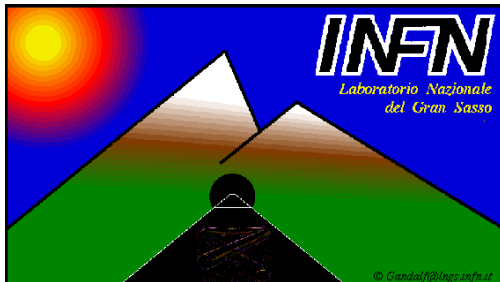




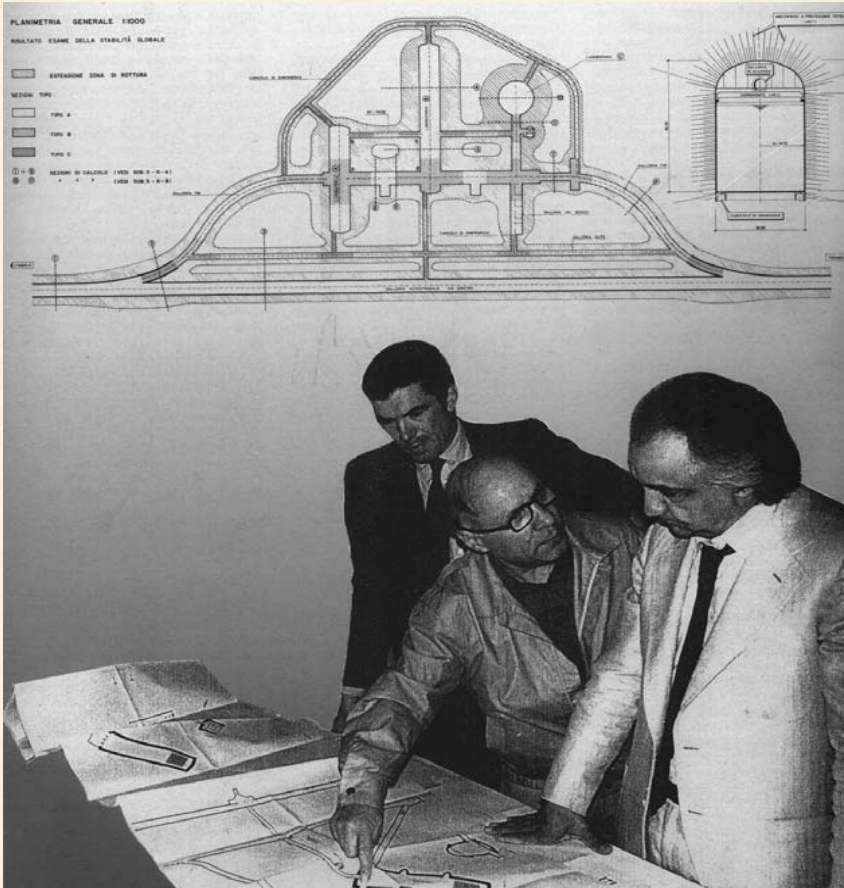
Status and future prospects of Gran Sasso



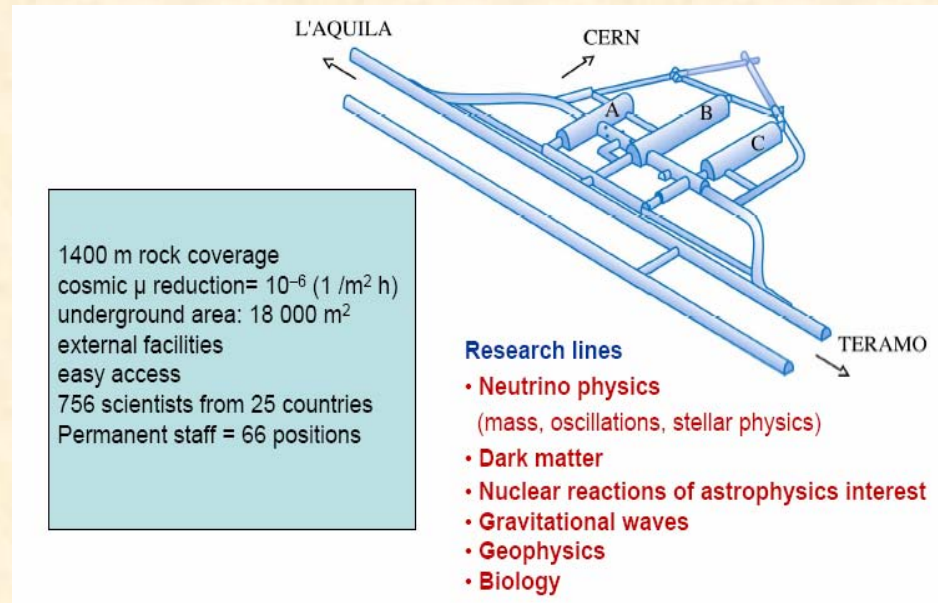
Aldo Ianni
INFN Gran Sasso Laboratory
NNN05 Aussois, April 7-9

The Gran Sasso Underground Laboratory

- ❑ Proposed in 1979
- ❑ Approved in 1982
- ❑ Since 1989 w/ the first experiment: MACRO



Aldo Ianni



Scientific achievements

Neutrino oscillations:

- ❑ GALLEX/GNO for solar ν 's
- ❑ MACRO for atmospheric ν 's

Cosmic rays:

- ❑ unique study with EAS-TOP
LVD/MACRO

Rare phenomena:

- ❑ $\beta\beta$ w/ Heidelberg-Moscow ($m_{ee} \sim 0.44\text{eV}$) & Cuoricino
- ❑ Dark Matter w/ DAMA

Nuclear astrophysics:

- ❑ with LUNA

R&D:

- ❑ Low energy (<1MeV) solar neutrinos with the Borexino prototype: a pioneer project
- ❑ LAr technology
- ❑ Low counting techniques

The Gran Sasso Laboratory in the future (<2010-2012)

- ❑ **Safety and infrastructures upgrade (2004-2006)**
- ❑ **CNGS program: OPERA, ICARUS**
- ❑ **Low energy solar neutrinos: Borexino**
- ❑ **DM: LIBRA, CRESST, WARP, LXe(?)**
- ❑ **$\beta\beta$: Cuoricino, Cuore, Gerda**
- ❑ **Nuclear astrophysics: LUNA**

Safety and Infrastructures upgrade

Upgrade of infrastructures [2004-2006]



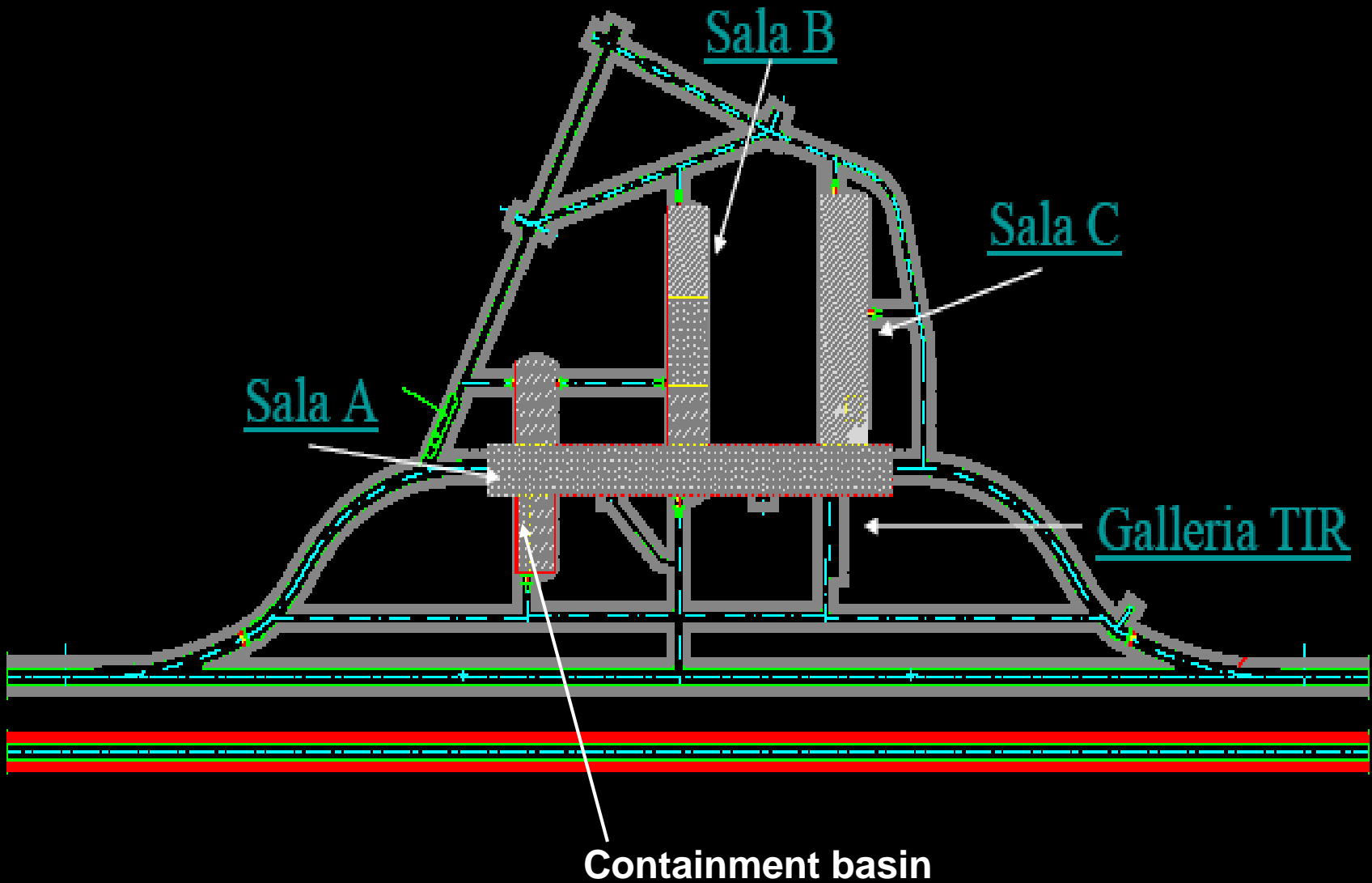
First phase

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

Second phase

- Upgrade of the ventilation system
- Upgrade of the cooling capability
- Upgrade of the electrical power

