Deep Underground Laboratories In Europe

F. Piquemal

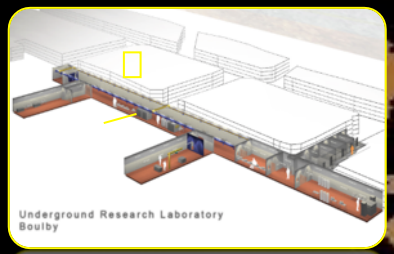
Modane Underground Laboratory
CNRS/IN2P3

URL Workshop, Montréal, May, 10 2015

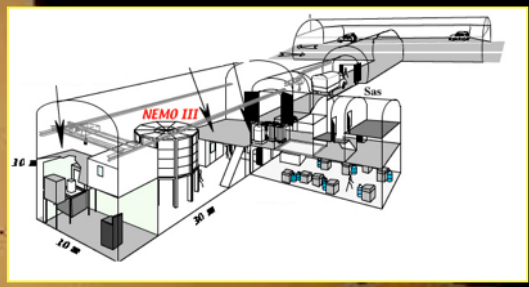
Deep Undergroung Laboratories in Europe

Coordination efforts in the context of ILIAS and ASPERA EU networks

Boulby (UK)



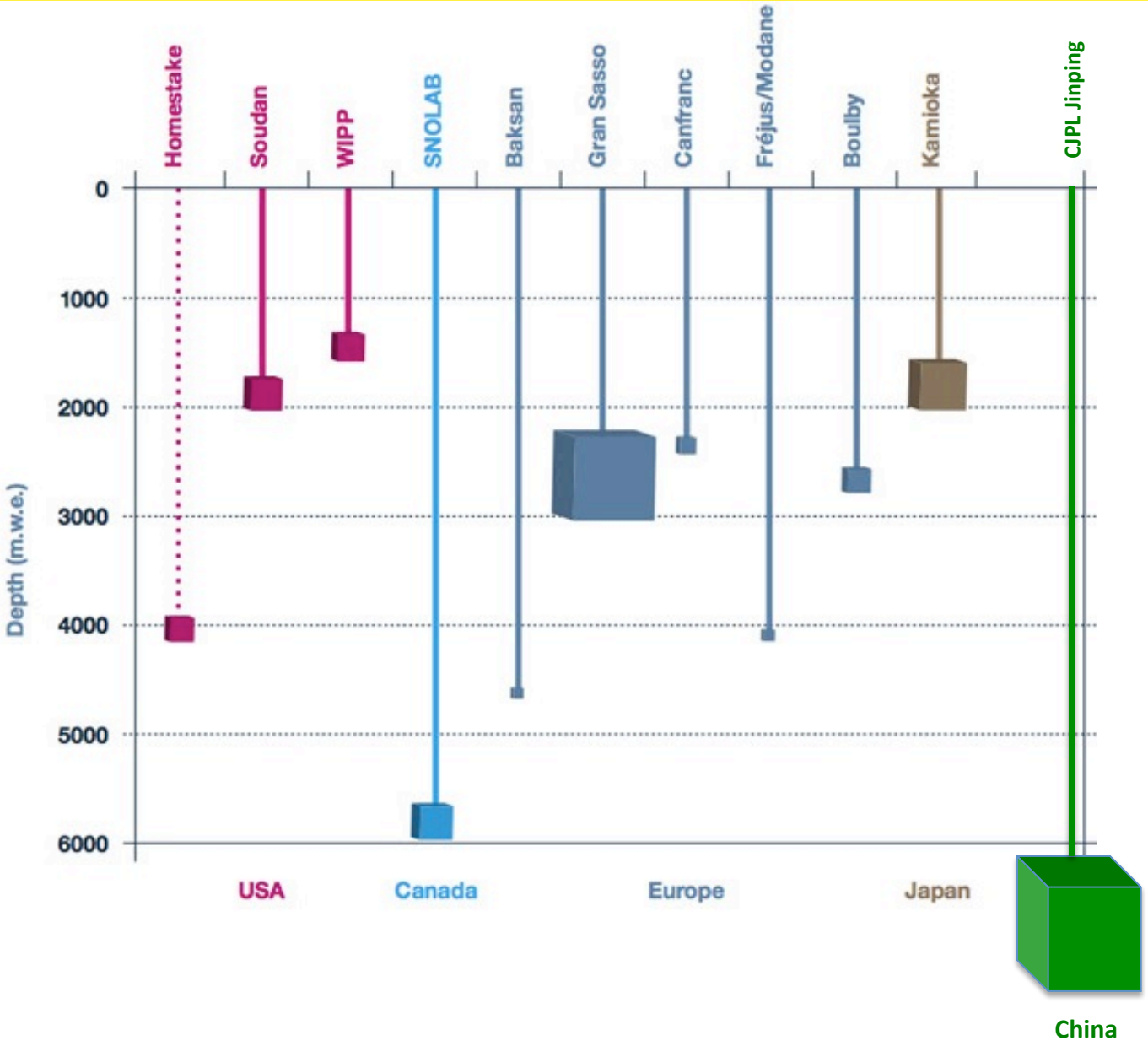
Modane (France)



Canfranc (Spain)

Gran Sasso (Italy)

Underground Science Laboratories



Plot adapted from http://www.deepscience.org/contents/facilities.shtml

European DUL characteristics

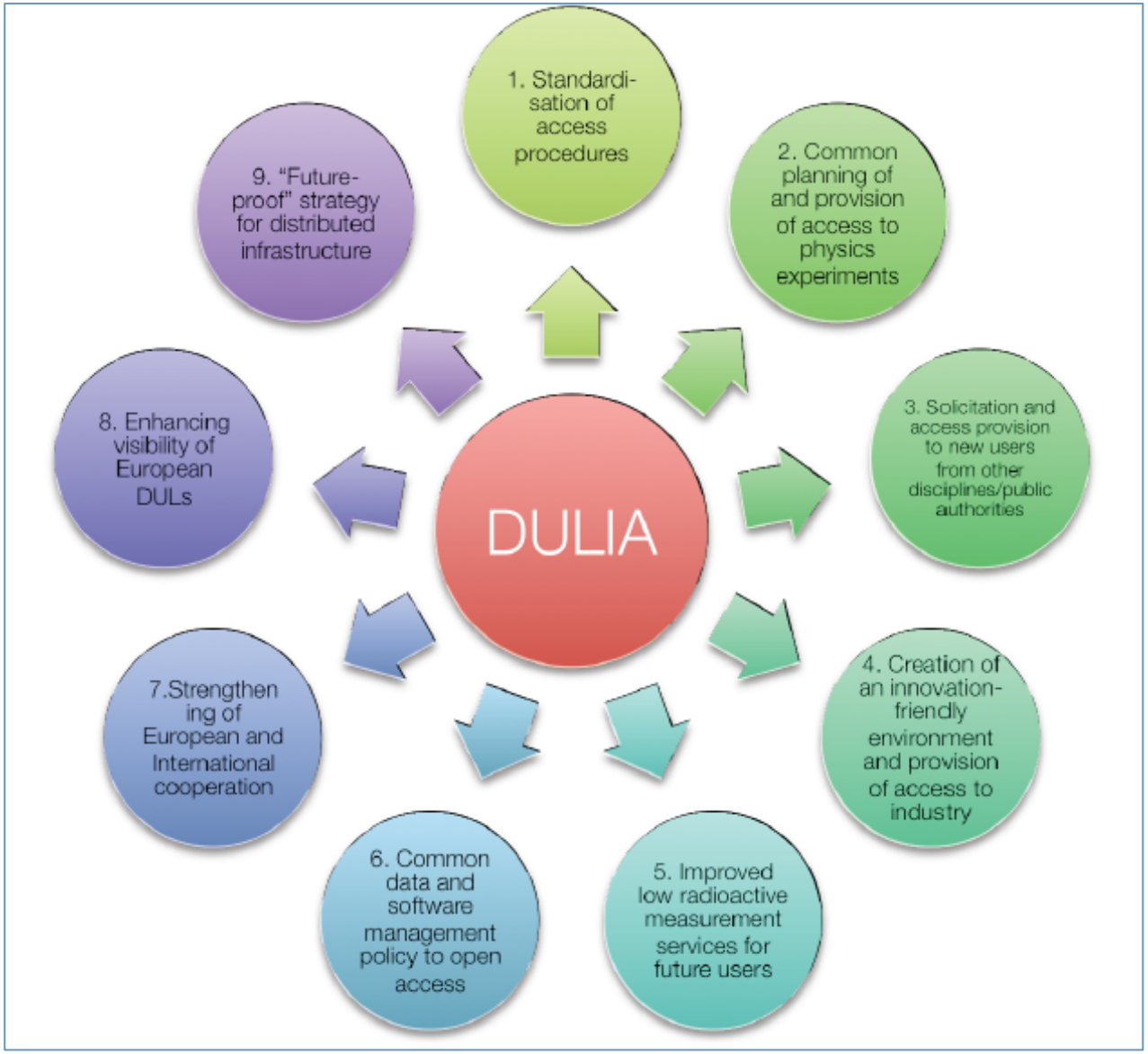
	LNGS	LSM	LSC	BUL
Date of Creation	1987	1982	2010	1989
Surface m^2	18 000	500	1600	500 + 1000
Volume m^3	180 000	3 500	10 000	3 000
Personnel	51 (A-T) + 16 eng + 12 phys + 27 postdocs	11 + 1 postdoc	10	5
No of users	950	150	275	70
Depth meter water equivalent (mwe)	3 700	4 800	2 450	2 800
Altitude	1 000	1 240	1 195	-1000
Temperature (base) in Celsius	10°	28°	12°	30°
Humidity (base) in %	90	30%	60%Wint - 80%Sum	30-35%
Available electrical power kW	1500	60 ➔ 300	692	
Air renewal flux m^3/h	50 000	4 800	11 000	24 000
Muon flux/$(m^2.s^{-1})$	2.87×10^{-4}	$4{,}6\ 10^{-5}$	$2\text{-}4 \times 10^{-3}$	$4.1\ 10^{-4}$
Air renewal/total vol/h	0.3	1.5	1.2	10
[Radon] Bq/m^3	20-120	10-15	70	<3
Gamma flux/ $(m^2.s^{-1}$	$0.3 - 1 \times 10^4$	3.8×10^4	$1.23 \pm 0.17\ 10^4$	$\sim 1.3 \times 10^4$
Neutron flux (>1MeV)/$(m^2.s^{-1})$	$\sim 3.78 \times 10^{-2}$	$(1.06 \pm 0.1 \pm 0.6) \times 10^{-2}$	$3.47 \pm 0.35\ 10^{-2}$	$<1.5 \times 10^{-2}$

European DUL characteristics

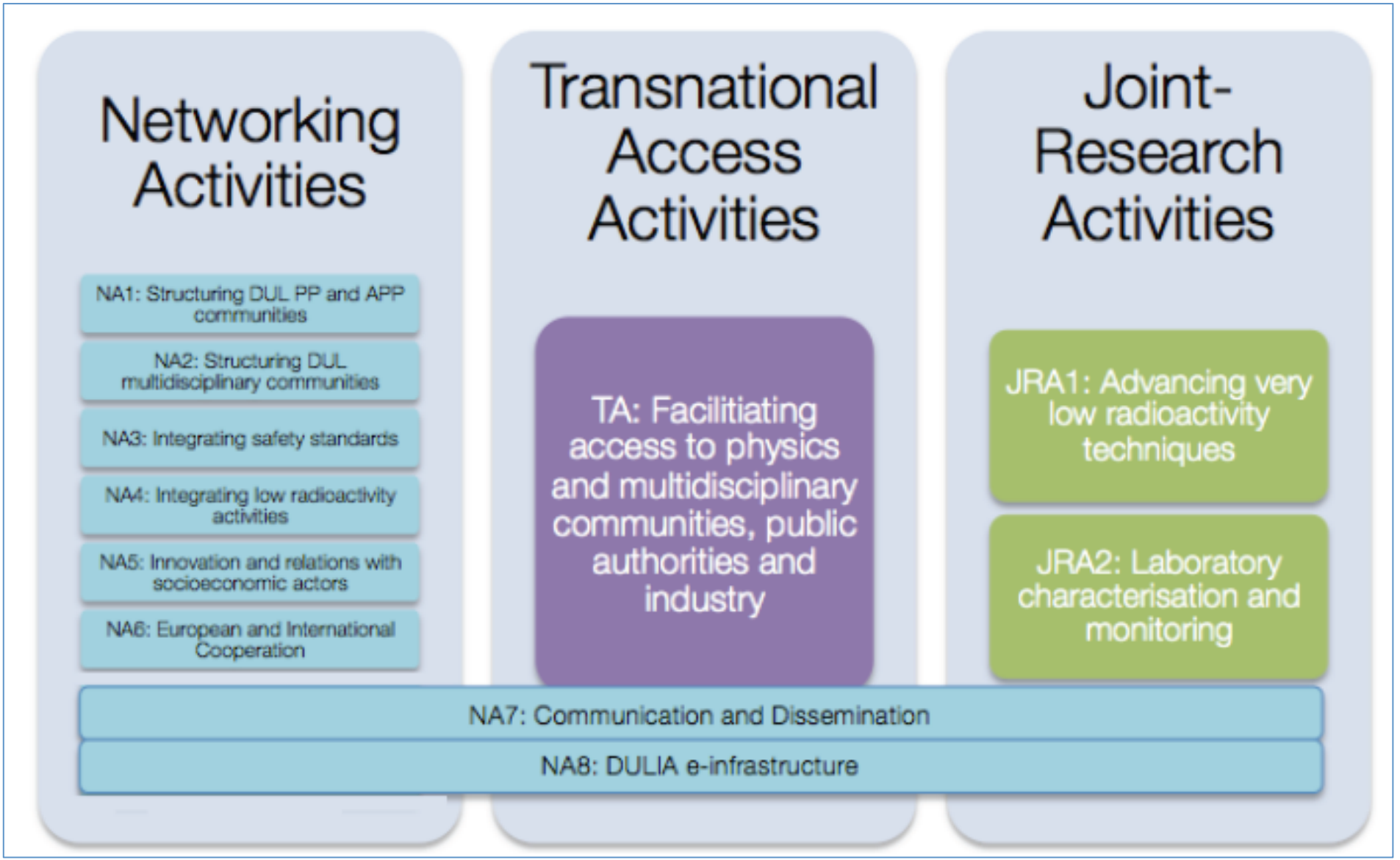
	LNGS	LSM	LSC	BUL
Main Physics Activities	DM, 0νββ, neutrinos, NP, LR measurement	DM, 0νββ, neutrinos, NP, LR measurement	DM, 0νββ, neutrinos, LR measurements	DM, LR measurements
Access	Horizontal	Horizontal	Horizontal	Vertical
Travel time between surface building + lab access	20 min	20 min	15 min	25 min
γ spectroscopy LR Ge's	12 units	15 units 200cc: 6 / 400cc: 4 /800 cc :1 1000 cc: 2	7 units: 400 cc	4 units: 400 cc
Additional low background measurements radioactivity Ge's	Radon water mon, liq scint setup	Rn monitor @ few mBq/m^3	Low background alpha-beta counting system	Rn monitor @ few mBq/m^3
Background reduction equipment	Radon purify in LN2: @ $\mu Bq/m^3$	Radon-free air system: 150 m^3/h @ 0.10 Bq/m^3	Clean room	Clean room

Deep Underground Laboratory Integrated Activity

DULIA: towards a deep underground European distributed platform



DULIA Structure



Project not selected in 2015 in Horizon 2020 project. Will be submitted again in 2017

Scientific activities in European DUL

Fundamental physics

Proton decay

Neutrino physics
- Nature of neutrino
- Masse of neutrino
- Solar neutrinos
- Supernovae neutrino
- Géoneutrinoss

Dark Matter :
Direct search of WIMPS

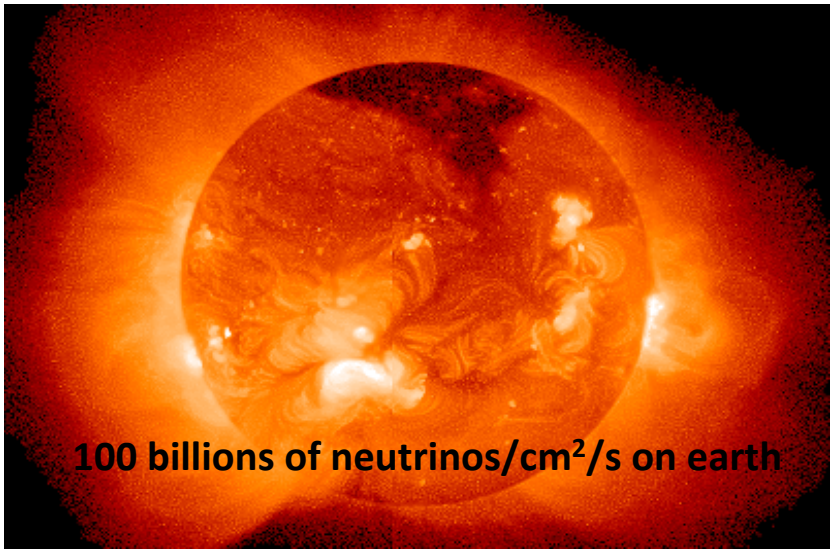
Nuclear physics
- Cross section for astrophysics
- Very rare radioactivities
- Search of Super Heavy Elements

