The First Kenya University NanoSatellite 1KUNS-PF: capacity building using the KiboCube launch opportunity

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United Nations / Austria Symposium
Access to Space: Holistic Capacity Building for the 21st Century
Graz, 3-7 September, 2017

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  Build capacity in space mission design and management
- **The framework:**

  ASI – Sapienza Agreement for the Broglio Space Centre (BSC)
- **The main Tool:**

  The University satellite1KUNS, built in cooperation between University on Nairobi and Sapienza, in the Joint Postgraduate Course in "Space Mission Design and Management"

  1KUNS (First Kenya University Nano Satellite)
- **The International support by UNOOSA and JAXA**

  The Kibo-Cube program
- **Conclusions**

Capacity Building

Capacity for the 2030 Agenda

"To develop capacities to enhance global decision-making and to support country level action for shaping a better future."

(UN Institute for Training And Research)

Space Capacity of Kenya

The Kenya Space Agency

"I am happy to announce the establishment of the youngest Space Agency in the World.

The Kenya Space Agency (KSA) was established on the 7th March, 2017.

The establishment of the KSA did not mark the start of Space

RCMRD

Kenya hosts the Regional Centre for Mapping of Resources for Development (RCMRD). The centre assists member countries in capacity development for space applications. The centre works closely with ESA, NASA, etc.

Space Capacity of Kenya

The DRSRS

The Department of Resource Surveys and Remote Sensing (DRSRS) has so far provided for all remote sensing needs of the country. This function now shifts to KSA.

ARMC

Kenya is a member of the African Resource and Environment Management Satellite Constellation (ARMC) Initiative.

This initiative that aims at mapping Africa for Africa, was first agreed between the four countries namely; Algeria, Kenya, Nigeria and South Africa.

The Initiative is free for joining by all African countries.

Space Capacity of Kenya

African Space Agency

The future for Africa is certainly the establishment of the African Space Agency. The African Space Policy and Strategy has been developed.

Training

The future of the Kenya Space Programme will depend on how well training is managed.

The Programme will rely heavily on the following:

- Training provision in the Italy-Kenya Agreement
- Programmes at our Institutions in Kenya
- UNOOSA
- Other International Collaboration

The objective: Build capacity in Kenya in space mission design and management

- Skills in space mission design and management can only be gained in a **"learning by doing"** perspective, **using "hands-on" education.**
- The traditional approach to capacity building in developing countries is mainly based on fellowships granted to single selected students, to attend Courses and/or obtain a Degree in industrialized countries
- In this way the gained know-how is spread in several **"isolated" skilled individuals**
- **The challenge:**

How do we set up a process locally, so that the capacity is maintained and kept at an Institution level and not merely at the individuals level.

Motivation and origin of the University of Nairobi-ASI-Sapienza Agreement

- Kenya's participation in the utilization of space has a long history starting in 1962 when an agreement betwen the University of Nairobi (Formally Royal Technical College) and University of Rome "La Sapienza" were signed for using Kenyan territorial waters at Malindi to build the San Marco satellite launch platform and base camp for ground stations.

University of Nairobi-Sapienza Cooperation

- Between 1962 and 1987, 27 satellites were successfully placed in orbit. The ground stations at the Malindi base camp (renamed Broglio Space Centre) are currently operated by Italian Space Agency (ASI).

- In an MOU dated 20 June 2002 the University of Nairobi and University of Rome, Sapienza, established a Memorandum of Understading (MOU) to collaborate in education and research activities of common interest, including cooperation in the utilization of space resources and exchange of both students and faculty staff.

University of Nairobi-Sapienza Cooperation

- However, during the life of these agreements, **there has been limited progress in using these agreements to build local capacity and skills for Kenyans to fully participate in harnessing space resources**.

- To start addressing this gap, the University of Nairobi has renewed the partnership with University of Rome in July 2015, with **a new focus on cooperation to build local capacity** and skills to design and operate space missions for peaceful use of space resources.

