

Canfranc

Underground Laboratory (LSC)



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Canfranc Underground Laboratory (LSC)

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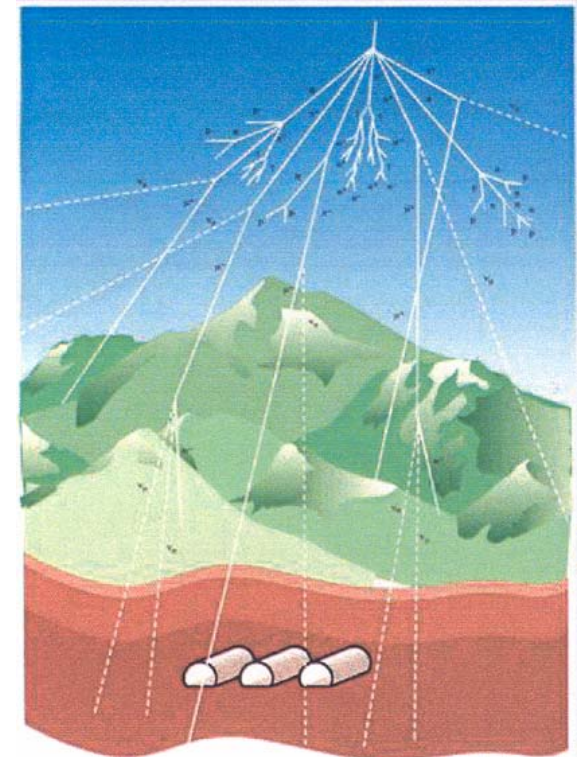
Underground Physics

- Physics in Underground Labs. developed during last 20 years with discoveries of great scientific impact. Why underground?
- This allows the screening of cosmic rays coming from space (one muon per cm^2 per minute in the earth surface). Only under big rock thickness one may study certain fundamental processes.
- The detectors are made with the extreme radio purity materials and isolated from the radioactive environment.

- NEUTRINO PHYSICS

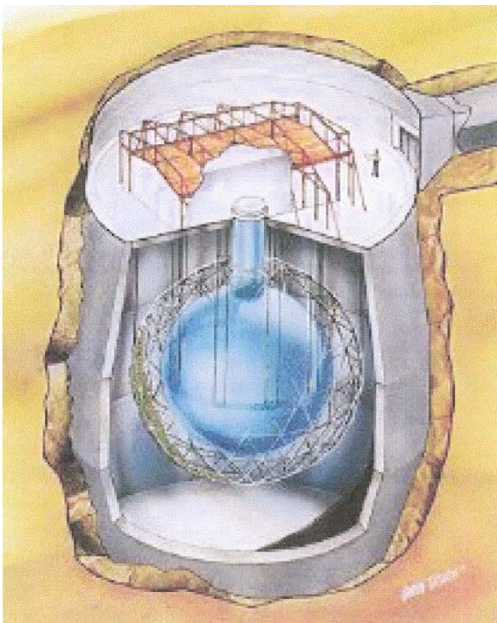
-Neutrino Nature: Dirac or Majorana? $\beta\beta 0\nu$ decay mediated by Majorana neutrino mass $\langle m_\nu \rangle = \sum_k U_{ek}^2 m_k$, sensitive to CP Violating Majorana phases.

-To reach the level of 10^{-2} eV or less, one needs target masses near one ton and drastic background reduction → Worldwide International Collaborations.



Underground Physics

- $\beta\beta 0\nu$ would be a signal of $\Delta L=2$ interactions at high energy scales. Experimentally, $AZ \rightarrow A(Z+2) + e + e$ gives a peak in the sum of electron energies.

