

ILIAS 4th Annual Meeting  
February 26th-28th, 2007  
Chambery, France

# ILIAS: Safety and Outreach in the European Deep Labs



Chiara Vignoli  
(INFN Pavia - Italy)

on behalf of the ILIAS N2-WP2 and ILIAS N2-WP3 Groups

# ILIAS: N2/DUSL networking activity

Coordinator: N. Spooner

## WP1. Performance, improvement and extensions of deep underground labs

Provision of higher quality environments and operational support to users, via coordination of site assignment and improvements on basic equipment, technical and logistic support, access and communication

## WP2. Safety issues

Improve health and safety issues, via exchange of best practice experience, progressing to a common approach on safety procedures specific to underground sites

## WP3. Communication, outreach, scientific coordination

- Stimulate coordination and promotion of Underground Science within the field across all the sites.
- Improve the quality of public communication of Underground Science activities to European citizens by exploiting together best practices in the field.
- Scientific coordination among all labs

# **ILIAS: Safety in the European Deep Labs**

# N2-WP2 Group

## WP2 members:

lab safety officers + collaborators

- Roberto, Matthias, Chiara\* (LNGS)
- Alfonso, José (LSC)
- Michel, Thierry (LSM)
- Jamie, Sean (IUS)
- Timo, Juha (CUPP) [later]
- \* coordinator, INFN Pavia



## WP2. Safety issues

Improve health and safety issues, via exchange of best practice experience, progressing to a common approach on safety procedures specific to underground sites

	LNGS Gran Sasso	LSC Canfranc	LSM Modane	CUPP Pyhäsalmi	IUS Boulby
<b>Location</b>	Motorway tunnel	Road tunnel	Road tunnel	Mine	Mine
<b>Depth</b>	1400 m	900 m	1750 m	≤ 1440 m	1100 m
<b>Access</b>	horizontal	horizontal	horizontal	"vertical"	vertical

# Overview

- These 5 labs have similar characteristics
  - **confined location (deep underground)**
  - **typology of the experimental plants hosted inside (cryogenes, scintillators, ...)**
  - **special boundary conditions (tunnel or mine)**
  - **safety aspects**
    - **Access protocol**
    - **Dedicated infrastructures and lab utilities**
    - **Experimental plant approval, commissioning, run and decommissioning**
    - **Special material storage and handling**
    - **Safety management and equipments**
    - **Fire risks and prevention**
    - **Emergency events**
    - **Evacuation plans**
- interesting to proceed towards a joint safety and training strategy
- In particular for the specific boundary conditions it is useful and more suitable to subdivide the five labs into two groups in order to even more specialize the safety and training approach as regard access protocol, evacuation and emergency procedures:
  1. the 3 "tunnel" labs (LSM, LSC, LNGS)
  2. the 2 "mine" labs (IUS and CUPP)
  - **possible interference (accidents, fire, ..) [as in the case of the Fréjus accident]**
    - v strict collaboration between the lab and tunnel/mine authority (evacuation plan)

# Overview

- Cooperation among the labs is particularly important as **from experience and lessons learned from mistakes or accidents it is possible to work toward a better safety quality of all the labs**
  - LNGS liquid spillage accident (August 2002)
  - Gran Sasso tunnel small accident (May 2004)
  - Fréjus road tunnel fire accident (June 2005)
- In particular **experience exchange and cooperation was/is important for lab upgrades and extensions**
  - **Recent upgrades**
    - IUS Boulby: « JIF » area (1000 m<sup>2</sup>)
    - New Canfranc facility
    - LNGS big civil works for safety improvements
  - **Future extensions**
    - Possible extensions for experiment demand of underground space in particular for neutrino physics, proton decay but also DM, DBD,...
      - CUPP (any extension)
      - Boulby
      - LSM (first step: safety tunnel approval already achieved)
      - LNGS (new location outside the motorway tunnel @ shallow depth) ?
    - Towards a Large International Underground Laboratory ?

- End 2004 Start of the work with the preparation and distribution of the different lab descriptions and Safety documents to the WP2 members:
- not uniform documentation, difficult to make comparisons among the various labs.
- Jan 2005 idea to have as soon as possible a detailed comparison table of the lab characteristics and specific key questions on safety and management to
- speed-up the exchange of information
  - compare all the lab characteristics and safety aspects
  - understand common and not common aspects
  - start the discussion and collaboration
  - identify weak points and possible interventions
- Feb 2005 **First version of the comparison table (13 pages Word doc)**
- very useful tool
  - but only the starting point...

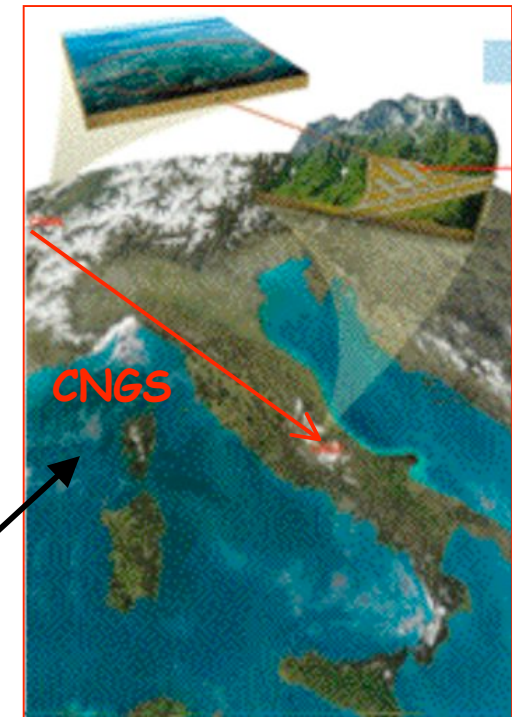
√ **necessity lab visit and working meetings to discuss on specific items**

	LNGS	LSC	LSM	Boulby	CUPP
<b>Opening</b>	1987	1986 old lab, 1995 extension 2006 new lab	1982	1993 old mine 2001 new mine	1989
<b>Location</b>	Highway tunnel 10.2 km long, 4.5 km from tunnel entrance	Road tunnel 8 km long, 2.5 km from tunnel entrance	Road tunnel 13 km long, 6.2 km from entrance	Operational mine 1100 m below ground	Operational mine down to 1440 m
<b>Depth/altitude</b>	1400 m (3700 mwe) under Aquila mountain + 1000 m a.s.l.	900 m (2450 mwe) under Tobazo mountain + 1080 m a.s.l.	1750 m (4800 mwe) under Fréjus mountain + 1263 m a.s.l.	1100 m (2800 mwe) below ground - 1000 m a.s.l.	Several levels: Bottom 1440 m below ground (4100 mwe) + 200 m a.s.l.
<b>Access type</b>	horizontal access	horizontal access	horizontal access	vertical by lift	vertical/lift and by decline
<b>Surface/Volume</b>	13500m <sup>2</sup> /180000m <sup>3</sup>	1500 m <sup>2</sup> /10720m <sup>3</sup>	500m <sup>2</sup> /3500m <sup>3</sup>	>1500m <sup>2</sup> /3000m <sup>3</sup>	Several possible sites
<b>Lab description</b>	3 main halls about 100Lx20Wx15H m <sup>3</sup> + interconnecting and service tunnels.	Main hall (40x15x11 m <sup>3</sup> ), low-background lab (15x10x8 m <sup>3</sup> ) + 1000 m <sup>2</sup> of services tunnels.	One main hall (30Lx10Wx11H m <sup>3</sup> ) + 3 additional rooms (70m <sup>2</sup> , 18m <sup>2</sup> , 21m <sup>2</sup> ).	2 areas: the JIF is the main one (>1000 m <sup>2</sup> ) and it is running as a clean room.	Small- or medium-size caverns at several depths.
<b>Temperature</b>	7-9 °C	10 °C	24-28 °C	28+/-2 °C	18-23 °C
<b>Experimental research</b>	DM, $\beta\beta$ , $\nu$ , p decay, Low Activity measures	DM, --	DM, $\beta\beta$ , Low Activity measurements	DM	EMMA - muons and CRs
<b>Lab users</b>	≈ 700	≈ 50	≈ 100	≈ 30	6
<b>Local team</b>	≈ 70	To be defined	8 11	3	1-2

