


COSMIC MAXIMUS!

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

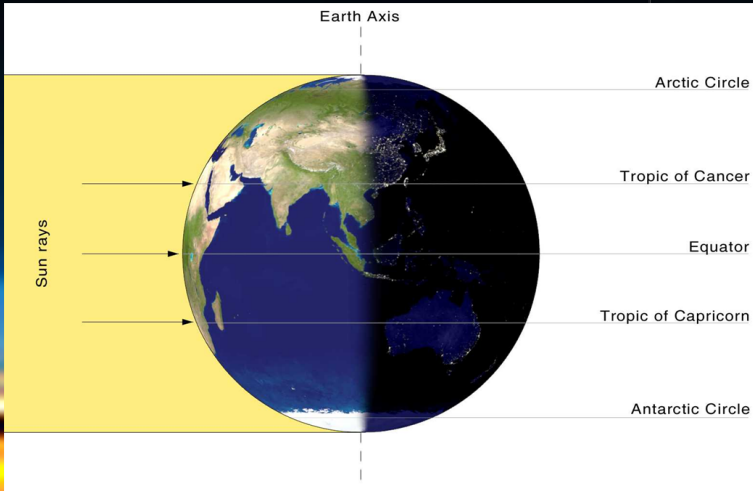
A Simple Study Conducted as Part of the PAN Project held at the NSCL of the Michigan State University July 30 - August 3, 2012
William Heeren

Partners... James Harvey and Manju Prakash



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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.

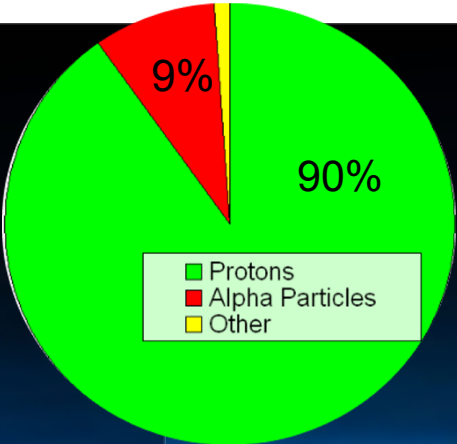


<http://scienceblogs.com/startswithabang/2010/03/21/weekend-diversion-a-little-sun/>

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Background

- Particles from
 - the Sun
 - Various Supernova
 - Other Extraterrestrial Sources
- Traveling at very high speeds
- Constantly raining down on Earth's surface



Particle Type	Percentage
Protons	90%
Alpha Particles	9%
Other	1%

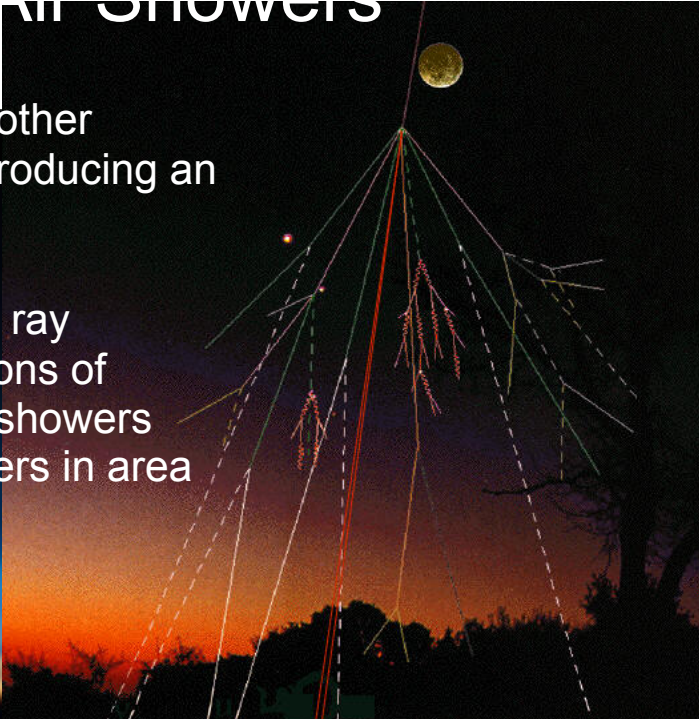
- Rarely does primary cosmic radiation reach the Earth's surface

