# Photometry of Helio-Originating Emissions of Near-earth Incident X-rays (PHOENIX)

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Image: NASA

# Mission Objectives

What will the satellite try to accomplish in space?

- Study solar flares and their influence on Earth's atmosphere during geomagnetic storms by measuring solar spectra soft X-rays via X-ray fluorescence spectrometry.

How will this CubeSat differ from other missions?

- It's inspired by the University of Colorado Boulder's MIN-XSS CubeSat, and will be an instrumentally-simplified & cost-optimized version.

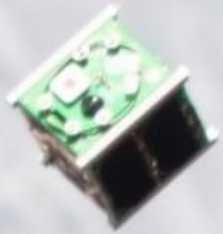


*Image: NASA*

# CONOPS (Concept of Operations)

1. **Launch**
   a. Disabled until Deployment
2. **Commissioning**
   a. Automated start up
   b. Deployment of solar panels
   c. Detumble
   d. Establish Communication link
3. **Nominal Mission Operations**
   a. Observe solar spectra via X-ray Flux Monitor
   b. Downlink in Eclipse
4. **Extended Mission Operations**
   a. TBD
5. **End of Life**
   a. Power shut-off
   b. De Orbit

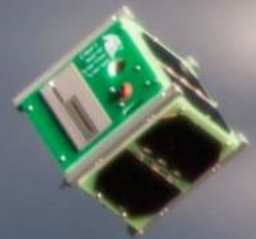
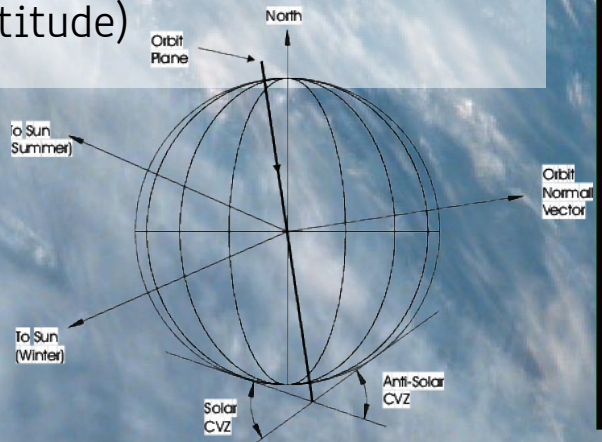


*Image: NASA*

# Proposed Orbit

- Planning a “Dawn-Dusk” sun-synchronous orbit for maximum sun observation
- Proposed Altitude: 500km
- Proposed Inclination: approx. 97° (depends on altitude)




*Continuous Viewing Zones for a Dawn/Dusk Sun-Synchronous Orbit, The MOST Microsatellite Mission: Canada's First Space Telescope*