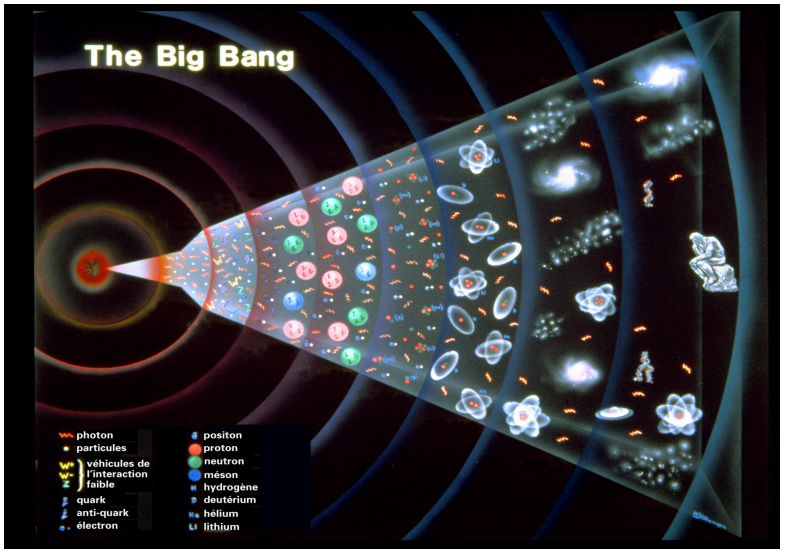
A common link for most of the activities:
the very low radioactivity

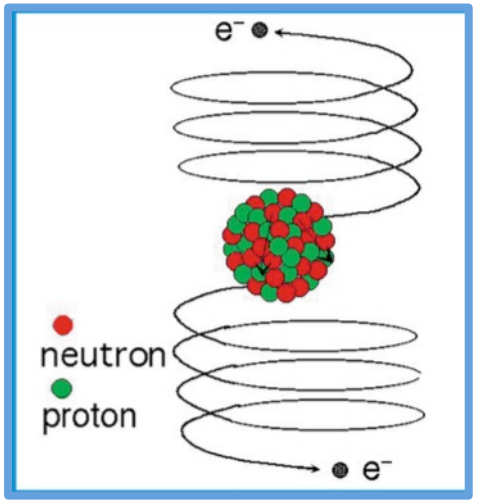
Interdisciplinary

- Environmental sciences
- Geology
- Biology
- Micro-electronics
- Archeology
- Applications to industry
- …..

Neutrino studies

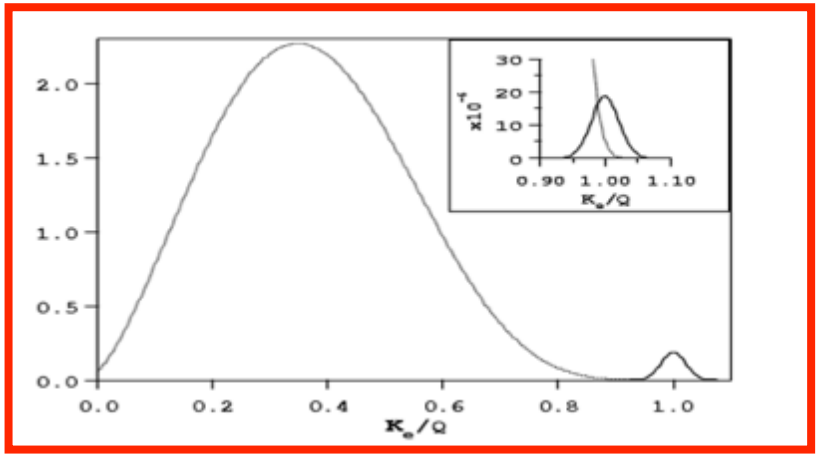






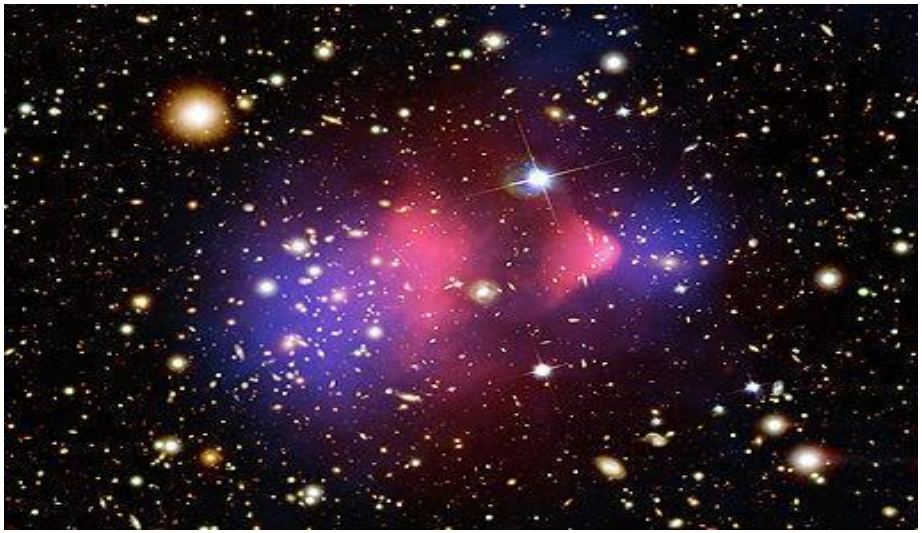
Neutrinoless
Double beta decay

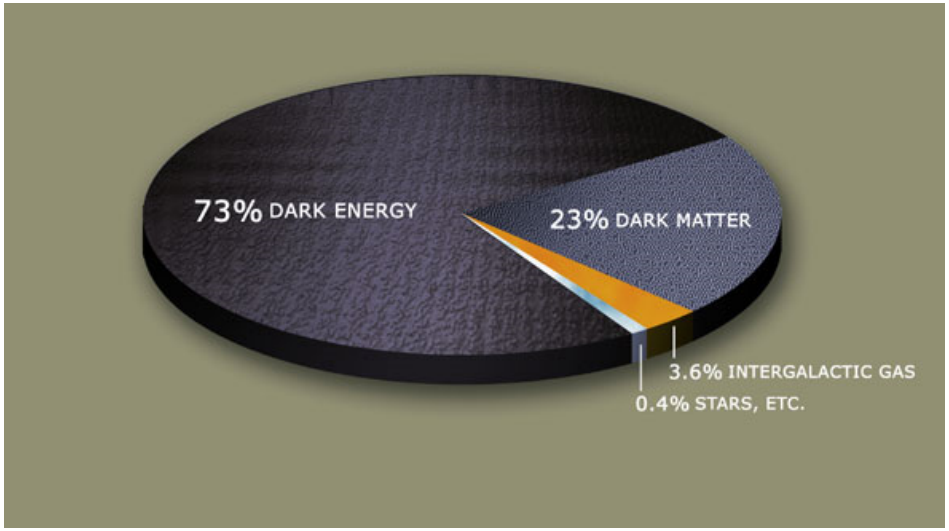
Nature ($\nu=\bar{\nu}$) ?
Masse ?

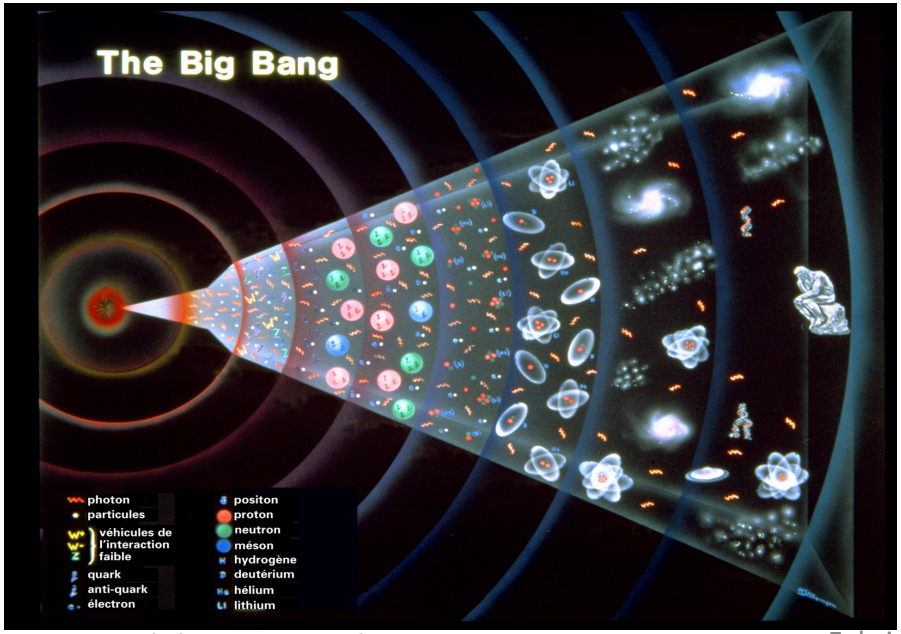


Période > 10^{25} years

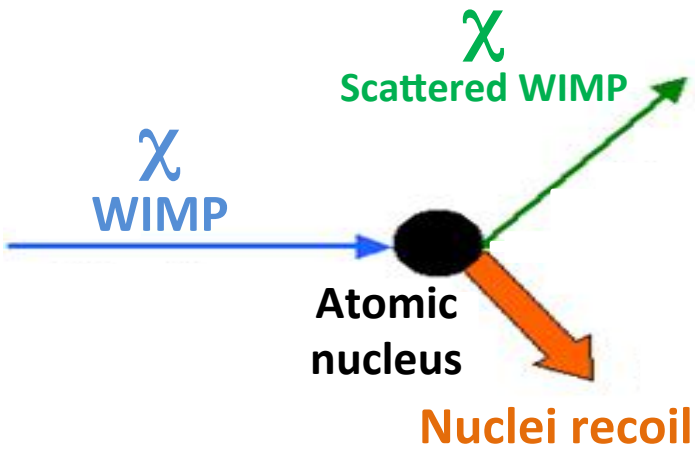
Dark Matter search







WIMPS Weakly Interacting Massive Particle



Modane Underground Laboratory (LSM)

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Depth: **4800 m.w.e.**

Surface:: **400 m2**

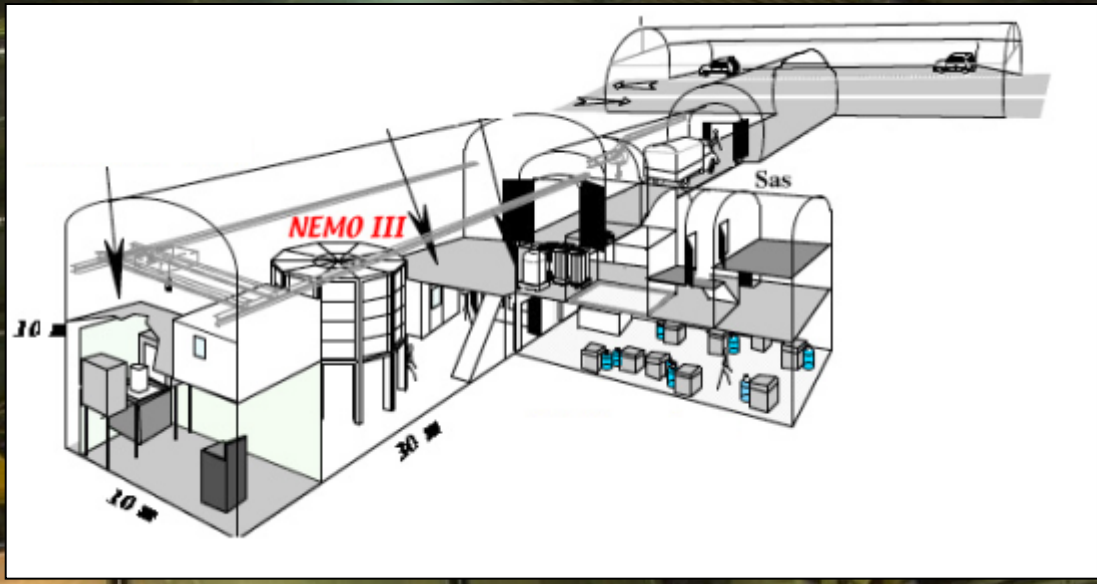
Volume : **3500 m^3**

Muon flux: **4 10^{-5} $\mu.m^{-2}.s^{-1}$**

Neutrons:
Fast flux: 4 10^{-2} $n.m^{-2}.s^{-1}$
Thermal flux: 1.6 10^{-2} $n.m^{-2}.s^{-1}$

Radon: **15 Bq/m^3**

Access : **horizontal**



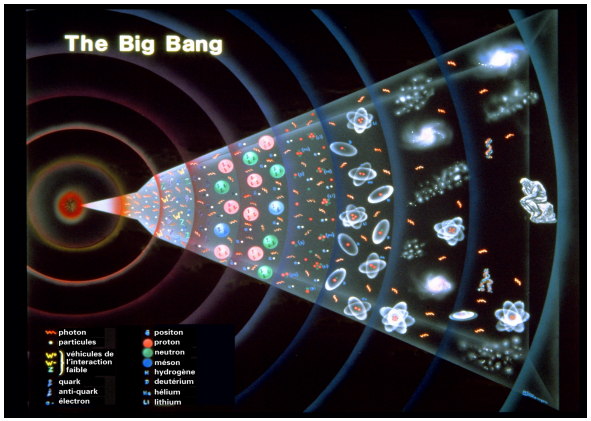
Budget (full cost): 1 M€/yr
Staff: 3 Physicists
3 Engineers
7 Technicians

International associated laboratory agreement with JINR Dubna (Russia) and CTU Prague (Czech Republic)

LSM external facility

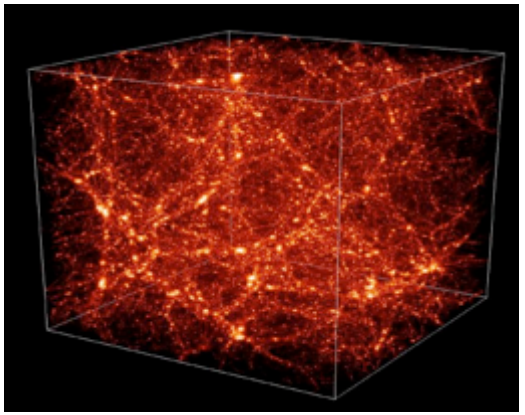
Permanent exhibition for general public

Scientific activities at LSM

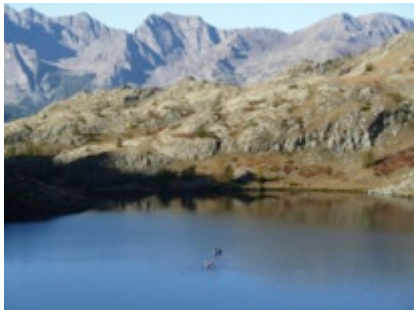


Creation of the matter

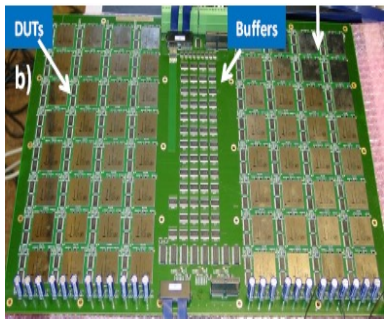
Search for Dark Matter



Evolution of Universe



Environment



Nano-electronics

Biology

Datation Bordeaux wine

And also :climatology, oceanography, Human effects on the environment, effets de l'homme sur l'environnement, glaciology, archeology,....

