

The Canfranc Underground Laboratory

A. Bettini

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<http://www.lsc-canfranc.es/>

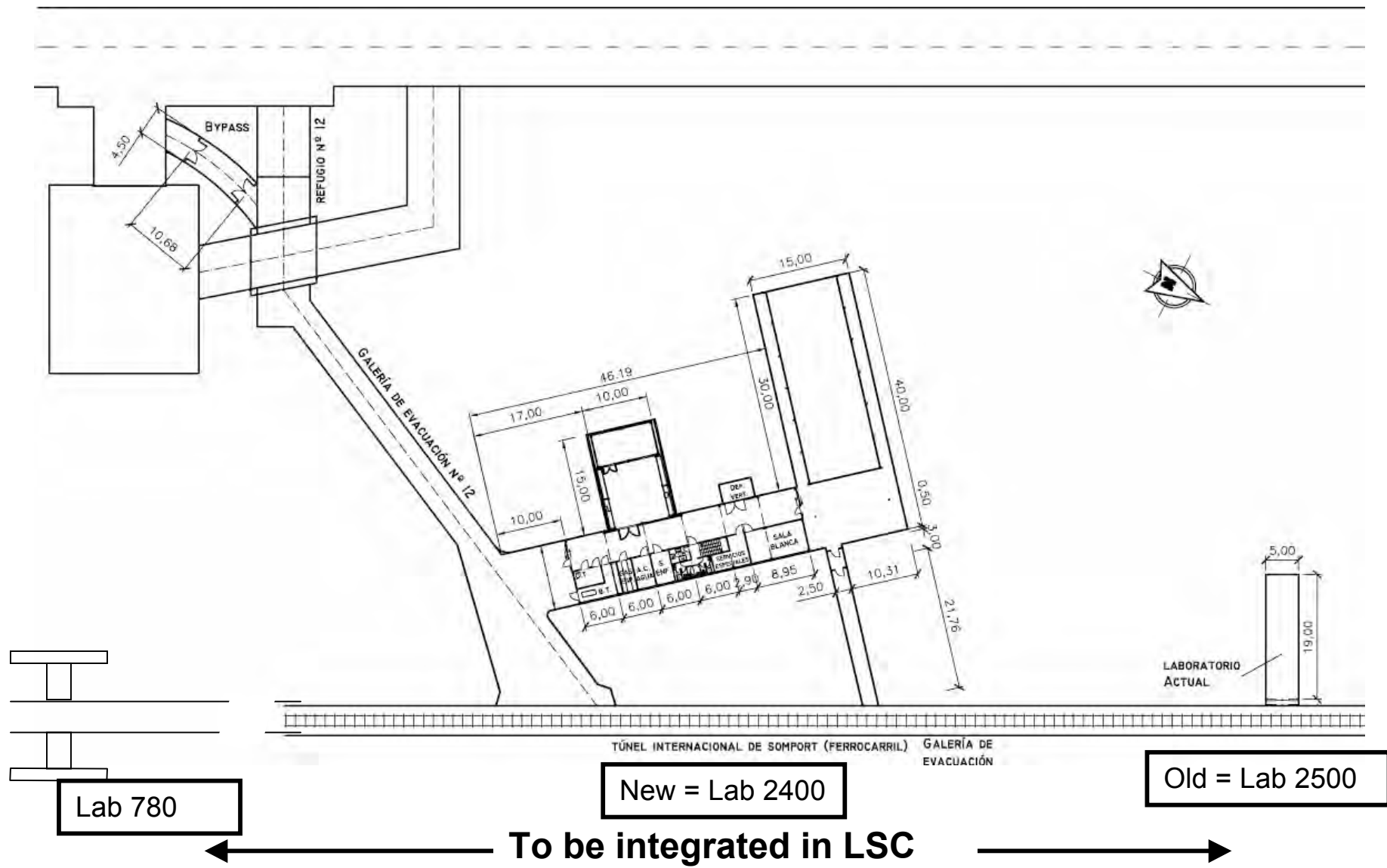


Official delivery of the laboratory

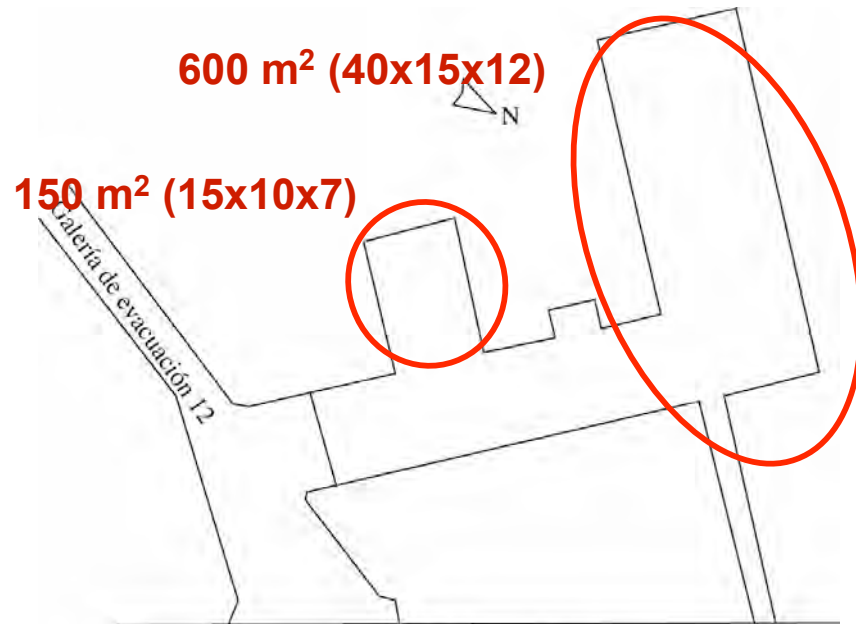
- **30/06/2010:** Delivery of the Laboratorio Subterráneo by the Saragossa University to the LSC Consortium



Map of LSC



Experimental halls A, B and C



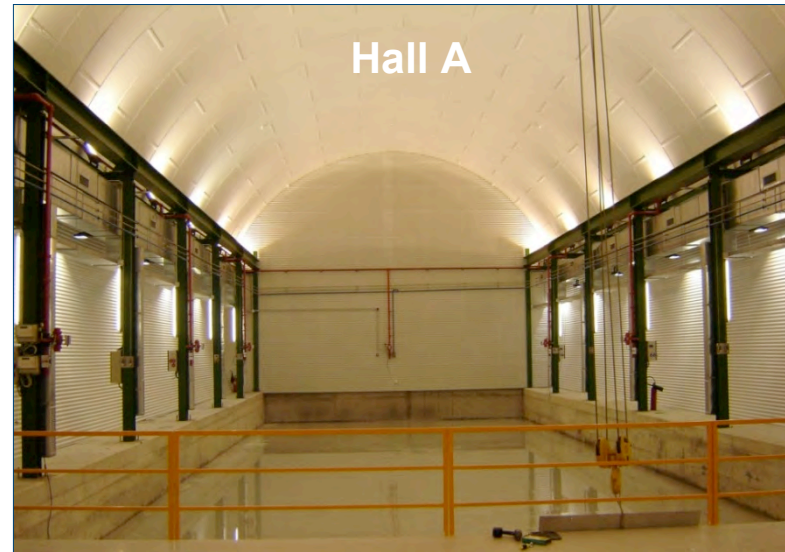
Galería de evacuación
Depth: 800 m

Muons: $0.47 \mu \times 10^{-2} \text{ m m}^{-2} \text{ s}^{-1}$

Ventilation: 11.000 m³/h

n and γ to be measured

Operative budget: $\approx 1600 \text{ k€}/\text{yr}$



LSC

Convergence Monitor System

During the consolidation works we designed and installed a new monitor system for the geomechanical control of the rock massive has been (stresses and convergence)

Continuous data acquisition with 1 μm resolution (over a few metres of optical fibre)

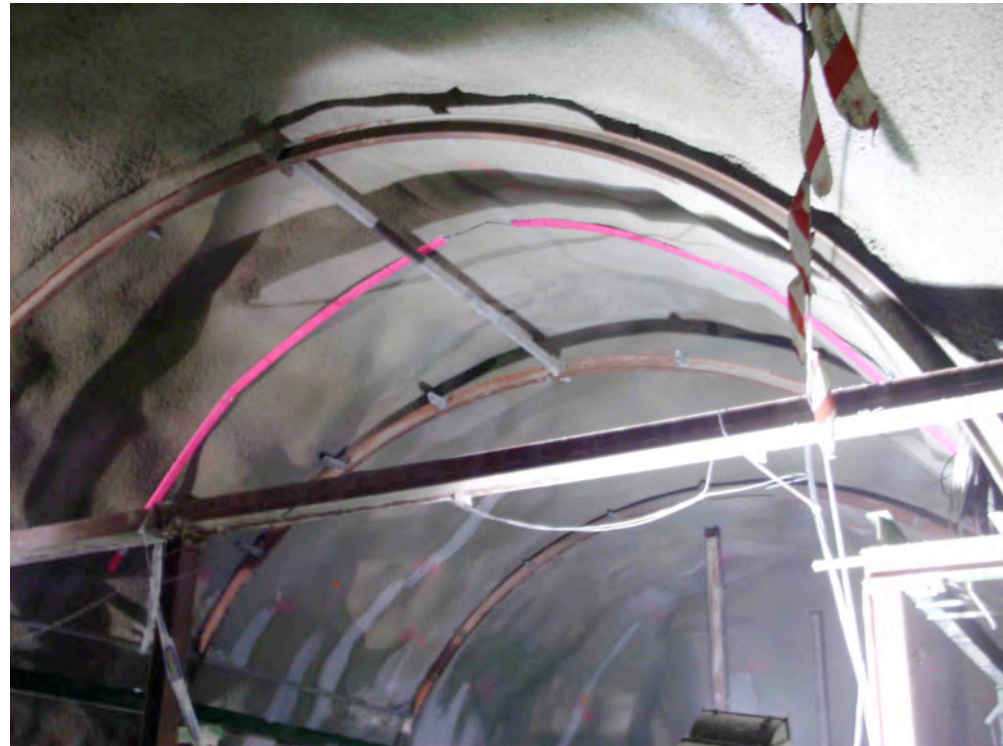
The system has 10 sections under control with 20 fibres in total

