

Data Quality Check and On-Site Analysis of the MAGIC Telescope

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Abstract We present the scheme developed for the quick analysis and data quality checks on the MAGIC Cherenkov Telescope at La Palma. Due to its low energy threshold MAGIC acquires data of atmospheric showers at a rate of more than 200 Hz, which translates in up to 700 GB per night. A fast On-Site data reduction is needed to detect hardware problems and in many cases to decide on observation strategies. The data are automatically calibrated and pre-processed at the MAGIC site using automated scripts on multiprocessor systems. Check plots are generated, and first results are available in the morning. This system complements a quick online analysis which runs in parallel with the data acquisition.

1 Introduction

MAGIC is an Imaging Air Cherenkov Telescope (IACT) located on La Palma, Canary Islands. It acquires images of the fast flashes of Cherenkov light created by atmospheric showers. They are initiated by high energy gammas and the much more

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numerous cosmic rays background. Each recorded image is called an event. MAGICs current energy threshold is around 50 GeV with the standard trigger setup [1].

2 Data reduction

The data volume gathered by MAGIC during its phase 1 (Old Siegen 300 MHz FADC) was 20 TB/year, while 45 TB/year are stored during phase 2 (Current MUX 2GHz FADC), and 130 TB/year is expected for phase 3 (future MAGIC I + MAGIC II). The obtained raw data consist of the digitized pulses recorded by the camera for each event. After the calibration [?], data contains physical information at pixel level: amount light recorded and arrival time. There is a reduction of a factor ten in data volume, partially due to compression. Images are reconstructed from the calibrated data and expressed in terms of their second moments respect to the main axis and the orthogonal one: the Hillas parameters [1]. These image files are 100 times smaller than raw files. Finally, the observation results are obtained from the statistical analysis of images including a strong background rejection.

3 On-Site Computing System

The MAGIC collaboration has deployed a powerful computer system at the telescope site. Apart from the Data Acquisition and control computers, it contains 3 multiprocessor systems. They are powered by 8, 4 and 4 processor Intel© Xeon™ processor each at 3 GHz. For storage purposes there are 2 Raids of 6 TB each. They are used for data transfer and a dual goal. The first goal is to run the data quality checks, that are a collection of programs that make plots of important variables to monitorize the telescope behavior and transfer them to web pages. Members of the MAGIC collaboration control these plots the next morning. The second goal is the so-called On-site Analysis. All data go through an On-Site reduction before being transferred outside the island. Observation results are available normally before the next night. It complements a quick look online analysis which runs concurrently with the data acquisition.

4 Data check tasks

The software is a collection of c-shell, awk scripts and ROOT macros which operate together the standard MAGIC software and are launched by cron daemon. The input are the reports from the auxiliary systems. The systems checked are: Calibration system, power supplies, drive system, weather station, camera, trigger, telescope

mispointing, rubidium clock, etc. Figures 1, 2, 3 are examples of the checks performed.

5 On-Site Analysis

The On-Site analysis software is launched as soon as the data is digitized. It uses similar tools as the previous Data check software. The data are divided in batches which run independently in different processors. Its robust design requires minimum human interaction. The processed files are transferred in the next morning and available for the analysis.

6 MAGIC database

The final repository of the data is the MAGIC database, at PIC (Port d'Informació Científica) at Barcelona, where the data is accessible for all members of MAGIC. If new calibration or data analysis procedures are developed, the reprocessing of data is done at PIC. The simulated event files are also stored there.

7 Outlook

Future improvements of the MAGIC experiment will need an upgrade of the software and hardware. The main upgrade will come when the MAGIC II telescope starts to work, as data volume will multiply by a factor of three and the telescope will operate in stereoscopic mode. An improvement on the automation on the data check scripts is almost ready, where human interaction will be still minimum.

8 Conclusions

A fast On-Site data reduction system has been set for the MAGIC telescope. The reduced data arrive after few hours to the datacenter, being accessible to the whole collaboration. Together with the quick look online analysis the system allows for fast reaction for source scheduling and follow up observations. Data check scripts have allowed a very fast and efficient method to detect hardware malfunctions of the detector, reducing the lost data taking time.

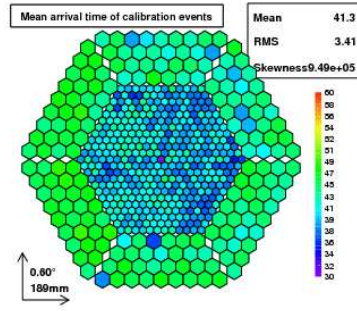


Fig. 1 Diagram of the camera photodetectors where the mean arrival time of the light pulse is shown. Units are sample number.

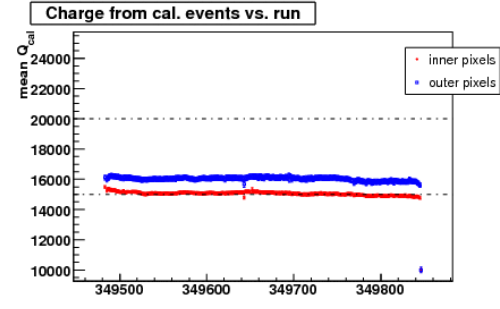


Fig. 2 Charge from calibration events plotted vs. the run number. Some evolution of this parameter can be seen along this night.

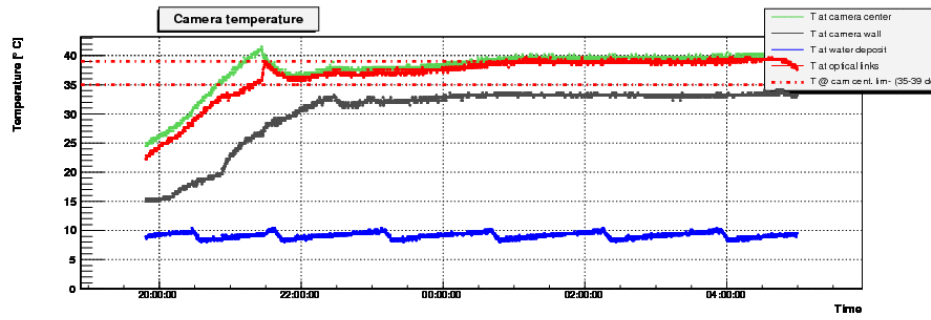


Fig. 3 Temperature in different parts of the camera plotted vs. time. The evolution during the first two hours correspond to the voltage ramping and occurs before data acquisition.

References

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