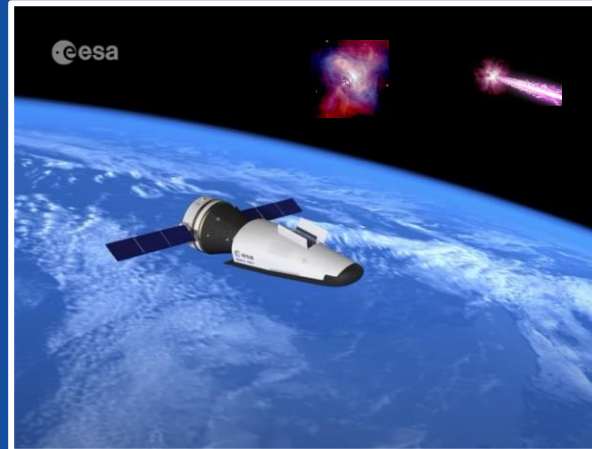


i-Astro Activities

R. M. Curado Silva, Jorge M. Maia, Cristiana Francisco, Alexandre Trindade, José Sousa, Joana Gonçalves, André Neves, Alexandra Roque, Pedro Carmo, Mariana Letra, Mário Cainé, Duarte Rodrigues, Matilde Mendes, Filipa Bessa, Bruna Jorge, Henrique Gaspar Gabriel Falcão, João Campos, Fernando Pinheiro

October 19th, 2024



Science

Society

Outreach



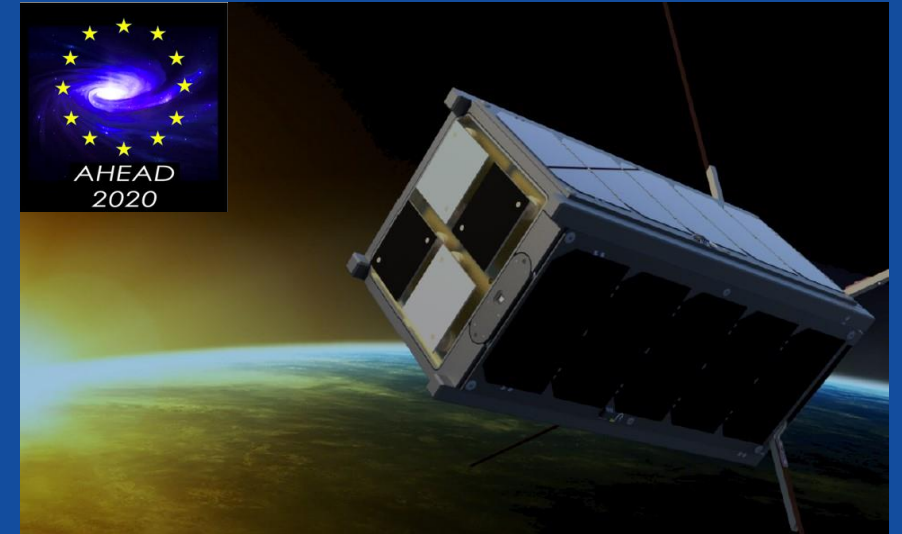
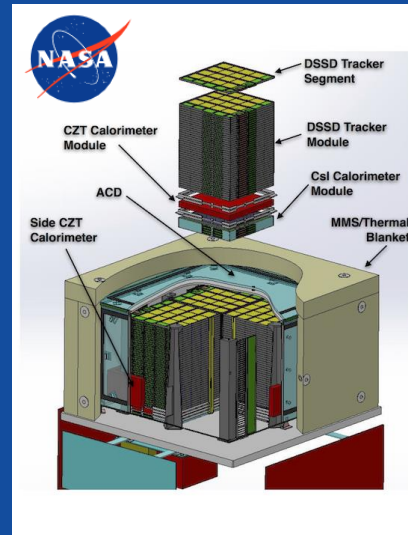
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Our
Partners



Jornadas LIP – Braga – 19/10/2024

High-energy Astrophysics Missions



ASTROGAM (ESA 2022 M7 Pre-selected)

