PISCES have begun exploring the possibility of identifying a specific location in Hawaii for this station.

The site chosen must have a good line of sight with the sky, be located in a statistically cloud free area, and have high rate fiber for data available. The engineering assessment co-funded through this legislation (with matching funds from NASA) would help identify the most appropriate location in Hawaii. The proposed ground station would also provide a significant upgrade to the fiber optic connections through ocean cables for the entire state.

In addition to the ground station infrastructure, this new technology will need a cadre of technical experts that will not only support NASA's first laser communications station, but also serve as a technical resource for the entire global network of such stations. It is envisioned that the University of Hawaii could provide the required technical expertise, beginning with support for an atmospheric characterization study in 2014, and leading to staffing for a center of excellence in ground to space laser communications in the future.

In light of the pioneering nature of this proposal and the significant benefits that would redound to our State, I would urge you pass SB2583 with the requested funding allocation. I would be happy to address any questions you may have concerning this recommendation, and may be reached by e-mail at kyahiku@wik.com , by phone at (808) 544-6765, or by fax at (808) 544-8398.

Thank you for the opportunity to testify on this bill.

Aloha,


George R. Ariyoshi

GRA:khy



**DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM**

NEIL ABERCROMBIE
GOVERNOR

RICHARD C. LIM
DIRECTOR

MARY ALICE EVANS
DEPUTY DIRECTOR

No. 1 Capitol District Building, 250 South Hotel Street, 5th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804
Web site: www.hawaii.gov/dbedt

Telephone: (808) 586-2355
Fax: (808) 586-2377

Statement of

RICHARD C. LIM
Director

Department of Business, Economic Development & Tourism
before the

HOUSE COMMITTEE ON ECONOMIC DEVELOPMENT & BUSINESS

Friday, March 14, 2014

9:00 a.m.

State Capitol, Conference Room 312

in consideration of

SB 2583, SD1

**RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR
EXPLORATION SYSTEMS AND NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION LASER COMMUNICATIONS GROUND STATION INITIATIVE.**

Chair Tsuji, Vice Chair Ward, and members of the Committee. The Department of Business, Economic Development and Tourism **supports the intent** of this bill to provide matching state funding to support an engineering assessment of a proposal to establish a laser optical communications ground station in Hawaii.

This study will be conducted in partnership with NASA, and will include site surveillance and selection, an analysis of power and cooling requirements, environmental assessments and permits, an assessment of structural pads, and an analysis of roadways and clearances for the transportation of communications equipment. Hawaii has been identified by NASA as the best site in the nation to establish this terminal, which will be the first in a global network of interconnected stations to communicate with orbiting and interplanetary spacecraft.

We support this measure provided that its passage does not replace or adversely impact priorities indicated in our Executive Budget.

Thank you for the opportunity to testify on this bill.



UNIVERSITY OF HAWAII SYSTEM

Legislative Testimony

Testimony Presented Before the
House Committee on Economic Development and Business
March 14, 2014 at 9:00 a.m.

by
Donald O. Straney
Chancellor, University of Hawai'i at Hilo

SB 2583 SD1 – RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER
FOR EXPLORATION SYSTEMS AND NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION LASER COMMUNICATIONS
GROUND STATION INITIATIVE

Chair Tsuji, Vice Chair Ward and Members of the Committee:

My name is Donald Straney, Chancellor of the University of Hawai'i at Hilo (UH Hilo). We support the intent of SB 2583 SD1 to fund the Pacific International Space Center for Exploration Systems (PISCES) to conduct an engineering assessment for a proposed laser optical communications ground station in Hawai'i in partnership with the National Aeronautics and Space Administration (NASA). We would hope this engineering study is conducted in conjunction with the University of Hawai'i at Mānoa College of Engineering.

This proposal will help to stimulate the growth of our State economy through the development of new innovative technologies that support the creation of high-tech jobs as well as improvements in broadband and optical fiber infrastructure statewide. UH Hilo views the proposal as an opportunity to collaborate with PISCES to provide higher education and career options to the people of our Hawai'i Island.

We support SB 2583 SD1 provided its passage does not replace or adversely impact priorities in our BOR approved budget.

Thank you for the opportunity to testify on SB 2583 SD1. Aloha.

DENNIS "FRESH" ONISHI
Council Member
District 3



PHONE: (808) 961-8396
FAX: (808) 961-8912
EMAIL: donishi@co.hawaii.hi.us

HAWAI'I COUNTY COUNCIL
25 Aupuni Street, Hilo, Hawai'i 96720

March 13, 2014

The Honorable Clift Tsuji, Chair
and Members of the Committee on
Economic Development and Business

Dear Representative Tsuji and Committee Members,

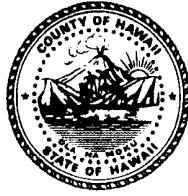
Thank you for the opportunity to provide testimony in support Senate Bill No. 2583, which will fund studies for a ground station for NASA's goal of establishing a global laser communication network from the Earth to spacecraft and to human outposts in deep space. Thank you also for your continuing support of the Pacific International Space Center for Exploration Systems.

In anticipation of this project moving forward, two engineers from NASA and a contractor came to Hawai'i Island last week to begin site selection and preliminary work for a weather station that will be used to study the cloud cover and other weather variables on Mauna Loa, where this first laser communication ground station will be located. PISCES is also working to get cost estimates to NASA so that it can be included in that agency's budget for the next fiscal year.

The laser communications ground station will also provide high-tech jobs for people in Hawai'i while allowing for the testing and development of technology that could revolutionize communication here on Earth in ways that are unimaginable today.