Sealing of floors





Hall C with Borexino & OPERA

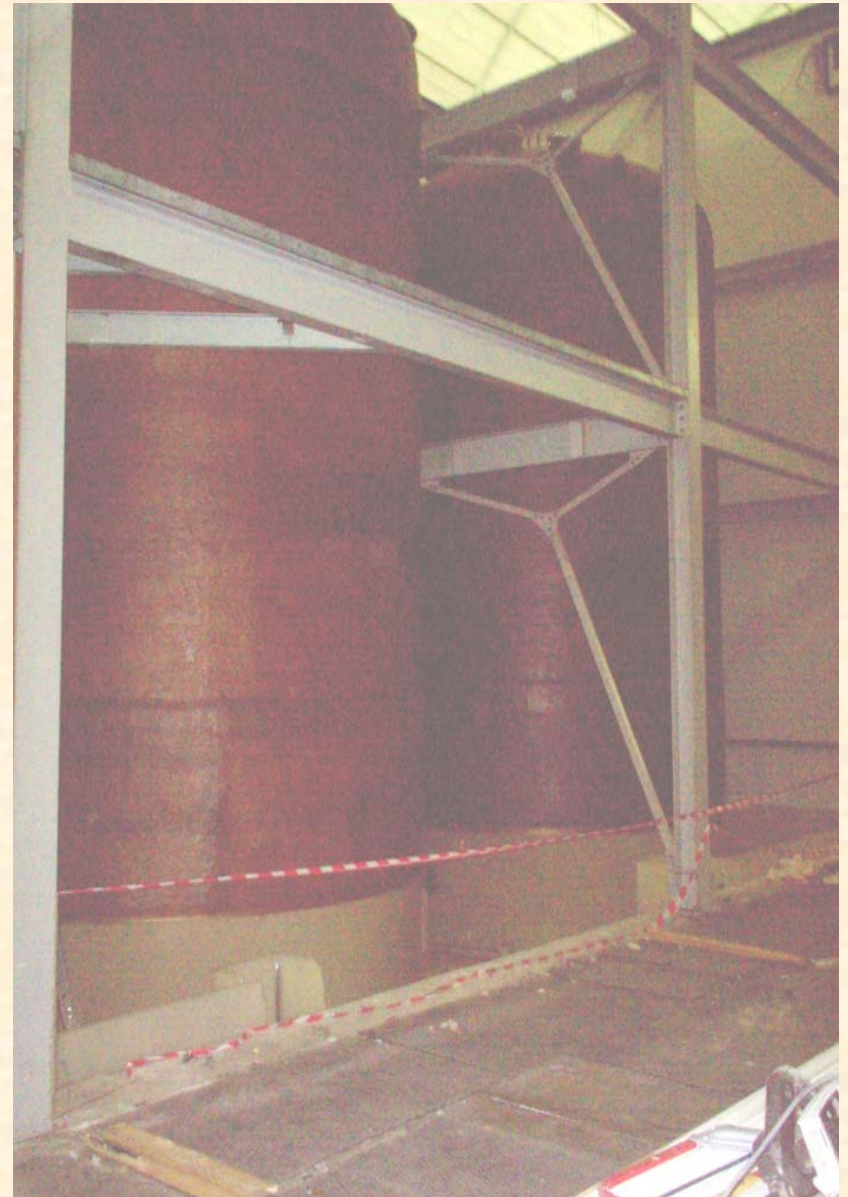
Hall C



Hall B w/ T600



Hall A with GNO being taken apart



New drain system

It needs excavation in the highway tunnel (east-west tunnel stopped for 3 months)

INFN
 ISTITUTO NAZIONALE DI FISICA NUCLEARE
 Laboratori Nazionali del Gran Sasso

Key-plan

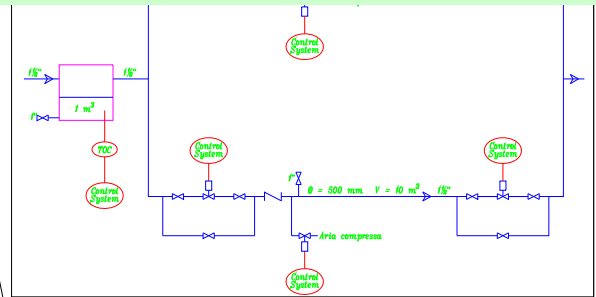
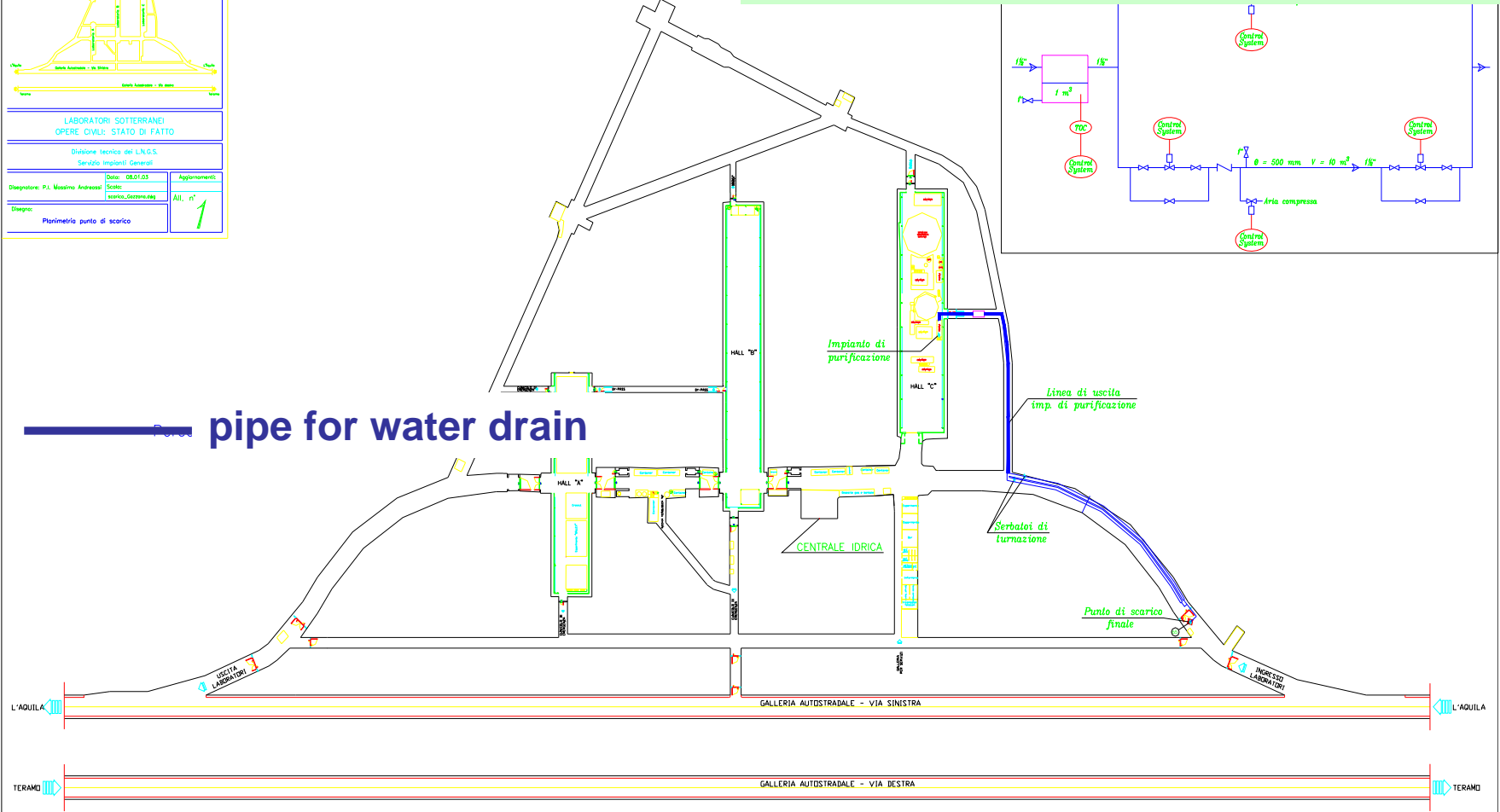
LABORATORI SOTTERRANEI
 OPERE CIVILI STATO DI FATTO