4 units in HALL A

1 in HALL B

2 in GALERÍA DE OFICINAS

3 in VESTÍBULO



Main services underground

Clean room (class 10 000/ 1000) (Silvia Borjabad) Autumn 2010

Ge counters screening facility (Iluian Bandac)

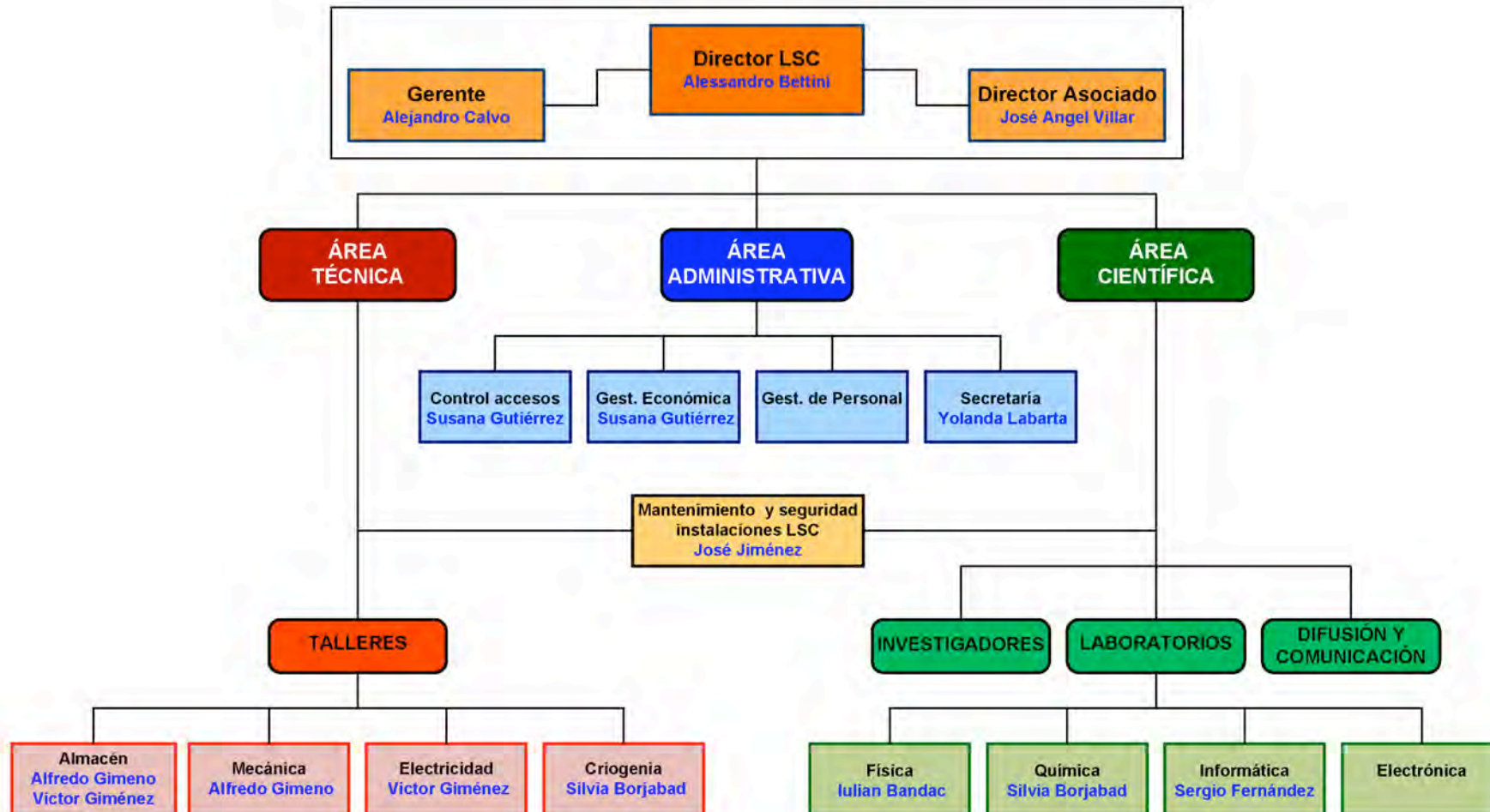
1 counter Unizar (lab 780)	Summer 2010 SuperkGd, NEXT
1 counter LSC (Hall C)	Autumn 2010 NEXT +.....
2 counters LSC (Hall C)	Winter 2011
1 counter Unizar (Hall C)	Winter 2011
2 counters LSC (Hall C)	2011
2 counters Unizar (tbd)	2011
2 more counters if needed in	2012

Surface building

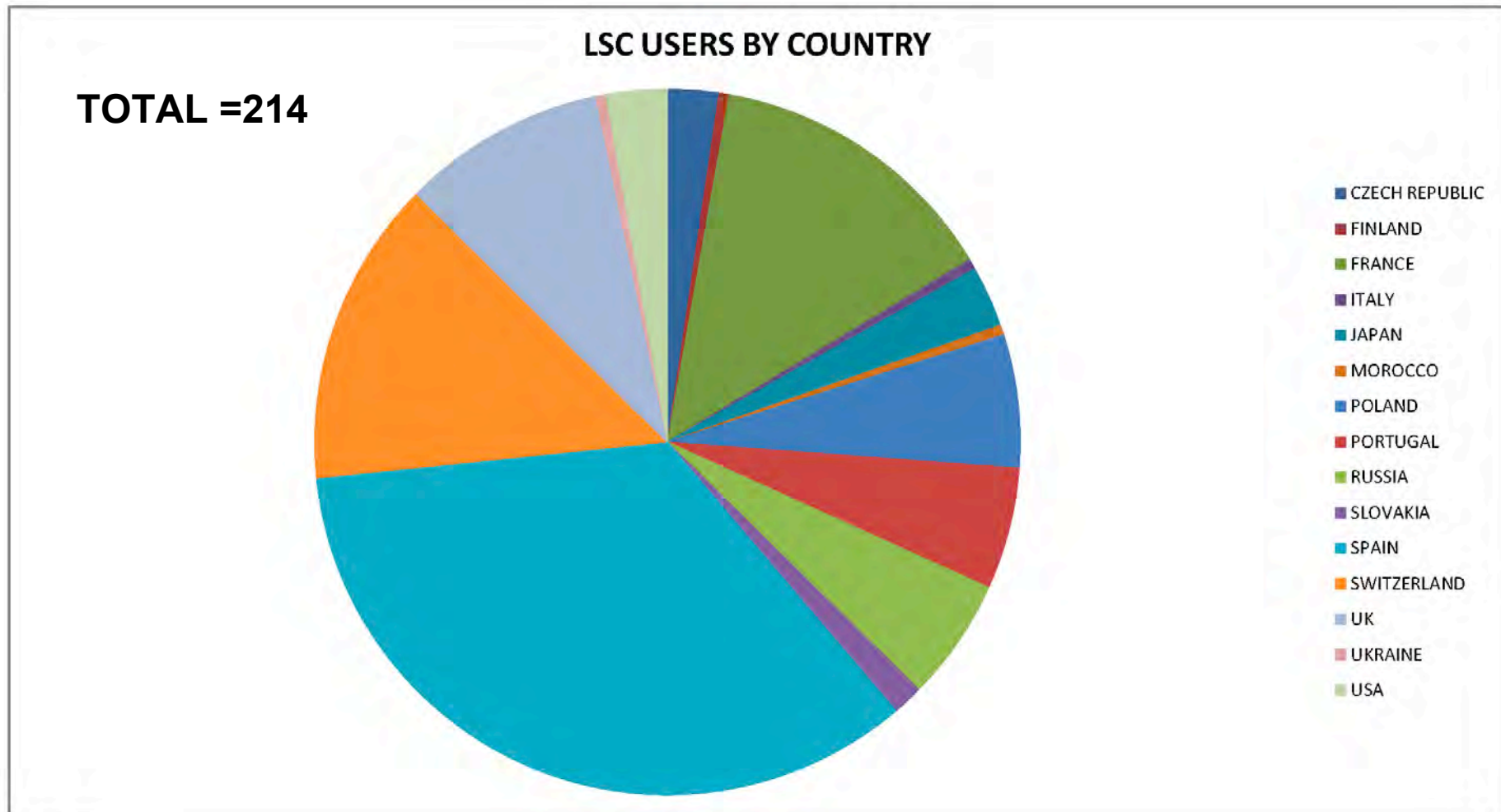
Headquarters & Administration
Safety and Quality Assurance
16 offices for scientific users
7 offices for LSC personnel
4 specialised laboratories
 chemical
 physics
 electronics
 informatics
Mechanical workshop
Storage room
Meeting room
Library
Conference room
Exhibitions room
2 apartments
Surface: 1.821 m² (2.115 m² built)
Completed: December 2010
Install equipment: Winter 2011



