

# Colorado



# PISCES Planetary Analog Site Current and Future Users

John Hamilton EPO and Test Logistics Manager

Christian Andersen Site Operations Manager

Rodrigo Romo Robotics Manager

Rob Kelso Executive Director



UNIVERSITY  
of HAWAII  
HILO



**HILO**



# Test Sites

- Facilities User Guide

- Sites:

- Haiwahine Valley      Mauna Kea      9,000 ft
- Apollo Valley      Mauna Kea      11,000 ft
- HI-SEAS      Mauna Loa      9,500 ft
- Old Hilo-Kona Road Mauna Loa      6,000 ft
- Various Lava Tubes around island
- Others as defined

# Interns

- Summer Interns
- UHH, Akamai, PIPES, MCC, Mainland volunteers
- Database being populated
- 2<sup>nd</sup> year of Analog Site Survey
  - Geology
  - Civil Engineer
  - Environmental Science
  - GIS/Geography

# PRISM

- PISCES Robotic International Space Mining
  - Follow on to NASA Robotic Mining Competition
  - International and conducted in the field

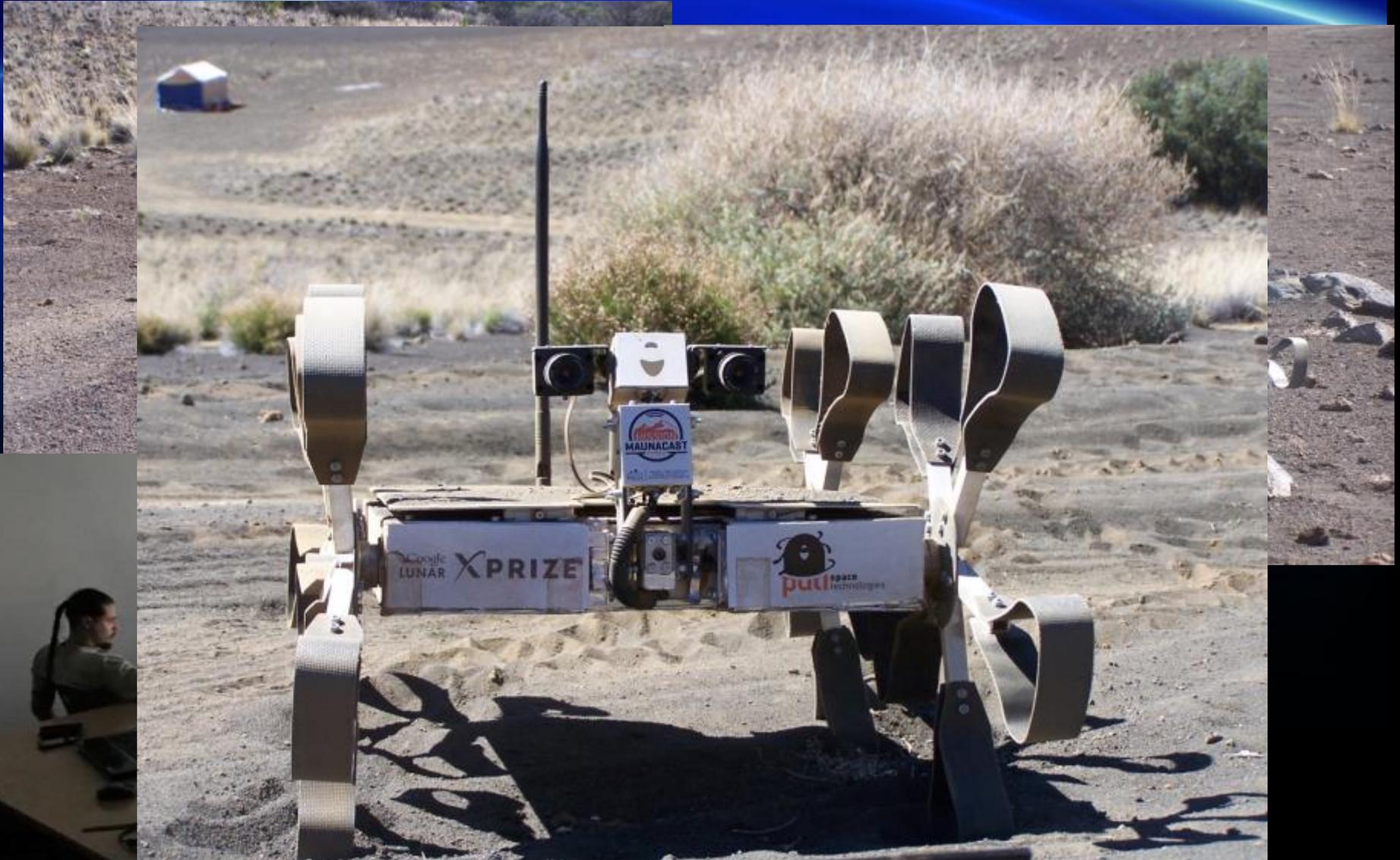


# Puli Space

- GLXP Team
- Accomplishments
  - First test of PISCES WiFi
  - Repeater Coms Relay
  - Performed 600m traverse with Mission Control in Budapest
  - Photo at end of traverse
  - Two rovers simultaneously controlled remotely
  - Island wide outreach
- December 2013 Field test









**600 meters to go!**



- **Extreme environment tests**







- **Terrestrial Milestone Prizes**
  - Announced Nov. 2013
  - Sept. 31, 2014 deadline
