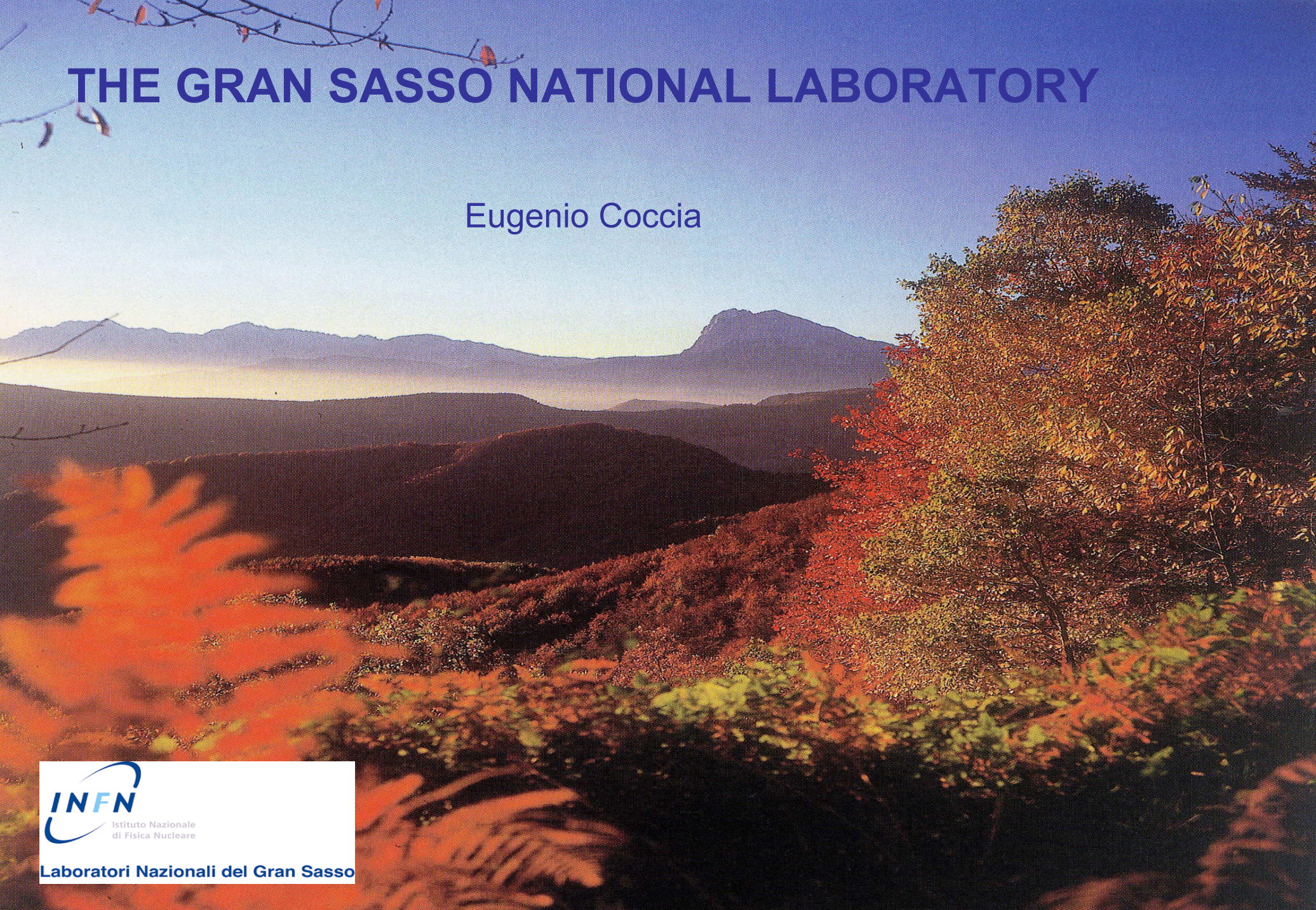
THE GRAN SASSO NATIONAL LABORATORY

Eugenio Coccia



INFN
Istituto Nazionale
di Fisica Nucleare
Laboratori Nazionali del Gran Sasso

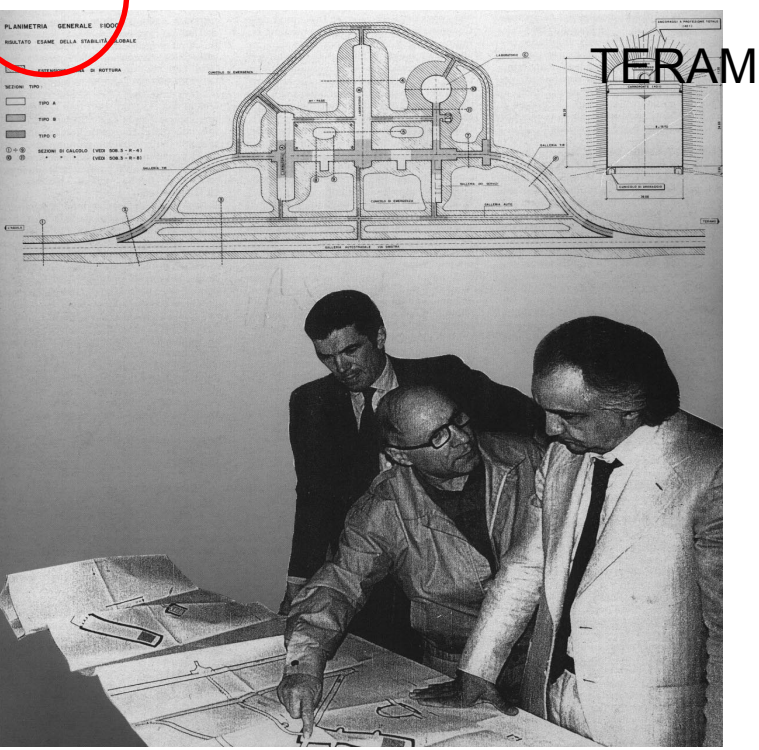
INFN Gran Sasso National Laboratory

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

L'AQUILA

Tunnel of 10.4 km

TERAMO



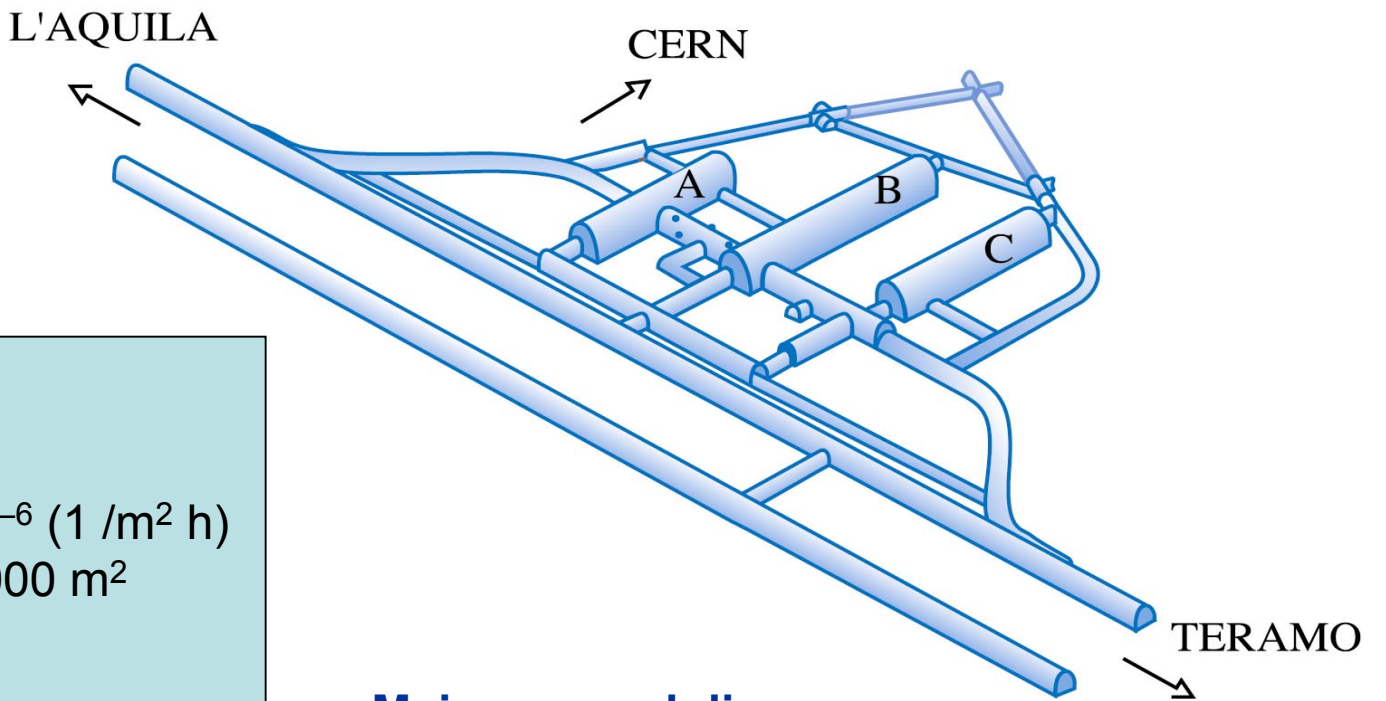
In 1979 A. Zichichi proposed to the Parliament the project of a large underground laboratory close to the Gran Sasso highway tunnel, then under construction

In 1982 the Parliament approved the construction, finished in 1987

In 1989 the first experiment, MACRO, started taking data

LABORATORI NAZIONALI DEL GRAN SASSO - INFN

Largest underground laboratory for astroparticle physics

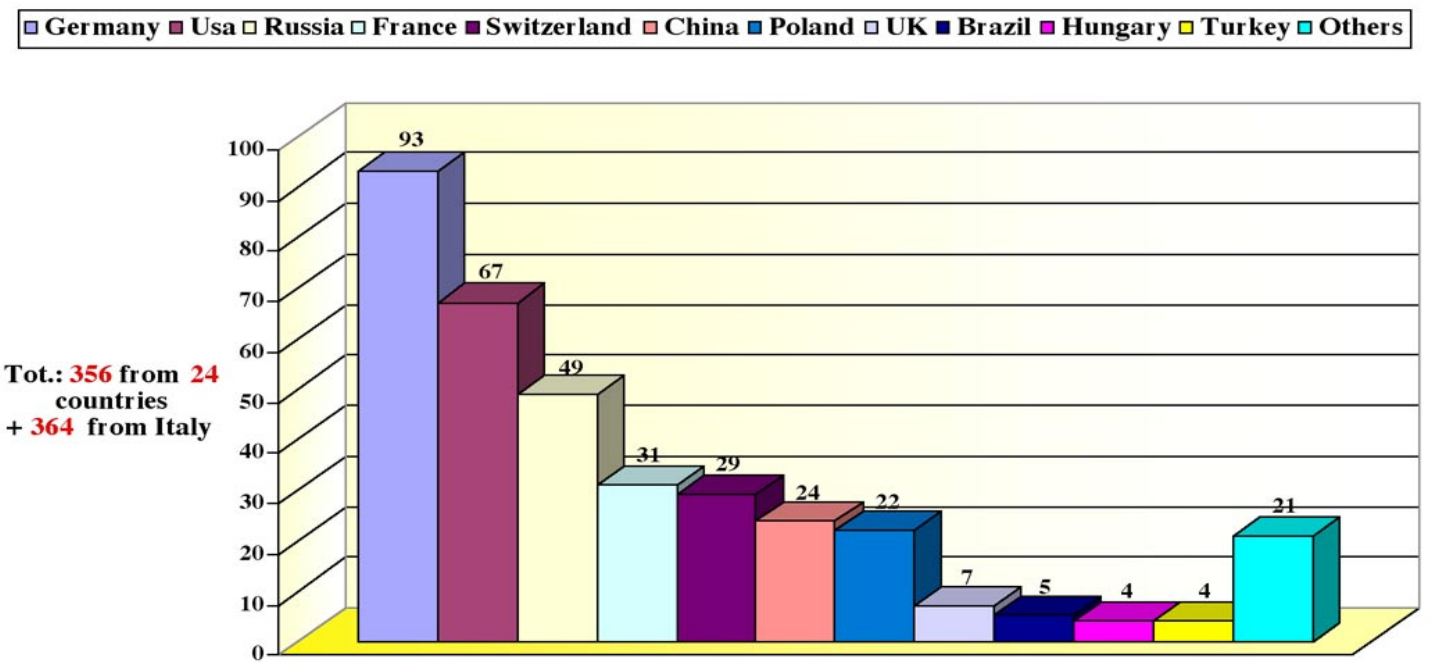


1400 m rock coverage
cosmic μ reduction= 10^{-6} (1 /m^2 h)
underground area: 18 000 m^2
external facilities
easy access
756 scientists from 25 countries
Permanent staff = 66 positions

Main research lines

- **Neutrino physics**
  (mass, oscillations, stellar physics)
- **Dark matter**
- **Nuclear reactions of astrophysics interest**
- **Geophysics**
- **Biology**

