Orbital Decay Accelerator: A case of QSAT-EOS

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Background

Research issues for space debris

1. Reduction	• Active / Passive space debris removal
2. Detection	• Detecting the size and density of space debris
3. Modeling	• Predicting the orbital space debris environment in the future
4. Protection	• Preventing damage from space debris impacts

Objectives

- Activities of QSAT-EOS project for research issues

1. Reduction: <u>Drag augmentation device</u>
→ De-orbiting within 25 years

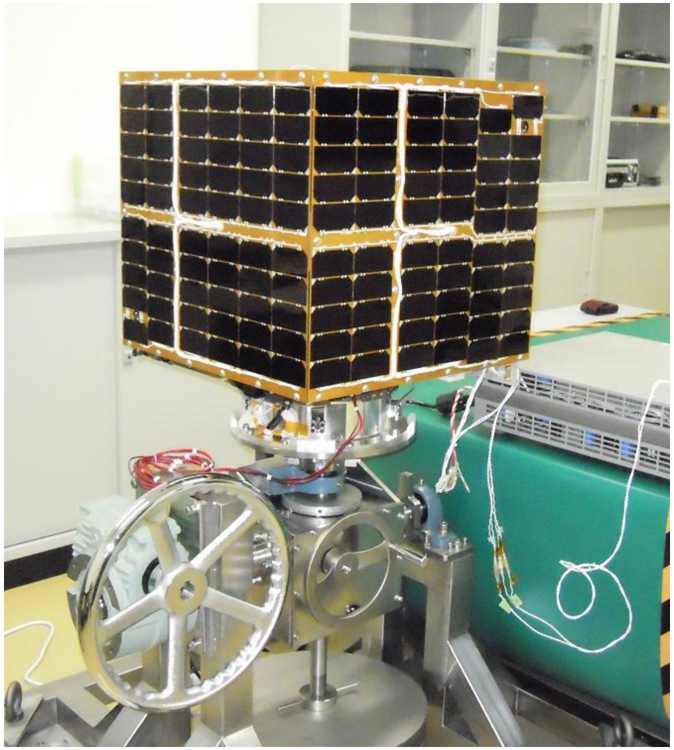
2. Detection: <u>In-situ debris-measurement device</u>
→ Detecting small space debris

QSAT-EOS project

QSAT-EOS

Kyushu Satellite for Earth Observation System Demonstration

- Mass: 50kg
- Size: 50cm cube
- Launch expected within 2012
- Development in Kyushu area
  - 4 Universities
  - Regional industries

