The JPL Cubesat Development Lab

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JPL Cubesat Development Laboratory

The Cubesat Development Lab (CDL) supports CubeSat development projects with a significant JPL involvement. The CDL is managed by the Instrument Division at JPL.

The physical 1500 sq. ft. facility, supportive of building and integrating flight unit, include:

- 250 sq ft viewing gallery/meeting room
- 1250 sq ft clean room
- Class 300K (ISO 8.5) controlled environment
- Complete internet/private intranet systems
- Electrostatic discharge (ESD) flooring
- Port for GPS applications
- 5 pure aire class 100 (ISO 5) clean benches
- Limited (small) thermal vacuum facilities
- Production soldering and fabrication station
- 3D printer
- Cryogenic ventilation system

JPL Cubesat Development Laboratory

http://scienceandtechnology.jpl.nasa.gov/cubesat-development-lab

JPL Cubesat Development Laboratory

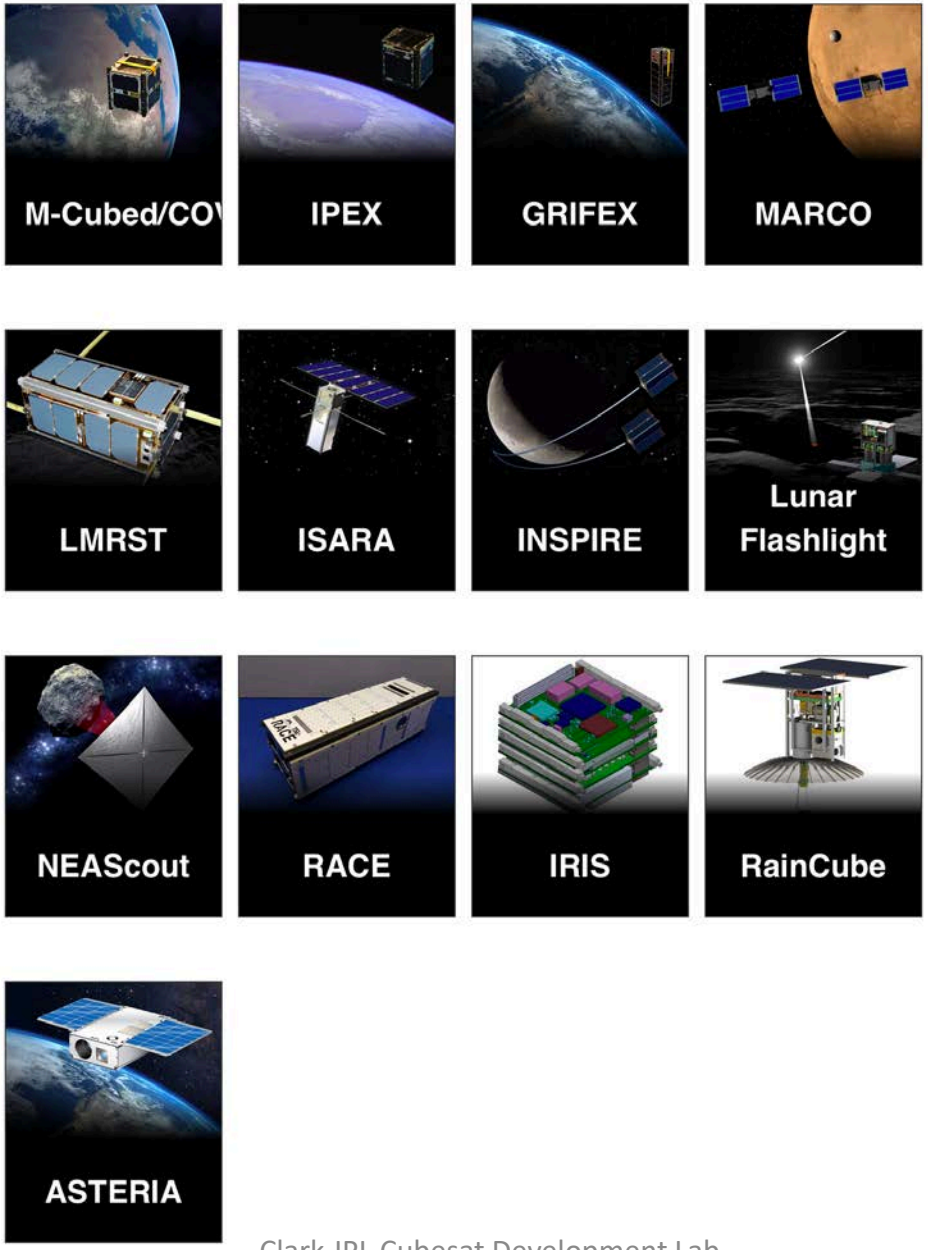
Personnel / Contacts:

- Pamela Clark (mailto:Pamela.E.Clark@jpl.nasa.gov) (818-393-3262) - Director

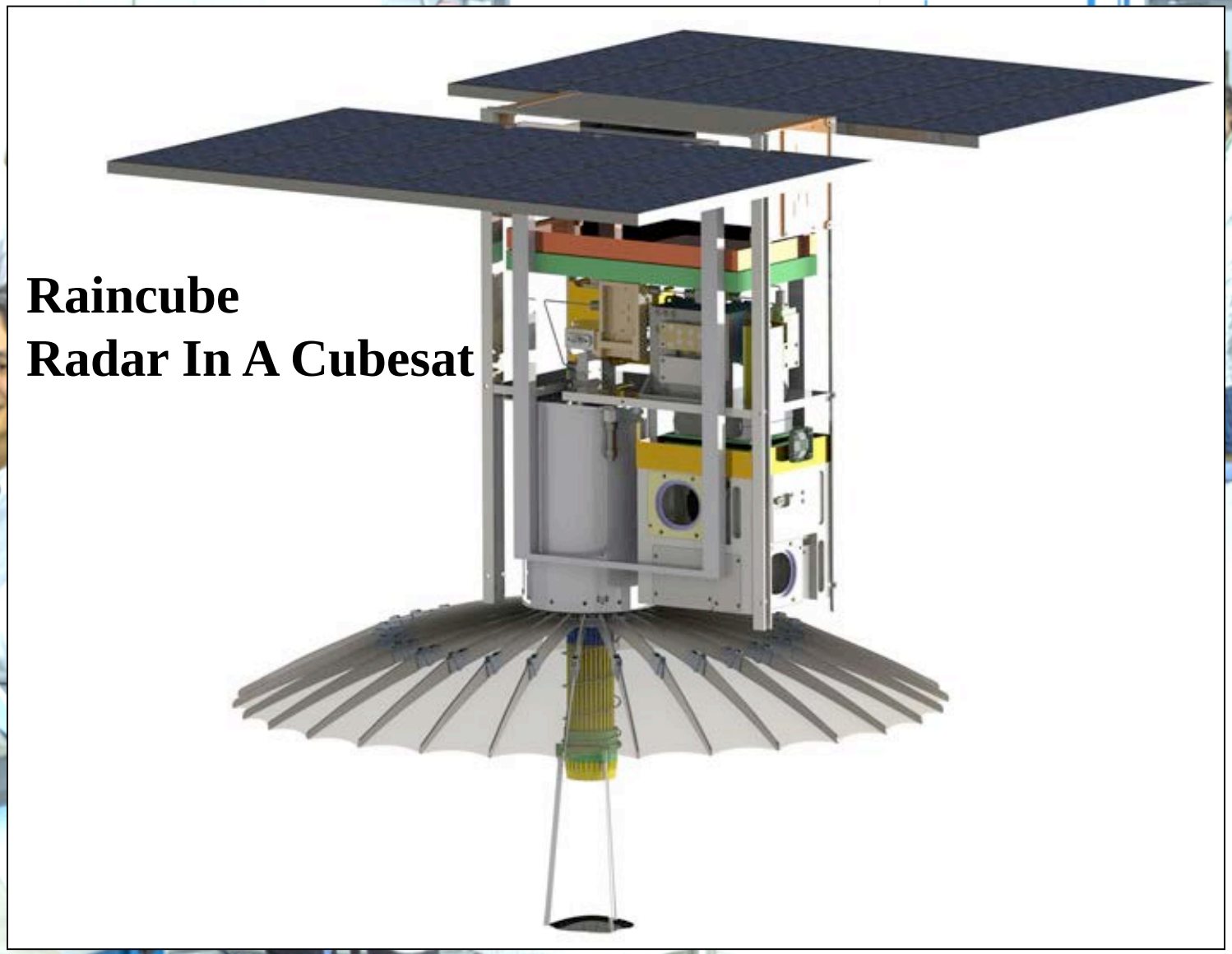
Ongoing Research Projects:

- Cubesats (http://www.jpl.nasa.gov/cubesat/missions/)
- MarCo, Raincube, Asteria, and Tempest D (RACE/MASC) have reserved lab bench space in the CDL at the present time.
- Tempest D (http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7167136)