LNGS Users



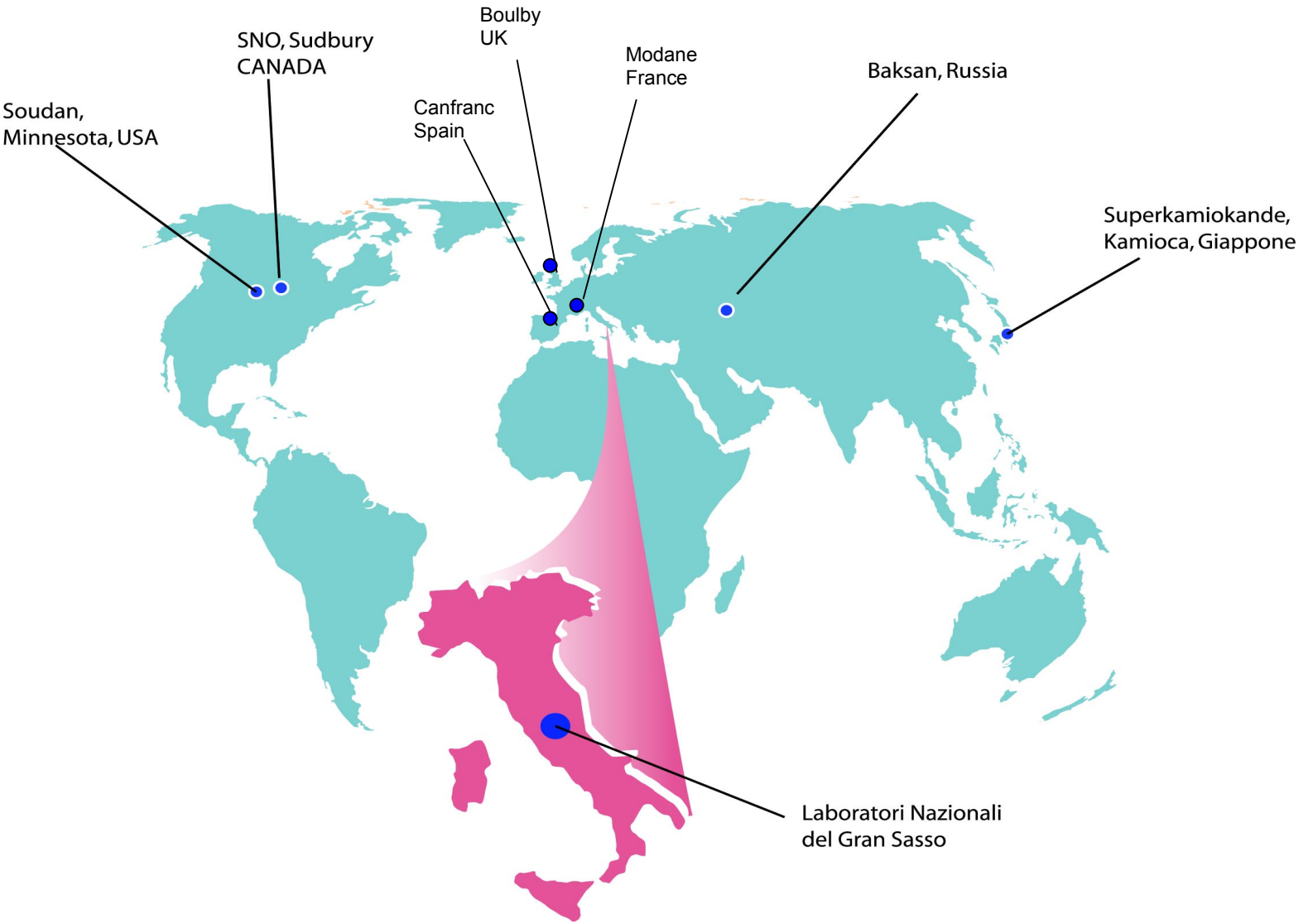
Foreigners: 356 from 24 countries

Italians: 364

Permanent Staff: 64 people


External facilities
Administration
Public relationships support
Secretariats (visa, work permissions)
Outreach
Environmental issues
Prevention, safety, security
General, safety, electrical plants
Civil works
Chemistry
Cryogenics
Mechanical shop
Electronics
Computing and networks
Offices
Assembly halls
Lab & storage spaces
Library
Conference rooms
Canteen

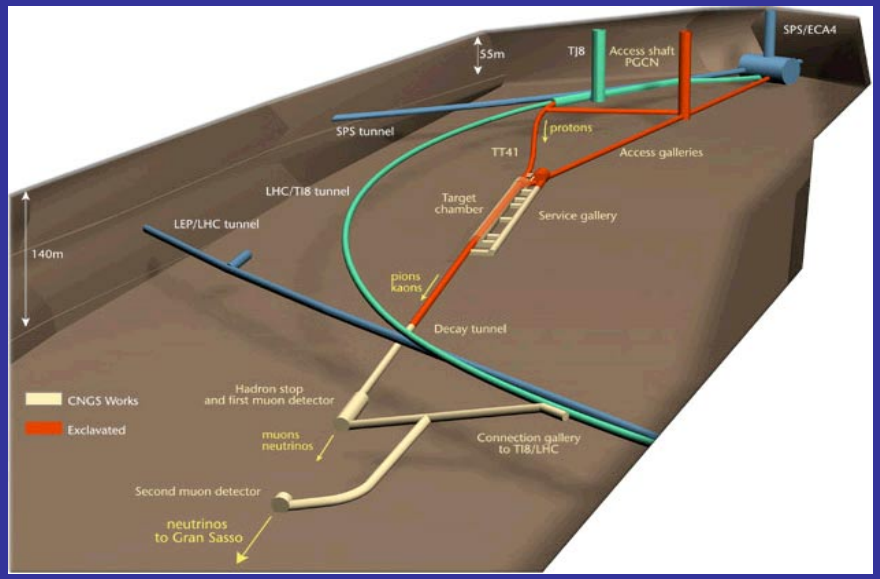
Underground Laboratories



ν beam from CERN:

ICARUS

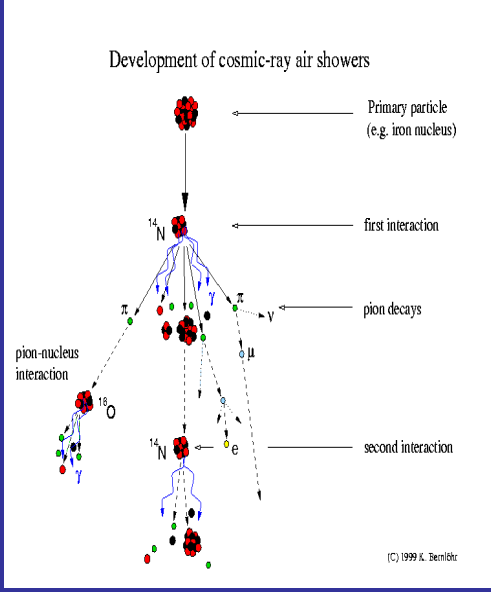
OPERA



Atmospheric ν

LVD

ICARUS



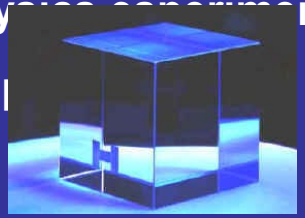
11 astroparticle physics experiments:

8 in operation, 3 in

4 exp. geophysics

1 exp. biology

4 proposals for future exps.

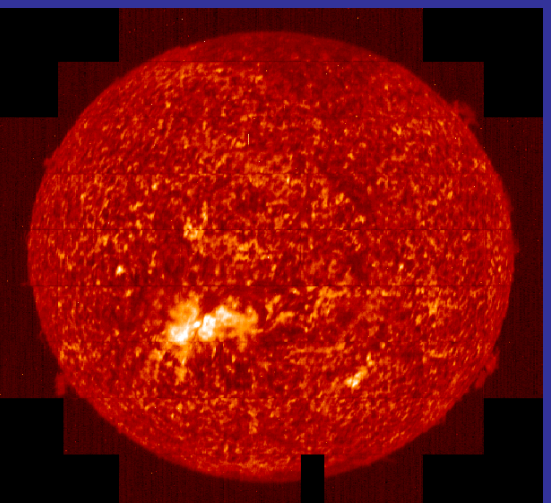


ββ decay and rare events

Cuore; HDMS; GENIUS-TF

Dark Matter

DAMA/LIBRA; CRESST



Solar ν

GNO

Luna

Borexino

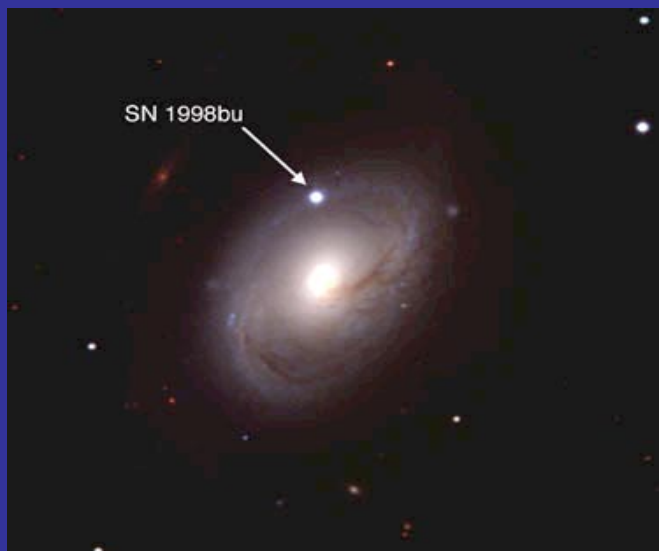
ICARUS

ν from Supernovae

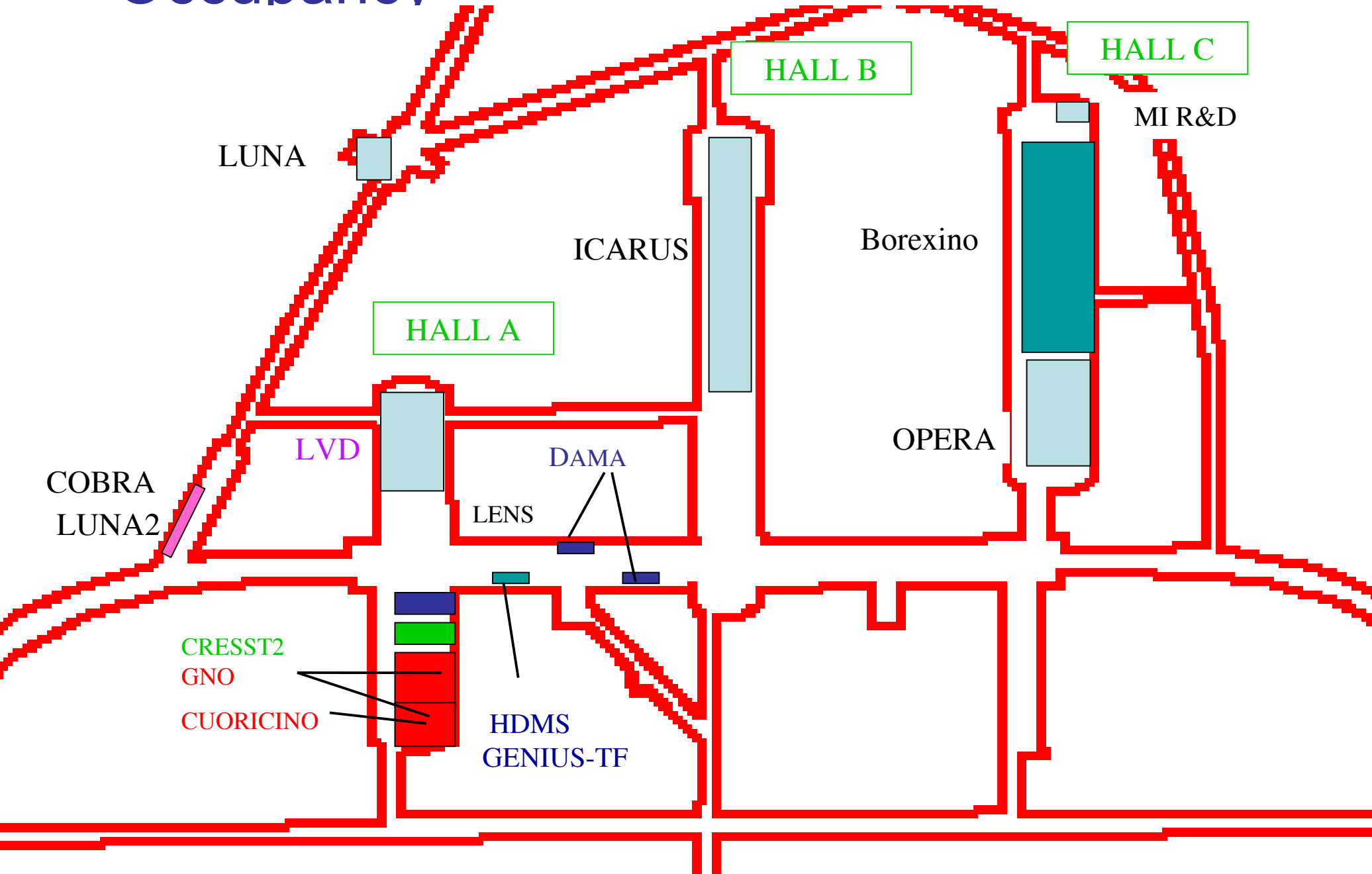
LVD

Borexino

ICARUS



Occupancy


HALL C
HALL B
MI R&D
LUNA
ICARUS
Borexino
HALL A
OPERA
LVD
DAMA
COBRA
LUNA2
LENS
CRESST2
GNO
CUORICINO
HDMS
GENIUS-TF

Status of neutrino mass and oscillations

3 x 3 mixing matrix U with parameters:

