Universidad de Sevilla

STCE Secretariado de Transferencia del Conocimiento y Emprendimiento

Vicerrectorado de Transferencia del Conocimiento

Fly your CubeSat

INTERNATIONAL UNIVERSITY PROGRAM

It´s for me

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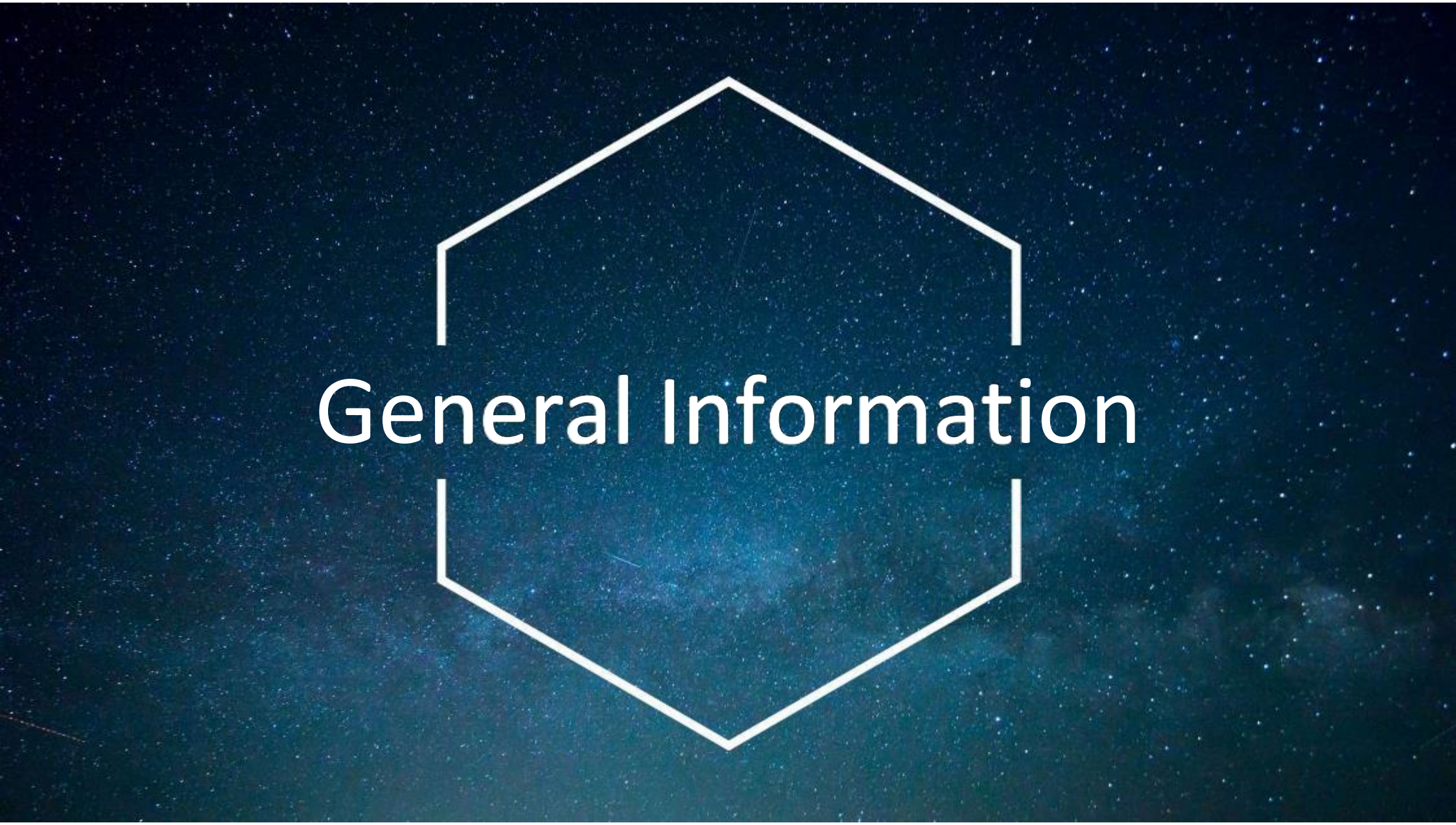
General Information

Taking university projects to the edge of Space

Fly your CubeSat Program

Fly your CubeSat is an **international project** that will provide students with **unique opportunities** to learn, develop their skills, fly and test their experiments in the edge of Space.

