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Mechanical Design of CAPE2 – the second CubeSat being designed under the Cajun Advanced Picosatellite Experiment (CAPE)

Abhishek Bajpayee

What is a CubeSat?

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- A miniature satellite built according to given specifications
- Specifications developed by California Polytechnic State University and Stanford University in 1999
- Volume Constraint: 1 litre (1U)
- Mass Constraint: 1.33 kgs (1U)

What is CAPE?

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- CAPE (Cajun Advanced Picosatellite Experiment) is a student CubeSat design project at UL
- Composed of various majors:
  - Mechanical Engineering
  - Electrical and Computer Engineering
  - Computer Science
- Currently involved in developing CAPE2
- CAPE1 was launched into orbit in 2007

What is CAPE2?

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- CAPE2 is a 1U Cubesat
- 1U CubeSat contraints:
  - Dimensions
    - Height: 113.5±0.1mm
    - Width: 100±0.1mm
  - Mass ≤ 1.33 kgs
- CAPE2 will tentatively be launched in 2012
- CAPE2 design team is composed entirely of undergraduate students

CAPE2 Subsystems

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- SDR (Software Defined Radio)
- COMM (Communication)
- OBC (On-Board Computer)
- Power
- Mechanical
- Balloon

1U CubeSat Mechanical Design Requirements

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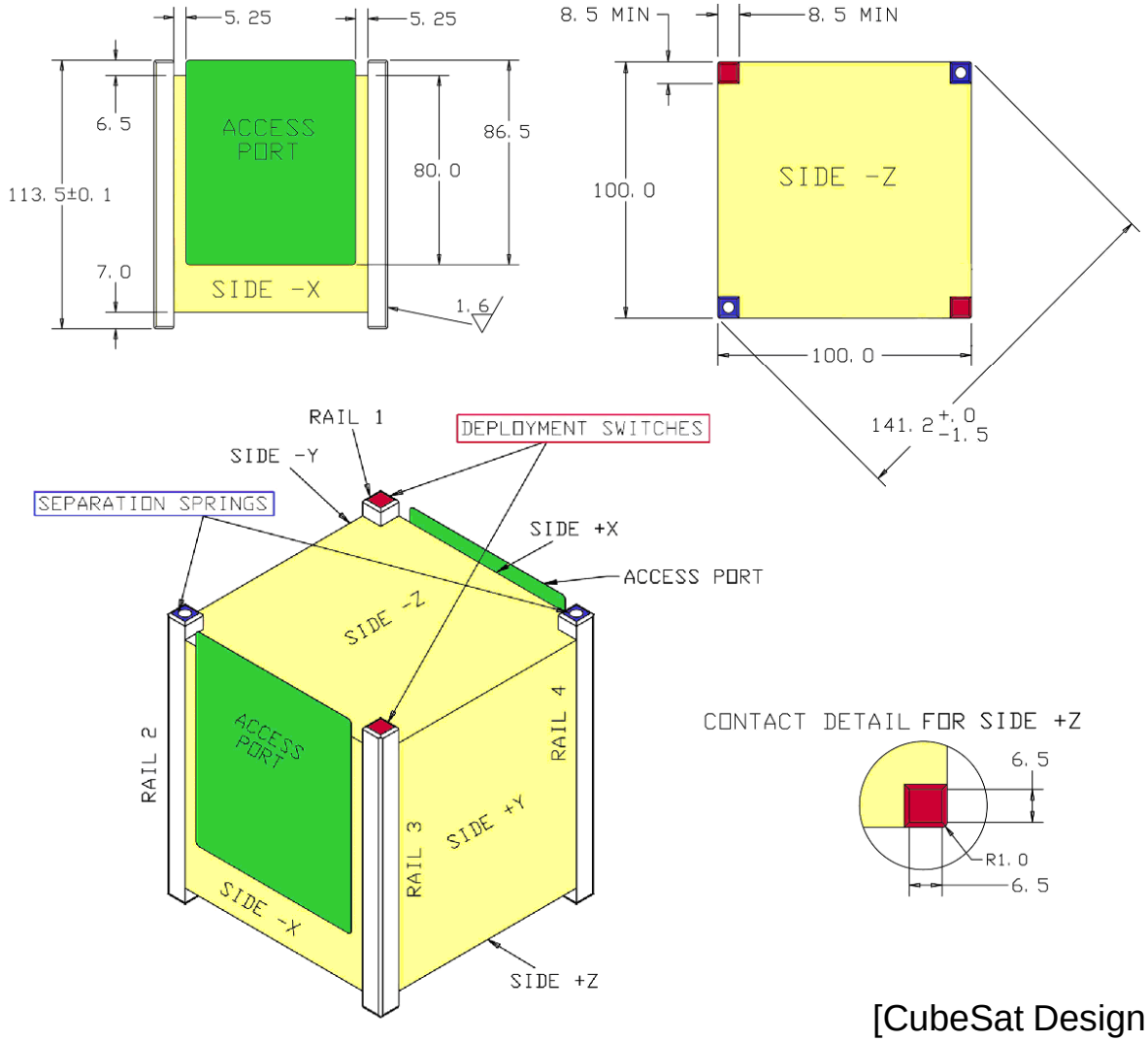

[CubeSat Design Specification Rev. 12]

