Laguna

and the LSC

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IMFP2011

Canfranc, 20110210

1. What is LAGUNA ?
2. Feasibility study for LAGUNA at the LSC
3. What is next ?

What is LAGUNA ?

- The current European approach to the next generation, liquid [Mt-like], p-decay and neutrino detectors

- It considers seven candidate sites:

CUPP @ Pyhäsalmi mine, Finland
IUS @ Boulby mine, UK
SUNLAB @ Sieroszowice mine, Poland
IFIN-HH @ Unirea mine, Romania
LSM @ Frejus tunnel, France
New-Italian-Site @ CNGS beam halo, Italy
LSC @ Canfranc RW tunnel, Spain

- It considers three different detector technologies:
  - Water-Cherenkov: ~ 1 Mt
  - Liquid-Argon TPC: ~ 0.1 Mt
  - Liquid-Scintillator: ~ 0.05 Mt

LNGS is not there (i!)

The LAGUNA Cosortium

- a pre-Collaboration was formed
  It did apply for 5 M€ funding
  to the EU within the program
  FP7-INFRASTRUCTUES-2007

- Only 1.7 M€ were granted.
  The explicit request by the EU
  was to focus in the Feasibility
  Study (FS), mainly Geotechnic,
  of the 7 candidate sites.

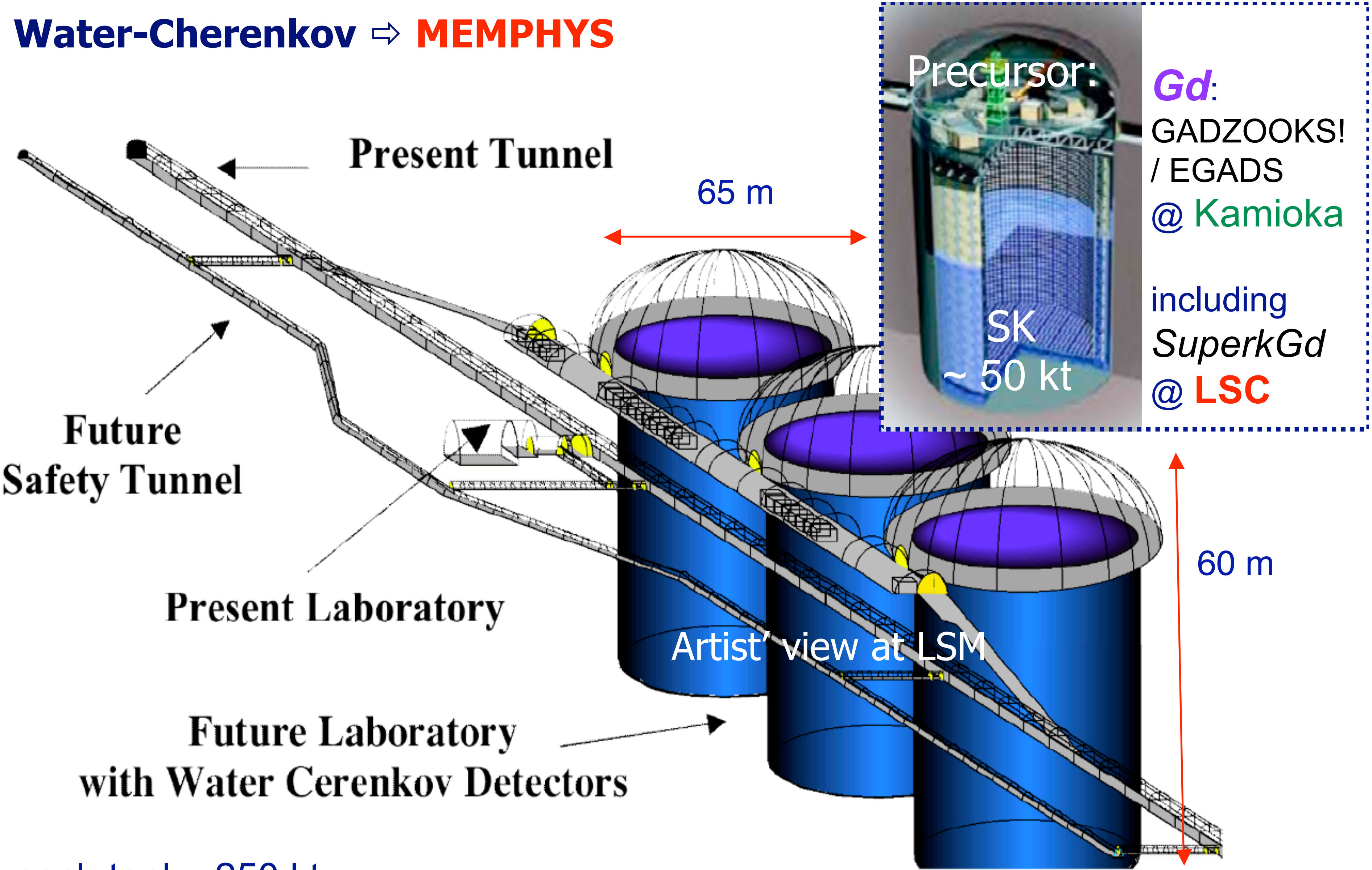
Italy (INFN) is not there (i!)

LAGUNA Governance structure **v2.0 / 14/10/08**

Coordinator		A. Rubbia
Deputy-Coordinator		??
Governing Board		
Coordinator		A. Rubbia
Deputy-coordinator		??
Administrator		F. Petrolo
WG2 coordinator		F. von Feilitzsch
WG3 coordinator		N. Spooner
WG4 coordinator		A. Zalewska
Academic partners' representatives		
	ETH Zurich	A. Marchionni
	U-Bern	A. Ereditato
	U-Jyväskylä	J. Maalampi
	UOULU	T. Enqvist
	CEA	M. Zito
	IN2P3	Th. Patzak
	MPG	M. Lindner
	TUM	L. Oberaurer
	IFJ PAN	Jan Kisiel - US (for IFJ PAN)
	LSC	A. Bettini ←
	UAM	L. Labarga ←
	UDUR	S. Pascoli
	USFD	P. Lightfoot
	AU	H. Fynbo
	IFIN-HH	R. Margineanu
Industrial partners' representatives (ex-officio)		
	Rockplan	G. Nuijten
	KGHM CUPRUM	W. Pytel
	IGSMiE PAN	K. Slizowski
	Technodyne	J. Thompson
	AGT	M. Temussi
	Lombardi	P.F. Bertola

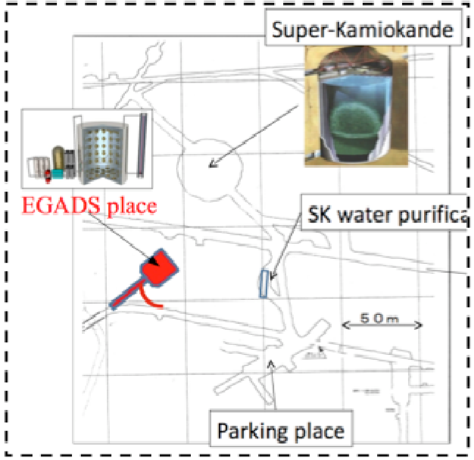
The LAGUNA detector-technology approaches

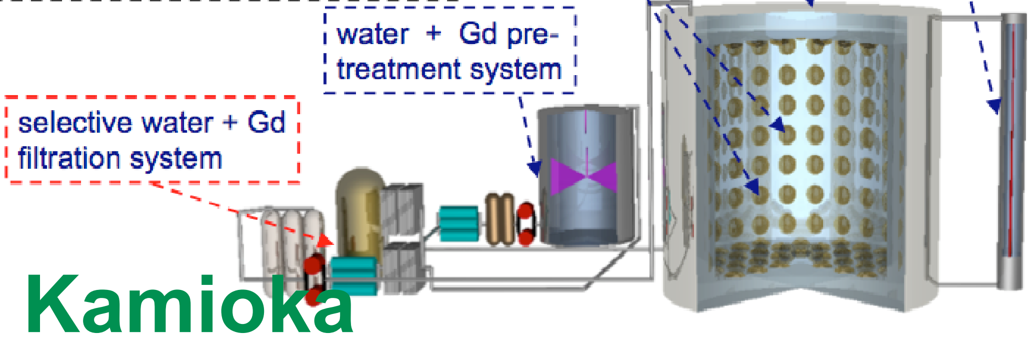
Water-Cherenkov ⇨ MEMPHYS

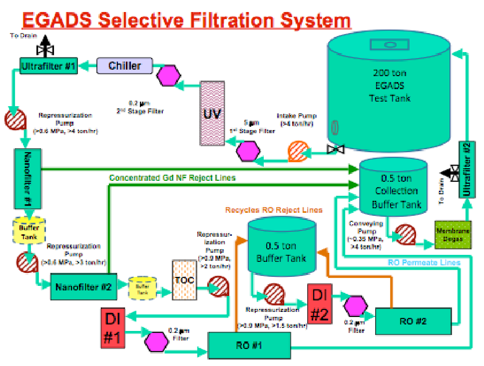


- each tank ~250 kt
- tank size limited by light attenuation length (λ ~ 80m) and pressure on PMTs
- readout : ~3 x 81K 12” PMTs, 30% geom. Cover
- hopefully with matter-flavour/neutron tagging ⇨ ***Gd*** solute

main characteristics of *EGADS*

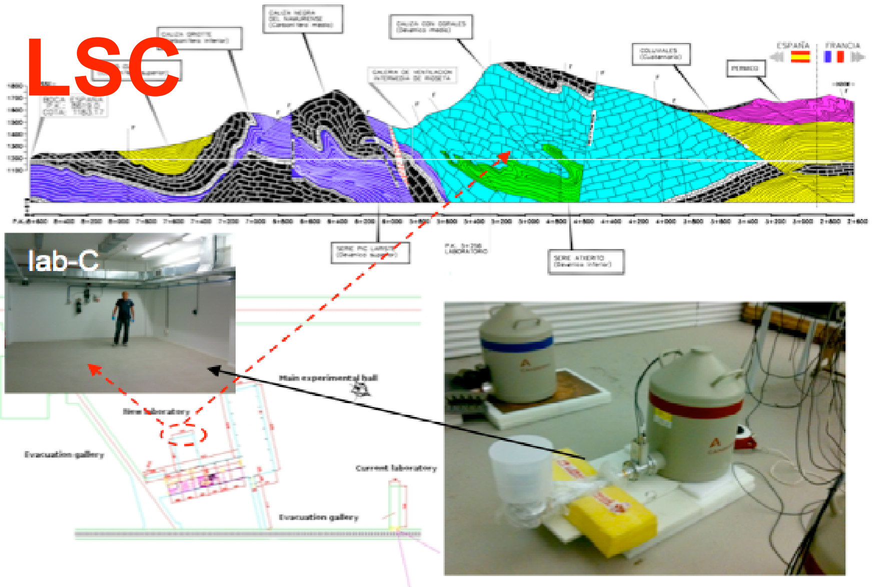


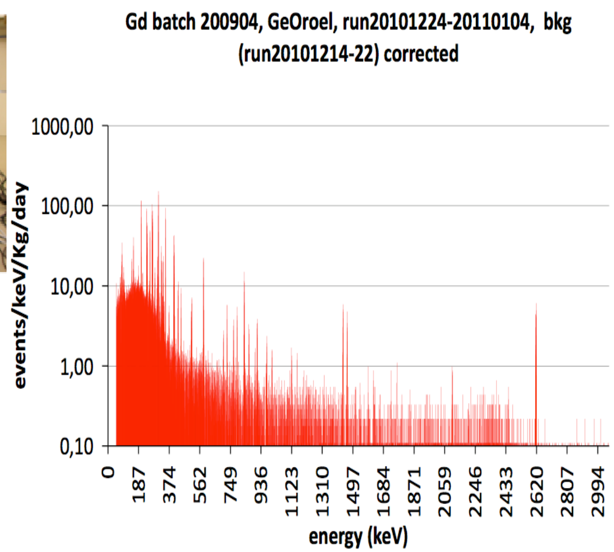




Kamioka

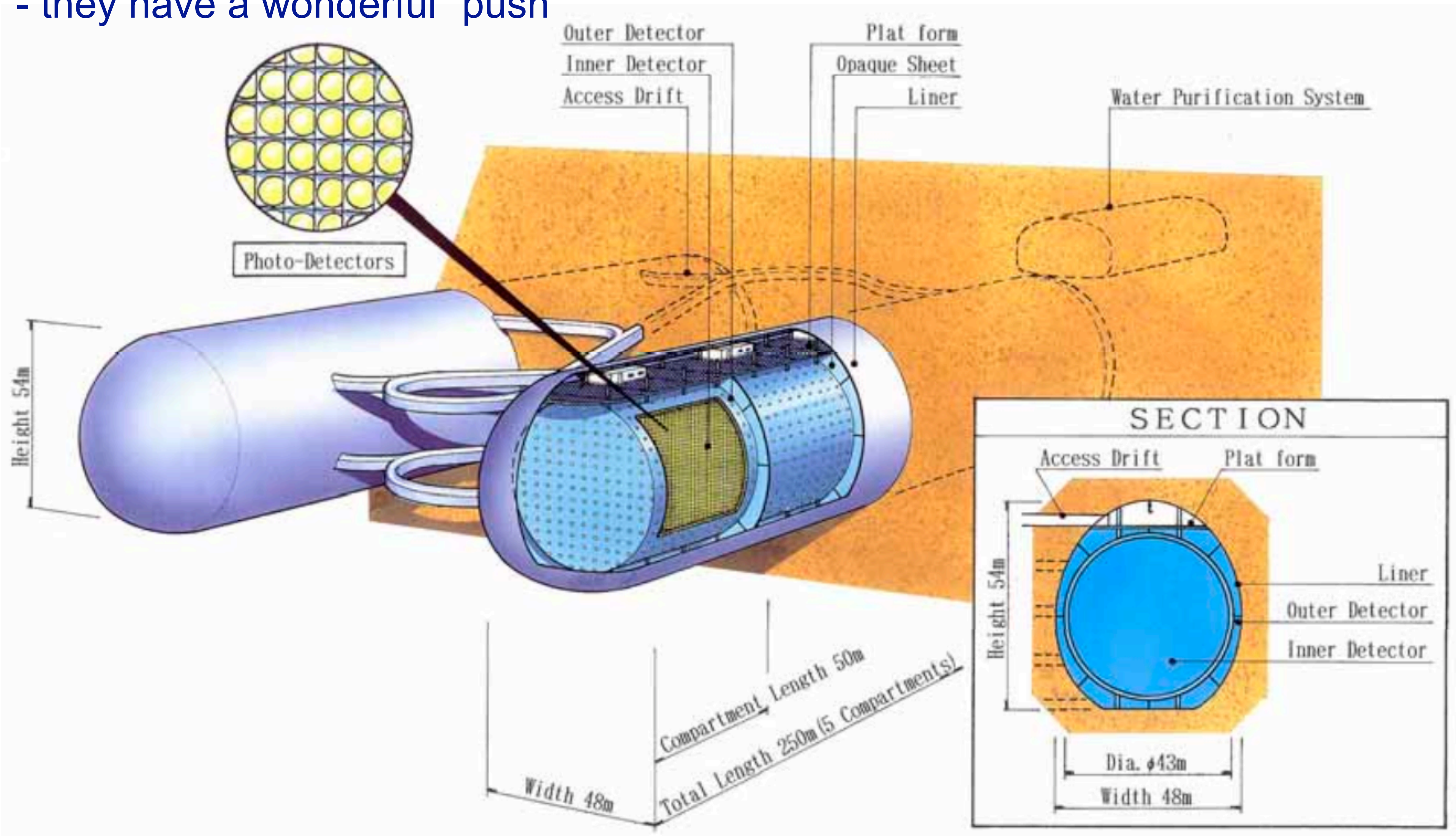
LSC





LAGUNA (MEMPHIS) is the European "competitor" of SuperKamiokande's successor: HyperKamiokande

- they have the expertise
- they have a powerful ν beam
- they have a wonderful "push"



