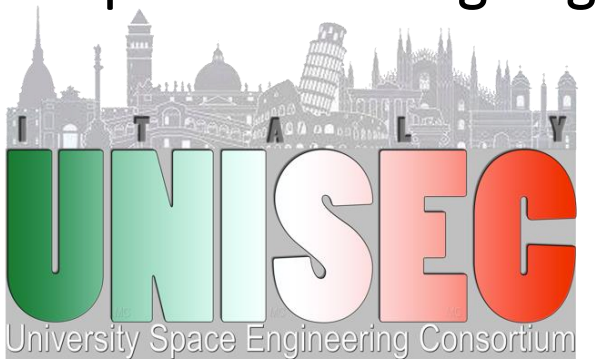
UNISEC-Italy – Regional report

Space systems development and ongoing student activities



Paolo Marzioli, *(on behalf of Prof. Fabio Santoni)*
Sapienza University of Rome, Rome, Italy

paolo.marzioli@uniroma1.it

8th UNISEC Global Meeting

Istanbul, 19-21 October 2022

Last time we saw each other…

- The MARGE Team from Italy won the Student Prize at the 7th UNISEC-Global Meeting in Tokyo in December 2019
- Preliminary talks on smaller scale (and on-ground) experimentation were in progress with the San Gallicano researchers from Rome – who supported the project at the time of MIC
- The pandemic and the effort required to the medical community in Italy slowed down the process
- But the mission concept extension was published at IAC 2020

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Stratospheric experiments Programme

2016

- Demonstration of the «old» VOR nav. system in stratosphere
- Six students participating to the hands-on part
- First steps in SDR technology exploitation

2019

- Follow-up: demonstrating VOR and interpreting the data on-board with SDRs
- Ten students participating,

2021

- Research Programme: demonstrating novel tracking techniques
- 13 students and research fellows involved in development and launch campaign
- Supported by ASI

2023

- Exploitation of SDRs for GNSS Radio Occultation in stratosphere
- 12 students, 2 coming from STRAINS have leadership roles

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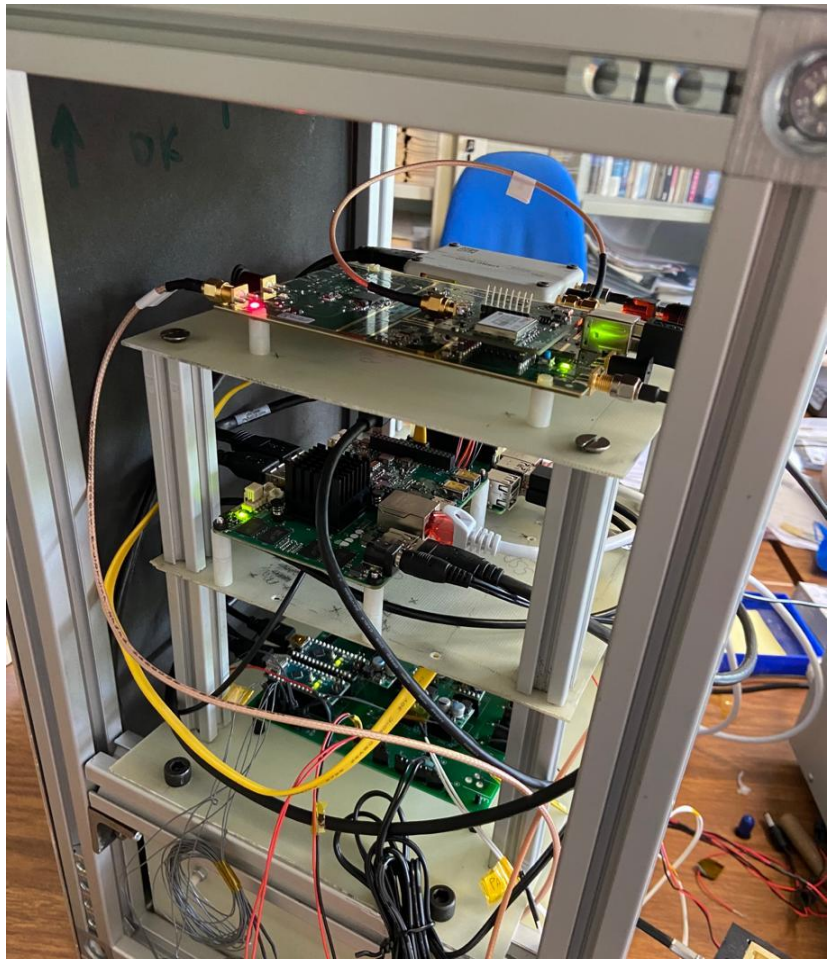
Experiment development: March-August 2021



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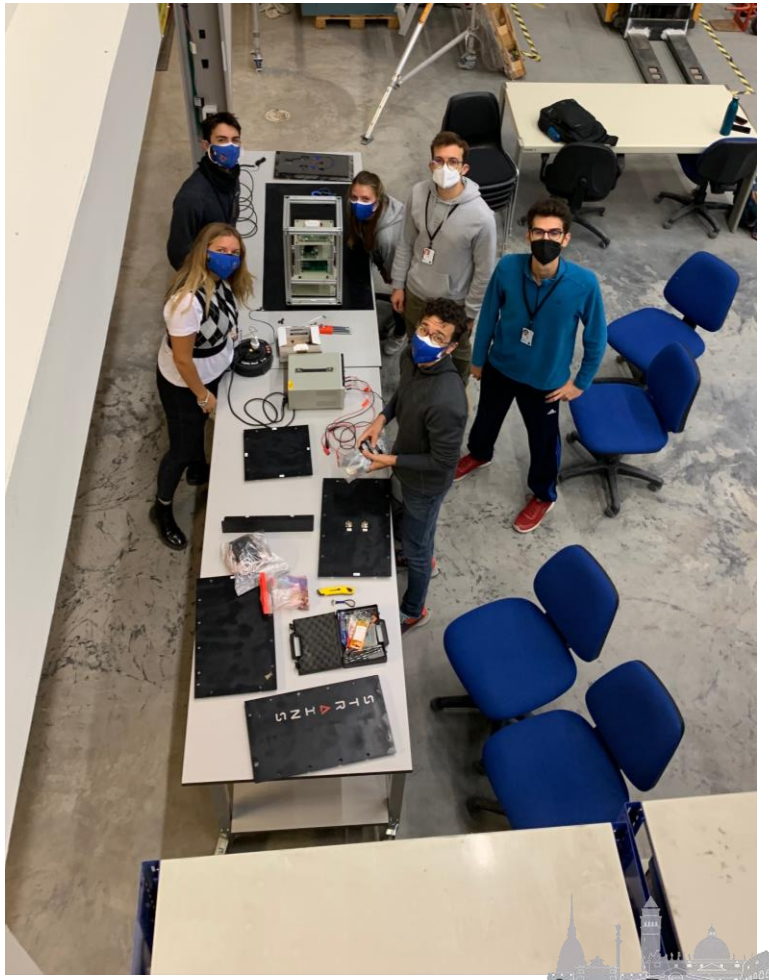
Launch Campaign – 5-17 September 2021