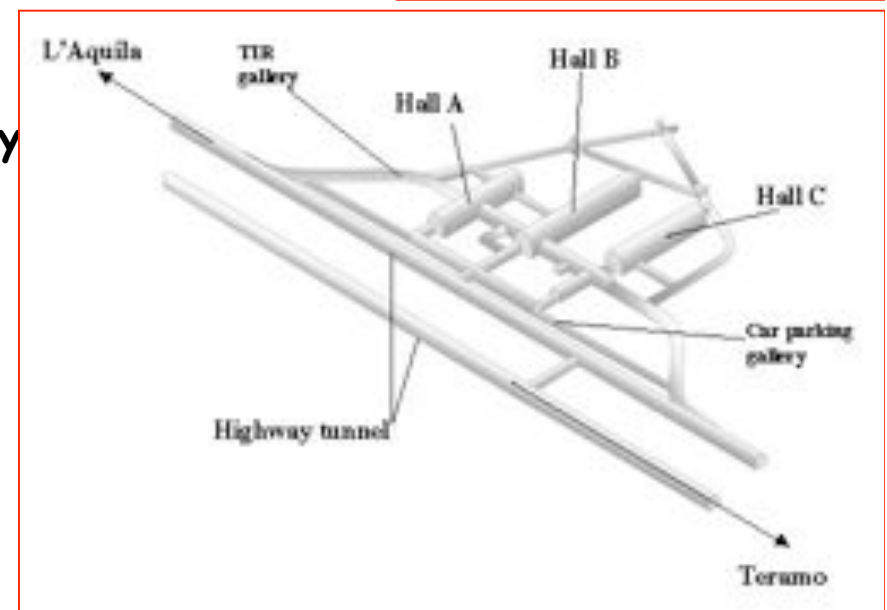


# LNGS: Laboratori Nazionali del Gran Sasso (ITALY)

- **Biggest underground lab in the world, opened in 1987**
- Highway tunnel: 2 independent tunnels, each 10.2 km long (4.5 km from the tunnel entrance)
- **1400 m deep** under Aquila Mountain, +1000 m a.s.l.
- 13500 m<sup>2</sup>, 180000 m<sup>3</sup>, 3 big halls (100x20x15 m<sup>3</sup> each)
- **Many experimental plants on all the underground researches (DM, Neutrinos, DBD p decay, ...), some examples:**
  - New DM experiments
  - Second generation experiments under completion (BOREXINO, OPERA, ICARUS T600, CUORICINO)
  - **CNGS experiments (CERN-Gran Sasso neutrino beam)**

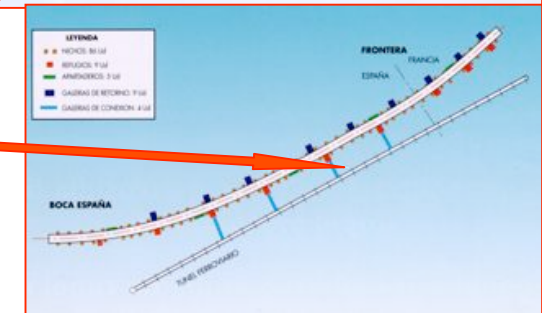
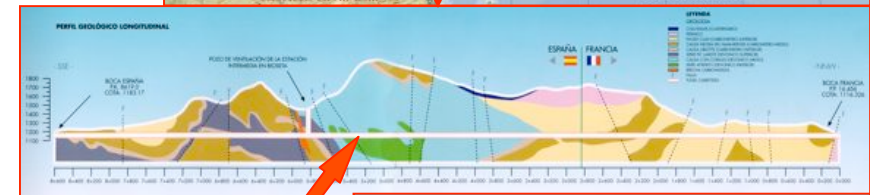


- **Big civil works just completed strongly improved lab safety**
  - upgrade of ventilation system/redundancy
  - new fire compartments
  - upgrade of cooling system
  - upgrade of power supply
- **and to prevent environmental pollution (safety of the water system)**
  - floor leak-proofing and containment
  - liquid spillage storage

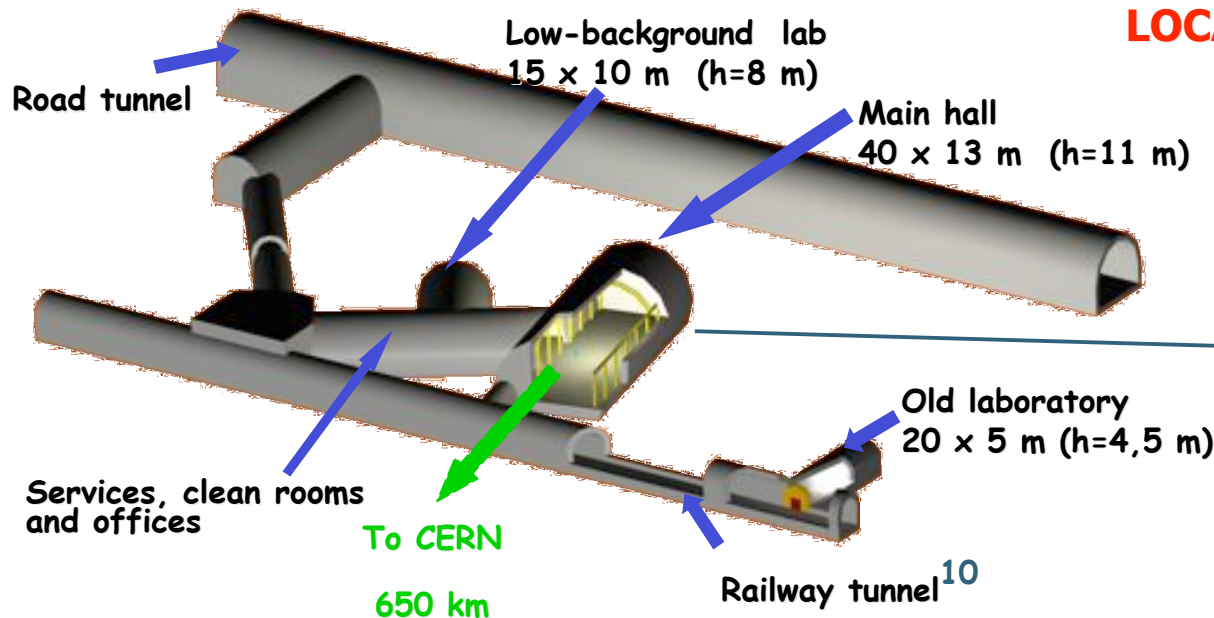


# LSC: Laboratorio Subterráneo de Canfranc (SPAIN)

- Old lab: since 1985 experiments were performed in several locations in the railway tunnel (small halls and mobile cabins) + dedicated hall (1995 onwards)
- New lab: start of the civil works of the new facility during Summer 2004. Official opening: March 27th, 2006
  - 800 m deep
  - 1500 m<sup>2</sup>/10720m<sup>3</sup>
  - Somport Road tunnel, 8 km long
  - Independent access (by pass) 3,5 Km from the road tunnel entrance
  - **Railway tunnel as emergency exit** (2,5 Km from the railway tunnel entrance) and material transport
- Experiment proposal and selection ongoing



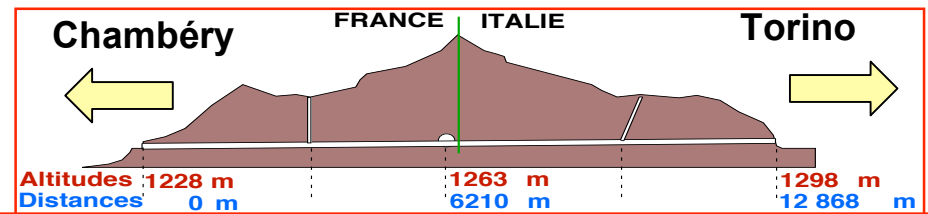
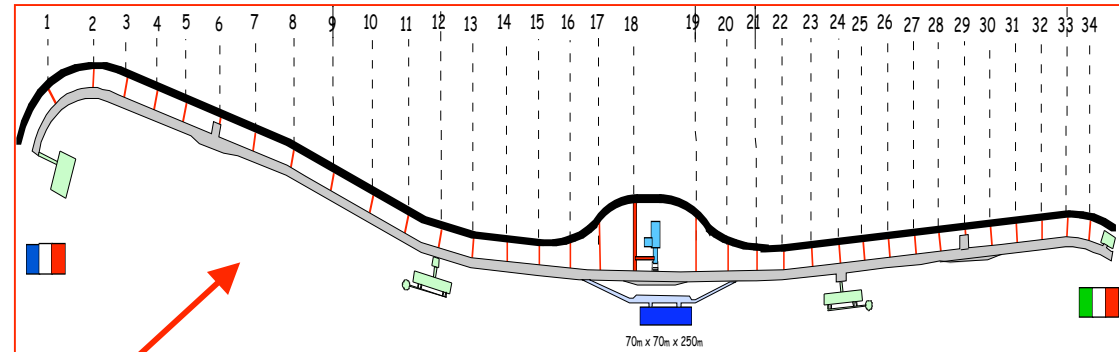
**LAB  
LOCATION**



