1st LSM extension workshop

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Laboratoire Souterrain de Modane and CNRS/IN2P3

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Laboratoire Souterrain de Modane

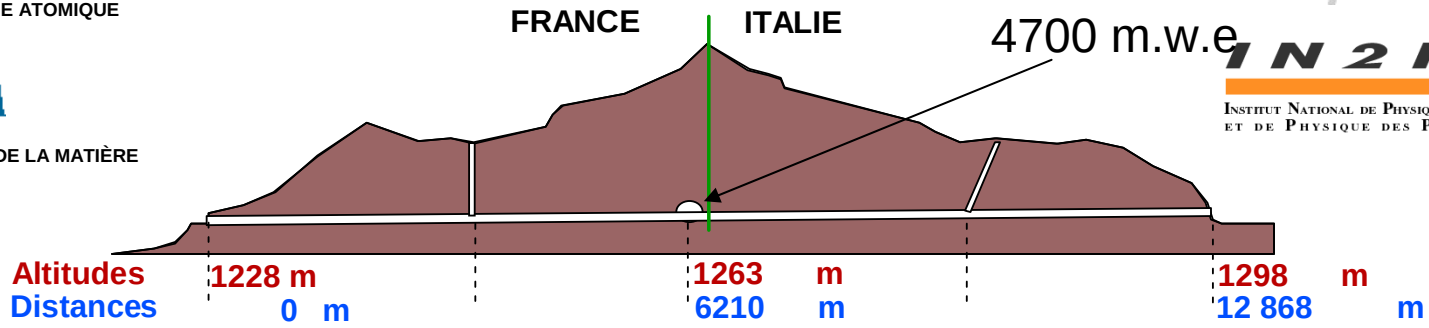
LABORATOIRE SOUTERRAIN DE MODANE

COMMISSARIAT À L'ÉNERGIE ATOMIQUE

DIRECTION DES SCIENCES DE LA MATIÈRE

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

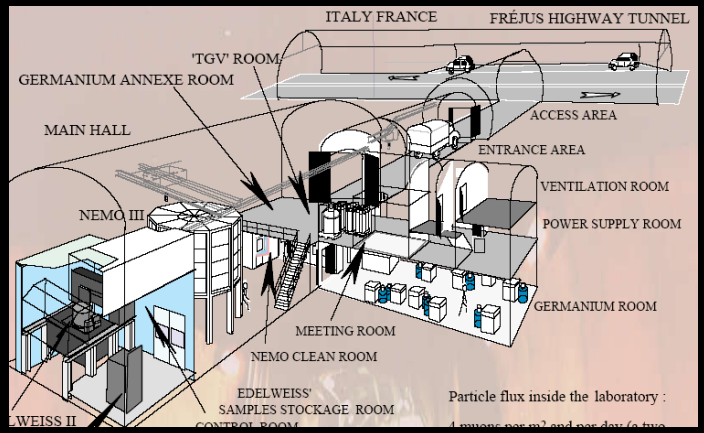
IN2P3 Institut National de Physique Nucléaire et de Physique des Particules



Built for τaup experiment (proton decay) in 1981-1982

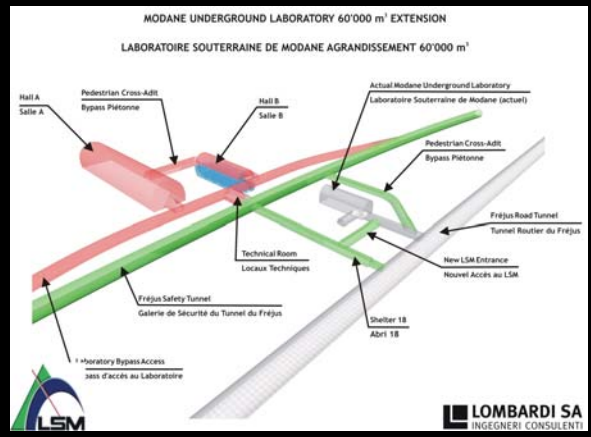
LSM and future projects

IN2P3 (CNRS) and DAPNIA (CEA) run the Modane Underground Laboratory (LSM)
The Lab Facilities are composed by:

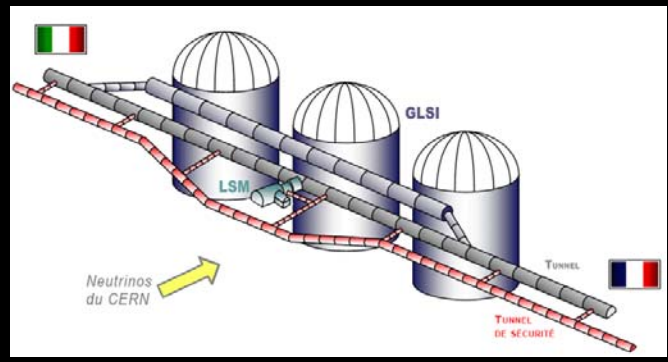


A cavity of about 3'500 m3 at middle of Fréjus Road Tunnel in French Territory

External LSM buildings (construction 2008)



LSM Project for a 60'000 m3 extension to be constructed according to on-going projects (safety tunnel)



Project for Large scale underground laboratory (1'000'000 m3)

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Roles of the laboratory:

- To provide an underground infrastructure with related facilities
- To host experiments and to provide support for running
- To insure the safety of the users and experiment
- To develop, its own research activity in low background measurement (technique and applications)

