

Pierre Auger Project

Progress Report

Summary ([photo album](#))

We have passed an important milestone for the fluorescence detector installation and, indeed, for the Auger Observatory. All six telescopes at Los Leones are operational and were recording data at the end of the April dark period. There are now a total of eight telescopes in data taking mode, a third of the observatory total. There is also remarkable progress at Coihueco where all the mirrors are now installed. The cameras for the last four cameras will be installed in June. Construction of the third fluorescence building at Los Morados is progressing well with completion expected at the end of July.

As of 10 May there are 325 surface detector stations in the field taking data. A stretch of bad weather and the lack of some crucial material for PMT base potting have slowed recent deployment. The potting material, however, has now arrived and PMT potting is going full blast. All the necessary components for several months' deployment are now in hand.

The third water transport tank has arrived at the site. This tank is being mounted on a truck bed and will be commissioned soon. With this new transport tank the fill rate will increase from two tanks per day to three tanks per day.

Although the communications system at Los Morados is commissioned, it is not yet in fully stable operation. A general gas shortage has resulted in gas delivery delays for the generator that powers the equipment.

The power line to Los Morados being provided by the Province of Mendoza is now under construction. Power is being provided by a temporary generator until the power line is complete.

The second beta version of the offline data processing software framework has been released.

Although longer-term prospects for construction funding remain good, there is a short term cash flow problem. Even though some new funds have become available in the last few weeks, these funds are not sufficient to maintain our construction schedule beyond the next few months. Unless new funds come soon the deployment will start to slow just as we go into the austral summer, the most favorable deployment season.

WBS 1.1 Fluorescence Detector (Jonny Kleinfeller – Karlsruhe)

Los Leones

All 6 telescopes are operational, completed with production parts, except for corrector ring lenses. Telescope 4 is the only telescope at Los Leones already fitted with corrector ring lenses. The other telescopes have their aperture reduced to 1.7m diameter by a mask fitted to the corrector ring frame. These masks are positioned near the centre of curvature approximately 5cm closer to the mirror than the centre of curvature. Fitting the masks exactly in the centre of curvature, would make it very difficult to install the lenses later.

Telescope 4, 5, 6 were operating with a mask of 1.7m diameter before, there is a change only for telescope 3, until 20. April, this telescope was in operation with a mask of 2.2m diameter.

The shutters of all telescopes are integrated into slow control and interlocked for light, wind and rain, there is currently a slow control software upgrade being tested, to enable semi-automatic setups for the telescopes. Integration of the failsafe curtains of telescope 1 and 2 will be completed this week. HV, LV control is as well integrated into slow control.

Relative calibration

The fibres for scripts A, B, and C are installed at telescopes 3, 4, 5 and 6, there are currently no fibres installed at telescope 1 and 2. This is scheduled for May 2004. The reflector screens for script C are installed for all telescopes.

Script A of the relative calibration is now powered by the LCU. Scripts A, B, and C are fully integrated into the DAQ software, i. e. no need to operate separate commands to run the calibration hardware.

The GPS unit has been fitted with a backup battery, which keeps the memory of the unit unchanged even after the standard UPS backup is switched off. Loss of memory of the GPS unit caused some problems for the DAQ during the recent shifts.

Jobs to do to complete Los Leones

Installation of internal light sensors for telescope 1 and 2, repositioning of those light sensors for the other telescopes (May 2004).

Wiring and integration into slow control of the curtains of telescopes 1 and 2 (May 2004).

Installation of relative calibration fibres (May 2004).

Installation of corrector ring lenses in telescopes 1, 2, 3, 5, and 6 (?).

Coihueco

The shutters, aperture boxes, filters of all telescopes are installed, corrector ring frames are installed for telescope 21 and 22, telescope 21 is also equipped with corrector ring lenses. The aperture of telescopes 1, 2, 4, 5, and 6 is as in Los Leones reduced to 1.7m by a mask. Failsafe curtains are installed for all telescopes, but not yet integrated into slow control. All mirrors are mounted and are currently being aligned for telescopes 1, 4, 5, and 6.

Telescopes 2 and 3 are operational, there will be no new telescope in operation during the shift in May and June, because the cameras are missing. The hardware of the missing cameras is on site, but the assembly and installation team will not start working before the 3rd week of June.