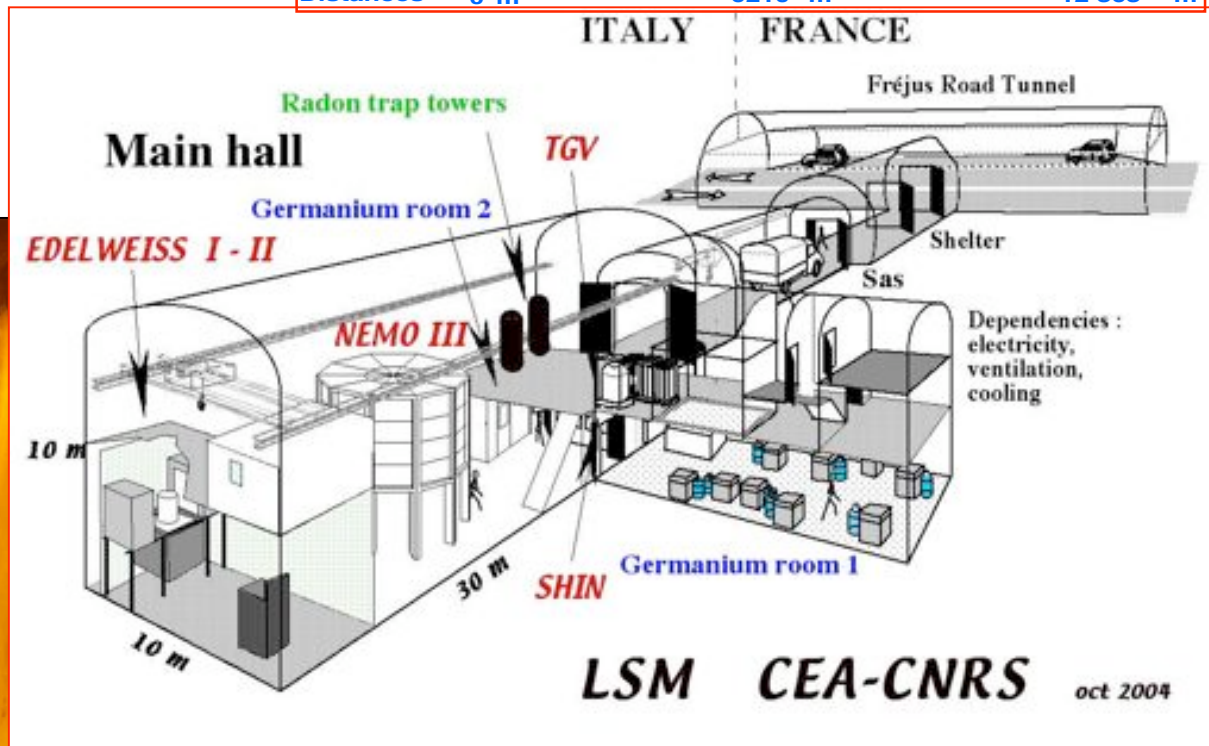
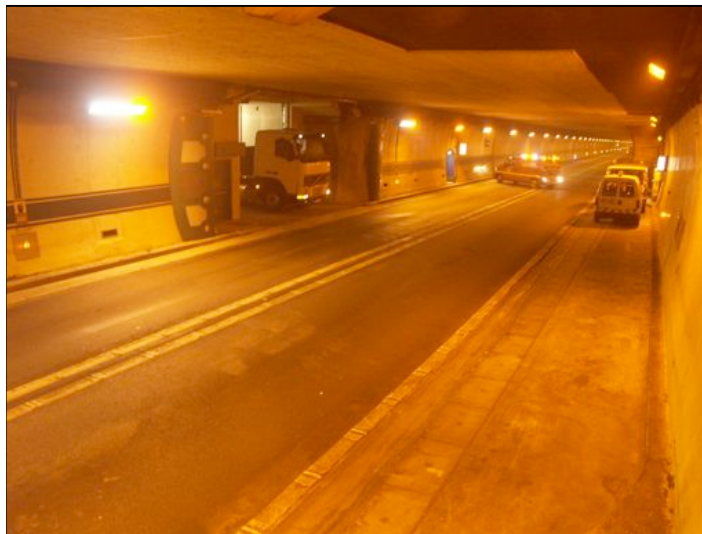


# LSM: Laboratoire Souterrain de Modane (FRANCE)

- Oldest (1982) and deepest lab
- **1750 m deep**, + 1263 m a.s.l.
- Fréjus Road tunnel, 13 km long
- 6.4 km from the tunnel entrance
- 500 m<sup>2</sup>/3500 m<sup>3</sup>: one main hall (30x10x11 m<sup>3</sup>) + 3 rooms (70m<sup>2</sup>, 18m<sup>2</sup>, 21m<sup>2</sup>)
- **DM, DBD experiments + low background measurements**

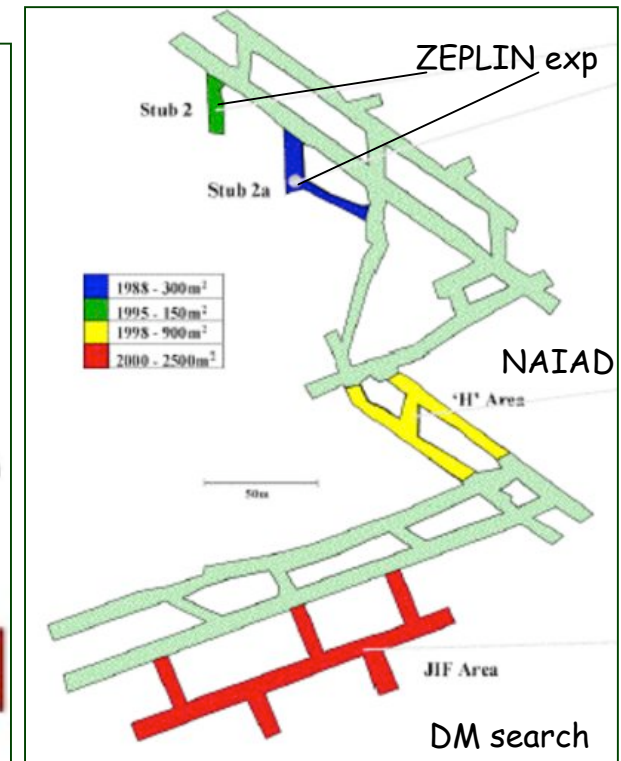
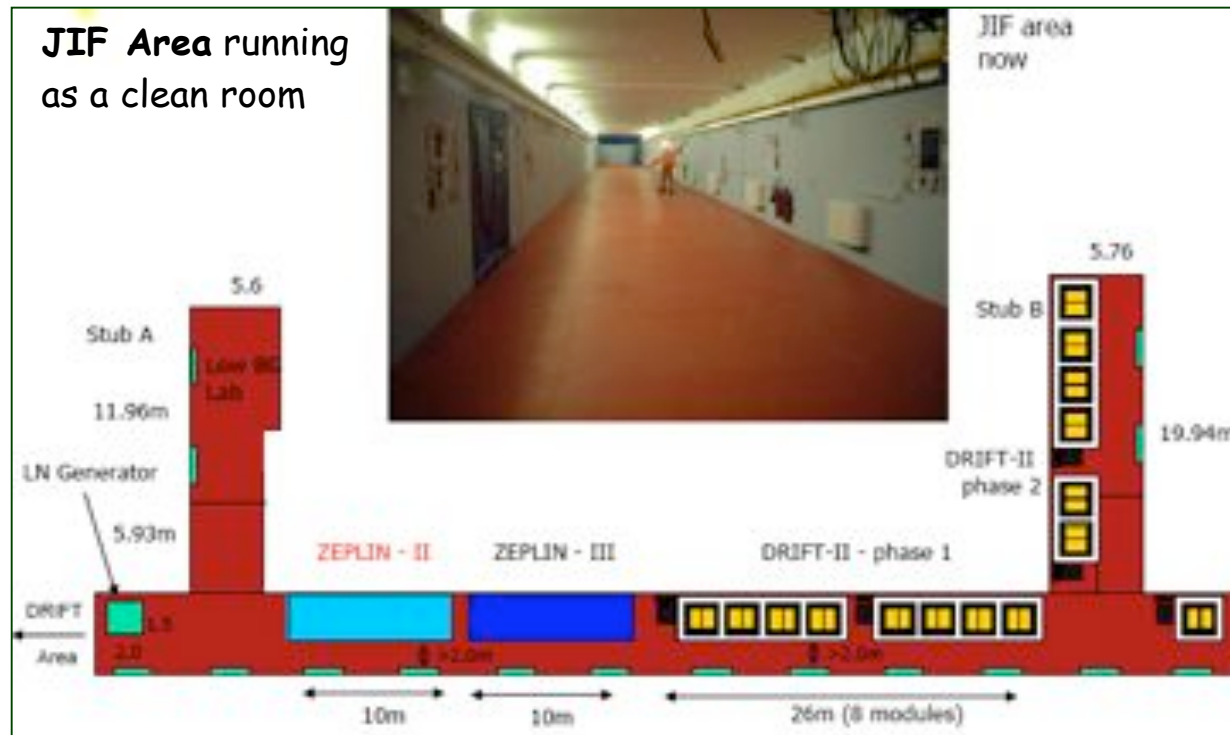
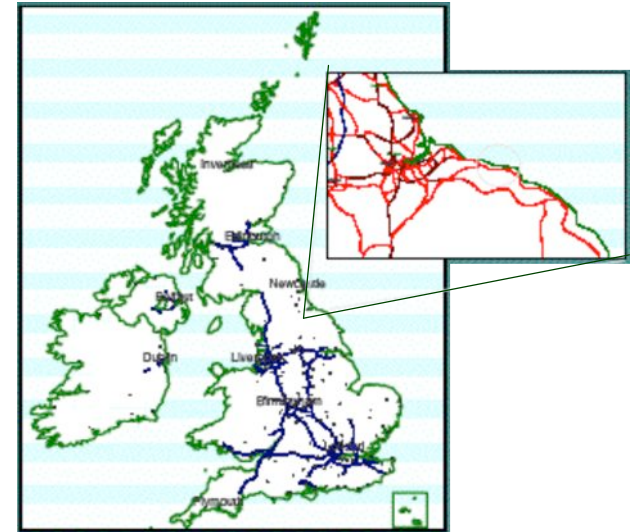


