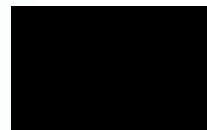




The Modane Underground Laboratory

GDRDUPhy - Plenary Meeting

Silvia Scorza
(CNRS-LPSC)



The LSM Underground Laboratory



The LSM is a French National Research Infrastructure

- Experimental site midway in the 13km France/Italy highway road tunnel
- Surface lab (*office, garage, small museum*)

Modane:

- 130 km from Grenoble
- 200 km from Lyon
- 100 km from Torino
- Deepest site in Europe dedicated to astroparticle, nuclear & particle physics
- 4800 m.w.e: muon flux reduced by $>10^6$ relative to surface
- Flexible access (hall accessible to trucks up to 9m);
- Natural radioactivity due to radon of about 10-15 Bq/m³



LSM Scientific Policy

Until 2018: Independent laboratory of IN2P3 and CEA

Since 2019: *“National Platform of IN2P3”*

IN2P3 National Platforms Management Plan:

- The LSM is administratively attached to the LPSC. Its activities, budget, and resources are reviewed annually by a management committee (IN2P3, University, and LPSC).
- IN2P3 has mandated an International Strategic Council to provide annual recommendations on the LSM's scientific program and overall strategy (this year's meeting on March 11 to 13, 2025).
- The Scientific Director is appointed directly by IN2P3 (in consultation with LPSC) to ensure that the LSM's scientific program aligns with IN2P3's national and international objectives.

The LSM Organization

Laboratoire de Physique Subatomique et de Cosmologie

Directeur de'Unité : Laurent Derome

Adjoints à la direction : Fabienne Ledroit-Gillon ; RA : Alain Retailleau ; RT: Christophe Vescovi

Laboratoire Souterrain de Modane

Direction

Directrice de la Plateforme (DP)

Silvia Scorza

Directrice Opérationnelle (DO)

Nadine Sauzet

Chargés de Mission

Communication (CMC)

Guillaume Warot

Qualité (CQM)

À nommer

Service Ultra Basse Radioactivité

Responsable de Service

Guillaume Warot

Membres

Ali Dastgheibi-Fard (PCR)

