Laboratoire Souterrain de Modane

P. Loaiza

Cygnus workshop, Aussois France
June 2011

The LSM laboratory

Experiments

Future prospects

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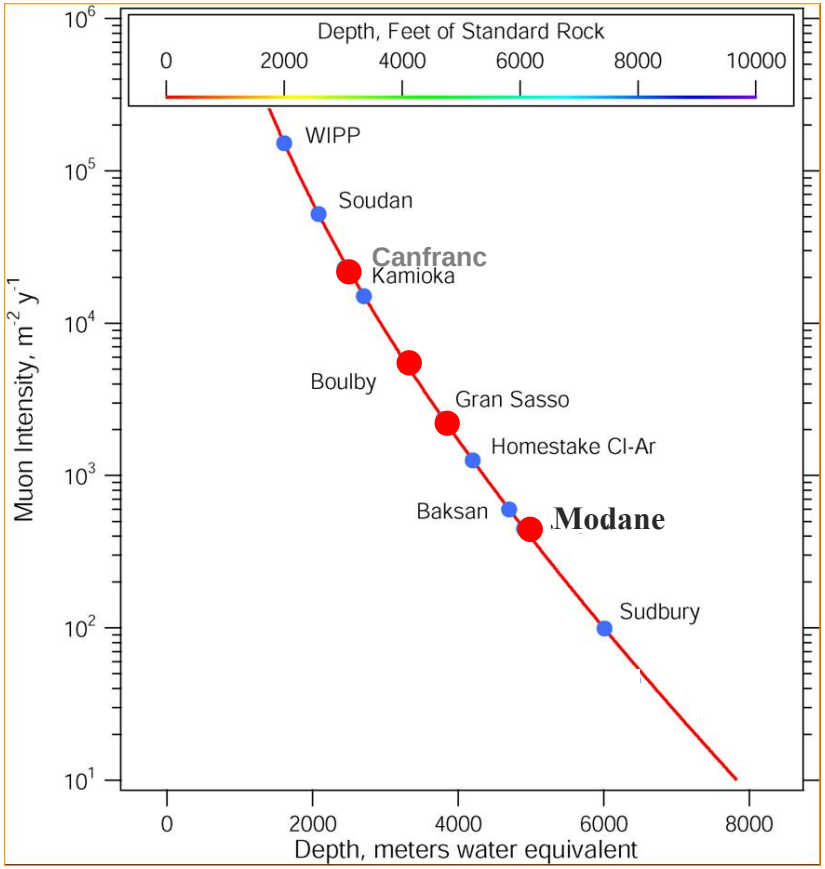
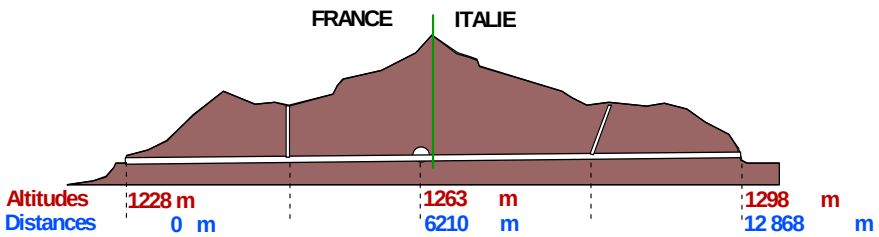