Liquid Scintillator ⇨ LENA

DETECTOR LAYOUT

~ 50 kt Liquid Scintillator

Cavern
height: 115 m, diameter: 50 m
shielding from cosmic rays: ~4,000 m.w

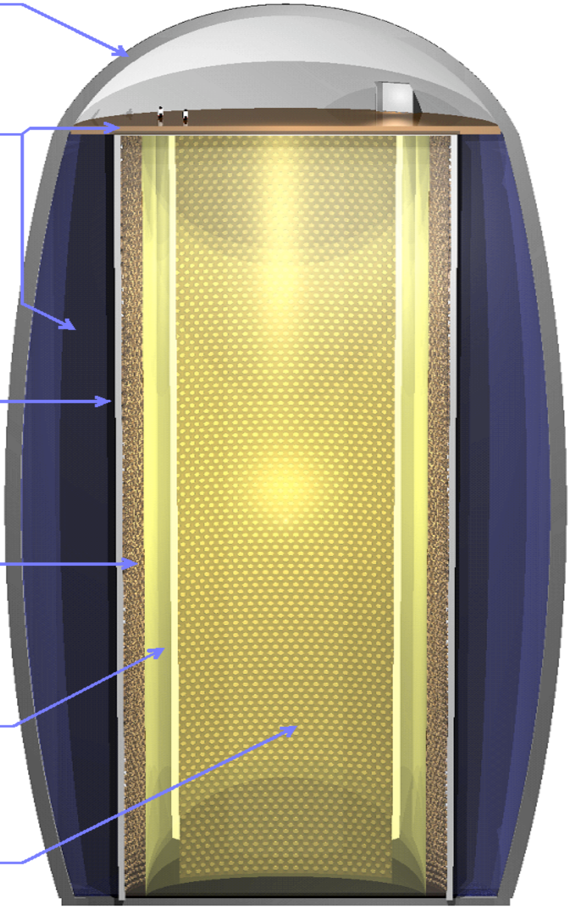
Muon Veto
plastic scintillator panels (on top)
Water Cherenkov Detector
1,500 phototubes
100 kt of water
reduction of fast
neutron background

Steel Cylinder
height: 100 m, diameter: 30 m
70 kt of organic liquid
13,500 phototubes

Buffer
thickness: 2 m
non-scintillating organic liquid
shielding external radioactivity

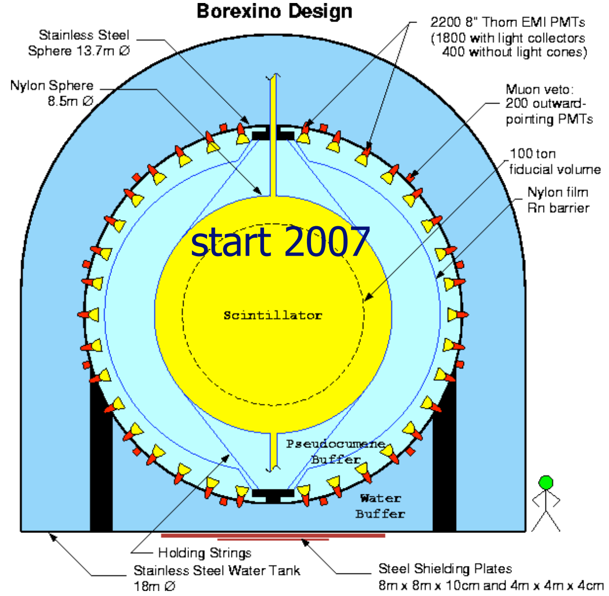
Nylon Vessel
parting buffer liquid
from liquid scintillator

Target Volume
height: 100 m, diameter: 26 m
50 kt of liquid scintillator

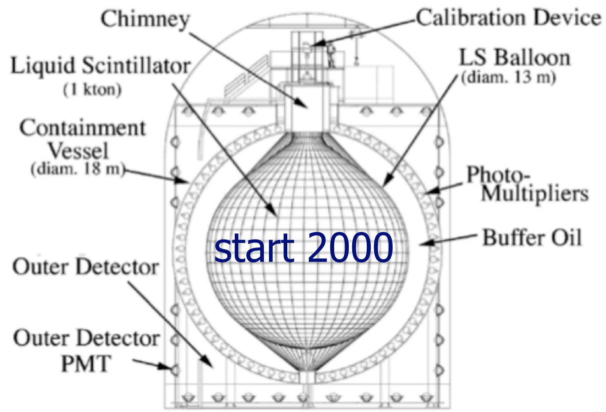


vertical design is favourable in terms of rock pressure and buoyancy forces

Borexino (LNGS):
LSci fiducial/tot vol.: 100/300 t
Buffer UP-org/water: 1k/2.4k t

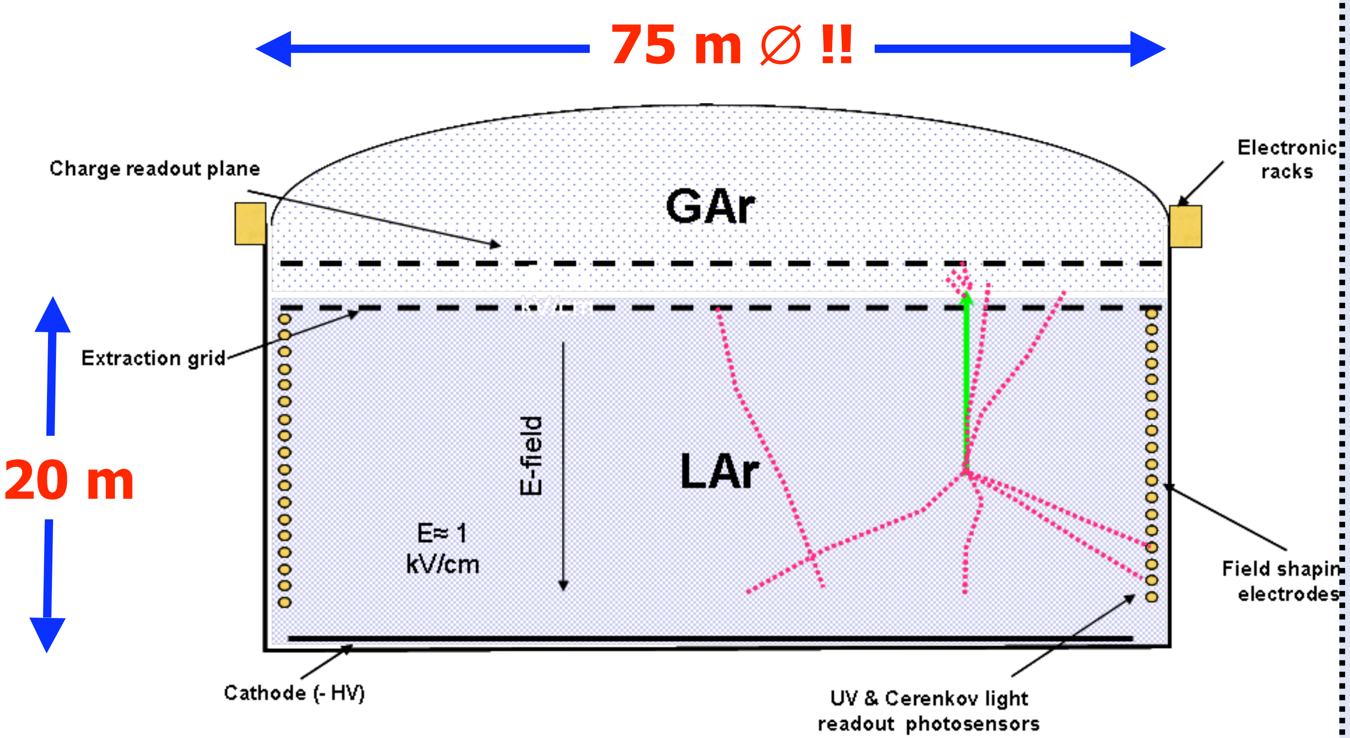


KamLand (Kamioka):
LSci fiducial/tot vol.: 400/1k t
Buffer UP-org/water: 2k/3k t



Liquid Argon ⇨ GLACIER

- LAr storage based on LNG tank tech
- Double - Phase LEM readout (gain ~ 10^4)
- Cockroft-Walton [Greinacher] Voltage Multiplier (~ 1 kV/cm)
- Very Long drift distances (~ 20 m !!)
- ~ 100 kt



"Precursor"
ArDM-**LSC** 1 t LArg

Rough Comparison of Potentialities:

Table 12. Summary of the physics potential of the proposed detectors for astroparticle physics topics. The (*) stands for the case where gadolinium salt is added to the water of one of the MEMPHYS shafts.

D. Autiero et al.; JCAP11(2007)011

Topics	GLACIER 100 kton	LENA 50 kton	MEMPHYS 440 kton
Proton decay			
$e^+\pi^0$	0.5×10^{35}	—	1.0×10^{35}
$\bar{\nu}K^+$	1.1×10^{35}	0.4×10^{35}	0.2×10^{35}
SN ν (10 kpc)			
CC or inverse β	$2.5 \times 10^4 (\nu_e)$	$9.0 \times 10^3 (\bar{\nu}_e)$	$2.0 \times 10^5 (\bar{\nu}_e)$ (*)
NC	3.0×10^4	3.0×10^3	—
ES	$1.0 \times 10^3 (e)$	$7.0 \times 10^3 (p)$	$1.0 \times 10^3 (e)$
DSNB ν (S/B 5 yr)	40–60/30	9–110/7	43–109/47 (*)
Solar ν (evts. 1 yr)			
^{8}B ES	4.5×10^4	1.6×10^4	1.1×10^5
^{8}B CC	—	360	—
^{7}Be	—	2.0×10^6	—
pep	—	7.7×10^4	—
Atmospheric ν (evts. 1 yr)	1.1×10^4	—	4.0×10^4 (1 ring only)
Geo ν (evts. 1 yr)	Below threshold	≈1000	Need 2 MeV threshold
Reactor ν (evts. 1 yr)	—	1.7×10^4	6.0×10^4 (*)

⇨ "~ similar" physics output in "~ similar" periods of time

We must bear in mind, always, a possible new ν beam, of some kind, from CERN

[explicitly addressed in LAGUNA-LBNO, see end of the talk]

⇨ what is θ_{13} ?

Feasibility Study *for*

Laguna *at the* LSC

Some items about this first period LAGUNA-LSC

- The coordinator of the Feasibility Study (FS) for the LSC was L. Labarga (UAM); he had the help of LSC staff

- For the FS, LAGUNA-EU assigned ~145 K€ to the LSC, and 31 K€ to the the UAM, the LSC and UAM contributed with ~100 K€ and 7 K€ respectively (the later from the AC FPA2008-03002-E)

- The LSC has not Geotechnic Dept.; technical part had to be subcontracted

- July 2008 --> March 2009
  - Contact, discussions and (private) pre-selection of Geotechnic Companies candidate to carry out the FS for the LSC
  - Administrative and legal procedure to select the Company.
  - Select Company (got a *"dream team"*, see next slide), sign contract, Company starts working

- June 2010: the main document basis of WP2's *"Interim Report for the LSC"* is delivered
  [final version is at http://www.lsc-canfranc.es/ links *activity → LAGUNA*]

Main work
Help work

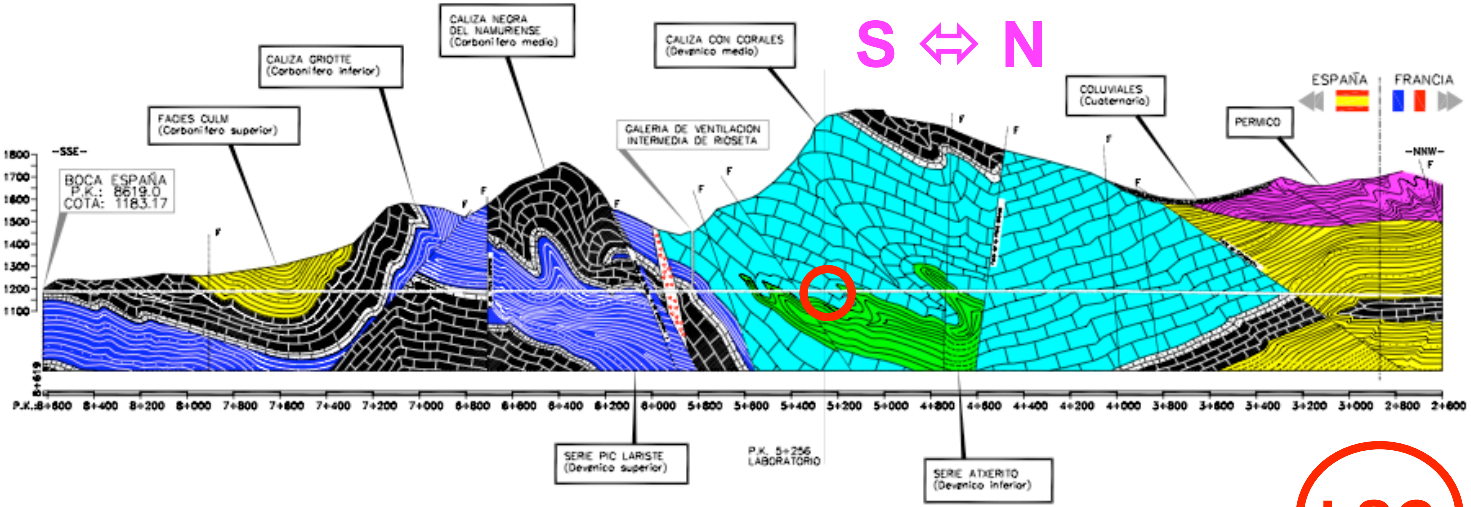
PROJECT TEAM

leader: *Manuel Romana* (STMR)
co-leader: *Clemente Saenz* (Iberinsa)
Companies involved:

LAGUNA Canfranc feasibility study

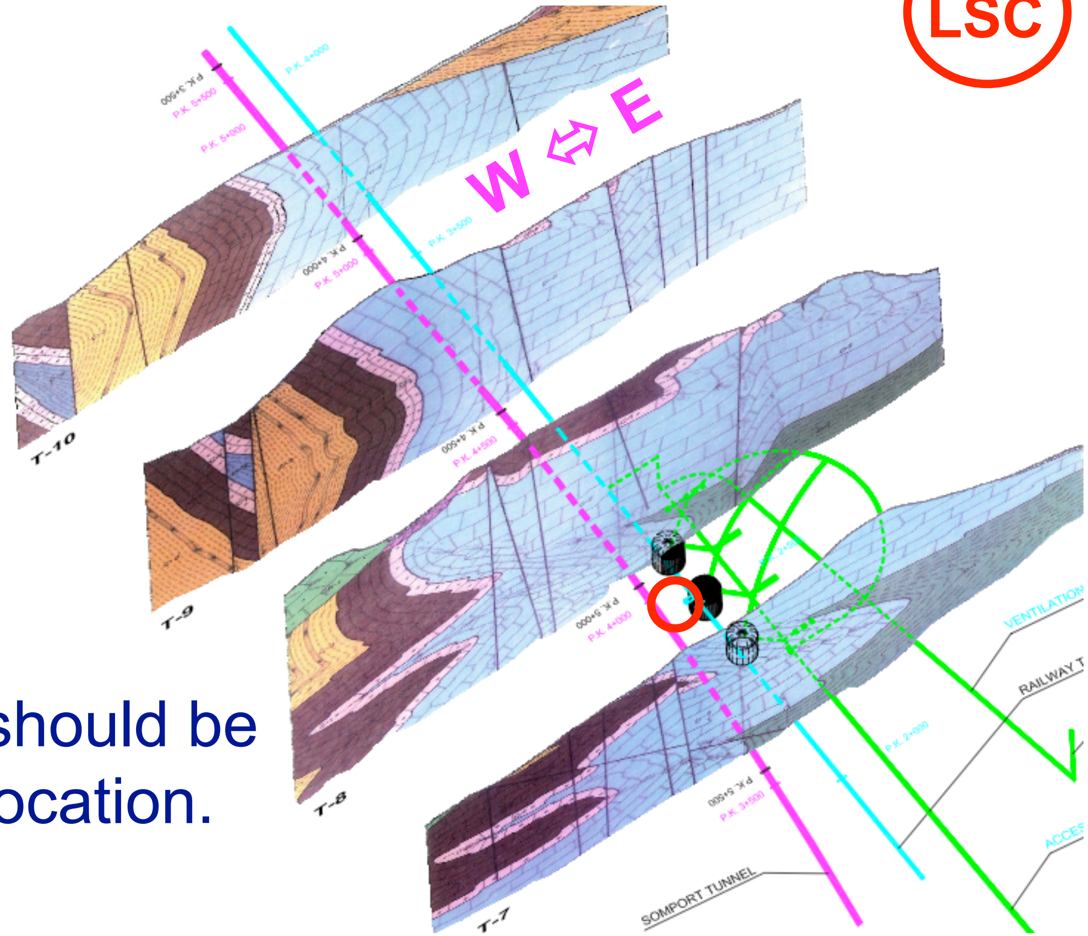
- **Iberinsa: big Spanish consulting firm**
  - Geological-geotechnical work (General)
  - Numerical modelling
  - Environmental questions
  - Auxiliary installations. Buildings
  - Cost estimates
- **STMR: small Spanish geotechnical and tunnelling firm**
  - Project managing and coordination
  - Geologic-geotechnical work (Rock Mechanics problems)
  - Construction processes and work methods
- Obras Subterraneas (OSSA): Biggest Spanish firm for underground works contruction
  - Construction processes and work methods
  - Cost estimates
- Itasca Spain: Local branch of Itasca network of firms
  - Numerical modelling
- Individual consultants
  - Site knowledge (project and construction Manager for Somport Tunnel)
  - Tectonic stresses and seismicity (Madrid Geology Faculty Professor)

