

The Hawaii Space Flight Laboratory and the LEONIDAS Program



Program Summary and Goals

Reaching for the Stars: NextGen Aviation and Space Launch

August 21, 2008

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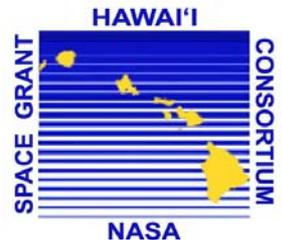
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Hawaii Space Flight Lab Origins

- Collaborative program between the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST) and College of Engineering (CoE).
- Connections through the Hawaii Space Grant Consortium since 2001.
 - **CoE provides small satellite engineering experience**
 - National Electrical Engineering Undergraduate Students of the year in 2001, 2003 and 2005.
 - Engineering faculty specializing in nano- and micro-sat design.
 - **SOEST provides instrumentation design and science applications**
 - Faculty with instrument building experience.
 - Faculty investigators on many NASA missions.
 - **HSGC provides NASA support**
 - Network of 52 space grant consortia in each State as well as District of Columbia and Puerto Rico.
 - Grant funds for undergraduate and graduate fellowships on UH system campuses.
 - Pipelines of K-16 activities in engineering, space science, and remote sensing.
 - Connections to NASA Centers and NASA HQ through Office of Education.



The University of Hawai'i at Mānoa Centennial Spotlight



Celebrating a
Century of Excellence

Leadership



Excellence



Innovation



Hawai'i Space Flight Laboratory On the Leading Edge of Space Exploration and Research

Designed as a multidisciplinary research and education activity bringing together individuals from diverse areas to explore, study and advance the understanding of the space environment, the Hawai'i Space Flight Laboratory positions UH Mānoa to become the first university in the world with the capability to design, fabricate, launch and control its own satellites. For information about HSFL, its programs or the many educational opportunities provided for students interested in the areas of research, development and engineering, visit

www.hsfl.hawaii.edu

Reliable, Low-Cost Access to Space ♦ Space Exploration
Microsatellite Design, Fabrication and Launch ♦ Payload Design and Integration
Ground Systems and Operations Support ♦ Workforce Development



Small Business
A Centennial Sponsor



The mission of HSFL is to:

- *promote innovative engineering and science research for terrestrial and planetary space missions*
- *develop, launch, and operate small spacecraft from the Hawaiian Islands to accelerate the validation of new space technologies*
- *provide workforce training in all aspects of unmanned space missions*
- *promote synergistic collaborations between educational, governmental, and corporate institutions interested in space exploration*



HSFL Near-Term Objectives

- Hawaii-based end-to-end small satellite development, integration, launch, and on-orbit operations activity.
- Satellite development and testing; payload integration at University of Hawaii.
- Sustainable launch activity using Pacific Missile Range Facility (PMRF) assets within present boundaries.
- Development of a skilled workforce and new economic opportunities for Hawaii business.
- Facilitate technology transfers to State entities.
- 1st mission in FY10, 2nd mission in FY11. Intended sustained rate of at least one to four research missions per year.

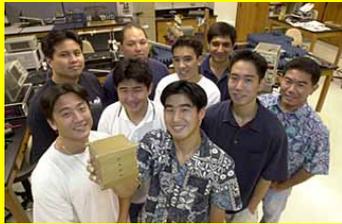


How Will We Do This?

Spacecraft

- Partner with NASA Centers and others to advance small spacecraft design.
- HSFL Spacecraft Team has designed a 50-70kg small sat for a variety of science and educational tasks.
- Support technology validation missions for government agencies (NASA, DoD), as well as other University or corporate missions.

- Draw from cadre of EE and ME students in CoE CubeSat Group



Integration and Test

- Clean rooms in UH/POST will be used to assemble satellites.
 - Systems integration
 - Thermo-vac testing
 - Vibration testing



Instruments

- The HSFL can call on a diverse group of instrument-developing faculty from HIGP and SOEST.
- A number of businesses in Hawaii also develop a wide array of instrumentation. The HSFL will partner with these organizations to provide technology demonstration opportunities.
- NASA Centers (Ames and JPL) are interested in joint technology missions.