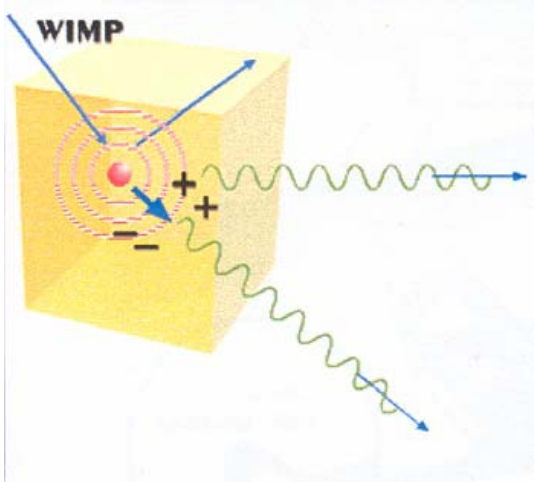


- The solar neutrino problem was solved by SNO by comparing neutral current (total ν flux) and charged current (ν_e flux) detections by deuterium. SNO is sensitive to ^8B neutrinos and Borexino will be more sensitive to ^7Be neutrinos in the energy region where the MSW effect in the Sun is most important.
 - To complete the picture, a direct detection experiment is recommended for low energy pp neutrinos with few percent precision:
 - Definitive proof of the MSW mechanism
 - Measurement of Sun luminosity from neutrinos
- One needs a few kiloton detector.

Underground Physics

■ DARK MATTER

- Recent cosmological observations say that 95% of the matter-energy content of the Universe is unknown to us. Baryonic matter accounts for 5% (1% is visible as stars, clouds and other objects)
- 70% is dark energy (we don't know what we are talking about)
- 25% is non-baryonic dark matter and most of it has to be cold: these particles are WIMPs with a very weak interaction with matter, of the order of one particle per day and per kilogram of the detector.



- The signal is induced by coherent nuclear recoil which manifests either by light or charge or heat.

- For liquid argon detector, the signal could be scintillation light produced from excited molecular states, being effective down to the keV recoil energy → one ton detector would provide much better sensitivity.



Need of Underground Space

- Existing facilities in the EU:

- LNGS (Eugenio Coccia)

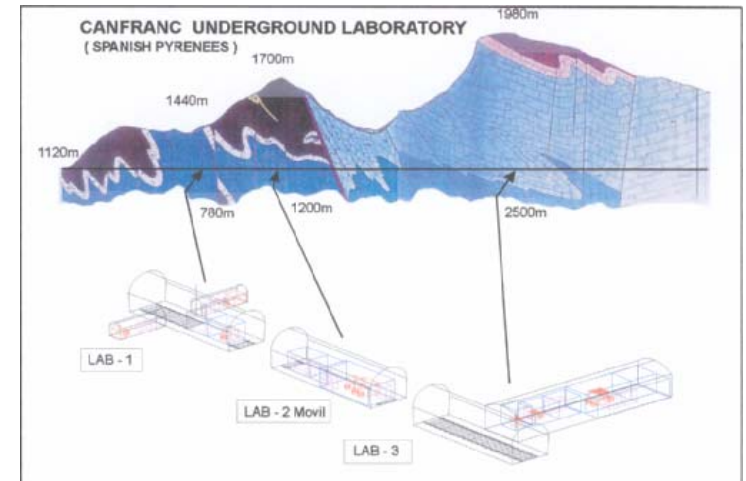
- LSC: Conceived by Angel Morales in 1985 under the Spanish Pyrenees

The past underground facilities are inside the (unused) railway tunnel and had LAB-1 and LAB-3 as working laboratories. In LAB-3 the muon flux is $2 \times 10^{-3} \text{ m}^{-2} \text{ s}^{-1}$, that of neutrons is $(3,8 \pm 0,4) \times 10^{-2} \text{ m}^{-2} \text{ s}^{-1}$ and that of gammas is $200 \text{ m}^{-2} \text{ s}^{-1}$. Radon activity is variable around $50\text{-}100 \text{ Bq m}^{-3}$.

