

2019/12/03 The 7th UNISEC Global Meeting

Students Representative Presentation

UNISEC JAPAN

Current Status of Japanese CubeSat Development and the Significance of International Community for Future Development

Seki Hiroto

Intelligent Space Systems Laboratory (Nakasuka/Funase Lab.)
Department of Aeronautics and Astronautics
The University of Tokyo, JAPAN

ISSL = Intelligent Space Systems Laboratory

Research

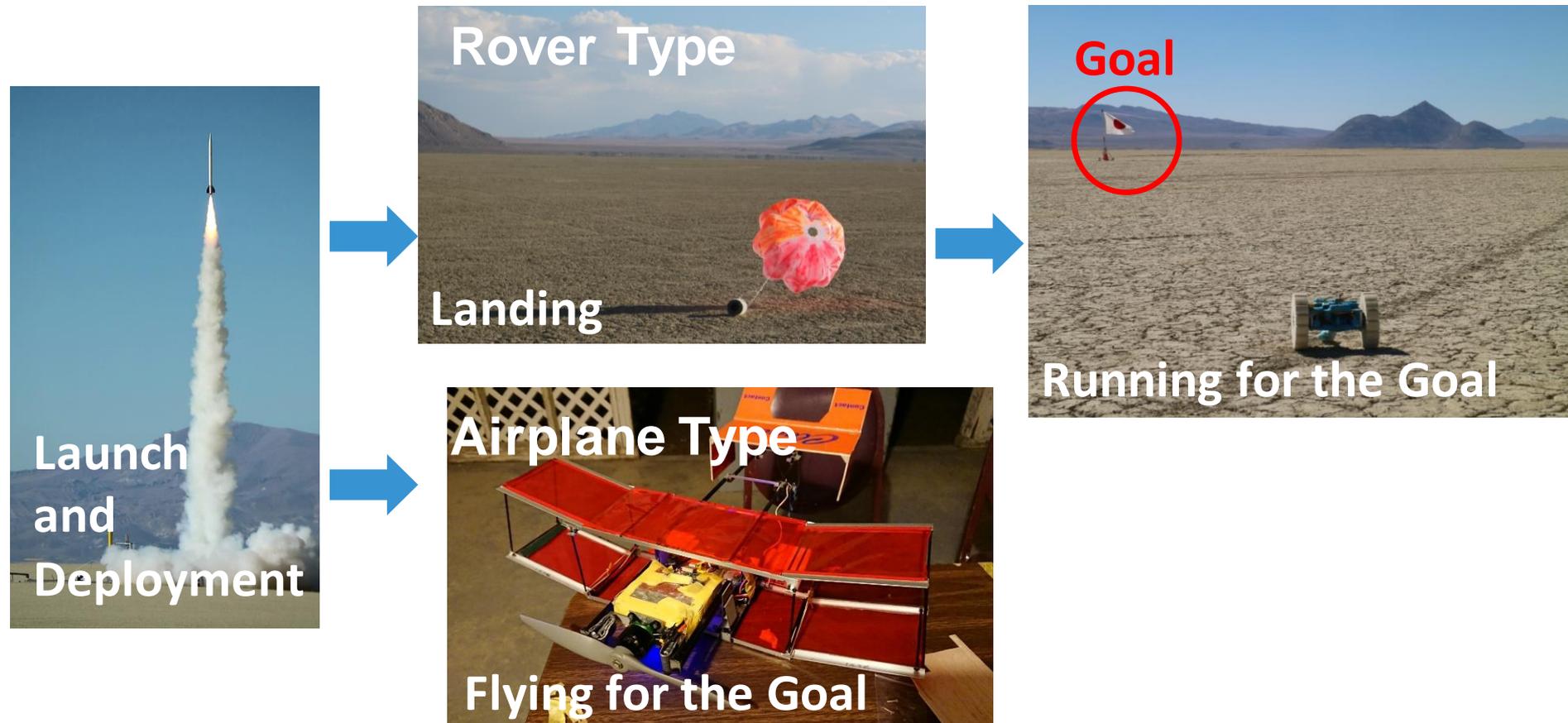
- Spacecraft Control
- Orbit Design
- New technologies for spacecraft
- Architect and system design of spacecraft
-and so on!