CAPE2 Mechanical - Goals

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- Can handle the thrust during launch
- Can handle the vibrations when in the launch rocket
- Perform efficiently in space temperatures which range from -100°C to 120°C
- Deploy solar panels once in orbit
- Deploy antennas once in orbit
- Restrict motion to rotation about earth's magnetic field using magnets
- Easy to assemble/disassemble during testing phase
- Follows the CubeSat specifications

Mechanical Design - Subcategories

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- Structure
- Solar Panel Deployment
- Antenna Deployment
- Attitude Control

Structure – The P-POD

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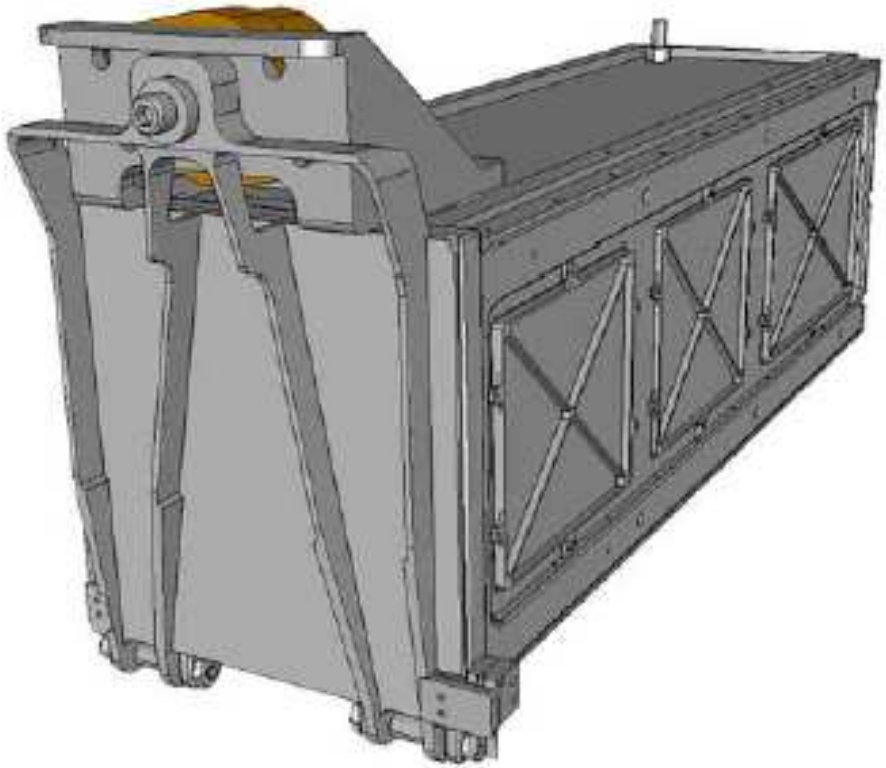

[CubeSat Design Specification Rev. 12]