The objective of the program is that, through an academic year, the students will work towards:

- Designing a CubeSat to perform a mission of their choice (Earth Observation, Environment Control, Communications).
- Build the satellite and perform ground tests of the equipment.
- **Fly their CubeSat to the edge of Space**, in a Stratospheric flight at around 30 km of altitude, in a special event with **international teams from 10 countries.**

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Fly your CubeSat Program

Students can participate in different ways:

- As part of the team that integrates the systems in the CubeSat.
- As part of a team that proposes “scientific missions" to be fulfilled by the CubeSat (capturing images or data for particular purposes, such as environmental, biological, research...)
- As part of a transversal team with various tasks such as:
  - ↳ managing the communication and dissemination of the project (documenting the development of the project and generating messages about different milestones for its dissemination),
  - ↳ managing the financial aspects (program cost control and future financing needs),
  - ↳ monitoring and analysis of the coordination and development processes of the participants,
  - ↳ other tasks that are detected as necessary or that you propose.

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Introduction

Thanks to the advancement of microelectronics, now CubeSat projects can be performed at low-cost with commercial components such as Raspberry Pi's and Arduinos, with the ability to perform more and more complex missions.

Throughout the project, we will:

Organize students in multi-functional project teams (Project Manager, Software Engineer, Electronics Engineer, etc.)

Provide mentorship and guidance to design, build and test their CubeSat

Bring industry experts to deliver lectures, awareness sessions and answer technical questions

Fly the student's project on a stratospheric flight, performing a mission simulation, in an event with other international teams:

- Launch team
- Ground Control
- Analysis of the flight data recorded

At the end of the project, the university will keep the CubeSat and all data, and will be provided with exciting images of the CubeSat at the edge of Space

Benefits for the students

"Fly you CubeSat" program provides students with a unique and exciting experience

Develop technical and management skills

Through a multi-functional team approach, the students will gain valuable and useful knowledge for their careers, making them standout and increase their employability.

Engagement on an exciting "hands –on" project

Design, Build and Test their own project from End to End is an enriching and fulfilling experience, that will keep them motivated and engaged throughout the academic year.

Fly their experiment to the Edge of Space

Students will perform a flight mission that will make them feel like in NASA or ESA , sharing an experience with teams from 10 different countries, and could be one of their greatest experiences in their education.

WAY OF WORKING

Organisation of students in teams

- Avionics
- Structural & Mechanical
- Project Management
- Thermal Management
- Payload
- Marketing / Other functions

Weekly 90 minutes sessions

Each week we will start with a lecture / session on the subject to be worked on that week, followed by an interactive workshop / Q&A to help you solve your technical questions

Dedicated email address to submit questions

Project coordinator will compile all questions you may have during the work you are performing, and send to Focal Point all the questions on a weekly basis. We will analyse and reply with advice, tips and guidance to progress your work

Progress Reviews

Monthly, we will ask teams to present a report on the progress of your project, highlighting achievements, areas where support is needed, any identified risks and next steps.

