Pierre Auger Project
Progress Report
February 2000

Summary:

A significant milestone was passed in February when the first surface detector station was assembled and cosmic ray signals recorded. A second detector station was deployed at the first Engineering Array location. Because of various delays in clearing customs the components for the first detector stations arrived late to the site. Nevertheless our Auger collaborators worked very hard and were able, in about three days, to assemble the tank and record signals. This accomplishment is described in an excellent report (below) by Laudo Barbosa, the surface detector coordinator for the Engineering Array.

http://tdserver1.fnal.gov/project/Auger/Public/Sitephotos/Feb_photos_Laudo

Preparations for work at the site in April are underway. Although both Brazil (Alpina) and Mexico (Rotoplas) are preparing to build more tanks of the next design iteration it appears unlikely (at this writing) that either firm will deliver tanks to the site for April deployment. At least one additional tank already at the site, however, will be deployed at an Engineering Array position.

A major effort on the communications system will be mounted in April. Communications will be established between the concentrator tower at Los Leones and at least the two surface detector stations. Hair raising stories are coming in of our fearless comms colleagues training to work on towers:

> *"I was on a comms tower!!*
> *We had had to climb around on the outside of the tower at 30 meters*
> *height!! The training we are getting is first rate and our equipment is*
> *very very good. We all feel happy working at height (loco Inglis??)" Paul Clark 16Mar00.*

Another important milestone was passed at the College de France when the Comms Task and the SDE Task had a very successful integration trial in which they connected a surface detector local station controller with a subscriber unit of the wireless LAN radio (report below).

The contract for power lines to the Los Leones Fluorescence site is just about to be signed. The contracts for the FD and campus assembly building are about to be negotiated.

1.2.2 Roving Flasher **(**Louisiana State University, Southern University)

Prototype assembled using laboratory flask and stainless fitting for fiber optic. Planning machined version for tests.

1.2.2 Calibration Flashers **(**University of Utah)

Prototype assembled using laboratory flask and stainless fitting for fiber optic. Planning machined version for tests.

1.2.3 Calibration **(**University of Colorado Nuclear Physics)

A purchase order has been issued to Acton Research for the main components of the calibration lab, including a monochrometer, deuterium light source, order sorting filters, beam splitter, and data acquisition system. Attempts to purchase similar items from other suppliers failed because their data acquisition systems could not support 2 detectors simultaneously. A pc has also been purchased.

1.2.4 Flat Field **(**Louisiana State University, Southern University)

Consult with engineering staff about cylindrical structure to replace hemisphere which has been tested. Designed ray-tracing algorithm to assist in design.

1.3.2 Vertical Flasher **(**University of Utah)

We received and tested the power pack and flash lamp. A Synergy GPS controller kit was ordered.

1.3.3 Horizontal Attenuation **(**University of Utah)

We wrote and tested the CCD control and readout software for use on linux platforms, wrote and tested the photometric analysis software, performed a full-scale test of the presently envisioned H.A.M. concept in Millard County, including an evaluation of the calibration technique.

1.3.4 Vertical Star **(**Louisiana State University, Southern University)

Celestron 2000 telescope system with photometric software under test and development in laboratory.

1.3.8 Weather **(**University of Chicago)

A PO has been sent to CSI for $16,800. Shipment is scheduled for 7 Mar 00. I still have to complete shipping and customs paperwork and I will need to fly over to Chicago in approximately two weeks to do this. Shipping to Bs As / Malargue is planned for 7 April 00.

2.0 Surface Detector (A. F. Barbosa)

Report on the Assembly of First Surface Detectors at the Auger Site – (Laudo Barbosa) Photos at http: / / tdserver1.fnal.gov / project / Auger / Public / Sitephotos.

Report on the Assembly of First Surface Detectors at the Auger Site

Brief History

In the last collaboration meeting, it was decided that the surface detector deployment activities were to begin with the installation of a prototype detector near a laboratory facility (by that time we were thinking of CNEA), and another one on the Auger site. These detectors were supposed to be as complete as possible, but we had not a precise idea about the difficulties we would face. Actually we intended to learn a deployment procedure to be adopted while installing the Engineering Array tanks. We also intended to synchronise the activities of all the task and sub-tasks of the SD group.

Activities in Malargue from February 5th to 29th

Although we had well planned this stay, only the liners (03) were available in Malargue when we arrived. Tanks were supposed to be on their way from Brazil to Argentina. Other detector parts and tools were being sent by mail. We brought with us from Brazil a set of basic tools, and some equipment: soldering station, oscilloscope, DVM's, lap-top, driller, cables, etc.

The idea of using CNEA facility was abandoned, but we had not yet rent a provisory Auger space. You all must know that the Auger buildings will not be ready before the next few months. Therefore we started by visiting, with Gualberto Avila and Ken Gibbs, galpons available for rental. For those not familiar with the word 'galpon', this means something like a big, huge shed. There are lots of these in Malargue. Three were visited, and we chose one with a house. This choice was based on cost, timing and suitability considerations. It also meant to provide us with a convenient environment (house + galpon) for the different planned activities.

