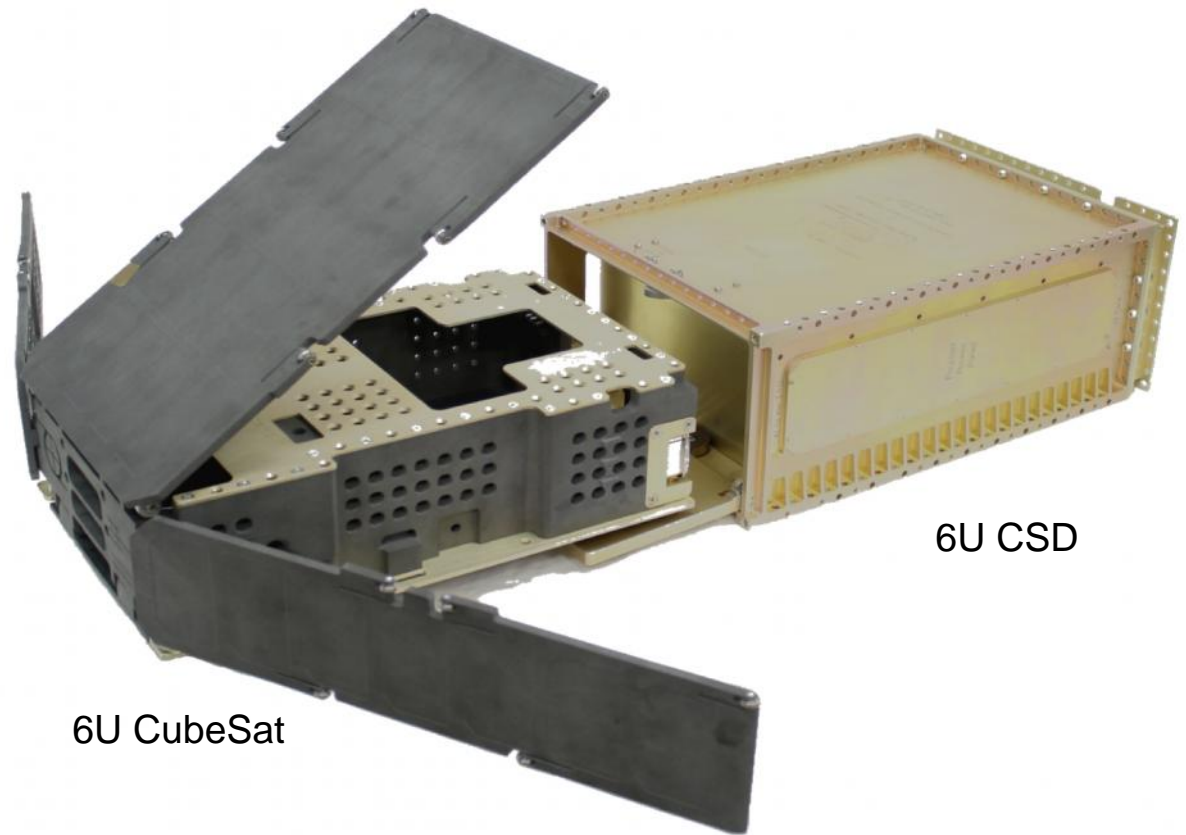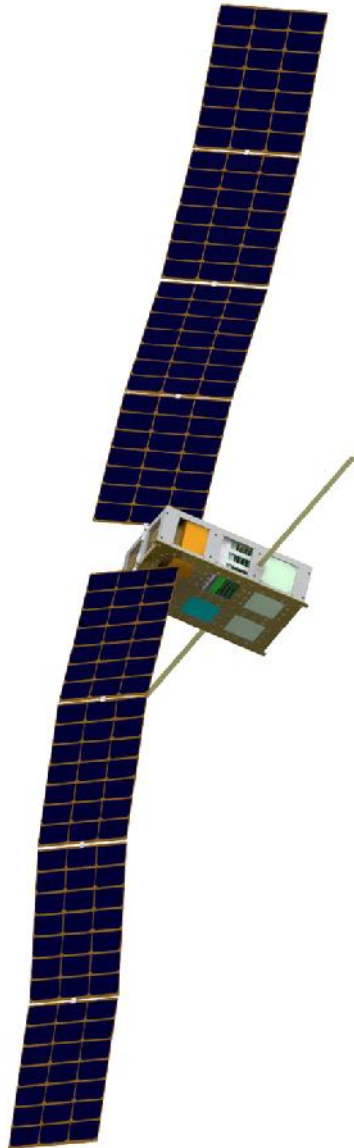# Innovative Uses of the Canisterized Satellite Dispenser (CSD)
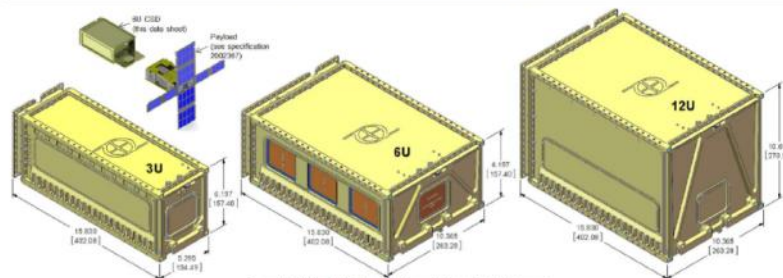
By Walter Holemans (PSC), Ryan Williams (PSC), Andrew Kalman (Pumpkin), Robert Twiggs (Moorehead State University), Rex Ridenoure (Ecliptic Enterprises Corporation), Tom Walkinshaw (Pocketcubeshop), Ryan Hevner (PSC), and Floyd Azure (PSC)

