HEARTS
Follow-up Session
2nd Annual Meeting
WP6

19 February 2025

https://indico.cern.ch/event/1500292/

Christoph Schuy
GSI

Funded by the European Union

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Outline

- Tasks
- Deliverables and Milestones
- Status
- Plans for the future

Tasks

Task 6.1: Standardized setup for the GCR/SPE simulation experiments (GSI, TAS, *M1 – M24*)
Task 6.2: Quantitative measurement of shielding effectiveness (GSI, TAS, *M12 – M36*)
Task 6.3: Radiobiological characterization (GSI, *M24 – M48*)

Deliverables and Milestones due in Y2

Deliv. No.	Deliverable name	Due date	Status	Summary
D6.1	GCR/SPE simulator setup	2024-12-31	Achieved	A detailed description of the experimental demonstrator of the GCR/SPE simulator setup used in GSIs Cave A in 2024.

Milest. No.	Milestone name	Due date	Status	Summary
-	-	-	-	-

The achieved deliverables are available on HEARTS website page: https://hearts-project.eu/project/deliverables/
The achieved milestones are available on HEARTS website page: https://hearts-project.eu/project/milestones/

Upcoming Deliverables & Milestones

Deliv. No.	Deliverable name	Due date	Status
D6.2	Dosimetry of the GCR/SPE simulator with shielding	2025-12-31	Pending
D6.3	Radiobiology of the GCR/SPE simulator with shielding	2026-12-31	Pending

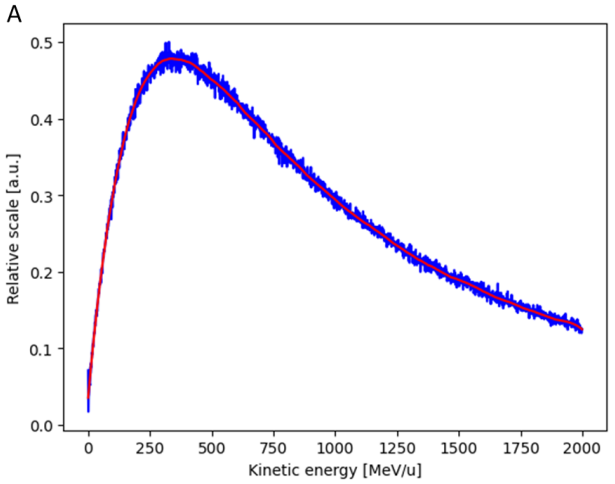
Milest. No.	Milestone name	Due date	Status
MS18	First experimental demonstration of dose increase behind thick shields in Europe	2025-12-31	Pending
MS19	Achievement of TRL6-7 for the SIS18 GCR/SPE simulator	2025-12-31	Pending

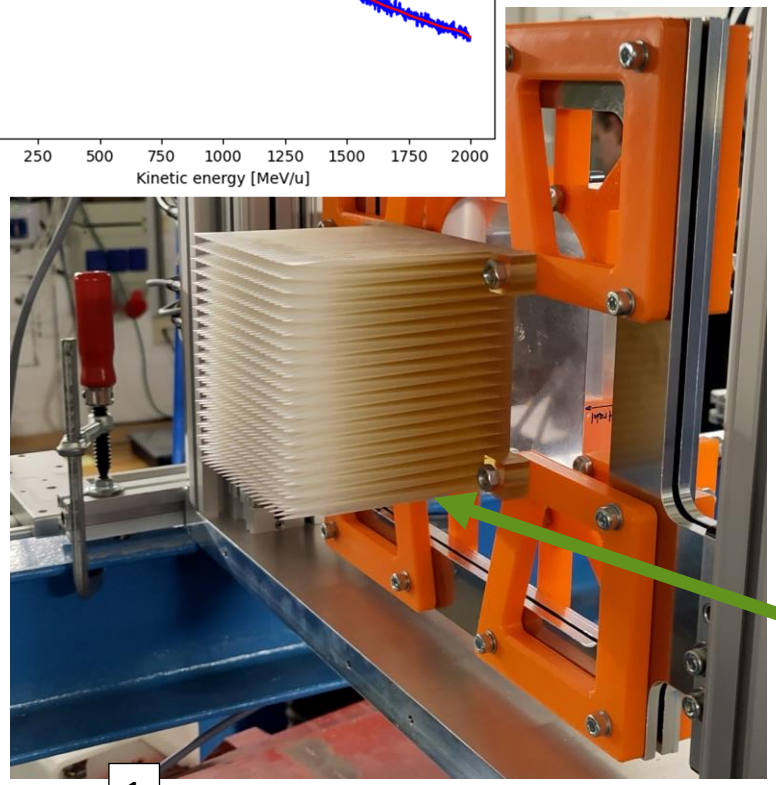
Task 6.1: Standardized setup for the GCR/SPE