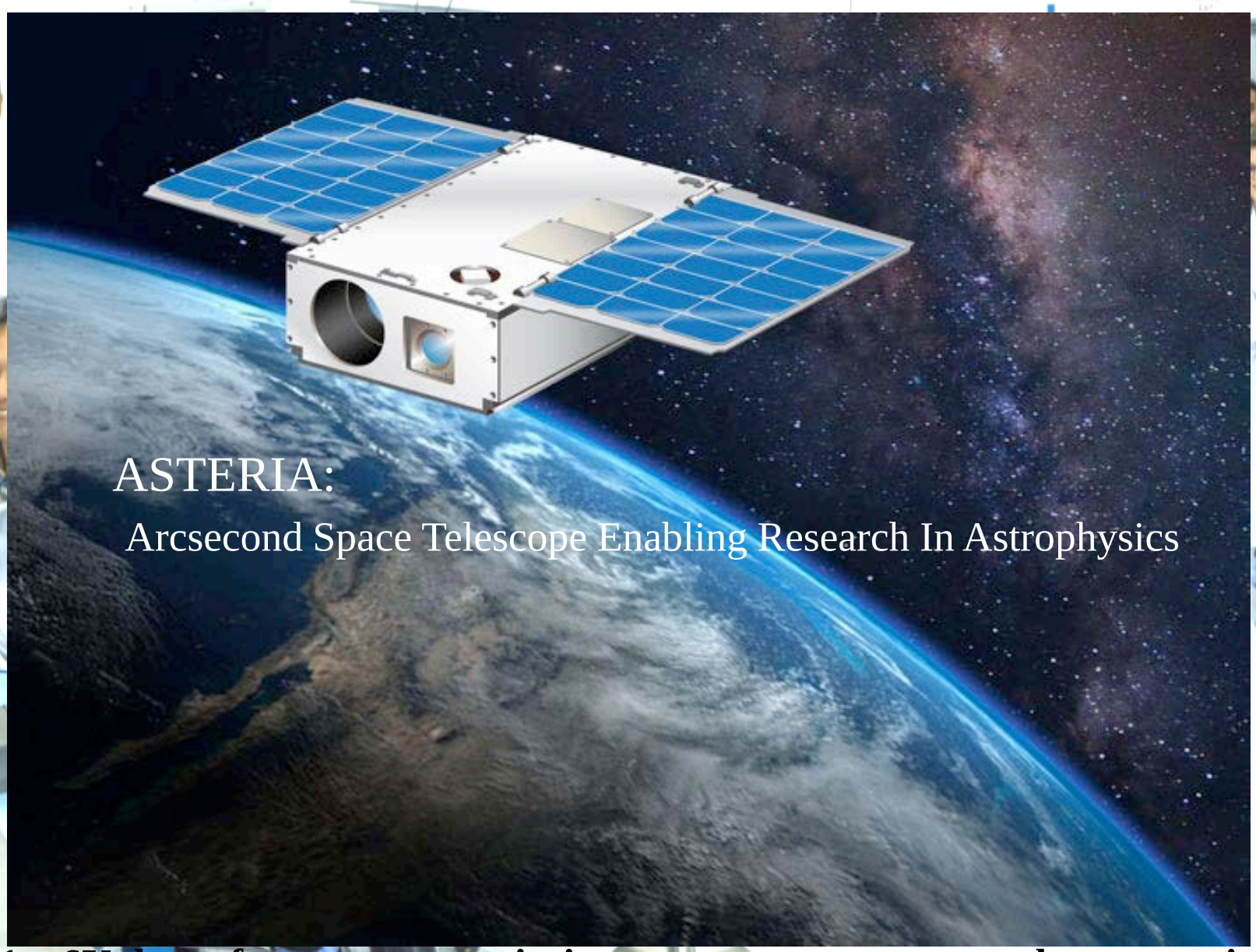
CubeSats to Date with JPL CDL Associations