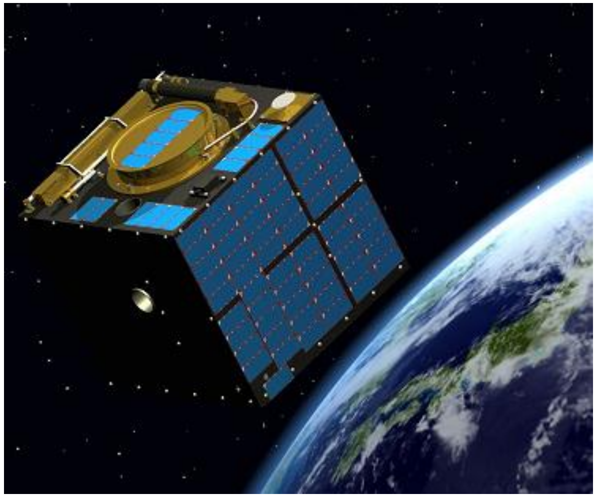


Drag augmentation device

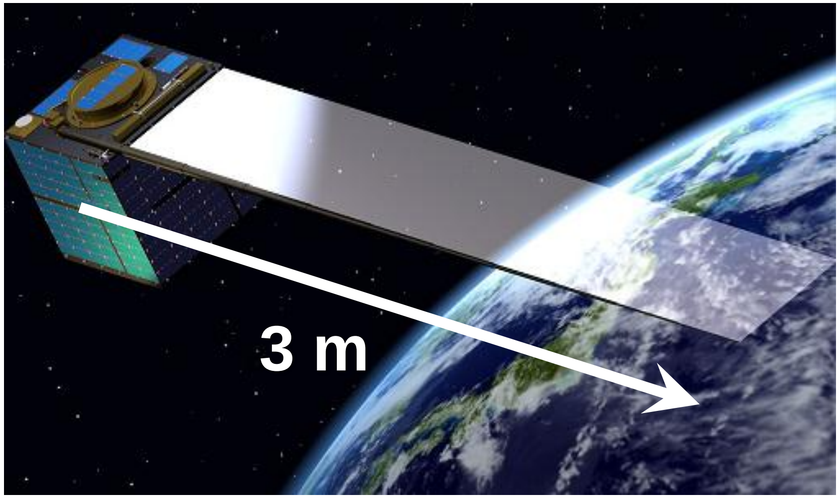
How to de-orbit?

- Cross-section area is enlarged by deploying film
- Orbit decays due to the atmospheric drag

During operations



After mission completion



Design concept

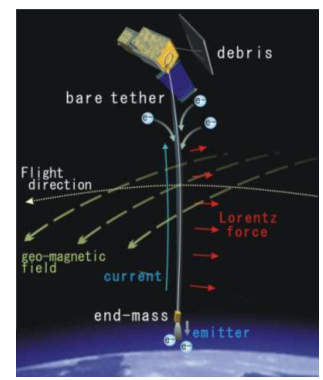
- Simplicity
- Compactness
- Low weight
- Low cost

Existing de-orbiting devices

Micro thruster[1)]

Inflatable balloon[2)]

Electrodynamic tether[3)]



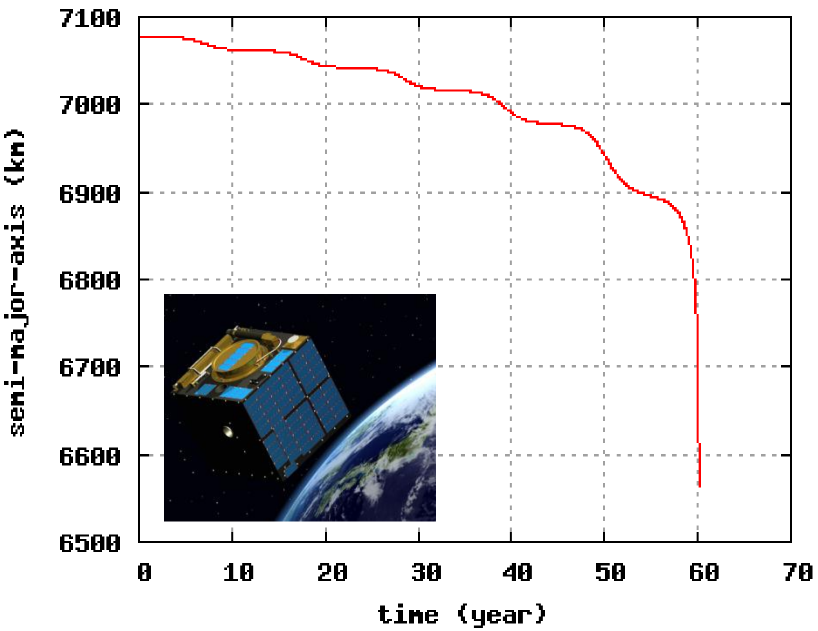
1) Note: From Masato Tanaka *et al.*: "Flowfield Calculation of Electrothermal Pulsed Plasma Thrusters for Nano-Satellite PROITERES", ISTS, 2011.
2) Note: From Shinichi Nakasuka *et al.*: "Simple and Small De-orbiting Package for Nano-Satellites Using an Inflatable Balloon", ISTS, 2008.
3) Note: From Satomi Kawamoto *et al.*: "Control Technologies Required for Electrodynamic Tethers and Active Debris Removal", ISTS, 2009.