History of LSM

From a particle physics experiment to a multi-science plateform

1979 - 1981 | **1982- 1990** | **1990- 2000** | **2000 - ….**

Construction

τ_p Experiment

Proton decay

Prototypes → Experiments

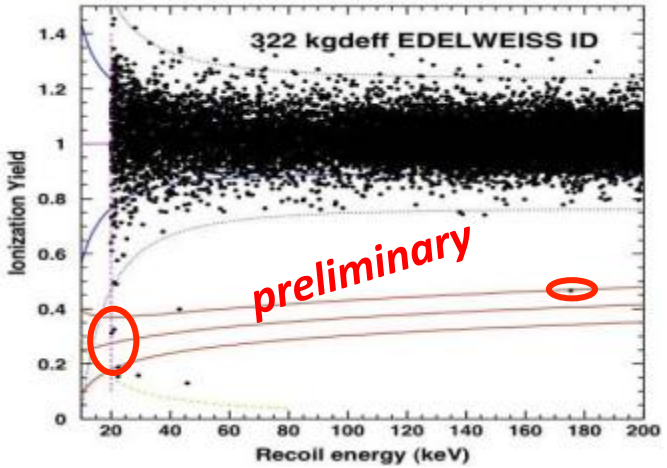
Neutrino: double beta decay, double EC
Dark matter
Nuclear structure

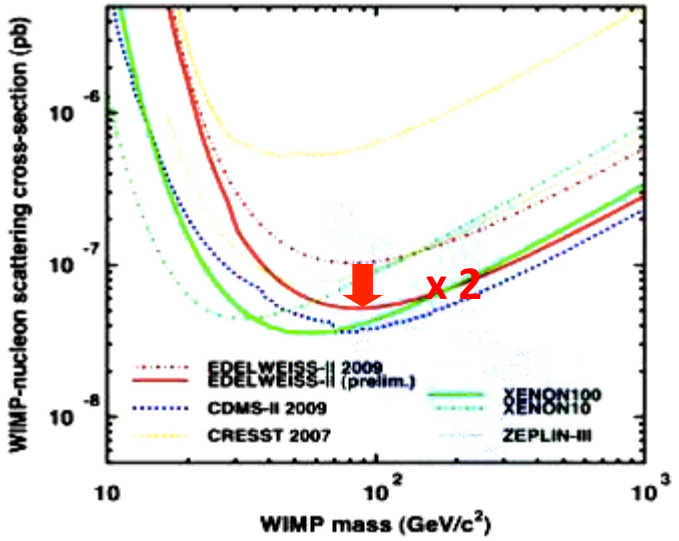
Ultra low radioactivity measurement:
Environmental sciences, applications, expertises

Logical test failures in microélectronics

EDELWEISS: Dark matter search

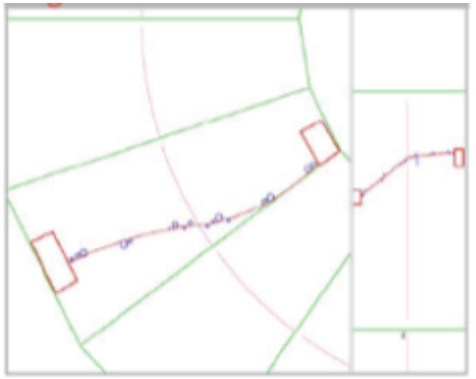
Bolometric technique: Heat + Ionization Ge crystals - 40 kg

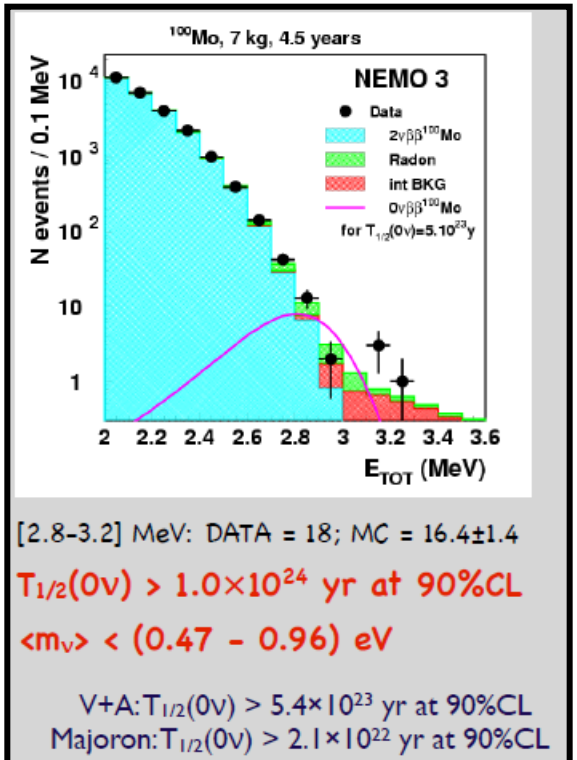




Double beta decay NEMO3 detector

Double beta decay : Tracking + calorimeter - ^{100}Mo 7 kg





[2.8-3.2] MeV: DATA = 18; MC = 16.4±1.4

$T_{1/2}(0\nu) > 1.0\times10^{24}$ yr at 90%CL

$\langle m_\nu \rangle < (0.47 - 0.96)$ eV

V+A: $T_{1/2}(0\nu) > 5.4\times10^{23}$ yr at 90%CL

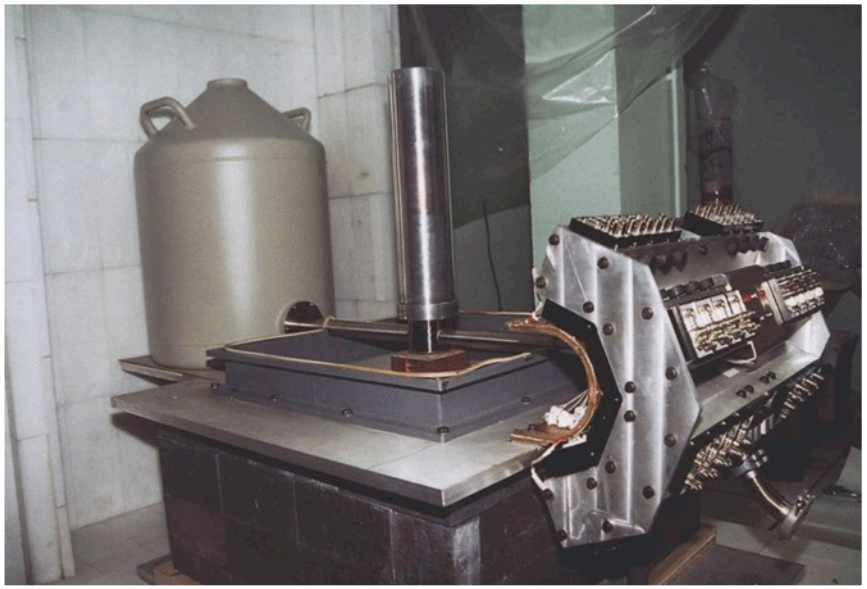
Majoron: $T_{1/2}(0\nu) > 2.1\times10^{22}$ yr at 90%CL

Dismantled, installation of SuperNEMO experiment in progress

Other experiments

Neutrino physics
Double EC search (^{106}Cd)
TGV-II (Ge with sheets of Double EC candidates)

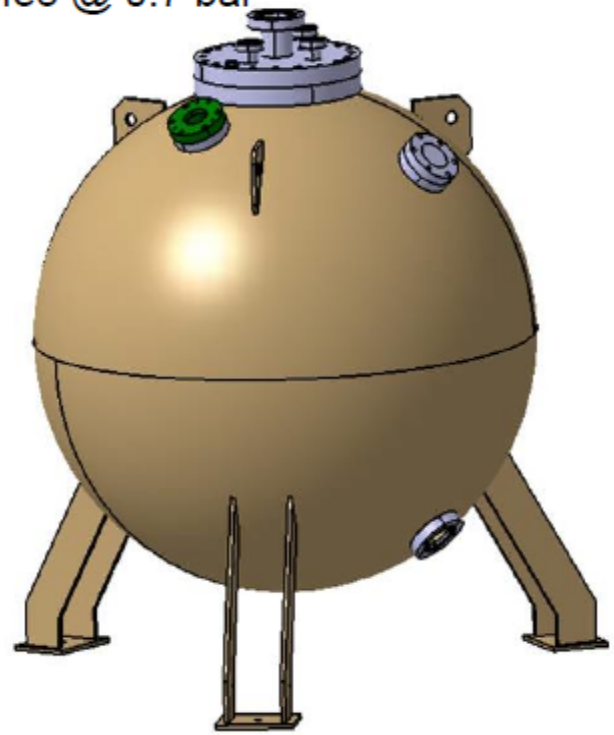
Nuclear physics
Super Heavy Element In nature
SHIN (osmium ore surrounded by ^{3}He neutron detectors)

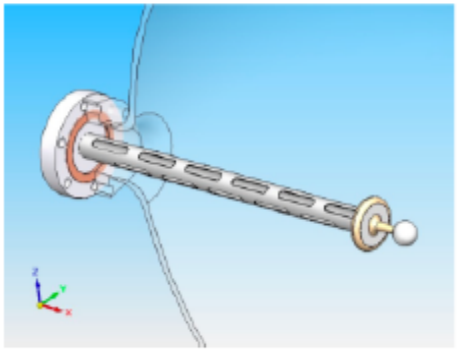


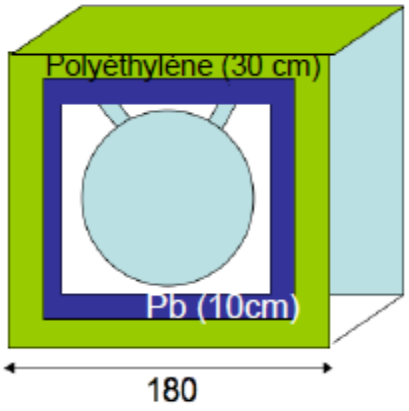
SEDINE: Dark matter search

- Sphere of 60 cm diameter in low activity Cu and steel
- Low activity material + low Rn emanation

-2 kg Ar @ 10 bar
-10 g He3 @ 0.7 bar







15

Radon-free air facility

Gamma-ray spectroscopy at LSM

15 HPGe from 7 different laboratories of CNRS , CEA, JINR DUBNA and CTU Prague are available at LSM

- Material selection for astroparticle physics,
- Environnemental research (oceanography, climat, retro-observation,….)
- Environmental survey
- Applications (wine datation, salt origin,…)
- Developements of Ge detector (ILIAS)

Use of the ulta-low gamma-ray spectroscopy

Radio-isotopes are used as tracers in the environment or as chronometers for dating of glacial or sedimentary layers.

They are used also for archaeological objects which sometimes require non-destructive measurements

Some exemples:

- Environmental survey

- Characterization the age of the suspended solids and pollutants associated with them in rivers

- Marine and continental geochemistry

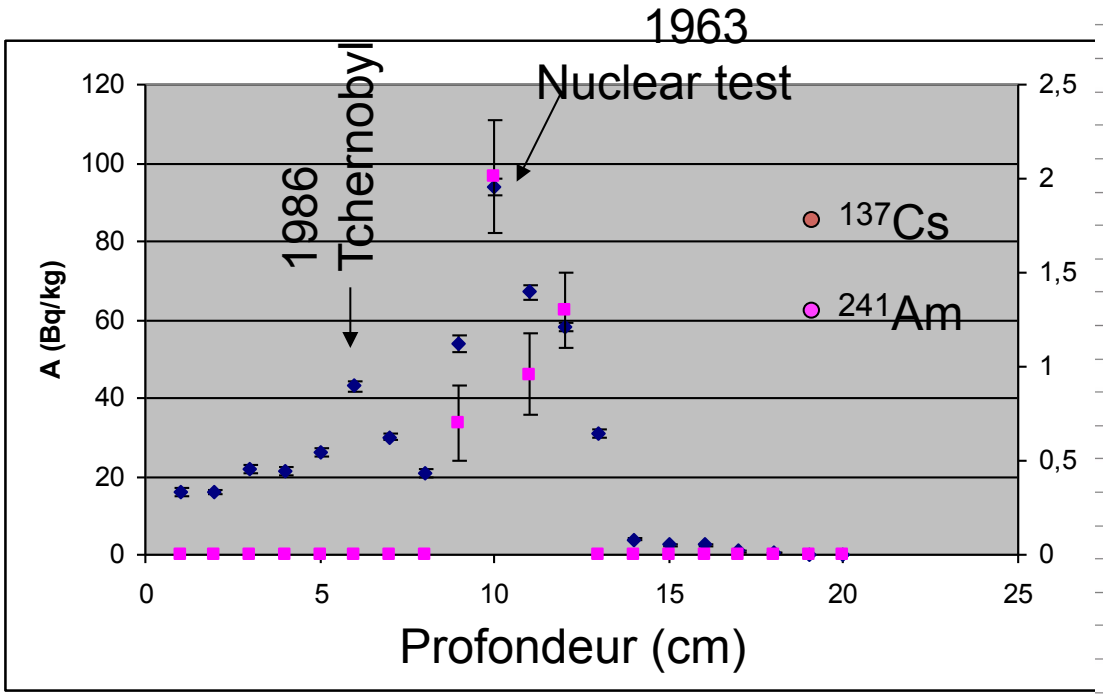
- Characterization of water masses, their origin and age in the ocean

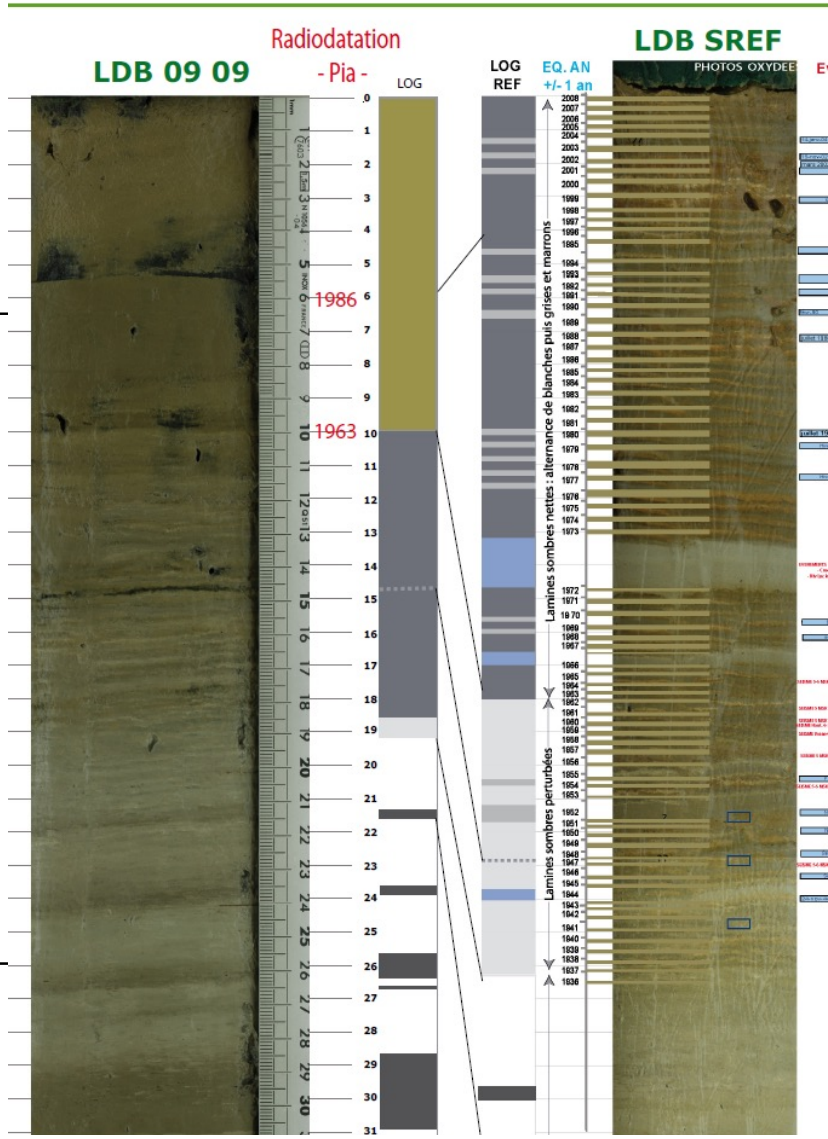
- Retro-observation (effects on human activities on the environment)

- Radioactivity in the atmosphere

Environmental researches

Datation of a carot from Bourget lake :





The scientific and societal usefulness of recent (< 250 years) Alpine lake sediment studies

An overview on LSM – Université de Savoie joint scientific progresses in paleolimnology