Divisione tecnica del L.N.G.S.
 Servizio Impianti Generali

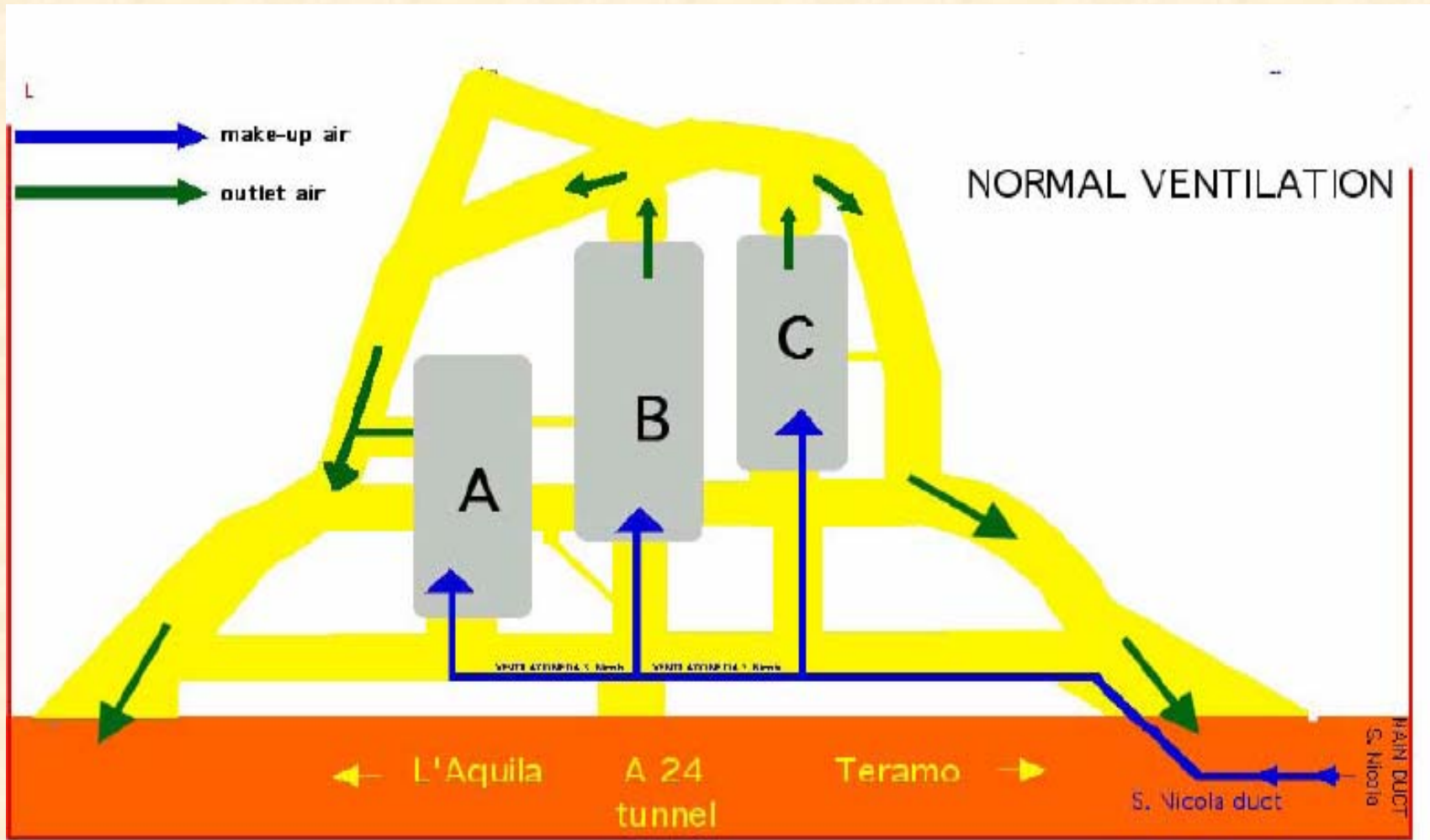
Dato: 05.01.03	Aggiornamento:
Disegnato: P.L. Massimo Andreassi	Scritto: scarico_carreina.dsg
Disegno: All. n° 1	

