Pierre Auger Project
Progress Report
June 2000

Summary

The Auger Photo Album for June (http://www.auger.org/admin/Reports/photos_jun00.html) shows work on the Fluorescence Building at Los Leones and the Assembly Building at the Central Campus. Though already several weeks old, the pictures indicate good progress in the construction. Not long after the pictures were taken, however, Malargue received a record snowfall!

A follow up of the seven channel "Sunflower" test is now underway in Karlsruhe. The objective of this test of the Fluorescence Detector Electronics is to verify that some of the problems encountered in the first test have been resolved. A test of one hundred channels of the FD electronics will occur in Rome in September. A decision was recently made to proceed on a second version analog board to be ready for the full prototype camera (440 channels) to be send to Malargue. The aperture and alignment hardware and the prototype mirror assembly are projected to arrive in Malargue in November coincident with the completion of the Los Leones building. The camera will arrive at the site early in the year.

Equipment is being sent to the site for the installation of surface Detector tanks. The first tanks are expected in late September with all of them delivered by the end of the year. Three vendors are working on tank fabrication. Liners have arrived at the site for ten tanks and ten more are ready to be shipped from IHEP, Beijing. All solar panels have been procured and ready for shipment to the site. Bids for a plant to produce high quality water are being taken. The water plant is expected to be operational at the Central Campus in September. The first electronics packages will be available in November. A contract has been let for the communications tower at the Central Campus. Data acquisition equipment is expected at the site in October. Beginning in September a major effort will be made to deploy and instrument the Engineering Array detector stations. The ominous cloud on the horizon remains our ability to import observatory equipment into Argentina.

1.0 Fluorescence Detector

1.1.3.1.1.2 (central) FD optical calibration system (University of New Mexico)

The recent work is on the monitoring hardware and software for the optical calibration light source(s). A Pentium-I CPU (w/no moving parts except the power supply fan), 8 port RS232 I/O board, and 16 relay boards have been acquired. A Red Hat Linux system operating system and the Linux drivers for the RS232 and relay boards have been loaded. In addition, Linux control code for the filter wheels has been written and Linux code for the Rm6600 radiometer has been provided by L. Wiencke of the HiRes collaboration.

A portable xenon flash tube light source including battery power, self contained pulser, UG1 filter, optics for high efficiency coupling into 200um fibers, 2m optical fiber and diffuser was assembled. The intensity at the (output) end of the 200um fiber was measured with the same system used for the development of the prototype optical calibration light source. This allows a direct comparison of results from the portable light source to the prototype light source.

The source was then taken to the University of Roma2. Our Rome collaborators include: Paolo Privitera, Pedro Facal San Luis, and Claudia Bernardini. Gianni Vitali and Enrico Tusi (technicians) very, very helpful in assembling the test. In the test the source was mounted (as it would be in the FD telescope) at the (future) position of the center of the mirror with the diffuser directed towards the center of the camera. Photos of the setup can be seen at: http://www-hep.phys.unm.edu/roma2_test.html.

The two goals for the test were:

1. **to measure the PMT signal(s) (e.g. at the center of the camera) to be sure that the final system will provide enough light to reach the high intensity end of the PMT dynamic range, and**

2. **to measure the azimuthal uniformity of the diffused light to see if 0.6mm or 1mm thick teflon adequately diffuses the light. To this end PMT signals were obtained at the center and at the four "corners" of the camera ... initially ONLY with the 1mm teflon diffuser.**

The initial analysis of the data provided the following results:

1. **A conservative estimate for the light intensity (at the output of 1:7 optical splinter at the light source) should be >130nJ/pulse [with the UG1 filter] to produce a 4V signal from the PMTs. As it happens this is rather close to the maximum signal size we expect from the light source!**

2. After correction for 1/distance^2 and PMT viewing angle effects (but not angle of the diffuser) the PMT signals from the camera corners differed from the central values by <4%. With a few cm correction (for a possible horizontal offset in the position of the diffuser) the signal differences (camera corners VS camera center) were reduced to <2%.

3. Atmospheric monitoring - The prototype light source was assembled. Studies of the light optics now suggest that a simpler design, while not essential, would be desirable. In the simpler design the interference filter(s), used to select the wavelength of the light beam, are placed immediately adjacent to the xenon flash tube light source (rather than in a parallel light beam provide by placing the xenon flash tube at the focus of a f/1.5 lens). In this geometry the light passes through the filter at a range of angles. As a consequence the effective wavelength "window" of the filter is changed. Initial measurements find that the broadening of the wavelength "window" is modest (a few nm) for the f/2 optics of the aerosol phase function monitor light source. Additional measurements and simulations are in progress.

