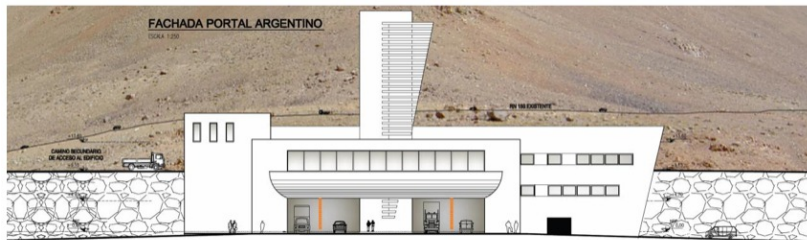


# The ANDES Laboratory Configuration



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X. Bertou

CNEA/CONICET, Centro Atómico Bariloche, Argentina

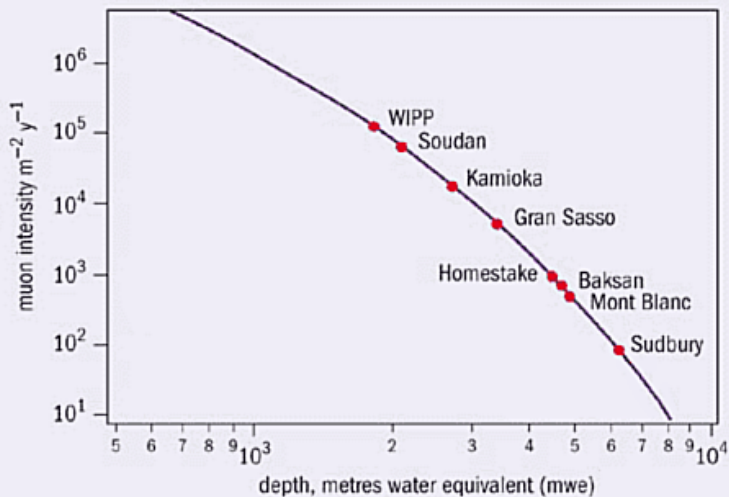
1<sup>st</sup> ANDES International Workshop

Tandar, Buenos Aires / 11-14 April 2011

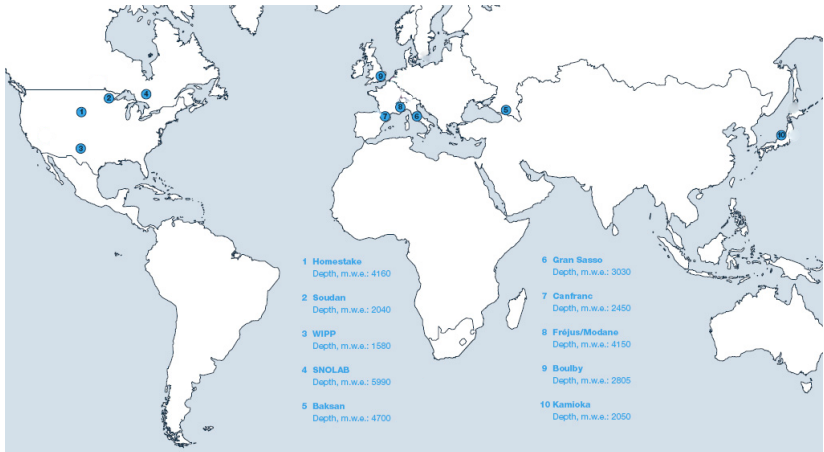
# Underground Laboratories

# Muon flux vs depth

Muon flux at sea level: few  $100 \text{ m}^{-2} \text{ s}^{-1}$



# Underground Laboratories



- None in the southern hemisphere

# Some Underground laboratories

## Laboratories in mines

- ▶ SNOLab, Kamiokande
- ▶ Homestake: possible extension (DUSEL)

## Laboratories in tunnels

- ▶ Gran Sasso: 3 halls of  $(100 \times 20 \times 20) \text{ m}^3$   
Total volume:  $180\,000 \text{ m}^3$
- ▶ Modane: main hall of  $(30 \times 10 \times 11) \text{ m}^3$   
3 secondary rooms  $(70 + 18 + 21) \text{ m}^2 \times 4.5 \text{ m}$
- ▶ Mines easier to build/expand
- ▶ Tunnels easier to access, to work within