Personnel LSC



Users = signatures on approved proposals



Approved experiments

- ✓ EXP-01-2008 (ANAIS) Dark Matter (NaI, Annual modulation)
Direct check of DAMA/LIBRA result
- ✓ EXP-02-2008 (ROSEBUD) Dark Matter (Scintillating bolometers)
Integrated in the European EURECA project
- ✓ EXP-03-2008 (BiPo) $0\nu 2\beta$ decay (extra-low surface background meas.)
Ancillary to Super-NEMO
- ✓ EXP-05-2008 (NEXT) $0\nu 2\beta$ decay (Enriched ^{136}Xe TPC)
Majorana vs Dirac neutrinos
CUP Consolider approved
- ✓ EXP-06-2009 (SuperK-Gd) Systematic low background assay for
Superkamiokande Gd proposal (Ge detectors)
- ✓ EXP-07-2009 (GEODYN) Under-surface geodynamic observatory
(Integrated in TOPO-IBERIA and TOPO-EUROPE)
- ✓ EXP-08-2010 (ArDM) Dark matter (LAr TPC)

Proposals under discussion

✓ EoI-12-2009 (CUNA)

Underground Nuclear Astrophysics Facility

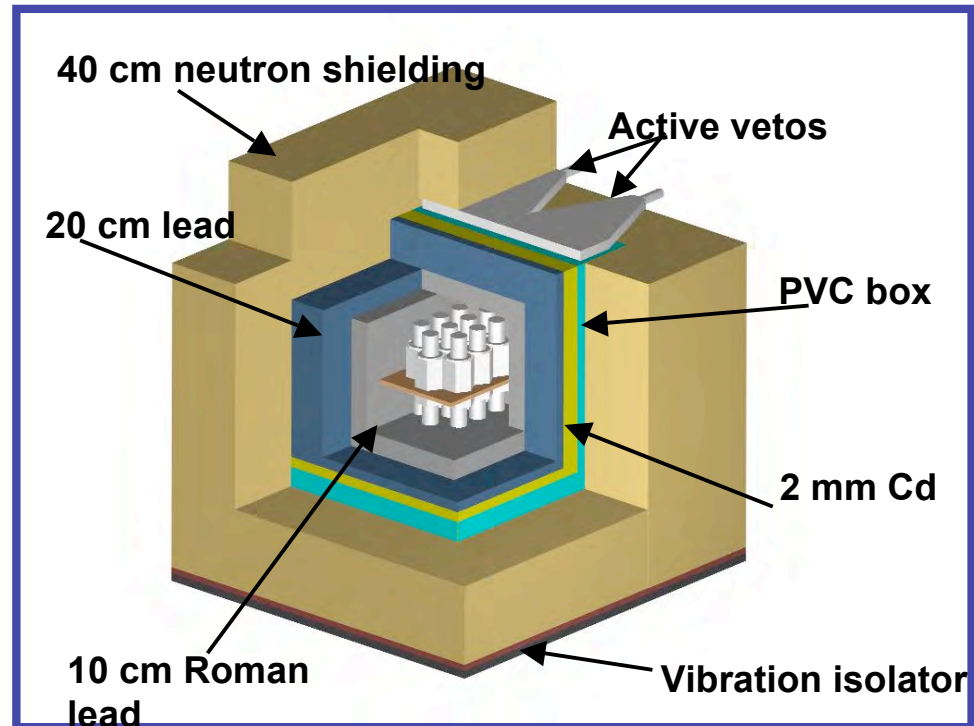
Build a new hall

Install 3 MV (commercial) linear accelerator

Actions for foster proposals for more geology, environmental measurements, biology, being pursued

EXP-01-2008 ANAIS

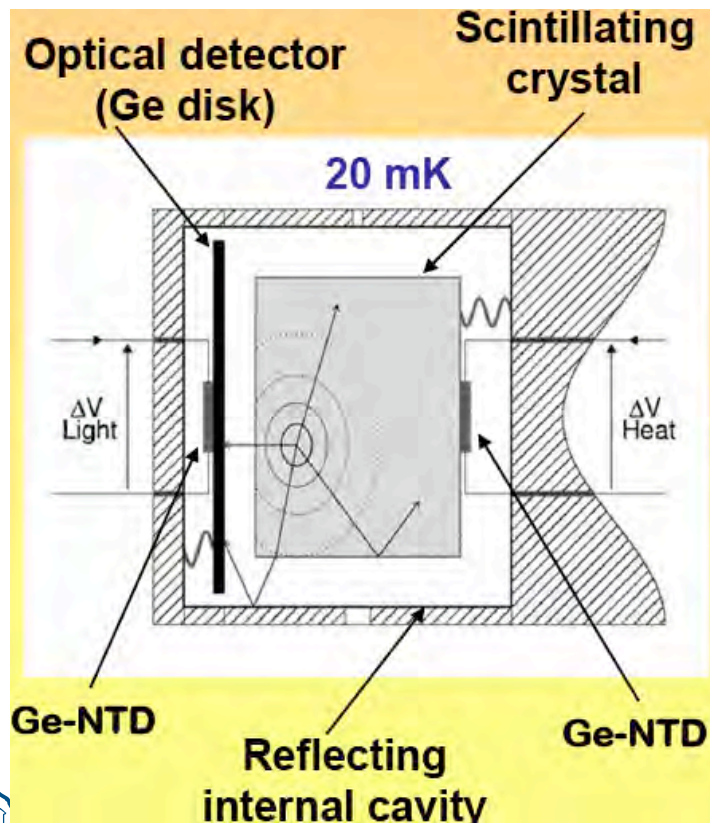
- ANAIS: Direct search for WIMPs through annual modulation on NaI(Tl) scintillating crystals at LSC.
- Goal up to 250 kg
- ANAIS: uses same target as DAMA
- Purification procedure started to achieve best possible Bkg (goal 1c/(keV kg day))
- **Install in new LSC 2011**
- If crystals available start data taking 2012



EXP-02-2008 ROSEBUD

Develop cryogenic temperatures bolometers with heat and scintillation light readout, focussing on prototypes for EURECA (next-generation European project for DM search with bolometers)