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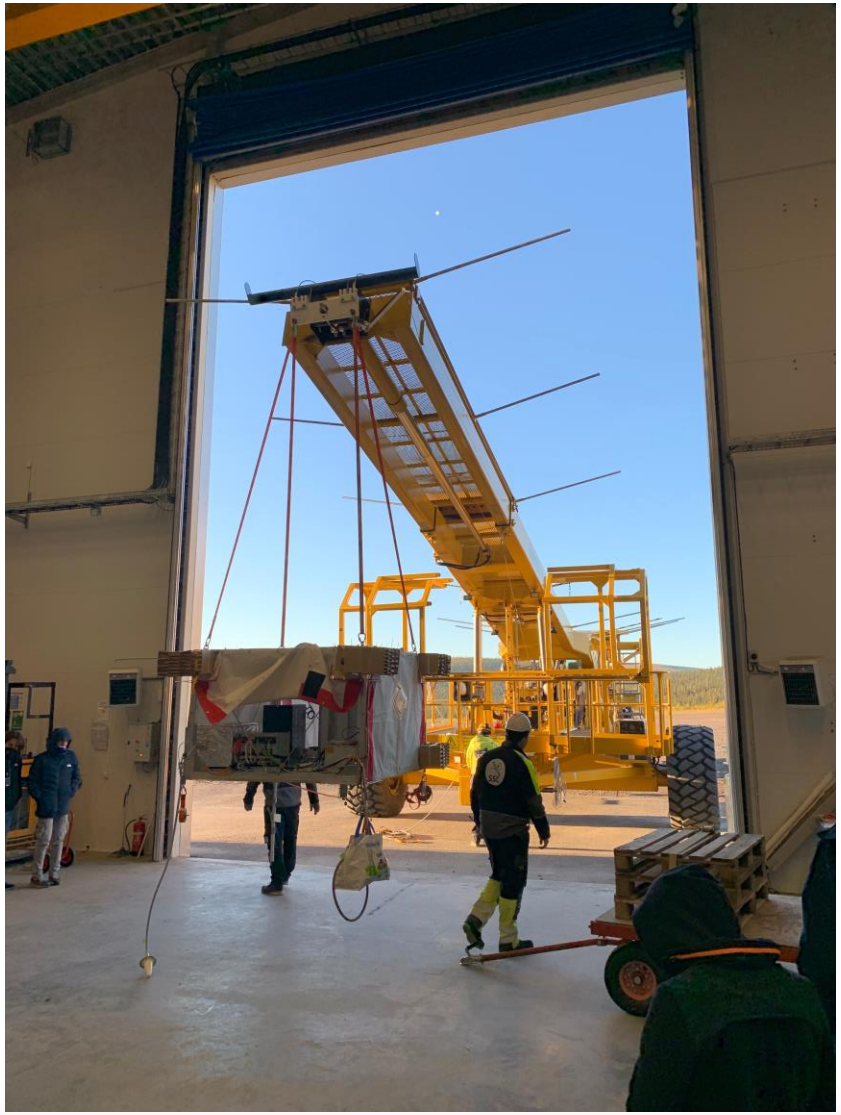
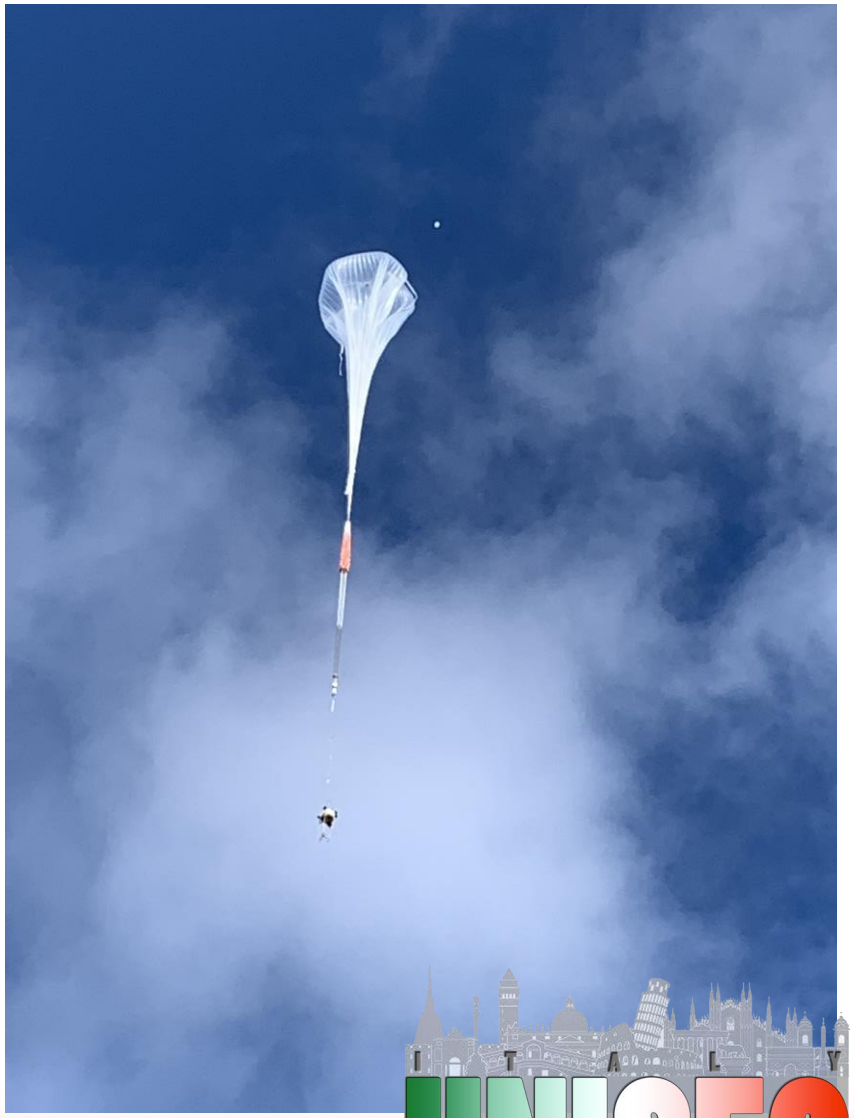
Launch! 11 September 2021 at 9.53 UTC





