Capacity Building for Satellite Technology through UN/JAPAN Long-Term Fellowship Programme

Mengu Cho
Laboratory of Spacecraft Environment Interaction Engineering
Kyushu Institute of Technology
Kitakyushu, Japan

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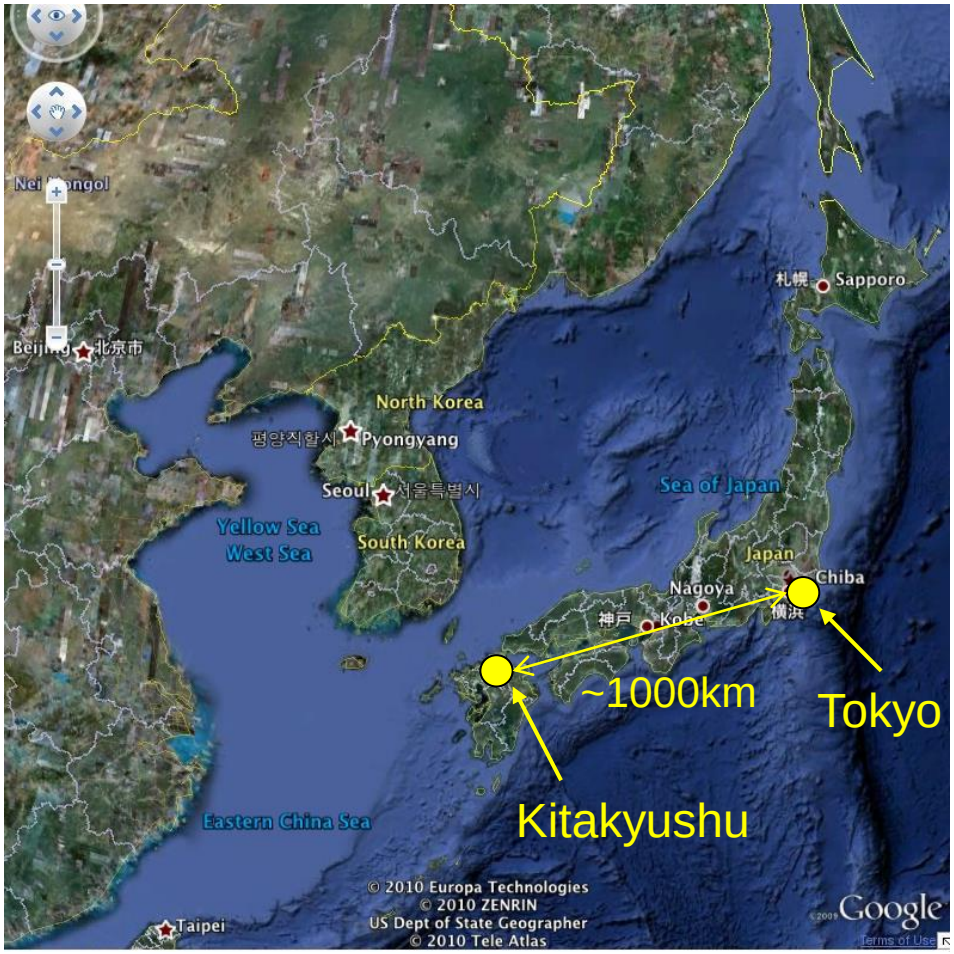
Kyushu Institute of Technology (Kyutech)

- A national university founded in 1909
  - 4,200 Undergraduate students
  - 1,300 Graduate students
  - 360 Faculty members
  - Engineering, Computer science, Life-science
- Located in the Kitakyushu region
  - Population of more than 1million



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Space Engineering Research and Educations at Kyutech

- Space Engineering Education at Tobata Campus since 1993
  - Undergraduate (30 students/class) and graduate levels
- Laboratory of Spacecraft Environmental Interaction Engineering
  - Established in 2004
- Center for Nanosatellite Testing
  - Established in 2010

- Member of International Astronautical Federation (IAF) since 2011
- Department of Space Systems Engineering from April, 2018