(same parameters as in the CKM quark matrix)

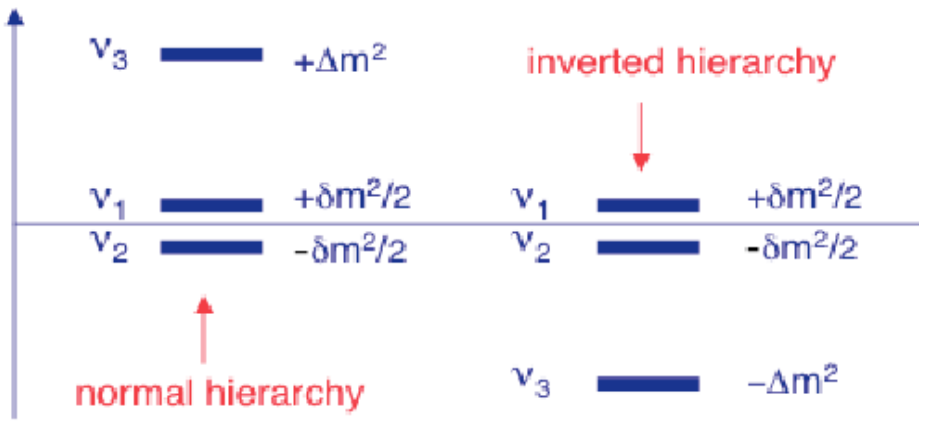
θ_{12}, θ_{23} **measured**

θ_{13} δ **(phase) unknown**

If both different from 0 ==>CP violation

Δm^2_{12} δm^2_{23} **measured**

M_0 **unknown**



M_0 direct mass measurement β decay

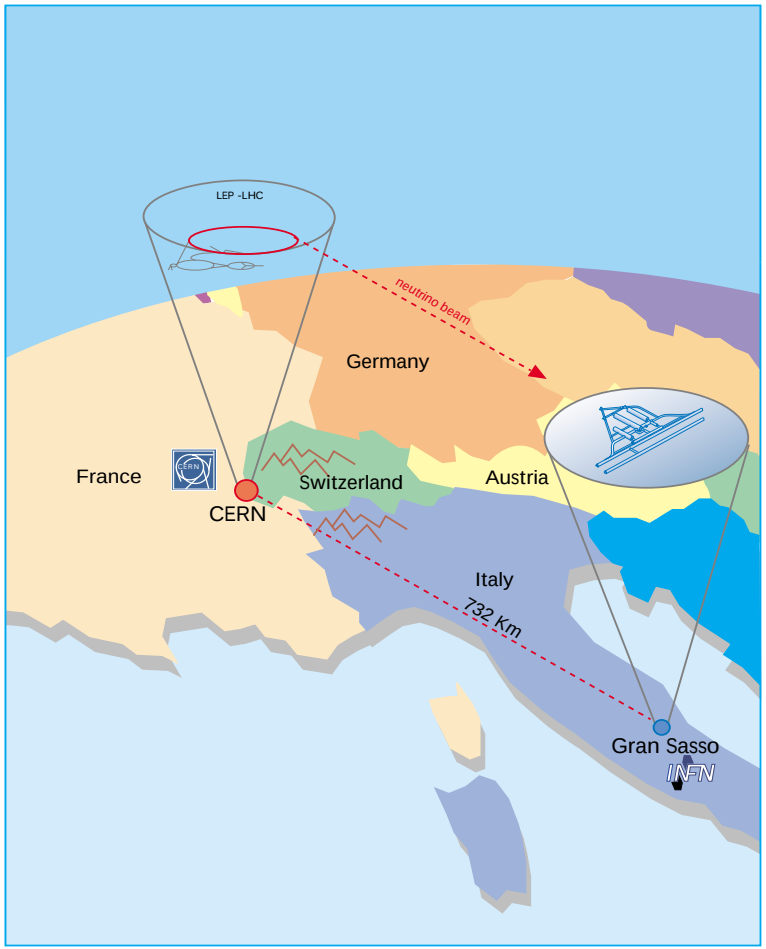
2 β decay if Majorana neutrino

astrophysical measurement (Wmap..)

Gran Sasso contributions

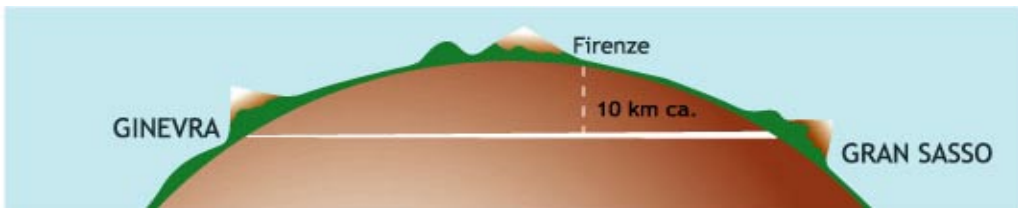
GALLEX/GNO (solar ν) and MACRO (atmospheric ν)

CNGS CERN to Gran Sasso Neutrino Project



ν_μ beam produced at CERN and detected at LNGS after a travel of 730 km

Approved by CERN and INFN in 1999, ready in 2006



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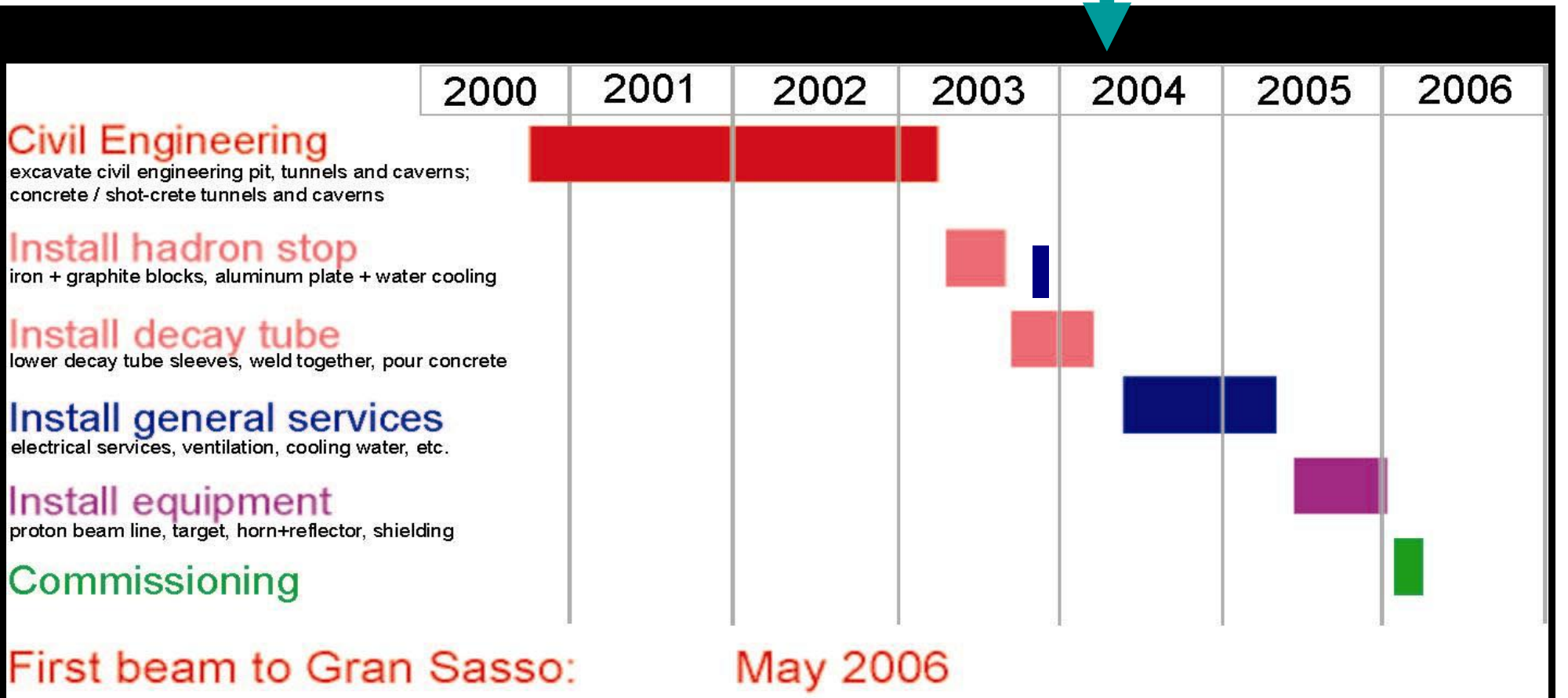
Neutrino Beam CERN-Gran Sasso

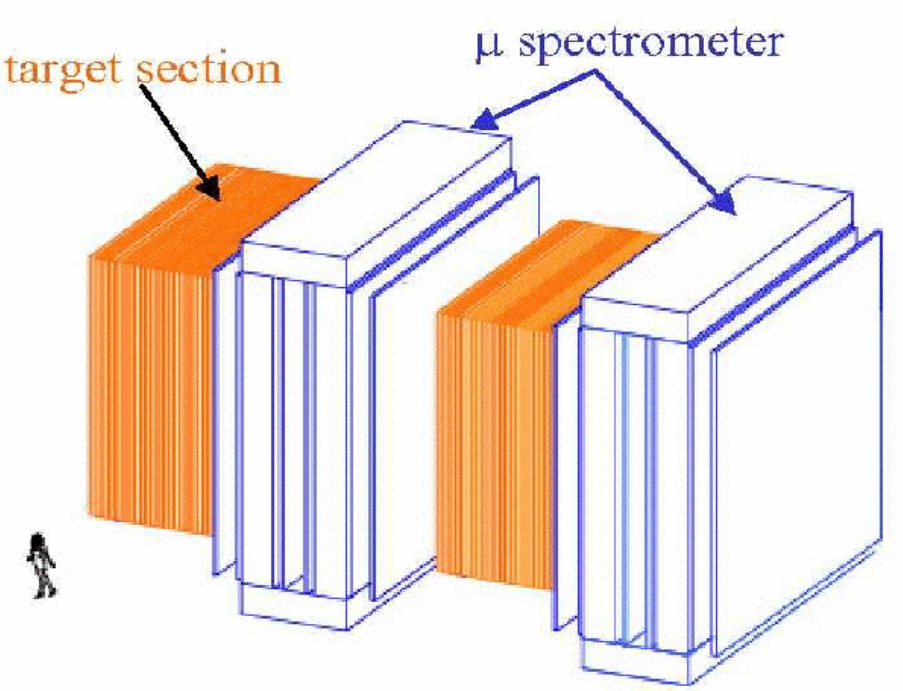
CNGS schedule

(schematic, simplified version)

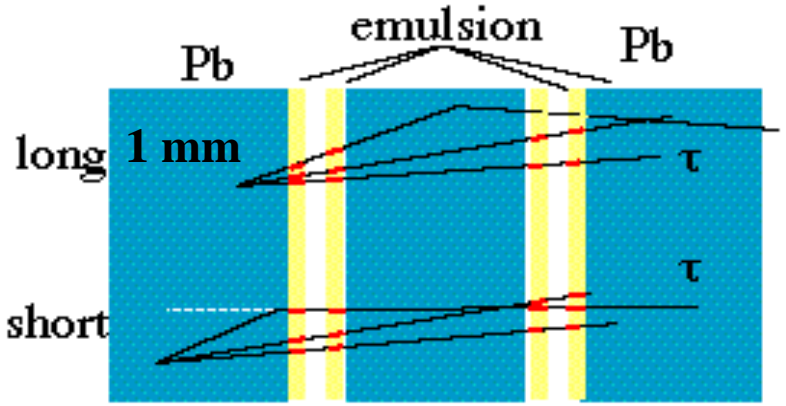


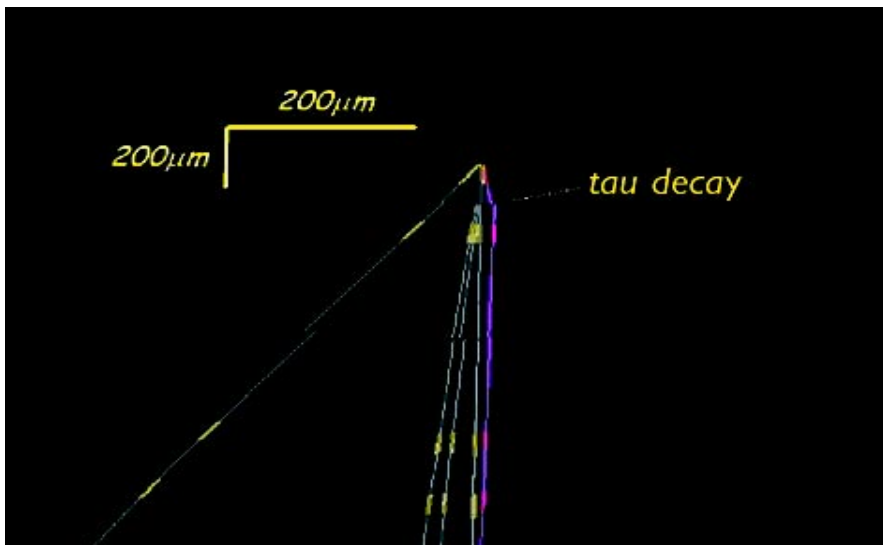
OPERA

Collab.:
Italy, France, China, Germany, Belgium, Turkey, Switzerland, Russia, Japan, Israel, Croatia



