Cosmic Maximus?

Using a Scintillator Counter to Evaluate the Sun's Contribution to Cosmic Radiation

A Simple Study Conducted as Part of the PAN Project held at the NSCL of the Michigan State University July 30 - August 3, 2012

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Partners... **James Harvey** and **Manju Prakash**

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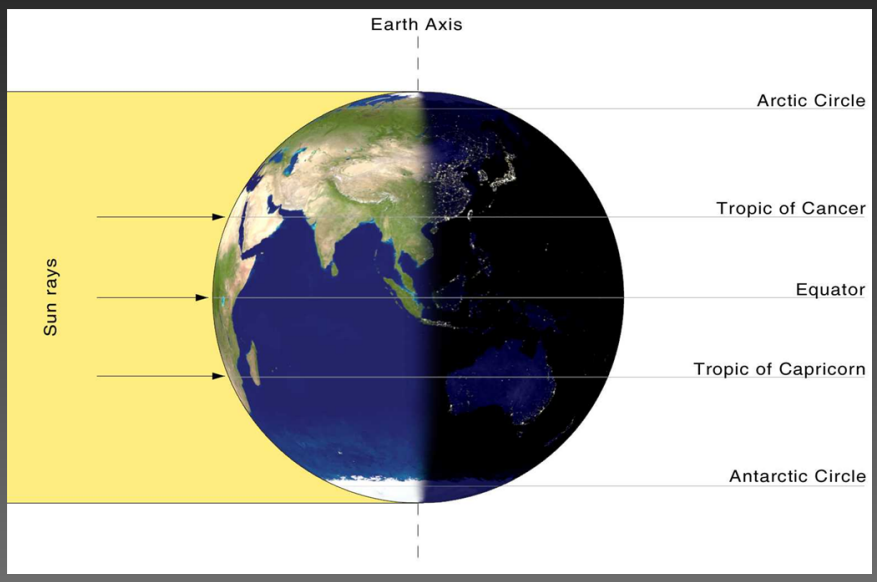
Cosmic Maximus?

To Be Tested... If the Sun contributes a large fraction of the cosmic radiation, then cosmic radiation levels should be higher during the day than at night.



http://scienceblogs.com/startswithabang/2010/03/21/weekend-diversion-a-little-sun/

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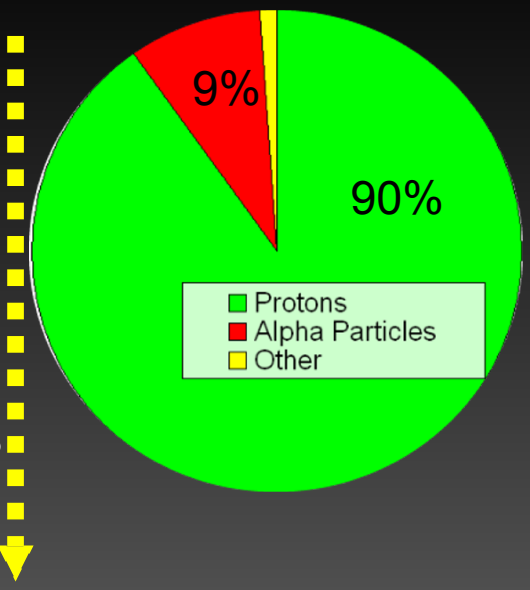
Primary Cosmic Radiation

