

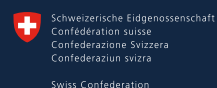
# IGLUNA

A space habitat

Remote operations

10 – 19 July 2020

Virtual Field Campaign









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# INTRODUCTION

From the 10th to the 19th of July 2020, 15 international student teams will present their projects on the topic “A space habitat with remote operations” in virtual format to conclude their participation in IGLUNA 2020 after one academic year. The Field Campaign was initially planned to take place in Lucerne at the VERKEHRSHAUS – Swiss Museum of Transport and on top of Mount Pilatus. Due to the Covid-19 situation the original plans have been postponed to July 2021, and the current edition has been replaced by an online version.

Coordinated by the Swiss Space Center, the ESA\_Lab@CH project IGLUNA 2020 offers the opportunity to 15 student teams to participate in an international, collaborative project. From September 2019 until July 2020, more than 130 students from 10 countries (Switzerland, Belgium, Italy, Poland, USA, Germany, Greece, Estonia, United Kingdom, Romania) gathered their knowledge to design, build and test technologies addressing the challenge to sustain life in an extreme environment. The developed technologies covered six research topics: life support systems, habitat conception and structure, communication and navigation, power management, human well-being and science.

The Virtual Field Campaign consists of several kinds of online events: inauguration, student project shows, guests presentations, space awards ceremony and closure. Jan Wörner, ESA Director General, will join the Virtual Field Campaign on 10 July to welcome everyone with an inauguration speech. Over six consecutive days (10 – 16 July), every team will independently showcase their project, each during an online one-hour presentation. Throughout these live events, the public will be able to interact with the teams and experts through an online Q&A section. In the afternoons, space experts will present public talks, featuring Claude Nicollier and representatives from Astrocaster, iSpace, Spaceship EAC (ESA) and others. Finally, within the framework of the space awards, three teams that show the greatest motivation and involvement will have the opportunity to exclusively present their project to Jan Wörner, followed by the closing ceremony on 19 July.





## IGLUNA 2020

Life Support Systems	Habitat Conception & Structure	Communication & Navigation	Power Management	Human Well-being	Science
P01_MELISSA	P07_HABITAT	P11_CELESTIAL	P15_POWERHAB	P10_FOCUS	P14_LDMS FOR LIFE
P02_GROWBOT HUB	P08_AMPEX	P13_LIGHT		P12_SMART LUNAR CLOTHING	
P03_SWAG		P16_ROVER			
P04_V-GELM					
P05_SAMPLE					
P06_HYDRATION II					

15 Teams from 10 countries to showcase relevant technologies for early phases of the lunar exploration in July 2020: robotic systems, in-situ resource utilization, moon base demonstration and life support

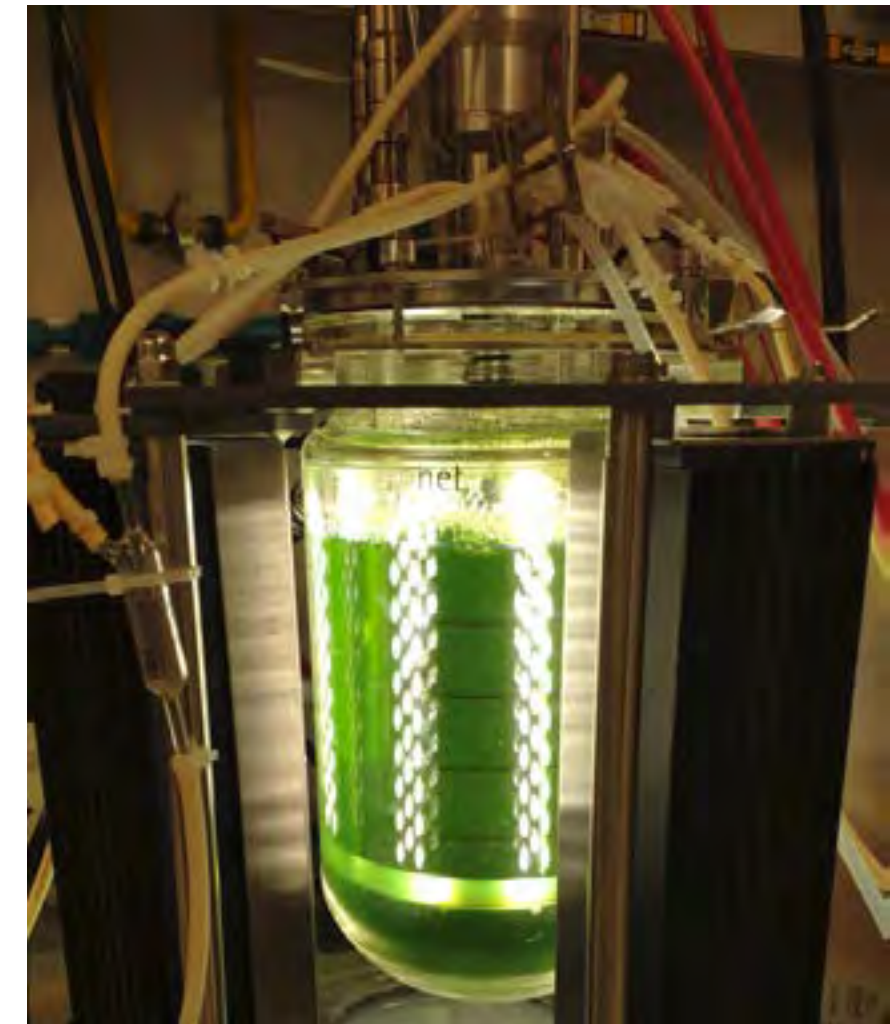
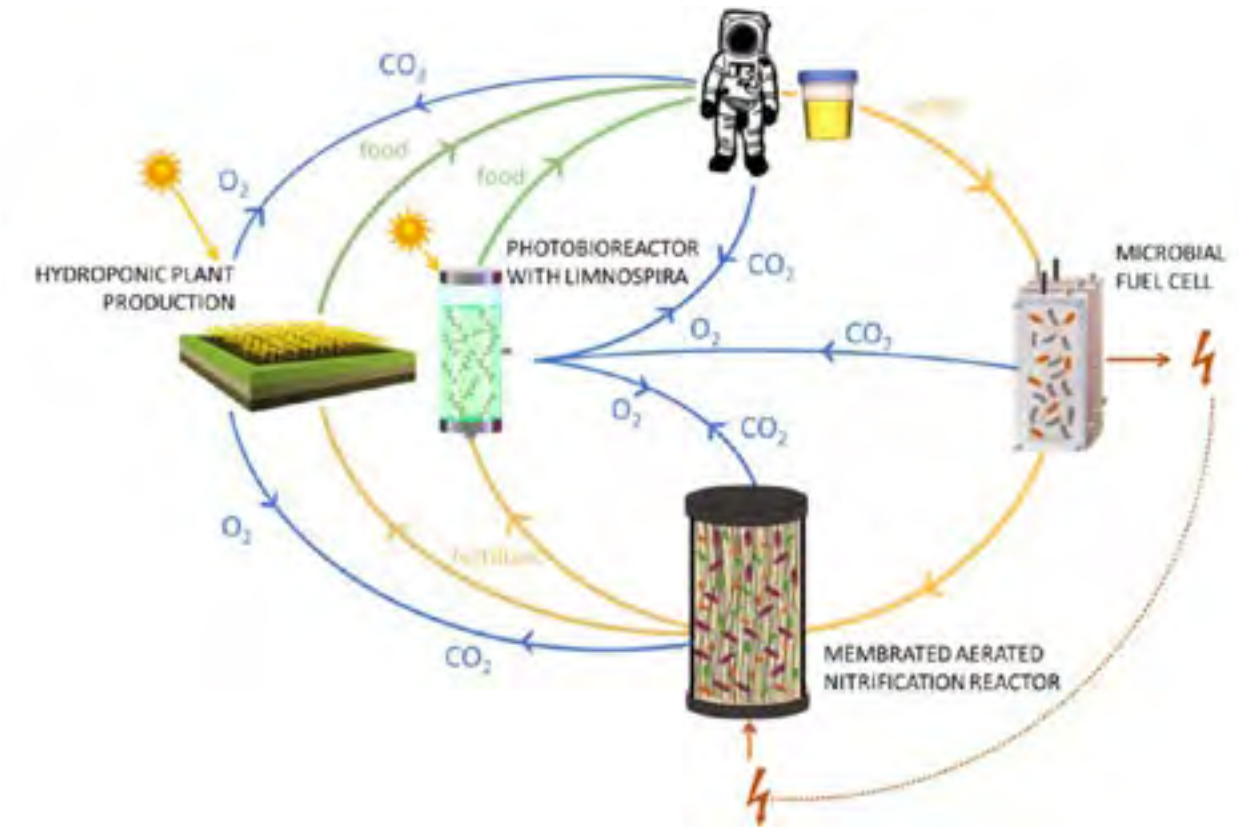