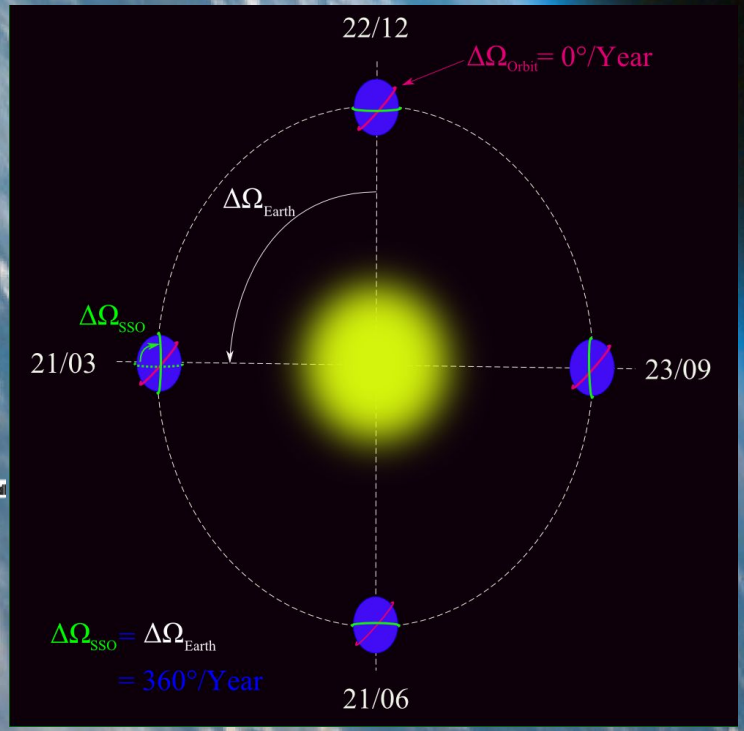



*Image: Brandir, XZise, (Wikimedia Commons)*

*Image: NASA*

# Budget

| Item | Cost |
|---|---|
| Flight Model Hardware Cost | $49,177.34 |
| Mission Operation | $20,000.00 |
| Testing | $10,000.00 |
| Lab Equipment | $20,000.00 |
| Engineering Models and additional Flight Model Hardware | $70,000.00 |
| | |
| Total Expect Costs | $169,177.34 |
| Margin | $30,823 |
| Total Budget | $200,000 |

**FM Hardware Costs Include:**

Magnetorquer: Torque Rods

Beaglebone Black + LinkStar STX3 Radio (Transmitter)

Linkstar Antenna

GPS Add-on

Deployable 3U Solar Panel Array

Electrical Power System

Amptek X-123-SDD X-Ray Spectrometer

*Image: NASA*

# Schedule

We are currently in Solar Cycle 25 with peak solar activity expected in 2025. This is when we plan to launch the satellite in order to maximize the data collected to serve our mission of contributing to space weather understanding.

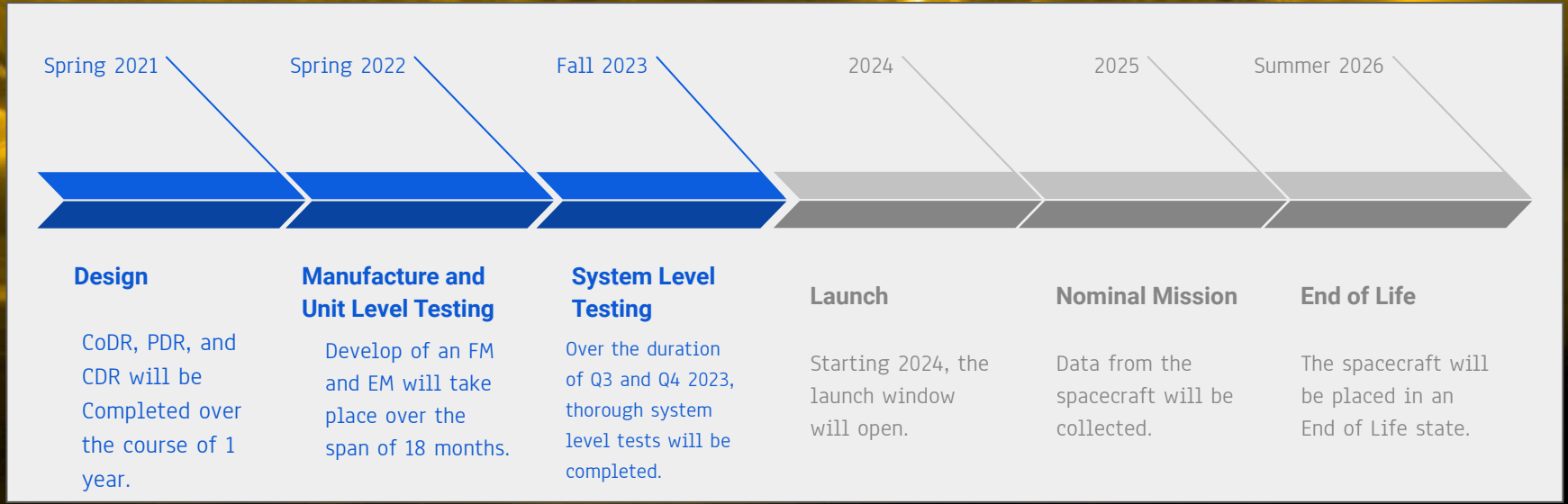



*Image: NASA*

# Subsystems

- CubeSat Overview
- Payload
- ADCS
- Component Selections
- Power System
- Communications
- Thermal Analysis
- Environmental Certification