Background

Particles from
- The Sun
- Various Supernova
- Other Extraterresterial Sources

-Traveling at very high speeds
-Constantly raining down on Earth's surface



- Rarely does primary cosmic radiation reach the Earth's surface

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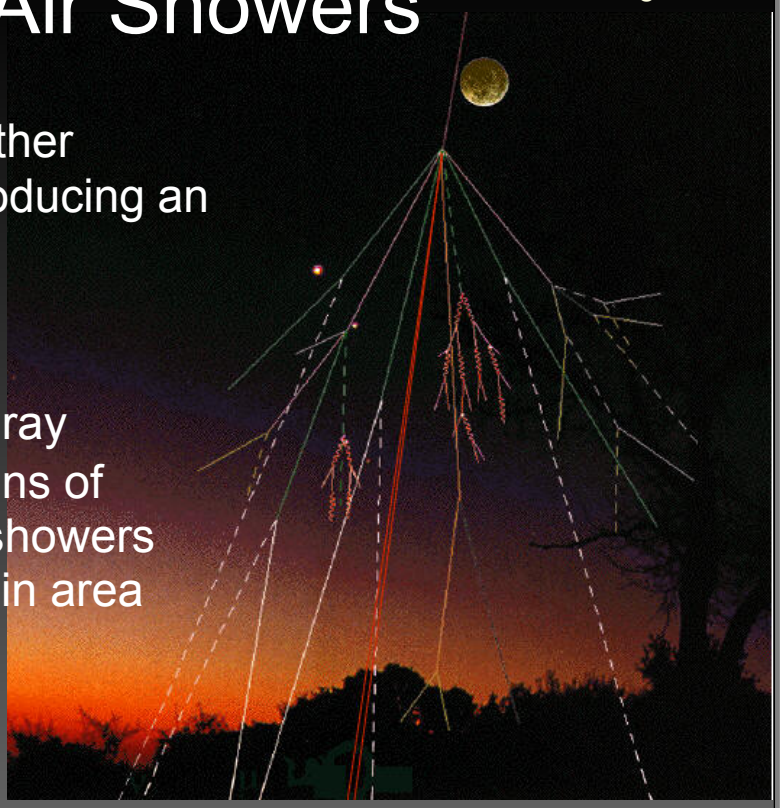
Cosmic Ray Air Showers

Background

- Particles collide with other atmospheric particles producing an assortment of particles

- A high energy cosmic ray (proton) can initiate billions of collisions producing air showers many tens of kilometers in area



http://www.particle.kth.se/SEASA/
http://www.theresilientearth.com/?q=content/attempt-discredit-cosmic-ray-climate-link-using-computer-model

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Background

Some Important Cosmic Ray Collisions

$n + {}^{14}N \rightarrow p + {}^{14}C$ Formation of C-14

${}^{14}N + n \rightarrow {}^{12}C + 3T$ Formation of tritium (H-3)

${}^{16}O + n \rightarrow {}^{10}Be + {}^{4}\alpha + 2{}^{1}p + n$ Formation of Be-10

http://www.particle.kth.se/SEASA/
http://www.theresilientearth.com/?q=content/attempt-discredit-cosmic-ray-climate-link-using-computer-m
http://en.wikipedia.org/wiki/Cosmic_rayodel

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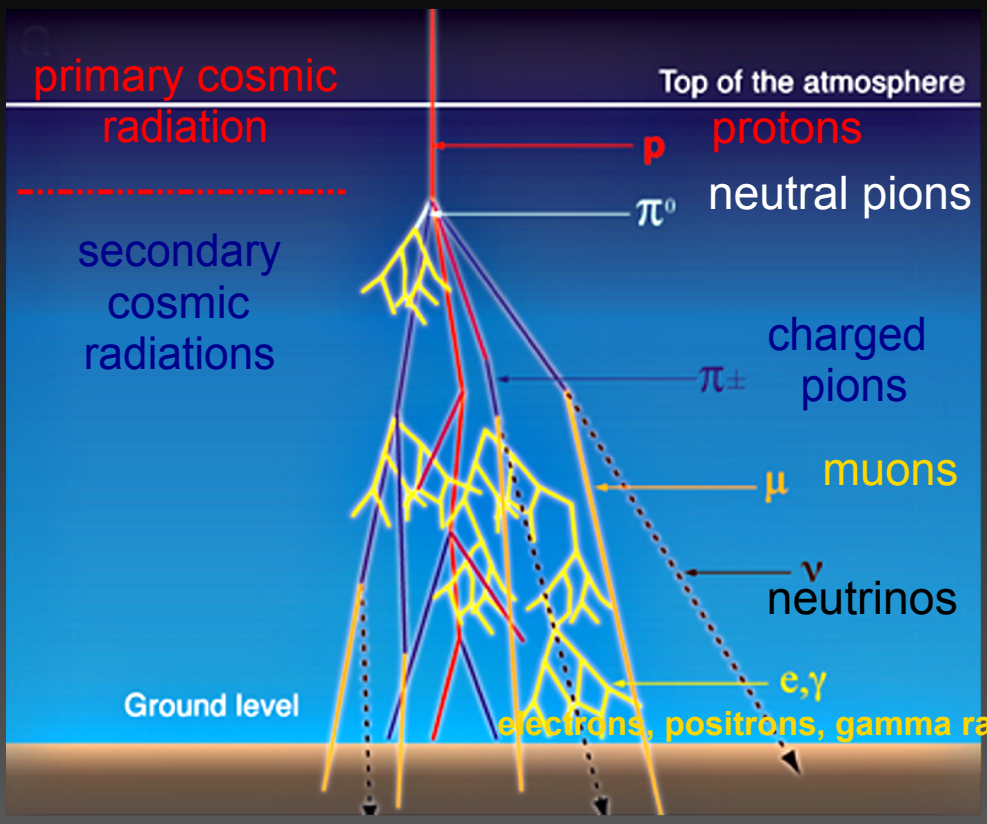
Background

