

CTA Candidate sites in Argentina

**CTA SITE SELECTION COMMITTEE
HEIDELBERG, APRIL 2013**



**For Argentinian-Brazilian CTA Collaboration:
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Two sites in Argentina



2 sites selected in Argentina, based on a combination of atmospheric conditions and infrastructure requirements

(A) San Antonio de los Cobres (SAC), Salta Province

(B) El Leoncito, San Juan Province

San Antonio de los Cobres

Location: Argentinian Puna highland

- **Distance to Salta City:** 182 km

Highly developed province capital city, pop. 550.000. Nearly equal dist. to Jujuy City.

- **Distance to San Antonio d.I.C.:** 22 km

Small village, pop. 6.000, availability of basic services. Town for local staff.

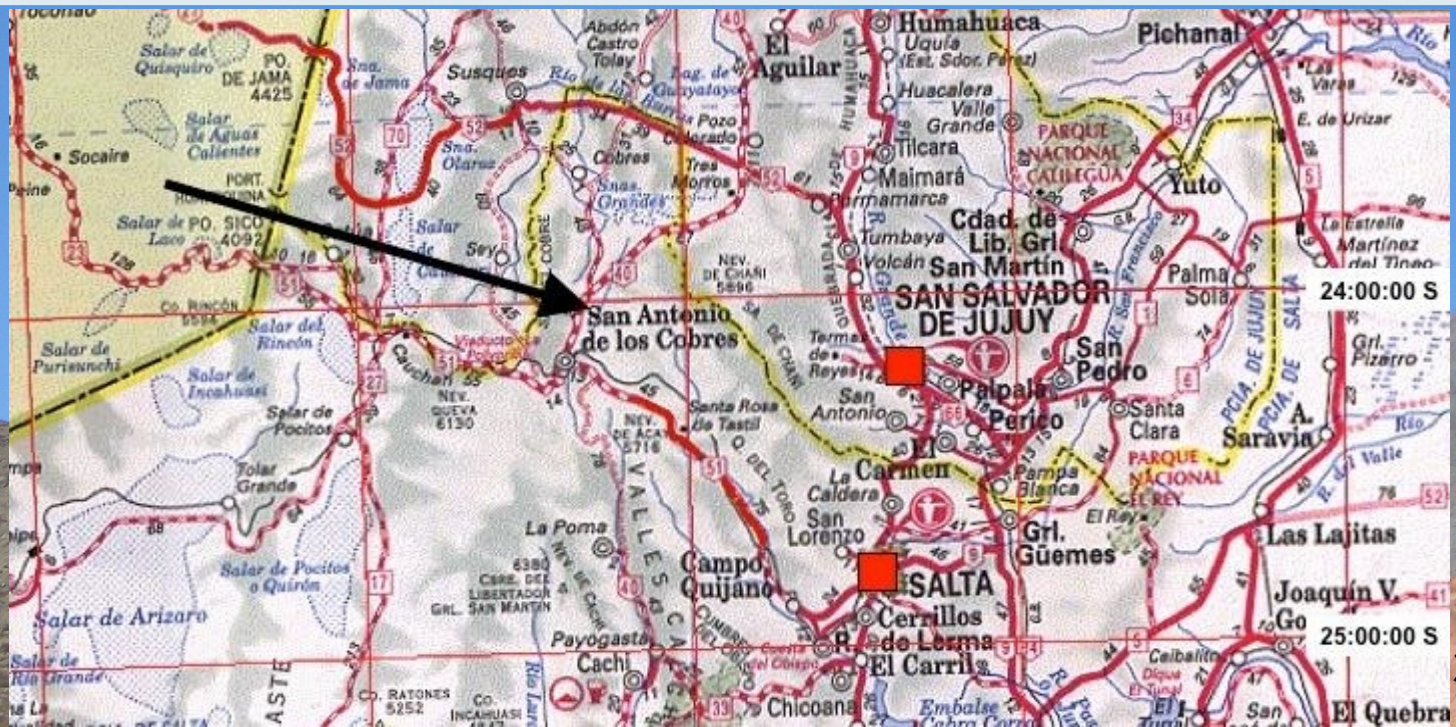
Access: Paved/Gravel road from Salta

- 3 hours by car, 3,5 hours by mini-van or truck along a road in good conditions.

- 20 km not so good gravel road, being improved

- transitable all year long (maintained for strategic reasons), suitable for heavy loads

- Alternative access via Jujuy or Chile (paved road from maritime ports)



San Antonio de los Cobres

Geotechnical characteristics:

- Highest altitude site (3600 masl):

Optimal for Gamma Ray Astronomy at low E

("The STAC underlines the importance of all the detector systems, SST, MST and LST, for making possible observations with unique sensitivity, including transient sources down to 20 GeV").

- Flat area in excess of 10 km², gentle slope

- Detailed topographical survey done, data available

- **Preliminary soil studies & georadar profiling:** homogeneity in deposits, "gravel or sandy gravel, poorly graded" - General geotechnical characteristics over all the site are good to very good for telescope foundations. See technical report by Viramonte-Peralta.



San Antonio de los Cobres

Climate and atmosphere

On-site instrumentation:

