

# **Pierre Auger Project Progress Report**

## **Summary (photo album)**

Another construction milestone has been passed. As of 11 May three quarters of the surface array (1200 detector stations) are now in operation! Deployment on the Villar land in the northeast part of the array is now finished. The weather has been cold but clear so that deployment on the Rufinelli land is proceeding at a rapid pace. We have only one parcel of land for which we have not yet obtained access. Negotiations are in progress.

There are 1689 tanks deployed or in the pipeline. We expect the last of the tanks to be at the Observatory ready for assembly by August. There are nearly 200 electronics kits ready for installation and the rest are expected to be ready in another two months.

All of the fluorescence telescopes are operational. A complete calibration is underway and should be complete by September.

The two enhancements that involve an infill array overlooked by telescopes that extend fluorescence coverage up to 60 degrees from the horizon are in the final stages of technical review. Plans are being made to include radio air shower detectors over all or some of part of the infill array.

Auger will once again be a major participant in the International Cosmic Ray Conference with 35 talks and posters. The conference this year will be held in Merida, Mexico.

## **WBS 1.1 Fluorescence Detector cont. (Jan Ridky – FZU)**

There are under way several analyses of FD calibration (yet not fully understood), new design for drum calibration and on negative side not running of Loma Amarilla due to late gas delivery.

## **WBS 1.2 Fluorescence Detector Electronics digital electronics and readout systems (Matthias Kleifges – FZK-IPE)**

### **Software progress**

- During his last stay H.J. Mathes has commissioned the DAQ software for Loma Amarilla. At the same time also the software for LL, Co and LM was updated to revision 3.2.2 (the previous version dated back to February 2006). The work included the update of the hardware libraries und the Wiki based documentation. The new release supports now the filling of monitoring and configuration databases with data of the DAQ process. In addition, the communication with the Lidar and the Calibration computer was improved.

- Our group was also actively working on the monitoring task (e.g. providing PHP-scripts to display monitoring data and scripts). Details are reported by Cyril.

### **R&D for Auger North and the HEAT proposal**

- First new SLT board produced, test will be done in the coming weeks.
- PCB layout for new FLT still in progress.
- Circuit diagram for new AB (IPE version) is finished. The PCB layout design was started.

### **WBS 2.1 SD (Ingo Allekote – Instituto Balseiro)**

In the period February-March 2007 the following tasks have been accomplished:

- Tanks received and inspected in Malargue: 0
- Detectors assembled: 8
- Detectors positioned: 28
- Detectors filled with water: 46
- E-kits installed: 88

Although we only count 8 tanks assembled, PMTs were installed on many tanks that had been assembled before (and these have not been counted again).

During February, water deployment occurred at the highest pace ever achieved, but it came to a stop when we ran out of potted PMTs to continue assembly.

As of March 31st, 2007:

- Total SD in the field: 1297
- Total SD with water: 1272
- Total SD with e-kit: 1215

The deployment in the land of VILLAR was completed in the first week of march 2007. The 3 landowners of the Northeastern part of the array (Villar, Rufinelli and the Italians) are now very cooperative with the project. Auger has opened some roads in the Villar land and is doing the same in the Rifinelli land at present. A minor accident, which resulted in a loose tooth of Alfonso, the driver of the CNEA truck, was caused by the recoil from a heavy iron cable used to pull a weight which was used to flatten the roads.

Tank CEIBO, which had a large erosion of the ground around it, needed replacement to avoid a complete collapse of the tank. It was emptied and replaced by the tank BOCA.

Vandalism to tanks was also registered. Tank Lucande was perforated with a knife and was leaking badly. The tank has been retired from the field and replaced. Although the tank might be repaired, the liner is probably lost. Other detectors, USA and NEGMEN JR, had their solar panels broken.

The surveying company re-measured with differential GPS a series of tanks whose altitudes or positions were not accurately determined (mainly due to stakes that were missing at installation times). This work has to be finished during this month. Survey of the land of Rufinelli is now also nearly completed.