Cosmic Ray Air Showers

Breakdown into more elementary particles



http://physics.aps.org/assets/d22f9a3393df823f

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Secondary Cosmic Radiation

Background

Some Decay Reactions

proton + neutron → proton + proton + charged pions

charged pions → muons + neutrinos

proton + neutron → proton + neutron + uncharged pions

uncharged pions → gamma rays

http://cosmic.lbl.gov/documentation/UsingtheDetector.pdf

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Secondary Cosmic Radiation

Background

Some Decay Reactions

$$p + n \longrightarrow p + p + \pi^{+/-}$$

$$\pi^{+/-} \longrightarrow \mu + \nu$$

$$p + n \longrightarrow p + n + \pi^{0}$$

$$\pi^{0} \longrightarrow \gamma$$

http://cosmic.lbl.gov/documentation/UsingtheDetector.pdf

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Secondary Cosmic Radiation

Background

Some Decay Reactions

muons$^-$ →

electrons + antielectron neutrinos + muon neutrinos

$$\mu^- \longrightarrow e^- + \bar{\nu}_e + \nu_\mu$$

Muons are the usual form of cosmic radiation that reaches the Earth.

http://en.wikipedia.org/wiki/Muon#Muon_decay

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Secondary Cosmic Radiation

Background

Some Decay Particles

Particle	Lifetime (seconds)	Composition
neutron	881.5	3 quarks (1 up and two down quarks)
pion	2.6×10^{-8}	2 quarks (up or down quark and an anti up or down quark)
muons	2.2×10^{-6}	Elementary particle

Muons are the usual form of cosmic radiation that reaches the Earth.

http://en.wikipedia.org/wiki/Muon#Muon_decay

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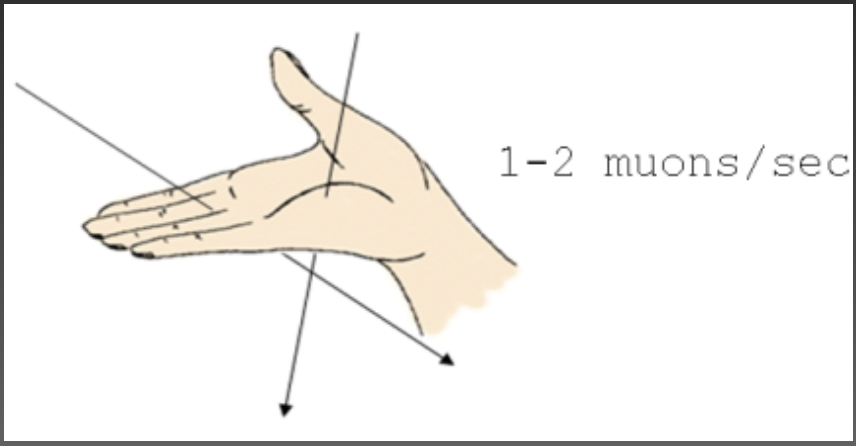
Background

