Shift executive report for the DAQ of the Fluorescence Detector of the Pierre Auger Observatory

R. Assiro[2], C. Bleve [1,2], G. Cataldi[2], M. R. Coluccia[1,2], A. Corvaglia[2], P. Creti[2], S. D'Amico[2,3] G. Fiore[2], A. Innocente[2],I. De Mitri[1,2], G. Marsella[1,2], D. Martello[1,2], A. Miccoli[2], L.Perrone[1,2], C. Pinto[1,2], V. Scherini[2], F. Strafella[1,2] and the Pierre Auger Collaboration[4]

[1] Dipartimento di Matematica e Fisica "Ennio De Giorgi", Università del Salento, Italy
[2] Istituto Nazionale di Fisica Nucleare sez. di Lecce, Italy
[3] Dipartimento di Ingegneria dell'Innovazione Università del Salento, Italy
[4] http://www.auger.org/archive/authors_2016_06.html

1. Abstract

A simple toolkit aimed at performing a preliminary analysis of the data collected along a FD shift has been implemented and it is currently available to FD shifters in Malargüe. An important goal is to get the shifters closer to physics results through a deeper understanding of data production and reconstruction, thus leading to an ongoing monitoring of their quality. This procedure, in combination with the wide and versatile set of information provided by the Auger monitoring program, may help addressing possible acquisition or data quality issues. Part of the task is also to identify (and quantify) the most (how many) interesting events (are) in a FD shift. A report can then be produced according to a layout that will be discussed here. Finally, we wish that this procedure could enhance the feeling of closeness of shifters to the Pierre Auger Observatory.

2. Introduction

The procedure to acquire the cosmic rays with the fluorescence detector is described in [1]. As a first check, the working status of each FD-site can be checked using the monitoring [2] program. Figure 1 shows the FD on-time fraction in minutes per each telecope and for each FD site.

A $\overline{\texttt{Offline}}$ [3] based simplified reconstruction, without connection to databases (i.e. using fixed FD calibration constants and parametric models for modeling the Atmosphere response) can be used to reconstruct almost in real time the FD events detected during a data acquisition shift.
This can be done in different steps as described in the following:

- Analyze FD data every night;

- Analyze the Hybrid events, this is possible only after 3-4 days from DAQ;

- Analyze the data during the shift;

At the end of the shift the shifters could produce a FD report following the schema shown in the last section.

3. Processing FD and Hybrid data

Analyzing and reconstruction FD data during nights is a way to become a "real" scientist during the data acquisition period. A procedure has been provieded and is now a standard during each FD data taking. The details are provieded in a wiki page available to the shifter:
http://wiki.auger.org.ar/doku.php?id=fd:reconstruction_and_analisys_tools

3.1. Data visualization

The shifter can use two simple root macros for basic plots, to produce namely the event rate and the energy/zenith/xmax distribution. The shifter can identify interesting hybrid reconstructed events and compare the performance of hybrid versus FD-only reconstruction.
In addition to this, the shifter may want to check also the SD reconstruction for the sub-sample of events with enough number of stations. This can be done using the SD Event Display from CDAS.
While browsing the reconstructed events, the shifter may want to select the highest energy event and provide a beautiful picture of the best event collected during the shift. Possible issues with DAQ or production of hybrid data can be inspected by monitoring the rate of hybrid events. Basic root scripts are provided to the shifters for producing all mentioned plots.
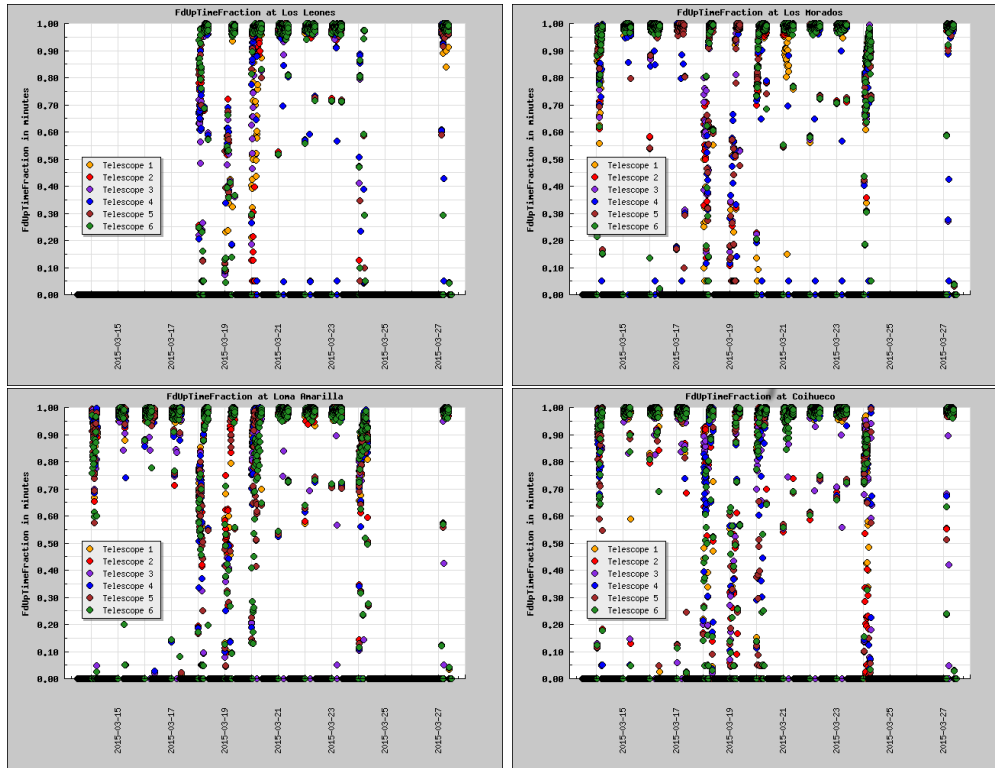
Figure 1. FD on-time as derived from the Auger monitoring [2]

4. Producing the FD shift report

In this section a schema of the FD shit report is proposed.