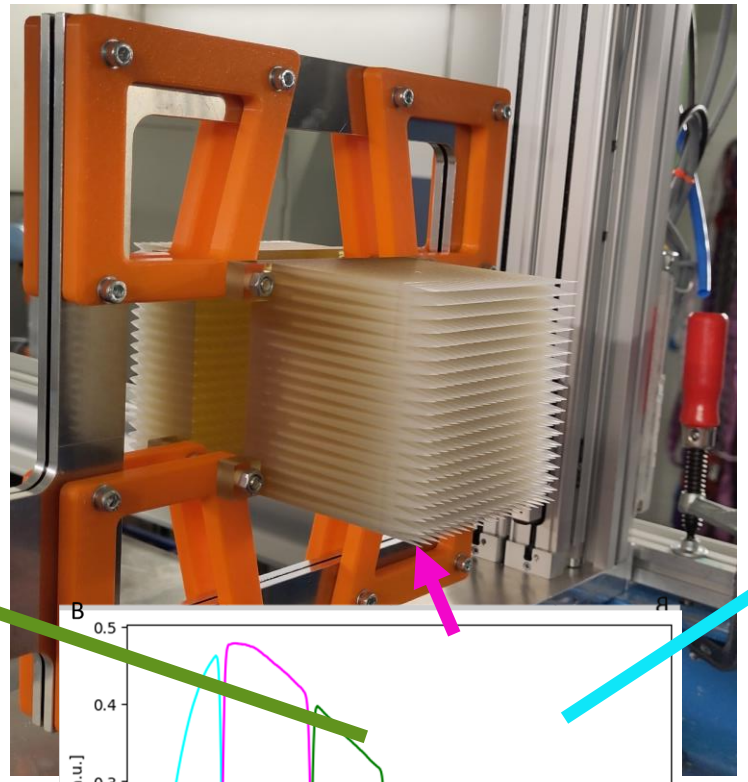
Irradiation Setups:

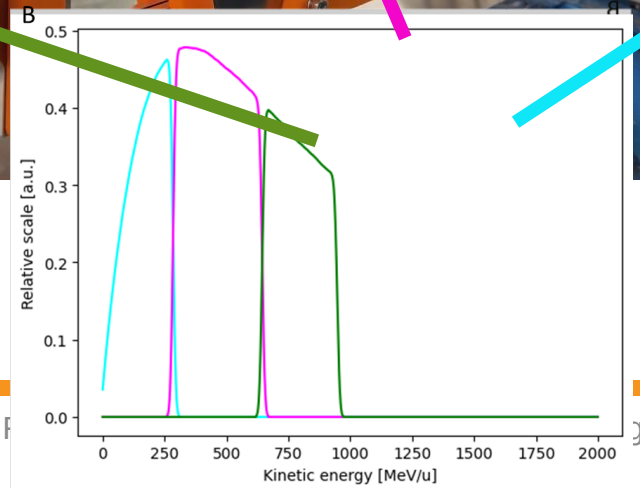
1	2	3	4	5	6
1 GeV/n ^{56}Fe + Modulator	700 MeV/n ^{56}Fe + Modulator	350 MeV/n ^{56}Fe + Modulator	1 GeV/n ^{56}Fe + Al + PMMA slabs	700 MeV/n ^{56}Fe + Al slab	350 MeV/n ^{56}Fe + PMMA slab