6U CSD

6U CubeSat

What is CSD?

- **A high performance Cubesat dispenser**
    - **Preloaded Payload Tabs** create a predictable load path to and from the payload.
    - **CSD Constrained Deployables** eliminate the payload's need for complex restraint mechanisms.
    - **Six Mountable Sides** increase integration options
    - **Motor Driven Initiator** creates a reliable and testable deployment mechanism that automatically resets without consumables.
    - **Separation Electrical Connector** allows communication and charging between payload and launch vehicle.
    - **P-Pod Compatible Mechanical Interface** ensures compatibility with existing Cubesats.
    - **Lowest External Volume** versus existing designs increases packaging density on launch vehicle.
    - **Largest Internal Volume** versus existing designs accommodates larger payloads.
    - **Safe/Arm Access on Front Door** ensures payload access at all times.

- 3 part encapsulant holds 8 PocketQubs in a ~1U
  - The 3U CSD is 1 inch longer internally allowing the extra length of the encapsulants, allowing 24 PocketQubs

8 PocketQubs

PocketQub

Encapsulant

24 PocketQubs

3U CSD

Multi-Piece Payload
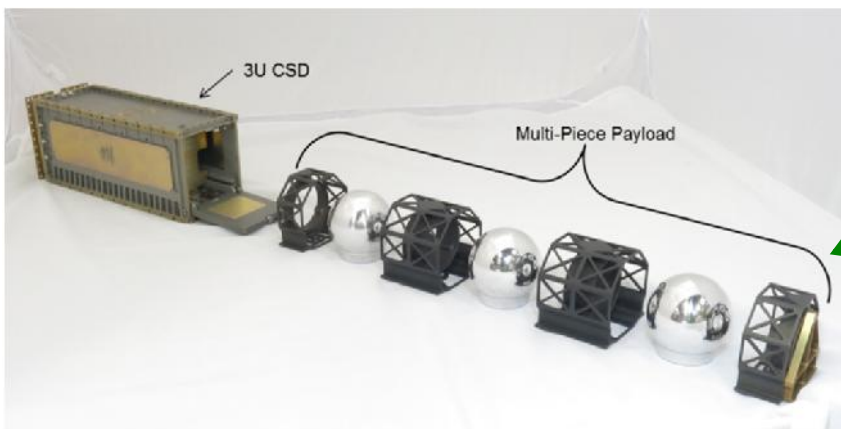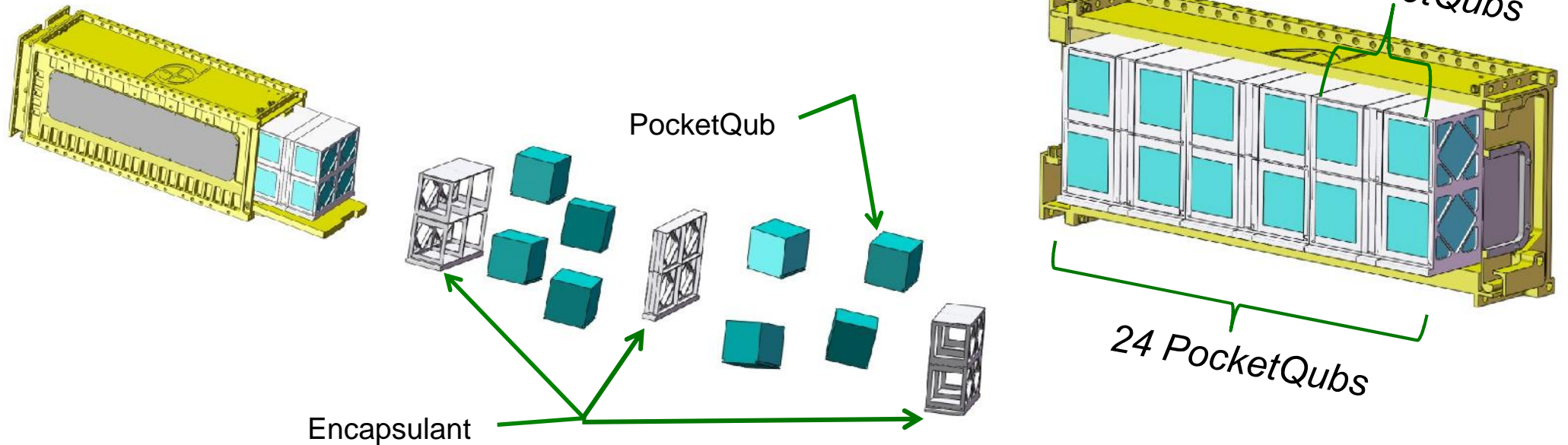
Tab: load path to CSD