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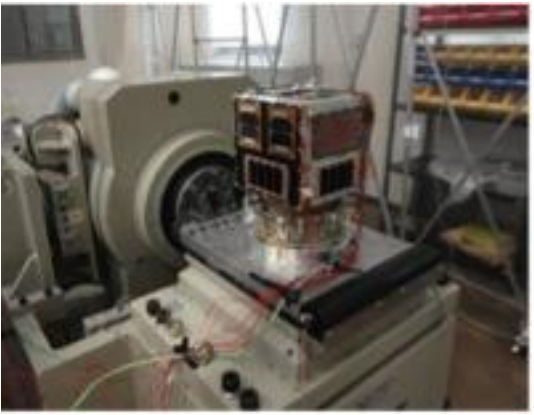
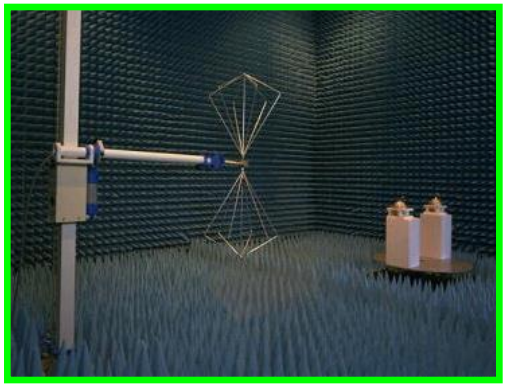
Center for Nanosatellite Testing