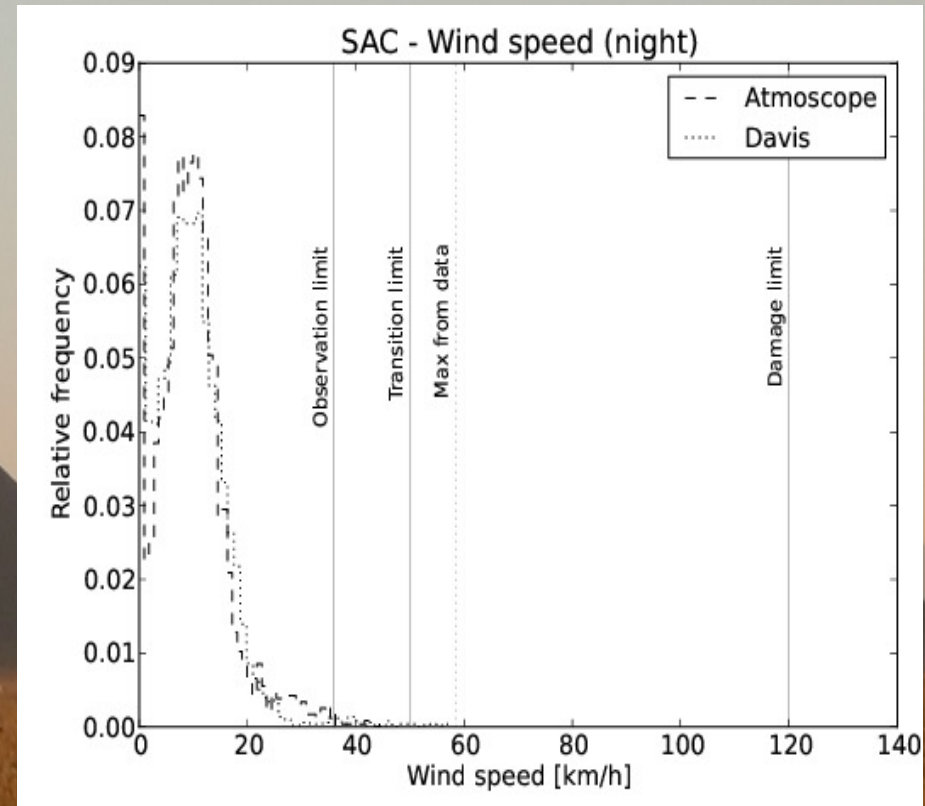
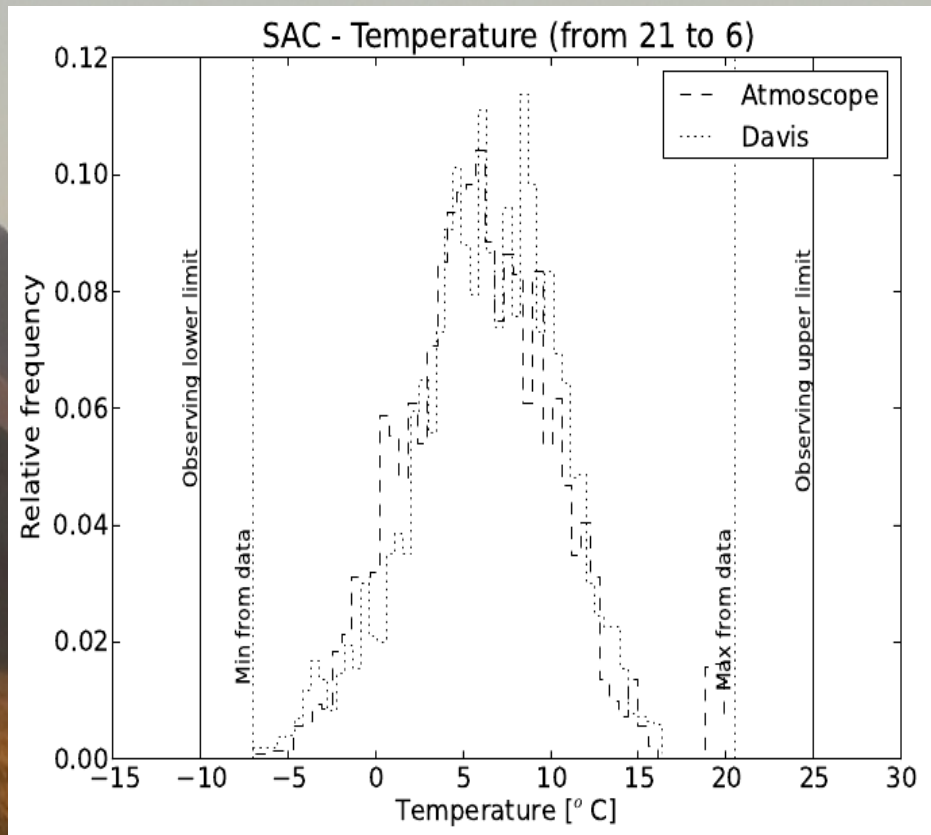
- Automated meteorological station at SAC Town (2008 - 2011)
- Dedicated Davis meteorological station (since 4/2011): T, P, wind, RH
[see: [http://sion.frm.utn.edu.ar/ctaweather/user CTA](http://sion.frm.utn.edu.ar/ctaweather/user%20CTA), pass: site4cta]
- Dedicated SQM (since 4/2011)
- CTA Full sky camera (since 12/2011) - data not yet processed
- CTA Atmoscope (since 8/2012)
- Grimm aerosol spectrometer



San Antonio de los Cobres

Meteorological conditions:

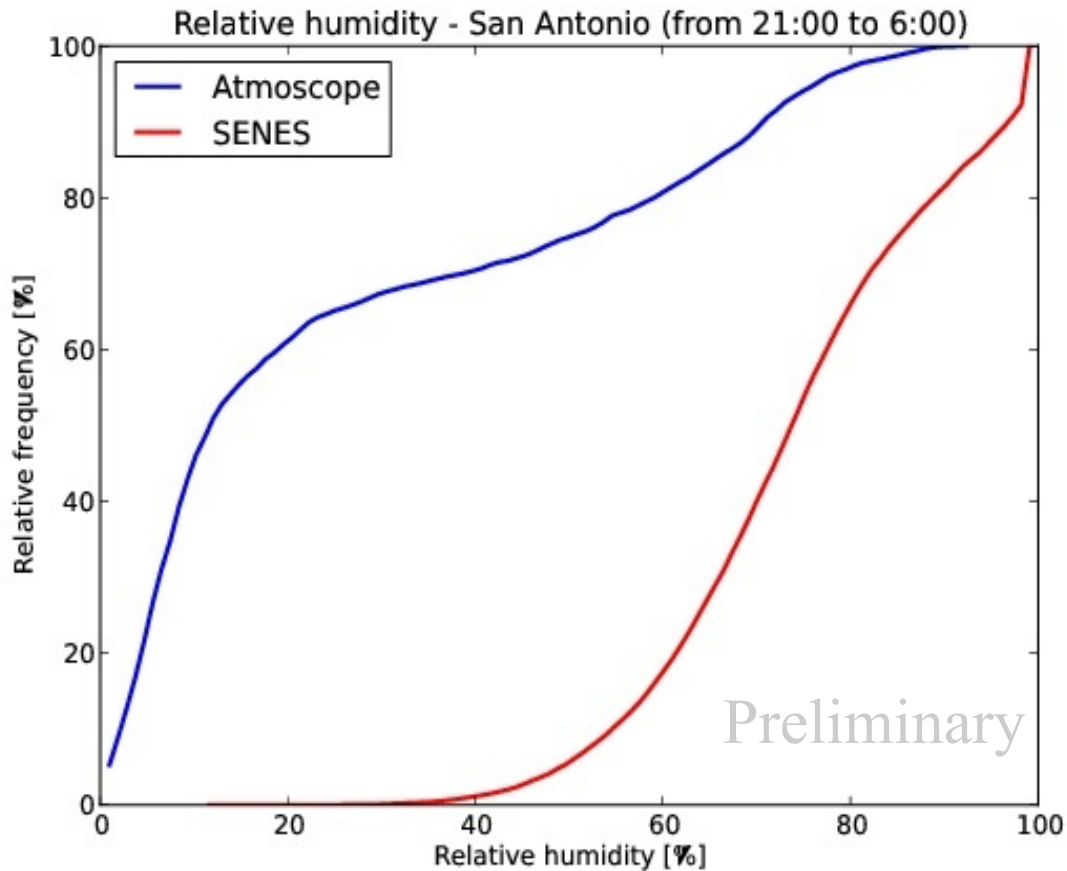
- **Temperature** and **Winds** well within specifications.



