LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

Medical and Space Applications

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15 minutos

Medical and Space applications

- Use of Beam lines and accelerators
- Detector design and development
- Radiation analysis and dosimetry
- Detector Simulation
- Data Analysis / Image reconstruction techniques

Medical Applications

In 2018 the Portuguese Government approved the strategic orientations for the creation of a health unit for the treatment of cancer with charged particle beams

DRE
DIÁRIO DA REPÚBLICA ELETRÓNICO
SEXTA-FEIRA, 17 DE MAIO DE 2019

Resolução do Conselho de Ministros n.º 28/2018

Publicação: Diário da República n.º 49/2018, Série I de 2018-03-09
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Tipo de Diploma: Resolução do Conselho de Ministros
Número: 28/2018
Páginas: 1246 - 1249
ELI (Identificador Europeu da Legislação) :
https://data.dre.pt/eli/resolconsmin/28/2018/03/09/p/dre/pt/html

Versão pdf: Descarregar
SUMÁRIO

Aprova as orientações estratégicas para a criação de uma unidade de saúde para o tratamento de doentes com cancro com recurso a terapias de feixes de partículas de elevada energia

Medical Applications

An association, Prototera, was then funded

The ProtoTera Association aims to promote and develop a national research and teaching network in advanced therapies and associated technologies, enhancing research infrastructures,training and healthcare associated with the treatment of patients with cancer using new technologies, namely in:

A) Effects of high energy radiation on biological and material systems

B) High energy particle beam therapies (eg protons)

C) Theranostic for the increment of a precision and customized medicine

D) Accelerators, beam lines, planning systems, imaging

E) Advanced Medical Imaging

SUPPORT

The ProtoTera is a joint collaboration between:

Instituto Português de Oncologia

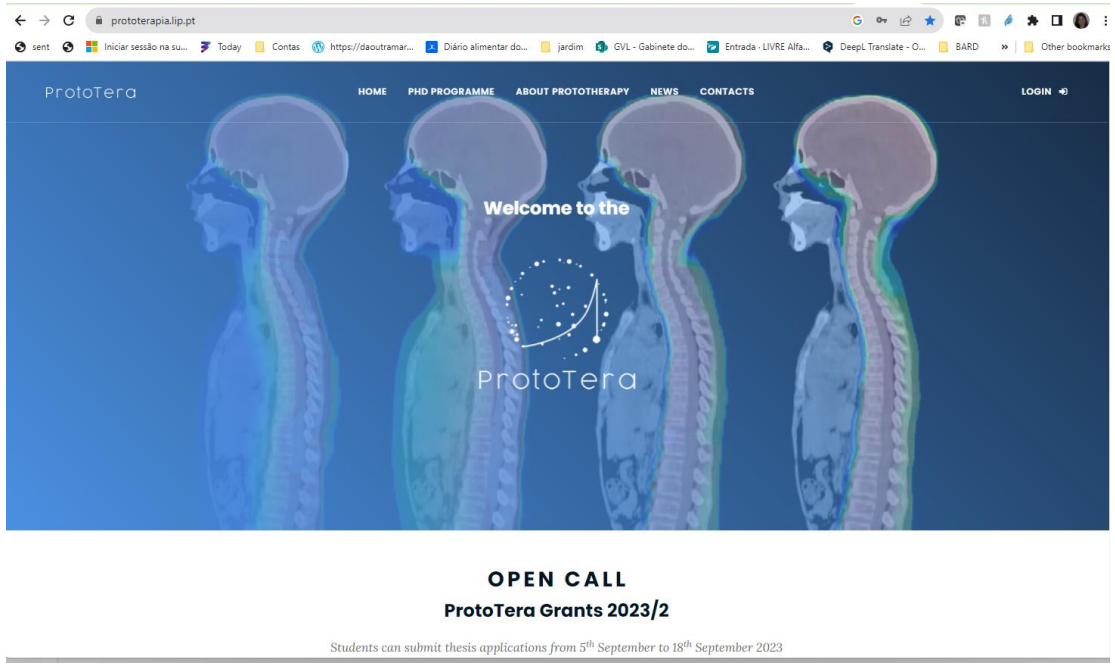
CTN - Campus Tecnológico e Nuclear do Instituto Superior Técnico

ICNAS - Instituto de Ciências Nucleares Aplicadas à Saúde

LIP - Laboratório de Instrumentação e Física Experimental de Partículas

Medical Applications

The Prototera Grant Programme



Last call – Programme will be discontinued

A PhD Program to constitute a community of PhDs with multidisciplinary training in the areas of medicine, technology and physics that support the installation and operation in Portugal of cancer treatment centres using proton beam therapy.

The grants are funded by FCT and managed by LIP under the Agreement signed between FCT and the ProtoTera Association

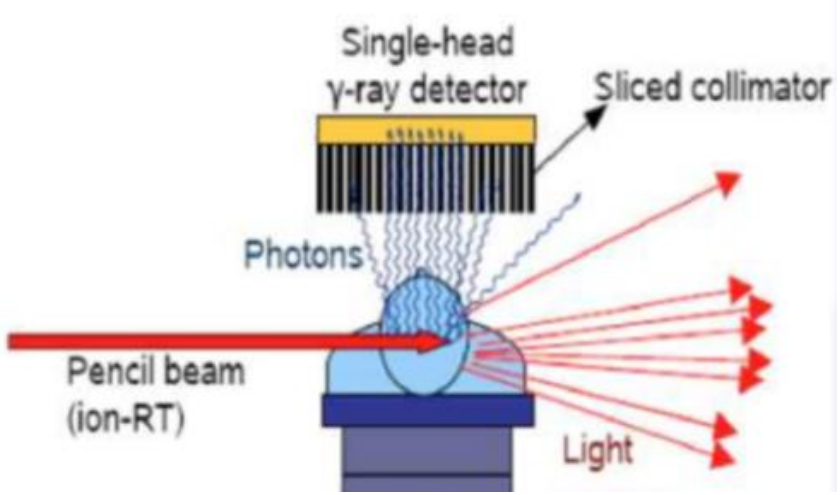
1st call - fall 2020	– 4 grants
2nd call - spring 2021	– 4 grants
3rd call - fall 2021	– 5 grants
4th call - spring 2023	– 6 grants
5th call - fall 2023	– 11 grants (*)
Total	**30 grants**

