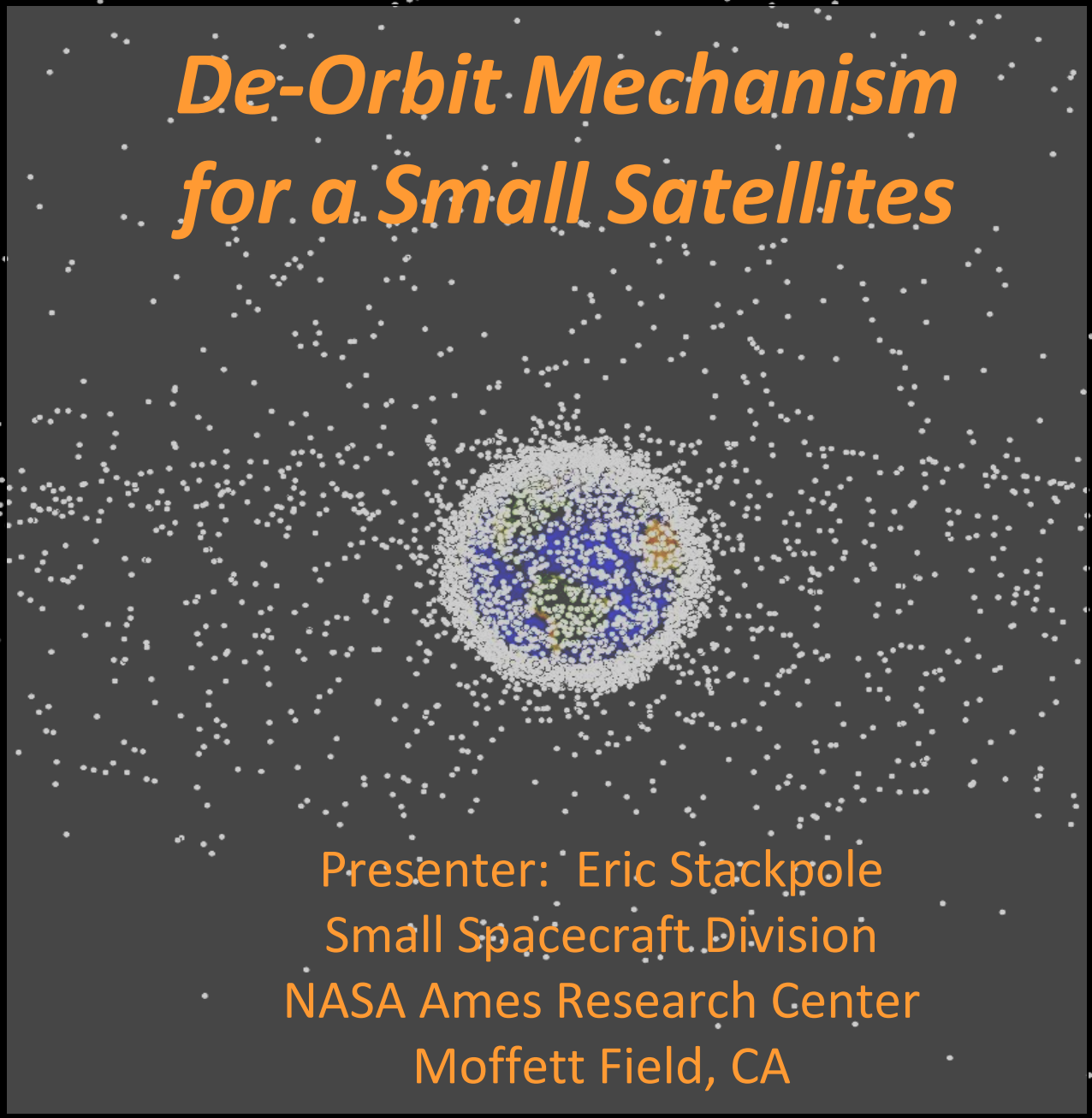
De-Orbit Mechanism for a Small Satellites



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Division focus:

NASA's ability to rapidly develop and launch ground-breaking technologies into space just got more efficient and less expensive.