- The whole activity is supported by the Italian Space Agency (ASI) **in the framework of the ASI-Sapienza Agreement for the BSC.**

The framework: ASI – Sapienza Agreement for the Broglio Space Centre (BSC)

The Italian Space Agency and the University of Rome "La Sapienza" signed an Agreement in 2013:

1) ASI holds the management of BSC and assumes the use of all the assets in the Centre (facilities, systems and equipment of both ASI and Sapienza).

2) ASI coordinates the research and training activities referred to the Additional Protocols of the Italy/Kenya Intergovernmental Agreement

3) ASI is committed to involve Sapienza in these activities

4) The involvement of Kenya Universities and Research Institutions will be encouraged

The ASI-Sapienza Meetings with Kenya Universities

Joint conferences are organized on a yearly basis to share research findings, management and utilization of space resources, with participants from:

- Kenya Universities and research institutions
- National Space Secretariat of Kenya
- University of Rome, Sapienza
- Italian Space Agency

The **First ASI-Sapienza Meeting with Kenya Universities** was held at University of Nairobi, January 27th 2015

The **Second ASI-Sapienza Meeting with Kenya Universities** was held at University of Nairobi, January 26th 2016

A **Third ASI-Sapienza Meeting with Kenya Universities**, might be held in 2018

The second ASI-Sapienza meeting with Kenya Universities
University of Nairobi – 26th January 2016

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The main Tool:
the joint Postgraduate Course in "Space mission design and management"

Bearing in mind the question on how we can set up a process to build capacity locally, we decided to establish a **joint Postgraduate Course in "Space Mission Design and Management"**, with these main objectives:

- **Make the process Institutional, not individual**
- **Make the process "active" locally.**
- **Not just "transfer" know-how, but "build" know-how locally**

To achieve these goals, not only students, but **Professors** at University of Nairobi and experts form Kenya Space Agency **are directly involved** in **designing and setting a higher education program** together with professors from Sapienza and experts form ASI.

This course is "tailor-made" in the spirit of the Italy-Kenya Agreement

Organization and target students

By analyzing “possible” forms of cooperation institutionally recognized according to the Regulations of Sapienza and University of Nairobi, we agreed that the only possible form was:

Joint International Postgraduate Course (Diploma)

In this form of collaboration:

- Students **MUST attend al least 30% of the credits in the partner university**
- **Professors in both Universities are Active in making decisions and giving classes**

The way the Course is organized, the practical and interdisciplinary approach to space applications makes the **Course well suited for students with a BSc Degree**

The space missions:
focus the Course on space applications, mainly research programs of the ASI-Sapienza Agreement

- The Postgraduate Course is coherent with the research granted by ASI in the framework of ASI-Sapienza Agreement.
- Aim: **translate the research activity** in which the Kenya institutions are active **into education and prepare professional skilled in these fields**.

Research programs in the framework of the ASI-Sapienza Agreement are:

- **IKUNS** (Italy-Kenya University Satellite)
- **SBAM** (Satellite-Based Agricultural Monitoring)
- **EQUO** (EQUatorial Space Debris Observatory)
- **OSL** (Outer Space Law)
- **DAKTARI** (Digital Aids Kenya Telemedicine A Revival Italian)
- **RISC** (Remote Informative System for integrated Coastal management)

The application tool: desing, build, and deploy a "real" space mission in ONE YEAR – The Cubesat

Learning the space mission process, not the details

(international organization, technical and managerial aspects of space mission, timeline of events, implementation of space standards)

The right tool for this is the **UNIVERSITY SATELLITE** concept

(Bob Twiggs, Stanford University, 1996)

- It is a **funcional spacecraft**, rather than a payload instrument or component. it **must operate in space with its own independent means of communications and command**.
- **Untrained personnel** (i.e. students) performed a significant fraction of key design decisions, integration & testing, and flight operations.
- **The training of these people was as important as** (if not more important) **the nominal** "**mission**" of the spacecraft itself.