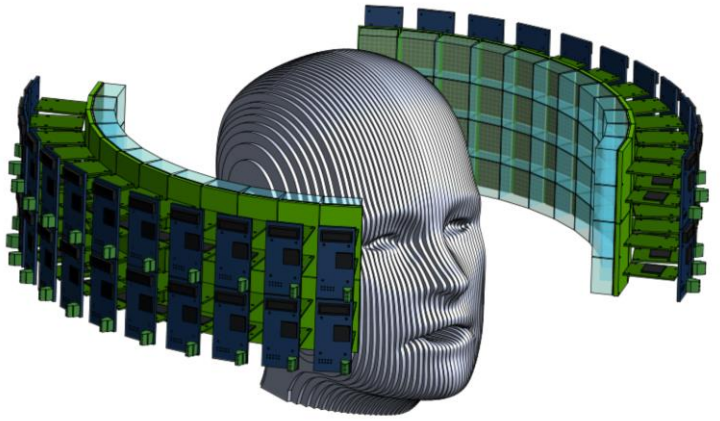
OR-Imaging
Orthogonal Gamma Imaging

LIP Coimbra pole
PI : Paulo Crespo

Themes

1. Ortho CT - Orthogonal Computed Tomography for X-Ray Therapy)
2. O-PGI - Orthogonal Prompt-Gamma Imaging for Proton Therapy)
3. TPPT - In-Beam TOF-PET for Proton Therapy)





FCT: CERN/FIS-TEC/0017/2021 & CERN/FIS-TEC/0019/2019

UT-Austin Project 45904 (SI-47-2019-05) - PetSys, ICNAS (UC), CTN(IST) & LIP

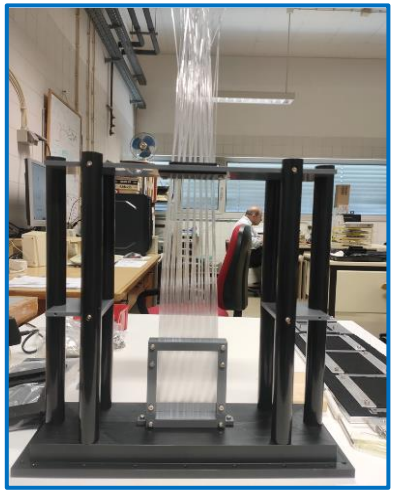
Dosimetery / RADART

Radiation dosimetry to Advance RadioTherapy

LIP Lisboa pole
Group created in 2018
PI: Jorge Sampaio

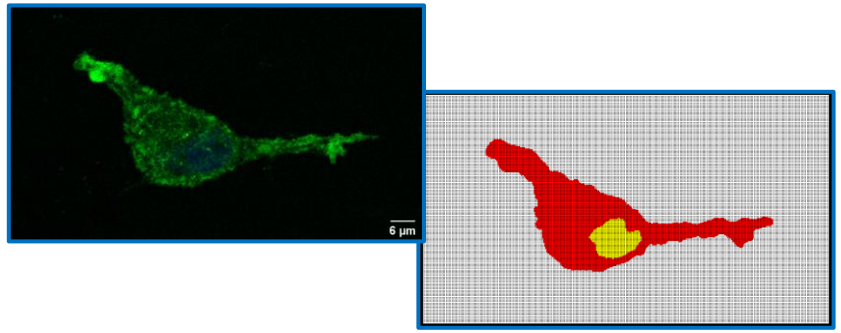
Detectors and materials for high-resolution dosimetry

- SPOF array for high-res dosimetry
- Development of materials for micro and nanodosimetry



New modalities and applications in RT

- Modeling radiobiological effects of Nano Particles
- Advance charged-particle MBRT
- Advance FLASH-RT
- Effects of PT in NeuroDegenerative Disorders



Funding

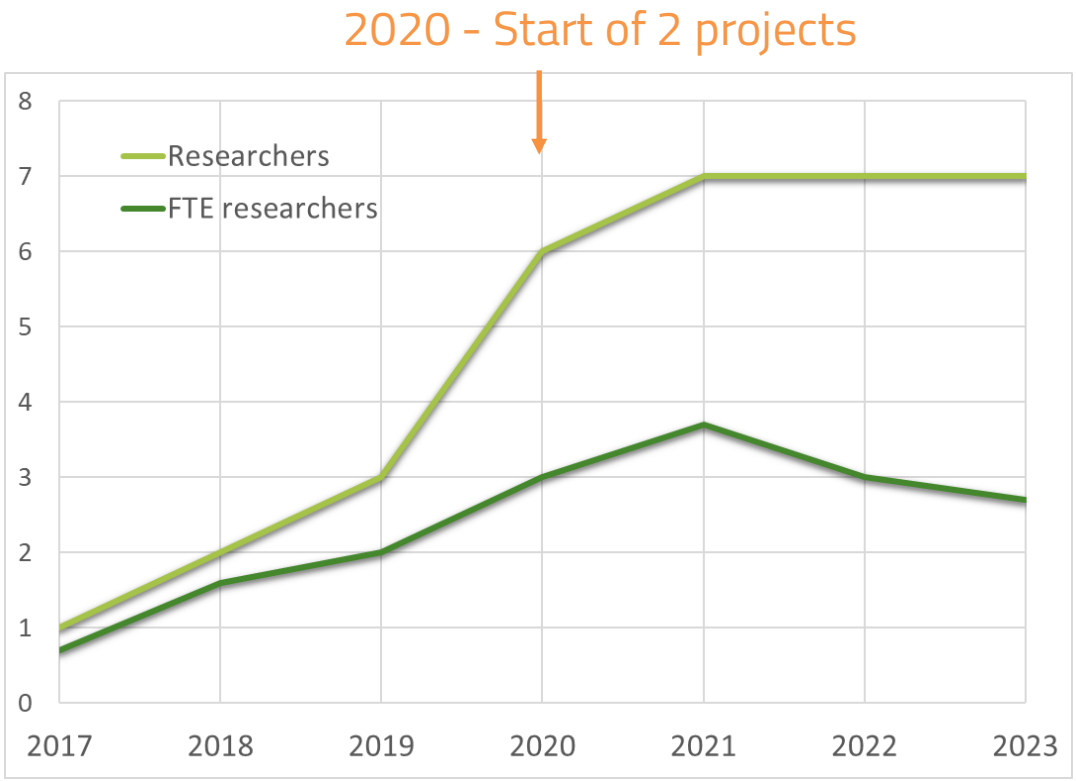
Average funding (k€)	Group	2017	2018	2019	2020	2021	2022	2023
TPPT (PT-Austin)	OR-Imaging				55.5	55.5	55.5	55.5
CERN FIS 2019	OR-Imaging & RADART				45.0	45.0		
CERN FIS 2021	OR-Imaging & RADART						45.0	45.0
Total		**0**	**0**	**0**	**100.5**	**100.5**	**100.5**	**100.5**