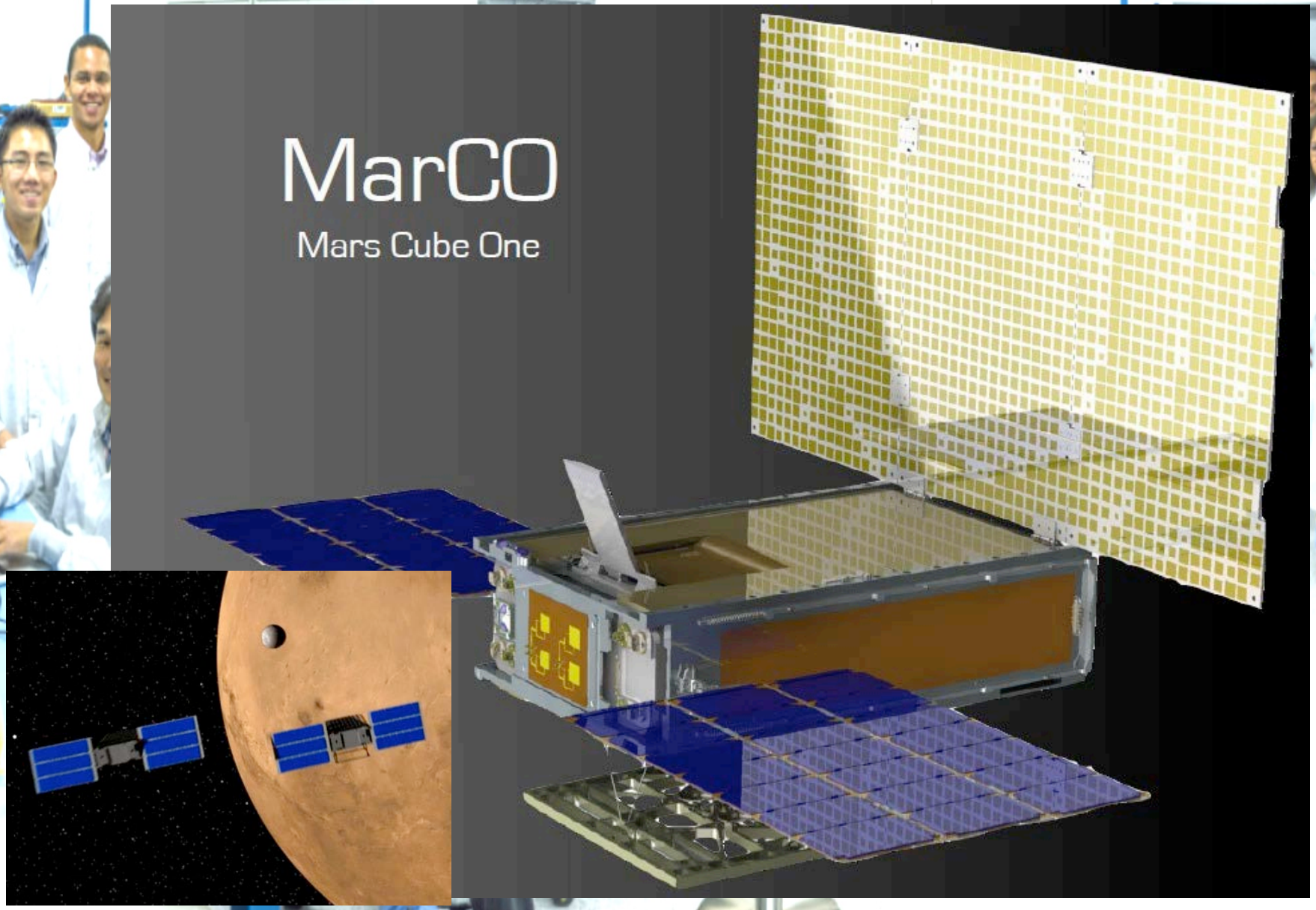
Some Recent Users of JPL CDL



1 x 6U demo compact Ka-band precipitation radar and ultra-compact deployable antenna