Planimetria punto di scarico

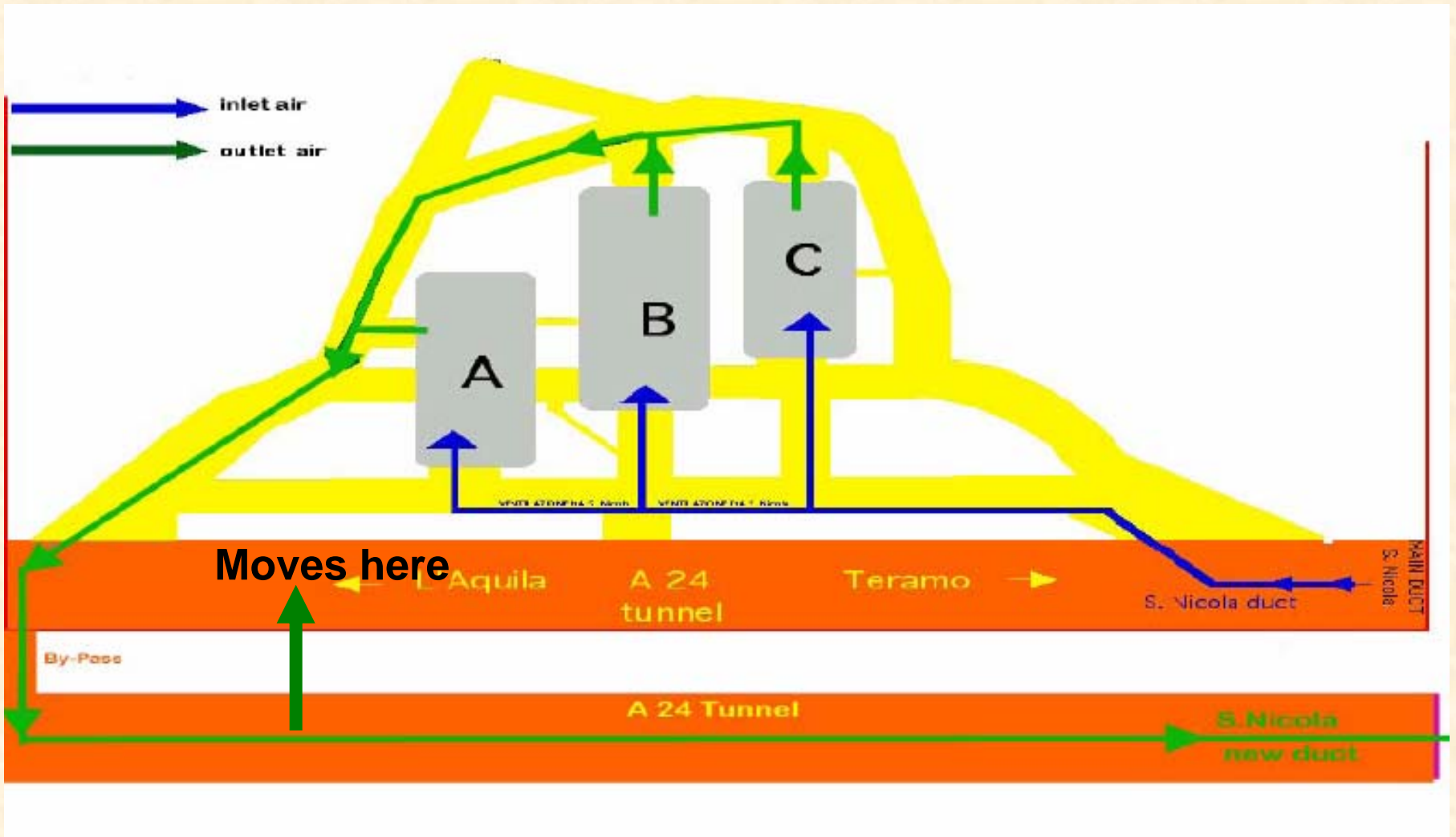
pipe for water drain



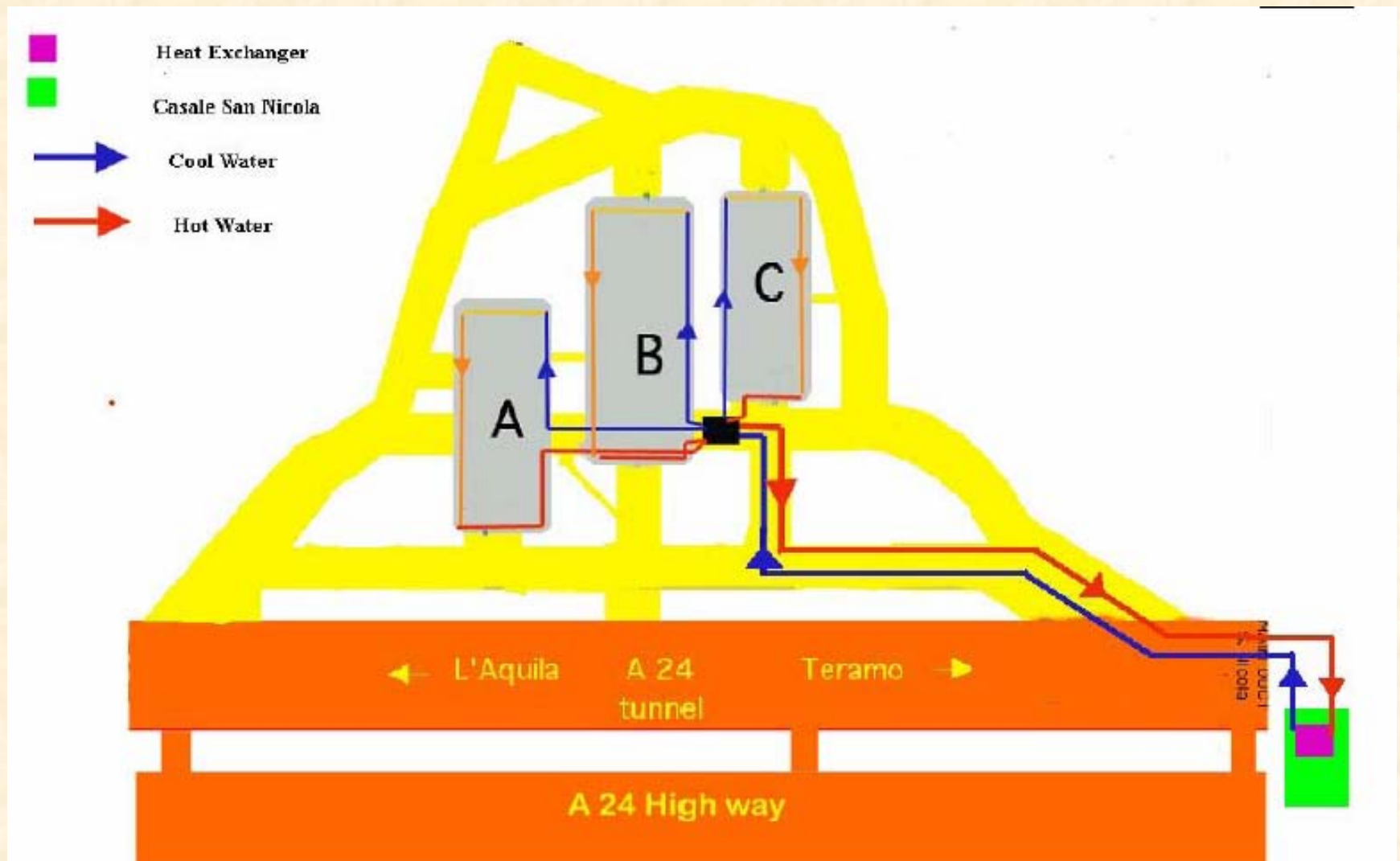
Ventilation system at present



New ventilation system

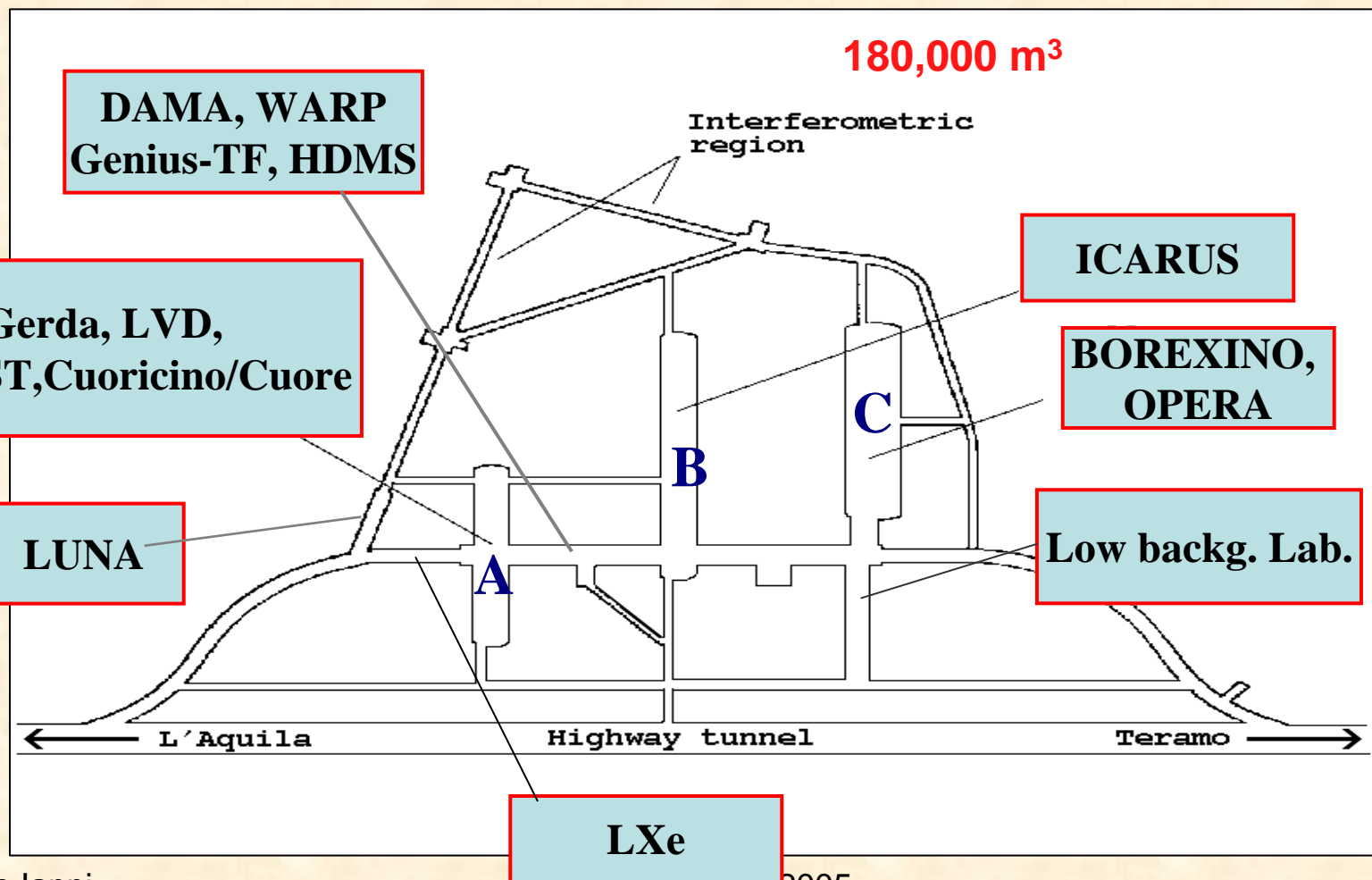


Cooling system



LNGS physics program before 2010

Existing and under way projects at the Laboratory



Physics program before 2010

Solar neutrinos:
Borexino searching for ${}^7\text{Be}$ and pep

SN neutrinos:
LVD (~400 events for a std SN)
running with 99.3% duty cycle in the
last 5yrs
T600 (~100), Borexino(80)