Batteries are still a problem. The Moura batteries that are in use for the SD have a very high failure rate. Prior to testing, they need to be fully charged; testing takes a long time and large effort and has to be performed on all batteries due to the high failure rate. A set of 8 intelligent battery chargers was purchased by Brazil and is available for recharging batteries before testing them and before sending them out to the field.

Two new technicians (Mauro Gajardo and Luciano de Rosa) have been trained and started to work on SD assembly and deployment. Oscar Saez is now also well trained for SD electronics deployment and maintenance.

Rotoplastyc in Brazil has resumed tank manufacturing after a long delay caused by difficulties in the delivery of funding from the Federal government. At the end of March they had 94 tanks ready to ship plus resin available to complete 50 more to complete the basic requirements for the Project, including spares.

Shipping has been further delayed pending transfer of the funds received from the Brazilian Federal government through the research organization at the University of Campinas. This bureaucratic delay is expected to be short and deliveries are expected to resume in April.

R&D on rotomolding tanks with foam insulation inside continues and three full size tanks have been made with foam insulation. The three had foam thicknesses of 30-40 mm, 20-30 mm, and 10-15 mm. The last tank had an unusually thin wall because the foam did not expand completely, so this tank will be deployed as an ordinary Auger South tank. The foam thickness in the other two tanks is much more interesting and they will be deployed as thermal test tanks in Malargue as soon as shipping can be arranged. These tanks still have some unevenness of the foam layer so development work will continue. The interior of the 20-30 mm foam thickness tank is shown in the figure. It is believed that slightly higher density foam will be more stable during molding and produce a smoother, more uniform interior. Rotoplastyc will make two test tanks with the higher density foam and, if these are successful, they will be shipped to Colorado to be deployed for thermal testing.

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

The total number of Ekits assembled and tested in the SDE-Fabrica is 1484. There are currently 180 Ekits ready for the field deployment. Ekit assembly will be completed in 2 months. 5252 PMTs have been received from Photonis (total 5040+240 spares). More bases are currently being fabricated in Torino. The possibility to solder the base in Malargue will be studied by the Grenoble group. About 1200 PMTs still need to be tested and potted. The testing and potting rate is currently about 190/month. If more manpower is allocated in the PMT testing, this rate can still be increased.

There are currently 1215 detectors with Ekits in the field. The deployment is now done by the SD group (maintenance is done by the SDE technicians). A new SDE technician has been trained: Oscar Saes. Javier Alcaya, who has been on leave due to his accident last November, will come back to work early May. A second maintenance truck has been bought for the observatory.

The SDE maintenance is performed now since 18 months. Below is a graph showing the maintenance rate per month (trips and tanks visited).