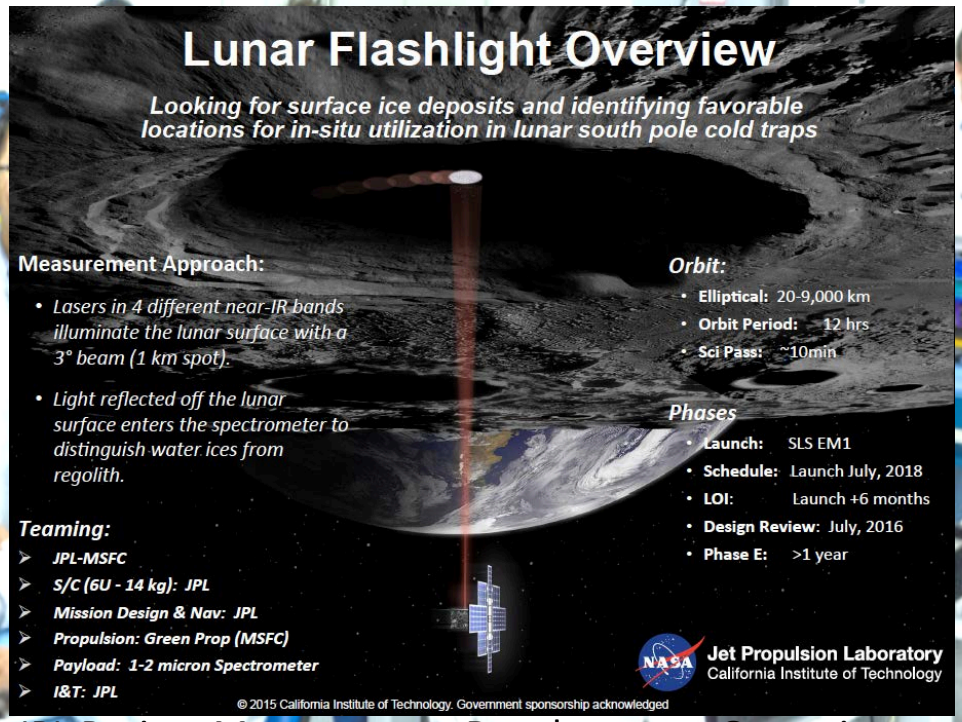


1 x 6U demo for two-stage pointing system to support exoplanet transit photometry

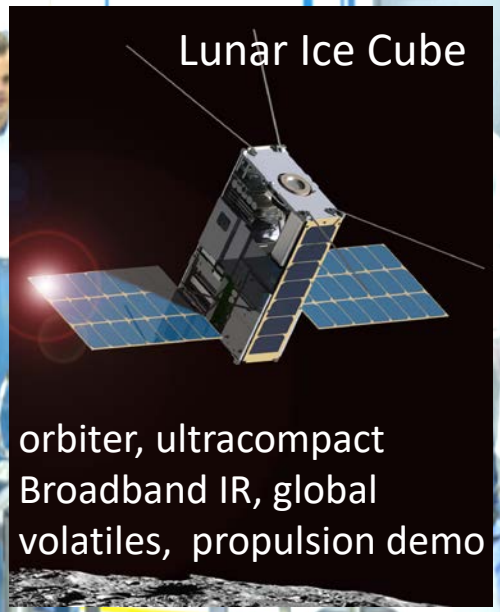


2 x 6U Demo dual band communication to support local and long range communication during INSIGHT EDL

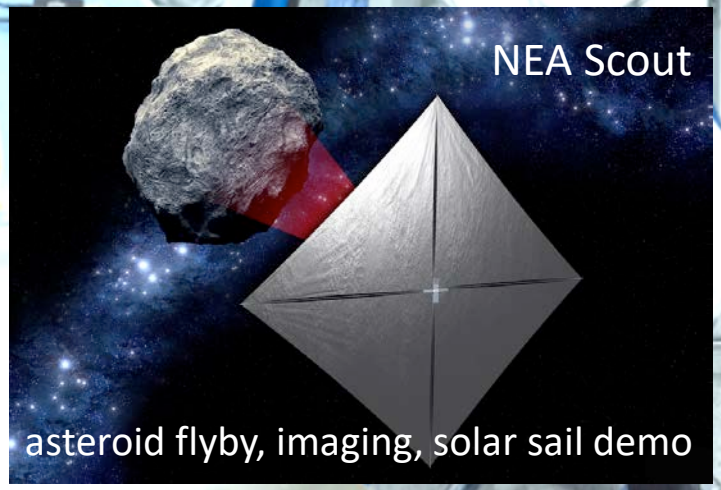
JPL Involvement with several EM1 Missions taking advantage of Cubesat Development Lab



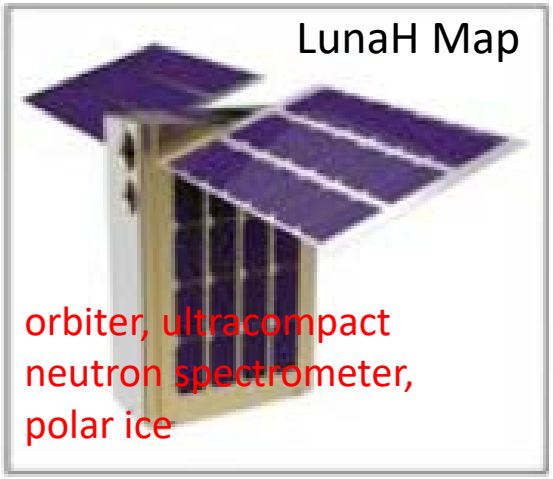
JPL Project Management, Development, Operation