Projects

- CanSat
1999~ ARLISS(every year)
- CubeSat
2003 XI-IX: The first CubeSat
:
Now EQUULEUS: under developing
- Small Sat
2009~ ~50kg class nano satellites

CanSat: Small mock satellite

- Doesn't go to space, but basic function is similar
- In comeback competition, Cansats run/fly for the goal automatically



Noshiro Space Event (Japan Competition)

- ◆ Competition of amateur rockets and CanSats
- ◆ CanSats drop from drones/balloons



ARLISS (world competition)

(A Rocket Launch for International Students Satellite)

- ◆ CanSat Competition (Comeback, Mission)
- ◆ In Black Rock Desert, Nevada, USA
- ◆ Participants from Japan, Korea, USA, Egypt,
- ◆ CanSats is launched by amateur rockets



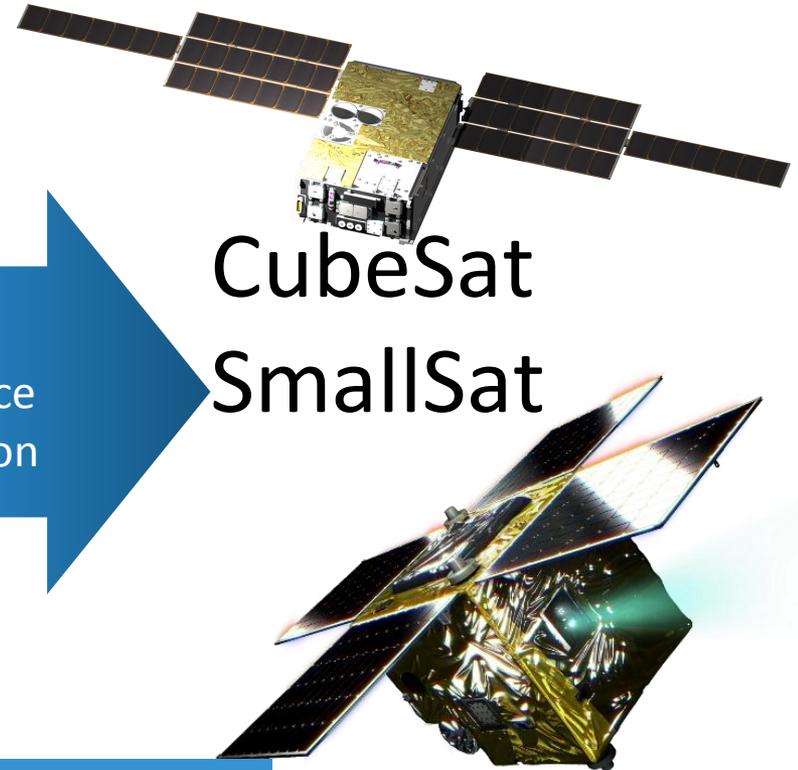


CanSat



Skill
Experience
Motivation

CubeSat
SmallSat



- ◆ Many Similarities
 - Subsystem
 - Requirement
 - Project Management
- ◆ But, Spacecraft is more complex

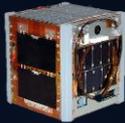
ISSL Spacecraft

XI-IV
(2003)



In operation (16 years)

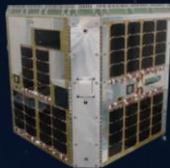
XI-V
(2005)



In operation (14 years)

Nano-JASMINE

Awaiting launch
Collaborator: NAOJ



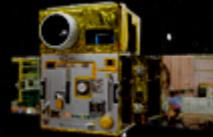
PRISM (2009)

In operation (10 years)



HODOYOSHI 1, 3, 4 (2014)

In operation (5 years) Collaborator: Axelspace, NESTRA



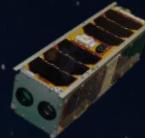
TRICOM-1R
(2018)

End of operation (0.5 years)
Collaborator: JAXA



RWASAT-1
(2019)

Will be launched in 2019
Collaborator: Rwanda



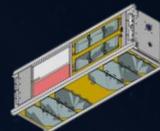
AQT-D
(2019)