andardized setup for the GCR/SPE









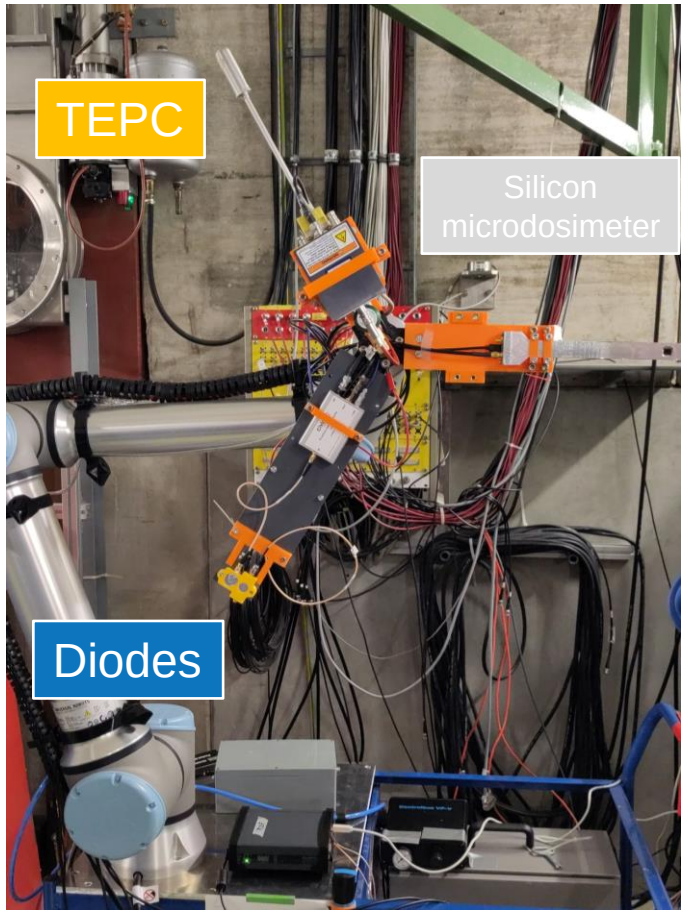
1

1 GeV/n ^{56}Fe
+
Modulator

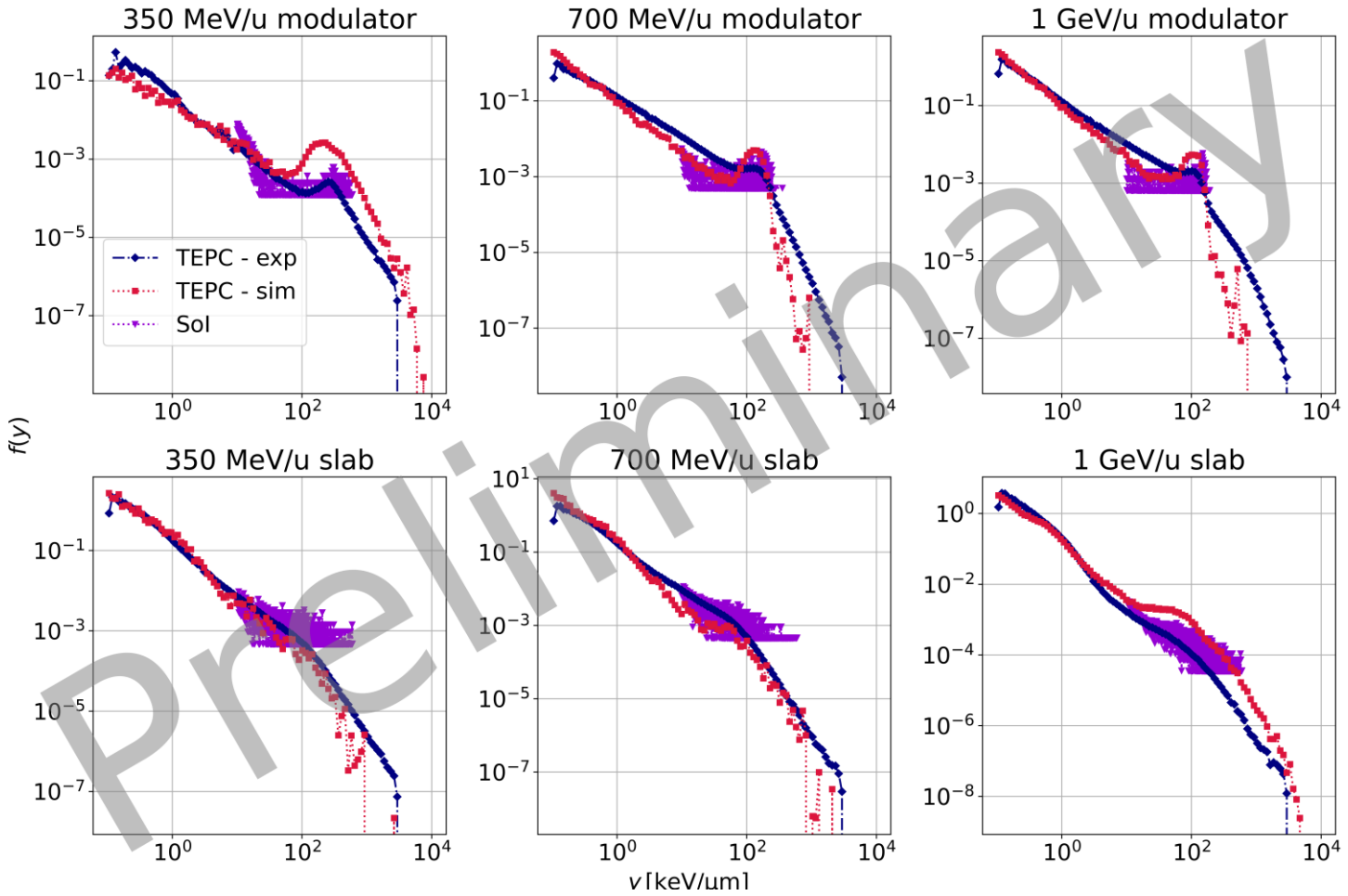