Sincerely,

Dennis "Fresh" Onishi
Hawai'i County Council Member

RESOLUTION NO. 300 14

A RESOLUTION URGING THE HAWAI‘I STATE LEGISLATURE TO PASS SENATE BILL NO. 2583 AND HOUSE BILL NO. 2151, WHICH APPROPRIATE FUNDS TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS FOR JOINT STUDIES WITH THE NATIONAL AERONAUTICAL AND SPACE ADMINISTRATION FOR A LASER COMMUNICATIONS GROUND STATION IN HAWAI‘I.

WHEREAS, Senate Bill No. 2583 and House Bill No. 2151 appropriate \$500,000 for a joint study with the National Aeronautics and Space Administration (NASA) for an engineering assessment; and

WHEREAS, the Pacific International Space Center for Exploration Studies (PISCES) promotes economic development for Hawai‘i Island and the State of Hawai‘i; and

WHEREAS, NASA will establish a global network of next-generation laser communications ground stations to increase its data transfer rate with spacecraft by 10 to 100 times the current rate; and

WHEREAS, Mauna Loa has been identified as a location for NASA’s first lunar laser communications ground station; and

WHEREAS, infrastructure construction for this \$20 million laser communications ground station would begin in 2016, following the completion of site studies, environmental assessments and permit approvals; and

WHEREAS, the successful operation of a \$20 million proof of concept laser communications ground station will support the construction of a future \$200 million permanent laser communications ground station in Hawai‘i to provide a high-bandwidth link for spacecraft from low Earth orbit to the outer planets and deep space; and

WHEREAS, a NASA-funded laser communications ground station will stimulate economic development with high technology jobs and investment from NASA; and

WHEREAS, Senate Bill No. 2583 and House Bill No. 2151 will make funds available only if NASA provides matching funds; and

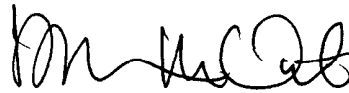
WHEREAS, the Hawai‘i County Council supports PISCES, economic development and the advancement of space technology in Hawai‘i; now, therefore,

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAI'I that the Hawai'i State Legislature is urged to pass Senate Bill No. 2583 and House Bill No. 2151, which appropriate funds for a joint study with PISCES and NASA for a laser communications ground station in Hawai'i.

BE IT FINALLY RESOLVED that the County Clerk shall transmit a copy of this resolution to the Honorable Governor Neil Abercrombie; the Honorable Senate President Donna Mercado Kim; the Honorable House Speaker Joseph Souki; the Honorable Senator Will Espero; the Honorable Senator David Y. Ige; the Honorable Representative Clift Tsuji; and the Honorable Representative Sylvia Luke.

Dated at Kona , Hawai'i, this 19th day of February , 2014.

INTRODUCED BY:



COUNCIL MEMBER, COUNTY OF HAWAI'I

COUNTY COUNCIL
County of Hawai'i
Hilo, Hawai'i

I hereby certify that the foregoing RESOLUTION was by the vote indicated to the right hereof adopted by the COUNCIL of the County of Hawai'i on February 19, 2014 .

ATTEST:



COUNTY CLERK



CHAIRPERSON & PRESIDING OFFICER

ROLL CALL VOTE

	AYES	NOES	ABS	EX
EOFF	X			
FORD	X			
ILAGAN	X			
KANUHA	X			
KERN	X			
ONISHI	X			
POINDEXTER	X			
WILLE	X			
YOSHIMOTO	X			
	9	0	0	0

Reference: C-665/Waived GREDC
RESOLUTION NO. 300 14

TESTIMONY IN SUPPORT OF SB 2583 – RELATING TO THE PACIFIC
INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS
(PISCES) AND NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION (NASA) LASER COMMUNICATIONS GROUND
STATION INITIATIVE.

Dear Members of the 27th Hawaii State Legislature,

I strongly support the intent of this bill to provide Hawaii State funding to PISCES on a dollar-for-dollar matching basis with NASA to fund an engineering assessment and study related to the establishment in Hawaii of a laser optical communications ground station.

This companion / matching bill between the State of Hawaii and NASA came as a direct result of the close/established working relationship between the PISCES Director and officials of NASA Headquarters in Washington. Over the last year, officials within NASA, universities and the commercial space sector have all noticed the recent growth and performance of Hawaii's State-funded PISCES program.

I believe PISCES is an ideal partner for NASA to jointly assess the viability and desirability of such a laser optical ground station in Hawaii. In addition to the statistical weather driven reasons for NASA selecting Hawaii as the most promising location for its initial ground station, I also believe the other activities of PISCES will prove to add considerable incremental value to the location of such a facility and capability in Hawaii. In particular, the robotic exploration focus of PISCES is a natural fit with a broadband optical, point-to-point communications architecture such as the one underlying this study. Not only will NASA be able to test the robustness of the laser communications link under various weather conditions and transmission geometries, they might also be able to test and demonstrate use of laser communications for a typical network of human and unmanned exploration systems. For instance, co-locating such a ground station in Hawaii may permit testing of end-to-end communications from a NASA center to a geosynchronous satellite, to the International Space Station, to the Hawaii ground station, to a ground-based relay, and ultimately to an unmanned rover at the PISCES facility on the Island of Hawaii simulating exploration on Mars. An end-to-end, broadband laser communications link such as this will allow NASA and PISCES personnel to both control robotic exploration systems and return sensor data and scientific information back through the communication chain.

