



# *LSM future experiments*

*LSM organization and science program*

*Foreseeable scenarios for medium- and large-scale experiments*

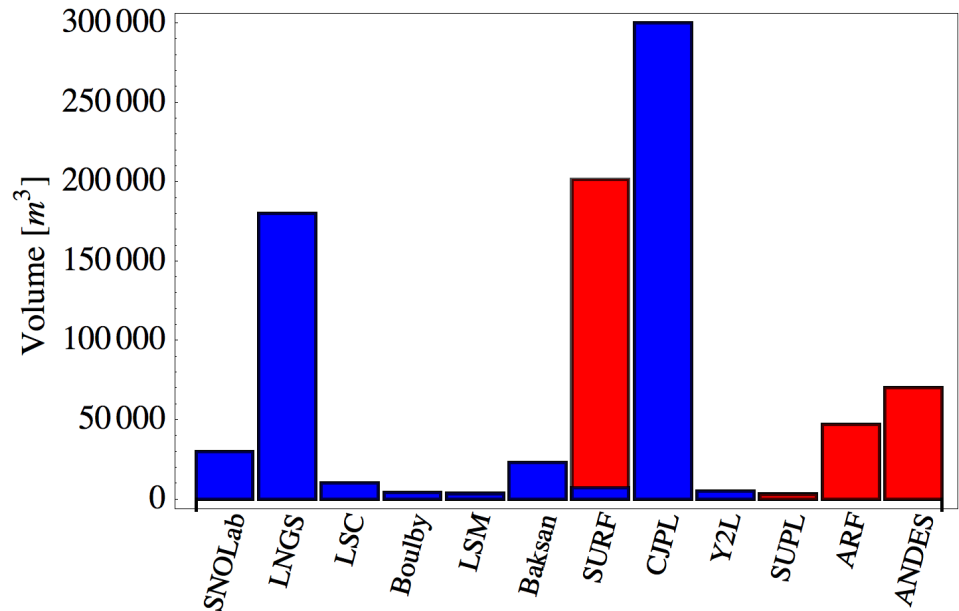
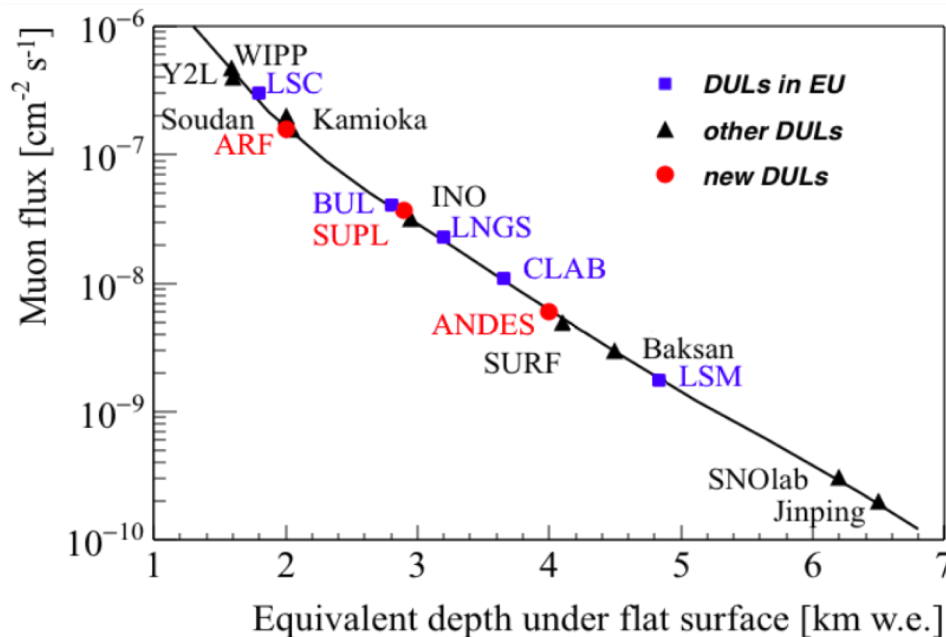


Scientific Director: Jules Gascon  
(Université Lyon 1 + CNRS/IN2P3)