To be capable of doing all the tests for a satellite up to 50cm, 50kg



Vibration

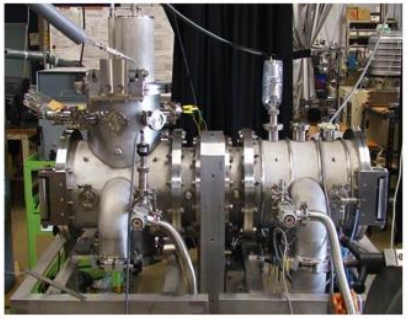


EMC & Antenna pattern

Pressure & Leak

Thermal vacuum

Assembly & Integration



Thermal vacuum

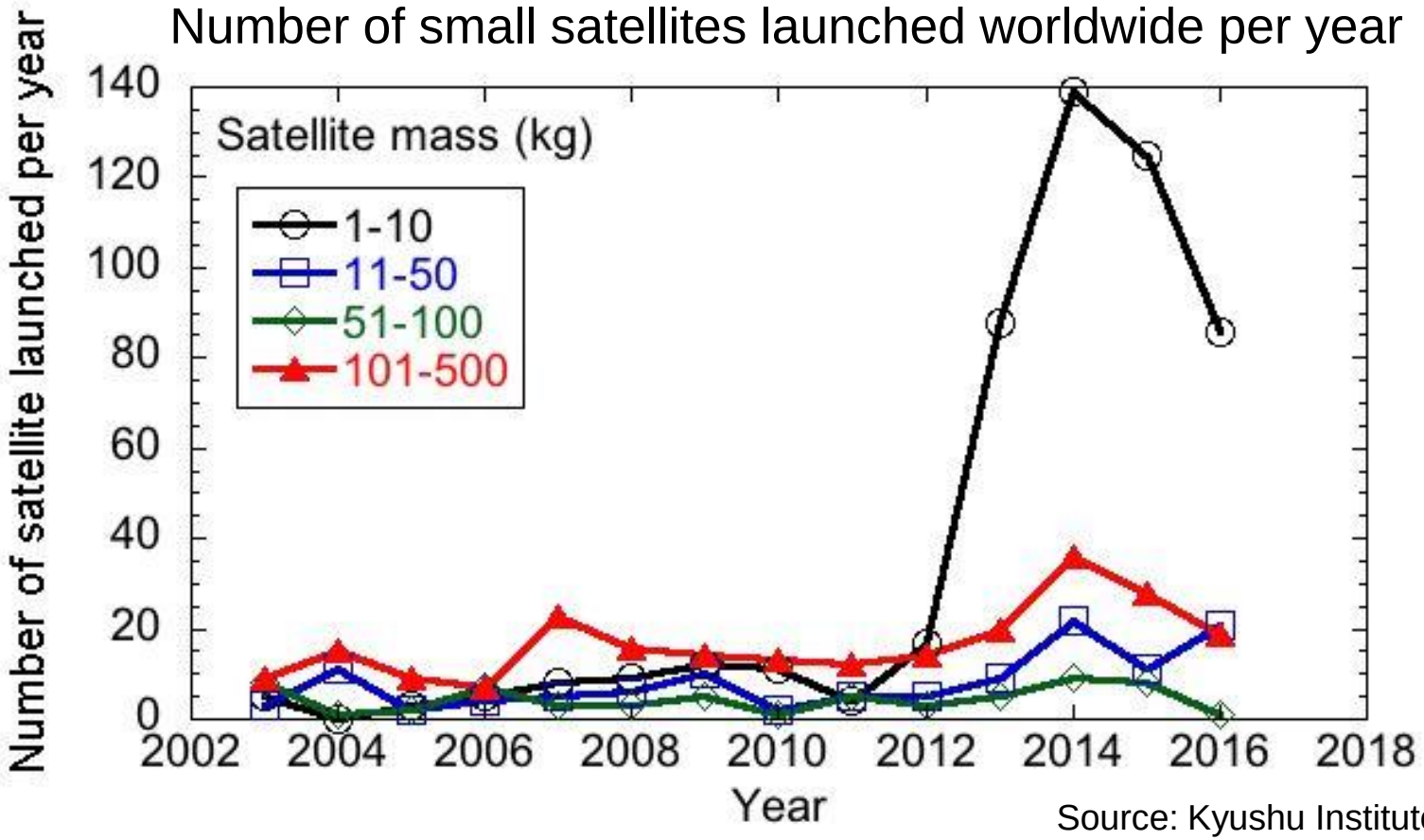
Thermal cycle

Shock

Outgas
(ASTM E595)

α&ε measurement

Background



Source: Kyushu Institute of Technology

- Satellites affordable even to universities, small business, developing/emerging countries
- Interest in capabilities for basic space technology development

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Needs of Long-term Fellowship for Capacity Building

- Reading books or attending lectures can not make a satellite
- Experience the complete cycle of designing, building, testing and operating
  - Learn through the failures during the tests and the efforts necessary to correct the defects
- Long-term fellowship to support students studying abroad and gaining experience through *on-the-job training (OJT)*
- Learn to *think and be innovative*
  - Participate in a satellite project *as a team member not as a guest*
  - Experience necessary to *build a facility from scratch* in home country
  - University-like environment is more suitable than well-prepared comfortable institutions, such as space agencies or industries

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

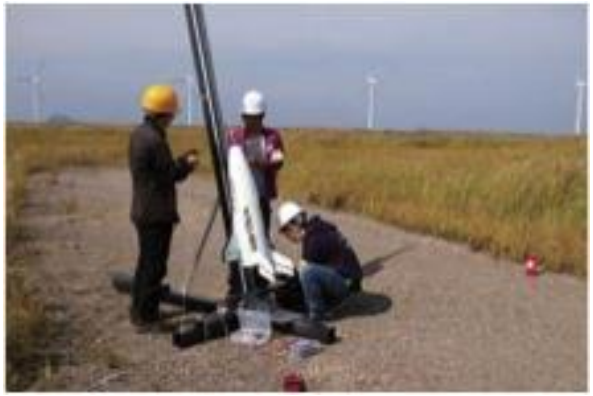
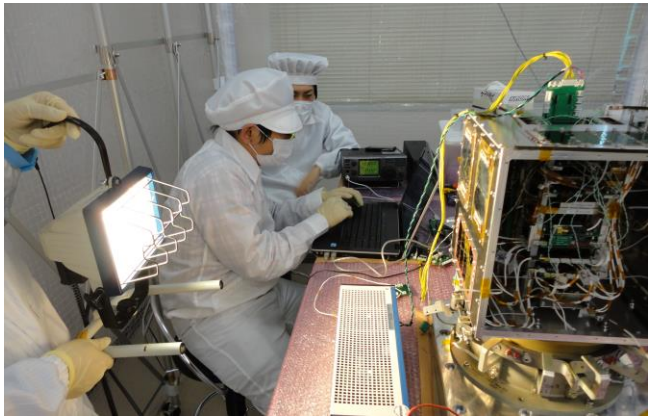
- 2013: **Post-graduate study on Nano-Satellite Technologies (PNST)** initiated
  - 2 Masters students selected per year
  - 4 Doctoral students selected per year
  - MEXT (Japanese government) fellowship support

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

Space Engineering International Course (SEIC)