Small and very small satellites (weighing between 2-440 pounds) can test innovative science and engineering technologies on a smaller scale in the space environment and better understand how hardware will survive the radiation, temperature and vacuum conditions encountered in space.

NASA nanosatellites are designed for a wide spectrum of space missions including biology experiments, testing advanced propulsion and communications technologies.

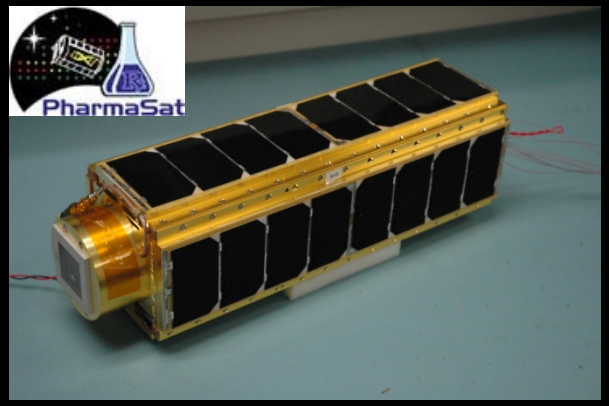
Presentation Overview

1) Heritage of 3 Cube Spacecraft
2) Why de-orbiting is important
3) Design
    Mechanism, Spacecraft, Deployment
4) Future Development

Heritage of 3 Cube Spacecraft

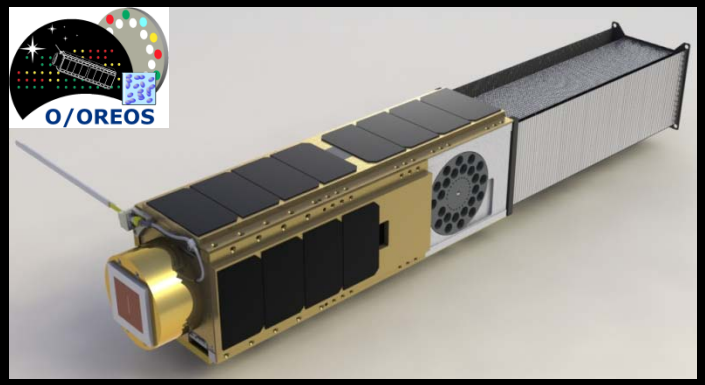
GeneSat-1

- Measured genetic changes E. coli bacteria in space environment
- Launched December 2006



PharmaSat

- Examines yeast growth following exposure to antifungal in microgravity environment
- Launch May 2009



O/OREOS

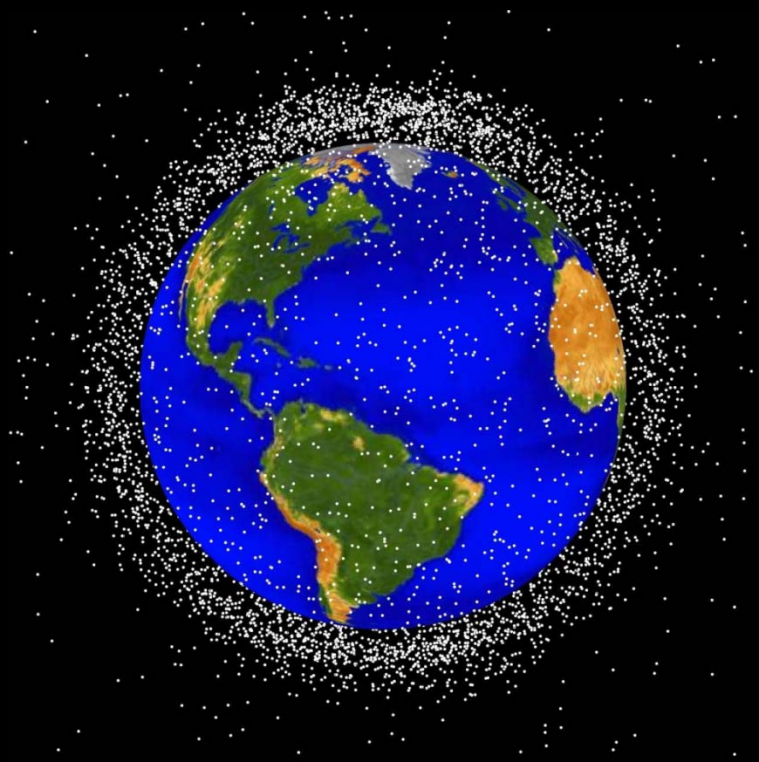
- Dual Payload
  - Biological growth experiment
  - Organics experiment using spectrometer
  - First de-orbit mechanism deployment
- Launch December 2009