General I:



LSC

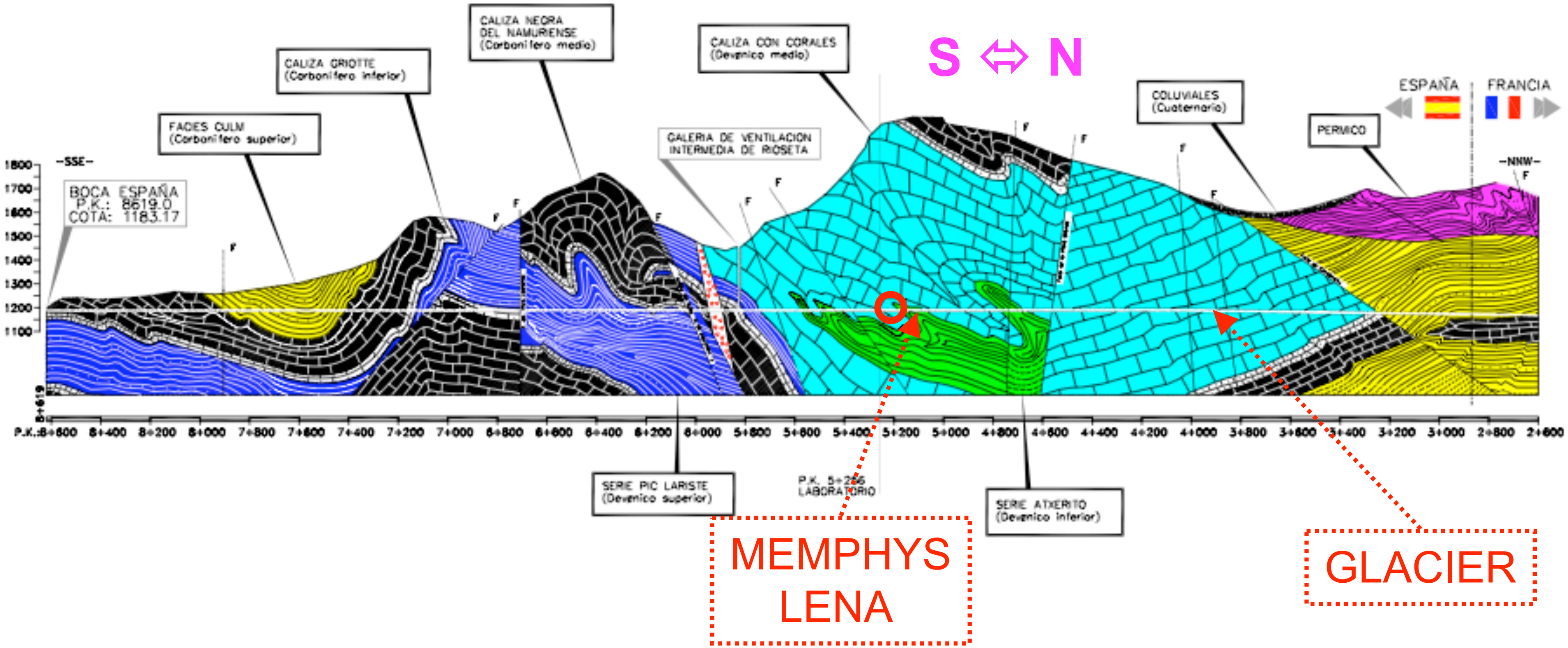
best compromise between overburden, rock quality, knowledge (within FS) and expectations of rock quality, centralization of services ... :



⇨ the LAGUNA experiment should be close to the current LSC location.

General II:

⇨ place MEMPHYS and LENA where overburden is largest



- GLACIER can work at shallower locations.
- Its 75 m ∅ dome (!) is a geotechnic challenge; less overburden and best rock quality will be of big help.
- There is a region along the tunnel shallower and of better rock

⇨ place GLACIER there

Important reminder

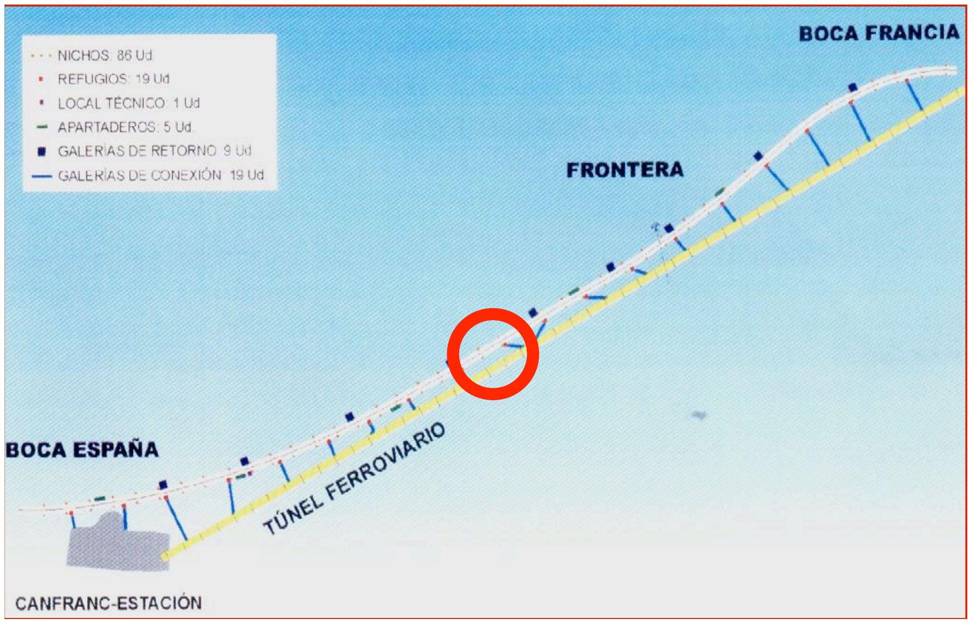
The LSC lies physically in between:

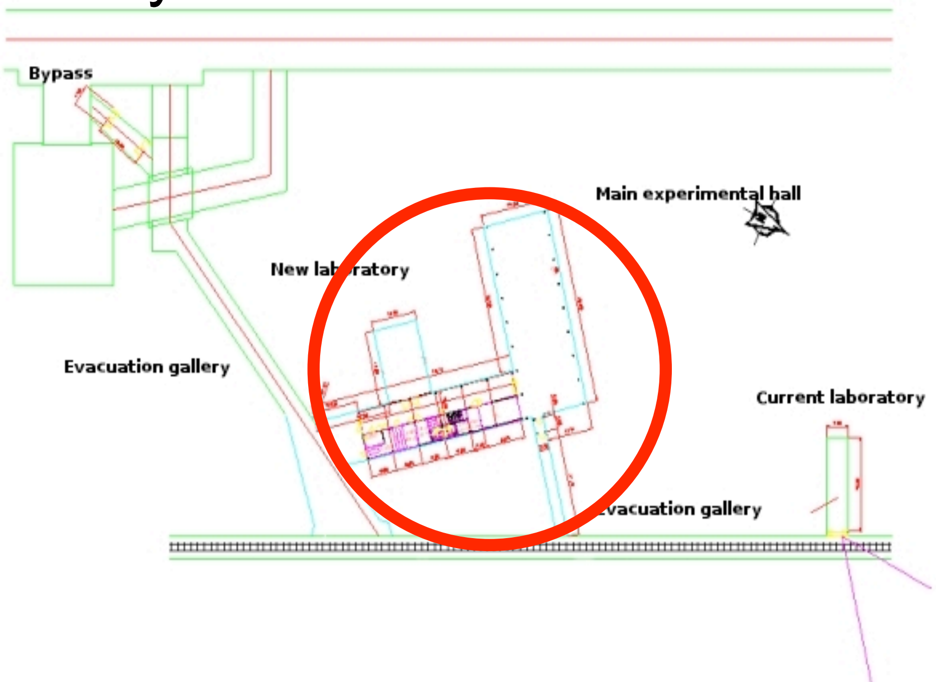
a New Road Tunnel (Somport tunnel, opened 2003)

- binational: Spain (Jaca) - France (Pau)
- Length: 8,6 Km (5,7 in Spain + 2,9 in France)
- State of the art on safety features (EU directive 2004)

an Old Railway Tunnel

- Now used as service and emergency exit of Road Tunnel
- Safety galleries connecting both tunnels every 400 m
- Current Access for Laboratory





General III:

- The main layouts in the three experiments have been designed neither to interfere with the regular running of Road Tunnel nor with the emergency and service purposes of Railway Tunnel.
- Of course they try to take the maximum profit of them, but at the same time they are thought to operate independently if necessary.

⇨ An independent access tunnel (2 - 3 Km long, ~ 4 - 7% downwards) almost parallel to existing ones

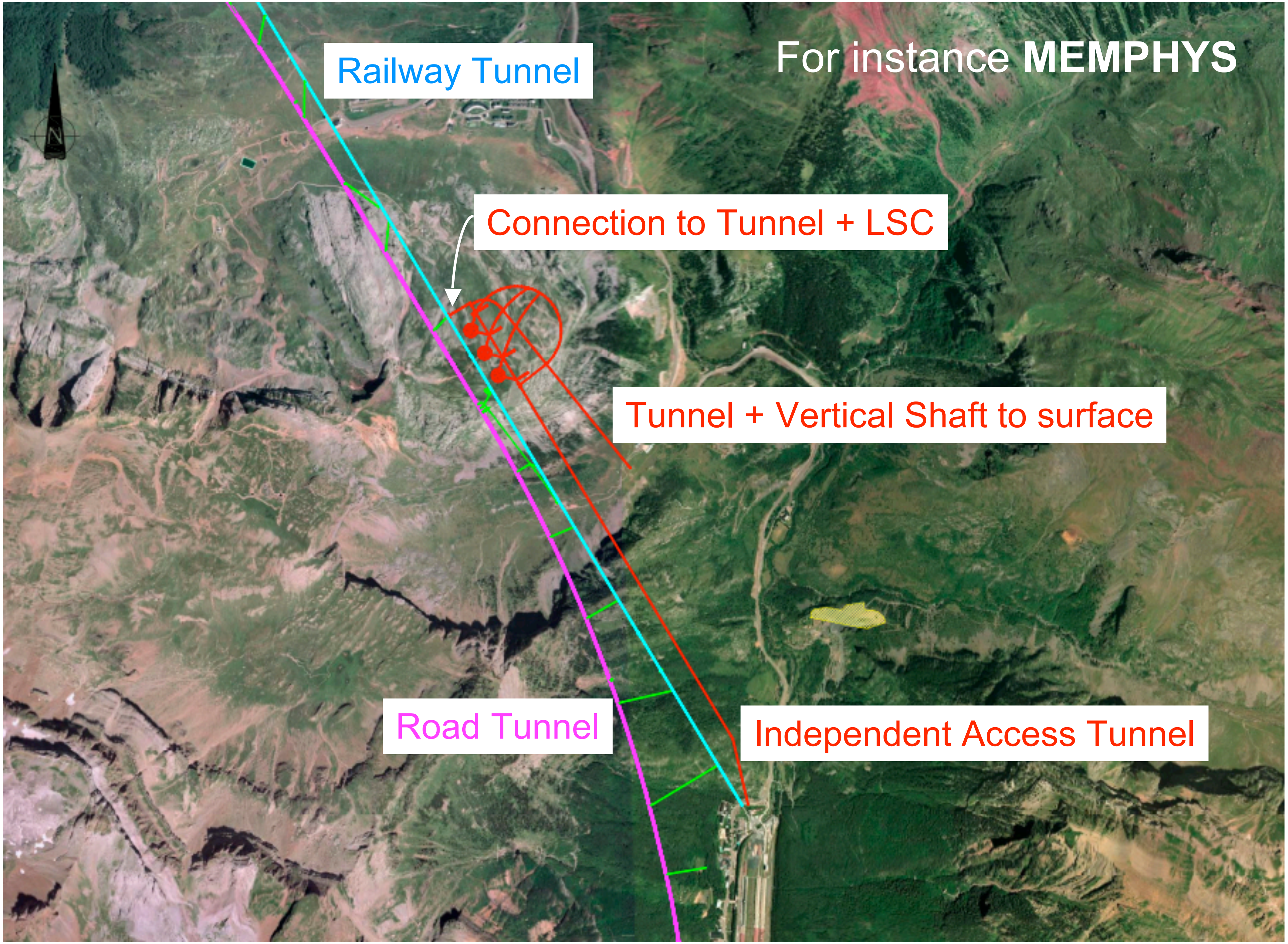
- For construction access (!)
- For regular operation/running and maintenance access
- For radon-free air conduction
- For supplies: energy, water, others
- For Liquid Scintillator .OR. Liquid Argon supply by truck
- For ventilation: regular operation/running and fire

⇨ A permanent connection with the Road and Railway tunnels and the LSC

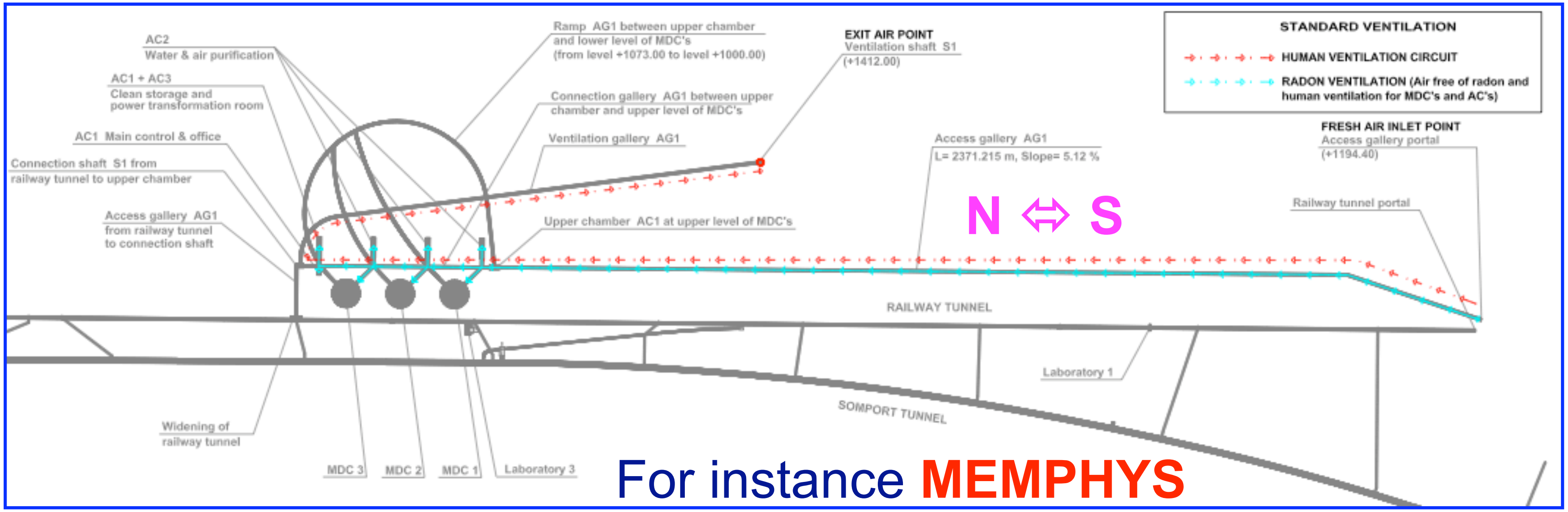
- For normal operation (connection to LSC)
- As an emergency escape way