Staff: 2 researchers, 8 technicians and engineers

~100 physicists are involved in the experiments hosted by LSM

➔ 1000 visitor.days per year

Agreement with JINR Dubna

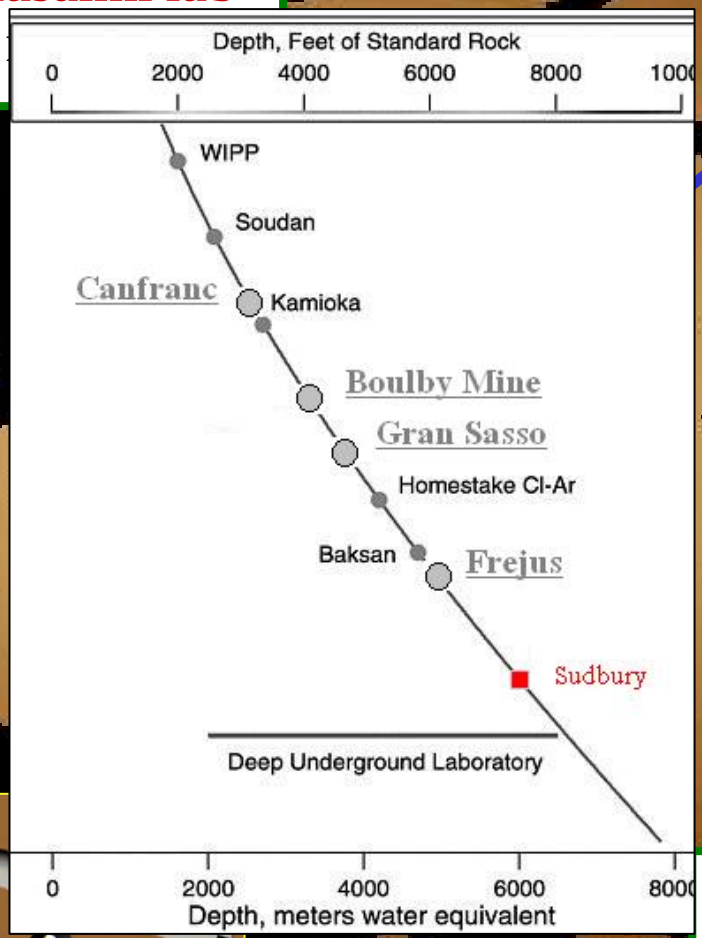
Participation to ILIAS european program

Deep Underground Labs Tunnels and Mines

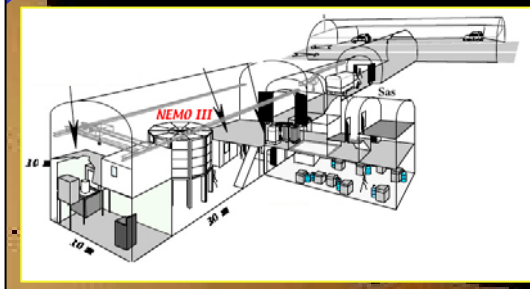
JRA 1, A1
N 2

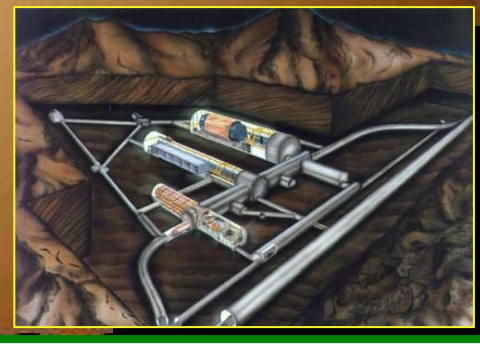
Pyhasalmi lab

Boulby (UK)

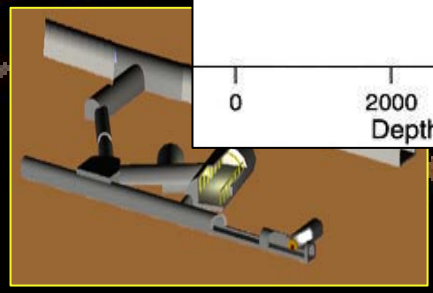


Frejus (France)





Canfranc (Spain)



Gran Sasso (Italy)

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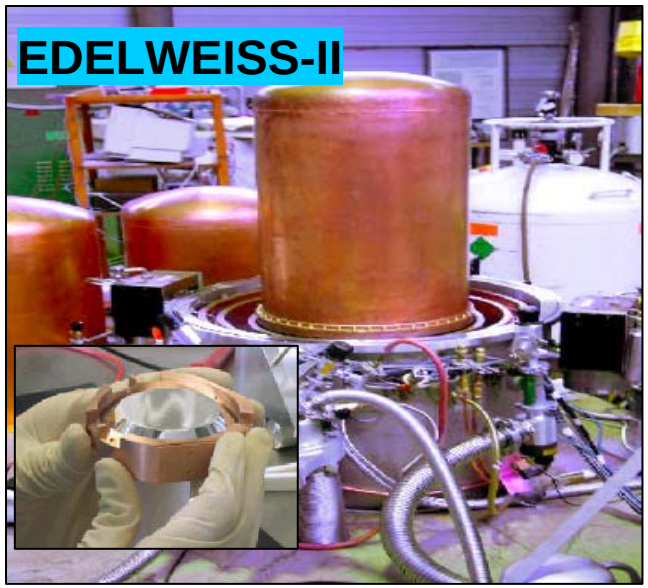
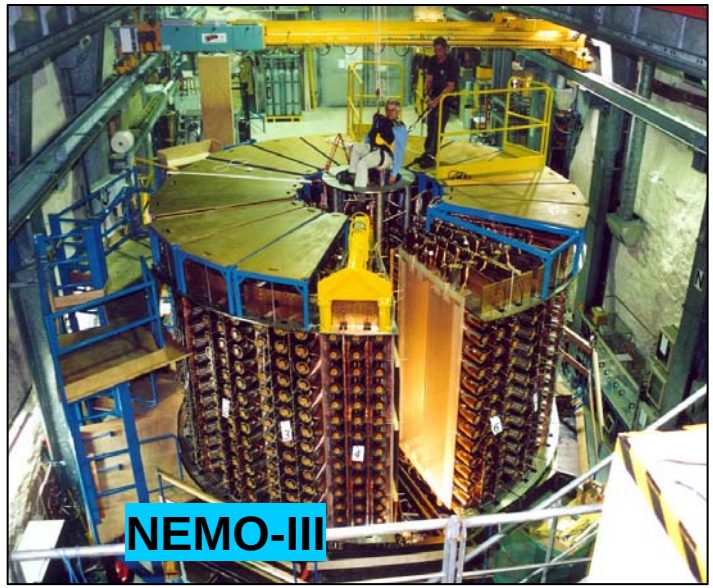
2 main experiments

Double beta decay **NEMO-III (tracking + calorimeter - ^{100}Mo 7 kg)**

Dark Matter **EDELWEISS-II (10 to 35 kg Ge heat+ion)**





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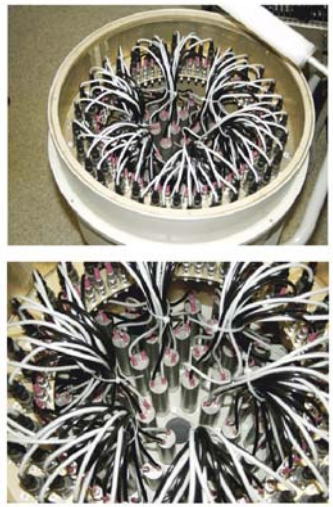
Double EC **TGV-II (Ge with sheets of Double EC candidates)**

Heavy elements **SHIN (super heavy elements in nature, Z=108, A=280)**



SHIN

- **Sphere TPC (Neutron flux measurement)**
- **BiPo (related to SuperNEMO)**
- **Neutron detectors (^{3}He counters from Dubna and liquid scintillator ball)**
- **Radon detectors (Saga University (Japan) and Dubna (Russsie))**