Launch Vehicle and Launch Support

- **Pacific Missile Range Facility (PMRF)**
- Local launch facility and mission support
- Use launcher within PMRF boundaries

- **Kauai Test Facility (KTF)/ Sandia National Lab**
- Experience with solid rockets and missile design.
- Can send 300 kg to low-Earth orbit (400 km).
- Heritage working with PMRF as on-site contractor
- Over 1500 successful launches, second only to NASA
- Will provide technology transfer to University of Hawaii



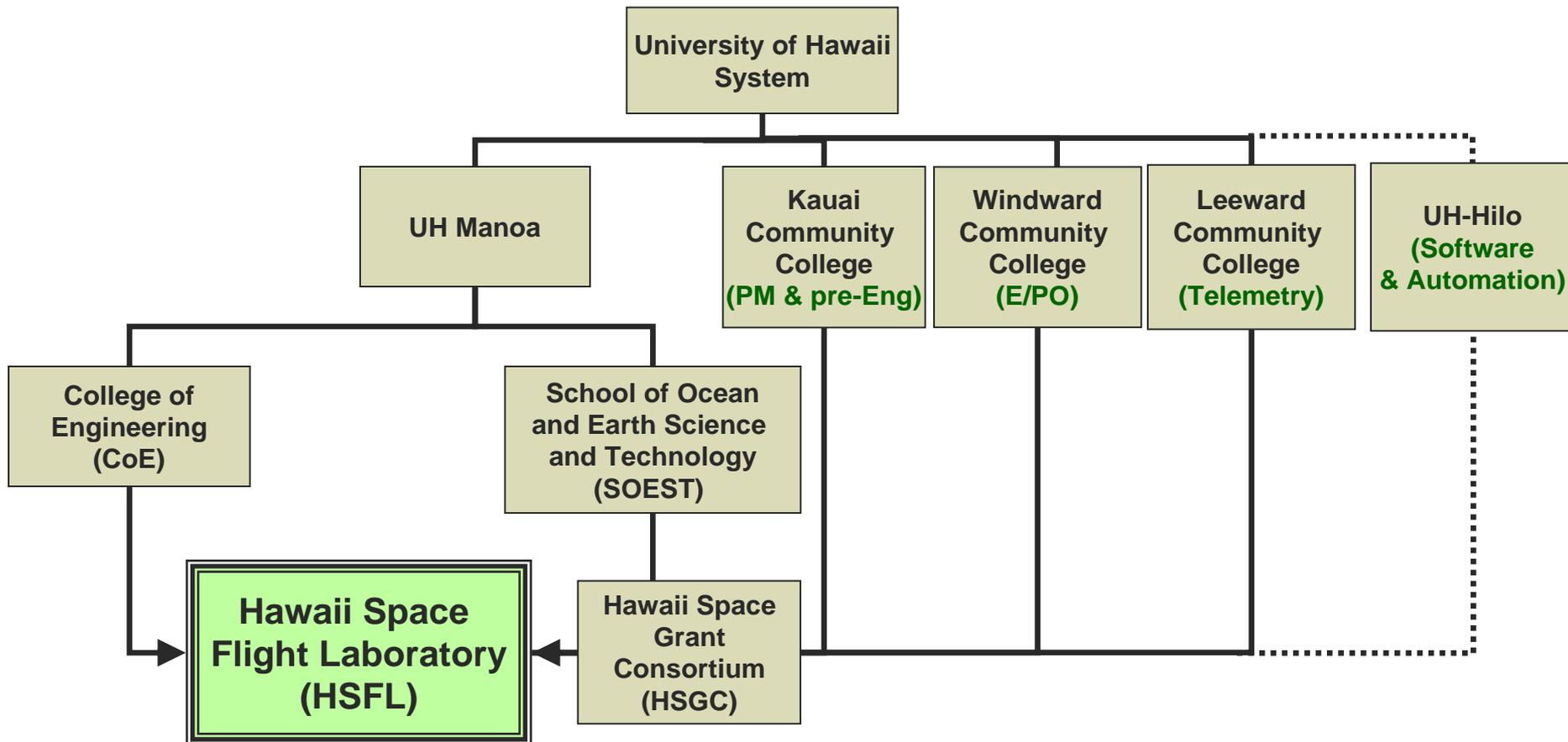
Ground Station & Mission Operations

- UH/HSFL building up telemetry capability at Leeward CC in 2008.
- UHF/VHF station in operation at LCC.
- Ground stations provide command and control broadcast as well as data downlink capabilities.
- Mission Ops Center on POST 5th floor.