Similar to encapsulation of POPACS spheres

50 [2]   50 [2]   50 [2]
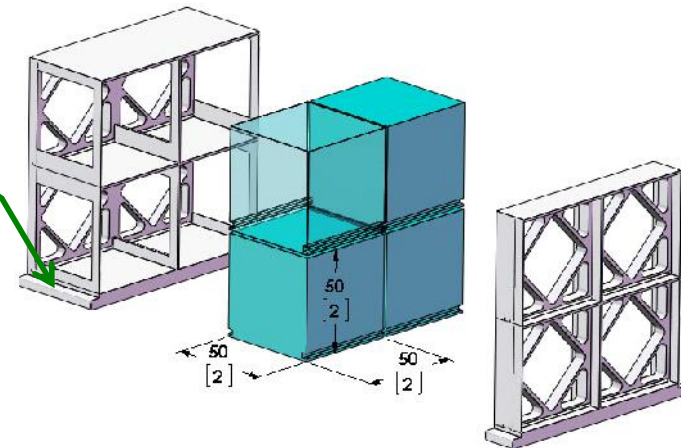
6U Structure

- Designed by Pumpkin, Inc.
  - Holds six standard CubeSats as subsystems in larger 6U CubeSat

Aluminum structure

Tab: load path to CSD

361
14.21

239
9.41

6 x 1U CubeSat

204 Watt PV panel can drive electric propulsion to the planets

2.87 m (113 in)