The ANDES laboratory  
in the Agua Negra tunnel

Agua  
Negra  
Deep  
Experiment  
Site

# Location of the Agua Negra pass





# Tunnel proposed

- ▶ 2 tunnels, 12 m  $\varnothing$  each, separated by 60 m,  $\approx$  14 km long
  - ▶ Argentine entry point at the Quebrada San Lorenzo, 4085 m a.s.l.
  - ▶ Chilean entry point on a ridge, at  $\approx$  3600 m a.s.l.
  - ▶ Internal connexion galleries every 500 m
  - ▶ Deepest point at  $\approx$  1750 m depth
- 
- ▶  $\approx$  3700 m of altitude
  - ▶ relatively remote
  - ▶ “hot” tunnel  $\approx$  30 – 40° C
  - ▶ Ideal depth for an Underground Laboratory ( $\approx$  Frejus-Modane)

## 2 tunnels separated by 60 m

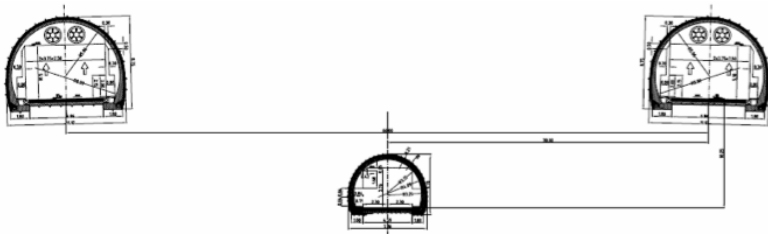


Figura 3 – Corte transversal del Túnel en sector con excavación convencional

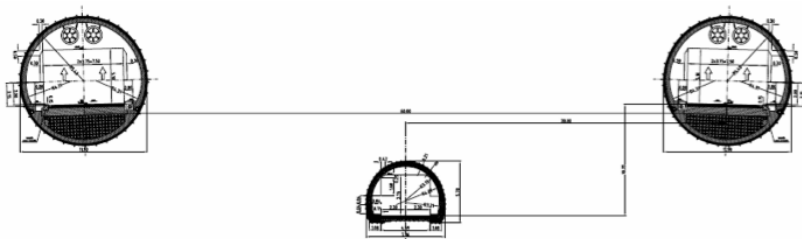
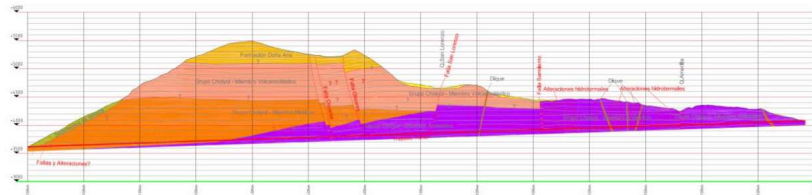
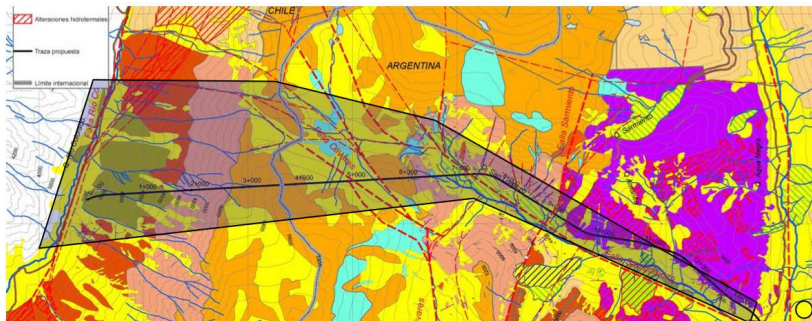


Figura 4 – Corte transversal del Túnel en sector con excavación con máquina tunelera