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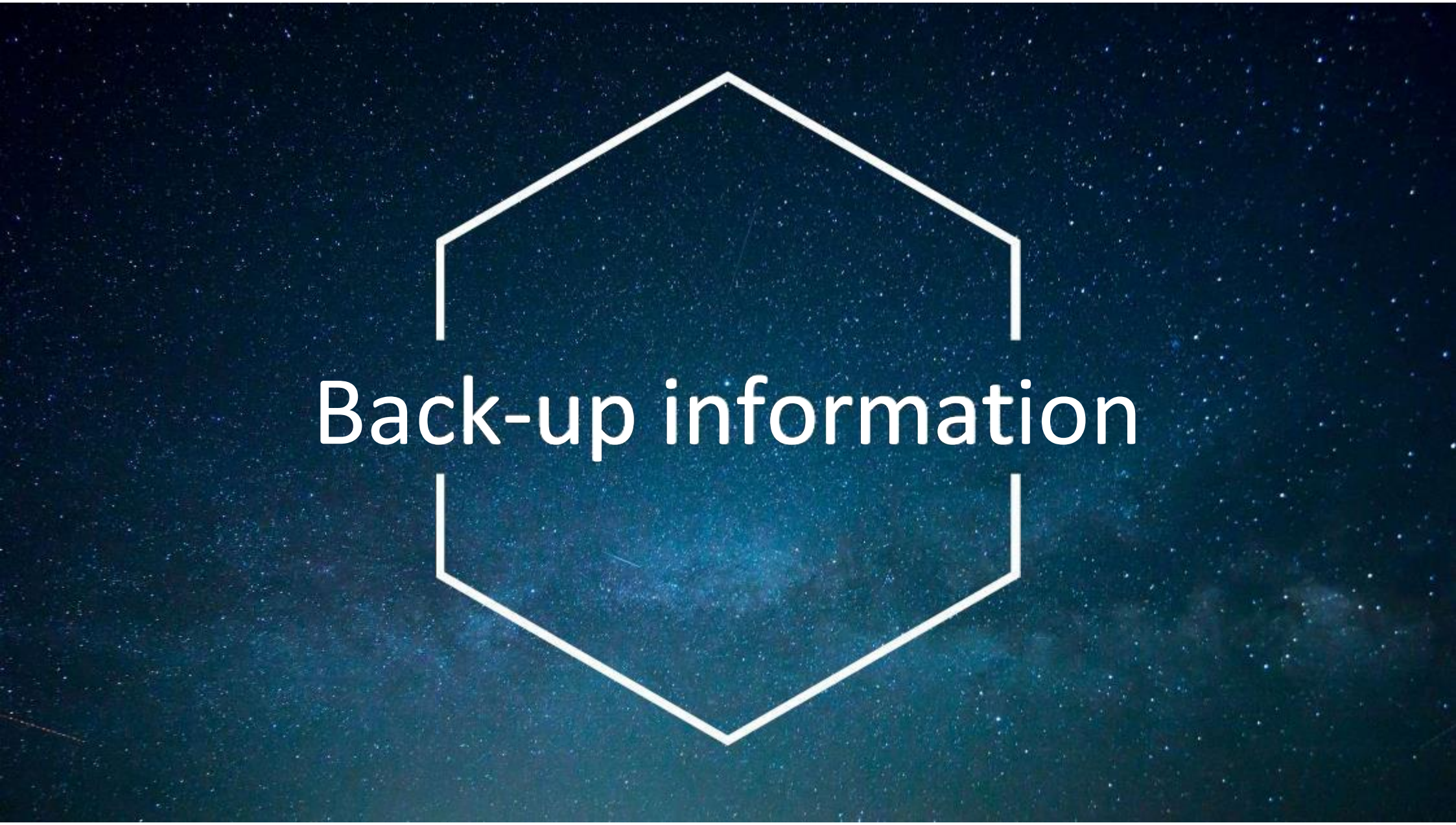
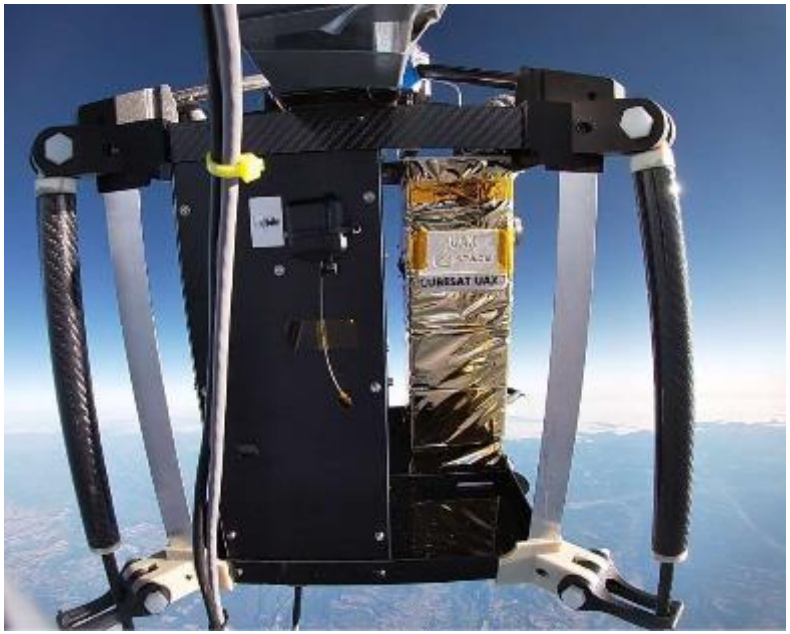