- Started in April 2013 at Graduate School of Engineering, Kyutech to support PNST

1. Research toward a Master or Doctoral degree
2. On-the-job training such as space environment testing workshop
3. Project Based Learning (PBL) through a space project
4. Space-related lectures in English
   - Not only engineering, but also space policy and others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PNST/SEIC students

Fiscal Year	PNST				Non-PNST enrollment to SEIC	Foreign students enrollment total	Japanese students enrollment
	Application			PNST Enrollment			
	Number of countries	Web registration	Application documents submitted				
2013	28		83	5	4	9	10
2014	55	509	69	6	4	10	5
2015	44	156	45	6	17	23	9
2016	52	386	71	6	10	16	10
2017	98	1439	128	6*	7*	13*	11
Total				29	42	71	45

* To be expected in October 2017

71 foreign students enrolled in 5 years

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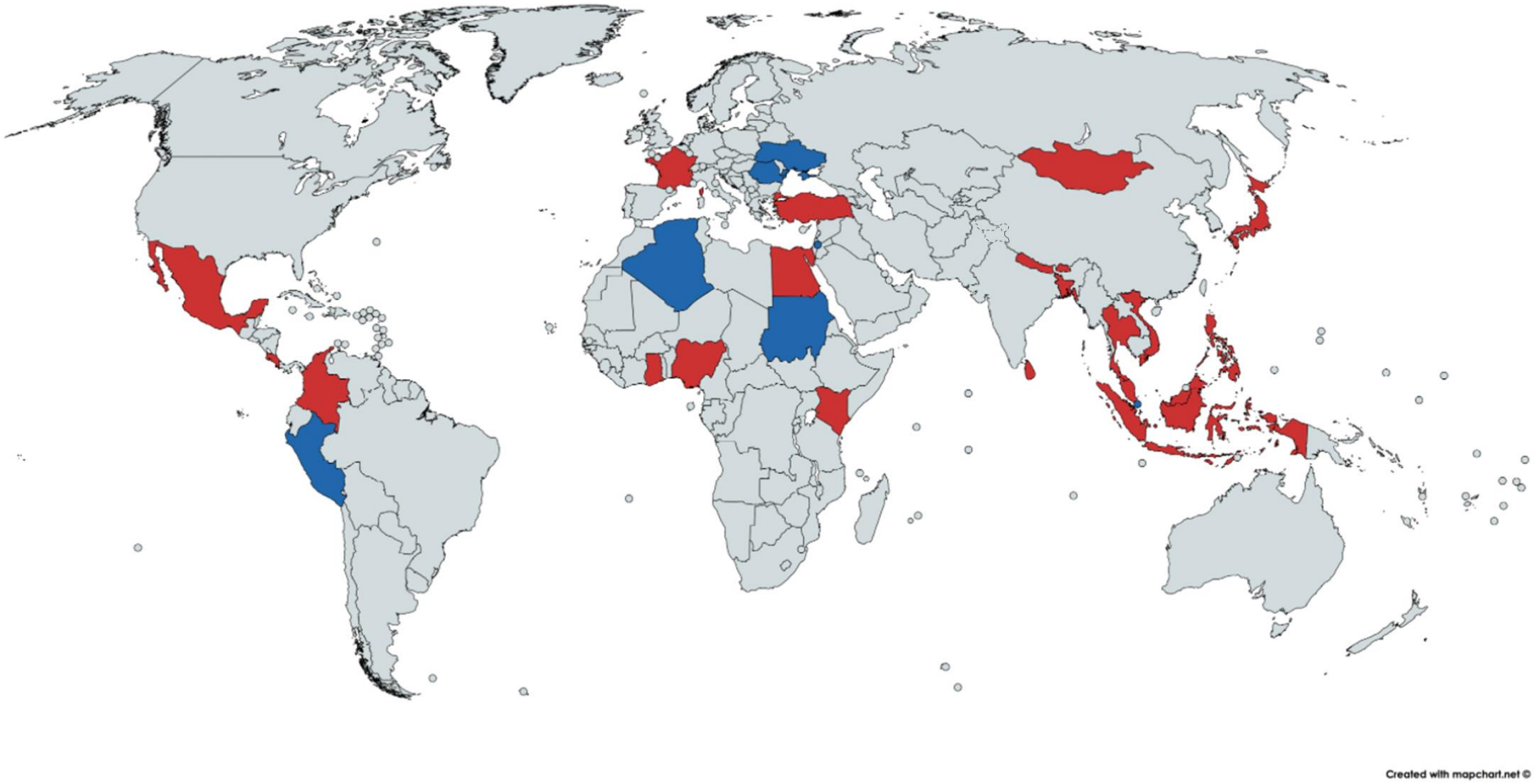
PNST/SEIC Student Composition