Structure – Current Design

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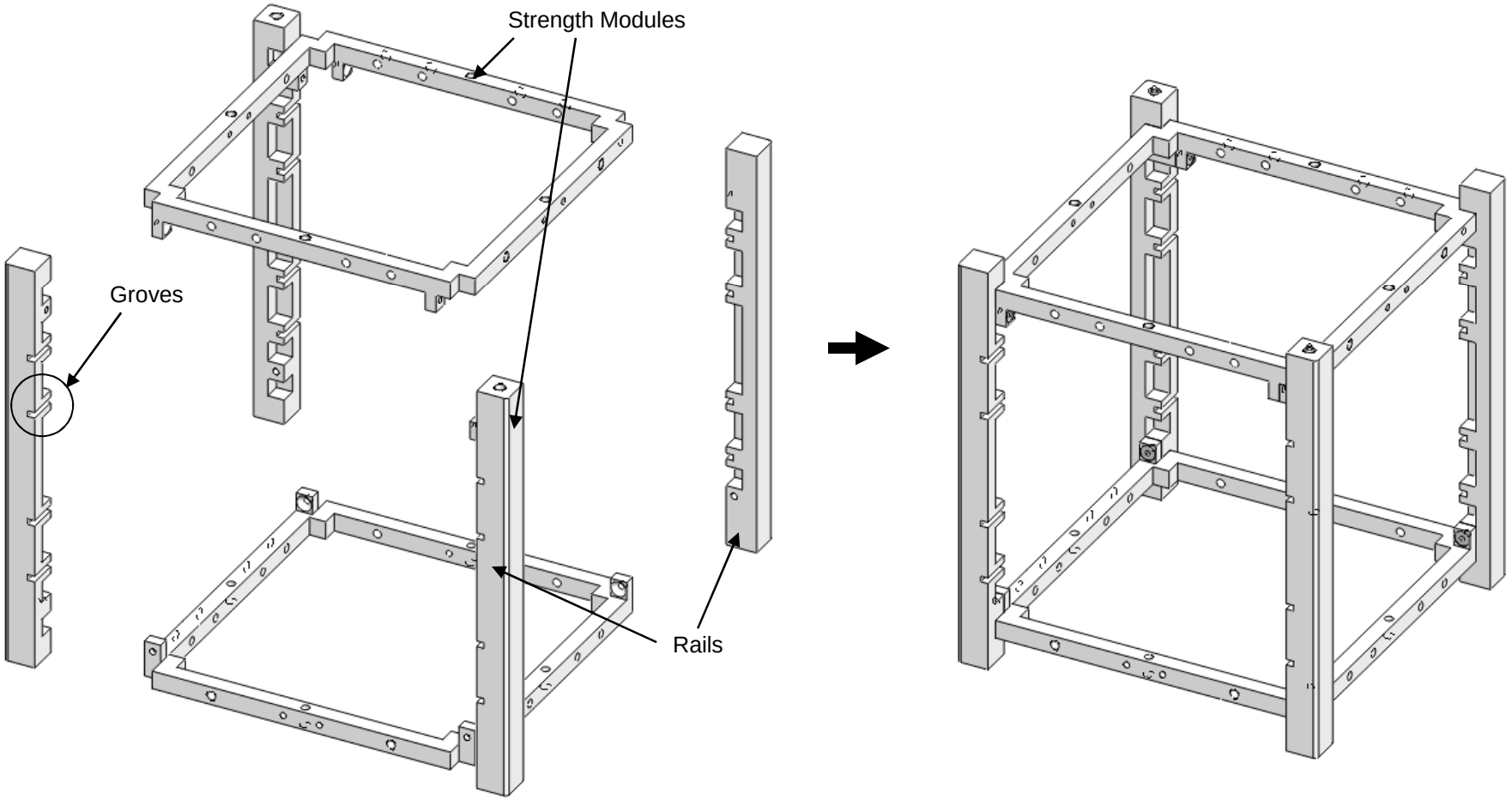
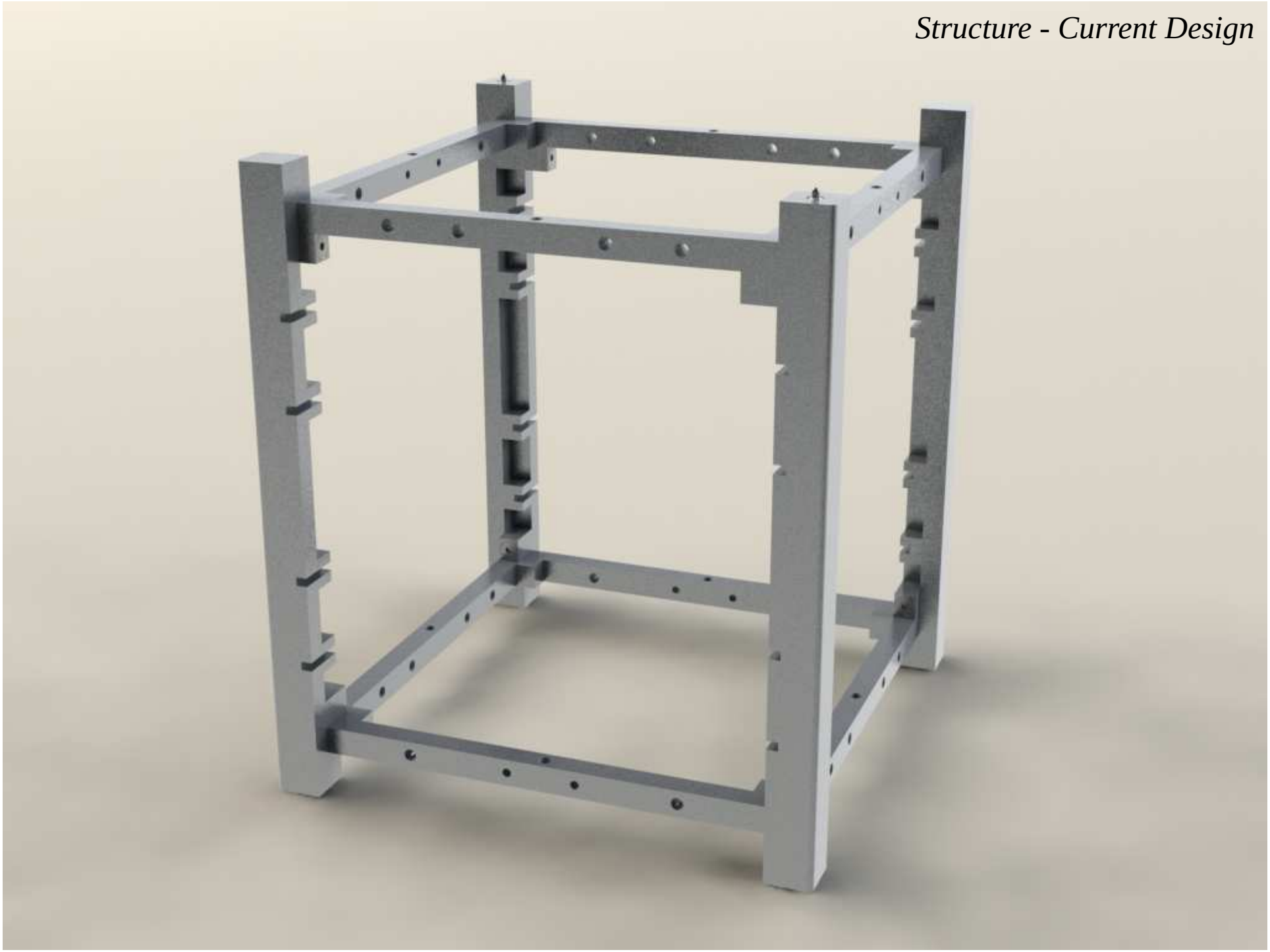


Structure - Current Design



Solar Panel Deployment

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- CAPE2 will be the first 1U CubeSat to use deployable solar panels
- A custom spring hinge was designed for this system
- A fishing line running through a resistance coil melts and deploys the panels