# Geology studies

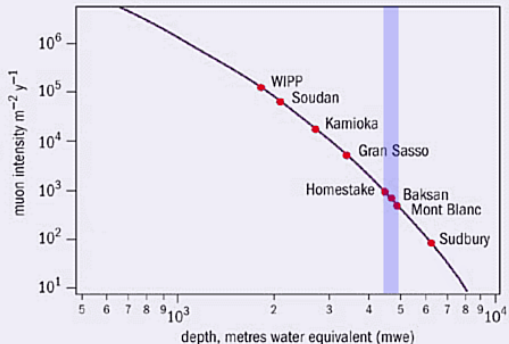


# Results of Geology studies

## Main rock: Andesite

- ▶ density  $\approx 2.7 \text{ g.cm}^{-3}$ , low radioactivity
- ▶ Variations:
  - ▶ basalt (+ dense, - radioactive)
  - ▶ rhyolite (- dense, + radioactive)

4500-4800 mwe



# ANDES Laboratory proposal

Located at km 3.5-5

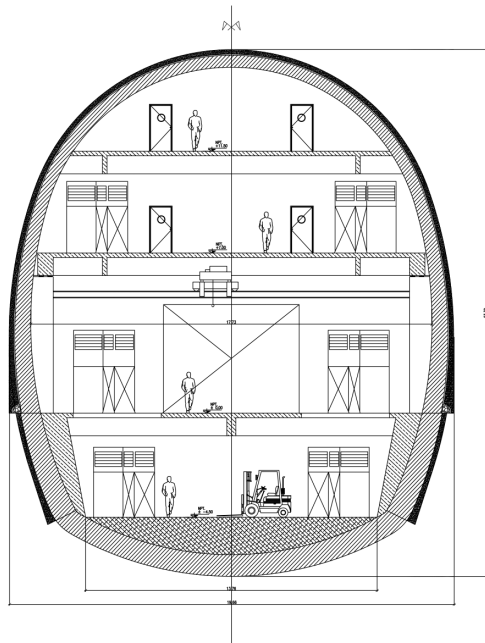
3 big halls:

- ▶ main hall 1:  
(20×25×50) m<sup>3</sup>
- ▶ hall 2: same size,  
3-4 floors
- ▶ hall 3: pit  $\varnothing$ 15-20 m,  
20 m depth

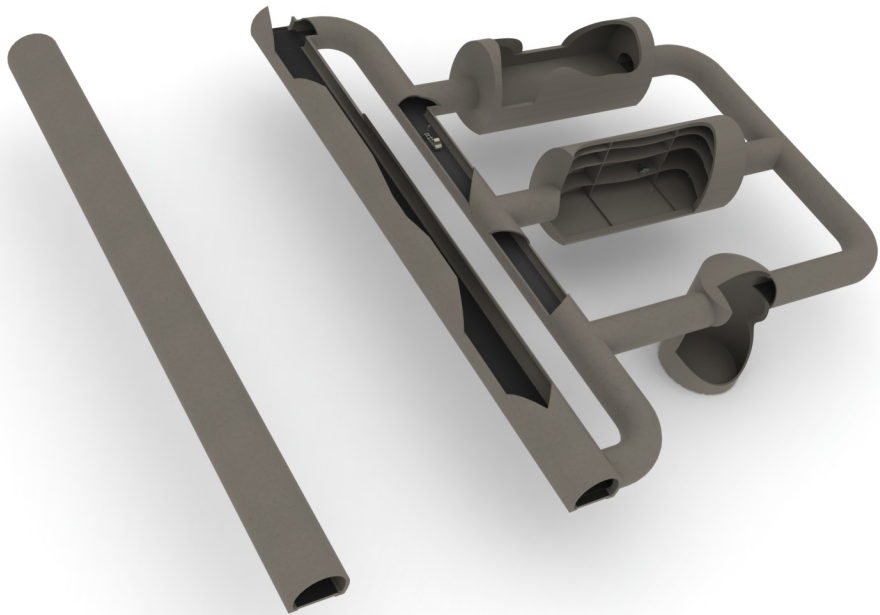
Linear tunnel for interferometer/accelerator