Small satellites for space education

Practical Training of **Whole Cycle of Space Mission Development**
Know <u>what is important</u> and what is not

- Mission conceptualization, satellite design, fabrication, ground test, preparation for launch and operation in orbit

- **Synthesis** (Not Analysis) of an effective system
- Feedback from the real world to evaluate design, test, etc.
- **<u>Interdisciplinary Approach, not strictly technical</u>**
- **<u>Importance of regulatory aspects</u>**

Education and experience of Project Management

- Four Managements: **time, human resources, cost and risk**
- **Team work**, conflict resolution
- Effective discussion, **documentation**
- **<u>International cooperation</u>**, negotiation, mutual understanding

Shinichi Nakasuka
Department of Aeronautics and Astronautics, University of Tokyo

1KUNS- First Kenya University NanoSatellite

- **The Italy-Kenya University Nano-Satellite (IKUNS)** program was established in September 2015, in a partnership between Sapienza and University of Nairobi, with the main goal of **designing, building and launching a "student-built" 6U Cubesat in a three year timeline**
- The opportunity to have a **"precursor flight"** for this mission was envisaged, by applying to the **UNOOSA/JAXA Announcement of Opportunities for 1U Cubesat Launch from the ISS Japanese Module "KiboCube"**.
- **The 1KUNS-PF (First Kenya University NanoSatellite-Precursor Flight)** was indeed selected. **Launch from the International Space Station in January 2018**

1st KUNS PF CubeSat Launch Opportunity

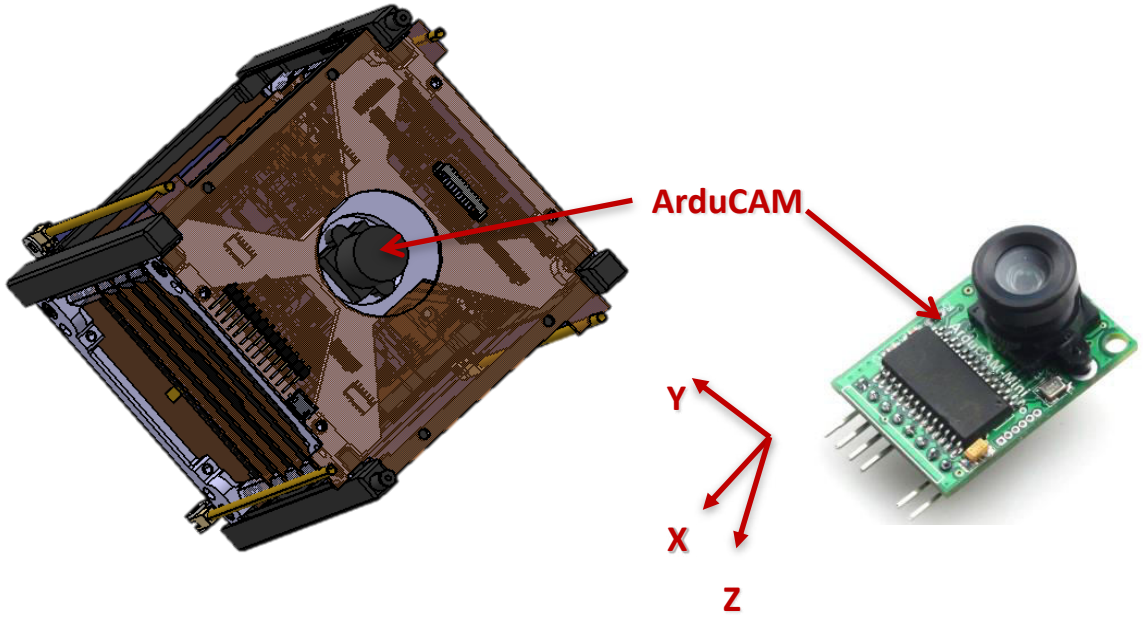
- The 1KUNS-PF team responded to the announcement of a launch opportunity through the **United Nations/Japan Cooperation Programme on Cubesat Deployment from the International Space Station (ISS) Japanese Experiment Module (Kibo) "KiboCUBE" deployed on ISS by Japan Aerospace Exploration Agency (JAXA)**

- The 1KUNS-PF team application was successful and by using **"KiboCUBE"**, the 1KUNS-PF will achieve successful deployment and the mission goals.