Solar Panel Deployment - Hinge

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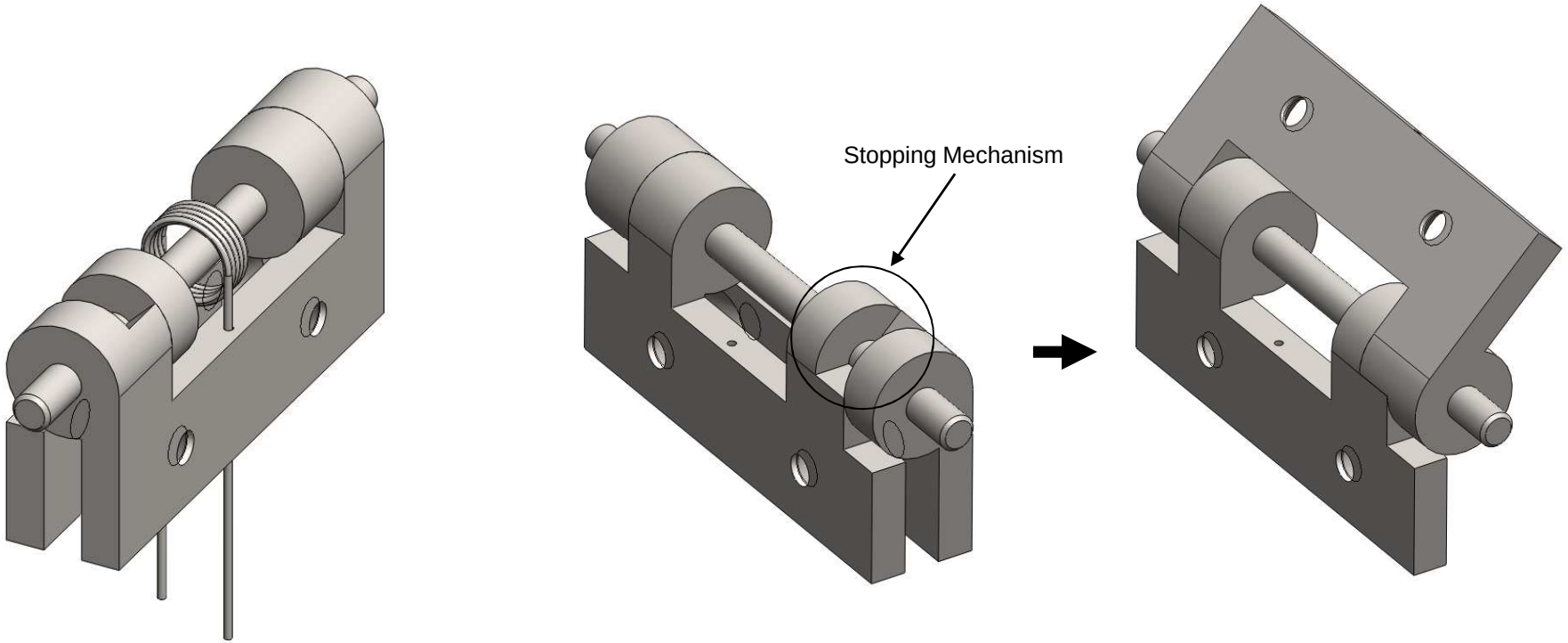

Solar Panel Deployment System

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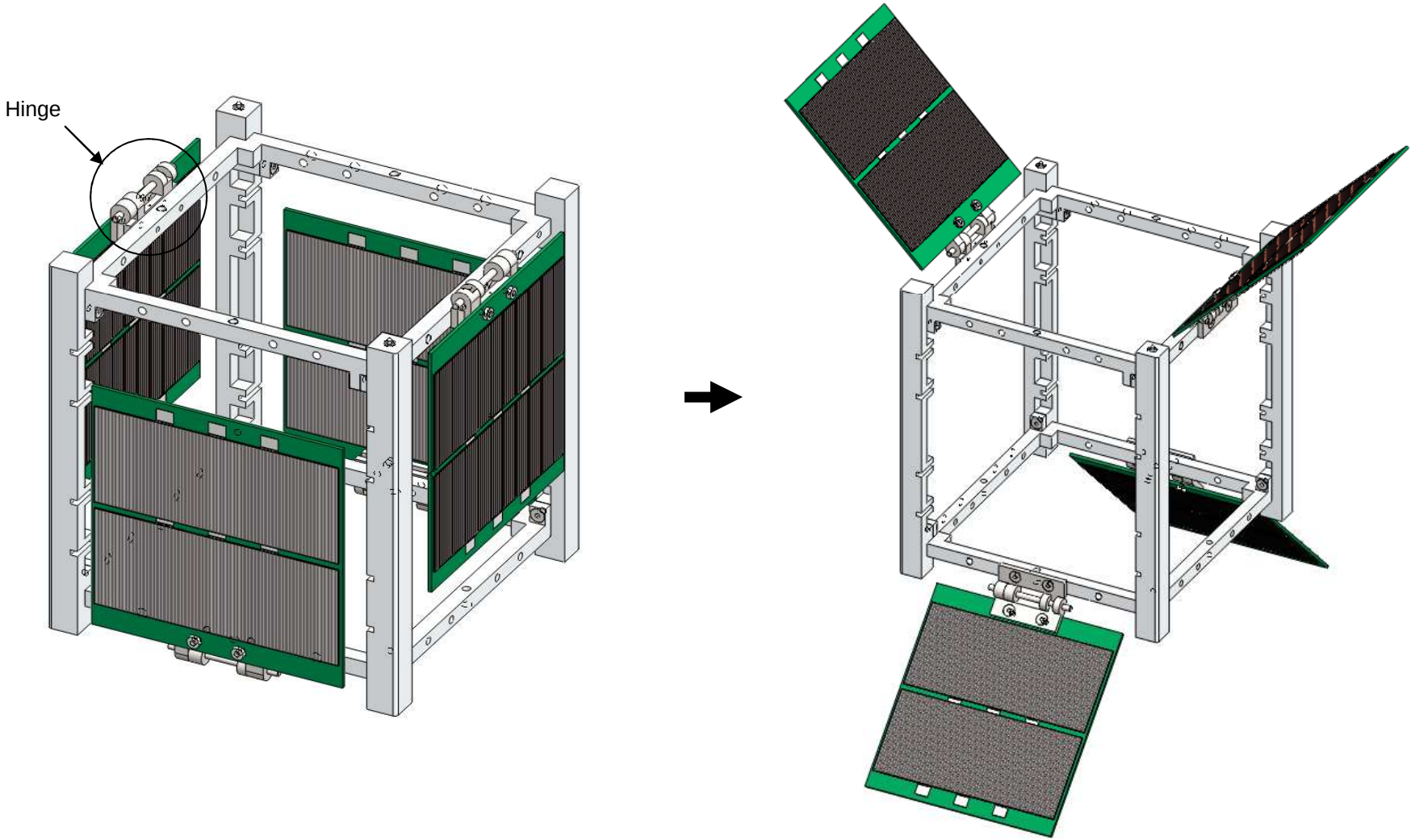