The scientific program included dark matter search (ANAIS, IGEX-DM, ROSEBUD) and $\beta\beta 0\nu$ (IGEX- 2β)

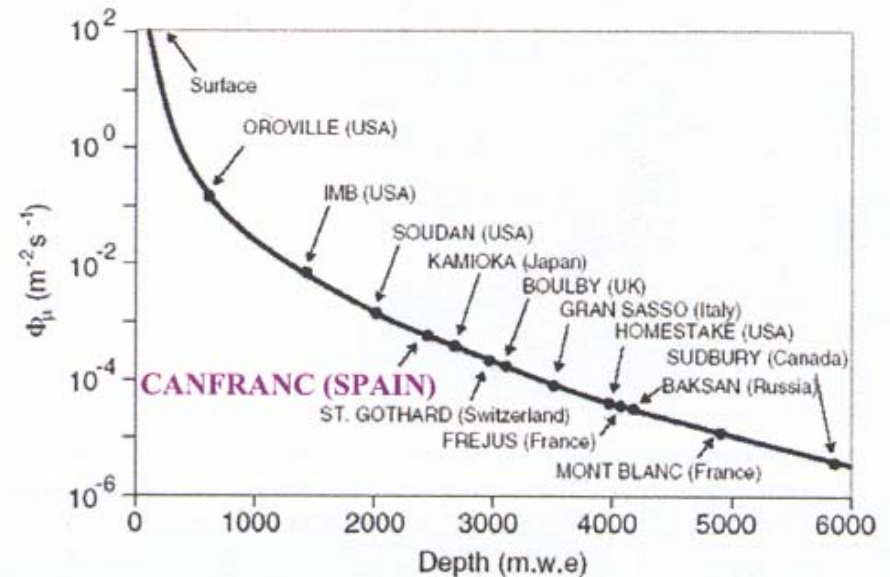
- LSM: French Lab. belonging to IN2P3 (CNRS) and DSM (CEA), with site in the Frejus Tunnel in the Highway connecting Lyon with Torino.

- Boulby Mine Underground Facility, near Sheffield: dark matter collaboration in UK



Need of Underground Space

- At present, there is an increasing interest in the Underground Physics described before with a series of proposals, letters of intent or conceptual designs at different levels of development. The present restrictions in the available underground space and the corresponding infrastructures are the most important limitations to the development of the field, including the creativity of the community of physicists.
- Furthermore, the existing advances were made possible due to a certain redundancy in some of these delicate experiments, using experimental techniques either complementary or different: think of the examples of solar neutrinos.
- The good environmental conditions of Canfranc Lab. justifies the project for the new facility which is now in construction: it is based in civil engineering work for the excavation of two new experimental halls.