While the primary purpose of this laser optical ground station would be to support the space exploration work being done at NASA and PISCES, it is very worth noting that breakthroughs in laser communications of this type may have tremendous terrestrial and commercial applications. Commercial satellite communications is today a \$115

billion a year industry. According to the Union of Concerned Scientist – Satellite Database, as of September 1, 2013 there were 1,084 operating satellites orbiting the earth with 437 of those in geosynchronous orbit. Many of these satellites cost hundreds of millions of dollars to build and launch and some government satellites cost over a billion dollars to develop and place into service. These satellite currently rely on different radio frequency (RF) bands of the electro-magnetic spectrum to communicate with Earth, however, the ever growing number of satellites and the increasing bandwidth needs of the users and communication applications is creating a growing scarcity of radio spectrum. Satellite operators today must go through lengthy and sometimes costly international coordination process in order to use their spectrum allocations and interference of communications signals (both inadvertent and intentional) is a growing problem. The industry has already begun to exploit new areas of the RF spectrum such as Ka-band and others like V-band and Q-band are on the horizon. Laser optical communications, is also being considered and offers vastly more bandwidth and the potential for more secure communications. As with other satellite communications advances in the past, it is likely that commercial industry's adoption of laser communication will lag the government's development and demonstration of the technology and the reduction of system cost and operating risks. Having Hawaii participate in the development of laser communications for space exploration could pay large dividends in the future as this technology migrates to the commercial realm.

I therefore strongly encourage you to pass SB 2583 with the requested funding allocation. I am available to answer any questions you may have and can be reached at 832.628.1730 or by email at rkelso54@gmail.com.

Thank you for the opportunity to testify on this bill.

Aloha,

Signed by

A handwritten signature in black ink, appearing to read "Robert M. Kelso", written over a light blue horizontal line.

Robert M. Kelso

Executive Director, PISCES



January 29, 2014

Mr. Jim Crisafulli, Director
Office of Aerospace Development
Strategic Industries Division
DBEDT/State of Hawai'i
P.O. Box 2359
Honolulu, HI 96804

Dear Mr. Crisafulli and Members of the 27th Hawaii State Legislature:

I am very pleased to provide testimony in strong support of the State of Hawaii's efforts through Senate bills SB2383, SB 2384 and SB 2385 to continue development and promote the evolution in capabilities of the Pacific International Space Center for Exploration Systems (PISCES) into a world-class space center in Hawaii that can facilitate the design, testing, and validation of new technologies that support both robotic and human missions to space. Due in large measure to the State of Hawaii's steadfast support for PISCES during the past five years - as well as that of the PISCES team, led by former NASA Flight Director Mr. Robert Kelso - PISCES continues to make notable progress in laying the strategic foundation for such an ambitious endeavor, including endorsements by NASA, Google, Planetary Power, and other private sector and academic organizations involved in development of technologies that will be enabling to lunar and planetary exploration as well as to the future environmental and economic well being of the State of Hawaii. However, their efforts must continue to receive your unwavering support.

I continue to informally serve as a senior industry advisor and staunch advocate for the PISCES team; I am a seventeen-year participant in Hawaii's JUSTSAP forum (recently renamed PISA); I am currently the Chief Executive Officer of JAMSS America, Inc. (a U.S. registered aerospace company with U.S. and international contracts); I formerly served as Senior Vice President of SPACEHAB, Inc.; and, served as a former project manager within the NASA Mission Operations Directorate at the Johnson Space Center. My continuous 47 years in the U.S. aerospace business have made me acutely aware of the unique challenges that space exploration places on human innovation as well as on the resource limitations of sponsoring federal, state and local government, private sector and university organizations. However, it is my experience that the best way to mitigate project and program costs during space exploration hardware and software product development cycles is through rigorous planning on the front end and through use of those research and testing facilities that can best represent the in-space environments within which robots and human space explorers will conduct their actual operations using these products. Hawaii and PISCES provides such a research environment! As those whom I support within PISCES know, as a young NASA engineer during the Apollo Program, I was indeed fortunate to accompany several of the Apollo crews to the Big Island where they experienced a simulated lunar surface training environment unlike any other on Planet Earth. To a crewmember, each Apollo astronaut returning from the moon said that Hawaii was the most useful training environment that they experienced during their extensive geologic and surface operations training program.

With the establishment of the highly successful International Space Station Program, space utilization and exploration programs have become increasingly multinational in nature. Many nations have now executed robotic Earth orbit, lunar and planetary missions; Japan has returned surface debris samples from a far-away asteroid; ESA is within months of landing a robotic spacecraft on a comet; China has landed a robotic spacecraft on the lunar surface; India has a robotic spacecraft en route to Mars; and NASA is currently working with other space agencies and a growing number of commercial entities planning for



the start of expeditions to other worlds using their new Orion Spacecraft and mammoth Space Launch System rocket.

As an avid participant in several of these exploration initiatives, I am proud to have been a part of the evolution of Hawaii's PISCES organization and its capabilities and I have been encouraged by the continuing and enthusiastic bipartisan support received for PISCES from your office and from the State of Hawaii's Legislature. NASA also has taken note in your collective support - as have international space agencies, private sector companies and universities - and PISCES has received contract funding over the past five years from multiple sources to support technology development projects within NASA, CSA, DLR and private sector organizations. Within my familiar territory of Japanese industry, academia and the Japan Aerospace Exploration Agency (JAXA), I continue to speak to top management in each sector about the many opportunities for exploration technologies development, test and checkout that PISCES offers. I anticipate an ever-growing interest within Japan for collaboration with other international organizations in the utilization of Hawaii's PISCES assets going forward.