Layers of emulsions and Lead





2 super-modules
1800 t sensitive mass
To detect τ is necessary a μm resolution because the τ decays in a really short time

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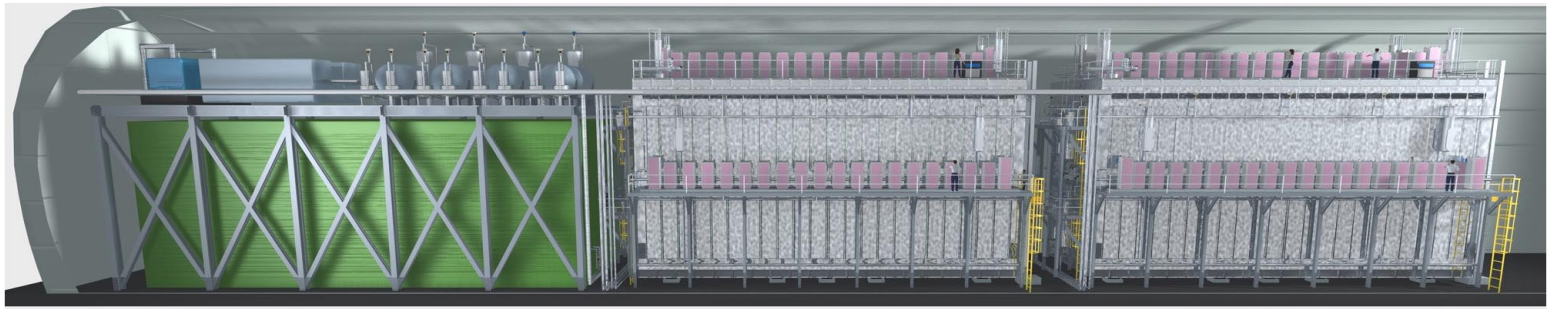
ICARUS Imaging Cosmic and Rare Underground Signals

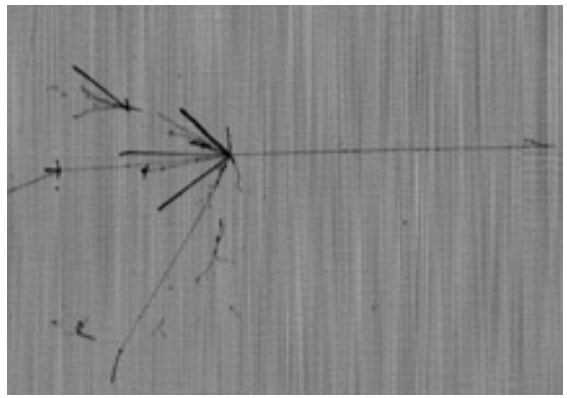
First Unit T600	T1200	T1200



Liquid Argon (-176 °C)

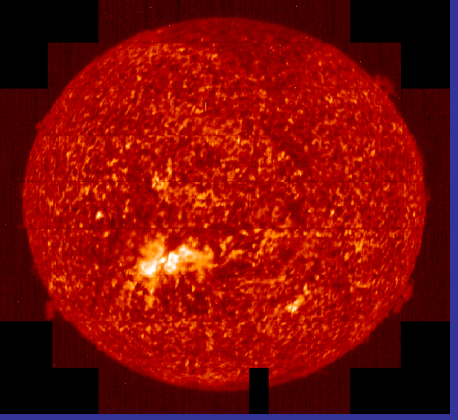
Collaboration:
Italy, Poland, China
Spain, Switzerland, USA

First half of T600 module successfully operated in Pavia
Expect to install T600 in 2004
T3000 detector proposed as a series of five T600 modules



17 m

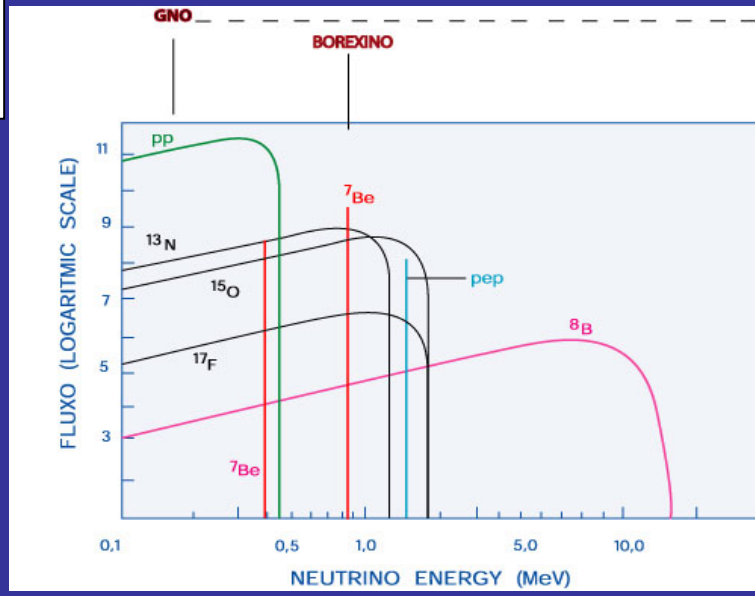
- Wide physics program
  - ν_τ and ν_e appearance on CNGS
  - atmospheric neutrinos
  - supernova neutrinos
  - solar neutrinos
  - proton decay



GNO

Collab.:
Italy, France, Germany

Goals: measurement of the interaction rate with an accuracy of 4-5% and monitoring the neutrino flux over a complete solar cycle.



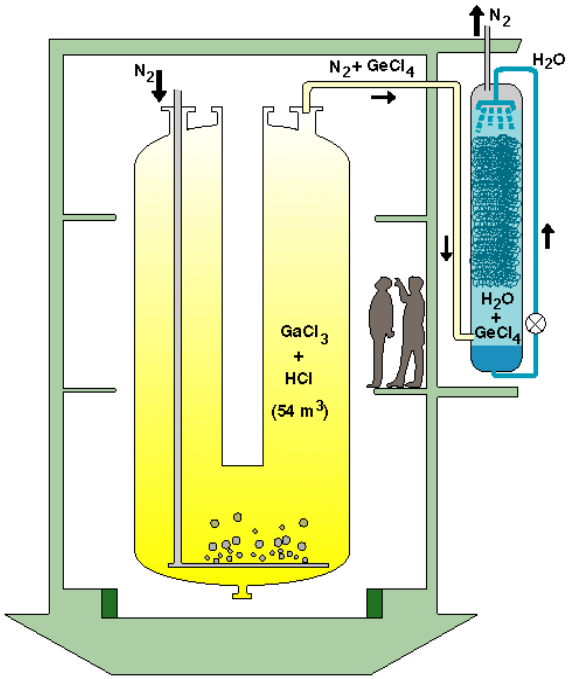
101 tons Gallium Cloride solution

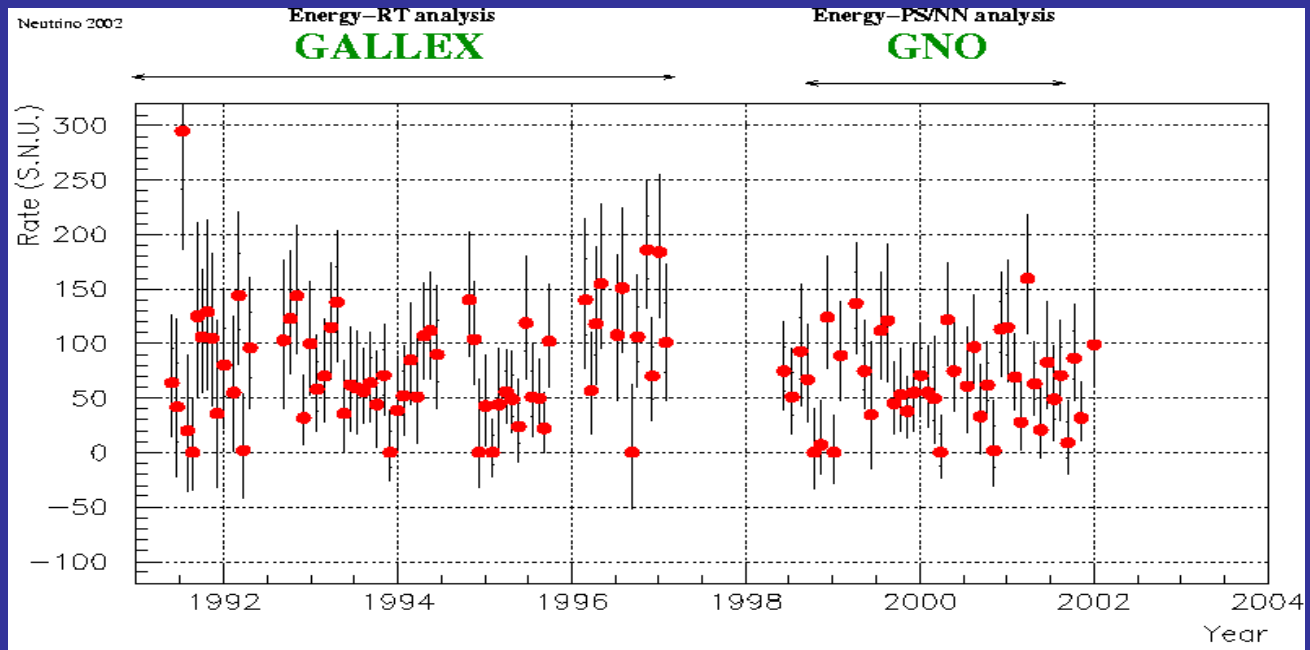
^{71}Ge(ν_e,e)^{71}Ge

Energy threshold > 233 keV

Sensitive mainly to pp -neutrinos

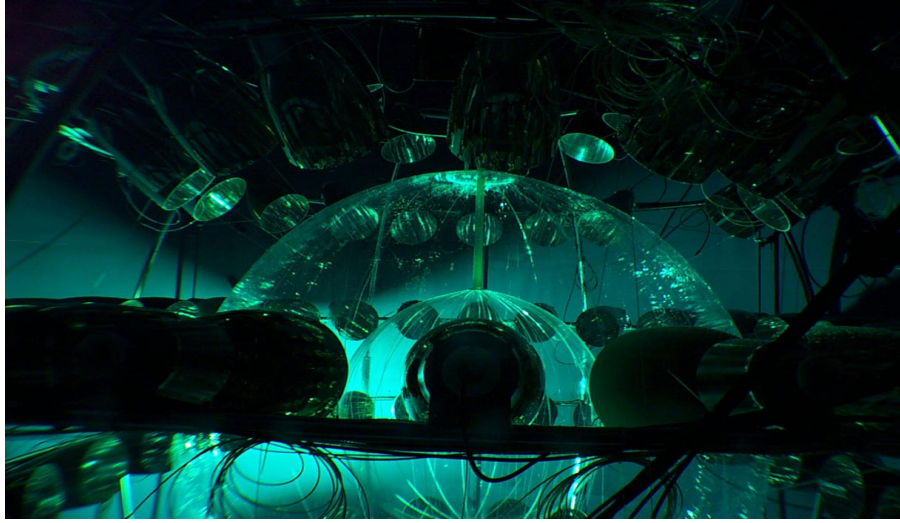
SSM ⇒ 115 -135 SNU





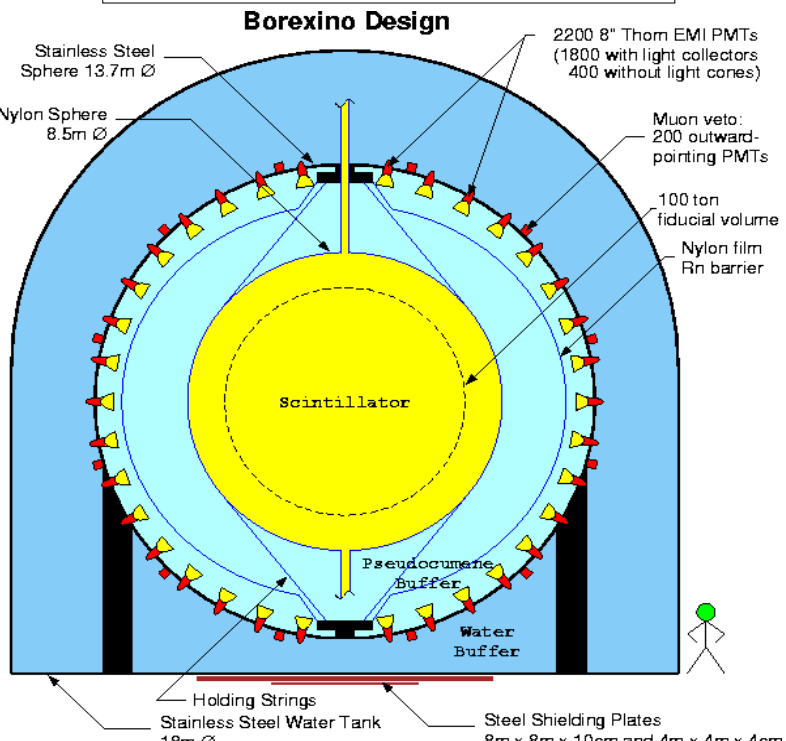
GALLEX	65 SR	77.5 +– 6.2 (stat) +– 4.5 (sys) SNU
GNO	43 SR	65.2 +– 6.4 (stat) +– 3.0 (sys) SNU
GNO+GALLEX	108 SR	70.8 +– 4.5 (stat) +– 3.8 (sys) SNU

