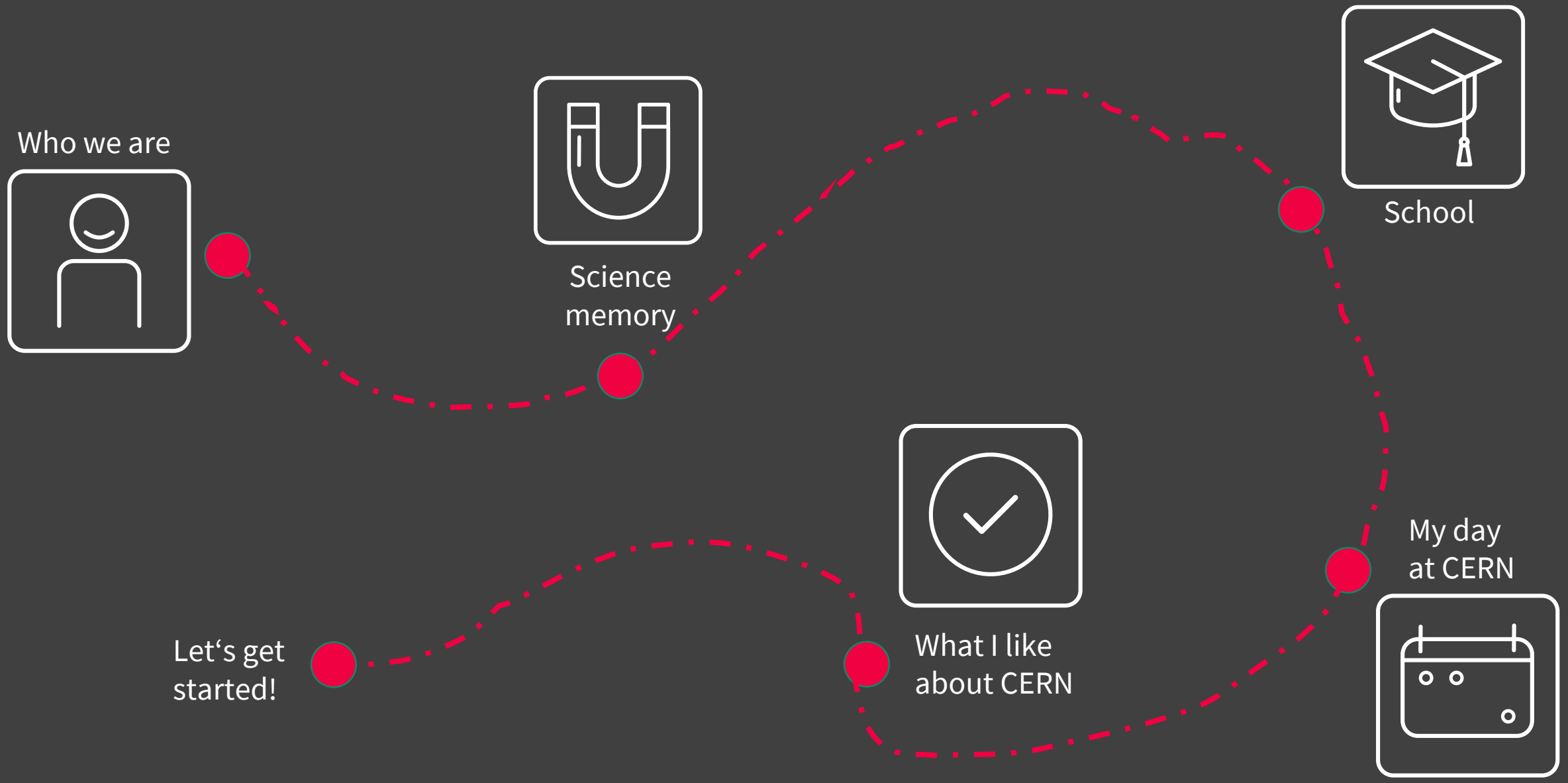
CERN | CERN Science Gateway

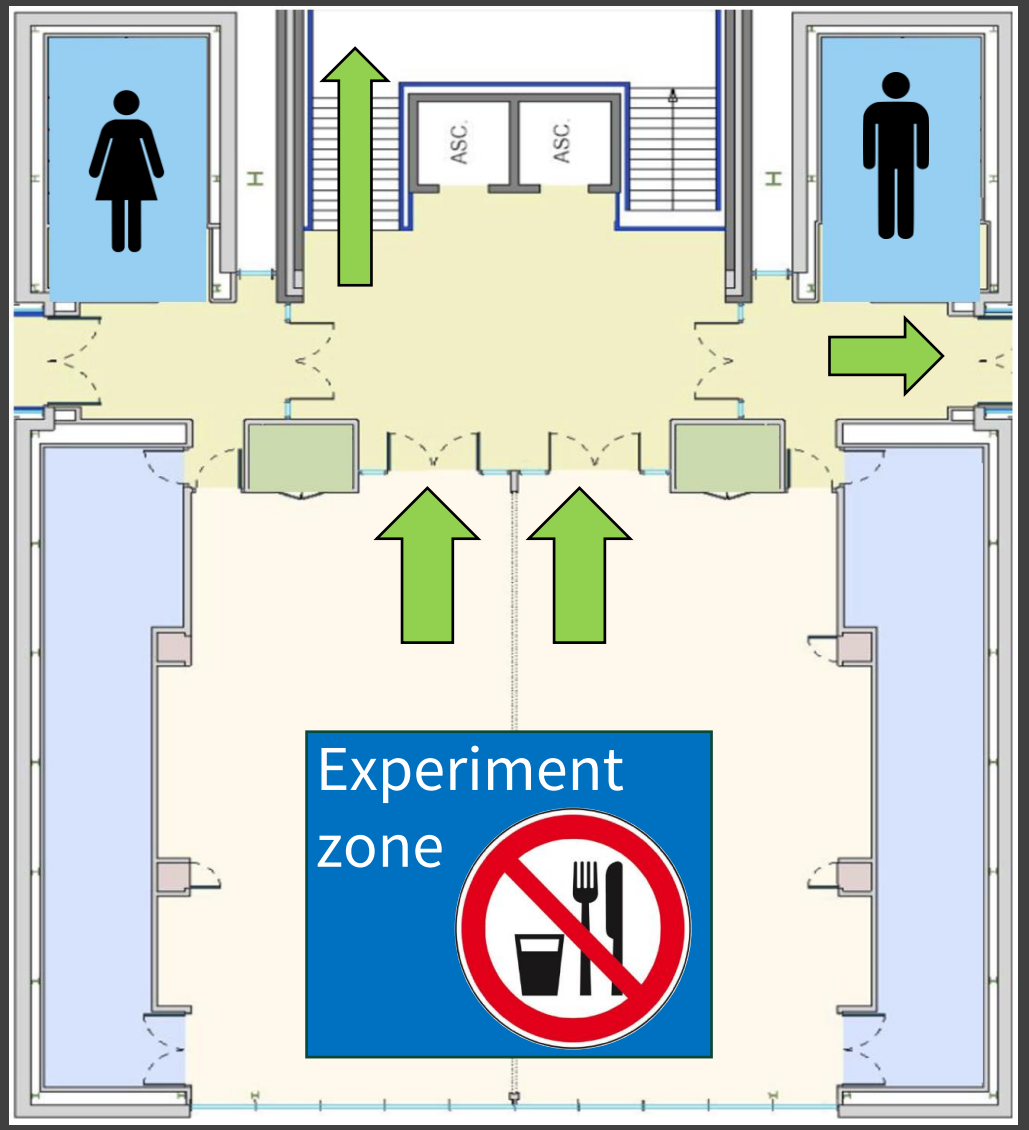
Lab workshop
Cosmic SOS

Discover particle detectors as you travel through space!

We are your guides for this workshop



Emergency exits and general rules



In case of an evacuation alarm:

- Leave your bags behind
- Follow guides to the nearest emergency exit and assembly point
- Wait for the CERN fire brigade

No open flame / No smoking

Toilets

Eating & drinking

Pictures

#CERNScienceGateway

Welcome on board!

