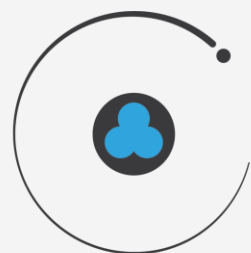


Detector Laboratory of Helsinki Institute of Physics and University of Helsinki



HELSINKI INSTITUTE
OF PHYSICS

HIP Scientific Advisory Board meeting
26/08/2026

Matti Kalliokoski
Laboratory Director

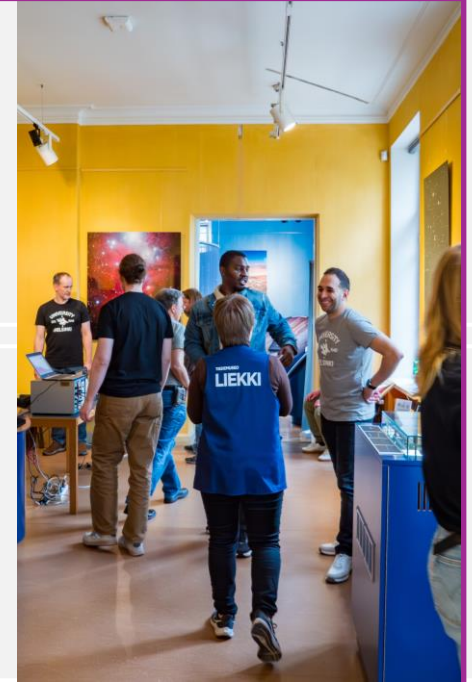


UNIVERSITY OF HELSINKI
FACULTY OF SCIENCE



Detector Laboratory: Staff and Users

- **Laboratory personnel**
 - Matti Kalliokoski, staff scientist and university researcher, laboratory director
 - Mihaela Bezak, laboratory engineer
 - Michael Campbell, visiting scientist
 - Francisco Garcia, laboratory engineer, 20%
 - Pirkitta Koponen, laboratory engineer
 - Raimo Turpeinen, senior research technician
- **External support**
 - Juha Aaltonen, laboratory engineer (HIP), technical and media support, purchases and tendering
 - Timo Hildén, senior scientist (CMS Upgrade), purchases
- **Project based personnel**
 - 1 university lecturer (CMS Upgrade)
 - 1 post doc (CMS Upgrade)
 - 2 technicians (CMS Upgrade/ALICE)
 - 4 doctoral researchers (CMS Upgrade/Forward)
- **Other people**
 - Erasmus+ trainees from IMT Atlantique during April-July
 - Usually offer 2-3 positions per year
 - Next year a trainee also from Lise-Meitner school in Berlin during Jan-May
 - Summer worker during May-August
 - Users from HIP member institutes
 - Master's and bachelor students



Laboratory facilities

- Laboratory facilities consist of two laboratory rooms and three cleanrooms.
 - Cleanrooms were completely renovated this spring, with improved air circulation and environmental control.
- Tools for electrical and optical testing.
 - Probe stations, TCT setup, transmittance imaging, and machine vision.
- Tools for assembly.
- Wire bonders and a pull tester.
- Temperature cycling equipment.
- Basic tools for detector testing and characterization.
- Gas lines.
- Radiation sources.
- Access to the Physicum mechanical workshop.



HIP Projects in the laboratory

- AI-GRID
 - Utilization of the laboratory's IDEAS CZT detector as part of the HIP technology program.
- ALICE
 - Presentation by Sami
 - TAB-bonding of modules
- CMS
 - Upgrade and forward, presentations yesterday by Kenneth and Erik
 - Module assembly
 - Characterization of diamond detectors
 - Testing of LGADS
- COSINUS
 - Update of the magnetic field compensation coil control computer
- FAIR Super-FRS / NuSTAR
 - Presentation by Tuomas
 - Assembly and testing of GEM-TPC detectors for the Super-FRS
- MoEDAL
 - Scanning of NTD foils
 - Simulation software development
 - GEM-Timepix detector R&D



Project timetables

[illegible]

CMS Upgrade + ALICE

Project leader: Erik Brucken, *Senior Scientist:* Timo Hildén, *Postdoctoral Scientist:* Hussam Badran, *Technicians:* Antti Nikkanen and Kaino Kantakoski,
Doctoral Researchers: Nikita Kramarenko, Santeri Saariokari, Mila Myllymäki
From DetLab Laboratory Engineer: Pirkitta Koponen, *Senior Research Technician:* Raimo Turpeinen