Installation in “new” LSC in 2011

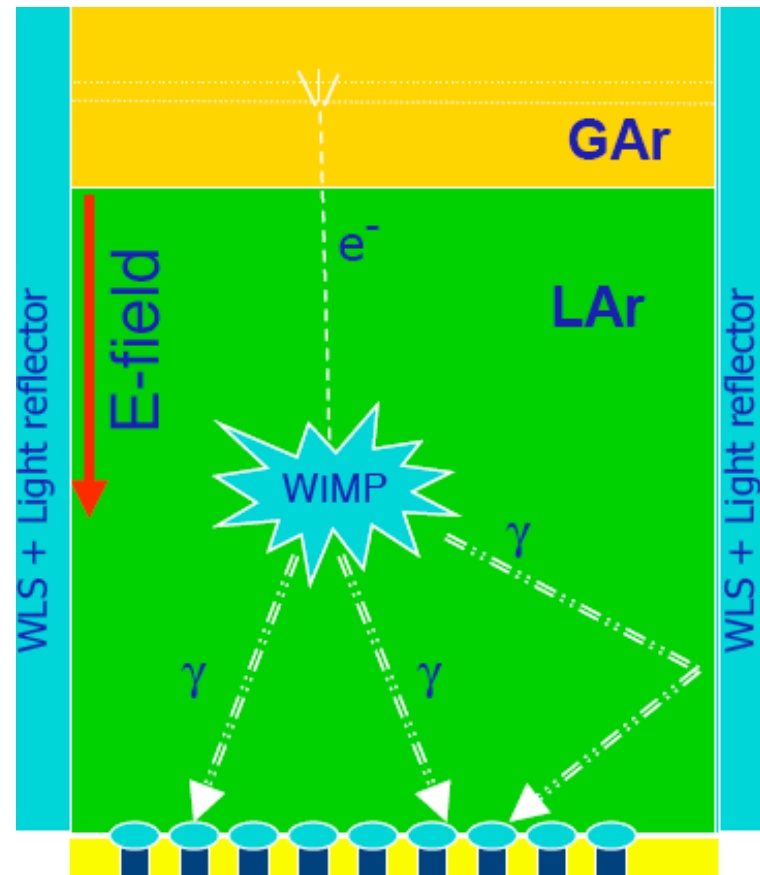
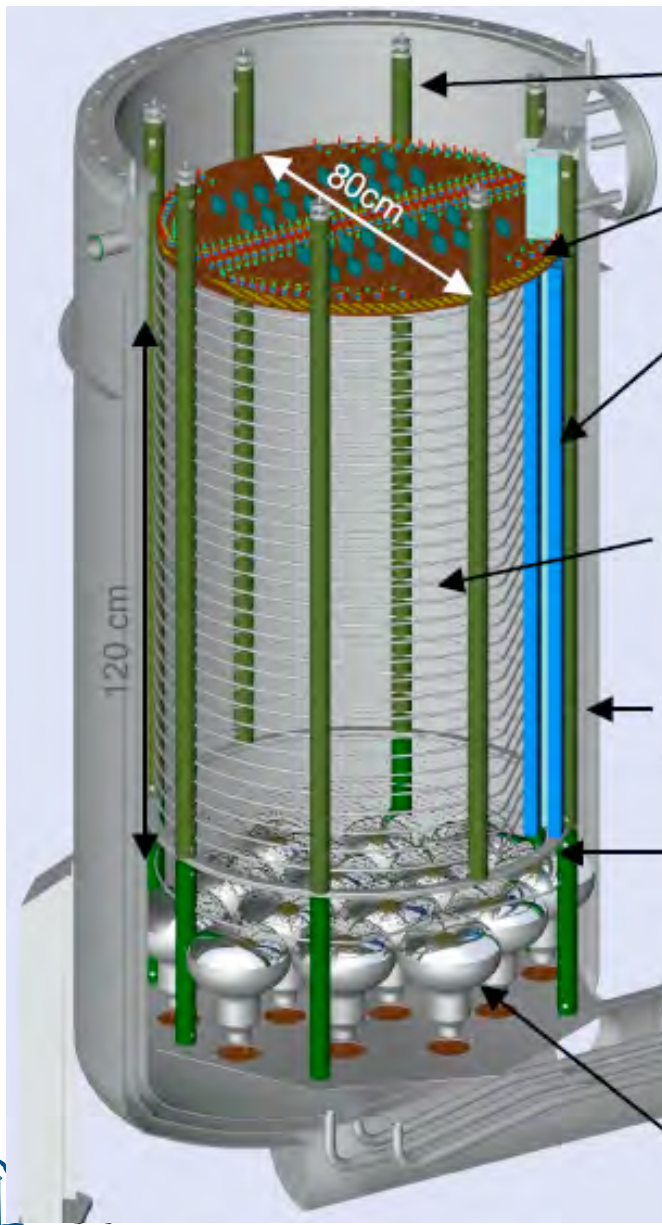


EXP-08-2010 ArDM

Ar two-phase TPC

Tests on 1 t prototype going on at CERN

Installation in 2011



EXP-03-2008 BiPo

$\Delta E_{FWHM}/E$ @ 1MeV

NEMO3 = 14-17%

Best prototype so far = 8%

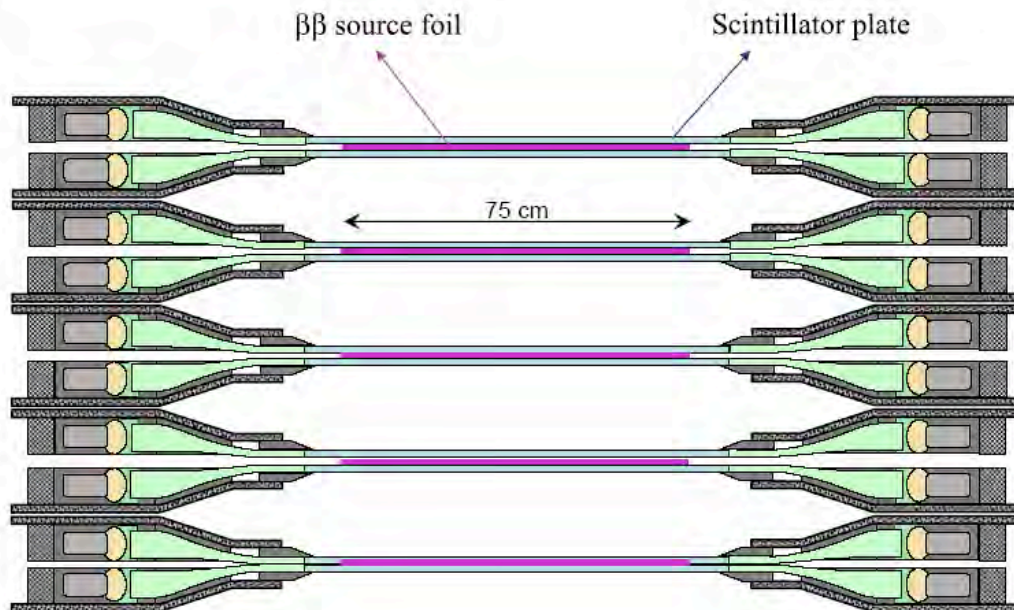
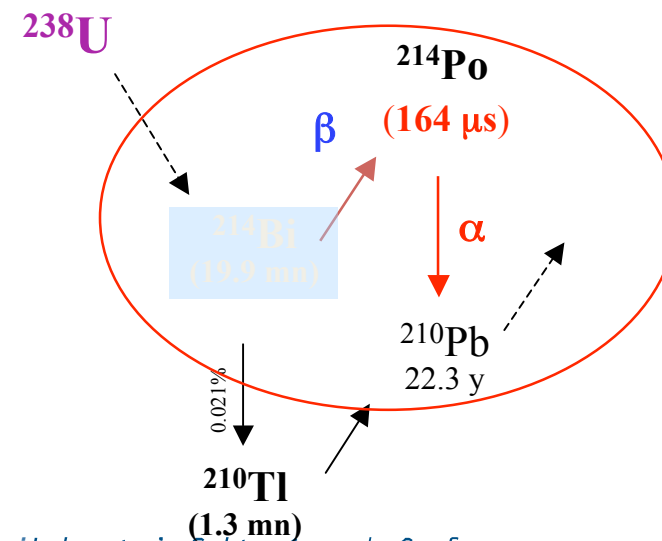
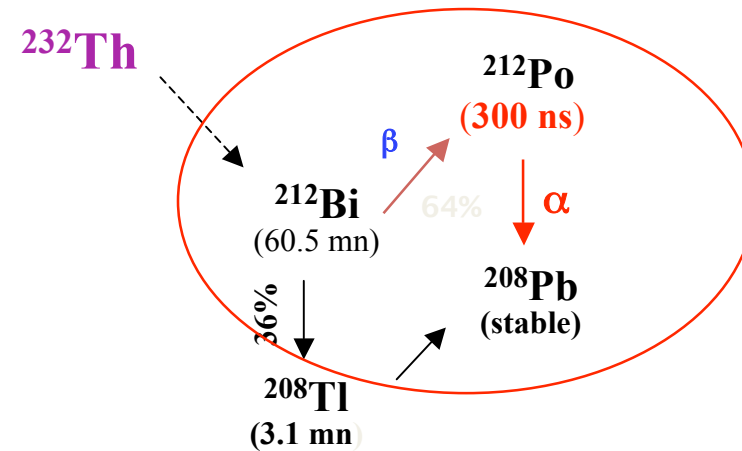
Design figure = 4% @ 3 MeV

Installation in 2011

Contamination of the (large) source foil
BiPo detectors for requested sensitivity

