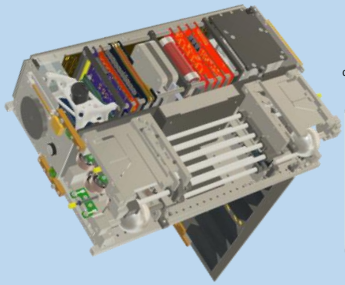
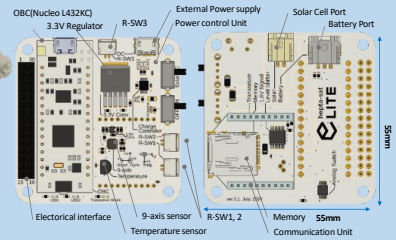
Activities and Future Plans for UNISON Satellite Working Group

Nagisa Sone
Nihon University,
College of Science and Technology, Department of Aerospace Engineering,
Yamazaki Laboratory.





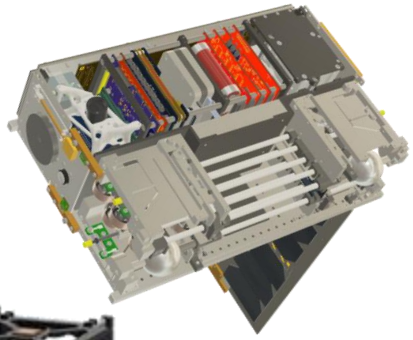
Self Introduction

Nagisa Sone

Nihon University, College of Science and Technology,
Department of Aerospace Engineering,
Yamazaki Laboratory.

Master's 2nd Year.

Main Activities



W6U sized CubeSat "PRELUDE" project

- Project Management
- Communications Subsystem
- Attitude Control Subsystem

Space engineering educational training "HEPTA-SAT"

- Development of kit & textbook and organization of workshops

The UNISON Satellite Working Group

- UNISON : UNISEC Student Organization
- Enhance fundamental skills in university satellite development.

Today's Topic

1. My Lab's Satellite "PRELUDE" Project Introduction

- A W6U sized CubeSat developed by the Yamazaki Laboratory of Nihon University.

2. Space engineering educational project HEPTA-SAT

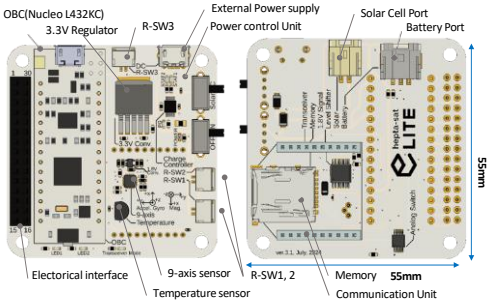
- Create experiences for students to communicate internationally through engineering.

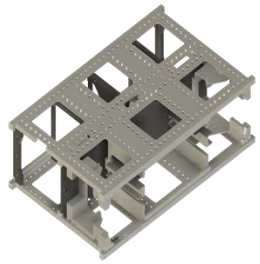
3. Next HEPTA-SAT "Otenki(weather) Sat "

- Creating a new educational program that integrates science and engineering.

4. UNISON (UNISEC student group) satellite working group activity

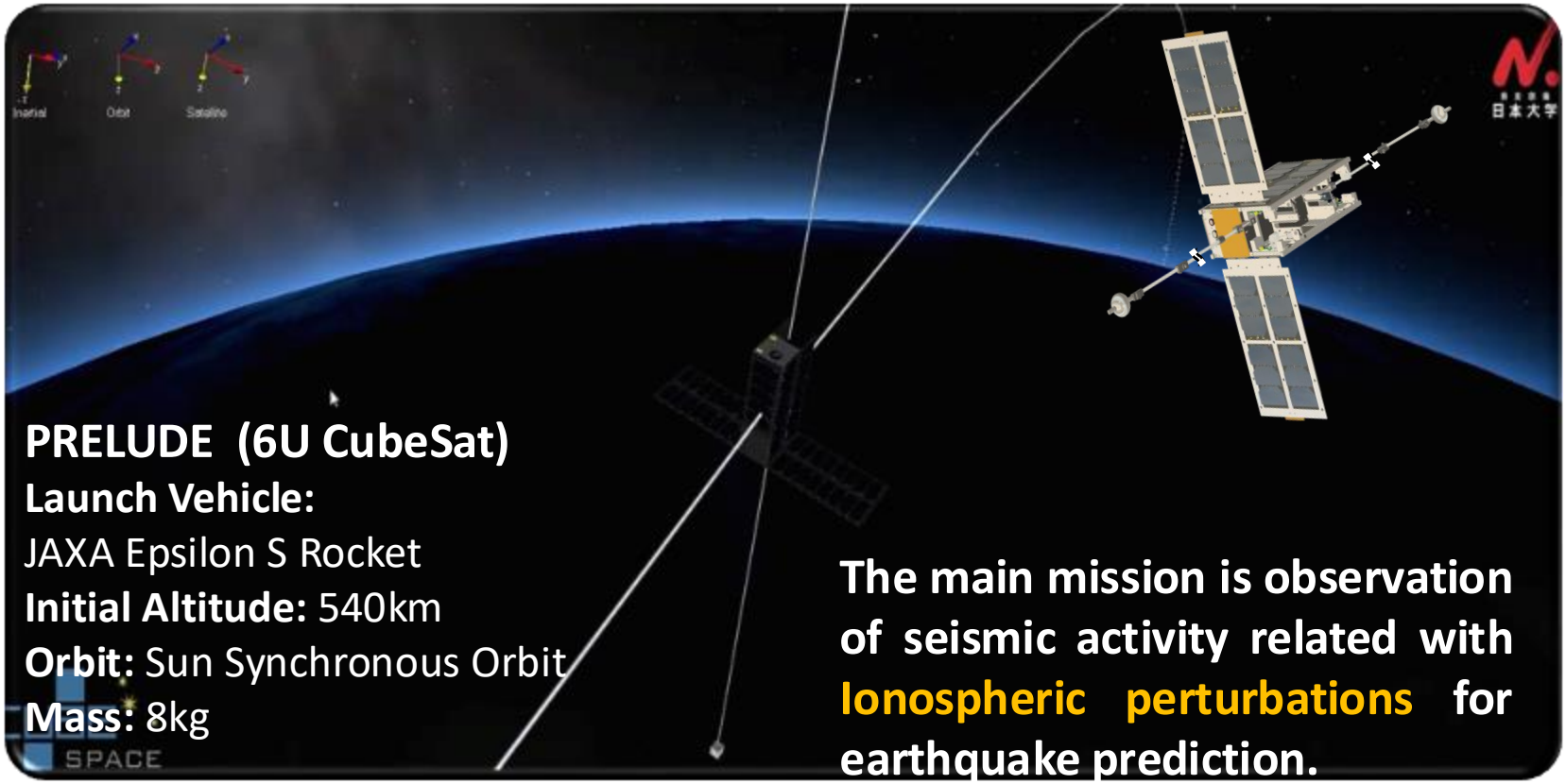
- Students will take the initiative in space satellite development and challenge themselves to do what only they can do.