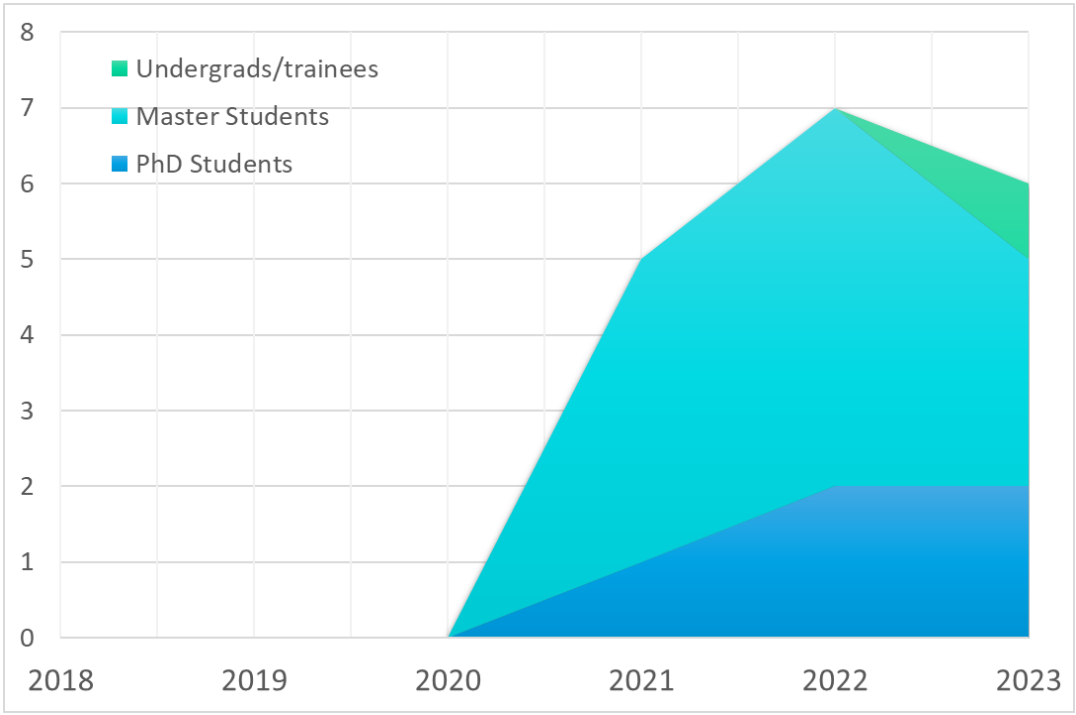
For 2024 - …

- OR- Imaging -> Application to a NIH (USA) call:
  FLASH beam studies using PET/PGI/SPECT imaging and dosimetry
  311 k€ for a 5-year project == 1 researcher
- LIP is Joining a COST Action on
  "Anatomy and Biomarker-Based Adaptive Particle Therapy for Cancer Patients across Europe."
- CERN FIS 2023 ? 2023 generic call for project funding ? **November/December 2023 ?**