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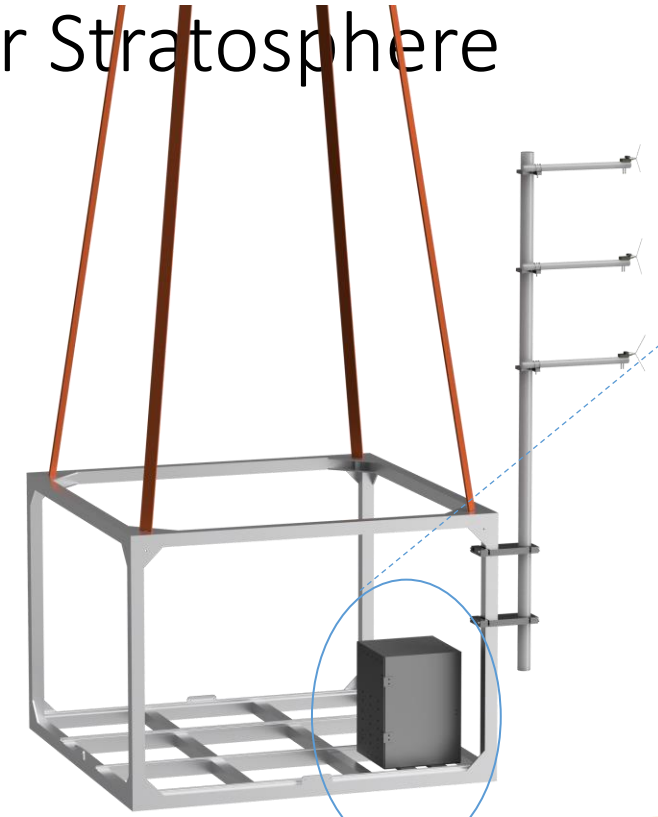
ROMULUS – Radio Occultation Monitoring Unit for LEO and Upper Stratosphere

- Test a small-scale system for balloon-borne **GNSS-RO** based on a **Software Defined Receiver**

- Perform radio occultation with **Galileo** signals and **GPS** signals in the **L5 band** and assess their performance



REXUS/BEXUS Student Experiment Programme

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…With Launch in mid-2023

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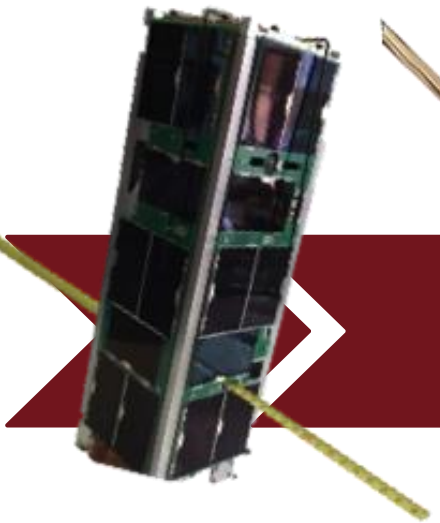
CubeSat activities and launches



URSA MAIOR

University of Rome La Sapienza Micro-Attitude In-Orbit Testing

2014 – In orbit

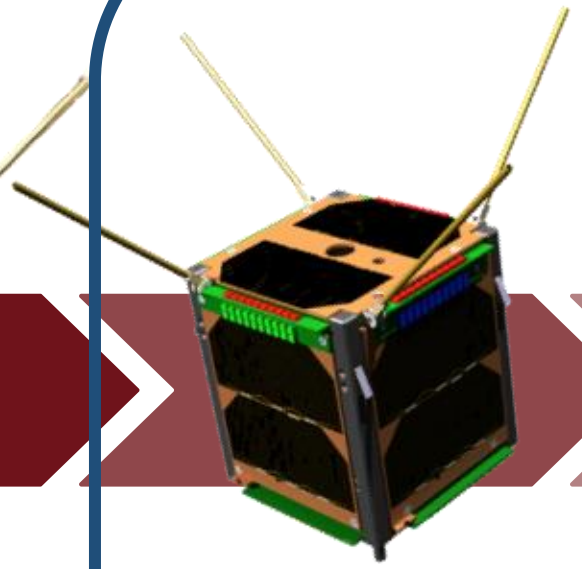
Status: Launched on **23 June 2017**

1KUNS-PF

1st Kenyan University Nano-Satellite – Precursor Flight

2017 – Mission concluded

Status: Launched on **11 May 2018,** Deorbited in **Summer 2020**

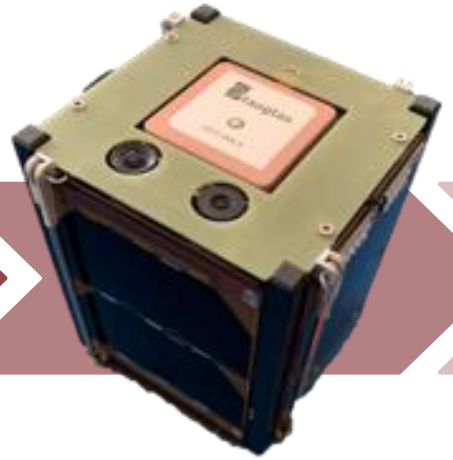


IKUNS-B/LEDSAT

Italian-Kenyan University Nano-Satellite / LED-based small SATellite

2017 – Operational in-orbit

Launched on **17 August 2021**

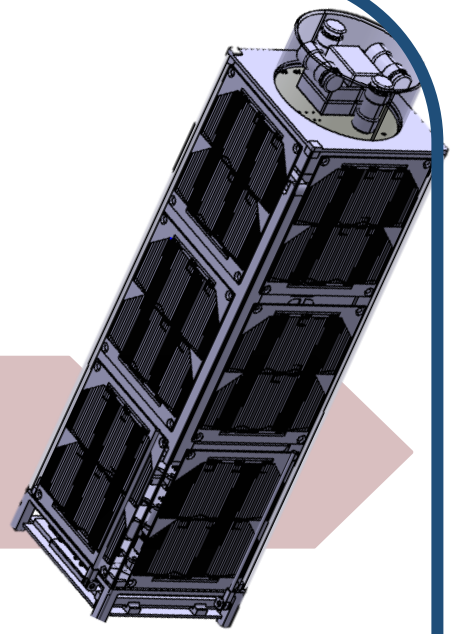


WILDTRACKCUBE-SIMBA (IKUNS3)