Orbital life

- Initial orbit: Typical sun synchronous orbit

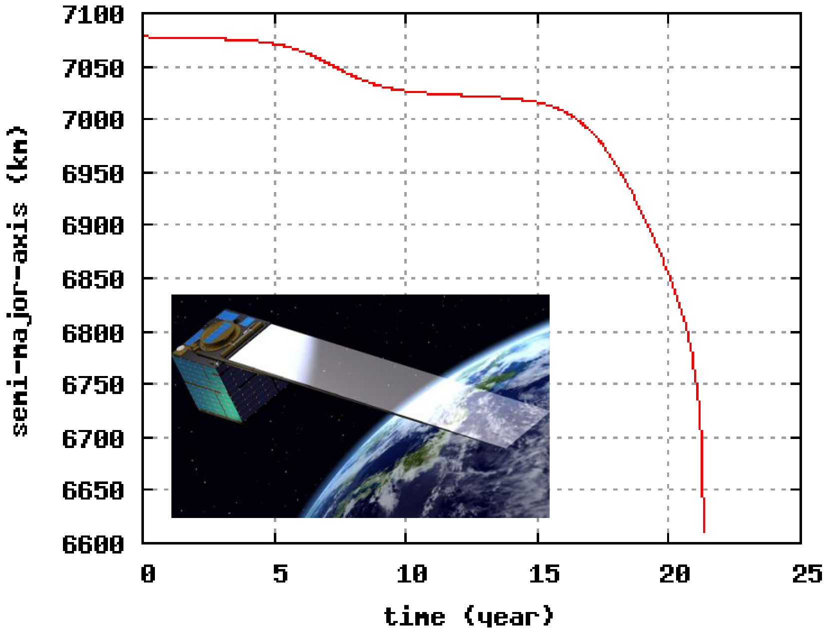
Without drag augmentation device

Lifetime : 60 years

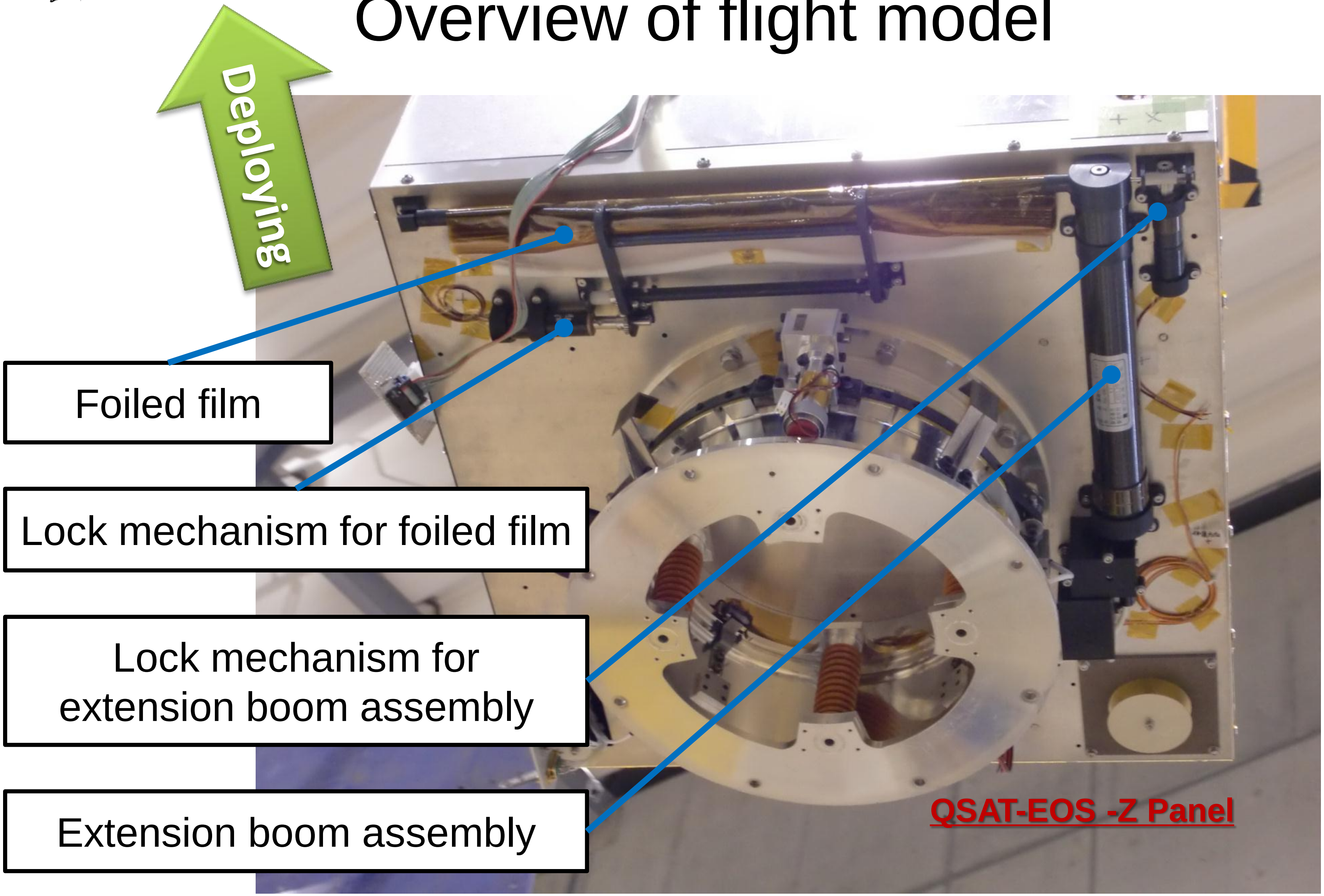


With drag augmentation device

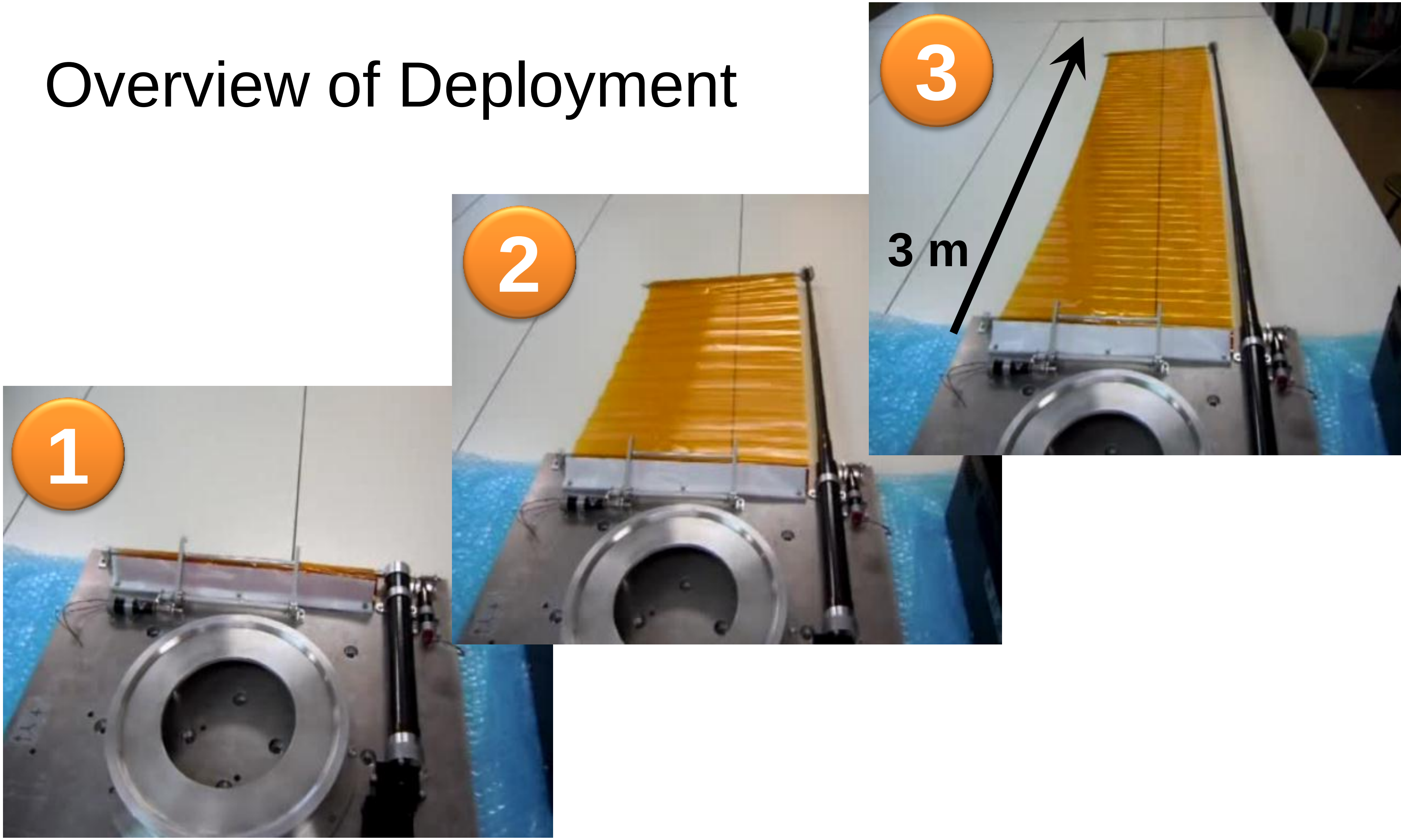
Lifetime : 21 years