My Lab's Satellite "PRELUDE" Project Introduction

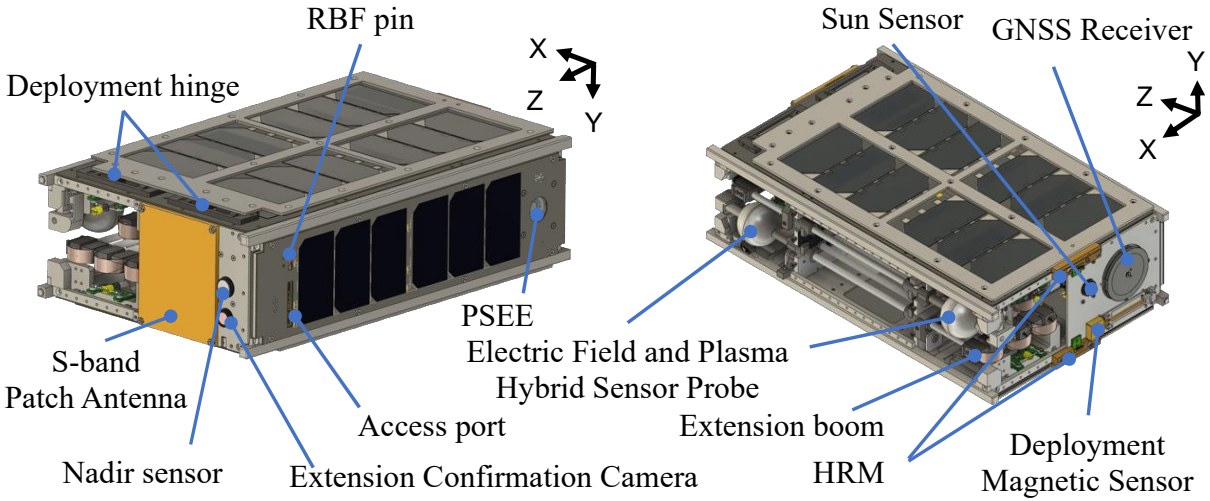
- Developed in **Yamazaki Laboratory in** Nihon University
- It is mainly developed by **2nd year Master curce student(3 people), 1st year Master curse student (6 people), and b4 students (2 people)**
- **PRELUDE will be launched between FY2025** (2025/4~2026/3) by JAXA's Innovation 4th project.



My Lab's Satellite "PRELUDE" Project Introduction
– PRELUDE Overview –

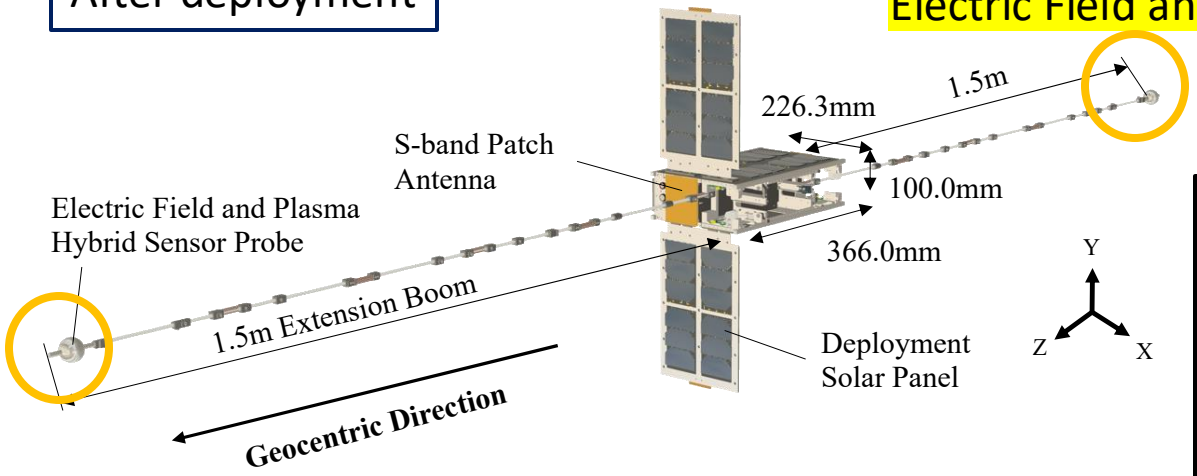
The main mission is observation of seismic activity related with Ionospheric perturbations for earthquake prediction.