## *Human urine recycling system linked with photobioreactor and hydroponic growing unit*

We focus on creating a complete recycling system for long-term space missions through the biological conversion of human urine for food and bio-based oxygen production.



UAB, Barcelona, Spain; ETH, Zurich, Switzerland; EAWAG, Zurich, Switzerland; Gent University, Gent, Belgium; University of Leuven, Leuven, Belgium



# P02\_GROWBOTHUB

***GrowBotHub aims for a fully automated & autonomous system to grow and harvest vegetables for extreme environments in a closed loop fashion***

Machine learning, computer vision and a robotic arm are used to monitor and harvest the plants. We grow vegetables with an aeroponic system (soil-less culture) and recycled human wastes together with a fully autonomous robotic system. Everything is handled and synced by a custom made controller.



<https://growbothub.space/>

EPFL, Lausanne, Switzerland





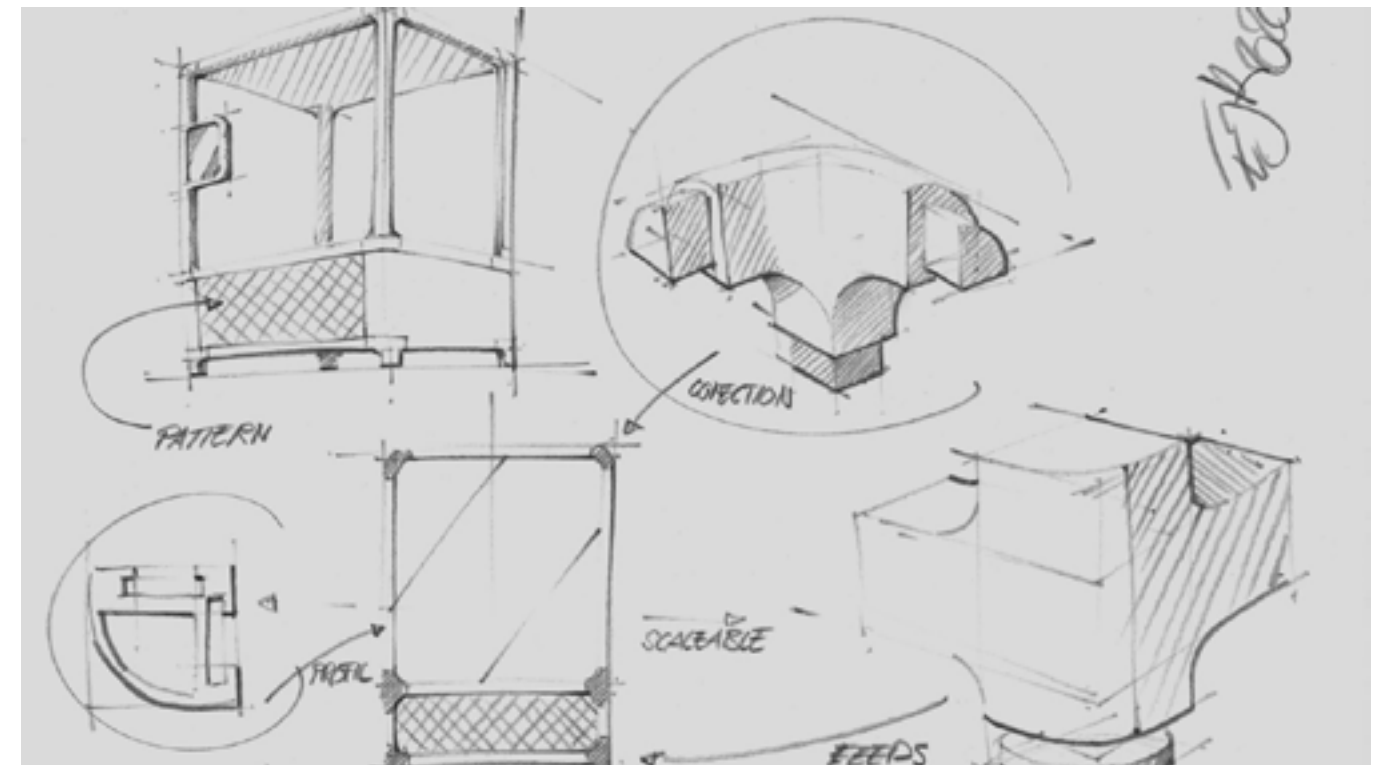
***Plant vending machine in which different crops can be cultivated, using hydroponics, smart lighting, climate control and a sensor mesh. All controlled by an app***