⇨ Another tunnel + vertical shaft to the surface

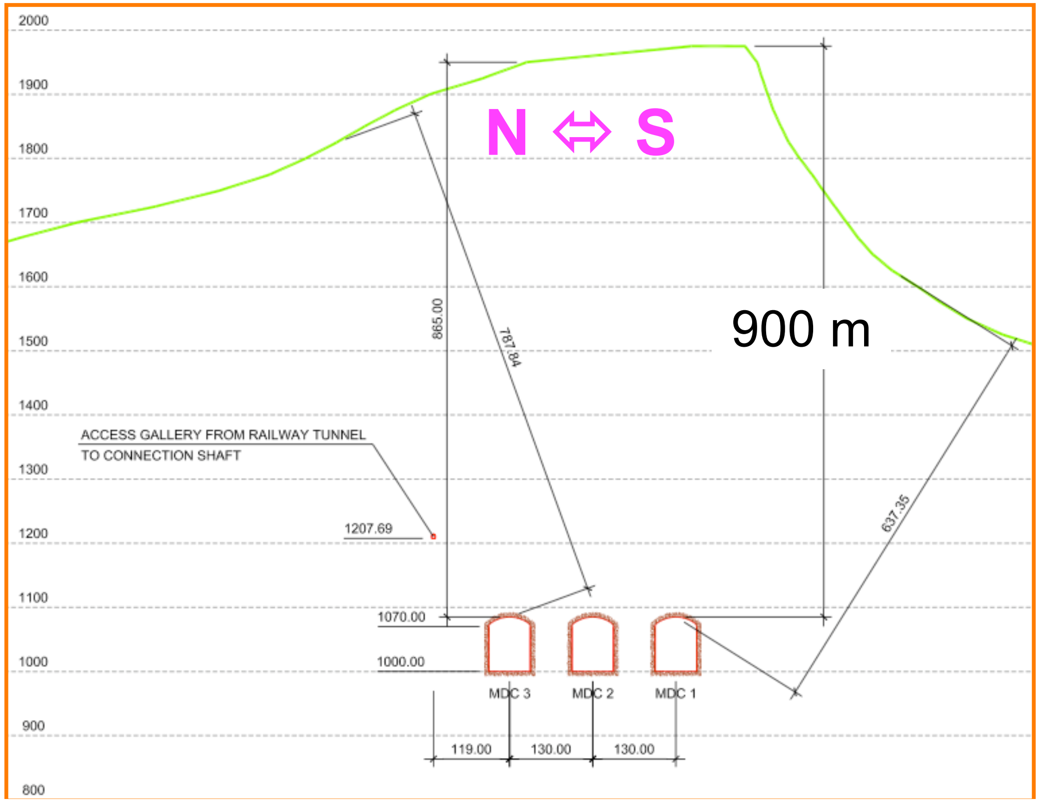
- For ventilation: regular operation/running and fire

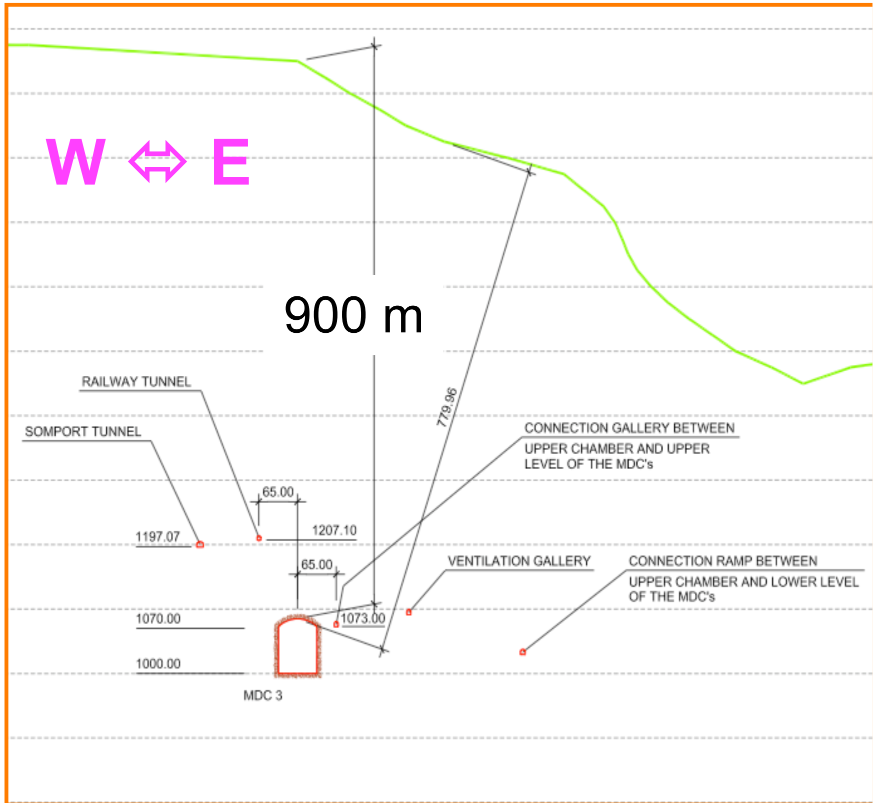


For instance **MEMPHYS**
Railway Tunnel
Connection to Tunnel + LSC
Tunnel + Vertical Shaft to surface
Road Tunnel
Independent Access Tunnel

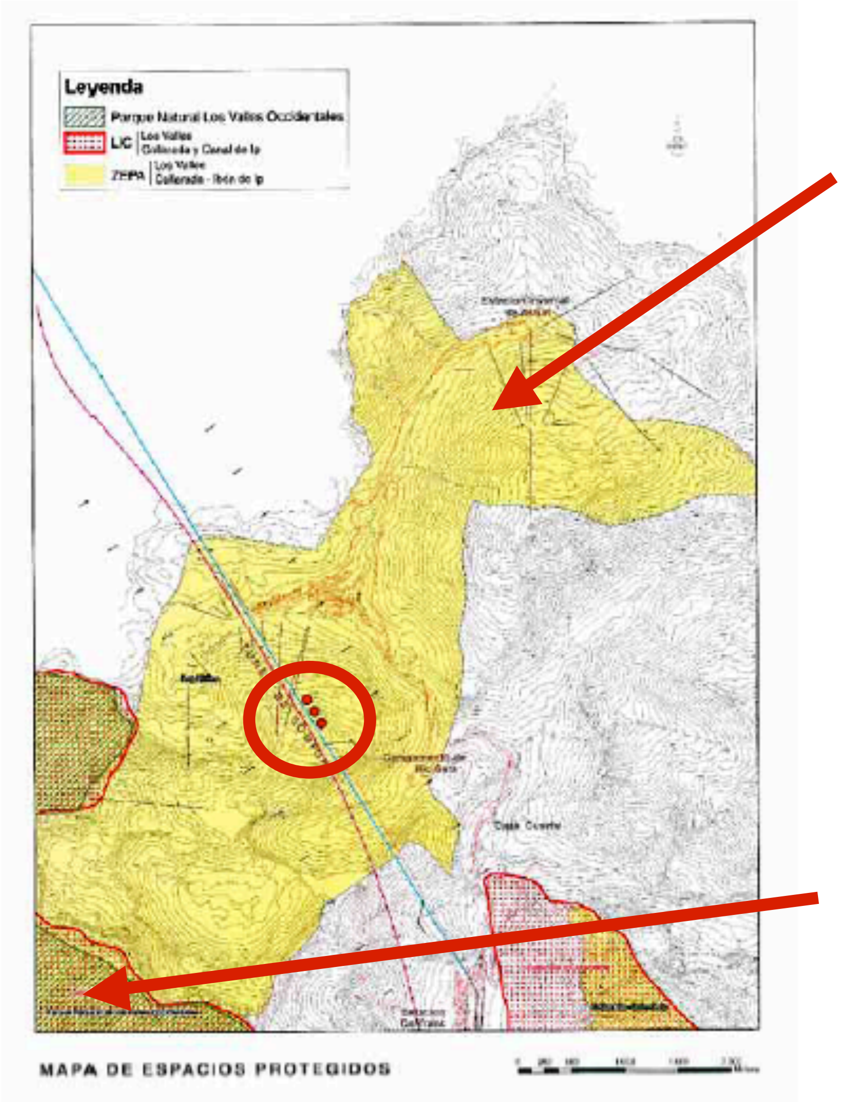


For instance **MEMPHYS**





Environmental I:



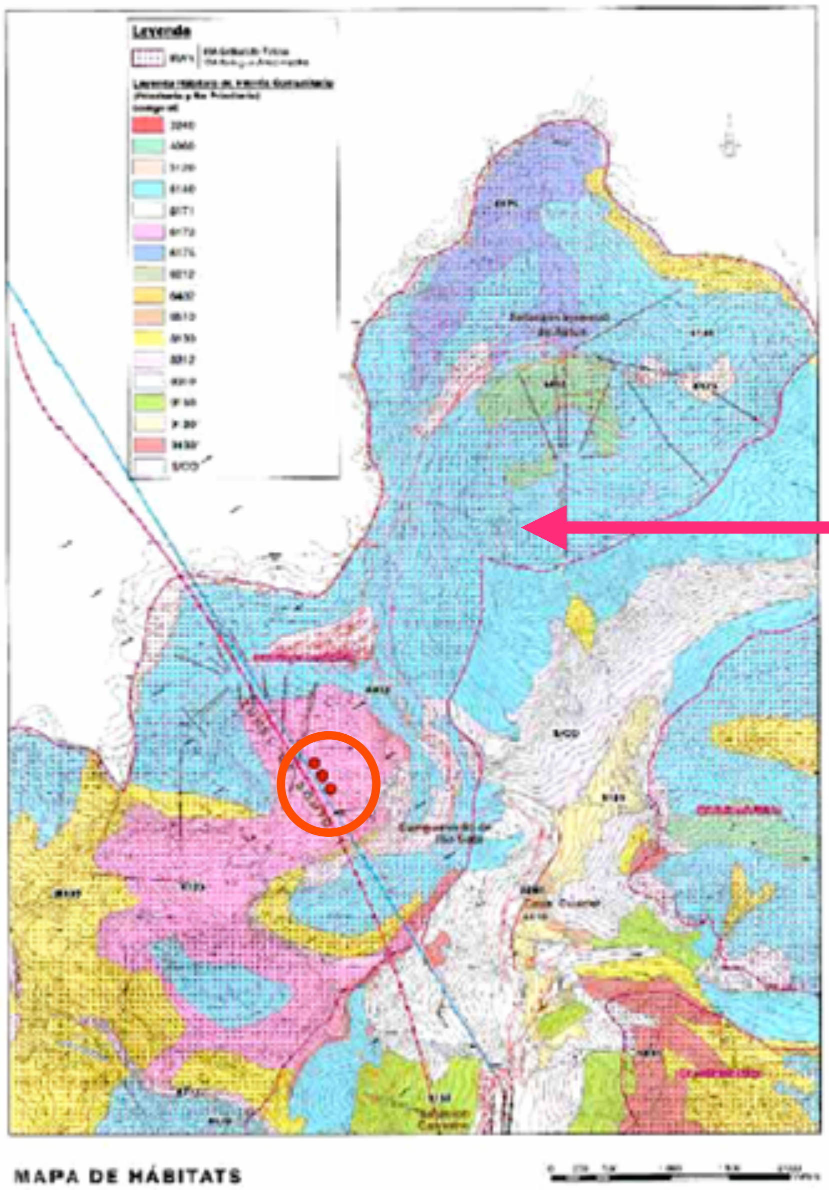
LIC ≡ SCI, Spaces of Community Importance; ZEPA ≡ SPA, Special Protection Areas (Birds); Parque Natural ≡ Nature Park

Nearby protected sites

- Special protected area for birds (ZEPA)
  - Includes site
  - There is a rare vulture protected species
  - No influence for underground works
  - Regulations for surface works during birds nesting period
- Nature Park
  - Far away from the site

Environmental II:

Animals habitats network



- Maps for animal and vegetal habitats network around the site have been drawn

- There is no special problem at the site for underground works

Environmental III:

Places for waste rock

Waste rock quantities are big

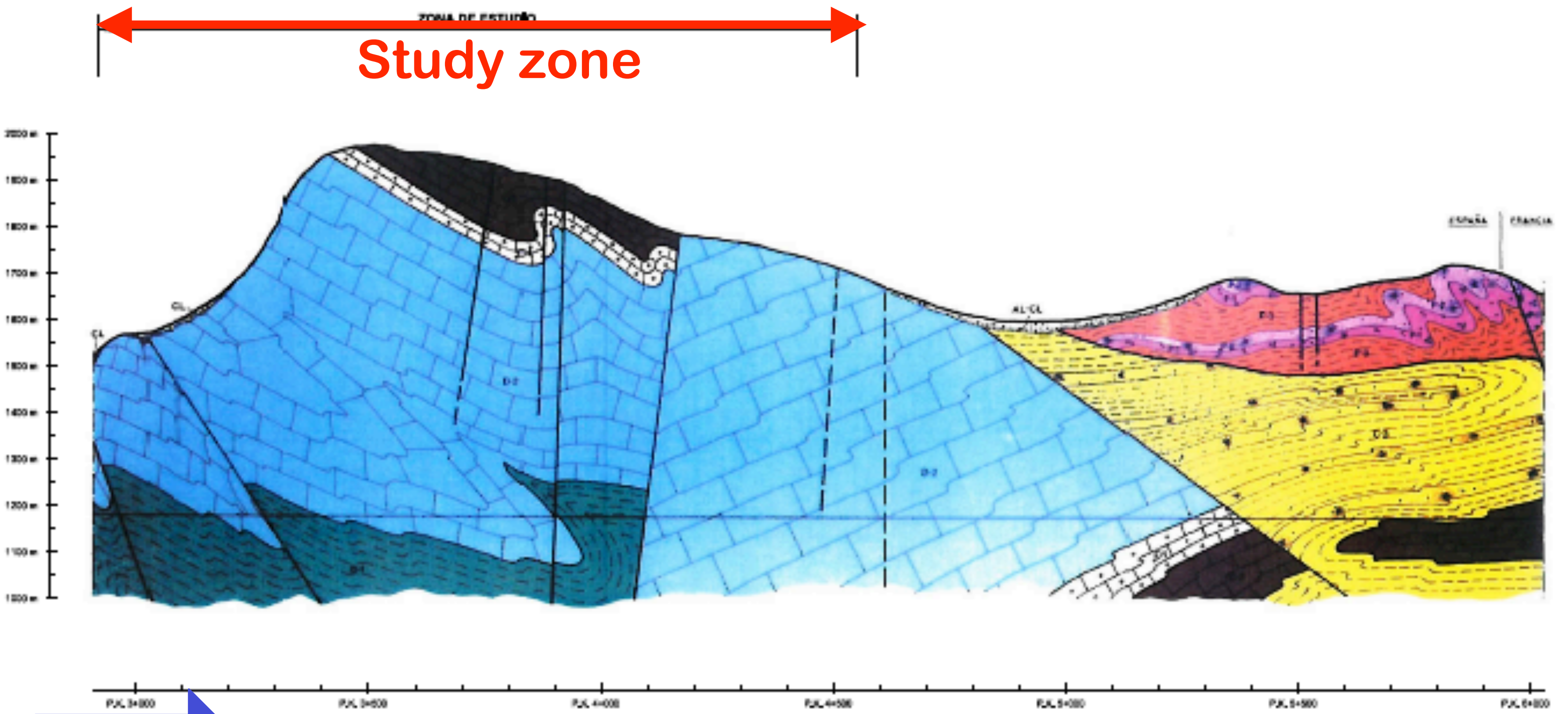
MEMPHYS ~1.000.000 m^3

GLACIER ~200.000 m^3

Two sites are selected closer than 20 Km. with no environmental problems

The places would be reforested like it was done for the Road Tunnel waste rock sites