Launch state



After deployment

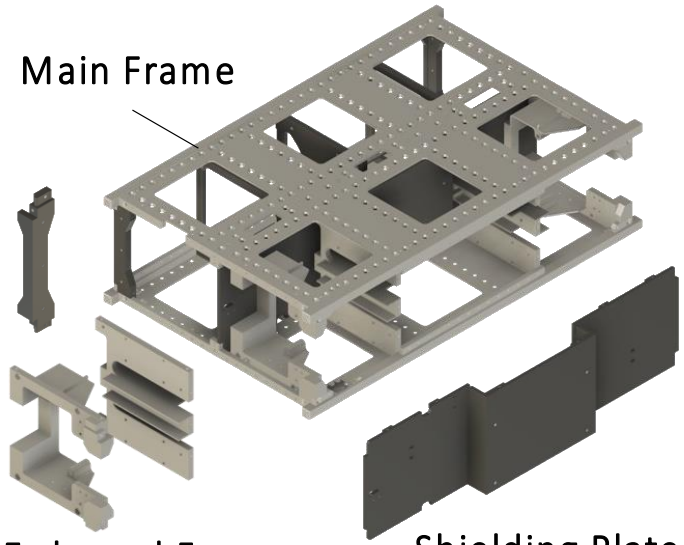
Electric Field and Plasma Hybrid Sensor



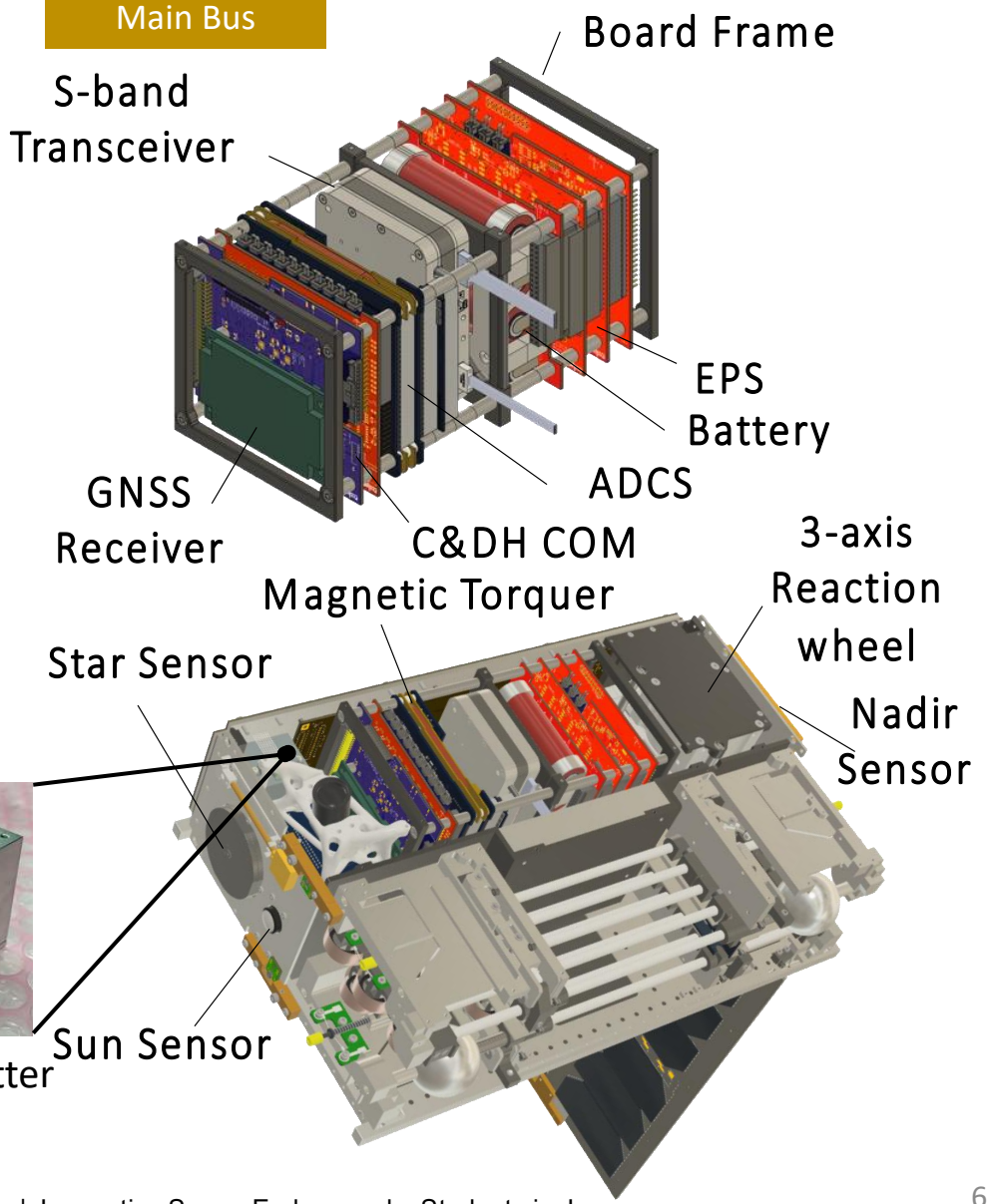
Mass: 8kg
Launch Vehicle:
JAXA Epsilon S Rocket
Initial Altitude: 540km
Orbit: Sun Synchronous Orbit

My Lab's Satellite "PRELUDE" Project Introduction – PRELUDE BUS unit –

Main structure

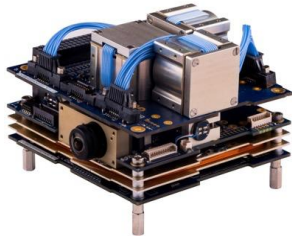


Main Bus

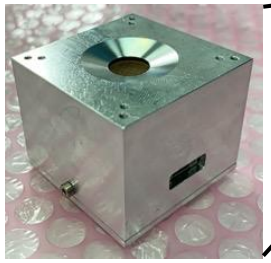


COTS

Transceiver (IQSpacecom)

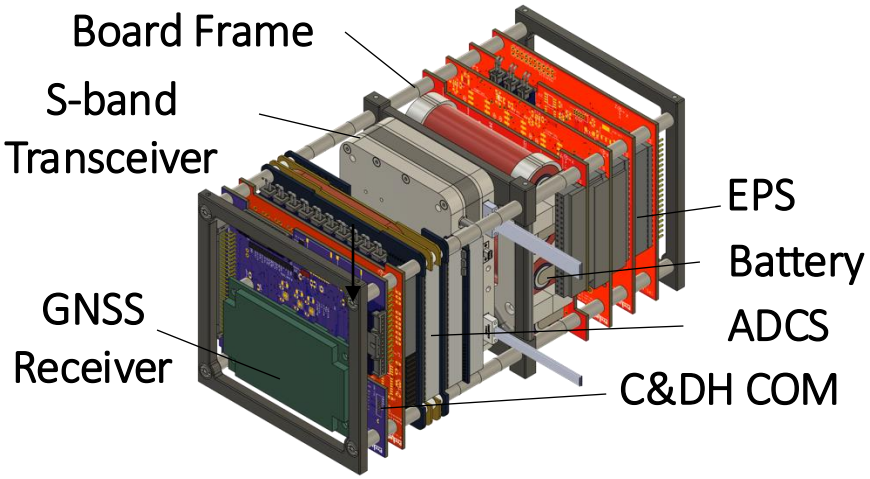


ADCS unit (CubeADCS)

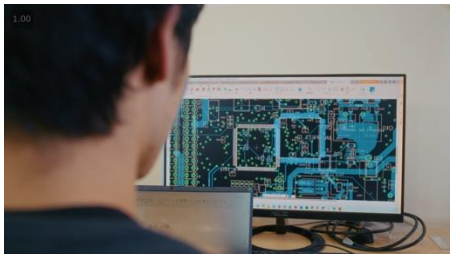


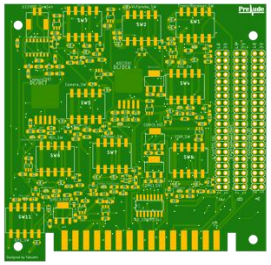
Electron Emitter (LATMOS)

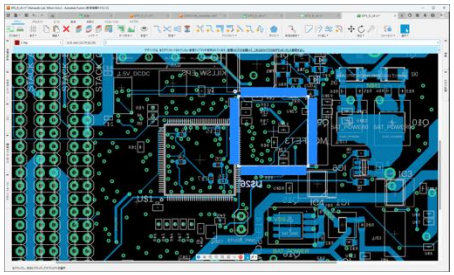
My Lab's Satellite "PRELUDE" Project Introduction
– design development process by students (in-house/outsourced) –