3

350 MeV/n ^{56}Fe
+
Modulator

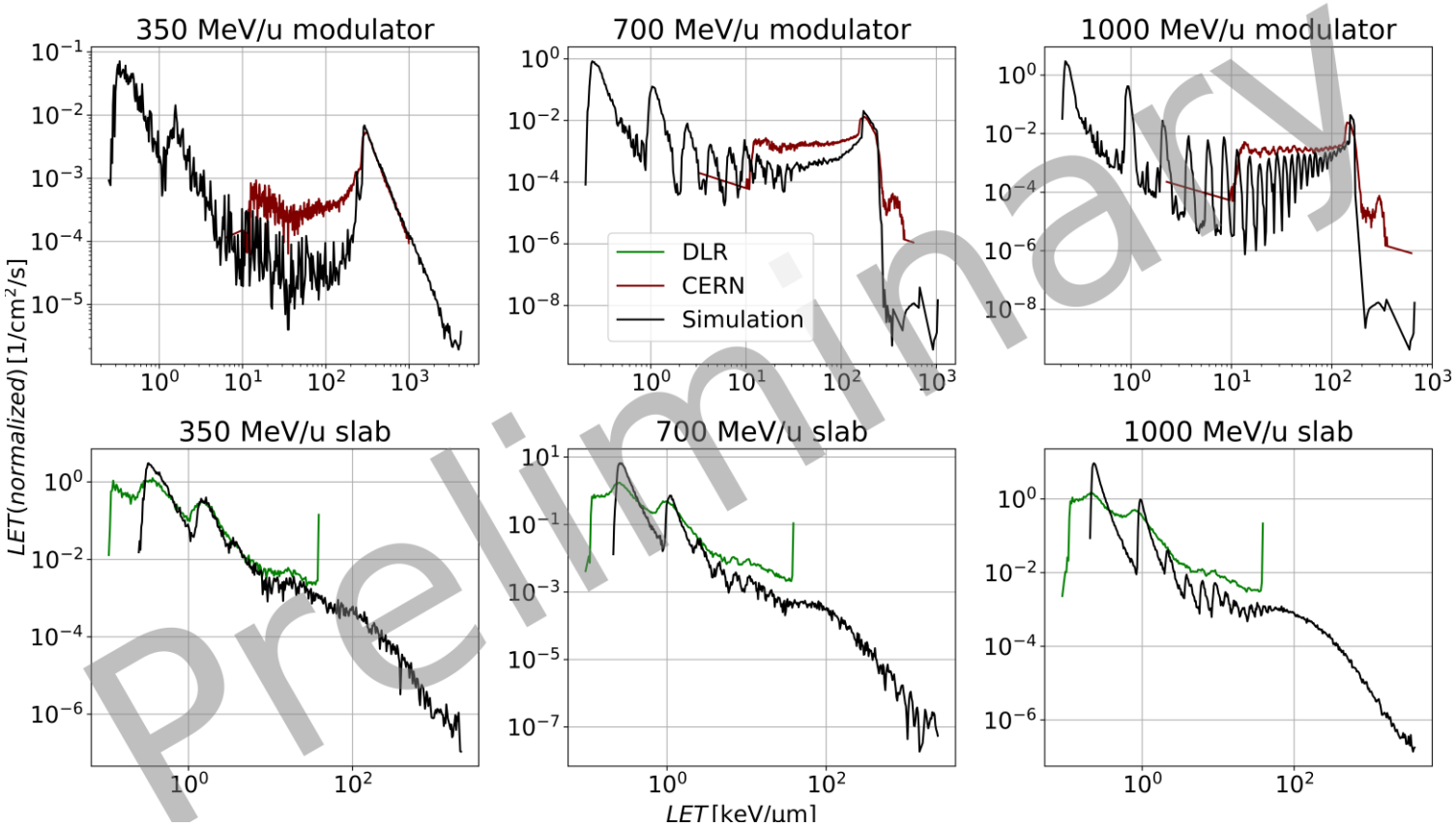
Task 6.1: Standardized setup for the GCR/SPE