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Muon Flux
0.17 μ m^{-2} h^{-1}

Neutron Flux	
1.6 10^{-6} n cm^{-2} s^{-1}	(0-0.63 eV)
4 10^{-6} n cm^{-2} s^{-1}	(2-6 MeV)

Primordial Radionuclides		
^{238}U	0.84 ppm	Rock
	1.9 ppm	Concrete
^{232}Th	2.45 ppm	Rock
	1.4 ppm	Concrete
K	213 Bq/kg	Rock
	77 Bq/kg	Concrete

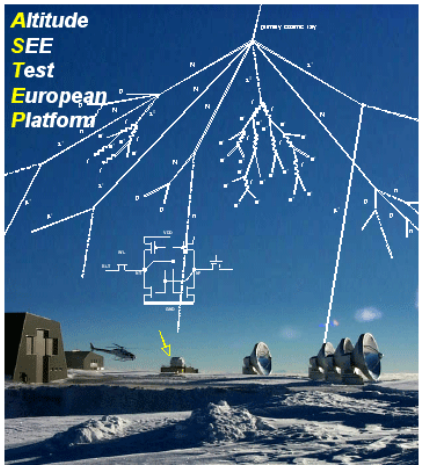
13 HPGe from 6 different laboratories of CNRS and CEA are available at LSM

- Material selection for astroparticle physics,
- Environnemental measurements
- Applications (wine datation, salt origin,…)
- Developements of Ge detector

New Ge detector from Prague University soon !

Radon free air purification system

Logical failure tests



Study of the effect of neutrons and alpha on the micro-electronic circuits

Software to repair one bad bit but in the futur a neutron or an alpha could damaged several bits → No sofware solution

A serious problem for the next technologies

Measure in LSM (Alpha contribution) Radioactivity could be a problem ?

LSM is now referenced in JEDEC

ULISSE project

- **An unique opportunity**
  - **Deepest site in Europe (4800 mwe) (Deepest in Pyhasalmi mine is deeper)**
  - **Known and « good » site (low convergence, dry, stiff rock)**
  - **Central location in Europe, easy access (plane, train car)**
  - **23 years experience in running such platform**
  - **Independent, convenient, safe, horizontal access**
  - **European Roadmap new projects (SuperNemo, EURECA,…)**
  - **Italo-french intergovernmental green light to start work**
  - **Integration of project to tunnel company planning and constraints**
  - **Performed pre study : moderate cost**

- **Not only « one more cavity »**
  - **Building a very low background cavity : an underground submarine**

To open the laboratory to new users: geophysics, geobiology, hydrology, sismology,…..

Calendar of the extension is driven by the safey galery.
Laboratory can be digged when french « tunnelier » will arrive at the middle of tunnel.

Detailed study must be order in ~1 year

Main constraints:

- Impact on safety galery operation must be small (time to dig)

-Volume of excavated rocks must fit with the place reserved by the tunnel company (700 000 m^3 + 300 000 m^3)

-Cost

- Requests from the experiments

Idea of extension started 3 years ago. Conjonction of 3 projects:
NEMO3 → SuperNEMO
EDELWEISS → EURECA
Fréjus roadway tunnel → Safety galery

2006: Pre-study funded by LSM and PPARC (UK) based on the space needed by:
SuperNEMO: Neutrino physics
EURECA: Dark matter

Pre-study performed by Lombardi company :

- **Calendar**
- **Impact on safety galery**
- **Feasability**
- **Cost**

The Main Underground Projects in Area

Historical tunnelling in the area since 1480 (Pertuis di Visio)

…existing Fréjus Railway tunnel (1857-1871) 12.2 km …

…existing Fréjus Motorway tunnel (1975 -1978) , 12.8 km…

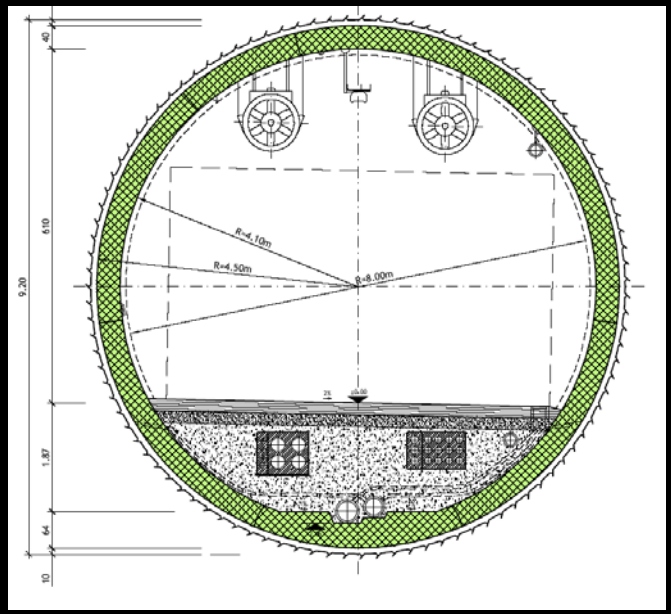
…Fréjus Road Tunnel safety tunnel, 12.8 km…

…Lyon-Turin Railway base tunnel, ~57 km

The On-Going Safety Tunnel Project

Frejus safety tunnel project (safety tunnel to road tunnel):
Aims to raise safety level of Fréjus Motorway tunnel by (Governments requirements):

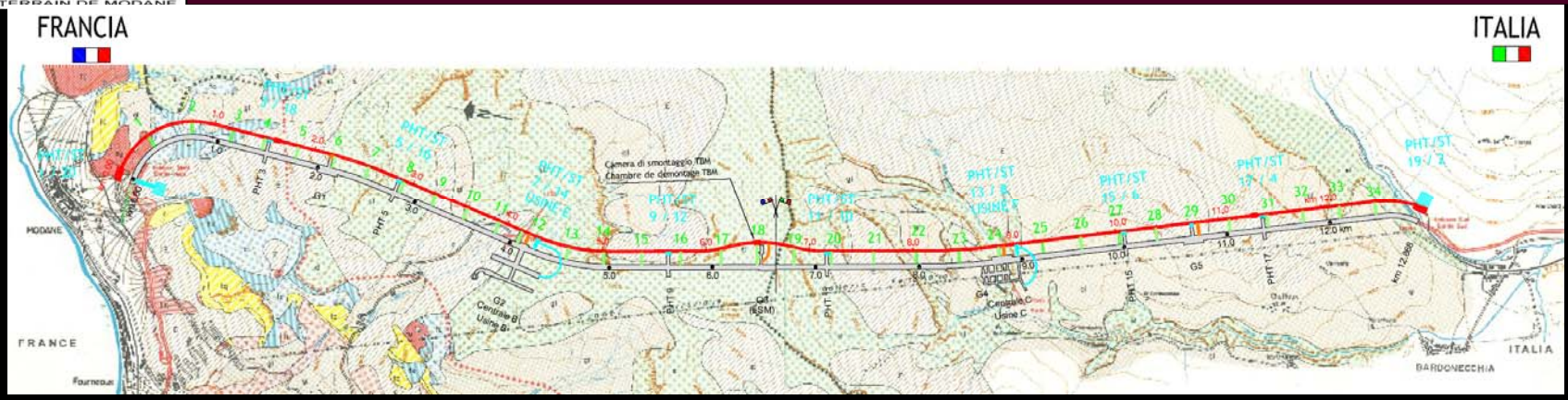
- Adding 34 new shelters (every max 400 m) for auto-rescue of users;
- Provide a safe issue for fire brigades for rescue purposes;
- Provide an alternative issue to attack and manage fires and accidents in tunnel;
- Provide new rooms for technical equipment renewals;
- Accede to LSM without interferring with tunnel operation;
- Possibility of maintenance of tunnel equipments not affecting Tunnel operation;
- Provide fast access in case of accident.