System for Improving Monitoring the Behaviour of Animals

Launched on **22 March 2021**

Status: **operational in orbit**



GREENCUBE

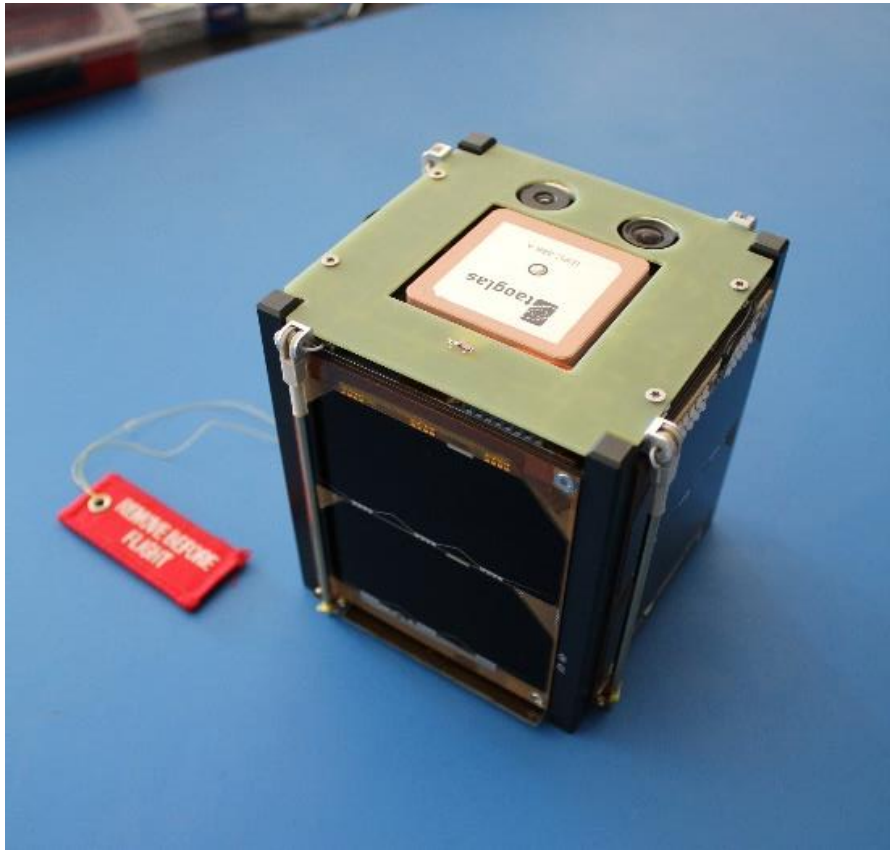
Microgreen cultivation in MEO

Launched on 13 July 2022

Status: **Operational in MEO**

WildTrackCube-SIMBA

System for Improving Monitoring the Behavior of Animals



AIMED AT TESTING AN INNOVATIVE WILDLIFE MONITORING METHOD WITH RADIO-FREQUENCY TRACKING AND SOFTWARE DEFINED RADIO TECHNOLOGY

PREVENTING THE HUMAN-WILDLIFE CONFLICTS VIA SATELLITE COULD LEAD TO A SUSTAINABLE FUTURE FOR PRESERVES AND CULTIVATIONS

SAPIENZA UNIVERSITÀ DI ROMA

UNIVERSITY OF NAIROBI

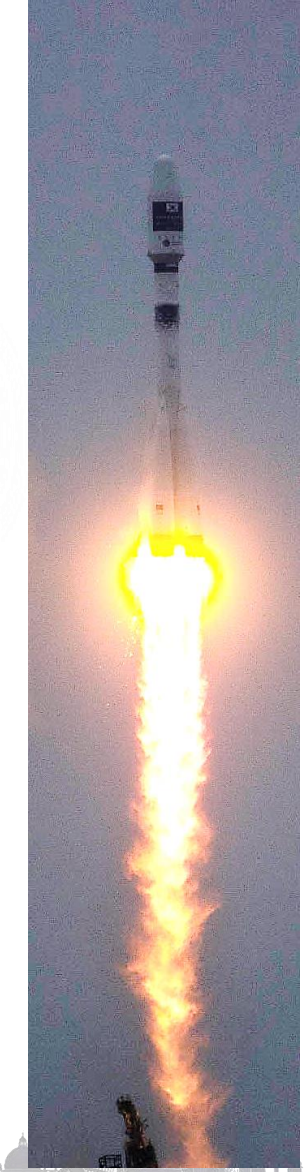
Agenzia Spaziale Italiana

KENYA SPACE AGENCY
Possibilities beyond our skies

ITALY UNISEC
University Space Engineering Consortium

09/11/2022

WildTrackCube-SIMBA: Launch Opportunity



- The mission was awarded with a free launch opportunity offered by IAF and GK Launch Services at the 2019 IAC
- The satellite was launched in March 2021 from the Baikonur Cosmodrome

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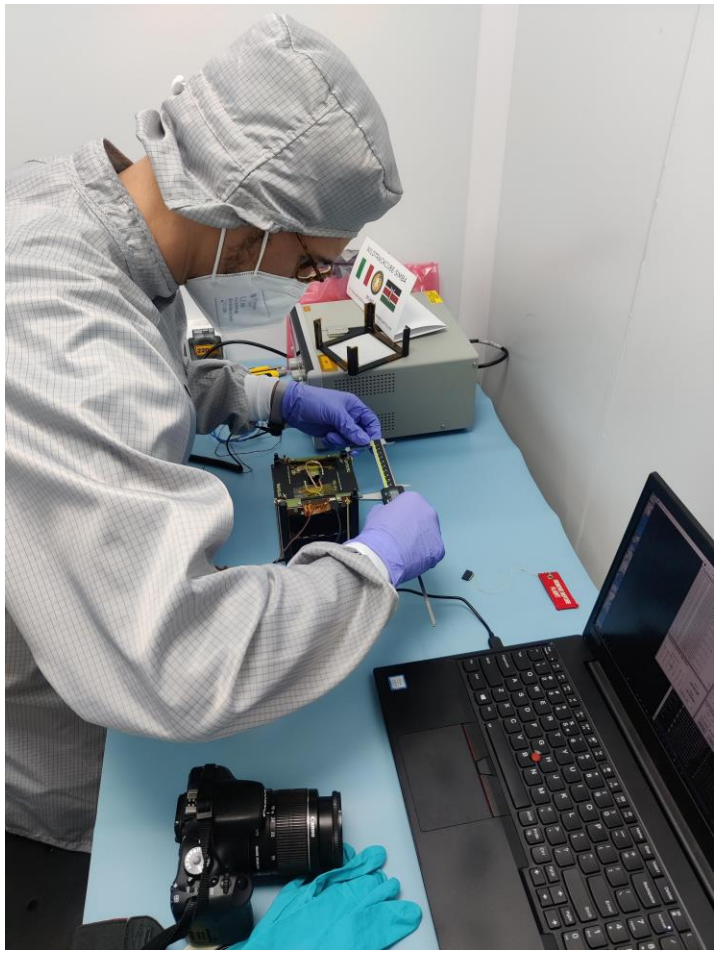
INTEGRATION ACTIVITIES ON WILDTRACKCUBE-SIMBA