OR-Imaging

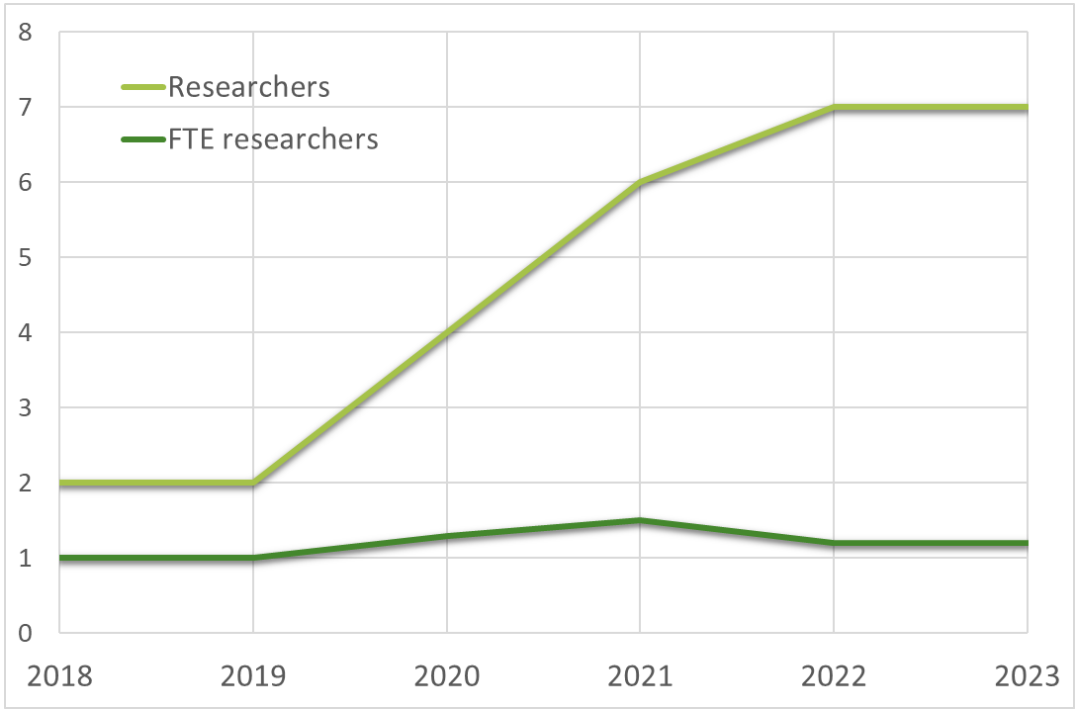
Orthogonal Gamma Imaging



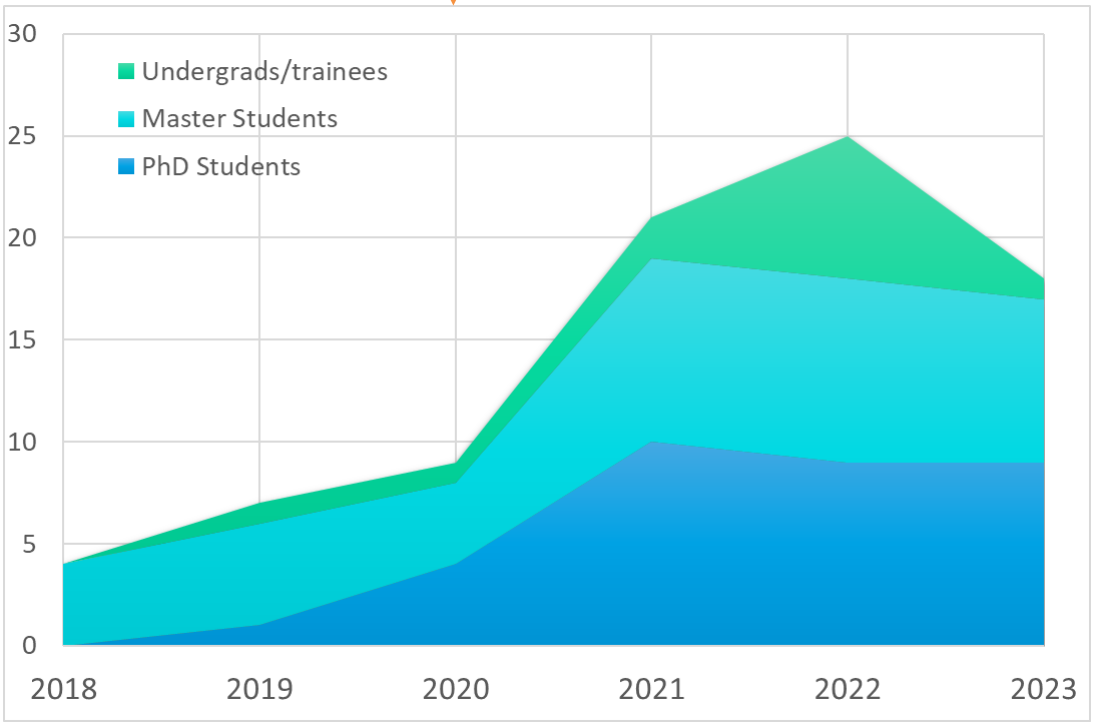


Dosimetery / RADART

RAdiation Dosimetry to Advance RadioTherapy



2020 – Start of Prototera Grants

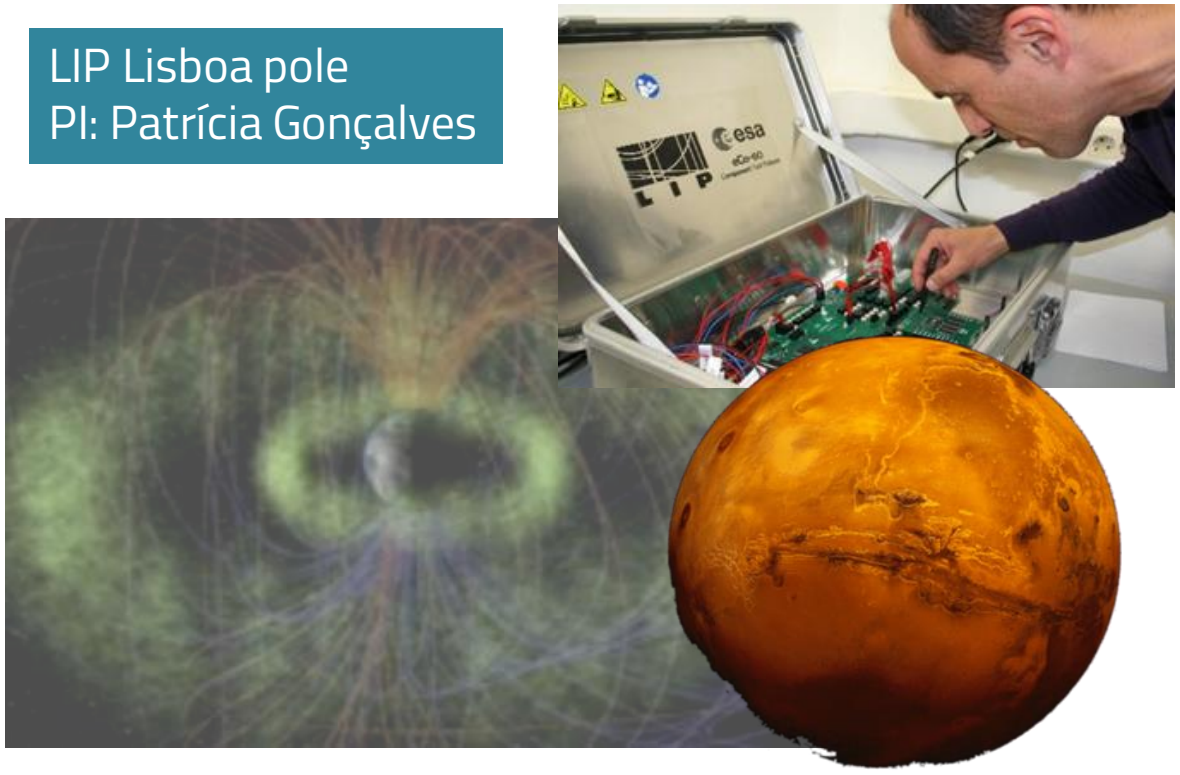


Space Applications

Portugal Joined ESA in 2000

SpaceRad
Space Radiation Environment and Effects

LIP Lisboa pole
PI: Patrícia Gonçalves



i-Astro
Instrumentation for high energy gamma ray astrophysics in Space

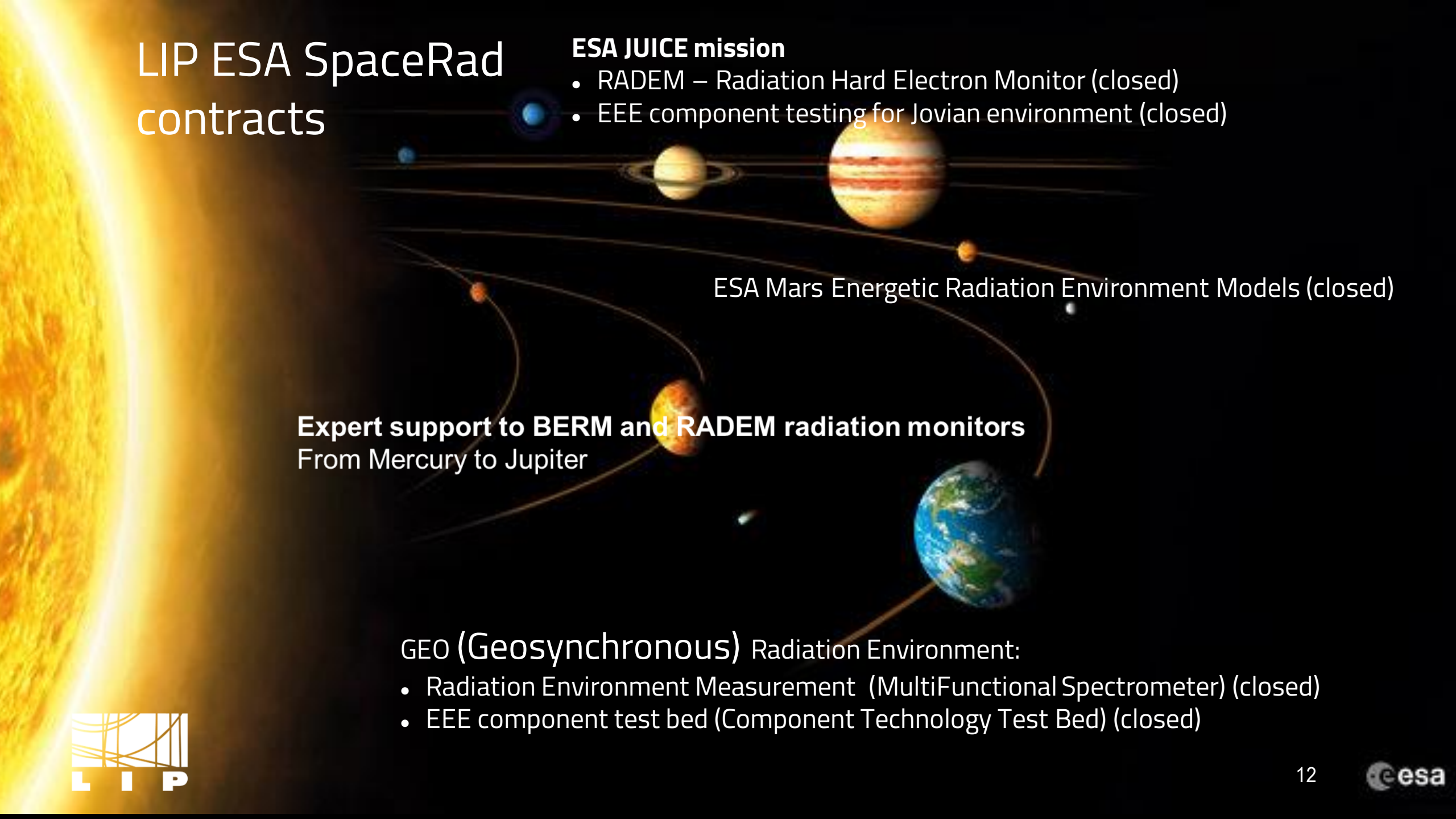
LIP Coimbra pole
PI: Rui Curado da Silva

LIP ESA SpaceRad contracts

ESA JUICE mission

- RADEM – Radiation Hard Electron Monitor (closed)
- EEE component testing for Jovian environment (closed)

ESA Mars Energetic Radiation Environment Models (closed)



GEO (Geosynchronous) Radiation Environment:

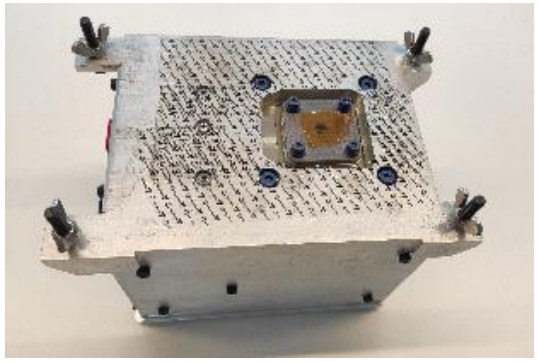
- Radiation Environment Measurement (MultiFunctional Spectrometer) (closed)
- EEE component test bed (Component Technology Test Bed) (closed)