Secondary Cosmic Radiation

Incidence

At the Earth's surface, a rough estimate is that in one second there are 1-2 muons passing through your hand.



http://www18.i2u2.org/cosmic/library/upload/3/3f/6000CRMD_How_to_Plateau.ppt

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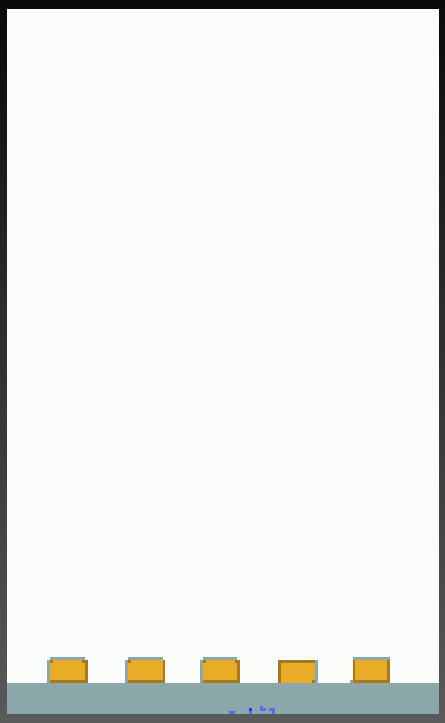
Secondary Cosmic Radiation

Detection

On a large scale, cosmic air showers can be measured by arrays of detectors placed strategically at different parts of the Earth's surface

http://www.particle.kth.se/SEASA/#rain

Background



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Background

Secondary Cosmic Radiation

Detection

On a small scale, the rate, direction and energy of cosmic radiation can be measured by using a cosmic ray detector such as this...

http://cosmic.lbl.gov/documentation/CosmicDetector2-0.pdf

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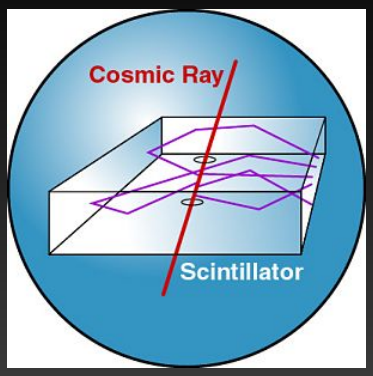
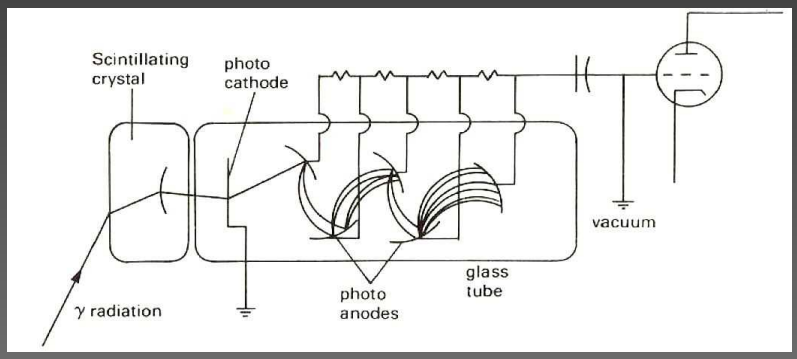
Secondary Cosmic Radiation

Background

Detection

Charged cosmic rays excite atoms in scintillator panels (often Plastic Lucite panels), causing the atoms to emit light. The light is directed to photomultiplier tubes which amplify the signal.





http://durpdg.dur.ac.uk/vvc/cosmicrays/images/scintillator2.jpg
http://2.bp.blogspot.com/-rvLZGzU7Bb8/TigiHs4EvKI/AAAAAAAAAWs/l4l-Rxiy1_Y/s1600/scintillation+chamber.JPG

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Cosmic Maximus?