Worker	Project	Q1/2026	Q2/2026	Q3/2026	Q4/2026	Q1/2027	Q2/2027	Q3/2027	Q4/2027
Timo Hildén	TEPX	25	25	25	25	25	25	25	25
Timo Hildén	MTD	25	25	25	25	25	25	25	
Timo Hildén	PPS2	10	10	10	10	10	10	25	25
Timo Hildén	Gen R&D	10	10	10	10	10	10	5	10
Hussam Badran	TEPX	50	50	50	50	50	50		
Hussam Badran	FoCal	0	0	0	15	15	15		
Hussam Badran	PPS2	10	10	10	10	10	10		
Hussam Badran	Gen R&D	20	20	20	10	20	20		
Antti Nikkanen	TEPX	40	40	30	30	30	30		
Antti Nikkanen	FoCal	35	35	50	50	50	50		
Antti Nikkanen	Gen R&D	20	20	10	10	10	10		
Pirkitta Koponen	TEPX	15	25	25	25	25	25		
Pirkitta Koponen	FoCal	10	15	25	25	25	25		
Raimo Turpeinen	TEPX	0	0	5	5	0	0	0	0
Raimo Turpeinen	FoCal	5	5	5	5	0	0	0	0
Raimo Turpeinen	MTD	10	10	5	5	0	0		
Raimo Turpeinen	Gen R&D	5	5	0	0	0	0	0	0
Raimo Turpeinen	PPS2	5	5	0	0	0	0	15	20
Nikita Kramarenko	MTD	50	50	40	20	20	20		
Nikita Kramarenko	Gen R&D	40	40	50	70	70	70	90	90
Santeri Saariokari	Gen R&D	90	90	90	90				
Mila Myllymäki	Gen R&D	90	90	90	90				
Kaino Kantakoski	MTD		75	90	90	90	30		
Total (FTE)		5.65	6.55	6.65	6.70	4.85	4.25	1.85	1.70
Total (CMS only FTE)		5.15	5.90	6.00	6.05	4.35	3.75	1.70	1.50
FTE no Gen R&D		2.90	3.80	3.95	3.90	3.75	3.15	0.90	0.70
CMS Upgrade personnel (FTE)		7	8	8	8	6	6	3	3

 Laboratory staff

FTE/project

	Q1/2026	Q2/2026	Q3/2026	Q4/2026	Q1/2027	Q2/2027	Q3/2027	Q4/2027
FoCAL	0.5	0.55	0.8	0.95	0.9	0.9	0	0
MTD	0.85	1.6	1.6	1.4	1.35	0.75	0.25	0
PPS2	0.25	0.25	0.2	0.2	0.2	0.2	0.4	0.45
TEPX	1.3	1.4	1.35	1.35	1.3	1.3	0.25	0.25
R&D	2.75	2.75	2.7	2.8	1.1	1.1	0.95	1

CMS Forward

Project leader: Kenneth Österberg, Laboratory Engineer: Francisco Garcia, Doctoral Researcher: Milla-Maarit Rantanen

Worker name	Role / Title	Start date	End date	Worker	Project	Q1/2026	Q2/2026	Q3/2026	Q4/2026
Francisco Garcia	Setting up system and commissioning	1.6.2026	31.12.2026	Francisco Garcia		40	40	40	40
NN	Testing 5 samples	1.6.2026	31.07.2026	NN (student)				50	50
NN	Testing 10 samples	1.9.2026	31.12.2026						

FAIR

Project leader: Tuomas Grahn, Laboratory Engineer: Francisco Garcia
From DetLab Senior Laboratory Engineer: Raimo Turpeinen

FAIR					
#	Subproject	PI	Start date	End date	Status
1	Drives & Ladders assembly		01/2017	04/2027	ongoing
2	GEM-TPC assembly and QA				Ongoing
WORKFORCE					
#	Worker name	Role / Title	Unit	Start date	End date
1	Raimo Turpeinen	Technician	Detector Laboratory	01/2027	04/2027
2	N.N.	Technician	Detector Laboratory	01/2027	02/2027
3	?	Technician	Detector Laboratory		

