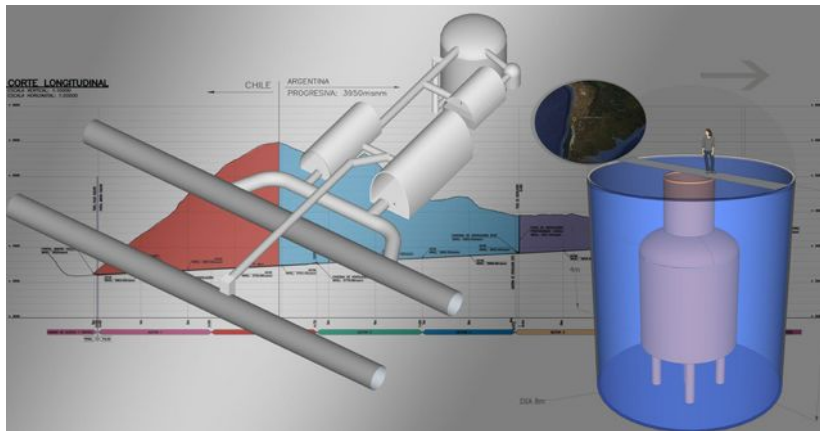


The ANDES Underground Laboratory in South America



X. Bertou

CNEA/CONICET, Centro Atómico Bariloche, Argentina

ASPERA Workshop - The next generation projects in Deep Underground Laboratories - Zaragoza - 1 July 2011

An Underground Laboratory in South America

Deep Underground Laboratories



+ China, Korea, India

▶ None in the southern hemisphere

Southern hemisphere and Latin America?

South Africa

- ▶ Gold mines (1965...)

South America

- ▶ Argentina: experiment at Sierra Grande mine (1000 wme)
 - ▶ Search for an annual modulation of dark-matter signals with a germanium spectrometer at the Sierra Grande laboratory
Astropart.Phys. 10 (1999) 133-139
- ▶ Brazil: search for a mine by Lattes
- ▶ Chile: El Teniente mine prospected

Latin America

- ▶ Mexico: proposal of the multidisciplinary mexican underground laboratory (LSMM) for Mega Proyectos 2006

the Agua Negra tunnel

Andes crossing

- ▶ It is of strategic importance for the region to increase exportation to the Asian market
- ▶ The natural way for Argentina and Brazil is to export by boat through Chile
- ▶ There are various passes. The main one, the Cristo Redentor tunnel from Mendoza to Santiago, cannot fulfil the increasing international demand, especially in winter when it has to close due to strong snows, with thousands of trucks stuck every year

- ▶ Argentina, Brazil and Chile have been looking for years at an alternative based on a low altitude tunnel
- ▶ There have been various proposals for Mendoza - Santiago (train tunnel, Las Leñas pass) and San Juan - Coquimbo (Agua Negra)

The Agua Negra tunnel context

- ▶ Recently the San Juan - Coquimbo option is favoured
- ▶ Pre-feasibility study done in 2005, feasibility in 2008
- ▶ Cristina Fernández de Kirchner and Michelle Bachelet signed a Bi-National Integration treaty, including the San Juan - Coquimbo option, in October 2009, voted later on by both countries
- ▶ August 2010 MERCOSUR meeting was in San Juan and a strong support for the Agua Negra tunnel was given, with Luis Inácio Lula da Silva pushing for the tunnel tender
- ▶ In December 2010 and January 2011 the governor of San Juan met with Sebastián Piñera and his ministers. When Dilma Rousseff visited Argentina, he presented her the tunnel project
- ▶ In April 2011, Sebastián Piñera received 14 Argentine governors and stressed Agua Negra (and Aconcagua train tunnel)
- ▶ Last month, in Italy, Piñera and Kirchner met again and looked for financing for the Agua Negra tunnel civil work