Antenna Deployment System

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- Two antennas operating at different frequencies:
  - 6 inch long - 2
  - 19 inch long - 2
- Necessary for communication with ground station
- Need to be oriented parallel to the surface of the earth for effective communication (Attitude Control)

Antenna Deployment System

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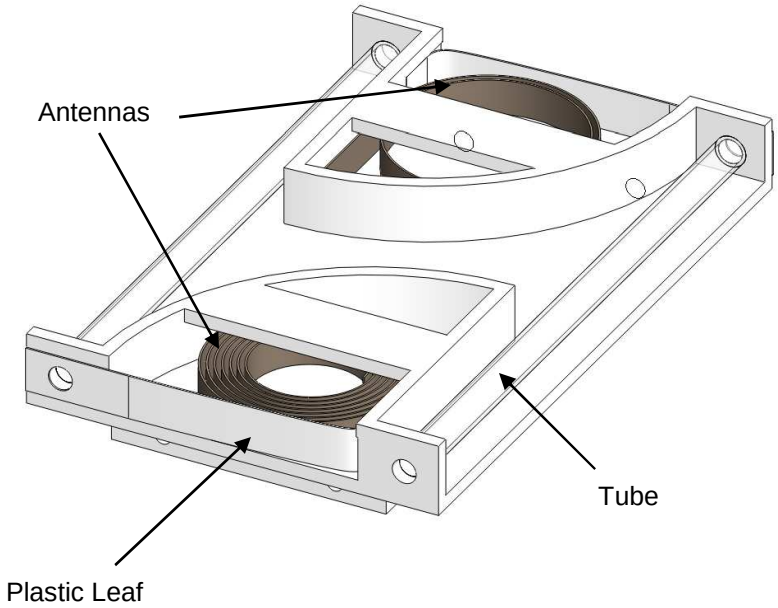