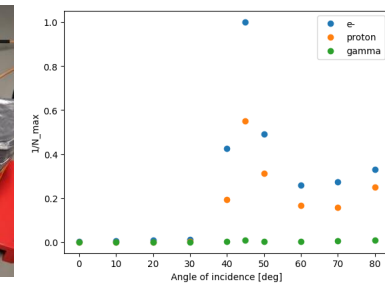
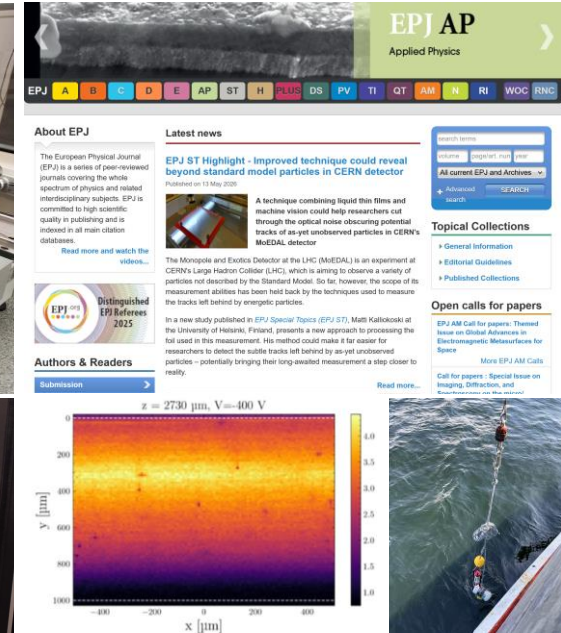
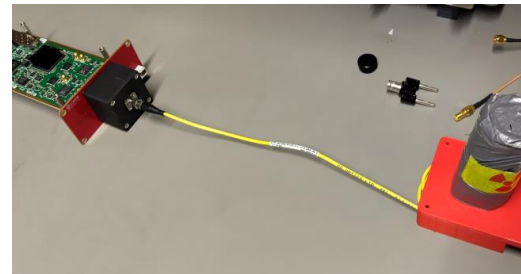
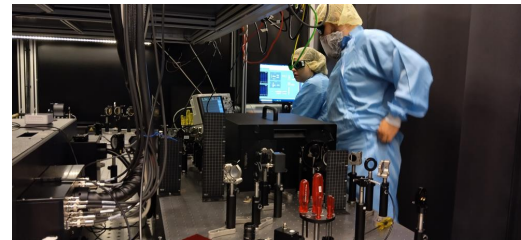
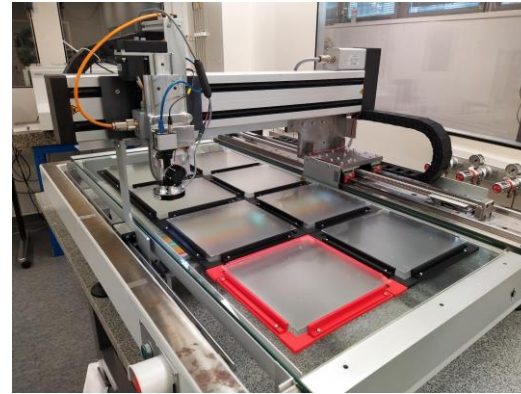
Detector Laboratory

Laboratory Director, Staff Scientist: Matti Kalliokoski, Laboratory Engineers: Mihaela Bezak, Pirkitta Koponen, Senior Research Technician: Raimo Turpeinen

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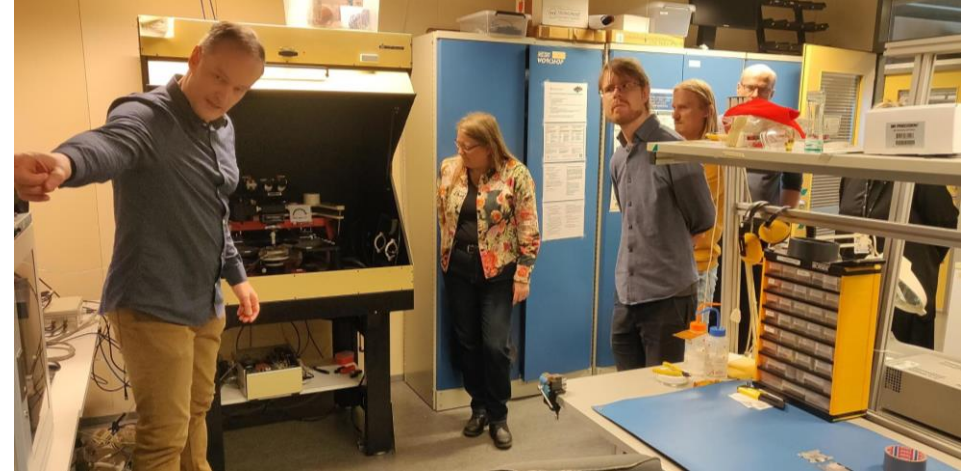
Research Highlights Beyond Hosted Projects