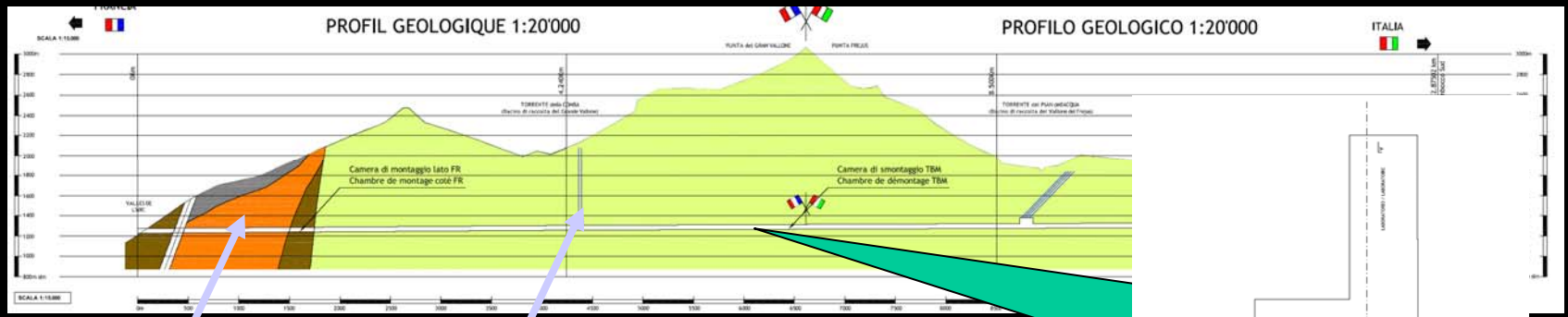


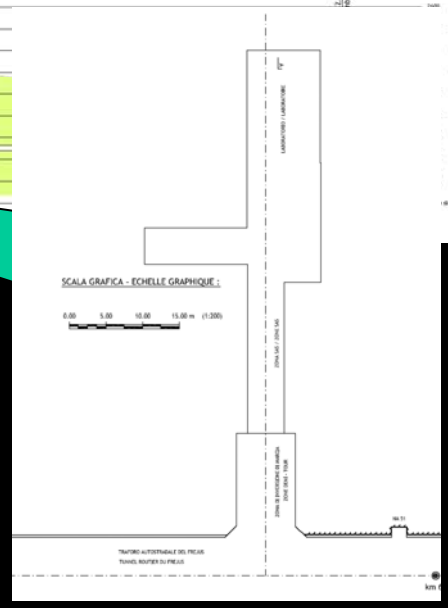
Frejus safety tunnel project 2006
(approved by Governments on 11.12.06):

- Internal safety tunnel diameter 8.00 m (clearance profile 6.6x4.0m)
- 5 carriage cross-adits (bypass)
- Longitudinal ventilation of safety tunnel
- 2 underground ventilation plants
- Portals energy supply up to 8 MW on each side