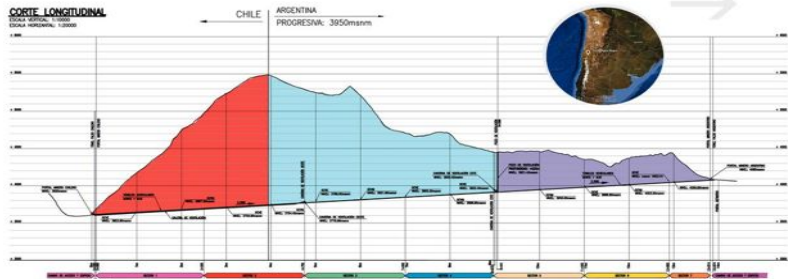
- ▶ Tender foreseen to start September 2011
- ▶ Total cost is estimated to about 850 MU\$D

Location of the Agua Negra pass

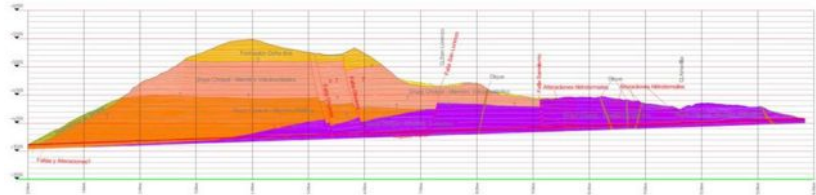
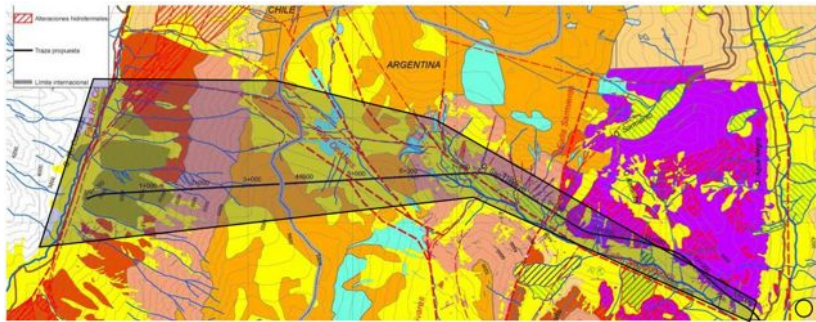


Tunnel proposed

- ▶ 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
- ▶ Tender in September 2011, Construction 2012-2018



