Name of research institute or organization:

Department of Physics, University of Rome La Sapienza

Title of project:

Test for a new concept of EAS detectors for UHE neutrinos

Project leader and team:

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Project description:

The detector installed at the Sphinx is a prototype of an element of large array (TAUWER) designed to measure large extensive showers with energy greater than 10^{17} eV produced by the tau-neutrinos that interact with the Earth crust. The tau particle from interaction decays in a shower produced mainly at large zenith angles (about 90 degrees). Each detector station, shown in Fig. 1, consists of two pairs of scintillator counters (20 x 20 cm^2, 1.4 cm thick) named 'towers' separated by 60 cm. The distance of one pair is 160 cm corresponding to 5.3 ns of time of flight (TOF) of a horizontal track crossing the two scintillating tiles. The scintillating light produced by the cosmic rays passing through the counter, is detected by a Photomultiplier (PMT). To be able to select the track direction with more efficiency we need to select only events where longitudinal or diagonal tracks are selected by OR-AND logic. In our experiment we only need to collect the longitudinal or diagonal tracks because we have to reconstruct tau horizontal showers. In order to enhance the coincident triggering rate of these longitudinal or diagonal tracks, we developed an electronics board, trigger board (TB). This board provides:

- low-level, ultra-fast differential low threshold discriminator channels to select signals above noise
- coincident trigger under the desired conditions
- low-power consumption.

In 2012, we have done extensive tests with a 4-channel preamplifier-shaper-discriminator board (TB). These test results of the trigger board were presented in Turkish Physical Society 29th International Physics Congress [4].

In November 2012, we changed the read-out system of the station by installing a new generation of solid state photodetector, SiPM, that provides high time resolution (300 ps) and has high detection efficiency (few photoelectrons detection). These performances give us the possibility to reduce the thickness of the scintillating tile and to improve the measurement of TOF. The current produced into the depletion junction of SiPM depends on the temperature, hence we have to monitor by a sensor the temperature inside the counter and change the bias Voltage. In November we installed the SiPMs with an amplifier in one tower and started the data taking with and without trigger board. A device to adjust the bias voltage according to the variation of temperature is ready to be installed.

Key words:

Cosmic rays, neutrino, silicon photomultiplier, time of flight

Internet data bases:

http://pciori13.roma1.infn.it/

Figure 1: Detector located at the Sphinx. The four black boxes contain the tiles, SiPM and amplifier. They are 60 cm apart and 160 cm along the path of flight of horizontal tracks.

Scientific publications and public outreach 2012:

Refereed journal articles and their internet access

[1] Yilmaz, A., H. Denizli and M. Iori, Preliminary Test Results of a Prototype at Sphinx Observatory Center, BPL, 19, 191050, 438-444, 2011.

Conference papers

[2] Yilmaz A., H. Denizli and M. Iori, Preliminary Test Results of a Prototype Detector at Sphinx Observatory Center, Turkish Physical Society, 27th International Physics Congress, Istanbul, Turkey, September 14-17, 2010.

[3] Yilmaz A. et al, Turkish Physical Society, 28th International Physics Congress, Bodrum, Turkey, September 6-9, 2011.

[4] Yilmaz A., A. Aydemir, H. Denizli and M. Iori, Test Results of Low-Level Discriminator Board for TAUWER Experiment, Turkish Physical Society, 29th International Physics Congress, Bodrum, Turkey, September 5-8, 2012.

[5] Iori M. et al., Test of a new concept of EAS detector for UHE neutrinos, European Cosmic Ray Conference, Moscow, Russia, July, 2012. To be published in JPCS.

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