The Geology







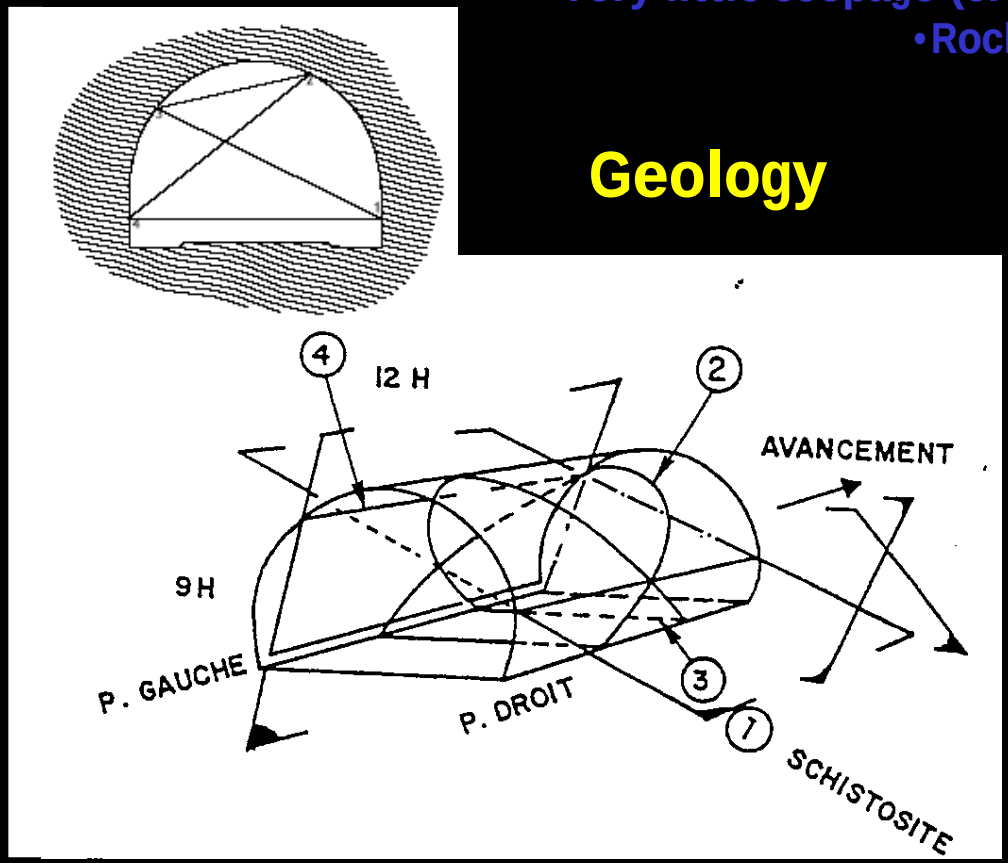
Trias Series

LSM Underground Facilities
~1800 m overburden

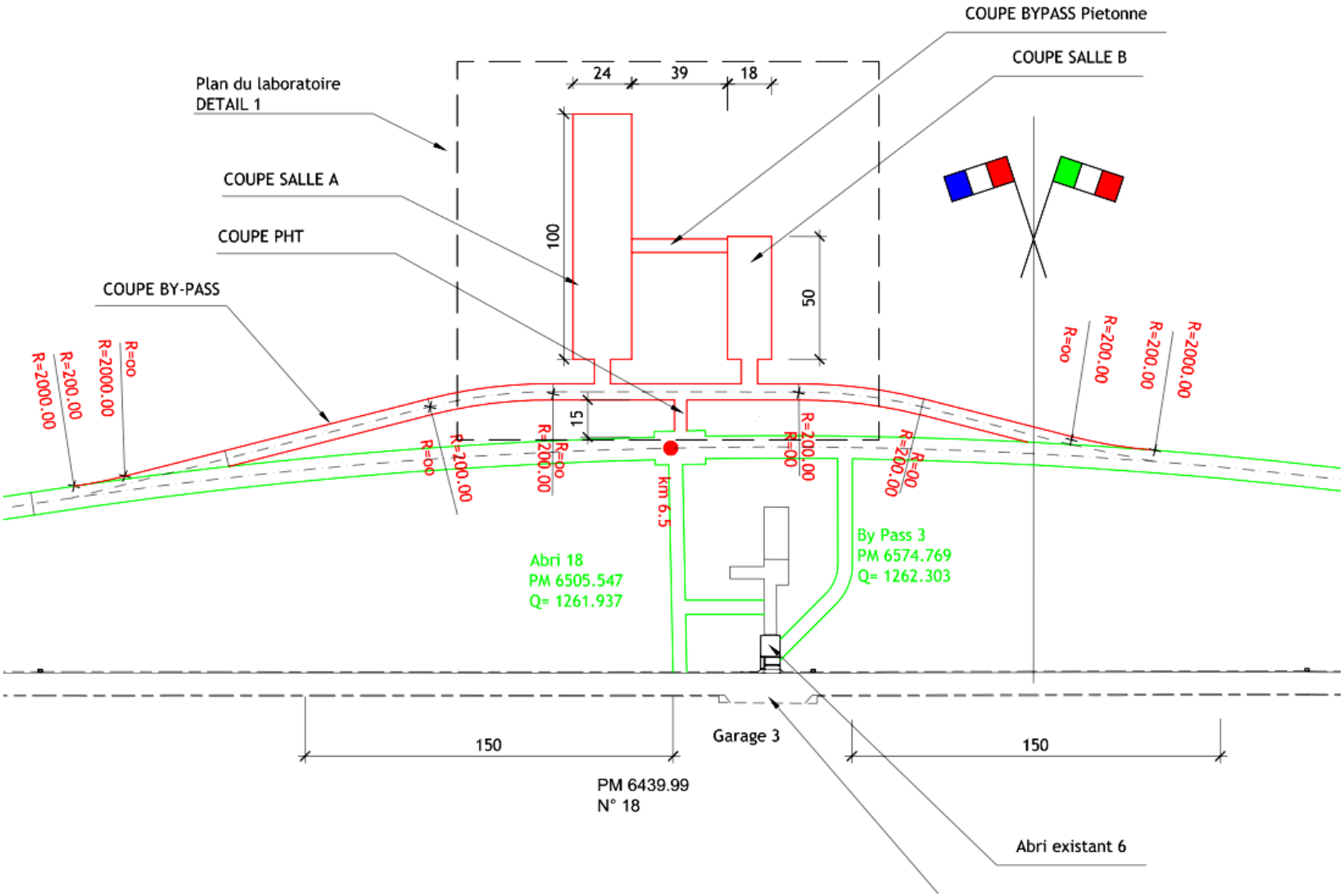
Geotechnics and Excavation Results

- Geology: Calcitic Schists UCS (30-80 MPa)
- Overburden: about 1800 m
- Fractures 4 main systems
- Exacavation profitable orthogonally to actual Tunnel (ENE)
- Very little seepage (cracks filled)
- Rock temperature around 30°

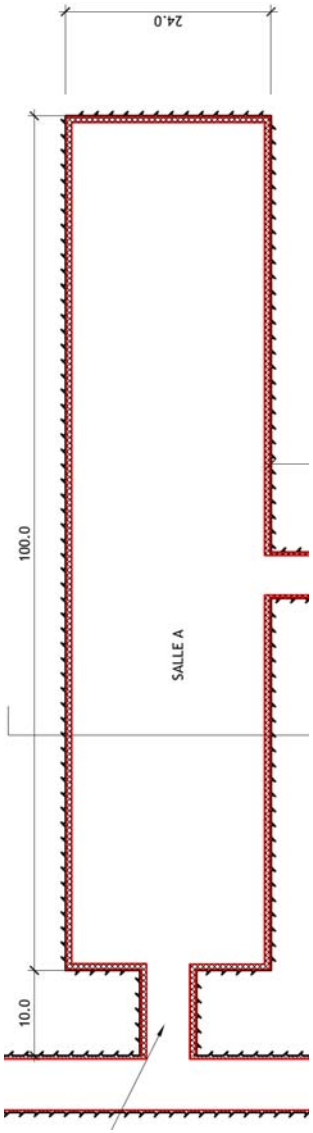
Geology



ULISSE project



HALL A (SuperNEMO type)