Director of Operations: Christophe Vescovi  
(CNRS/IN2P3/LPSC)

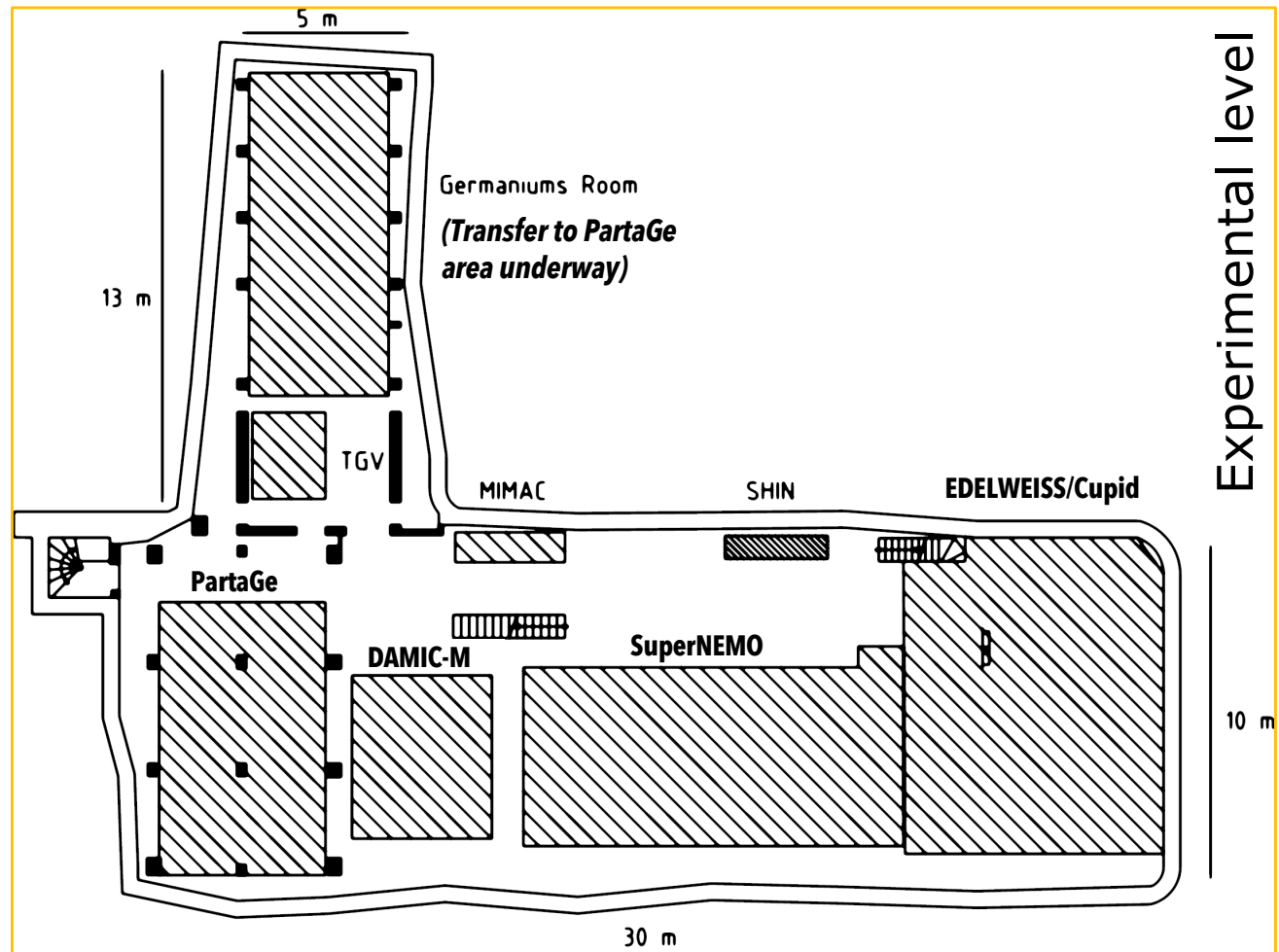
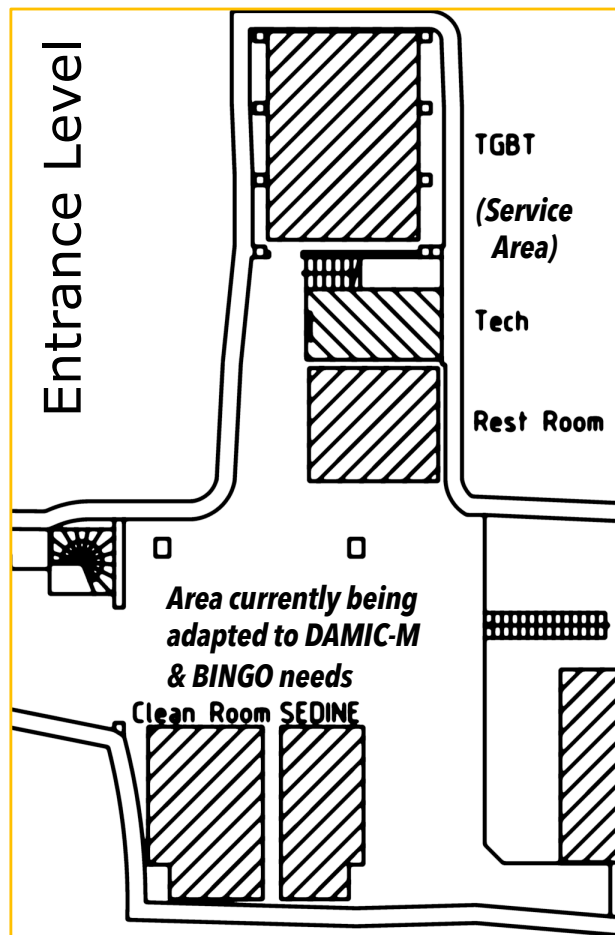
# LSM experimental site