You and your fellow crew members are on a critical mission to save Earth. An unknown signal from deep space has caused malfunctions in our spaceship's systems, and it's up to you to troubleshoot and repair the damage. Each activity you complete will bring you one step closer to deciphering the signal and ensuring the safety of our planet.

Safety Instructions

Sensitive and very expensive equipment

Resistors and batteries might heat up during operation. Turn off after use.

Group Roles & Responsibilities

Systems Engineer

Responsible for handling the equipment.

Mission Safety Officer

Responsible for safe use of equipment and PPE.

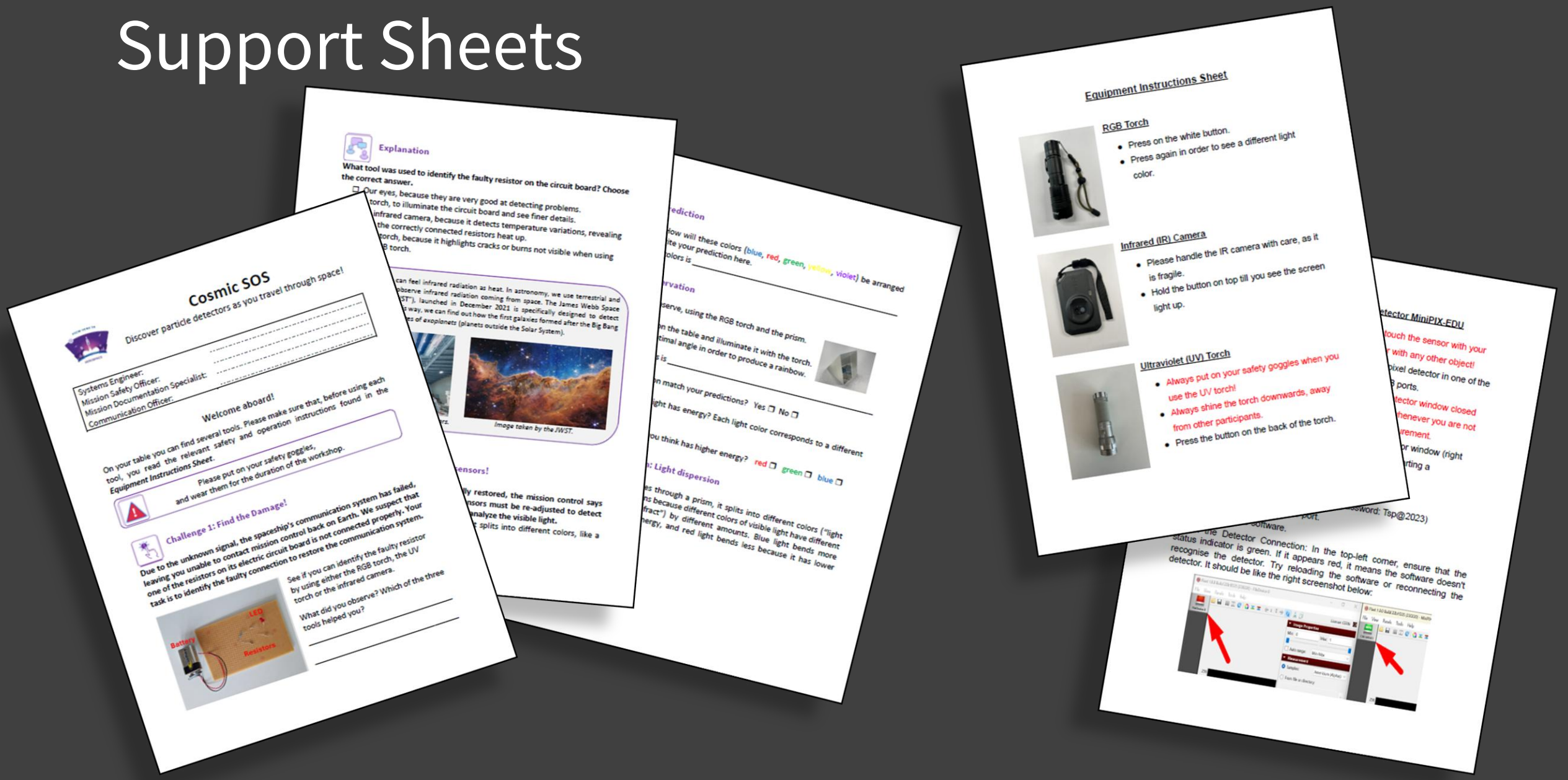
Mission Documentation Specialist

Keeping notes and writing down results.