Relative calibration

The fibres for scripts B, are installed at telescopes 20 and 21, the fibre for script A is only installed for telescope 21, there are currently no fibres installed at telescope 19, 22, 23, and 24. This is scheduled for May 2004. The reflector screens for script C are installed for all telescopes. The central mirrors in telescopes 20 and 21 have been replaced to allow easier installation of the script A fibre.

Jobs to do to complete Coihueco

Installation of internal light sensors for telescope for all telescopes (May 2004)
Wiring and integration into slow control of the curtains of tall telescopes (May 2004).
Installation of relative calibration fibres (May 2004).
Assembly and installation of cameras of telescopes 19, 22, 23, and 24 (June 2004).
Installation of corrector ring frames in telescopes 19, 20, 23, and 24.(September 2004)
Installation of corrector ring lenses in telescopes 19, 20, 22, 23, and 24 (?).

WBS 1.1 Fluorescence Detector continued (Miguel Mostava – University of New Mexico)

CLF

The CLF hardware ran without incident until early May when it was discovered that the gas heater was not working. This is a critical issue because if the coolant freezes it may damage the laser. This problem is -being addressed-

CLF analysis has not progressed significantly since the March meeting in Malargue.

Los Leones LIDAR

The Los Leones LIDAR is working again, and data is being routinely sent to the Lyon data server. During the next few months we will determine the stability of the hardware and develop a fixed scanning routine for the LIDAR operation during FD data taking.

WBS 1.2 Fluorescence Detector Electronics (Daniel Camin – Milano)

1) Production of the Head Electronics:

The HE's are the non-commercial units produced in the largest quantity in the whole experiment.

Particular attention was therefore devoted to reliability. All main electrical parameters were measured by a test system developed on purpose in Milano, in close collaboration with Intratec/Elbau.

At present, the fourth and last production batch of about 3000 units have been virtually completed. There are about 800 HE's in Intratec ready to be sent to Photonis. The results of the test were very satisfactory, as the failure rate was about 1.5 %. The final figure of failed units will be calculated after the completion of the production, that comprises a 10 % spares.

The burn-in procedure was effective to unmask the origin of an abnormal increase in the PMT biasing network, after applying HV to the HE. An analysis of the data revealed that a long tail towards higher HV currents disappeared after burn-in, due to the evaporation of a solvent in the Flex mask used to protect the pads connecting to the PMT flying wires.

The terminated units present, after burn-in, a standard deviation of less than 1% with the exception of the power supplies that reaches 4 % maximum, due to the dispersion of the supply current of the Maxim Driver chips.

A comprehensive GAP note on this issue will be delivered after the completion of the whole production followed by an accurate analysis of the results of tests.

2) Design of a debugging unit or the PMT/HE assembly.

The development of this unit was initiated by November 2003. The scope is to be able to verify the behavior of a suspected FD pixel. Initially we planned to dismount a failing PMT+HE assembly to insert it later into a test box. More recently, we thought that avoiding the dismounting of the PMT+HE assembly is very convenient. The debugging system now foresees a more simple operation, that consists on unplugging the 10 pin-3 M cable that delivers the HV, and LV and receives the signal. Then, the system is connected plugging in a cable with a similar 3M connector and a number of tests are performed by a test HW under control of SW Lab View. In case of confirmation that the HE is good, the whole assembly is dismounted and is sent to perform a full test at the PMT testing facility in Malargue.

3) Analog Boards:

All necessary AB's have been shipped long ago to FZK. This item has been completed.

4) HV/LV-PS System:

The two systems for LL and CO have been installed. Nowadays all the cabling has been completed. The third HV/LV system for Morados shall be ready by the end of 2004. For detailed information on the HV/LV system see the comprehensive GAP-2003-094 published by November 2003. DVC, 5 May 2004.

WBS 1.2 FD digital electronics and readout systems – (Matthias Kleifges – FZK – IPE)

Installation work in Malargüe:

- During the March collaboration meeting some errors were fixed by implementing the new firmware release 3.5 for the GPS clock and release 04/1e for the FLT/SLT front-end. The release will solve problems with missing GPS seconds due to a change in the synchronization and provide requested changes to the LIDAR steering.
- To use the new features also different parts of the software (DAQ, FEShell, GPS server) had to be updated or linked with a new front-end library.
- We found problems with the power supply of MirrorPC's and the boot procedure. A power supply was replaced. The problem seems to be related with incorrect wiring of the AC power in the Los Leones FD building, which is now fixed.
- The second LCU (LED calibration unit) (now in Coihueco) was implemented in the DAQ scheme and the software was upgraded to follow the scheme of external triggers. The calibration setup was tested and was working in principle except for those bays, where no fibres are yet installed or the reflecting screen at the inner site of the shutters was missing.
- Thanks to the work of Primo and others we have now (with some exceptions) finished the work in Los Leones: all 6 telescopes are in operation. Primo is now preparing together with Norbert Barenthien the installation of the remaining systems in Coihueco (# 19, # 22, # 23, # 24) and the slow control system.