Jean-Louis Margueron

Eric Pailla

Christian Ranieri

Aurelian Rojas-Harillo

Thierry Zampieri

Comités

Comité Stratégique Externe

Aldo Ianni

Marie Davidkova

Sean Paling

Stefan Schöner

Nigel Smith

- LNGS

- NPI CAS

- Boulby

- TUM

- TRIUMF

CoDir

DAS Astroparticules, DAS Nucléaire, DAS Interdisciplinaire, DAT

Représentant Pôle PAGE

DU, DP, DO

- IN2P3

- UGA

- LPSC/LSM

Service Techniques

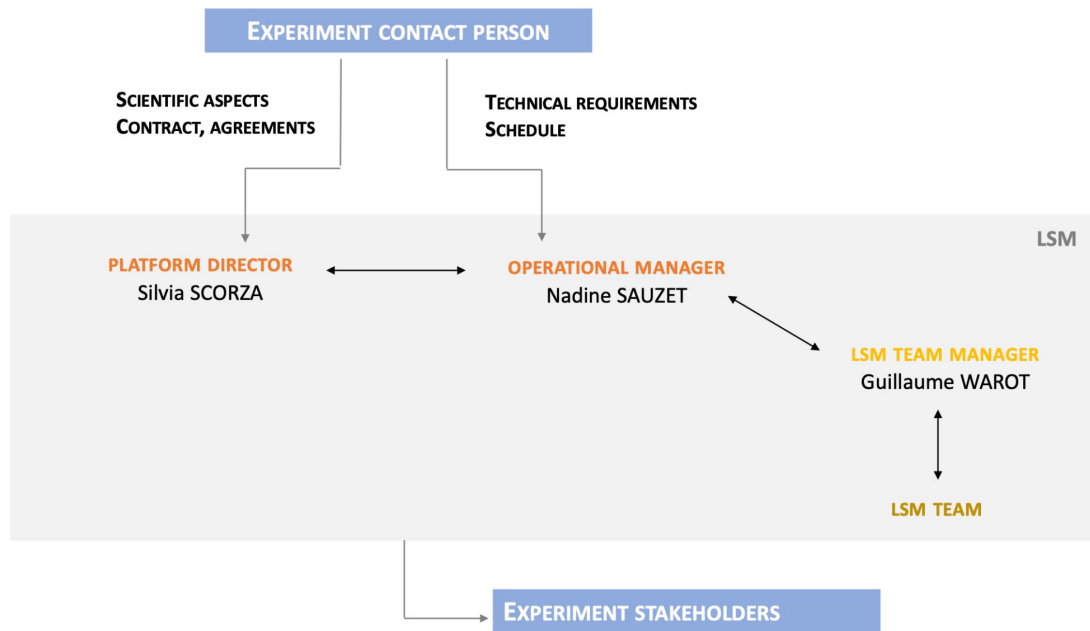
Service Administratif et Financier

Valérie Favre

Service Informatique

LSM Organization Updates Over Last Year

- The directors (ops and sci) are the point of contact for the experiments.
- The Ops director interacts with the head of the SUBR department and defines objectives and priorities.
- The head of the SUBR department organizes activities and defines resources.

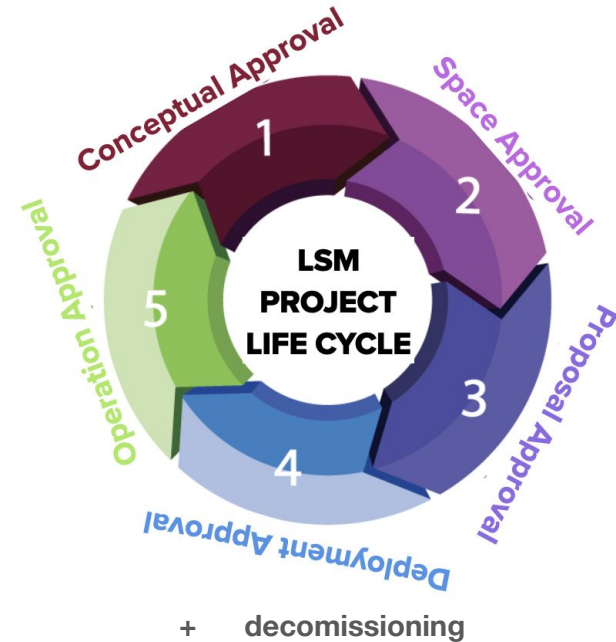


LSM Project Life Cycle

From Feb 2024

- |

- Formalisation of the Experiment Life Cycle
- Focus on the definition of the LSM responsibilities
- Focus on the definition of the Experiment responsibilities
- Agreement on the **occupied footprint** and LSM facility needs (timeline, surface, fluids, mechanical interfaces, environment constraints,...) : through technical specifications
- Agreement on the **operations process**: technical review and analysis, list of documents required (risk assessment, prevention plan, review report,...)
- **Contracts** regularization in progress / new contracts for new experiments hosting
- Formalization of **quotations** based on a new price list process



LSM Strategic Plan

- Enhance the laboratory visibility at the forefront of nuclear and astroparticle physics by delivering world-class science and boosting its scientific leadership (**objective 1**);
- Maintain a strong focus on the delivery of science, and support to the continued progress of current and future experiments (**objective 2**);
- Continue to develop and improve internal project and programme management capacity to enable and optimise its impact on the effective and efficient development and implementation of science experiments (**objective 3**);
- Strengthen its global partnerships with European and international laboratories to further consolidate the role of France and IN2P3 in world-class physics research in the domain of deep underground physics (**objective 4**).