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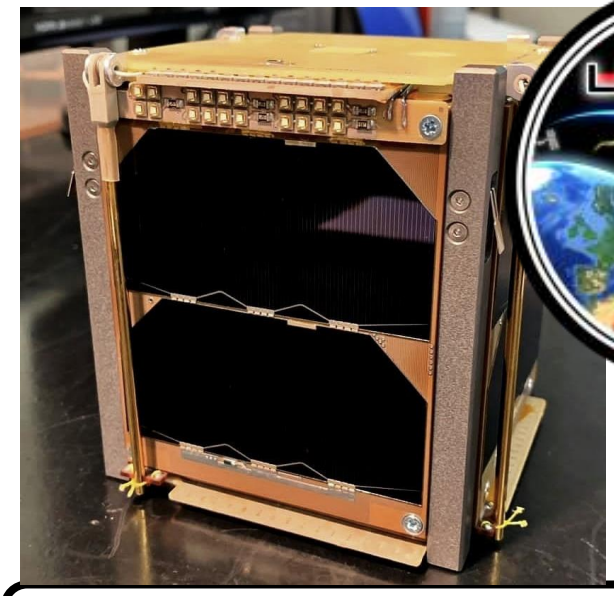
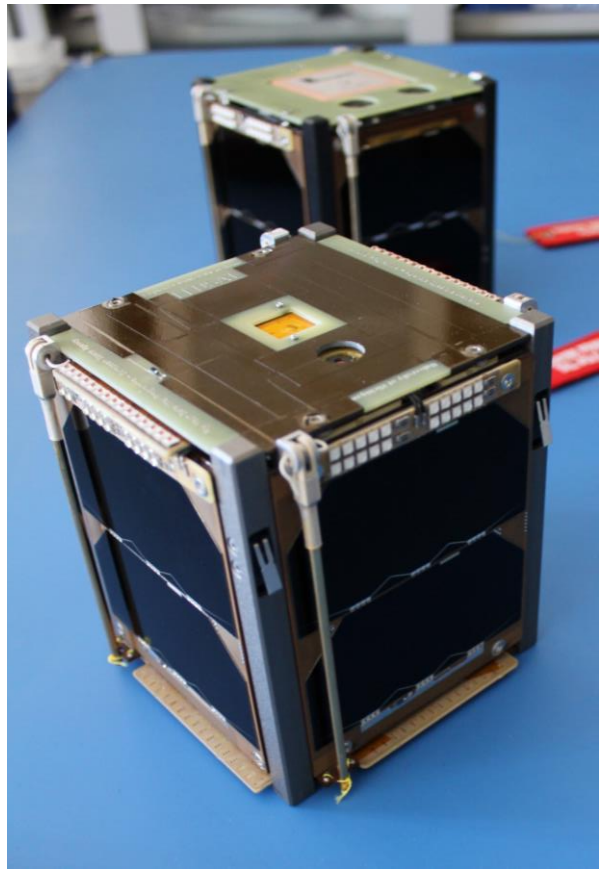
LED-equipped satellites

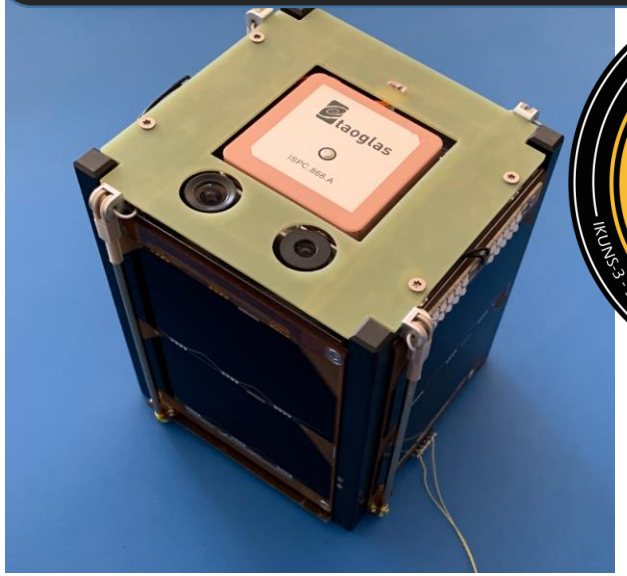
LEDSAT - 49069



- Six LED boards +1 Controller board
- LEDs as primary payload
- Three colors: Red, Green,Blue



WILDTRACKCUBE-SIMBA - 47941



- Two LED boards + 1 mini-controller
- LEDs as secondary payload
- Blue LEDs only