- *Deepest* site in Europe dedicated to Astropart., Nuclear & Particle Physics
- 4800 m.w.e: Muon Flux reduced by  $>10^6$  relative to surface (/5.5 LNGS)
- *Flexible access* (hall accessible to trucks up to 9m);
- *Small* experimental surface: 400 m<sup>2</sup>  
*cf:* Canfranc 600 m<sup>2</sup>, Boulby 1700 m<sup>2</sup>, SNOLAB 5350 m<sup>2</sup>, Gran Sasso 180000 m<sup>2</sup>
- Natural radioactivity due to Radon  $<5$  less than LNGS et LSC



# LSM Floor plan (ca 2021)

- Tight occupation of available 400 m<sup>2</sup>
- Plans to install 180 m<sup>2</sup> mezzanine level (over the crane access) above expt. level



# LSM in pictures

- Ge counting facility and main hall in 1990



- ... And now

## ■ Subatomic/Astroparticle physics Platform *[this session's topic]*

- Hosting fundamental physics experiments, in particular those supported by IN2P3, with international, bi-national or national collaborations
- Host R&D and detector physics for future expts (larger detector deployed in larger DUL)
- Provide technical support to experiments
- **Priority topics (well-adapted to depth+size): Light Dark Matter, R&D for  $\beta\beta 0\nu$**

## ■ Germanium $\gamma$ -ray assaying

- Very low radioactivity measurements
- Associated technology developments



## ■ Opening to multidisciplinary applications

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

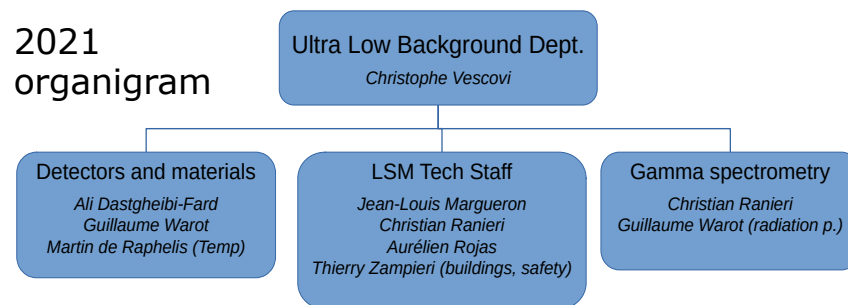
## ■ Coordination with networks of European underground laboratory

- Request by APPEC
- Common working groups in preparation

Subjects for future DUPhy sessions?

