Quarknet 2017: Cosmic Ray Detector

**Participants:**

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**Purpose:**

Originally, our purpose was to collect data from cosmic ray events to upload to the Quarknet website for other institutions to use for research; however, most of our time was spent troubleshooting to make sure our equipment was fully functioning.

**Equipment:**

* Counters – Scintillators, photomultiplier tubes and PVC housing.
* BNC signal extension cables.
* QuarkNet DAQ data acquisition board.
* CAT-5 network cable.
* GPS module.
* GPS antenna.
* Temperature sensor.
* 5 VDC power supply.
* PDU power cable.
* Power distribution unit, PDU.
* Power extension cables for PMTs.
* USB cable.
* Personal Computer.

**Procedure:**

First, we had to set up the panels with the corresponding cables to the power supply and the data acquisition board (DAQ). Once we had everything set up, we ran into a problem with the power supply, where we had a loose connection. We solved this by soldering the wire back in place. Then, we had issues with the plateauing process. The plateauing process is a systematic approach to determine the ideal voltage for each of the cable and panel pairs. (See graphs below). Following along with a PowerPoint from the e-labs website, we used channel 0 as a reference and recorded different voltages for channel 1. This graph turned out very well, as we could observe where the coincidence counts started to level off, which is where you should set the voltage. Next, we tried testing channel 2 with channel 0 as a reference. This one did not turn out as well because there were not any counts from channel 2, so the coincidence count was also zero. After that, we decided to test channel 3 with channel 0 as a reference. This graph looks better; however, the reference points followed a linear trend, when they were supposed to be close to horizontal. The coincidence count follows a very slight increasing linear pattern. Lastly, we tested channel 0 with channel 1 as a reference, and it turned out poorly as well. Our coincidence count was in the 300-400 range with a wide variety of voltages. Whereas channel 0 was giving us extremely high counts, in the sixty-thousands. With all this inconsistency, we decided to do some troubleshooting to find out what the problem was. We tested multiple variables including different panels, different cable and panel pairs, and different orders of panels. All of these tests yielded inconsistent results. Finally, when rearranging the cables into their original configurations, the BNC end on cable A flew off, resulting in our realizing that the connections were poor, which was skewing our data. We had help from two of the engineers at the University of Iowa to fix our connections. As of the end of the summer, we believe that all panels, cables, and connections work, and we are taking this setup back to Bettendorf to collect data for Quarknet throughout the school year.









To fill the time while troubleshooting the CRD, we were given the task to test a different set of scintillating panels. Our first goal was to see if the cover over the scintillating material remained light tight since they were in storage for many years. The six panels were much larger than the Quarknet panels, and were not attached to any PMT’s yet. To test the panels, we built a black box from plywood for the panels to rest in. Before closing the box, we covered the panels in a black fabric. The PMT’s were placed in a housing and placed onto the optical neck of the scintillating panels. After setting up the panels to an oscilloscope and a high voltage source we observed detections by seeing a voltage drop and slight “ringing”. We turned on the lights in order to determine if any ambient light was leaking into the scintillators, but the oscilloscope remained constant. Once we noticed that we were getting detections, and that the box is light tight, we removed the plywood box, and pulled back the fabric to expose the panels. When we checked the oscilloscope with a black room as well as when the lights in the room were on, we noticed no change in the readings. Therefore we are confident that the panels are still in good working order.

The next steps that should be completed before using these panels include, getting PMT’s that have the proper diameter to match the optical neck of the panels, as well as create a way to keep the PMT attached to the panel while keeping it light tight. Once those two tasks are completed, the panels should be in good working order for whatever measurements would like to be taken.