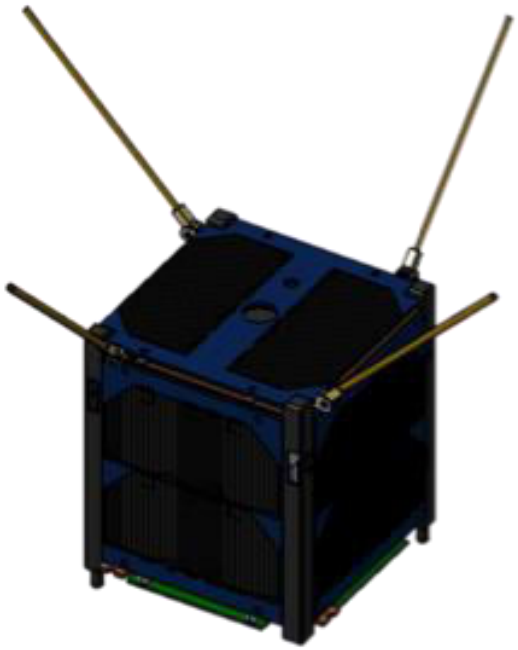
Japanese Experiment Module (JEM) deployed on ISS "KIBOCUBE"

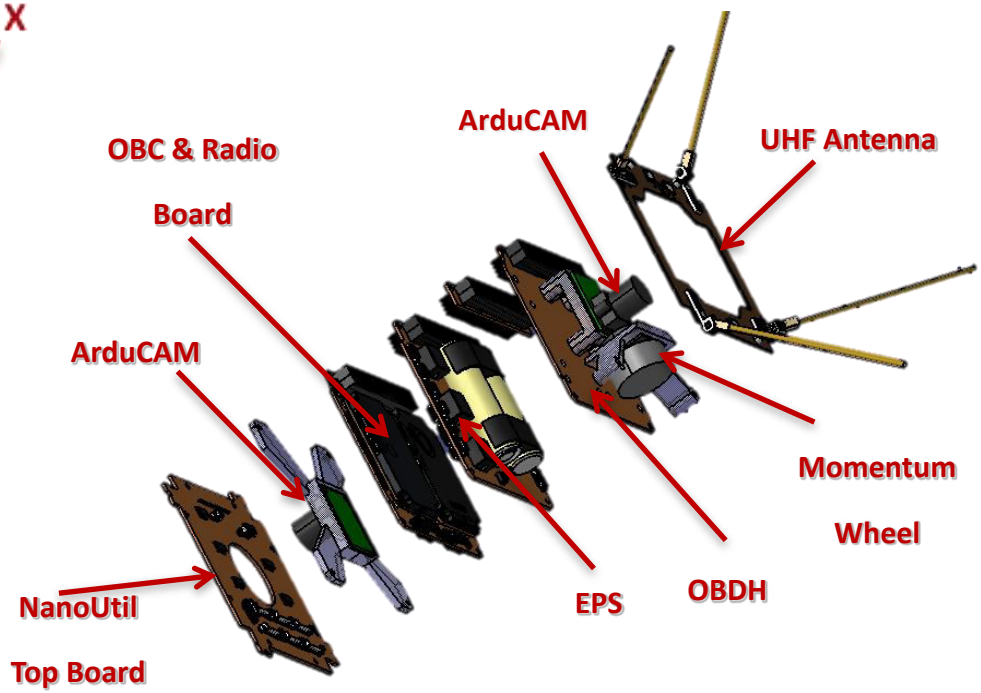
The mission goal:
Take low resolution pictures of the Earth

The student payload consists in two commercial cameras, located in opposite axes of the satellite.