**Approval of the excavation of the safety gallery (summer 2006): access for lab**



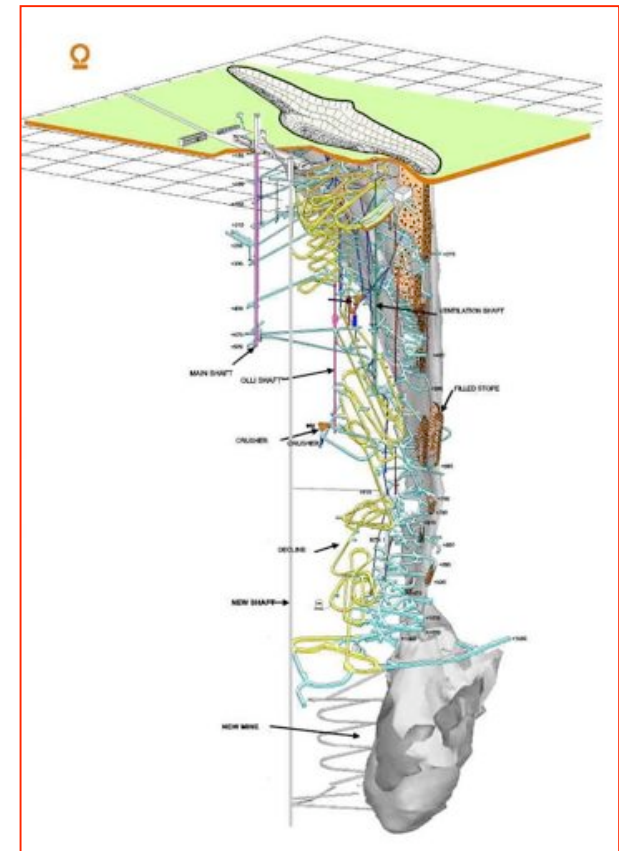
# IUS Boulby Mine Underground Laboratory (UK)

- UK's Potash and rock-salt operational mine (1970)
- Mining horizon ~ 1100 m to 1300 m
- 900 kms of mine tunnels: 8 miles North, 5 Miles South
- **Laboratory @ 1100 m depth (1989 onwards)**  
 $>1500\text{m}^2/3000\text{m}^3$ 
  - Old areas: Stub2 + Stub2a: ZEPLIN experiment (90's)  
 H Area: NAIAD crystals (late 90's)
  - 2002 onwards: JIF Area (~1000 m<sup>2</sup> new lab) for  
**2nd generation DM detectors (ZEPLIN II, DRIFT II)**



# CUPP: Pyhäsalmi Mine Laboratory (FINLAND)

- Pyhäsalmi Mine in Pyhäjärvi, in the centre of Finland.
- The deepest operational base-metal mine in Europe (zinc, copper, pyrite)
  - Old mine: 1050 m (1962-2001)
  - New mine: 1440 m (2001- ), called the "main level"
- **Experiments can be carried out at many different levels (depth) underground**
  - In the old mine at the depths: **85 m, 210 m, 400 m, 660 m, 980 m** (access by decline by trucks and four-wheel vehicles)
  - At the new mine main level (1440 m) small-size and medium-size experiments can be carried out (access by decline-11 km- or by lift)
- The first large-scale experiment is under construction at the 85 m depth: **EMMA experiment** to study the chemical composition of **cosmic rays** at the knee region with gas drift chambers
- **No technical limitations for excavating large-size underground halls to host new/big experiments**



# Working group activity

## Projects:

1. Joint training strategy
2. Joint safety strategy
3. Report on strength and weakness of the labs
4. Relation with the High Energy Physics Safety Group
5. Safety Auditing Group
6. N2 - WP2 Web Page



# 1. Joint safety training strategy

- We started with the **safety courses** in each lab (Boulby and Phyasalmi)
- The goal is to **organize dedicated joint training courses (only for safety officers and Glimos)**.
- **Proposal of involvement of tunnel/mine operators.**
- At the moment the **LNGS Safety course** (a course in English organized once per month) seems **the most general and even the most detailed course** among the 5 labs:
  - LNGS is the biggest and more exemplificative lab
  - The course foresees the projection of a film of a simulation of an emergency situation (car and bus crash in the motorway tunnel near the lab entrance) in which lab staff, tunnel personnel and fire brigades took part.
- We decided to **jointly attend the LNGS Safety course at the begin of 2007.**
  - In that occasion also technical staff of LNGS will be present.
  - In order to exchange experience and promote discussions together with the course it is foreseen:
    - presentations on the other 4 laboratories
    - Michel presentation of the lesson learned by LSM from Fréjus Tunnel accident.



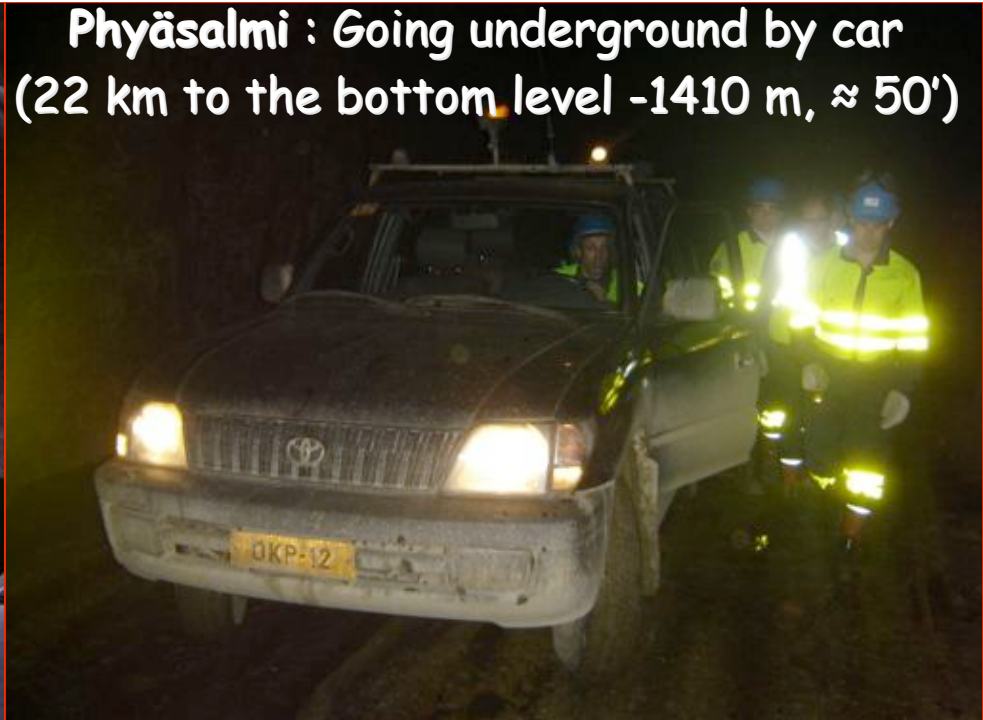
# Joint training







Phyäsalmi : Going underground by car  
(22 km to the bottom level -1410 m,  $\approx$  50')







