CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J0805

Project Title
Cosmic Bullets: Does Local Weather Affect the Intensity of Cosmic Radiation at Sea Level?

Abstract

Objectives/Goals
This experiment examined whether the local variables of temperature, humidity and barometric pressure influence the frequency of muon strikes at sea level.

Methods/Materials
A lead-lined vault with 15.24 cm lead on all sides, ample to stop all terrestrial radiation, was used as a control to determine the frequency of muon strikes at sea level. Using a DSLR camera with a CMOS sensor sensitive to radioactivity, three 10 minute exposures were taken inside the vault with the lens removed and the camera sealed from light. Atmospheric temperature, humidity, and barometric pressure at the time of each exposure were recorded. Each image was enlarged 500% and examined for muon strikes (which appeared under magnification as white or colored dots or trails). This was then repeated for 30 exposures of 10 minutes each, taken in a radiation-shielded container of .635 cm thick lead at the average coldest and hottest times of the day. The data were graphed on scatterplot charts and subjected to regression analysis to determine correlations.

Results
There was a strong correlation between between temperature and muon strikes, which were inversely related. There was a strong direct correlation between humidity and muon strikes. There was no observable correlation between barometric pressure and muon strikes.

Conclusions/Discussion
While it is known that the atmosphere reduces cosmic radiation, there has been little analysis of how local variables of temperature, humidity and barometric pressure affect muon strikes at sea level. This experiment showed an inverse relationship between temperature and muon strikes, suggesting that as higher temperatures expand the atmosphere, it becomes less likely that cosmic radiation will collide with atmospheric gases and be deflected back into space. In addition, as humidity makes the atmosphere more dense, the frequency of collisions is increased and more cosmic radiation is scattered back into space. Further experimentation is needed to explain the lack of correlation with pressure. The correlation with temperature and humidity is promising for the study of local weather, since cosmic rays are already known to influence climate on a global scale.

Summary Statement
Using digital images from a radiation-sensitive CMOS chip in a radiation-shielded lead container, correlations were discovered between local atmospheric conditions and the intensity of cosmic rays at sea level.

Help Received
Mission Hospital donated the use of their lead-lined vault. Pico Metal Products helped me build the lead container. My uncle, a NASA astronaut, explained to me the affects of cosmic radiation on humans in space. My Dad helped me select books and research materials.