Motors drive PV panels

Separation connector to LV
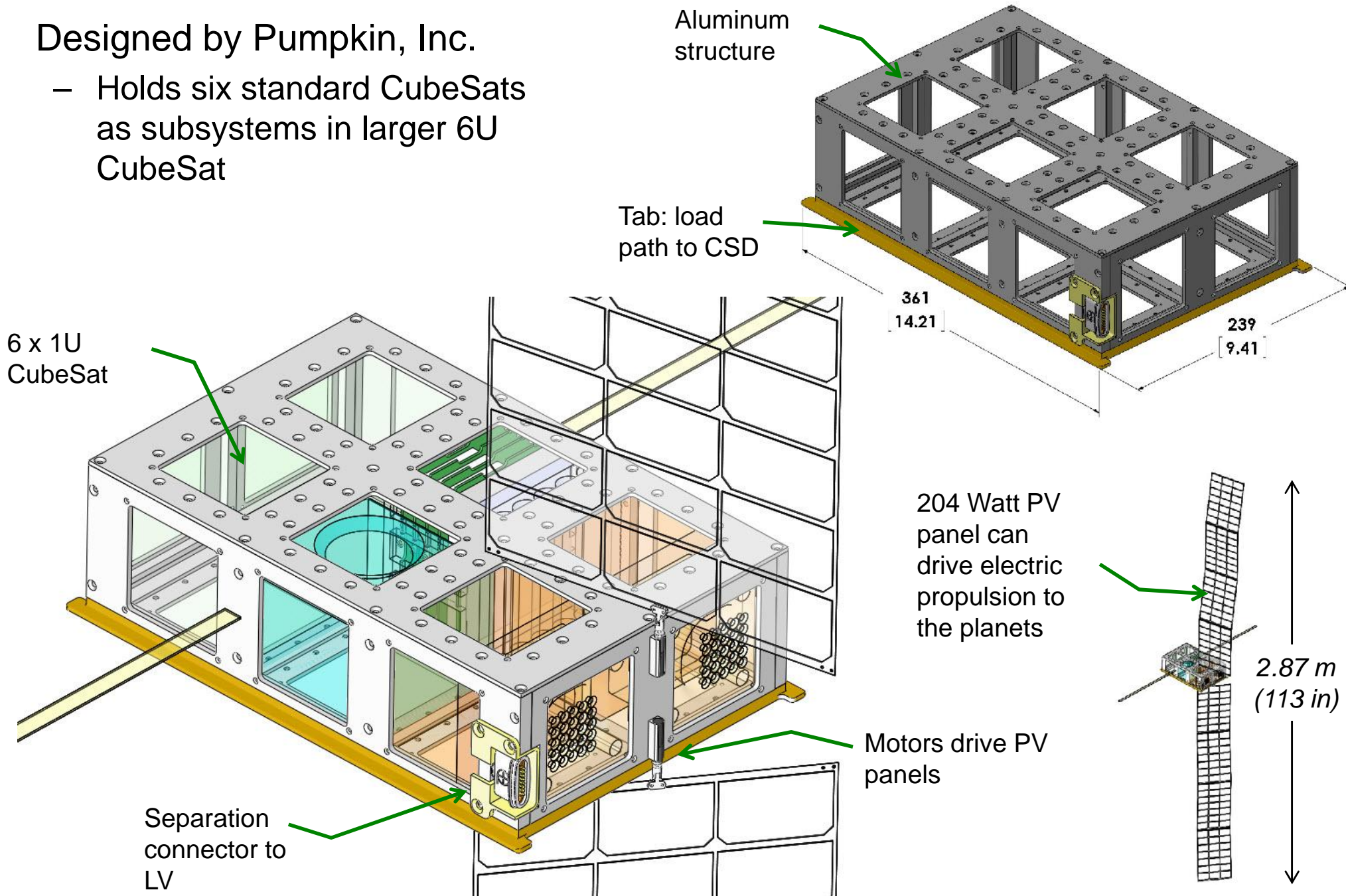
- 3U CSD constrains and dispenses 5 CubeSats
- Total length does not have to fill CSD