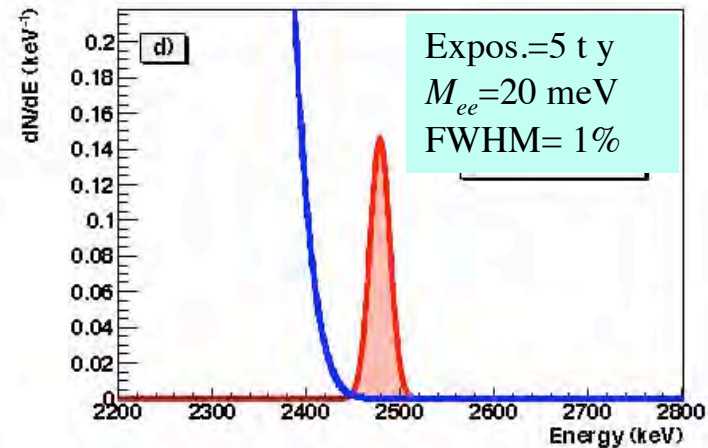
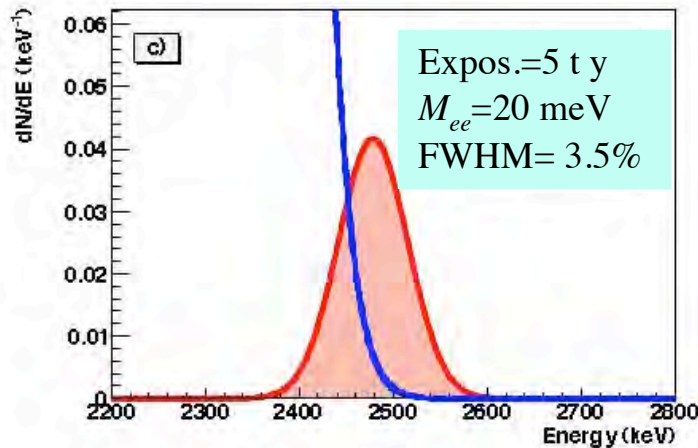
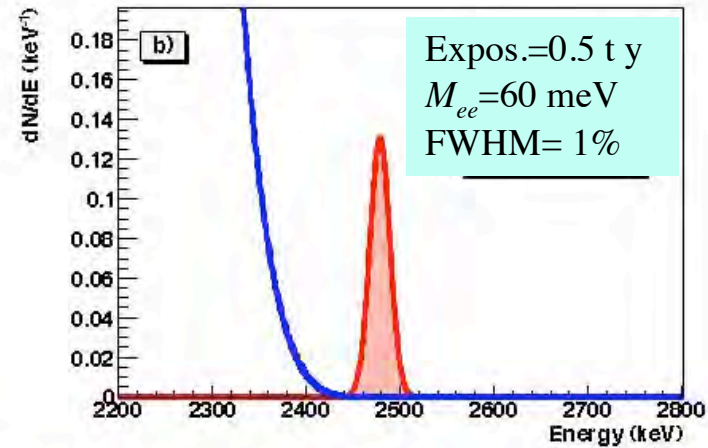
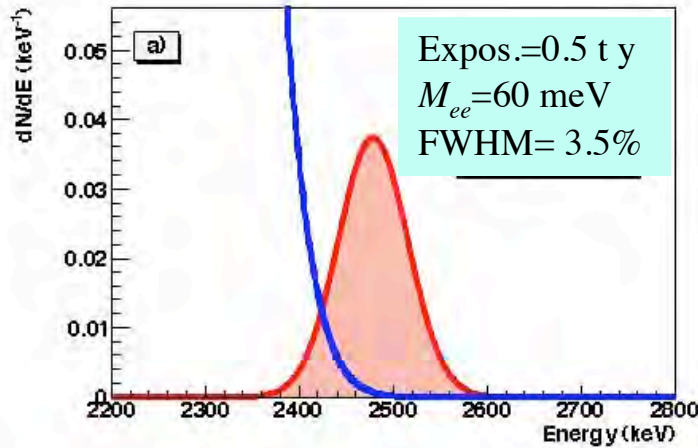
$^{208}\text{Tl} < 20 \mu\text{Bq/kg} \Rightarrow < 2 \mu\text{Bq/kg}$

$^{214}\text{Bi} < 300 \mu\text{Bq/kg} \Rightarrow < 10 \mu\text{Bq/kg}$



The ultimate background: $2\beta 2\nu$

Case of ^{136}Xe assuming $T_{1/2}(2\nu 2\beta) \approx 10^{21}$ (measured lower limit) $\frac{S}{B} \approx \frac{m_e Q_{\beta\beta}^5}{7(\Delta E)^6} \frac{T_{1/2}^{2\nu}}{T_{1/2}^{0\nu}}$



EXO achieved

High pressure TPC

Strong R&D effort needed



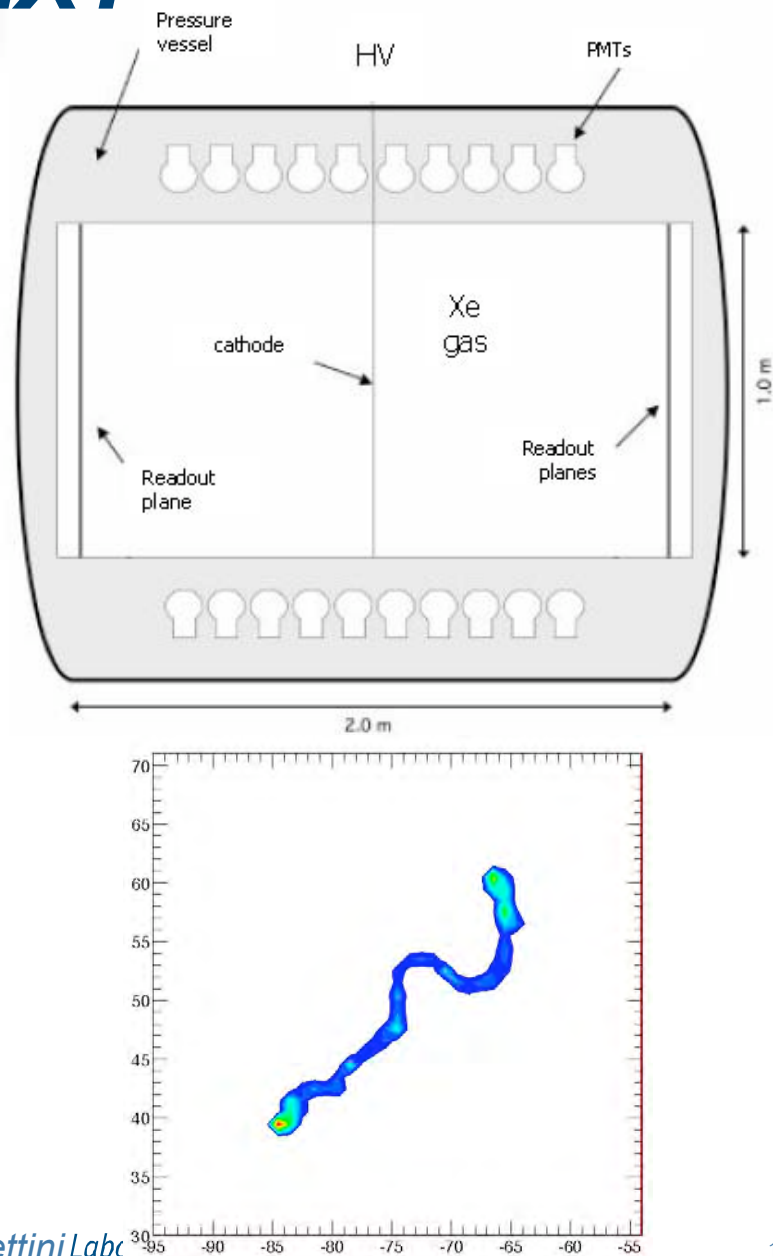
EXP-05-2008 NEXT

High pressure gas TPC with enriched ^{136}Xe

Complementary to EXO

Status. Initial R&D phases. CUP “Consolider” (mainly NEXT) approved (5 M€)

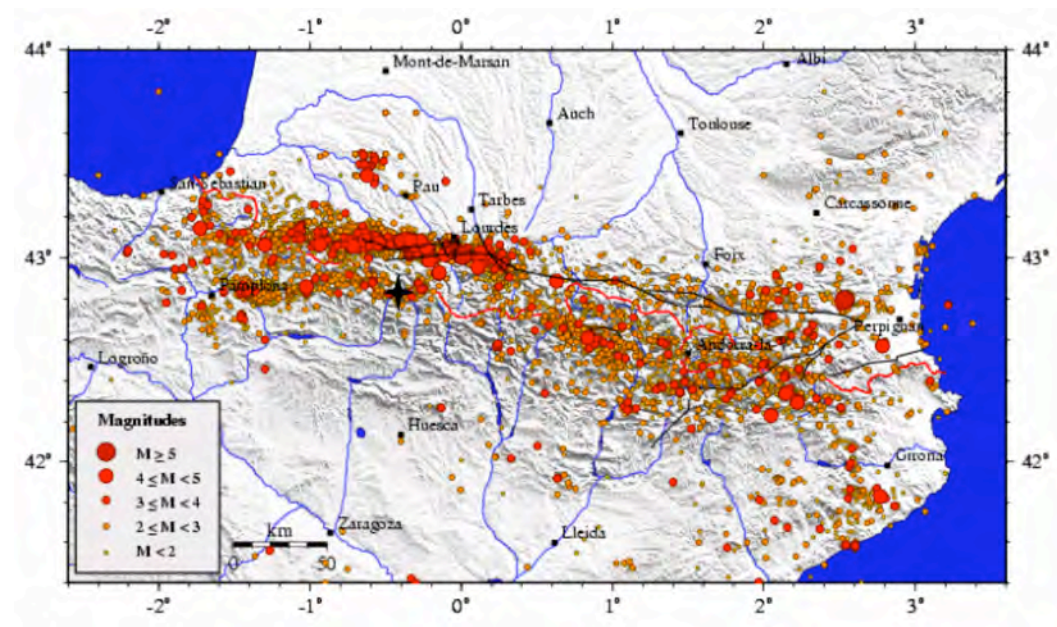
- Avoid charged background from surfaces by eliminating surfaces, based on 100% active, completely closed **virtual** fiducial surface
- Obtain fine topological information
 - Tag signal by topology: 2 balls at the end of the spaghetti
 - Expected reduction of (dominant) gamma background > 100
- FWHM resolution $O(1\%)$ appears feasible with latest TPC R/O techniques
- Montecarlo evaluation of the tolerable radioactive contaminants in materials & screening starting now
- Water or PB+Cu shields