JPL Science PI, iris radio (MarCO)



JPL Science PI, Operation



JPL Comm, Flight Dynamics, iris radio (MarCO)

Future Planned Directions

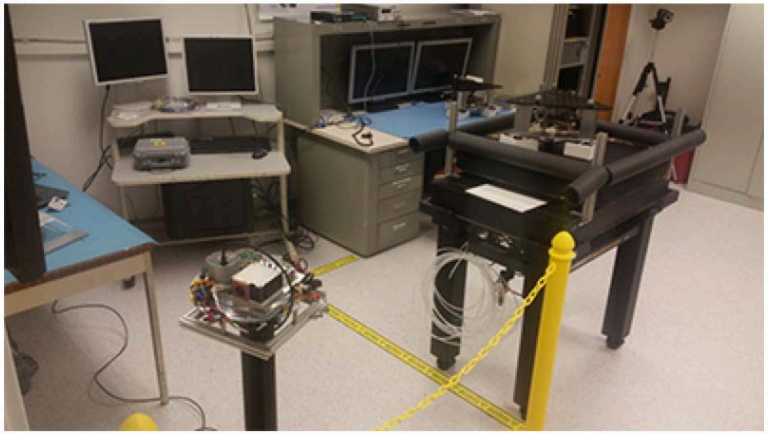
Goals for the future of the Cubesat Development Laboratory include:

- CDL becomes self-sustaining and is open to those with a JPL partner.
- CDL physical facility expands to provide not only 'late stage' clean room facilities for cubesats, but collaborative meeting space for one or more teams, and facilitates access to lab bench space for quick and dirty testing, as well as to 'specialized' facilities such as the Small Satellite Development Testbed for the testing of essential subsystems.
- CDL acts as a 'virtual facility', coordinates and provides a rapid, low-cost 'broker' service and logistics support (including reusable 'clean container') for access to major subsystem (external or in-house) performance data and testing in facilities where these subsystems behavior have been thoroughly characterized, documented, and made accessible (SSDT model).
- CDL acts as a central clearinghouse for information at every stage of cubesat development for inputs on approaches and resources for the development process through website access and walk-in appointments.

Small Satellites Dynamics Testbed (SSDT)

- Small spacecraft now far more numerous
- Dynamic control systems (ACS) especially important to achieving performance
- SSDT capability to characterize, verify, document, and improve these systems

- SSDT Does this by:
- Library of hardware and software control components tested and characterized.
- Planar and spherical air bearing simulation enviornments enable hardware-in-the-loop testing of sensors, actuators, algorithms, integrated control systems
- Hardware environments mirrored in computer environment supporting analytical system dynamics modeling at varying levels of fidelity
- Tools thus useful to technology developers, flight projects, proposal teams to mature and assess system performance.
- By maturing and increasing fidelity of cubesat verification and validation, enables more complex mission-level concepts such as formation flying and autonomous rendezvous and docking required for science-driven and interplanetary missions.



The SmallSat Dynamics Testbed includes a variety of CubeSat hardware integrated into spherical and planar air bearings

Conclusions

- The ‘cubesat landscape’ has changed dramatically over the last decade, but key attributes of the paradigm, including compactness, standardized interfaces, COTS with minimum modification wherever possible, lower resource expenditure, more frequent flight opportunities, new approach to minimizing risk by ‘numbers’, affordable multi-platform distributed measurements of dynamic systems are more desirable than ever
- High priority science driven and ‘prototype’ deep space concepts are greatly impacting and demanding more from the cubesat paradigm
- Maintaining the highly desirably attributes of the paradigm will require a new approach to development, being incorporated by JPL, including
  - sharing and leveraging of tools and facilities
  - Accessible ‘libraries’ of documentation on parts and subsystem performance
  - ready access, through formal and informal means, of lessons learned;
  - minimal effort templatized, built-in capture and tracking of essential planning, building, testing, integration documentation
  - Taking lessons learned from airborne/balloon/suborbital platform folks when appropriate
- Meeting high priority science goals of our end users demand the creation of cleverly tailored solutions with a standard platform where the layout depends on the payload, rather than ‘one of a kind’ solutions

Questions?