CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
S1508

Project Title
Counting Muon Cosmic Rays from Space

Abstract

Objectives/Goals
Energetic protons from deep space continuously barrage our planet and strike atoms in the upper layers of the atmosphere. Tiny collisions form muons, which are particles with enough penetrating power to reach the earth's surface untouched. The first goal is to build a detector which counts muons. The second goal is to count the number of muons per second and how this changes as the angle of incidence changes.

Methods/Materials
The device consists of two large, flat chambers that are placed on top of each other. A 10% vacuum is reached in each of the chambers. Inside are sets of fine wires and plates of aluminum foil which are connected to a high voltage power supply. This potential creates an enormous electric field near each wire. When a cosmic ray enters this space, it ionizes the atoms it passes by, leaving a stream of electrons, which are picked up by the highly charged wires. The current then goes through the wires to a connected circuit of electronics which registers the current as a count if both chambers record the current; thus, a muon particle is counted.

Results
When the vertical distance between the two chambers increased by two and eight times, the number of counts decreased by 12 and 24 percent, respectively. When the angle in which cosmic rays were counted was 20 and 45 degrees, the number of counts decreased by 46 and 53 percent, respectively. When only one of the chambers was tested for counts, the number of counts was practically identical to that of a comercial Geiger counter; therefore, the individual counters worked well.

Conclusions/Discussion
About one muon per second in a 10 cm^2 area were recorded when the chambers were placed directly on top of each other. My results agreed with my hypothesis in that the number of counts decreased when the angle at which cosmic rays were counted from moved away from the zenith and towards the horizon, and the number of counts decreased when the opening angle decreased. The individual count rate was much higher than that of coincidences because of the natural radioactivity inside of the chambers; a single counter will not eliminate any false counts. This type of radioactivity is too weak to penetrate both chambers and be counted as a coincidence, which is why two counters were used for this experiment.

Summary Statement
To build a muon detector and count the flux of cosmic rays at various angles of incidence.

Help Received
Used Physics demo room at UCSD under supervision of Jeff Paterson. Received guidance from Profs. James Branson, David Macfarlane and my father Benjamin Grinstein. Earl Dollnick helped debugging electronics.