Collaborator: UT-SPL



G-Satellite

Will be launched in 2020
Collaborator: TOCOG, JAXA



11

Satellites Launched

3

Satellites will be
launched soon

16

Years of In-orbit
Satellite Operations

104

Students Graduated

MicroDragon
(2019)

In operation (0.5 years)
Collaborator: VNSC



PROCYON
(2014)

End of operation (3 years)
Collaborator: JAXA



EQUULEUS

In development
Collaborator: JAXA



EQUULEUS

EQUilibriUm Lunar-Earth point 6U Spacecraft

Development

- ▶ Mainly by the University of Tokyo & JAXA

Spacecraft-System

- ▶ Weight : 12 [kg] ▶ Power : 48 [W]
- ▶ Size : 6U (10cm × 20cm × 30cm)

Launcher

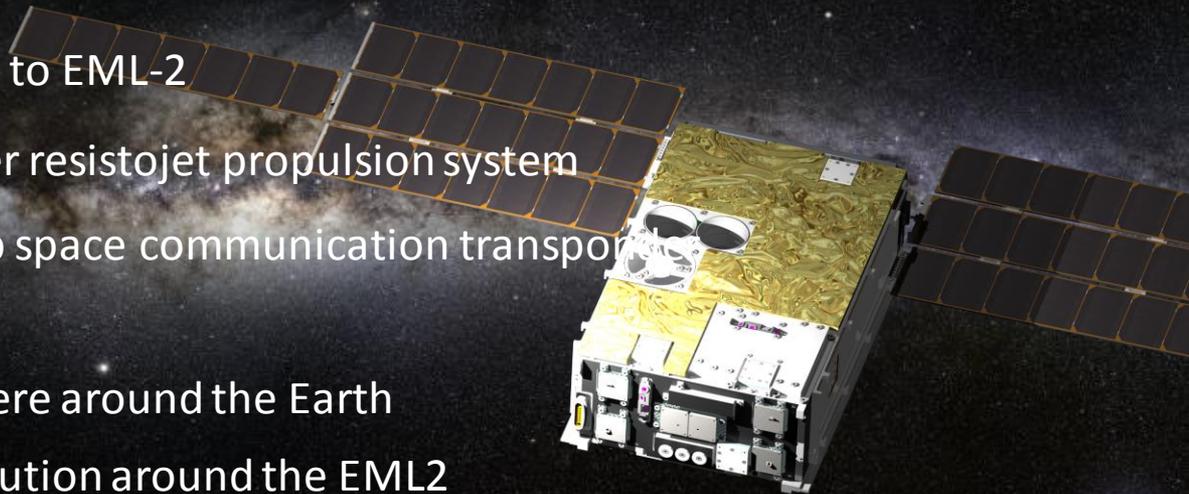
- ▶ NASA Space Launch System (SLS) EM-1

Technological Mission

- ▶ Trajectory design & control to EML-2
- ▶ Demonstration of the water resistojet propulsion system
- ▶ Demonstration of the deep space communication transport

Science Mission

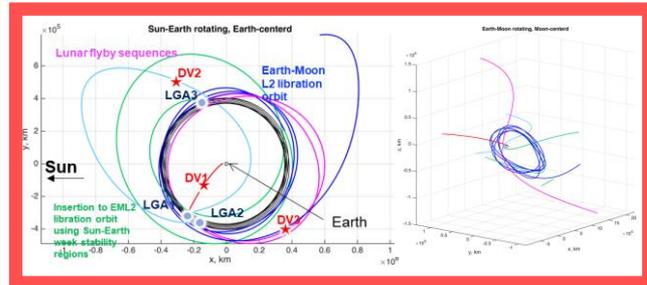
- ▶ Observation of plasmasphere around the Earth
- ▶ Observation of dust distribution around the EML2
- ▶ Observation of lunar impact flush on the moon surface



Technology

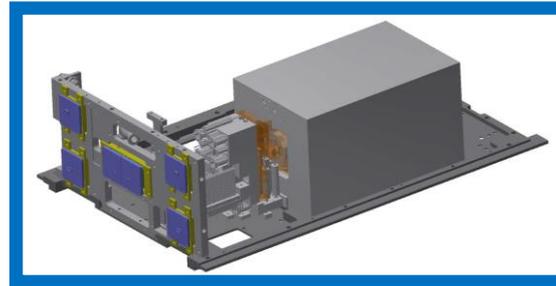
Trajectory Control to EML2

- ~6 months flight to Earth-Moon Lagrange Point 2
- Multiple lunar gravity assists