- MoEDAL-MAPP experiment
 - Development of a new method to improve the transmittance of CR39 foils.
 - Development of improved simulation models for new physics searches.
 - Studies and detector development for Run 4 upgrades.
- Semiconductor research
 - First TPA measurements with CdTe materials at ELI Beamlines
 - Deployment of CZT detectors for seafloor measurements aboard the research vessel *Aranda*.
- Optical Beam Loss Monitors
 - Funding from the Magnus Ehrnrooth Foundation to develop a test system for Cherenkov fibres for ESS and FCC.
- More details are provided in the backup slides.



Education, Outreach and Industry Cooperation

- Education
 - The laboratory hosts PhD, MSc, and BSc students.
 - Several master's-level courses are held on the premises each year.
- Outreach
 - We coordinate and participate in various outreach activities.
 - The laboratory hosts visits from upper secondary schools.
- Industry cooperation
 - We offer various characterization services and expertise to industry.
 - The number of projects was reduced this year due to laboratory renovations.



Summary

- The Detector Laboratory is a strategically important infrastructure that combines international scientific impact, technology development, education, and societal engagement.
- The Laboratory has a strong user community and a detector development infrastructure that is becoming unique in the Nordic countries.
- We host multiple projects, including ALICE, CMS, and FAIR, with significant contributions from the Laboratory staff.
- Laboratory resources have been distributed efficiently, supported by various management tools.
- The Laboratory's detector R&D and participation in various projects are based on the expertise of its staff.
- We also have a strong commitment to education and outreach, as well as a significant industrial impact.
- The Laboratory aims to strengthen its position as a hub for detector R&D, fostering international collaboration, supporting the next generation of researchers and engineers, and increasing its impact on industry and society.

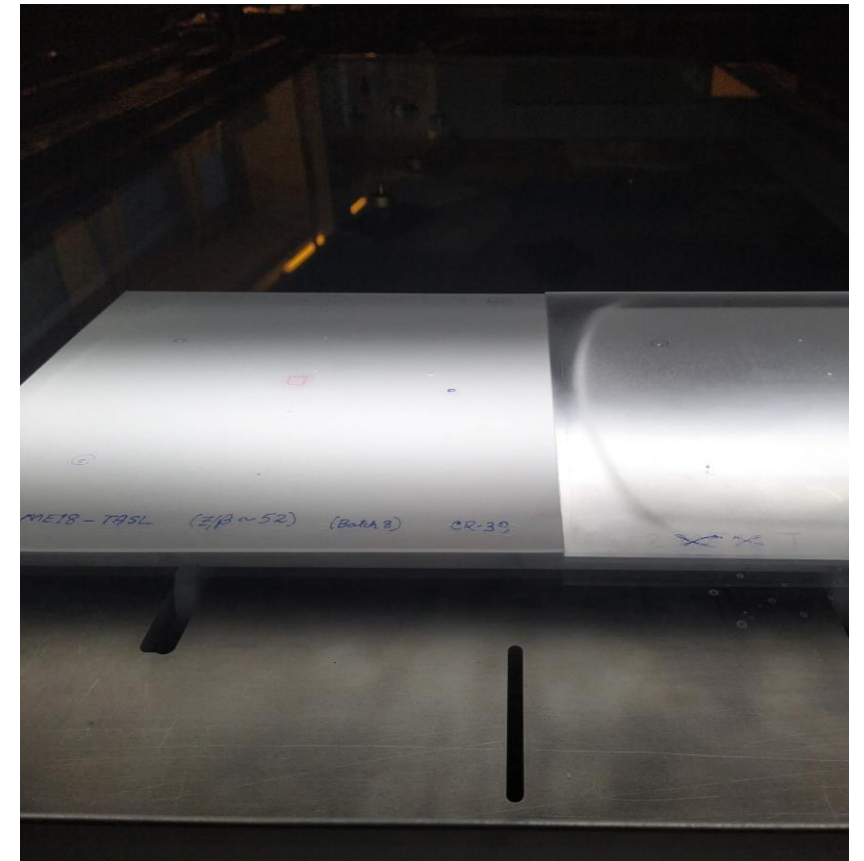


Backup slides

MoEDAL experiment

M. Bezak, M. Campbell, M. Kalliokoski, P. Koponen, R. Turpeinen

- Our involvement in MoEDAL-MAPP consists of optical scanning and analysis of Nuclear Track Detector (NTD) foils, studies of new detector developments for the HL-LHC, and development of simulation models for new physics searches.
- Our developments in thin-film deposition on NTD foils allow us to achieve unprecedented resolution in particle identification.
 - Together with optimization of the machine vision system over 2.3 m² of foils can be scanned per week
- A sealed Timepix detector with GEM amplification allows us to achieve unprecedented sensitivity in measuring high-charge events around IP8 during Run 4 and beyond.
- New activities include studies of photoluminescent chemicals and UV-transmittance analysis.