In particular, I strongly endorse the current PISCES plans to promote the use of PISCES assets in support of basaltic-based construction materials, in-situ resources utilization and integrated resources extraction technologies, a planetary analog test site, a secondary school's lunar surface flight experiment, and an international robotics mining competition. Additionally, PISCES plans to develop and beneficially exploit the applications of self-sufficient technologies in renewable energy, water reclamation and basaltic construction will inevitably result in benefits to local, State and National ground and space-based scientific, technological, educational and economic interests. Lastly, the development of a laser communications technology research center in Hawaii will further solidify Hawaii's and PISCES's reputation as forward thinking entities who intend to position themselves at the forefront of our nations efforts to directly improve life on Earth while developing technologies essential to robotic and human exploration of the cosmos. The increasing number of cash and in-kind and "investors" in PISCES programs including NASA, the State of California and Google among others is further evidence of the return-on-investment the State of Hawaii is receiving for its funding support to PISCES through the passage of bills such as those currently being considered.

Jim, and Rob Kelso, I applaud and encourage the continuation of your Hawaii aerospace and PISCES leadership. I also encourage the Hawaii State Government to continue its support of our nation's space exploration program through continuing funding support of PISCES. With the PISCES team of professionals and its access to the abundant resources of the Hawaiian Islands, along with your continuing support through the passage of these three legislative bills, I am confident that PISCES has a great future ahead!

My very best wishes for your continued success,

A handwritten signature in black ink that reads 'Dan A. Bland'.

Dan A. Bland

Chief Executive Officer
JAMSS America, Inc.
16055 Space Center Blvd.
Houston, Texas 77062



January 29th, 2014

Jim Crisafulli
Office of Aerospace Development
Dept. of Business, Economic Development & Tourism
State of Hawaii
Honolulu, Hawaii 96813

Dear Jim:

Per our recent discussions concerning aerospace initiatives in Hawaii, I commend your State for its visionary efforts to help grow and diversify both your local aerospace industry and our national space program. Hawaii has many diverse resources, capabilities and advantages that can positively contribute to our national space endeavors.

For example, your strategic mid-Pacific location and long-standing ties with nations across Asia and the Pacific make the islands an ideal site to support collaborative international scientific, educational, and commercial development programs related to space exploration. In particular, the Big Island's diverse volcanic terrain is most suitable for developing an analog lunar base to test and evaluate new technologies to support future robotic/human missions to the moon and Mars.

Hawaii also has resident expertise in space-related fields, with over forty NASA principal investigators at the University of Hawaii performing ongoing research in astronomy, planetary geosciences, robotics, satellite communications, laser-based power systems, and other technologies critical for supporting future space exploration missions around and beyond planet Earth.

The NASA Space Portal fully recognizes these strategic advantages, and looks forward to our continued collaboration with the State of Hawaii in advancing our nation's space exploration efforts. In my role as the NASA ex-officio member of the PISCES board, I would like to endorse the activities proposed by the three following Senate Bills that will help advance our mutual goals: S.B. No. 2585, "A Bill for An Act Relating to the Pacific International Space Center for Exploration Systems (PISCES)", S.B. No. 2584, "A Bill for an Act Relating to the PISCES Planetary Sustainability Technologies Initiative", and S.B. No. 2583, "A Bill for an Act Relating to the PISCES NASA Laser Communications Ground Station Initiative".

Sincerely and with best wishes,

A handwritten signature in blue ink that reads "Daniel J. Rasky".

Dr. Daniel J. Rasky
Director, Space Portal, NASA Research Park
Senior Scientist, NASA Ames Research Center
M/S 555-3, Moffett Field, CA 94035
Phone/fax: (650) 604-1098/4666

International Ventures Associates

January 29, 2014

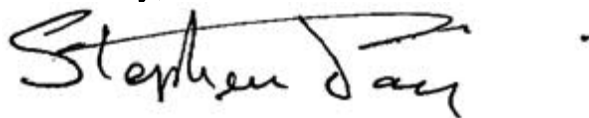
To: Members of the 27th Hawaii State Legislature:

I am writing as a member of the Hawaii Aerospace Advisory Committee (HAAC), and previous chairman of JUSTSAP, where I served for seven years.

In previous years, I have submitted testimonials for initial and continued funding for the Pacific International Space Center for Exploration systems (PISCES). I would like to do so again for Senate Bills 2583, 2584 and 2585.

In my judgment, these bills enhance Hawaii's competitive position in the international Aerospace sector, and provide an "accelerator" for important R&D projects, facilities testing, and higher skilled labor for the State - as PISCES develops funded projects that will no longer require State funding over the coming years. PISCES is developing a positively differentiated capability that the great State of Hawaii has incubated and nurtured, and that is now on the verge of providing sustainable ROI benefits.

Sincerely,

A handwritten signature in black ink that reads "Stephen Day". The signature is written in a cursive, slightly slanted style.

Stephen Day
President, International Ventures Associates

IVA, 5333 Potomac Avenue, Suite 100, Washington, DC 20016



TESTIMONY IN SUPPORT OF SB 2583 – RELATING TO THE PACIFIC
INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS
(PISCES) AND NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION (NASA) LASER COMMUNICATIONS GROUND
STATION INITIATIVE.

Dear Members of the 27th Hawaii State Legislature,

I strongly support the intent of this bill to provide Hawaii State funding to PISCES on a dollar-for-dollar matching basis with NASA to fund an engineering assessment and study related to the establishment in Hawaii of a laser optical communications ground station.