- **Launch Milestone Prize**
  - \$7,000,000 purse split (using a % of launch cost formula with a cap) between teams making the earliest successful launches
- **Lunar Arrival Milestone Prize**
  - \$1,000,000 for first team to reach a specified distance from the moon
- **Lunar Landing Prize**
  - Dec. 31, 2011

February 19, 2014

- Landing System Milestone Prize: \$1,000,000 per team. based on the hardware and software that enables a soft-landing on the moon  
**Astrobotic, Moon Express, Team Indus**
- Mobility Subsystem Milestone Prize: \$500,000 per team. based on the mobility system that allows the craft to move 500 meters after landing  
**Astrobotic, Moon Express, Hakuto, Part-Time-Scientists**
- Imaging Subsystem Milestone Prize: \$250,000 per team. based on producing “Mooncasts” consisting of high-quality images and video on the lunar surface  
**Astrobotic, Moon Express, Part-Time-Scientists, Team Indus**

# Hakuto

## 2012 field demo



# Back to the Moon

## PISCES LUNAR FLIGHT EXPERIMENT

- High Schools system engineer NASA technology
- Electrodynamic Dust Remover – KSC Swampworks (Carlos Calle)
- Field testing of GLXP (Earthrise) Lander Leg mockup with EDS, camera system by High School engineers with re-duster.
- CATALYST call with other GLXP teams for lens covers (Astrobotics, Moon Express)



Your graphic here!

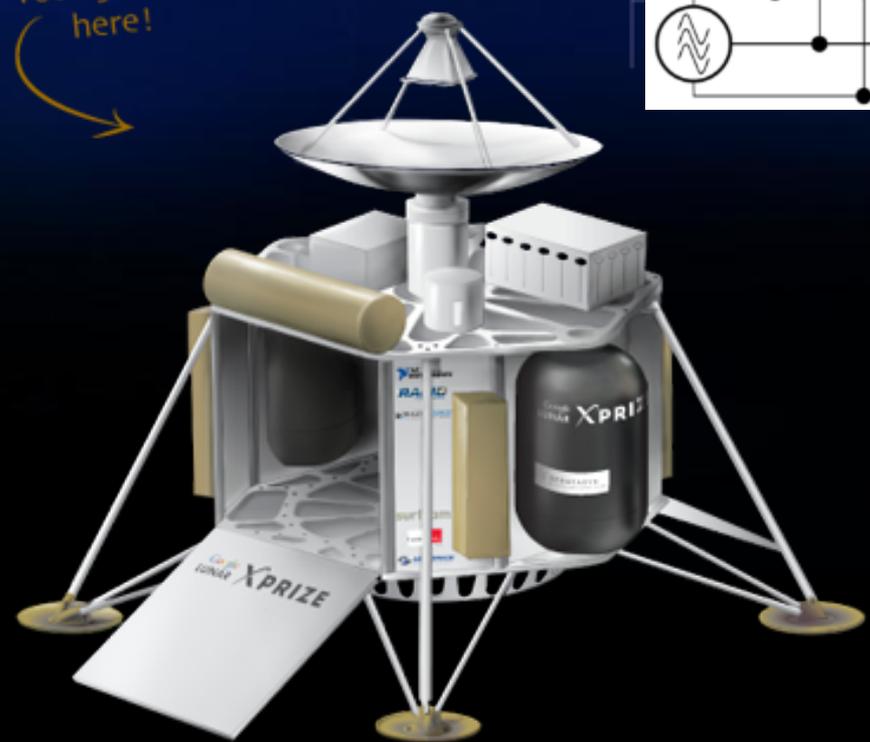
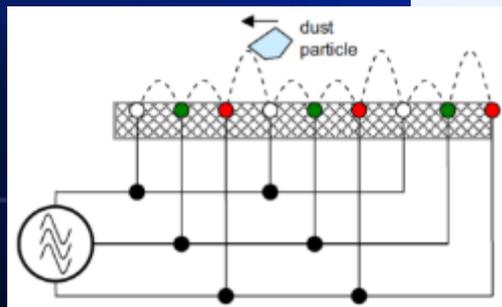


