Nano-Satellite Project-Based Learning for Capacity Building in Basic Space Technology Development

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Outline

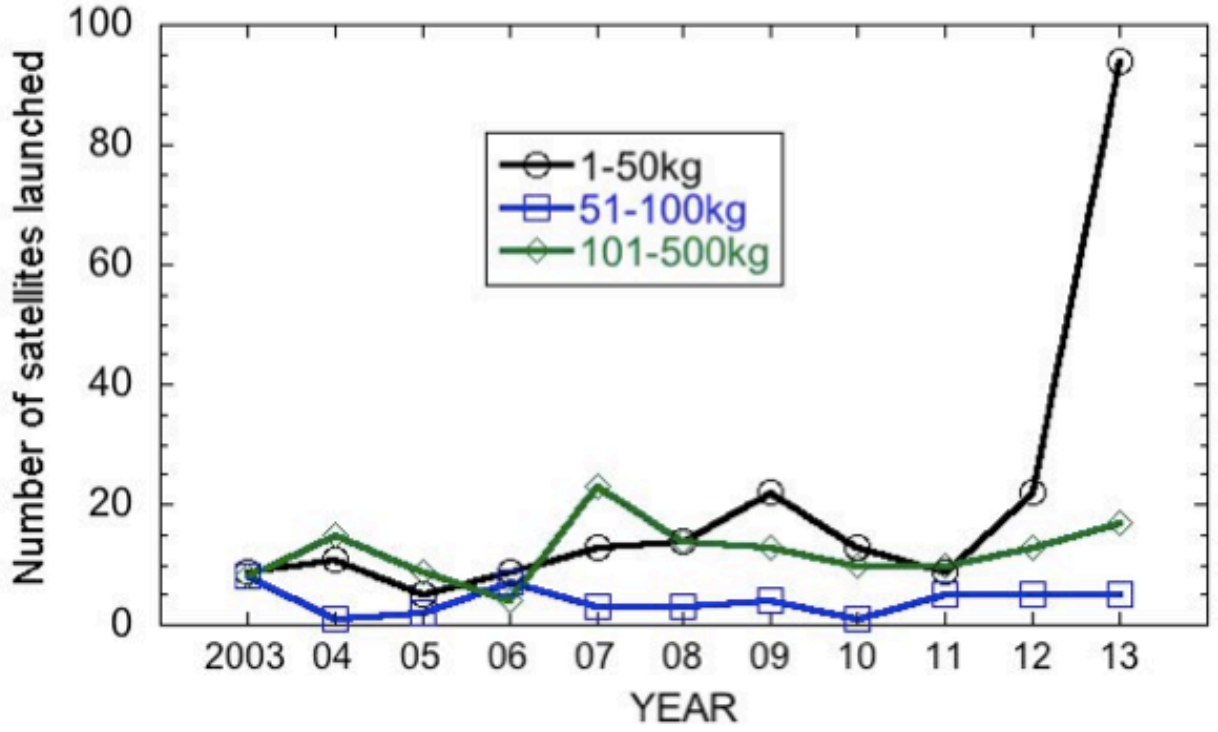
- Introduction/Motivation
- Kyushu Institute of Technology

- HORYU nano-satellite activities
- SEIC and PBL
- UN/Japan Long-term Fellowship Programme

- Collaboration opportunities

Demand for Basic Space Technology

- Growing demand for capabilities for basic space technology development
- Satellites affordable even to universities and smaller institutions

