SIMULATION AND RECONSTRUCTION OF COSMIC RAY SHOWERS FOR THE PIERRE AUGER OBSERVATORY

ON THE EGEE GRID

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Pierre Auger Observatory

Pierre Auger Cosmic Ray Observatory (http://www.auger.org) is studying the Universe's highest energy particles ($E > 10^{18}$ eV) which impact into the Earth atmosphere and create air showers. The Auger Observatory is a "hybrid detector" using two independent detection methods. The first detecting method uses 1600 water tanks that cover enormous section of the Pampa Amarilla (yellow prairie) in western Argentina and serve as a particle detector measuring Cherenkov light. The second detecting method tracks the development of air showers by observing ultraviolet light emitted in the Earth's atmosphere.

Cosmic Rays Simulations

The Pierre Auger Observatory studies ultra-high energy cosmic rays. Interactions of these particles with the nuclei of air gases at energies many orders of magnitude above the current accelerator capabilities induce unprecedented extensive air showers in the atmosphere. Different interaction models are used to describe the first interactions in such showers and their predictions are confronted with measured shower characteristics.

We created libraries of cosmic ray showers with more than 47,000 simulated events using CORSIKA with EPOS or QGSjetII models. These showers are reused several times for simulation of detector response at different position within the detector array.

The CORSIKA simulations can run on every AUGER site, while the simulation of the detector response and shower reconstruction run on 4 sites, where the corresponding SW (OFFLINE) is installed.

Figure 2. CORSIKA showers selection form. At this page user obtains a list of logical file names in the catalogue.

User Access to the Simulated Data

Simulated libraries of cosmic ray showers are currently available at grid storages. We provide a custom database of simulated and reconstructed showers as a part of the Production Dashboard. Users from the collaboration can access the shower database via their web browser (Fig 1).

Users can query the database and obtain a list of all showers of desirable properties (Fig 2). We provide a set of tools which help download the simulated data from a Storage Element to the User Interface.

Computing resources

Virtual Organisation AUGER was created in 2006 by the Czech Auger group in cooperation with CESNET. The VO AUGER has almost 50 members. CESNET provides and maintains central resources such as LCG RB, gLite WMS, LB, UI, LFC, registration portal and the VOMS server. VO AUGER benefits from both dedicated and opportunistic computing resources available at the Grid provided by 16 different sites in 10 countries world-wide. AUGER sites offer ca 500 dedicated CPU cores and 100 TB of disk space at storage elements. At some of the sites we share available computing resources with local users. AUGER Grid resources are used mainly for the official CORSIKA and OFFLINE production.

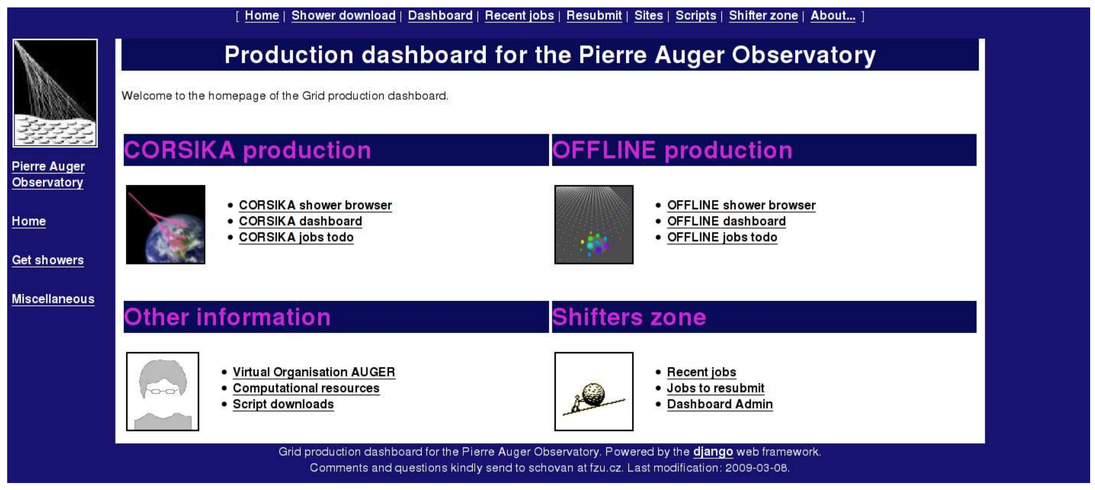

Figure 1. Homepage of the Production Dashboard, http://auger.farm.particle.cz/auger_dashboard/.