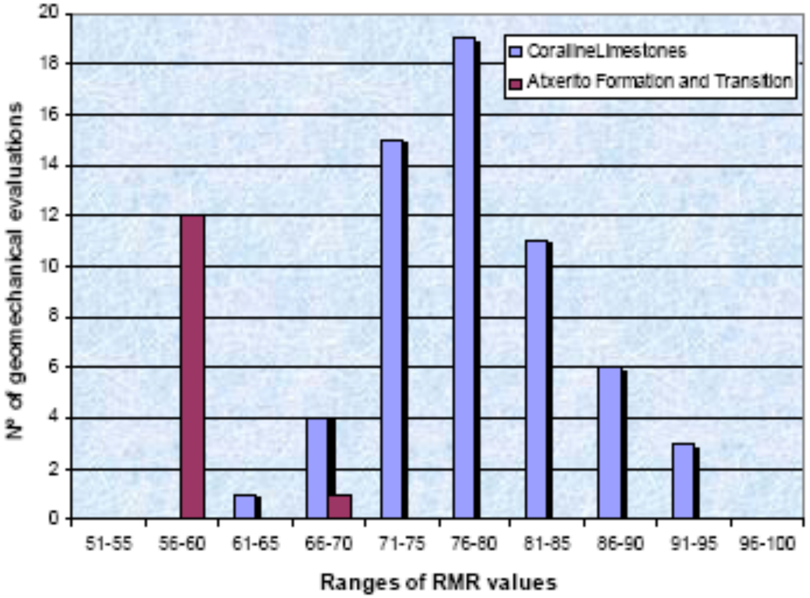
Geology I: profile at site from Road Tunnel studies



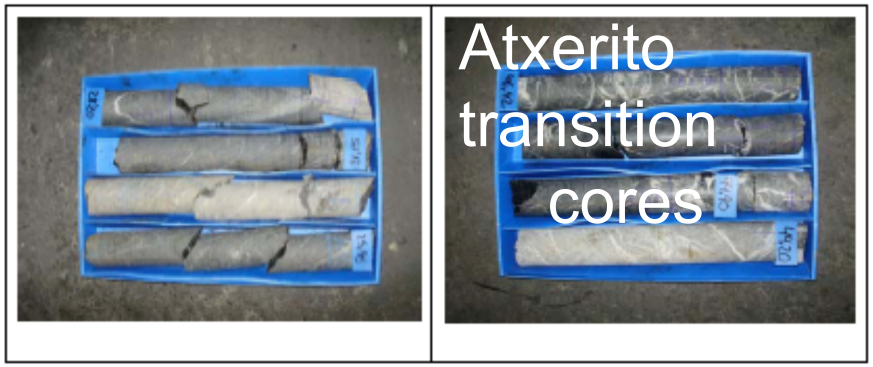
- Calcareous slate (Atxerito series) LSC
  - Metamorphic (low grade)
  - Schistose texture
- Limestone (Coralline limestone Series)
  - Sedimentary
  - Bedded texture

Geology II: geological studies in this FS

- Retrospective analysis of falls in the current LSC in order to check the real rock parameters around the laboratory
- Revision and analysis of geological data gathered at Road Tunnel excavation fases
- Two probing boreholes (40 and 70m long) in key locations
- Laboratory tests



Two boxes of S-1. At left, from 11,00 to 13,25 meters deep. At right, from 37,00 to 39,20.



Two boxes of S-2. At left, from 25,90 to 28,20 meters deep. At right, from 44,20 to 46,420.

Geology III: conclusions and assumptions for calculations

- The rock in most of the site is good quality marine coraline limestone
- There is a transition between the limestone and medium quality folded Atxerito beds
- The distribution of both rocks is well known at the Road Tunnel elevation (both from tunnel excavation and further studies for LAGUNA project)
- To know the exact distribution of both rocks at larger depths it is necessary a further campaign of geological-geotechnical boreholing

The rock assumptions for the calculations of this study are:

- MEMPHYS and LENA are assumed to lie in the worst possible situation (the Atxerito beds)
- GLACIER is known to lie in good quality limestones beds

Conceptual support design I: MEMPHYS and GLACIER

There are ***no precedents***

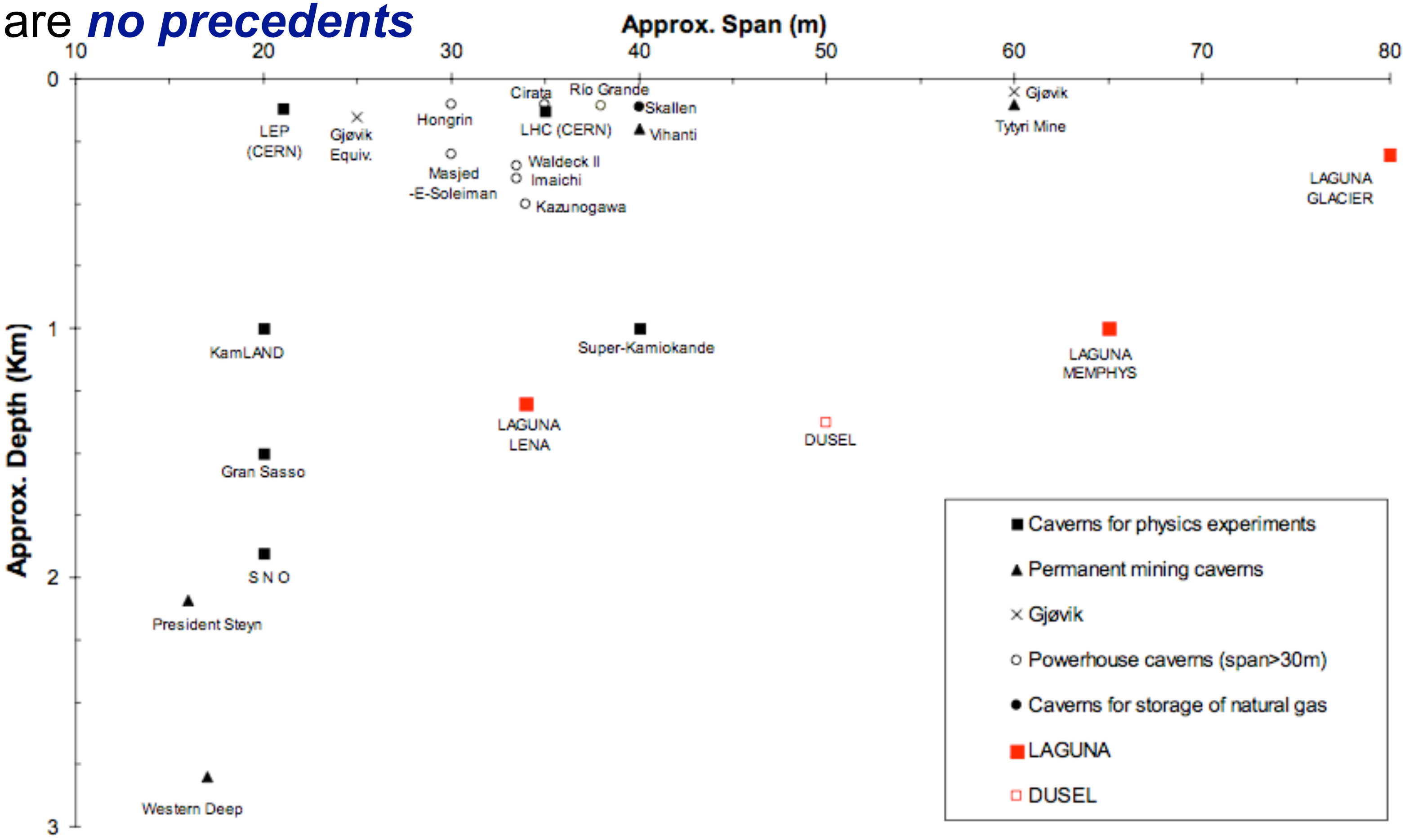


Figure 3.1-5. Scattered plot span vs. depth of permanent large caverns classified by use.

M. Romana: *"we are dealing with world record stuff"*

Conceptual support design I: MEMPHYS and GLACIER

There are ***no precedents***

Their big spans cannot be supported by conventional methods (cables < 20 m, bolts, shotcrete):

- Able to cope with rock stresses near excavation limits
- Able to cope with “minor” wedges (relative to big spans)
- Not able to cope with “major” wedges

A complete concrete roof vault is not considered

⇨ Go for a partial concrete structure to cope with eventual big wedges

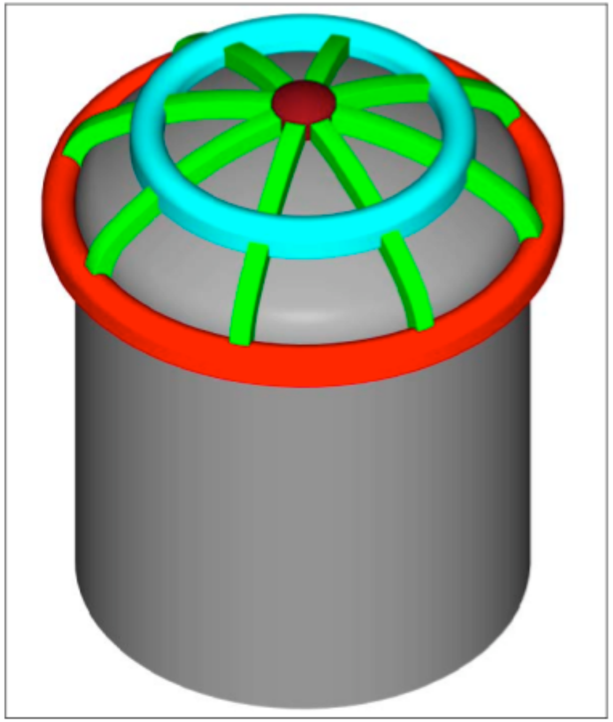


Figure 7.3-2. Perspective view of the vault system.

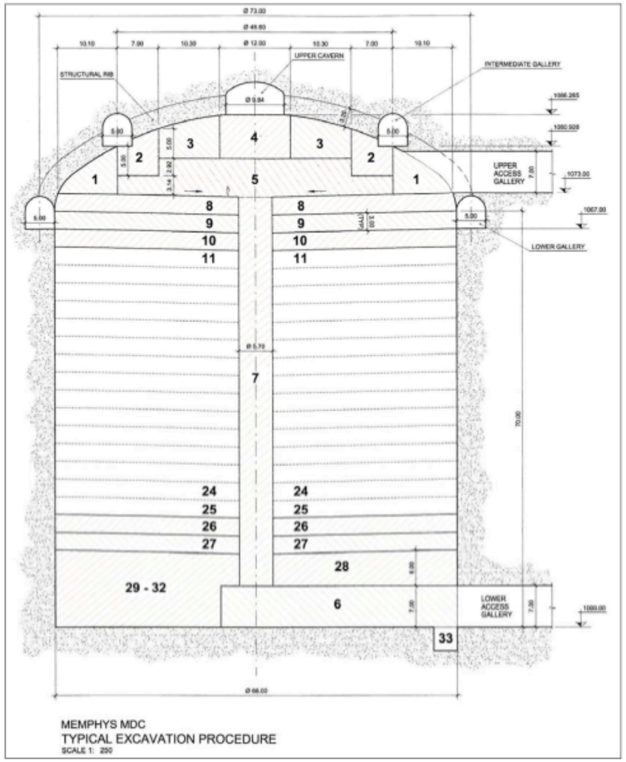


Figure 7.3-3. Excavation sequence for the MEMPHYS caverns.

Conceptual support design II: LENA

There are precedents: Mingtan cavern in weak rock (by *Hoek*)

1. Preliminary circular gallery excavated over the cavern

2. Support cables installed from the gallery before cavern excavation

3. Support completed with more cables, bolts and shotcrete during excavation

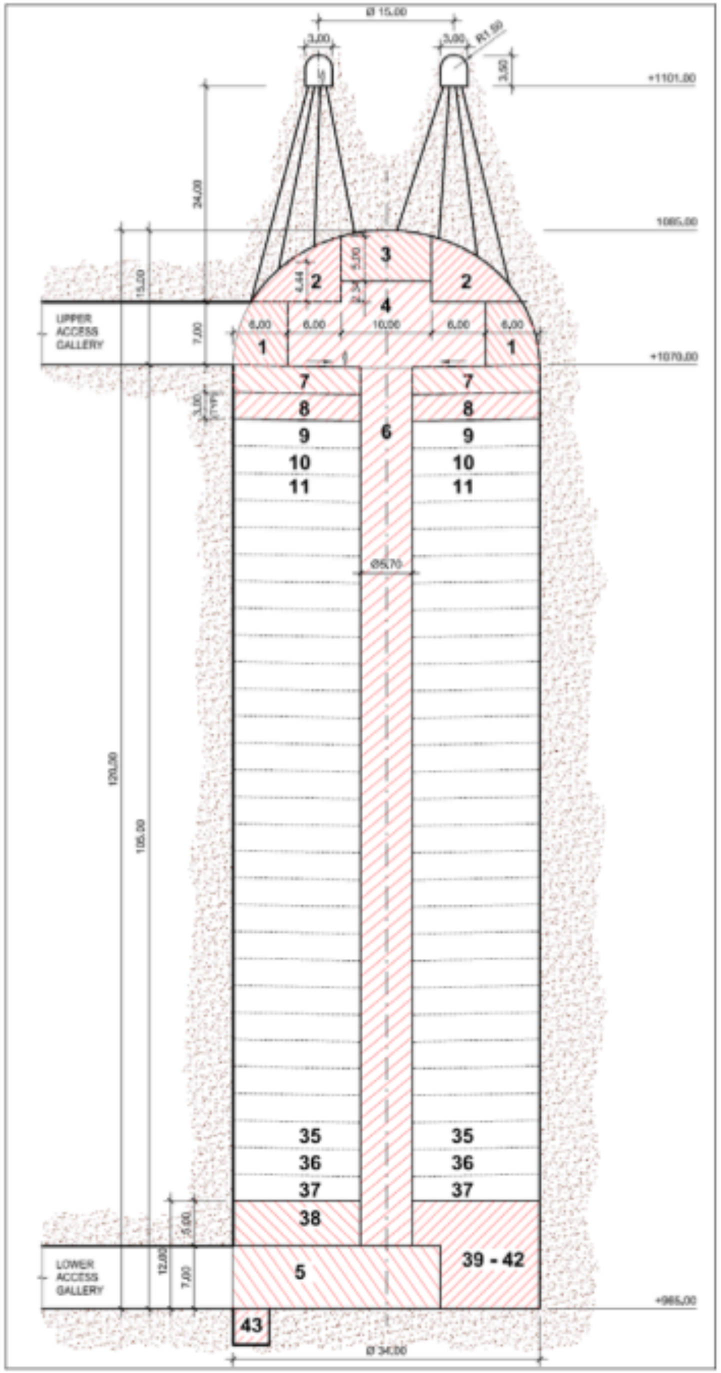
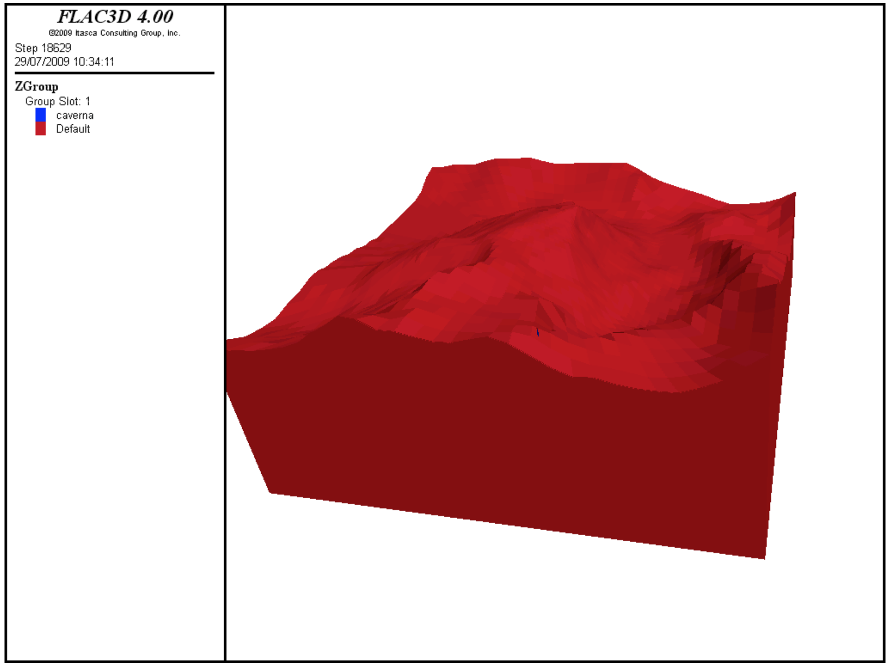
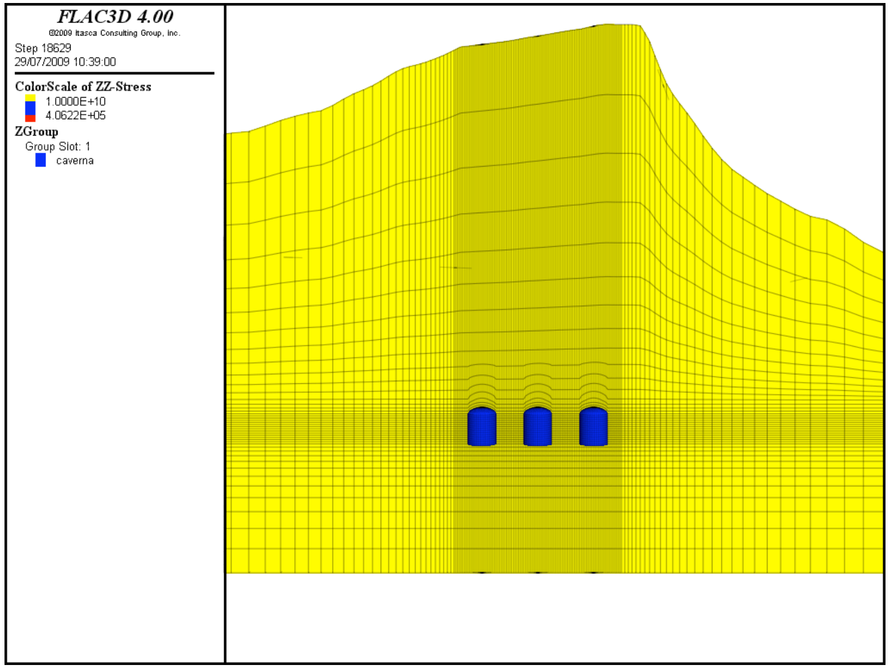