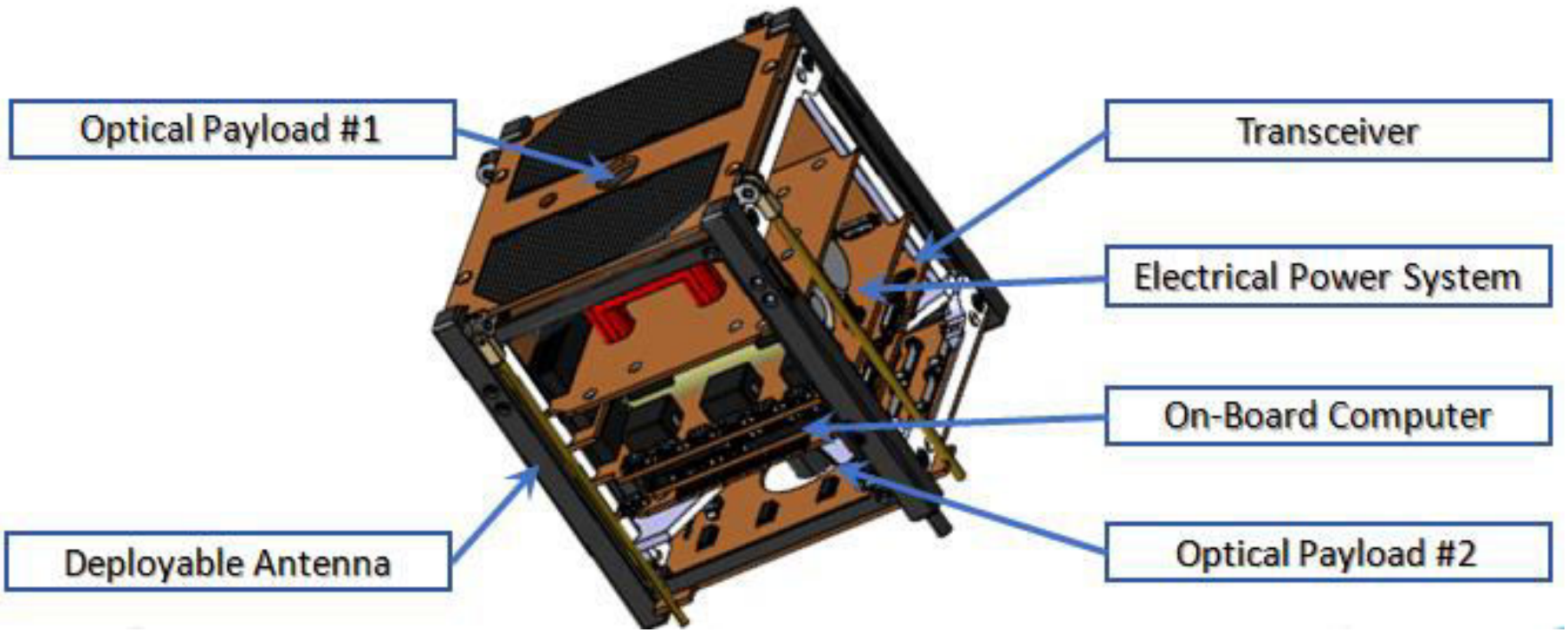


Satellite design

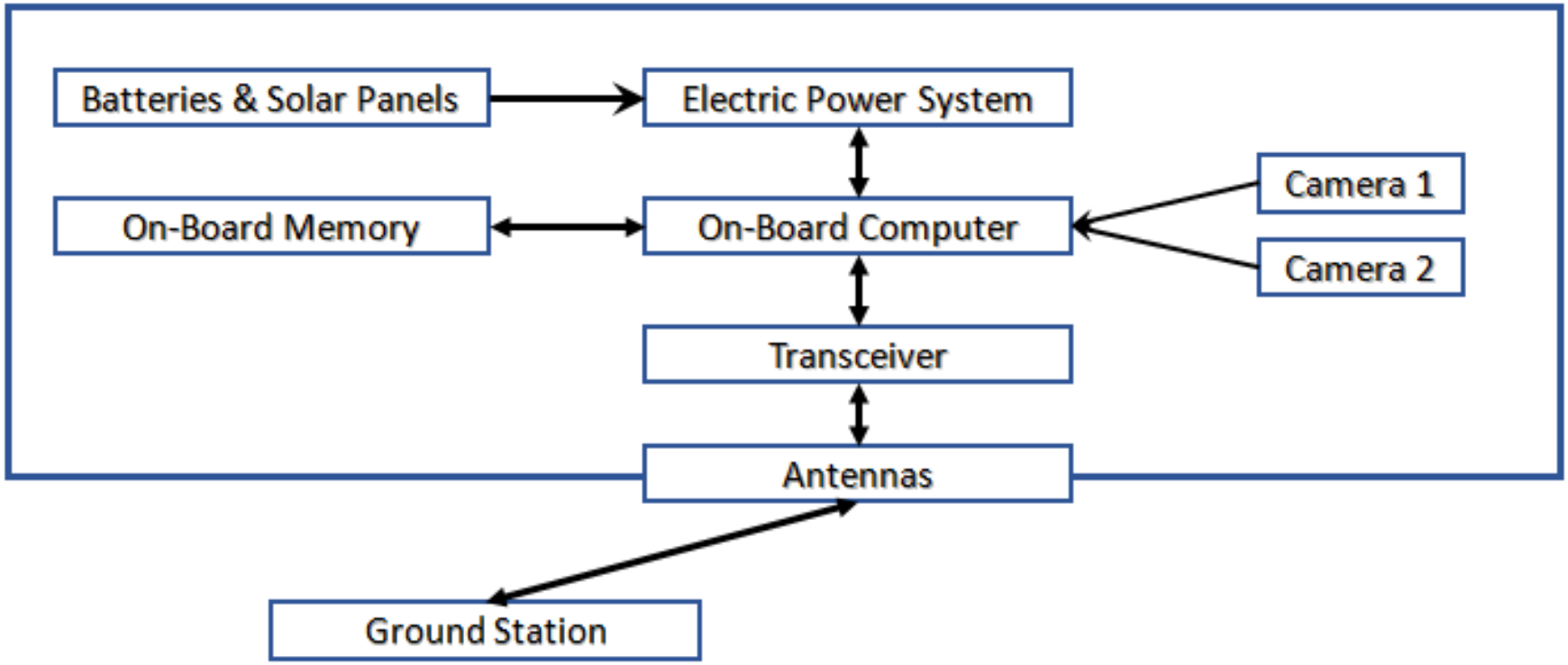




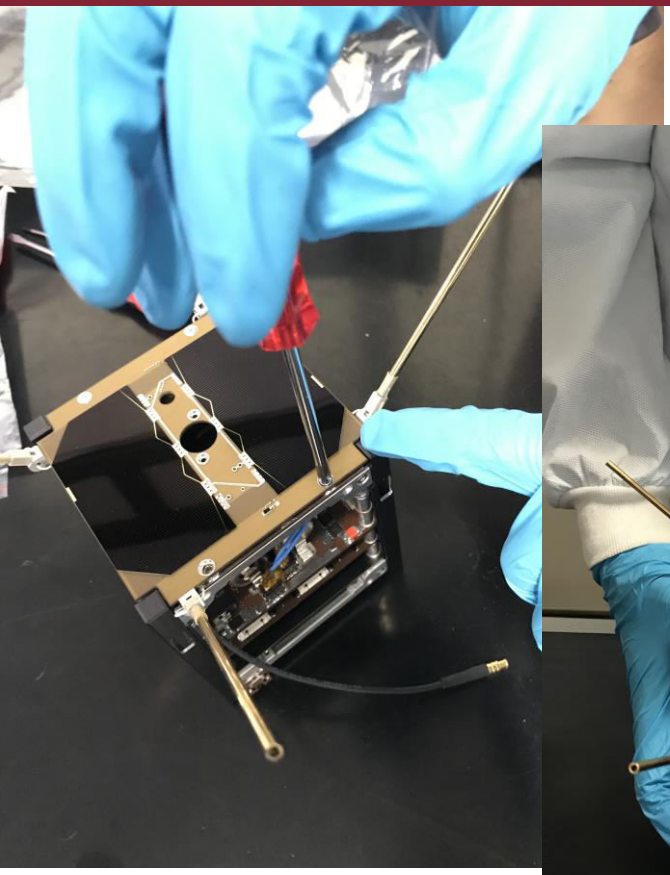
1KUNS Configuration

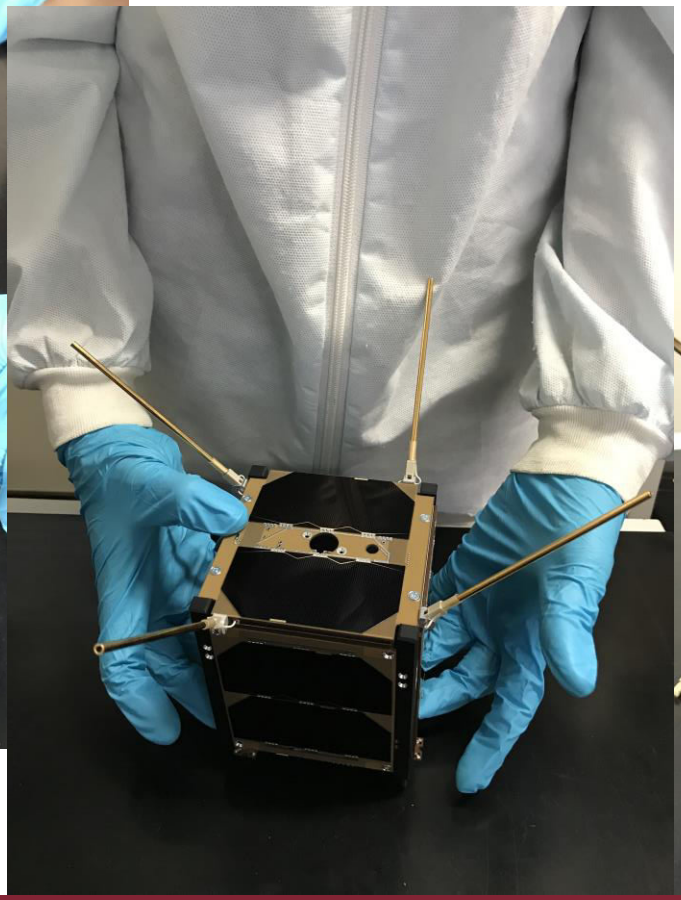


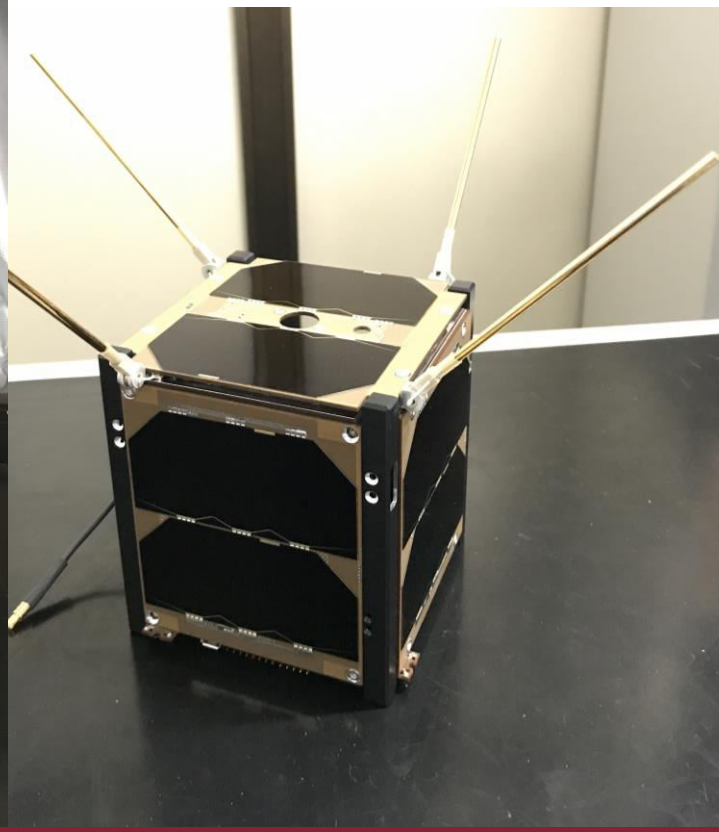
1KUNS System Architecture



Satellite manufacturing







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Sapienza and UoN Student's Joint Activites

- Radio Amateur Ground Station Installed at University of Nairobi
- Solar panel assembled at University of Nairobi

Meeting with JAXA in preparation for the launch on KiboCube

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URSA-MAIOR

First contact 23th June 2017, 10:37 am

Ground station at DIAEE (Roma-URBE)