Service and support from Karlsruhe:

Due to the necessary upgrades in certain modules (see below) the data taking of the March shift was not so smooth as before. Handling problems of the GUI due to missing (obsolete) information in the shifters documentation, but also these updates in software and hardware required frequently support from FZK experts. H.J. Mathes was able to improve the situation with his activities on site since April.

We want to improve the situation in future by more intense tests of hardware and software in Karlsruhe before delivery. However, not all bugs can be found as the Karlsruhe setup doesn't include cameras to produce event like data for debugging. In addition, Patrick Alison (many thanks to him) installed the bugzilla system to improve the error tracking also for FDE.

Transport #22 arrived with installation items:

Our last transport (FZK #22) has arrived in the last week in April. It contains the missing parts to complete the Coihueco building. The main parts are 2 complete front-end electronic systems, the associated MirrorPCs and cables, and a spare GPS clock.

Production and tests in Karlsruhe:

We have continued or production and test with the electronic parts for FDE and SDE. In total we have reached following output figures (as May 4th):

- **FLT:** 450 from 520 modules are produced; about 300 are tested and 243 are in Malargüe.
- **LED driver:** 2640 (from 3000) drivers are produced and tested; about 1500 are in Malargüe for soldering the cables and potting.
- **LED controller:** 1450 (from 1800) controller are produced; about 1000 are in Malargüe. The remaining need to be tested and coated by an external company.

- **RAID system for the EyePC:** We have procured a 19" RAID system which will replace the EyePC in use to increase the reliability. Installation of system software is in progress.

WBS 2.1 SD Site (Ingo Allekote – Instituto Balseiro)

There were 66 tanks delivered by Rotoplas during this period. This was less than expected because the truck, owned and operated by Rotoplas, broke down and required an overhaul. Tank manufacturing continued at Rotoplas, but they are limited by delivery capability. Recently they have obtained another truck and predict the ability to deliver as many as 60 tanks per month in the future, if there are no weather-related interruptions.

The first eight tanks were delivered from the new vendor Formingplast, using a trucking company contracted by Tandar Laboratory. These tanks are the first useful tanks made by Formingplast after an extensive effort to get them started and indicate the start of routine production.

207632 kg of resin, purchased by Fermilab, was delivered to Buenos Aires. It is stored at Tandar Laboratory and the inventory and handling is managed by Tandar personnel. The resin is shipped to the molding companies as they need it to make our tanks. This quantity is sufficient for approximately 360 tanks, plus some of the tubos for the battery boxes.

140 liners were produced at the facility in UTN in Mendoza and will be shipped to Malargüe soon.

A total of 56 surface detectors were deployed in the field and 55 were filled with water during March - April 2004. The lower deployment rate was due to the lack of catalyst for potting PMTs at the beginning of April and very bad weather conditions at the end of the month.

The water plant operated without difficulties. The connection to city water was improved, with a new piping that allows a larger input flux to the water plant. The water plant is now operating with 100% of city water.

The third water transport tank (Tk-12-Gamma), made by Equipos y Proyetos, and the corresponding trailer, fabricated by Petinari, were delivered to Malargüe. All accessories (hoses, pump, generator, etc.) are available and have to be cleaned, assembled and mounted.

Contacts made by Juan Carlos Meza with landowners allowed for 9 new contracts that have been signed for access to land in the Los Morados area. On behalf of Auger, these contracts were signed by the newly created Fundacion Auger.

A method to carry detector tanks on the small red trailer, pulled by the Auger 4x4 truck, was developed by Mariano Berisso. As proposed by Carlos Hojvat and implemented by Gualberto, Roberto Argumedo, Iuri and Germano, the water from the EA tank Daniela was recirculated through a mixed resin bed in the field and re-used in a production tank ("Cielo"). To fill up the

missing 4 cm of water, a 1000-liter water tank was carried with the Auger trailer. On the way back, the old EA tank was brought back with the trailer. Although the water transfer is slow (4 hours), the system worked well and can be used in the future. This system can also be used to fill detectors with water in difficult areas, to re-fill detectors (e.g., leaking liners or not completely filled tanks) and to bring back or deploy isolated detectors, without the need of a truck and a crane.