The SWAG system is a circular, closed hydroponic system in which vegetables, herbs and spices can be grown. Due to its modular construction, the interior and exterior of the system can be individually adapted. The fertilizer supply, filter function, light regulation and climate management can be controlled via an app. Sensor data is stored and can be evaluated visually.



<https://swagsystem.space/>

Zürich University of Applied Sciences (ZHAW) ,Wädenswil,  
Switzerland





## ***Virtual Greenhouse Experimental Lunar Module***

The project V-GELM will be important for future missions in space and for the astronauts training process. The project aims to develop a virtual reality simulation of a lunar outpost's greenhouse in order to demonstrate how new technologies, virtual reality and hort3 module, can be a useful tools for future mission planning, being cost and time effective.



Sapienza University of Rome, Rome, Italy









## ***Semi-Autonomous Modular Plant and other Life-sustaining Experiment***

A module for the cultivation of plants in a closed cycle of matter in extreme conditions outside of a human habitat. The environment inside SAMPLE is controlled thanks to insulation and cooling/heating systems. The conditions are monitored by sensors and can be automatically adjusted. After introducing plant seeds and necessary nutrients inside, the module is closed and can function autonomously.



Warsaw University of Technology, Warsaw, Poland





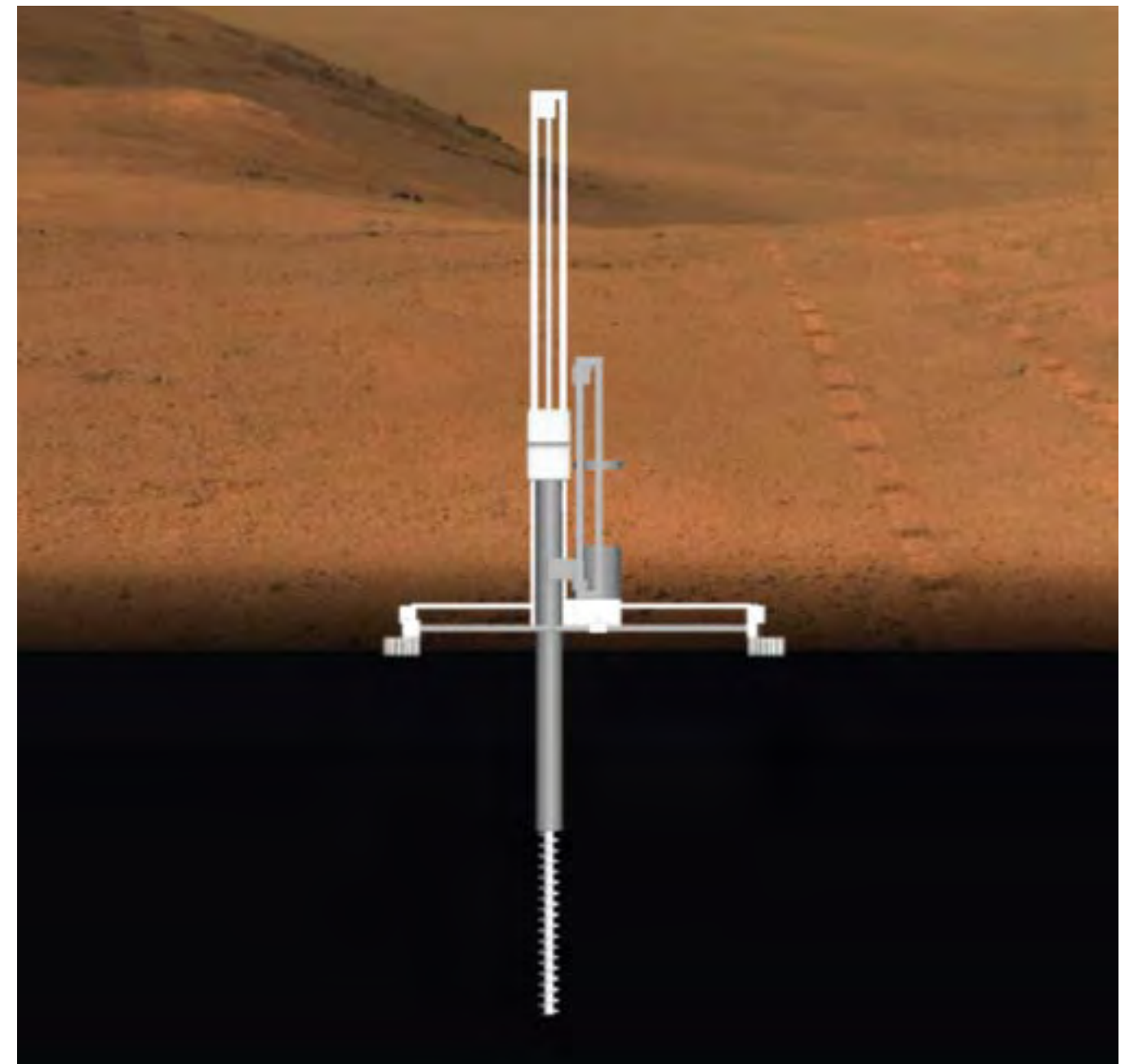
## P06\_HYDRATION II

### ***A system to produce water on Mars using radiative heating and to characterize icy regolith layers near the lunar south pole using a neural network***

HYDRATION II (High Yield Dihydrogen-monoxide Retrieval And Terrain Identification On New worlds II) is a proof of concept for a semi-autonomous robot that augers through overburden to melt subsurface ice deposits using radiative heating and to reconstruct a digital profile of the overburden layers using multi-sensor fusion and a pre-trained neural network.