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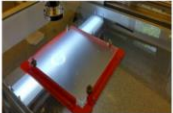
The European Physical Journal (EPJ) is a series of peer-reviewed journals covering the whole spectrum of physics and related interdisciplinary subjects. EPJ is committed to high scientific quality in publishing and is indexed in all main citation databases.

[Read more and watch the videos...](#)

Latest news

EPJ ST Highlight - Improved technique could reveal beyond standard model particles in CERN detector

Published on 13 May 2026



A technique combining liquid thin films and machine vision could help researchers cut through the optical noise obscuring potential tracks of as-yet unobserved particles in CERN's MoEDAL detector.

The Monopole and Exotics Detector at the LHC (MoEDAL) is an experiment at CERN's Large Hadron Collider (LHC), which is aiming to observe a variety of particles not described by the Standard Model. So far, however, the scope of its measurement abilities has been held back by the techniques used to measure the tracks left behind by energetic particles.

In a new study published in *EPJ Special Topics (EPJ ST)*, Matti Kalliokoski at the University of Helsinki, Finland, presents a new approach to processing the

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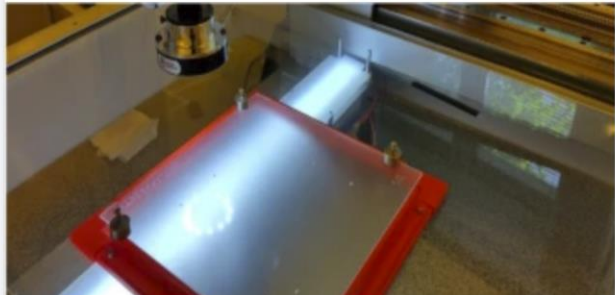
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EPJ ST Highlight - Improved technique could reveal beyond standard model particles in CERN detector <https://www.epj.org/.../3004-epjst-highlight-improved.....> See more



MoEDAL-MAPP publications

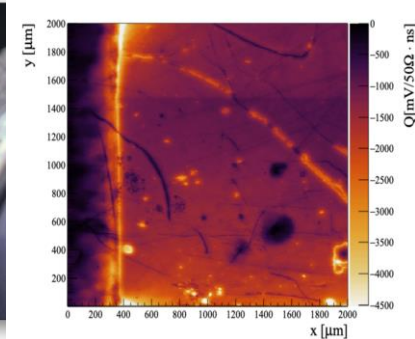
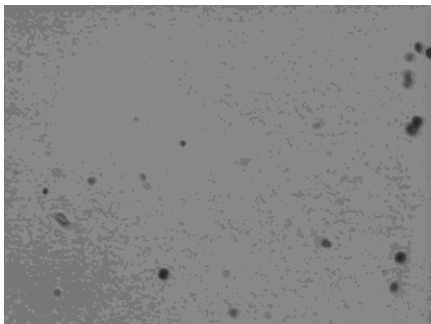
- 2 new publications since the previous SAB:
 - M. Kalliokoski et al., “[Minicharged particle sensitivity of the MAPP Outrigger Detector](#)”, EPJ-ST (2025)
 - M. Kalliokoski, “[Increased sensitivity in optical scanning of irradiated CR39 foils with liquid thin films](#)”, EPJ-ST (2026)
- The latter publication was selected as a highlight in EPJ-ST and appeared on [epj.org website](https://www.epj.org).