Figure 1

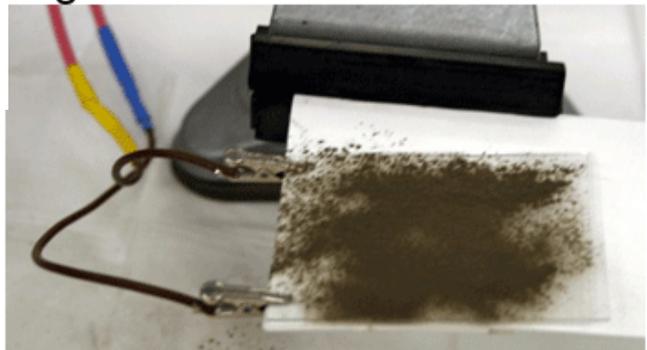
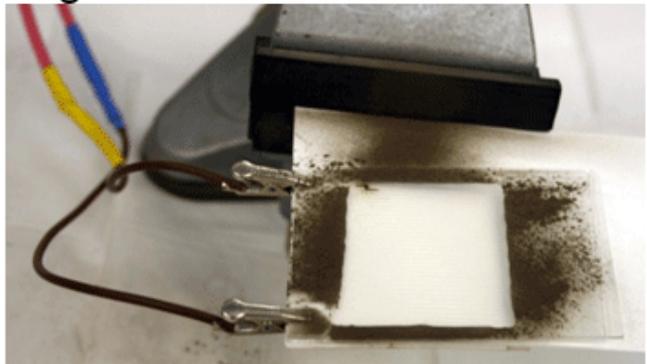