BOREXINO



300 tons liquid scintillator in a nylon bag
2200 photomultipliers
2500 tons ultrapure water
Energy threshold 0.25 MeV
Real time neutrino (all flavours) detector
Measure mono-energetic (0.86 MeV) **^{7}Be** neutrino flux through the detection of ν-e.
40 ev/d if SSM

18 m diam., 16.9 m height



Sphere 13.7 m diam. Supports the P□Ms & optical concentrators
Space inside the sphere contains purified PC
Purified water outside the sphere

running in 2005

Collab.:
Italy, France, USA, Germany, Hungary, Russia, Belgium Poland, Canada

INFN

LUNA Laboratory for Underground Nuclear Astrophysics

Study of the cross section of nuclear reactions at stellar energies

in particular for pp chain

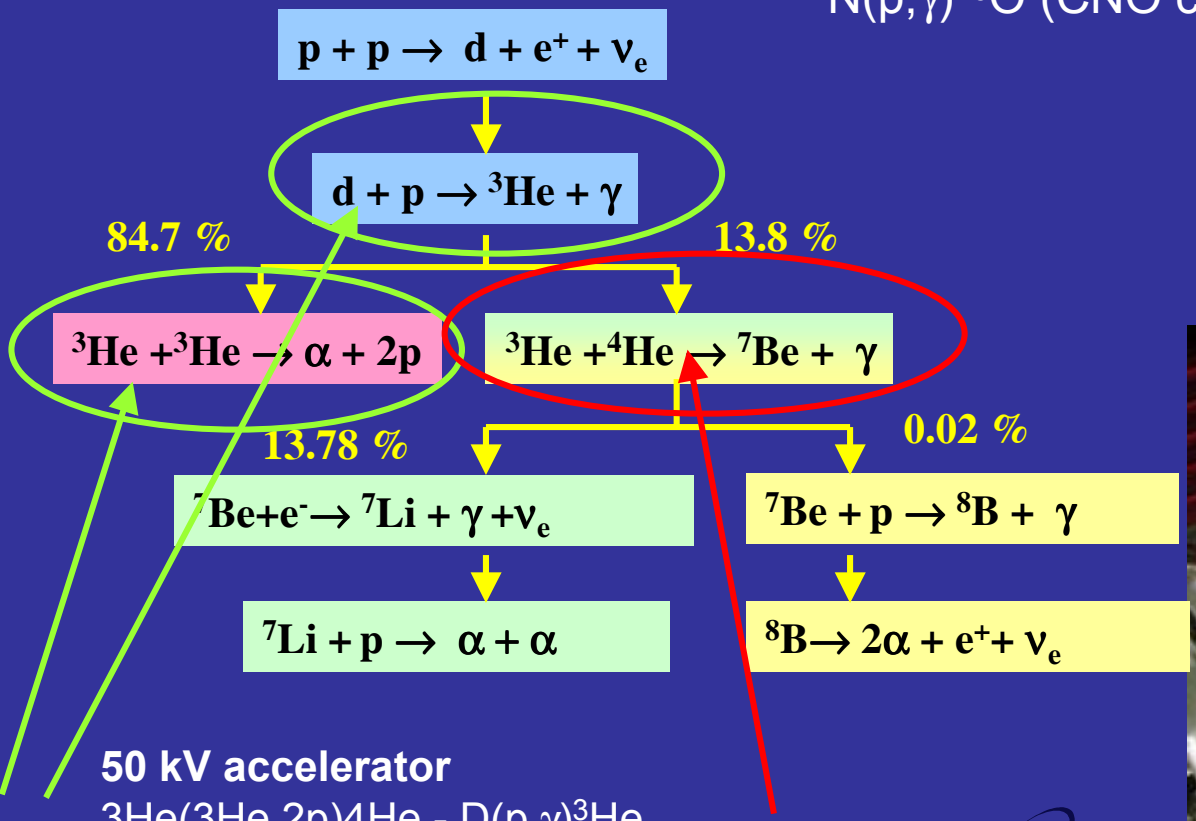
pp chain

2 accelerators: 50kV - 400kV

400 kV accelerator

$^{14}N(p,\gamma)^{16}O$ (CNO cycle)

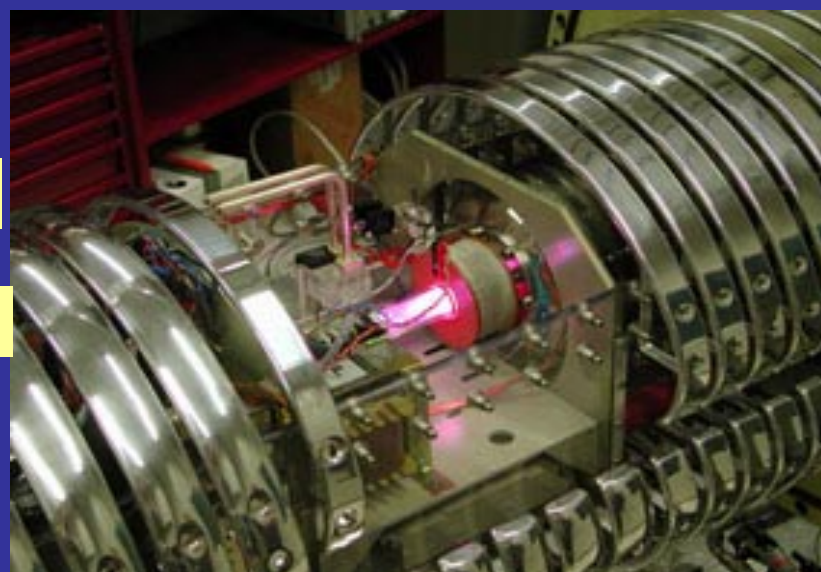
Collab.:
Italy, Germany, Hungary
USA, Portugal



50 kV accelerator
3He(3He,2p)4He - D(p,γ)3He

done

in 2003



The Universe, seen under the Gran Sasso mountain, seems to be older than expected

2004 May 13

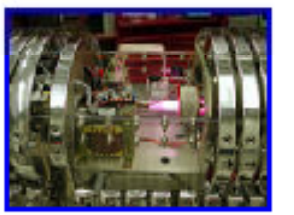
Press release n. 42

Istituto Nazionale di Fisica Nucleare

2004 May 13

The Universe, seen under the Gran Sasso mountain, seems to be older than expected

Some nuclear fusion reactions inside stars occur more slowly than we thought and, as a consequence, stars themselves, as well as galaxies and the entire universe are a bit older than expected. This is what comes out from the last results of Luna experiment (Laboratory for Underground Nuclear astrophysics), settled by National Laboratories of Gran Sasso and realized in cooperation by Infn and Ruhr University in Bochum (Germany). The study, that will be published on the review Physics Letters B next June 17, has been published today on the website of the review. A second article has been accepted by the review Astronomy and Astrophysics.



LVD Large Volume Detector

Collab.:
Italy, Brazil, Russia, USA, Japan

Running since 1992

1000 billions ν in 20s from the SN core

Measurement of neutrinos spectra and time evolution provides important information on ν physics and on SN evolution.

Neutrino signal detectable from SN in our Galaxy or Magellanic Clouds

2 - 4 SN/century expected in our Galaxy.

Plan for multidecennial observations

1000 tons liquid scintillator + layers of streamer tubes

300 ν from a SN in the center of Galaxy (8.5 kpc)

SN1987A

Early warning of neutrino burst important for astronomical observations with different messengers (Gravitational Waves)

SNEWS = Supernova Early Warning System

LVD, SNO, SuperK

in future: Kamland, BOREXINO

INFN

DAMA

Dark Matter Search

Collab.:
Italy, China, Ukraine

Detection of WIMPs (Weakly Interacting Massive Particle) through the flash of light produced by a Iodine nucleus recoiling after having been hit by the WIMP.

DAMA looking for annual modulation with 100 kg NaI(Tl)

DAMA/NaI-1 to -7

107731 kg · d

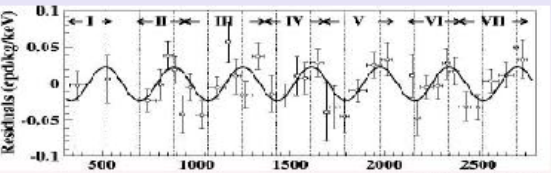
Annual modulation of the rate: the model independent result

Residuals of the rate vs time and energy

Riv. N. Cim. 26 n.1. (2003) 1-73

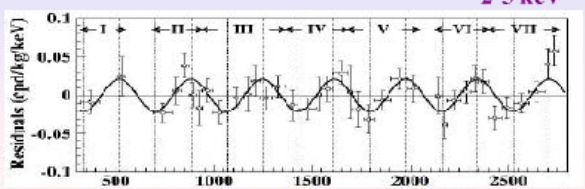
$A\cos[\omega(t-t_0)]$; continuous lines: $t_0 = 152.5$ d, $T = 1.00$ y

2-4 keV



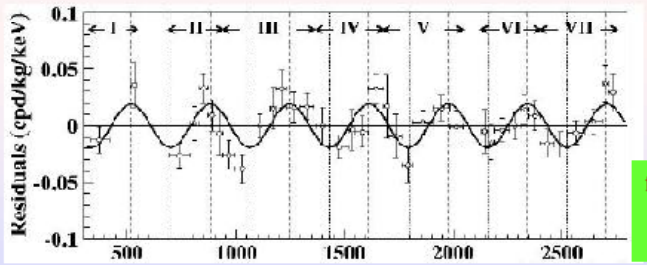
fitted: $A = (0.0233 \pm 0.0047)$ cpd/kg/keV

2-5 keV



fitted: $A = (0.0210 \pm 0.0038)$ cpd/kg/keV

2-6 keV



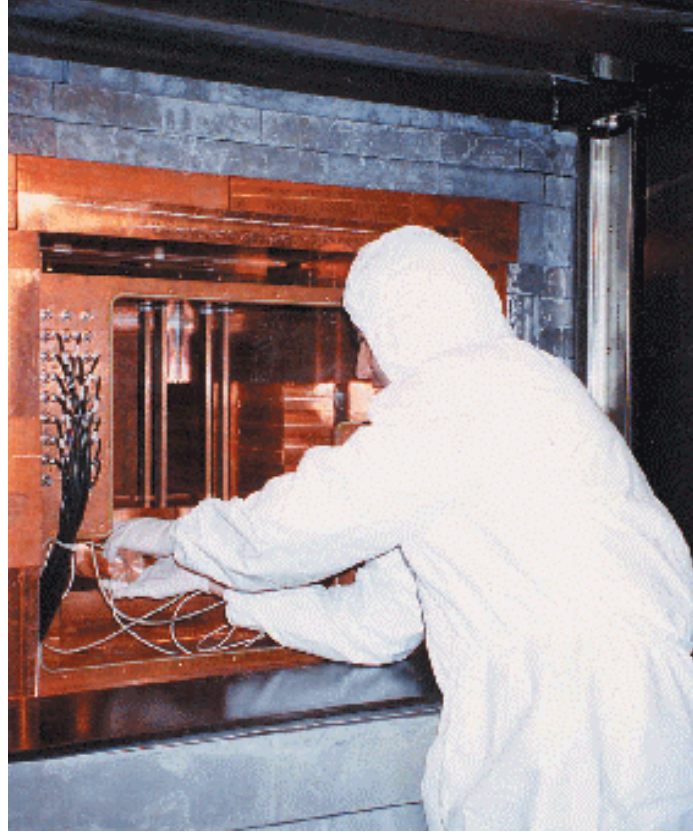
$P(A=0)=7\cdot10^{-4}$

$\chi^2/dof=71/37$

fitted: $A = (0.0192 \pm 0.0031)$ cpd/kg/keV

fitted (all parameters free):
$A = (0.0200 \pm 0.0032)$ cpd/kg/keV ;
$t_0 = (140 \pm 22)$ d ; $T = (1.00 \pm 0.01)$ y

The data favor the presence of a modulated behavior with proper features at 6.3σ C.L.