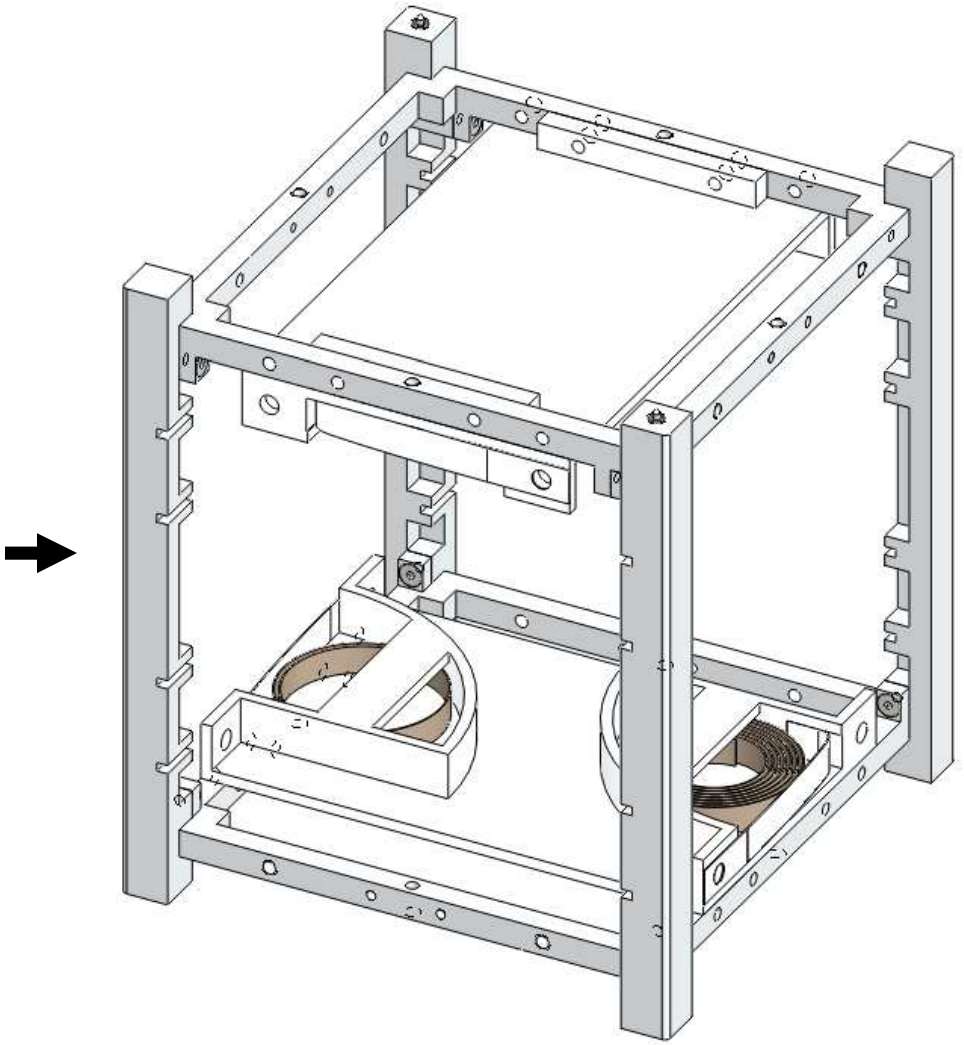

Antenna Casing

Attitude Control

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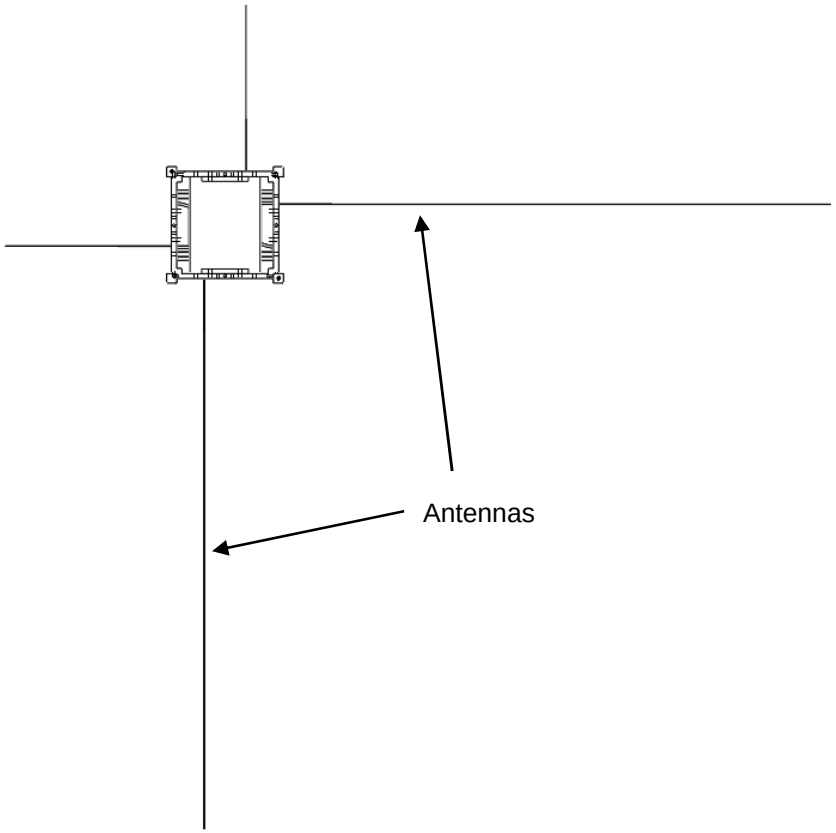
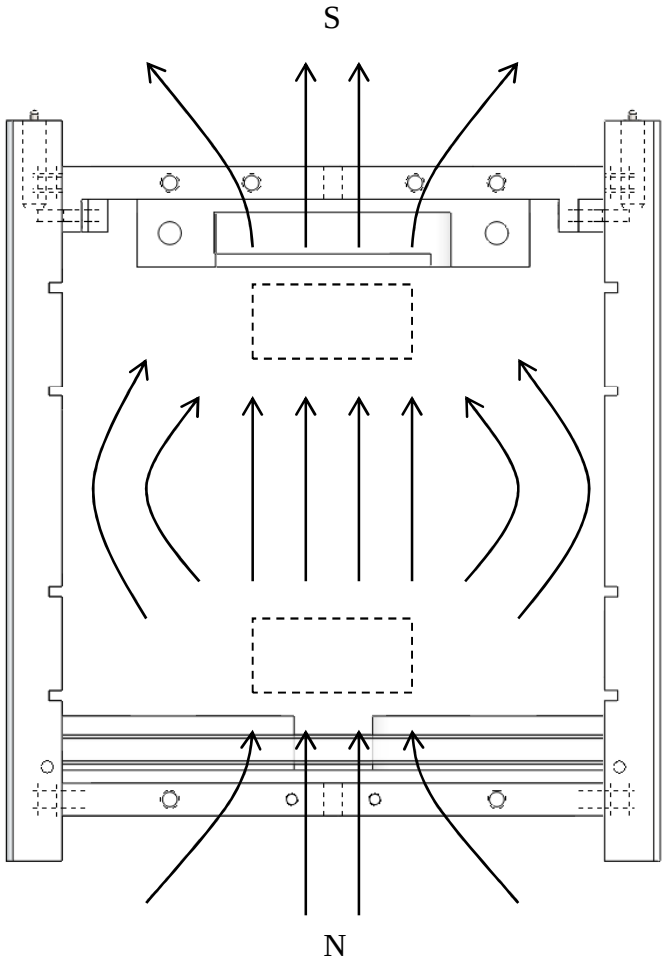