Production Monitoring

We have developed a production framework for an easy submission of a bunch of the jobs, simple retrieval of the Output Sandboxes and user friendly job resubmission. Based on the information extracted from the job logs we feed our monitoring tool, the Production Dashboard (Fig 1). The Production Dashboard content is updated regularly.

The Production Dashboard is a Python application based on the django web framework (http://www.djangoproject.com/). We use the MySQL database as a storage of the object information.

The Production Dashboard helps the people, who are running the production, to easily distinct successful jobs, which produced data to the showers library, from those, whose output cannot be used for a physics analysis of the simulations.

We have introduced a simple color scheme so the production shifter quickly sees which job has failed and can chase the cause of the problem (data management problem, software failure, site problem, etc.). An example of the production dashboard overview of a library is shown in Fig 3.

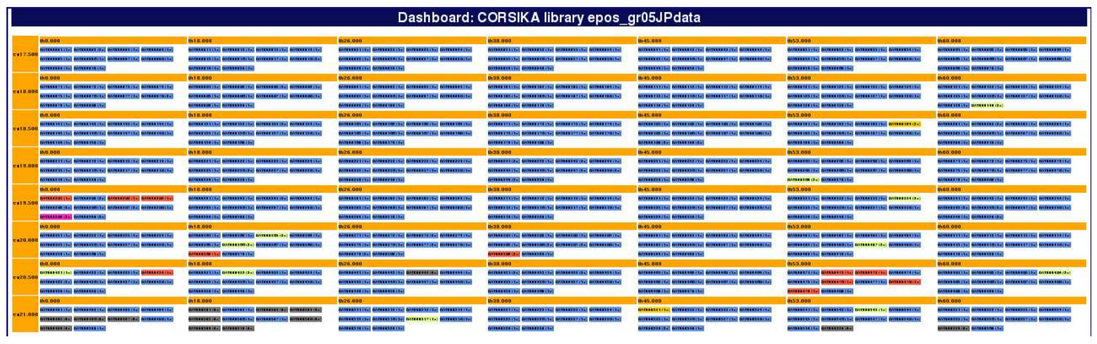

Figure 3. Dashboard view of a simulated library. Blue rectangle represents a successful job, worth of physics analysis, other colors distinct between various job failures.

The Production Dashboard features also list of recently finished jobs (Fig. 4), we provide a "failed jobs" and "all jobs" view.

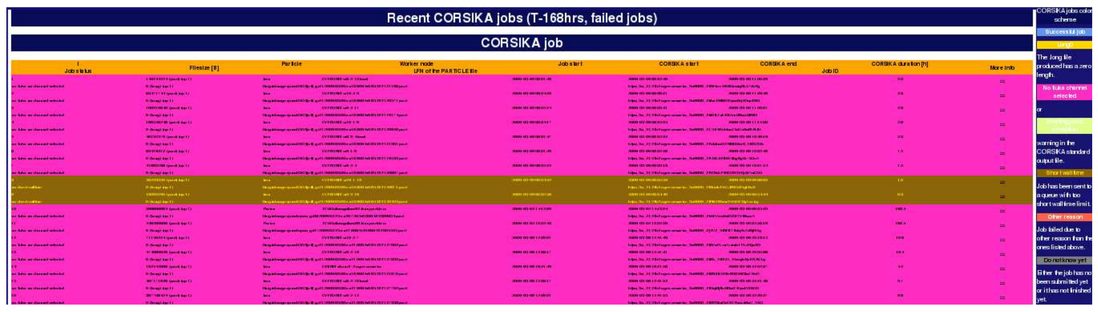

Figure 4. List of recently failed CORSIKA jobs. The failure reason is explained in the right dashboard pan.

The production dashboard provides a list of jobs to be resubmitted due to some of the previously mentioned reasons. Each list contains selection criteria in commentaries and list of job definitions which are then passed to the production framework.

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