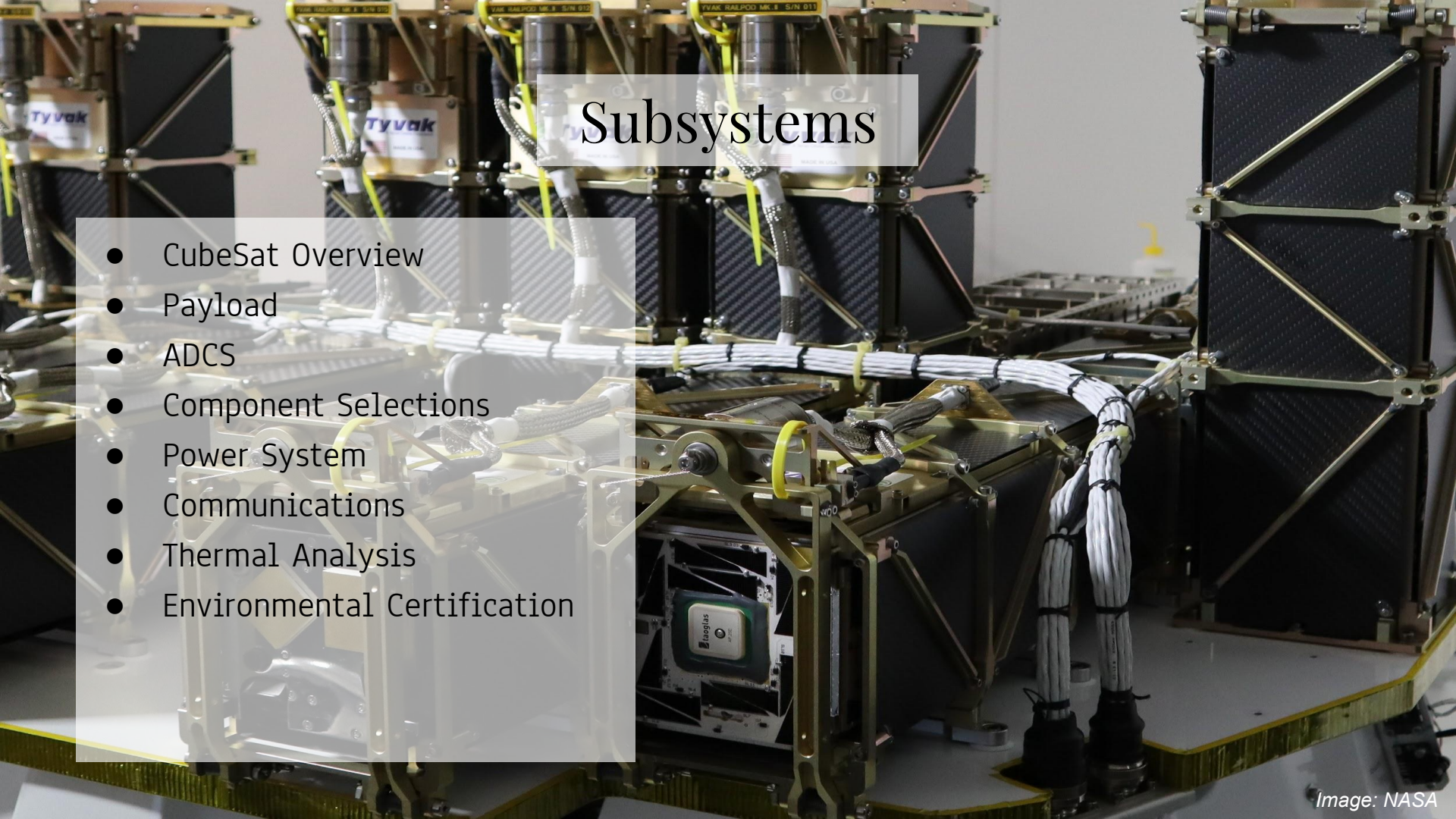



*Image: NASA*

# Cubesat Overview

- 3U cubesat
  - 1U Instrument
  - 2U Bus
- Globalstar communication
- Robust ADCS
  - Reaction Wheels and Magnetorquer
- X-Ray Flux Monitor
  - Scaled down from GOES's X-ray spectrometer
- High TRL COTS components