Double beta decay:
Cuoricino with about 40kg of TeO_2 (with 34% ${}^{130}\text{Te}$) in 3yr can reach
 $T_{1/2} > 1.8 \times 10^{24}$ yr (90%CL)
GERDA with ~20kg Ge enriched. ~1yr to confirm at 5σ or reject HM

Dark Matter:
CRESST: upgraded to 33detectors(10kg) + neutron shielding
operational by endo of 2005
LIBRA with 250kg of NaI already running (1.5yr)
WARP from 2.3kg to 100kg if background problems solved

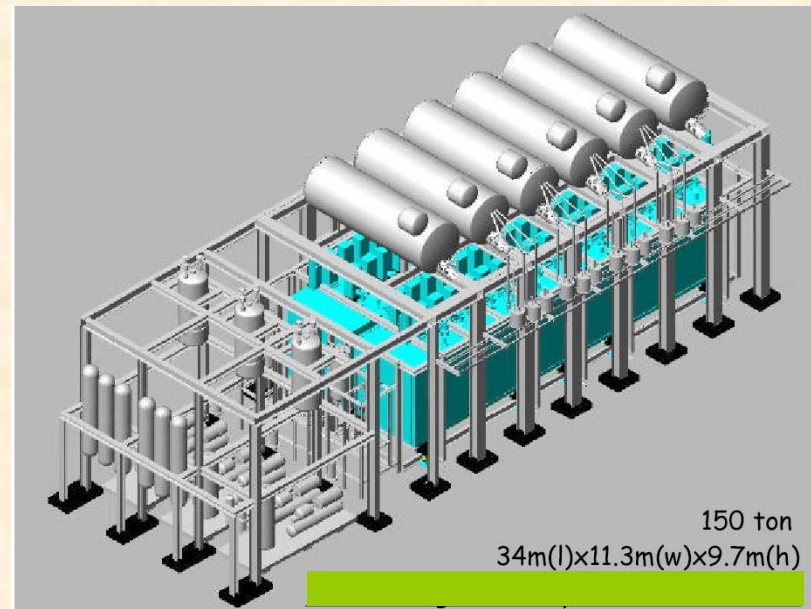
CNGS:
OPERA + ICARUS(T1800/T3000)

Gravitational waves:
2m in deameter spherical antenna to be
Installed on surface and moved later
underground

T600 at Gran Sasso



2 modules for T600 in Hall B since end of 2004



**T600 will be in operation by fall 2006
At present coll. working on infrastructures
(power supply, ventilation, heat dissipation)**

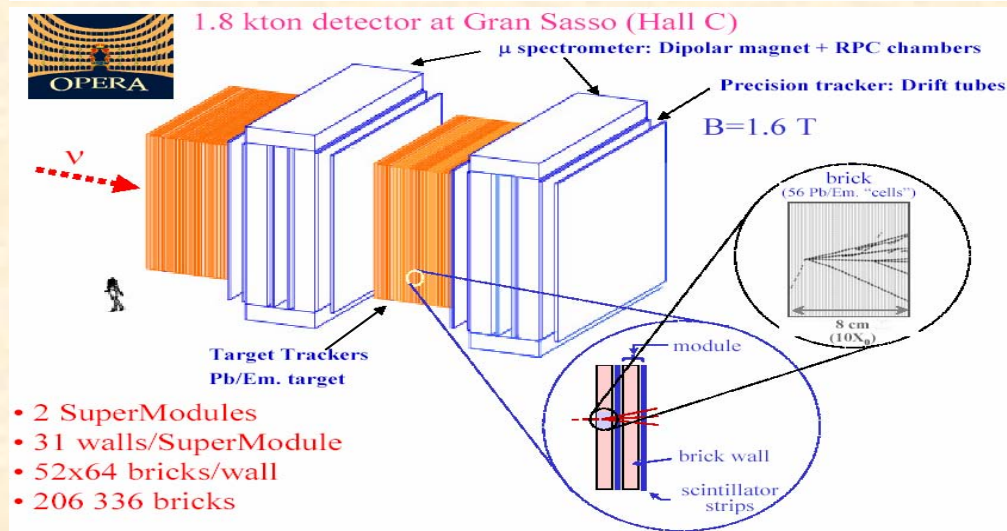
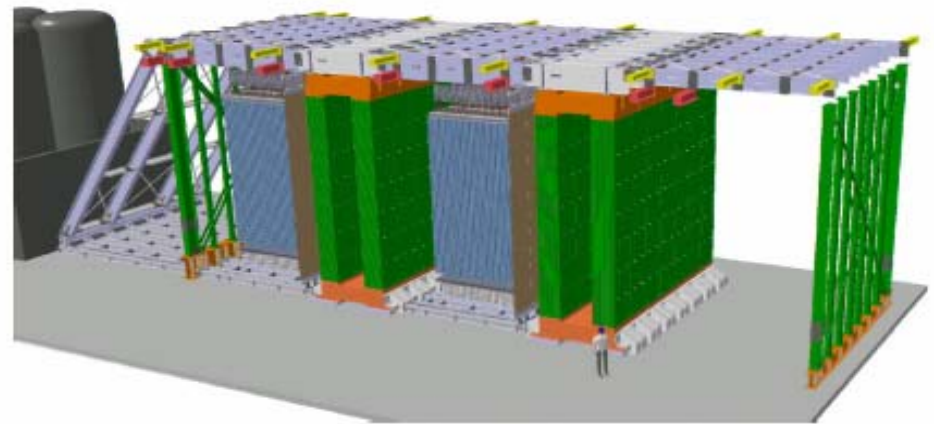
OPERA

Goals:

- $\nu_\mu \rightarrow \nu_\tau$ in appearance
- sub-leading $\nu_\mu \rightarrow \nu_e$

Technique:

- ✓ Pb nuclear emulsions
- ✓ 1.8kton target Pb mass
- ✓ Determination of decay topology



- 5 years with 4.5×10^{19} pot/year,
- expected ~ 10 events for $\delta m^2 \sim 2.5 \times 10^{-5} \text{ eV}^2$ @ ~ 0 background and for maximal mixing

Building OPERA ...