International Network of Deep Underground Laboratories (DULs)

- Stronger collaboration between underground laboratories to improve support for the scientific community
- DUL creation of joint working groups
 - Sharing of good practices
 - Development in operational matters, Health and Safety, experience management, etc.
 - Low background counting/analysis (“Low Radioactivity Techniques” workshop series), shared databases
- **DULIA Network**
- iDMEU <https://www.idmeu.org/> [Initiative for Dark Matter in EUrope and beyond]
- DMInfraNet <https://arxiv.org/abs/2504.01688> [Enhancing European Cooperation in the Search for Dark Matter]
- ISAPP Network (LSM participating in SC since 06.06.2025)
- Coordination of the response of underground laboratories to European calls for tenders
 - MSCA-SE February 2025 - NEXUS
 - EU INFRADEV change of panorama

NEXUS: North-south EXchange for Underground Science

Consortium: EU(CNRS,INFN,LSC,UKRI, SKAO), SNOLAB, SURF, UoMelbourne, UoAdelaide, ZA(SU,UWC,UNISA,Wits)

Project Coordinator: [F. Malek](#) (CNRS DR11-IN2P3)


Grant amount: 771 540.00 EUR

Project duration: 48 months

Project Start: 1st January 2026

5 Working packages (WP):

- 1- Low background Technologies: [S. Scorza](#) (CNRS)
- 2- Muons and radiation Measurements: [N. D'ambrosio](#) (INFN)
- 3- Modelling and Computing: [L. Mantile](#) (UNISA,ZA)
- 4- Quantum science and Technology: [J. Hall](#) (SNOLAB)
- 5- Education, Training, Communication: [C. Oana](#) (INFN)

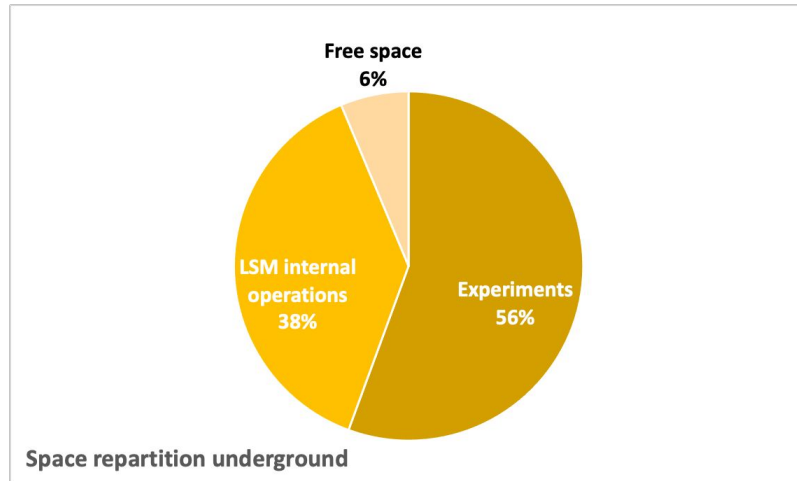
	EUROPEAN COMMISSION	Evaluation Summary				
	Horizon Europe Framework Programme (HORIZON)	Report - Staff Exchanges				
Call: HORIZON-MSCA-2024-SE-01						
Type of action: HORIZON-TMA-MSCA-SE						
Proposal number: 101236929						
Proposal acronym: NEXUS						
Duration (months): 48						
Proposal title: North-south EXchange for Underground Science						
Activity: PHY						
N.	Proposer name	Country	Total eligible costs	%	Grant Requested	%
1	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	210,420	27.27%	210,420	27.27%
2	ISTITUTO NAZIONALE DI FISICA NUCLEARE	IT	350,700	45.45%	350,700	45.45%
3	CONSORCIO PARA EL EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO SUBTERRANEO DE CANFRANC	ES	0	0.00%	0	0.00%
4	THE SQUARE KILOMETRE ARRAY OBSERVATORY	UK	10,020	1.30%	10,020	1.30%
5	STELLENBOSCH UNIVERSITY	ZA	110,220	14.29%	110,220	14.29%
6	UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG	ZA	10,020	1.30%	10,020	1.30%
7	UNIVERSITY OF THE WESTERN CAPE	ZA	55,110	7.14%	55,110	7.14%
8	QUEEN'S UNIVERSITY AT KINGSTON	CA	0	0.00%	0	0.00%
9	THE UNIVERSITY OF ADELAIDE	AU	0	0.00%	0	0.00%
10	UNIVERSITY OF MELBOURNE	AU	0	0.00%	0	0.00%
11	UNITED KINGDOM RESEARCH AND INNOVATION	UK	0	0.00%	0	0.00%
12	UNIVERSITY OF SOUTH AFRICA	ZA	25,050	3.25%	25,050	3.25%
13	South Dakota Science & Technology Authority	US	0	0.00%	0	0.00%