# LSM Organisation

- Since 2019: national platform of the French CNRS/IN2P3, hosted and operated by LPSC (CNRS + Grenoble-Alpes University)
  - Merging LSM (~10 personnel) with LPSC (~200 personnel) for improved administrative & technical support, and improved link with Grenoble University (*infrastructure support*)
  - National status of LSM ensured by nomination of Scientific Director by IN2P3
  - LSM included 2022 by French Ministry on its national list of Research Infrastructures



*New (December 2022):  
LPSC recruits new DR with strong  
background in low-radioactivity to  
boost its involvement in LSM*

- Director of operation (C. Vescovi, LPSC)
- Scientific director (J. Gascon, Lyon University + CNRS/IN2P3)
- LSM Steering committee includes CNRS/IN2P3 & Université Grenoble Alpes
- LSM External Strategic Council: A. Iani (LNGS), S. Paling (Boulby), S. Schönert (TUM), N. Smith (Triumpf) ... *importance of DUL coordination in strategy discussion*
- *Scientific coordination of French efforts in Deep Underground Physics via DUPhy "Groupe de Recherche" (GDR): (<https://gdrduphy.in2p3.fr/>)*

# *How to propose a new experiment*

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## ■ Small-scale experiments:

- Just contact LSM direction (Gascon/Vescovi)

## ■ Medium- and large-scale experiments:

- Need to interact with LSM to define schedule & space constraints
- Setting up one expt affects (+/-) all others : optimization of use of volume, required investment by LSM (+ support from funding agencies)
- Negative interferences: space, installation schedule
- Positive interference: common facility (Radon-free air, joint use of cryostat)

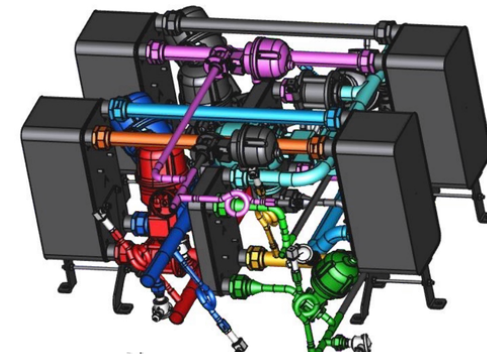
## ■ Approval process

- Contact LSM direction to present your project
- Discuss with LSM to optimize (expt needs vs implantation constraints) :
  - preparation of agreement
- Plans for major LSM use (ex: experiments in main hall) presented to the Conseil Strategic Externe, to issue recommendations to LSM and IN2P3
  - Next CSE meeting: ~February-March 2023
- Approval of resource uses by funding agencies (IN2P3+University)
  - Next Comité de Direction: ~March-April 2023.
- Signature of agreement

# Common facility upgrade

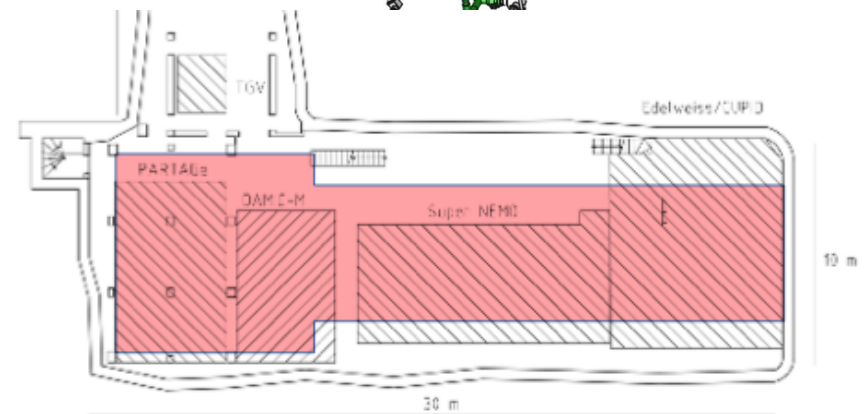
## ■ Radon trapping

- First facility installed in a DUL (2005)
- Initially for NEMO-3, → **shared with other expts**
- 120 m<sup>3</sup>/h flow of air with 15 mBq/m<sup>3</sup> Rn concentration (~ /1000 ambient)
- Failure of aging facility, dismantled
- **Major upgrade** (250 m<sup>3</sup>/h) under way (LSM+CPPM+Prague+Ateko)
- Reduced electricity & cooling needs