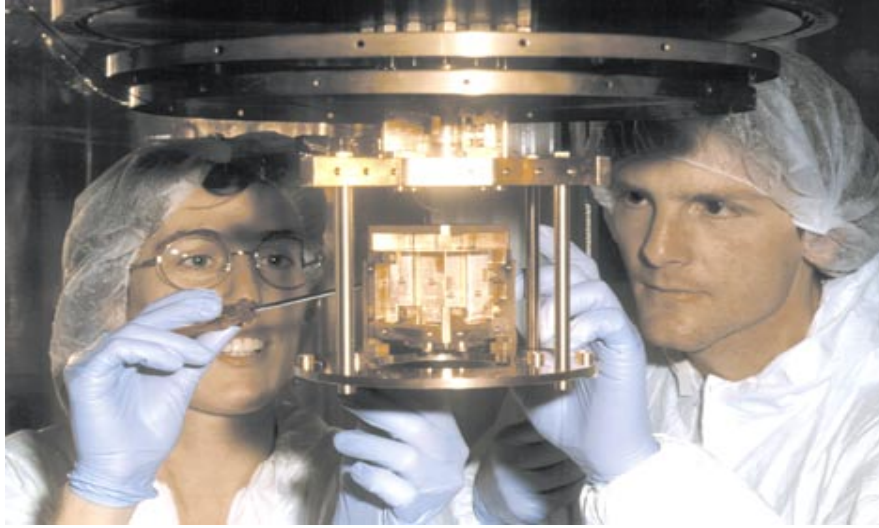


Present:

LIBRA

250 kg NaI(Tl)

Collab.:
Italy, Germany, UK



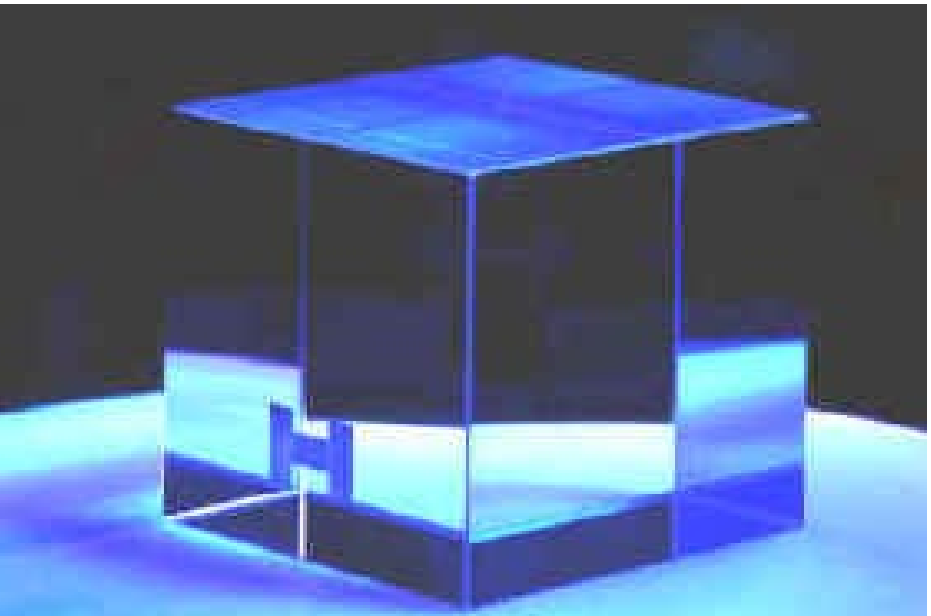
CRESST

(Cryogenic Rare Events Search with Superconducting Thermometers)

4 sapphire crystals= 1 kg

WIMPs search with cryogenic technique (running at 15 mK)

Looking for a very tiny temperature increase in the detector due to the energy deposited by nuclei hit by the WIMPs



Run until 2005

INFN

ββ decay neutrinoless experiments

β decay n --> p + e- + $\bar{\nu}$

2β0ν is a very rare decay: T(half life) ≥ 10^{-25} years)

$\nu = \bar{\nu}$

→Upper limit on the mass of ν_e 0,39 eV

Majorana neutrino

MIBETA (Milan)
20 detectors of natural TeO_2 crystals
^{130}Te mass = 2.3 kg

CUORICINO
Sensitive ^{130}Te mass = 40 kg
Status: running

CUORE
proposal presented in 2003
^{130}Te mass = 250 kg

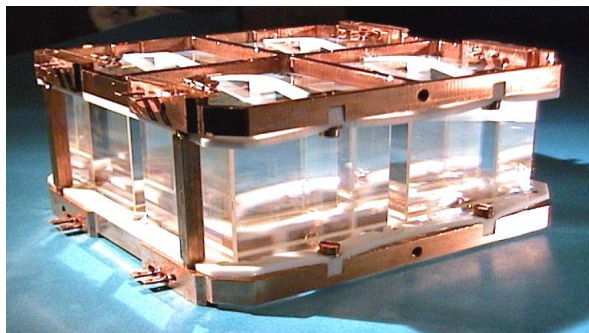
Collab.:
Italy, Netherland, Spain, USA

Heidelberg-Moscow
11 kg of enriched ^{76}Ge detect.
The most sensitive experiment in the world
^{76}Ge -->^{76}Se + $2e^-$

Collab.:
Germany, Russia

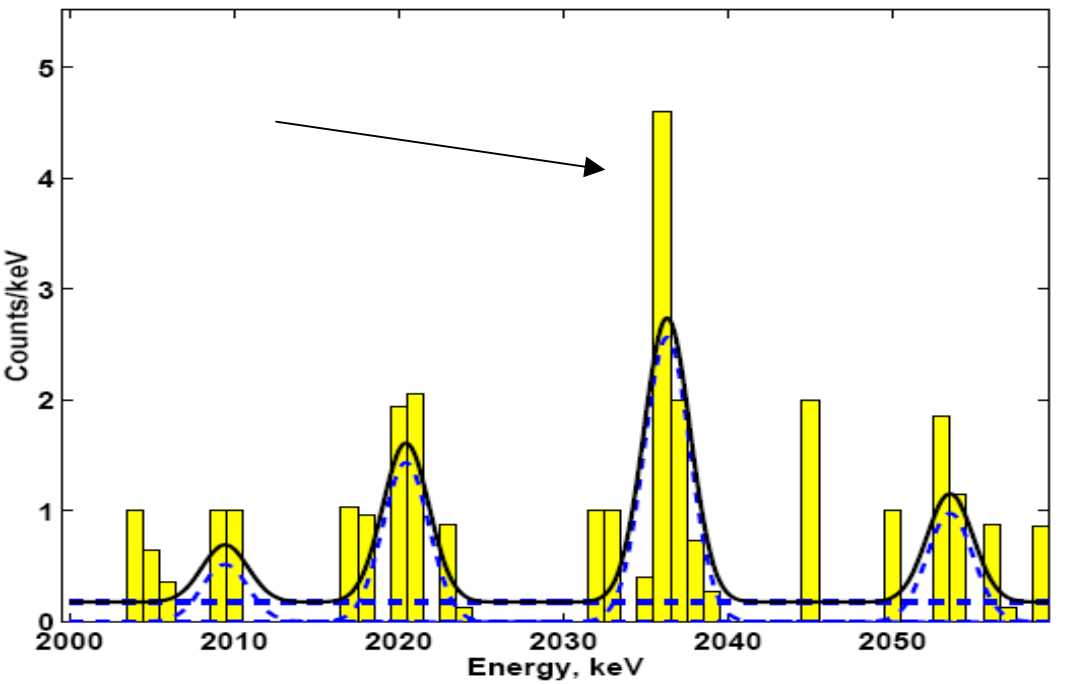
GENIUS-TF
Test facility for GENIUS
40 kg HM Ge

GENIUS (project)
Sensitive mass: 1 ton enriched Ge crystals in Liquid N_2
Status. Experimental tests requested (GENIUS-TF)