San Antonio de los Cobres

Meteorological conditions:

- **Humidity:** from Atmoscope - clear discrepancy with SENES prediction - relevant for condensation on mirrors. Project to test condensation on mirror samples underway (awaiting shipment of samples)



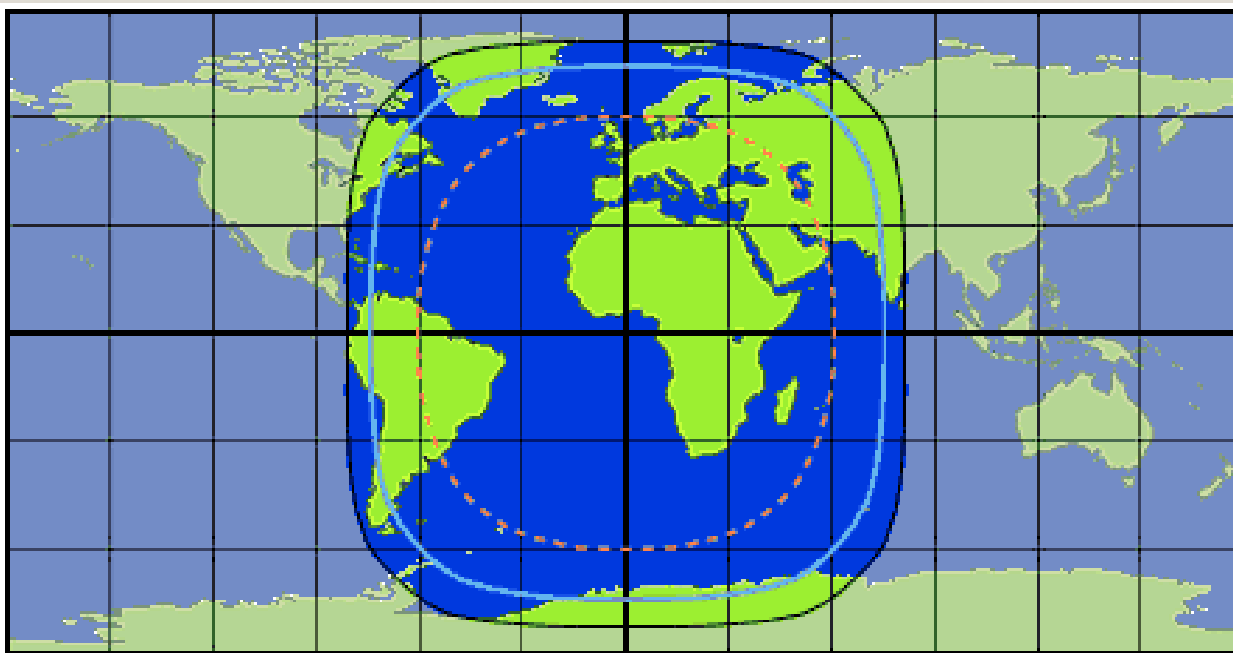
San Antonio de los Cobres

Meteorological conditions:

3rd Internal Site Review Report:

"Neither SENES results nor satellite cloud-cover data may be reliable indicators of their merit."

- **Sky darkness:** SQM data available. No nearby sources of light pollution.
- **Cloud coverage:** until data from All Sky Camera is processed, only satellite data is available. Meteosat data unreliable (2.9x larger pixels, averaging over pixels beyond the site produces huge biases).