Overview of flight model



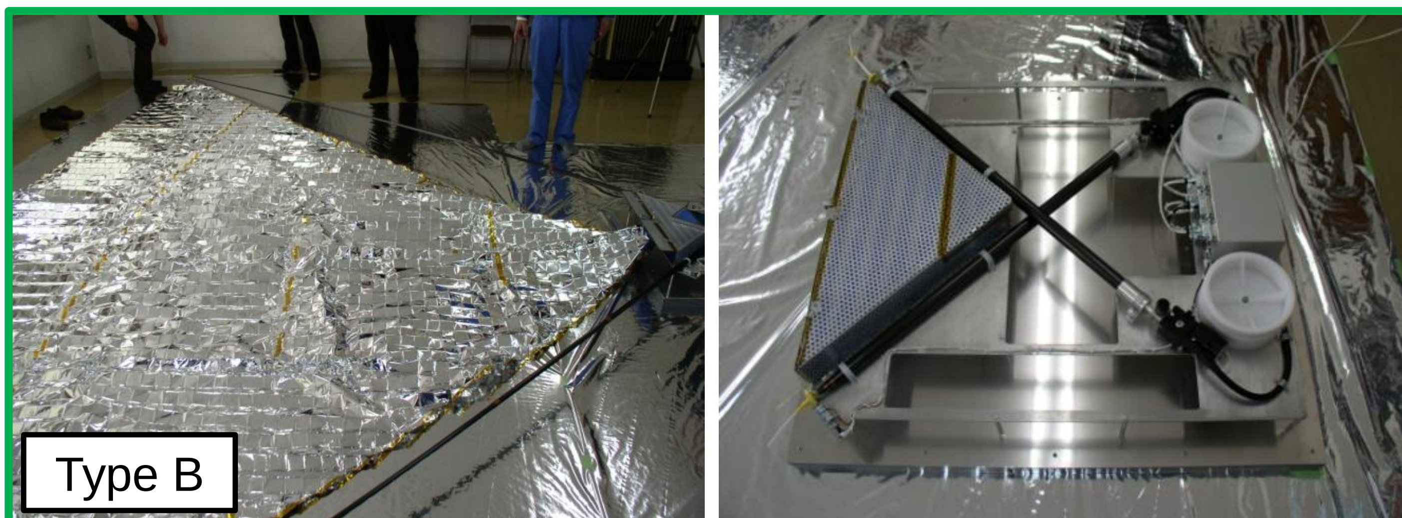
Overview of Deployment



Base technology

Extension boom assembly

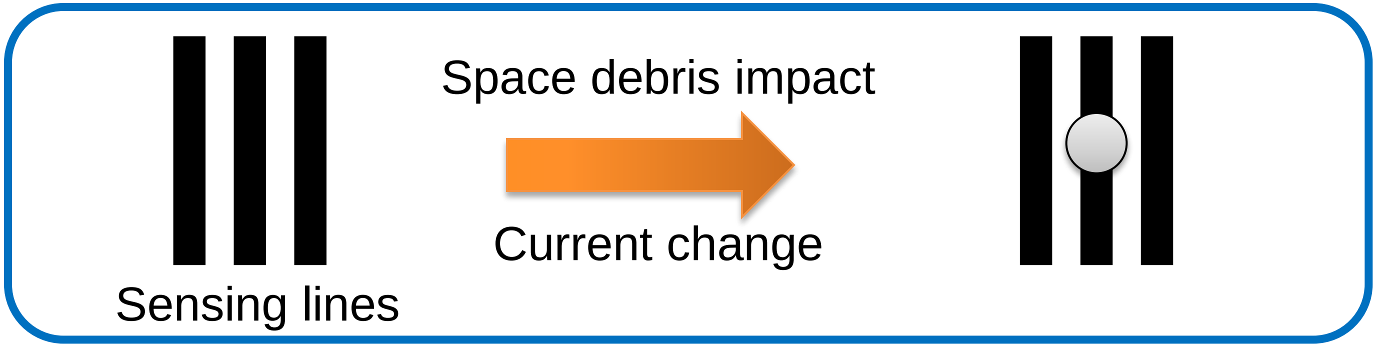
- Developed 2 types
- CFRP fishing rod



In-situ debris-measurement device

Design concept

- Simple and unique principle