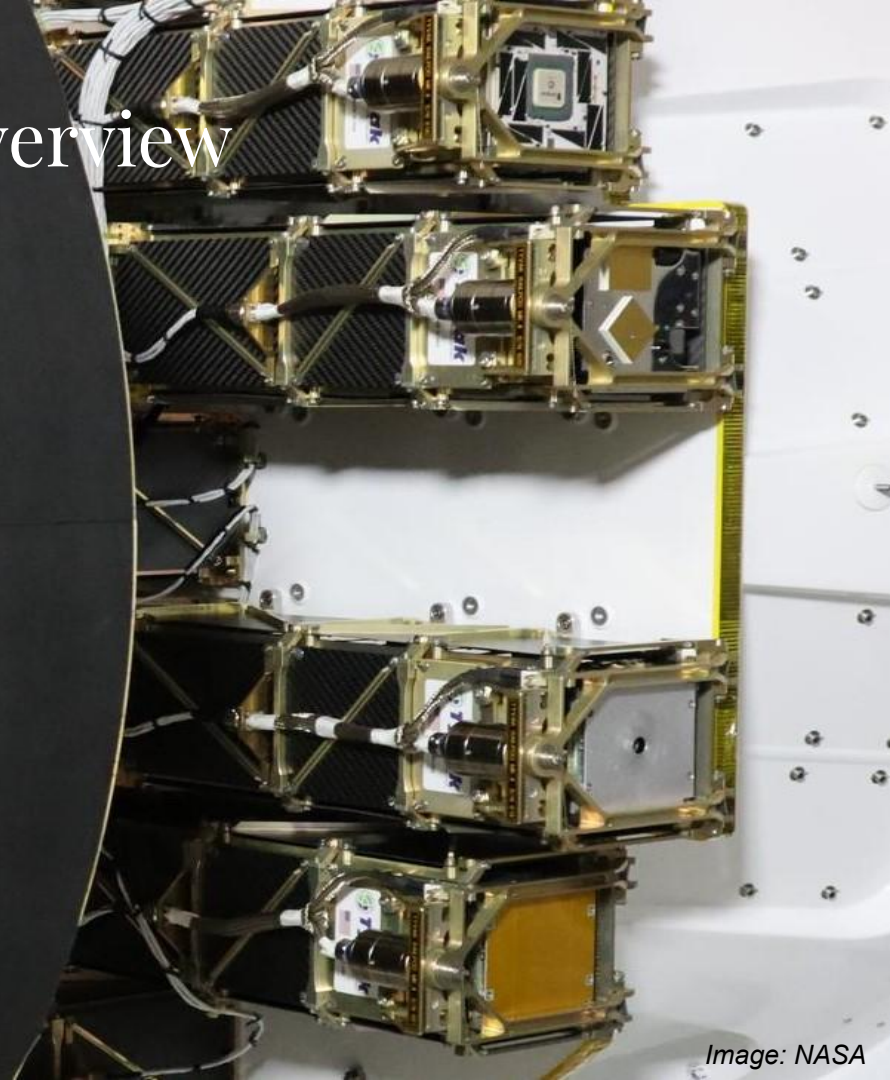


*Image: NASA*

# Payload

- An Amptek X123-SDD X-Ray Flux Monitor will be used to gather X-ray fluorescence spectrometer data
- Measures ‘soft X-rays’ and solar line emissions, which provide information about solar storm activity and coronal mass ejections, and help in understanding geomagnetic storms
- Will use Doppler shift post-data collection to analyze data on ground