This companion / matching bill between the State of Hawaii and NASA came as a direct result of the close/established working relationship between the PISCES Director and officials of NASA Headquarters in Washington. Over the last year, officials within NASA, universities and the commercial space sector have all noticed the recent growth and performance of Hawaii's State-funded PISCES program.

I believe PISCES is an ideal partner for NASA to jointly assess the viability and desirability of such a laser optical ground station in Hawaii. In addition to the statistical weather driven reasons for NASA selecting Hawaii as the most promising location for its initial ground station, I also believe the other activities of PISCES will prove to add considerable incremental value to the location of such a facility and capability in Hawaii. In particular, the robotic exploration focus of PISCES is a natural fit with a broadband optical, point-to-point communications architecture such as the one underlying this study. Not only will NASA be able to test the robustness of the laser communications link under various weather conditions and transmission geometries, they might also be able to test and demonstrate use of laser communications for a typical network of human and unmanned exploration systems. For instance, co-locating such a ground station in Hawaii may permit testing of end-to-end communications from a NASA center to a geosynchronous satellite, to the International Space Station, to the Hawaii ground station, to a ground-based relay, and ultimately to an unmanned rover at the PISCES facility on the Island of Hawaii simulating exploration on Mars. An end-to-end, broadband laser communications link such as this will allow NASA and PISCES personnel to both control robotic exploration systems and return sensor data and scientific information back through the communication chain.

While the primary purpose of this laser optical ground station would be to support the space exploration work being done at NASA and PISCES, it is very worth noting that breakthroughs in laser communications of this type may have tremendous terrestrial and commercial applications. Commercial satellite communications is today a \$115



billion a year industry. According to the Union of Concerned Scientist – Satellite Database, as of September 1, 2013 there were 1,084 operating satellites orbiting the earth with 437 of those in geosynchronous orbit. Many of these satellites cost hundreds of millions of dollars to build and launch and some government satellites cost over a billion dollars to develop and place into service. These satellite currently rely on different radio frequency (RF) bands of the electro-magnetic spectrum to communicate with Earth, however, the ever growing number of satellites and the increasing bandwidth needs of the users and communication applications is creating a growing scarcity of radio spectrum. Satellite operators today must go through lengthy and sometimes costly international coordination process in order to use their spectrum allocations and interference of communications signals (both inadvertent and intentional) is a growing problem. The industry has already begun to exploit new areas of the RF spectrum such as Ka-band and others like V-band and Q-band are on the horizon. Laser optical communications, is also being considered and offers vastly more bandwidth and the potential for more secure communications. As with other satellite communications advances in the past, it is likely that commercial industry's adoption of laser communication will lag the government's development and demonstration of the technology and the reduction of system cost and operating risks. Having Hawaii participate in the development of laser communications for space exploration could pay large dividends in the future as this technology migrates to the commercial realm.

I therefore strongly encourage you to pass SB 2583 with the requested funding allocation. I am available to answer any questions you may have and can be reached at 832.628.1730 or by email at rkelso54@gmail.com.

Thank you for the opportunity to testify on this bill.

Aloha,

Signed by

Robert M. Kelso

Executive Director, PISCES



BUZZ ALDRIN
Astronaut

01/28/2014

Testimony in strong support of Hawaii State SB2583, SB2584, and SB2585

Statement of Buzz Aldrin, Apollo XI

To the Members of the 27th Hawaii State Legislature:

I am pleased to offer my strongest endorsement of Hawaii State Bills SB2583, SB2584, and SB2585, which will provide continued support for the Pacific International Space Center for Exploration Systems (PISCES).

I commend the Great State of Hawaii for the outstanding leadership you are demonstrating in developing and maintaining this unique and vitally important capability that will serve Hawaii, the United States, and the international space community as a premier planetary analog test bed to help prepare for humanity's next bold frontier - the scientific investigation, sustainable exploration, commercial development, and settlement of space.

One of the most important lessons learned from our remarkably successful Apollo experience was the need to conduct high-fidelity simulation and training sessions in a highly relevant analog research environment, and Hawaii provides perhaps the best site on Earth to develop, test and validate the technologies, capabilities and systems that will be required to realize the vision I have articulated above.

The investment that you are making today in supporting this urgently needed capability will undoubtedly assure Hawaii a unique leadership role in this challenging new frontier – an investment that will also contribute substantially to the economic prosperity and well being of the State, while also inspiring Hawaii's future aerospace workforce to pursue Science, Technology, Engineering and Math (STEM) related academic training in your schools and universities.

BUZZ ALDRIN 10750 Wilshire Blvd. Suite 1004 Los Angeles, CA 90024

I have had the pleasure of personally attending and participating in several PISCES conferences and workshops over the past several years, and have seen, first hand, how well this new capability is coming together. As such, I urge you to continue to support its development and operations so it can achieve its full potential to meet this critical need for our space program – an investment that I am confident will be returned many fold to the great State of Hawaii.

As you may be aware, I recently published my latest book – *Mission to Mars, My Vision for Space Exploration* – in which I lay out my long term strategy for the exploration and settlement of space, as well as the steps I feel are required to implement this strategy. As I emphasize in my book, it is my view that future journeys into space can and will begin here in Hawaii - with innovators, scientists, technologists, and explorers from across the world conducting vital research at PISCES on the Big Island. These Hawaii-based experiments will subsequently be operated tele-robotically from other sites around our planet to simulate the control of lunar robots on the surface of the Moon from stable orbits near our natural satellite - thus reducing the time delays associated with attempting to conduct these operations from Earth.