Figure 2



# Juno





# PISCES

- Juno Rover on loan from
- Merrie Monarch Parade





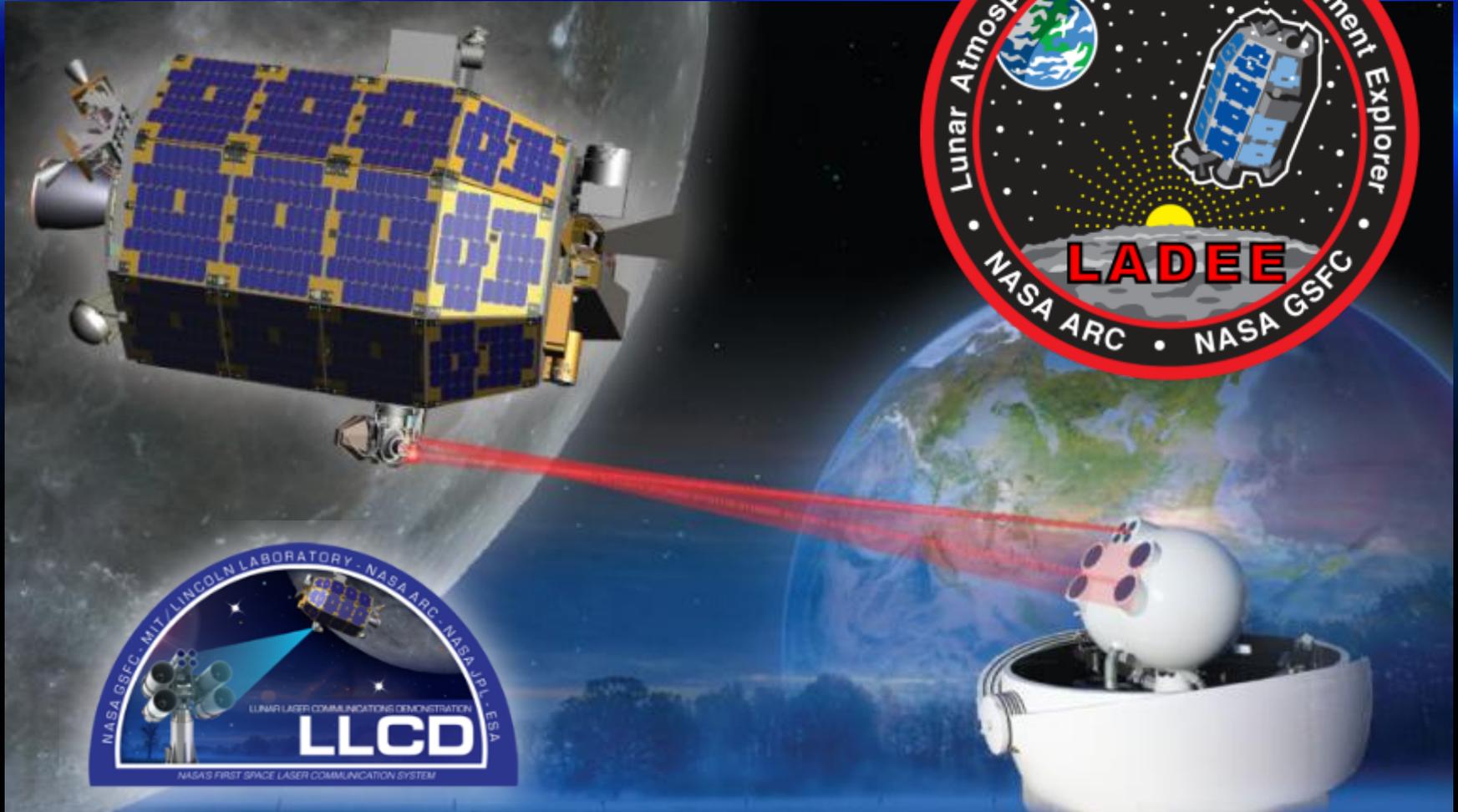
# Communications



**Fiber Optic to Hilo & Waimea**

# LLCD 2013

THE FUTURE OF SPACE MINING



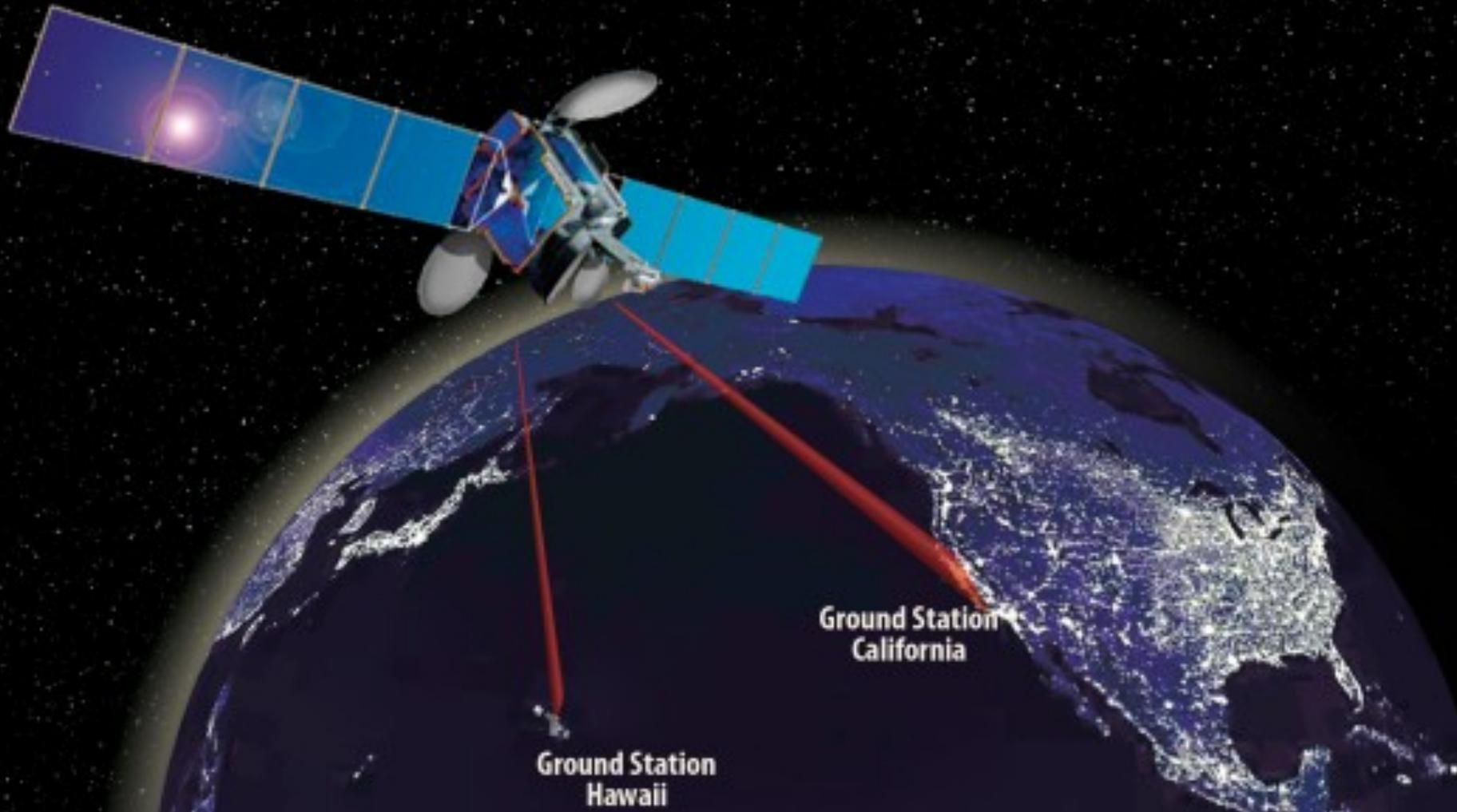
Golden, CO 10-11 June 2014

**PTMSS**

Planetary & Terrestrial Mining Sciences Symposium

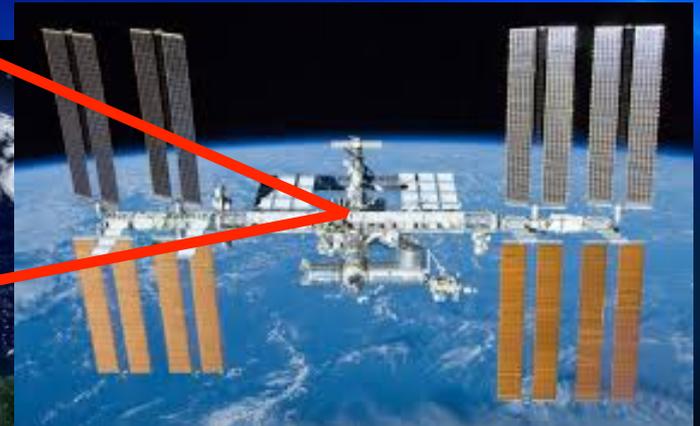
# LCRD 2016

THE FUTURE OF SPACE MINING



Ground Station  
California

Ground Station  
Hawaii



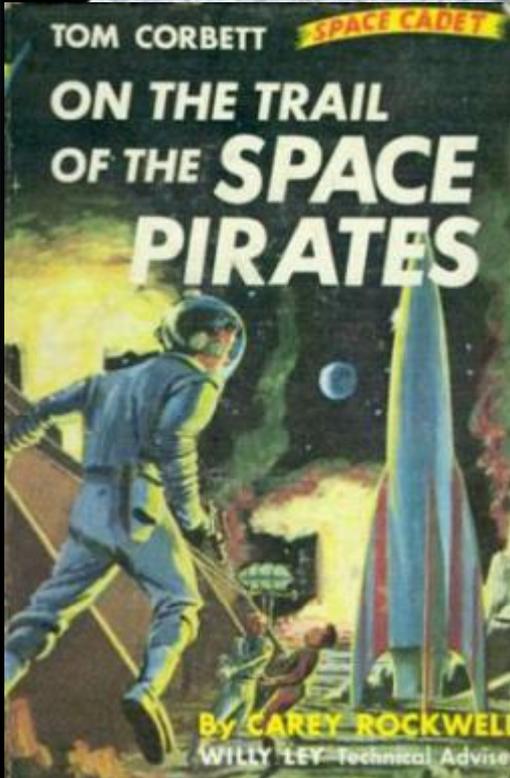
# Orbital Teleoperation of surface rovers - Lunar Analog



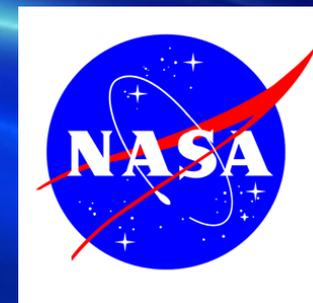
# Mining!



# MINING ON THE MOON



# RPM



- Resource Prospector Mission
- NASA's first attempt to demonstrate in-situ resource utilization (ISRU) beyond Earth.
- “Notionally” slated for a 2018 launch
- “A lot of the technologies have broader use than just lunar, so RPM is not about a lunar mission per se. It's just a convenient location to be testing the ISRU technology,”
  - Jason Cruzan, NASA.

# RPM

- Possible mission scenario practices
  - Total mission or sub-components
  - May be able to use PISCES rover as Artemis Jr. sub.



Hawaii Field tested 2008, 2010,  
2012



# Frank Schowengerdt

FRANKLIN SCHOWENGERDT / 1936-2014