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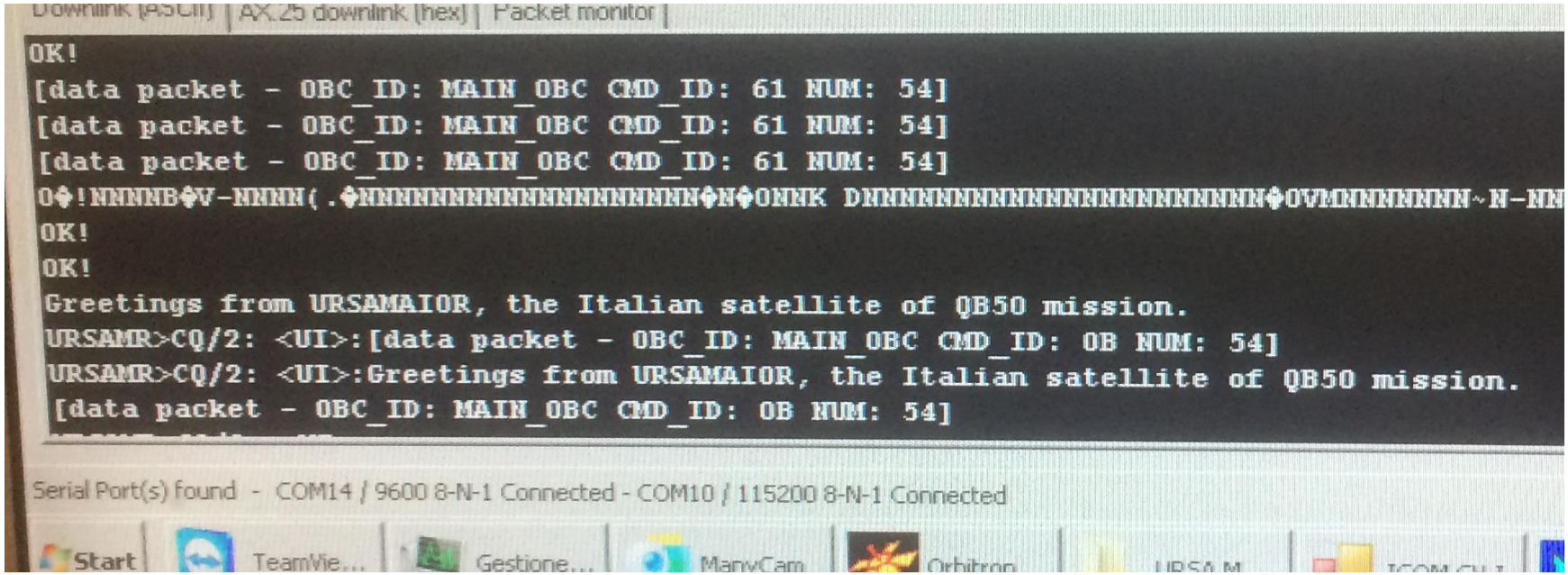
URSA-MAIOR
Beacon received, commissioning ongoing

- **Receiving the beacon**



- **Contacts reported from US and Radio Amateurs in Cesena (IT)**

A view of the future

- Maintain the Course regularly every year. Next Academic Year 2017/18 already in place
- Involve more students, not only from Engineering, focusing on the applications. **Student payload in telemedicine and coast observation under discussion**
- University satellites built together by Italian and Kenyan students:

2017: 1KUNS

2018: 2KUNS

:

20nn: nnKUNS

- **Exploit the capacity developed locally**, obtaining technical support by the Postgraduate Course Alumni, as the mentors for younger students
- **Foster involvement of Companies from Kenya** (existing or to come….)

Conclusions

- The Italy-Kenya cooperation in aerospace has proven to be mutually beneficial
- The Joint International Postgraduate Course in Space Mission Design and Management seems the right tool to pursue this cooperation further, for what concerns **capacity building** and joint research and education programs
- We are looking forward to **seeing the 1KUNS-PF satellite in orbit soon**, commanded by students of the Postgraduate Course in the ground stations in Nairobi and Broglio Space Center in Malindi (….Rome as a backup…..)
- Involving students in practical activities and **giving them responsibilities in a real program foster their interest and**

make the learning process fast and effective

THANKS

- We wish to thank UNOOSA and JAXA for the launch opportunity they provide, which really pushed the Kenya Space Capacity Building Process.