Massachusetts Institute of Technology, Cambridge, USA and  
EPFL, Lausanne, Switzerland





# P07\_HABITAT

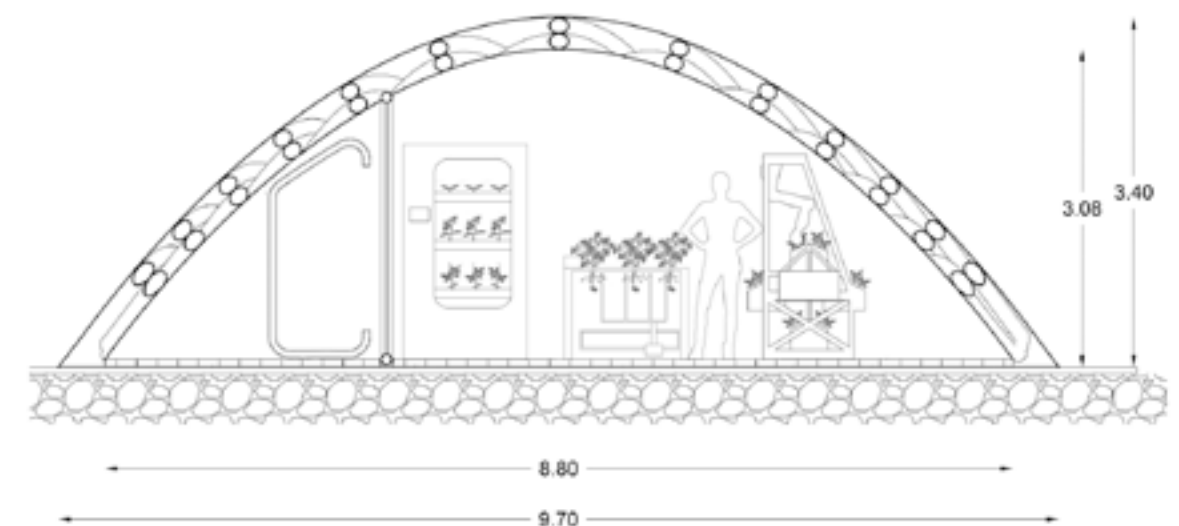
## ***Lightweight inflatable module for scientific expeditions adapted for extreme conditions***

The Habitat is an inflatable aerodynamic dome structure designed with two structural layers: a strong grid of inflatable tubes engineered from textile membrane and two over-pressured foil layers coating the tube grid. An additional skin is protecting from solar radiation and harvesting energy through integrated solar foil. The habitat includes an airlock-system and can be adapted for different use. The vision for moon settlement is to connect the habitats to each other.