Neutrino masses and 0ν2β decay Heidelberg Moscow experiment

0.1< mν (0.4) <0.6 eV
4 sigma

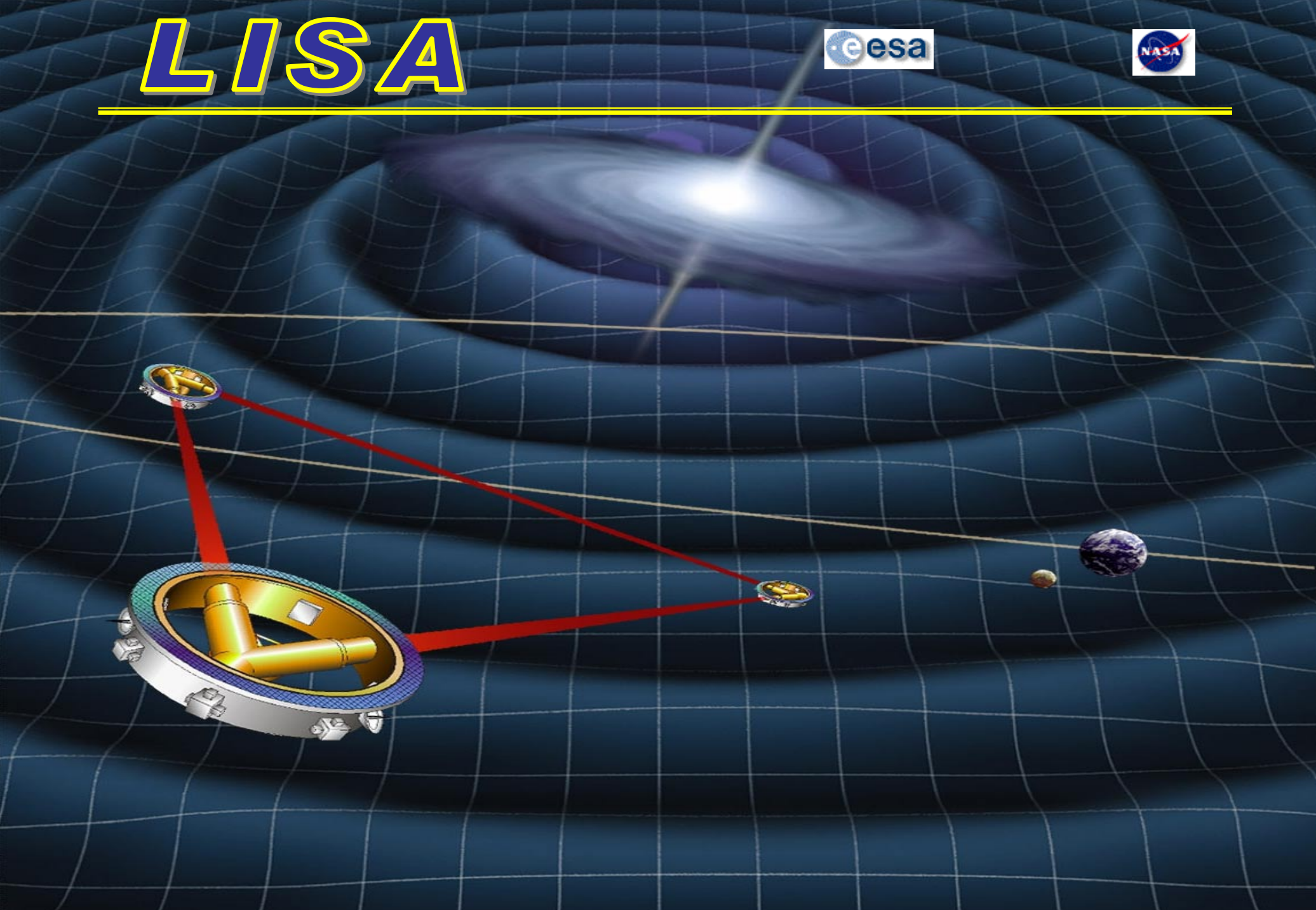


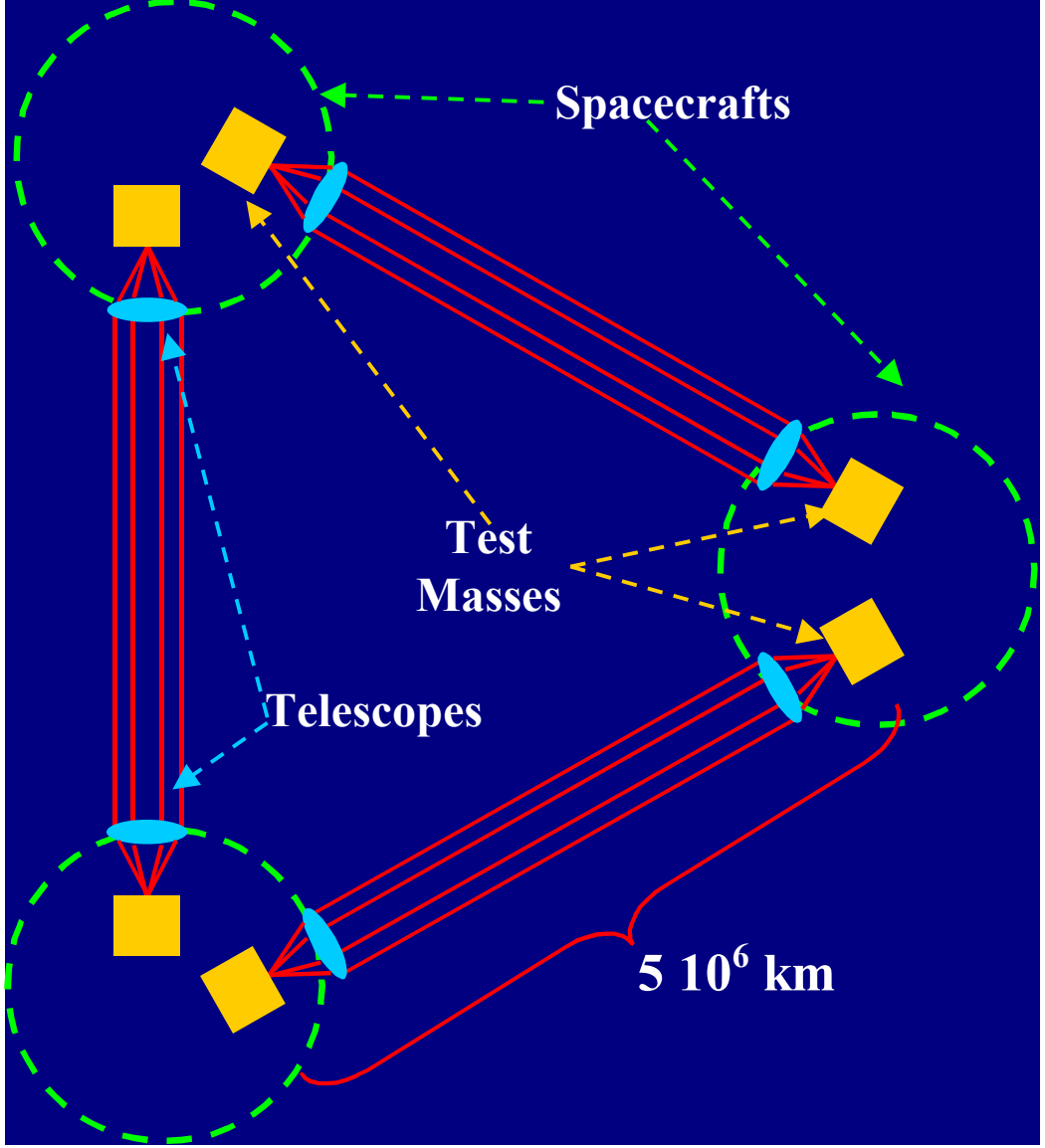
HV Klapdor et al, NIMA: Data Acquisition and Analysis of the 76-Ge Double Beta experiment in Gran Sasso 1990-2003

New proposals

LISA
Cuore
Warp
Xenon
ββ Ge
MCavern

LISA





3 pairs of "free falling" test masses
(3 10^{-15} ms^{-2} $Hz^{-1/2}$ @ 0.1 mHz)

3 "test-mass follower" shielding spacecraft

2 semi-independent 5 10^6 km Michelson Interferometers with Laser Transponders

(40 pm $Hz^{-1/2}$)

Goal: GW at

0.1 mHz – 0.1 Hz

Sensitivity

4 10^{-21} $Hz^{-1/2}$ @ 1 mHz

Transnational Access to LNGS

LNGS has been recognized by EU as a European **Large Scale Facility**
A contract between EU and INFN funds **access** to the LNGS facilities for EU researchers
Start of the contract: December 2002; duration 28 months

- **17 research Projects in the sectors**

Low background instrumentation
Accelerator facilities (LUNA)
Cryogenic facilities
Computing facilities
Geophysics and environmental physics

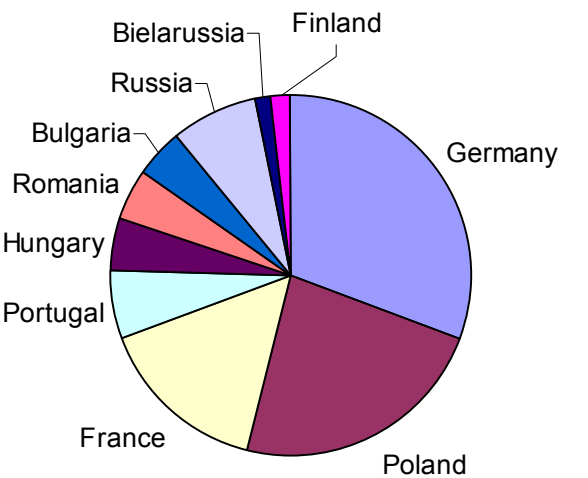
- **1020 Person-days delivered (July 2003)**

  880 person-days allocated

  900 person-days available

- **65 scientists from 10 different countries are accessing LNGS through TARI**

More than half of them are new users



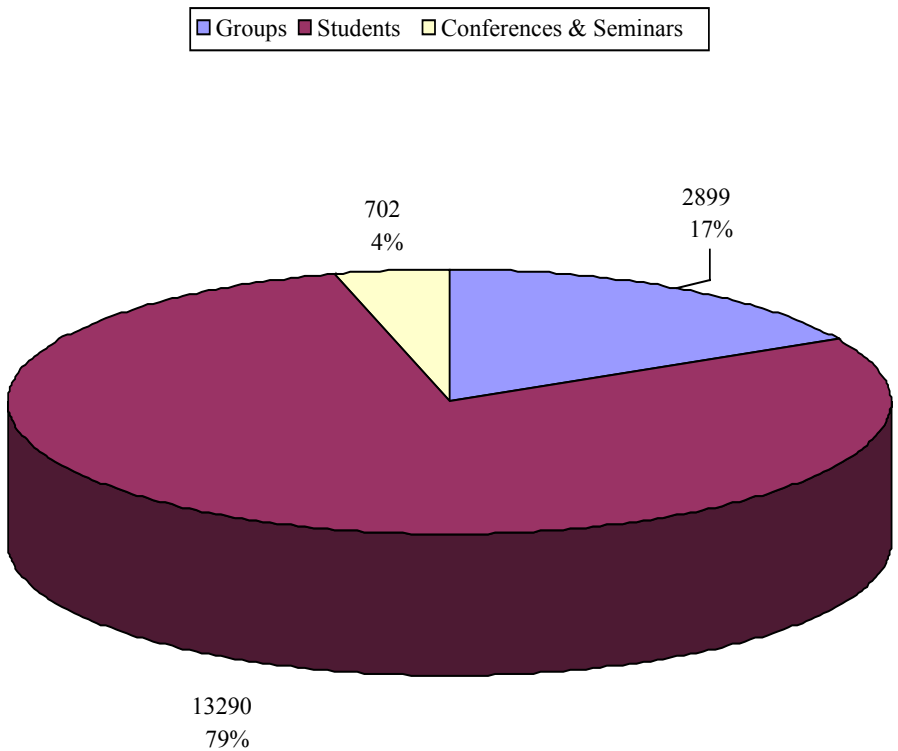
Users

Visits at LNGS

Since 1990 it is possible to visit the Lab.

The number of visitors has increased during the years.

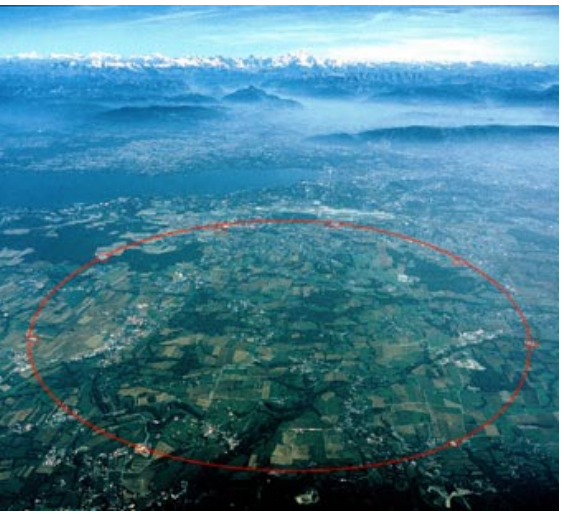
17,000 in 2003 **80% are students**



INSIDE THE BIG BLACK BOX:

ANALYSING VISITS TO PHYSICS LABORATORIES

Project financed by EC with 325,000 $ in the 5th FP.
The project aims to analyse the impact of visits to important physics laboratories on the lay public, using the results to produce guidelines with a view to improving the communication efficiency of such centres.



CERN

Visitors:

20,000/year

DESY

Visitors:

10,000/year

Juelich Research Centre (Germany)

Visitors:

10,000/year

LNGS

Visitors:

17,000/year

Demokritos National Centre for Scientific Research (Greece)

Visitors:

4,000/year

May 29th, 2003

Information which threw strong doubts upon the water-tightness of the draining system of the Highway and the Gran Sasso laboratory.

Infn decided as a precaution to suspend the activities implying manipulation of any kind of liquid and ask for an immediate intervention of the competent government authorities.

The same day the entire Hall C was placed under judicial attachment by the magistrate.

June 27th, 2003

The Council of Ministers declared the State of Emergency for the Gran Sasso facility (road tunnels, Labs., water system).

This allows radical and urgent technical intervention of a government authority (Commissioner), without bureaucratic delays.

December 2003

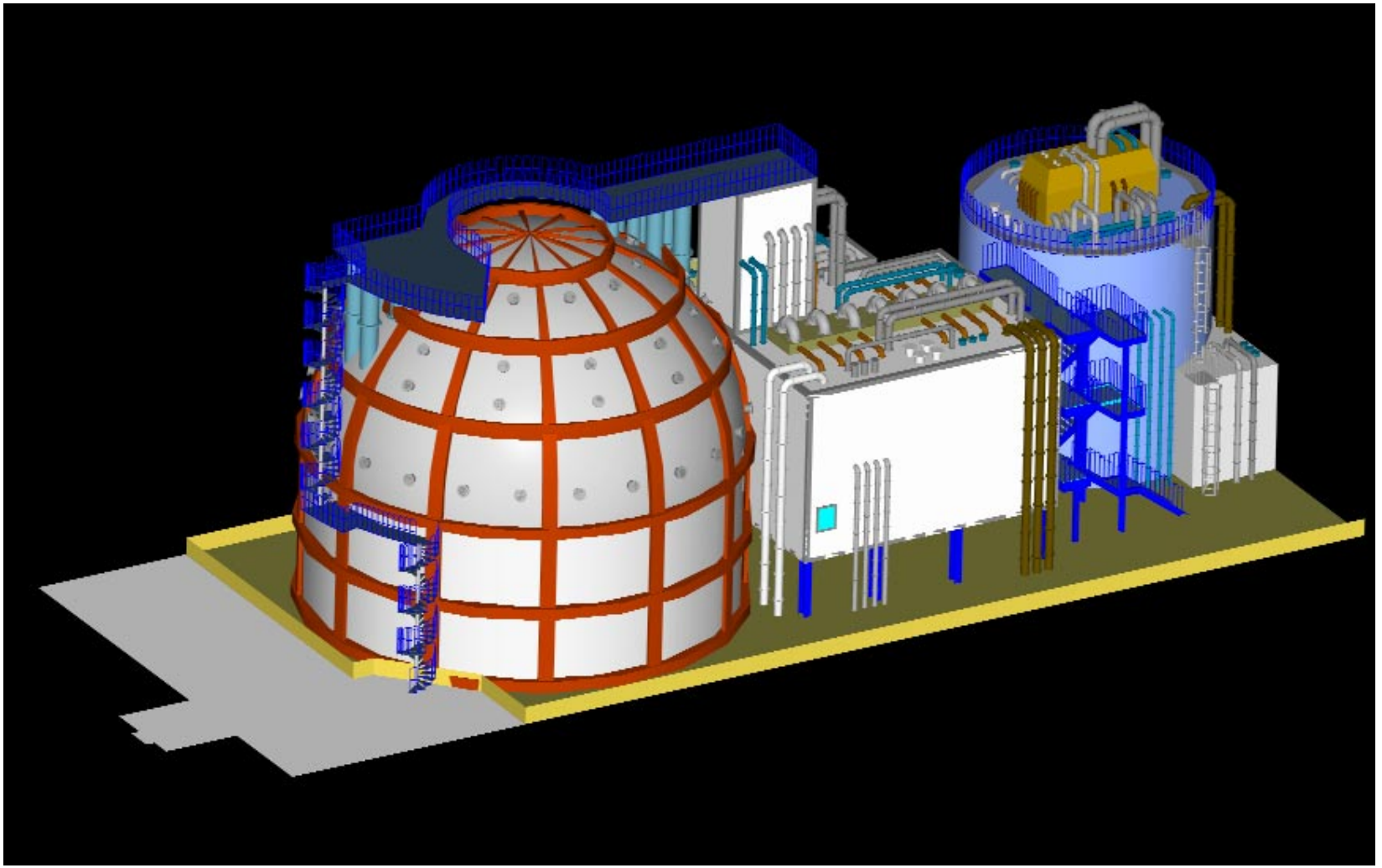
Approval of the “first phase” designes by local authorities and Prosecutor.

This enabled the normalization of the activities of the Laboratories.

All the activities back to normal but Borexino and GNO.

First phase

- Floor waterproofing
- Realization of containment basins
- Safety measures for the drinkable water

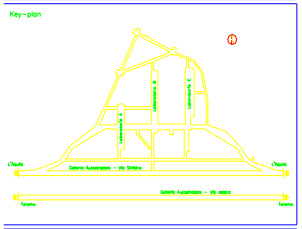


INFN

ISTITUTO NAZIONALE DI FISICA NUCLEARE

Laboratori Nazionali del Gran Sasso

Key - plan



LABORATORI SOTTERRANEI

OPERE CIVILI: STATO DI FATTO

Divisione tecnica del L.N.G.S.