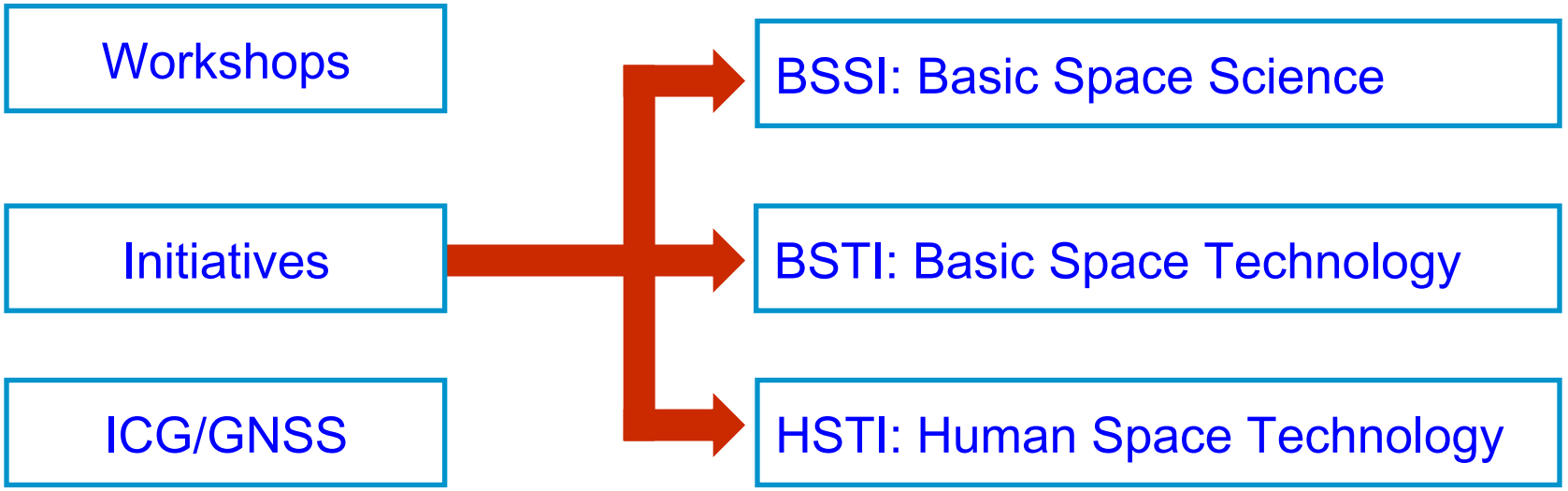


Satellites less than 50kg launched per year has spiked dramatically

UNOOSA Programme Mandate and Activities

- Mandate
  - A. International Cooperation
  - B. Capacity Building
  - C. Dissemination of Information
  - D. Technical Advisory Services
- Activities

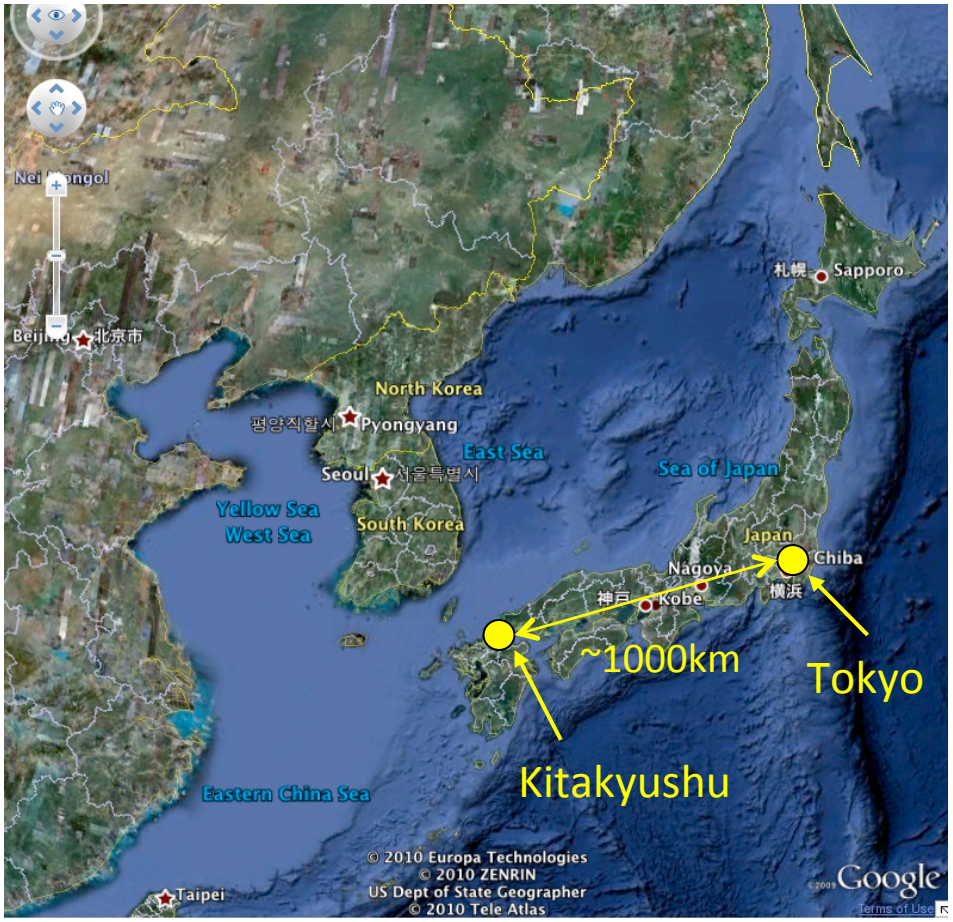
Regional Centres (9-month courses for under graduate students)