Fabien Arnaud
Charline Giguet-Covex
Bruno Wilhelm

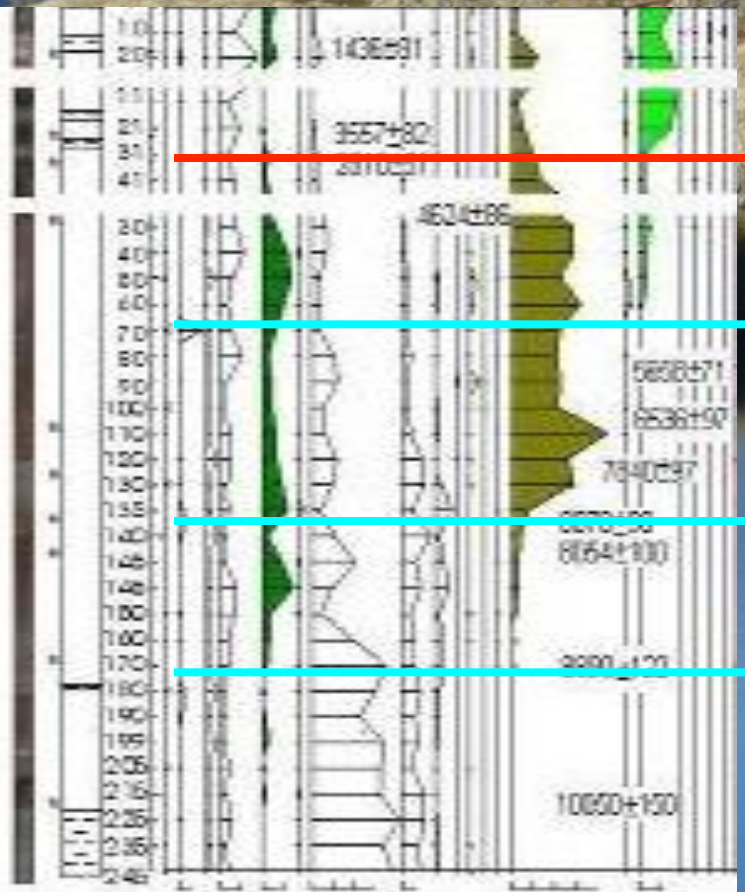
Jean-Louis Reyss

Marie-Elodie Perga

In Europe, even remote mountain landscapes are man-made

Noisetier Epicéa
Pin cembro Sapin

Pollen data, Villy, Haute Savoie, 2250m asl



Epicéa

3600 cal. BP

Pin cembro

Epicéa Sapin

5600 cal. BP

Pin cembro

Sapin

8000 cal. BP

Pin cembro

8900 cal. BP

Noisetier

Open space: deforestation

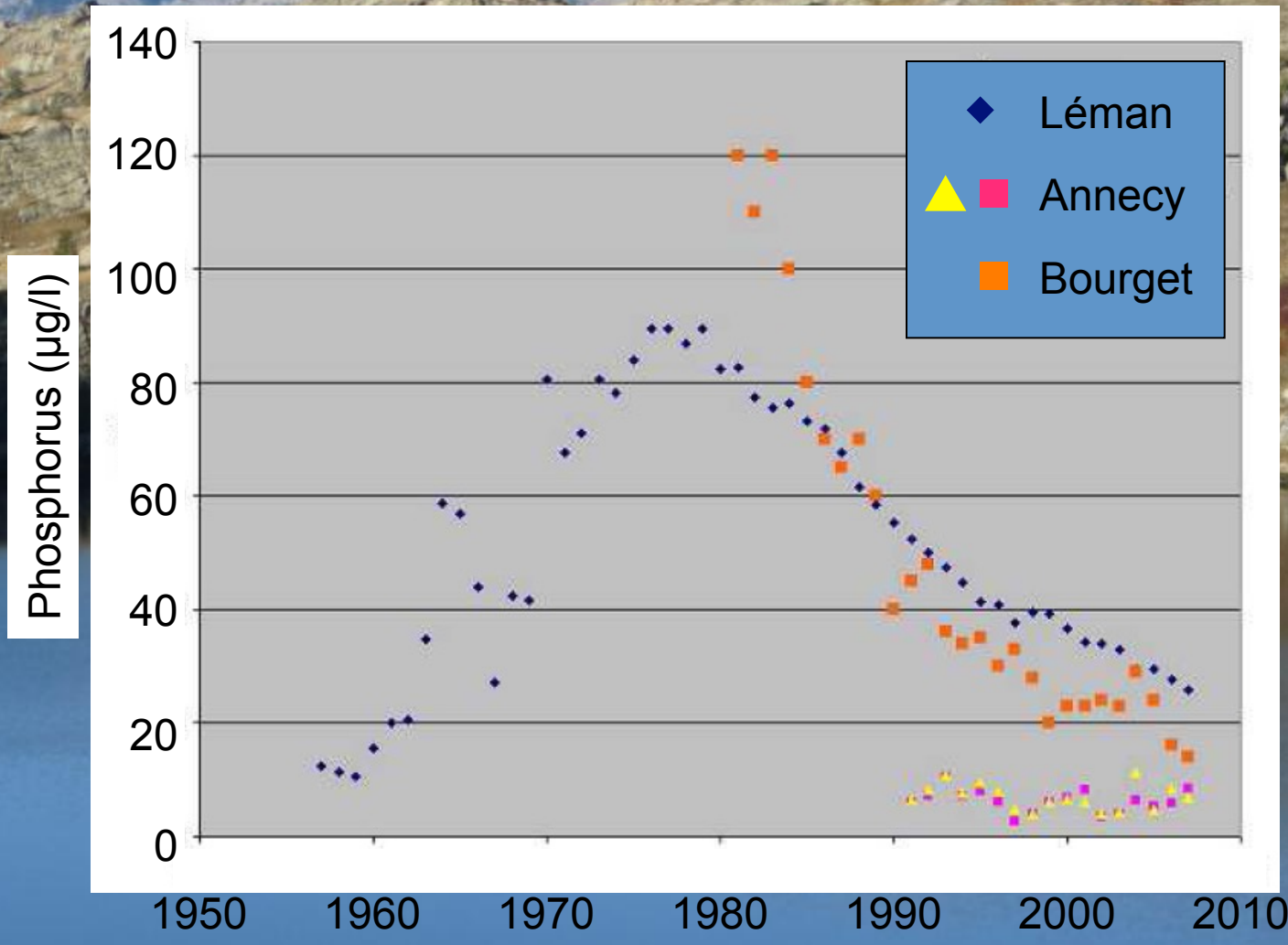
First forest opening (human or climate?)

Closing of the forest space

Forest reconquest

Current global changes are hard to assess due to lack in monitoring data

Phosphorus, brought by wasted waters, is one of the main nutrients responsible of the degradation of lacustrine ecosystems



Current global changes are hard to assess due to lack in monitoring data

Lake sediment may have archived some environmental variables (climate, trophic state, pollutant inputs, erosion etc.)

Their study may thus bring useful information to evaluate the effect of past land-use and the efficiency of management policies

From a scientific point of view, such a "retro-observation" is crucial to assess the intensity and kinetics of global changes compared to a measured (i.e. non-hypothetical) "reference state"

Environmental researches

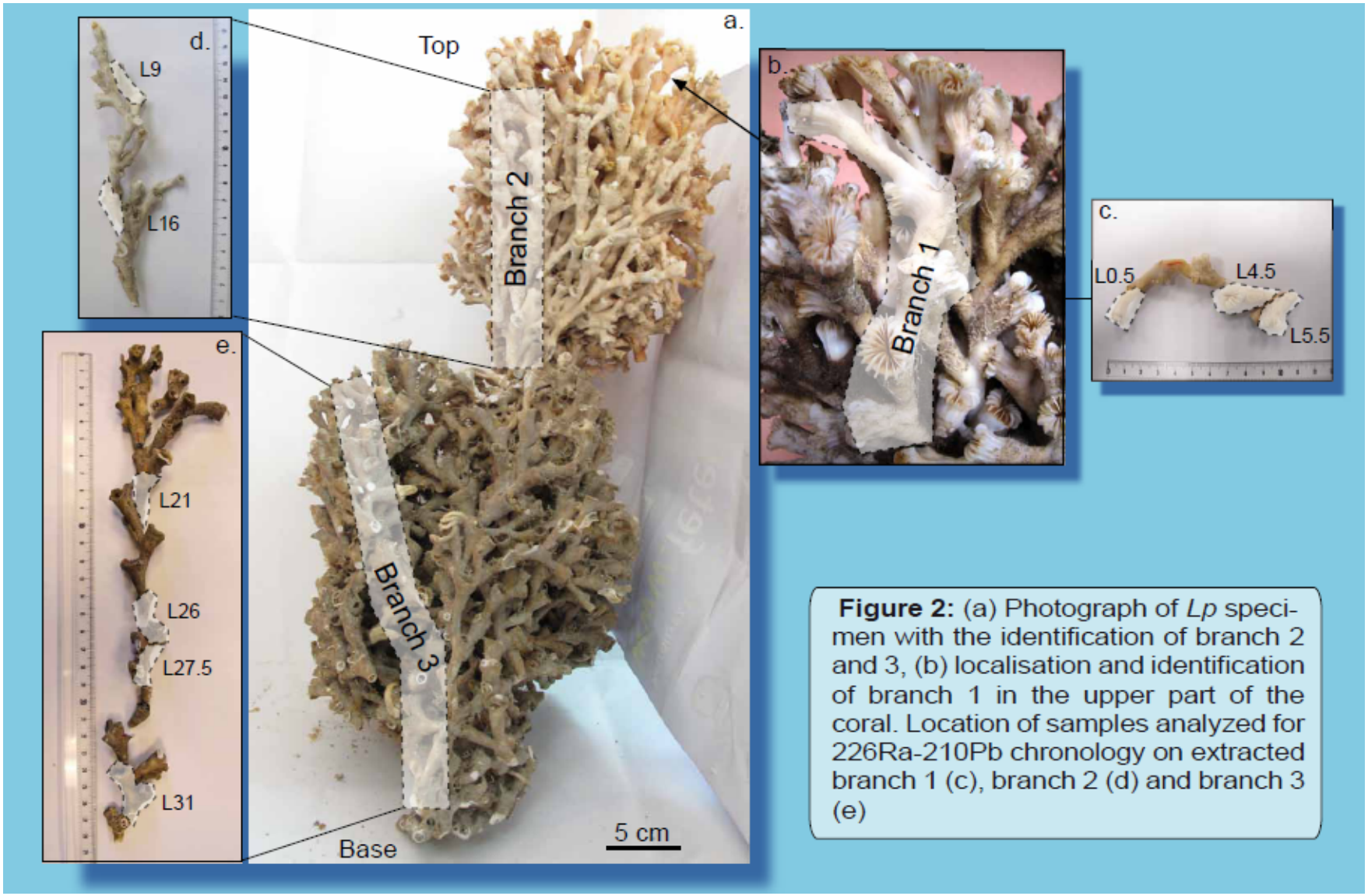
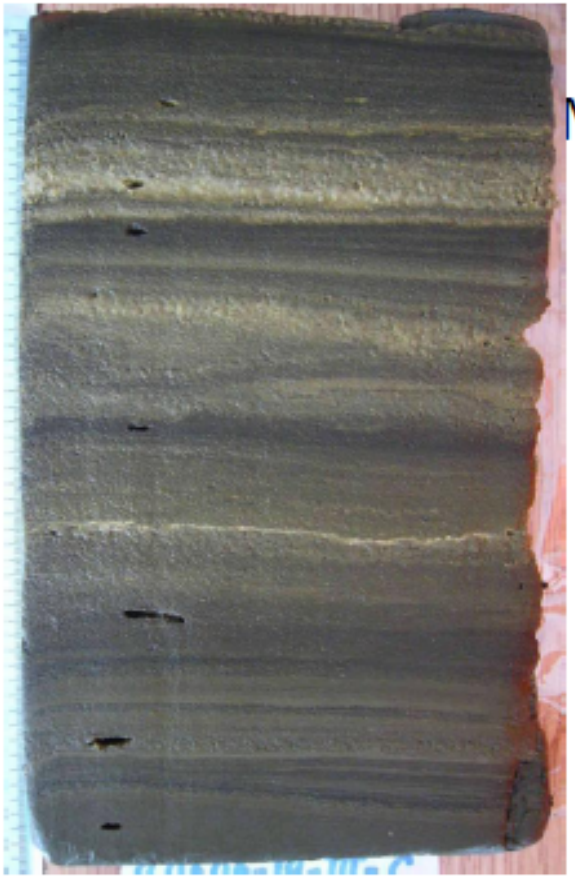


Figure 2: (a) Photograph of *Lp* specimen with the identification of branch 2 and 3, (b) localisation and identification of branch 1 in the upper part of the coral. Location of samples analyzed for 226Ra-210Pb chronology on extracted branch 1 (c), branch 2 (d) and branch 3 (e)

Deep-sea Coral are useful archives to study seasonnal, interannual and decadal paleoclimate changes using 120Pb, 226Ra, 230Th,14C

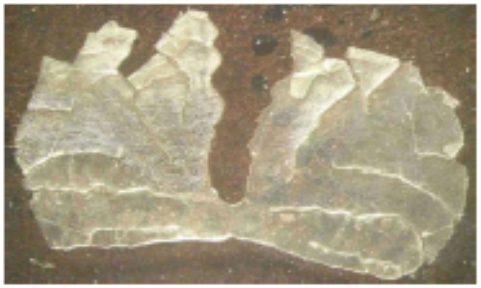
Environmental researches

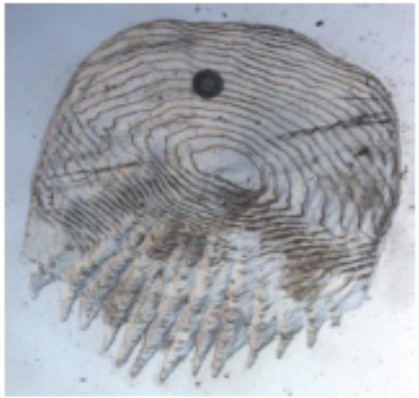


Multi-decadal to centennial scale variability in fish scale preservation and burial from marine laminated sediments off Pisco, Peru during the late Holocene

Salvatteci, R.

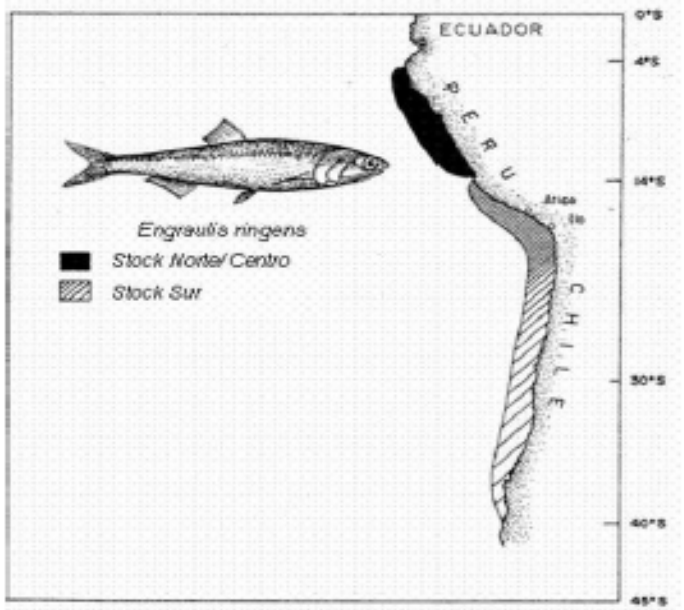
Paris, October 2010





Environmental researches

The Humboldt Upwelling Ecosystem is characterized by strong ENSO variability and the highest pelagic fish productivity



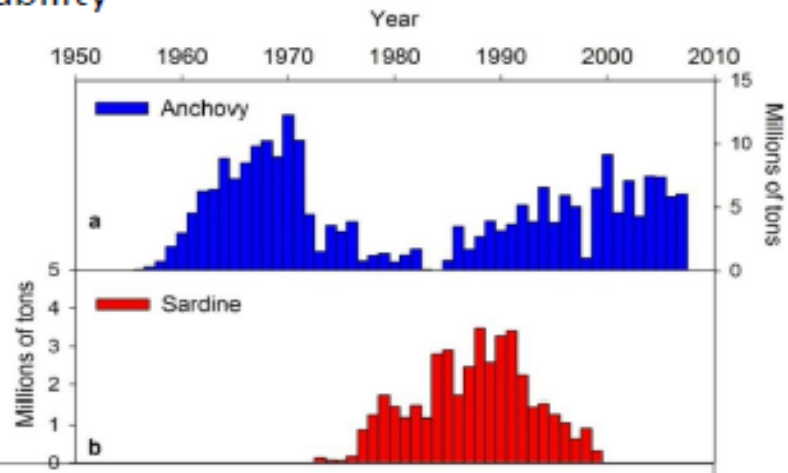
-Continuous coastal upwelling throughout the year

-The northern Humboldt Current System off Peru presently produces about 10% of the world fish catch based primarily on anchovy.