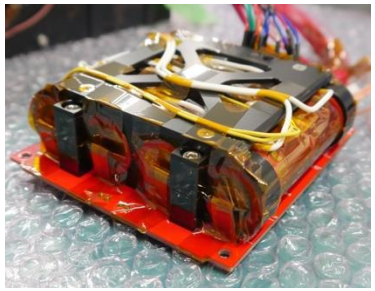


Boards Design with ECAD by student

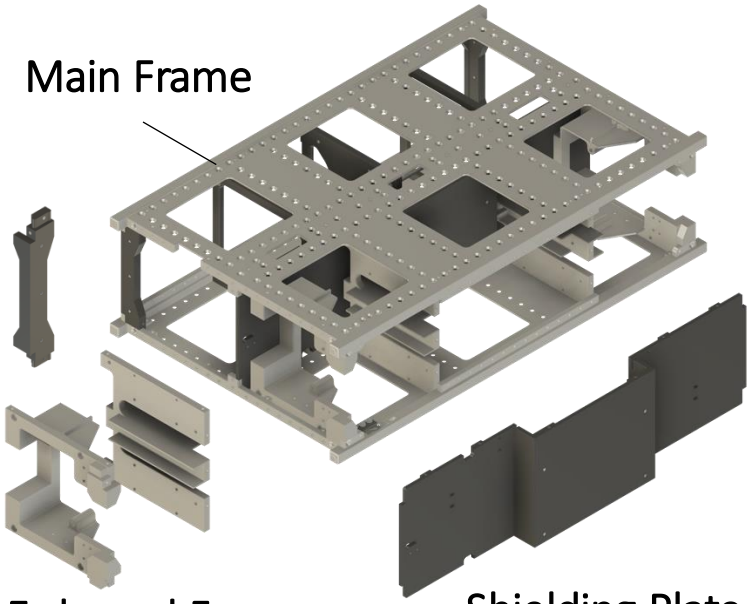






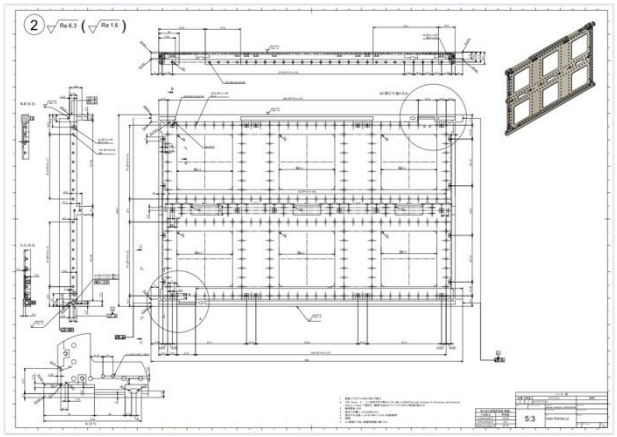


Manufactured at company



C, E shaped Frame

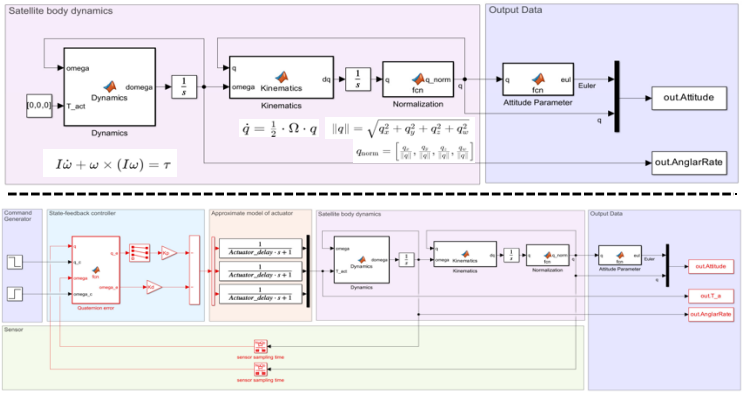
Shielding Plate



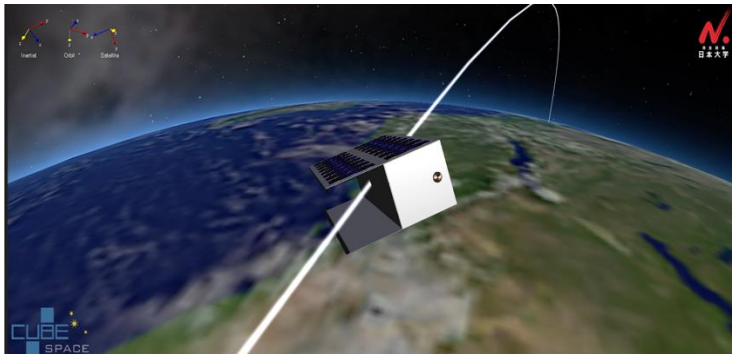
Students create drawings and manufacture them at the company.

My Lab's Satellite "PRELUDE" Project Introduction – design development process (in-house/outsourced) –

Analyzed and evaluated EPS・ADCS・TCS by MATLAB, etc.



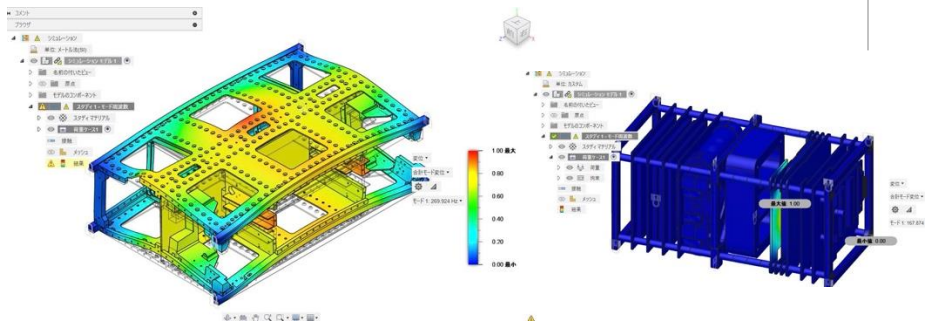
We would like to upgrade SILS and HILS..

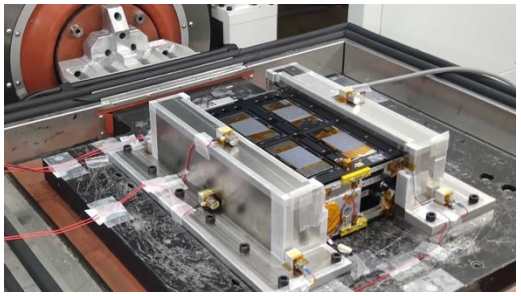


Other analysis is also done using a combination of home-made code, Excel, and purchased software.

3D printer mock-up

Assembly / evaluation in clean room





Environmental testing(Vibration, Shock)