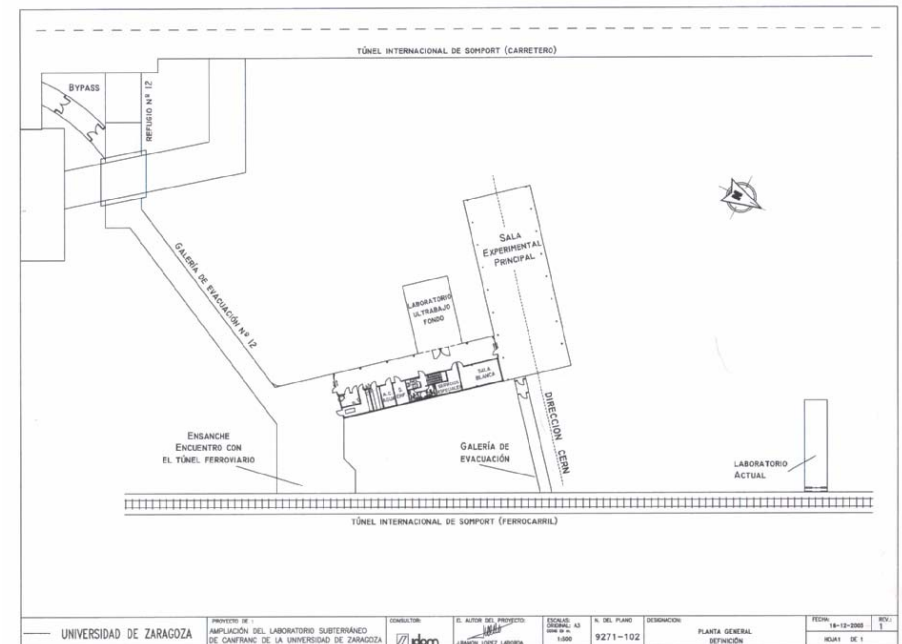
Civil Work in the new LSC

- The Main Hall will have $40 \times 15 \times 12 \text{ m}^3$ and it is oriented towards CERN
- A smaller Hall of 150 m^2 of surface and 8 m height will constitute the ultralow background Lab. for $\beta\beta 0\nu$ and dark matter studies.
- In the access corridor, one will have a White Hall, offices and workshops for more than 1000 m^2 .



Complementary Facilities

- Besides the civil engineering, the ongoing work contemplates the construction of the basic infrastructure of ventilation, electric power and security. All these works are expected to be finished around the Summer 2005.
- As seen in the plan, the access to the facilities is extraordinarily easy. The geologic conditions, the absence of underground water, etc., are positive too.
- The new LSC has to have service structures in the surface: general ones like electric, hydraulic, ventilation, experimental setup, safety, administration, etc., as well as those directly related to experiments as computing, networks, mechanical workshops, storage, offices, residences, etc.



Complementary Facilities

- A definite Project was presented through the National Programme of Particle Physics to the authorities of the Ministry of Education and Science last October 2004.
- As external facilities, one contemplates the store and workshops, mechanical as well as electronic, the deposits for cryogenic liquids and a building for general services. This will be the main external reference and the official site of the Lab.



Laboratorio Subterráneo
de Canfranc

Septiembre 2004

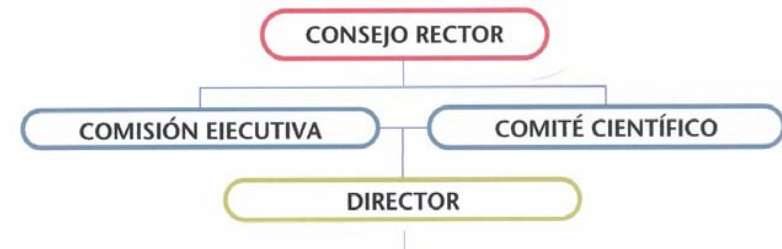
José Bernabeu
Alessandro Bettini*
Domènec Espriu
José Angel Villar

The estimated surface for this building is 1200 m². There exists one which is a property of the Aragon Government.



Management of LSC

- The new LSC should have a simplified structure adapted to the legal environment of Spain. The administrative structure could be that of the Consortium (see later)
- The management of LSC contemplates:
 1. The Government bodies of the Consortium
 2. The Scientific Advisory Committee
 3. Three Divisions under the Director General:
 - Administrative and foreign relations
 - Technical
 - Scientific
- The LSC will have its own budget and staff depending of the Directorate. The members of the Lab. with equal duties and rights in agreement with their qualification, will be not only the proper staff of the Lab., but also the attached personnel from the University of Zaragoza or other Institutions, as well as attached fellows.



Scientific Policy Committee

- The MEC has followed a methodology, to start with the management of the LSC, of appointing a SPC with the following tasks:
 - To define the International Character of the Lab. and the corresponding Programming as such from the very beginning.
 - To promote International Collaborations with experiments to be installed in this Facility.
 - To propose to the Consortium Bodies the Director General of the Lab., with the control of the quality of the installations in the overall Facility.

UNDERGROUND LABORATORY OF CANFRANC SCIENTIFIC POLICY COMMITTEE

- Chairman: Prof. Jose Bernabeu (IFIC, Spain)
- Secretary: Prof. Domenec Espriu (PP Programme)
- Members:
 - Prof. Frank Avignone (South Carolina, US)
 - Prof. Eugenio Coccia (Director of LNGS, Italy)
 - Prof. Enrique Fernandez (IFAE, UAB, Spain)
 - Prof. Concepcion Gonzalez-Garcia (SB, US)
 - Prof. Rafael Rebolo (IAC, Spain)
 - Prof. Michel Spiro (Director of IN2P3, France)
 - Prof. David Wark (Rutherford Lab., UK)