Tab: load path to CSD

46.36 [1.83] 46.36 [1.83] 113.54 [4.47] 50.64 [1.99] 50.64 [1.99] 50.80 [2.00]
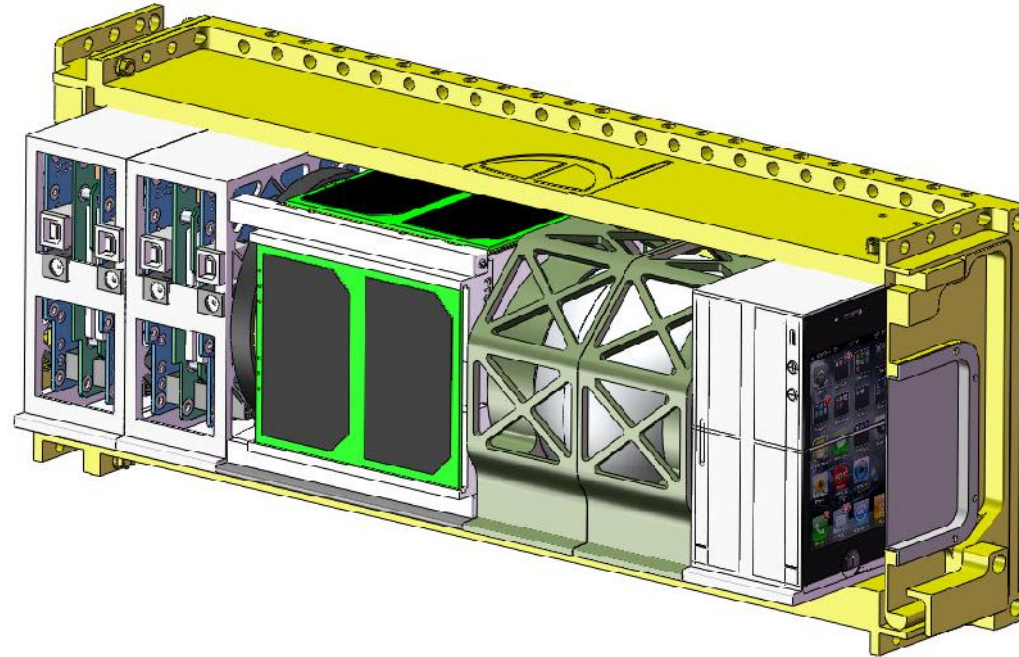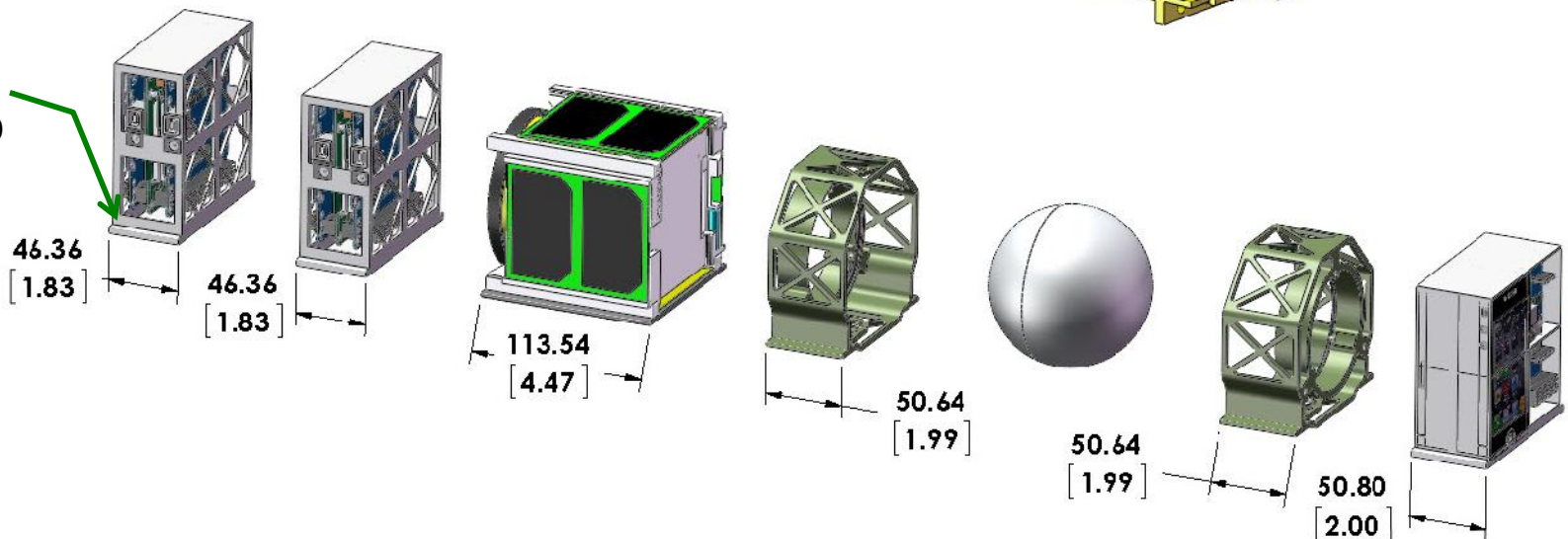
Dispensing Hosted Payloads from large spacecraft

- Dispensing spacecraft from geostationary spacecraft allows electric propulsion to Moon, Mars etc.
  - Need 1.6 km/sec to Moon from Geostationary: about 1 kg of propellant at an Isp of 1,500 sec

Geostationary spacecraft

In CSD: Trickle charge, thermal control and state of health telemetry via separation connector for days, months or years

T+ 0.5 seconds,
$\Delta V = 1.0$ m/sec

PV panels and RF antenna automatically fully deploy in 10 seconds

- Stabilize in 30 minutes
- RF communication to Earth
- Verify state of health of subsystems
- Await propulsion enable