AQUARIUS

- New resistojet water propulsion system
- Non-toxic, easy to handle



XTRP for CubeSats

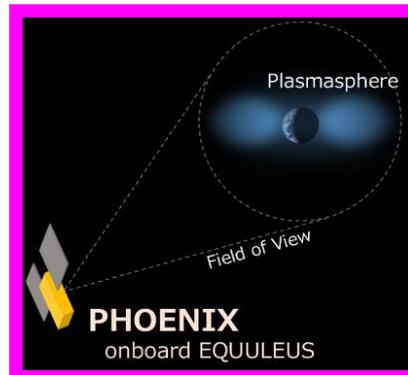
- Miniaturization of the deep space communication transponder for CubeSats



Science

PHOENIX

Observation of the Earth's plasmasphere



CLOTH

Measurement of dust in cis-lunar region



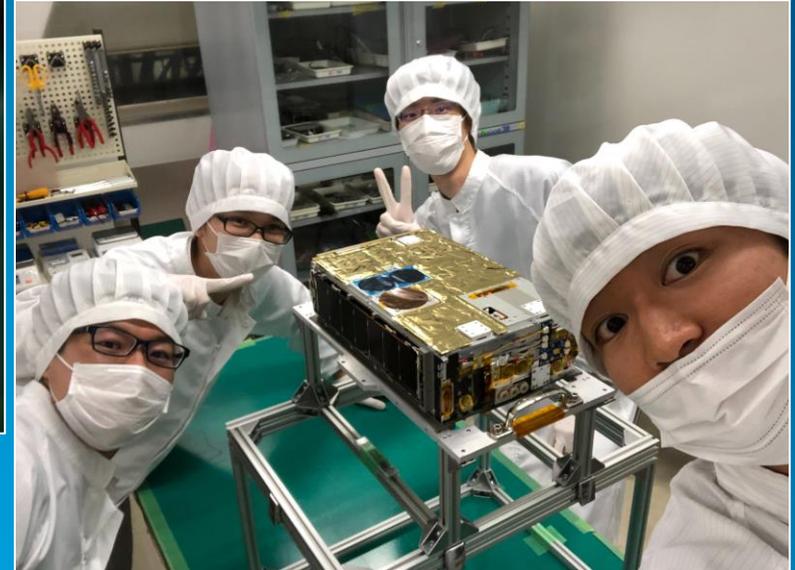
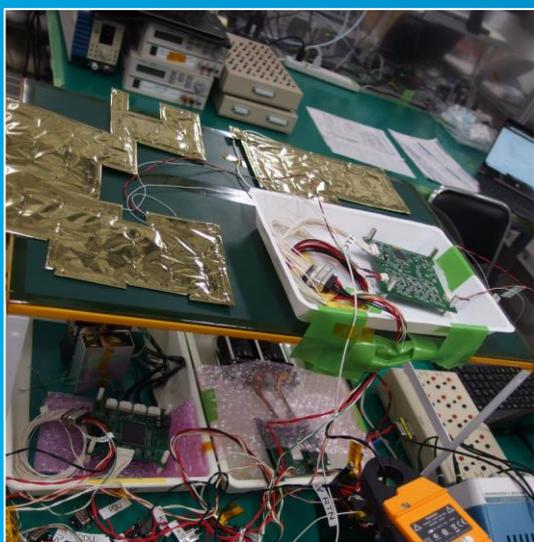
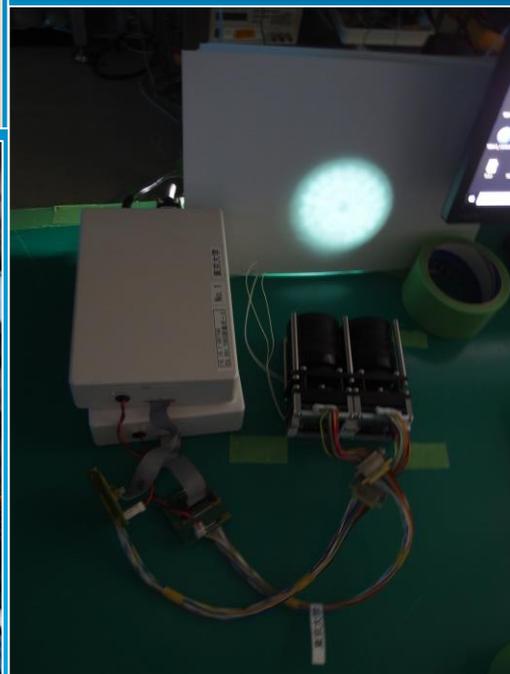
DELPHINUS