Ultimately, I expect this approach will enable space commerce on the surface of the Moon on a scale that we have yet to anticipate, and that PISCES will continue to serve as the premier Earth-based proving ground for these systems for the foreseeable future.

In the longer term, having demonstrated the value of conducting these planetary research investigations with PISCES, I anticipate we will use these same capabilities and procedures to prepare for a permanent international settlement of Mars by exploiting the moons of Mars to conduct similar, nearly real-time tele-robotic operations on the Martian surface.

This approach would afford PISCES several decades of sustained pioneering research on the Big Island, bringing long-term development and prosperity to this region, and indeed to all islands of Hawaii.

In support of the vision I have articulated in my new book, I have spent the past six-months meeting with senior leadership in the U.S. Administration and on the Hill, and have hosted book signings and forums all over the world. At each venue I have also made it clear that this bold journey into space can begin with PISCES and the Great State of Hawaii.

By supporting PISCES through the legislation before you today, you will affirm that Hawaii will expand its role as a leader in the international exploration and development of space, which in turn will afford exceptional economic and societal returns to humanity on Earth, as well as to the Aloha State – enhancing economic prosperity and wellbeing for generations to come.

I again, strongly encourage your continued leadership in supporting PISCES – a timely and vitally important asset not only for Hawaii, but also for our Nation and the broader international space community.

Thank you for the opportunity to testify on this important initiative.

Buzz Aldrin
Apollo XI

A handwritten signature in black ink that reads "Buzz Aldrin". The signature is written in a cursive style and is underlined with a single horizontal line.

BUZZ ALDRIN

Testimony in strong support of Hawaii State Bills SB2583, 2584, and, 2585

Statement of Lewis L. Peach, Jr., NASA (retired), and PISCES Board Secretary

To the Members of the 27th Hawaii State Legislature:

I would like to thank you for the opportunity to offer my strongest endorsement for Hawaii State Bills - SB2583, 2584, and, 2585 to provide continued international leadership in space with the establishment and operation the Pacific International Space Center for Exploration Systems (PISCES).

Having been involved with the development of this exceptional capability for much of its definition and execution phases, it has been very rewarding to see it coming to fruition, so I would like to commend the Great State of Hawaii for the outstanding leadership you are demonstrating by establishing this unique and vitally important capability that will serve Hawaii, the United States, and the international space community, as a premier planetary analog test bed to help prepare for humanity's next bold frontier - the scientific investigation, sustainable exploration, commercial development, and settlement of space.

If the unfortunate circumstances of our Nation's involvement in two World Wars helped establish America as a world super power, certainly our Nation's leadership in space has cemented the US as the technological leader and economic power that has enhanced the quality, prosperity, and well being of our Nation for more than five decades.

Many of the products and services that we now take for granted have direct origins to the technological and scientific advances that resulted from our leadership in space, and this relatively modest investment in our future has provided an exceptional returns that far outweigh their costs.

During my tenure as Director of Advanced Programs at NASA, I co-founded the NASA/NSF Antarctic Analog Program, which continues to serve the international space community as an important capability to validate some of the scientific investigations we will undertake in planetary science for the foreseeable future. Many of NASA's current leaders in planetary science participated in these investigations over the past nearly 25-years since it's founding in 1990.

I also supported other analog research in the northern arctic regions, and in the desert southwest, as well as at most of the NASA centers, as we have found that it is essential to conduct high-fidelity technology development and scientific research investigations in a highly relevant analog research environment.

Fortunately, Hawaii provides one of the very best analog sites to develop, test and validate the technologies, capabilities and systems that will be required to realize conduct the future scientific and human exploration missions that are

being planned within NASA, and by our international space partners, as well as by a growing and vigorous commercial space community.

By virtue of the investments that you are making today in supporting this unique and urgently needed capability, PISCES will undoubtedly help assure Hawaii's leadership role in this challenging new frontier, an investment that will also contribute substantially the economic prosperity and well being of the State, while also inspiring the State's future aerospace workforce to pursue Science, Technology, Engineering and Math (STEM) related academic training in your schools and universities.

I would like to close by thanking you for the opportunity to serve as Secretary to the PISCES Board of Directors, and again , strongly encourage your continued leadership in supporting PISCES - a timely and vitally important asset for not only your State, but also for our Nation, and for the broader international space community.

Thank you for the opportunity to testify on this important Legislation and opportunity for Hawaii, and for our Nation.



Lewis L. Peach, Jr.

Aerospace Consultant

Former Director, Advanced Programs, NASA (retired)

Secretary, PISCES Board of Directors

January 28, 2014

Members of the 27th Hawaii State Legislature

Re: Support for Senate Bills (SB) 2583, 2584 and 2585

Dear State Senators and State Representatives:

Ferraro Choi is a leader in the design of sustainable educational and research projects throughout the State of Hawaii and the Pacific. On the Island of Hawaii we were the architects for the USDA Institute for Pacific Islands Forestry Laboratory, the NELHA Gateway Energy Center and the West Hawaii Exploration Academy charter school. We have worked with NOAA on the planning and design of research and outreach facilities on Oahu, Maui, Kauai and throughout the Papahānaumokuākea Marine National Monument. In Antarctica we designed the Amundsen Scott South Pole Station and various remote support facilities for the National Science Foundation in conjunction with NASA as an analog for lunar and Mars habitats. Closer to home, we recently completed the design of the Stevenson Middle School's Science Center which will house among other projects, the school's award winning robotics program.