Task 6.1: Standardized setup for the GCR/SPE



Task 6.1: Standardized setup for the GCR/SPE

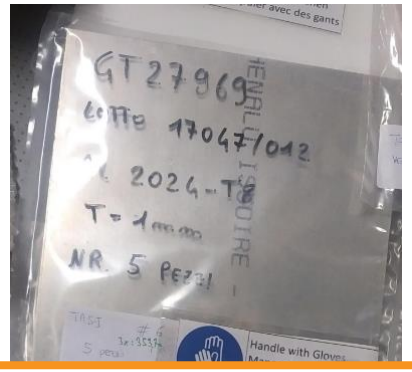


Task 6.1/6.2: Standardized setup for the GCR/SPE

TAS-I relevant materials survey

A survey of various potentially interesting materials to be tested has been carried out by TAS-I:

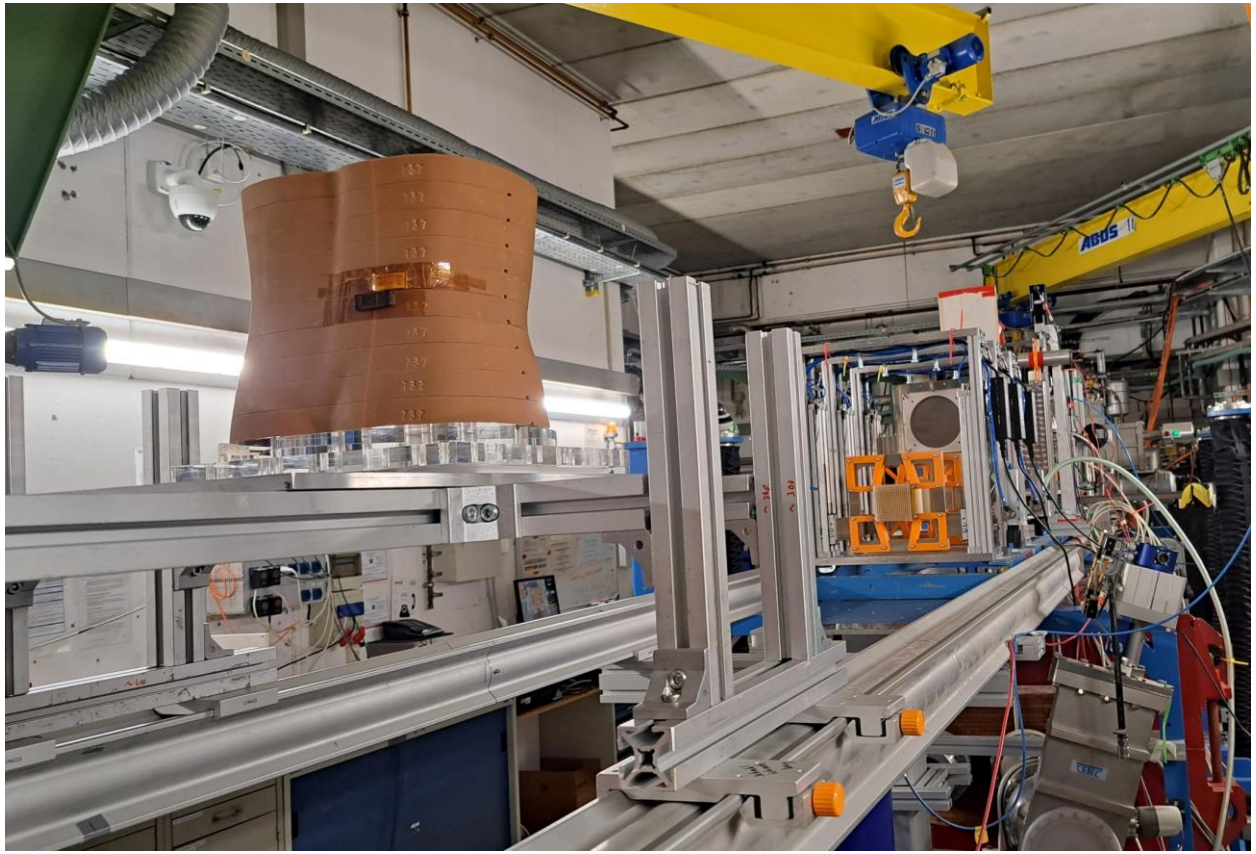
- **Structure materials**
  - Al6064
  - Al7075
  - Composite innovative materials
  - Multilayer innovative materials
  - Honeycomb panels (still under evaluation)
- **Materials with different functions**
  - MLI materials
  - Polyethylene
  - Inflatable materials
- **On-site available materials**
  - Lunar regolith (in PMMA container) and concrete
  - Mars regolith (in PMMA container) and concrete