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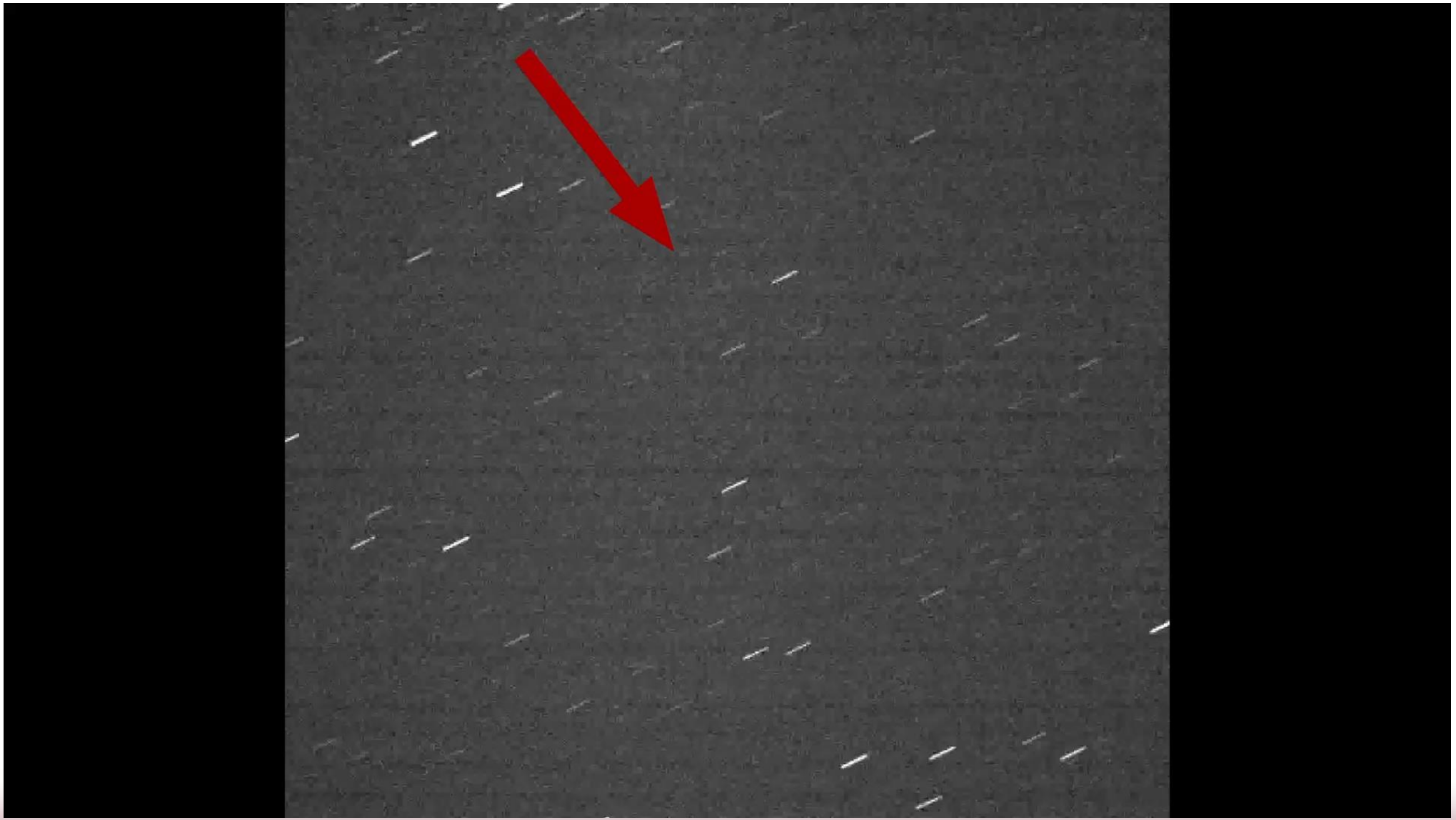
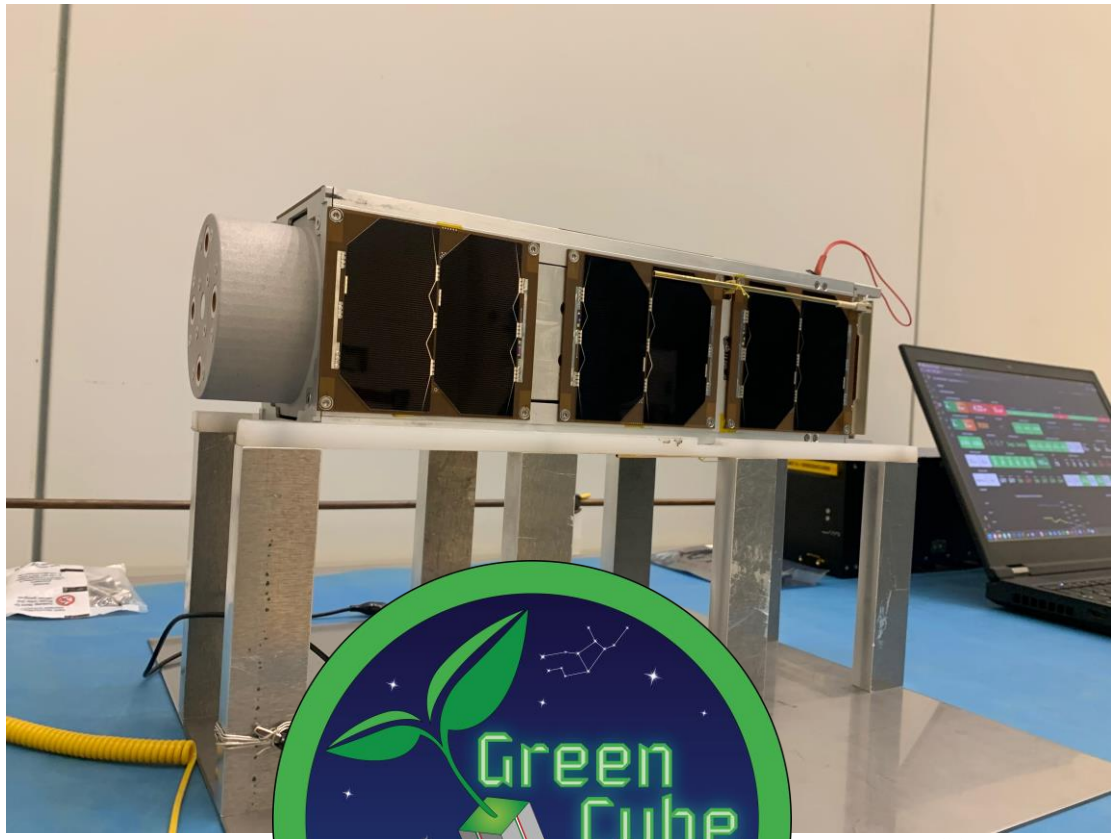
LED observations



GreenCube: CubeSat plant cultivation

- The satellite, exploiting the same design concept of the current generation of S5Lab, allows a 2U Payload to perform a cultivation experiment
- **GreenCube, with its launch opportunity in MEO, is the farthest example ever of higher plants cultivation in microgravity**
- The main aim is to demonstrate the capabilities of a «turnkey» CubeSat solution for fast prototyping and performance testing of plants in space – aimed at verifying the suitable plants for tomorrow's astronaut nutrition, supporting «bigger» facilities



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FEDERICO II

ENEA

Agenzia Spaziale Italiana

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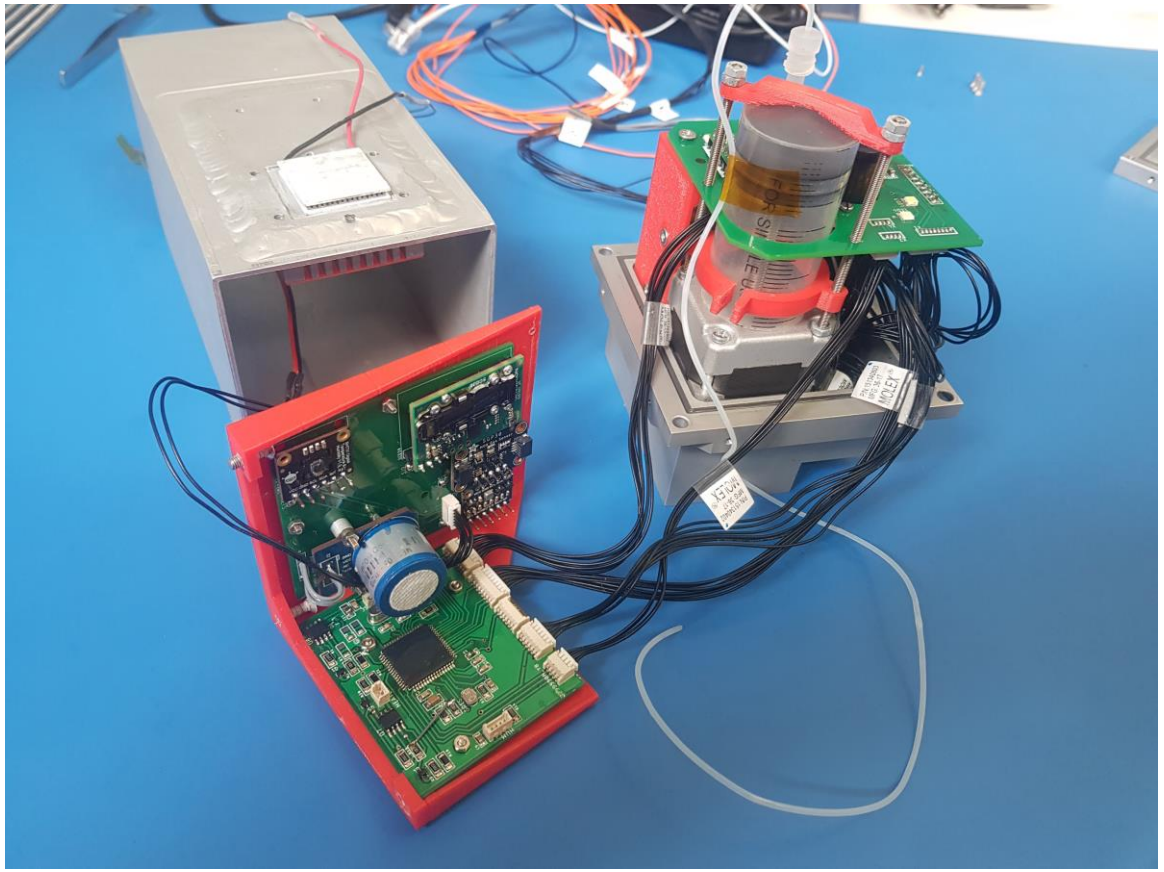
Growth experiments

