Name of research institute or organization:

Department of Electric & Electronics Engineering,
Giresun University, Turkey
Department of Physics, University of Rome La Sapienza, Italy
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Title of project:

φ Dependence study of TAUWER Prototype detector and correlation study of cosmic ray rate with solar activity

Project leader and team:

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Project description:

The project aims for the establishment of an improved silicon photomultiplier (SiPM) readout board system to determine the φ dependence of the cosmic ray rate and to correlate the rate with solar weather parameters. The detector prototype shown in Figure 1, will be a part of a large array which will observe the horizontal and upward going exceptional Ultra High Cosmic rays (UHECRs) and fewer neutrino triggered air-showers may be caused by the interactions in air or by higher energy tau air-showers originated by ντ skimming the Earth [1]. In order to investigate about the vertical noise, we dump the horizontal component of cosmic rays pointing to the Jungfraujoch and compare these results to the detector pointing to the Concordia place.

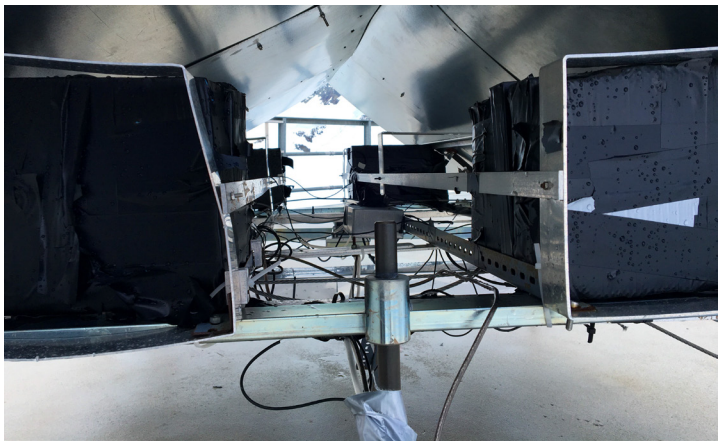

Figure 1. Prototype detector installed at Sphinx (HFSJG) to test upward/downward particles' separation and environmental effects.

Each detector station, shown in Figure 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 detector prototype is using a SiPM produced by SensL and a DRS4 chip as read-out part. In this work we present preliminary results of the prototype detector station.

The first objective is to determine the φ dependence of the cosmic ray rate to evaluate the capability to reject the vertical background. That leads to identify a good place for observing an air-shower as its maximum developed altitude and directions is studied at high altitude since the air density is so low the noise contribution is also low. For that we change the Φ angle. To detect this influence, the distance between the cosmic ray interaction point and the detection level, the detector prototype was installed on the terrace of the Sphinx Observatory at Jungfraujoch at 3570 m above the sea level, pointing to the valley 3.3° below the horizon and the distance between cosmic ray is around 1.75 km and to Monch is 0.76 km. This setup permits us to measure vertical cosmic background to verify the capability of the detector to reject them. The setup is depicted in Figure 2 and the data taken in this setup are labelled as phase 1.