To the Moon, Mars, etc.
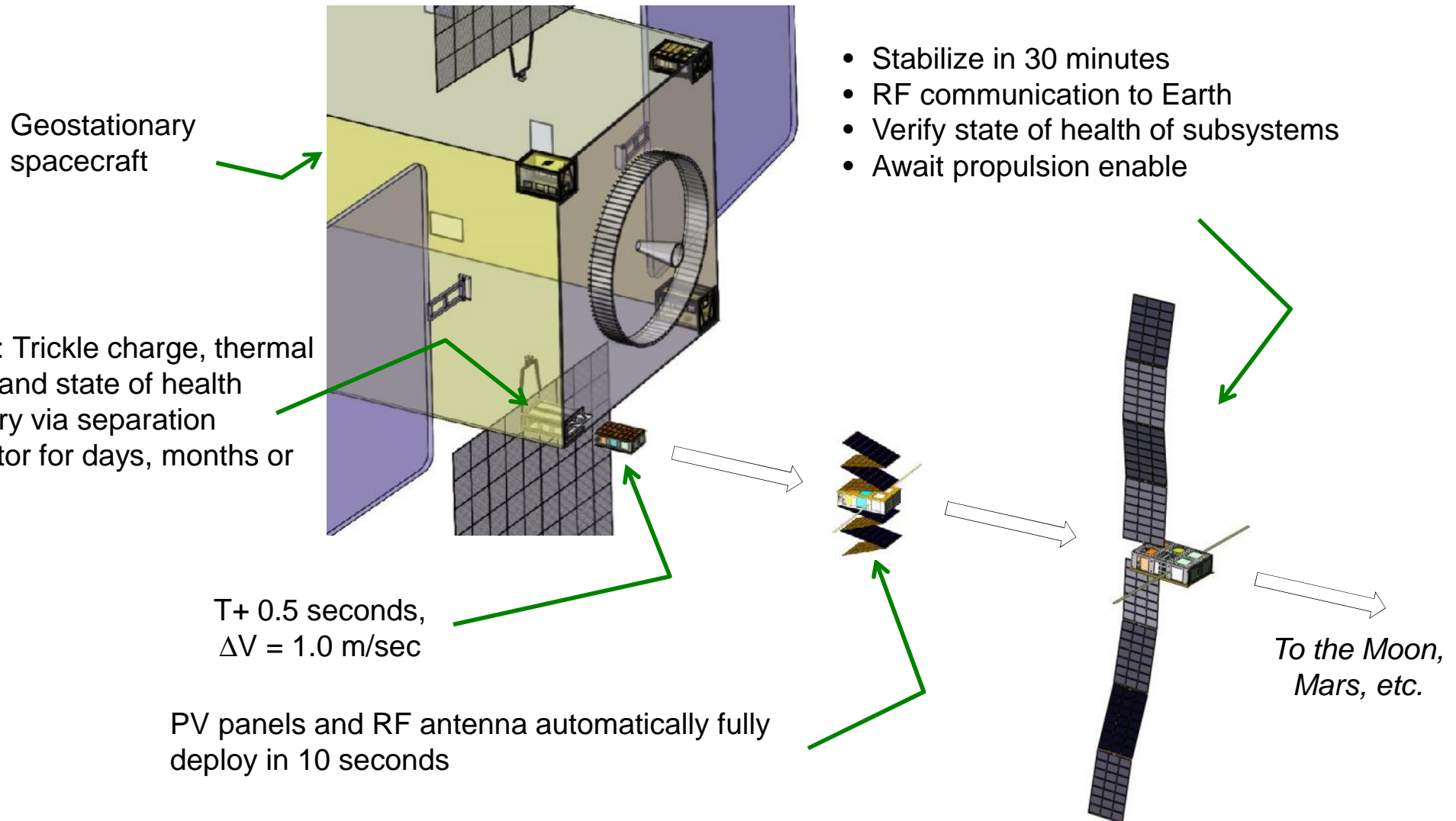
- A simple, flat Interface Plate allows rapid and robust integration to ESPA