Agua Negra geology

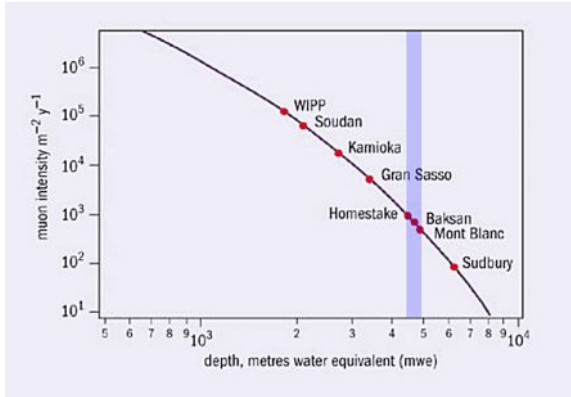


Results of Geology studies

Main rock: Andesite

- ▶ Variations:
 - ▶ rhyolite
 - ▶ basalt
 - ▶ dacite
 - ▶ trachyte

4500-4800 mwe



- ▶ data from 8 main perforations of up to ≈ 600 m deep

Ongoing rock radioactivity measurements



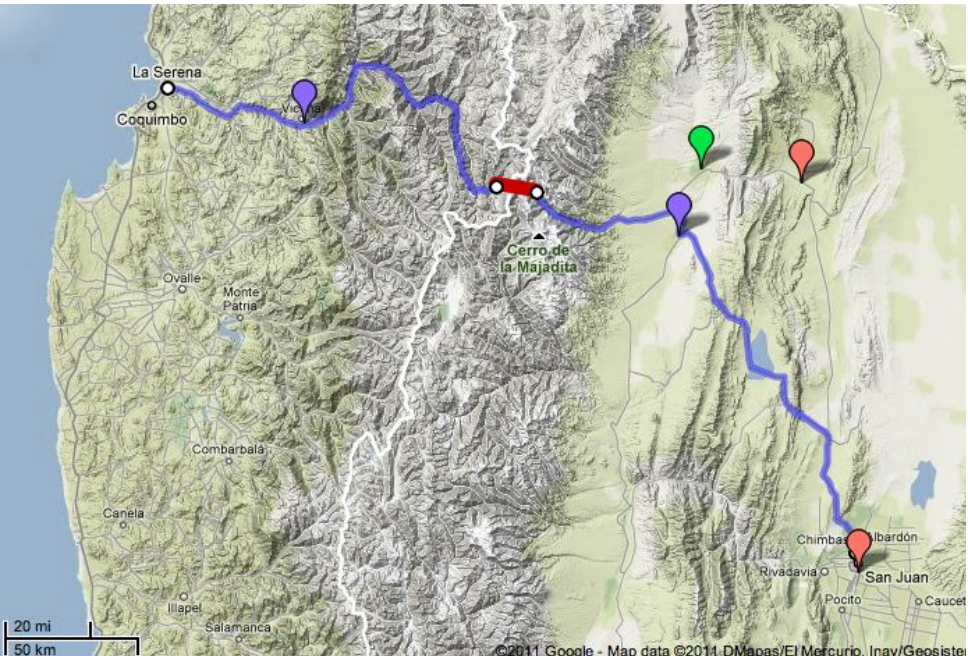
- ▶ 9 samples, mostly from ≈ 600 m deep

Preliminary data (Bq/kg)

	Basalt	Andesite	Rhyolite 1	Rhyolite 2
^{238}U	2.6 ± 0.5	9.2 ± 0.9	14.7 ± 2.0	11.5 ± 1.3
^{232}Th	0.94 ± 0.09	5.2 ± 0.5	4.5 ± 0.4	4.8 ± 0.5
^{40}K	50 ± 3	47 ± 3	57 ± 3	52 ± 3

(thanks to laboratorio de activacion neutronica, this morning)

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 (should improve)
- ▶ Iglesia
 - + Close-by (65 km)
 - Tiny town
- ▶ Rodeo
 - + Close-by (75 km), nice and touristic area
 - Small town, windy

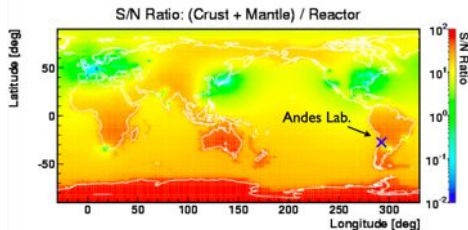


The ANDES laboratory

What makes ANDES special?

(in addition, for us, of being in Latin America)

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



ANDES Initial Scientific Programme

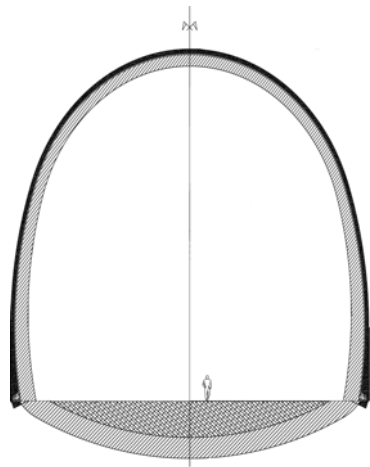
- ▶ Neutrino
 - ▶ host double beta decay experiments
 - ▶ large Latinamerican neutrino detector
 - ▶ KamLAND/Borexino style
 - ▶ focus on low energy
 - ▶ solar/SN/geo neutrinos
- ▶ Dark Matter
 - ▶ modulation measurement
 - ▶ new technologies
- ▶ Geophysics
 - ▶ link Argentine and Chilean seismograph networks
- ▶ Biology
- ▶ Low Background measurements
- ▶ Accelerator
 - ▶ Nuclear Astrophysics
 - ▶ DAR neutrino beam?