LSM Science Programme

Science programme adapted to LSM size:

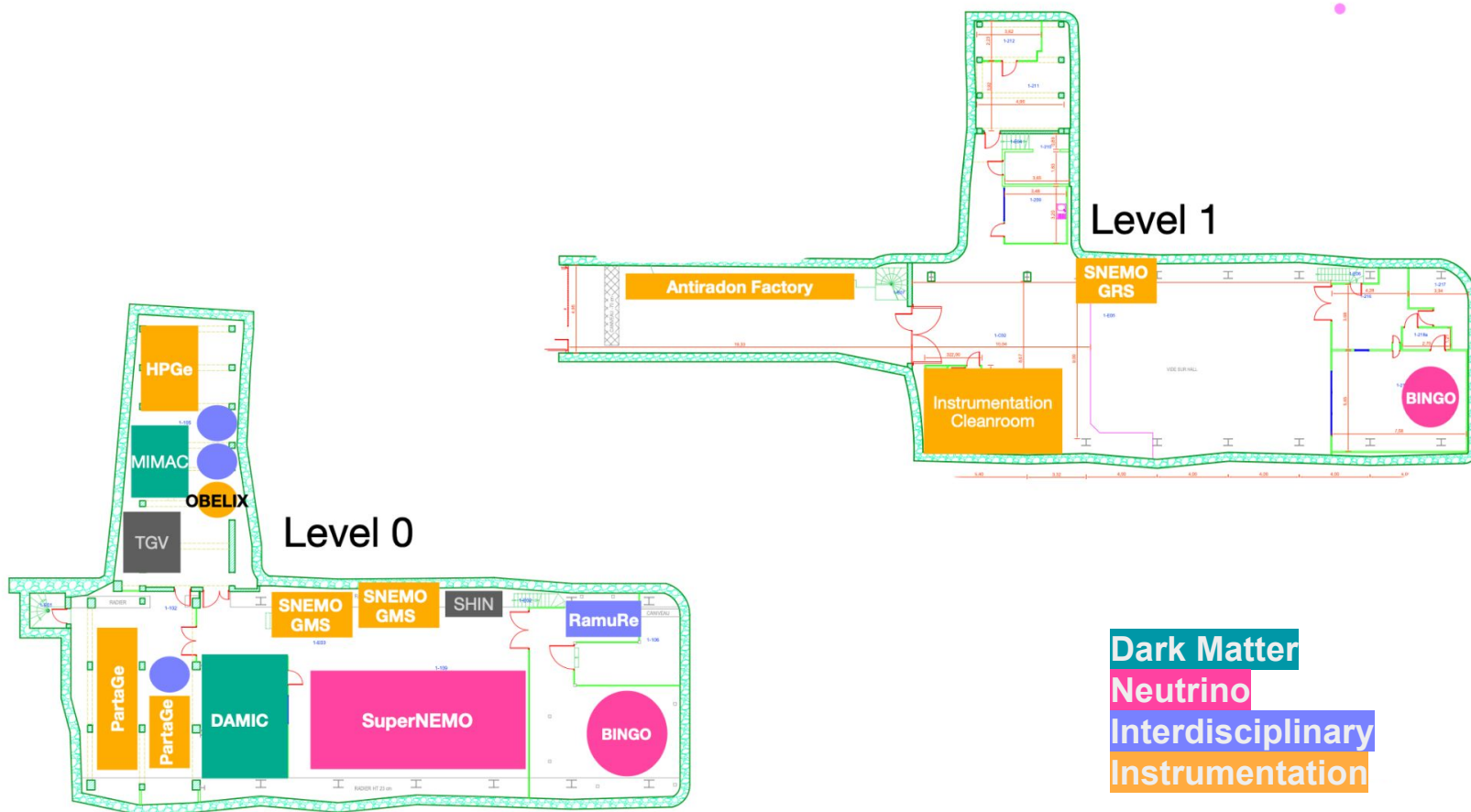
- Low-mass Dark Matter Experiments
- $0\nu\beta\beta$ demonstrators & technologies
- HPGe array for low-radioactivity