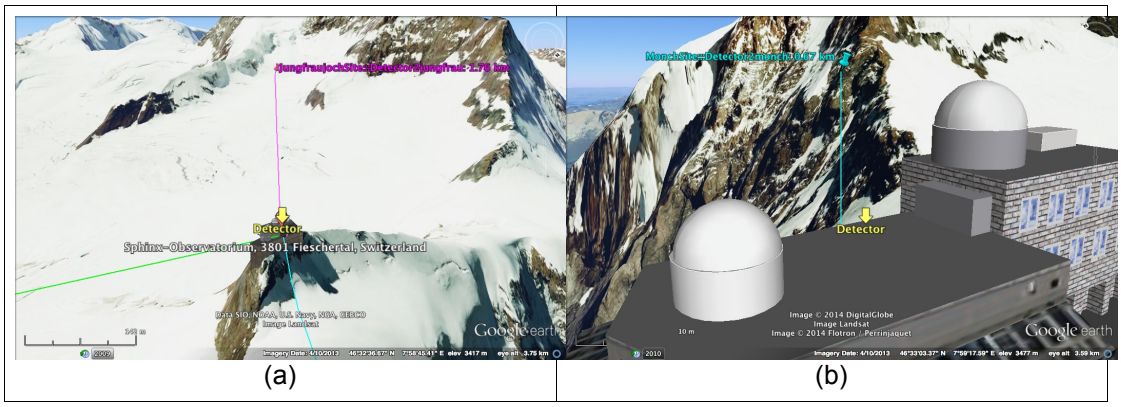

Figure 2. Detector station is located at the Sphinx Observatory. (a) The magenta arrow, pointing to the Jungfrau mountain, is about 1.76 km from the detector. (b) The turquoise color arrow is pointing to the Monch mountain is about 0.76 km from the detector.

Figure 3 shows the registered temperatures inside Tile 1, Tile 2 and the adjusted operating voltages accordingly over all run time for phase 1. The average temperatures on Tile 1 and Tile 2 are about 5.713 ± 3.323 °C, 10.16 ± 5.598 °C, accordingly. The average adjusted operating voltages of SiPMs on Tile 1 and Tile 2 are about 29.65 ± 0.1287 V, 29.8 ± 0.1885 V, accordingly.