Observation of Lunar Impact Flash



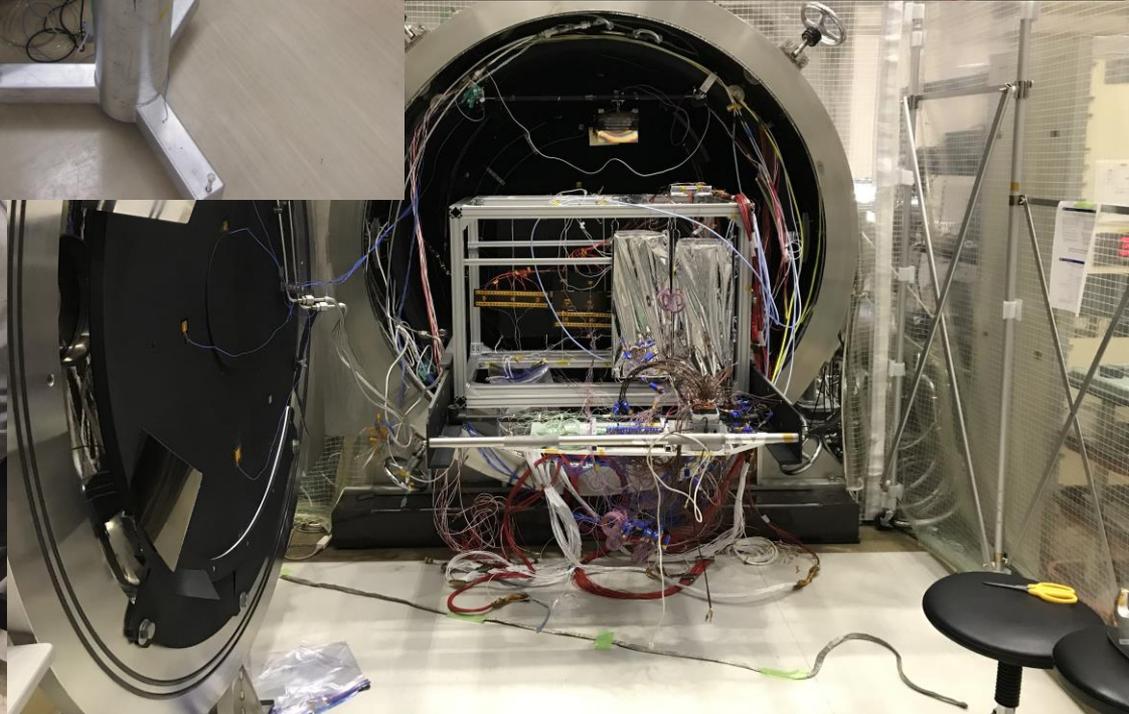