<https://www.lunarhabitat.net/>

BTU Cottbus-Senftenberg, Cottbus, Germany





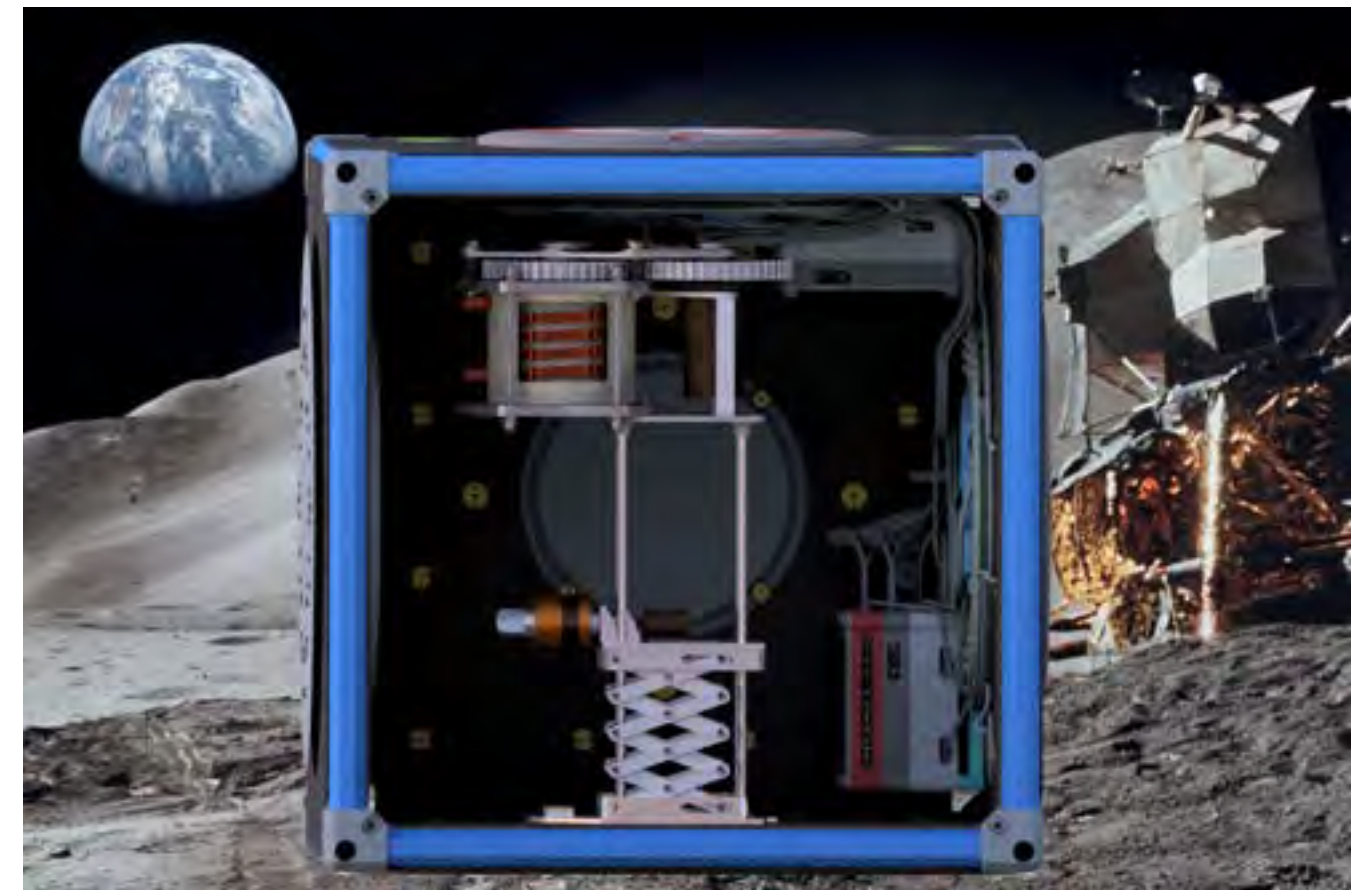
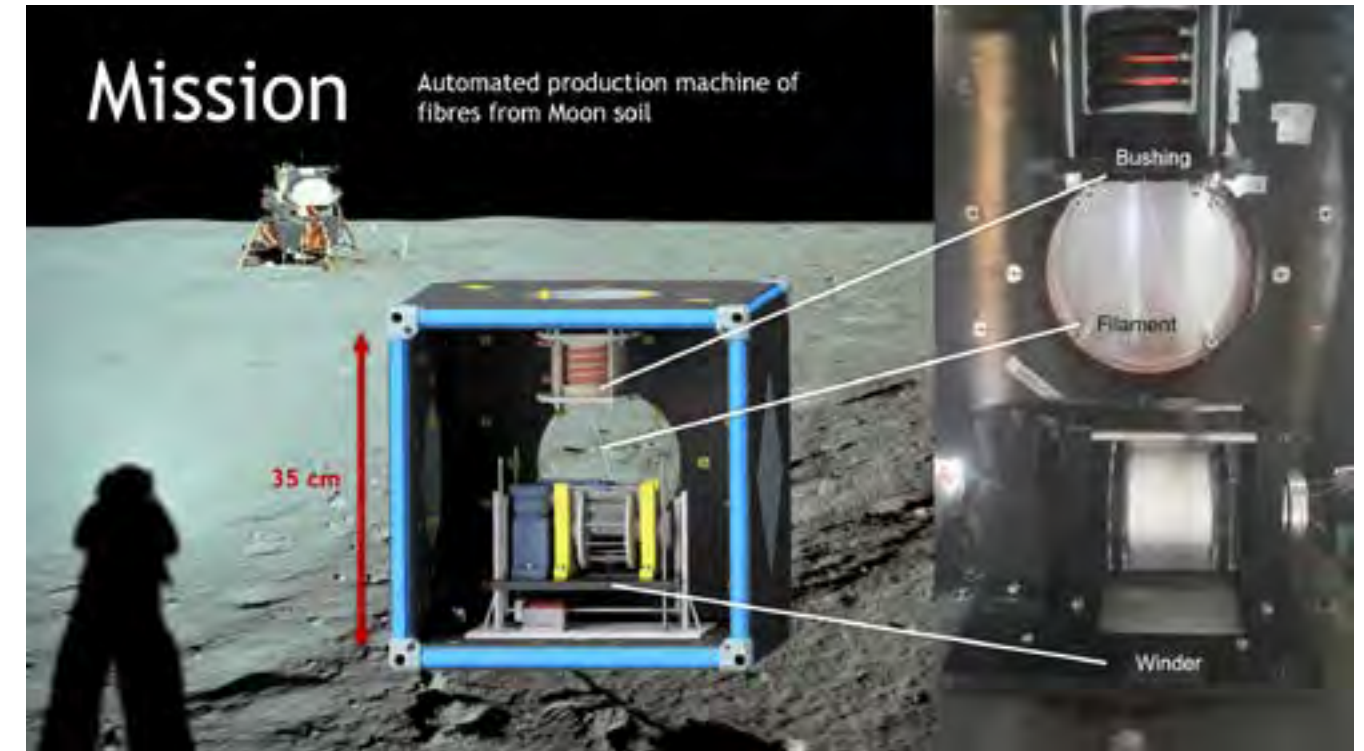
## *Fibres made of the Moon*

AMPEX20 develops and designs a miniaturized spinning unit in an space element measuring  $30 \times 30 \times 30 \text{ cm}^3$ . The system aims to perform the process with minimal human interaction. As the complete automation of industrial fibreglass production plants has not yet been ever realised, AMPEX 20 spinning unit will be the first to achieve full automation on these systems with its control system.