United Nations General Assembly Resolution 37/90 (§7), http://www.unoosa.org/oosa/en/SAP/mandate.html

Kyushu Institute of Technology

- Founded in 1909
  - 4,400 Undergraduate students
  - 1,700 Graduate students
  - 370 Academic staff
  - Engineering, Computer science, Life-science
- Located in the Kitakyushu region
  - Population of more than 1million



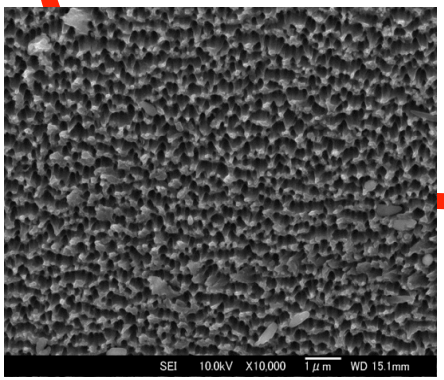
Laboratory of Spacecraft Environment Interaction Engineering (LaSEINE)

La SEINE

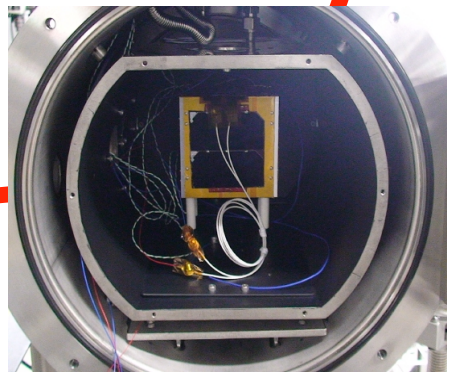
- Inauguration: December 2004
- 11 academic staff
- Partners
  - Space agencies
  - Space industries
  - Local small industries
  - International institutions

Electrostatic Discharge

Hypervelocity impact



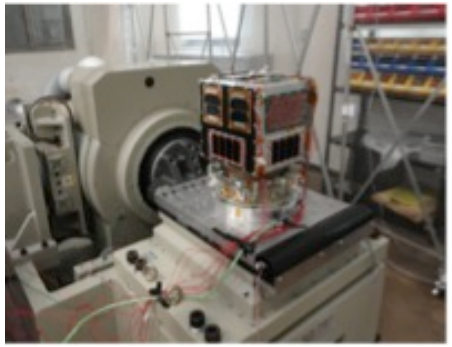
Material degradation



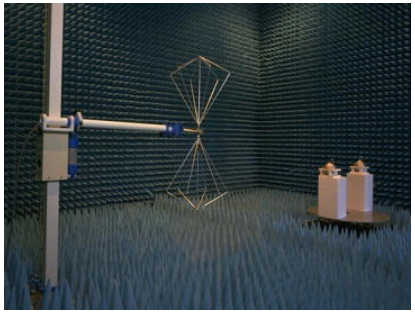
Nanosatellite environment test

Center for Nanosatellite Testing (CeNT)