Arrangement of Antennas



Location of Magnets

Attitude Control

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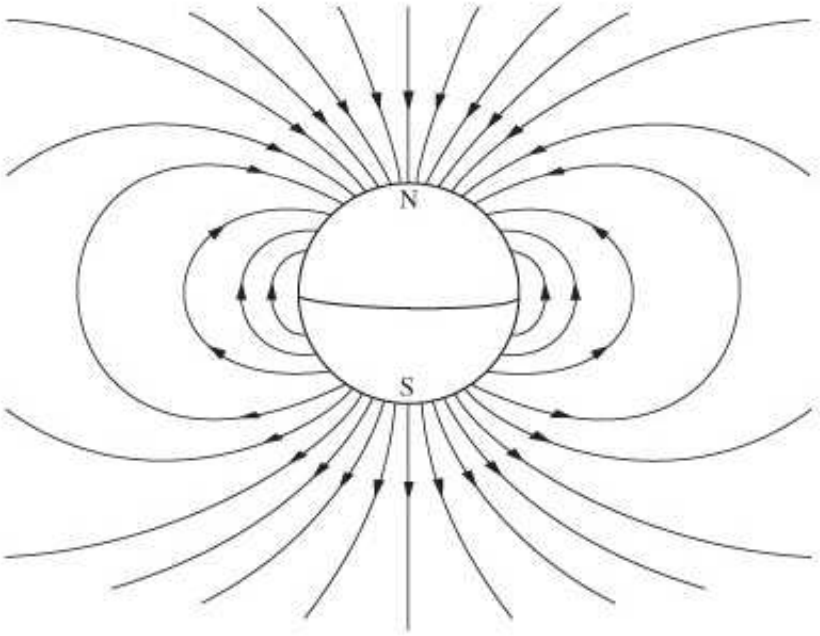
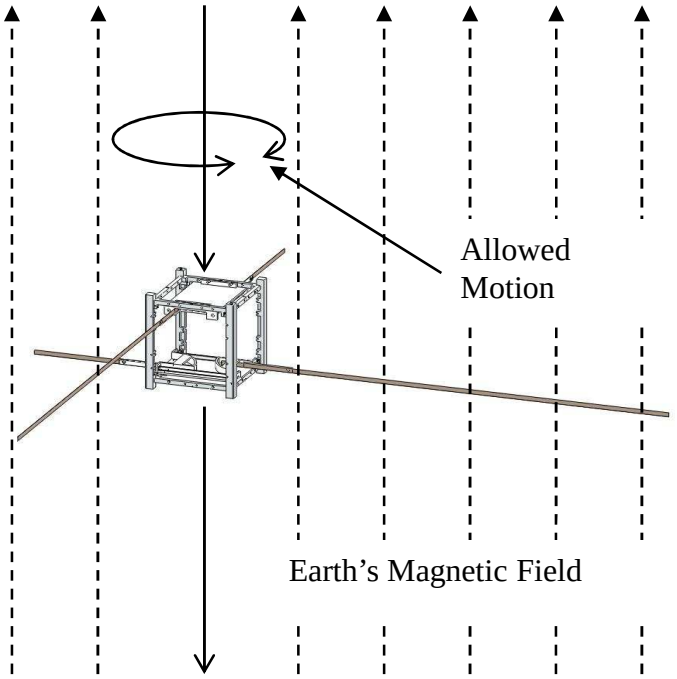