6U CSD

ESPA

Aluminum Interface Plate

CSD is cantilevered off of Interface Plate

Interface plate

6U CSD cantilevered off interface plate between ESPA and 15inch Lightband.
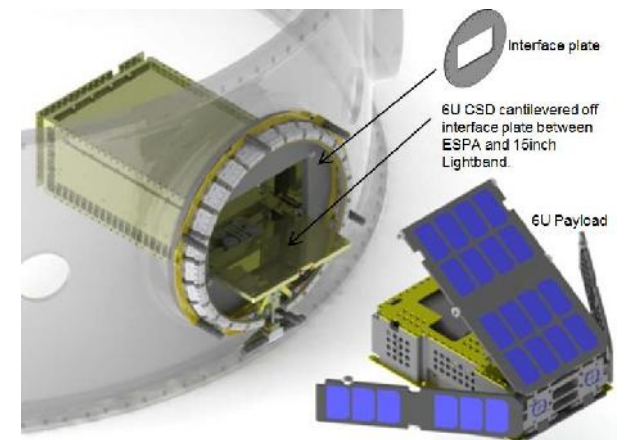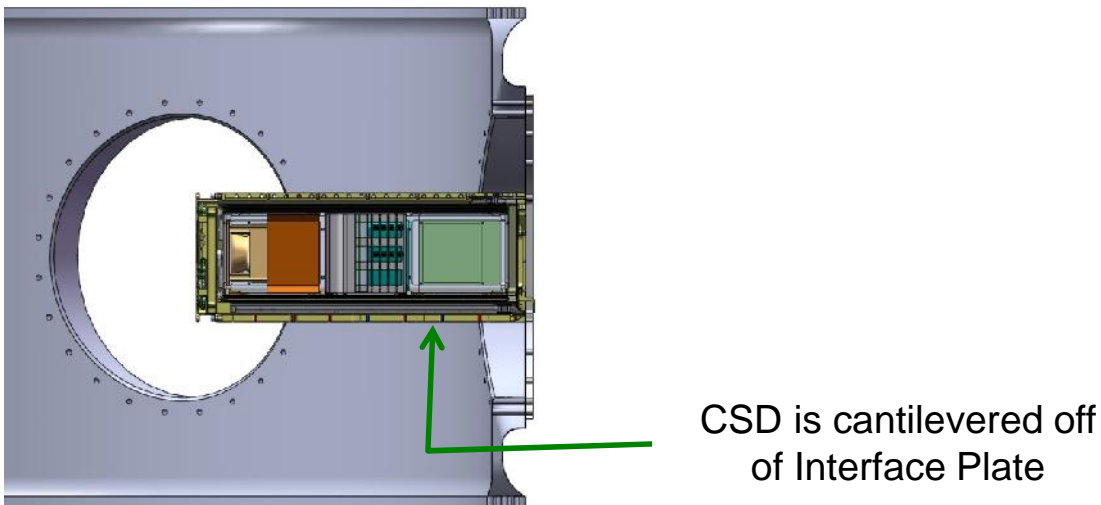
6U Payload

- Sequencer (By Ecliptic) initiates the dispensers once launch vehicle (LV) enables

- Camera(s) records
  - Initial conditions of missions
    - Tumble rates and velocity
    - Shape of deployables
    - CubeSat constellation shape
  - Proximity operations

SAFE/ARM connector

Door opens to expose camera

(Sequencer does not dispense itself)

Separation connector to LV

ESPA Grande

Sequencer and camera mount to aluminum plate (tab to CSD)