Experiment	Focus	Technology	Activities in 2024
SuperNEMO	$0\nu\beta\beta$	Tracking-calorimeter	Iron shielding installation. Water walls matter. Commissioning of the detector without neutron shielding. Installation of the Gas mixture recycling system. Start of the commissioning.
BINGO	$0\nu\beta\beta$	Cryogenic	Cryostat validation. Detector installation. Vibration study. Lead shield delivery. Ongoing contract, through a hosting convention.
Obelix ^{82}Se	ECEC2 ν	Ge ionisation	Counting of 6kg enriched ^{82}Se sample from LNGS started in January 2022: ECEC2 ν to excited states. Transfer Material agreement signed. MoU to be done.
TGV	$0\nu\beta\beta$	Ge ionisation	Detector upgrade delayed - Collaboration frozen
DAMIC-M	DM	Si CCD	Continuing test chamber (LBC) Physics run in 2024. Relocation of LBC in a "LSM-detector" cleanroom. MoU to be done, agreement letter <i>in-fieri</i> . 2025: Ongoing relocation of the LBC.
MIMAC	DM	TPC	Detector upgrades with commissioning planned in 2025. Convention d'accueil to be done as soon as an EOI is received.



Tight occupation of the available 640m²

LSM Layout 2025



LSM Interdisciplinary Focus

LSM hosts small experiments that can benefit from the exceptional low-radioactivity environment and the staff expertise in this domain (ex: biology, earth sciences..)

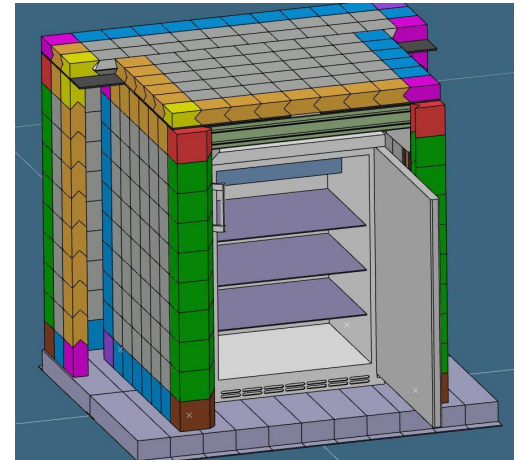
Stem cells storage underground

Allowed to test a stem cell storage shielded from natural radioactivity and terrestrial cosmic rays

- CellTEREO startup (France)
- Cell cryopreservation under extremely low radiation background (CVUT)

RAMURé project

- Funded by CNRS interdisciplinary mission
- Study of the long-term impact of natural radioactivity on living organisms, in particular those inhabiting aquatic ecosystems (three species of diatoms).
- Reduced radiation levels lead to various physiological consequences, such as growth inhibition and increased sensitivity to chemical mutagens.



Screening and Material Assay Platform

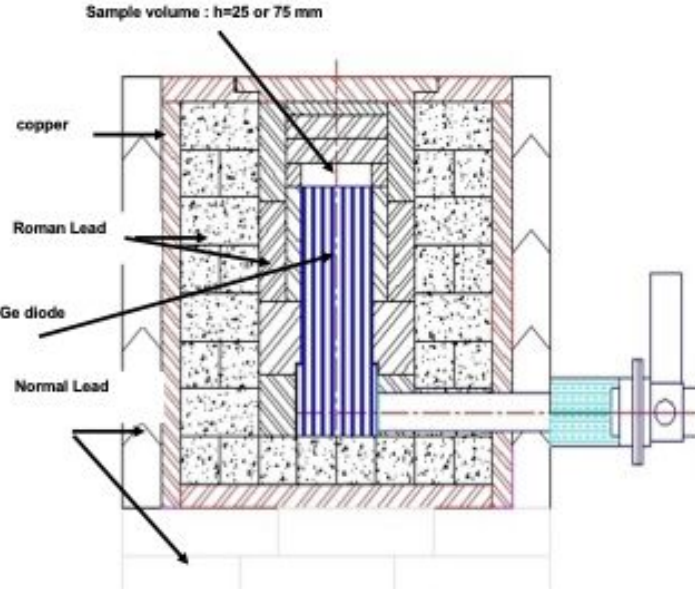
Wide-range program for Astroparticles, Earth Sciences (sediment and ice core sample datation), environmental safety (CEA), biology, etc...