4. A paper for Journal of Physics G on "Fluorescence Detector Optical Calibration and Atmospheric Monitoring for the Pierre Auger Experiment" is posted at:
http://www-hep.phys.unm.edu/~johnm/jpg_draft_v13.ps
This paper should appear as GAP Note 2000-033 in the near future.

1.1.3.1.1.3 Sky Monitor (Michigan Technological University)

Equipment for 1 sky monitor has been ordered. This keeps us on the track of having a shot at having it available when the first eye can use it.

1.1.3.1.1.3.5 Aerosol Phase Function Monitor (University of New Mexico)

The prototype light source was assembled.

Studies of the light optics now suggest that a simpler design while not essential, would be desirable. In the simpler design the interference filter(s), used to select the wavelength of the light beam, are placed immediately adjacent to the xenon flash tube light source (rather than in a parallel light beam provide by placing the xenon flash tube at the focus of a f/1.5 lens).

In this geometry the light passes through the filter at a range of angles.

As a consequence the effective wavelength "window" of the filter is changed. Initial measurements find that the broadening of the wavelength "window" is modest (a few nm) for the f/2 optics of the aerosol phase function monitor light source. Additional measurements and simulations are in progress.

1.1.3.2.1.3 Roving Flasher (Louisiana State University, Southern University)

The second prototype diffusing ball is nearly complete. The aim of this device is to provide an airborne source of calibrated light. Our responsibility is to develop a vessel which will hold a diffusing fluid in order that the light emission be isotropic. We have experience with similar structures which have been employed in the IMB experiment. For example, Ludox is an inexpensive, nontoxic solution of water and very small silicon spheres. Use of this in IMB gave a very isotropic distribution of laser light when a fiber optic is placed in the vessel.

1.2.2.1.3-1.2.2.1.4 FD Digital Electronics (Forschungszentrum Karlsruhe)

FD Digital Electronics and Readout System

During June the main activities of HPE/IK personal working on FD electronics are summarized as follows:

1. **Analysis of the data recorded during the first test with the sunflower configuration (WBS 1.1.5.1.1.1)* revealed a software problem with the data readout. We fixed the bug in our simple test program and improved it with new features like a first statistical analysis, taking into account the time stamp during readout etc.**

2. **More functionality of the Second Level Trigger (SLT) board (WBS 1.1.6.2.1.4) was tested. It is now possible to store the configuration file for the FPGAs on SLT and FLT into a special EEPROM-like memory (EPC memory), which automatically configures all FPGAs on power-on.**

3. **We have now implemented an sliding sum integration on the First Level Trigger boards using the 10 bit data of up to 10 ADC values. The hit rate measurement is working and hit rate regulation was successfully tested.**

4. **In order to prepare for the test of 110 PMTs in Rome (WBS**

1.1.5.1.1.2) in September we produced more digital boards:

a) Three HTXM modules (WBS 1.1.6.2.1.5) were assembled and are already tested.

b) Four FLT modules (WBS 1.1.6.2.1.4) were assembled, but are not yet tested.

c) Two Analog test boards (WBS 1.1.6.2.1.2) are in the assembly line. These boards contain a pattern generator necessary to test the pattern recognition of the SLT.

5. We prepared the mechanical drawings for the front panels of the SLT and FLT. The ordered 55 SLT and 110 FLT front panels are already delivered.

6. Meanwhile, we have started to put Auger technical and administrational documentation into a data base system. The system can be accessed by anyone of Auger HPE/IK personal via any WWW browser. For some data we will allow access from outside the FZK campus via an anonymous account.

7. For the near future we are going to:

a) complete the documentation in the data base system,

b) repeat the sunflower measurement during 17.22.July, extent the test possibilities,

c) set the current monitor readout of the FLT into operation, · test the pattern generator on the analog test board and the SLT trigger,

d) prepare test software with a GUI for the SLT trigger test,

e) go over to Linux as OS.