The Test

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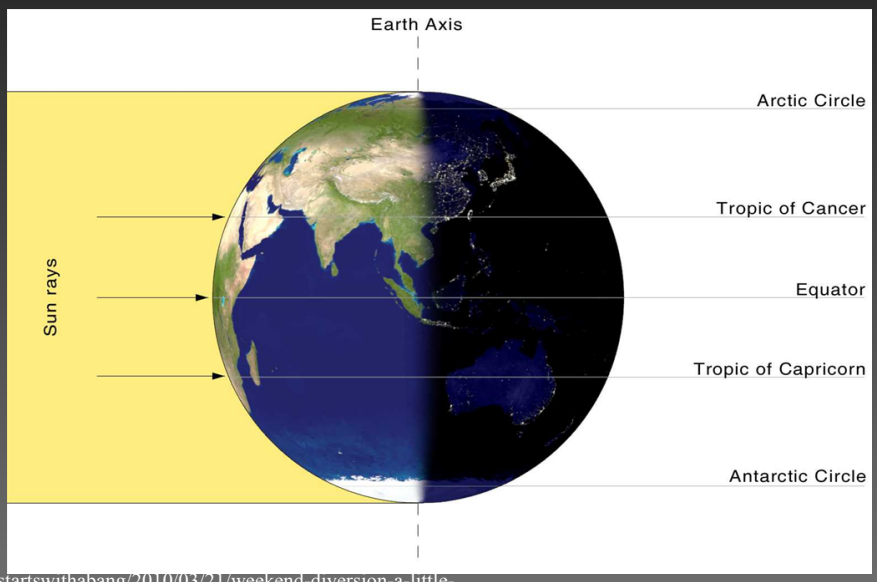

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The Test

- **Using a Scintillator Counter, take three different sets of cosmic radiation data: at 9:00PM, 5:00AM, 1:00PM**
- **Several three minute test samples will be taken during each interval.**

View from the test site

The Scintillator Counter

View of one of the scintillating panels wrapped in aluminum foil

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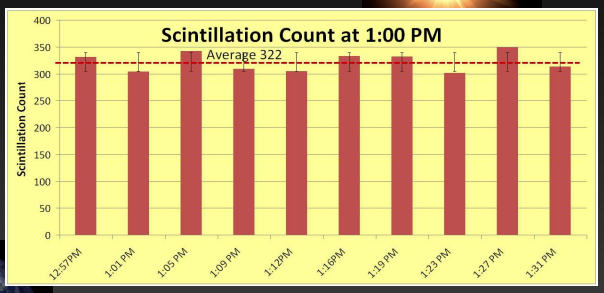
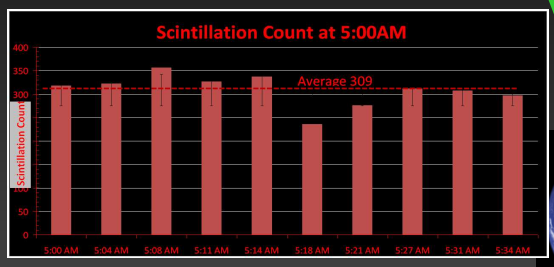
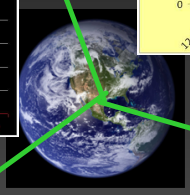
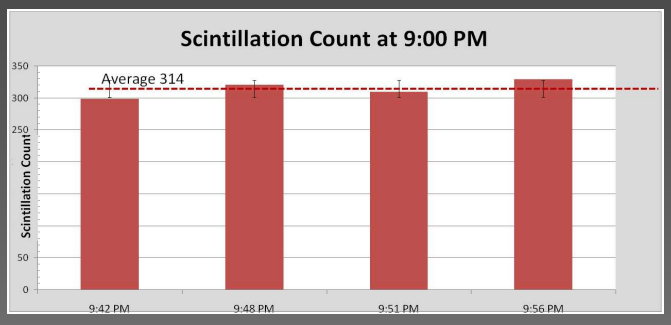
The Data