**Boulby visit**

## 2. Joint safety strategy

- Most of us have completed the 5 lab visit and attended several working meetings:
  - Modane lab visit, first meeting (Jan 2005)
  - Boulby lab visit, working meeting and safety courses attended (Mar 2005).
  - LNGS lab visit, working meeting and safety courses attended (May 2005). People from Finnish lab first joined WP2 group.
  - Paris working meeting (July 2005) : Fréjus tunnel fire accident report, lesson learned. Proposal to interact with the HEP Forum.
  - LSC visit and working meeting (Sep 2005)
  - ILIAS annual meeting @ LNGS (March 2006) : working group and visit to the lab safety installations, lab and tunnel control rooms.
  - Phyäsalmi lab visit and working meeting (June 2006)
  - Modane lab visit, ILIAS general meeting (Feb 2007)
- **We have a complete scenario of the different characteristics and safety aspects of the various labs**
  - ✓ Detailed discussion and comment on specific items
  - ✓ Upgrade of the lab comparison table
  - ✓ As a result of this discussion we started the **work towards the report on strengths and weaknesses** of the various safety policies (N2 deliverable).
    - ✓ A list of strong and weak points of each lab was prepared.

### 3. Lab strength and weakness (N2 deliverable)

	Strong points	Weak points
LNGS	<p>The big civil works just completed and lasted some years have greatly increased lab safety quality, highly improved lab infrastructures and enhanced reliability of systems: water proofing, spillage containment and storage, redundancy for all the important systems and utilities (ventilation, power supply, optical fibre, ...). New segmentations and compartments, fire proof doors, sensors, differential fire extinguishing systems, ...</p> <p>Firemen on site, emergency team and on-call technicians.</p>	<p>Proximity to general public (tunnel), natural park and water table.</p> <p>No independent evacuation tunnel (but 3 different exits and in most cases the second road tunnel could be used as evacuation route to be reached by means of by-passes).</p> <p>No communication via radio during the travel from the external labs and inside, portable phones inactive inside.</p>
LSC	<p>As lab is a new construction the safety quality is high. Nevertheless the lab has been recently completed at the present stage lab organization and management is under definition. No emergency plan at the moment too.</p> <p>Access protocol integrated with Tunnel Authority. Identification.</p> <p>Independent evacuation tunnel (old Canfranc rail-way tunnel)</p>	<p>No redundancy is present in the ventilation system, safety controls, etc.</p> <p>No filtration of water.</p>
LSM	<p>Integrated emergency and evacuation plan with Tunnel Authority and Fire Guards.</p> <p>Safe duct on tunnel top (lab ventilation and electrical cars for rescue)</p> <p>Independent safety/access tunnel was approved in 2006 and is under preparation.</p>	<p>Proximity to general public.</p> <p>Direct access from the tunnel. Car parking outside. Huge vehicles traffic in the tunnel (60% trucks).</p> <p>No identification of people (in progress).</p> <p>No radio to keep in contact with the tunnel at the moment (under development).</p>
Boulby	<p>New facility (JIFF area) with high safety standards.</p> <p>Emergency and evacuation plan with Mine Authority.</p> <p>Individual Protection Devices well selected and complete.</p> <p>Strict rules on safety courses frequency, different level of responsibilities.</p>	<p>Size of equipment that can be fitted into shafts.</p> <p>Full scale fire evacuation to be completed in the future (underground fire simulation to be organised).</p>
CUPP	<p>Lab upper level (EMMA experiment @ 85 m) is near to the rescue area (@65 m): escape route to surface by lift or on foot.</p>	<p>No air conditioning in the mine upper level, also for radon.</p> <p>Suggestion to improve Individual Protection Devices.</p>



# 4. Relation with the High Energy Physics Safety Group

Two main reasons:

## 1. Labs working in similar conditions

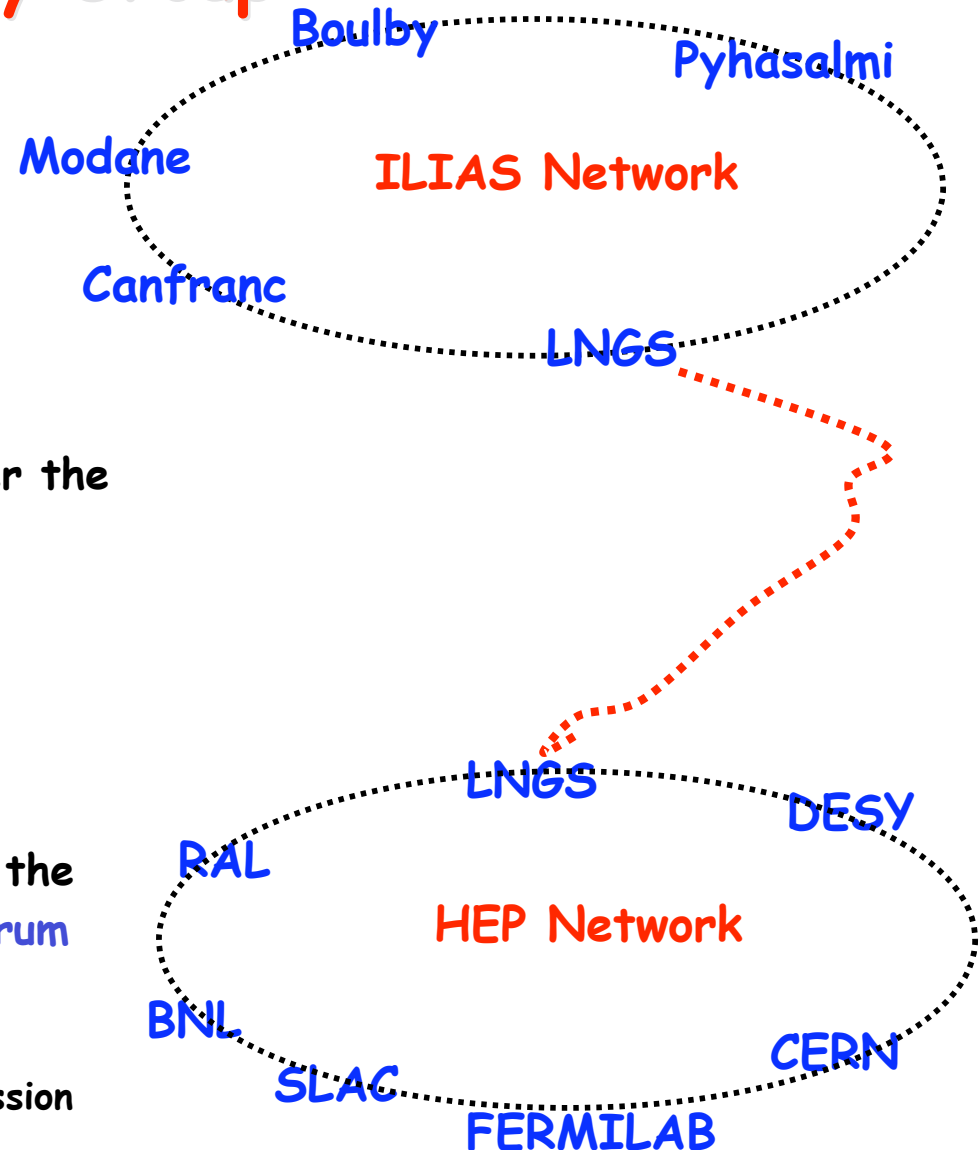
- confined area
- access rules
- companies control
- similar plants
- gas mixtures use
- cryogenic fluids

## 2. There are several experts from all over the world in different fields

- risk assessment
- safety audits
- electrical plants, liquid scintillators, cryogenic liquids
- environmental monitoring and control
- operational training/safety briefings

## v Participation of the N2-WP2 Group to the HEP International Technical Safety Forum 2006 (September 2006) at RAL (UK):

- ✓ ILIAS & N2-WP2 presentation
- ✓ N2 labs' presentation and safety discussion



## 5. Safety Auditing Group

- Discussion on the possibility to elect a Safety Auditing Group and its role.
- This point has to be discussed with each lab Director as it could be a delicate issue.
  - In each lab it is present a safety management structure together with a Scientific Committee and the outcome of the auditing group could be different with the lab internal approach.
  - For this reason the target activity of the Auditing Group has to be discussed in details with all the labs and formalized.
- A safety Auditing Group could be **useful for all the labs** ("super partes" point of view)
  - general lab safety/training strategies
  - risk analysis but also in specific topics connected for example with the proposal of new experimental plants
  - lab utilities and systems upgrades.**and in particular for labs under development/enlarging.**
- LNGS people referred some examples of their experience.
- Possible participants to the Auditing Group:
  - People from each lab, international experts in specific fields and people from HEP Group.
- A list of possible topics for the Auditing Group was prepared.