Two Engineering Array tanks were brought to the Assembly Building from the field. The liners were removed, the solar panel brackets were modified as required to add an antenna mast. (Some of the EA tanks did not have masts as part of the bracket system. The masts were a development from the EA experience.) Two sets of polyethylene spacer rings were brought down from Fermilab. These spacer rings, 50mm high, are screwed to the tanks around each hatch, then welded with a polyethylene welding tool and welding rod to make a permanent water seal. They make the EA tanks functionally equivalent to the Production tanks and allow mounting of the modern hatchcovers, shims, gaskets, and electronics enclosure.

WBS 2.2. Surface Detector Electronics (Tiina Suomijarvi – IPN Orsay)

The pace of surface detector electronics installation has increased over the last several months, as new batches of unified boards and front ends were shipped to the site. The integration of these units with other components at the SDE fabrica in Malargue is proceeding smoothly. Mariela Videla, Federico Suarez and Javier Alcaya, key members of the local electronics staff, were brought to France and Italy for a training trip for 2 weeks. They visited Photonis and LST (the UB company) in France.

Recent activities have focused on maintaining and assessing the reliability and stability of the detector. The local station software has been operated in a stable configuration since late December. Minor enhancements were added in late March, including an improved intercalibration of the high-gain and low-gain channels. At the March collaboration meeting, we reviewed the types of failures occurring in the field. Several types of problems have appeared: failure of some cables during or after deployment, temperature dependent instability of gain for a small fraction of PMTs, and failure of some battery temperature sensors which in turn has affected other housekeeping measurements on the station. Both of these problems are being investigated and corrective actions are in progress. At least some of the PMT instability problems are likely to be due to cables which were damaged during the deployment. The temperature sensor problem has been traced to shorting of the sensor in the harsh battery box environment and steps are being taken to both improve the potting of the sensor and to limit the effect of a shorted sensor on other measurements using the same multiplexer. In general, however, the detectors have been operating well and taking data in a stable fashion.

WBS 3.0 Comms (Paul Clark – Leeds)

1) 39 Kits were mounted during March 2004, 18 during April 2004 and there are 100 ready to install.

The 335 antennas of Pre-production and production were reached. "All the tanks that have water, also have antenna".

2) The Stock is controlled. We are only waiting for the arrival of 200 GPS Antennas. Corbin is working with the documentation to dispatch ASAP the antennas.

3) Small problems of time are generated in the purchase management. With found of Argentina we can make purchases direct (To the traditional suppliers) if the amount does not pass PESOS 4000 (about US\$ 1400). This causes that we must make "partial purchases". The problem is not serious.

4) The problem with the WLAN Antennas suppliers is "solved". Both provide "technically equal antennas" and with very near price. The price low a little with each quotation. We have reached US\$ 15+IVA(21%) each. We have the production assured and with very good price.

WBS 5.0 DPA/Offline- (Stefano Argiro – INFN)

The Offline project proceeds steadily. The second version of the Framework has been released under tag 0.2.1-beta. The release is meant to provide more developed core framework components, but that the distributed modules are still meant more to verify the framework than to produce real physics results. Physics modules are ultimately the responsibility of the whole collaboration with guidance from the analysis subtask coordinators.

The ambitious plan is to have everything required for physics simulation and analysis by the end of this northern Summer. This will need a great deal of contribution from the whole collaboration.

The organization of the analysis tasks has been rediscussed at the last meeting. A document describing the physics goals has been circulated. A new group has been created for hybrid reconstruction.

WBS 8.0 Education and Outreach (Greg Snow – University of Nebraska)

During the March 2004 collaboration meeting

March 17, 2004, marked the 5th anniversary of the groundbreaking ceremony for the Auger Observatory in Malargüe. A poster commemorating the anniversary was prepared and a copy can be found in the photo gallery of this report. During the collaboration meeting, framed copies of the poster were presented to government officials from Malargüe and Mendoza Province who have supported the Observatory over the years.

