Astrophysics

Pierre Auger Project

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The Pierre Auger Project aims at studying a foremost issue in astrophysics today, the origin of the most energetic cosmic rays with energies in excess of 10^{19} eV, focusing our attention in energies above 10^{20} eV. The flux of these latter cosmic rays is roughly estimated to be 1/km^2/century/sr and due to this, an International Collaboration spanning institutions in 15 countries has met to build two similar observatories 3,000 km^2 each, one in the southern hemisphere (in Malargüe, Province of Mendoza, Argentina) and one in the northern hemisphere (in Utah, USA).

Two experimental techniques will be used: surface detectors and fluorescence telescopes. Such hybrid approach will diminish systematic errors and will allow to measure both lateral and longitudinal shower profiles, respectively. The construction of the southern observatory has begun, and we built the so-called Engineering Array consisting in 32 surface detectors, two fluorescence telescopes, telecommunications and Central Station buildings. After finishing this phase, we plan to begin full construction.

CNEA leads the Project in Argentina. Alongside with Mendoza we have undertaken the following responsibilities (many tasks with the help of Centro Atómico Constituyentes/Balseiro, and Complejos Fabriles San Rafael y Malargüe).:

Construction of rotomolded tanks (mold construction and tests)

We have to provide 550 out of the 1600 surface detectors. We have had two molds and a few prototypes built. We are in the process of commissioning tanks for the Project.

Design and construction of rotomolded battery boxes

We have provided all of the battery boxes installed in Malargüe and have to provide the rest of the 1600 required. We helped in the design and in commissioning them

Manufacture of liners

We have developed a few manufactures and allocated the task to the Mendoza branch of the National Technological University. We will supervise the work and collaborate in the liner installment inside each tank.

Manufacture of solar panels aluminum brackets

We have searched different manufactures and assigned the job, brackets are already produced according to our request and are already installed in Malargüe

Facility building and testing of phototubes

CNEA has provided a building at CNEA/Malargüe which is being turned into a phototube testing facility. We are ready to make an opening for technicians to perform the testing of the 4800 9” phototubes.

Telecommunications

We are providing all of the 1600 antennae for the tanks and all the telecommunication towers. We have instrumented all tanks deployed (under the technical supervision of UTN/Mendoza) and built 3 (out of 5) towers.

Pure water production, storage tanks, transportation tanks

We had a bidding for the water plant, which was bought and it is now operational (though we had a variety of technical problems). We designed and bought the two water transportation tanks and the storage tank.

Detector deployment, filling with pure water, bacteriological tests
We are heavily involved in all of these site activities

Surface detectors assembly and commissioning
Activities alongside with those above.

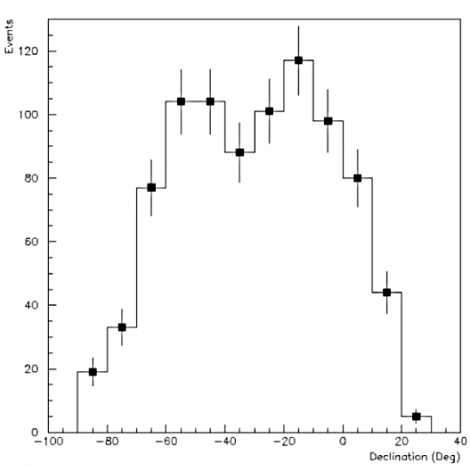
Surface detector calibration
The idea of calibrating with just a 3 PMT´s coincidence (bump calibration) was originated from Tandar. We have continued to develop and help in this matter.

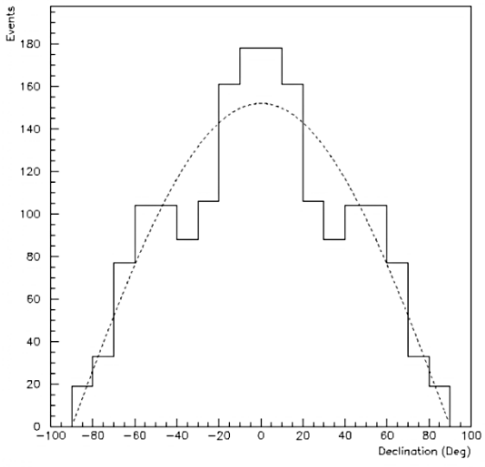
Mirror Data Center at Centro Atómico Constituyentes
We have a prototype working computing center which currently stores all data taken in Malargüe, for further use of scientists. We envisage continuing efforts in this matter.

Outreach
We are involved in outreach activities, such as seminars in/to schools, and in communicating with the society through media.

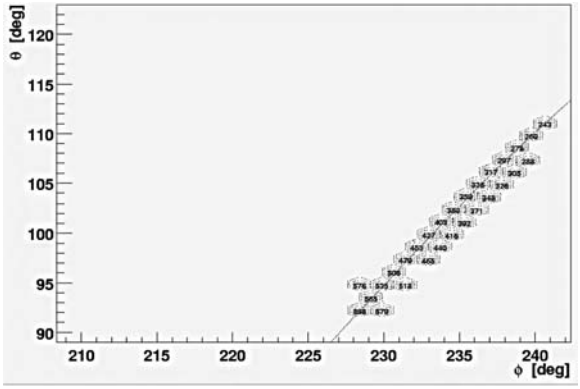
Observatory operation and maintenance
These activities are currently simultaneous with commissioning but will increase as time go by.

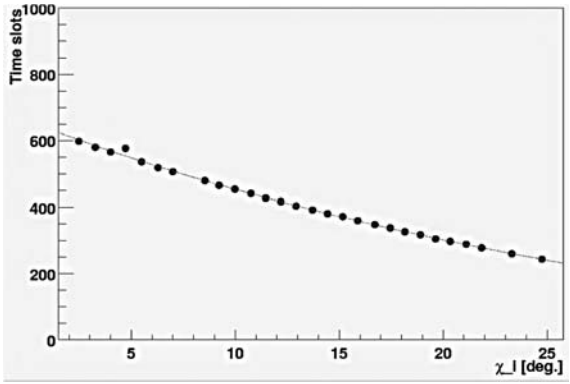
Data Analysis
Auger is already taken valuable data and we are dedicating an increasing time to it. In the following figures we show a reconstruction done on fluorescence and surface detector data (work in progress).





In the above lhs picture, it is displayed the declination distribution of a subset of Auger surface detector data. Note the ample sky coverage, approximately a FWHM » 75^0 . On the rhs the data is mirrored to the northern hemisphere assuming a twin detector and both southern and northern exposures summed. The dotted line correspond to the uniform cosine of the declination (solid angle) exposure. It is seen that with both observatories will have a good overall exposure.





The above picture shows a reconstruction of a single fluorescence telescope event. In the lhs, it is seen the pixels (phototubes) selected and the reconstructed track. On the rhs it is displayed the time vs. pixel data and the reconstructed track, i.e. from the time at which pixels fired the track is reconstructed and shown in red is the time at which each pixel should have fired for the obtained geometry.

Remote Particle Density Calibration of a Water Cerenkov Detector using Crossing-Through Muons

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During the construction of the southern component of the Pierre Auger Observatory 1600 surface detector stations will be deployed, over an area of 3000 km2, near the town of Malargüe, Mendoza, Argentina. In order to keep the whole system running efficiently during its expected 20 years lifetime it is very important to be able to monitor the detector behavior remotely. Furthermore, remote calibration of the detector stations will be mandatory. In this paper we propose, from experimental grounds, a simple method for remote calibration of the detected particle density using the normally present background cosmic radiation.