# List of auditing topics

#	Item	Comment
1	<b>Cryogenic equipment/storage</b> <ul style="list-style-type: none"> <li>•Oxygen deficiency</li> <li>•Spillage containment</li> </ul>	Most of the labs have cryogenic experiments
2	<b>Flammable/toxic chemicals use/storage</b>	
3	<b>Confined space - working in</b>	
4	<b>Fire Risk assessment</b> <ul style="list-style-type: none"> <li>•Material selection</li> </ul>	It is the most important emergency situation for all the labs
5	<b>Evacuation procedures/ plans/ training</b>	
6	<b>Environmental factors</b> <ul style="list-style-type: none"> <li>•Liquid spillage control</li> <li>•Monitoring/ gas, Radon, etc</li> <li>•Waste management</li> </ul>	
7	<b>Ventilation issues</b>	
8	<b>Access protocol / control</b> <ul style="list-style-type: none"> <li>•people</li> <li>•vehicles</li> <li>•security</li> </ul>	Crucial point, weak point for most labs at the moment
9	<b>External interactions/ interference</b> <ul style="list-style-type: none"> <li>•Utilities, supply of</li> </ul>	
10	<b>Geological/Seismic Risks</b>	
11	<b>Health and Safety Training</b>	
12	<b>User Awareness</b>	

## 6. N2 - WP2 Web Page

- It is under preparation a **Web Page on Safety** with a **general part** and a **restricted area** in which we can share documentation for our activity and a list of our meetings, minutes, picture gallery, reports, list of the foreseen safety training courses and so on.
  - **The goal is to improve as much as possible the information exchange in order to study and focus common strategies**
- This page is being **organized by the LNGS group with the help of LSC group and located in the LNGS web site.**



# ILIAS: Communication/Outreach in the European Deep Labs

### **WP3. Communication, outreach, scientific coordination**

- ❑ Stimulate coordination and promotion of Underground Science
- ❑ Improve the quality of public communication of Underground Science activities
- ❑ Scientific coordination among all labs

### **WP3 members:**

- Roberta \*, Claudia (LNGS)
- José, Gloria, Marisa (LSC)
- Luigi, Pia, Gilles (LSM)
- Juha (CUPP)
- Sean, Neil (IUS)
- \* coordinator

## Projects

1. Joint outreach web page
2. Posters
3. Joint brochure /Booklet on underground physics
4. Joint film
5. Joint Open Day
6. Web-cam links and Web-casts

## Recent Important Outreach Events

1. New Canfranc laboratory official inauguration (March, 27 2006) and scientific inauguration (July, 6 2006)
2. CERN-LNGS neutrino beam start (August 2006) and opening ceremony (September, 11 2006)



#### BOULBY



Home page:  
Boulby Underground Laboratory  
UKDA/C Press & PR.  
 Download the brochure pdf

The Boulby Underground Laboratory is an amazing place: a self-contained, high-tech laboratory located 1.7km below ground, in the UK, under the conditions of the largest and deepest salt and potash mine in Europe. [more...](#)

#### LNGS



Initiatives for public:  
Open Labs  
Gran Sasso-Primoston  
[Pictures](#)

The LNGS is one of the four Laboratories of the National Institute for Nuclear Physics. [more...](#)

#### LSM



Home page:  
Laboratoire Souterrain de Modane  
 Download video vimeo  
(31.5 mb)

The Laboratoire Souterrain de Modane, LSM, is a French underground laboratory located in the French-Italian border, near the middle of the Pizella highway tunnel between Modane (France) and Bardonecchia (Italy). The LSM, with a rock coverage of 1700 m, is the deepest underground laboratory in Europe. [more...](#)

#### CANFRANC



Home page:  
Canfranc Laboratory  
 Download the brochure pdf  
(dutch version)  
 Download the brochure pdf  
(spanish version)

The Canfranc Underground Laboratory, working since 1986, is located inside the Canfranc railway tunnel connecting Spain and France, under the Spanish Pyrenees. The present laboratory facilities are below a rock overburden equivalent to 2400 meters of water, shielding from cosmic rays. [more...](#)

#### CUPP



Home page:  
Centre for Underground Physics  
in Physics (CUAPP)

# 1. Joint Web Page @ LNGS

[www.lngs.infn.it/ILIAS\\_outreach.htm](http://www.lngs.infn.it/ILIAS_outreach.htm)

The page has been working since February 2006:

- Short description of the labs and their research activities, several pictures, brochures and videos available for download.
- Short summary of the lab outreach activities.
- List of the forthcoming events dedicated to science communication and outreach, like Open Days.

[www.shef.ac.uk/physics/research/pppa/boulby/boulby.php](http://www.shef.ac.uk/physics/research/pppa/boulby/boulby.php)  
[www.lngs.infn.it/lngs\\_infn/contents/lngs\\_en/public/visiting/visits/index.htm](http://www.lngs.infn.it/lngs_infn/contents/lngs_en/public/visiting/visits/index.htm)  
[www-lsm.in2p3.fr/](http://www-lsm.in2p3.fr/)  
[www.unizar.es/lfnac/lfnac\\_eng.html](http://www.unizar.es/lfnac/lfnac_eng.html)  
[cupp oulu.fi/](http://cupp oulu.fi/)

## 2. Lab posters

- Updated posters have been prepared by each lab in order to be put in the Outreach Web Page, to be exchanged to promote ILIAS and the various lab activities and to be used during meeting, conferences and other outreach events
- 2 kind of posters per lab:
  - lab characteristics
  - experimental activities

You can see the new posters here at the meeting

### Gran Sasso National Laboratories

The GRAN SASSO NATIONAL LABORATORIES (LNGS) ARE, BOTH IN SIZE AND INFRASTRUCTURE, THE MOST ADVANCED UNDERGROUND LABORATORIES WORLDWIDE. THE LABORATORIES ARE IN ITALY, 120 km EAST OF ROME, UNDER THE GRAN SASSO MOUNTAIN. THE LABORATORIES WERE COMPLETED IN 1987 AND, TODAY, HOST ABOUT 15 EXPERIMENTS CARRIED OUT BY ABOUT 720 RESEARCHERS FROM 25 COUNTRIES ALL OVER THE WORLD. RESEARCH IS FOCUSED ON ASTROPARTICLE PHYSICS: NEUTRINOS, DARK MATTER AND RARE DECAYS.

The natural shield of 1,400 meters of rock allows scientists to work in the so-called "cosmic silence", looking for rare events. The Earth's surface, indeed, is continuously hit by an enormous amount of particles originating from the interaction of primary cosmic rays with atoms that constitute the atmosphere. Under the mountain, inside the Laboratories, the flux of such particles is reduced to a part in a million. That's why not only sub-particle physicist but also geologists as well as biologists are collaborating on the unique characteristics of the laboratories in order to conduct cutting-edge experiments.

### CNGS: Cern Neutrino to Gran Sasso

OPERA

The detector is made of a sensitive part consisting of 12 million nuclear emulsions assembled with as many thin lead plates to form about 200 000 "stacks" in which the neutrino interacts, and by detectors consisting of scintillating strips which allow the determination, in real time, of the coordinates of the interaction event.

ICARUS

The beam, produced at the CERN, will consist of only muon-type neutrinos. Neutrinos will pass undisturbed underground, owing to their destination, the LNGS, 730 km away from CERN. OPERA (emulsion detector), specifically designed to detect the rare low-neutrinos created by "oscillation" from muon-neutrinos on the way between CERN and LNGS. ICARUS 1000 is sensitive to the detection of all types of neutrinos and will contribute in providing information on the oscillation mechanism.

### The New Canfranc Underground Laboratory (LSC)

Laboratory of Nuclear and High Energy Physics, University of Zaragoza, 5003 Zaragoza, Spain. The new project entry.

- The Canfranc Underground Laboratory (LSC) is an underground scientific facility devoted to experimental research in Astroparticle and Neutrino Physics since 1985. The LSC is operated by the Research Group on Nuclear and Astroparticle Physics of the Zaragoza University.
- It is located in the Somport railway tunnel (7.8 km long, not in use). The LSC connects Spain and France across the Central Pyrenees.

**Physics at the LSC:**

- Dark Matter Physics: Direct detection of galactic WIMPs.
- Neutrino Physics: Double beta decay.
- R+D on Low Background Physics: Natural underground sources, development of materials, active and passive shielding development, ...