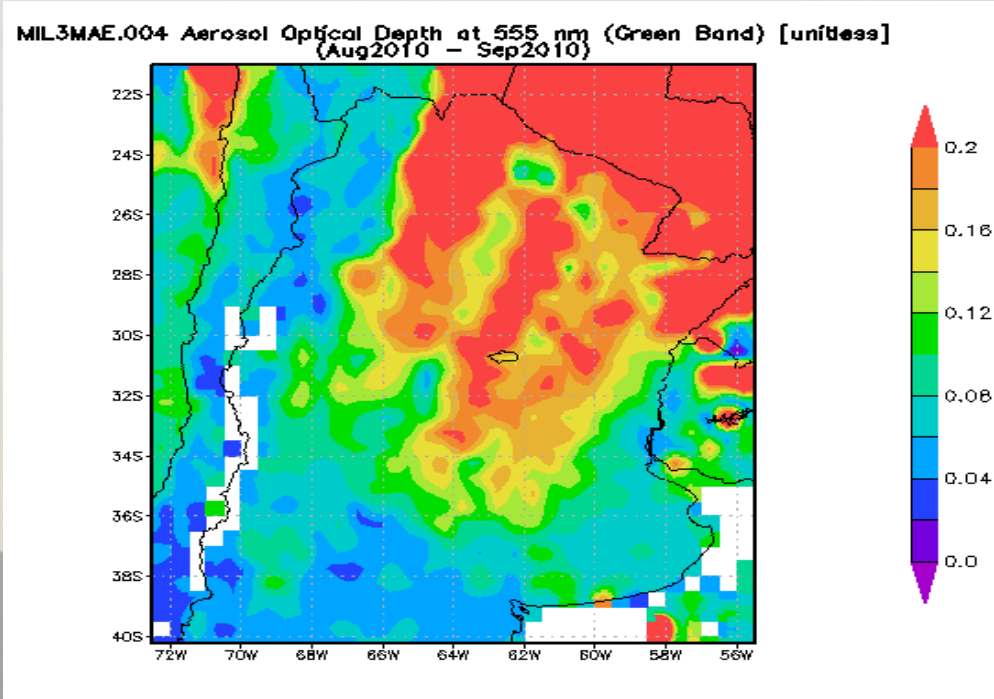


- Maximum theoretical coverage
- Imaging and telecommunications coverage
- - - Meteosat images within this area used quantitatively

San Antonio de los Cobres

Meteorological conditions:

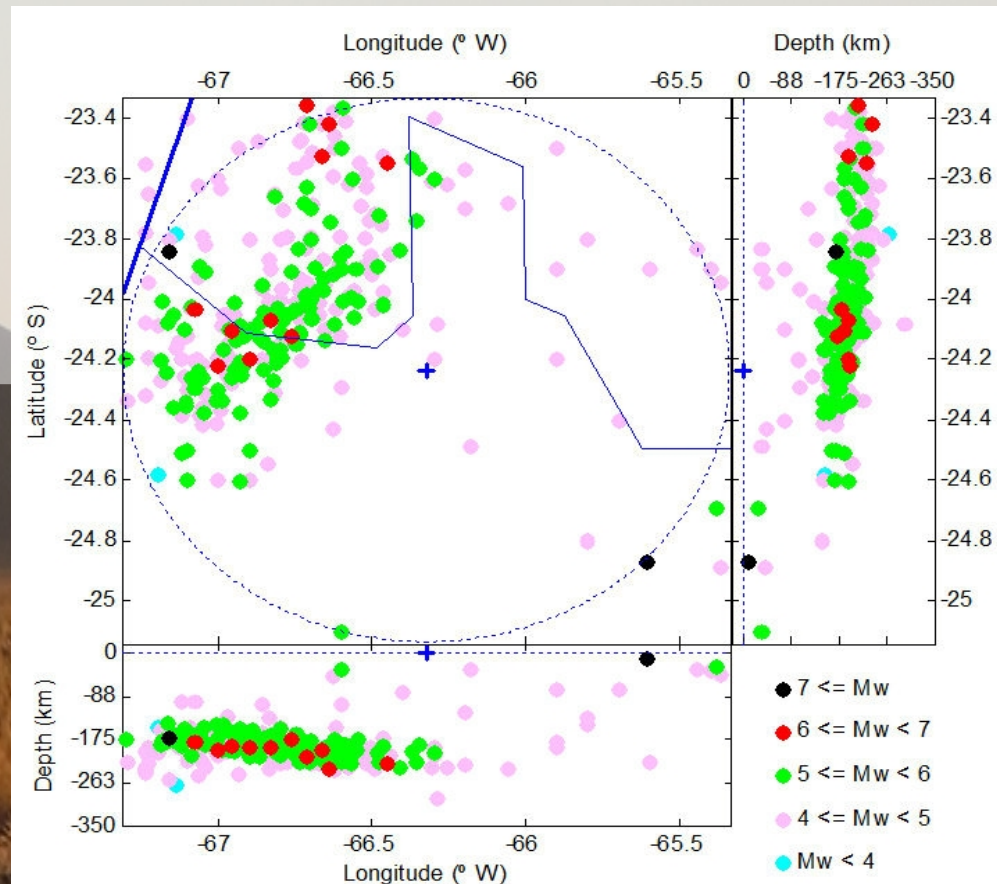
- **Aerosols:** Grimm spectrometer (ICRC 2013).
Modis (qualitative tracing of biomass burning)
[http://www.met.reading.ac.uk/~aer/new_biomass.html].
Data 2001-2011 analyzed:
no effects from burnings of biomass (AOD at 555 nm green band).
- **Dust storms:** no relevant sources nearby.



San Antonio de los Cobres

Risk assessments:

- **Seismicity:** Local seisms located deep underground. Dedicated seismic assesment done for San Antonio (see document by Viramonte et al): PGA of $1,4 \text{ m/s}^2$, specific for the CTA site, using a combination of databases.
 - **Flooding:** not a problem
 - **Hail:** less than 1 hail event per year.
- Rainfall less than 100 mm per year
- **Thunderstorm:** lightning protection will probably be required.



San Antonio de los Cobres

Infrastructure:

- Moderate infrastructure in San Antonio
- First aid available
- However, see country commitment to comply to requirements
- Railway Salta-Antofagasta to San Antonio
- Mining activities beyond SAC
- LLAMA will contribute to development of SAC

Land ownership: state-owned land. Commitment by government.



