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Data processing and distribution in the PAMELA experiment

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Abstract

YODA is a semi-automated data handling and analysis system for the PAMELA space experiment. The core of the routines have been developed to process a stream of raw data downlinked from the Resurs DK1 satellite (housing PAMELA) to the ground station in Moscow. Raw data consist of scientific data and engineering information. Housekeeping information are analyzed in a short time from download ($\simeq$ hours) in order to monitor the status of the experiment and for the mission planning. A prototype for the data visualization runs on an APACHE TOMCAT web application server, providing an off-line analysis tool using a browser and part of code for the system maintenance. A quicklook system with GUI interface is used for operator monitoring and fast macrocommand issuing. On a longer timescale scientific data are analyzed, calibrations performed and the database adjourned. The data storage core is composed of CERN's ROOT files structure and MySQL as a relational database. YODA++ is currently being used in the integration and testing of ground PAMELA data.

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Keywords: Cosmic rays; Data analysis; Object oriented framework; Software architecture

1. Introduction

PAMELA aims to measure with great precision the matter and antimatter components of cosmic rays in space [1]. The detector is housed in a pressurized container on board the Resurs DK-1 satellite and can provide up to 20 Gbyte/day. These data are processed in short time ($\simeq$ hours) to assess the status of the detectors and optimize the observation capabilities of the PAMELA (for instance taking into account the occurrence of a Solar Particle Event). On a longer time scale (one day) data are transferred from Russia to Italy (CNAF) where they are calibrated, processed and stored.

2. Satellite data collection: from satellite to ground

Data from PAMELA to the mass memory of Resurs-DK1 are transmitted to ground by portions in several downlink sessions [2]. The receiving antenna system TNA-7D has a parabolic reflector of 7 m in diameter and azimuth-elevation fulcrum-rotating mechanism and with two frequency diverged radio channels. PAMELA data reception is performed at Digital Processing Data System (DPDS), which is the component of Moscow Ground station at NTSOMZ institute with high-rate disk recording and transmission system. The information from DPDS is sent to the operational data archive server. This server provides security connection with the ground segment of PAMELA where first analysis takes place (Fig. 1).

3. The Yoda reader

After data reception on ground packet quality and corruption is verified; data are then processed by the Yoda reader (YR). For our specific needs the objects composing the YR tool have been modelled over the ROOT libraries to generate a corresponding file structure. C++ was used as the main programming language but many subdetector analysis routines are in Fortran. Yoda unpacks all different structures creating the various trees (event, calibration, telemetry, macrocommand, orbital information, etc.). Also

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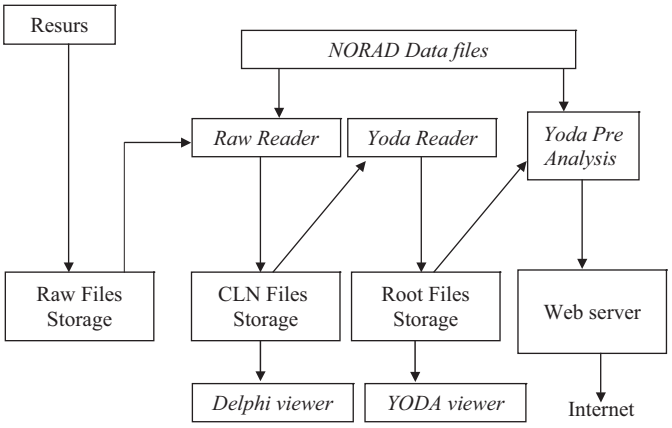

Fig. 1. The data flow from satellite downlink to data distribution. It is possible to see the various processing steps and their relative dependencies.

in this phase data quality of the various packets is verified. A quicklook task monitors the status of engineering and physics data in order to allow local and remote (web based) assessment of the status of the experiment. Short term programming and telecommand issuing is based on the results of this quicklook. Data are then transferred to CNAF (Italy), where they are processed, calibrated, analyzed and stored.

References

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