Why Satellite De-orbiting is Important:

- Space is getting cluttered
  - Increasing interest in small spacecraft usage
  - Unused satellites become “space debris”
  - Increasing challenge to track all debris
  - Recent satellite collision

- NASA-STD-8719.14:

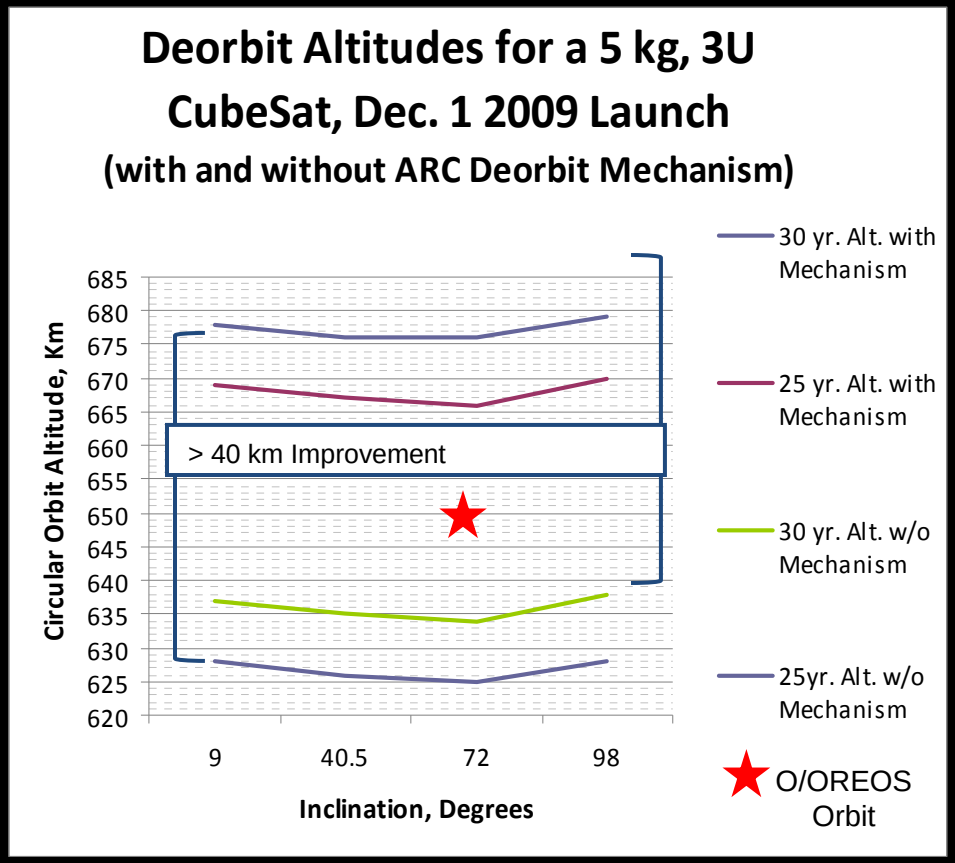
  Spacecraft in Earth orbit must re-enter
  - 25 years after end of mission (or)
  - 30 years after launch

