

**PISCES: HAWAII FACILITY FOR SIMULATION AND TRAINING.** M. B. Duke<sup>1</sup>, F. D. Schowengerdt<sup>2</sup>, J. Crisafulli<sup>3</sup>, S. M. D. Day<sup>4</sup>, R. A. Fox<sup>5</sup>, M. Henley<sup>6</sup>, N. I. Marzwell<sup>7</sup>. <sup>1</sup>1030 Sunset Canyon S., Dripping Springs, TX 78620, [mikeduke@earthlink.net](mailto:mikeduke@earthlink.net); <sup>2</sup>Affiliate Professor of Physics and Astronomy, University of Hawaii at Hilo, 709 Fitzhugh Way, Alexandria, VA 22314, [fschowen@spacepartnerships.com](mailto:fschowen@spacepartnerships.com), <sup>3</sup>[jcrisafu@dbedt.hawaii.gov](mailto:jcrisafu@dbedt.hawaii.gov), <sup>4</sup>[SSDAY1@aol.com](mailto:SSDAY1@aol.com), <sup>5</sup>[rfox@hawaii.edu](mailto:rfox@hawaii.edu), <sup>6</sup>[mark.w.henley@boeing.com](mailto:mark.w.henley@boeing.com), <sup>7</sup> NASA Jet Propulsion Laboratory, [Neville.I.Marzwell@jpl.nasa.gov](mailto:Neville.I.Marzwell@jpl.nasa.gov).

**Introduction:** JUSTSAP (Japan/US Science, Technology and Space Application Programs), a non-profit bilateral Space exploration “think tank,” has initiated the Pacific International Space Center for Exploration Systems (PISCES) to advance research and education in space exploration technology and systems. Working closely with the Hawaiian Department of Economic and Business Development and the University of Hawaii, Hilo, a plan has been formulated to establish a simulation, research and training facility on the Big Island starting in late 2007. Initial capabilities will include a test range for demonstration of robotic exploration systems on Hawaiian volcanic terrain. Subsequent capabilities will include a simulated human outpost, long duration technology test beds, a high vacuum facility, research and educational components. PISCES will be supported initially by the State of Hawaii, but is intended to become self-supporting as its user community grows.

**Background:** The volcanic terrain of the Big Island of Hawaii, including Mauna Kea, Mauna Loa, and Kilauea, are among the most realistic sites available for simulation of fieldwork on lunar volcanic terrain. During Apollo, astronauts were trained there and regarded the area as the most lunar-like that they had observed. High elevations, dry weather conditions and availability of lunar regolith-like deposits of volcanic ash contribute to the similitude. The sites are easily accessible and can be afforded service by the near-by University of Hawaii campus at Hilo. Noting these possibilities, the Japan-U. S. Space Technology and Applications Program (JUSTSAP) recommended in 2006 that a simulation facility be constructed that could be utilized by space agencies, industry and academic personnel to test and demonstrate exploration systems. JUSTSAP emphasized the potential benefits of a Hawaiian facility for U. S. Japan cooperation in space exploration. PISCES will be supported by the State of Hawaii and expects to have initial funding in the summer of 2007. The program will be a part of the State’s efforts to build its technical and scientific capabilities associated with advanced technology and space exploration. In 2006, PISCES received a unanimous resolution of support from the Hawaii State Legislature.

**Location:** The program of PISCES is intended to be broad, including simulation, technology demonstration, research, and education. The facility will be a distributed one, in which the simulation facilities will be a principal component. A permanent location will be selected in 2007, following a survey of available locations on the flanks of Mauna Loa and Mauna Kea and appropriate coordination with the Hawaiian community with regard to cultural matters. Funding for the procurement of capital equipment will be sought from private sources; however, initial simulations of robotic field experiments can take place at a temporary site as soon as next summer.



Astronaut Alan Shepard (Apollo 14) simulates lunar operations in a realistic Hawaiian training exercise.

**PISCES simulation capabilities:**

For robotic field simulations, a location will be selected that will allow equipment to be tested over 1-5 kilometers of range and over slopes of 20-30 degrees, including small craters. Infrastructure capabilities will include a solar power system and communications links. Investigators will be expected to provide their own documentation equipment.

Over the first three years of PISCES buildup, a simulated lunar outpost will be designed and implemented. The outpost will include lunar habitats, life support, power, communications, ISRU processing and other principal systems of an early lunar outpost. The initial facility will be sized for 6 crewmembers; as funding allows, additional facilities may be added to represent a full lunar base.

**Education:** One of PISCES' programmatic objectives is education at all levels. Hawaiian school children will be introduced to space exploration through observation of field experiments and crew simulations. Undergraduate and graduate science and engineering students can take advantage of PISCES' student design competition to define the characteristics of a lunar outpost and its terrestrial simulation. See the PISCES web site (<http://www.pisces.hilo.hawaii.edu>). For details. The first winning competitor will be chosen in July, 2007.

**Summary:** By 2011, a fully developed PISCES human outpost simulation facility will be available, in time to begin to develop capabilities for the Vision for Space Exploration's projects planned for the mid to late 2010's. A vigorous program of simulation and education for lunar outpost operators, both on the Moon and on Earth, will become a centerpiece of the facility and the space exploration program at the University of Hawaii, Hilo and throughout the State of Hawaii.