Semiconductor research

M. Bezak, M. Campbell, M. Kalliokoski, N. Kramarenko, R. Turpeinen, M. Väänänen



- Multicomponent semiconductor studies
- Development of new analysis tools and improvements to existing devices.
- The main focus has been on CdTe and CZT, but the results can be extended to other multicomponent materials.
 - Perovskites, GaN, GaAs, etc.
- Last year, we performed the first Two-Photon Absorption (TPA) measurements of CdTe materials using the ELI Beamlines laser.
- This work enhances our expertise in the application of such materials.
 - Deployment of detectors in various environments.
- Publications since previous SAB:
 - N. Kramarenko et al. [Evaluation of CZT detector performance in alpha and gamma spectrometry](#), Journal of Instrumentation **21** (2026) C01022



Balloon-borne Instrument for Spectral Scanning of high-altitude Environments – BISSE

T. Hildén, M. Kalliokoski, A.-P. Leppänen, J. Paatero, J. Sorri, R. Turpeinen, M. Väänänen



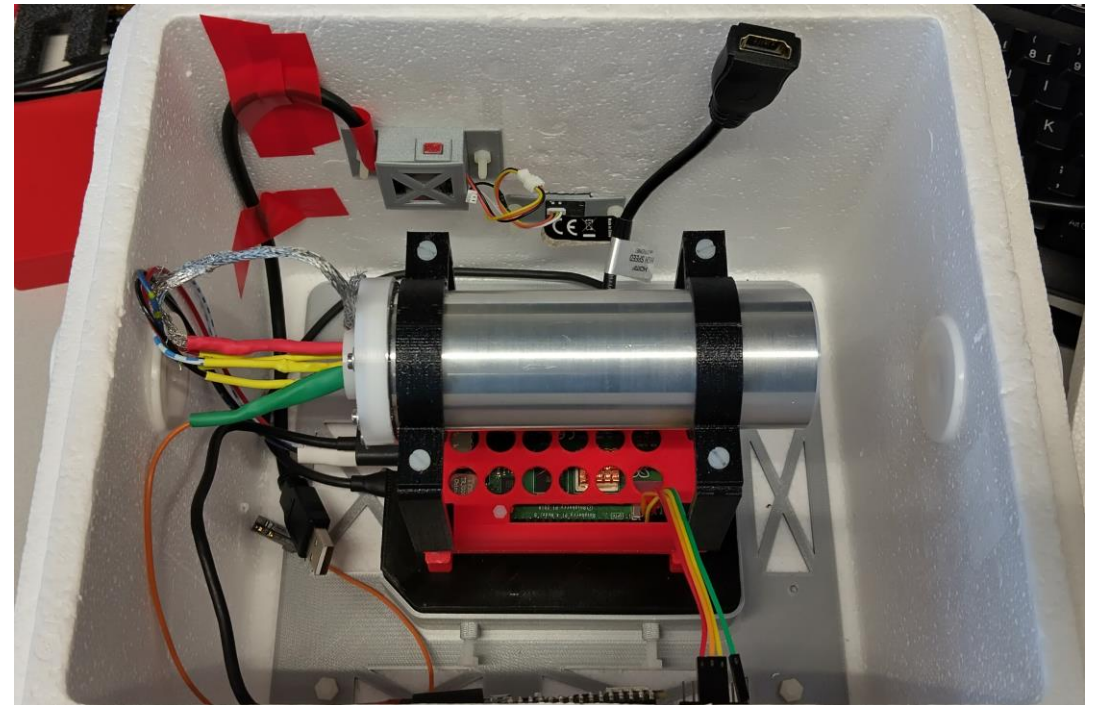
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FINNISH METEOROLOGICAL INSTITUTE



- CZT-based spectrometer controlled with single board computer
- Capable of continuous data acquisition for over six hours.
- Designed to be carried as a payload on a weather balloon at altitudes of up to 40 km.
 - Total weight, including the polystyrene box ~1.0 kg
- The first flight was postponed from March 2026 to September 2026 due to warm winter conditions in Sodankylä.
- Publications since previous SAB:
 - K. Haikarainen et al., [CZT based spectrometers for environmental radiation measurements](#), Journal of Instrumentation **21** (2026) C01014