EXP-07-2009 GEODYN

- LSC is located underground in one seismically very active areas in Europe
- Ideal position for an advanced geodynamic observatory with
 - two perpendicular LASER strainmeters
 - broad-band and strong motion seismometers
 - CGPS stations on the surface
- Integrate in the TOPO-IBERIA project
- Local phenomena
 - measure seismic phase velocity
 - Slow earthquakes
 - Strain seasonal changes
 - Tectonic deformation
- Global phenomena
 - Seismic core modes
 - Free oscillations of the Earth
 - Free core nutation

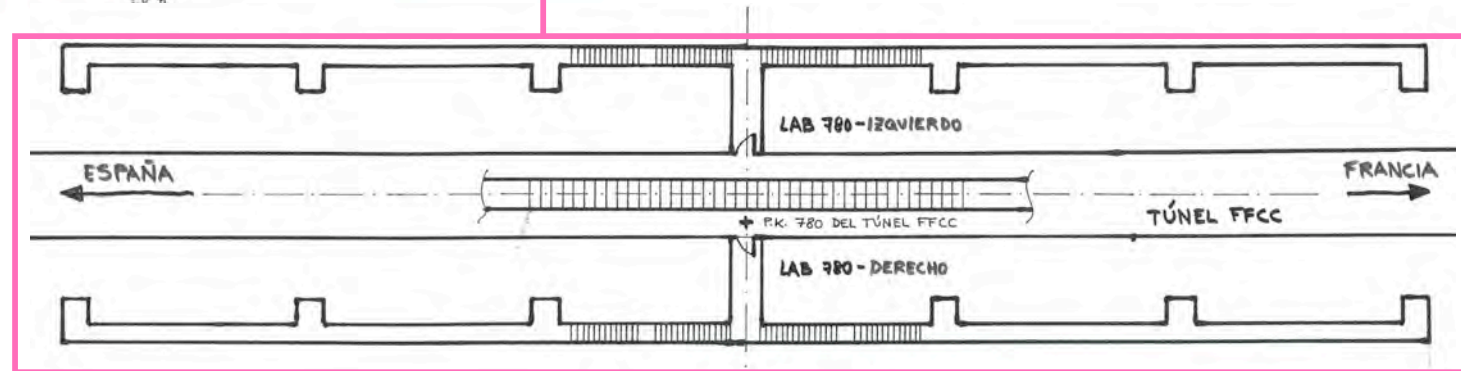
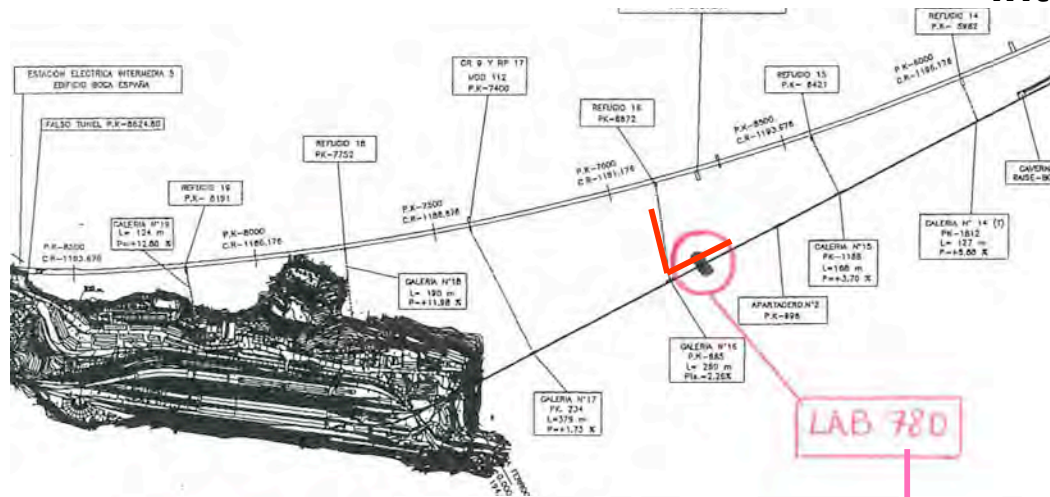
Installation in 2011
Lab 780



Lab 780 and GEODYN

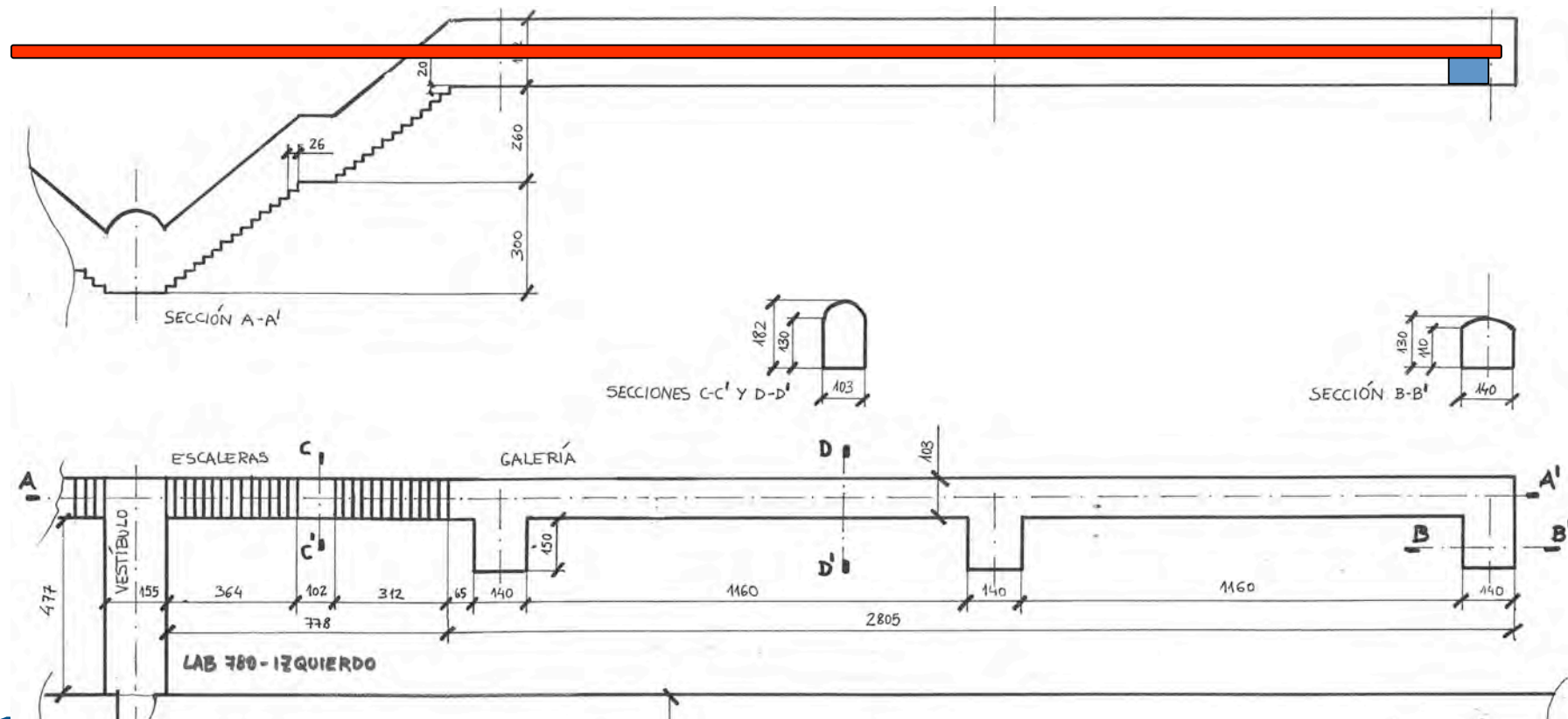
Lab 780 L ready for installing one interferometer