Salta City



San Antonio de los Cobres Town, hotel lobby and entrance



El Leoncito

San Juan Province

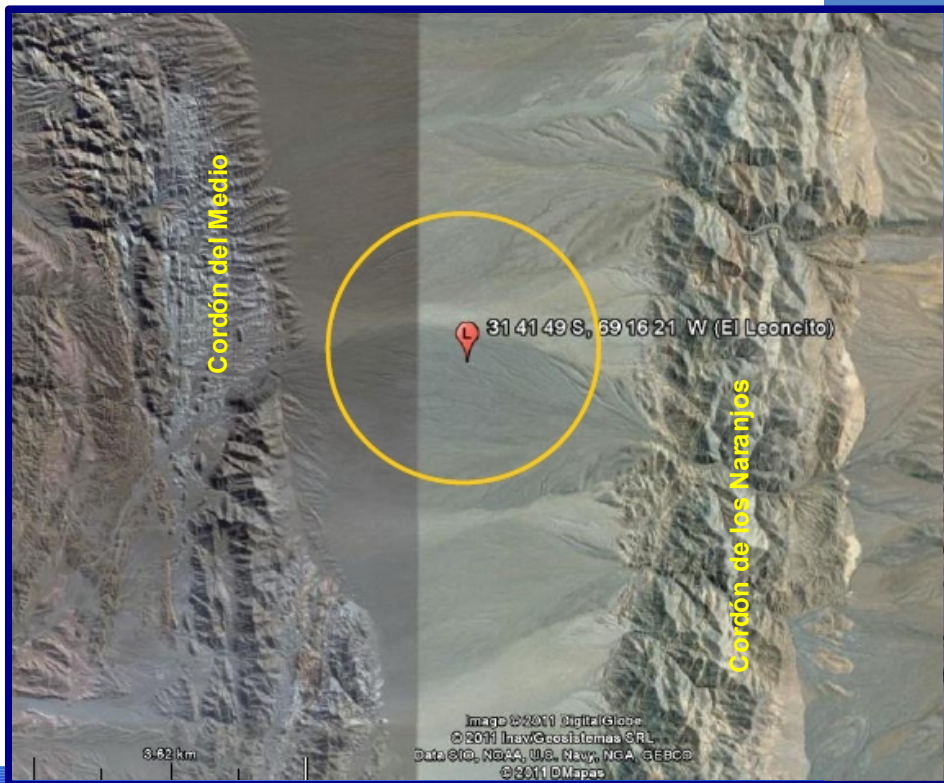
31° 41' 19" S

69° 16' 58" W

h: 2640 m.a.s.l.

Large flat area (>>10km²),

East-west slope



El Leoncito

Location: nearby CASLEO in El Leoncito National Park

- Distance to San Juan City: 235 km

Highly developed province capital city, pop. 450.000. Nearly same distance to Mendoza City.

- Distance to Barreal: 35 km

Small picturesque village, pop. 4.000, availability of basic services (hospital, ATM, police, tourism office, supermarkets, hotels, restaurants, gasoline station, stores).

Town of residence for staff.



El Leoncito

Instrumentation:

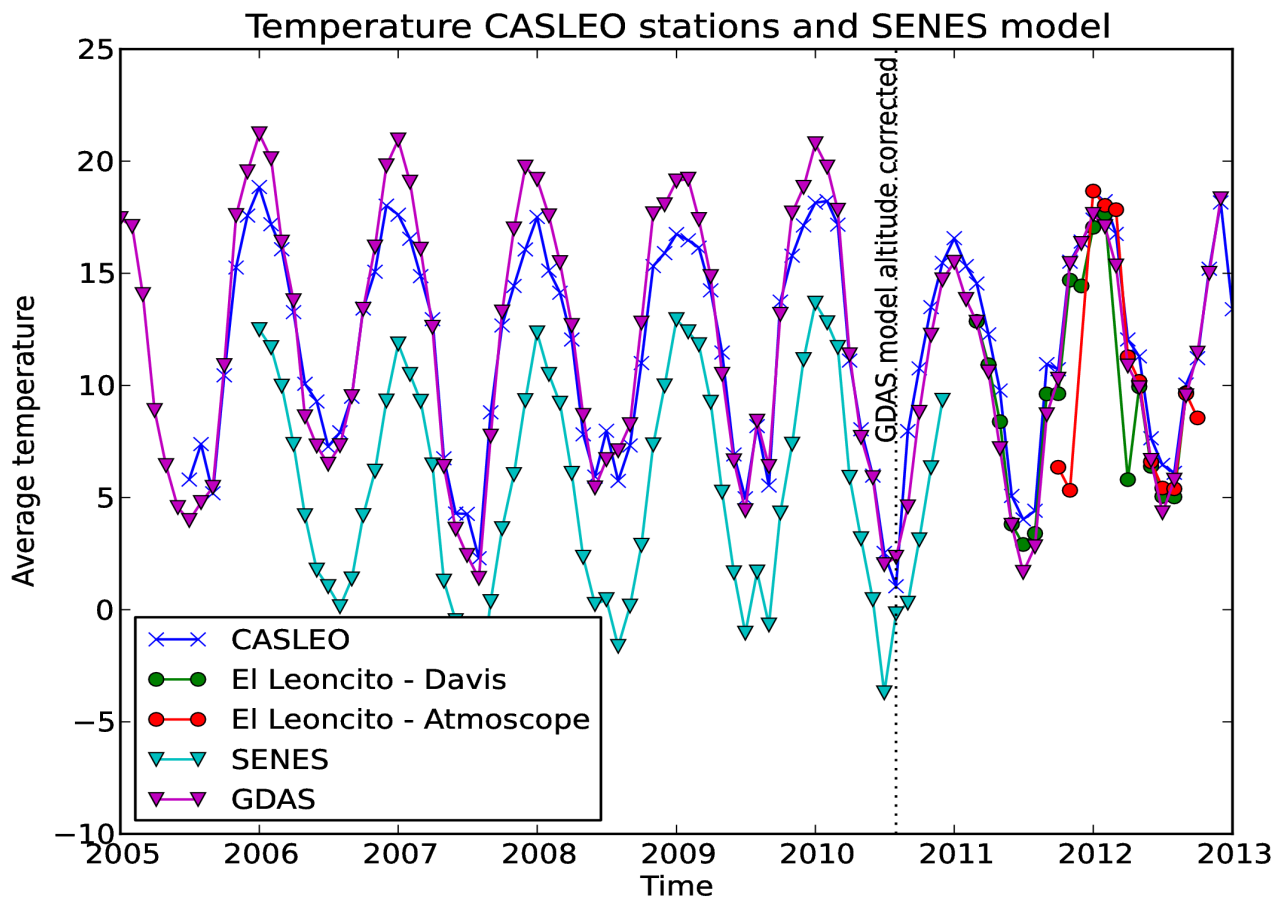
- CASLEO meteorological station
- CASLEO SQM
- CASLEO All Sky Imager (ASI)
- AERONET station (measurement of aerosols)
- Dedicated meteorological station (since 3/2011)
- Dedicated SQM
- ATMOSCOPE (temp., humidity, wind, SBB, cloud height) (since 1/2012)



El Leoncito

Meteorological conditions:

- Temperature and Winds well within specifications
- Temperature: comparison SENES-ground data