Connectors to wiring harness to other dispensers

Optical or IR camera, RADAR/LIDAR

Battery if LV does not supply power

Sequencer in 3U CSD
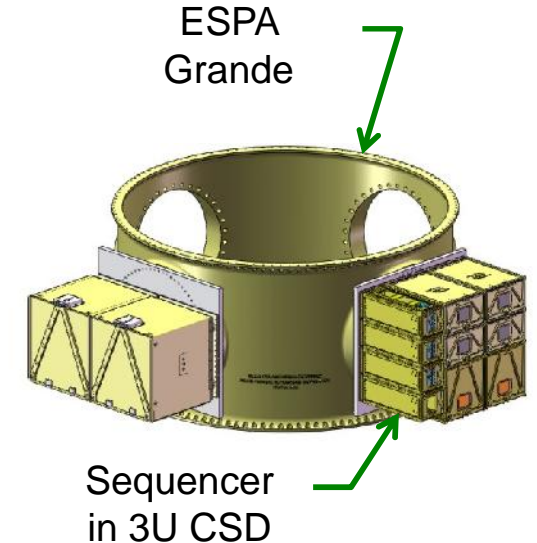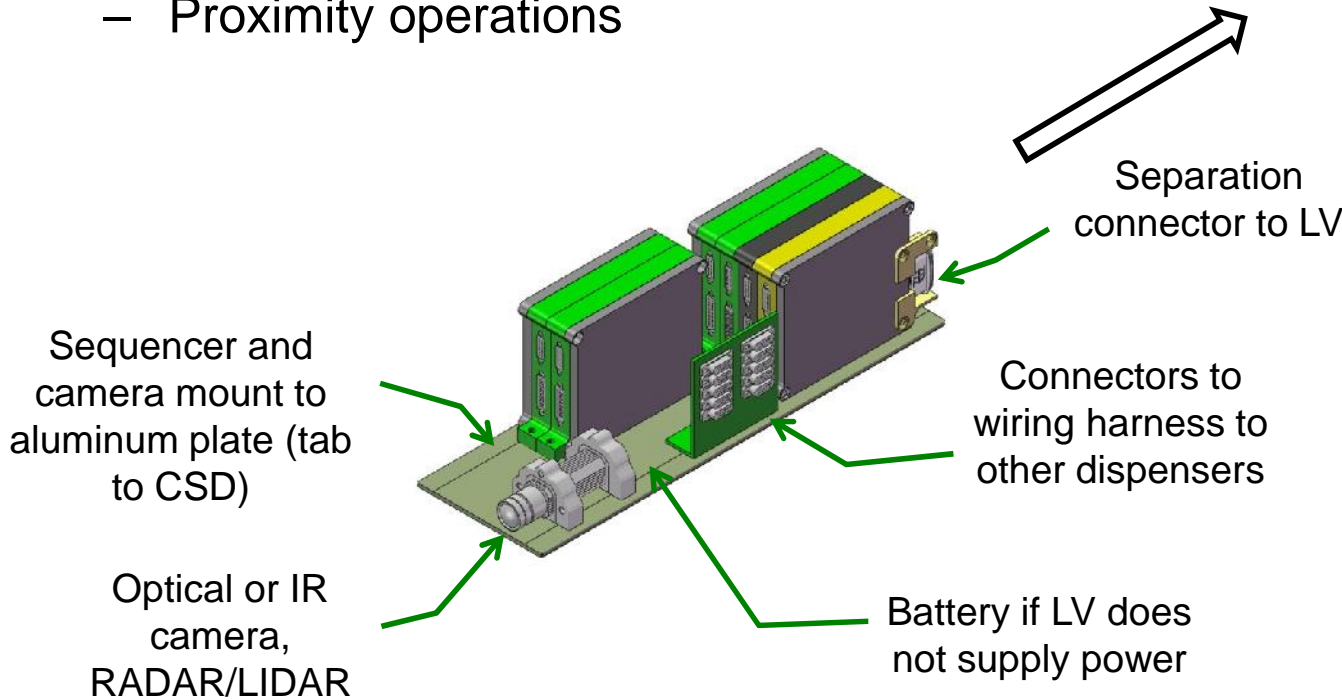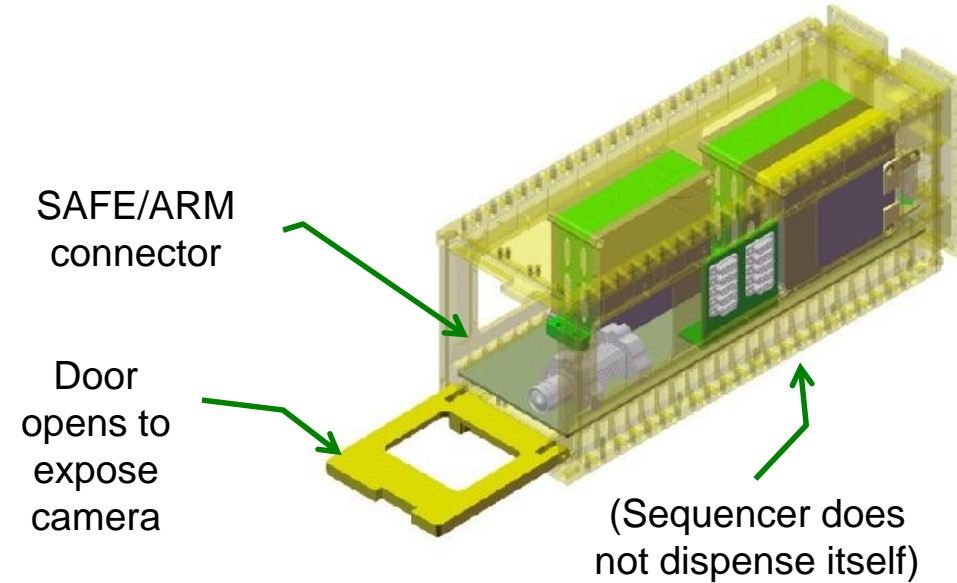
References

- **Staehle, Robert L.** *Lunar Flashlight: Finding Lunar Volatiles Using CubeSats,* **Third International Workshop on LunarCubes Palo Alto, California, 2013 November 13**