Authorisation requested for the interferometer in bypass 16



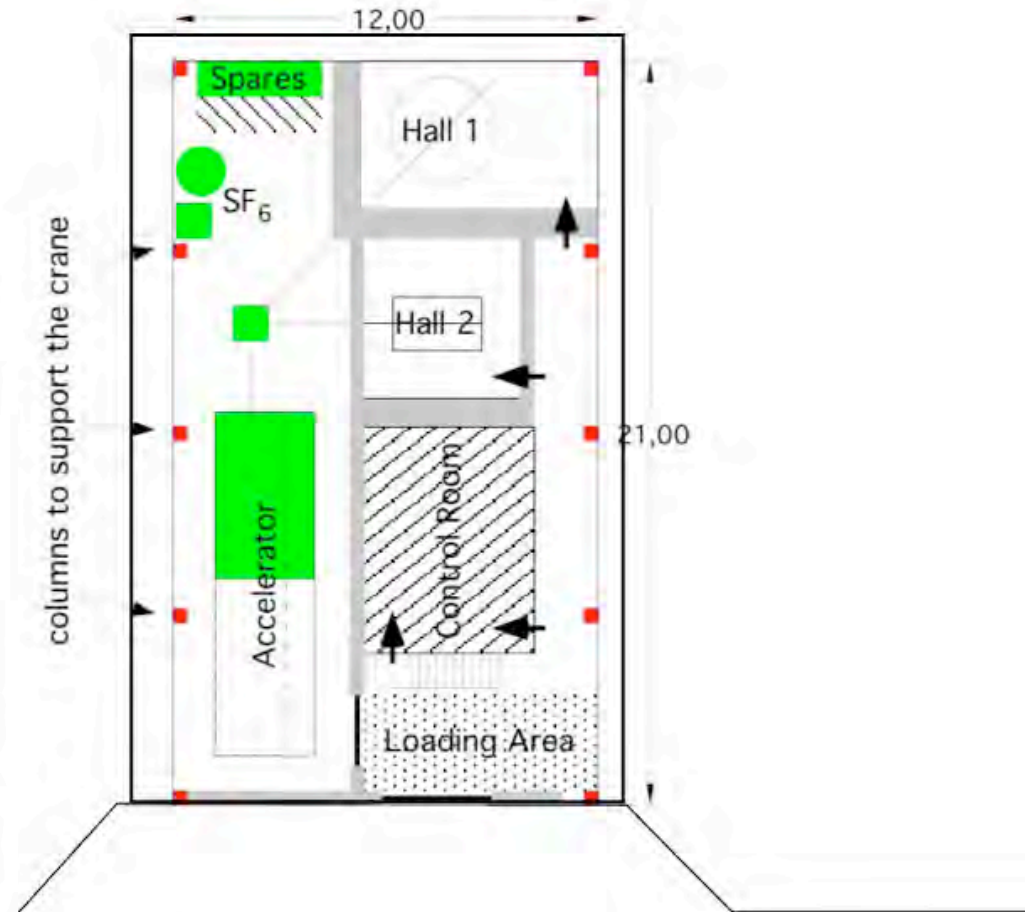
Lab 780 L

Rock drilled (17 m, 200 mm diameter)



CUNA, Canfranc Nuclear Asrtophysics facility

- New dedicated hall & Accelerator (about 3 MeV)
- Develop synergic program with LNGS
- Dedicated scientific Workshop in Barcelona 19-20 Feb 2009
- Design hall in 2011
- Hall excavation in 2012



"Train" tunnel (existing)

Preliminary design in 2011



Dark Life

- **Microbiology**

- How deeply in the earth does life extend?
- What makes life successful deep under the surface?
- What can life underground teach us about how life evolved?

- **Cross-disciplinary work between biologists and geologists**

- Do bacteria enter into the genesis of minerals and rocks?

Subject considered, in particular, by the DUSEL projects in the USA

No proposal yet

LAGUNA

European initiative (1.7 M€ PM7) for next generation detectors for neutrino physics and proton decay

Siete candidatos a albergarlo:

1. Laboratory IUS Boulby Mine, UK
2. Laboratory LSM, France
3. Laboratory LSC, Spain
4. Pyhäsalmi Mine, Finland
5. Unirea Mine, Rumania
6. Sieroszowice Mine, Poland
7. Non INFN site, Italy

Three technologies:

1. Water-Cherenkov ~ 1 MT
2. Aliquid Ar ~ 0.1 MT
3. Liquid scintillator ~ 0.05 MT

Feasibility study: geotechnique, economic, environmental, social, political, etc.

Conclusions: July 2010 + 1 year no-fund prolongation

LAGUNA-LSC-GLACIER

75 m (h), >35 m (dia)

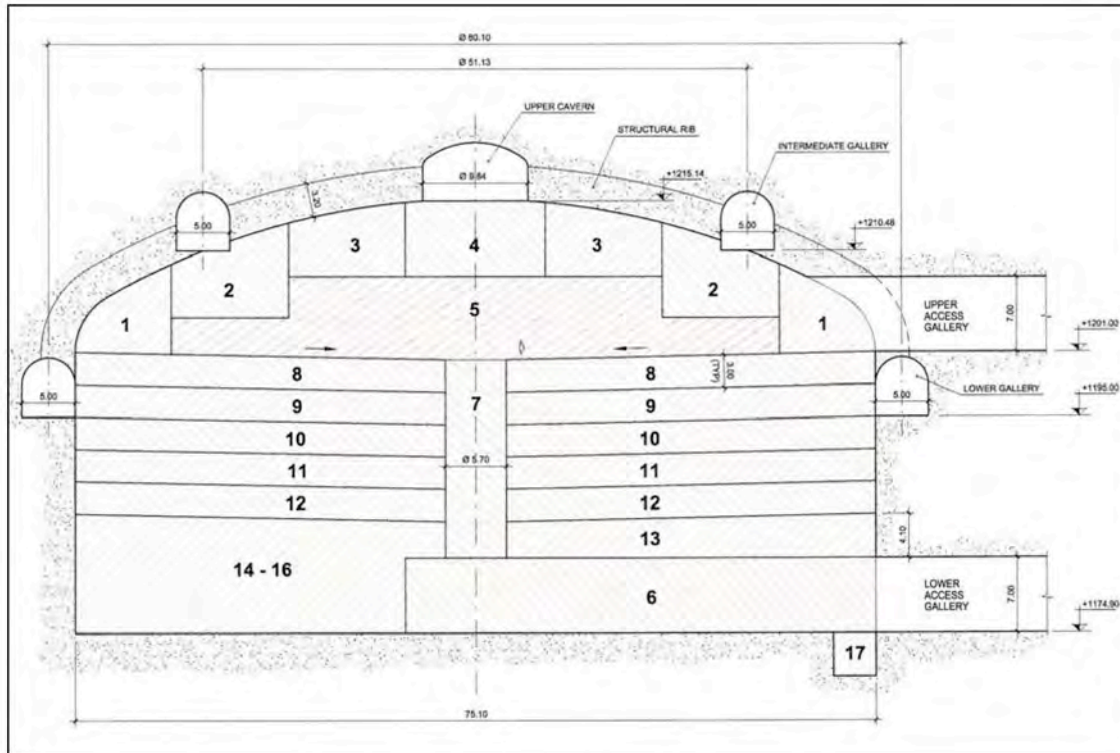
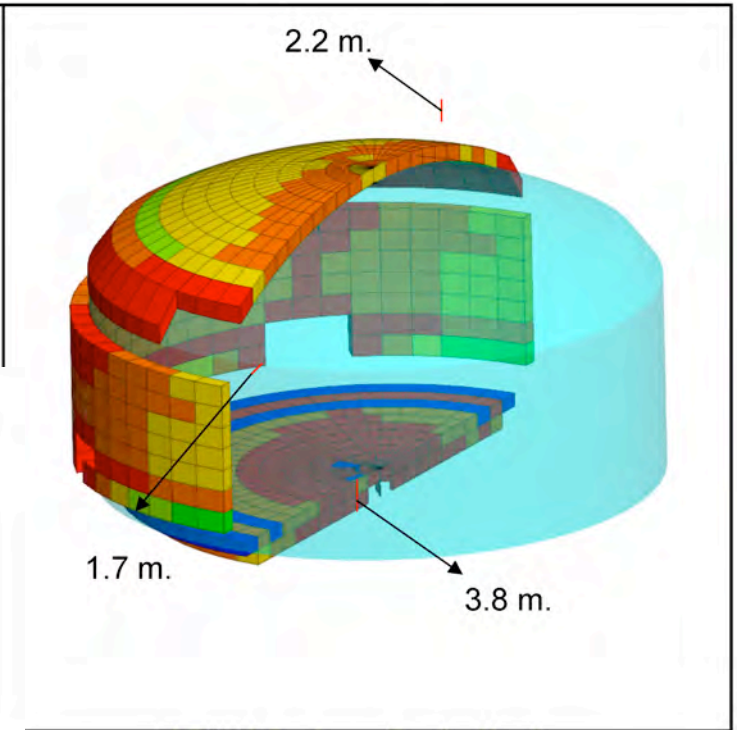
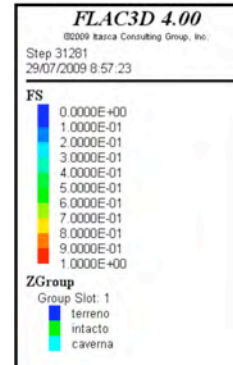


Figure 9.3-1. Excavation sequence for the GLACIER cavern.

