Auger Front-End ASIC Simulations

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Abstract

We discuss some simulations of the performance for the Auger front end ASIC, and show results for photon, proton and iron showers using the AIRES package.

1 Introduction:

The Auger Observatory is intended to observe the highest energy cosmic rays. It is designed to trigger with 100% efficiency on air showers induced by primary particles with energies exceeding 10^{19} eV. The surface array of the Observatory has 1600 stations arranged on a hexagonal grid. Stations locally store data and communicate with neighboring stations in order to determine whether a large air shower has struck the array. The data stored at each station undergo some filtering before an overall global trigger is decided upon.

Single muons, small showers and PMT noise will produce a rate of approximately 5 kHz on a 10m^2 surface detector. This is known as the Level 0 trigger, based on pulses above a threshold. A next-level trigger (Level 1) provides discrimination against uncorrelated single muons and small showers, reducing the rate to 100 Hz or less at each station.

The logic of the Level 1 trigger is implemented using an application-specific integrated circuit (ASIC). There are two main functions of the Level 1 trigger ASIC. The first is to produce a trigger unbiased by primary composition, and the second is to differentiate large distant showers from smaller 'local' showers without discarding potentially interesting near horizontal showers. The former is achieved by clipping the peak of the muon signal. Suppressing the peak of the signal pulse generated by a through-going muon before integrating the remainder of the signal produces a trigger less dependant on the primary particle composition. The second function is achieved by requiring the signal be distributed in time. This biases against small showers that fall near a station, which deposit their signal over a relatively short time spread. Additional Level 1 trigger channels pick up the near horizontal showers.

We will present simulations of the ASIC trigger using the AIRES program for photon, proton, and iron showers.

References

The Auger Collaboration. 1998, Piere Auger Project Design Report