**Scientific equipment:**

- Low temperature facility (10-20 mK)
- Shielding super facility (by steel and lead)
- Underground clean room for R+D on detectors
- Ultra-low background Ge detectors (for neutrino measurements)
- Tools of anthropological and very old heat (for passive shielding)

**LSC: Status and future plans**

- The new LSC was officially inaugurated in March 2005.
- At present a complete background characterization of the laboratory is being carried out.
- Experiments to be considered in the new laboratory (with the partnership of ILIAS) are: Double Beta Decay, Dark Matter, Gravitational Waves, Neutrino Oscillations, ...

### The LSM, present and future

The « Laboratoire Souterrain de Modane »:

- Hosts experiments in fundamental physics and very-low radioactive background measurements.
- Has a team of 11 persons, 8 of which are permanent and are running the lab.
- Is used by about 100 physicists, engineers and technicians.
- Is in a close collaboration with the SPTFR (Société Française du Tunnel, Roulier du Fréjus).
- Participates to ILIAS, the European underground laboratories network.
- Is associated with the Joint Institute of Nuclear Research, Dubna, Russia.
- Is constructing a new building with offices, communication services, garage, guest housing...
- Intends to extend the laboratory from 3 500 to 60 000 m<sup>2</sup> by 2012.
- Has a long term project for a huge laboratory of worldwide renown.

The new building at « Tignes Blancs » in Modane

Extension to 60 000 m<sup>2</sup>

A world-scale project, in collaboration with the CERN!

An illustration for the project of a very large laboratory sheltering a water Cherenkov detector for the study of neutrinos, the proton decay and the observation of

### The Boulby Underground Laboratory for Dark Matter Research

Boulby Mine

Surface Facilities

Underground Facilities

Dark Matter Studies at Boulby Mine

Background Radiation

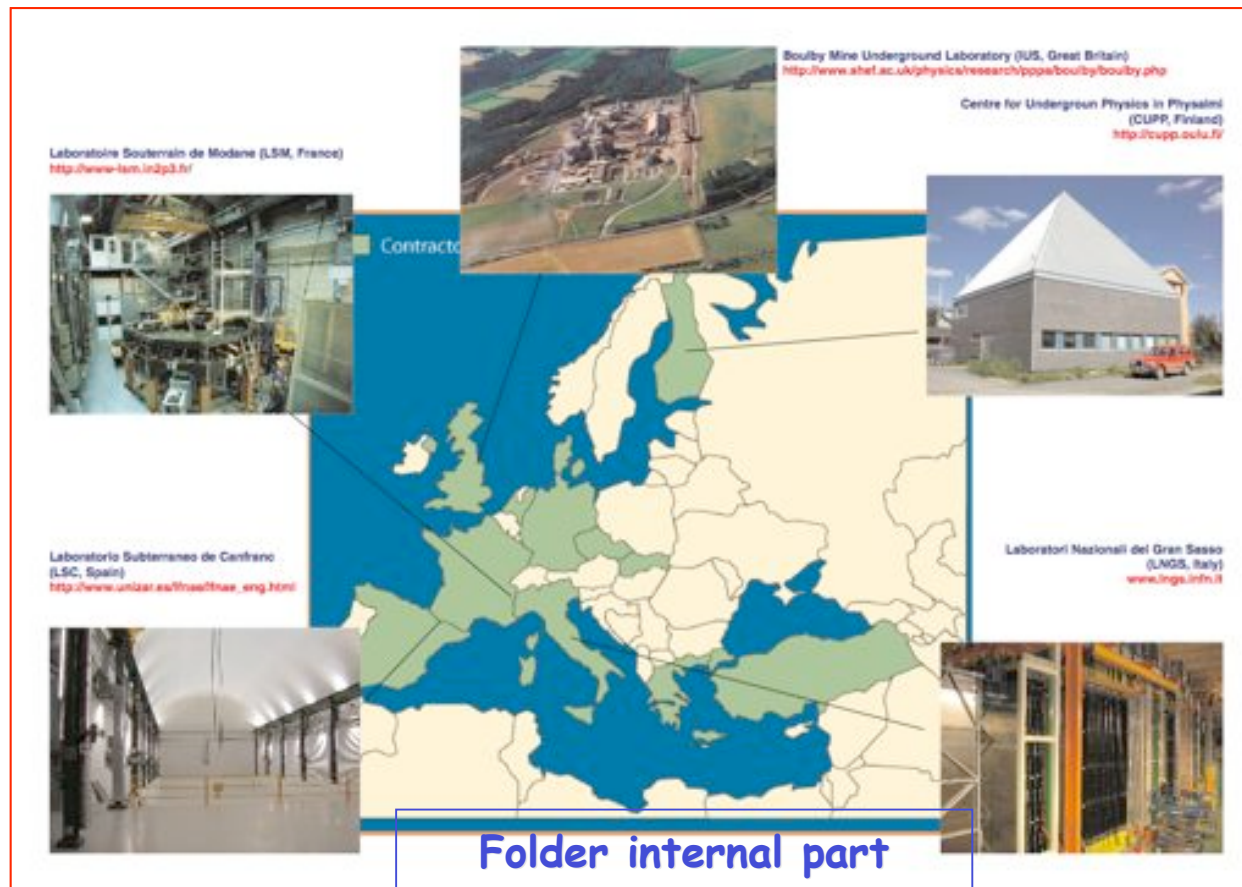
The new LSC access to facilities/surfaces

New LSC Main Hall



# 3. Joint brochure / Booklet on Underground Physics

- A prototype of the joint brochure has been prepared.
- The idea is to prepare a **common folder** containing a general introductory brochure about ILIAS and the 5 labs.
  - Lab brochures to be contained inside.
  - Flexible format: new information can be easily added or modified at will (lab development/update)
- **The brochure will be translated into all the languages of the 5 labs (ongoing)**
  - At the moment LSC brochure in Spanish and Italian and LNGS brochure in Italian and English



## 4. Film

- Present films (if they are) on the various labs are not homogeneous
- 2006: start of the project of the **ILIAS film (N2 deliverable)**
- July 2006: **"Film Festival" @ Zaragoza during JRA1/N2 meeting**
  - LSC film on Dark Matter
  - BBC film on Dark Matter
  - LNGS/CERN film on Neutrino
  - Finnish film on the Pyhäsalmi lab
- **It was decided to assign the production of a common ILIAS film to Javier Paricio (from Zaragoza University) who produced the LSC film on DM** and who could use all the material his team had filmed in the past (taken in Modane, Gran Sasso, Canfranc and CERN) integrating it with new film in the other labs, interviews, animations, etc.
- Sub-group of work: José (LSC, coordinator), Luigi (LSM), Roberta (LNGS), Sean (Boulby)
- Translation into each language to be used by all the labs as outreach activity

# 5. Joint Open Day

- For the moment only organized at LNGS
  - The LNGS Open Day takes place every year (since 2002) at the end of May. It is a day (Sunday) during which the external and underground laboratories are open to the public with plenty of events (guided tours, conferences, concerts, exhibitions, amusements for kids) aiming at communicating physics and science in general to youngsters and less young.
  - The number of visitors attending the Open Day has reached its climax in 2003 with about 2000 people, 1000 of which visiting the underground structures.
- **First participation of ILIAS to the LNGS OPEN DAY 2004**
  - participation of people from IUS + posters from all the labs
- **Participation of ILIAS members and people from CUPP to LNGS OPEN DAY 2005**
  - ILIAS stand with educational material in Italian
- **Full participation of ILIAS to the LNGS OPEN DAY 2006**
  - ILIAS stand with ILIAS Labs brochures and posters
  - First attempt at a joint web-cast successfully completed: internet connection to lab web-cams to Boulby and LSM (N2 deliverable)
  - PC showing lab movies (LSC and Boulby DVDs)
- **Next edition: LNGS OPEN DAY 2007 on May 27th (sixth edition)**
  - **You are welcome!**