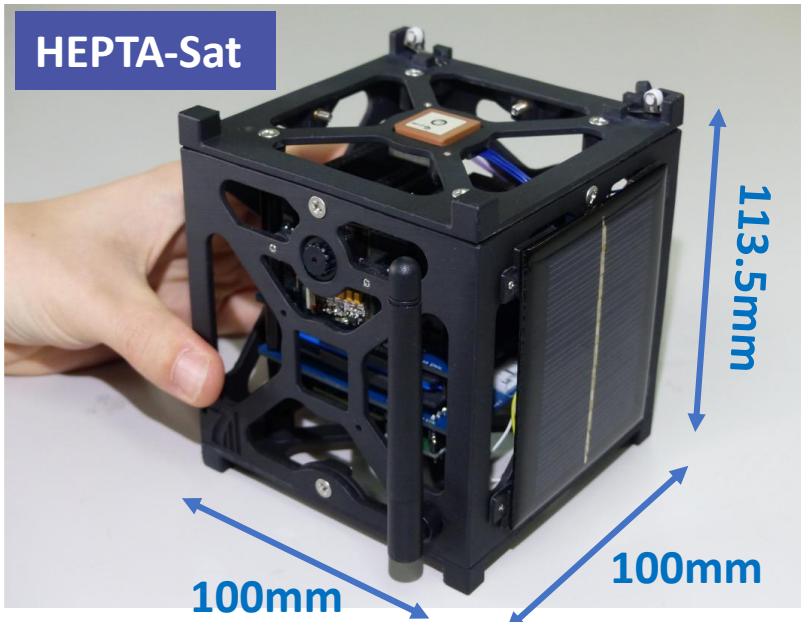
UNISEC - “HEPTA-SAT” -

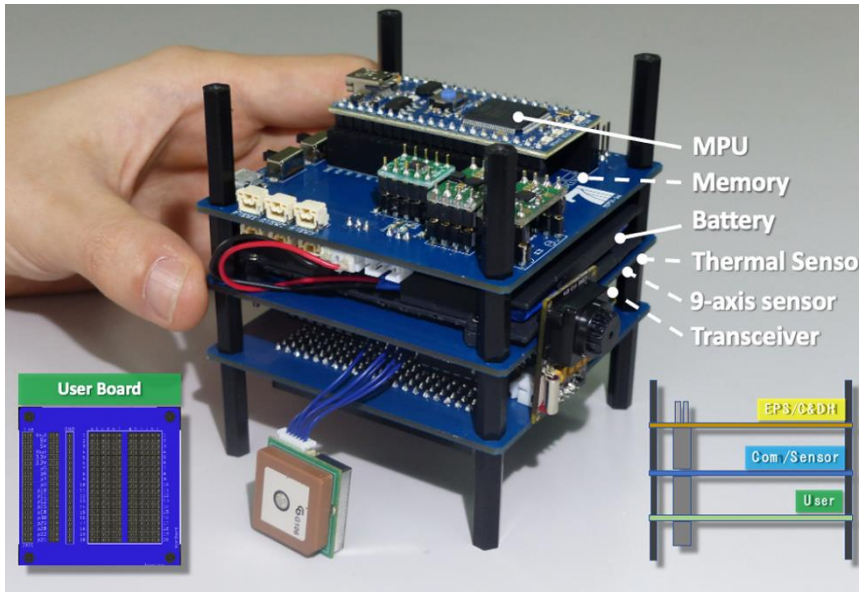
The HEPTA-SAT training course is practical hands-on learning of the **“CubeSat”** system, which is widely used in universities and companies around the world, to learn the basics of **“Space Systems Design”** through actual products.

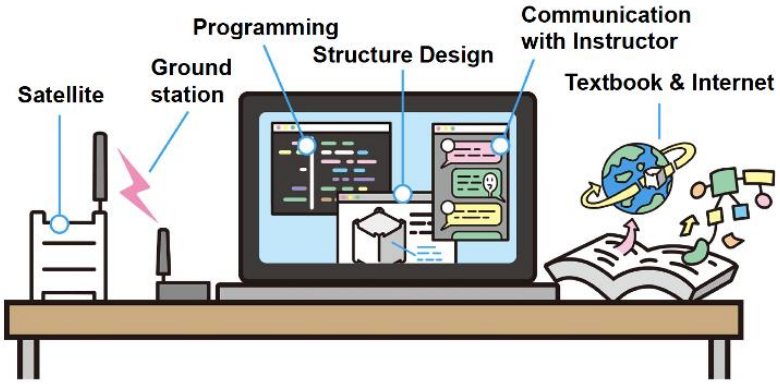
- Workshops at International Space University (France, Australia)
- JICA's Overseas Human Resources Dispatch Program
- Training for space agencies (JAXA, Kenya, Oman, etc.)
- University Lectures (UAE, Taiwan, Kyoto University, etc.)
- UN side event workshop (South Africa)
- Development of training programs for astronaut candidates (JAXA, JAMSS)
- Lectures for junior high and high school students (Science Museum)

UNISEC - “HEPTA-SAT” -

HEPTA-Sat is a 1U CubeSat education kit that contains a satellite bus system, including a microcomputer, battery, transceiver, sensor devices, and structure.



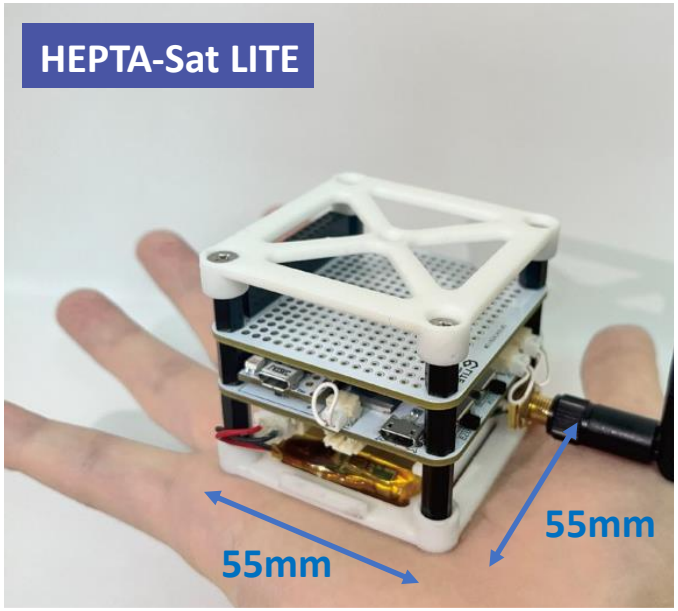


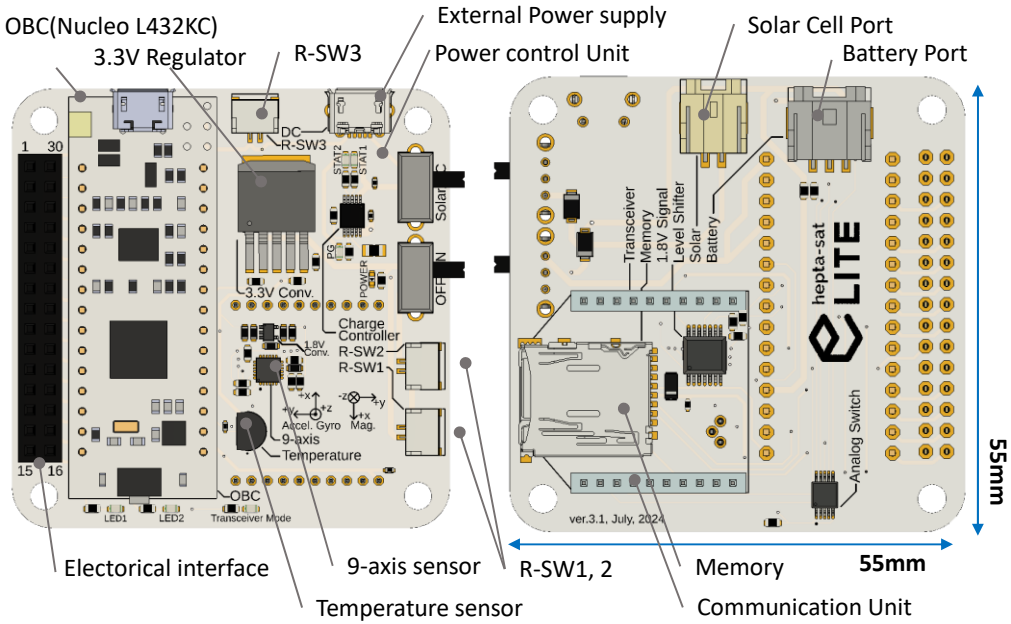


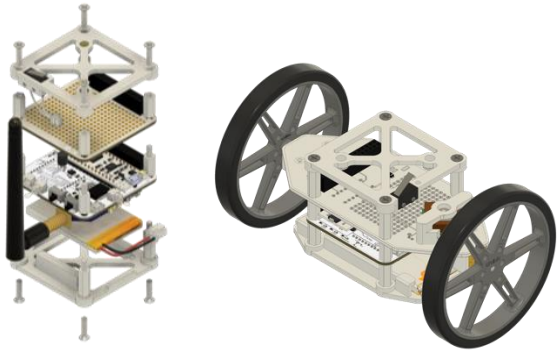
By using the kit corresponding to the textbook, anyone can understand satellite systems in a short time.
Easy access to space for newcomers, requiring only an Internet environment and a laptop computer.

UNISEC - “HEPTA-SAT LITE” -

The HEPTA-Sat LITE is a new training kit that simplifies HEPTA-Sat into a single chip, only 55mm x 55mm palm-sized board.







- Easier to use because of its smaller size and lower cost.
- Most sensors and other functions are already included on a single board, making it easy to use for other applications.