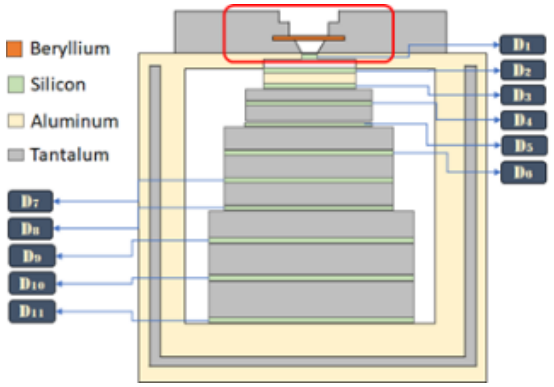
The radiation environment in the solar system: from Mercury to Jupiter

To Mercury – BepiColombo Mission (2018)
BERM – BEpiColombo Radiation Monitor

Measurement
- electron, proton and ion spectra

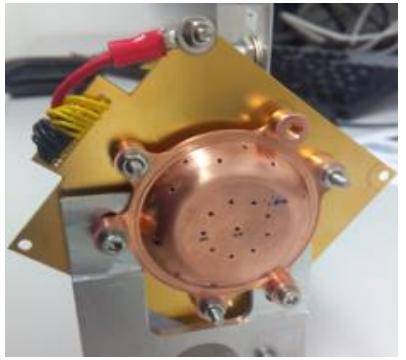
Earth radiation belts measurements in 2021
Now near Mercury

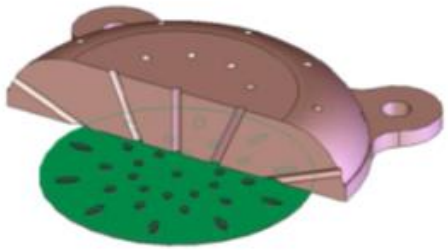




To Jupiter – ESA JUICE Mission (2023)
RADEM – RADiation hard Electron Monitor

Measurement
- electron and proton spectra
- ion LET
- electron directionality
- **JUICE launched in April 23**





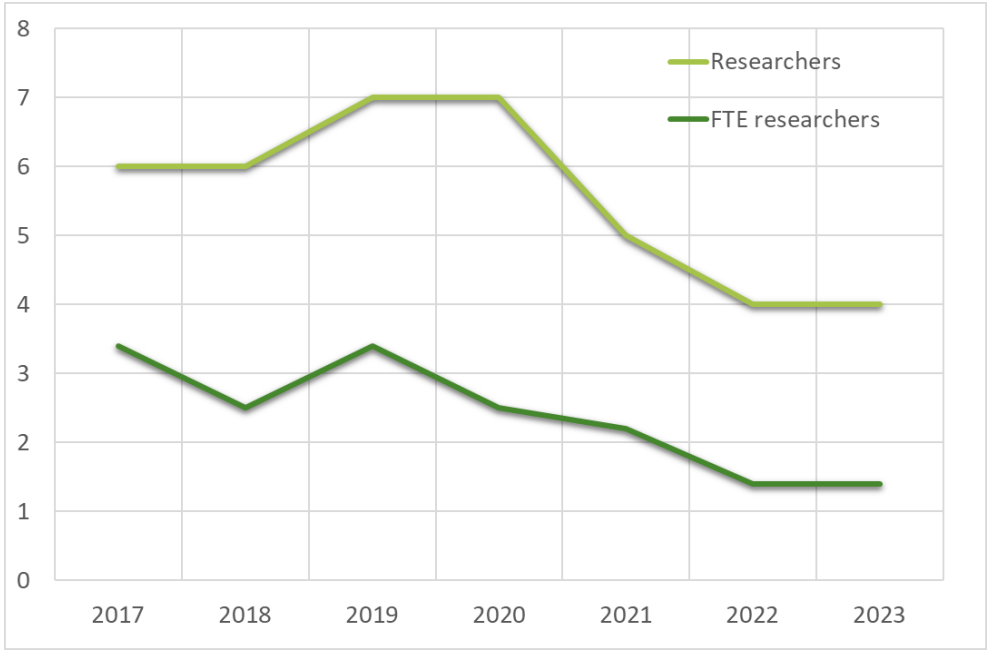
ESA Contract No. 4000137865/22/ES/JD - Expert support to BERM (BepiColombo Environment Radiation Monitor) & RADEM units on board BepiColombo and JUICE spacecraft (LIP,SE2S)
ESA Contact No. 4000110643/13/NL/HB - RADEM Proto-Flight Model (EFACEC, PSI, IDEAS, LIP)