Ferraro Choi is in support of SB2583 to provide matching funds in partnership with NASA to assess the feasibility of a laser communication ground station in Hawaii. If established, the ground station would connect Hawaii to the 21st century network of super high speed optical communications to spacecraft and extraterrestrial sites on the moon and asteroids. It can stimulate and enhance STEM programs in elementary and secondary schools and provide opportunities for research at our university. If not enacted, Hawaii may be left behind in the space communications network.

We support SB2584 for applied research in self sufficient and sustainable technologies in partnership with the State of California and NASA. Hawaii's remote geographic location and unique natural resources are an analog for extraterrestrial settlement. They also provide our state an opportunity to move forward in independence from polluting energy sources and reduce importation of building materials. This bill will enable research in alternative basaltic construction modules, three dimensional printing, renewable energy systems, and water reclamation all systems.

We also support SB2585 for the procurement of land for the construction of the PISCES administrative offices and test facility on Hawaii Island. The project is currently in the pre-design and site investigation stage. Its development will initially support the design and construction industry in the state and thereafter attract a multitude of high technology institutions and national space programs to test their equipment *insitu* at this unique facility.

We respectfully ask your support of these bills during your legislative session. Thank you for your consideration.

Sincerely,



Joe Ferraro, FAIA, LEED AP
Principal



William Brooks, AIA, LEED AP
Principal



Troy Miyasato, AIA, MBA
Principal

Henk B. Rogers
55 Merchant Street, 17th floor
Honolulu, HI 96813

January 28, 2014

TESTIMONY IN SUPPORT OF SB2583 – RELATING TO
THE PACIFIC INTERNATIONAL SPACE CENTER FOR
EXPLORATION SYSTEMS (PISCES) AND THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
(NASA) LASER COMMUNICATIONS GROUND STATION
INITIATIVE

Dear Members of the 27th State Legislature,

I strongly support the intent of this bill to provide matching Hawaii State funding to PISCES on a dollar-for-dollar matching basis with NASA to fund an engineering assessment and study related to the establishment of laser optical communications ground station based in Hawaii.

The future of satellite communications lies with lasers. Lasers have the advantage of being able to send signals to and from satellites form 10 to 100 times the speed attained by present day radio frequency (RF) systems.

RF systems present a security problem since they are broadcast over a wide area making it possible for the security of the RF system to be compromised or otherwise interfered with by those who seek to compromise the communication systems of this country. Since RF systems broadcast their signal over a wide area, most of the signal produced is wasted since only a small percentage of the signal actually reaches the receiver in both directions.

Laser communications however do not waste any signal outside the target receiving system. This has the advantage that less power is needed to send a signal between ground stations and satellites. The additional benefit lies with security, since the laser signal only exists

in a perfectly straight line between the satellite and the ground station in is much more difficult to intercept (if a signal were to be somehow intercepted, we would be able to tell that something had interfered with the transmission and the message had been compromised).

For the same reason that the Big Island of Hawaii is one of the best locations in the world to locate an optical telescope, it is also the best place to put a laser communication ground station. Since NASA has already made the decision to move from RF to laser based ground to space communication systems why not have Hawaii become the prime location in the United States for such a ground station.

The expertise needed to create and maintain such a communication system should be developed with the help of the University of Hawaii. This would be an excellent opportunity for us to create high paid engineering jobs to keep our graduating engineering students from having to go out of state to find employment.

I strongly urge you to pass SB2583 with the requested funding allocation. You can reach me at 808-954-6100 or by e-mail at henk@tetris.com should you have any questions about my testimony.

Thank you for the opportunity to testify on this bill.

Aloha,

A handwritten signature in black ink, appearing to read "Henk", with a large, stylized flourish extending to the right.

Henk B. Rogers

Hoyt L. Davidson
Managing Partner
Near Earth LLC
243 Tresser Boulevard, 17th Floor
Stamford, CT 06901

January 21, 2014

TESTIMONY IN SUPPORT OF SB2583 – RELATING TO THE PACIFIC INTERNATIONAL
SPACE CENTER FOR EXPLORATION SYSTEMS (PISCES) AND NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION (NASA) LASER COMMUNICATIONS
GROUND STATION INITIATIVE.

Dear Members of the 27th Hawaii State Legislature,

I strongly support the intent of this bill to provide Hawaii State funding to PISCES on a dollar-for-dollar matching basis with NASA to fund an engineering assessment and study related to the establishment in Hawaii of a laser optical communications ground station.

I believe PISCES is an ideal partner for NASA to jointly assess the viability and desirability of such a laser optical ground station in Hawaii. In addition to the statistical weather driven reasons for NASA selecting Hawaii as the most promising location for its initial ground station, I also believe the other activities of PISCES will prove to add considerable incremental value to the location of such a facility and capability in Hawaii. In particular, the robotic exploration focus of PISCES is a natural fit with a broadband optical, point-to-point communications architecture such as the one underlying this study. Not only will NASA be able to test the robustness of the laser communications link under various weather conditions and transmission geometries, they might also be able to test and demonstrate use of laser communications for a typical network of human and unmanned exploration systems. For instance, co-locating such a ground station in Hawaii may permit testing of end-to-end communications from a NASA center to a geosynchronous satellite, to the International Space Station, to the Hawaii ground station, to a ground-based relay, and ultimately to an unmanned rover at the PISCES facility on the Island of Hawaii simulating exploration on Mars. An end-to-end, broadband laser communications link such as this will allow NASA and PISCES personnel to both control robotic exploration systems and return sensor data and scientific information back through the communication chain.