http://www.swpc.noaa.gov/primer/primer.html

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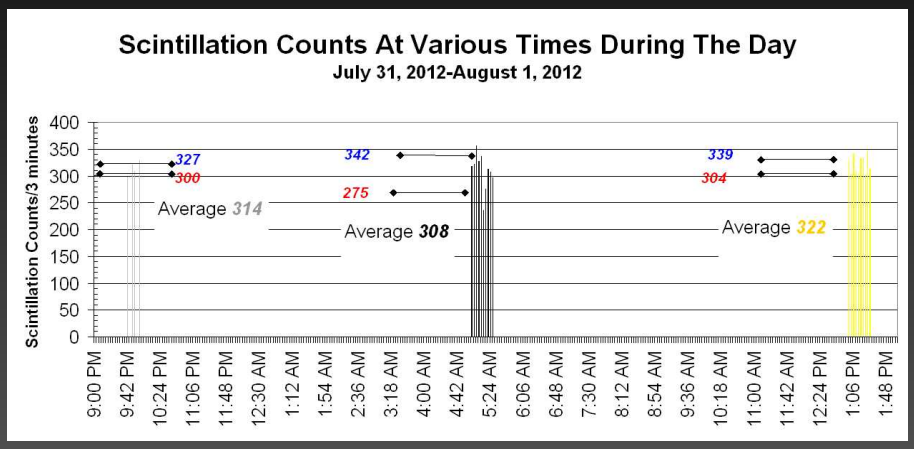
The Data



Notice that the averages all fit within the error ranges shown

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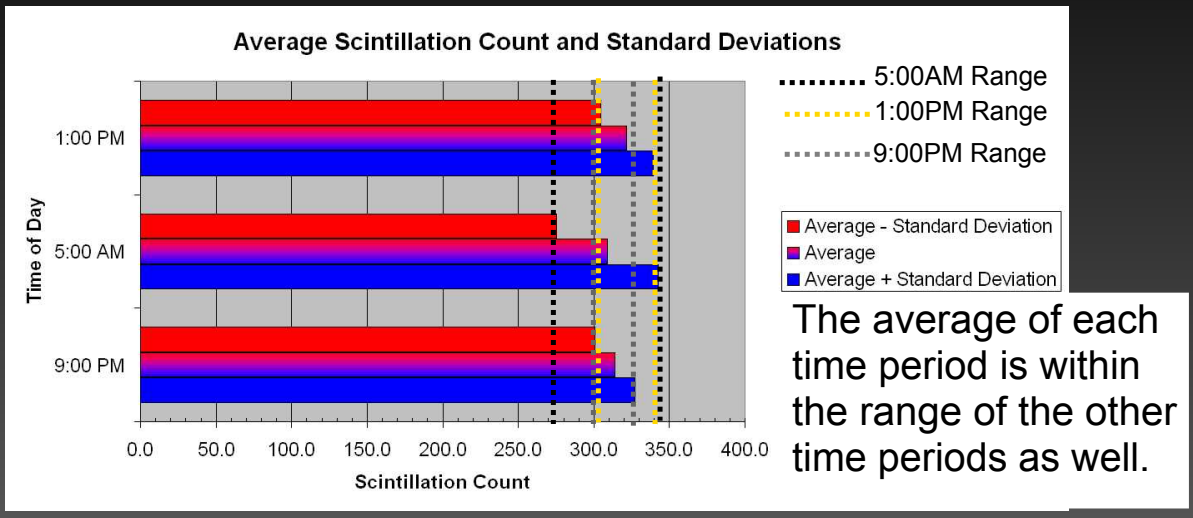
Analysis



The average of each time period is within the range of the other time periods as well.

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Conclusion

We cannot conclude that the cosmic radiation levels are higher during the day than they are during the night. This agrees with other sources that suggest very little (O.2% Blanco, et.al.) differences exist between the amounts of cosmic radiation reaching the Earth at various times of the day.

http://www.eurekalert.org/multimedia/pub/2413.php?from=86777
http://oldweb.ct.infn.it/~rivel/cosmic/Documents/Publications/NOVA_Publisher.pdf

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The End...