Consortium MEC-DGA-UZ

Excmo. Sr. Alberto Larraz Vileta
Consejero de Ciencia, Tecnología y Universidad.
Gobierno de Aragón.
Avda. Gómez Laguna, 25, 2ª Planta
50009 Zaragoza

Muy Sr. Mío:

Madrid, a 1 de febrero de 2005

Tras las conversaciones mantenidas con su Consejería y la Universidad de Zaragoza en relación a las obras emprendidas por esta universidad de ampliación y mejora de servicios del Laboratorio Subterráneo de Canfranc, obras que posibilitarán que el laboratorio pueda llegar a constituirse en una Gran Instalación Científica al servicio de la comunidad científica nacional y en un centro de referencia europeo en actividades de bajo ruido de fondo, quiero manifestarle nuestro interés en trabajar conjuntamente para intentar concretar, mediante la suscripción de un convenio específico con la Diputación General de Aragón y la Universidad de Zaragoza, la creación de una entidad jurídica independiente a través de la cual el Ministerio de Educación y Ciencia pueda participar en la explotación del Laboratorio Subterráneo de Canfranc.

En este sentido, y siempre de acuerdo con las reuniones celebradas hasta la fecha, proponemos que el Prof. José Ángel Villar, Vicerrector de Investigación de la Universidad de Zaragoza continúe los trabajos que permitan definir completamente el proyecto de equipamiento científico-técnico, infraestructuras complementarias, modelo de explotación y presupuestos de inversión y de operación y mantenimiento, así como proponemos al Prof. José Bernabeu Alberola, Catedrático de Física Teórica de la Universitat de València y Presidente de la División Europea de Física de Partículas, como coordinador de las actividades encaminadas a definir y potenciar el proyecto científico del laboratorio.

Quiero expresarle nuestro interés en evaluar los aspectos científico-técnicos y presupuestarios de este proyecto final así como nuestra intención de suscribir un convenio específico que defina las características y condiciones de nuestra posible participación en la explotación del Laboratorio Subterráneo de Canfranc.

EL SECRETARIO GENERAL DE POLÍTICA
CIENTÍFICA Y TECNOLÓGICA

Salvador Barberá Sáenz

Excmo. y Magnífico Sr. D. Felipe Pétriz Calvo
Rector de la Universidad de Zaragoza
Pedro Cerbuna, 12
50009 Zaragoza

Muy Sr. Mío:

Madrid, a 01 de febrero de 2005

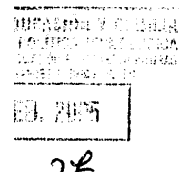
De acuerdo con las conversaciones mantenidas con el Vicerrectorado de Investigación de su Universidad y la Consejería de Ciencia, Tecnología y Universidad del Gobierno de Aragón, me he dirigido a esta última expresando nuestra intención, en concretar, mediante la suscripción de un convenio específico con la Diputación General de Aragón y la Universidad de Zaragoza, la creación de una entidad jurídica independiente a través de la cual el Ministerio de Educación y Ciencia pueda participar en la explotación del Laboratorio Subterráneo de Canfranc.

La próxima conclusión de las obras en que se encuentra el laboratorio, posibilitará que el laboratorio pueda llegar a constituirse en una Gran Instalación Científica al servicio de la comunidad científica nacional y en un centro de referencia europeo en actividades de bajo ruido de fondo.

En este sentido, quiero expresarle nuestro interés en evaluar los aspectos científico-técnicos y presupuestarios del proyecto final así como nuestro deseo de suscribir un convenio específico que defina las características y condiciones de nuestra posible participación en la explotación del Laboratorio Subterráneo de Canfranc.

EL SECRETARIO GENERAL DE POLÍTICA
CIENTÍFICA Y TECNOLÓGICA

Salvador Barberá Sáenz



Outlook

- Good luck to the new LSC!
- Unique in Spain.
- Experiments of unprecedented interest and dimensions for the International Scientific Community.
- See you in 'El Tobazo'