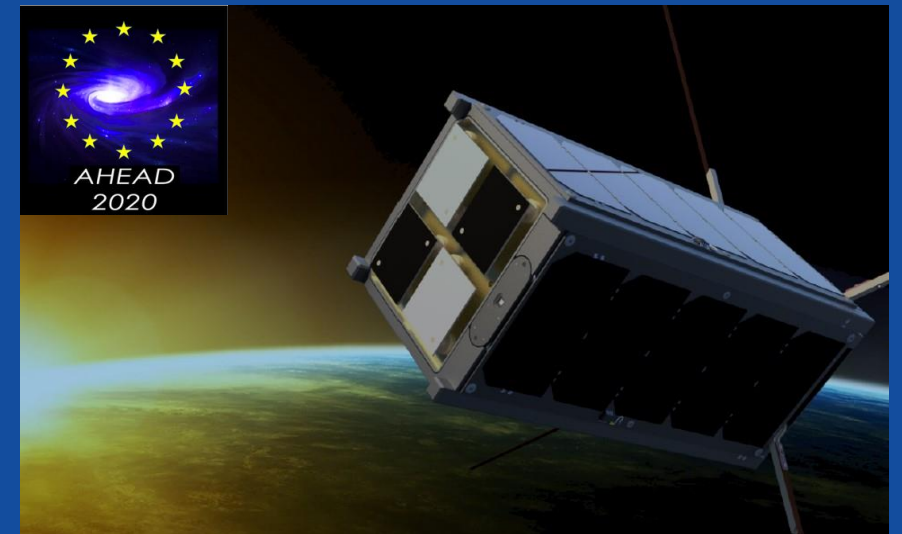
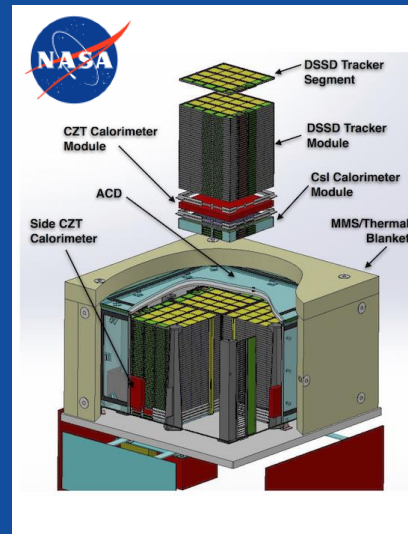
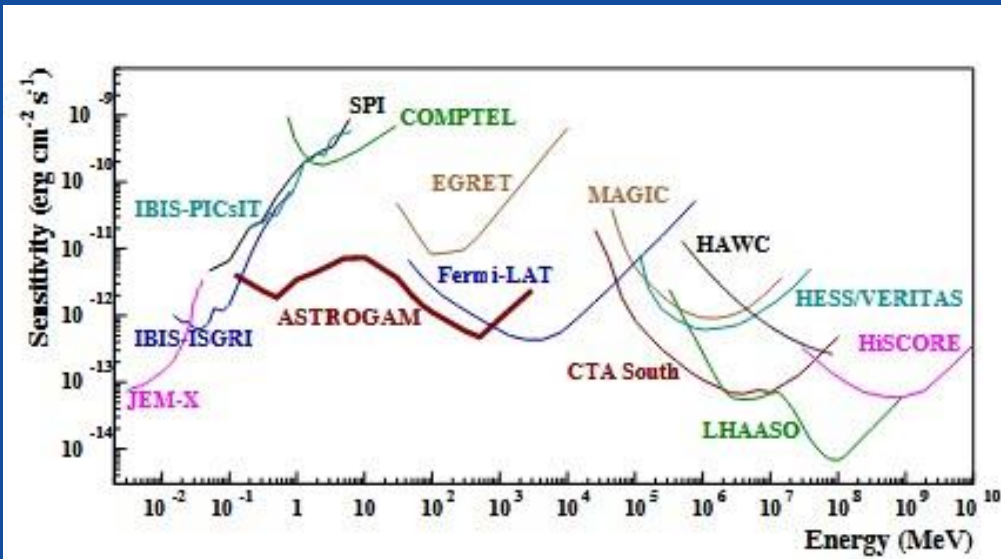
- New MeV Mission is being setup by the same team for next ESA call in 2025

AMEGO (NASA)

- ▶ Polarimetry (sim. and exp.)

COMCube Constellation (EU)

High-energy Astrophysics Missions



ASTROGAM (ESA 2022 M7 Pre-selected)

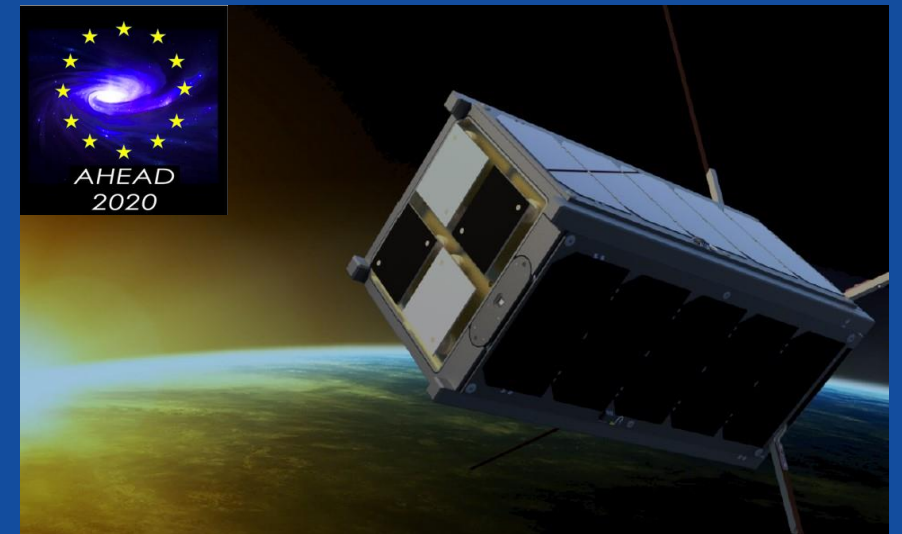
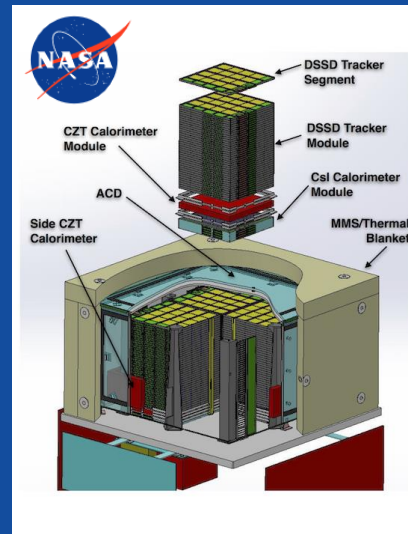
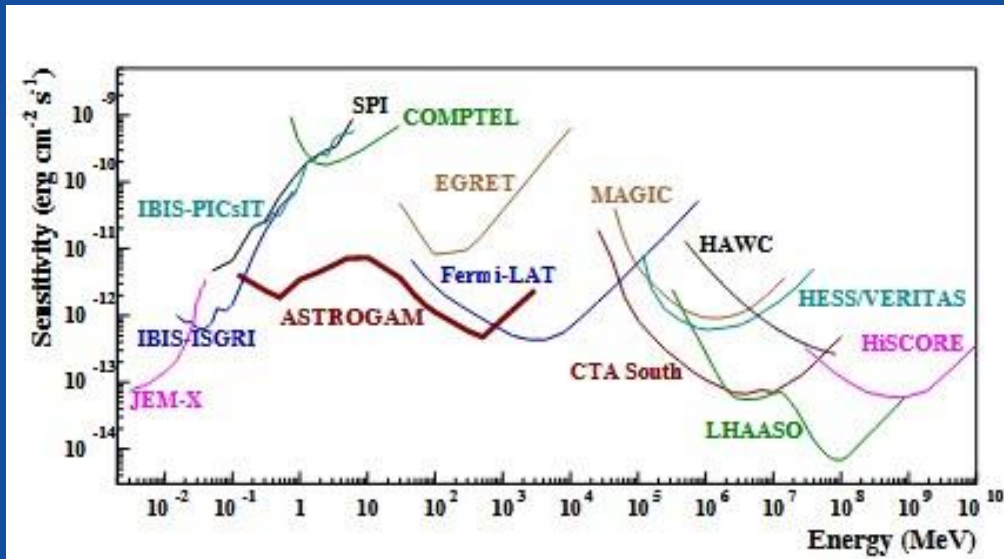
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High-energy Astrophysics Missions