## Physicist recognized isles' value to space research

**Joie Nishimoto**

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Franklin Schowengerdt, regarded as a visionary leader of space research programs in Hawaii, has died of cancer in Alexandria, Va. He was 77.

Schowengerdt, a physicist and former program director at NASA, was the founding director of the Pacific International Space Center for Exploration Systems, also known as PISCES.

He was also U.S. vice chairman of the Japan-U.S. Science, Technology

and Space Applications Program (JUSTSAP).

His career included teaching positions at the Colorado School of Mines, California Institute of Technology and the University of Hawaii at Hilo.

In a tribute written last week, former Gov. George Ariyoshi called Schowengerdt "a man of diverse talents and impeccable vision."

The state Legislature also recognized Schowengerdt's career, saying his efforts at JUSTSAP and PISCES helped to make space exploration more sustainable as well as

more affordable through international partnerships.

Jim Crisafulli, director of the Hawaii Office of Aerospace Development, said he worked with Schowengerdt "for decades" and that Schowengerdt worked assiduously to advance Hawaii's engagement in space research, making the state a major contributor to and beneficiary of global space enterprise.

"He recognized the unique assets of the state — being in the Pacific and so close to the equator as well as Hawaii's moon-Mars-like

terrain," Crisafulli said. Rocket launches are more efficient near the equator because they take advantage of the earth's angular momentum.

Crisafulli said Schowengerdt was also passionate about opening up job opportunities for aspiring scientists in Hawaii.

A memorial service will be held May 8 in Arlington. Schowengerdt died Feb. 12.

He is survived by wife Ellen, daughter Anna, son John and brother Richard.

Contributions can be



**Franklin Schowengerdt:**

*The NASA scientist, who taught at the University of Hawaii at Hilo, was the first director of the Pacific space center PISCES*

made to the Frank Schowengerdt Memorial Fund at the University of Hawaii at Hilo's PISCES a

# Frank

- Frank Schevengerdt 1026 2014

- SB

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CES

(2008)

# ALOHA



**Back to the Future**

Golden, CO 10-11 June 2014

**PTMSS**

Planetary & Terrestrial Mining Sciences Symposium

# PAU HANA

THE FUTURE OF SPACE MINING



DOUGLAS FISHER

Golden, CO 10-11 June 2014

**PTMSS**



Planetary & Terrestrial Mining Sciences Symposium

THE FUTURE OF SPACE MINING