Low-weight Aranda-based Gamma-ray and Environmental Radiation sensor – LAGER

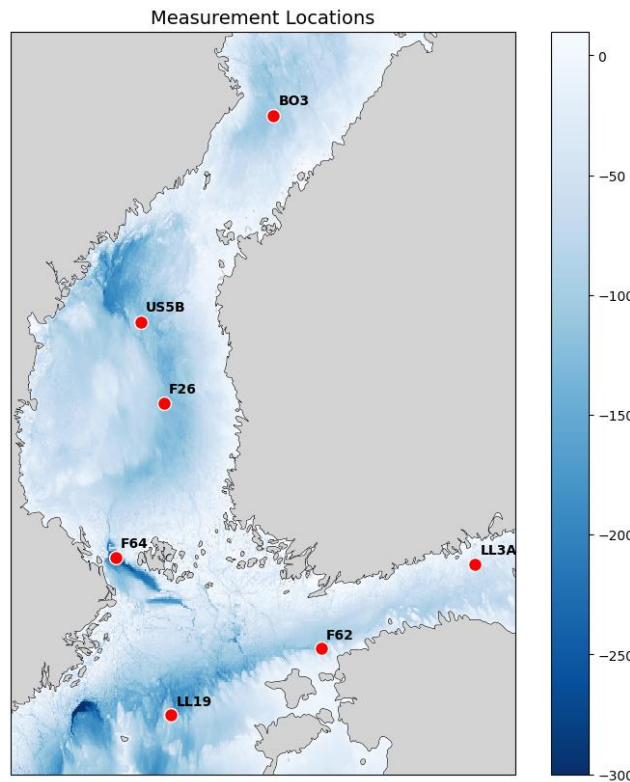
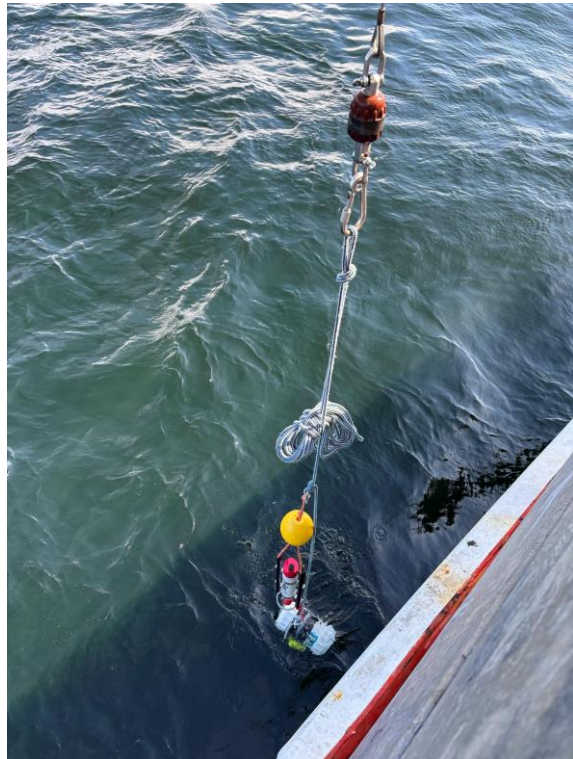
T. Hildén, M. Kalliokoski, J. Paatero, S. Rantapusa, T. Roine, R. Turpeinen, M. Väänänen



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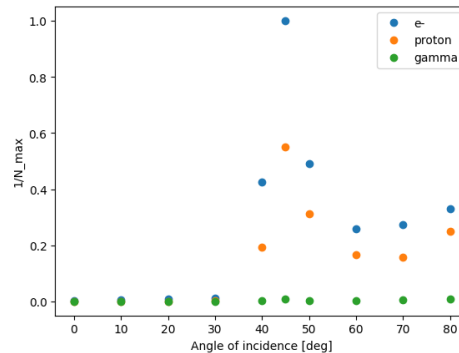
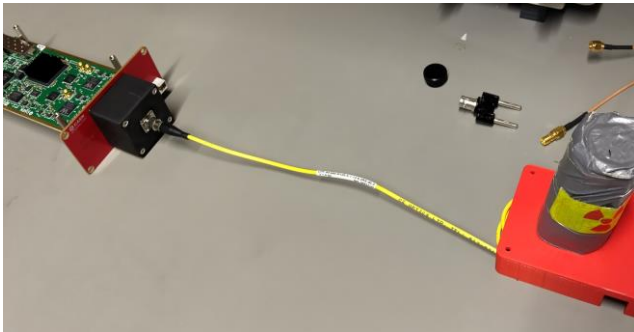
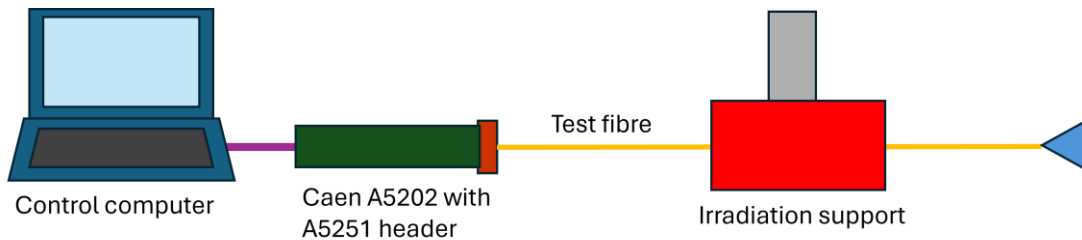
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FINNISH METEOROLOGICAL INSTITUTE



- CZT-based spectrometer controlled by a single-board computer.
- Designed to be housed in a water- and pressure-tight enclosure for seafloor measurements.
- First deployment in April 2026 from the research vessel *Aranda*.
- Publication in preparation.