ASTROGAM (ESA 2022 M7 Pre-selected)

- New MeV Mission is being setup by the same team for next ESA call in 2025

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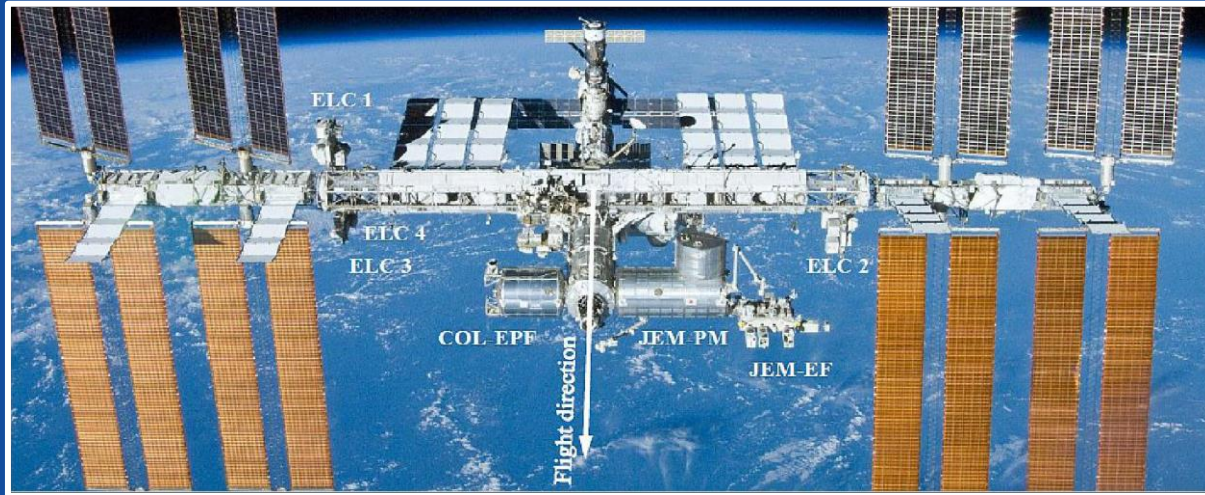
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COMCube Constellation (EU)