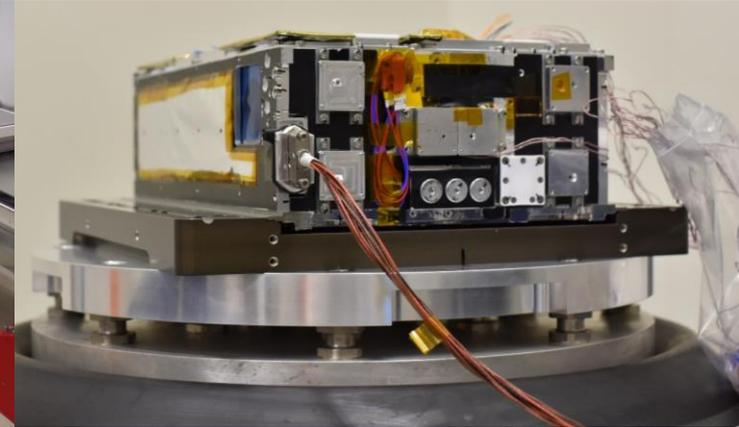
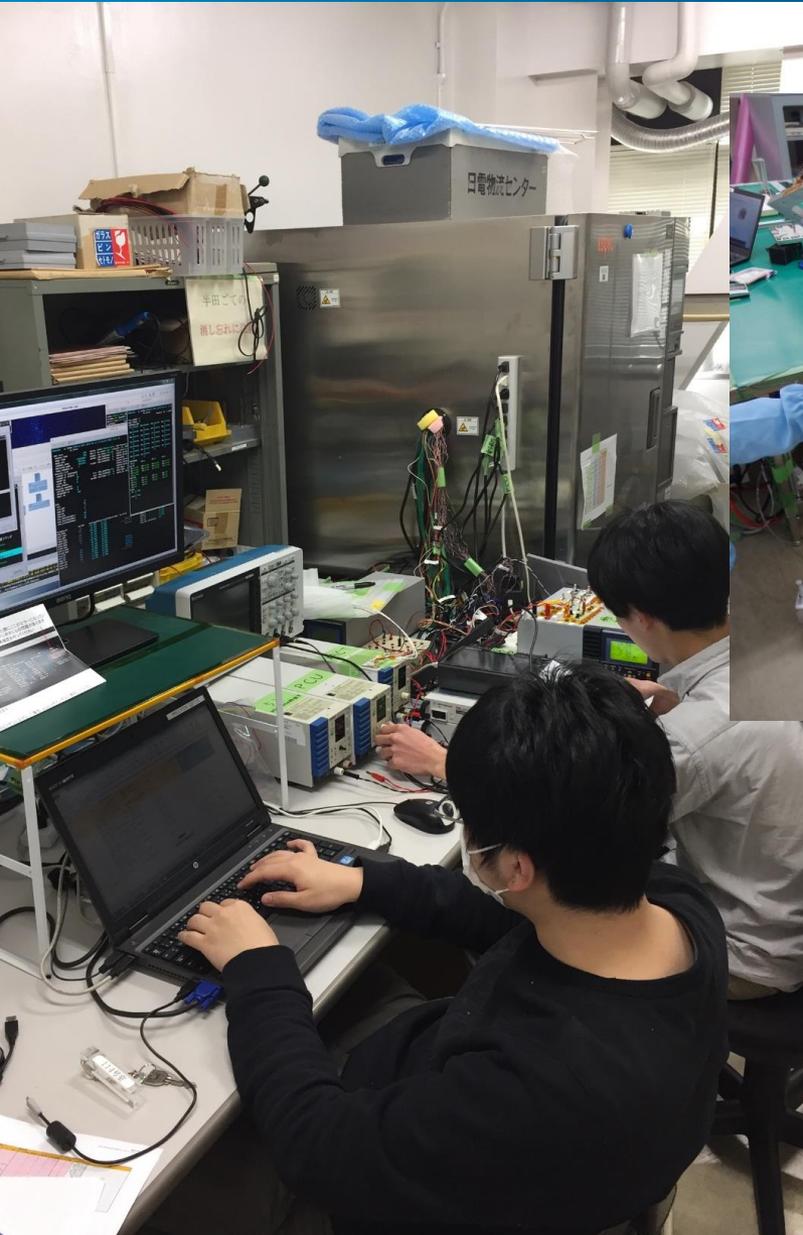
EQUULEUS Development①