- Capable of all tests up to satellite size 50cm, satellite mass 50kg



Vibration

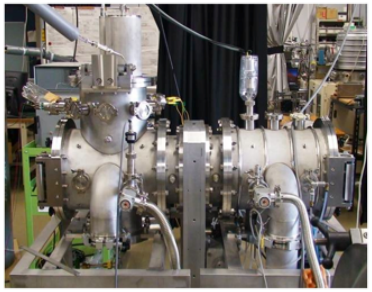


EMC & Antenna pattern

Pressure & Leak

Thermal vacuum

Assembly & Integration



Vacuum thermal shock

Thermal cycle

Shock

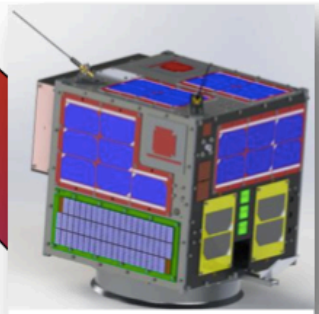
Outgas (ASTM E595)

α&ε measurement

HORYU Series Legacy at Kyutech

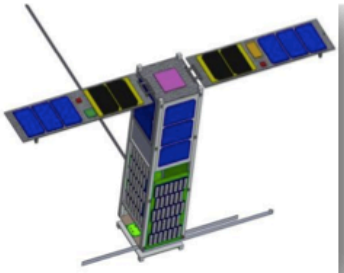
- HORYU Series
  - HORYU-I to HORYU-V
  - 1U, 3U, 9U
  - To do experiment in "real" space environment

October 2013~



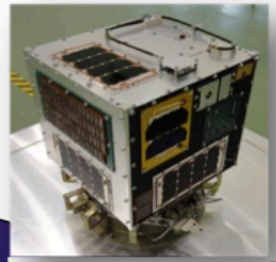
HORYU-IV

April 2013 to May 2014



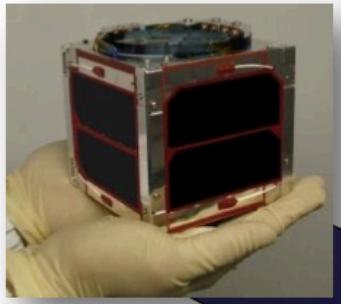
HORYU-III
(3U, EM)