Communication Officer

Liaise with other peers and tutors.

Support Sheets



Cosmic SOS

Discover particle detectors as you travel through space!

Systems Engineer:
Mission Safety Officer:
Mission Documentation Specialist:
Communication Officer:

Welcome aboard!

On your table you can find several tools. Please make sure that, before using each tool, you read the relevant safety and operation instructions found in the *Equipment Instructions Sheet*.

Please put on your safety goggles,
and wear them for the duration of the workshop.

Challenge 1: Find the Damage!

Due to the unknown signal, the spaceship's communication system has failed, leaving you unable to contact mission control back on Earth. We suspect that one of the resistors on its electric circuit board is not connected properly. Your task is to identify the faulty connection to restore the communication system.

LED
Battery
Resistors

See if you can identify the faulty resistor by using either the RGB torch, the UV torch or the infrared camera.

What did you observe? Which of the three tools helped you?

Explanation

What tool was used to identify the faulty resistor on the circuit board? Choose the correct answer.

❑ Our eyes, because they are very good at detecting problems.
torch, to illuminate the circuit board and see finer details.
infrared camera, because it detects temperature variations, revealing the correctly connected resistors heat up.
torch, because it highlights cracks or burns not visible when using B torch.

can feel infrared radiation as heat. In astronomy, we use terrestrial and observe infrared radiation coming from space. The James Webb Space ST"), launched in December 2021 is specifically designed to detect way, we can find out how the first galaxies formed after the Big Bang s of exoplanets (planets outside the Solar System).

Image taken by the JWST.

ensors!

ly restored, the mission control says nsors must be re-adjusted to detect analyze the visible light.
splits into different colors, like a

ediction

ow will these colors (blue, red, green, yellow, violet) be arranged te your prediction here.
olors is _____

rvation

serve, using the RGB torch and the prism.
n the table and illuminate it with the torch.
timal angle in order to produce a rainbow.
s is _____

n match your predictions? Yes ❑ No ❑

ght has energy? Each light color corresponds to a different

ou think has higher energy? red ❑ green ❑ blue ❑

: Light dispersion

es through a prism, it splits into different colors ("light ns because different colors of visible light have different fract") by different amounts. Blue light bends more ergy, and red light bends less because it has lower

Equipment Instructions Sheet

RGB Torch

- Press on the white button.
- Press again in order to see a different light color.

Infrared (IR) Camera

- Please handle the IR camera with care, as it is fragile.
- Hold the button on top till you see the screen light up.