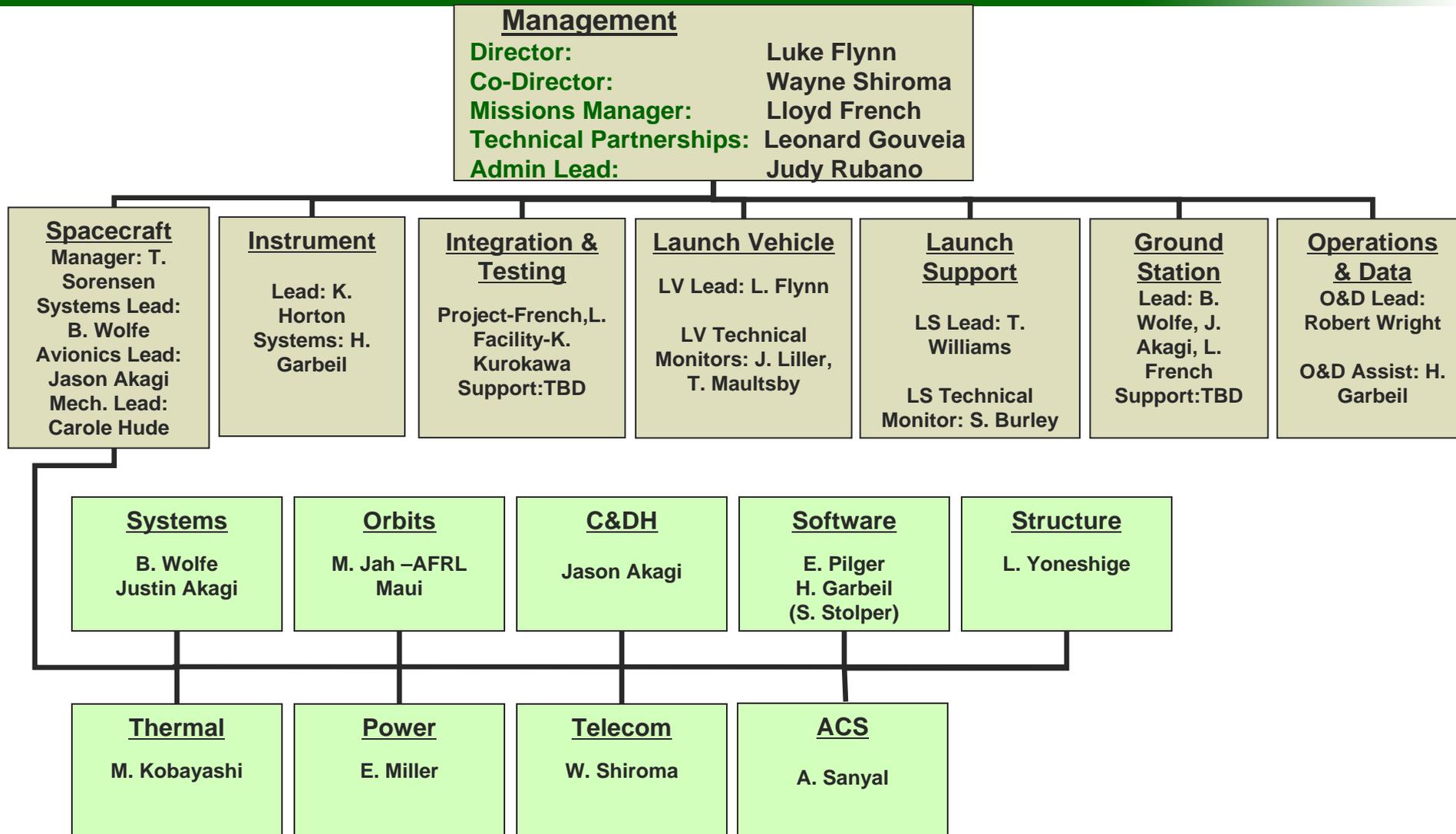


UH System Support for Workforce Development





Hawaii Space Flight Lab





HSFL Program: LEONIDAS



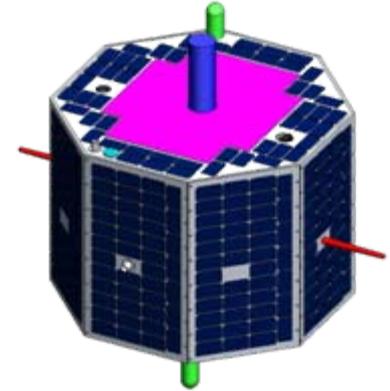
- LEONIDAS was proposed as an experimental demonstration program. LEONIDAS is a Department of Defense Operationally Responsive Space Program that has Congressional support.
- HSFL received letters of commitment for launch motors for first two flights plus 2 spare first stage motors.
- LEONIDAS project costs cover two launches and two spacecraft. Partial cost-matches by NASA Space Grant and NASA EPSCoR for instruments and small satellites. Not included is a cost match of over \$1M from SOEST and the University of Hawaii.
- HSFL has also received a commitment of 5300 sq ft of clean rooms from College of Engineering.
- Spacecraft would leverage less-expensive, already-developed, Commercial-Off-The-Shelf (COTS) systems. Satellite is low-cost platform for flight validation of advanced technologies.
- **Recurring launch costs at less than \$10M/launch.**



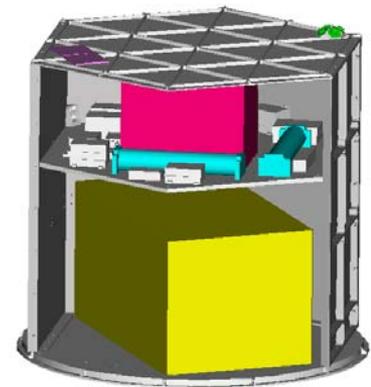
First Two Missions: STUs

- STU: Science and Technology for the University
- STU-1: First launch, test deployment of multiple satellites from SPARK LV. Uses HSFL LEO-1 bus.
 - LEO-1 Spacecraft: Instrument 1: Imaging cameras to record photos from space. Instrument 2: Beacon used to locate the satellite in orbit. Possible Instrument 3: Clean propulsion experiment using water as propellant.