2010~2012



HORYU-II
Launched on May
18, 2012

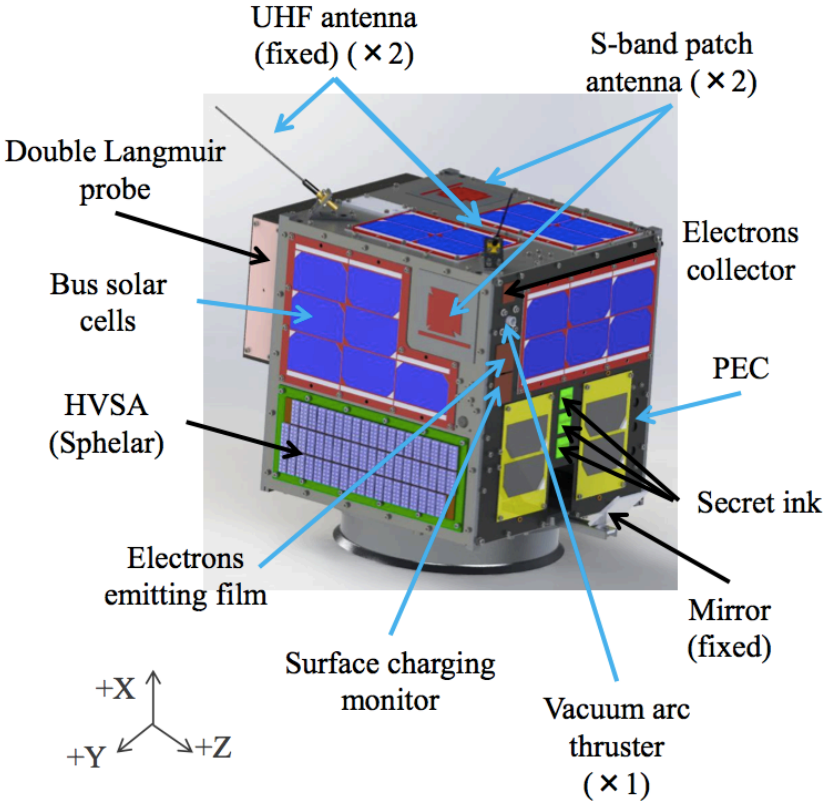
2006~2009



HORYU-I
(1U, FM)

HORYU-IV project:
Arc Event Generator and Investigation Satellite (AEGIS)

HORYU-IV external configuration +X+Y+Z



AEGIS
HORYU-IV

- Primary mission objectives:
  - 300V photovoltaic power generation
  - Capture discharge current waveform
  - Capture images of arcs occurring

- 40cm x 30cm x 40 cm
- 10 kg
- 575 km orbit (tentative)
- Launch anticipated ~2015-2016

Space Engineering International Cource (SEIC)

- Post-graduate degree curriculum in Space Engineering
  - 2 year Masters degree; 3 year Doctorate degree

- SEIC curriculum 4 major components
  1. Research toward a Master or Doctoral degree
  2. On-the-job training in space environment testing
  3. Project-based learning through a space project
  4. Lectures in English on space engineering

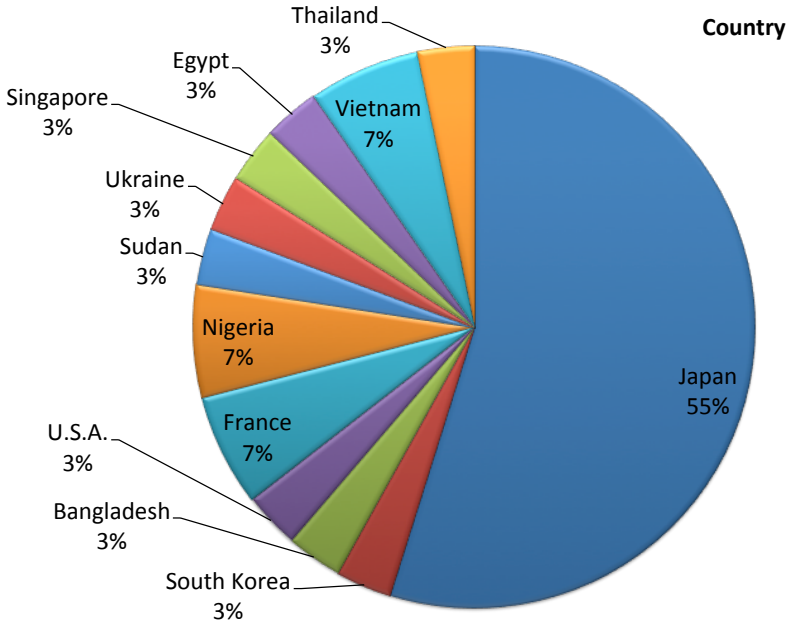
	Japanese	Foreign	All
Masters	14	12	26
Doctoral	2	8	10
Total	16	20	36

SEIC enrollment as of October 2014

Project-Based Learning (PBL)

- "Learning by doing"
- Solve open-ended real-world problem or challenge
- Critical thinking, collaboration, communication
- Examples at Kyutech
  - PBL course on nanosatellite development (team will apply to MIC3)
  - HORYU-IV

PBL students at lecture



HORYU-IV project team by country

UN/Japan Long-term Fellowship Programme

- 2009: Presentation of UN Basic Space Technology Initiative (BSTI) at 27th International Symposium on Space Technology and Sciences, Tsukuba, Japan
- 2009: Kyutech and UNOOSA begin developing fellowship programme