Deepest underground laboratory in Europe: 4800 m.w.e

2nd deepest underground in the world

Located in the Fréjus tunnel at the french-italian border

Operated by CNRS and CEA

Environmental backgrounds

Muon Flux

$4.2\ \mu\ m^{-2}\ d^{-1}$

$(5.14 \pm 0.39)\ 10^{-9}\ cm^{-2}\ s^{-1}$

NIM A262 (1987) 463

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

Astrop. Phys. 9 (1998) 163

Neutron flux

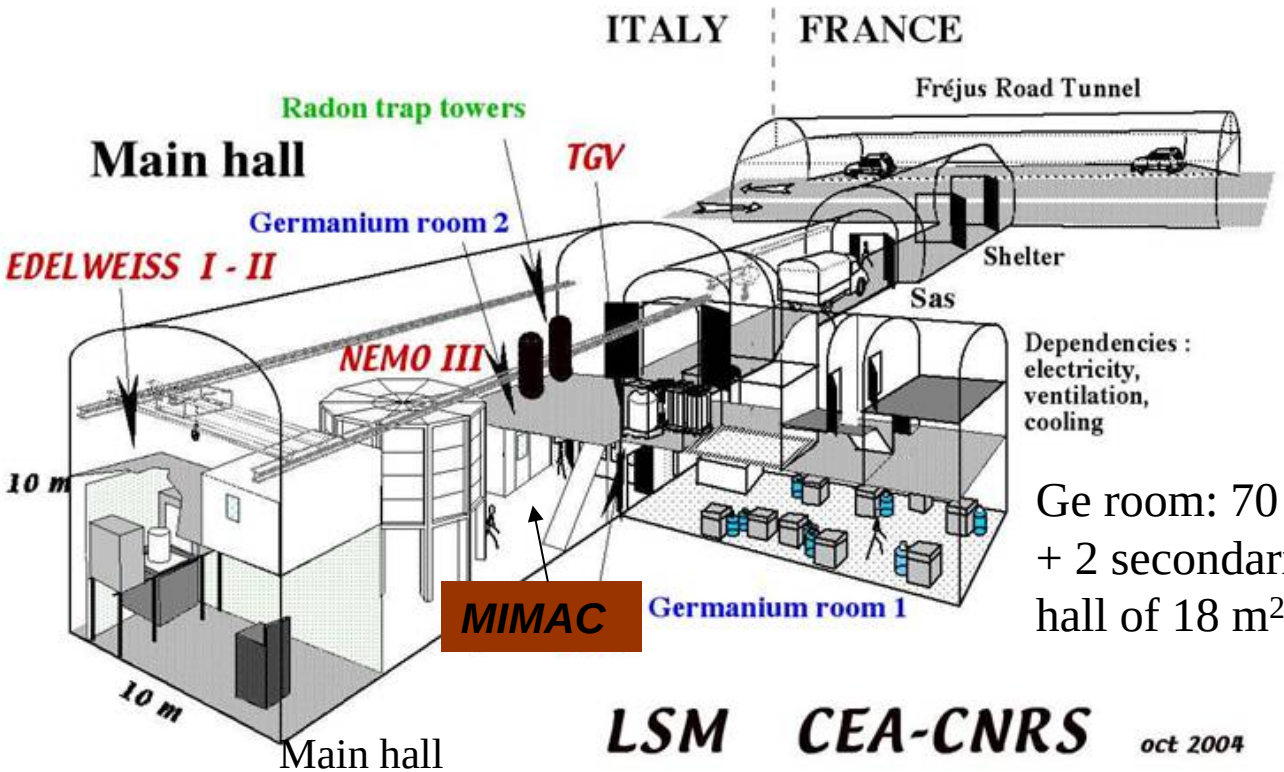
$1.6\ 10^{-6}\ n\ cm^{-2}\ s^{-1}$	thermal
$4\ 10^{-6}\ n\ cm^{-2}\ s^{-1}$	2-6 MeV

Radon concentration

5 to 15 Bq/m^3

The laboratory

Total Vol:
3500 m^3



Main hall
30m x 10 m x 10m

Ge room: 70 $m^{2:}$
+ 2 secondaries:
hall of 18 m^2 and 21m^2

NEMO-3 is being dismanteled, finished by end of August 2011

NEMO-3 : neutrinoless double beta decay

Source: 10 kg of ββ isotopes
cylindrical, S = 20 m², e ~ 60 mg/cm²

Tracking detector:
drift wire chamber operating in Geiger mode (6180 cells)
Gas: He + 4% ethyl alcohol + 1% Ar + 0.1% H_2O

Calorimeter:
1940 plastic scintillators coupled to low radioactivity PMTs

Magnetic field: 25 Gauss
Gamma shield: Pure Iron (e = 18 cm)
Neutron shield: 30 cm water (ext. wall)
40 cm wood (top and bottom)
(since march 2004: water + boron)