## ■ Mezzanine

- Increase floor area by 180m<sup>2</sup>
- For computing/DAQ rooms, integration areas, "light" experiments
- Estimated cost 250-300k€
- Feasibility and mechanical analysis done
- Delayed CPER decision





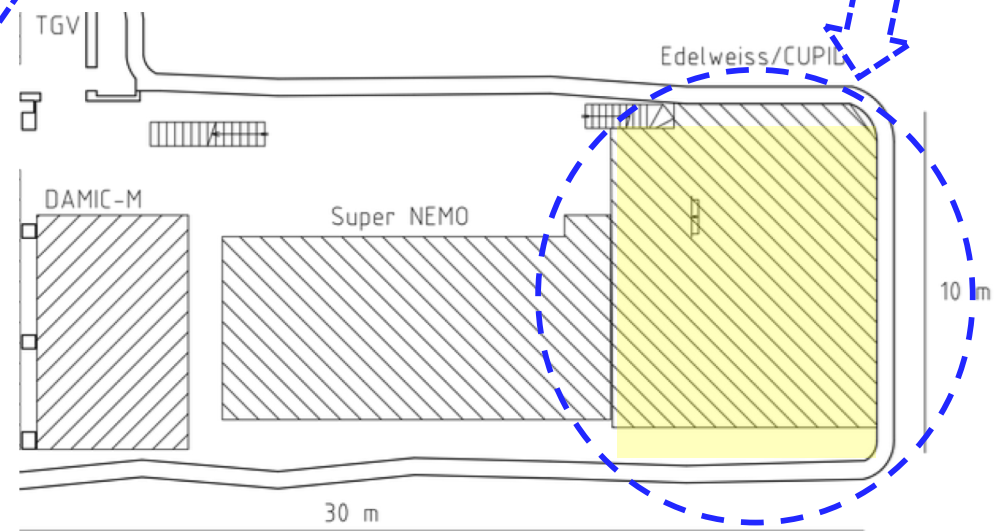
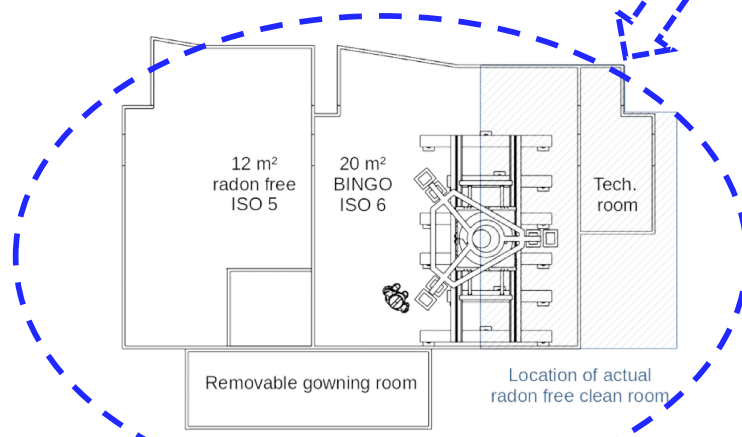
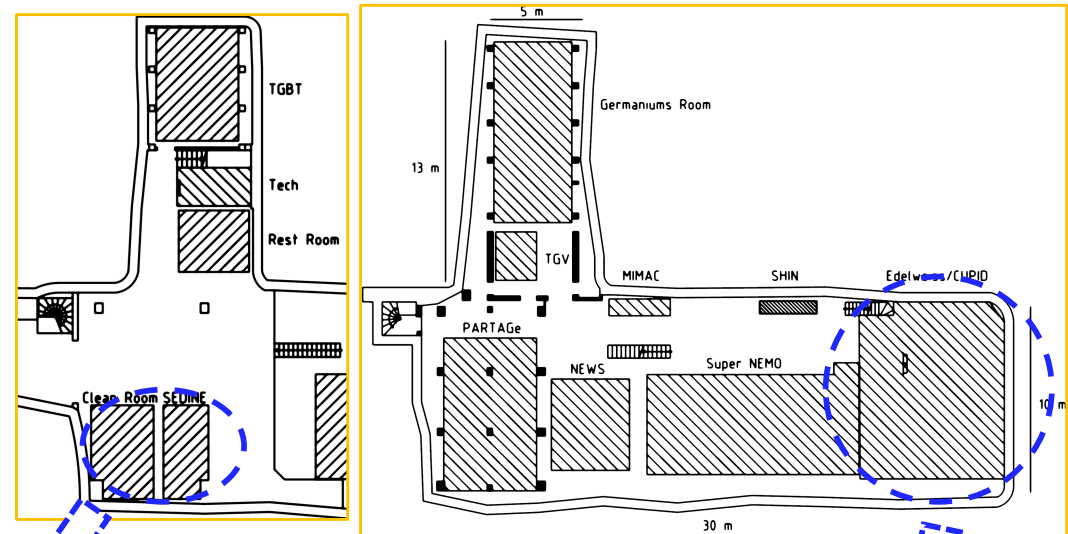
# Common facility upgrade

