Cosmic Ray Studies

Muon Flux and Muon Lifetime

Johns Hopkins University, 25 July 2014

Abstract

Using the cosmic ray muon detectors, we attempted to learn more about the nature of these high-energy showers and their sources. Our goal was to collect muon flux data throughout the day to see how the time of day and the position of the Earth relative to the sun affect muon flux. By doing this, we hoped to uncover more information about sources of cosmic rays. Unfortunately, we found little to no correlation between the time of day and muon flux. However, this is still an important and enlightening result. From this we can conclude that the sun is not a significant source of cosmic ray activity on Earth.

Setup/Procedures

- The four paddles were stacked vertically
- We used a three-fold coincidence to improve accuracy
- We started each study at 9:00 am and ran it for twenty-four hours
- We used the program HyperTerminal to collect data

Results/Conclusion

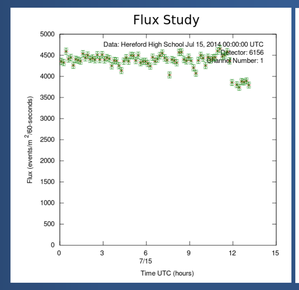

Figure 1

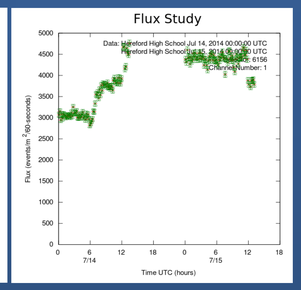

Figure 2

- Figure 1 shows a good flux study from 8:00 pm July 14 to 10:00 am July 15
- This graph was similar to many of the graphs we plotted, with little or no long-term variability in muon flux
- Figure 2 is a graph which demonstrates the problems we had with our paddles
- The sun is not a significant contributor to muon flux

Issues

- Channel 3 (paddle 2) frequently stopped working, leaving holes in our data (as seen in figure 2)
- The detectors needed to be plateaued several times because the voltages drifted
- The discovery of the equipment flaws will aid future studies

Group Members

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Abstract

Once we got the cosmic ray detectors set up, we had decided to perform a lifetime study, specifically gather data and use a website to analyze it so that we could try to determine the average lifetime of the muon. With help of the Cosmic Ray e-Lab website and the HyperTerminal program, we were able to collect, upload and analyze data and, as a result, determine the mean lifetime of the muon.

Results

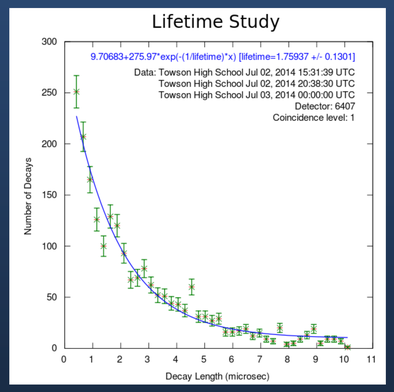

Figure 3

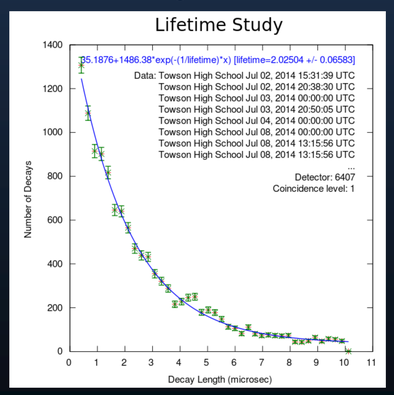

Figure 4

Discussion

We were able to figure out from the internet that the true average lifetime of the muon was about 2.2 microseconds. But in our trials, early on (Figure 3), we were able to approximate the lifetime to about 2.6 microseconds. But with more data, we were able to get a more accurate 2.4 microsecond average lifetime. So, of course, there was some error. We had a lot of trouble setting up the experiment and plateauing the photomultiplier tubes to appropriate voltages.

Setup/Procedures

- The four paddles were stacked vertically.
- Set coincidence level at one-fold
- Started each study at 9:00 a.m. and ran for twenty-four hour periods.
- Used HyperTerminal program to collect data.

Issues

Channel 3 was leaking light so we had to re-tape the paddle before we were able to calibrate the system as a whole.

Group Members

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