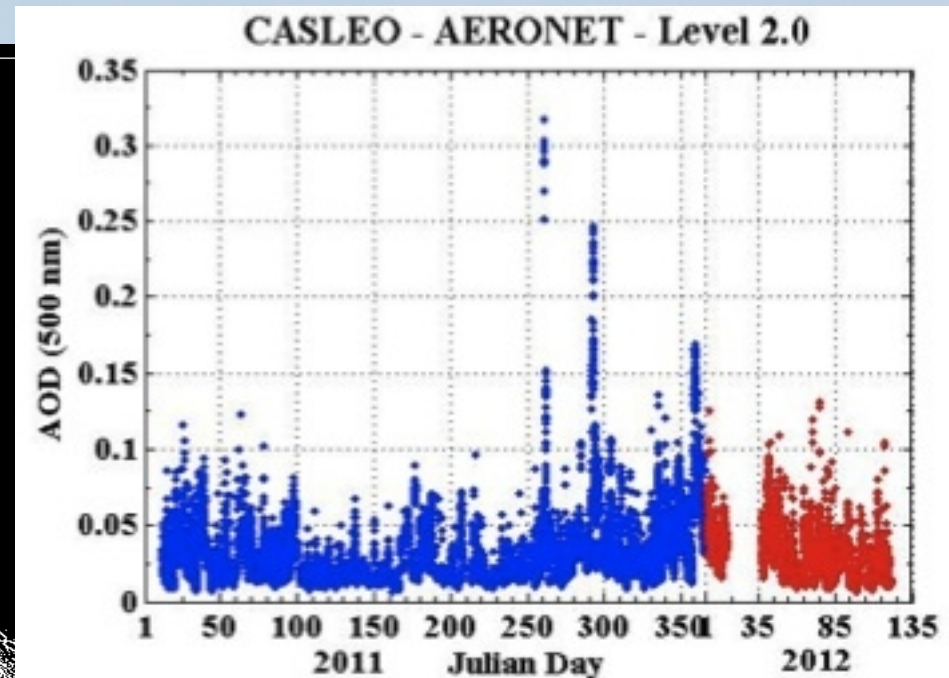
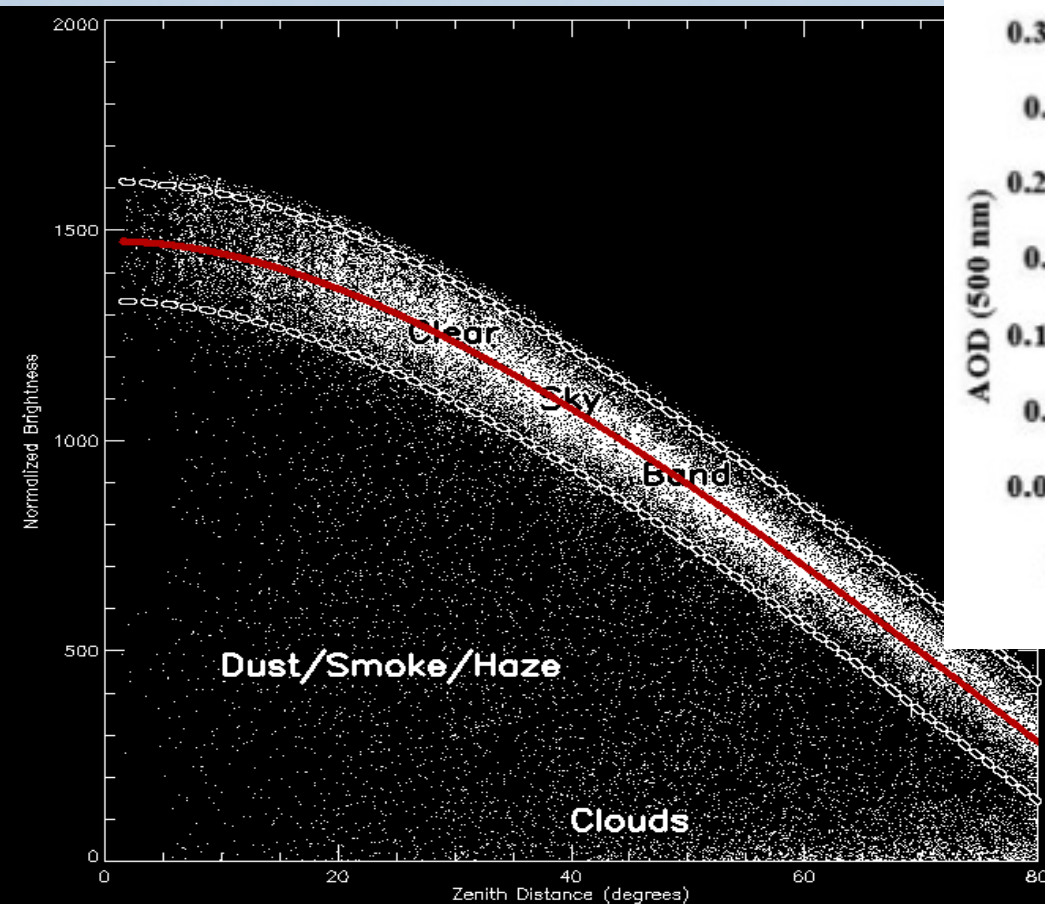