Plastification study

Romana Ruiz

115 m (h), 34 m (dia) **LAGUNA-LSC-LENA**

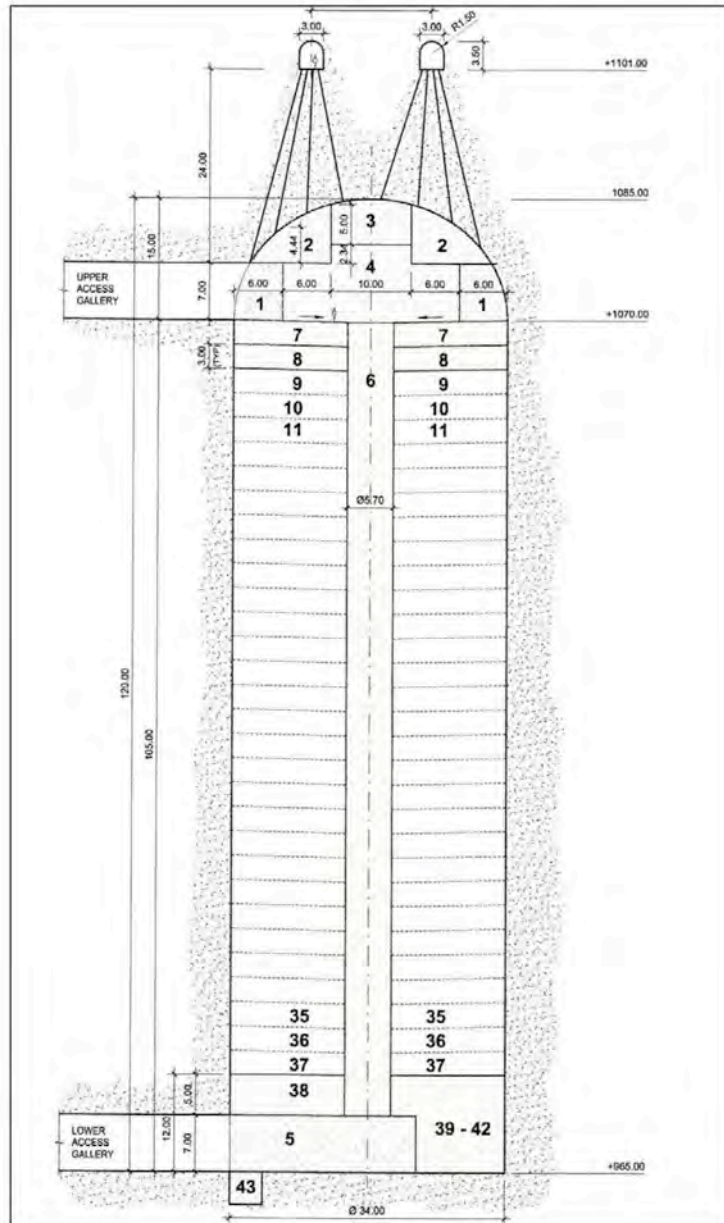
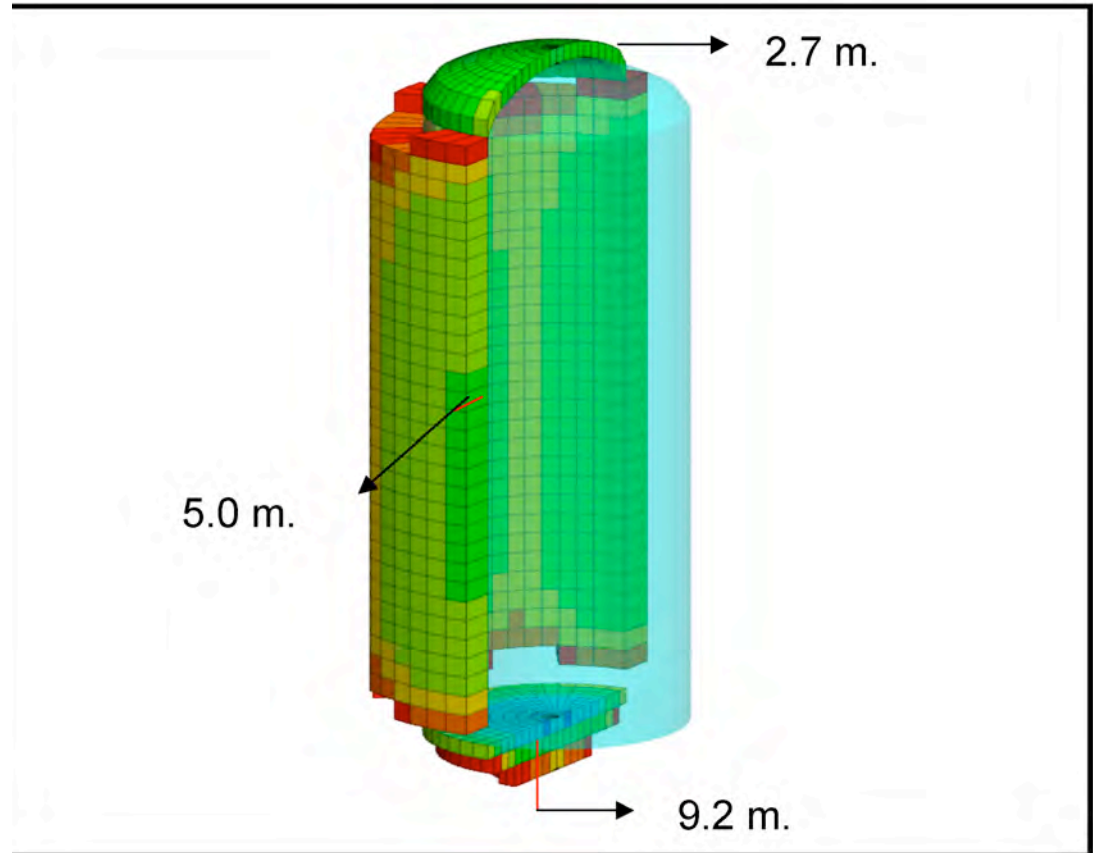


Figure 8.3-2. Excavation sequence for the LENA cavern.

Plastification study
Romana Ruiz



5.0 m.

2.7 m.

9.2 m.

LAGUNA-LSC-MEMPHYS

Plastification study

85 m (h), 65 m (dia)

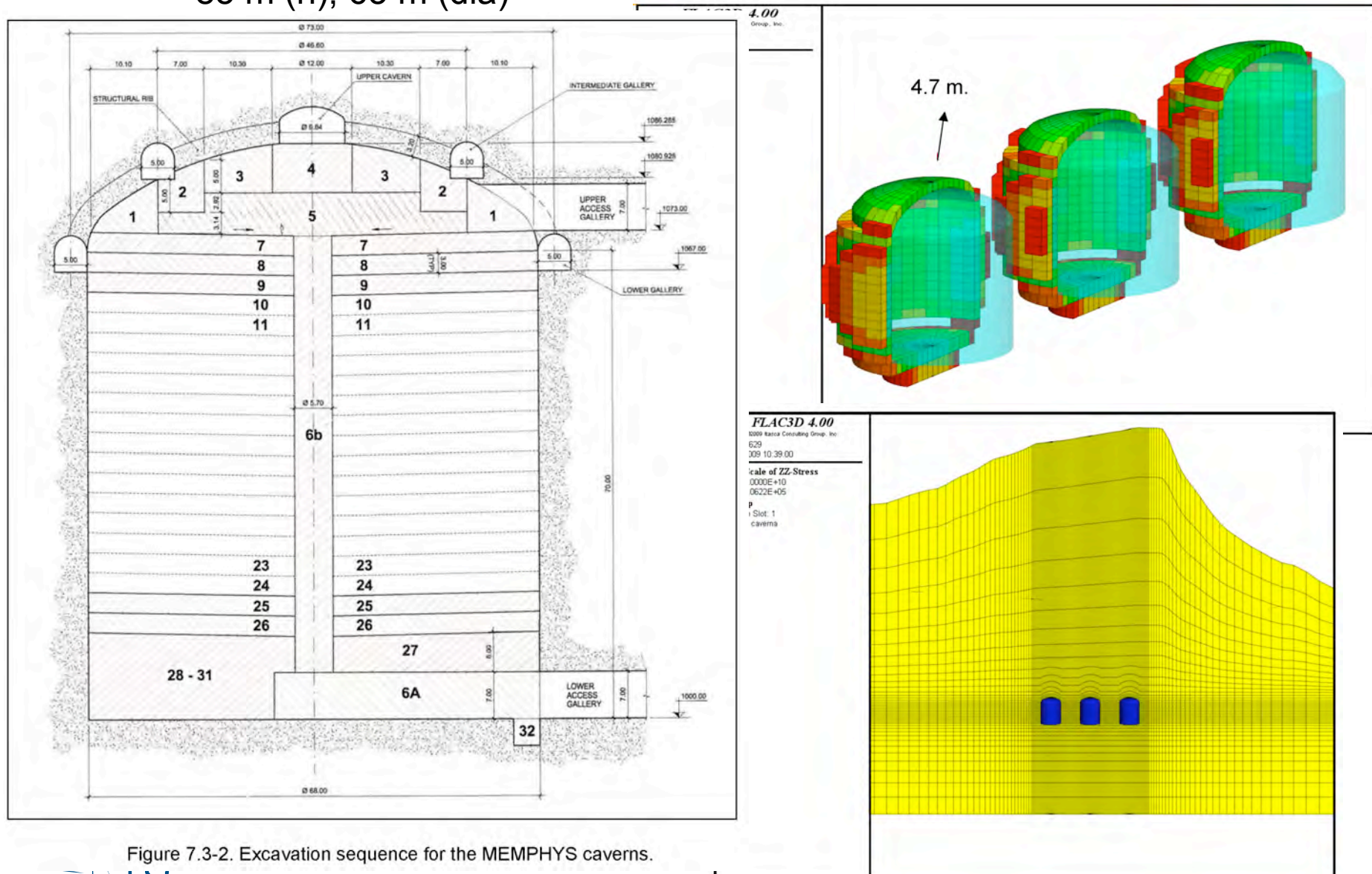


Figure 7.3-2. Excavation sequence for the MEMPHYS caverns.