<https://ampex.space/>

RWTH Aachen University, Aachen, Germany









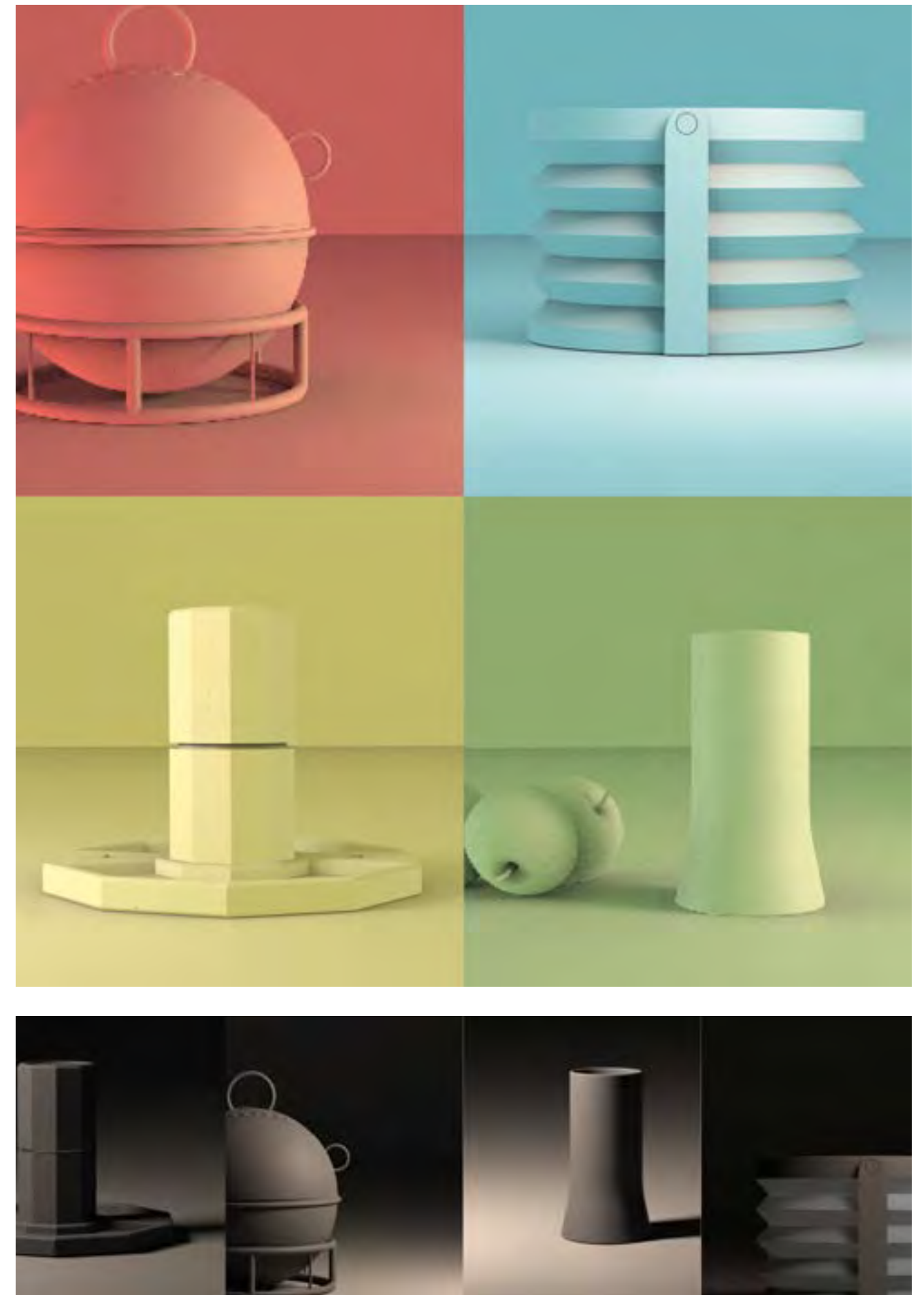
## ***New kitchen tools for the Moon base station***

Firmly believing that astronauts should really live in Space instead of simply surviving, we want to create multifunctional kitchen tools that can help them to easily prepare and eat their food. In particular, trying to stress the regolith re-usability as much as possible, we design products that can give astronauts the possibility to feel more like home.



<https://focusprojectigluna.wordpress.com>

Politecnico di Milano, Milan, Italy





# P11\_CELESTIAL

## ***Remotely configurable communication system with customized antenna for applications in small satellite or space habitat missions***

Celestial developed an SDR-based communication system and a patch antenna. The system will be remotely controlled during system operations and re-configured for signal processing, data transmission, and firmware. During the demonstration the system will set up its own wireless communication link using the in-house developed patch antenna.



<https://celestialcomm.wixsite.com/moonshot>

Technische Universität Berlin, Berlin, Germany





## P12\_SMART LUNAR CLOTHING

### *Two smart clothing concepts to improve life inside the Moon habitat*

Smart Lunar Clothing explores human well-being and waste reduction through wearable technology. One concept integrates data monitoring in daily wear, and provides a connection to the moon base through IoT. The second concept utilizes modularity to reduce cargo space by 70%.



Tallinn University of Technology, Tallinn, Estonia





## ***LIGHT shall be a gadget based on AR technology for astronauts' navigation and assistance on lunar exploration missions***

LIGHT, aims at designing and testing a smart AR navigation system to be implemented in future space or earth missions. The mixed reality headset can give the astronaut the guidelines to follow, in order to fix a potential mechanism. For IGLUNA 2020 V.F.C., LIGHT will implement the AR navigation system on a Microsoft Hololens I. A video of the experience of an analogue lunar mission will be shown.



Aristotle University of Thessaloniki (AUTH), Thessaloniki,  
Greece







Credits : Image data: NASA/JPL-Caltech/SwRI/MSSS  
Image processing by Kevin M. Gill, © CC BY



# P14\_LDMS FOR LIFE

## *Implementing the ORIGIN instrument in a rover platform for the search for signs of life on extraterrestrial bodies*

A moving 3D-printed rover scale-model, equipped with a model of our ORIGIN laser desorption mass spectrometer. ORIGIN is capable of detecting and identifying molecules of biological origin (so-called biomolecules) at extremely low concentrations, which might be crucial in the search for signs of extinct or extant life on planetary bodies other than Earth.