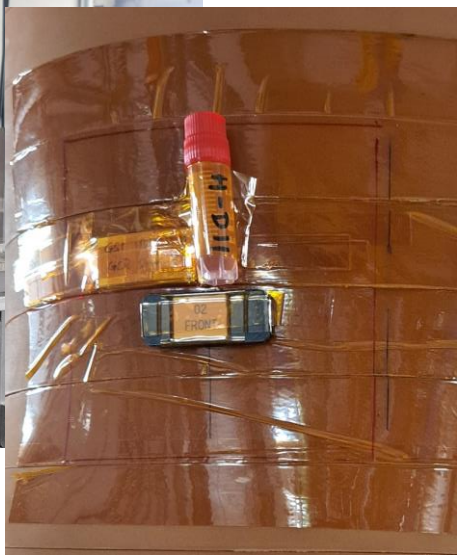


‘Standardized materials’ have to be characterized/tested before they can be offered to users!

Example of ROSSINI space materials

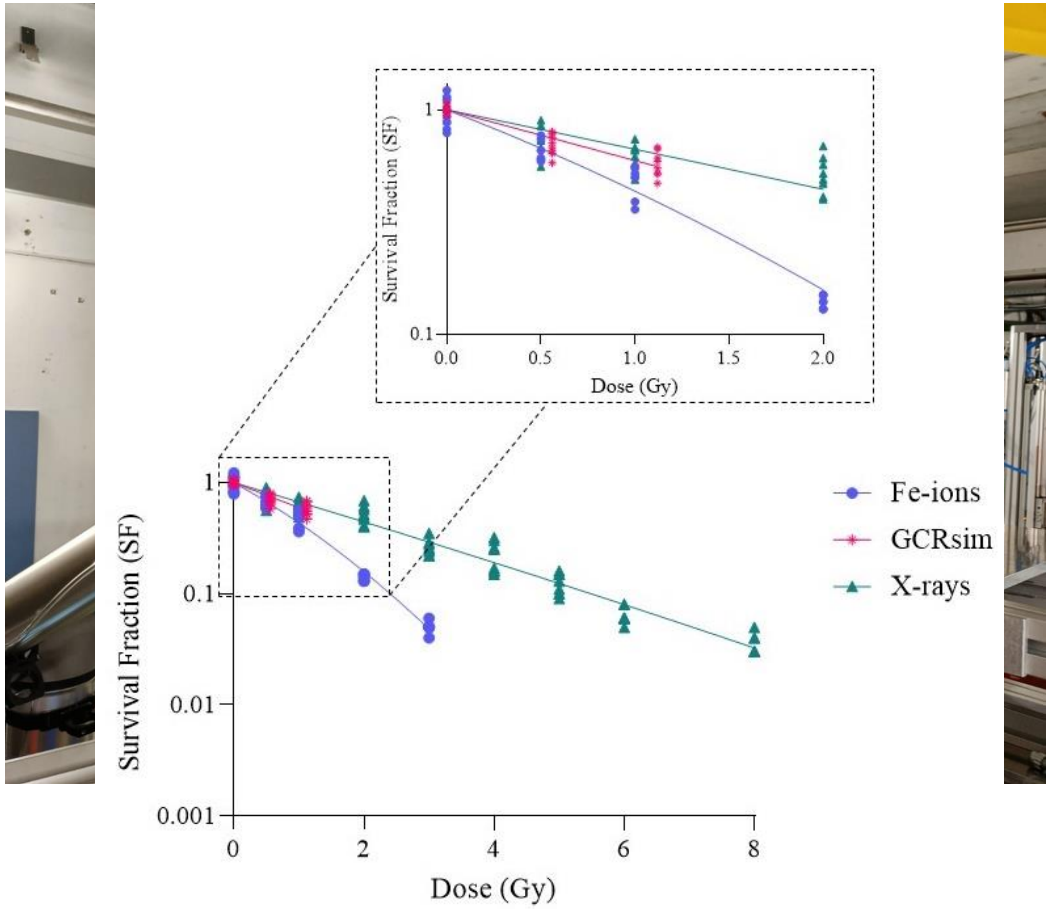
Task 6.2: Quantitative measurement of shielding effectiveness