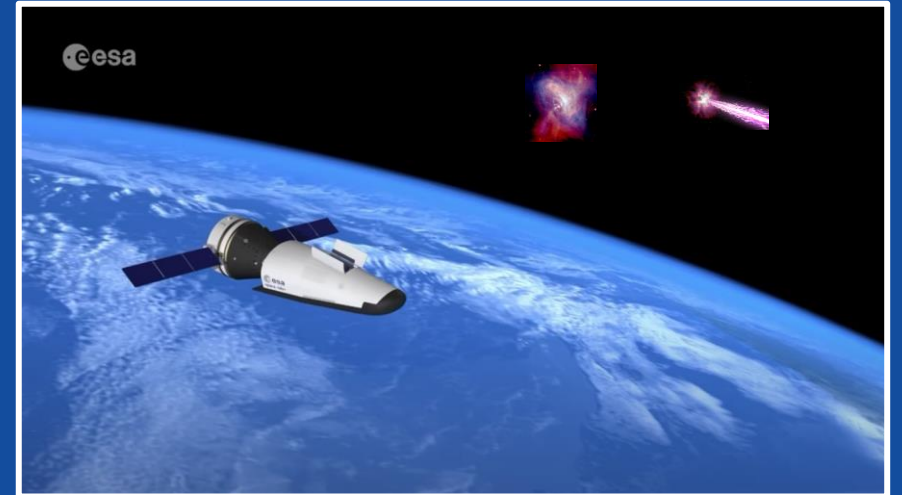
Funded by AHEAD2020

Horizon EU Project

Space Experiments for High-energy Astrophysics



**GLOSS: Gamma-ray Laue Optics and Solid State detectors
(ESA/CNES Euro Ageing Materials)**



**THOR-SR
(ESA Space Rider Maiden Flight Opportunity)**

GLOSS Experiment

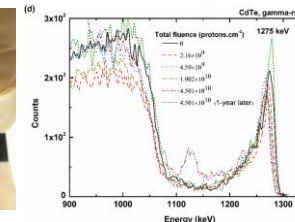
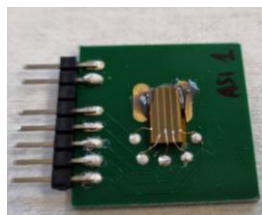
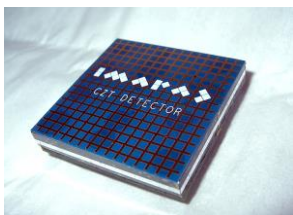
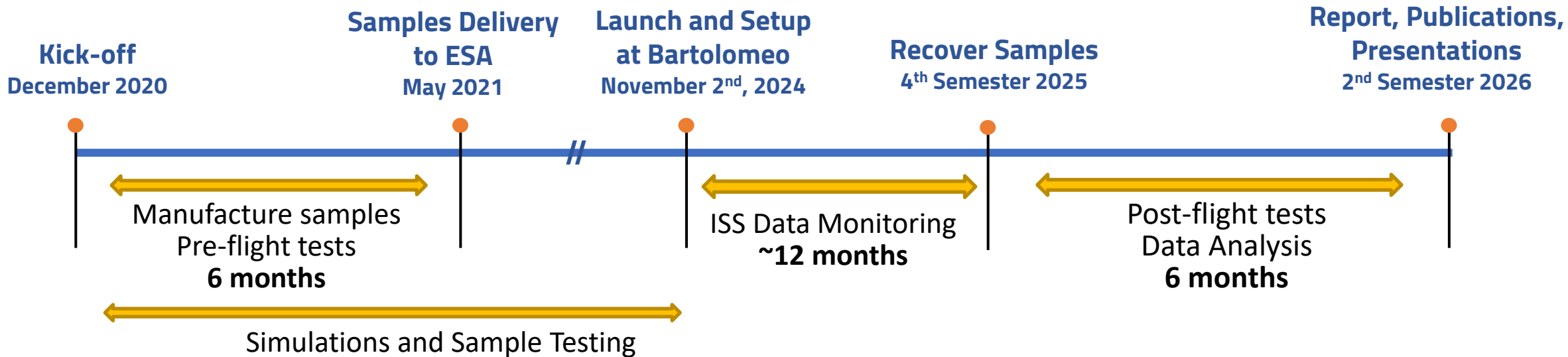


LIP - PI

LIP: CZT

INAF/UF/IMEM:
Ge and Si

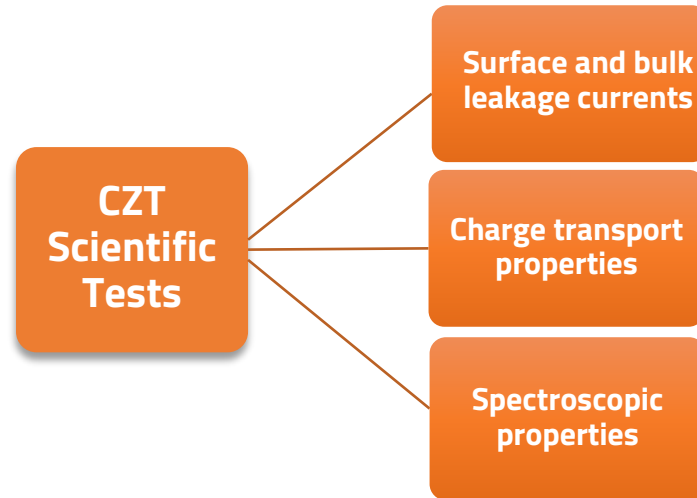
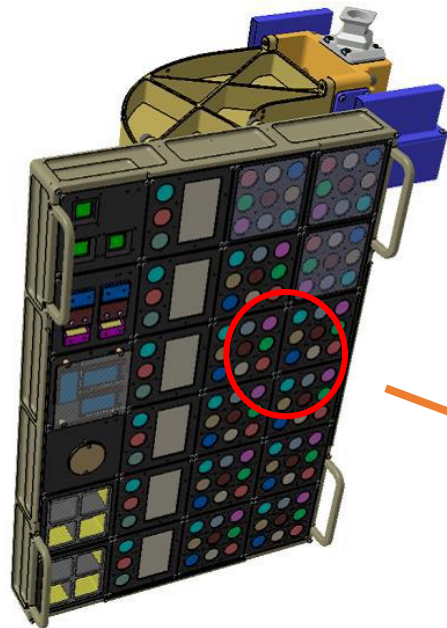
PRODEX
LIP: 115 k€ -> 2026



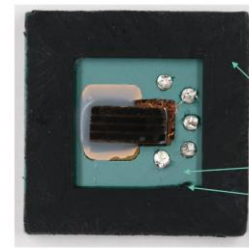
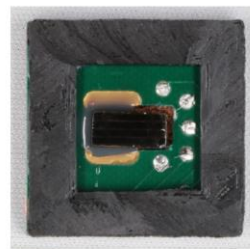
ESA Euro Material Ageing ISS Bartolomeo Experiment