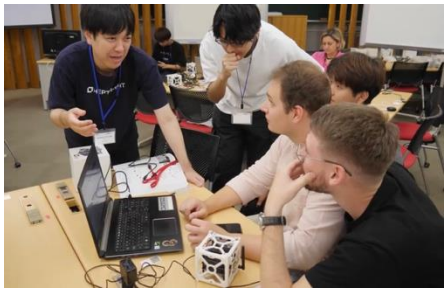
UNISEC - “HEPTA-SAT Training Effects on assistant students” -

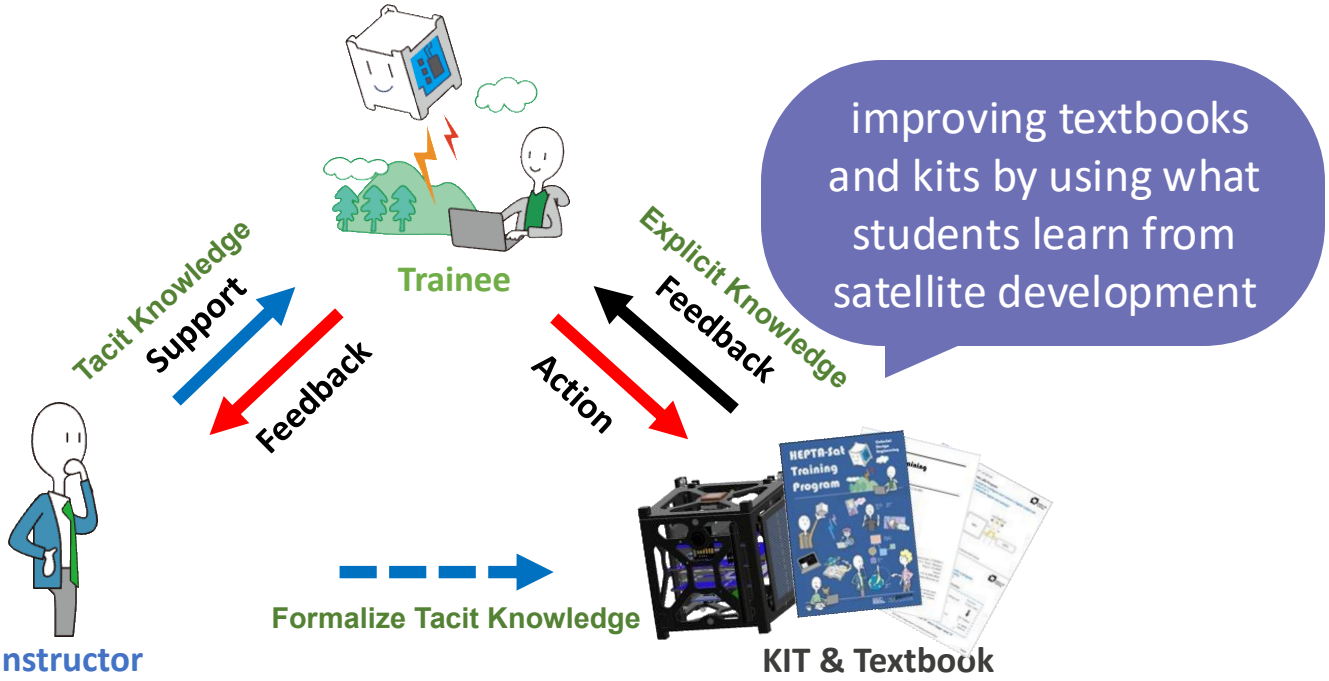
HEPTA-SAT is a good opportunity for the participants and also for the students.

Students who are developing satellites at Yamazaki Laboratory participate in HEPTA-SAT training workshop as teaching assistants.

✓Can experience international activity

✓feel closer to the world and grow to skill of engineering communication



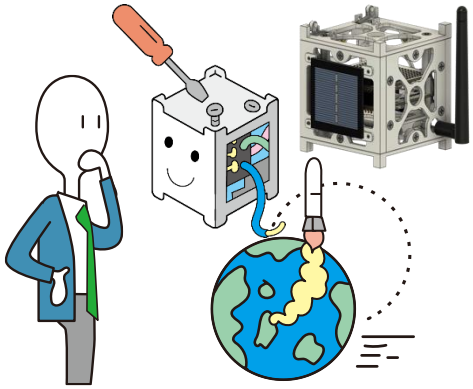


UNISEC - New HEPTA-SAT Training vision “Otenki Sat” -

- We are currently looking to create new HEPTA-SAT training that integrates engineering and science.
- Add learning experiences in satellite operations and data analysis.

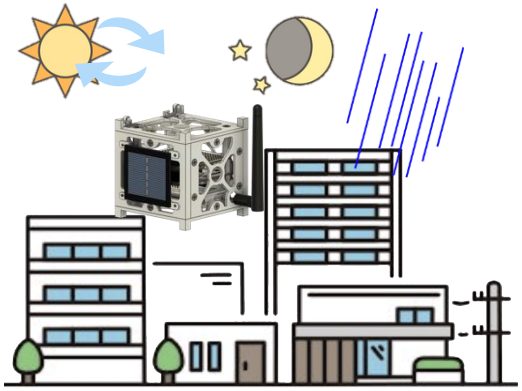
“The Otenki (weather) sat “ (Planning now…)

1. Design・develop・testing



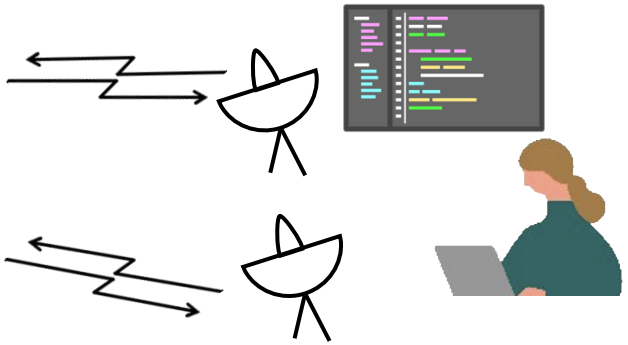
HEPTA-SAT LITE is equipped with a weather sensor.

2. Long-term weather observation



satellite observes weather outside for long term.

3. Operation, data analysis



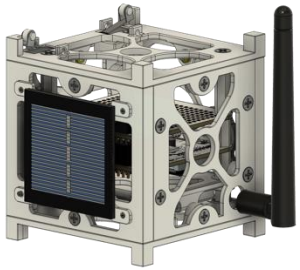
estimate satellite condition from the data analysis.