Back-up information

Flight characteristics

The CubeSat will be flown to the stratosphere, where it will face extreme environment conditions, and would be able to obtain breath-taking images from the edge of Space.



The flight will have the following characteristics, depending on each mission:

- Cruise Altitudes from 18 to 40 km.
- Length of flights from 2 to 12 hours.
- Availability to launch from multiple locations, all year round. [current launch locations in Spain (2) , UK (2)]

On the flight day, the students, with B2Space staff, will be organized in teams:

- Launch Team.
- Mission Control.
- Payload Recovery Team.

B2Space will manage all coordination activities with the required agencies (CAA, UKSA, DGAC, Enaire).

Near Space Testing – Mission examples

Test of radiation sensors for future spacecraft

- Phoenix Space - Flight performed March 2020
- University of Aberdeen – Flight scheduled November 2020

Proof of Concept of Bio-Reactors

- Flight performed March 2020

Flight demonstration of new avionics system

- Flight performed March 2020

CONFIDENTIAL CUSTOMER

IoT satellite in flight demonstration

- Flight scheduled March 2021: to capture readings of LoRa ground agriculture sensors in a demonstration flight over an interest area.

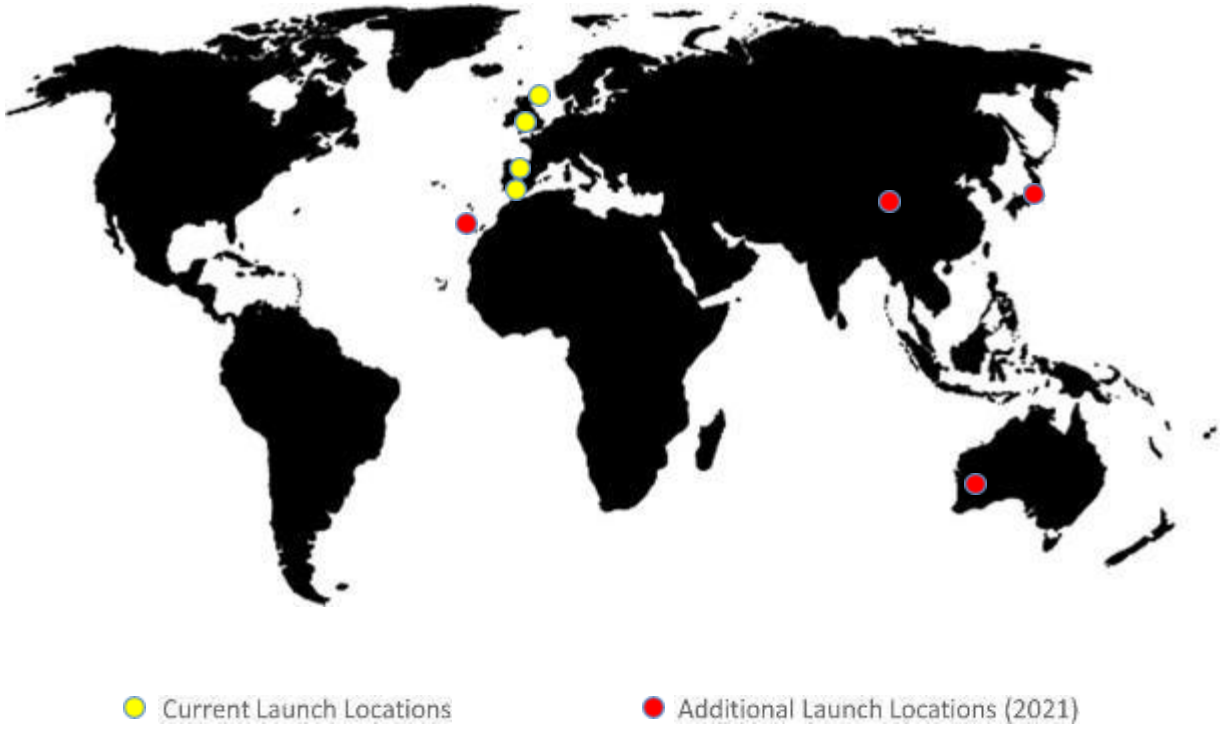
CONFIDENTIAL CUSTOMER

Demonstration of ultra-secure RF communication for future satellite to satellite links

- Flight scheduled April 2021

Launch locations

We have agreements with 2 spaceports in the UK and 2 spaceports in Spain. Additionally, we are finalizing agreements with additional spaceports worldwide (Australia, Japan, China) to ensure year-round launch capabilities.