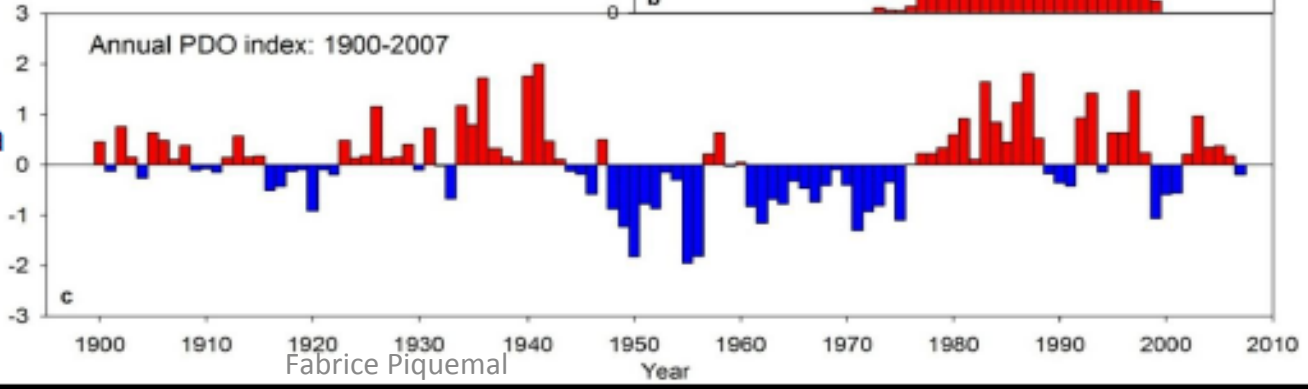
-Anchovy and sardine landings show strong annual and decadal biomass variability

Engraulis ringens

Sardinops sagax sagax

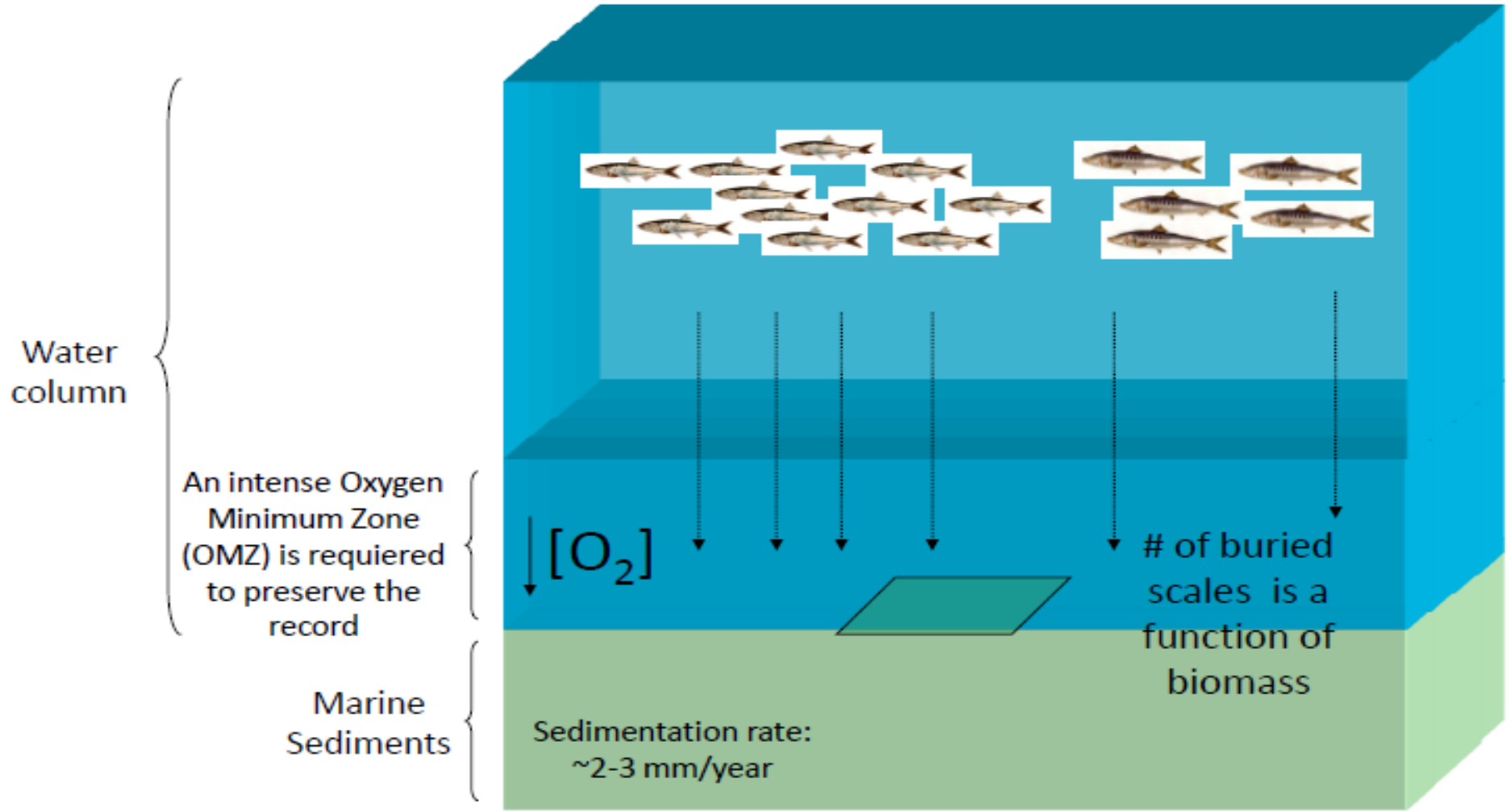


The Pacific Decadal Oscillation (PDO) Index is defined as the leading principal component of North Pacific monthly sea surface temperature variability (poleward of 20N for the 1900-93 period).

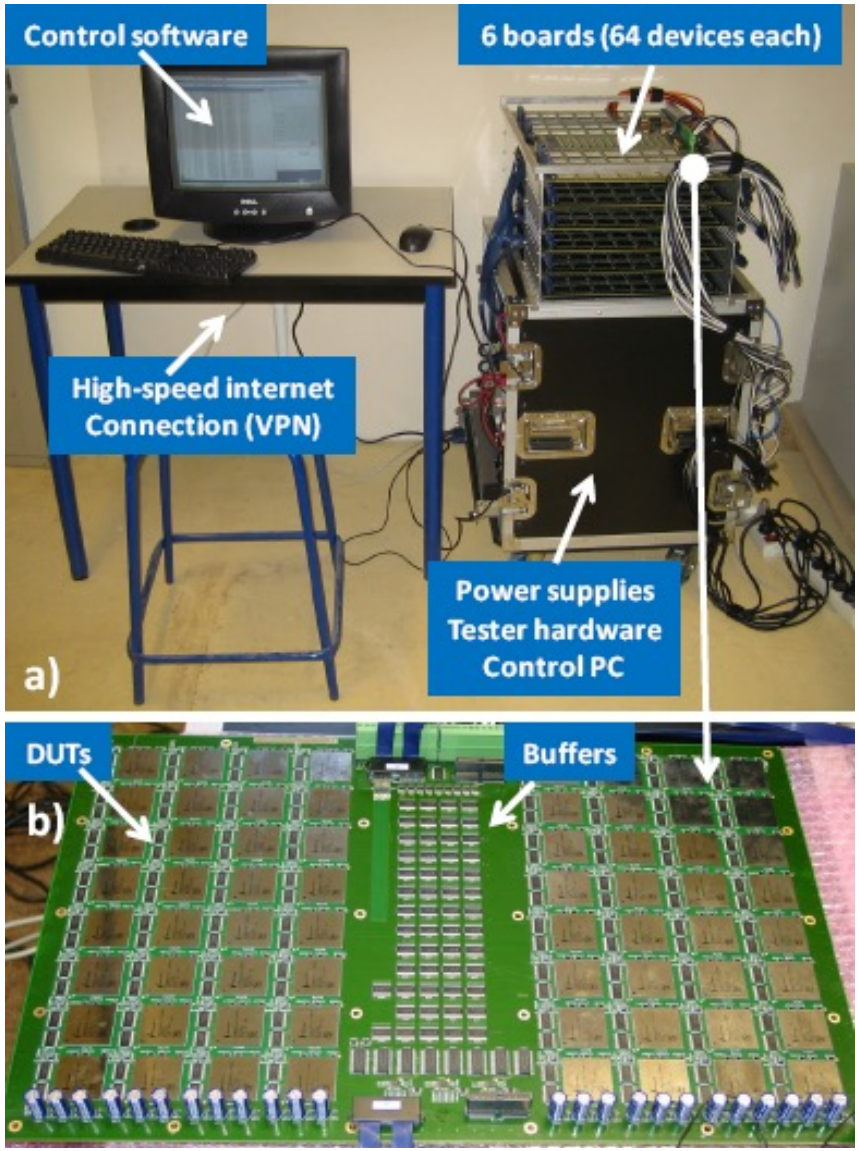


Environmental researches

Fish scales buried in marine laminated sediments can provide a record of population variability of small pelagic fishes prior to the development of the fisheries



Micro-electronics test failures



Neutrons and alpha natural radioactivity can lead to failures in micro-electronics circuits

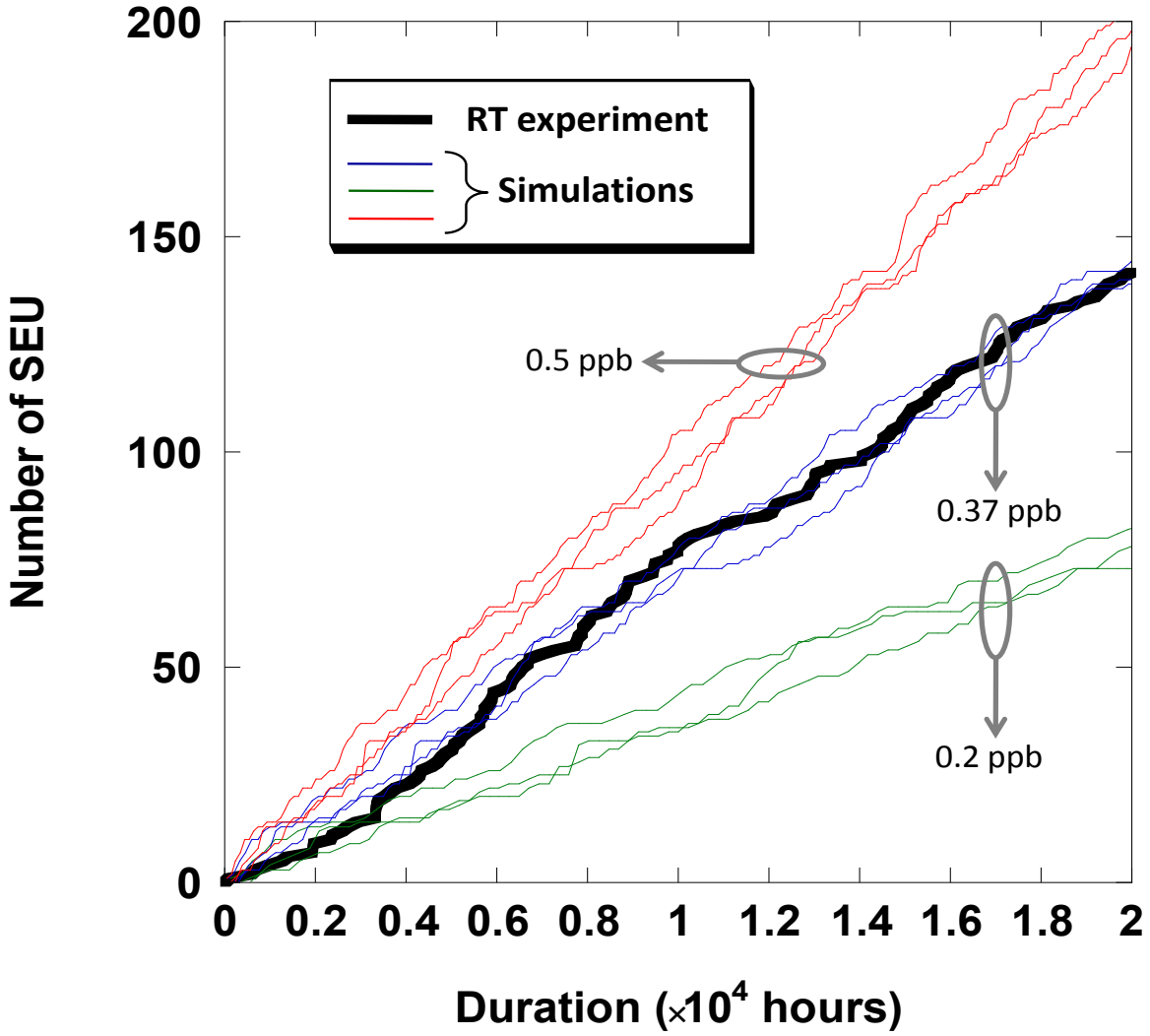
The use of « too radioactive » materials can Lead to major industrial accidents

LSM is reference laboratory for the international JEDEC norm for the tests of mirco-circuits resistance to radiation.

Environmental researches

Monte-Carlo Simulation of Underground Experiments

- Up to 20,000 h of cave characterization
- α-SER reevaluated to 2079 FIT/MBit
- Monte-Carlo simulation gives a contamination level by ^{238}U impurities of 0.37 ppb
- Very good agreement with wafer-level characterization (alpha emissivity) in the range [0.2-0.5] ppb



Biology

- **Modeling the impact of radiation on living cells: Geant4 DNA**
- **Validation: need for relevant observables to characterize biological systems**
  - Cell survival rate
  - DNA single or double strain breaks
  - Molecular biology: genomic mutations, gene expression
- **Experimental protocol: compare observables after controlled radiation exposure**
  - In normal lab conditions
  - After beam irradiation (γ, e-, p, α)
  - Need for a reference point at zero-radiation: Modane

Biologists, computer scientists
Physicists, chemists

Geant4 DNA

Biology

- **In normal lab conditions, cultures are exposed to 10 Millions cosmic rays per day per square meter**
  - Low but significant radiation exposure
- **In Modane, down to 4 cosmic rays per day per square meter**
- **Goal: study evolution of model organisms in radiation free environment**
  - Bacteria life cycle
  - Mutation rate
  - Localization of gene mutations, gene expression
  - DNA breaks

Interdisciplinary@LSM

Applications :

- Charaterisation of water (lake, river, underground water) EU directive

-For drug and food administration ex. wine dating, marine salt origin

- Judicial expertises

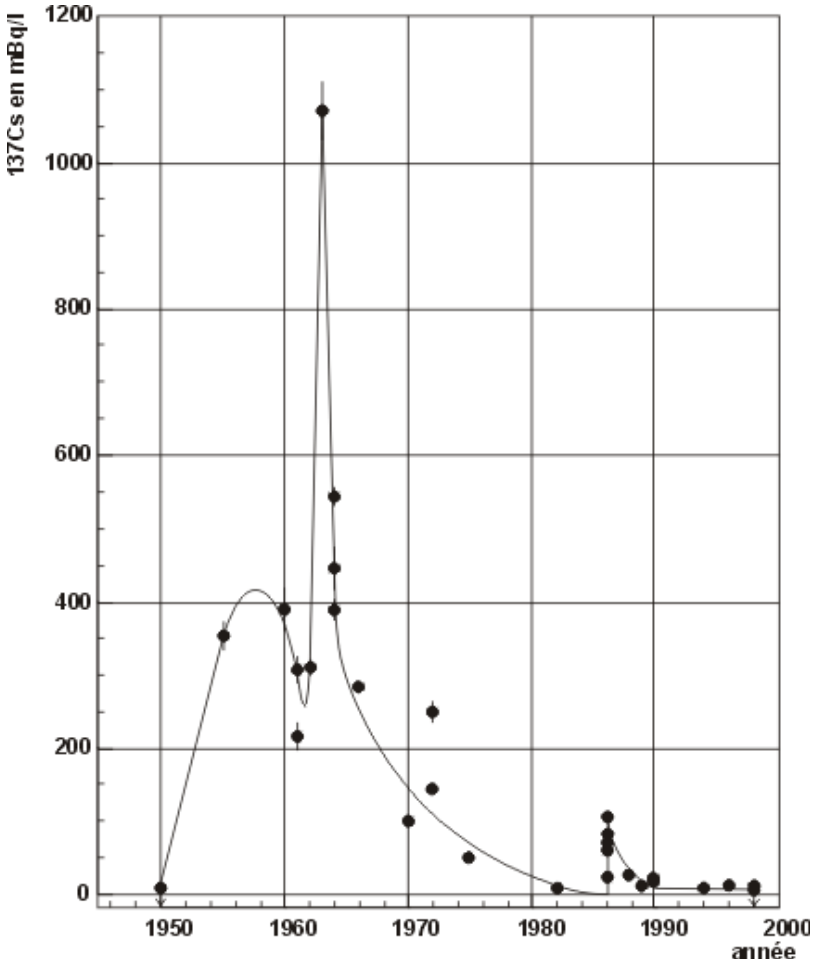
- Mean age of crustacean livestock for fishing regulation