Graduated

Current (as of October 2017)

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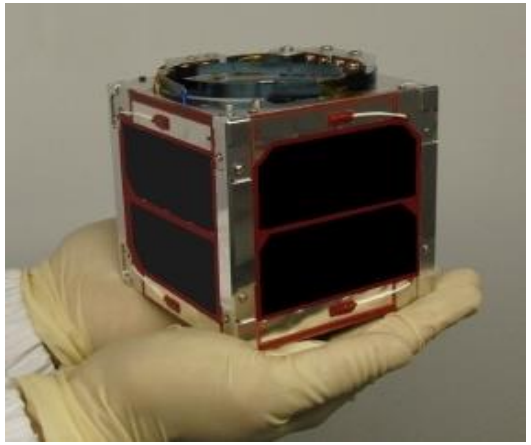
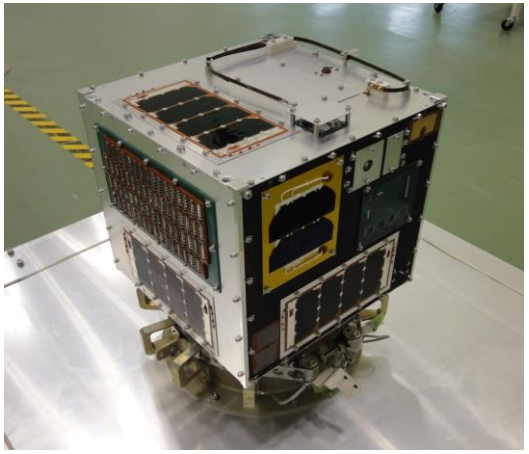
Kyutech Satellite Heritage