- The growth chamber prototypes were tested many times for growing microgreen plants at different environmental conditions
- The 8 performed tests have verified the functionalities in hypobaric, low and high temperatures, full automatic mode features with success



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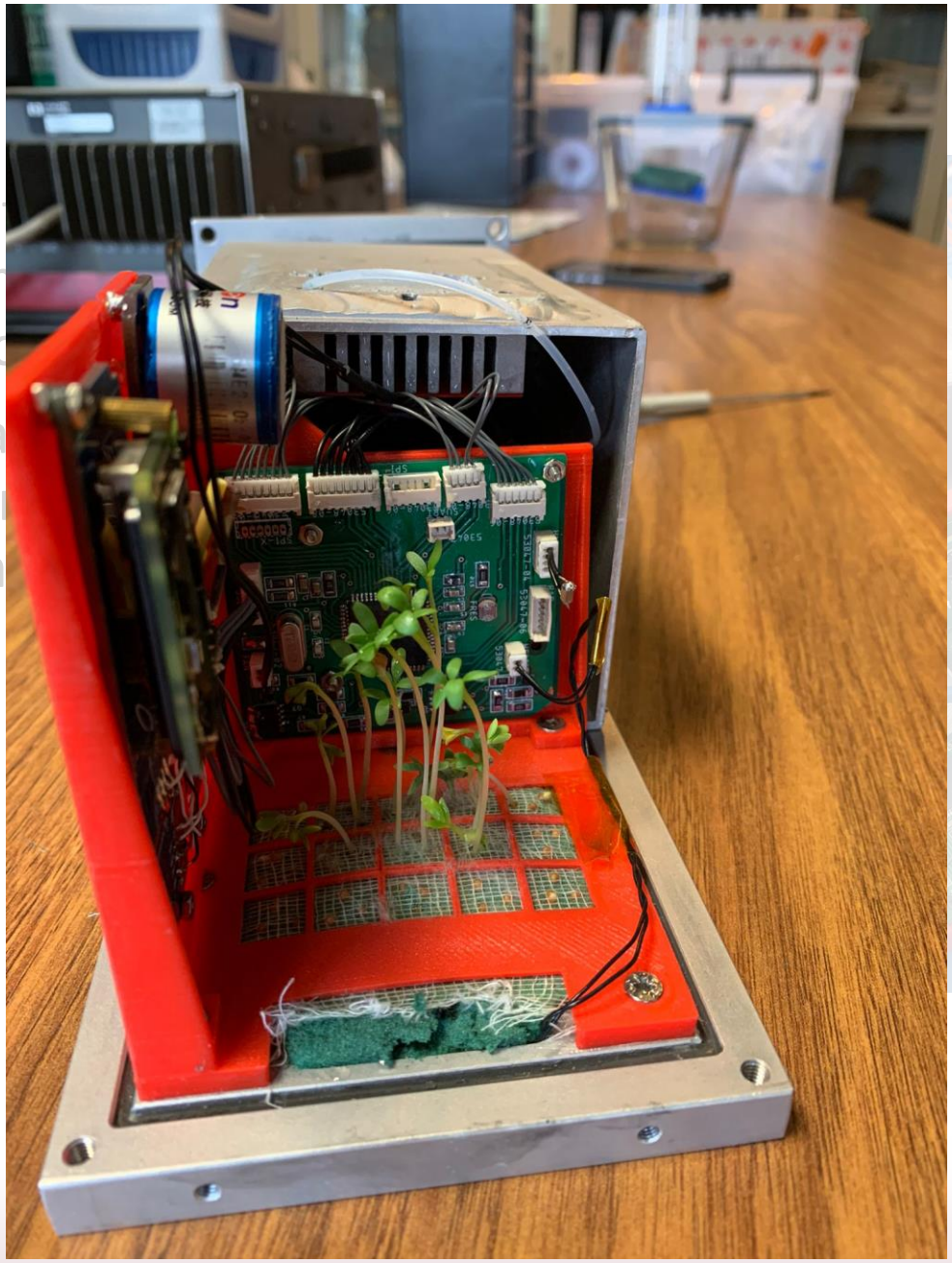

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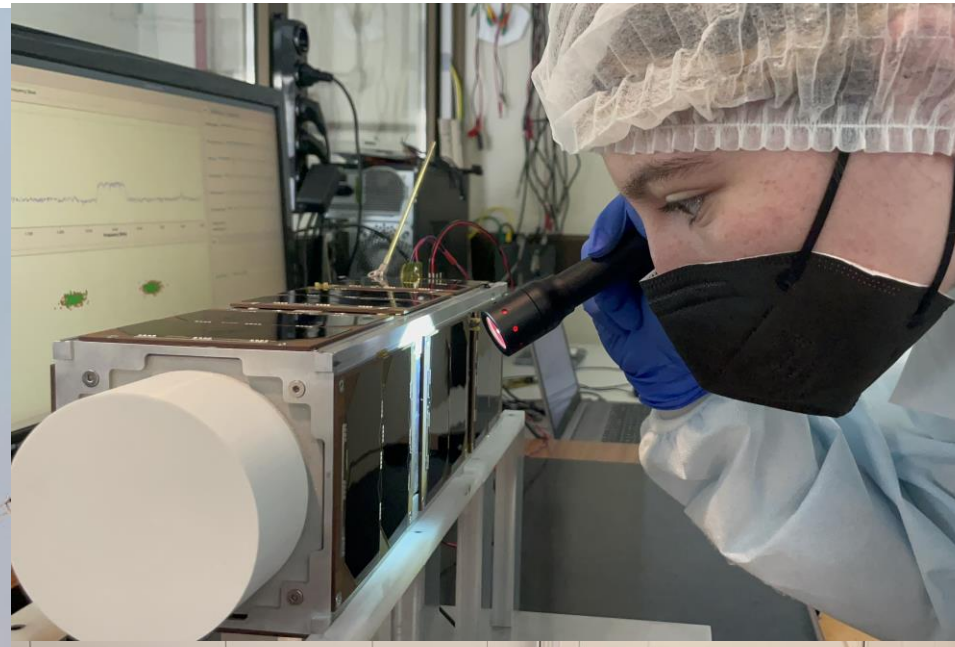
GreenCube: Current status