Assembly



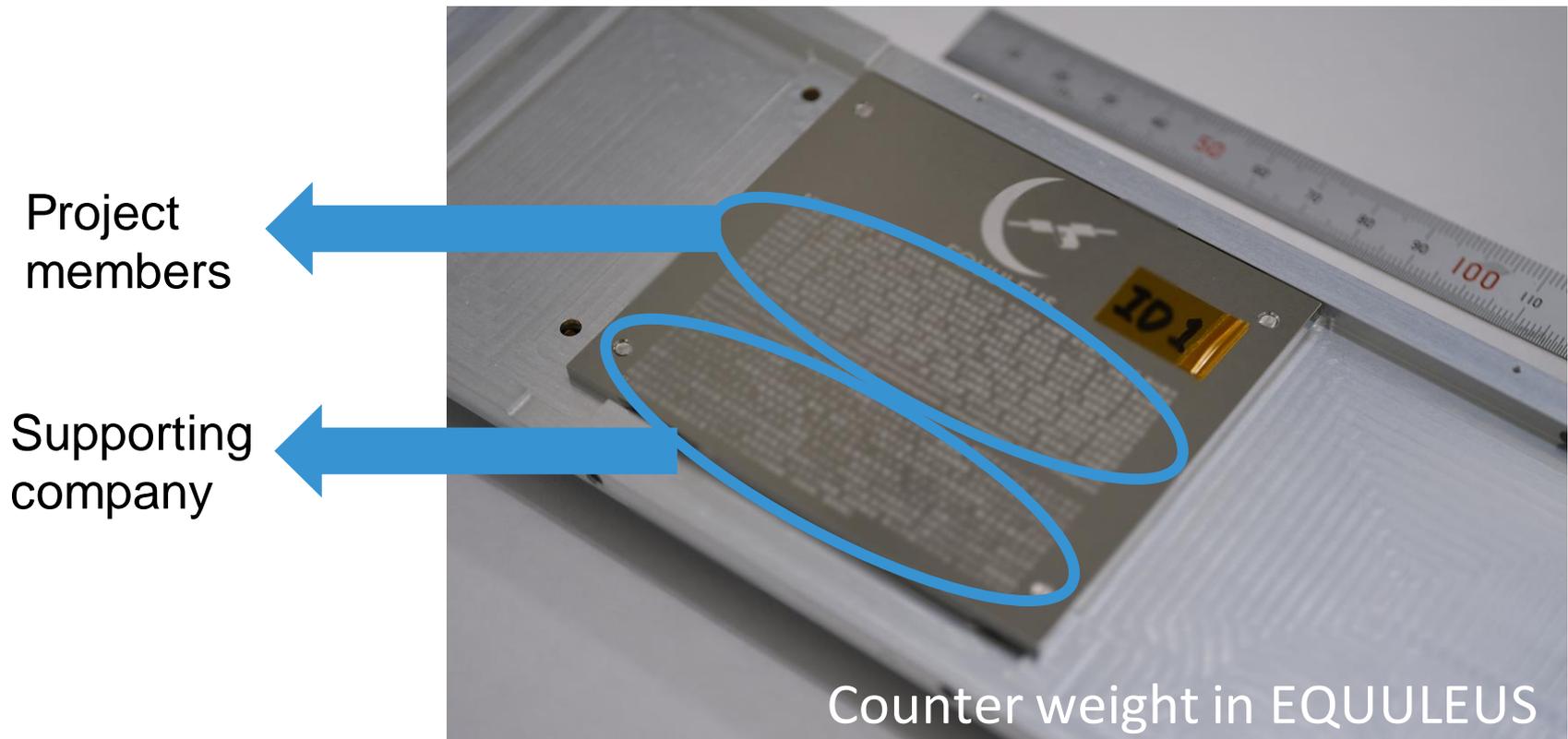
Components Test

Environment test, operation test



Cooperation is indispensable for EQUULEUS

- Project members form many laboratories, JAXA
- Many companies support with component development, manufacturing, test, technical advice, analysis, and so on.



Standardization can reduce the difficulty and cost of developing satellites

- 
- Same size satellite can use same component, bus system
 - ➔ “HODOYOSHI” projects used standardized bus system
 - Satellites can have common function and architecture
 - ➔ ISSL have used same software architecture among many satellites
 - ➔ In UNISEC, there is a movement to standardization of software

Many people can achieve more challenging missions

- Contribute to the goal of UNISEC-Global 2030
“Everyone in the world can participate in space development”

ISSL is laboratory which makes SmallSats

- ◆ Knowledge and experience can be acquired through CanSats development and motivating events

ISSL is challenging to innovative SmallSats missions

- ◆ It is difficult to do them without cooperation even if ISSL students have experienced CanSat & CubeSat development

Cooperation and standardization enable challenging missions

- ◆ UNISEC global community provides good opportunities