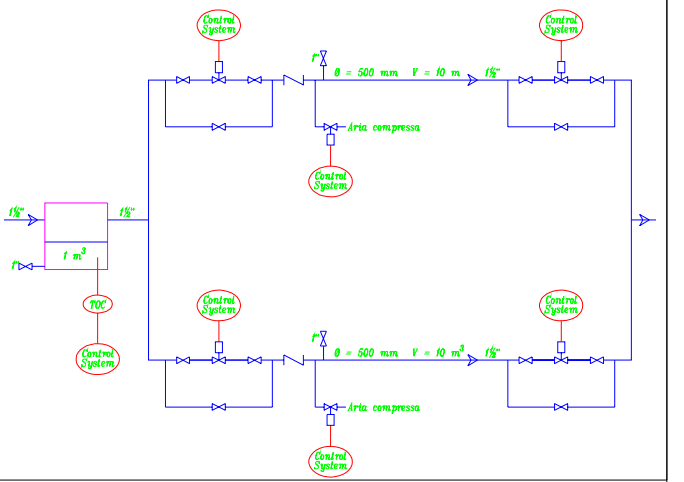
Servizio Impianti Generali

Disegnatore: P.I. Massimo Andreassi	Data: 08.01.03	Aggiornamenti:
	Scala:	
	scarico_Gazzano.dwg	All. n° 1

Disegno:

Planimetria punto di scarico

Schema funzionale serbatoi di turnazione



Percorso delle tubazioni

First phase

- Floor waterproofing
- Realization of containment basins
- Safety measure for the drinkable water

Second phase

- Up grade of the ventilation system
- Up grade of the cooling capability
- Up grade of the electrical power

Borexino

Activity restarted

Use of pseudocumene: end 2004

Opera

Ready for mid 2006

Icarus

T600 underground in 2004, data taking end 2005

Definition of a roadmap for the T3000 in progress

Borexino
Inner vessel installation

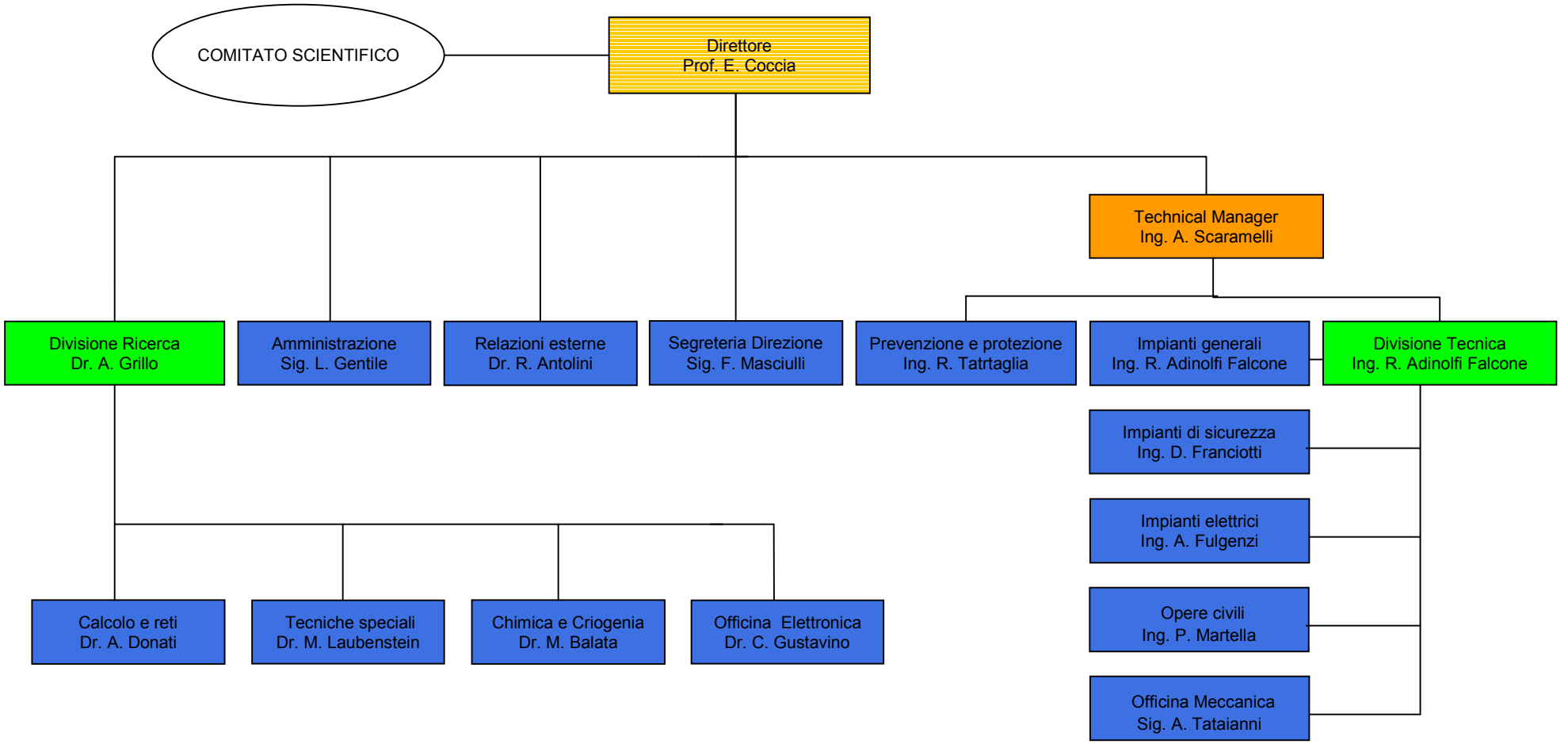
May 3, 2004


Hall C 14 July 2003
PC
D4
PC
D1


Hall C 14 October 2003

May 18th 2004

QuickTime™ e un
decompressore TIFF (Non compresso)
sono necessari per visualizzare quest'immagine.


COMITATO SCIENTIFICO
Direttore
Prof. E. Coccia
Technical Manager
Ing. A. Scaramelli
Divisione Ricerca
Dr. A. Grillo
Amministrazione
Sig. L. Gentile
Relazioni esterne
Dr. R. Antolini
Segreteria Direzione
Sig. F. Masciulli
Prevenzione e protezione
Ing. R. Tatrtaglia
Impianti generali
Ing. R. Adinolfi Falcone
Divisione Tecnica
Ing. R. Adinolfi Falcone
Impianti di sicurezza
Ing. D. Franciotti
Impianti elettrici
Ing. A. Fulgenzi
Opere civili
Ing. P. Martella
Officina Meccanica
Sig. A. Tataianni
Calcolo e reti
Dr. A. Donati
Tecniche speciali
Dr. M. Laubenstein
Chimica e Criogenia
Dr. M. Balata
Officina Elettronica
Dr. C. Gustavino

Improving the relationship with local authorities and citizens

Meetings with:

- President of the Gran Sasso Park

- Archibishop of L'Aquila

- WWF

- Council of the town of Teramo

Gran Sasso Initiatives:

Gran Sasso - Princeton Summer School for L'Aquila and Teramo students

Incontri di Scienza e Letteratura

Public Conferences and concerts

il Centro
L'Aquila e provincia

LA SICUREZZA COME OBIETTIVO COMUNE

Laboratori, segnali di pace

Il direttore Coccia e Ruffini: «Lavoreremo insieme»

CONVEGNO

L'AQUILA. Stretta di mano tra il presidente della Provincia di Teramo, Claudio Ruffini, e il neo direttore dell'Infn, Eugenio Coccia, durante il convegno sull'acqua promosso dal Parco Gran Sasso Laga. «In futuro si lavorerà insieme».

Insieme il direttore dei laboratori Coccia, Mazzitti e Ruffini

Un futuro quanto mai vicino, visto che la messa in sicurezza del sistema delle acque reflue dei laboratori di fisica nucleare del Gran Sasso è l'intervento più immediato che il direttore Coccia si appresta a realizzare. «Un'opera che può essere portata a termine in tempi brevi e a costi limitati», ha sottolineato Coccia, «e per la quale si stanno già individuando i finanziamenti. In tre mesi vorrei risolvere il problema e programmare così il rilancio delle attività dei nostri laboratori».

E' stata una giornata all'insegna dei buoni propositi, quella di ieri, in occasione del convegno dedicato alla presentazione della Carta per la valorizzazione e la tutela dell'acqua nelle aree protette, messa a punto da Federparchi e presentata in anteprima ritrovato clima di serenità», dopo gli aspri contrasti che hanno visto opposti, negli ultimi mesi, gli amministratori teramani e i rappresentanti dell'Infn. La vicenda è quella nota, con l'incidente del 16 agosto ai laboratori, lo sversamento del trimetilbenzene nelle reti idriche e il recente sequestro della sala C della struttura. «La nostra azione non è stata rivolta contro qualcuno», ha spiegato Ruffi- ti: ho salutato con piacere il nuovo direttore dei laboratori, con cui divido le origini picene. Credo che attraverso un'iniziativa comune, coordinata dalla Regione, riusciremo a trovare la soluzione che accontenta tutti». La strada, il governo regionale, la sta già tracciando: «Non bisogna dimenticare», ha sottolineato l'assessore alle opere pubbliche Giorgio De Matteis, «che il Gran Sasso è un patrimo-

il Centro
Teramo e provincia

DOM 22 giugn

Laboratori più trasparenti

L'impegno del nuovo direttore dell'Infn

WWF SUL GRAN SASSO

TERAMO. «Il laboratorio vuole essere trasparente». E' stata questa l'affermazione di Eugenio Coccia, neodirettore del Laboratorio del Gran Sasso, presente ieri a Teramo, in un incontro-dibattito sulla sicurezza dei laboratori organizzato dal Wwf. «Abbiamo voluto realizzare questo incontro pubblico» spiega Dante Caserta, presidente regionale del Wwf.

«Per fare il punto della situazione sui laboratori del Gran Sasso. Abbiamo, infatti, costatato che, anche al nostro interno non c'è molta chiarezza su quanto è accaduto finora. La presenza del nuovo direttore è senza dubbio un primo passo ma vogliamo poter vedere dei fatti concreti». Al termine di una lunga relazione, che ha ripercorso le diverse tappe dell'intricata vi- c'erano sostanze pericolose. E anche la questione del 3° tunnel ha esasperato gli animi. Proprio per questo stiamo facendo uno sforzo maggiore per avere un rapporto più diretto con il territorio, perché i cittadini hanno diritto di sapere cosa viene fatto con i loro soldi. E noi saremo ben lieti di spiegarglielo».

Anche sulla questione della sicurezza Coccia va spedito. «Dobbiamo essere in grado di garantire degli standard tali da non costituire un pericolo per la salute del cittadino. L'incidente dello scorso anno ha dimostrato che c'era una debolezza. Ma la sicurezza rimane il primo punto del nostro programma e i lavori previsti saranno completa-

il Centro
Teramo e provincia

GIOVEDI' 10 luglio 2003

«Acqua potabile, niente allarmi»

La commissione ambiente incontra il direttore dei laboratori

COMUNE

Ma la falda è sempre a rischio

Il direttore dei laboratori di fisica del Gran Sasso Eugenio Coccia

TERAMO. «La potabilità dell'acqua teramana non è stata mai in pericolo. L'acqua che bevono i teramani è sicura». E' questo il passaggio principale dell'intervento del presidente della Ruzzo servizi (ex Acar) Pino Casalena, che ha partecipato ieri alla riunione della commissione ambiente del Comune, nella sala San Carlo. L'incontro, voluto dal presidente della commissione Roberto Zilli, doveva servire a fare il punto sulla qualità dell'acqua in provincia, a un mese dal ritrovamento nelle sorgenti del Ruzzo di quantità minime di naftalene, e ad un anno di distanza dallo sversamento nelle acque del Mavone di trimetilbenzene, incidente che fu causato da alcuni ricercatori del laboratorio di fisica nucleare del Gran Sasso. Annualmente, è stato ricordato, sono quasi 7.000 i controlli che Arta, Asl e Ruzzo servizi, quest'ultimo attraverso l'istituto Zooprofilattico, svolgono per accertare la potabilità dell'acqua. Alla riunione della commissione ha partecipato anche il di- che mese organizzeremo un incontro pubblico, nel quale spiegheremo tutto quello che stiamo facendo per mettere in sicurezza il laboratorio». «Mi complimento con Coccia per il modo con cui si sta ponendo nei confronti delle istituzioni e della comunità teramana», ha esordito Sacco, «ma non vorrei che lo stato di emergenza per il Gran Sasso, decretato dalla presidenza del consiglio dei ministri alcune settimane fa, sia in realtà un pretesto per realizzare il terzo traforo».

«La Provincia», ha affermato Zecchino, «continuerà a ri- cessario l'amministrazione provinciale intraprenderà nuove azioni legali per ostacolare la costruzione dell'opera». Daniela Marcozzi Rozzi, dirigente dell'Arta, si è invece soffermata sul ritrovamento di naftalene, avvenuto un mese fa." «Non è una sostanza che compare nell'elenco ufficiale del laboratorio di fisica nucleare», ha spiegato, «e pertanto dobbiamo escludere che provenga dall'istituto di ricerca. Voglio rassicurare i teramani perché la quantità di questo idrocarburo ritrovata nell'acqua è bassissima,