2020-2023 ESA Euro Material Ageing Orbital Radiation Damage on CZT Detectors

- South Atlantic Anomaly
- Solar Activity
- Temperature: -150° up to +120°C
- Radiation



Orbital Oxidation Tests at ESTEC ESA



Significant discoloration

Material flaking off, potential contamination/debris source



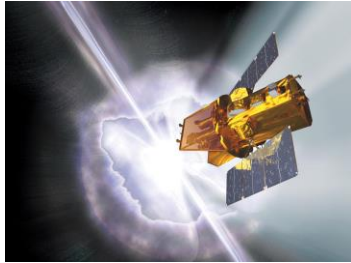
Launch: November 2nd, 2024
Cape Canaveral pad 39A

THOR-SR

Scientific Objectives



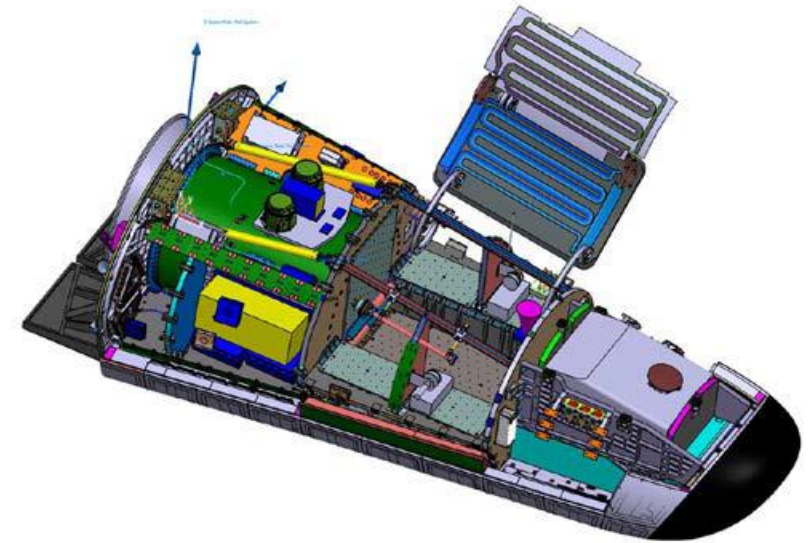
TGF and High energy astrophysics Observatory for gamma Rays



- **High-energy Astrophysics Pathfinder Instrument**
 1. High-energy Sources: Crab Nebula or GRB. Spectroscopy, Imaging, Time Variability and Polarization in all-sky mode.
 2. Particle environment measurements and Radiation ageing (Space Exposure Locker);
- **TGF Science and Aviation Safety:**
 1. TGF monitor test;
 2. TGF polarization: outstanding scientific measurement



THOR-SR Experiment



- Locker for Space Exposure or Locker for Field of View
- Volume: ~4U
- Scientific Payload Mass: < 3 kg
- Not pressurized, (0° min up to 50° max)