**** Discrepancies in the WBS designations are being resolved.***

2.0 Surface Detector

2.1.1.1.1 Tank Engineering and Specification; Parts Fabrication (Fermilab)

Resin to make tanks at Alpina in Brazil has been made and shipped, and resin from the same lot was made for shipment to Plastrong in Argentina. Shipment will be delayed until all technical issues with the mold being made by Plastrong are resolved. This could occur in the next few weeks. The second large batch of resin for Alpina, enough to make an second group of 18 tanks, has been ordered by Brazil. All components for the bracket systems which will support the solar panels, electronics housing, and possibly the communications antenna mast, have been received with few exceptions. The remaining components are expected within days.

2.1.5.1.1 Liner Engineering, specification, and QA (Fermilab)

2000 pounds of Tyvek-polyethylene laminate has been ordered which will be sufficient to complete the Engineering Array liners as well as to do some developmental work on liner fabrication techniques. Delivery is expected in late September. ten liners have been delivered in Malargue from China, ten more are ready for shipment, and two more will be ready for shipment when the customs clearance paperwork has been completed.

2.1.7.1.1 Procure 40 Solar Panels and Regulators (Fermilab)

All solar panels for the Engineering Array have been delivered either to Malargue (24 panels for the next 12 detector stations) or Fermilab (remainder) except for five panels, which are due within a week. All solar power regulators have been delivered to Fermilab. Preliminary data from tests on shading effects due to the communications antenna mast have been recorded and suggest significant loss of power results, but only in the late evening when power production is somewhat reduced. The program continues.

2.1.8.1 Water Quality Measurements (Fermilab)

Data taking continues with the Fermilab tank. Ricardo Eusebi a student from Argentina visited Fermilab and greatly contributed to the analysis of data.

Data taking continuos with a trigger on passing through central muons. Two PMTs continue to show a gently decrease of signal with time. The third tube that had a constant signal vs. time (it has a grounded rf screen over the phototube face) has started a slow decrease at the same time of an access to the tank above the liner.

2.1.8.1.1 Water Purity Studies (Fermilab)

The operation of the full size tank at Fermilab continues for water purity studies. Drum size test facilities are under construction and the first is ready for filling. Argentina is out for bids on the final water treatment plant for Malargue.

2.2.3.1 Station Electronics (College de France)

1. **Three new sets (mother board, controller, ethernet) are being assembled [1]. They will be ready by 13th of July. It will take one week to test them. One will then be sent to Penn state (Jim Beatty).**

2. **The modifications to be applied on the mother board (-3.3 volts) and to the controller board (RS232: add RTS/CTS signals) are under way. Some other minor modifications will also be made on the mother board. We expect to start the CAO this week. The cabling and test of the first prototype will be made in our laboratory. We expect to start printed circuits and cabling for 20 prototypes (mother board, controller, ethernet) at the beginning of August. The 10 first prototypes should be ready at mid September and sent to Penn State before end of September.**

3. **Time Tagging ASCII: writing under Verilog and synthetisation (Synopsis) is well advanced. We are starting the layout preparation. We are fighting some integration problems, but no more than expected. Tests are foreseen in August with Mietec company to see if they can read and deal with the files generated in our lab. A first ASCII run in expected before Christmas. The aim is to have the last EA prototypes.**

This month, an important effort has been done to integrate the monitoring task [2]. Messages between central and local stations have been defined and a first version is under test. The definition for the GPS errors and corrections is under way. A version including all these modifications should be ready by mid September.

References :

More information on:
http://cdfinfo.in2p3.fr/Experiences/Auger/work.html.

[1] Local Station electronics integration
[2] Local Station Acquisition Overview

2.2.3.1.1.2 Trigger ASIC (Michigan Technological University)

Trigger Chip: Test chip was submitted to the June 12 Mosis run. Work continued on design, simulation, and layout of phase 1 trigger chip. Layout of fifo memory section 95% complete. Stuffing of the PLD adapter board was completed. After returning from necessary visa trip, Zbigniew is starting to test loading of the configuration file into the PLD. An updated PLD has been ordered which should be able to perform the complete "phase 1" trigger at full speed. Layouts of next iteration PLD adapter board and test board for the test chip nearly completed. We hope to send the layouts out for quotes within the next 2 weeks.