Total cost  $\approx$  10 MU\$D

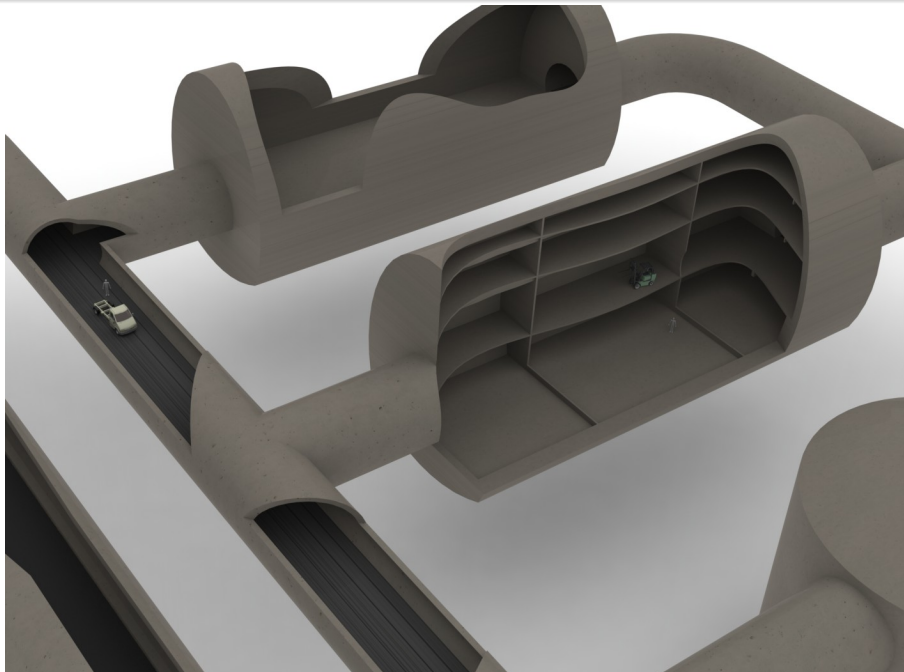
- ▶ + 2 external labs
- ▶ + experiments cost



# ANDES Laboratory concept

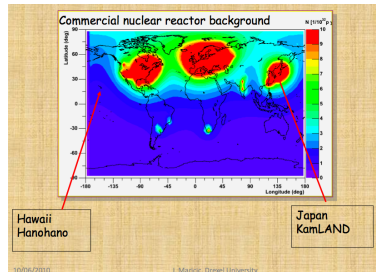


# ANDES Laboratory zoomed



# What makes ANDES special?

- ▶ Only underground laboratory in southern hemisphere
- ▶ Opposite weather induced modulations
- ▶ very long baselines:
  - ▶ (CERN: 9920 km)
  - ▶ Fermilab: 7640 km (“magic” baseline)
  - ▶ KEK: 12425 km (1500 km from Earth center)
- ▶ low reactor neutrino background
  - ▶ Embalse: 2.1 GWt, 560km
  - ▶ Atucha: 1.2 GWt, 1080km (Atucha II: 2.1 GWt)





# Experiments in ANDES?

Open discussion tomorrow

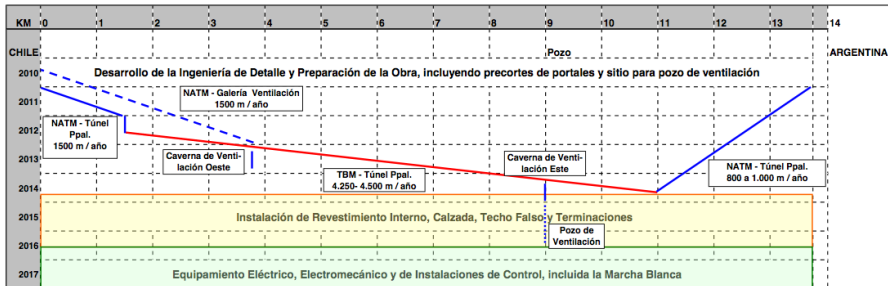
## ANDES specific

- ▶ DAMA-like experiment
- ▶ Big neutrino detector (SN/geo/very long baseline)
- ▶ Geophysics (seismology)

## More generic

- ▶ Part in a big international collaboration or two
- ▶ Have a regional-size experiment
- ▶ Have national-size experiments
- ▶ Low radiation measurement lab
- ▶ Biology

# Tunnel schedule



## Inauguration in 2017 (2018?)

- ▶ The laboratory would be in the km 3.5-5
  - ▶ Lab construction starting in 2013 (2014?)