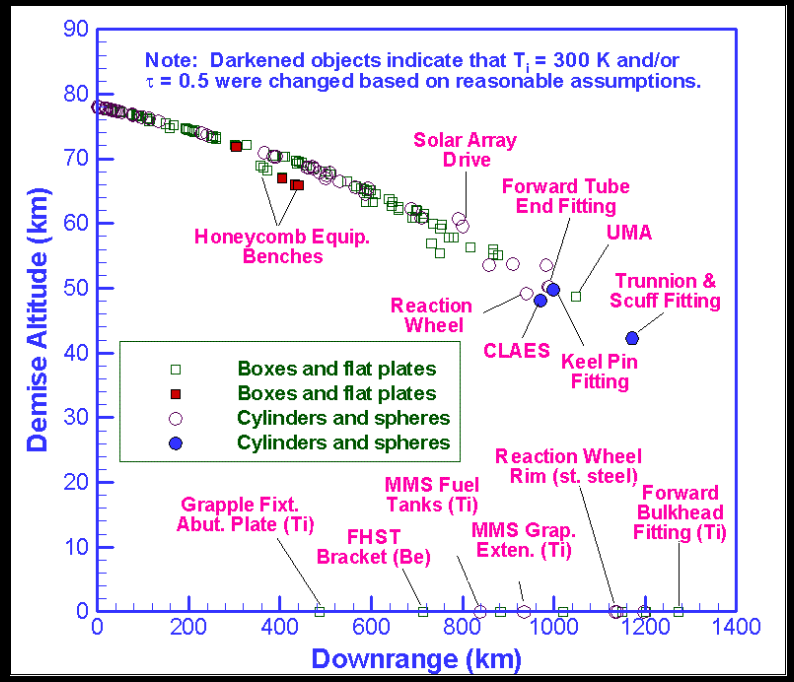


De-Orbit Mechanism Design Requirements:

- Allows satellite to re-enter on reduced time table
- Simple, purely mechanical actuation
- Low profile package ≤ 0.30” thick when collapsed
- System does not interfere with satellite operation
  - Solar panel exposure
  - Thermal properties
  - Tumble/Pointing is unaffected (magnetic passive control)
  - Deployment
- Deploys automatically during satellite release

