

Variation in Levels of Cosmic Radiation Throughout the Day

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ABSTRACT

A study was conducted to record the average amount of cosmic radiation striking Earth throughout the day. The purpose of this experiment was to determine whether the radiation levels followed a pattern. Using a geiger counter connected to a laptop computer, radiation levels were logged for a period of 13 days, and consolidated data to shows average levels for different times of day.

METHOD

To measure levels of incoming cosmic radiation, a geiger counter built from a kit purchased from MightyOhm was used. A separate power supply replaced the batteries so that the power supplied to the counter would be continuous. The device was capable of data output to a computer, which recorded the detected CPM (counts per minute) every second. The geiger counter and computer were set up on a rooftop shaded by plastic and left undisturbed for 13 continuous days at 34°01'N 118°24'W (from 12/21/2015 to 1/2/2016).



Fig.1: MightyOhm Geiger Counter v1.0 (see reference 1)

DATA

After the initial data collection, the data was condensed. First, a computer program was implemented to average each 10 minutes of data, giving a short enough sample to work with. This was done for each day individually and then the levels for each time of day were averaged. The data is plotted in Figures 2 and 3 below.

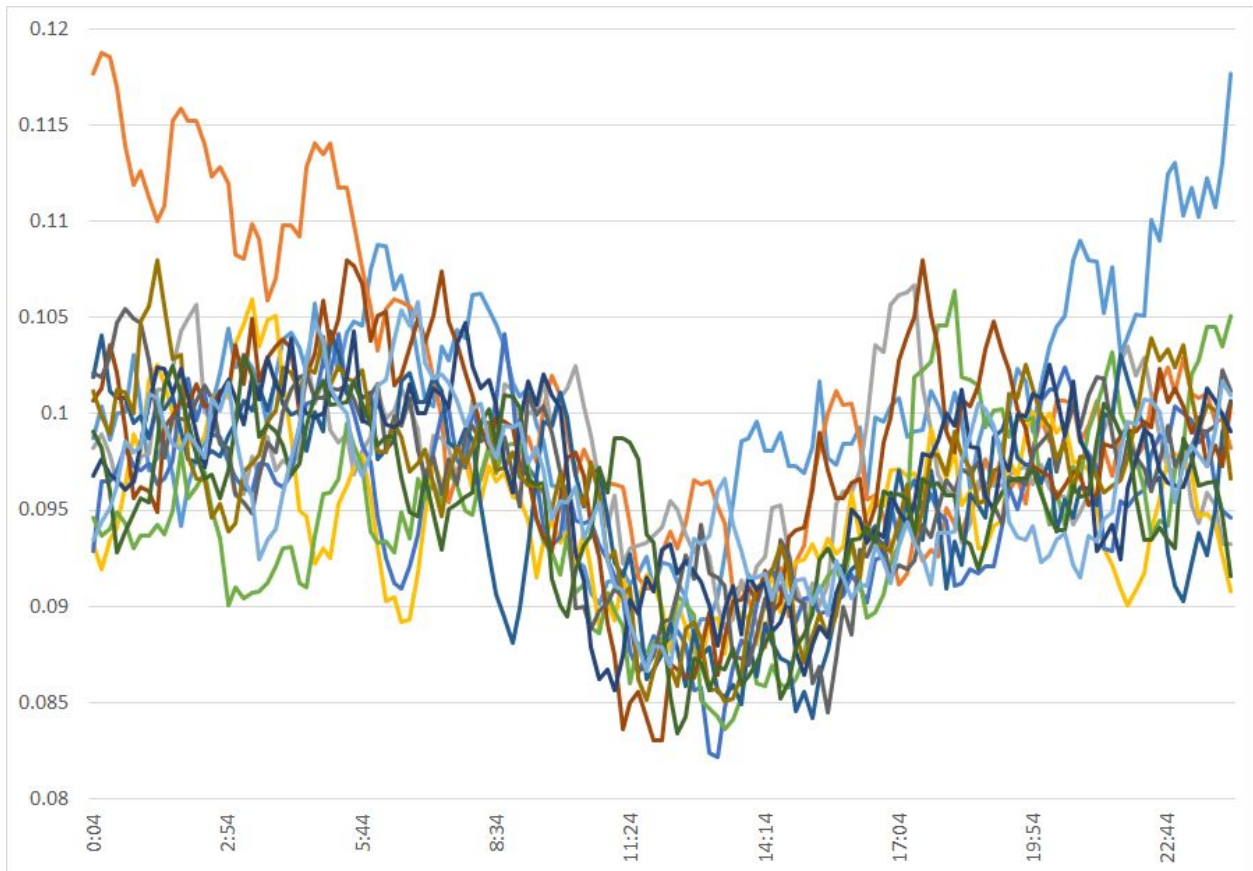


Figure 2: Radiation levels throughout the day for each individual day.