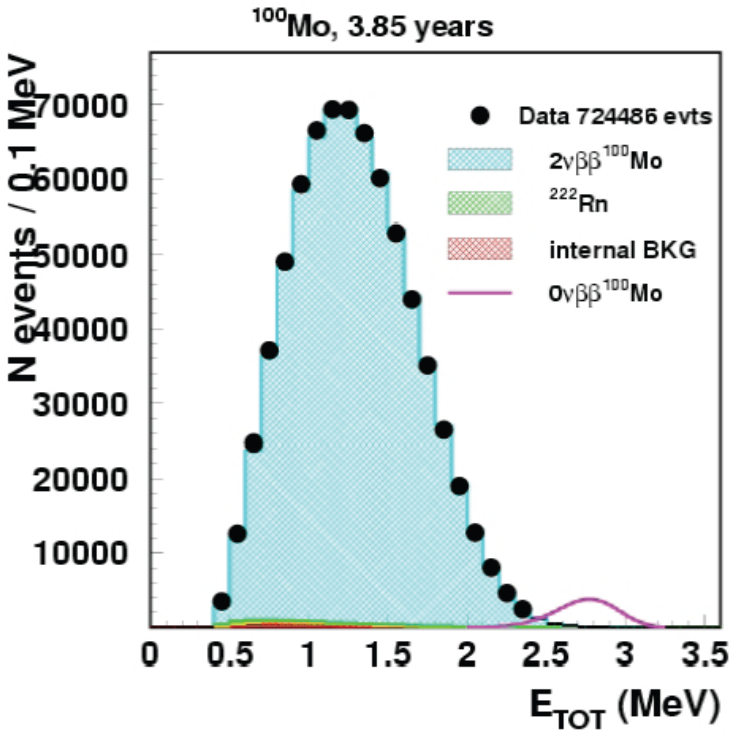
Radon-free air around the detector
- Phase I (Feb 2003 oct. 2004): High Radon
- Phase II (Dec 2004-Dec 2010): Low Radon
  (Radon cont. reduced by factor 6)