- ……

Development of a national ultra-low radioactivity platform measurements with

EDYTEM (University of Savoie/CNRS), LGGE (University of Grenoble / CNRS), LSCE (CNRS/CEA), LPSC (University of Grenoble / CNRS) and LSM

Application: wine dating



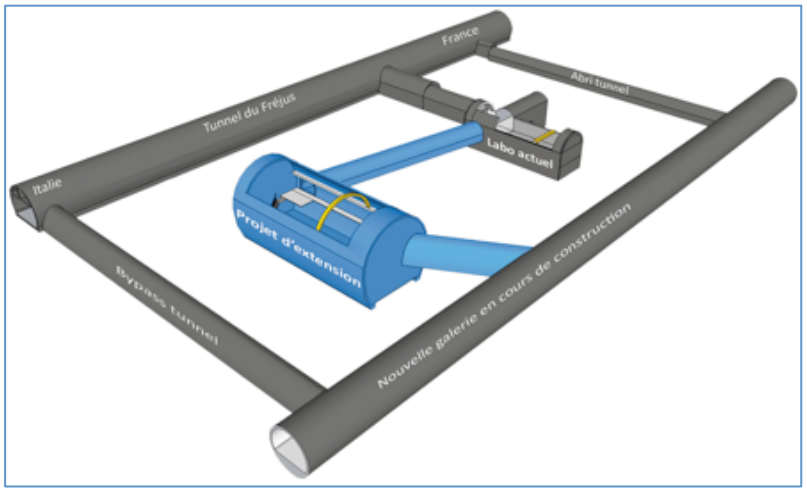
137Cs measurement

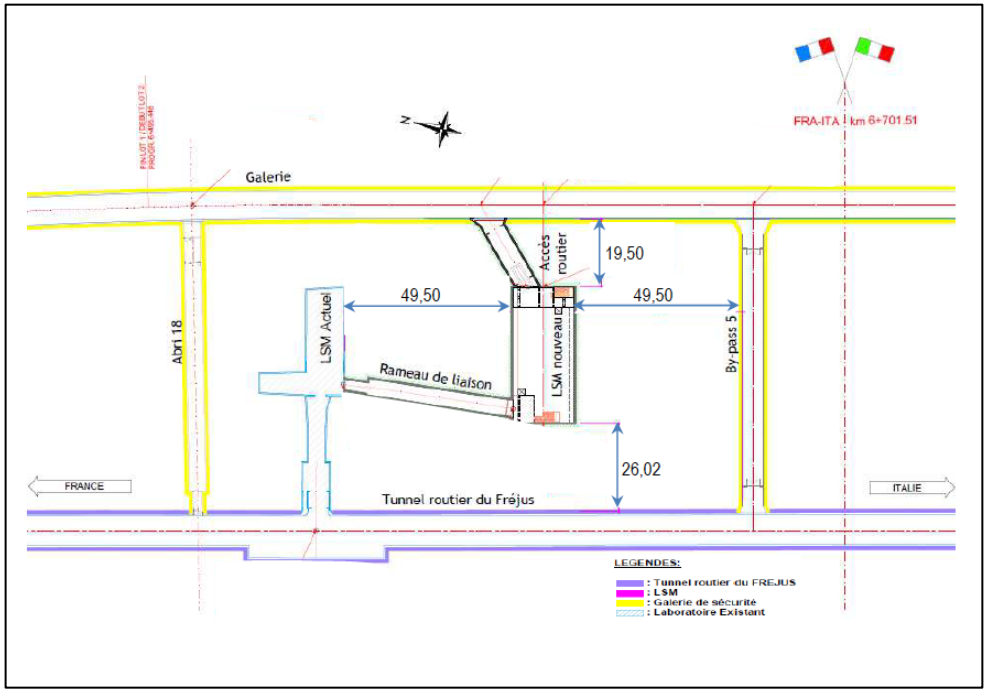
(Ph. Hubert CENBG)

Studies for a possible extension

Next generation of underground astroparticle physics requires more space

DOMUS extension project 14 000 m^3 (X4 present LSM)





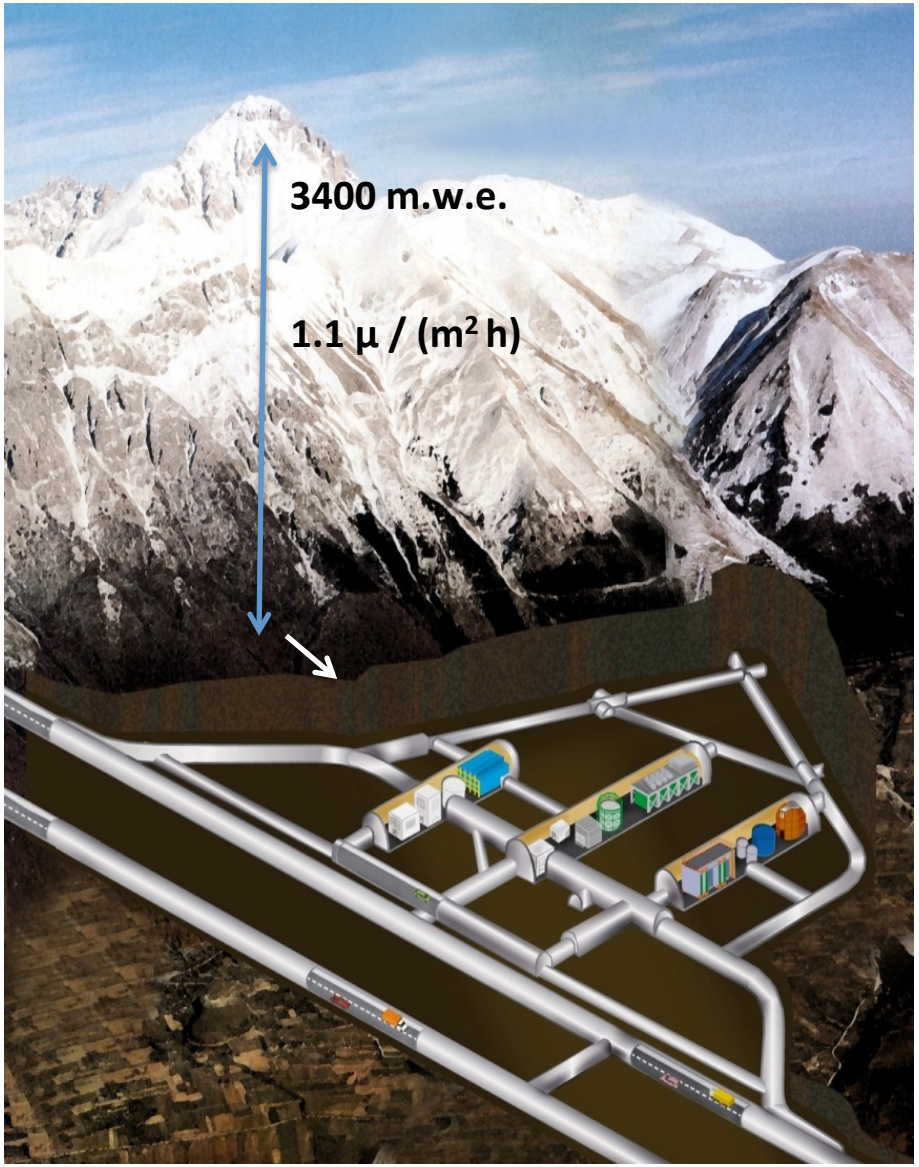
Cavity: Length 40 m,width18 m, height 16 m

3D simulations to anticipate effect on existing structures
Study of rock mechanical properties of the possible place of the extension
2 drilling of 70 m

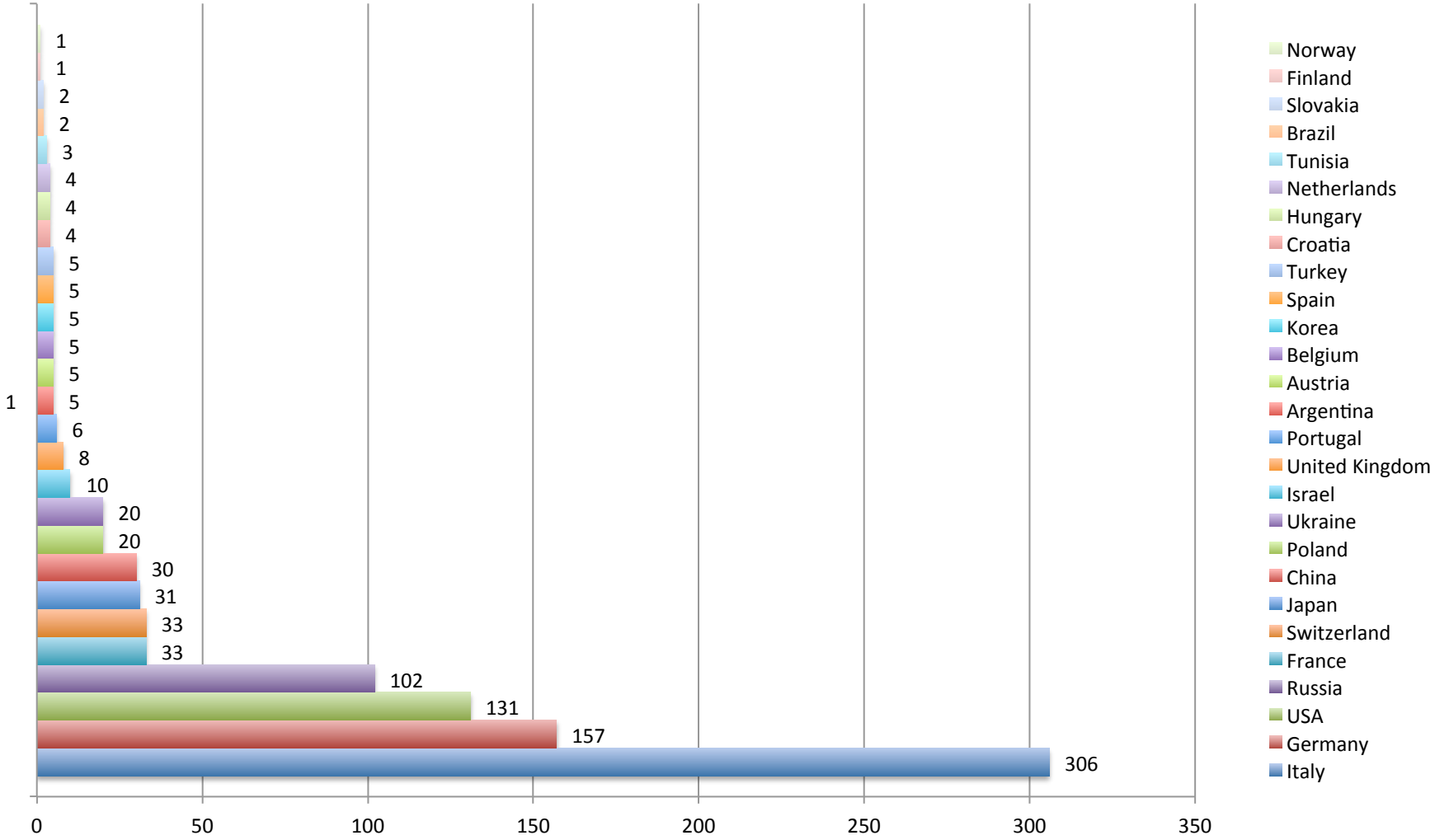
Laboratori Nazionali del Gran Sasso (LNGS)

Laboratori Nazionali del Gran Sasso

- Muon flux: 3.0 10^{-4} $m^{-2}s^{-1}$
- Neutron flux:
  2.92 10^{-6} $cm^{-2}s^{-1}$ (0-1 keV)
  0.86 10^{-6} $cm^{-2}s^{-1}$ (> 1 keV)
- Rn in air: 20-80 Bq m^{-3}
- **Surface: 17 800 m^2**
- **Volume: 180 000 m^3**
- Ventilation: 1 vol / 3.5 hours
- **Mechanical Design and Workshop**
- **Electronics Lab & Service**
- **Chemistry Lab & Service**
- **ULB Lab & Service**
- > 900 users from 29 countries
- ~ 100 Staff
- 225 avg. daily presence in 2014
- ~ 8000 visitors/y
- Virtual tour via Street View



LNGS Users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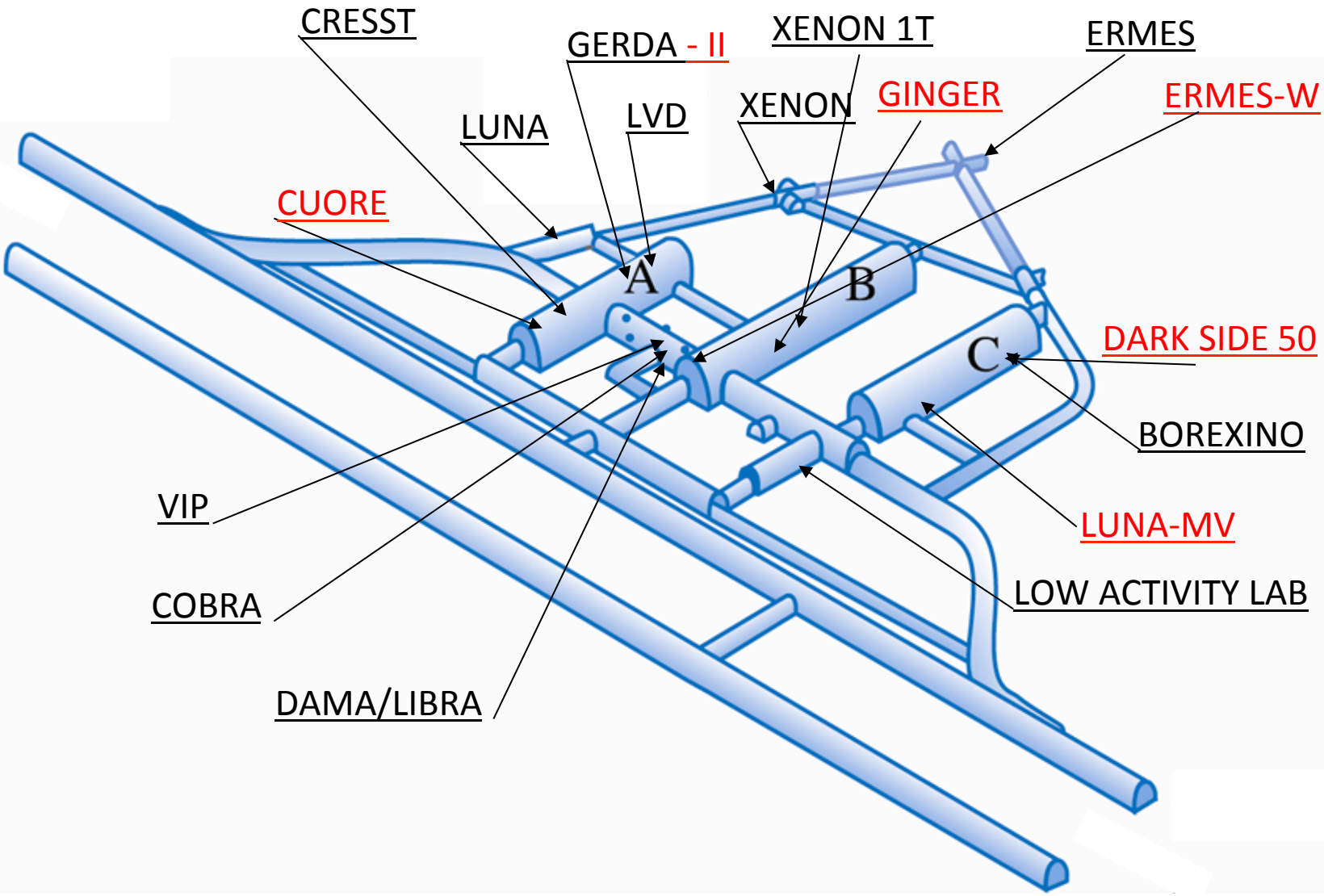
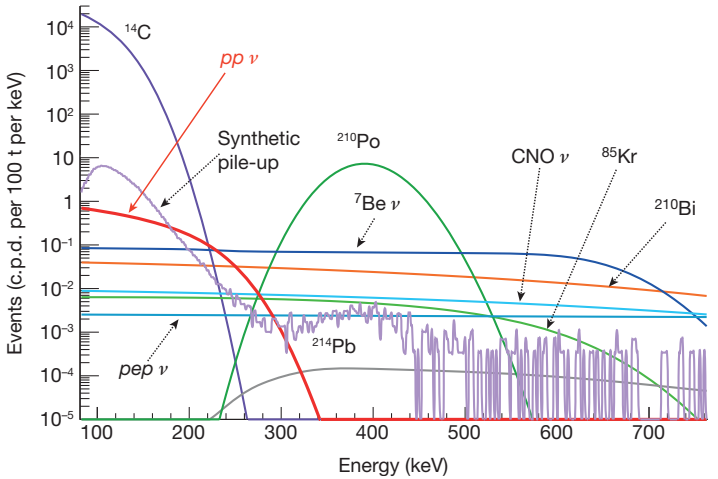
31
33
33
102
131
157
306
0
50
100
150
200
250
300
350
Norway
Finland
Slovakia
Brazil
Tunisia
Netherlands
Hungary
Croatia
Turkey
Spain
Korea
Belgium
Austria
Argentina
Portugal
United Kingdom
Israel
Ukraine
Poland
China
Japan
Switzerland
France
Russia
USA
Germany
Italy