PRODEX

LIP: 480 k€ -> 2027

Industrial Partners



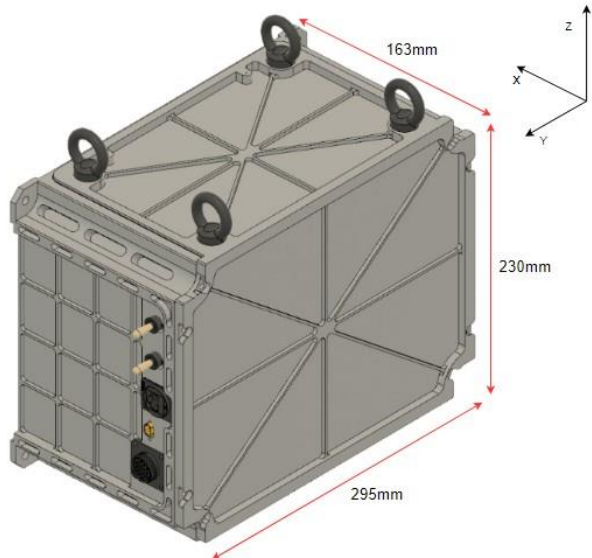
- Payload enclosure



- Detector and readout electronics

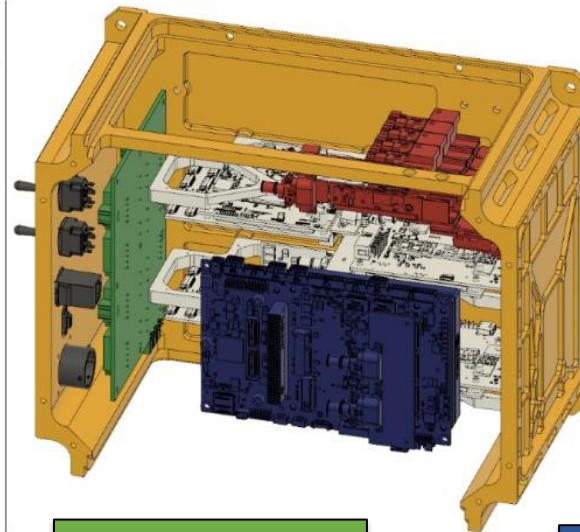
WP3: THOR Payload Design status

Enclosure View



Anodized Al
Interface w/ SR
20°-40° C
Power 50W

Subsystems View



PDU

OBC

ADVACAM
Imaging the Unseen

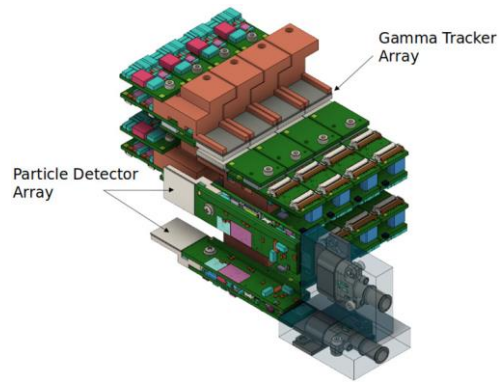
Detector Unit

16 CdTe detectors – Gamma-ray sky and TGFs
2 Si detectors – Orbital environment

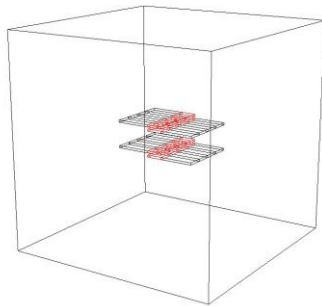
Nvidia Jetson Orin GPU

Simulations

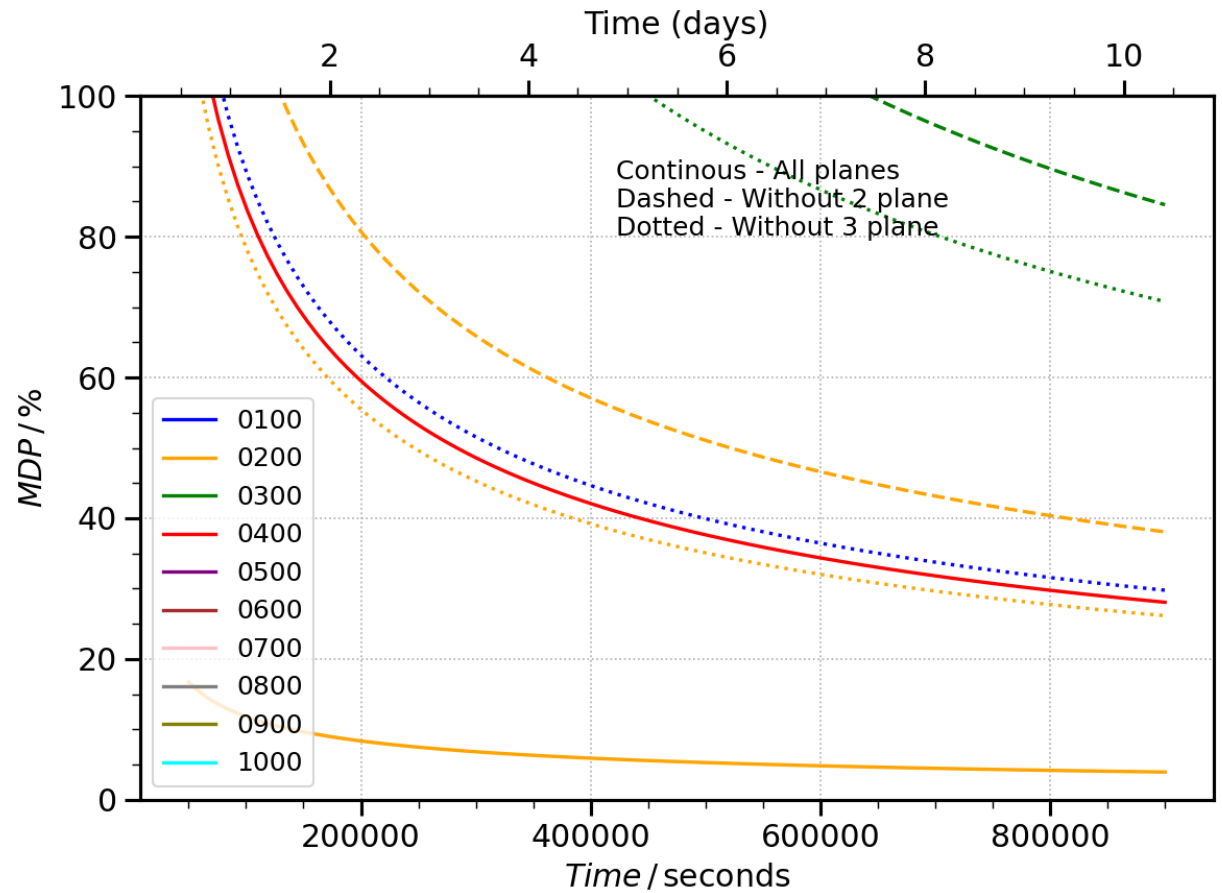
Fine polarimetry even when only 3 DU gamma-ray tracker layers are operating, therefore when a lower power consumption mode can be implemented if needed