Optical Beam Loss Monitoring

M. Bezak, V. Grishin, M. Kalliokoski, B. Salvachua Ferrando, C. Thomas, R. Turpeinen



- The main goal of the study was to develop a beam loss monitoring system for the European Spallation Source (ESS) for locations where conventional ionization chambers cannot be used.
 - Joint development; deployment has been delayed due to delays in the commissioning of the ESS linac.
- Since Cherenkov fibres are well suited for electron loss monitoring, the study was extended to the Future Circular Collider (FCC).
 - A single fibre can cover hundreds of meters.
 - Quantum enhancement is required.
- At HIP, the initial focus is on fibre lifetime and radiation hardness.
 - A test setup was acquired with support from the Magnus Ehrnrooth Foundation.

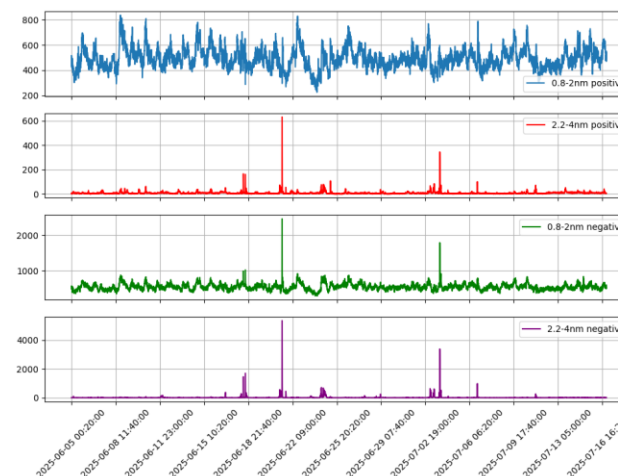
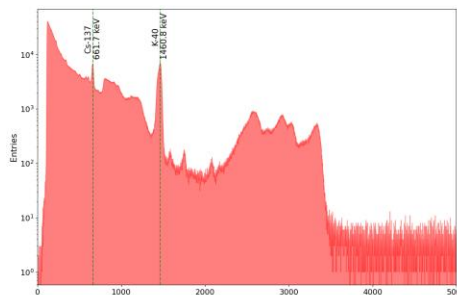
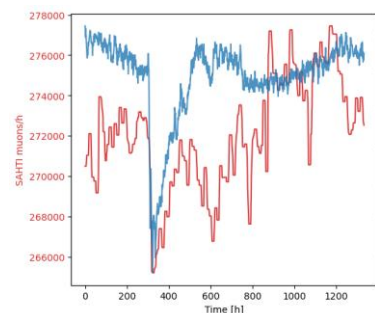
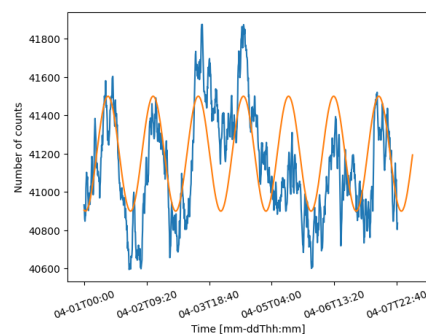
Scintillator Apparatus at Hyytiälä for Total Ionization measurements – SAHTI



L. Ahonen, T. Hildén, M. Kalliokoski, M. Kulmala, T. Petäjä, P. Schiestl-Aalto, R. Turpeinen, M. Väänänen



- Scintillator-based setup for measuring radiation-induced ionization levels in the Hyytiälä forest.
- The detector setup is currently based on two scintillators.
 - Large-area detector for cosmic background analysis.
 - Spectrally sensitive LaBr_3 detector for environmental radiation measurements.
- The first year of continuous data acquisition was completed in April.
 - Updates to the control computer and DAQ software are planned for this fall.



- Initial analysis shows a response to the diurnal cycle of muon rates and sensitivity to cosmic events such as Forbush events.
- Spectral measurements show, for example, variations in radon progeny during rainfall.