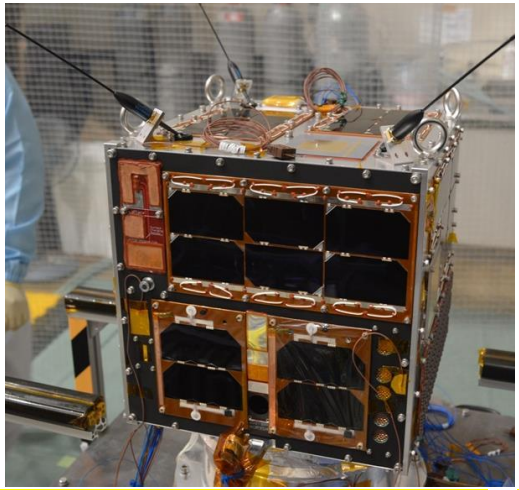


HORYU-1 (1U)
2006-2010
Not launched

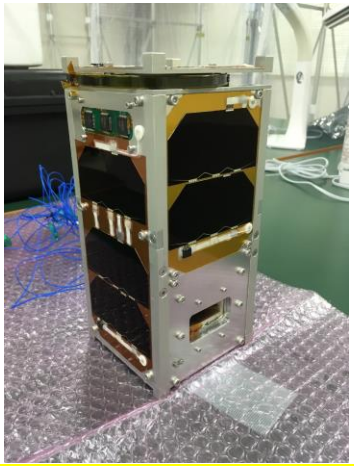


HORYU-II (30cmx30cmx30cm)
2010-2012
Launched on May 18, 2012

Shinen-2
2013-2014
Launched on December 3, 2014

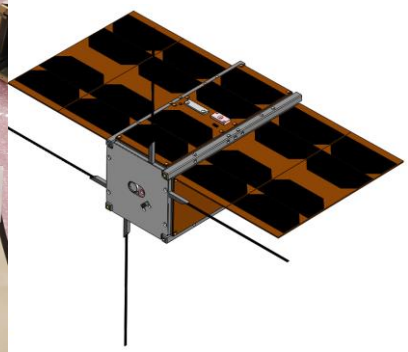


HORYU-IV
2013-2016
Launched on Feb. 17, 2016



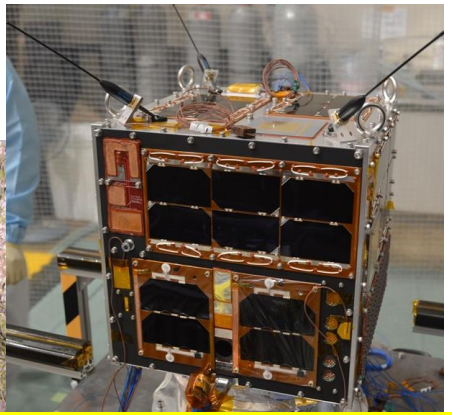
AOBA VELOX-III
2014-2016
ISS release on Jan. 19, 2017

BIRDS constellation
2015-2017
Launched on June 4, 2017



AOBA VELOX IV
2016-
To be launched in 2018

HORYU-IV Project



Launched on Feb. 17, 2016

44 members from 18 countries

First and second generations of PNST/SEIC students

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BIRDS Program

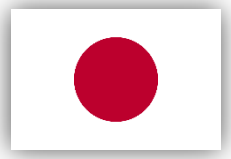
Satellite program for non-space faring countries.

Mission Statement

By successfully building and operating the first national satellite, make the foremost step toward indigenous space program at each nation.

BIRDS-I (2015-2017)

JAPAN



GHANA

MONGOLIA

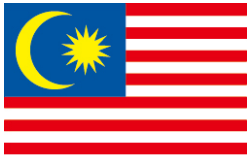
NIGERIA

BANGLADESH

BIRDS-II (2016-2018)

Bhutan

Malaysia



Philippine

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BIRDS-I Project

- 1U CubeSat constellation of 5 satellites by **Bangladesh*, Ghana***, Japan, **Mongolia***, and Nigeria

** First national satellite*

- Made by students at Kyutech
- 2 years from concept design to disposal
- Earth observation, Outreach, Space environment measurement

BIRDS-I team with flight model

Launched successfully to ISS on June 4!

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To be released from ISS in early July. Live broadcast available at https://www.youtube.com/watch?v=sP5YZi5usHc

The BIRDS Program – Key Traits

- Kick-off to On-orbit operation must be under 2 years (to fit into the two-year program of a Master's degree)
- Very low-cost launch (via International Space Station)
- The students come up with a common design
- With the common design, each national team builds their own CubeSat
- Their respective home universities install and operate a BIRDS ground station
- BIRDS-2 project (Bhutan, Malaysia, Philippine) follows BIRDS-1 project one year behind, to transfer the know-hows and lessons
  - BIRDS-3 will start from fall 2017