Irradiation of biological samples with the GCR simulator on the skin and inside the Matroschka Phantom. (Doses: ~1 Gy and ~0.5 Gy)

Task 6.3: Radiobiological characterization



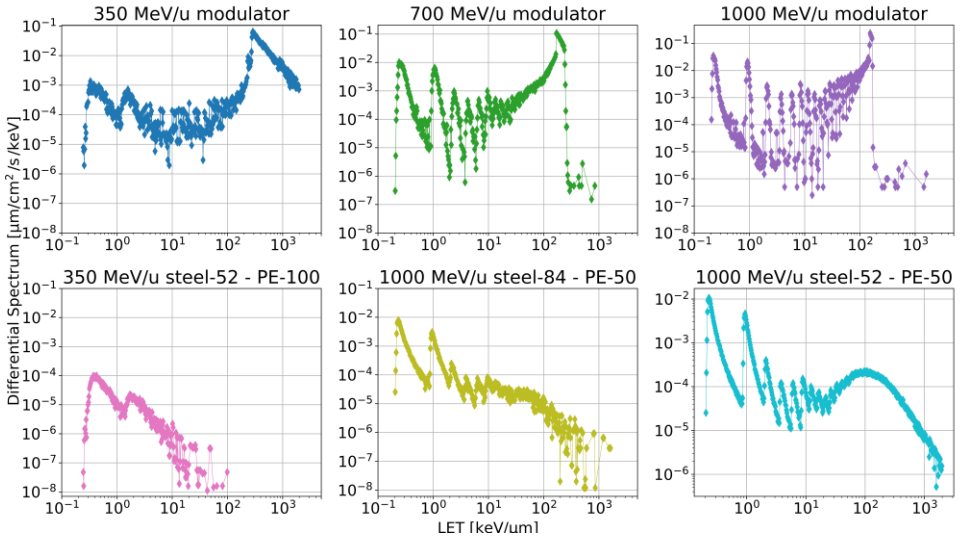
Biological exposure

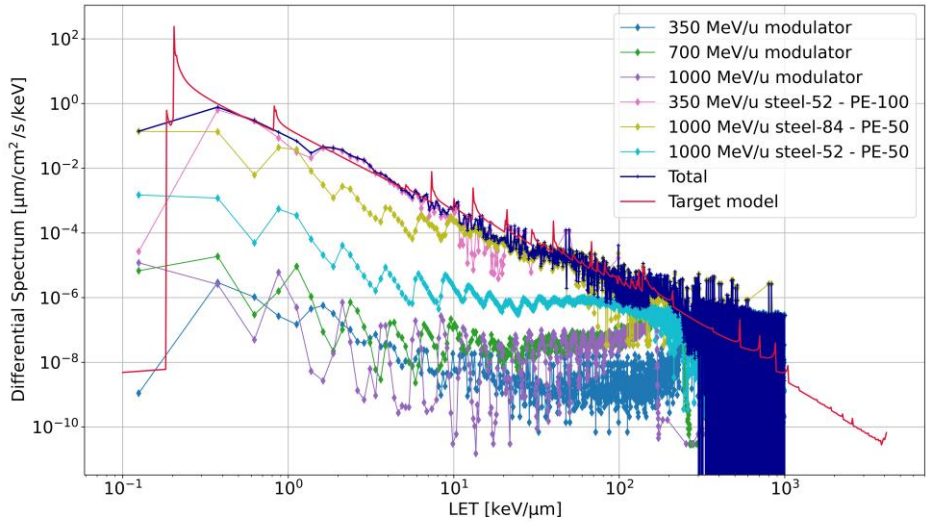
- Primary iron beam
- GCR simulator exposures (2 doses)
- Exposure behind shielding (1 dose)