Figure 8.3-3. Excavation sequence for the LENA cavern.

First estimation of the caverns feasibility I:





Modelling / Calculations [elastic]

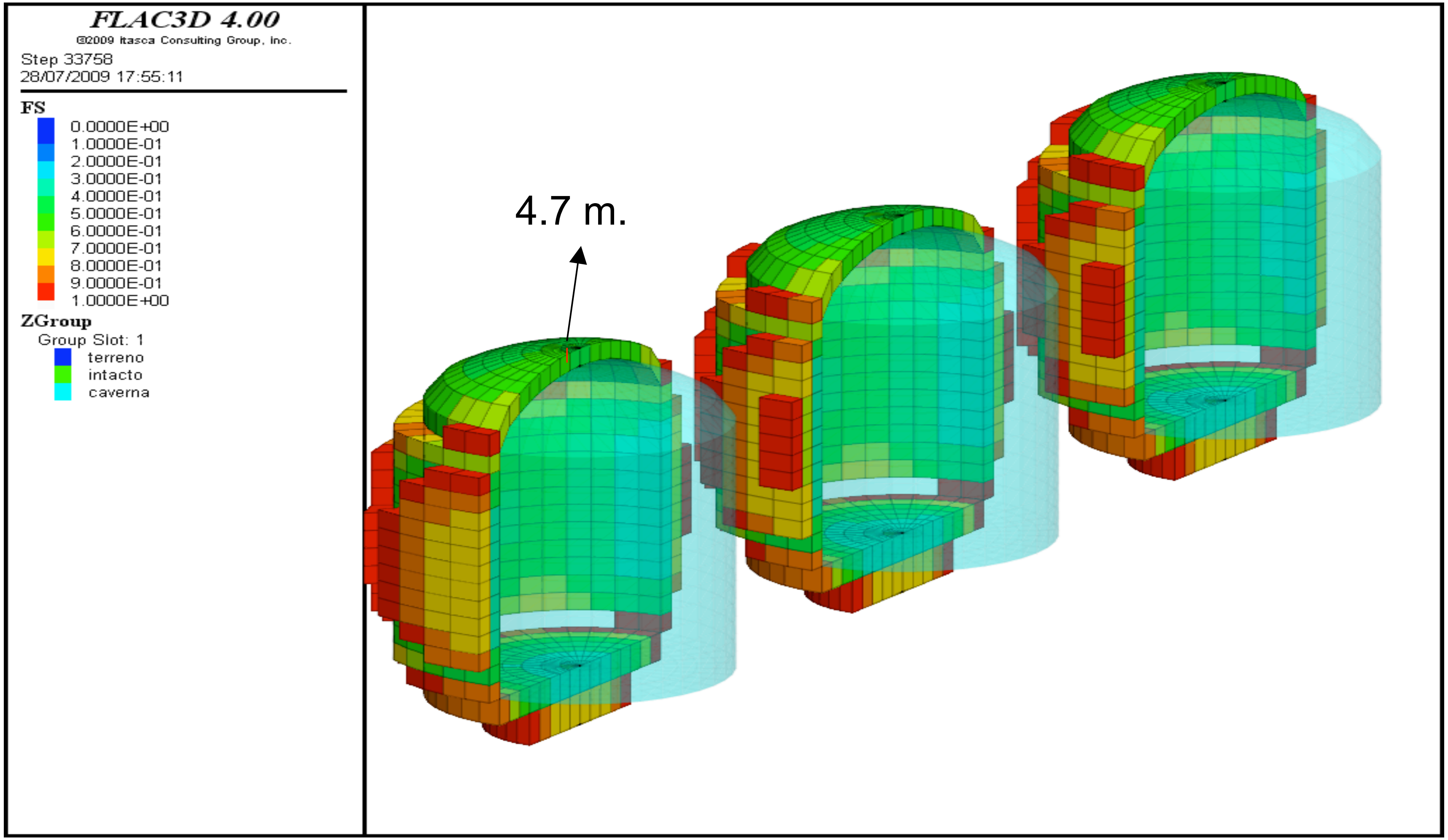
1. Check the effect of real topographic features

⇨ no significant effect

First estimation of the caverns feasibility II:

Modelling / Calculations [elastic]

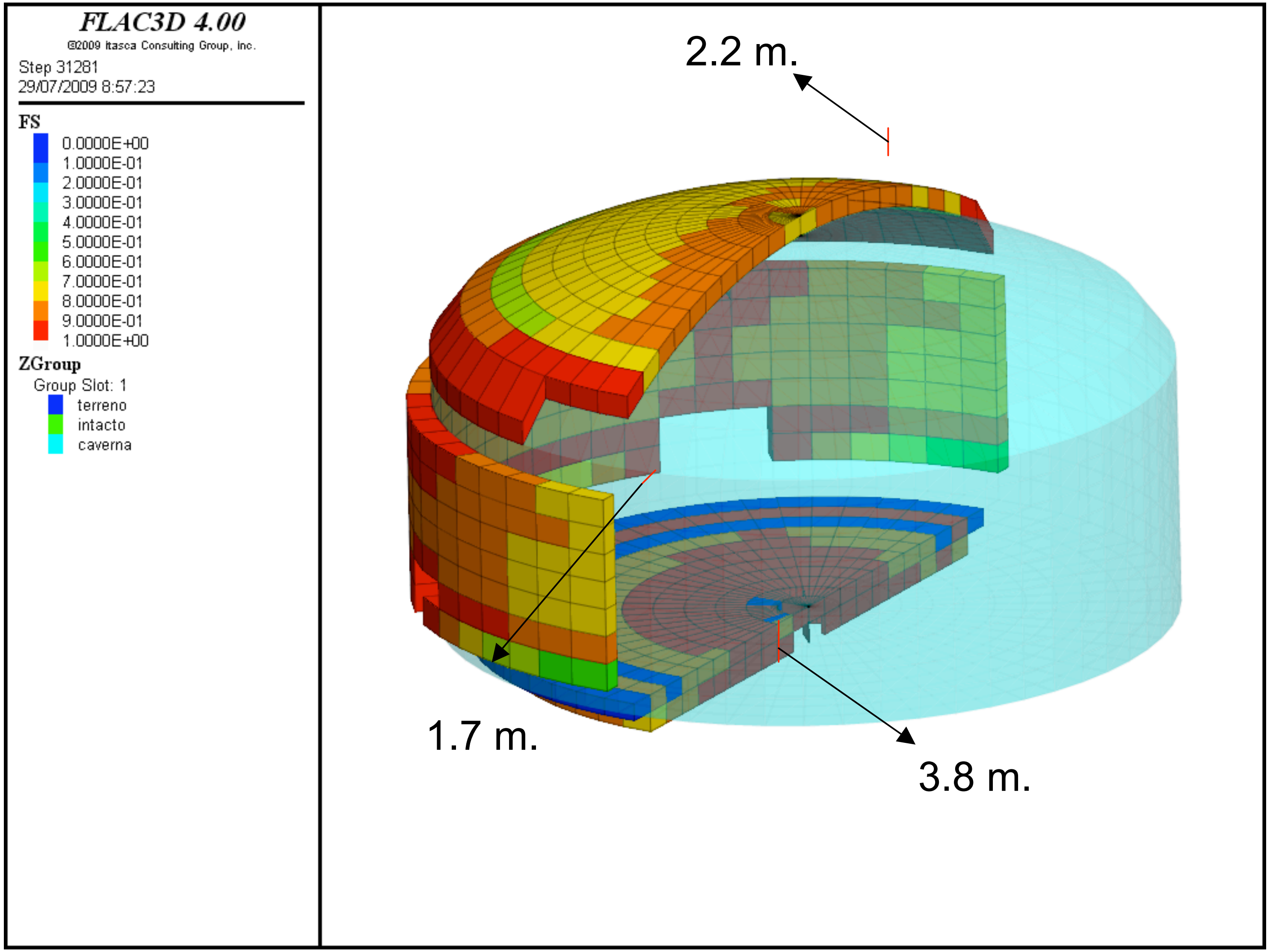
2. Three MENPHYS caverns; Plasticity Indicators ⇨ OK



First estimation of the caverns feasibility III:

Modelling / Calculations [elastic]

3. enormous GLACIER cavern; Plasticity Indicators ⇨ OK



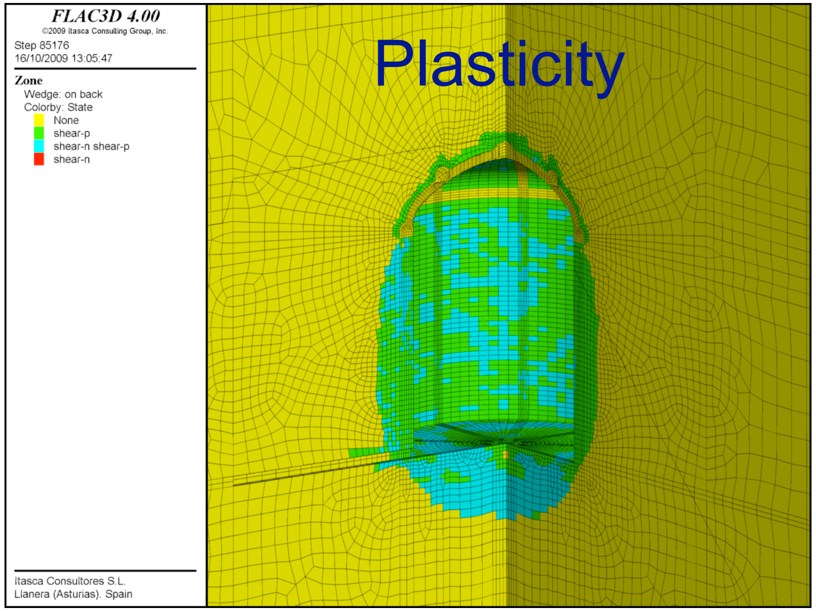
Realistic Calculation: **MENPHYS elasto-plastic modelling**

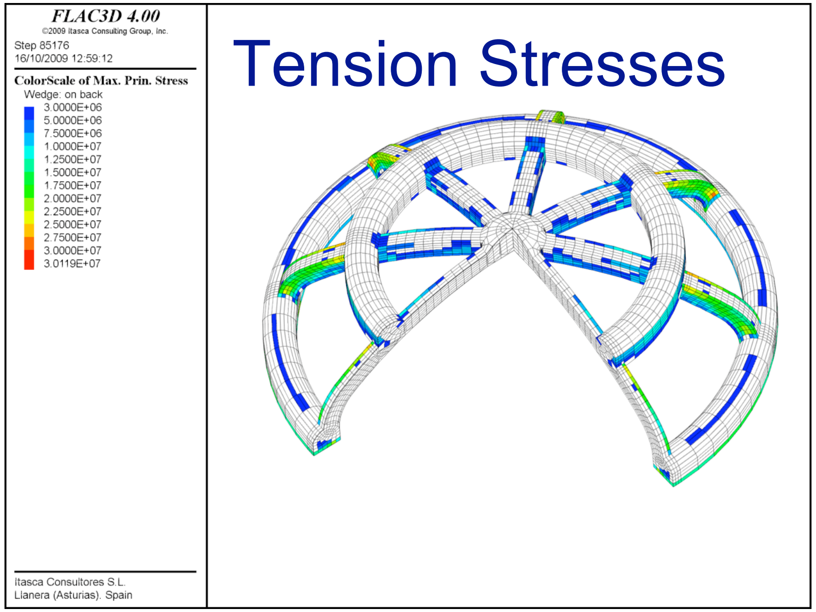
- Assumed worst rock conditions
- Almost all construction stages (slightly simplified)
- Three different behaviour laws for concrete
  - Elastoplastic
  - Brittle failure
  - Softening
- Two different concrete sequences
  - Prior to cavern excavation
  - By stages with cavern excavation
- Concrete needs some reinforcement in the roof lower gallery

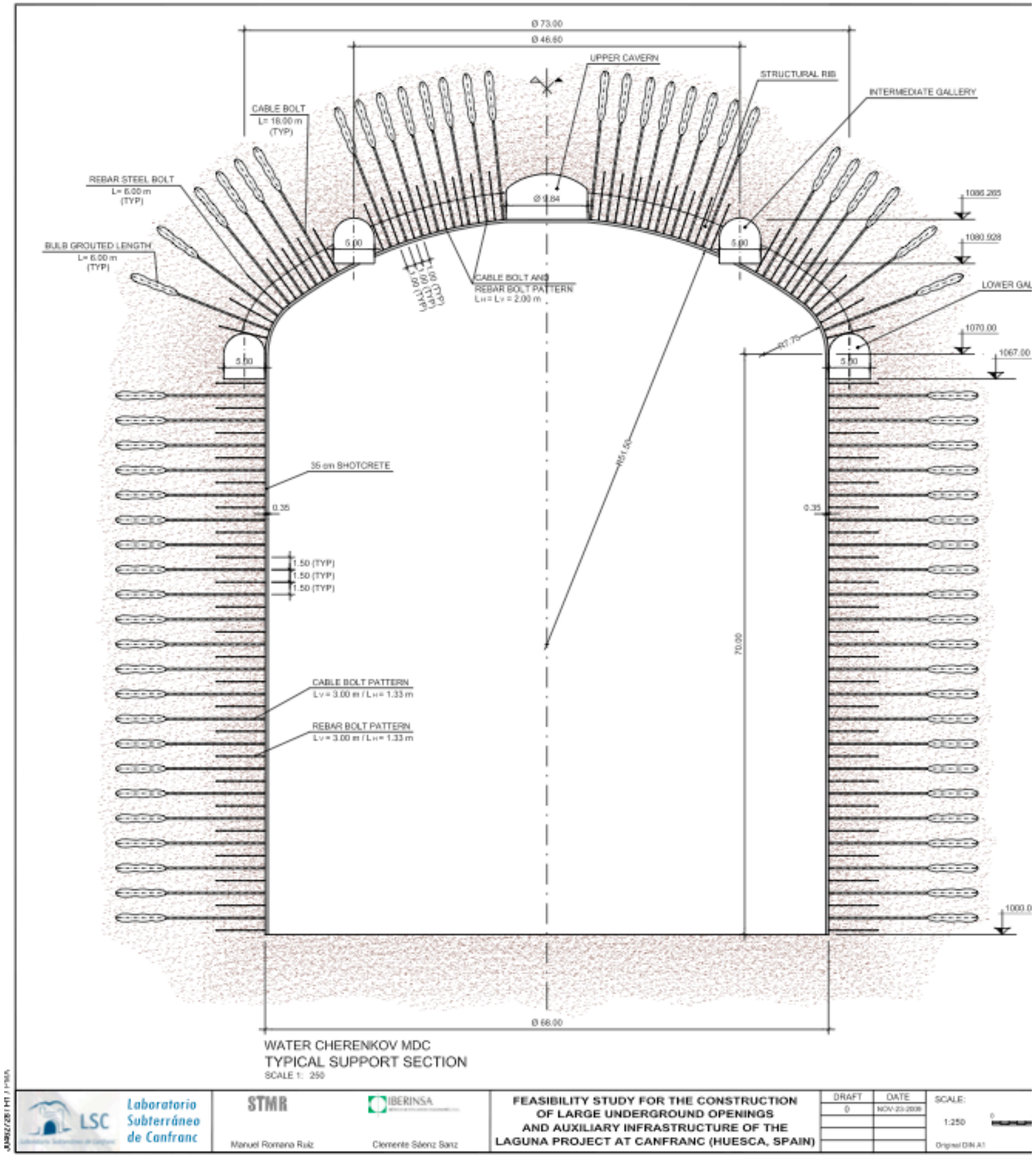
Elastic modelling studies allows us to extrapolate valid conclusions for LENA and GLACIER pre-designs