2.2.3.1.1.2.2 ASIC Test Fixture (Louisiana State University, Southern University)

We have created the layout drawings of the latest revision of the test board, in consultation with the MTU group. These are being checked by our engineering staff and will be ready for transmittal to the board manufacturer in July. We expect a relatively short turn-around on the production. The next step is then to incorporate the new board with the software that exists for our logic analyzer. At this stage we will be ready to begin the input of full logical wave forms into the board. We are on time and on schedule with the delivery of the first testable iterations of the PLD(s) from MTU. Rishi Meyhandan has made progress with the software simulations of various trigger conditions and criteria; these have been communicated to the designers of the trigger logic at MTU. The specific criteria which appear optimal are as they have been reported at the ICRC last summer and in the two Malargue meetings since. The newer results which have confirmed the earlier ones have arisen from the most recent modifications to the AIRES simulations by the LaPlata group. The optimum timing and levels indicated by these simulations are not strongly constrained at the moment. In other words, the desire for full efficiency at 1019 eV in a composition independent way can be achieved easily, it appears. The main constraint will likely be the additional requirement that the single tank noise rate remain below 20 Hz. Our estimates suggest that this too will not be a problem, but "noise" wave forms have not been fully simulated. It has proven difficult to obtain noise "data" from previous experimental work that are suitable for our purposes. The AGASA test tank has the most complete set, but there are many questions concerning whether it represents true random noise or is influenced by the triggering requirements of that set-up. These issues have been discussed extensively at several previous Malargue meetings. We are now developing simulated noise wave forms. This is straightforward, in principle, using well known cosmic ray singles rates and the AIRES**

program. At this stage it is not technically possible to insert such random particle data into the simulation stream of the AIRES program. We are working with the AIRES author (Sciutto at LaPlata) to create such code. We anticipate no major problems and expect to have this kind of coding in place in July.

2.2.5.1.1 Cables (Louisiana State University, Southern University)

We have worked closely with the engineers and physicists at Fermilab, Penn State, and in France to reach a final configuration of the cabling and sensor systems for the EA tanks. It is essential that the many elements be well integrated: there are numerous boards, power systems, and sensors which all will "arrive at the same place" on top of the tank. Some things, such as connections physically on boards, must be placed by the groups building that board. The connection off the board should in most cases be done by other responsible parties. Except for on-board connectors, all the cable bundling is the responsibility of the LSU/Southern group, subject to the specifications of the various designers. Matthews spent a few days at Fermilab conferring with Mazur, Andrews, Hoffer on the assignment of responsibilities. Beatty and Tuckey participated by conference call and/or email. We are now working with a common document and diagram - prepared by Matthews and Tuckey (Besancon) - to itemize all cables and connectors. This document has had input from all the engineering personnel involved in all the elements. The process is converging and we anticipate that we will successfully provide the needed cabling etc. to Penn State, on time for the eventual (November) beginning of the EA tank installation in Argentina.

2.2.5.1.2 Sensors (Louisiana State University, Southern University)

The sensor R&D and procurement is on time for the next round of EA tank installations in November 00. See the comments in the progress report on the "cables" task for a detailed summary.

3.0 Communications (University of Leeds)

Tender Evaluation for Campus Comms Tower

The tender evaluation procedure for our next communications tower has now been concluded and a supplier has been selected. We anticipate that the contract for our 50 meter tower at the observatory campus will be awarded during July. Construction should be complete within 60 days of order placement which means that the tower should be in position well before our next major comms deployment in November.

The Guzman-Nacich tower company will receive the contract to supply the tower. This company was also responsible for the supply of the Los Leones tower. Much praise goes to Norberto Fazzini for his tough negotiations with Guzman which enabled us to reduce the cost of this second tower considerably.

By means of his efforts and other cost saving measures that we have introduced on the comms shelter and ancillary equipment (based on our experience with our first tower at Los Leones), we expect to be able to save around $40k on the cost of our second tower.

5.2.1 Provide Project Management (Fermilab)

The meeting of the Pierre Auger Finance Board took place at CERN on June 23, 2000.

The meeting discussed possible dates and the organization of an international review of the Project, to consist of 4 to 6 experts and a chairman. The review is expected to take place around March / April 2001.

During the meeting Carlos Hojvat made a presentation on the present status of the Common Fund account at CERN and the amounts that have been advanced to different collaborating institutions.

Paul Mantsch presented the Auger Progress Report.

A discussion of the insurance to be obtained for civil liability also took place.

No insurance for damage or lost components is recommended at this time. Components can only be replaced by the institution that originally provided them. It is the equivalent of being self insured.