University of Bern, Bern, Switzerland





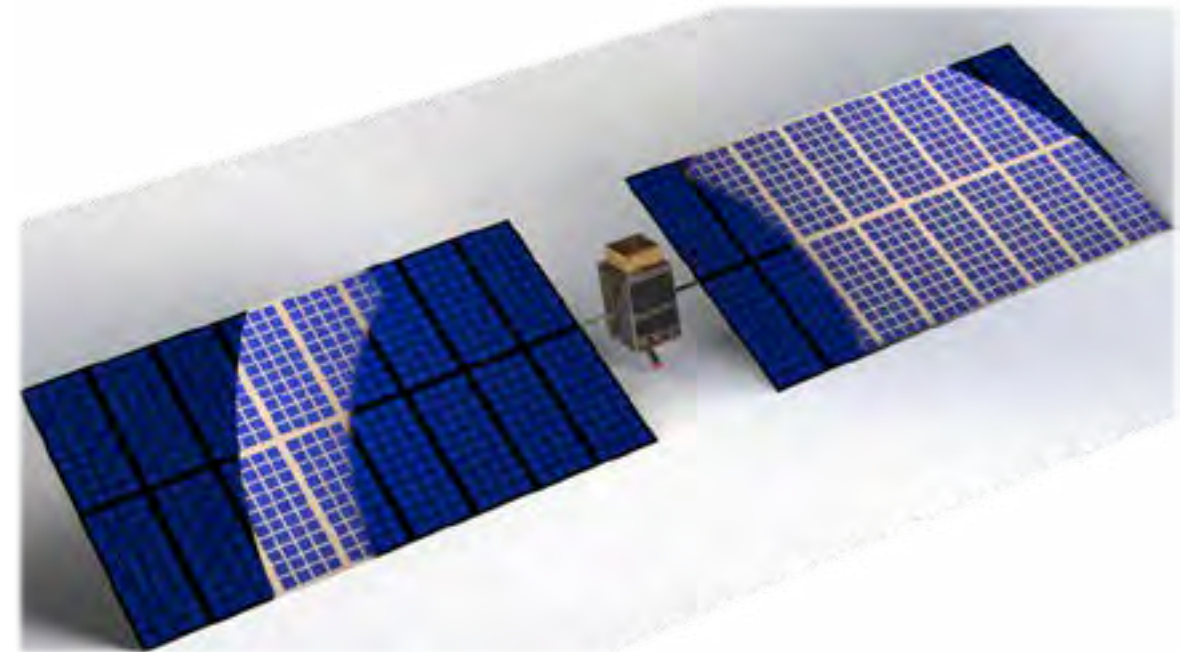
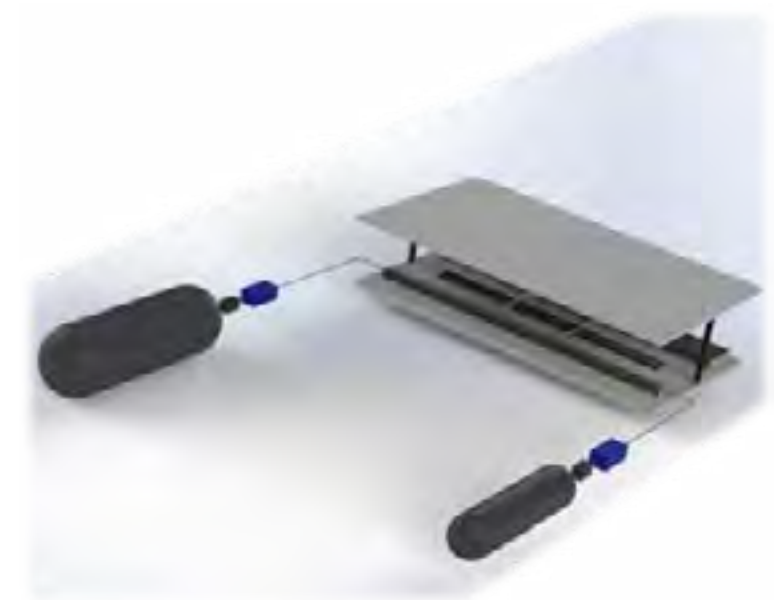
## ***Novel concepts for an holistic approach to generation, storage and distribution of power for a lunar base***

Using a combination of Reflector and Solar Power Satellites, solar energy is collected and transmitted to the lunar surface using Microwave Power Transmission where it can either be routed to the habitat or stored using Lithium-Ion Battery, Hydrogen Fuel Cell or Thermal Mass Storage Systems.



[www.powerhab.co.uk](http://www.powerhab.co.uk)

