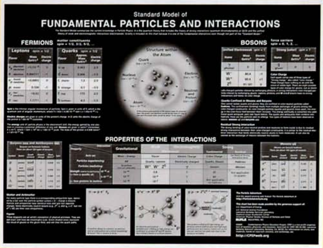
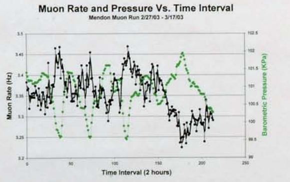
Pittsford Mendon High School

Physics Honors 9th Period Class

Muon Research:

Relationship Between Atmospheric Pressure & Muon Rate





Setup:

A singular muon detector with two identical 18.0cm x 19.5cm scintillators that were separated by 4.5cm was utilized. The data were collected in two-hour intervals creating 7200 bins each measuring muon rate in hertz. Simultaneously, a drum-style recording barometer monitored pressure in kilopascals.

Data:

The data collection began at 11:00AM on Thursday, February 27, 2003. The muon detector and barometer measured data successfully until Monday, March 17, 2003. The result was 214 bins of data to be analyzed.

Analysis:

All of the information collected was entered into Microsoft Excel where regression analysis and moving averages were employed to draw the final conclusions. Muon rate (in hertz) demonstrated an inversely proportional relationship to pressure (in kilopascals). For every increase of one kilopascal, a 1.7% decrease in the muon rate manifested. This relationship is quite comparable to the 2% decrease computed by researchers at the University of Adelaide.

The inverse relationship exhibited between muon rate and pressure is possibly due to the differences in density. Lower pressure facilitates greater quantities of water vapor to be present in the air. This water vapor is less dense than standard air and consequently provides less resistance to the muons created by cosmic rays entering the atmosphere. Thus, during intervals of low pressure, the muon rate is greater than times of high pressure. The opposite also holds true for if there is higher pressure and less water vapor present, the more dense air slightly hinders the travel of muons towards the surface of the Earth producing a lower muon rate.

Overall, this is not simply an exploration of pure science but rather of applied science. Muons are believed to ionize the atmosphere possibly creating weather patterns. In addition, by developing this consortium of information, muon rates and pressure can be applied toward various other pools of data.