Snowdonia

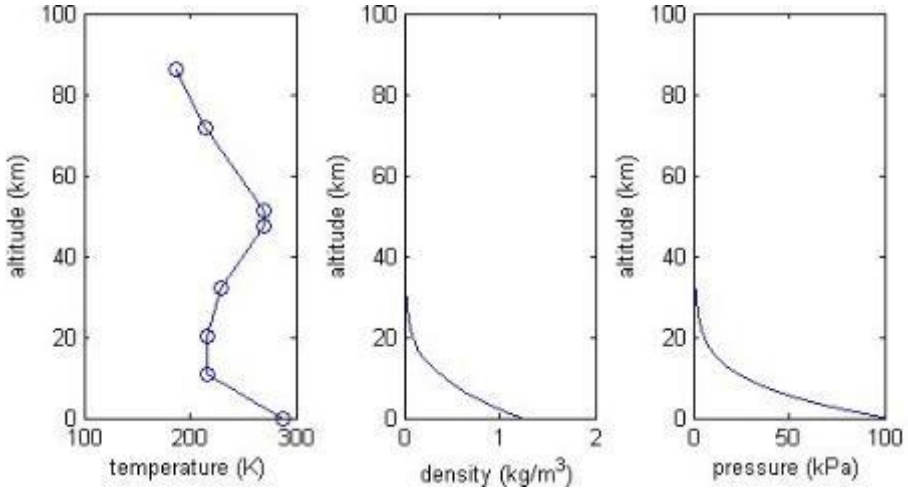
SHETLAND SPACE CENTRE

INTA

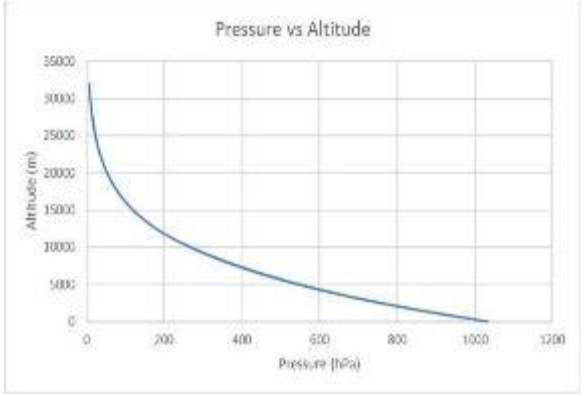
Flight conditions – temperature and pressure

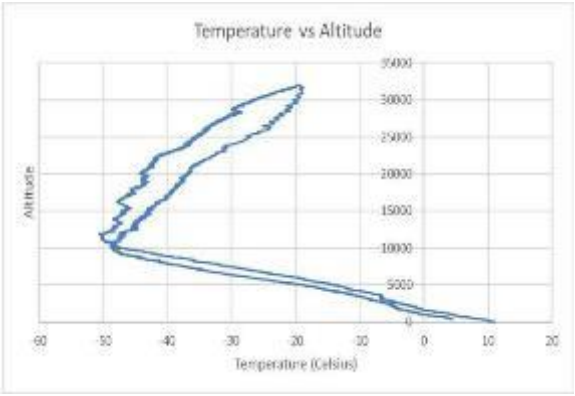
At the flight levels of our Near Space Test bench, the atmospheric temperature and pressure changes dramatically. The pressure and density at 35 k m of altitude is 99.9% smaller than on the ground.

Due to the reduced density of the air, thermal convection is negligible, and radiation becomes the main source of heat exchange in the stratosphere, therefore areas facing the sun will get extremely hot, while areas in the dark will be extremely cold (similar to in orbit conditions).