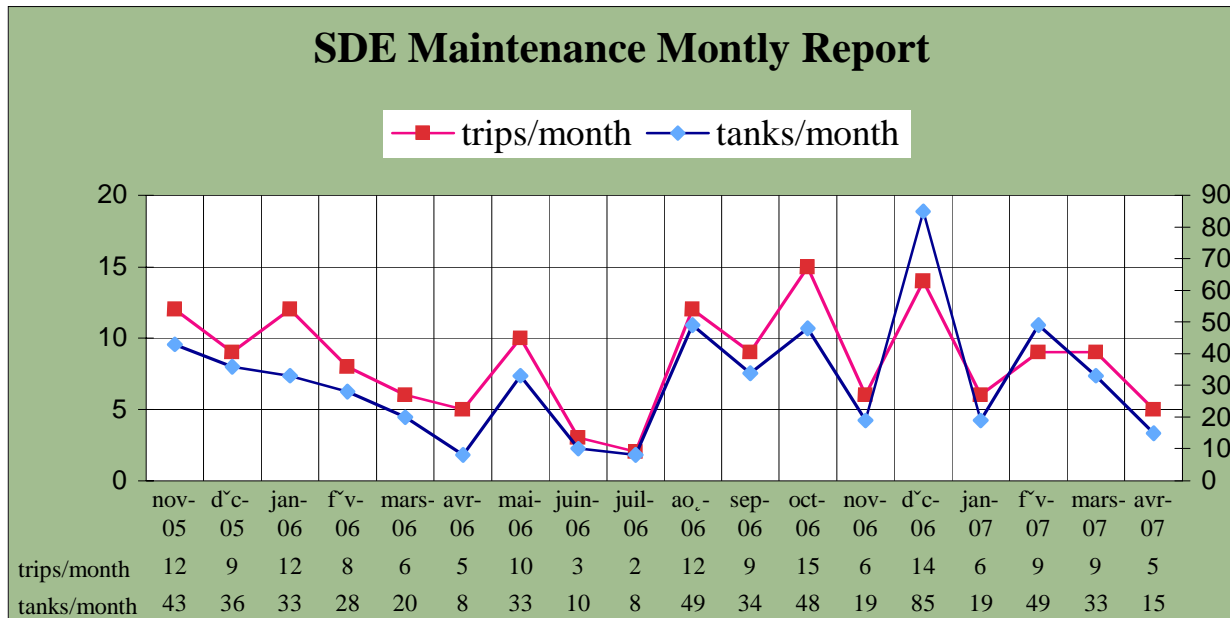


Figure : SDE maintenance rate (by Walter Fulgione).

There are currently about 4 « black tanks » per week. The efficiency in repairing them is above 97%. The table below shows the most common failures.

replacing E-Kit (blown fuse) or fuse	<b>174</b>
replacing Radio	<b>17</b>
resetting Radio	<b>82</b>
turn off/on	<b>9</b>
other (batteries)	<b>23 (9)</b>
E-kit freeze or died because of PMT short	<b>18</b>

Table : The most common « black tank » failures.

There are currently about 2.7 new PMT failures per week. These failures include connectors, bases and HV problems. The efficiency of repairing is about 70%. Since all the PMTs are currently needed for deployment, there is no PMT maintenance for the moment.

To increase the quality of the potting a clean room for the PMT potting area has been made. About 350 PMTs with increased potting quality has already been deployed to the field. However, no conclusions concerning the eventual decrease of the PMT failure due to better potting can be drawn for the moment.

PMTs failed in the field have been studied in Grenoble. The so called “square” PMTs (see figure below) are due to bad dynode contacts. This was also confirmed by studies done at Photonis.

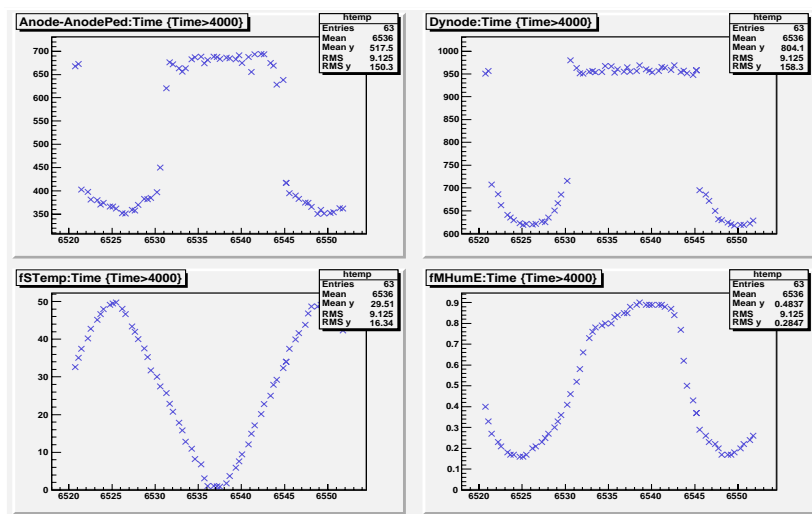


Figure: “Square” response of a PMT.