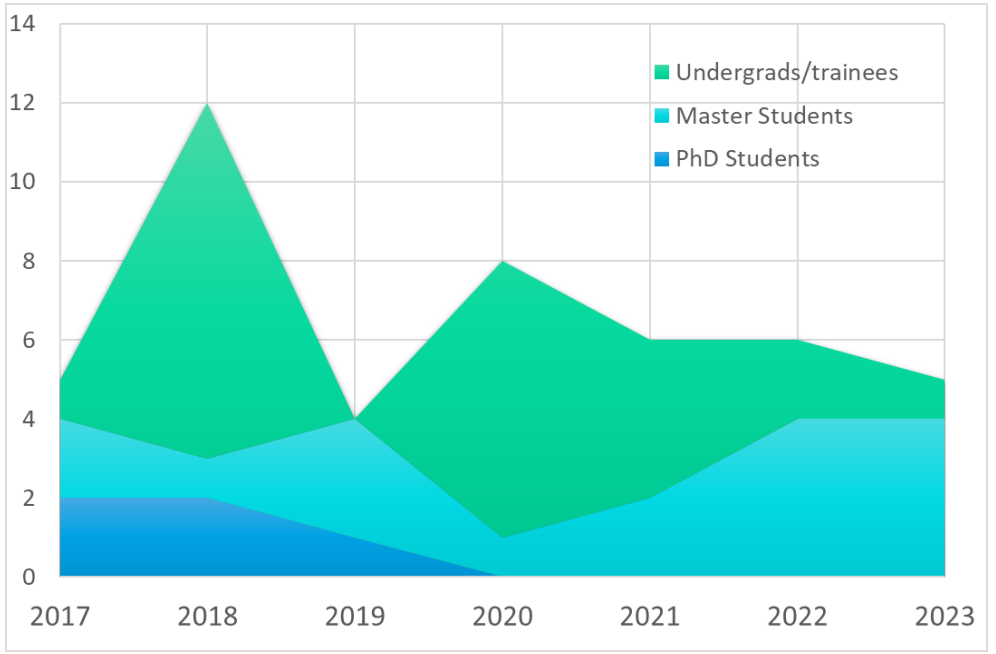
SpaceRad

Space Radiation Environment and Effects

Average funding (k€)	Period	Entity	2017	2018	2019	2020	2021	2022	2023
ESA JUICE radiation monitor - RADEM (300 k€)	2014-2022	ESA	33.3	33.3	33.3	33.3	33.3	33.3	
ESA JUICE EEE testing - ECO-60 (200 k€)	2014-2019	ESA	50.0						
MFS Radiation Monitor Data analysis (60 k€)	2015-2019	ESA	12.0	12.0					
CTTB (component test bed) Data Analysis (80 k€)	2016-2019	ESA	20.0	20.0	20.0				
Expert Support to BERM and RADEM (75 k€)	2022-2024	ESA						25.0	25.0
Total			**115.3**	**65.3**	**53.3**	**33.3**	**33.3**	**58.3**	**25.0**

SpaceRad


8
7
6
5
4
3
2
1
0
2017
2018
2019
2020
2021
2022
2023
Researchers
FTE researchers


14
12
10
8
6
4
2
0
2017
2018
2019
2020
2021
2022
2023
Undergrads/trainees
Master Students
PhD Students

THOR
SPACE RIDER

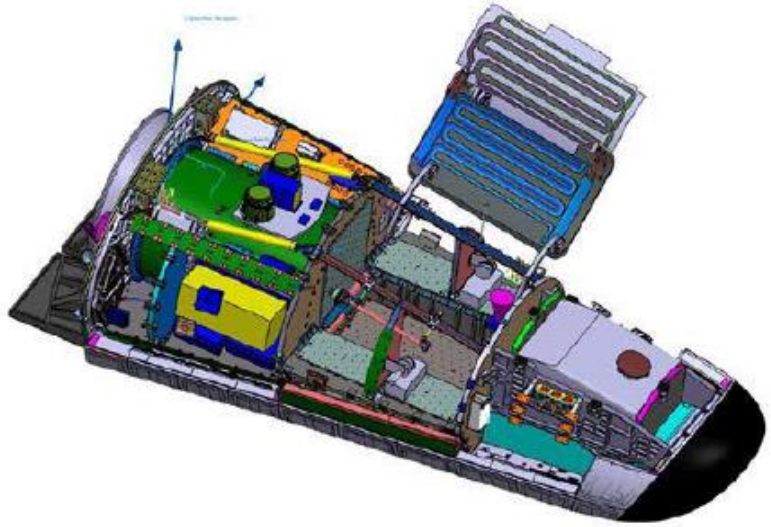
PRODEX

LIP: 470 k€ -> 2026

Industrial Partners

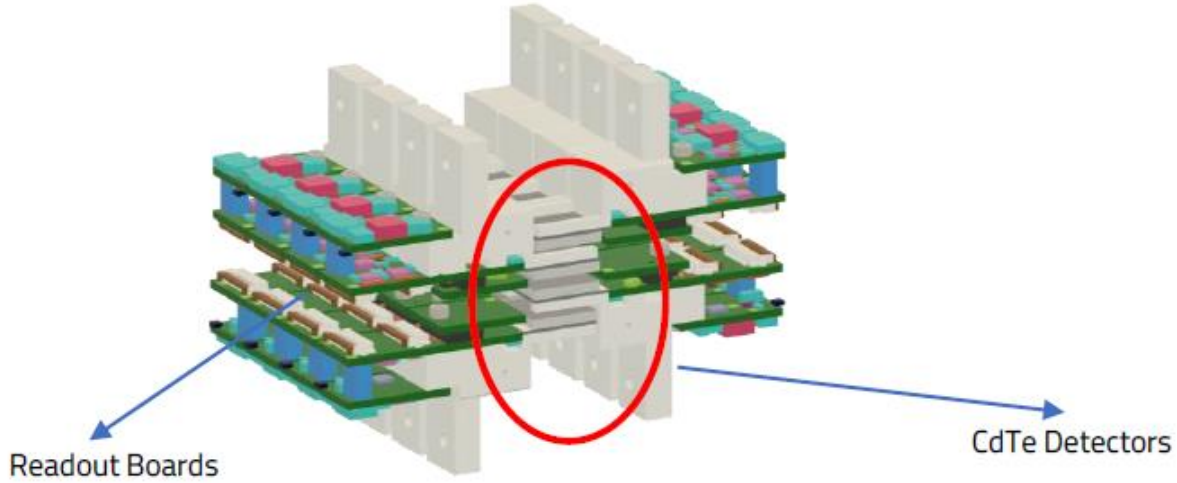
activespace technologies
making space a global endeavour

ADVACAM
Imaging the Unseen



- 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:
  3. TGF monitor test;
  4. TGF polarization: outstanding scientific measurement