University of Strathclyde, Glasgow, United Kingdom





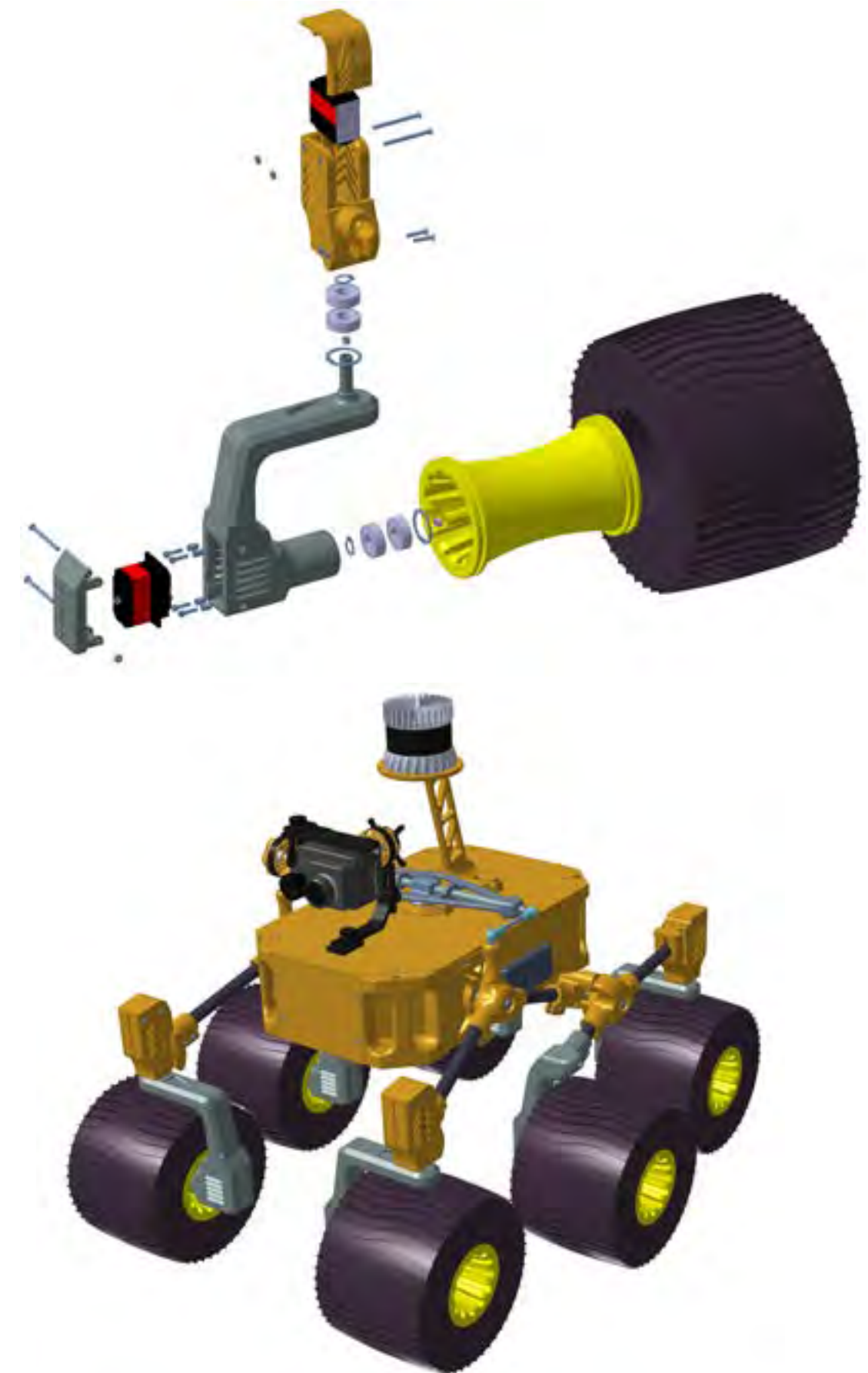
# P16\_ROVER

## *Remotely Operated Vehicle for Environment Reconnaissance*

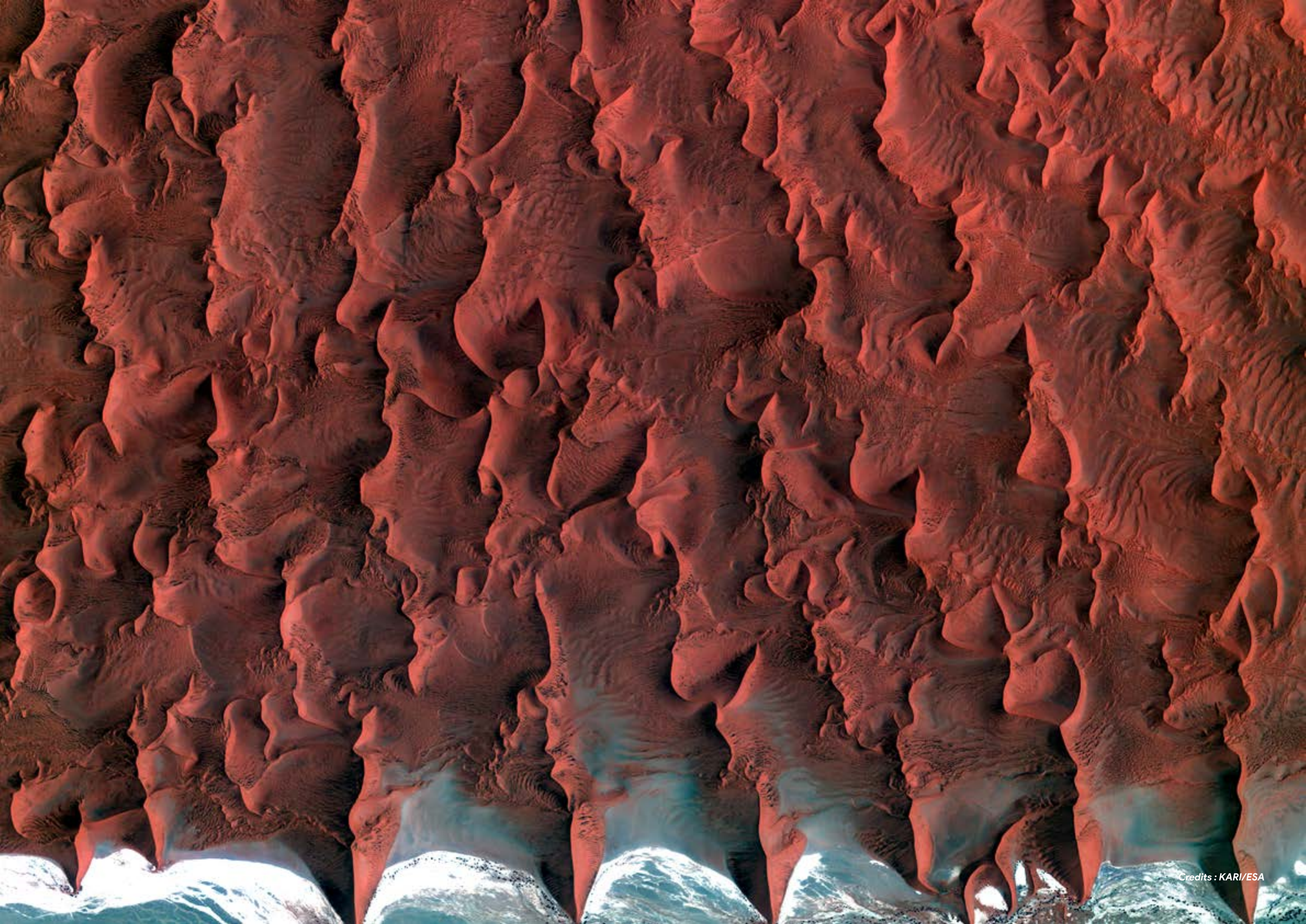
This project focusses on designing and developing a remotely controlled full functional rover vehicle with all terrain moving capability. Since the lunar surface presents a vast and rough terrain covered with craters and rocks, a rover would be a great technological capability asset for exploring the surroundings of the lunar base/landing site.



POLITEHNICA University of Bucharest, Bucharest, Romania









# IGLUNA

IGLUNA is a collaborative project gathering university student teams from all around the world on an interdisciplinary platform to demonstrate space technologies. It offers an opportunity for the students to get support from academia, industry, research organisations and space agencies for their projects.

The goals of IGLUNA are to demonstrate how to sustain life in an extreme environment, showcase and test innovative technologies as well as inspire and educate the next generation of space experts.

IGLUNA is part of the ESA\_Lab@ initiative launched by ESA in order to create a hub for disruptive innovation and cross-fertilisation all around Europe.



[igluna@spacecenter.ch](mailto:igluna@spacecenter.ch)

[www.spacecenter.ch/igluna](http://www.spacecenter.ch/igluna)

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## ABOUT THE SWISS SPACE CENTER

The Swiss Space Center is a national entity with offices in the Swiss Federal Institutes of Technology. The Swiss Space Center contributes to the implementation of the Swiss Space Policy. It provides a service supporting academic institutions, research and technology organisations and industries to access space missions and related applications, and promotes interaction between these stakeholders.



# IGLUNA PARTNERS



# IGLUNA SPONSORS





# PROJECT TEAMS SPONSORS