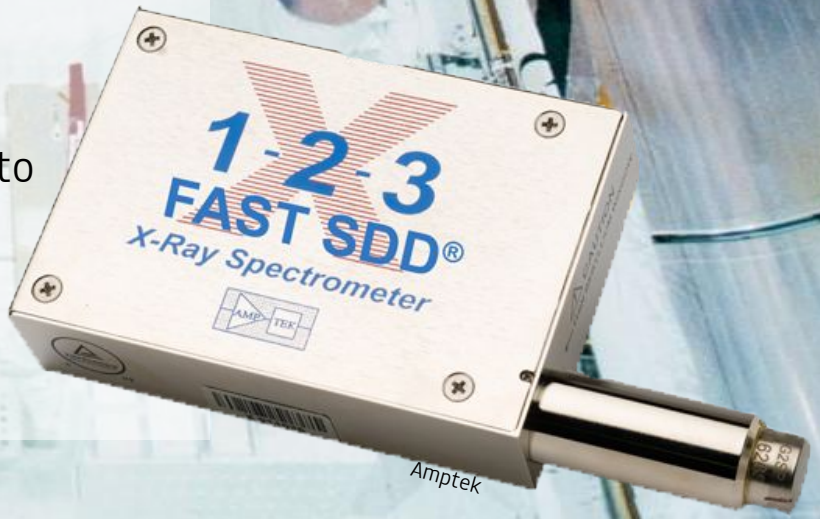
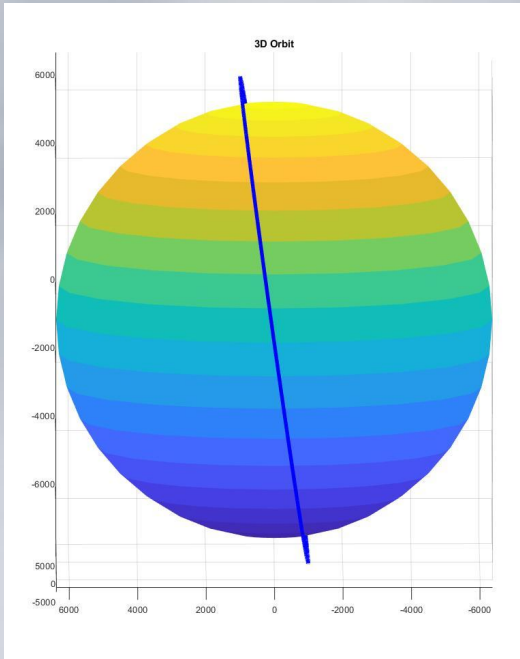



Image: NASA

# ADCS

3D Orbit




ADCS Hardware:

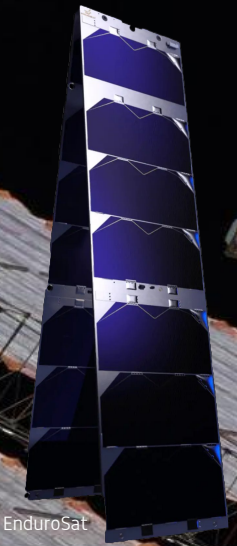
- Sensors
  - GPS
  - Sun Sensors
  - IMU
- Actuators
  - Reaction Wheels
  - Magnetorquer

*Image: NASA*

# Power System

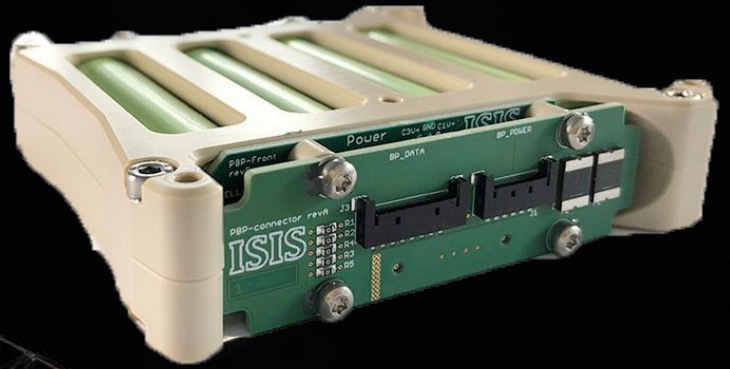
4 Faces of 3U

Deployable solar panels



EnduroSat

ISIS Space EPS




33.6 W of solar input

22.5 Wh battery storage

~10-15W total power consumption

Image: NASA

# Communications

- Using the Simplex receiver on the OBC, downlink will take place through the Globalstar Network
- Additional UHF/VHF or high band communications should be investigated and added to add uplink and commanding capabilities. An additional system would also help lower cost and increase redundancy.