 - UH Kumu A'o CubeSat: Hawaiian CoE student sat.
 - UH CubeSat Payload: 2nd CoE student satellite studying space weather phenomena.

- STU-2: HI-CRESPO: Coral Reef and Environmental Observer Satellite.
 - Partnering with NASA Marshall SFC on small satellite construction. Sensors in pressure vessel.
 - Instrument 1: NovaSol hyperspectral imager.
 - Instrument 2: UH-developed 7.0 – 12.0 micron IR hyperspectral imager.
 - **Sensor suite would be used to observe Hawaii and world coral reefs. Other environmental projects such as fire, volcano, and drought monitoring can be done.**



LEO-1 Spacecraft



STU-2: HI-CRESPO



Conclusions



Summary and Future Benefits

- UH to become the gateway for university-class and small satellite space access. Potential to relieve log-jam of national small satellite projects waiting for space validation of hardware.
- UH to provide student training opportunities from spacecraft design to launch to on-orbit operations by leveraging Hawaii partners (e.g. PMRF).
- Reliable, low-cost orbital access for satellites.
- Workforce development and training spawning hi-technology activities on many islands.
- 70% retention rate of Native Hawaiian students in Engineering (highest at UH)
- Remaining Challenges - Support for Telemetry (LCC), Flight Software Development (UHH) and Operations (UHM). Small satellite development efforts require non-Federal cost match for NASA funding for STU-1 and STU-2 UH spacecraft.