Ultraviolet (UV) Torch

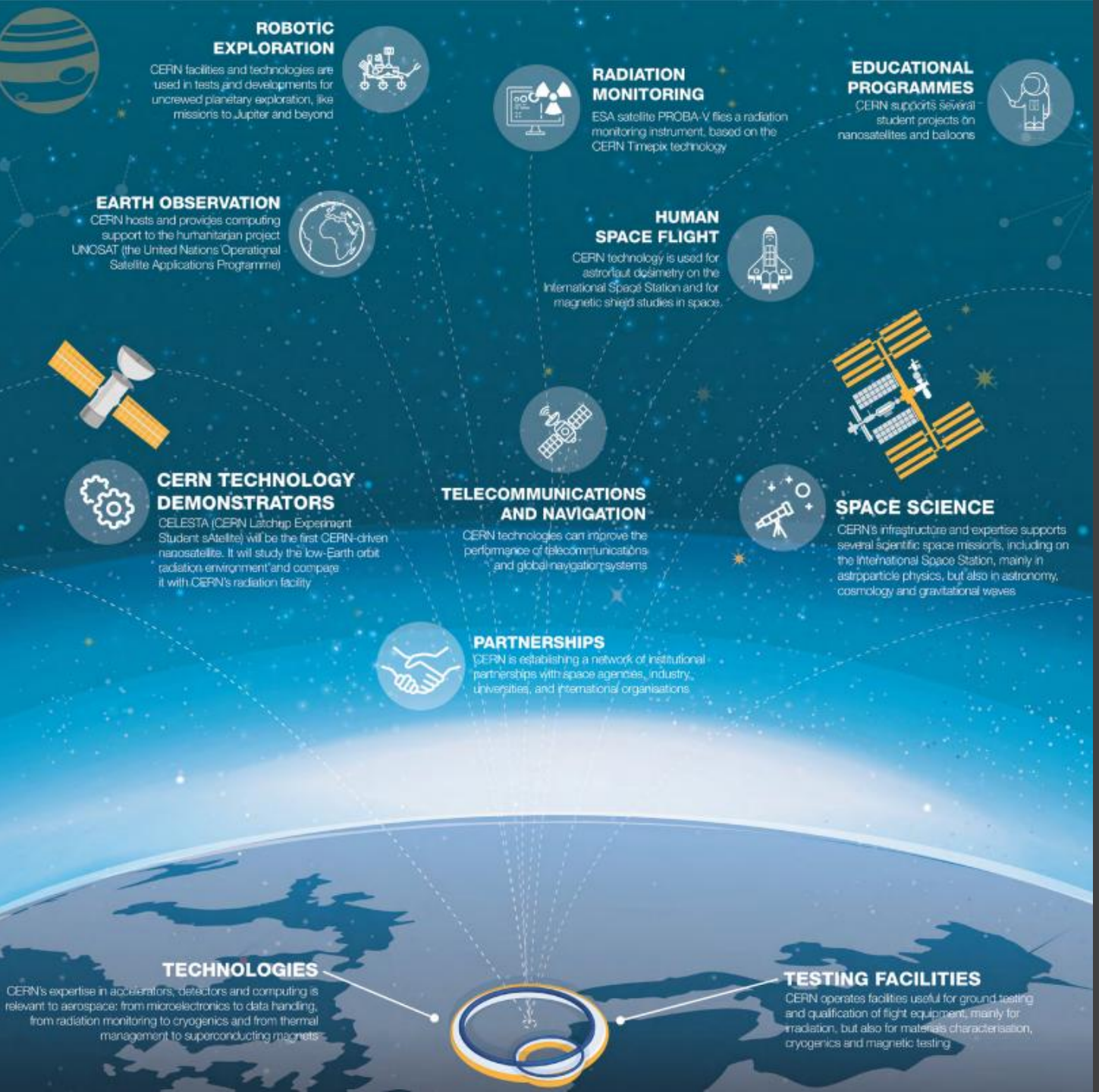
- Always put on your safety goggles when you use the UV torch!
- Always shine the torch downwards, away from other participants.
- Press the button on the back of the torch.

tector MiniPIX-EDU

ouch the sensor with your r with any other object!
ixel detector in one of the B ports.
tector window closed henever you are not rement.
r window (right rting a

Port.
sword: Tsp@2023)
software.

the Detector Connection: In the top-left corner, ensure that the status indicator is green. If it appears red, it means the software doesn't recognise the detector. Try reloading the software or reconnecting the detector. It should be like the right screenshot below:



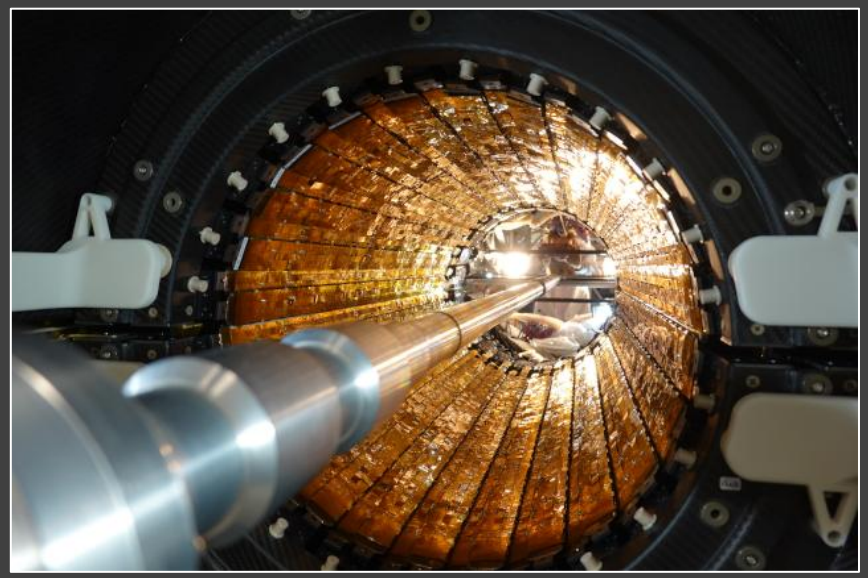
CERN & Aerospace

Aerospace and particle physics share technical similarities, for example:

- Both need electronics that can function in high radiation environments, extreme temperatures and high vacuum conditions.
- Both need to handle large amounts of data quickly and autonomously.

Pixel detectors at CERN and aerospace

Timepix on the International Space Station



The ALICE Inner Tracking system, consisting of about 12 billion pixels

Timepix on NASA’s Orion Rocket

The Alpha Magnetic Spectrometer (AMS)

It's a detector mounted on the International Space Station, orbiting about 400 km above Earth.

AMS uses the unique environment of space to study the universe and its origin by looking for antimatter and dark matter.

It also measures the composition and flux of cosmic radiation. In this way, scientists can better understand the challenges of sending humans to Mars.

AMS is monitored and operated from CERN, where the data analysis also takes place.

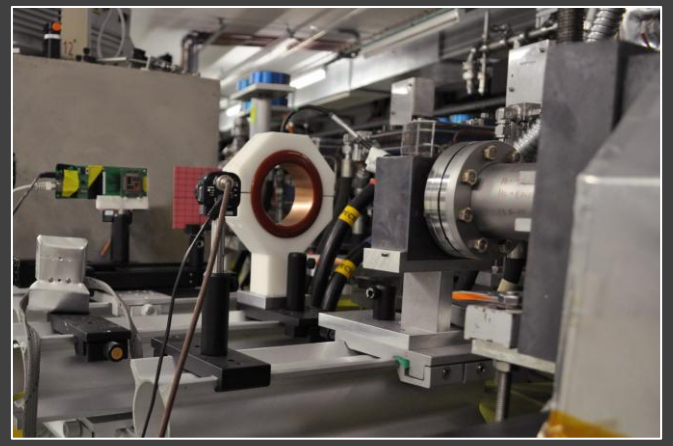
CERN aerospace facility examples

CHARM

Irradiation facility to test how electronics and materials respond to radiation in environments similar to those found in space.

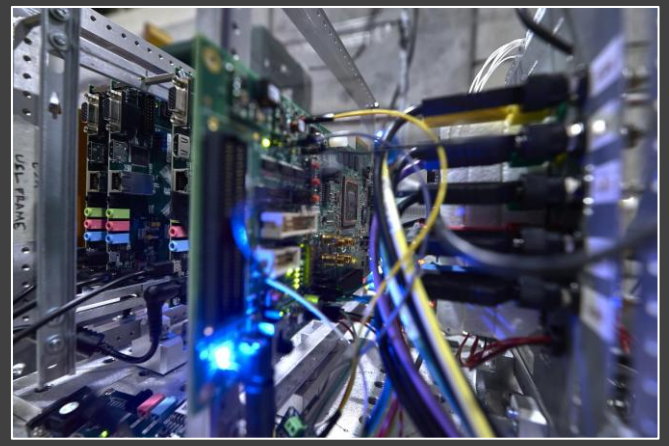
VESPER

High-energy electron beamline replicating Jupiter's harsh radiation environment. Electronic components for **JUICE,** an 8-year mission to Jupiter to explore its icy moons, are tested there.



SPS North Area

Replicates the actual galactic cosmic radiation spectrum, including heavy ions.
Also used to calibrate instruments for space like the AMS.



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Thank you for exploring with us !