COUPE TYPE SALLE A

SECTION EXCAVEÉ 375 m²

SECTION UTILE 320 m²

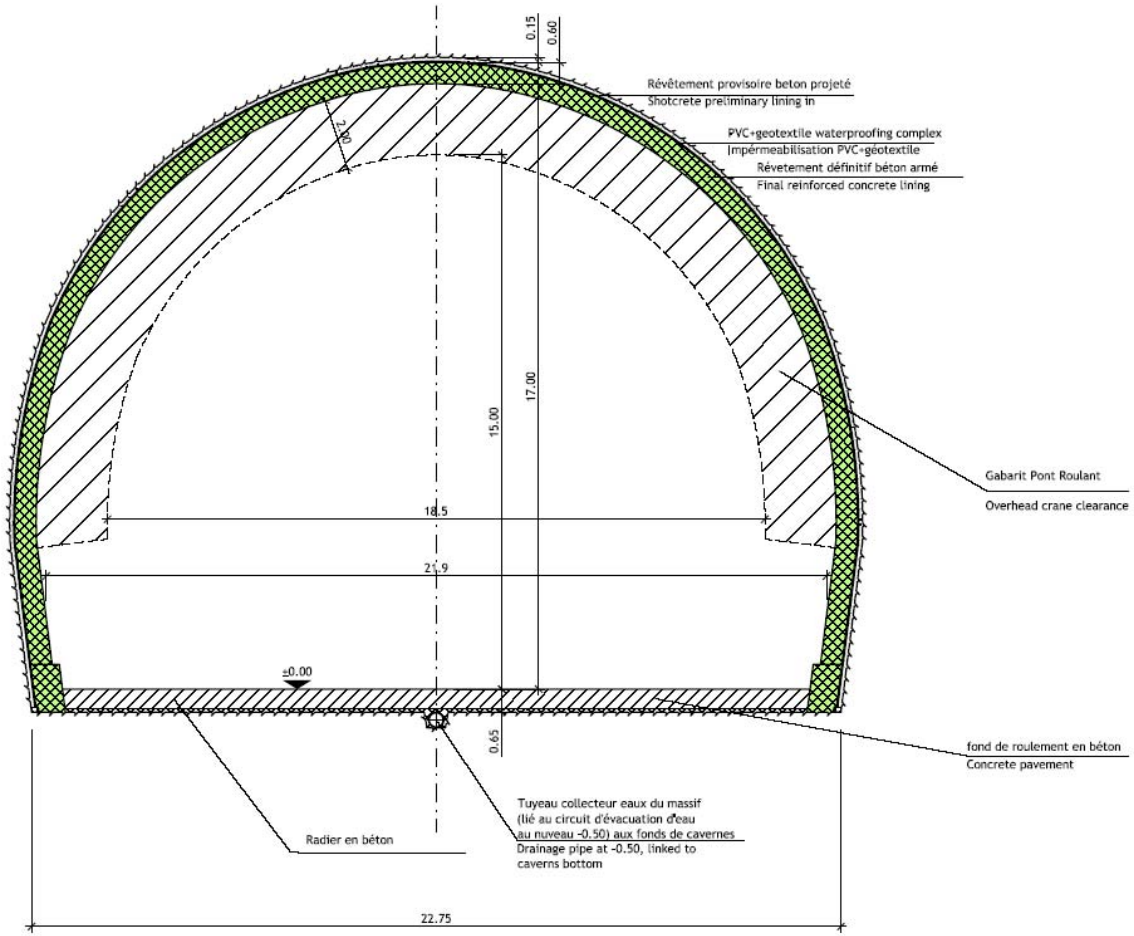
1:100

CAVERN A CROSS SECTION

EXCAVATED AREA 375 m²

INTERNAL CLEARANCE 320 m²

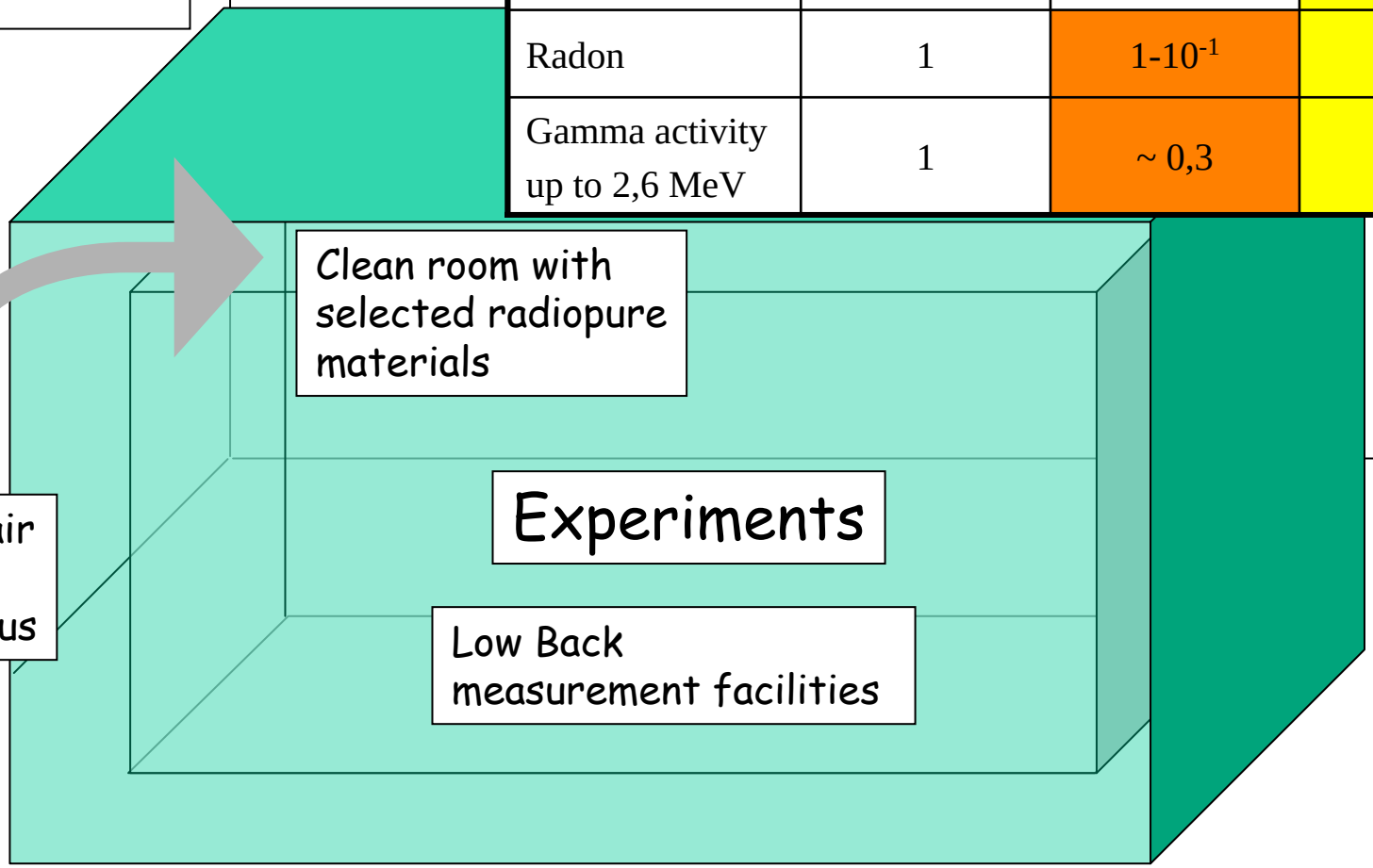
1:100



An Ultra-low radioactivy cavity

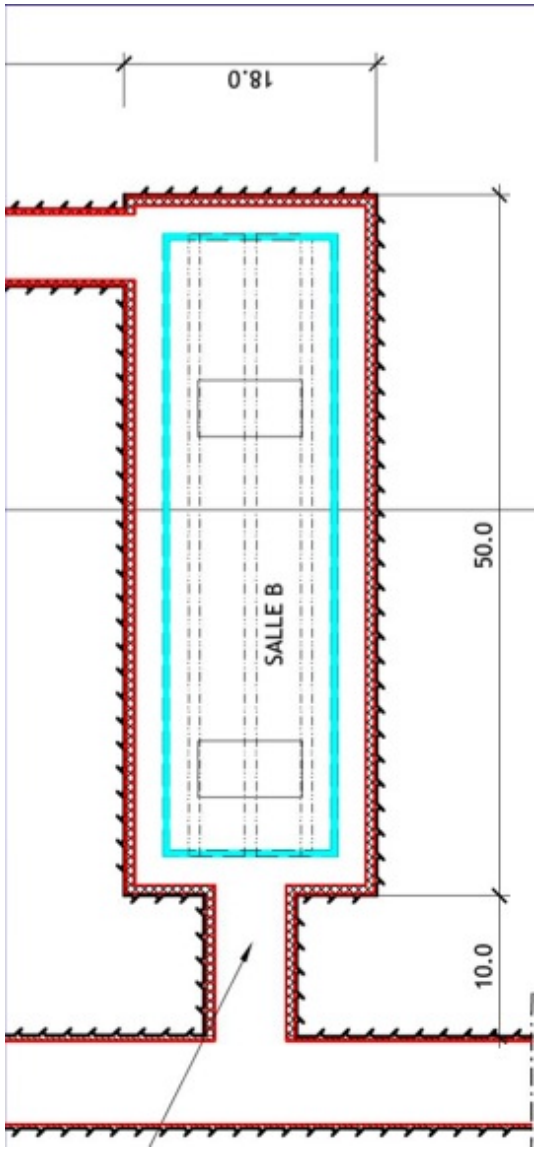