  - Detecting by monitoring currents

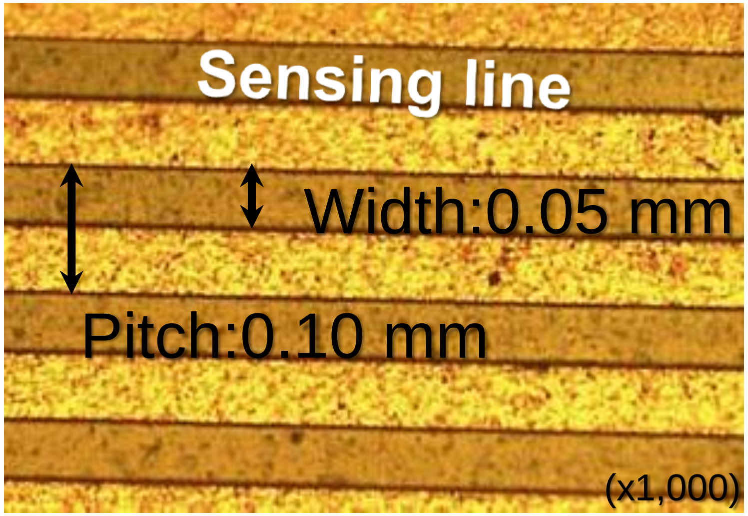


- Space-saving
  - Membrane structure

Overview of flight model[1)]

Sensing element

Detectable size: 0.10mm
Area: 100mm × 100mm
Thickness: 0.025mm



1) Note: From Yukihiro Kitazawa *et al.*: "Development of In-situ Micro-Debris Measurement System", IAC, 2011.

Conclusions

- QSAT-EOS project carries out two activities for research issues of space debris
- QSAT-EOS de-orbits within 21 years by Drag augmentation device
- In-situ debris-measurement device detects space debris which has the diameter of 0.10mm or more