Example for illustration follows:

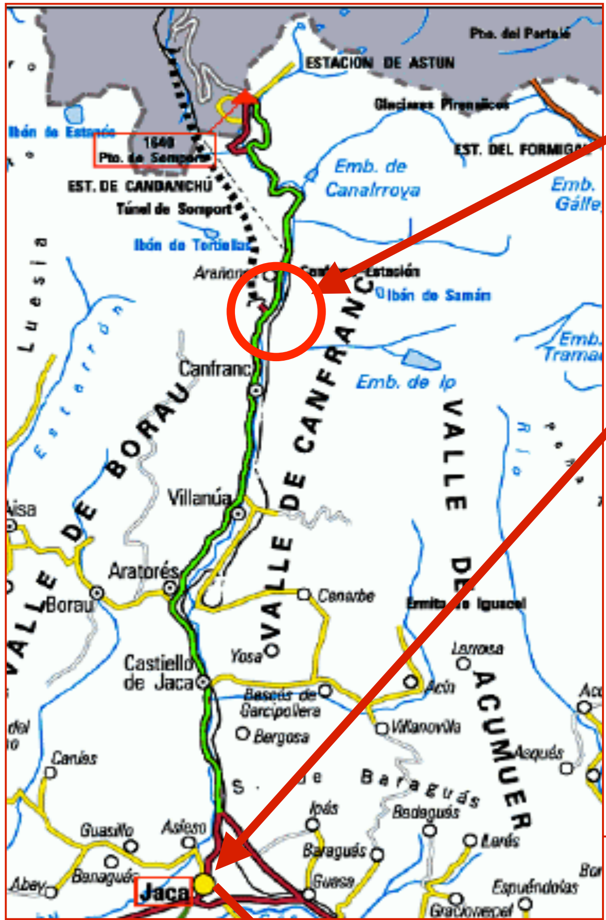
Pre-design after elasto-plastic structural calculations of one of the three MENPHYS detector' caverns







we even don’t forget (try to) that part of
our day-to-day life is outside physics ....



the LSC is in the middle-sized village of Canfranc

at 21 Km from the

old (~1097) but lively (~15000 inhab.) city of Jaca, that is well capable to provide all living services / needs

both with excellent road communications with all major Spanish cities, ports, airports etc.

also ...

How much would it cost ????

MEMPHYS

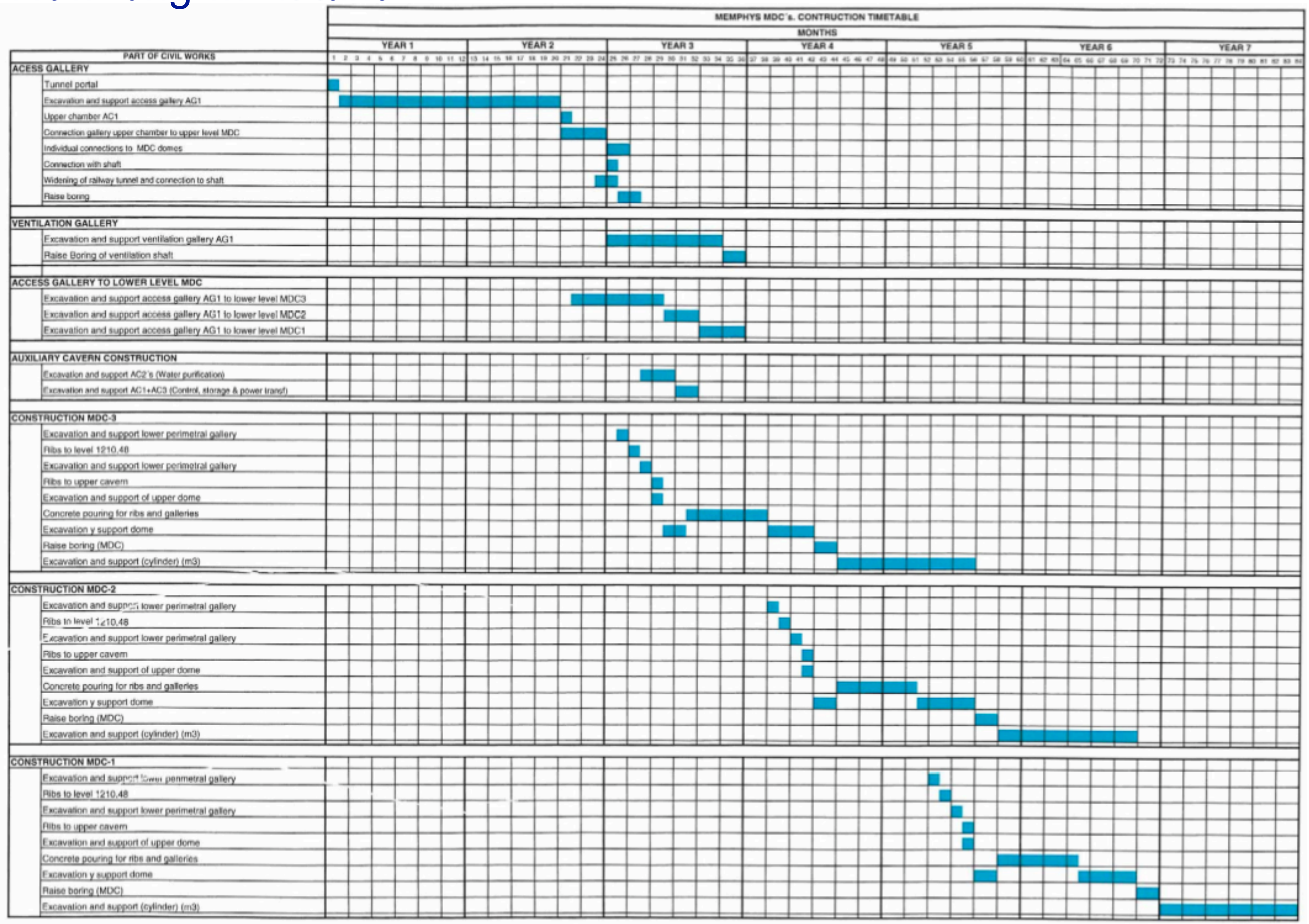
CHAPTER 1.- MDC EXCAVATION	
1.1 MDC EXCAVATION	70.600.064,33 €
1,2 MDC SUPPORT	40.095.850,77 €
PARTIAL CHAPTER 1 (euros)	110.695.915,10 €
CHAPTER 2.- ACCESS GALLERIES AND CAVERN EXCAVATIONS AND SUPPORT	
2,1 ACCESS GALLERIES	27.959.089,29 €
2,2 AUXILIARY CAVERNS	2.965.952,24 €
2,3 VENTILATION GALLERY AND SHAFT	7.301.460,87 €
PARTIAL CHAPTER 2 (euros)	38.226.502,40 €
CHAPTER 3.- INSTALLATIONS	
2,1 CONSTRUCTION INSTALLATIONS	641.750,00 €
2,2 UNDEGROUND INSTALLATIONS	9.993.420,00 €
2,3 SURFACE INSTALLATIONS	251.650,00 €
PARTIAL CHAPTER 3 (euros)	10.886.820,00 €
CHAPTER 4.- ENVIRONMENTAL MANAGEMENT	
4,1 ENVIRONMENTAL MANAGEMENT	700.000,00 €
PARTIAL CHAPTER 4 (euros)	700.000,00 €
CHAPTERS 1 TO 4 (euros)	160.509.237,50 €
HEALTH AND SAFETY	2.407.639,00 €
UNDERGROUND MONITORING	481.528,00 €
FURTHER SUBSOIL EXPLORATION	1.029.354,00 €
DETAILED DESIGN AND PROFESSIONAL ASSOCIATION FEES	2.639.910,76 €
TOTAL CONSTRUCTION COST	167.067.669,26 €
13% OVERHEAD EXPENSES	21.718.797,00 €
6% INDUSTRIAL PROFIT	10.024.060,16 €
TOTAL CONTRACTOR BUDGET	198.810.526,42 €
16% VAT	31.809.684,23 €
TOTAL TENDER COST	230.620.210,65 €

GLACIER

CHAPTER 1.- MDC EXCAVATION	
1.1 MDC EXCAVATION	14.900.941,42 €
1,2 MDC SUPPORT	9.381.232,69 €
PARTIAL CHAPTER 1 (euros)	24.282.174,11 €
CHAPTER 2.- ACCESS GALLERIES AND CAVERN EXCAVATIONS AND SUPPORT	
2,1 ACCESS GALLERIES	17.128.604,17 €
2,2 AUXILIARY CAVERNS	1.182.241,56 €
2,3 VENTILATION GALLERY AND SHAFT	8.151.843,43 €
PARTIAL CHAPTER 2 (euros)	26.462.688,17 €
CHAPTER 3.- INSTALLATIONS	
2,1 CONSTRUCTION INSTALLATIONS	641.750,00 €
2,2 UNDEGROUND INSTALLATIONS	6.213.500,00 €
2,3 SURFACE INSTALLATIONS	251.650,00 €
PARTIAL CHAPTER 3 (euros)	7.108.900,00 €
CHAPTER 4.- ENVIRONMENTAL MANAGEMENT	
4,1 ENVIRONMENTAL MANAGEMENT	620.000,00 €
PARTIAL CHAPTER 4 (euros)	620.000,00 €
CHAPTERS 1 TO 4 (euros)	68.471.763,28 €
HEALTH AND SAFETY	877.076,00 €
UNDERGROUND MONITORING	233.887,00 €
FURTHER SUBSOIL EXPLORATION	817.812,40 €
DETAILED DESIGN AND PROFESSIONAL ASSOCIATION FEES	1.269.035,27 €
TOTAL CONSTRUCTION COST	61.469.373,95 €
13% OVERHEAD EXPENSES	7.991.018,81 €
6% INDUSTRIAL PROFIT	3.688.162,44 €
TOTAL CONTRACTOR BUDGET	73.148.555,00 €
16% VAT	11.703.768,80 €
TOTAL TENDER COST	84.852.323,80 €

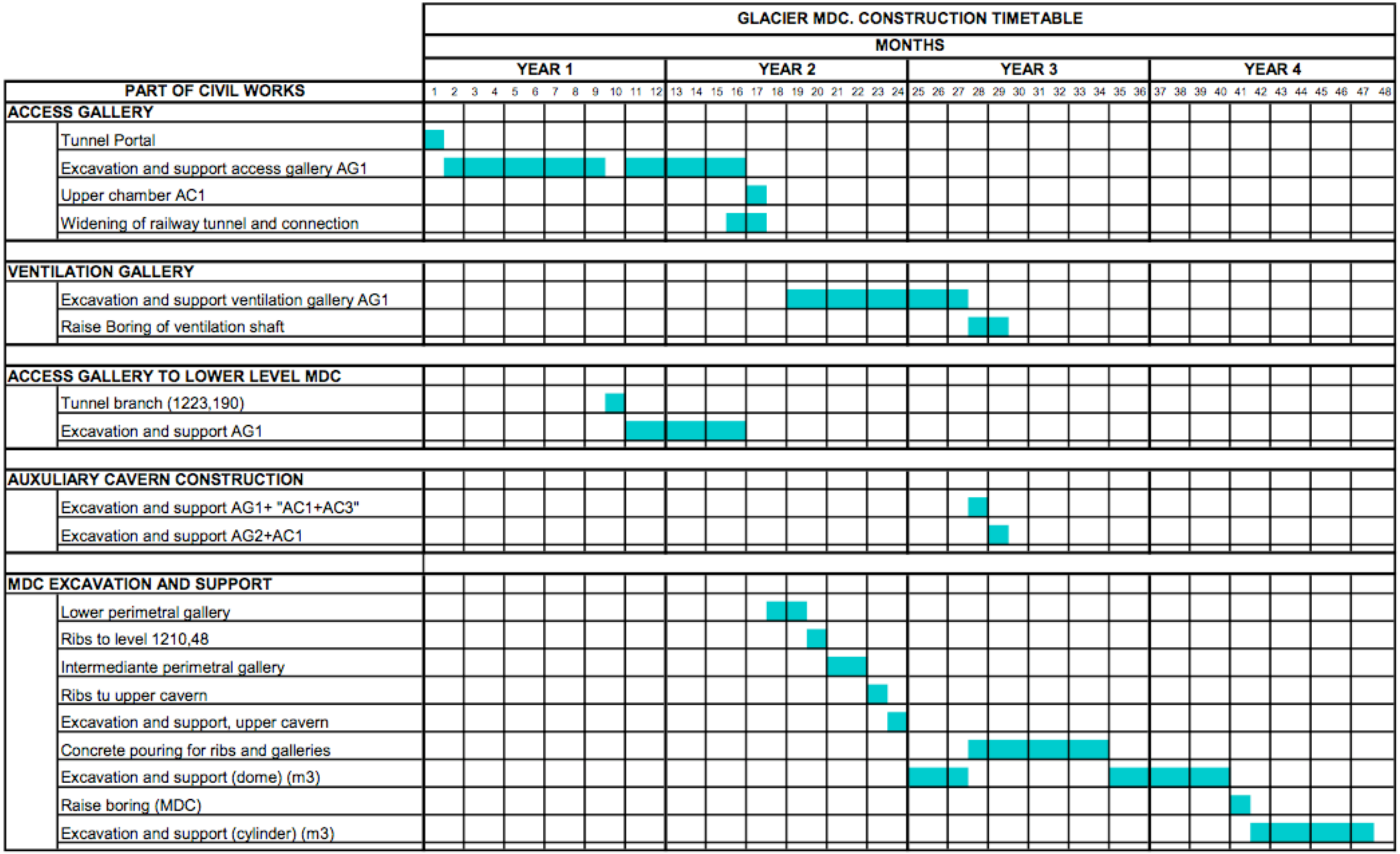
How long will it take ????

MEMPHYS



How long will it take ????