Standard Atmosphere model

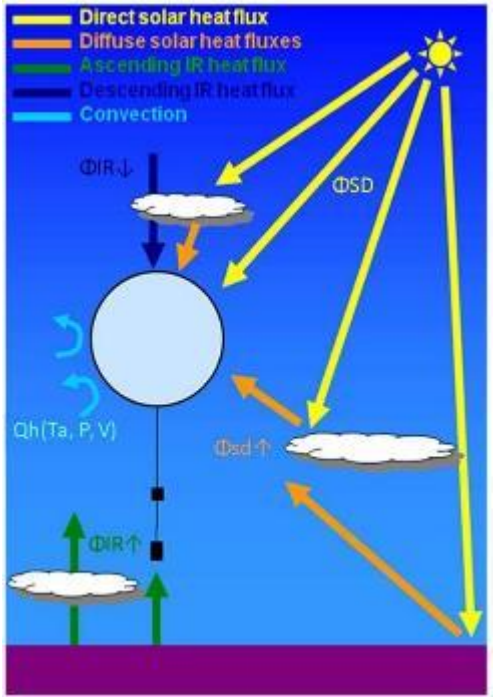




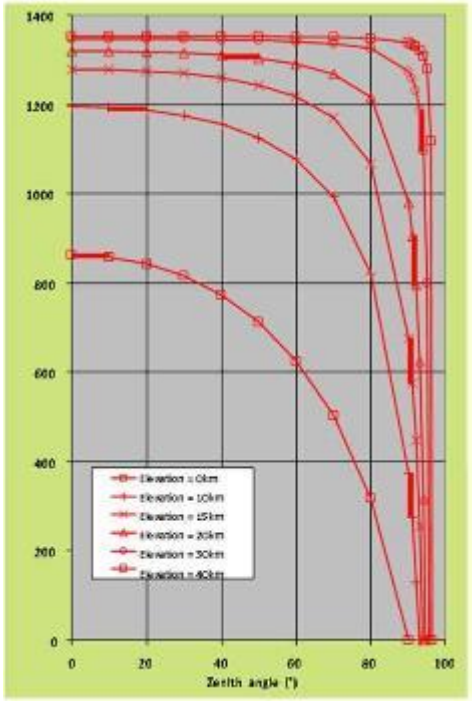
Measurements in flight test
30/03/2020

Flight Conditions – Solar Flux

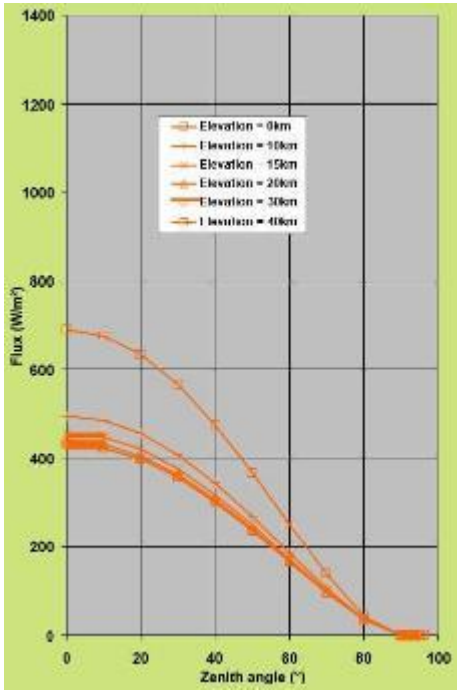
The payload , with its experiments, is exposed to direct solar flux, diffused solar flux reflected from the ground and the clouds (according to their respective albedo, AG and AC), upward infrared (IR) flux from the ground and the clouds at low altitude, downward IR flux from the sky and clouds at high altitude, and convection heat flux from surrounding air which is a function of air temperature, pressure and relative velocity. In the upper stratosphere, convection is negligible, and there is no downwards IR flux.