While the primary purpose of this laser optical ground station would be to support the space exploration work being done at NASA and PISCES, it is very worth noting that breakthroughs in laser communications of this type may have tremendous terrestrial and commercial applications. Commercial

satellite communications is today a \$115 billion a year industry. According to the Union of Concerned Scientist – Satellite Database, as of September 1, 2013 there were 1,084 operating satellites orbiting the earth with 437 of those in geosynchronous orbit. Many of these satellites cost hundreds of millions of dollars to build and launch and some government satellites cost over a billion dollars to develop and place into service. These satellite currently rely on different radio frequency (RF) bands of the electromagnetic spectrum to communicate with Earth, however, the ever growing number of satellites and the increasing bandwidth needs of the users and communication applications is creating a growing scarcity of radio spectrum. Satellite operators today must go through lengthy and sometimes costly international coordination process in order to use their spectrum allocations and interference of communications signals (both inadvertent and intentional) is a growing problem. The industry has already begun to exploit new areas of the RF spectrum such as Ka-band and others like V-band and Q-band are on the horizon. Laser optical communications, is also being considered and offers vastly more bandwidth and the potential for more secure communications. As with other satellite communications advances in the past, it is likely that commercial industry's adoption of laser communication will lag the government's development and demonstration of the technology and the reduction of system cost and operating risks. Having Hawaii participate in the development of laser communications for space exploration could pay large dividends in the future as this technology migrates to the commercial realm.

I therefore strongly encourage you to pass SB2583 with the requested funding allocation. I am available to answer any questions you may have and can be reached at (203) 355-3527 or by email at hoyt@nearearthllc.com.

Thank you for the opportunity to testify on this bill.

Aloha,

A handwritten signature in black ink, appearing to read "Hoyt Davidson". The signature is fluid and cursive, with a long horizontal stroke at the end.

Hoyt Davidson



SHACKLETON ENERGY COMPANY
3511 Caldwell Lane, Del Valle, TX 78617-3017

24th January 2014

**Testimony in Support of SB2583
Relating to the Pacific International Space Center for Exploration Systems (PISCES)
NASA Laser Communications Ground Station Initiative**

Dear Members of the 27th State Legislature

I strongly support the intent of this bill to provide Hawaii State funding to PISCES on a dollar-for-dollar matching basis with NASA to fund an engineering assessment and study related to the establishment in Hawaii of a laser optical communications ground station.

In context of the strategic location of Hawai'i and the other activities that PISCES is undertaking, the establishment of a laser comms ground station within the State meets several strategic and technical goals. Significant research is being undertaken globally in the development of high bandwidth narrow beam communications for command, control and data transfer. Examples of this include recent experiments on the International Space Station and also the NASA Laser Communications Relay Demonstration experiments that was successfully demonstrated around the Moon last year. These early steps are providing the underlying research that will underpin an entirely new field of high data communications from orbiting satellites to Earth ground stations. By integrating this capability together with PISCES other essential activities, we provide a clear set of opportunities for research and development for space companies bringing their business to the Islands.

The communications sector is one of the largest capitalization and revenue yield industries and it is imperative that PISCES can support this endeavor with the necessary resources allocated.

In light of the above, I strongly support the intent of SB2583 and would urge the Legislature to appropriate the full funding amount requested through this legislation.

Best regards

Jim Keravala
Chief Operating Officer
Shackleton Energy Company, Inc.
+1 650 387 0844
jim.keravala@shackletonenergy.com
www.shackletonenergy.com

"Fueling the Space Frontier"

Harvey S. Tajiri
569 Puloku Street
Hilo, HI 96720

TESTIMONY IN SUPPORT OF:

HB2150 and SB2584– RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS (PISCES) PLANETARY SUSTAINABILITY TECHNOLOGIES INITIATIVE.

HB2151 and SB2583 – RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS AND NATIONAL AERONAUTICS AND SPACE ADMINISTRATION LASER COMMUNICATIONS GROUND STATION INITIATIVE.

HB2152 and SB2585 – RELATING TO THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS.

Dear Members of the 27th Hawaii State Legislature,

I am writing in support of the passage of HB2150/SB2584, HB2151/SB2583 and HB2152/SB2585.

The State of Hawaii has a genuine need to broaden its economic base. We now have the opportunity to move towards that end.

Section I of all six measures aptly elucidates the positive aspects of their enactment and funding.

Your affirmative consideration of these six bills will be deeply appreciated.

Mahalo,

A handwritten signature in black ink, appearing to read "Harvey S. Tajiri". The signature is written in a cursive, flowing style.

Harvey S. Tajiri

ward2-Robin

From: mailinglist@capitol.hawaii.gov
Sent: Wednesday, March 12, 2014 3:06 PM
To: edbtestimony
Cc: ctakase@dcca.hawaii.gov
Subject: Submitted testimony for SB2583 on Mar 14, 2014 09:00AM

SB2583

Submitted on: 3/12/2014

Testimony for EDB on Mar 14, 2014 09:00AM in Conference Room 312

Submitted By	Organization	Testifier Position	Present at Hearing
Cathy Takase	Individual	Support	No

Comments: Submitting testimony on behalf of Cat Awakuni, Cable Television Administrator

Please note that testimony submitted less than 24 hours prior to the hearing, improperly identified, or directed to the incorrect office, may not be posted online or distributed to the committee prior to the convening of the public hearing.

Do not reply to this email. This inbox is not monitored. For assistance please email webmaster@capitol.hawaii.gov