

Muon Rate vs. Barometric Pressure

Pittsford Mendon High School

Period 8

ABSTRACT

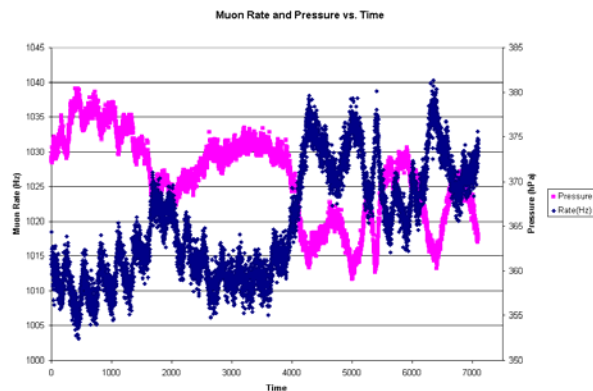
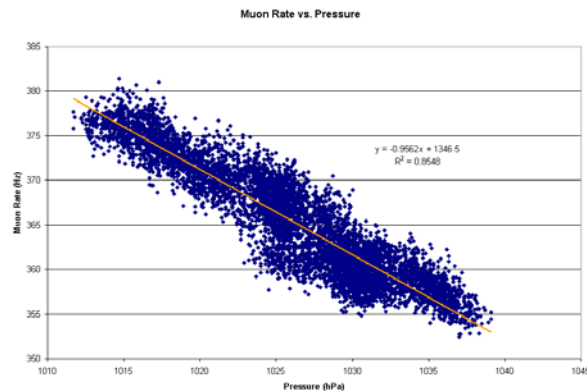
In this experiment we analyzed U of R muon data from October 2005.



INTRODUCTION

Introduction: A muon is a semistable fundamental particle with negative electric charge and a spin of $\frac{1}{2}$. Muons are formed when a charged pion decays. The pions are created in the upper atmosphere by cosmic radiation and have a very short decay time — a few nanoseconds. After the cosmic rays, (protons, electrons, neutrinos, and gamma rays, but mostly protons), hit the earth's atmosphere and form pions the pions quickly decay into muons and neutrinos. As the atmosphere becomes more dense, the muons hit more and more gas molecules, causing them to lose energy and slowing them down. The Cosmic Ray Detector used consists of three pairs of scintillator panels for muon detection. The panels are shielded from light with aluminum foil, black plastic sheets, and black tape. When muons penetrate through these panels, chemicals within will scintillate (emit flashes of light). When a signal is received from both panels, indicating a muon has passed through the detector, a muon is recorded. The objective of this experiment is to find the relationship between Muon rate and pressure.

METHODS



ANALYSIS

The result of this lab was that we found that Muon rate and pressure form a direct 'anti'-proportion. The reason for this is that more gas particles in a smaller space slow down the muons more because there is more chance that a muon will hit a gas molecule and ionize it, thereby causing the muon to lose energy. The reason muons are able to reach the earth at all is because although they have a decay time of microseconds, they travel near to the speed of light, which causes time to slow down for them. There is also the fact that muons are created when they hit the atmosphere, not beforehand, which results in them not having to travel very far. Possible sources of error for this lab could have been that Jeff Melville made a mistake in his program or that the muon detector made a small mistake in recording the number of muons. There is also the possibility of other unknown variables affecting the muon rate, such as the atmosphere being denser in certain places.