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Background

AIR SHOWERS

- 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 of 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

$$n + {}^{14}\text{N} \rightarrow p + {}^{14}\text{C}$$

$${}^{14}\text{N} + n \rightarrow {}^{12}\text{C} + 3\text{T}$$

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

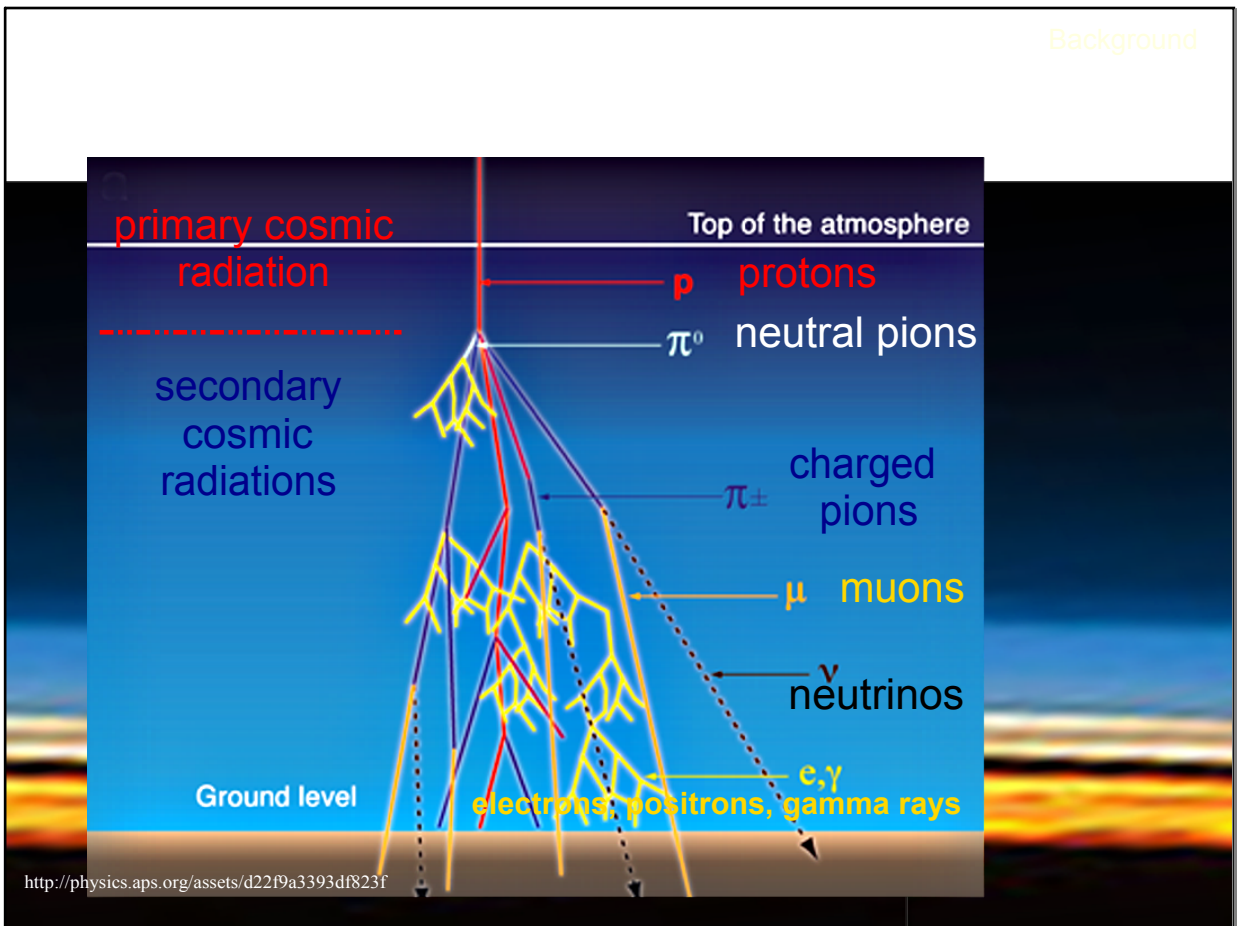
Formation of C-14

Formation of tritium (H-3)

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

proton + neutron \longrightarrow proton + proton + charged pions
 charged pions \longrightarrow muons + neutrinos

proton + neutron \longrightarrow proton + neutron + uncharged pions
 uncharged pions \longrightarrow gamma rays