On Thursday, March 18, a forum was held with over 150 Malargüe area science teachers and students to discuss future education activities and interactions with the scientists from the

Observatory. The forum was organized Mercedes Vergara Marquez, Graciela Viollaz, and several teachers from the James Cronin School. Participating Auger collaborators included Analía Cáceres, Jim Cronin, Alberto Echegoyen, Beatriz García, Rebeca Lopez, Andres Risi, Greg Snow, and Arnulfo Zepeda. English translation was provided by Malargüe teachers Carina Barone and Miguel Herrera. After introductory remarks by Cronin and Snow, the participants were divided into teacher and student groups and given a questionnaire to discuss and fill out. Many ideas for future education initiatives and interactions were offered by the groups, including an Auger-sponsored science fair for teachers and students in the region. Photos from the forum are included in the gallery of this report.

Arnulfo Zepeda and Rebeca Lopez traveled to General Alvear to present a workshop “Methodology in the Teaching of Physics” for 26 primary and secondary science teachers on Saturday, March 20. The workshop was held at the School of Agriculture which was celebrating its 50th anniversary, and photos are included in the gallery of this report. The interactive workshop focused on the teaching of optics using simple materials that are easy for the teachers to obtain. At the end of the workshop, participants filled out a questionnaire calling for future meetings and a workshop on the topic of energy. After the workshop, Arnulfo presented a talk “Cosmic Rays and the Pierre Auger Observatory” to the participating teachers and students from the School of Agriculture. Arnulfo and Rebeca acknowledge the support Malargüe’s Office of Tourism, General Alvear professor Denis Colla, the Director of the School of Agriculture, and the mayor of General Alvear, Ing. Juan Carlos De Paolo, for their support of the workshop.

In Argentina

Beatriz García reported on activities in Malargüe and Mendoza. During April in Malargüe, a presentation on the solar system was given by Andres Risi and Analía Cáceres for 150 students and teachers from San Rafael. Carlos Hojvat also participated and talked to the students in English. The event was deemed very successful. Several more astronomy talks for the public and students are planned in the upcoming months.

At the First International Conference on Informatics organized by CIDI-Cuyo on April 15-16 in Mendoza, the following Auger related talks were given: (i) “Graphical Design for Auger Topics” by Alejandra Cicero, (ii) “Communications and Internet at the Auger Observatory” by Javier Gitto, and (iii) “The Science of the Auger Observatory” by Beatriz García.

In Europe

The Auger Observatory has the opportunity to mount a display at the Open Day of CERN’s 50th Anniversary celebration on Saturday, October 16, 2004. The Observatory is on CERN’s list of experiments due to administrative matters handled by CERN. CERN expects over 20,000 visitors to tour the CERN site on the Open Day. Details of the Auger display will be worked out over the next few months.

Greg Snow, serving as the U.S. representative to the European Particle Physics Outreach Group (EPOG), presented a summary of U.S. education/outreach activities at an EPOG meeting on April 23 in Athens that included an overview of Auger outreach activities. EPOG members from several European countries and particle physics labs were impressed by the Observatory’s commitment to outreach.

Murat Boratov reported that on April 14, an audiovisual piece on the Auger Observatory was broadcast on the Euronews. An archive of the piece can be viewed at the web site www.euronews.com (click on “hi-tech” and scroll to the Auger piece). The broadcast featured short interviews with Carlos Hojvat and Xavier Bertou.

In Mexico

Rebeca Lopez presented the following talks during the Week of Science and Culture organized by BUAP and the Mexican Academy of Sciences: (i) “Boleadoras Cosmicas (Cosmic Bullets)” at the high school Escuela de Bachilleres No. 14 on April 27 and at the primary school Centro Escolar Morelos on April 28 and (ii) “Boleadoras cosmicas y el Observatorio Pierre Auger” at the high school Emiliano Zapata on April 28.

WBS 9.0 Observatory Operations – (Xavier Bertou – University of Chicago)

March data taking was quite unstable as usual due to the development in LS/CDAS/Comms done during the meeting period. April 9-12 showed crashes in the SD event builder. Except from these periods, data taking was quite stable.

From the 23rd to the 26th of March 30cm of water were removed from tank Palau Co (254) by a small leak. Analysis of the data taken during this experiment is underway. Preliminary results clearly show we can see this change of water level in calibration data.

April 1st a new LS software was installed in all the tanks, featuring an improved dynode/anode ratio determination algorithm, a fix for the 100 ns jumps in the US UBs, better tagging of the triggers, and including some muon decay data. All the tanks close to Los Leones have been implemented with electronics, allowing a large quantity of hybrid events to be registered close to the eye in the FD shift periods.

High energy, high multiplicity SD events are found every day now that the array is more than 300 tanks.