- GreenCube has been launched at 13:13 UTC on 13 July 2022
- The satellite integration was completed at CSG in Kourou in June 2022 in preparation of the LARES-2 launch on the Vega-C maiden flight
- The qualification, launch preparation and operations of GreenCube see a wide involvement of students
- The satellite is well-functioning in MEO after two months from launch – the experiment in plant cultivation has been activated and the preliminary results are being evaluated



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LEDSAT 2 and new collaborations: the future

- A new concept for the LEDSAT mission is being proposed to ESA for the Fly Your Satellite! Design Booster Programme: 39 students are participating
- LEDs might be implemented on other Italian CubeSats and other platforms
- Other CubeSat concepts are being investigated and realized

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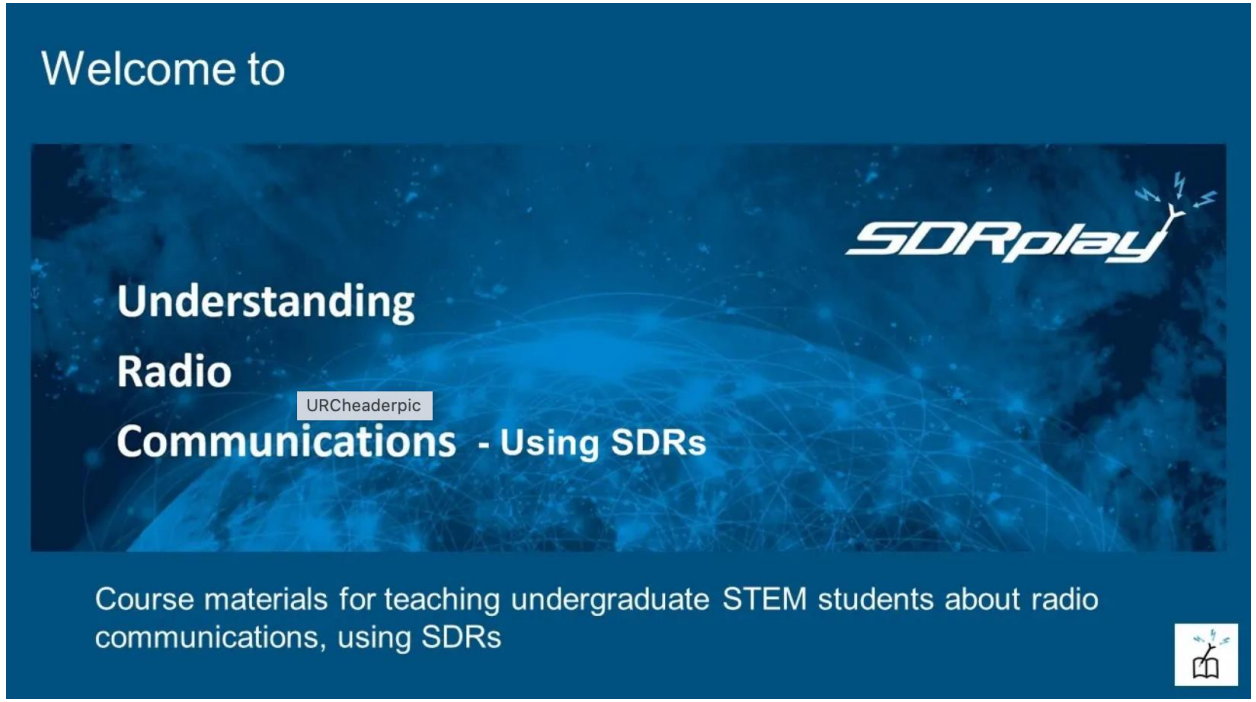
SDR Courses



A course on SDRs has been produced with the support of SDRplay. Materials are available free of charge

Analog Mission by students: GEA

- S5Lab – Sapienza Space Surveillance and Space Systems Laboratory
- GS – CAI (Club Alpino Italiano) of Rome

GEA: Analog Exploration Group

GEA is a **speleology Analog Mission** conducted in caves

- Extreme and unfriendly environments
- Interesting for exploration activities
- Speleological progression must respect different security procedures (such as the use of instruments and the knowledge of descending techniques)

GEA Concept Mission

Main Goal of GEA

- Establish an analog infrastructure, managed by **researchers and students**
- Recruitment and training of **12 speleonauts**
- Participating in a **real analog mission of 72 h**
- Living in a challenging environment
- Developing their own small scale experiments

GEA: Speleology Training

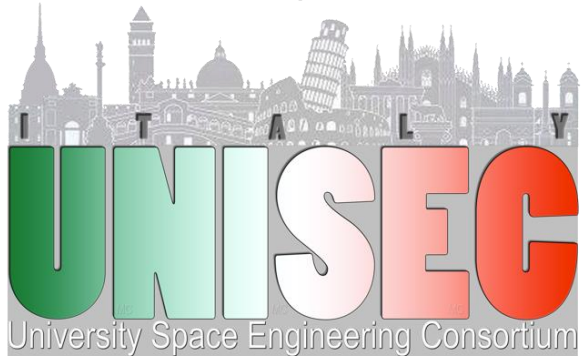
First steps in caving progression

- The students and researchers in GEA have been learning caving progression techniques in Spring 2022
- The techniques are necessary to operate safely in the extreme environment

GEA: Mission Organization

- Recruitment of **12 speleonauts**, with a **50% share of women** involvement in the mission
- **Two teams of six astronauts**: three men and three women for each one
- **A team of at least five mission controllers** that will manage the Mission Control Center (MCC)
- A team of at **least five speleology instructors**
- **Tentative analog mission date: March 2023**

Thank you for your attention!



paolo.marzioli@uniroma1.it

8th UNISEC Global Meeting

Istanbul, 19-21 October 2022