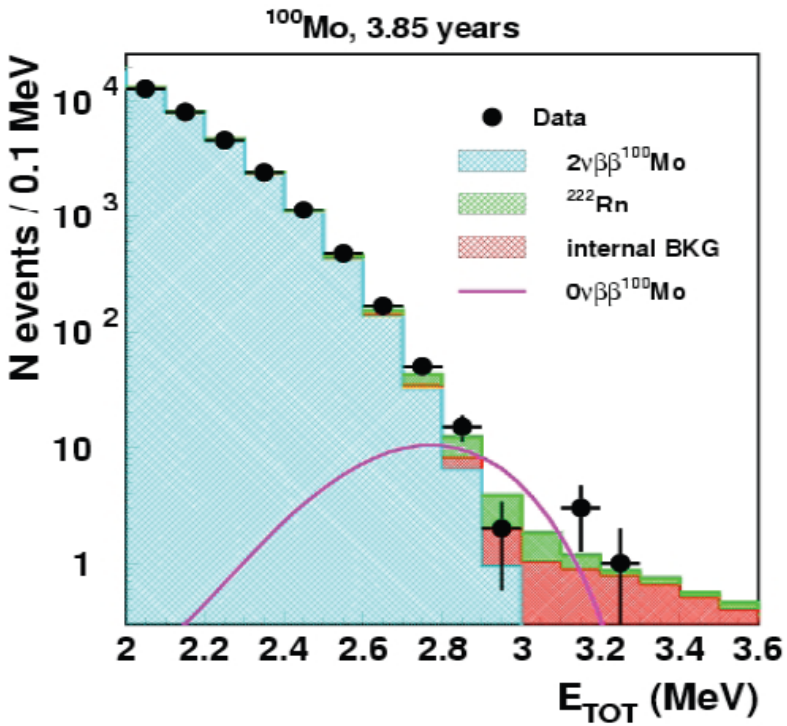
NEMO3

ββ0ν results with ^{100}Mo

T_{obs} = 3.85 years
M(^{100}Mo) = 6.914 kg

Data until the end of 2008





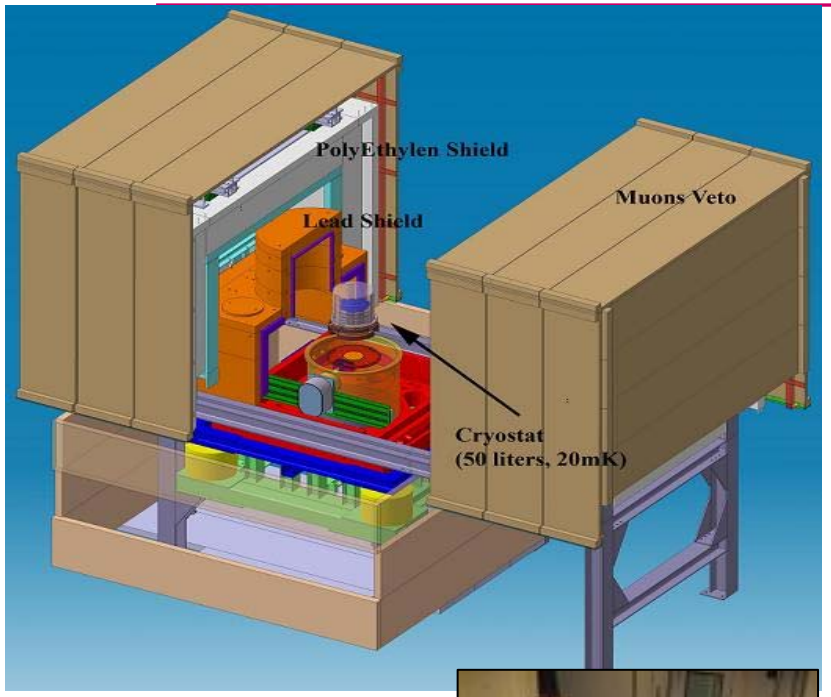
[2.8 , 3.2] MeV:
Data: 20 events, Expected: 18.6 events
Excluded at 90% C.L. 9.6 events
Efficiency ε= 0.0726

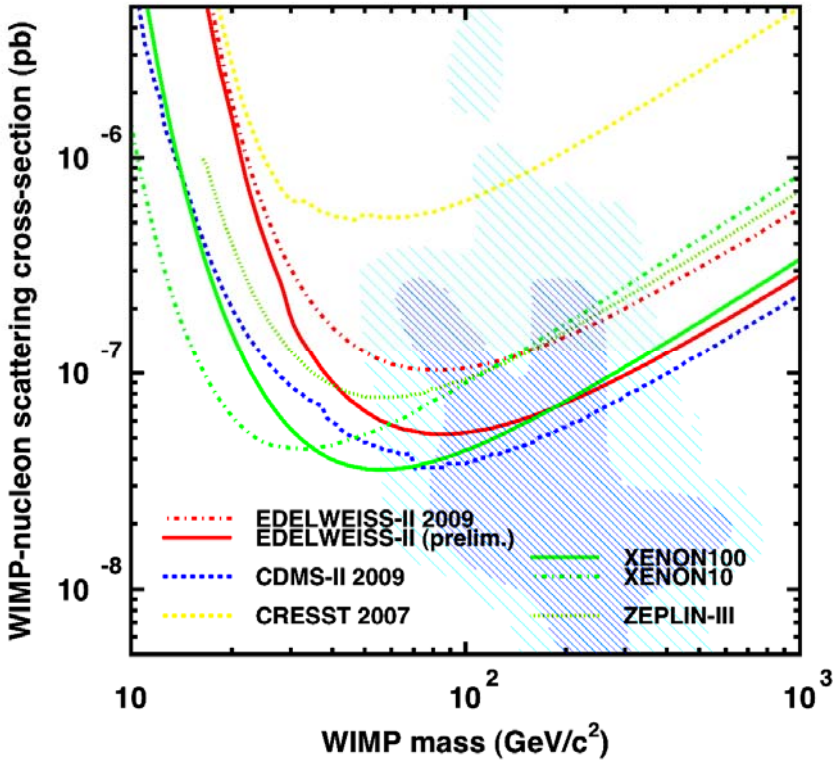
MCLIMIT : [2.0, 3.2] eV
18 events excluded
Total mean 0ν efficiency ε = 0.174

Both simple counting and likelihood methods are consistent

$T_{1/2}$ (0νββ) > 1.1 x 10^{24} y @ 90% C.L.
$\langle m_\nu \rangle$ < 0.45 – 0.93 eV