Installation will take one more year



Low energy solar neutrinos

Low energy solar neutrinos ... why?

Physics and astrophysics point of view:

- Test how the Sun shines. Input parameters (Z/X, opacity, ...) of SSM are correct?
- How much energy from CNO (1.5% from SSM)? Any other energy source?
- Photon luminosity versus Neutrino luminosity
- High precision neutrino flux and annual modulation determination.
High precision mixing angle (θ_{12}) determination [mainly by meas. pp].
- Test of vacuum-matter transition (energy dependence of ν oscillations).
- New physics (neutrino magnetic moment, NSI, new vacuum osc. [Vissani,03])
- CPT test by comparison with terrestrial anti-neutrino experiments

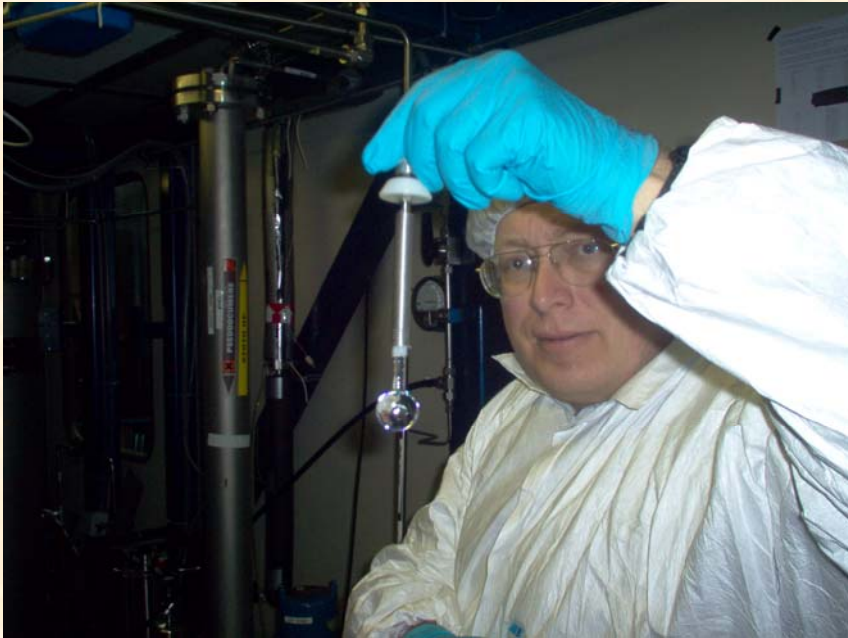
Future low energy solar neutrino experiments*

Experiment	Detection channel	target	Data taking	Expected signal counts/year for pp(Be)
Borexino	Elastic Scattering	100tons target mass	2007	30cpd only Be
KamLAND	Elastic Scattering	600 target mass	2007	
LENS	CC channel $^{115}\text{In} + \nu_e \rightarrow e^- + ^{115}\text{Sn}, \gamma$	20ton In-loaded scintillator cells	?	2190(511)
MOON	CC channel $^{100}\text{Mo} + \nu_e \rightarrow e^- + ^{100}\text{Tc}(\beta)$	3.3ton Mo foils + plastic scintillator	?	240(77)
XMASS	Elastic Scattering	10ton liquid Xe	?	2373(1241) with 50keV thres.
CLEAN	Elastic Scattering	10ton liquid Ne	?	2869(1518) with 50keV thres.

*only mentioned those which have a stronger R&D in progress!

Borexino back at work!

- ❑ Fluid handling operations back at work
- ❑ First operation just completed: calibration of the CTF with a Rn source
- ❑ Next important step: green light for distillation of scintillator



Schedule:

- ❑ major activities: distillation of PC, procurement of about 1kton, filling
- ❑ new drain system has a big impact on the schedule
- ❑ new drain system should be built by July this year! Hence, Borexino takes data by beginning of 2007

Summary

- ❑ Borexino back at work
 - ❑ OPERA on schedule
 - ❑ T600 underground being commissioned (next step: going toward kton scale)
 - ❑ Cuoricino running, GERDA approved and in start-up
 - ❑ Dark Matter: LIBRA, CRESST, WARP TF
 - ❑ GNO stopped and taken apart
-
- Sealing of floors in progress (Hall C done!)
 - New draining system installation, cooling and ventilation starting soon (April 18)

2006 A CRUCIAL YEAR FOR THE LNGS. Goals:
lab. upgrade works over
OPERA completed, T600 in operation, Borexino filled

After 2010 ... ?!

Space limitation underground but important physics program to be completed:

1. Borexino : ~2007-2012
 2. OPERA : ~2006-2012
 3. GERDA: starts 2006-2007
 4. CUORE: assembly over by 2009
 5. ICARUS: starts 2006 with T600
- Maybe after ~2013 some space free for ...
 - No Mton detector at Gran Sasso!
 - Rare phenomena & solar neutrinos**: going toward a measurement of pp neutrinos with a 10ton LNe Borexino-like detector?!
 - New ideas for ν -beams?