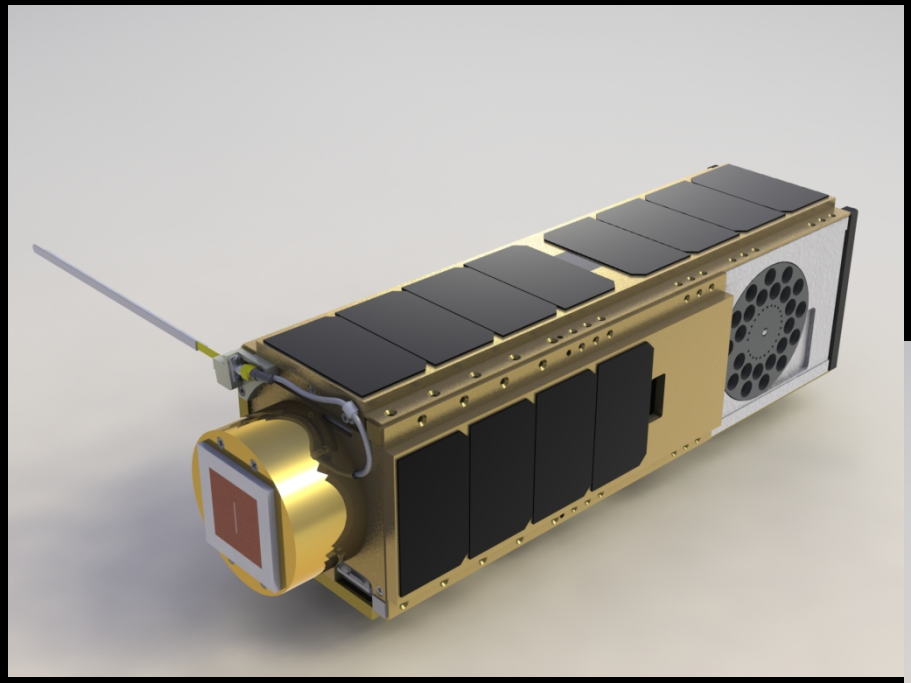
Object Re-entry Analysis

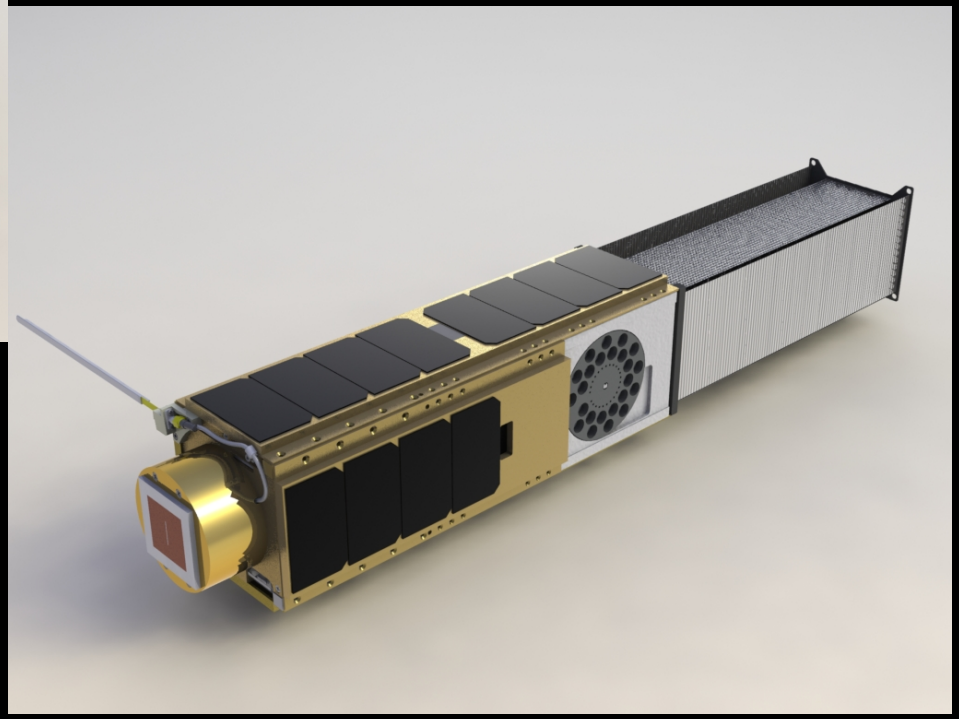




For O/OREOS characteristics, surface area must be increased by 60% to induce re-entry within 30 years

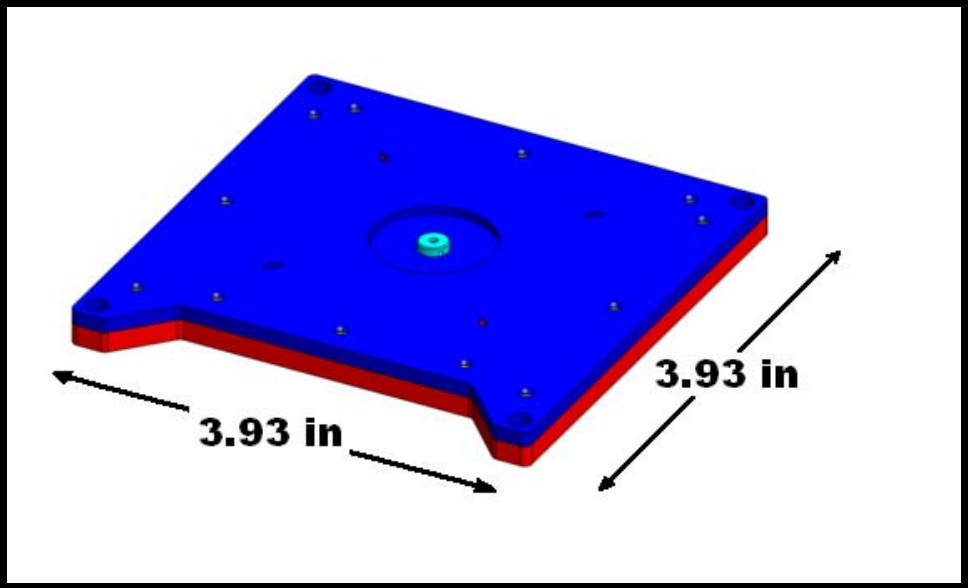
O/OREOS Spacecraft With De-Orbit Mechanism