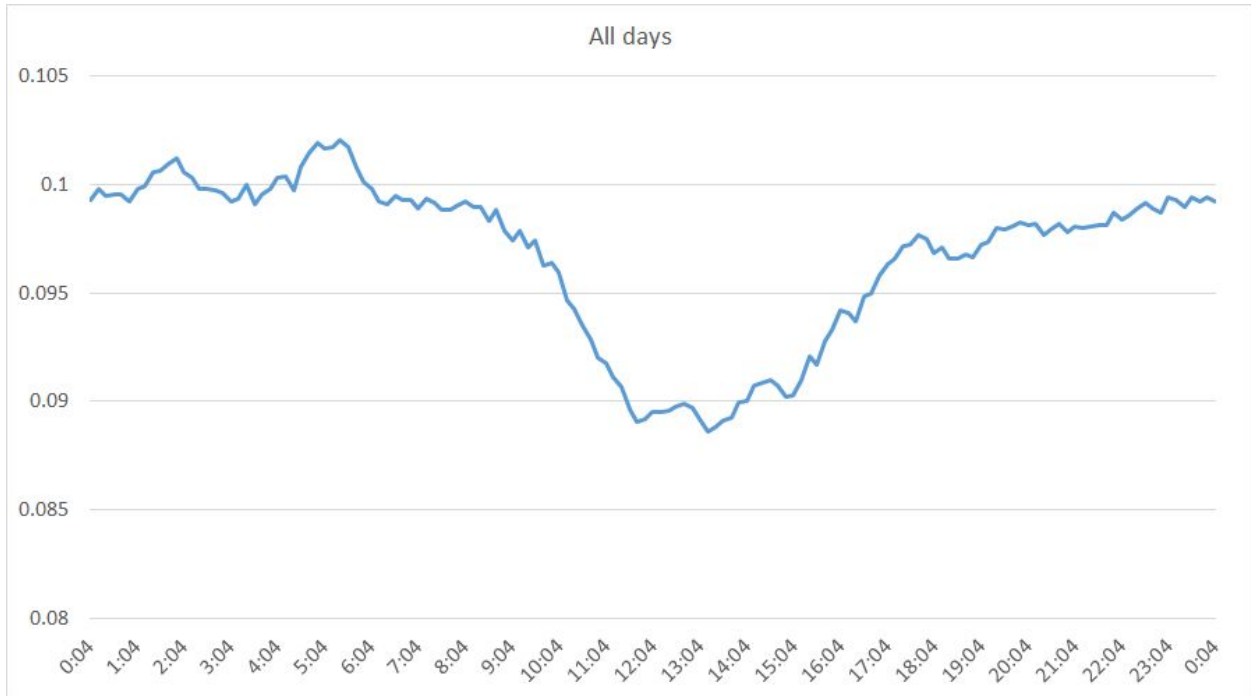


Figure 3: Average radiation levels throughout the day for all 13 days.

ANALYSIS

The results showed a significant variation in radiation levels throughout the day, with a consistent drop in radiation in the middle of the day. Starting at 8:00 A.M., levels began falling from around 0.1 CPM to about 0.09 CPM at 11:30 A.M. The rate remained at about 0.09 CPM until around 3:00 P.M. Levels then began to rise again, reaching 0.0975 CPM at 5:30 P.M. From then until midnight, levels rose at a slower rate to 0.1 CPM around midnight. These results are consistent with the findings published by H.M. Mok and K.M. Cheng in 2001 (see reference 2).

During the day, levels drop to a rate much lower than in the morning or the evening. The causes of this pattern are unclear, but may include atmospheric temperature, Earth's electromagnetic distortion, or other factors. The effect of temperature on the instrument itself is negligible, as applying heat to the Geiger counter with a hair dryer did not affect the radiation levels collected.

The data also shows that radiation levels in the early morning are more energetic than those in the evening, as would be expected because of Earth's motion around the sun. The explanation would be a headwind effect caused by the motion of the Earth. This is similar to the way that a person running in the rain will get more wet on the side facing their direction of travel.

SUMMARY

The experiment demonstrated that using simple and accessible equipment, the levels of cosmic radiation over time can easily be measured and analyzed. The results showed a recurring drop in radiation levels during the daytime, which may be partially because of changes

in atmospheric temperature. However, the relationship between the two variables has not been established because temperature data was not collected. In order to further test this hypothesis, the influence of atmospheric temperature must be accounted for (i.e. collecting temperature data) or eliminated (i.e. conducting the experiment in a place with little to no variation in atmospheric temperature throughout the day).

The data also shows Earth's motion around the sun causing variation in levels of cosmic radiation between the early morning and evening.

References

1. <https://cdn-shop.adafruit.com/1200x900/483-00.jpg>
2. "The Day-night Variation of Cosmic Rays Intensity at Sea Level Under the Influence of Meteorological Fronts and Troughs".
<https://arxiv.org/ftp/physics/papers/0105/0105005.pdf>