Earth's Magnetic Field

Earth's Surface

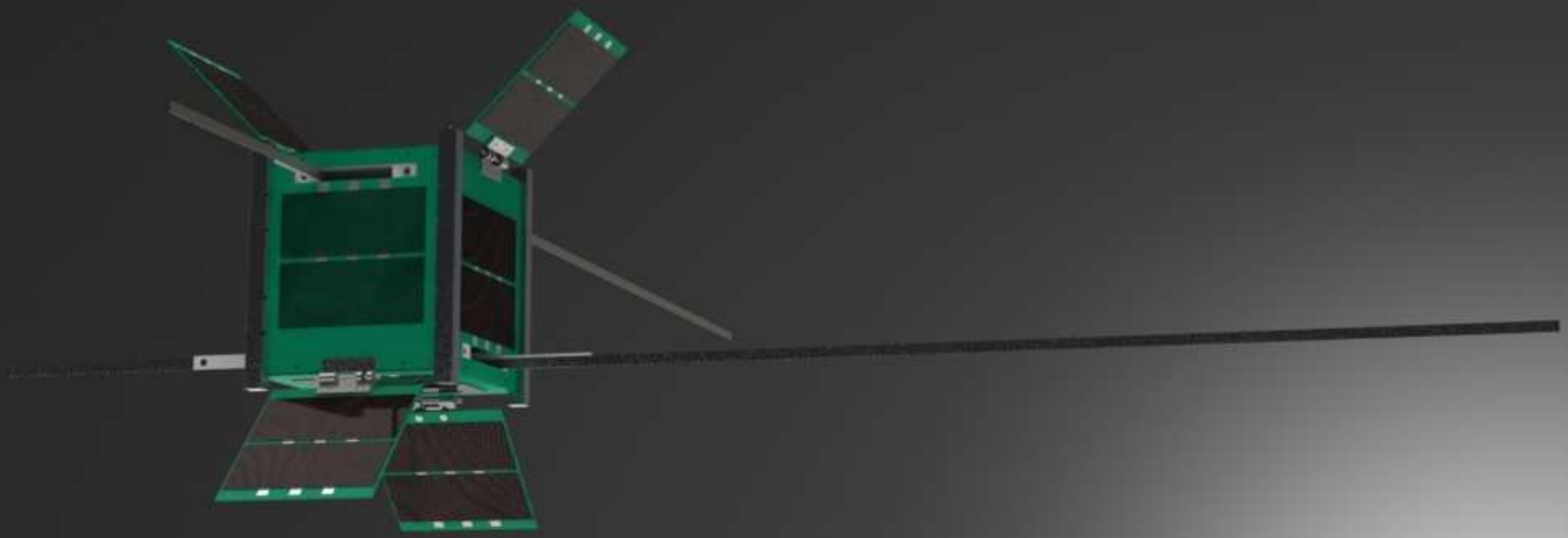


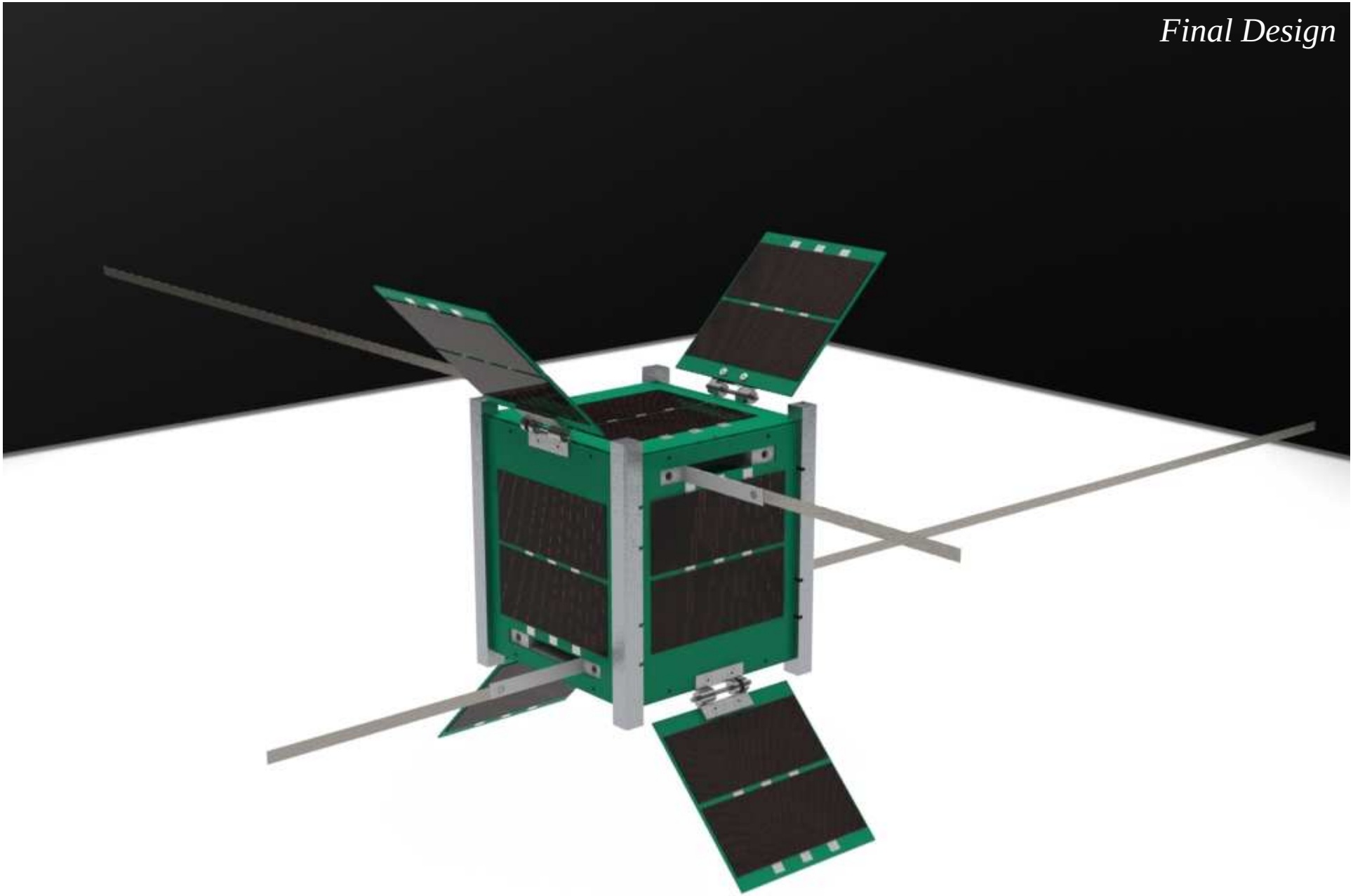
Alignment

Final Design

Final Design

Final Design





Final Design (Video)

Acknowledgements

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- Entire CAPE Team

Questions?