- HPGe gamma spectroscopy
- Alpha surface contamination via the XIA-UltraLo1800 counter
 - Commissioning at LPSC (surface cleanroom)
- Material assays for experiments based at LSM (SuperNEMO, EDELWEISS, CUPID-Mo, DAMIC-M), and also for other experiments (ex: JUNO, RICOCHET, Q-BITS Canada)
- Agreement with LNGS for long term (~ year) measurement of ECEC decay of ^{82}Se (6 kg) to excited state on large (600 cc) Obelix HPGe.

HPGe Obelix at LSM



The HPGe for astroparticle screening measurements



Gentiane

Available for Edelweiss collaboration since November 1997

High Purity Ge diode 210cm^3 n-type

- Closed-ended coaxial detector
- Ultra-low background cryostat
- Archeological lead shielding
- Nitrogen flux 150cc/min

Sensitivities

- Background counting rate $< 6.3\text{cts/hr}$ [0-3MeV]
- $\sim \text{mbq/kg}$ [0.1-0.2 ppb for U/Th]
- $10/\mu\text{Bq/kg}$ [^{60}Co in Cu]



The HPGe for astroparticle screening measurements



JASMIN

Available for NEMO collaboration

High Purity Ge diode 400cm³

- Ultra-low background cryostat
- Archeological lead shielding
- Nitrogen flux 150cc/min

Sensitivities

- Background counting rate <250cts/d [0.05-3MeV]
- ~mbq/kg

Screening and Assay Facilities

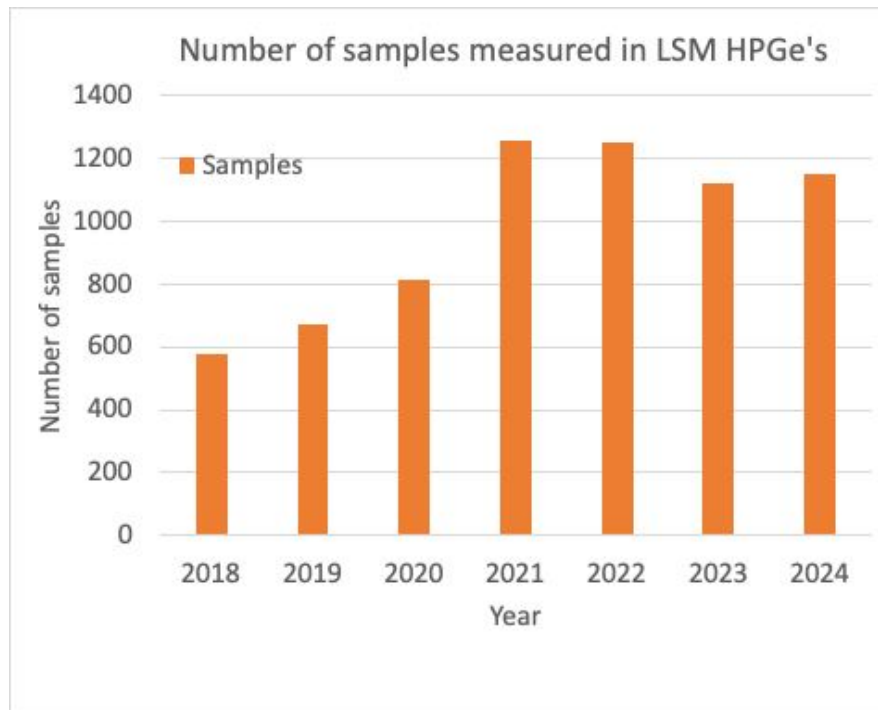
Gamma bulk (HPGe):

- 25 detectors in hands at LSM
- 15 installed in PARTAGe
- 5 detectors belonging to LSM
- ~1000 samples/year

Year	#Samples	HPGe in Partage
2018	579	0
2019	669	0
2020	810	0
2021	1253	5
2022	1251	12
2023	1119	15
2024	1150	15

Alpha Surface:

- New capabilities: surface contamination
- XIA-UltraLo1800
- Commissioning at LPSC (surface cleanroom)



PARTAGe





- **MoU/agreement** written/updated for all the HPGe users
- March 18, 2024: meeting with users of HPGe detectors. Clear feedback from users: **need to improve detector performances.**
<https://lpsc-indico.in2p3.fr/event/3591/>
- **Shieldings in progress:** standard lead shields are completed; ancient lead shields have been casted and machined; radiopurity assessment ongoing.