Sensitive Volume
18 CdTe matrices - each with 14x14 mm² and 2 mm thickness

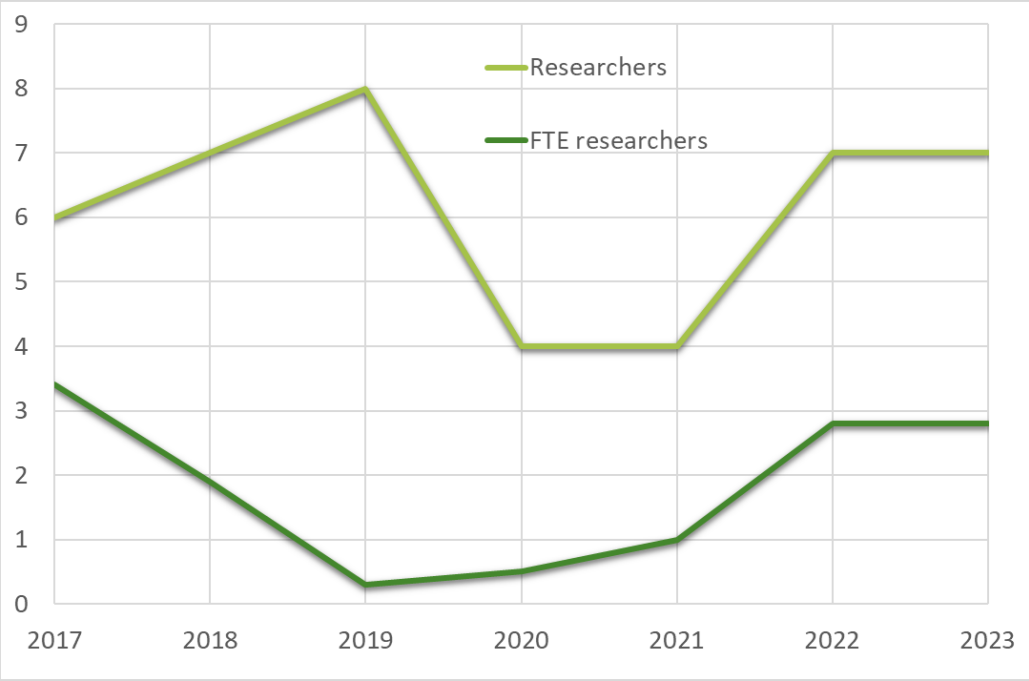
i-Astro

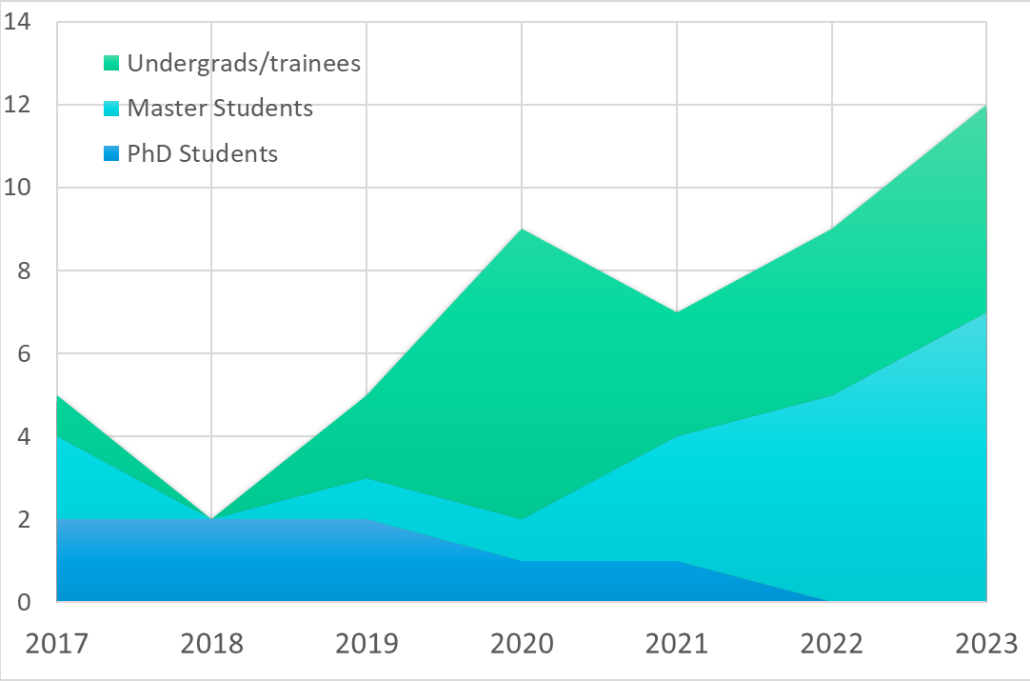
Space Instrumentation for Astrophysics

Average funding (k€)	Period	Entity	2017	2018	2019	2020	2021	2022	2023
AHEAD 2015 (61 k€)	2015-2019	EU	12.2	12.2	12.2				
AHEAD 2019 (30 k€)	2020-2024	EU				6.0	6.0	6.0	6.0
GLOSS (106 k€)	2021-2024	ESA					26.5	26.5	26.5
Terrestrial Gamma Rays (50 k€)	2022-2023	FCT						25.0	25.0
THOR (232k€)	2023-2024	ESA							77.3
Total			**12.2**	**12.2**	**12.2**	**6.0**	**32.5**	**57.5**	**134.8**

i-Astro

Space Instrumentation for Astrophysics





Outlook

Health applications

Two research groups in Lisbon and Coimbra

2023 – 14 + 7.7 FTE

- 11 researchers (with varying FTE)
- 10 PhD students
- 11 MsC students

Funding (last 7 years)

Average of100 k€/year from 2020-2023 from CERN fund and Portugal-UT Austin programme

2024:

- End of Prototera PhD Grant programme
- End of all ongoing Projects
- **funding is uncertain!**

Space applications

Two research groups in Lx and Coimbra

2023 – 5.4 + 9.8 FTE

- 10 researchers (with varying FTE)
- 0 PhD students
- 11 MsC students

Funding (last 7 years)

- Average 55 k€/year SpaceRad
- Average 40 k€/year i-Astro

2024:

- continuation of ongoing contracts
- SpaceRad: apply to additional funding
- **i-Astro PI contract finishes in April 2024**

From Particle Physics to Health & to Space

Particle and accelerator physics are often best known for the large-scale physics experiments performed at world-famous physics laboratories like CERN or Fermilab.

At these institutes, extremely high-energy accelerators are used to reconstruct, amongst other things, the conditions at the very beginning of our universe.

In addition to all the fundamental knowledge of nature, R&D in High Energy Physics has contributed to society with important spin-offs, applications, and multidisciplinary solutions in different fields such as Health and Space!