El Leoncito: Cloud Coverage

GROUND MEASUREMENTS performed over long period of time

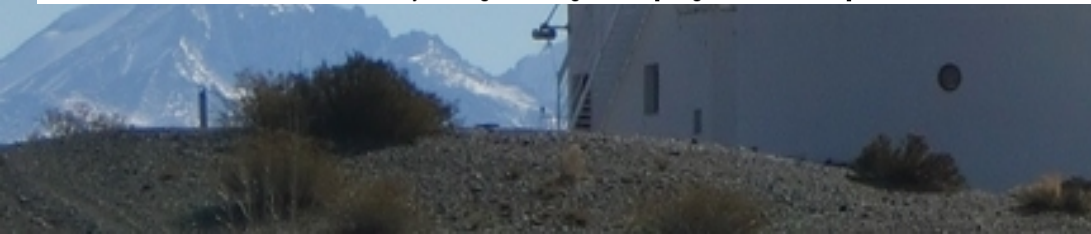
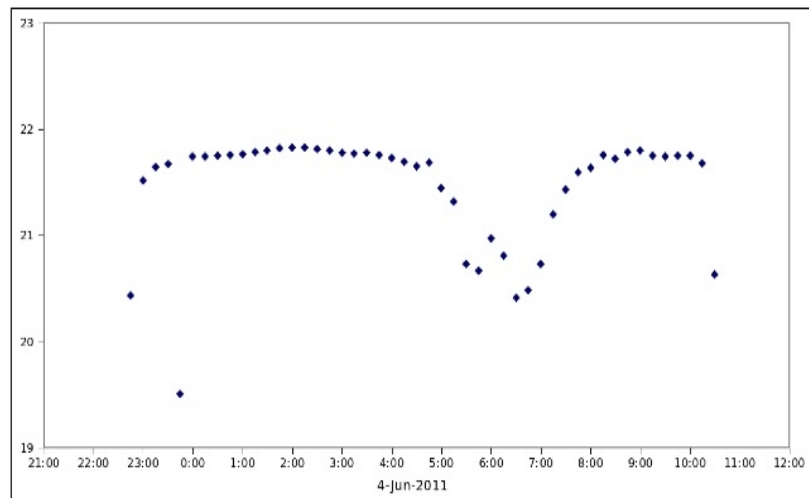
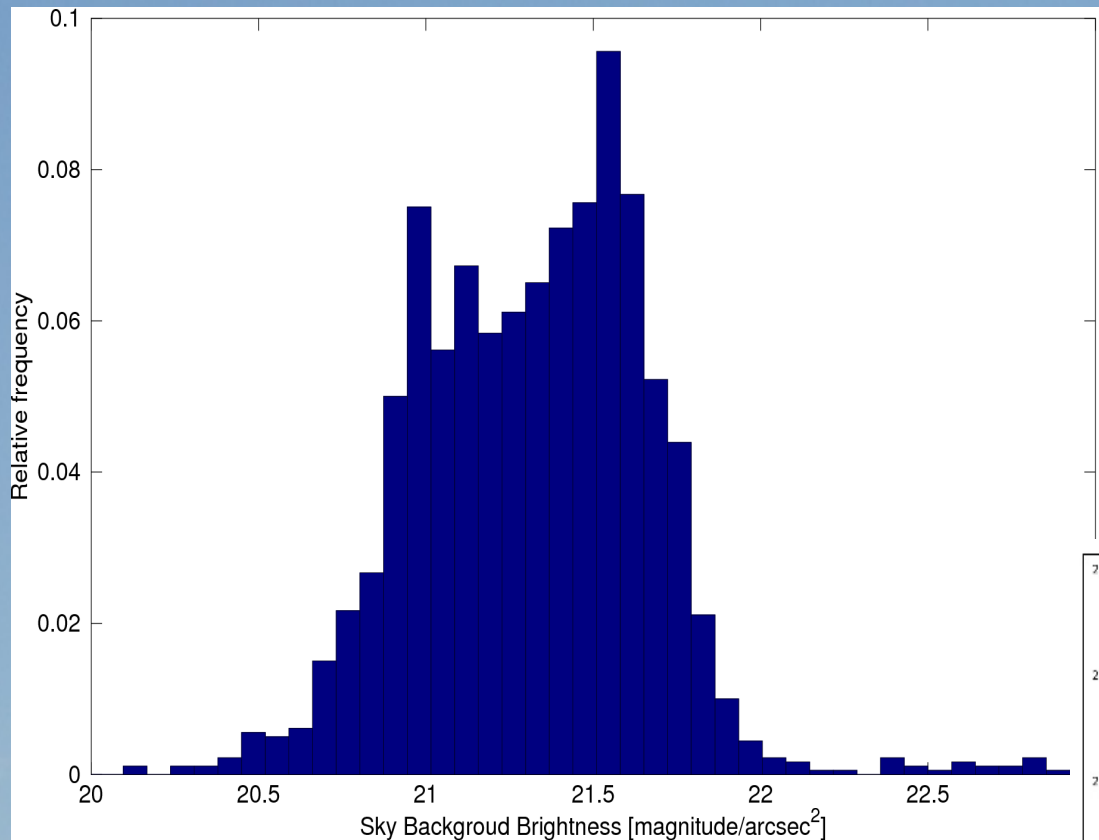
ALL SKY IMAGER (ASI) ground instrument from Boston University taking data since 2006 (www.buimaging.com). C. Martinis et al (Publ. Astron. Soc. Pacific, 125, 2013). 2006-2010 data: 78% of time totally clear skies.

AEROSOLS: AERONET Level 2 (Certified by NASA) 2011-2012: comparable to best sites in the world.



El Leoncito: Night sky background

Night sky background with contribution from Galactic Center and Milky Way (has to be subtracted).



COUNTRY CONTRIBUTIONS

Official Commitments

* **12 M€ for the construction of CTA:**

4 M€ Ministry of Science and Technology

4 M€ CNEA

4 M€ selected Province (Salta or San Juan)

* **Line electricity** and **fiber optic** communications to the site and to each telescope

* Consolidated road to each telescope

* **20 observatory staff:** 10 engineers and technicians from CONICET + 10 operation and maintenance for the Province

* 5 houses

Investments already disbursed

* 25 k€ for general PMO expenditures, transferred to Heidelberg

* 31 k€ for 1 PMO staff, transferred to Heidelberg

* 450 k\$us for operation

* 500 k€ construction of 1 SST in collaboration with Italy (framework CNEA-INAF agreement signed)

Brazil: 10 Meuro if in Mercosur country, 2 Meuro else

ARGENTINA SOCIO - POLITICAL ASPECTS

Political stability: republican democracy.

Crime: outside of large cities negligible.

Import regulations: customs and VAT free importation for scientific endeavours (see Auger).