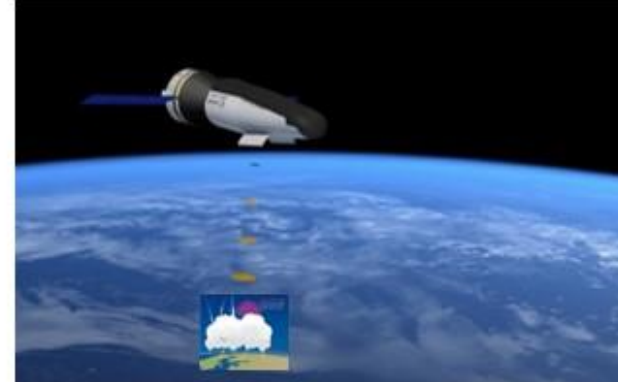
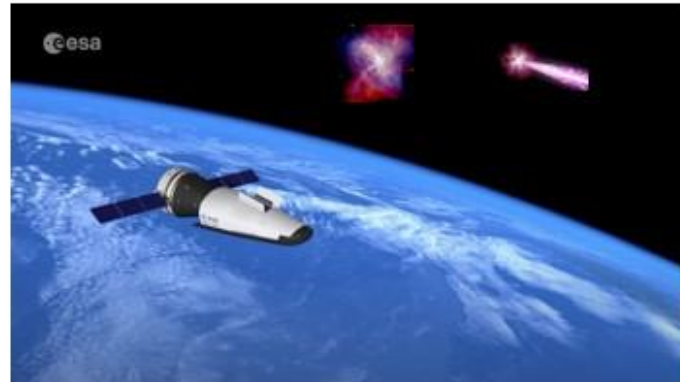
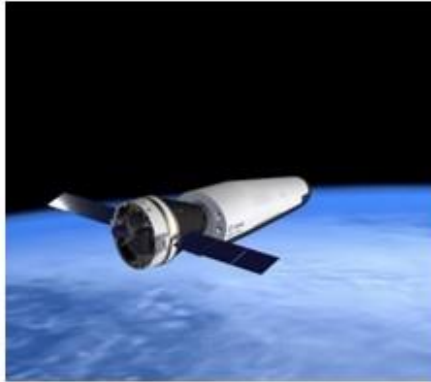
Gamma-ray Tracker Design



Simulation Model



Mission Flight Modes



Initialization



1 hour

The experiment power is switched on. The experiment starts to record gamma-ray events and storing the data.

Power off; No TD; No Com

Gamma Sky Mode



1 month

During this pointing mode, the monitor window and the top of the space rider should be oriented towards the deep sky (ideally to the zenith), to preferentially record gamma-ray astrophysical emission sources (Crab, GRBs or others).

Power 20W; TD 40W; Com 1.5 GByte/day

Earth Mode



1 month

During this pointing mode, the monitor window and the top of the space rider should be oriented towards Earth (ideally to the nadir), to preferentially record TGFs.