Most of the detector parts, including the tanks, only arrived more than a week later. We took this time to work on the house and galpon infrastructure. It had to be well cleaned, since it was not occupied after about two years, roof had to be sealed, gates had to be repaired, electric power had to be installed ... Besides, we had to build special devices to be used while working with the tanks (ex: skateboard, working benches).

When the tanks arrived, on February 18th, we had about all the material and parts we would need to assemble the detector. Anyway we had to improvise a lot, since some parts were still in transit from somewhere to Malargue and the infrastructure was not yet completed. In particular, we had no idea how tanks were transported until they arrived. Three main operations were required to unload them: taking out of the truck, placing horizontally, bringing to the house yard.

Tanks #1 and #2 were mounted at the house yard. Tank #2 was transferred to the Auger site before water filling. It took us about 4 days to have them both mounted and filled with water. Since we were many working on it (Iuri, Germano, Peter Mazur,

J. Beatty, Rishi, Humberto, Ingo, Eduardo), it is not possible for the moment to have a detailed assembly procedure description. Humberto has been taking data from tank #1, results will soon be presented. Tank #2 is the first to be installed on site. Its position was determined with standard GPS precision. It is filled with water and has its own electric power: solar panel, batteries, regulator. Presently it also has a data logger collecting information from four temperature sensors. Comms and electronics to tank #2 will be implemented in the near future.

Results

Besides the assembly of the tanks themselves, other achievements might be listed as important results:

- **We now have an address (Rua Rodolfo Alonso, 772), a place to store and mount tanks (Galpon), rooms for laboratory work (house), a telephone number (+2627 470 327), internet access, etc.**
- **With the help of Gualberto Avila, the acting site manager, we now know a lot about how to have things done in Malargue. More than that, we are known by the local people.**

  - The real problems and difficulties were faced, specifically: how to move tanks from the transporter truck to the galpon, how to clean them, what are the options to have water filling to tanks, how to take water to the site, how complex is each assembly step, etc. Of course there is still so much to be learnt, but we have a better idea of the directions that could be followed.

Outlook

Comms people are coming to Malargue in April. As far as I know they are bringing enough material to install comms to 10 detectors. We'll therefore push to have 10 tanks delivered to the site, as well as all other related parts, so that 10 detectors are available in April. We'll also work on the implementation of an optimum assembly strategy (material resources, manpower, infrastructure), so that the assembly of the whole Engineering Array is reduced to the fastest and safest process.

Acknowledgement

It's hard to tell the names of everyone contributing at this stage. However it is quite clear that Gualberto Avila was a key person, without him we would be in great trouble. All the colleagues who were in Malargue contributed a lot: Ken Gibbs, Jim Beatty, Rishi Meynhadan, Peter Mazur, Iuri Pepe, Germano Guedes, Ingo Alekotte, Humberto Salazar, Eduardo Moreno. The help from Pedro and Juan, from CNEA, was invaluable. We had almost daily communication with Paul Mantsch, Carlos Hojvat, Rich Andrews and Dean Hoffer, who took care of all the support we needed.

2.1.1.1 Tank Engineering and Specification; Parts Fabrication (Fermilab)

The first three tanks of the baseline design have been produced by Brazilian manufacturer Alpina with Brazilian funding. These tanks were delivered to Malargue and two of them fitted with solar power, liners and water. One had sufficient electronics installed to begin observing cosmic rays. Except for minor problems, these tanks appear to meet the project prototype requirements.

A second mold and a molding machine were fabricated by Mexican manufacturer Rotoplas in Mexico using Mexican funding. Tanks were manufactured for BUAP (Puebla) and improvements were scheduled for the mold before more tanks are to be manufactured. A third mold is under construction by Plastrong in Argentina using Fermilab funding. Delays by Plastrong's supplier have postponed completion of this mold.

Brackets for the solar panels and electronics were fabricated and installed in Malargue on the first two prototype tanks. These use an aluminum "Unistrut" type extrusion and appear to be both mechanically satisfactory and cost effective.

Port assemblies and the fixturing for their installation were fabricated and sent to Malargue for installation on the first tanks. Delays in shipping and customs in Argentina caused these parts to arrive after the installation was to occur, so temporary port assemblies were made.

2.1.1.3 Liner Engineering, Specification, and QA (Fermilab)

The first two liners from China using the new laminate and fabrication techniques were installed in the detectors in Malargue.

2.1.1.7 Thermal (University of Colorado Nuclear Physics)

The dead data logger in Fillmore has been repaired.

2.1.2.1 Water Purity Studies (Fermilab)

The full size tank operation at Fermilab continues. Discussions and plans for specifying water purity requirements and systems continues.

2.2.3 Prototype Tube (University of Colorado Nuclear Physics)

A shipment to Malargue this month included 7 enclosures, with attaching clamps, O-rings and PMT weight rings. Another 25 have been molded, and need assembly. Modifications will be made to seal the original cable entrance hole (top) and create a new 19 mm X 50 mm hole on a molded flat spot on the side.

2.2.3.1 Phototube (Colorado State University)

This report summarizes our University progress from February 1 through February 29, 2000.