BACKGROUND RATES in Mafalda

From Feb 2024:

- Ongoing tests on purging - first promising results (3 detectors)
- Updated cleanliness protocols
- Updated sample change protocols
- Systematic tests on all detectors

ROI	No purge	Purge	Ratio
^{222}Rn (609keV)	7.2	0.3	21.6
Thres - 1.5MeV	282.0	100.7	2.8

All rates are in counts/day
18

XIA - UltraLo1800

Alpha spectrometer for large surface screening: specialized ionization counter comprising an active volume filled with boiled-off argon, a lower grounded electrode that is a conductive tray (holds sample), and an upper pair of positively charged electrodes.



- Empty tray monitoring (*in-fieri*)
- Detector characterization via electroformed Cu tray (courtesy of SNOLAB) (*in-fieri*)
- First sample: Rn implanted copper lids of Ge semiconductor detectors to study the background discrimination power.
- Commissioning of gas recycling system (developed by CPPM - Marseille)
- Relocation underground at LSM (summer/fall 2025)

Technical Update

- **LSM user guide**

It is a short document meant to help users navigate the current LSM logistics, especially for shipments, shifts, badges, LSM rooms and meeting room booking.

Two new mailing lists are available for :

- Booking rooms: booking-lsm@lpsc.in2p3.fr
- Radioactive sources: crp-lsm@lpsc.in2p3.fr

A new form for network access requests has been implemented through a web interface :

<https://lpsc.in2p3.fr/LSMaccess>

- **LSM code of conduct**

The purpose of the Modane Underground Laboratory (LSM) Code of Conduct is to affirm the ethical environment of LSM's workplace by providing guidance on workplace standards of conduct in the performance of their duties and relationships with others and reporting violations of the Code of Conduct.

The Code of Conduct policy applies to all employees, contractors, users and visitors. As of July 2024

Infrastructure Update

-I

Anti-radon system

Done in 2024:

- The whole installation (electrical, cooling, compressed air circuits, equipments mounting, insulation and filling of the charcoal tank, commissioning of the dryer and the compressor)
- Regulatory inspections, documentations and declarations
- Ready to start
- System performance (without the cooling unit) - Tests over several days:
 - In line with expectations (compressor and dryer parameters, air flow rate, leakage)
- Cooling unit commissioning by the supplier - coming.



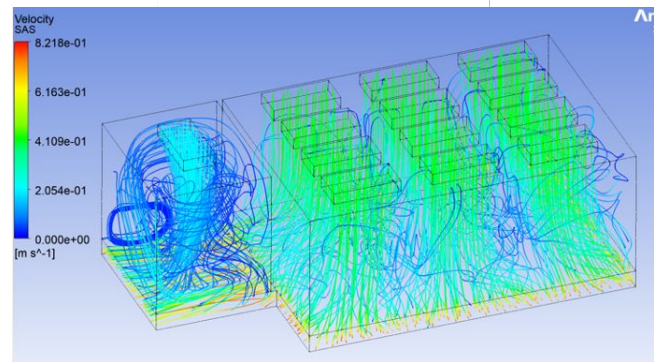
Infrastructure Update

Shared clean room for instrument prototyping

A home-made modular design, based on aluminum profiles, polycarbonate panels and 13 FFU.

Done in 2024:

- Design, mechanical and air flow simulations, purchases, integration (LPSC + LSM)
- Qualification: ISO 5 classification (particulate counter measurements by LSM)
- Equipped with UPS sockets, network, light, electrical cabinet,...



Computer Network:

- Objective: Improve the security and sustainability of the network – Sectorization by experiment
- Replacement of obsolete servers, installation of switches, cabling, and labeling.
- Implementation of EDUROAM at Carré Sciences.

Monitoring System: Design of a new architecture based on Schneider PLCs.

THE END

Thank You!