Pure 2 m water shield
PMT equipped
$\Rightarrow \gamma$ flux / 10^3
$\Rightarrow$ n flux / 10^6

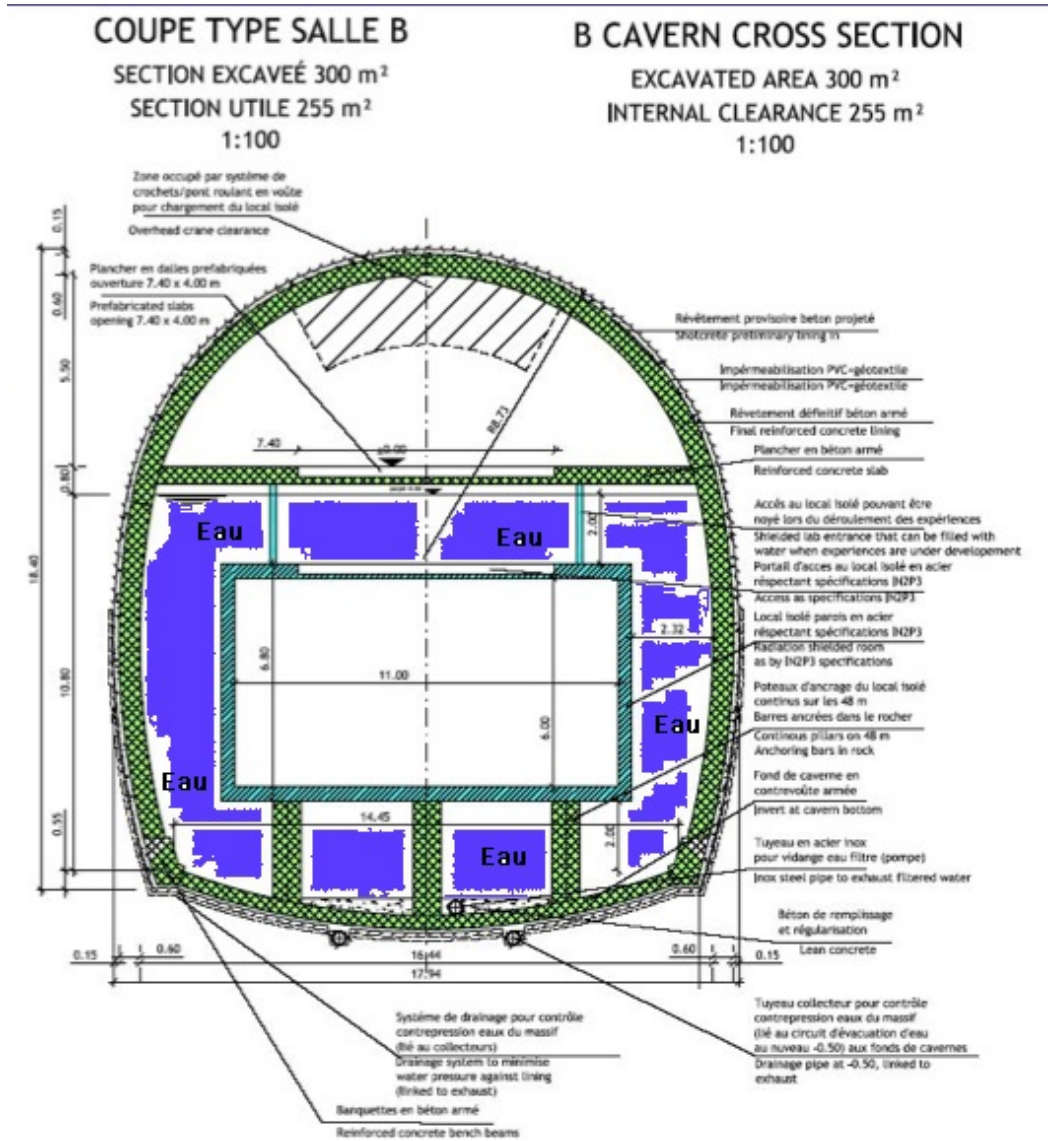
Background rate	@ surface	Current Underg labs	« Zero backg » goal
Muons	1	10^{-6}	
Neutrons (fast)	1	~ 10^{-4}	10^{-8}
Radon	1	1-10^{-1}	10^{-4}
Gamma activity up to 2,6 MeV	1	~ 0,3	10^{-4}