Open-air physics



Physics Circus

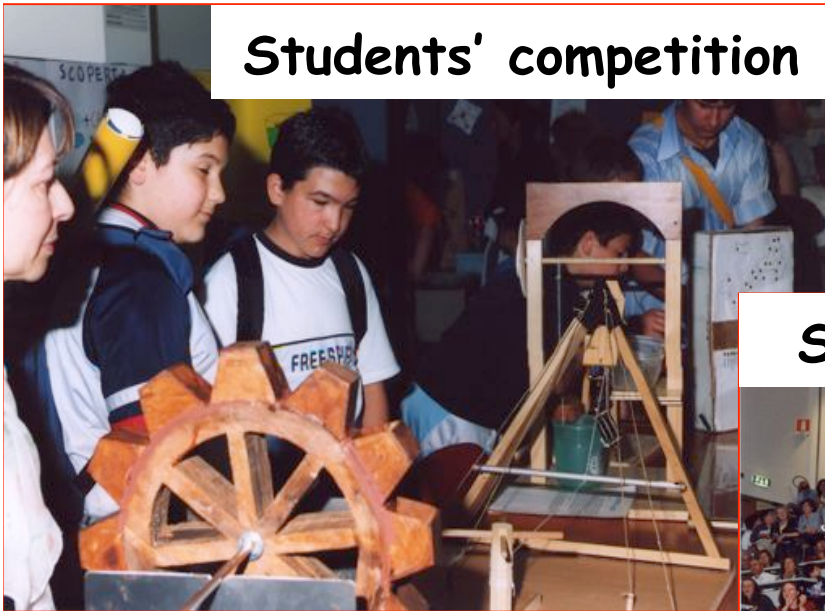


Science Desk



## LNGS OPEN DAY 2005

Students' competition



Students' reward





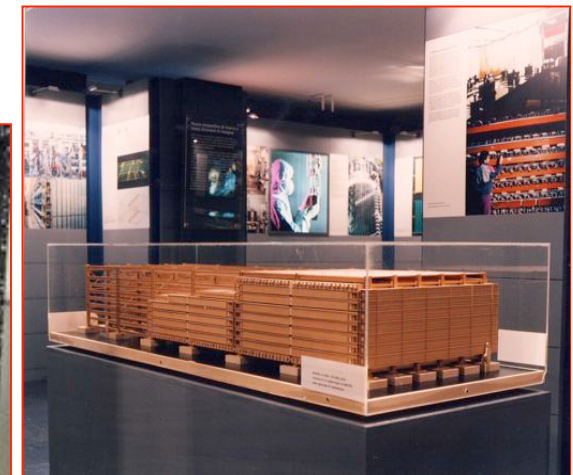
## 6. Web-cams links and Web-casts

- With the exception of the new Canfranc laboratory, which has been inaugurated only recently, **the labs have capabilities to switch on web-cams or to do web-casting** and are going to **use these capabilities in particular occasions and public events**, like for example the LNGS Open Day.
- Starting from the outcome of this first attempt, a subgroup working especially on this task (Michel Zampalo, Sean Paling, Roberta Antolini and José Manuel Carmona) will define a working plan for the future regarding, for example, **periodic video conferences among the labs, use of the web-cams to connect schools of different countries visiting the laboratories, etc...**
- Most of the labs have web-cams installed in particular for safety reasons but for privacy policy it is not allowed to show the person activity all the time.
- At the moment a web cam link is operative in Boulby (see web page).

# Lab initiatives (some examples)

- Lab visits
- Contacts with schools, teachers, populations, ...
- Competitions for schools
- Museum (posters, pictures, brochures, models of experiments,..)
- Experiments & laboratory for kids
- Web sites, TV programs
- Seminars
- Schools in collaboration of other institutes

- to improve and promote a wide and correct public understanding of the lab activities
- to inform young people of new and exciting aspects of modern physics, not studied at school
- facilities / demonstrators meant to promote the public understanding in physics, astrophysics and science in general



•Boulby Outreach projects:

•Schools & General Public

Talks, demonstrations and lab visits to introduce students, general public and wider scientific community to the world of underground science and the specific research activities of the Lab.

•Lab web-cams:

Installation of live web-cams in the underground labs is ongoing. Currently one test-camera is in place.



Laboratoire Souterrain de Modane  
 CEA DNE DAPNIA CNEA SFT  
 LSM  
 ANRS  
 CNEA  
 dapnia  
 cea  
 soday  
 Laboratoire  
 Activités  
 Projets  
 Communication  
 ILAD  
 Membres  
 Informations diverses  
 Liens  
 Rechercher  
 Sur le WEB du CEA  
 Sur le WEB du CNEA

**ACTUALITES**  
 décembre 2006  
**Présentation des métiers du LSM**  
  
 Le vendredi 22 décembre 2006, à l'initiative de Maurienne Expansion, le LSM a présenté son activité et ses métiers aux classes de 3ème du collège de Modane.  
 C'est en 3ème que les élèves commencent à orienter leurs études, c'est pourquoi le collège de Modane a demandé à Maurienne expansion de présenter les principaux secteurs d'activité de la Maurienne.  
 Florence VINCENOT de Maurienne Expansion a souhaité donner la parole aux entreprises un peu moins connues afin de proposer d'autres horizons aux jeunes moutonnais.  
 L'entreprise Arkema a présenté les métiers de la chimie et Michel ZAMFRALO du laboratoire souterrain de Modane a présenté les métiers de la recherche.

octobre 2006  
**La laboratoire souterrain de Modane sur les ondes**  
  
 Journaliste : Virginie Petit-Renaud  
 Du lundi 9 au jeudi 12 octobre 2006 à raison de 3-diffusions quotidiennes (7h, 13h et 19h), nous avons pu entendre la présentation du Laboratoire Souterrain de Modane en 4 épisodes :  
 1- Une bonne raison d'être caché : <http://webcast.r2d1.fr/31/maudio/bonne-raison-19011006.m3u>  
 2- Une bien jolie fleur : Edelweiss : <http://webcast.r2d1.fr/31/maudio/edelweiss-19011006.m3u>  
 3- Les explorateur de l'univers : <http://webcast.r2d1.fr/31/maudio/les-explorateur-19011006.m3u>  
 4- La science, spécialité Mauriennaise : <http://webcast.r2d1.fr/31/maudio/science-19011006.m3u>  
 Avec la participation de Gilles GERBER directeur du LSM et chercheur au CEA, Jean ZHIN-JUSTIN directeur du DAPNIA du CEA, Michel SPYRO directeur de l'IN2P3 du CNRS, Claude VALLET maire de Modane et Michel BOUVARD vice-président du conseil général de Savoie et vice-président de la commission des finances à l'Assemblée Nationale.  
 nécessite l'installation de realplayer (téléchargement gratuit : <http://fr.real.com/realplayer/>)

[www-lsm.in2p3.fr](http://www-lsm.in2p3.fr)

### LSM Outreach projects:

#### •School project

Presentation of Lab research activities to students near to select their study orientation.

#### •Lab presentation on TV channel in 4 episodes:

From October 9th to 12nd 2006 with 3 diffusions per day (7h, 13h et 19h) on "rhonalp'1"

1- Une bonne raison d'être caché

2- Une bien jolie fleur: Edelweiss

3- Les explorateur de l'univers

4- La science, spécialité Mauriennaise



[cupp oulu.fi](http://cupp oulu.fi)

- **CUPP Outreach projects: School project**

The aim of the school project is to **construct a net of measurement stations, which studies extensive air showers arisen from cosmic rays. Scientific research and teaching of physics and computer science are united in this project.** Origin of the highest energy cosmic ray particles is an actual scientific problem. The measurement equipment can also detect other radiation from space in addition to high energy cosmic rays. The measurement station consists of 3-5 scintillation counters, which will be placed in a few meter spacing from each other. Exact places of the counters and time stamp for an event are defined by GPS (Global Positioning System).

## Lab opening to the Public

	Visits	Open Day / Science Week
<b>LSM</b>	Monthly visits ~ 14 persons per visit ~ 300 /year	Week: "Sciences en Fête" (last edition: October 200)
<b>LSC</b>	Guided tours (*)	"Semana de la Ciencia" University of Zaragoza
<b>LNGS</b>	Guided tours organized regularly (**) up to 17000 visitors per year	Open Day since 2002 ~ 1700 people attending
<b>Boulby</b>	Guided tours for small groups ~ 100 visitors per year	To be organized
<b>CUPP</b>	Guided tours for small groups ~ 100 visitors per year	To be discussed

(\*) Not yet for the new lab

(\*\*) They were suspended in the past because of big civil works underground.

They were restarted on November 1st, 2006 but at the moment visits are allowed only during the weekends in order not to interfere with the installation of the experimental plants

# Conclusions

- Inside ILIAS we have developed a **powerful and useful tool: the network among underground labs and specific working groups on infrastructures, safety and communication** in order to exchange information and experience and operate common strategies.
- Most of the activity was started from scratch... There was a lot to do!
  - As regards safety, we started focussing on specific items. From lab comparison, pointing out strong and weak points and lessons learned by mistakes/accidents, we are working toward a better safety quality of all the labs making it possible to foresee future developments such as lab improvements/enlarging in order to host new/big experimental plants.
  - As regards outreach several achievements have been performed in order to have uniform approaches/joint strategies.
- **We are strongly and efficiently working toward the goal to reach a situation where the five European deep underground laboratories will be dealt with as a single entity**







Dedicated to  
our dear common friend  
Nicola,  
who gave a  
fundamental contribution in  
the ILIAS project

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