UNISEC -"OtenkiSat" Advantages of Working with Weather Data

wind velocity

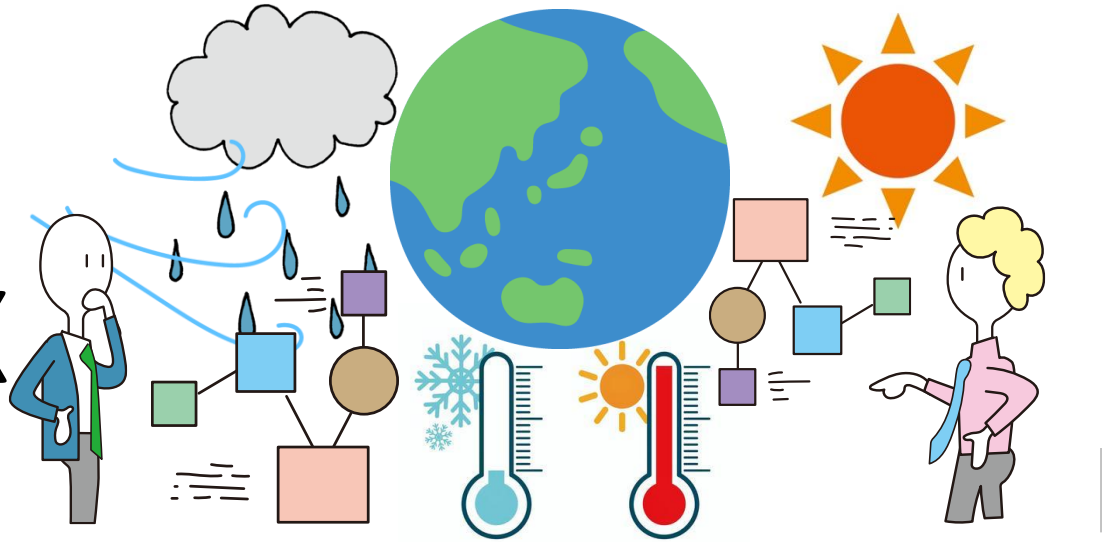
PM2.5

rainfall



Atmosphere

X



Advantages of Working with Weather Data

Easy to evaluate data

- Temperature, humidity… easy to understand, and can handle without any specialized background.
- Many reference data are available, making it easy to confirm the accuracy of the data.

Data Analysis Experience of natural Phenomena

- Natural phenomena caused unpredictable fluctuations and sudden events.
- Develop the ability to understand complex data in the process of analyzing them.

Why do I want to create new HEPTA (Challenges of HEPTA-SAT Training)

- HEPTA-SAT training lacks experience in the operational phase, especially in the use and analysis of data from a scientific perspective.

- In addition to an engineering approach, an understanding of the scientific theory of data is essential to the use of data.

Engineering

X

Sciense

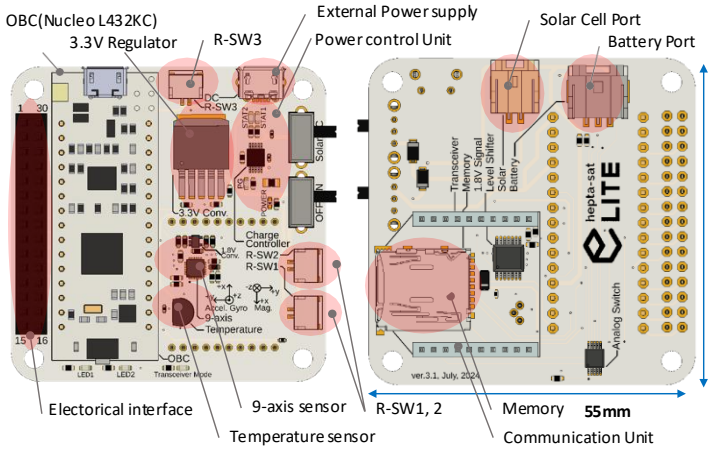
- Design, operation and technical realization of the mission
- Hardware, software, system design, etc.

- What do you want to achieve with the satellite?(mission design)
- how will the acquired data be read and analyzed?(data demand)

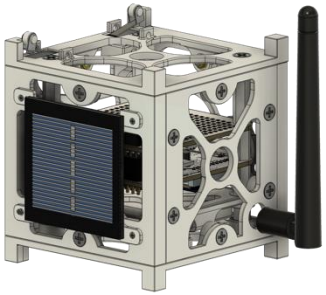
Design educational programs that cross the disciplines of science and engineering

Otenki Sat - Hardware Configuration -

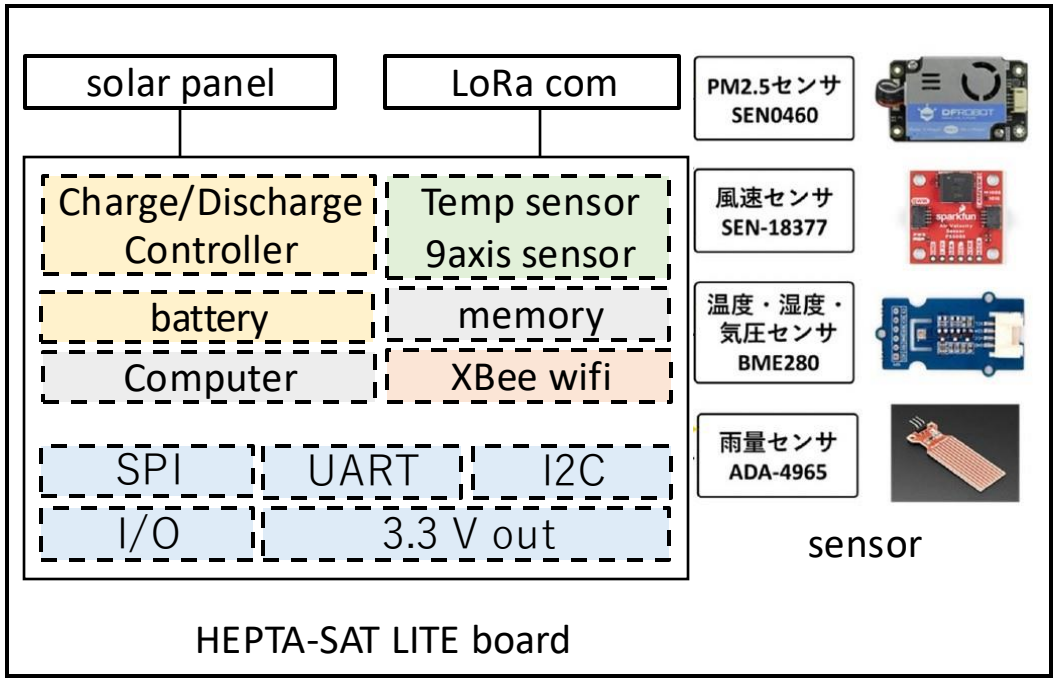
- The core consists of a 55mm x 55mm HEPTA-SAT LITE board containing the satellite bus system.
- Sensors for temperature, humidity, air pressure,wind speed,, etc., which can be changed according to the mission, are connected to HEPTA-SAT LITE.



HEPTA-SAT LITE board



3D Printer Structures (example)



Otenki-Sat Configuration Diagram

under construction. . .

UNISON –Satellite Working Group –

- The UNISON Satellite Working Group is composed of students doing satellite-related research.

UNISON satellite group's purpose

✓ To solve problems that cannot be done in the one labratory.