ANDES Laboratory proposal

Located at km 3.5-5

- ▶ main hall:
(21×23×50) m³
- ▶ secondary hall:
(16×14×40) m³
- ▶ multi-level hall:
(17×15×25) m³, on 3
floors (up to 1200 m³)
- ▶ ultra-low radiation pit:
∅8 m, 9 m depth
- ▶ single experiment pit:
∅30 m, 30 m depth

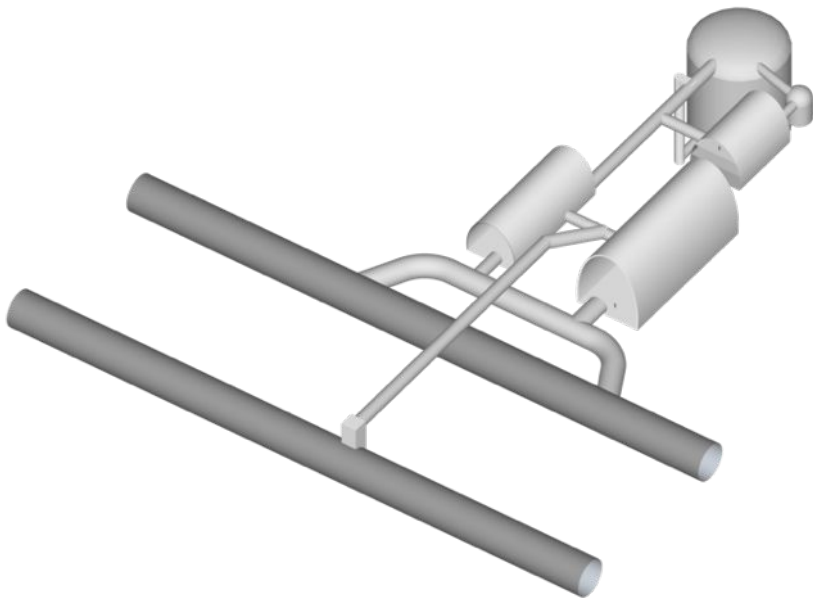
Linear tunnel for
interferometer



Total civil work cost \approx 15 MU\$D

- ▶ + 2 external labs
- ▶ + experiments cost

ANDES Laboratory concept



El Consorcio Latinoamericano
de Estudios Subterráneos (CLES)

The Latinamerican Consortium
for Underground Studies

The Latinamerican Consortium for Underground Studies (CLES)

- ▶ The MERCOSUR (UNASUR) aspect of the Agua Negra tunnel can be naturally extended to the ANDES laboratory
- ▶ Excellent opportunity to have an international laboratory, not only international experiments
- ▶ The CLES would be our “seed” for a small CERN with respect of underground science (not only high energy: geology, biology, technology...)

- ▶ Common participation for the ANDES laboratory operation and operating funds
- ▶ CLES forms the Scientific Committee to manage the ANDES laboratory

Early support letters - CLES



Asociación Física Argentina

Córdoba, 15 de diciembre de 2010

Dr. Xavier Bertou

Grupo de Teoría de Partículas y Campos
Centro Atómico Bariloche
Avda. E Bustillo 9500
8400 Bariloche - Argentina

De mi mayor consideración

Me dirijo a Ud. en mi condición de Presidente de la Asociación Física Argentina a fin de expresar el interés que reviste el proyecto de Laboratorio

UNIVERSIDAD TÉCNICA FEDERICO SANTA MARÍA
Departamento de Física



Dr. Xavier Bertou
Centro Atómico Bariloche
Argentina

14 Diciembre 2010

Estimado Dr. Bertou

Me dirijo a usted en nombre del grupo chileno de Física de Partículas y Alta Energía que ha promovido el establecimiento de la física experimental de alta energía en Chile y ha establecido la participación de Chile en los experimentos del LHC en CERN. Nuestro grupo está constituido por la totalidad de físicos de las áreas de fenomenología de partículas y de física experimental de alta energía existentes en Chile, entre los que se cuentan los participantes del experimento ATLAS y NA64 en CERN (Suiza), MINERvA en Fermilab (USA) y varios experimentos en Jefferson Lab (USA). El grupo incluye colegas de varias universidades (Universidad de Chile, Pontificia Universidad Católica de Chile, Universidad Austral de Chile, Universidad Técnica Federico Santa María).

Hemos sabido de su iniciativa de construir un Laboratorio Subterráneo bajo la cordillera de Los Andes en el túnel de Agua Negra, que se proyecta construir entre Argentina y Chile, idea que apoyamos con total entusiasmo.