LNGS Activities



LNGS Neutrino

- SN neutrino:
  - LVD 1 kton liquid scint. Waiting for SN since 1992
- Solar Neutrino:
  - Borexino: real-time measurement of pp neutrino, …, Geo-neutrinos
- Double Beta Decay
  - Gerda / Gerda-II: ^{76}Ge
  - CUORE – *the coldest m^3 in the world* : ^{130}Te
  - Cobra: ^{116}Cd
  - LUCIFER: R&D phase on crystals
- Sterile Neutrino
  - Borexino-SOX (CeSOX first)

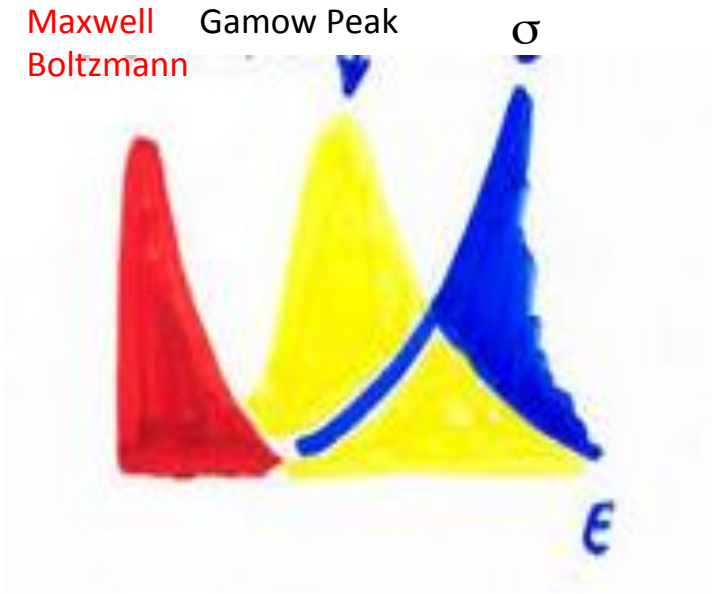


LNGS Dark Matter

- DAMA/Libra: NaI
  - Reports annual modulation
- NaI
  - INFN-LNGS is going to support independent test of DAMA result
- CRESST
  - $CaWO_4$ scint with bolometric r/o
- XENON family
  - Double phase liquid Xe TPC
- DarkSide
  - Liquid Ar TPC double phase

LNGS Nuclear Astrophysics

- LUNA-400 – LUNA-MV
  - Measurement of small x-section relevant to Nucleosynthesis
  - LUNA-MV upgraded with intense C-beam



- Solar neutrinos:
  - $^{3}He(^{3}He,2p)^{4}He$, $^{3}He(^{4}He,\gamma)^{7}Be$, $^{14}N(p,\gamma)^{15}O$
- Age of globular cluster:
  - $^{14}N(p,\gamma)^{15}O$
- Light nuclei nucleosynthesis
  - $^{15}N(p,\gamma)^{16}O$, $^{17}N(p,\gamma)^{18}O$, $^{25}Mg(p,\gamma)^{26}Al$
- Big Bang Nucleosynthesis:
  - $^{2}H(\alpha,\gamma)^{6}Li$, $^{3}He(^{4}He,\gamma)^{7}Be$, $^{2}H(p,\gamma)^{3}He$

- Next:
- Light nuclei nucleosynthesis:
  - $^{17}O(p,\alpha)^{14}N$, $^{22}Ne(p,\gamma)^{23}Na$, $^{23}Na(p,\gamma)^{24}Mg$, $^{18}O(p,\gamma)^{19}F$, $^{18}O(p,\alpha)^{15}N$
- He burning and stellar evolution:
  - $^{12}C(\alpha,\gamma)^{16}O$
- s process nucleosynthesis:
  - $^{13}C(\alpha,n)^{16}O$, $^{22}Ne(\alpha,n)^{25}Mg$

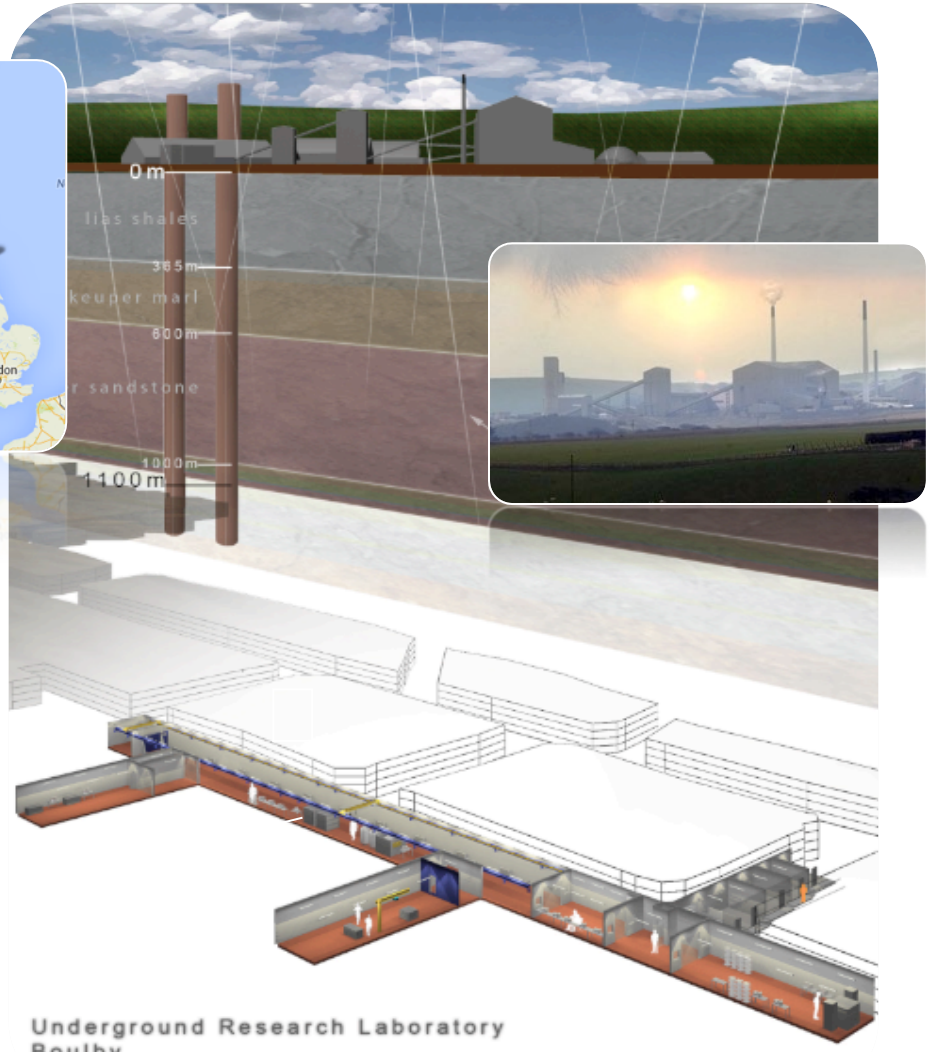
Boulby Underground Laboratory (BUL)

Boulby Underground Laboratory

The UK's deep underground science facility operating in a working potash and salt mine.

1.1km depth (2805 mwe). With low background surrounding rock-salt

Operated by the UK's Science & Technology Facilities Council (STFC) in partnership with the mine operators ICL



Boulby Palmer lab. >800m^2 floor space. Operating since 2001

S.M.Paling - Boulby@stfc.ac.uk

How does Boulby compare?

What Makes Boulby Special?

Requirements for an underground laboratory... 1.1 km deep (2,850+/-20 mwe)
CR muons attenuated by ~10^6
$(3.79\pm0.15)\times10^{-8}$ $cm^{-2}s^{-1}$

Low Backgrounds
- **Deep (to shield from cosmic rays)**
- **Low background rock/lab (and/or adequate shielding)**

Salt = low in U/Th (67±6/125±10ppb)
→ Low gamma & neutron backgrounds
→ Low Radon (<3Bq/m^3)

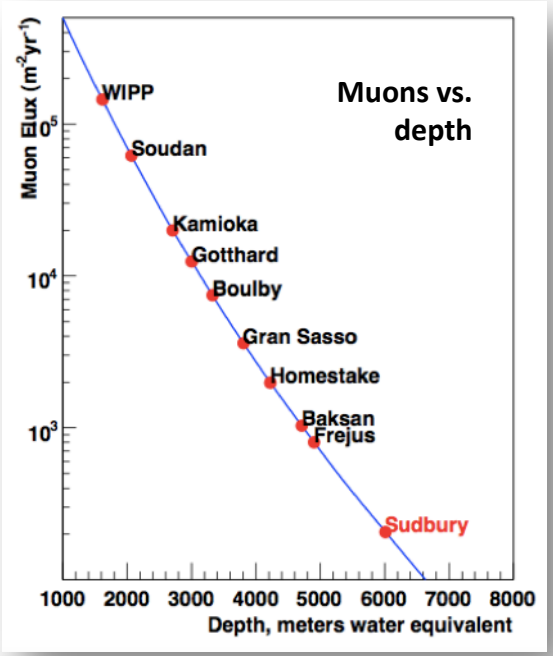
Plenty of Laboratory space — >1000 m^2 existing lab space & **excellent potential for expansion.**

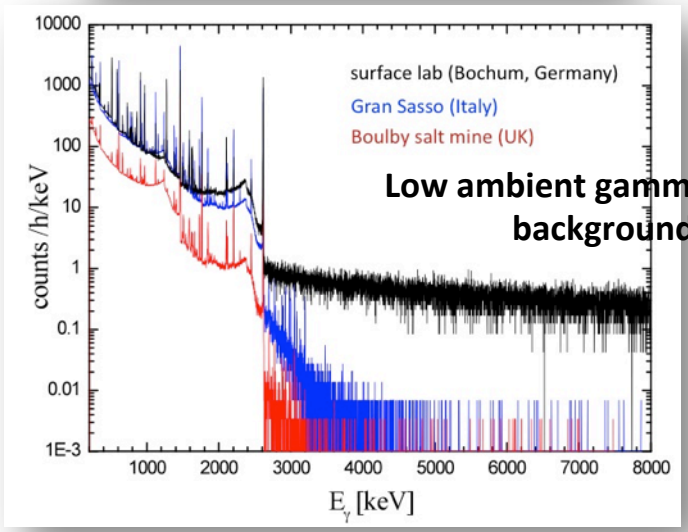
Easy access for equipment — Via mine shaft (5m diam. – 2×2×2m cage) + Transport underground

Proximity of services / civilisation — 20 min → Whitby, Saltburn
1 hr → York, Leeds, Middleborough
< 5 hrs → London, Manchester etc.

Good infrastructure + support
- JIF Underground & surface facilities
- **Wide-ranging support from mine operators (Cleveland Potash Ltd)**

A unique science / industry partnership





- **<u>VERY low</u> ambient Radon background: <u><3 Bq/m^3</u>**
- **<u>Low</u> ambient gamma backgrounds**
- **Interesting geology: Permian evaporite NaCl**
- **Operations well-supported by mine owners ICL**

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Underground Science @ Boulby Mine

- DRIFT: Directional Dark Matter Search
- DM Ice: NaI(TI) Dark Matter detector
- Ultra-low background material screening
- Deep Carbon: Muon Tomography for CCS (etc)
- ERSaB: Environmental gamma spectroscopy
- BISAL: Geomicrobiology / Astrobiology studies
- MINAR: Space Exploration Tech. Development
- Misc. Geology / Geoscience
- Misc. Low-background support projects
- Etc... (More to come).

Science & Technology Facilities Council

A growing **multi-disciplinary** science programme: from astro-particle physics to studies of geology, climate, the environment, life on Earth & beyond.

BOULBY UNDERGROUND LABORATORY

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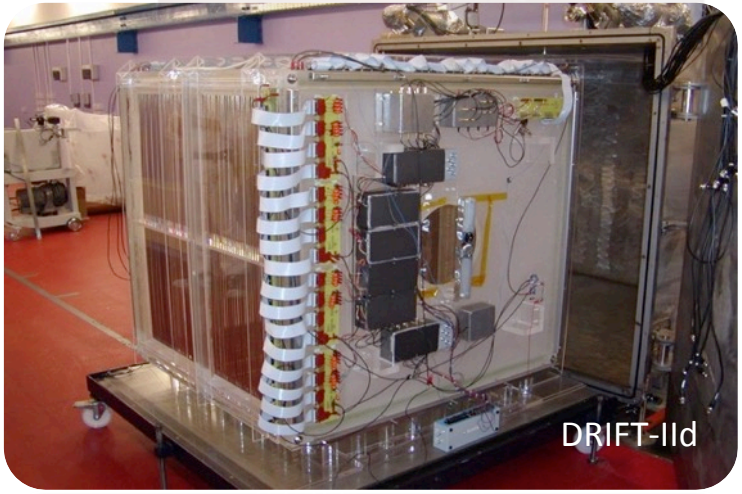
Boulby Dark Matter Studies

Boulby has hosted Dark Matter search studies for two decades. Including the NAIAD, DRIFT & ZEPLIN experiment programmes.

Boulby now hosts two on-site dark matter studies (**DRIFT** & **DM-Ice**) & provides ULB material screening for other studies, inc **LUX-ZEPLIN**

ZEPLIN: *The world's first 2-phase Xenon dark matter detector (Finished 2011)*

Wisconsin, Yale, FNAL, Illinois, Alberta, Sheffield, Boulby



DM-Ice: 250kg NaI(Tl) array for studying WIMP annual modulation

DRIFT: Negative Ion drift low pressure TPC ***directional*** dark matter detector

Occidental College, New Mexico, Colorado State, Hawaii, Wesley Coll. Sheffield, Edinburgh, Boulby

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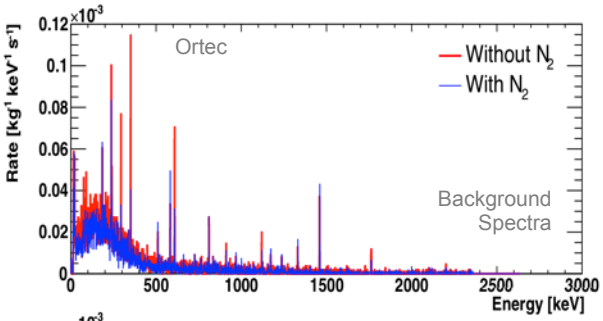
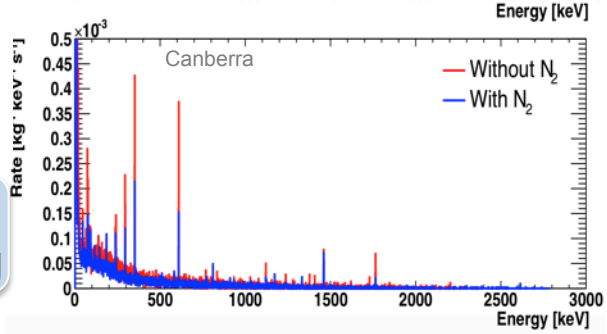
ULB Material Screening

Growing suite of Ultra-Low-Background germanium detector systems to support Dark Matter & misc ‘rare-event’ studies…

- Ortec 2kg Coax (90% eff).
- Canberra BEGe detector
- Canberra SAGe Well-type



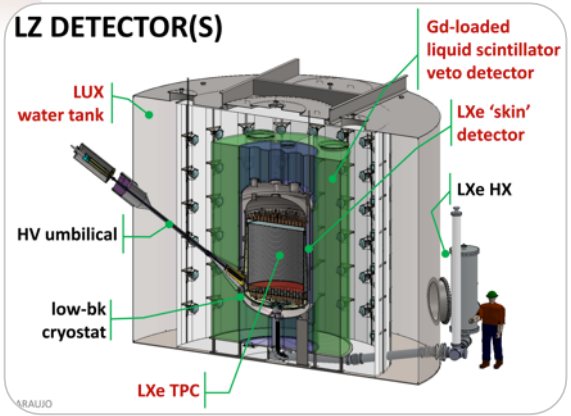


Sensitivity down to 50ppt U/Th per sample, & improving

Ultra Low background counting studies supporting UK DM (**LZ**) & 0nuBB communities.