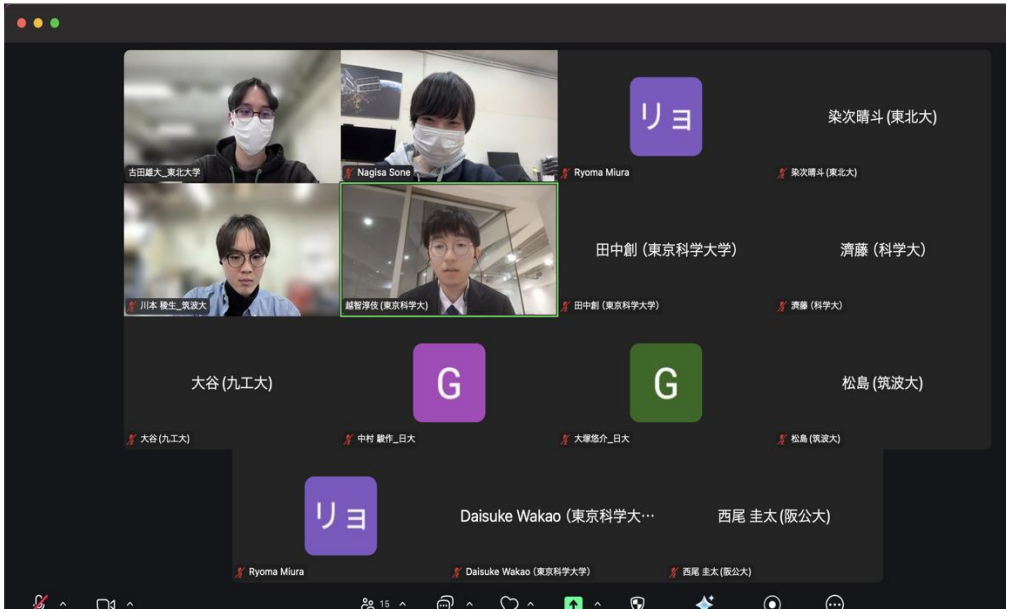
✓ Share issues that have come to light through the development of satellites.

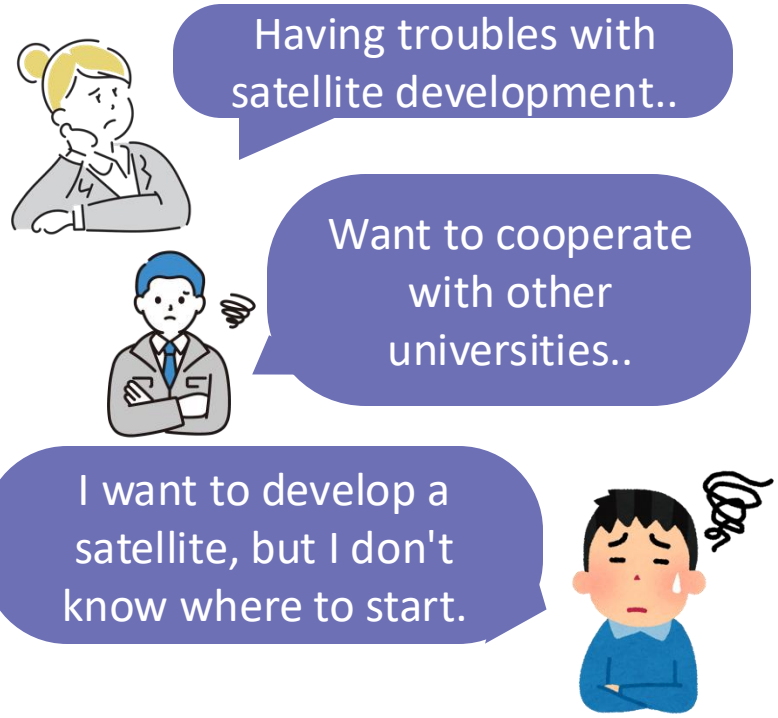
UNISON –Satellite Working Group “Main two Activities” –

1. Regular mtg to report on recent activities (once every two months)

- Regular mtg attended by students belonging to UNISON.
- To provide a platform for exchange of ideas and knowledge among students involved in satellite development

✓ We will share the efforts and issues of each university, and solve them together.

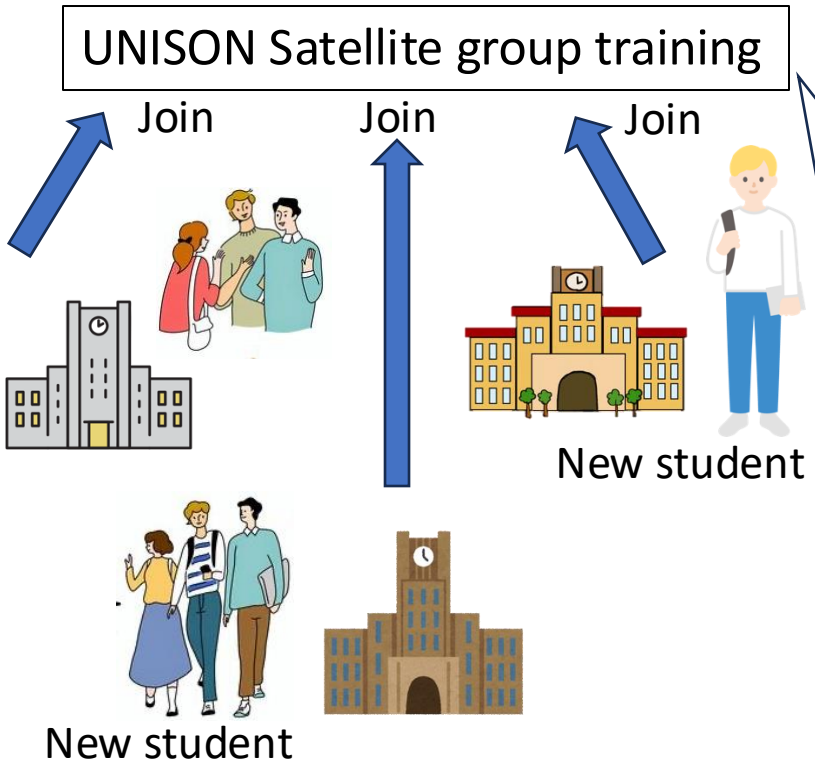




UNISON –Satellite Working Group “Main two Activities” –

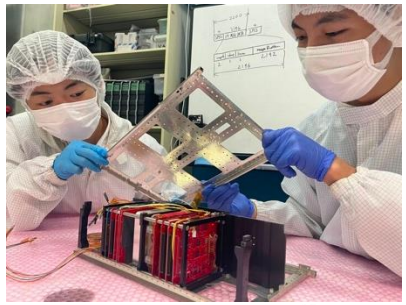
2. UNISON Training program for new student (plan to be held in this year 2025)

- It will be hold a training for new students in laboratories that are developing satellites. （2days training course ）



Share and teach

how to develop satellites, engineering knowledge and lessons learned from each university, and visit each laboratories.



✓To provide an opportunity for the new students to interact with other students, to make connections, and to give motivation.

UNISON –Future Plan Satellite Working Group–

Since the Satellite Working Group was inactive last year, we have restarted its activities this year.

We will start with the two main activities mentioned before slides.

Other opinions are raised as follows, and we will work on them one by one.

- A platform for easy information sharing
  - Share mistakes
  - Share lessons learned
- Share environment test plan and report templates
- Share design ideas
- Covering newcomers
- Create information sharing platform
- Create wikipedia on how to develop satellites

To improve the basic level of satellite development in Japan through students' activities. We would like to be a satellite working group to achieve this.

Conclusion

PRELUDE

- A W6U sized CubeSat developed by the Yamazaki Laboratory of Nihon University.
- It is developed mainly by students and they are learning knowledge through the real satellite development.

HEPTA-SAT

- space engineering educational program.
- Create experiences for students to communicate internationally through engineering.

Otenki Sat Next HEPTA-SAT vision

- Creating a new educational program that integrates science and engineering.

UNISON

- Students will take the initiative in space satellite development and challenge themselves to do what only they can do.