CHO clonogenic survival results following the irradiation with three modalities: 1 GeV ^{56}Fe-ions, GCRsim, and 250 kVp X-rays

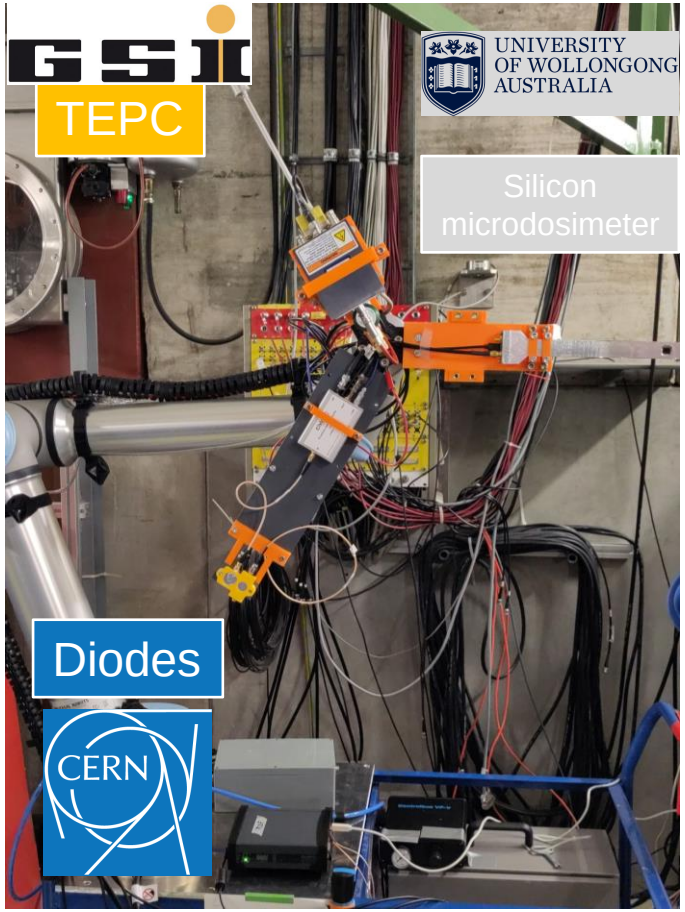
Outlook 2025

GCR simulator 2025



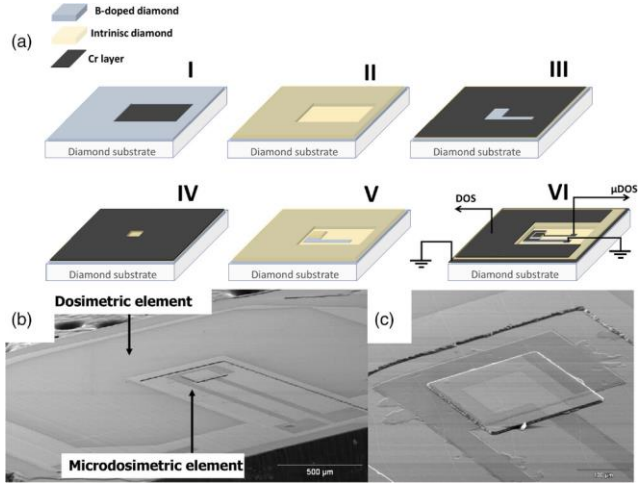


Outlook 2025



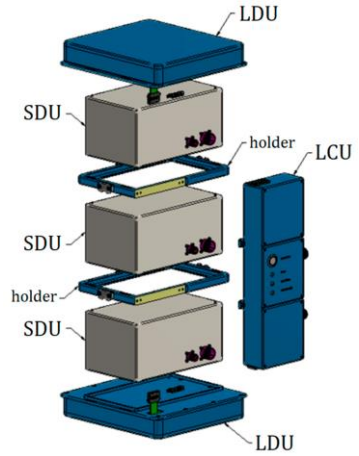
Additional detectors will be tested

Diamond microdosimeter



Verona et. al. 2023, https://doi.org/10.1002/mp.16698

LIDAL



Romoli et. al. 2023, https://doi.org/10.3390/s23073559

Plans for the future

- Amount of request from the science community is immense
- Characterize/benchmark new Cave A GCR simulator
  - Freeze geometry/composition
- Competitive analysis of QA strategies/detectors
  - reproducible
  - reliable
  - fast
- RBE measurements
- Characterization of standardized shielding materials

Thank you for your attention. Questions?

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