Setup of the italian AUGER GRID configuration at CNAF

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The University of Salento and the Lecce unit of INFN (Istituto Nazionale Fisica Nucleare) participate in an international astroparticle physics experiment called AUGER[1]. AUGER has been conceived to measure the flux, arrival direction distribution and mass composition of cosmic rays from 10^{17} eV to the very highest energies with high statistical significance over the whole sky. The experimental site covers a total surface of about 3000 km^2 at an altitude of 1400 m near the town of Malargue, in the province of Mendoza, Argentina. It is the largest experimental facility studying Ultra-High Energy Cosmic Rays, and it is well known to the community not only for the remarkable dimensions, but also since a hybrid technology has been applied. The Hybrid technology provides for two independent ways to see cosmic rays, using two type of detector complementary to each other: an array of Surface Detectors (SD) measuring the atmospheric shower size at ground and a collection of air fluorescence telescopes (FD) measuring the fuorescence light emitted by the de-excitation of atmospheric nitrogen. The small FD duty cycle (around 10% limited to clear, moonless nights) is compensated by the high statistics of the SD data (100% duty cycle). The apparatus is in continuos and efficient data taking and several results have been published[2].

After the first phase of measurement, the experiment is now in phase where the evaluation with larger accuracy of statistical and systematic uncertainties is needed. In order to do so, the size of the simulated event samples is crucial. The process of simulation and reconstruction of large data sets in Auger is a computationally demanding issue therefore the Grid is used. A Grid allows a computational service with secured services for running applications at distributed computational resources, dynamically aggregating a computational capacity of individual computers.

The use of condition data (i.e.atmosphere status, *real* geometry and calibration) requires specific configuration of the systems delivering the services and it has never been used on the Grid sites. For doing so in fact, a clear decoupling of data access, and storage services from the requirement of end-user knowledge of the physical location and configuration of the system that delivers the service is needed. This is usually accomplished from Cloud Computing.

The WorkerNodesOnDemand (WNoDeS[3]) is a software that INFN is developing and that provides on-demand, integrated access to boths Grids and Clouds through virtualization technologies. The software allows batch jobs submission on virtual worker nodes, i.e. computing resources functionally identical to traditional servers, but running on virtual machines. Virtual worker nodes are dynamically created at the time of job execution. The use of WNoDeS has been adopted for the main Italian Auger Grid based at CNAF(Bologna), and our group is strongly involved in the effort. This is unique inside the collaboration and allows the use of Grid also for the Reconstruction and analysis of large data samples, dependent from condition data (atmosphere status, *real* geometry and calibration).

The simulation process can be divided in two main streams: the simulation of the shower development in the athmosphere, and the simulation of the shower interaction with the experimental apparatus. The two interaction steps shows different problematic and are totally separated (different software codes are used). For the simulation of the shower development in the atmosphere the code used is mainly Corsika[4], this code does not require external libraries (apart FLUKA[5]), while the detector simulation uses a code ([7]) developed by collaboration members partially based on Geant4[6], using several support libraries.

The simulation of showers in atmosphere requires the use of an adronic interaction model for the simulation of the interaction processes. These models are built starting from measurement performed on beam and are referred to energy much lower then the ones accessible by AUGER. For a systematical study a comparaison of event li-

braries built with different interaction models is needed. A study of CPU time and occupancy has been performed in order to set up the AUGER grid site at CNAF, in agreement with the Italian group expectations. Figures 1 and 2 show the results of these studies. The studies allow to set up the requirements for computing elements (CE) and storage elements (SE) required by the Italian groups.

In Figure 3, the CPU time and the wall clock time for the AUGER virtual organization(VO) at CNAF is shown, for the year 2011. The AUGER VO at CNAF is presently fully available boths for shower simulation and for time dependent analysis, i.e. with DB access. For time dependent analysis, it uses a configuration unique inside the AUGER VO.

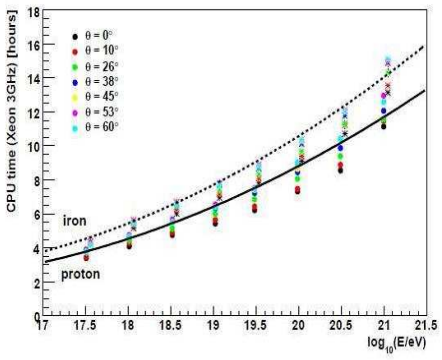

Figure 1. CPU estimated time to simulate the shower development in athmosphere for a CORSIKA shower, the interaction model used are QGSJETII and FLUKA for the electromagnetic part.

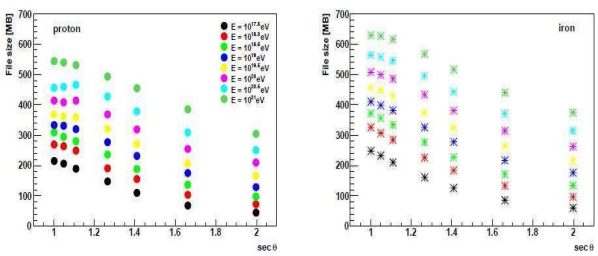

Figure 2. Disk space occupancy for showers simulated in athmosphere for proton and iron showers at various energies

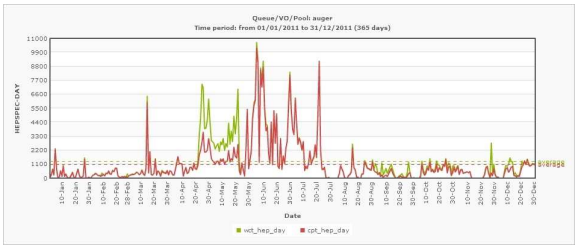

Figure 3. Usage of the CPU time and wall time for the AUGER Virtual Organization at CNAF during the year 2011.

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