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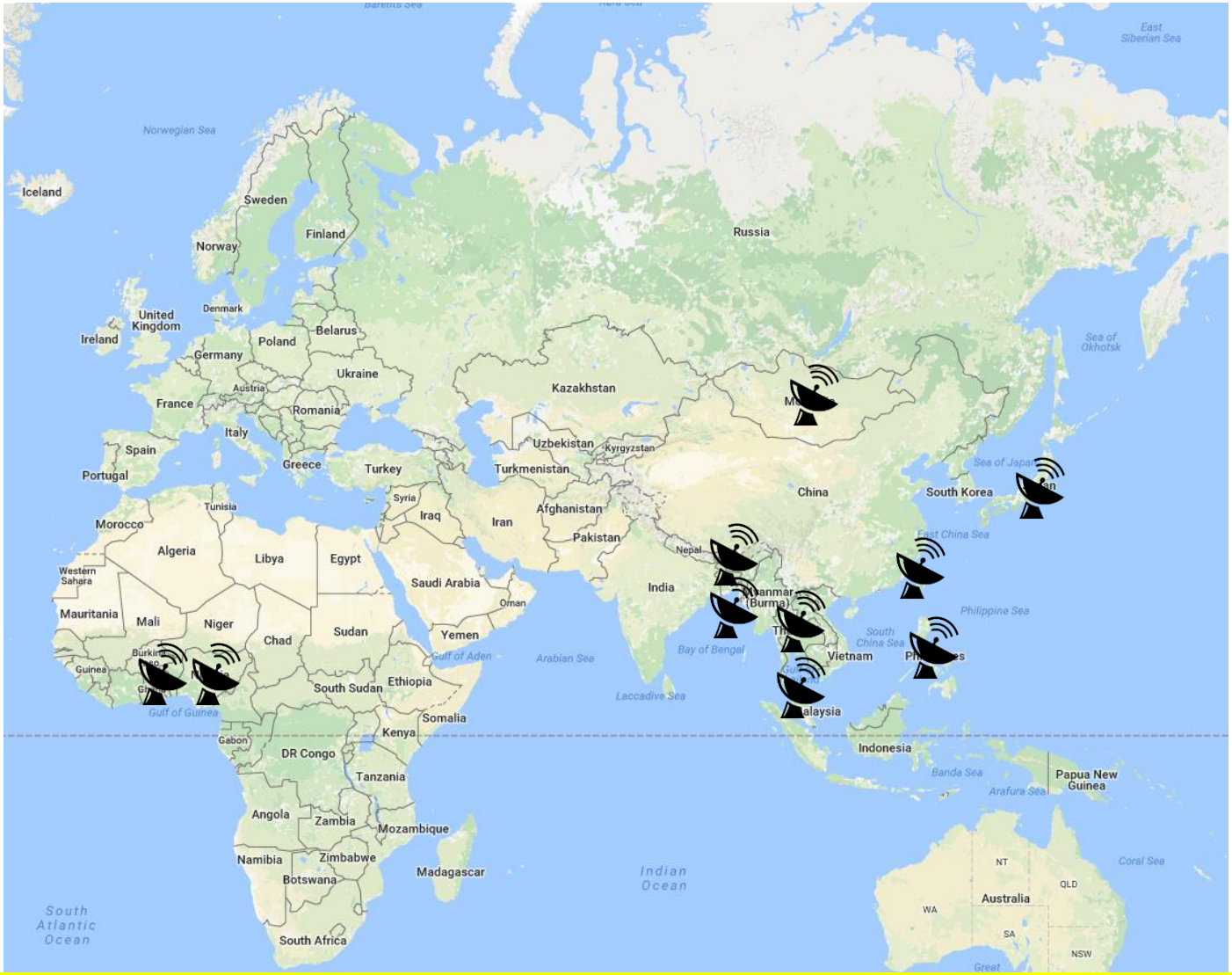
BIRDS Ground Station Network



Backbone of future joint space missions among BIRDS countries

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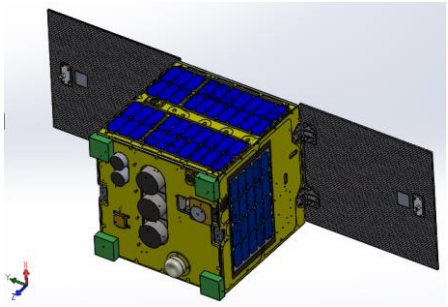
Other capacity building projects at Kyutech

Assist Costa Rican first satellite Irazu for launch (ISS) and testing
Three Costa Rican students at Kyutech (Two by PNST)



MicroDragon

Assist Vietnamese first 50kg-class satellite
Six Vietnamese students at Kyutech since 2013

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PNST/SEIC contribution

- PNST fellowship programme is a successful example of Basic Space Technology Initiative (BSTI), implemented by UNOOSA under the UN Programme on Space Applications
- PNST/SEIC provided a unique opportunity to students from non-space faring countries to have real experience of satellite development
  - One cannot build a satellite by reading books
  - Thanks to ISS CubeSat release by JAXA, students can experience from mission definition to operation in two years
- Return experienced and enthusiastic engineers to their home countries to initiate indigenous space program
- Human and ground station network (i.e. BIRDS network) will serve as backbone to support infant space programs through international collaboration

Conclusion – what we hope to achieve

- Enable more nations to become space-faring countries – to promote the peaceful and innovative use of outer space for the benefit of humanity with the participation of a larger number of countries
- The first essential step is **Capacity Building for Satellite Technology**
  - Countries need engineers who understand what a satellite can do and how to make and operate it
  - **Thematic Priority 7 of UNISPACE+50**
- Kyutech wishes to continue supporting the UN activity on Capacity Building for Satellite Technology in collaboration with Japanese government

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Contact Info:
Mengu Cho, cho@ele.kyutech.ac.jp