Name of research institute or organization:

Department of Physics University of Rome La Sapienza

Title of project:

Measurement cosmic ray flux at large zenith angle

Project leader and team:

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Project description:

Since the 2005 we are collecting cosmic rays at large zenith angle with a prototype of detector that uses 2 pairs of scintillators (named towers) separated by 160 cm. Each tile is read by a PMT Hamamatsu R5783. This detector provides a very good separation of downward-upward tracks by Time Of Flight (TOF). Due to the TOF, the detector has a large efficiency to measure large zenith cosmic ray flux. Because of very good time resolution and adjustable orientation it can be used as a part of an Array to measure Extensive Air Showers (EAS) produced at large zenith angle or neutrino flux generated by Ultra High Energy neutrinos ($> 10^{17}$ eV) skimmed by the Earth and producing at large zenith angle tau shower in air (about 90^0). A first prototype has been installed in the research station Jungfraujoch where the neutron calorimeter is located. The performances of the detector were extensively studied using the NIM-Camac electronics composed by a discriminator, logic units and ADC, TDC. In 2009 we have started the construction of a second prototype close to the final version of the station that will be used in the neutrino detection array. On September we have assembled the mechanics on the Sphinx terrace and in fall of the year we have installed the Data acquisition stream (DAQ). It is composed by a trigger board (TRG) designed and built in Rome. It summarizes the NIM electronics of the previous test. The TRG board amplifies the 4 PMT signals and by a low threshold comparator rail-to-rail selects the good signals. The internal isteresis ensures clean output transitions even with slow moving input signals. The TTL trigger is obtained by AND-OR logic circuits. The power supply is only +5V and the consumption less than 100 mA. These performances are important when the station will work stand alone with solar panel not yet installed. The trigger signal permit the digitization by the DRS4 board designed by S. Ritt (PSI, Zurich) and the 4 PMT signal compressed and sent to main PC to be analyzed. The station will start to operate continuously after several tests on middle of January 2010. A third module has been installed at KIT to test the electron/muon separation by optimization of a layer of lead. This test was performed in collaboration with Kascade-Grande Array [1]. The results show that a lead layer 1.5 cm thick is able to separate low momentum electron/gamma (100-200 MeV) from muons. This result has been applied on the station located at Sphinx.

Key words:

Cosmic rays, neutrino physics, scintillator

Collaborating partners/networks:

Carnegie-Mellon University Pittsburg, Abant Izzet Baysal University Turkey, Bolu and Kars

Scientific publications and public outreach 2009:

Conference papers

Iori, M., J. Russ, H. Denizli, F. Ferrarotto, M. Kaya, A. Yilmaz; Test results of a new concept of an EAS detector for UHE neutrinos, ICRC Proceedings, Łódź, Paper 0886, 2009.

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