(A Supernova has occurred.... :-)

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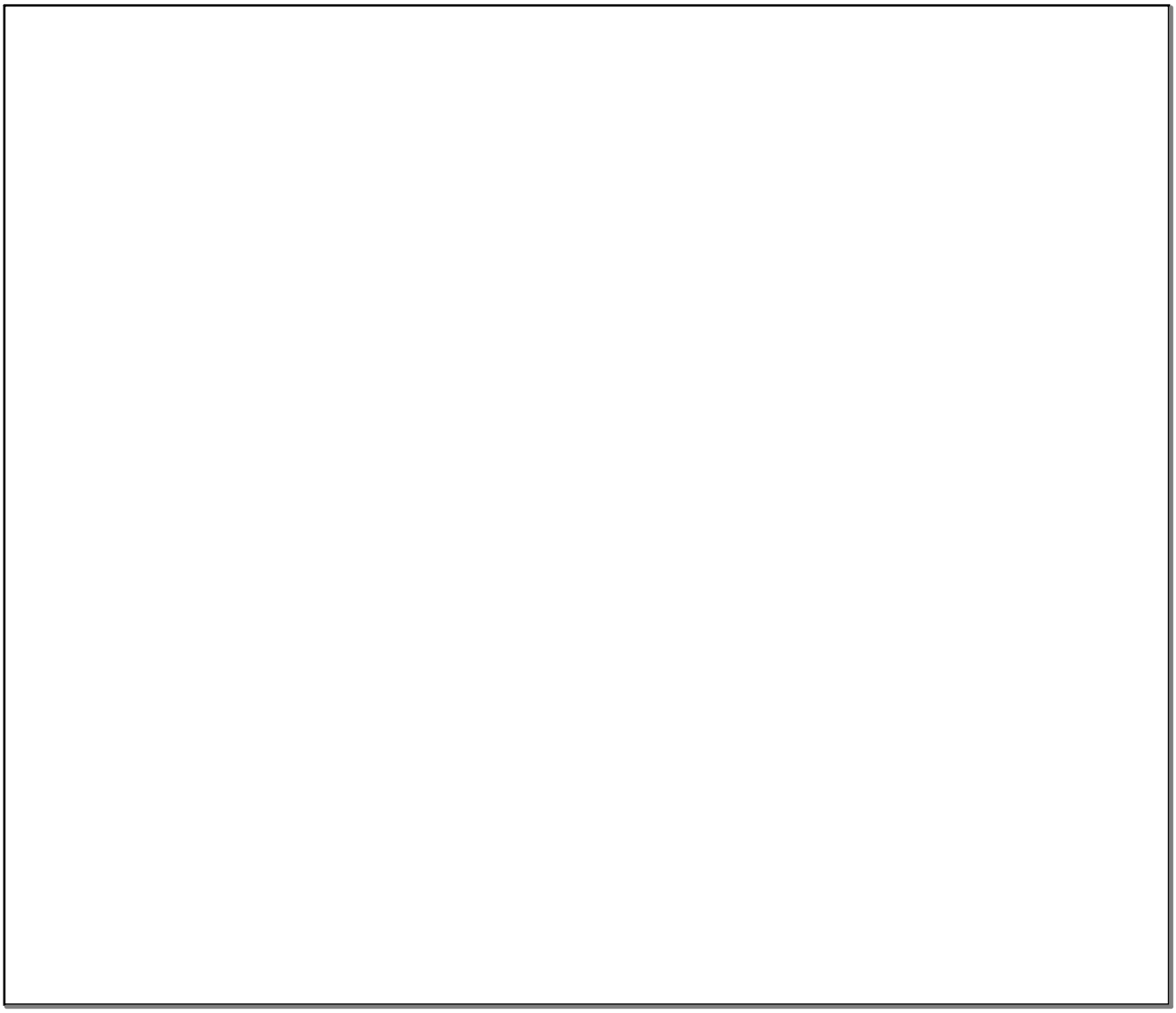

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