A Proposal for SD Calibration and Monitoring Database Quantities

A. Tripathi, T. Ohnuki, K. Arisaka
University of California, Los Angeles

7 November 2002

Introduction

The completed surface detector array would consist of 1,600 detectors. This translates into 4,800 PMTs, or 9,600 FADC channels. The array is intended to be in operation for 20 years. Unlike previous such detectors, auger will provide a **high statistics** sample of ultra high energy cosmic rays, so that systematic errors will become more important.

In order to obtain the physics results from the observed quantities, we need to simulate the detector behavior. For example, in order to obtain the energy spectrum, we need to know the detector aperture over time, which can only come from simulations. Therefore, the simulations have to incorporate the realistic detector behavior in order to provide reliable answers. Obviously, we need to not only monitor the relavant detector parameters in real life, but also make those parameters easily available for simulations.

Currently, in the EA, all the online calibration data is bundled into each triggered event. The monitoring data stream and the raw muon data stream are completely different. As a result, there is no quick way to access all the detector information contained in these three different data streams. The problem will become more apparent once we have the full array running over a long period.

Obviously, it is necessary to store all this information in a way such that a user can easily obtain all the relevant detector parameters for a given period of time. For example, a user in the year 2012 should be able to find out the VEM values for all the detectors during the year 2003, without having to process all the raw data collected during 2003.

In this brief note, we propose a list of variables that should be stored in this database.

The Database Variables for SD Calibration and Monitoring

Below is a proposed list of SD calibration and monitoring variables that we think should go into the SD calibration and monitoring database. The eventual decision will be taken after discussions in Malargue.

- **Tank Number**: To identify the detector.
- **PMT Number**: To identify the PMT in a given detector.
- **VEM_q_muon** : VEM (charge) value for this PMT from muon data.
- **VEM_q_LS**: VEM (charge) value for this PMT, as obtained from the local station calibration.
- **VEM_pk_LS**: The VEM peak value for this PMT, as obtained from the local station calibration.
- **DA:** The relative gain between the dynode and the anode. This will come from T2 data.
- **DARMS**: The RMS of the measured Dynode/Anode ratio (DA).
- **DA_LS and DARMS_LS:** Same as DA and DARMS, but calculated on the local station.
- **AndoePed** and **DynodePed**: The anode and dynode pedestals. Needed to mimic the actual dynamic range in the detector.
- **AnodePedRMS** and **DynodePedRMS**: The RMS spread in anode and dynode pedestals. Needed to simulate the noise realistically.
- **PulseDecayConstant**: Needed to simulate the pulse shape correctly.
- **HVSupplied:** The supplied high voltage to the PMT.
- **HVMeasured**: The measured high voltage from the base.
- **PMTOK:** Is this particular PMT well-behaved enough to be used in event reconstruction ?
- **IsInAcquisition:** Perhaps an integer, or a bullion, to indicate if a given station was in acquisition. There may be times when, for whatever reasons, even a fully functional station (or part of the array) may not be included in the data acquisition from CDAS.
- **StartTime**: UTC Time indicating the start of the period for which a given quantity is valid.
- **EndTime**: UTC Time indicating the end of the period for which a given quantity is valid.
- **UserID**: The name of the person who updated the database for a given period.
- **UDate:** The date and time (maybe UTC date) when a certain block of the database was updated.
- **SoftwareVersion:** The software version that was used to calculate the data used to update the database. We will have to provide standard software for this purpose.

We also need to include the data from LED runs here somehow, e.g., the dynode/anode ratio and the PMT linearity. Exactly how this will be implemented should be discussed at the collaboration meeting.

The Frequency of Database Updates

The frequency of necessary database updates would not be the same for different variables. For example, the supplied PMT HV would hopefully not change over large periods, say months, making it un-necessary to update this number on a weekly basis. The PMT VEM values, at least in the EA, appear to be stable within 5% on the scale of a week [1], suggesting a weekly update of these numbers might be sufficient. Hopefully, the production PMTs and associated hardware would be stable enough that the PMTOK variable will need to be updated rarely, and so on.

The point to be made here is that the database design must allow the flexibility of independent granularity (frequency of updates) for different variables. Such a scheme has already been proposed [2]. The kind of database to be used for this purpose, as well as the interface to access it will be provided by the DPA group.

How Do We Make the Updates

The numbers that will go into the SD calibration and monitoring database will be provided by the people doing calibration and monitoring analysis.

The conclusion that weekly update of most SD and Monitoring database quantities is sufficient for the EA was arrived at after careful study of raw muon data as well as the monitoring data over several months. This study is still in progress.

The pre-production and production detectors are entirely different compared to the EA detectors. As a result, we must continue the raw muon data taking into the pre-production phase of the Auger. We will continue the systematic anlysis of this muon data as well as the monitoring data into pre-production in order to understand the calibration needs of the production version of the Auger SD detectors. This analysis will tell us how frequently does a certain parameter need to be updated in the database.

We already have in place much of the neeeded software to perform such analyses [1]. Into a couple of months of stable pre-production running, we would have fully automated and standardized these software tools in order to produce the database numbers from the analysis of muon, T2, and monitoring data.

Acknowledgements

We would like to acknowledge Tom Paul, Xavier Bertou, Lukas Nellen and Marcel Urban for useful discussions and suggestions about the scheme presented in this note.

References

1. A. Tripathi *et al.*, "A Systematic Calibration of Surface Detectors Using Muon Data from the Engineering Array", **GAP 2002-046**.

2. T. Paul and J. MacLeod, "Prototype detector description and database handling for Auger offline software", private communications, soon to be published as a GAP note.