## Clean rooms

- Installation of BINGO clean room
- Relocation of the CTU/SURO radon-free clean room

## EDELWEISS-III dismantling

- High He consumption + ageing: not suitable for future expts
- ~100 m<sup>2</sup> (..space was more readily available in early 2000!)
- 7 m height under crane
- Operation being budgeted
- Access restricted by SuperNEMO
- Schedule driven by new projects



# Conclusion

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- In order to better prepare its medium and long-term science program, the LSM would like to hear from the GDR DUPhy community its ideas on possible medium- and large-scale experiments, as well as technological R&Ds, that could benefit from the exceptional environment at Modane.
- With the EDELWEISS-III and CUPID-Mo now completed, and, on a longer term, the completion of the SuperNEMO demonstrator run, new opportunities will open up in the coming years.
- *A feed-back from the DUPhy community would help LSM to optimize its coming calendar and its plans for future use of the experimental area as well as investments for equipment and facilities.*

# Summary of 2021 activities for experiments

- Program focused on development of new techniques (“demonstrator”) and low-mass WIMP searches: *well adapted to LSM constraints (small space) and strong point (lowest muon rate in EU, easy road/truck access, proximity to French labs)*
- *~400 users, including ~200 from 18 countries other than France*

LSM Experiment	Domain	Technique	Collaboration	Activities in 2020-2021
CUPID-Mo	$\beta\beta 0\nu$	Cryogenic LiMoO	France, Russia, Germany, Italy, USA, Chine, Ukraine	Physics exploitation. No futher runs in EDELWEISS-III cryostat.
SuperNEMO	$\beta\beta 0\nu$	Tracko-Calo	France, UK, Russia, Japan, USA, Czech Rep., Slovakia	Commissioning ongoing. Delays in the shield installation
BINGO	$\beta\beta 0\nu$	Cryogenic	France	Installation of cryostat to start end of 2022
Obelix 82Se	ECEC2v	Ge ionisation	France, Italy, Russia, Czech Rep.	Counting of 6 kg enriched 82Se sample from LNGS started in january 2022: ECEC2v to excited states
TGV	$\beta\beta 0\nu$	Ge ionisation	Russia	Detector upgrade delayed by covid & war
DAMIC-M	DM	Si CCD	France, USA, Canada, Switzerland, Denmark, Spain, Brasil, Argentina	Installation started in 2020, Test chamber data started in 2022, physics in 2023
EDELWEISS	DM	Ge Cryogenic	France, Russia, Germany	Physics exploitation. No furter runs in EDELWEISS-III cryostat
CRYOSEL	DM	Ge Cryogenic	France	EDELWEISS detector R&D using BINGO cryostat
MIMAC	DM	TPC Direct.	France	No runs in 2021
NEWS-G	DM	Spherical gas detecor	France, Canada, USA, Greece, UK	Plans for SEDINE detector tests in new shielding