Title: FD Shift Month start day – stop day

Authors: shifter local and remote.

General comments
- FD shift summary (problems if any);
- LIDAR shift summary (problems if any);
- bad/good weather conditions, volcano ashes etc..;

Main Issues/Problems (if any) encountered along the shift.

Extra activities during the shift such as dedicated measurements like calibrations, roving laser, raman campaign etc.. or changes of the standard procedure

Suggestions/improvements: any is welcome

Short overview of the data quality plots to be included in the report:
- Figure 1: FD on-time as derived from the Auger monitoring (shown before) ;
- Figure 2: Total Events rate by GPS second;
- Figure 3: Energy distribution of all FD data and for selected events.
- Figure 4: Atmospheric depth at shower maximum distribution of all FD data and for selected events.
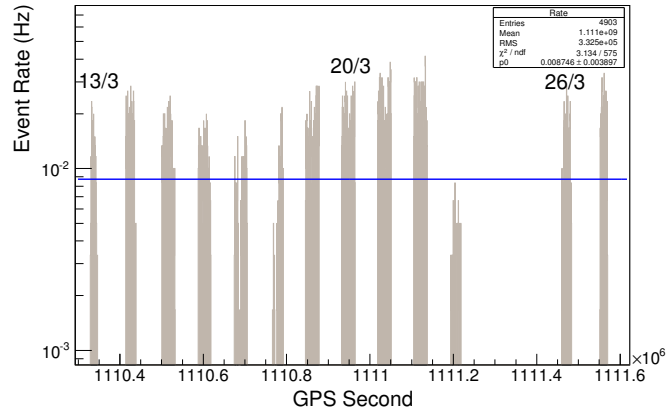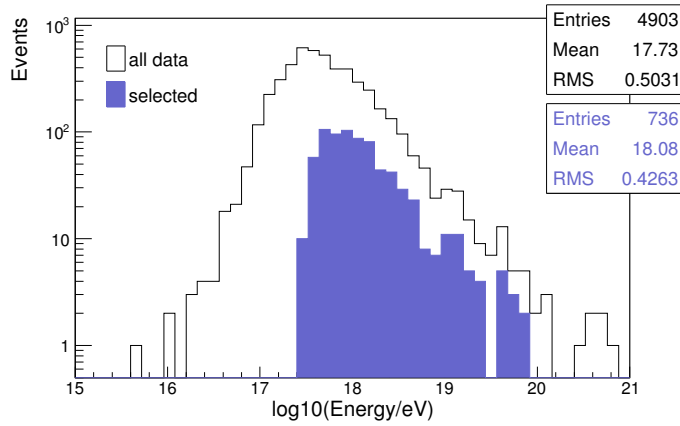
Figure 2. Total Events rate by GPS second

Figure 3. Energy distribution of all data and for the selected events.
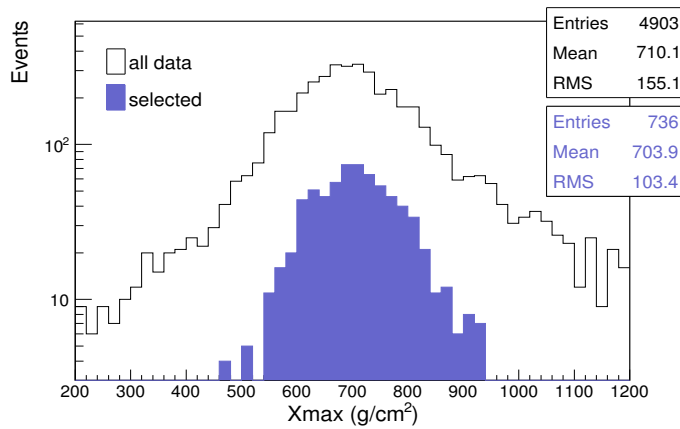

Figure 4. Xmax distribution of all data and for the selected events

5. Conclusions

A simple analysis procedure has been implemented at Malargüe to facilitate the monitoring of data quality during FD shifts and get shifters closer to physics results. The procedure is described in details (basically each command line is explicitly given) and plots with physics observables such as event rate, energy/xmax/zenith distributions are shown. We encourage all shifters to fully exploit this procedure and we wish it can help becoming more familiar with reconstruction and analysis chains.

REFERENCES

1. http://www.auger.org.ar/FD/fd_shift_manual_en_2015.pdf
2. J. Rautenberg for the Pierre Auger Collaboration, "The monitoring system of the Pierre Auger Observatory and its additional functionalities" 31st International Cosmic Ray Conference, Lodz , Poland, July 2009, The Pierre Auger Collaboration, NIM A 798 (2015) 172-213
3. Nucl. Instr. Meth. A580 (2007) 1485-1496.