Ronald Cintra Shellard
CBPF - Centro Brasileiro de Pesquisas Físicas - MCT
Rua Dr. Xavier Sigaud, 150 - 22270-180 Rio de Janeiro RJ Brazil
Tel. +55 21 2341 7301 - Fax +55 21 2141 7356 - email: shellard@cbpf.br

Dr. Xavier Bertou
Grupo Teoría de Partículas y Campos
Centro Atómico Bariloche
Avda. E. Bustillo 9500
8400 Bariloche - Argentina

Rio de Janeiro, 30 de November de 2010

Caro Dr. Bertou

Venho por meio desta expressar meu apoio entusiasmado ao projeto de construir o ANDES - Consórcio Latino Americano para Experimentos Subterráneos, no túnel de Agua Negra, sob os Andes. Creio ser esta uma oportunidade única para a preparação de um laboratório, na América do Sul, com capacidade para a realização de experimentos avançados nas áreas de estudos de Neutrinos, da Matéria Escura e de muitas outras áreas da ciência que necessitam de um ambiente protegido dos raios cósmicos. O laboratório poderia desde seu início, ter um caráter internacional, reunindo os países da região e oferecendo aos nossos cientistas vantagens comparativas relevantes, quando comparadas com nossos colegas do Hemisfério Norte.

Diciembre 14, 2010

Dr. Xavier Bertou
Centro Atómico Bariloche
Bariloche, Argentina

Estimado Dr. Bertou,

Me dirijo a Usted como representante de la Red de Física de Altas Energías (Red FAE) de México a fin de expresarle mi total apoyo a su iniciativa de construir un laboratorio subterráneo en el túnel Agua Negra que unirá Argentina y Chile, atravesando la Cordillera de los Andes a la altura de la provincia de San Juan.

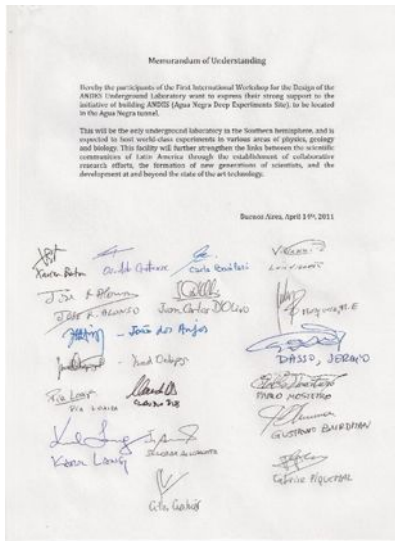
Nuestra Red, cuenta con el patrocinio del Consejo Nacional de Ciencia y Tecnología (CONACYT) de México y reúne a casi un centenar de investigadores de la especialidad, más un número considerable de estudiante de posgrado, pertenecientes a 15 universidades e institutos de investigación de nuestro país. Entre sus objetivos primordiales se encuentra el de promover la participación de grupos mexicanos en los grandes experimentos internacionales de frontera relacionados con la física y astrofísica de las partículas elementales.

Steering group of country representatives:

- ▶ Coordinator: Xavier Bertou
- ▶ Argentina: Osvaldo Civitarese
- ▶ Brazil: Ronald Shellard
- ▶ Chile: Claudio Dib
- ▶ Mexico: Juan Carlos D'Olive

Task forces on science topics:

- ▶ Neutrino: Renata Zukanovich Funchal
- ▶ Dark Matter
- ▶ Geophysics
- ▶ Interdisciplinary



Conclusions and prospects

Unique opportunity for a Latinamerican Consortium

- ▶ Argentina, Brazil, Chile, Mexico
- ▶ Participation to the Scientific Committee
- ▶ Contribution to Operating Costs
- ▶ Latinamerican neutrino flag experiment

Project status

- ▶ Scientific support
- ▶ Political support
- ▶ Finish Feasibility study
- ▶ Work on including the lab in the tunnel tender
- ▶ Work on science and lab white papers

Open laboratory

- ▶ Natural integration with other labs/experiments
- ▶ Host large 3-gen double beta decay/dark matter exp.
- ▶ Students/posdocs formation phase for 7 years

Web page: <http://andeslab.org/>

Thank you!

<http://andeslab.org/>