Sola Flux model



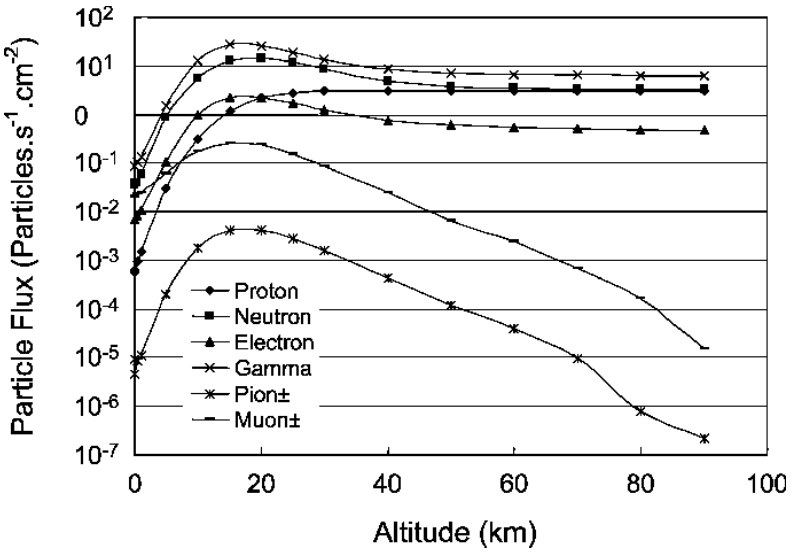
Direct Solar Flux



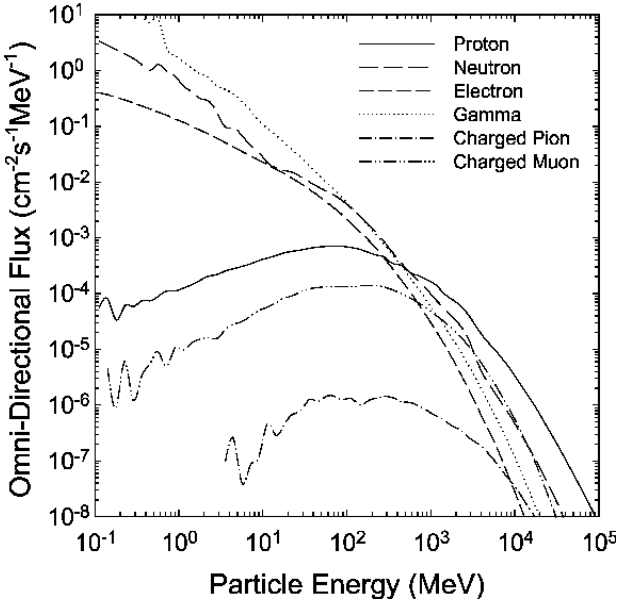
Indirect Solar Flux – Albedo

Flight Conditions – Cosmic Radiation

Current atmospheric radiation models based on cosmic rays interaction show the increasing particle flux with altitude, with maximums achieved between 20 to 40 km.



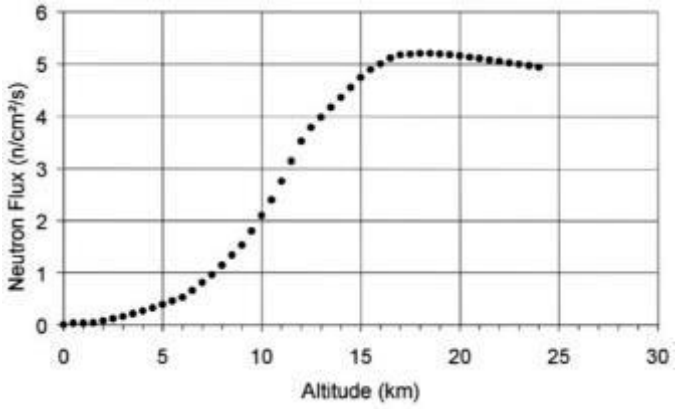
Particles flux in the atmosphere as a function of altitude
(F. Lei model)



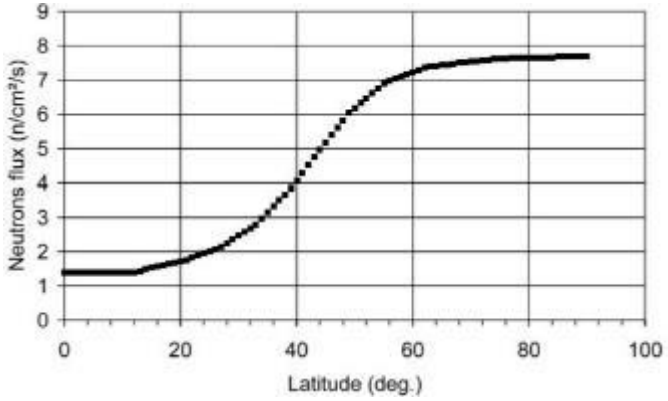
Particle spectra at 17 km of altitude
(F. Lei model)

Flight Conditions – Solar Flux

In the stratosphere, the neutron flux and radiation that systems have to face is several orders of magnitude greater than at ground level.



Neutrons flux in the atmosphere as a function of altitude
(At a latitude of 45° - NASA Langley model)



Neutrons flux in the atmosphere as a function of latitude
(At an altitude 19 km - NASA Langley model)

Latitude	Solar Activity	Flux Ranges $\left(\frac{neutron}{cm^2 hr}\right)$		
		10,000 ft	30,000 ft	60,000 ft
Equator	Active	54-66	609-806	1776-2533
	Quiet	57-72	667-907	2038-3020
45°	Active	105-141	1604-2723	6362-15016
	Quiet	121-178	1969-3832	8541-24261
Polar	Active	142	2744	15286
	Quiet	179	3884	24859

Neutrons flux in the atmosphere vs altitude and location
(NASA Langley model)

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