The universal particle detector at mountain level

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Abstract: The detector is aimed to perform long-term measurements of neutral and charged particle fluxes at mountain level. Very fast EM/Hadron calorimeter combined with fast EAS detectors allows precise particle arrival time registration with about 5 ns accuracy. Offline analysis gives a possibility to investigate time shift between high energy neutral/charged particle and EAS particles. Together with various types of neutron counters, the system allows to observe a possible correlation between cosmic rays and many different processes inside the earth and beyond.

Scientific tasks

- To measure a time shift between a hadron and accompanying EAS particles arrival.
- To determine a hadron accompanied by EAS arrival direction.
- To investigate how hadron/EAS flux and direction depends on or correlated with time, date, Earth, Sun and Moon position and other external and internal processes/events like Sun bursts etc.
- To register high and low energy neutron fluxes, their arrival time and flux correlation with various processes and events including external ones like cosmic ray particles and EAS flux, time, date and Earth position, Sun activity and internal events and processes like earthquakes etc.
- To register horizontal and backside muon fluxes and arrival time and correlations with various external and internal processes.

The device structure

The schematic view of the device structure is shown in Figure 1. The central part of the setup is relatively small but very fast EM/Hadron sampling calorimeter. The active elements of the calorimeter are $1m^2$ size 1cm thick scintillators (Sc1-Sc10) and 4-5 layers of silicon pad (large pixel) detectors (Si1-Si5) for precise particle position determination. Silicon layers are also used to separate EM/Hadron showers and to determine a single particle charge by dE/dx measurement.

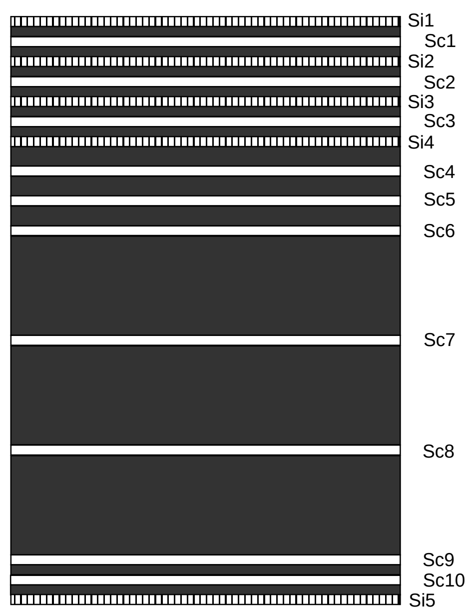

Figure 1: The device structure.

$1m^2$ scintillators are positioned between lead and iron absorber layers. Absorber layers are about $1X_0$ thick on the top of the device. They are used as EM part of the calorimeter. Hadron part of the calorimeter consists of the same scintillators and much thicker layers of the absorber.
The bottom part of the calorimeter also consists of a few thin layers of absorber, scintillating counters and one layer of silicon. It has to be able to pick up and identify charged and neutral particles going in back direction if they exist.
About 10 $1m^2$ scintillating counters (ScC) are positioned around the calorimeter to register accompanying the hadron particles as well as EAS without a hadron (Figure 2).
Neutron detectors are also situated nearby to register a correlations between hadrons, EAS and neutron flux. It is assumed that every part of the setup will generate its own trigger to abserve all possible correlations.
Important task of neutron counter system is to register the neutrons which came from all the sides including coming from the ground neutrons.
The setup is situated at Aragats cosmic ray station (Armenia) at 3200 m above sea level. First results are expected by the end of 2007.

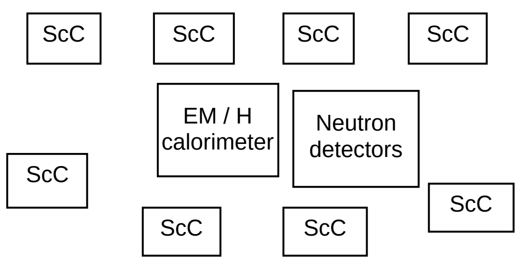

Figure 2: The layout of the setup.

Conclusion

This rather small setup is designed as a more or less universal system to learn more about neutron fluxes and to perform presise measurements of correlation between different particles as well as between particle fluxes and various types of Sun, Earth and human activities.
An additional interesting task is to register the muons horizontally going through Aragats mountain. This way muon energy spectra can be measured from 10 to 100 TeV.

References

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ICRC 2007 Proceedings - Pre-Conference Edition