Gain jumps of a few ADC channels correlated with current jumps have been identified to be due to bad DCDC converter. The Grenoble group is currently studying the so called “raining PMTs” which occur after tank id of about 600.

Several studies have been performed to confirm that these PMT instabilities will not affect the data analysis. These instabilities are of the order of a few ADC channels with characteristic time of about 10'. Due to the calibration with background muons every minute, these gain variations are compensated and do not affect the shower reconstruction. The figure below shows signal accuracy obtained by two pairs of twin tanks. One of them, Dia-Noche, has an unstable PMT. The signal accuracy obtained is similar for both cases.

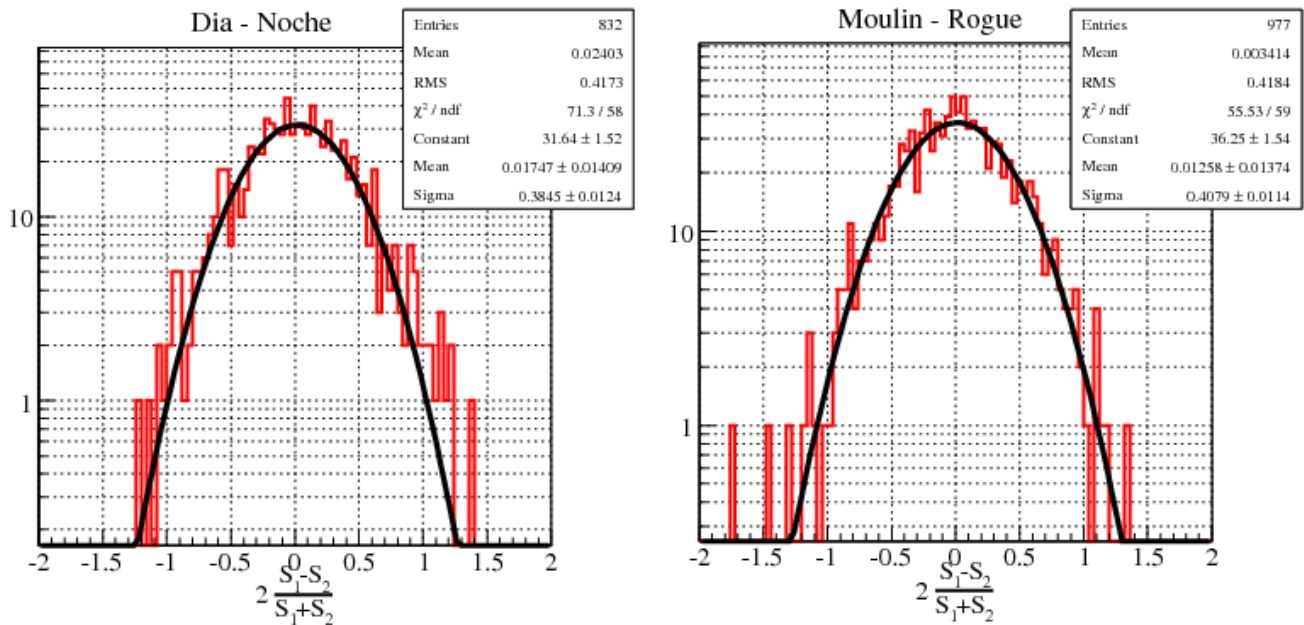


Figure: Signal accuracy for two twin tanks, one of them (Dia) having an unstable PMT.

Similar studies show that there is also no effect to the signal rise- and fall time and to the angular accuracy. A more detailed report concerning the PMT instabilities and their effect to the data analysis is currently under preparation.

### WBS 4.0 Online Monitoring (Cyril Lachaud – APC)

A workshop has been held between the 26th and 30th of March in Paris. All presentations are available on the page of the workshop: <http://apcauger.in2p3.fr/Protected/AugerMonitoringWorkshop/>.