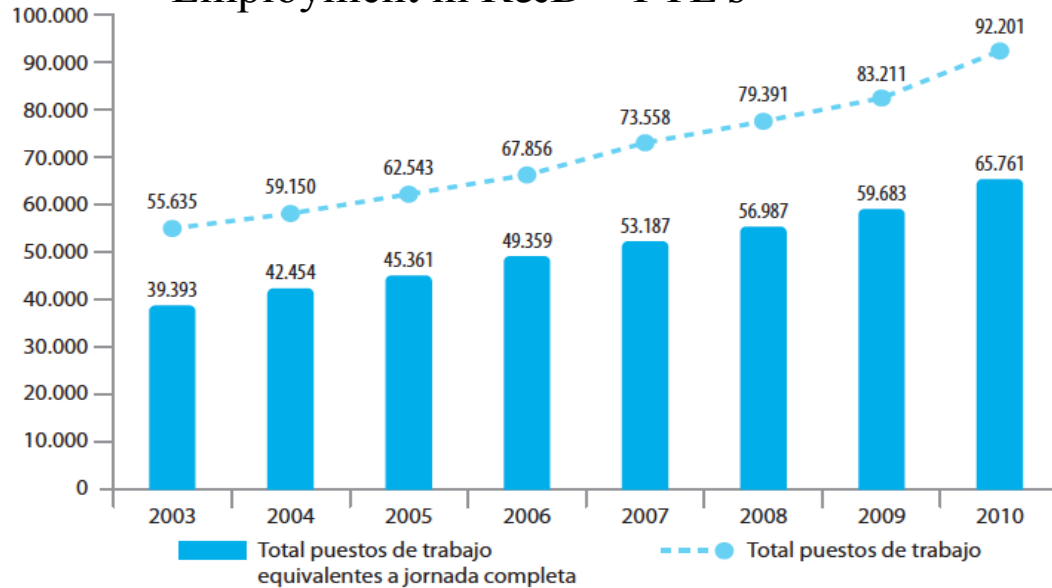
Regional considerations: strong local (Arg-Brasil) scientific and technical support (see Auger).



ARGENTINA SCIENCE & TECHNOLOGY

RECURSOS HUMANOS EN ACTIVIDADES DE I+D 2003-2010

Employment in R&D – FTE's

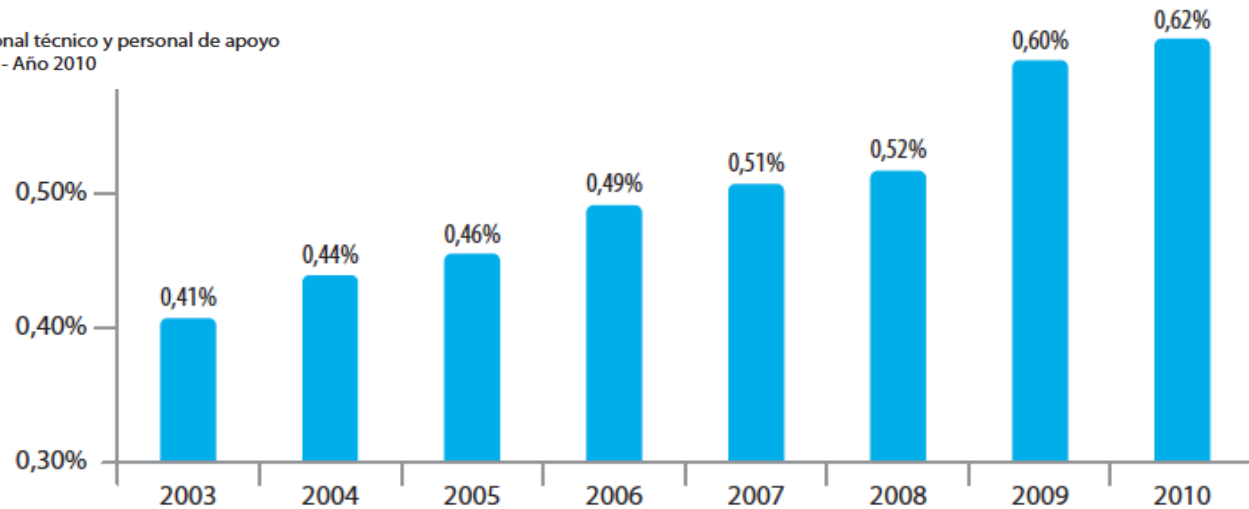


Nota: incluye investigadores, becarios, personal técnico y personal de apoyo

Fuente: Indicadores en Ciencia y Tecnología - Año 2010

DESARROLLO 2003-2010 COMO % DEL PBI

R&D investment as % of GDP



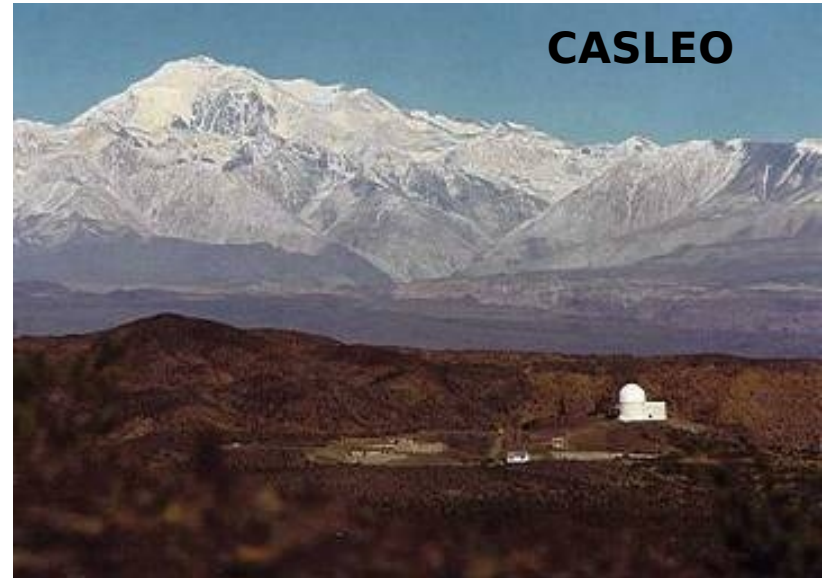
Fuente: Indicadores en Ciencia y Tecnología - Año 2010

Astrophysics in Argentina

Pierre Auger Observatory



CASLEO



Instituto Argentino de Radioastronomía



ESA Deep Space Antenna 3



Astrophysics in Argentina

LLAMA

- **Argentine-Brazil project in construction**
- **sub-mm interferometry with ALMA**
- **12 meter-dish**
- **12 Meuros**
- **28 km to SAC, 4813 m.a.s.l.**
- **approx. 30 km to CTA site**