Now **EXPANDING** low BG counting capabilities to meet international demand.

Working in collaboration with UCL, Oxford, STFC-RAL



Boulby undertaking major role in material selection for **LUX-ZEPLIN**

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A NEW LABORATORY now being built at Boulby

To replace current facility and host **planned & new projects** for the next decade and more…

Science & Technology Facilities Council

BOULBY UNDERGROUND LABORATORY

Project completion date: end 2015

Mars Analogue Area & outside testing area

Materials Entrance 1

Materials Entrance 2

Main hall: Internal Lab height/width of 4m/7m

Offices & People Entrance

Material Store

Low Background laboratory

Large Expt. Cave Area: Internal lab height/ width of 6m/7m

50m

Fully-equipped 1000m^2 lab. Class 10K & 1K clean room throughout. 5-10T lifting capacity.

S.M.Paling - Boulby@stfc.ac.uk

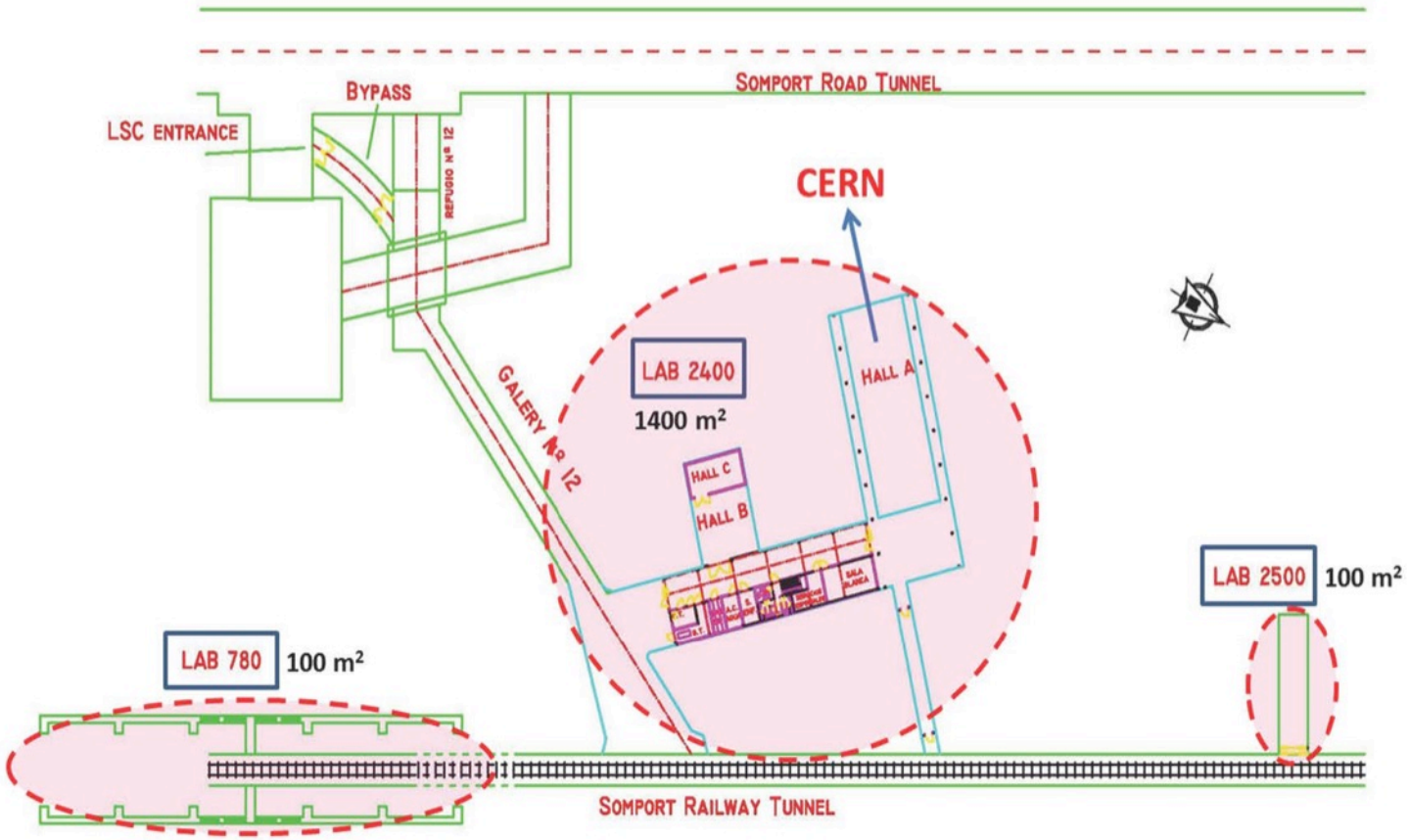
Canfranc Underground Laboratory (LSC)

LSC External building and Hall A

Headquarters & Administration
Safety and Quality Assurance
16 offices for scientific users
7 offices for LSC personnel
4 specialised laboratories
Mechanical workshop & storage room
Meeting room & Library
Conference room& Exhibitions room
2 apartments

Personnel: 10 units
Budget:≈ 1.6 M€/yr
Users: 275 (19 countries)
Visits (2014): 966

LSC Underground Layout



Experiments @ LSC

- ✓ ANAIS — DM (NaI, Annual modul. - operational)
- ✓ ROSEBUD — DM (Scintill. Bolometers – stopped)
- ✓ ArDM — DM (2phase Ar TPC – operational)
- ✓ NEXT — $0\nu2\beta$ (Enr ^{136}Xe gas TPC – prototype commissioning)
- ✓ BiPo — $0\nu2\beta$ (screening for S-NEMO – operational)
- ✓ SuperK-Gd — screening for Super-K-Gd – operational
- ✓ GEODYN — Geodynamics – operational

Expressions of Interest under review

- ✓CUNA — Nuclear astrophysics
  - ✓New 300 m^2 facility in project
- ✓GOLLUM — Characterising subterranean bacterial

Services

On surface

- ✓ Chemistry

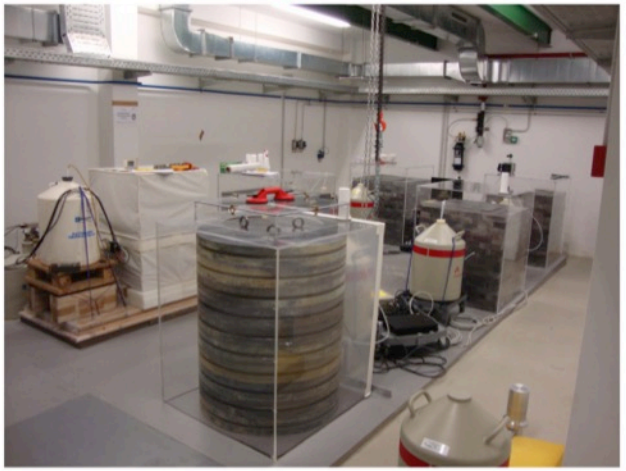
Electroforming and Environmental analyses

- ✓ Mechanics
- ✓ Electronics
- ✓ Computers&Network

Underground

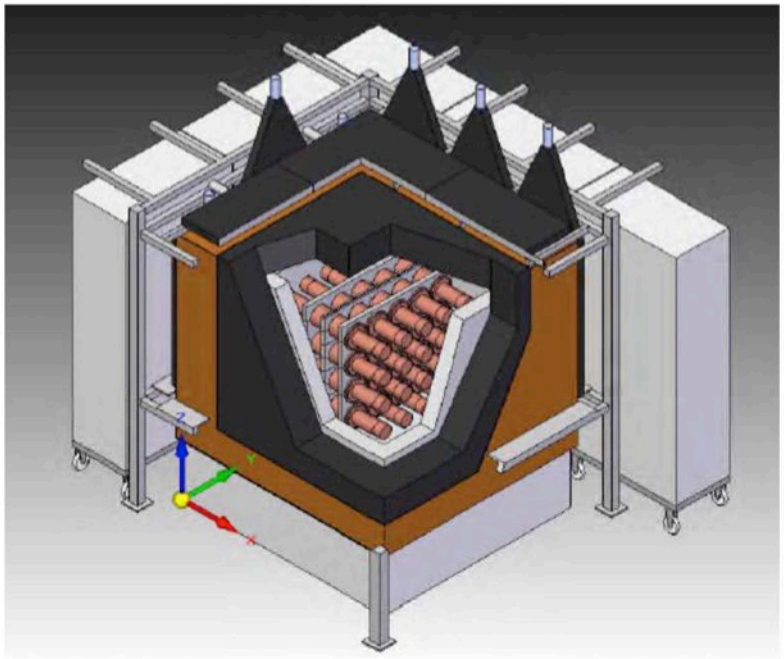
- ✓ Low activity (screening) 7 HpGe counters and related analysis software
- ✓ Clean room ISO 7 and 6 & mechanical shop
- ✓ Rock stability in experimental Halls and other locations
  - convergence
  - monitoring

Low activity 7 HP Ge



Direct Dark Matter Searches @ LSC

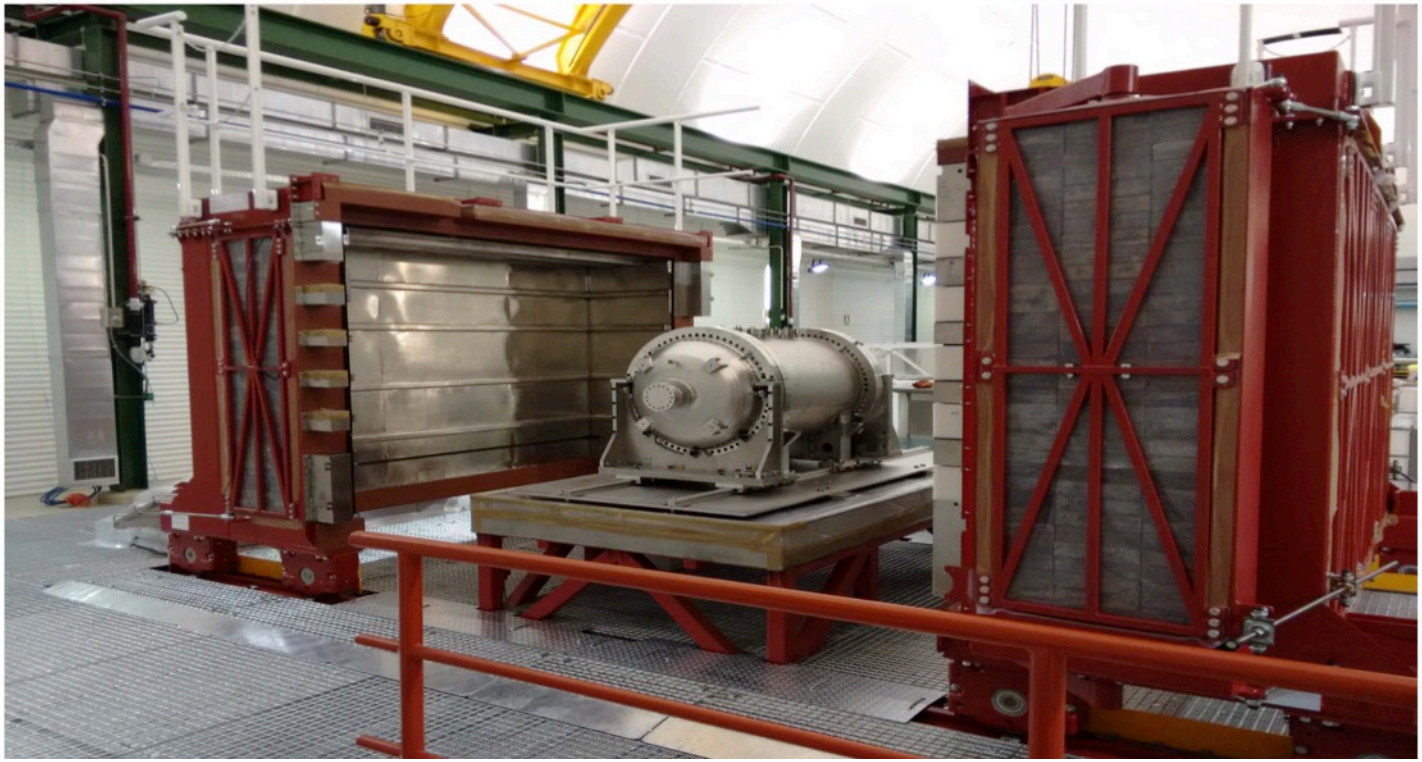
ANAIS NaI(Tl) crystals array
for annual modulation measurement



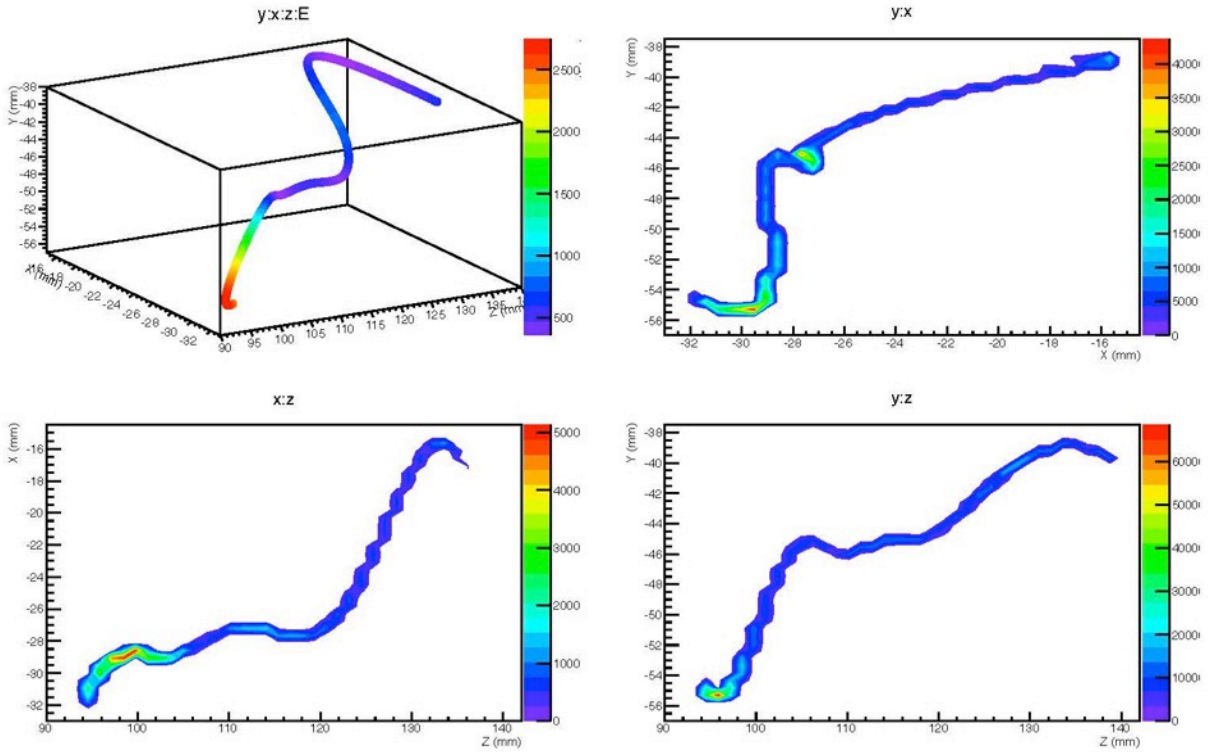
ArDM liquid argon TPC to
measure dark matter
induced nuclear recoils

Double Beta Decay @ LSC

Enriched ^{136}Xe (100 kg) High Pressure Time Projection Chamber
NEXT and its prototype NEW (10 kg Xe) being installed in its Pb shield



Expected electron tracks in NEXT



Unique technique for neutrinoless double beta decay

Summary

The European four DUL dedicated to astroparticle have complementaries activities.

The European DUL became interdisciplinary laboratories thanks to their deep undergound location and the development of low radioactive tecnhiques

Strong interactions with rock mechanics community for the study of new labs, especially for large cavities studies (> 250 000 m^3)

The four EU laboratories would like to be organized as a unique distributed platform and to be an ERIC (European Research Infrastructure Consortium) at middle term
In order to continue to develop more efficiently particle physics, astroparticle, Interdisciplinary and links with other underground laboratories in Europe and in the world.