Lot of progress has been made in many aspects of the project. We agreed on using a system running nagios to monitor the health of the hardware as well as some software of the Observatory (CDAS task involved). We're under investigation concerning the hardware to buy for the needs of the Auger Monitoring task.

I remind that you can watch the development on <http://moni.auger.org.ar/dev> or on the mirror <http://apcpaax.in2p3.fr/AugerMonitoring/> (must be used when you're not in Malargüe).

A paper and poster dedicated to the Auger Monitoring systems will be presented at the next ICRC by Julian Rautenberg.

### **WBS 5.0 DPA/Offline- (Bruce Dawson, Markus Roth and Tom Paul)**

A data production tag was made in March (v2r3p0-adst) for purposes of an ADST production run. A new full release is in preparation, but is awaiting resolution of some simulation and format conversion problems. The ADST writing modules are now distributed together with the the Offline code.

In the detector description part of the framework, new capability for supporting station triplets (or other larger groups) has been added. An example program for generating station lists from the database has been prepared.

A database monitor has been set up which allows you to quickly check the last time data arrived in the master and mirror database. It's available in the offline wiki area:

<https://www.auger.unam.mx/AugerWiki/NonEventDataBases>

A prototype offline-python binding has been started, which has potential to help with interactive analysis and visualization.

In the SD reconstruction area, a new module for signal recovery has been prepared. The UCLA FADC pulse parameters module, for computing rise times, has been added to the repository.

The MC event generation module has been revised to provide more flexibility, including capability to choose a random station from the detector description and throw a shower in a hexagon centered on it. The fast and full geant4 simulations have been combined into one, with a switch to choose custom photon tracking, reducing duplicated code.

To help with FD and hybrid simulations, a new FdUpTimeManager reads data from a root file (to be replaced by a database) giving dead time of eyes and telescopes, and dead time due to the CDAS veto. In reconstruction, an updated FD pulse finder uses pixel FLT traces instead of telescope SLT data for pulse-preselection.

### **Radio Detection R&D – (Ad Van de Berg – KVI)**

February and March. Near the BLS the installation for 2 stations by the group from OSU has been completed is running. For the third station essential pieces were lacking. Locally generated 'radio' T3 requests are being processed by the PC-DAQ system in BLS the container by observing a close timing coincidence of T2 reports from the stations as well as making random

T3 requests when trigger rates are low for a background study. CDAS generated 'real' T3 requests are also being processed with the local system listening for requests to the surrounding tanks and the infill tank. For the stations near the CLF radio-quiet units have been assembled and tested in France for the solar of the radio stations. In Karlsruhe and in Groningen further tests have been performed on the optimization of the noise and trigger conditions. On March 1st and 2nd a dedicated workshop took place in Karlsruhe to discuss progress and short-term goals.

**Malargüe Planetarium - “Planetario Malargüe”.**  
**(Reported by Beatriz Garcia and Carlos Hojvat)**

The formal contract for the purchase of the equipment from SkyScan (USA) was signed recently. Construction of the delicate projection dome has commenced at the factory. Procurement of the remainder of the equipment including the special seats has started.

Discussions are being held related to the schedule for delivery and installation. As mentioned before, it is a digital planetarium to seat about 65 persons.

Some shows will be purchased to start operations, but there will be in house capability for programming.

The building to house the planetarium is near completion, the photographs show the actual auditorium where the projections will take place and the entrance area.

A team is being formed for the operation of the complex. There will be a general manager and personnel to take care of the whole facility that includes areas for other purposes.

The Planetario belongs and will be operated by the City of Malargüe. All personnel will be hired by them.

A “scientific team”, to look after the content of the shows, has been formed under Dr. Beatriz Garcia, UTN Mendoza and a collaborator in Auger. An advisory council, with persons operating other planetariums, has been formed and will hold its first meeting shortly.