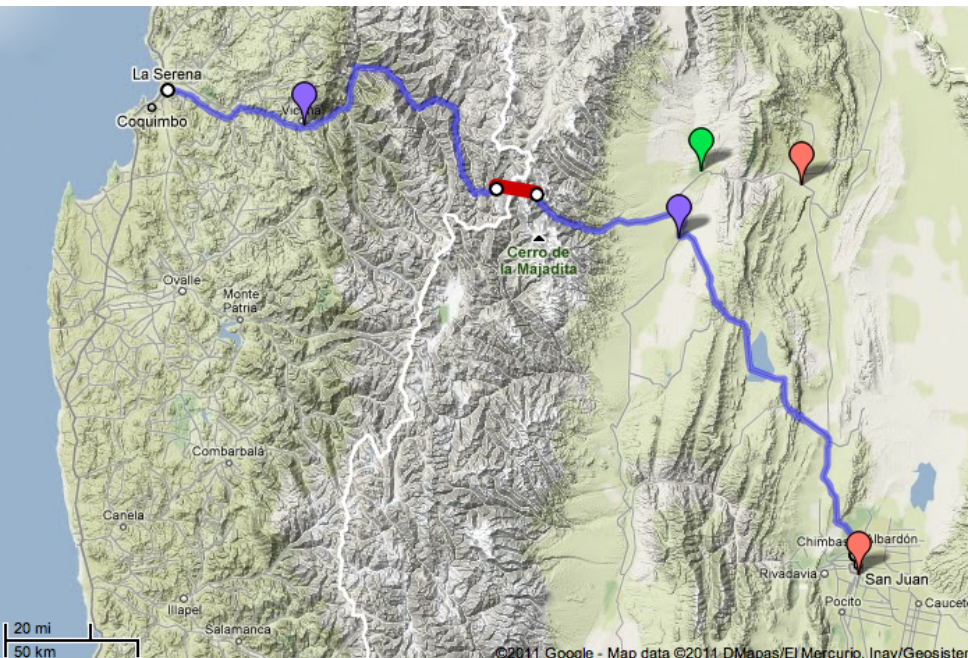
Have the civil work included in the tunnel tender

Need to have factibility studies mid 2011

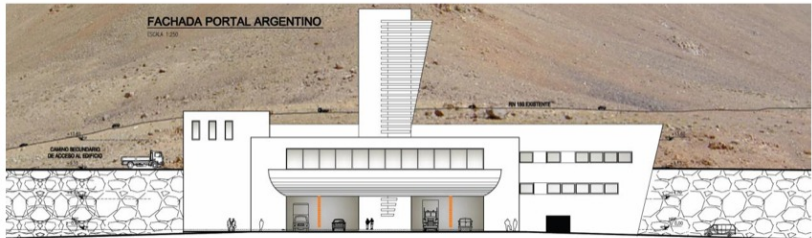
Cost  $\approx$  1% of lab cost (150 kUSD)

External support  
laboratories

# Agua Negra surroundings



# Offices at the portals



Each side will have a portal, with local services

- ▶ Ask for one or two ANDES office on each side
- ▶ Possible night sleep to avoid having to go back to support lab every day (mainly for technicians?)

Not explored in detail yet

Probable site: Vicuña

- ▶ closest city from tunnel (140 km)
- ▶ reasonable size (25 000 people)
- ▶ on the main tunnel access
- ▶ 60 km from La Serena
- ▶ some close-by observatories



# Argentine support laboratory

## Possible sites

- ▶ San Juan
  - + Big city, capital of the province, international airport
  - Far away (250 km)
- ▶ San José de Jáchal
  - + Reasonable size (15 000 people)
  - Not so close (120 km), mountain road access
- ▶ Iglesia
  - + Close-by (65 km), on the main tunnel access
  - Tiny town
- ▶ Rodeo
  - + Close-by (75 km), nice and touristic area
  - Small town, windy



No conclusions... Thank you!