- 2010: Doctor on Nano-Satellite Technologies (DNST) initiated at Kyutech
  - 2 Doctoral students selected per year
  - Kyutech provides financial support

- 2013 onward: Post-graduate study on Nano-Satellite Technologies (PNST)
  - 2 Masters students selected per year
  - 4 Doctoral students selected per year
  - MEXT (Japanese government) fellowship support

Objective: Provide hands-on experience necessary to build capabilities in basic space technology, especially infrastructure building through research and testing of nano-satellites

DNST/PNST program growth

	2011	2012	2013	2014
Number of countries	18	25	28	55
Number of applicants	36	39	83	509 (registered) 120 (submitted)
Doctor enrolled	2	2	3	4
Master enrolled			2	2
Countries represented	Egypt Mongolia	Nigeria Thailand	Egypt Romania Singapore Sudan Ukraine	Algeria Colombia Indonesia Mongolia Philippines Ukraine

Selected candidates native to these countries

How to Apply?

- Application package: http://www.unoosa.org/oosa/en/SAP/bsti/fellowship.html

  or

- Google: "BSTI Fellowship"

The application deadline is January 12, 2015

For further details, please contact

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cho@ele.kyutech.ac.jp (Kyutech)

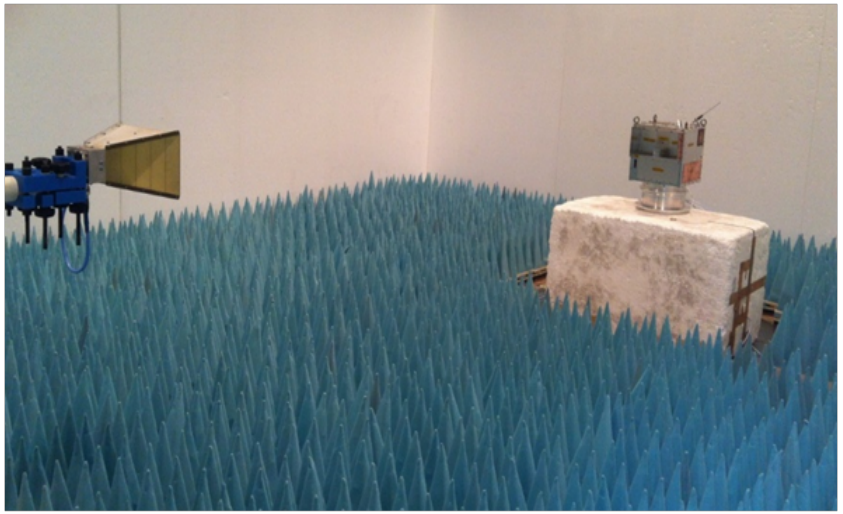
werner.balogh@unoosa.org (UN)

Collaboration Opportunities with Kyutech

- Joint research
- Human resource development
- Staff training
- Nanosatellite test services

Joint Research

1. Space environment research: Ground-based or Space-based
   a. Charging and ESD
   b. Hypervelocity impacts
   c. Material degradation
   d. Others



HORYU-IV antenna pattern testing

2. Satellite testing: Based on NETS ISO project
   a. Small-scale satellite test standard and handbook
   b. Certification small satellite components and products
   c. Others

Human Resource Development

1. Short-term
   a. Staff exchange
   b. Student exchange (internships)

2. Long-term
   a. PNST applicants for Ms and PhD
   b. "1-for-1" agreements
   c. Double-degree program (very long term)