Edelweiss-II: direct dark matter search





Next: Full Interleaved detectors 800 g

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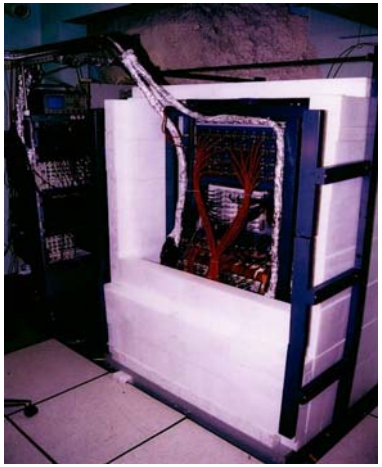
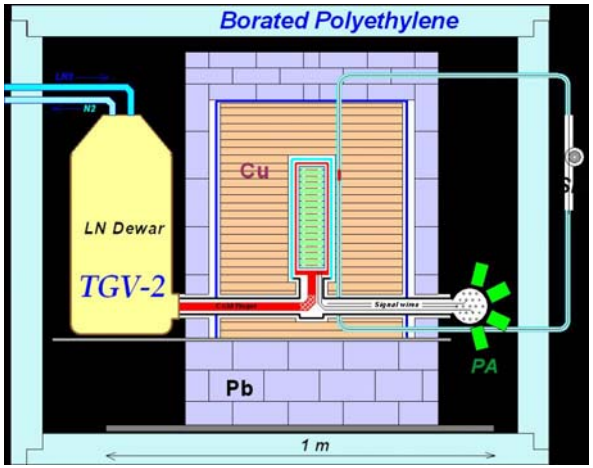
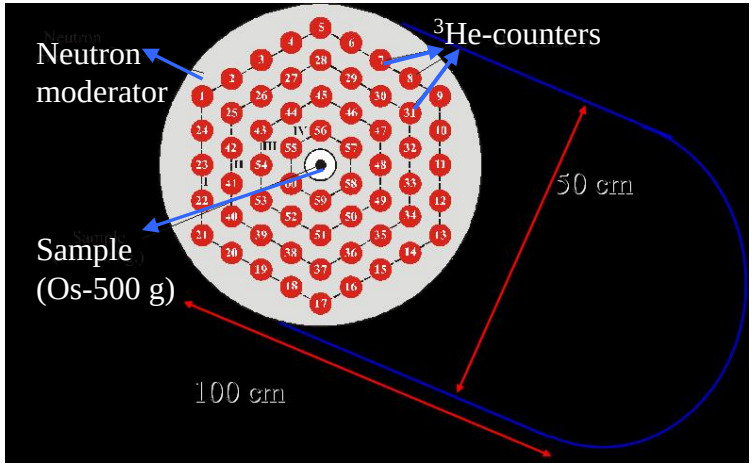


TGV-2 : Double EC

Ge with sheets of ECEC candidates

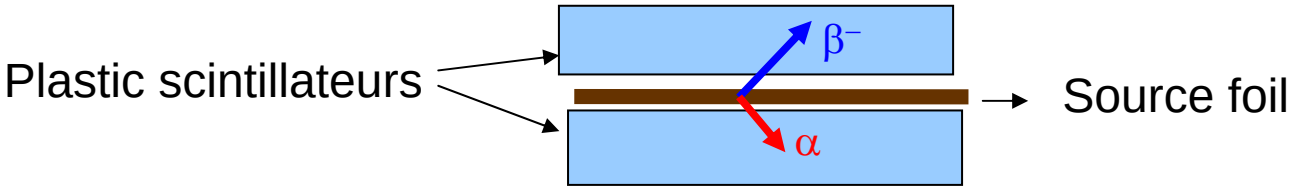




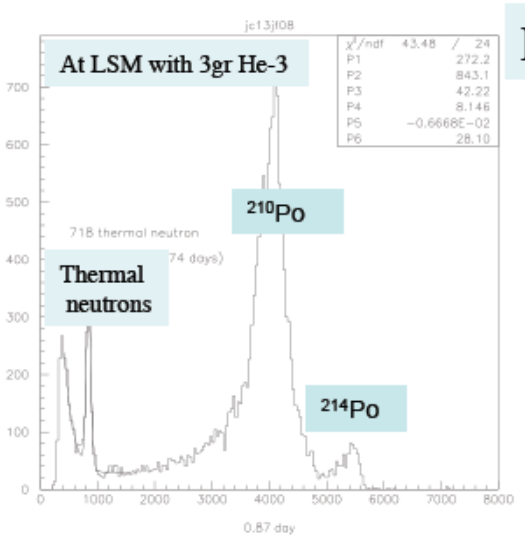
SHIN: Super **H**eavy elements **I**n **N**ature,
Z=108 A=280

Laboratoire Souterrain de Modane

- BiPo (measurement of radiopurity of sources foils for SuperNemo) :



- Sphere TPC (Neutron flux measurement) :



- Neutron detectors (He-3 detector and liquid scintillator)
- Radon detectors (~ 10 μBq/m³ sensibility)

Gamma-ray spectrometry

14 HPGe detectors for:

- **Material screening** for SuperNEMO, Edelweiss and ultra low background instrumentation
- **Environmental studies**
- **Environmental monitoring**

Developpement of low background Ge for γ-spectromety:

ULISSE: LSM NEW LAB

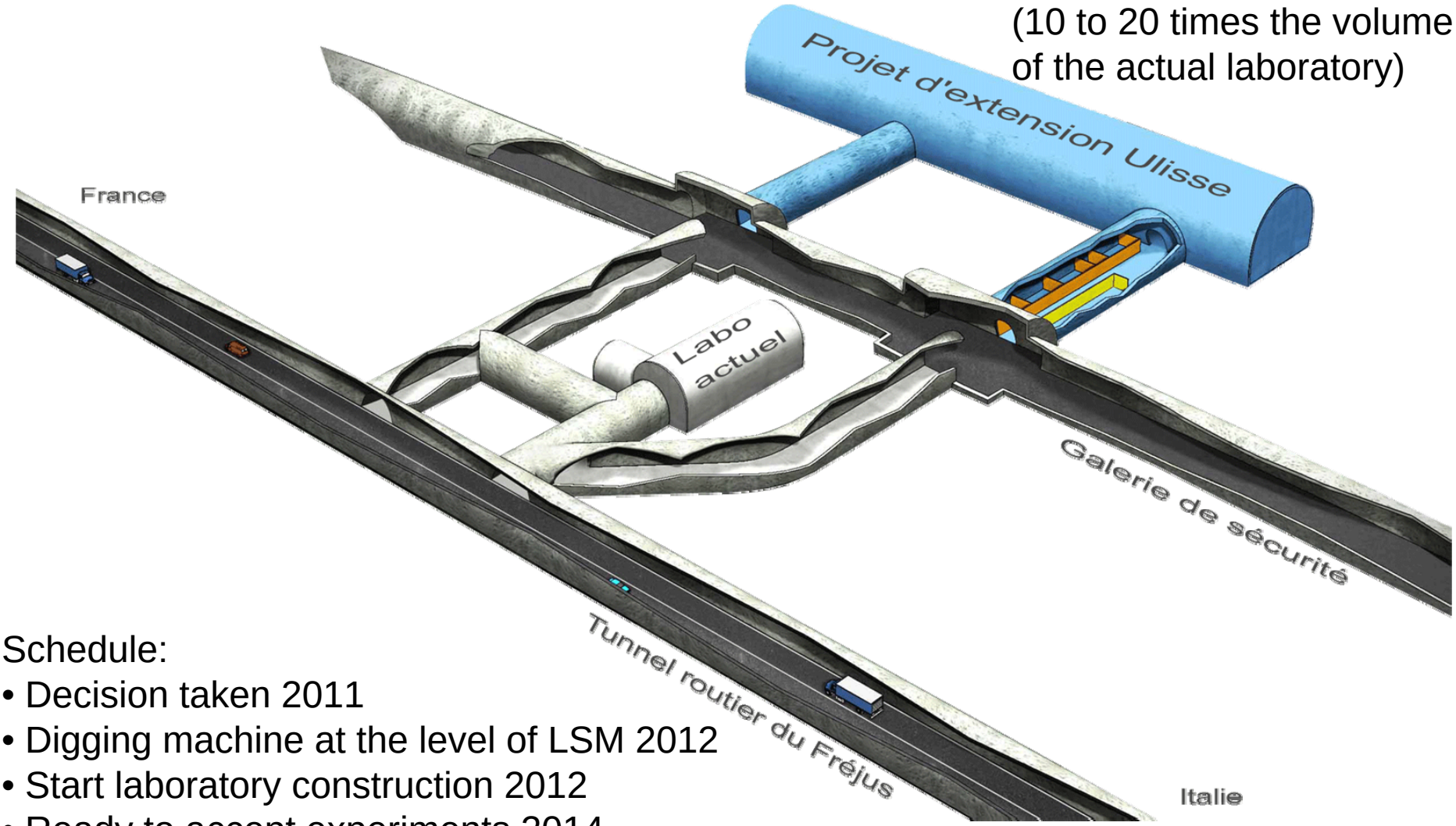
Excavation of safety gallery for the Fréjus tunnel: decision of funding taken on 12/12/06 by representatives of Italy and France.

Opportunity to excavate a new cavity to host next generation experiments

- 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,…)
  - Integration of project to tunnel company planning and constraints
  - Performed pre study : moderate cost

ULISSE PROJECT

30 000 m³ to 60 000 m³
(10 to 20 times the volume of the actual laboratory)



Schedule:

- Decision taken 2011
- Digging machine at the level of LSM 2012
- Start laboratory construction 2012
- Ready to accept experiments 2014