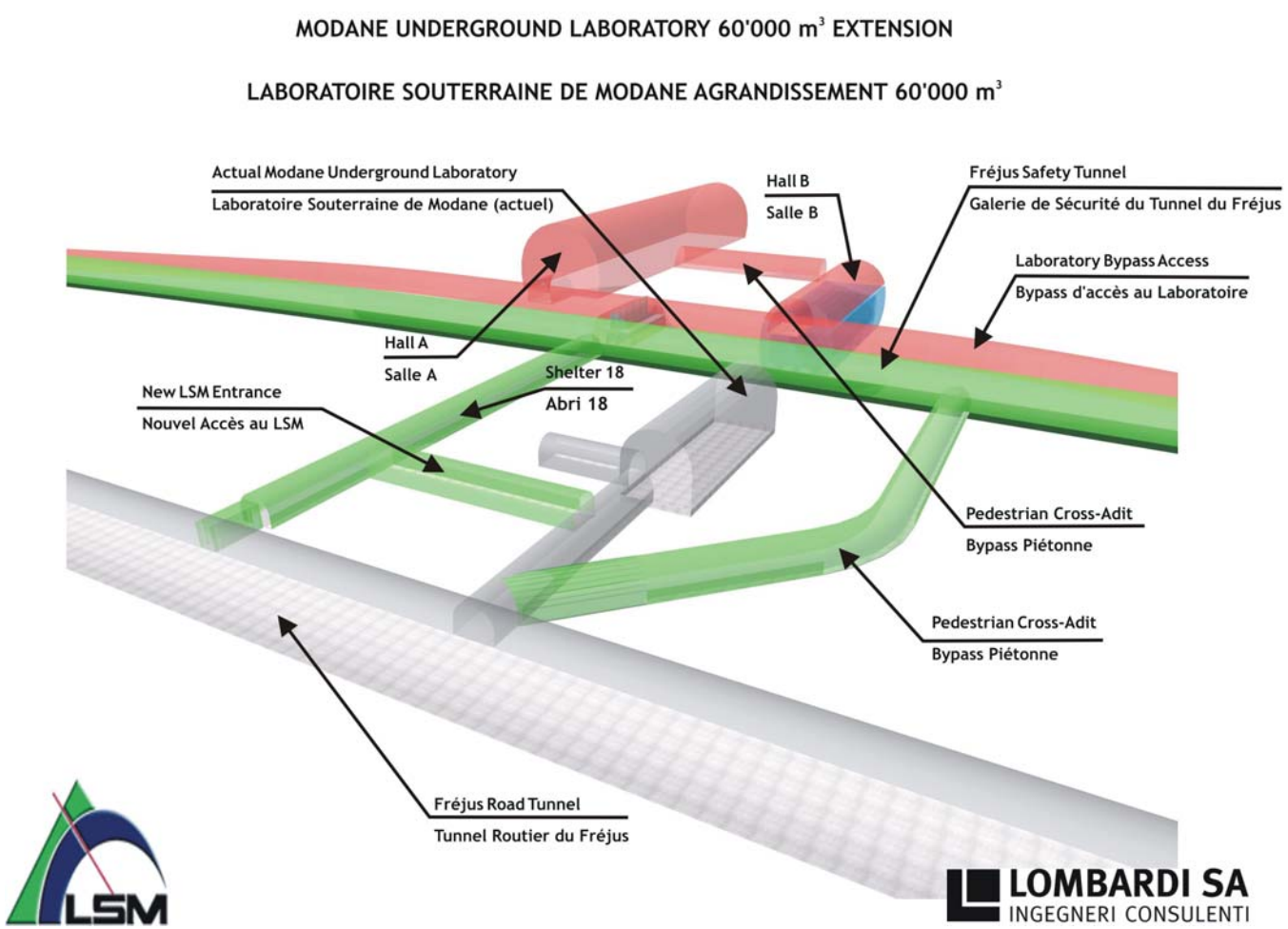
Radon free air
10 mBq/m^3
Done @ fréjus

HALL B: Dark matter (EURECA, liq.Xe,…)





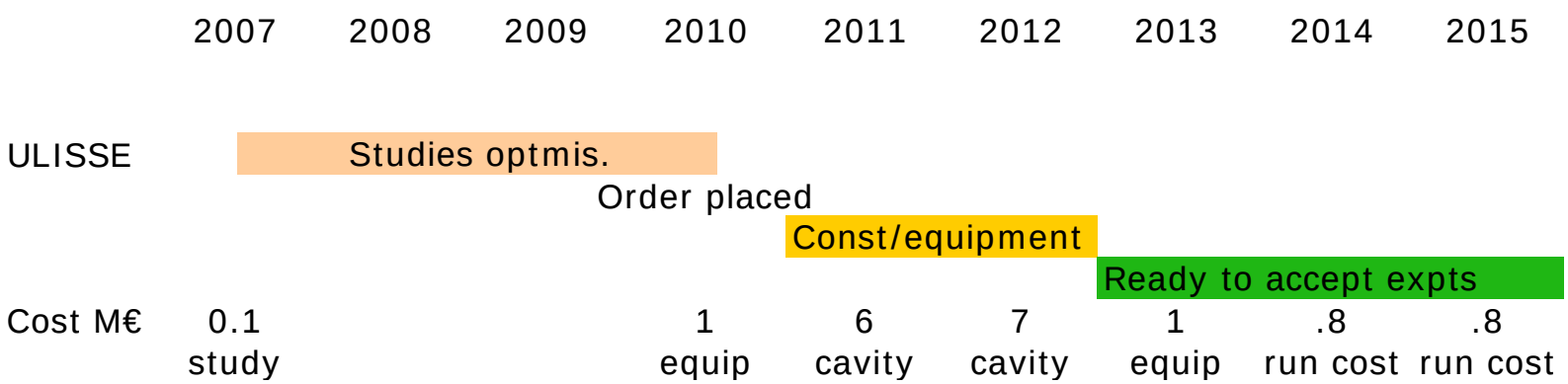
ULISSE project



ULISSE project

Realistic planning !

ULISSE timetable



Absolute constraint: Option must be confirm whitin 3 years after Ordering of the safety galery (end of 2008 or beginning of 2009)

Detailed studies must be ready in 2010

Moderate cost compare to the experiments !!!

New building

New infrastructure for offices, workshop, outreach space

VUE N°02 - Etat futur

Extension status

Strong support from CNRS and CEA

Strong support from local authorities :
- Rhone-Alpes region and Savoie department fund detailed studies
- Savoie deputy follows the project

Strong support from the tunnel company:
- Extension on option of the safety galery
- Accept to be ‘maitre d’œuvre’

French ministery of research support this project

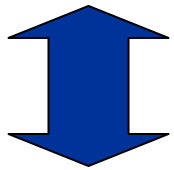
Several European countries interested to participate to the extension related to their participation to the experiment

SUMMARY

What we expect from this mini-workshop ?

1st step to define the extension

Presentation of extension project to a selection of experiments



To establish official link

Presentation of projects with related constraints and facilities:
Space, background levels, anti-radon factory, water purification,…

Next year: call for expression of interest with associated workshop (Space, electrical consumption, dissipated power, crane, clean rooms,outside facilities (mounting hall ?), Gas,…) End 2009