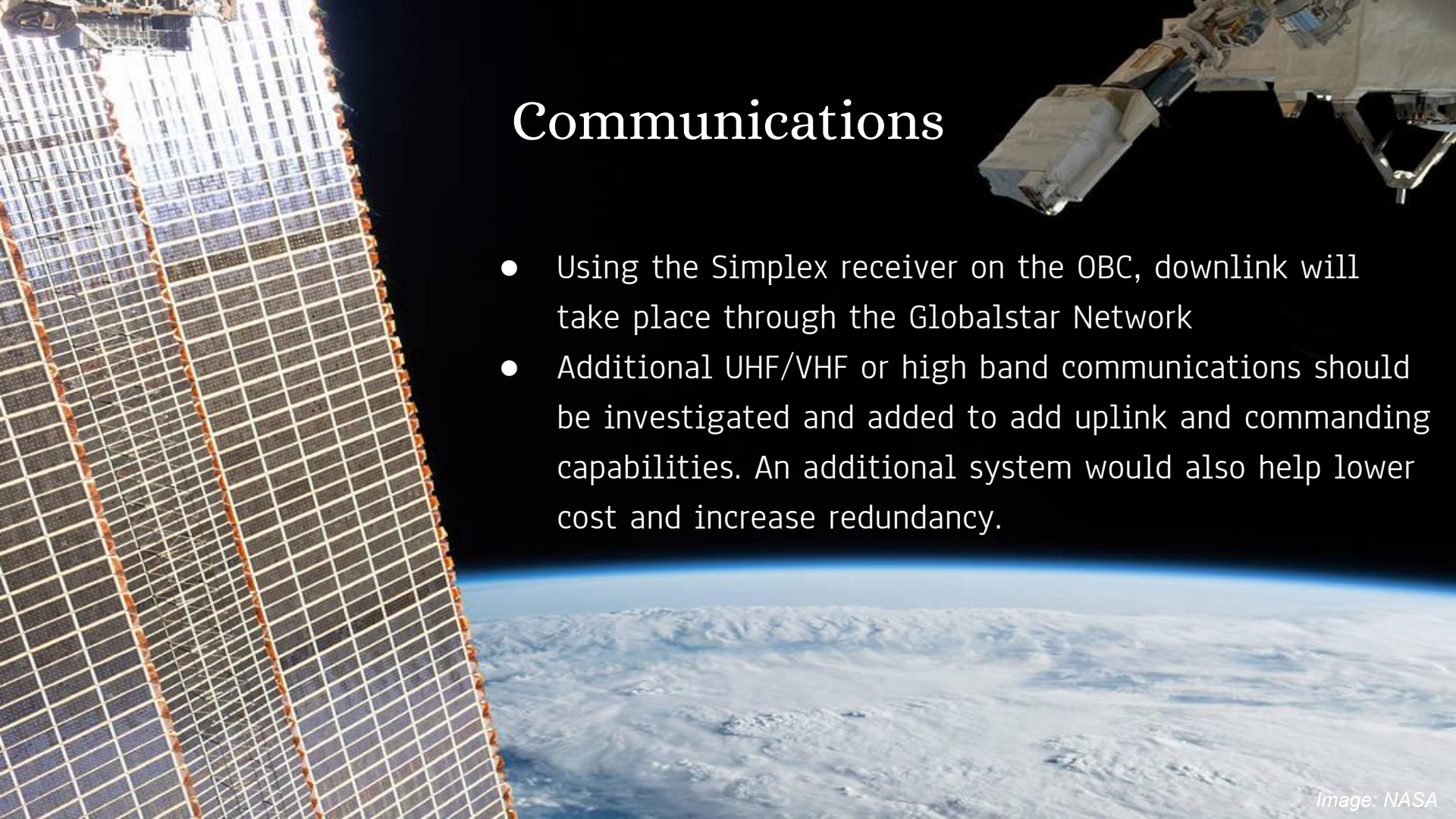


Image: NASA

# Thermal Analysis

- Sun-synchronous orbit
  - A consequence of facing the Sun 24/7 is lots of radiation hitting our satellite.
- As a result, we must look into passive and active cooling measures

| Passive Cooling | Active Cooling |
| --- | --- |
| ○ Testing different materials for our PCBs under expected solar radiation levels will be essential. | ○ No thermal model currently.<br>○ Multi-layer insulation most likely required.<br>○ Design of heat sinks also might be required. |

*Image: NASA*

# Environmental Certification

By using High TRL, space rated hardware, all necessary launch and space environmental requirements should be met and verified with simulation and testing.

*Image: NASA*