GLACIER



recapitulating:

- A very detailed feasibility study for LAGUNA at the LSC has been performed with positive results

  LAGUNA-WP2's "*Interim Report for the LSC*"
  [http://www.lsc-canfranc.es/ → *activity* → *LAGUNA*]

- Many items have not been presented here due to lack of time (in particular installations and auxiliary infrastructures). Please have a look to the above documents

- The Canfranc area is excellent to provide the social / living needs of the people forming a large Collaboration like LAGUNA

The LSC is found to be very well suited to locate any of the LAGUNA experiments

But, certainly, the important stuff is the experiment … ↲

… and much work is yet to be done to *solve* the master equation:

technology + *location* + **beam** =

excellent-physics

… *and* to *execute* its solution [… solution and execution are rather correlated issues …]

LAGUNA-LBNO

FP7-INFRASTRUCTURES-2011-1

Design Study (CP) proposal
[LAGUNA-LBNO]

COLLABORATIVE PROJECT

Design Study

FP7-INFRASTRUCTURES-2011-1

Proposal title (max 200 characters)	**Design of a pan-European Infrastructure for Large Apparatus studying Grand Unification, Neutrino Astrophysics and Long Baseline Neutrino Oscillations**
Proposal acronym	**LAGUNA-LBNO**
Type of funding scheme	RI Design study implemented as Collaborative Project
Work programme topics addressed	Deep underground science, particle physics, astroparticle physics, long baseline neutrino oscillations

Coordinating person: Prof. André Rubbia
E-mail: rubbia@ethz.ch
Phone: +41 44 633 3873

November 2010

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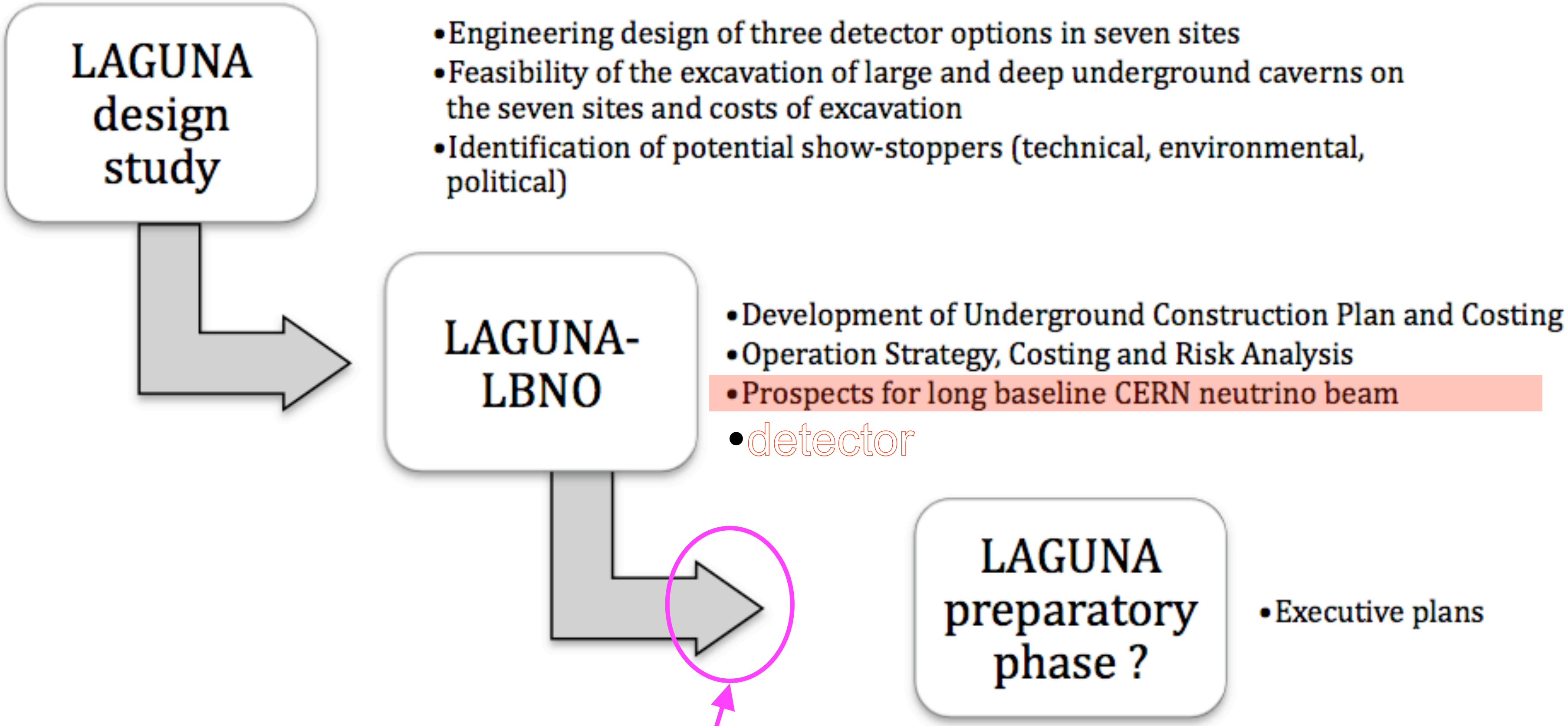


Figure 4: Graded strategy towards the technical definition of the LAGUNA project.

The goal is to be here in the position of submitting a firm proposal to the National Funding Agencies for the full realization of the LAGUNA experiment

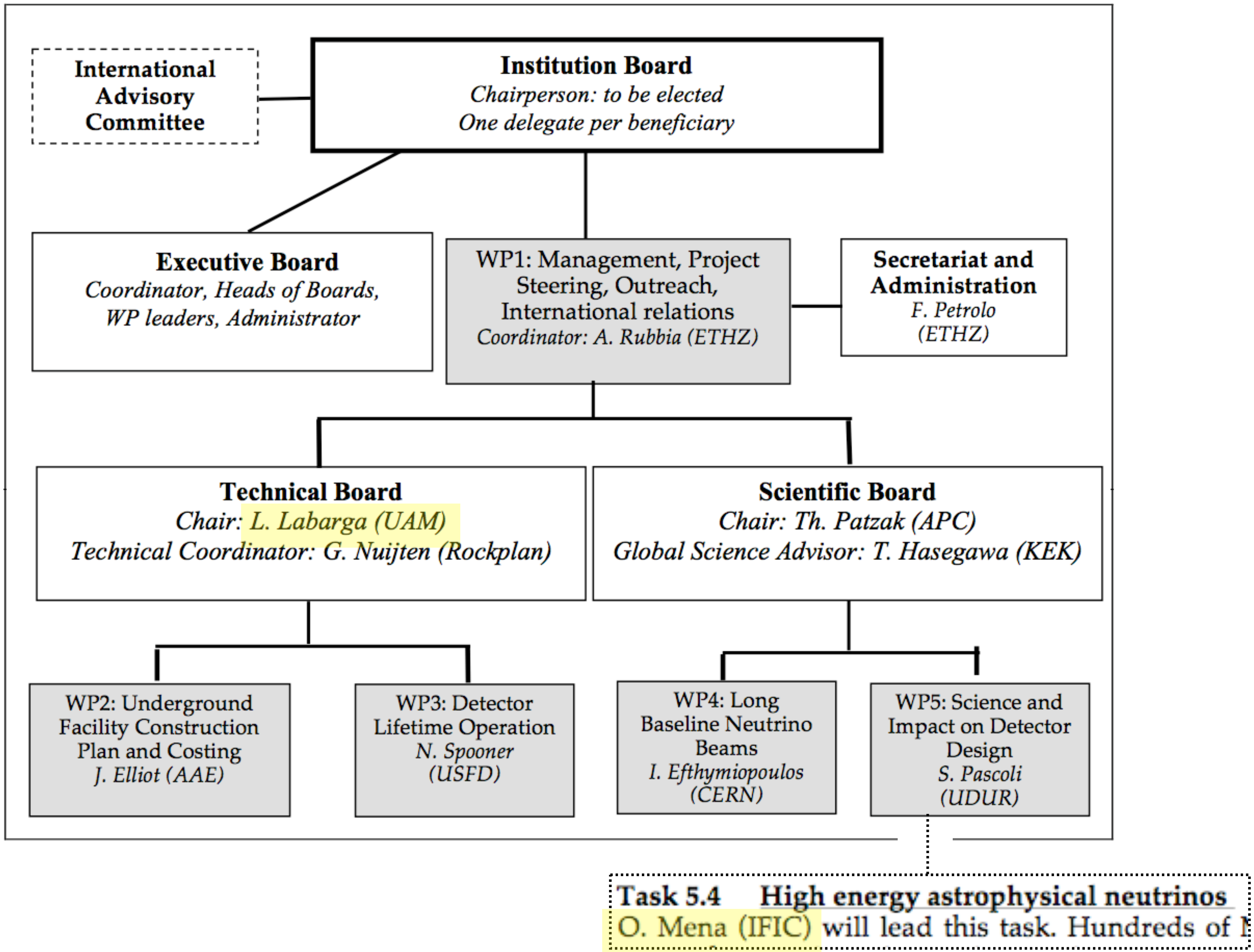
Beneficiary no.	Beneficiary name	Beneficiary short name	Country
1.	Swiss Federal Institute of Technology Zurich	ETH Zurich	Switzerland
2.	University of Bern	U-Bern	Switzerland
3.	University of Geneva	UNIGE	Switzerland
4.	Lombardi Engineering Limited	Lombardi	Switzerland
5.	EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH	CERN	International Organisation
6.	University of Jyväskylä	U-Jyväskylä	Finland
7.	University of Helsinki	UH	Finland
8.	University of Oulu	UOULU	Finland
9.	Kalliosuunnittelu Oy Rockplan Ltd	Rockplan	Finland
10.	Commissariat à l'Energie Atomique / Direction des Sciences de la Matière	CEA	France
11.	Institut National de Physique Nucléaire et de Physique des Particules (CNRS/IN2P3)	IN2P3	France
12.	Technische Universität München	TUM	Germany
13.	Hamburg University	UHAM	Germany
14.	H.Niewodniczanski Institute of Nuclear Physics of the Polish Academy of Sciences, Krakow	IFJ PAN	Poland
15.	IPJ Warsaw	IPJ	Poland
16.	Wroclaw University of Technology	WrUT	Poland
17.	KGHM CUPRUM	KGHM	Poland
18.	Laboratorio Subterraneo de Canfranc	LSC	Spain
19.	Universidad Autonoma, Madrid	UAM	Spain
20.	Consejo Superior de Investigaciones Científicas	CSIC	Spain
21.	ACCIONA INGENIERÍA & STMR	ACCIONA	Spain
22.	Imperial College London	ICL	United Kingdom
23.	University of Durham	UDUR	United Kingdom
24.	The University of Oxford	U-Oxford	United Kingdom
25.	The University of Liverpool	U-Liverpool	United Kingdom
26.	The University of Sheffield	USFD	United Kingdom
27.	RAL	RAL	United Kingdom
28.	The University of Warwick	U-Warwick	United Kingdom
29.	Technodyne International Ltd	Technodyne	United Kingdom
30.	Alan Auld Engineering Ltd.	AAE	United Kingdom
31.	Rhyal Engineering Ltd	REL	United Kingdom
32.	Sofregaz	SOFREGAZ	France
33.	AGT Ingegneria Srl, Perugia	AGT	Italy
34.	Institute of Nuclear Technology of Demokritos	DEMOKRITOS	Greece
35.	Horia Hulubei Institute of &D Physics and Nuclear Engineering, Bucharest and partners	IFIN-HH	Romania
36.	University of Bucharest	UoB	Romania
37.	Institute for Nuclear Research, Moscow	INR	Russia
38.	Petersburg Nuclear Physics Institute	PNPI	Russia
39.	High Energy Accelerator Research Organization	KEK	Japan

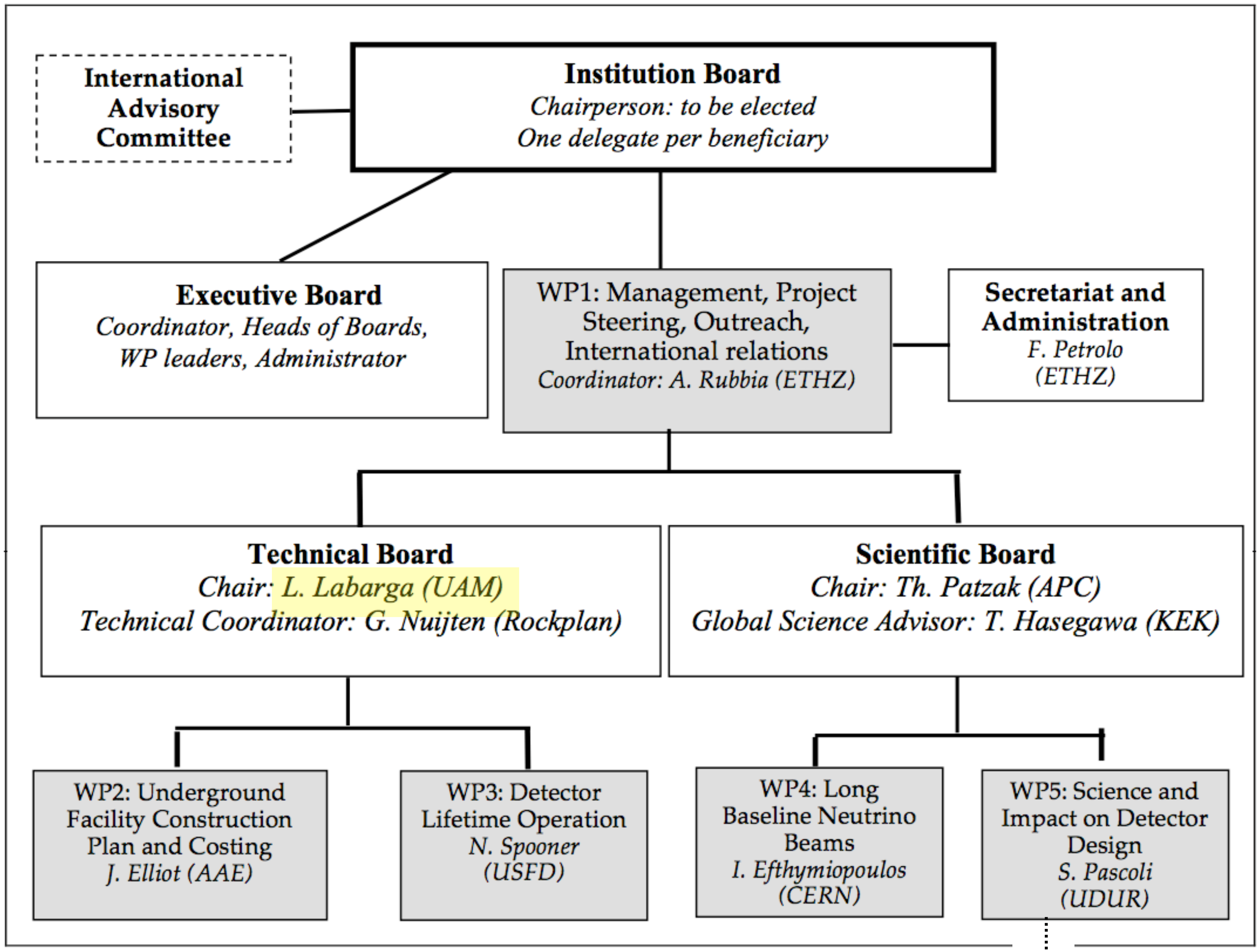
new Members Incorporated

⇨ Spain:
IFIC, ACCIONA-ING/STMR

⇨ Consortium (most relevant):
CERN !¡, KEK

Italy (INFN) is not yet in (i!)


International Advisory Committee
Institution Board
Chairperson: to be elected
One delegate per beneficiary
Executive Board
Coordinator, Heads of Boards, WP leaders, Administrator
WP1: Management, Project Steering, Outreach, International relations
Coordinator: A. Rubbia (ETHZ)
Secretariat and Administration
F. Petrolo (ETHZ)
Technical Board
Chair: L. Labarga (UAM)
Technical Coordinator: G. Nuijten (Rockplan)
Scientific Board
Chair: Th. Patzak (APC)
Global Science Advisor: T. Hasegawa (KEK)
WP2: Underground Facility Construction Plan and Costing
J. Elliot (AAE)
WP3: Detector Lifetime Operation
N. Spooner (USFD)
WP4: Long Baseline Neutrino Beams
I. Efthymiopoulos (CERN)
WP5: Science and Impact on Detector Design
S. Pascoli (UDUR)
Task 5.4 High energy astrophysical neutrinos
O. Mena (IFIC) will lead this task. Hundreds of



Task 5.4 High energy astrophysical neutrinos

O. Mena (IFIC) will lead this task. Hundreds of

there we are ...