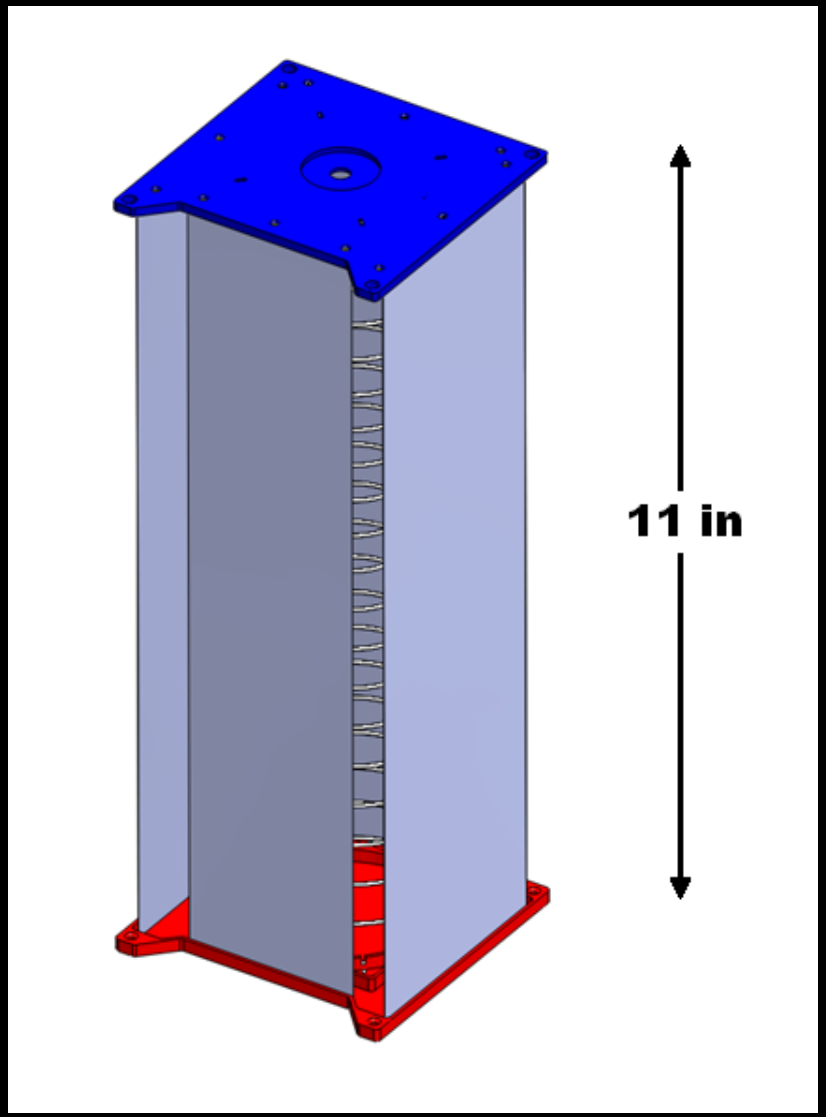




Surface area increased by 60%

De-orbit Mechanism Design Overview

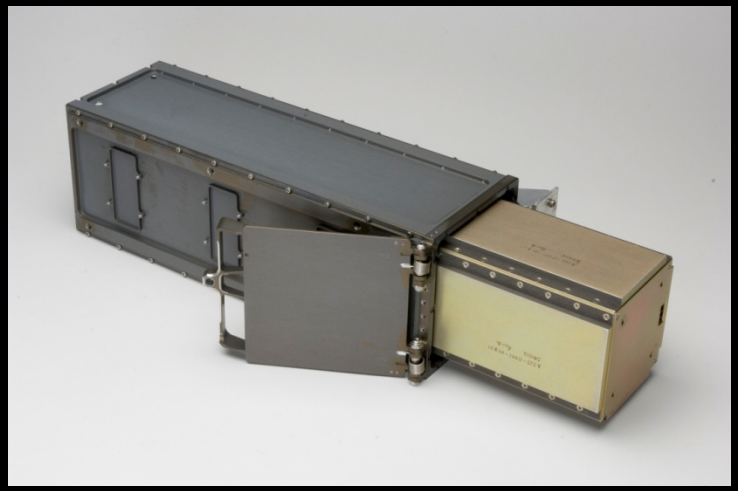


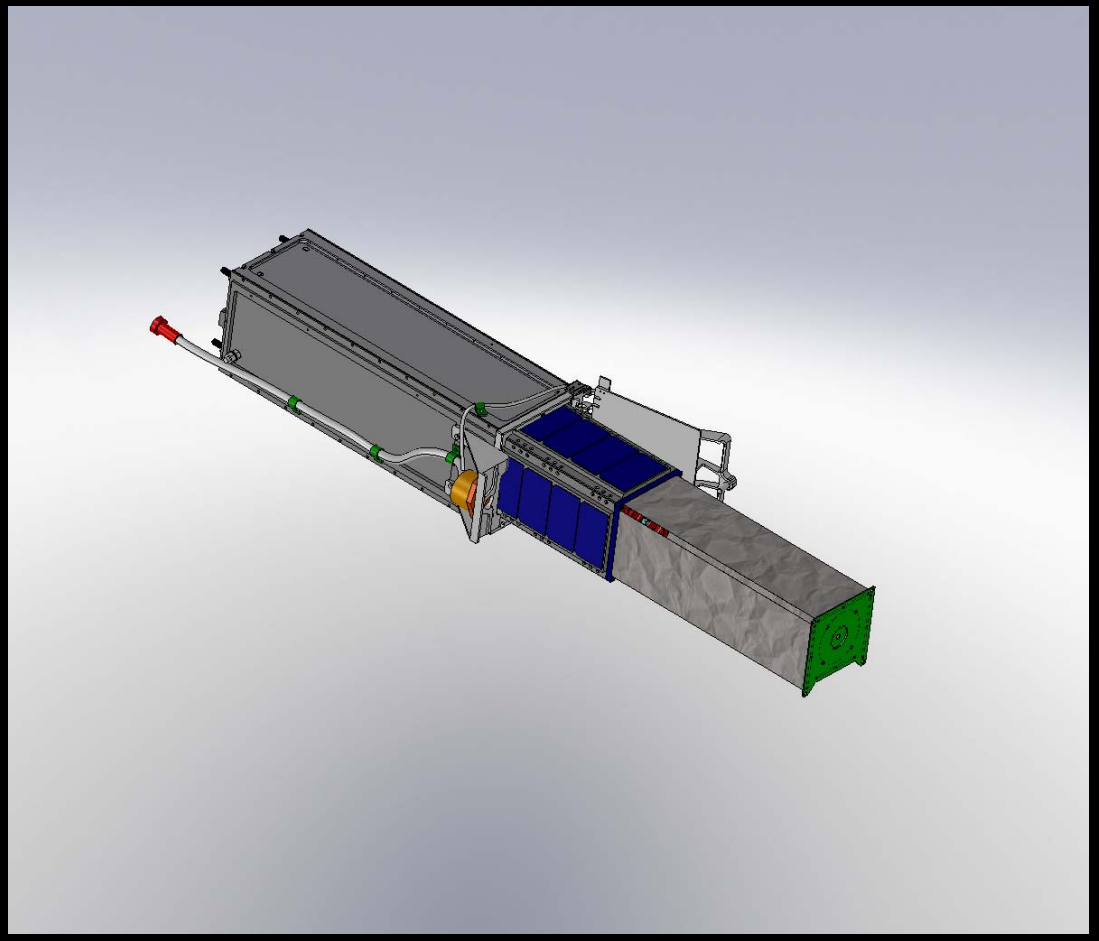


De-Orbit Mechanism Design Features:

- Mechanism completely contained during launch:
  - Protects fragile wall material
  - Reduced to small volume before deployment
  - Independent structural stability
- Ease of assembly and system reset ability
- Design Flexibility
  - Adjustable extended length (up to 15 inches = 184 sq in surface area)
  - Can be modified to meet specific requirements
- Passive deployment using P-POD door

P-POD Deployment





Future Work

- Additional testing
  - Vibration and shock testing
  - Thermal Studies
- Design refinement
  - Simplify components
- Implementation with other spacecraft
  - 1U CubeSat
  - 10+ kg spacecraft
- Additional deployment methods

Questions