Work continued on window-seal flange attachment, particularly testing the strength of various types of adhesive joints after immersion in DI water, at extreme temperatures, etc. Work began on a GAP note on transmission of light through PMT windows made of PETG, UVT Acrylic, and clear Metallocene LLDPE film. It appears that there is an increase of ~100% of the signal amplitude for vertical muons in the PMT if there is an optical coupling medium (silicone quartz matching fluid) between the PMT and the window. The light transmission for all three materials with the coupling oil was within ~10% of that seen with the tube face directly in water. Samples of clear Metallocene-LLDPE film in thicknesses between 200 microns and 550 microns were purchased, and will be tested for light transmission, water vapor permeability, and ease of use. Samples of 200 micron film have been welded into seal flanges and used in light transmission tests in the CSU tested (see above). Results are still looking promising. Blueridge Films has produced sample welds using an impulse thermal sealer. These samples, while not yet satisfactory in strength, look promising. We will continue to work with them with an eye towards getting 55-gallon drums.

2.3.1.1.1 Front End Analog Section (EA) (Michigan Technical University)

Work is continuing. During the past month we added a number of amplifiers to your library, including the AD8011 which looks to be very promising. This is the same OP amp that the MEPHI group selected. A revised analog chain was blocked out based on the AD9203 10 bit ADC, which simplifies the amplifier requirements.

2.3.1.2 Front End Analog Section (EA) (Michigan Technical University)

No work has yet been done on this item. Sufficient progress on 2,.3.1.1.1 is a prerequisite for 2.3.1.1.2

2.3.1.1.3 Trigger ASIC (Michigan Technological University)

The following people worked on this during January at MTU: D. Nitz, Z. Szadkowski, S. Ruotsala, J. Darling, A Dorofeev, H. Ma, M. Rench and M. Trombley. D. VanWashenova joined the group. We have split the trigger ASIC work into two paths in order to reduce the time to delivery of the first prototype system. PLD prototype: Z. Szadkowski has finished the design of implementation of the core logic of the ASIC in an Altera PLD, including now the external memory interface. Work on layout of the daughter board is continuing. ASCI version: M. Rench and H. Ma continued to work on simulation of schematic sheets. M. Trombley and M. Rench continued to work on the design of the modifications to the slow memory buffers. Layout of the address decoder sheet and registers_1 sheets began. Some time was spent working through glitches in our Cadence configuration. Design changes to trigger logic are being

delayed until the last moment to allow more simulation input.

2.3.1.1.4 ASIC Testing **(**Louisiana State University, Southern University)

Awaiting FPGA prototype.

2.3.1.1.5 Front End Board (EA) (Michigan Technological University)

The first iteration of the front end board is being produced by UNAM.

We have seen mechanical drawings and partial layouts. We are still awaiting arrival of first board. We were able to establish e-mail contact but communication broke down again after that. The information we did get indicates that the design of the board is nearly, but not quite ready. Generation of a second interaction awaits work on 2.3.1.1.1, 2.3.1.1.2
and the first iteration front end.

2.3.1.1.6 Testing of Front End Board (EA) (Michigan Technological University)

See narrative for WBS 2.3.1.1.5.

2.3.1.1.7 ASIC Test **(**Louisiana State University, Southern University)

Final minor corrections implemented to test board. Ready for first tests. First pass test vectors under study, will proceed upon delivery of prototype ASIC and/or FPGA.

2.3.7.1.1 Cables **(**Louisiana State University, Southern University)

Acquired and assembled wiring for first two level-sensors, sent to EA site. Awaiting specifications from electronics/communications tasks.

2.3.7.1.2 Sensors **(**Louisiana State University, Southern University)

Obtained prototype units for water level sensor from Ensor. Shipped and installed two units in first two prototype tanks in Malargue. Redesign in progress to reduce costs. Will depend on final tank design.

2.5.1 Solar Panels and Regulators

Solar panels, regulators, batteries, and battery boxes for the first two surface detector stations were purchased and installed in Argentina by Fermilab.

3.0 Communications

Comms - Surface Detector Integration Trials

The Comms and SDE teams are pleased to announce the successful integration of the surface detector local station controller and the subscriber unit wireless LAN

radio hardware. The integration testing took place at College de France, Paris and involved teams from CdF and the Leeds comms group. Testing extended over 3 days (6th-8th March) during which all aspects of the hardware and software communication protocol were exercised. The usual small bugs were successfully teased out of the system and these two hardware items can now be considered to be integrated.

7.0 Project Management (Fermilab)

No substantial progress has been made in relieving the customs and importation problems. We are exercising the donation route to move material and components into Argentina to avoid import taxes. Test cases involving solar panels are underway.

A student has been hired part time to develop tracking data bases for observatory components. An inventory data base for SD phototubes is nearly complete. If you have actually read this far I would be interested in hearing from you.

Project Engineer, Rich Andrews and Cost/Schedule manager Dean Hoffer visited Auger institutions Germany, Italy and France to refine WBS and schedules, help with MOU's, and understand interface issues.