Power 20W; TD 40W; Com 1.5 GByte/day

End of Operation



~1 hour

Switch off the experiment power

Power off; No TD; No Com

T0

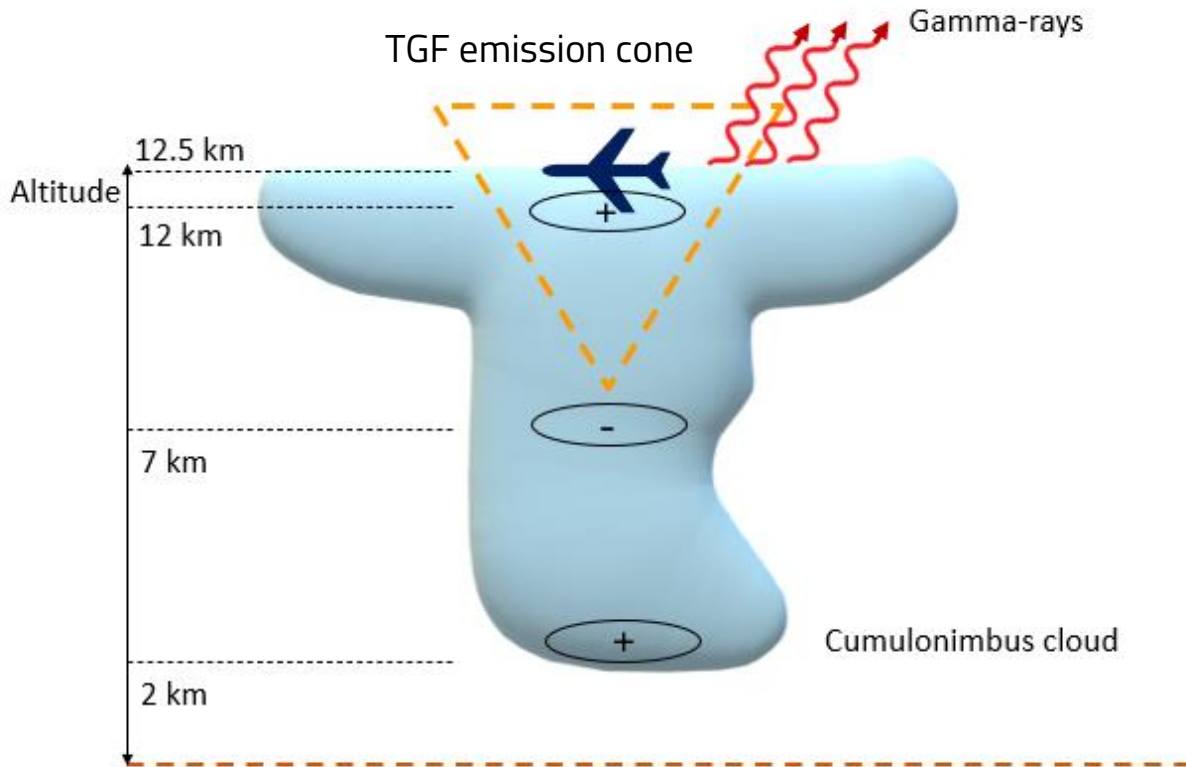
T0 + 1h

T0 + 1 month

T0 + 2 months

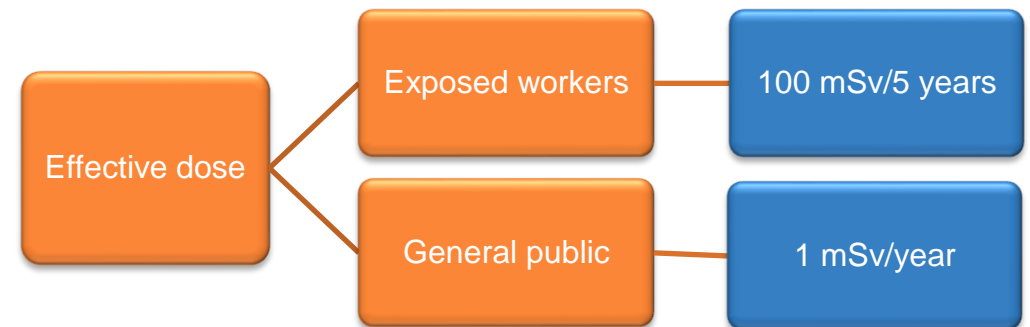
T0 +
2 months

Spin-off TGF Risks for Aviation

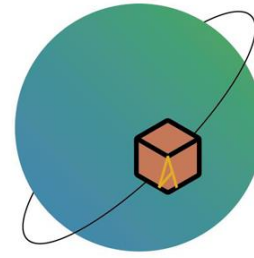


Tripole structure of a cumulonimbus cloud.

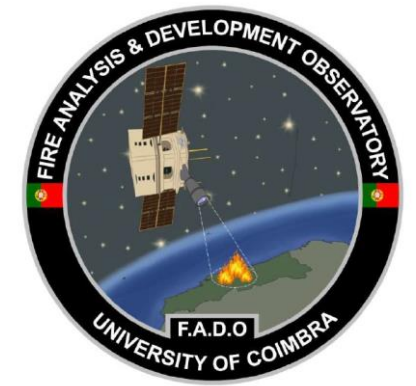
Distance (km)	Effective dose (mSv)	
	Average TGF	Strong TGF
5.0	1.4×10^{-4}	0.59
2.5	5.6×10^{-3}	20.1
0.5	0.38	211



Outreach Student Ballon and Cubesat Experiments



ANTAEUS



2022-23

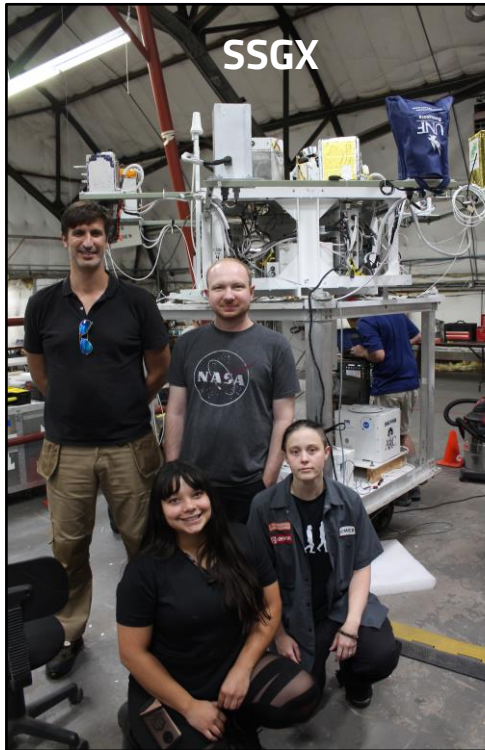
Pre-selected in Fly Your
Satellite ESA Call

High-energy astrophysics
instrumentation technology

2024

Proposal to Cubesat
Portugal PT Space Call

Demonstrator for fire-
fighting monitoring



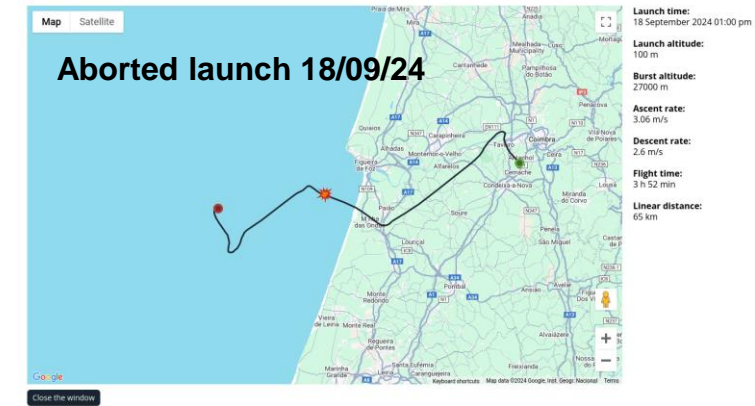
September 4th, 2018

3 days flight;
~40 km altitude



September 29th, 2021

3h flight;
~27 km altitude



Next Week: October 21 to 23rd

THOR Power Distribution Unit Prototype test Meteorological Ballon Flight ~22 km



i-Astro Group

i-Astro is an interdisciplinary team:

- Physics
- Electrotechnical engineering
- Computer Science
- Mechanical engineering
- **6 senior researchers; 1 postdoc; 2 PhD**; 11 master students

R. M. Curado Silva;
Jorge M. Maia;
Alexandre Trindade;
Cristiana Francisco;
José Sousa;
Joana Gonçalves;
André Neves;
Mariana Letra;
Alexandra Roque;
Pedro Carmo;
Mário Cainé;
Duarte Rodrigues;
Matilde Mendes;
Filipa Bessa;
Bruna Jorge;
Henrique Gaspar;
Gabriel Falcão;
João Campos;
Fernando Pinheiro;
Filomena Santos