Kyutech PNST students

PNST: http://www.unoosa.org/oosa/en/SAP/bsti/fellowship.html

Staff Training

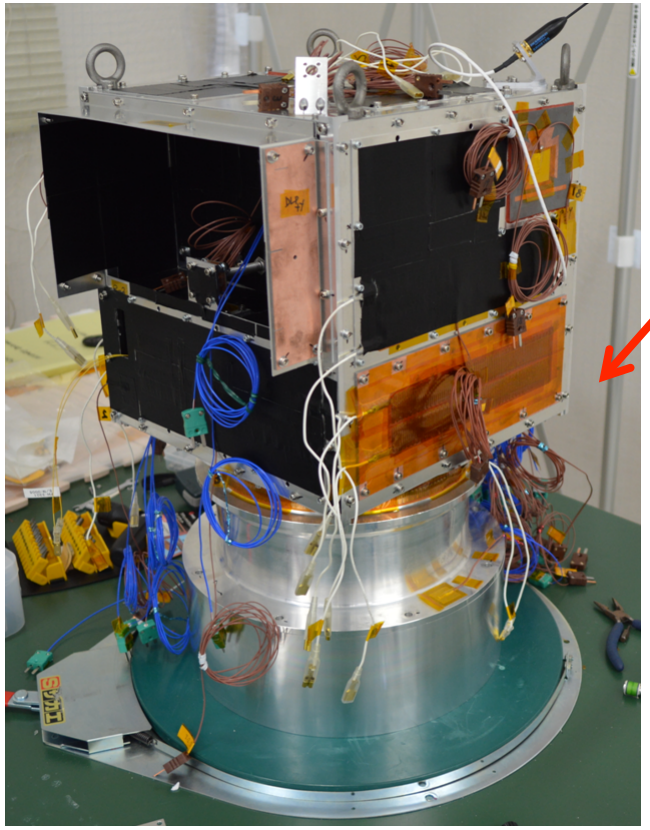
1. Weekly or monthly
   a. Staff/engineers come to Kyutech
   b. Dedicated training with dummy satellite
   c. Fixed training cost for ~1-10 people
   d. Transportation/living cost not included

2. Satellite Testing Tutorial
   a. November 15 to 16, 2014
   b. Cost ~$800 USD
   c. Co-located conferences: Standardization Workshop and UNISEC Global

Additional information:
http://www.unisec-global.org/

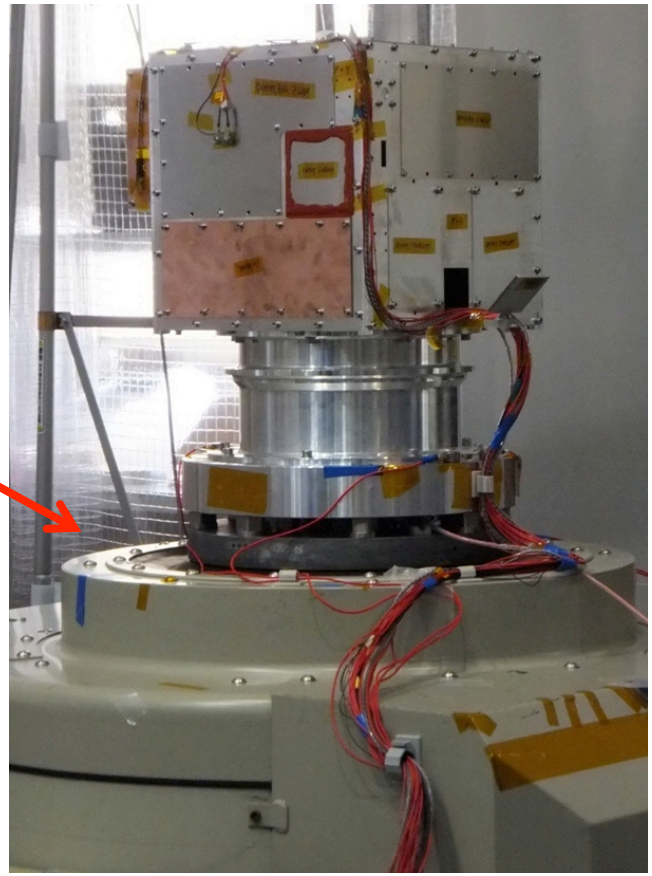
Nanosatellite Test Services

- Itemized or comprehensive services (may include launch opportunities)
- Contact Dr. Polansky for full price list: polansky.john260@mail.kyutech.jp



Thermal balance

Vibration



Questions?

For further details, please contact

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