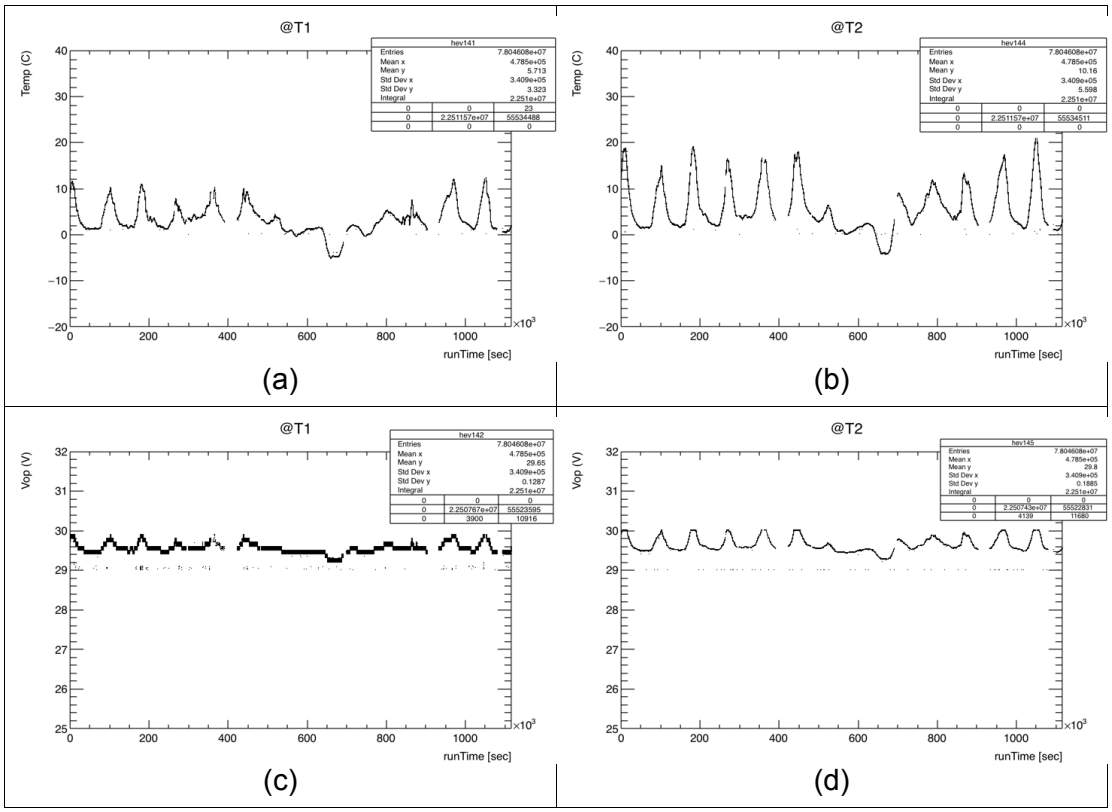

Figure 3. (a) Temperature over all run hours on Tile 1, (b) temperature over all run hours on Tile 2, (c) adjusted operating voltage of SiPM 1 over all run hours on Tile 1, and (d) adjusted operating voltage of SiPM 2 over all run hours on Tile 2.

Figure 4 shows the uncorrected rate over all run time. The average of the uncorrected rate is about 24.137 ± 0.923 Hz for phase 1. This rate will be used to study the correlation of solar activity.

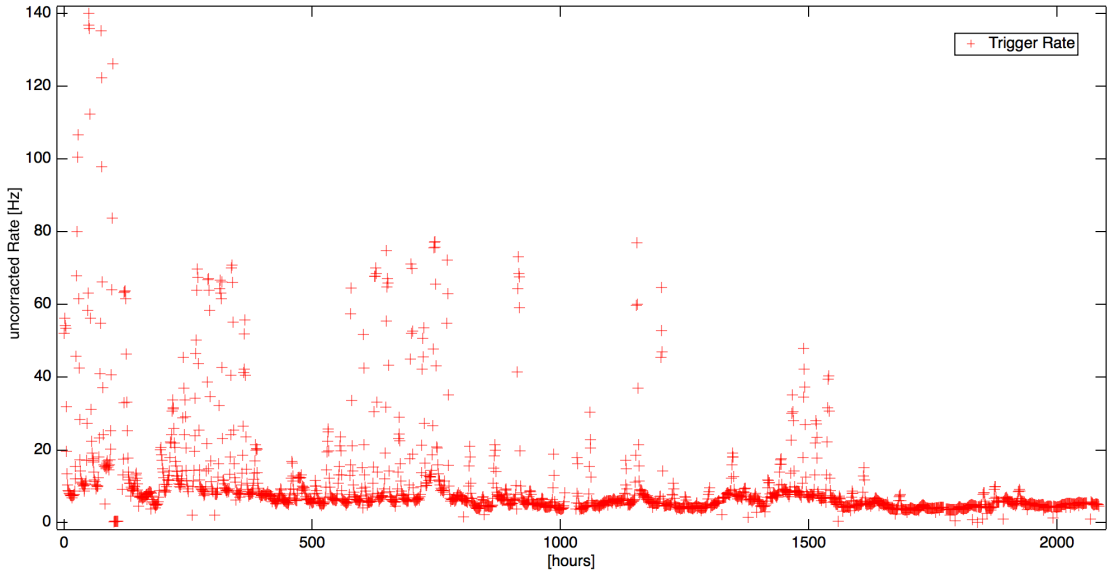

Figure 4. The average triggering rate over all run time for phase 1.

In December 2016 we have rotated the station through 90º according to the phase 1 setup and started phase 2 pointing to the valley to measure horizontal cosmic ray flux. The comparison between these two measurements gives us the evaluation of vertical background.

References:

[1] 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 (Oral), Istanbul, Turkey, September 14-17, 2010.

Key words:

Cosmic rays, neutrino, silicon photomultiplier, solar activity

Internet data bases:

http://pciori3.roma1.infn.it/

Scientific publications and public outreach 2016:

Conference papers

Yilmaz, A., H. Denizli and M. Iori, Characterization Study of Silicon Photomultiplier, FCC Physics, Detector and Accelerator Workshop, Istanbul, Turkey, March 11-12, 2016.

Yilmaz, A., H. Denizli and M. Iori, SiPM Applications on Astroparticle Physics, Accelerator and Detector Physics Workshop, Istanbul, Turkey, May 31-June 3, 2016.

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