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

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Background

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

$p + n \longrightarrow p + n + \pi^0$
 $\pi^0 \longrightarrow \gamma$

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

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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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Background

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

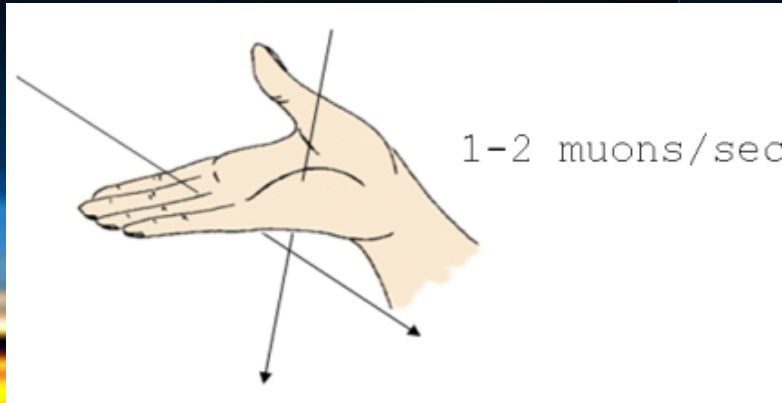
http://en.wikipedia.org/wiki/Muon#Muon_decay

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Background

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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Background

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/main>

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Background

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...

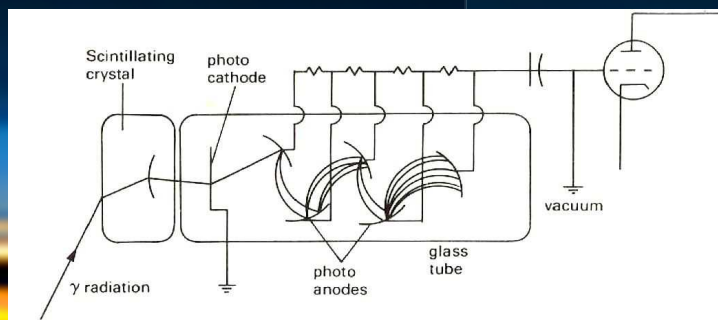
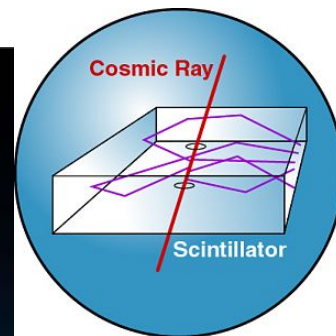


<http://cosmic.lbl.gov/documentation/CosmicDetector2-0.pdf>

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Background

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.

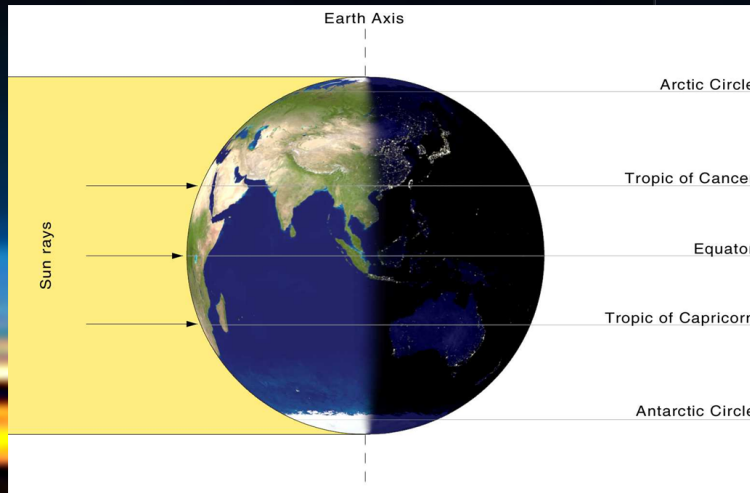


<http://durpdg.dur.ac.uk/vvc/cosmicrays/images/scintillator2.jpg>
<http://2.bp.blogspot.com/-nLZZGd7B8S7/1giiH4EK1/AAAAAAAAAAWw/14-Rxy1Ys1600/scintillation-chamber.JPG>

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The Test

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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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

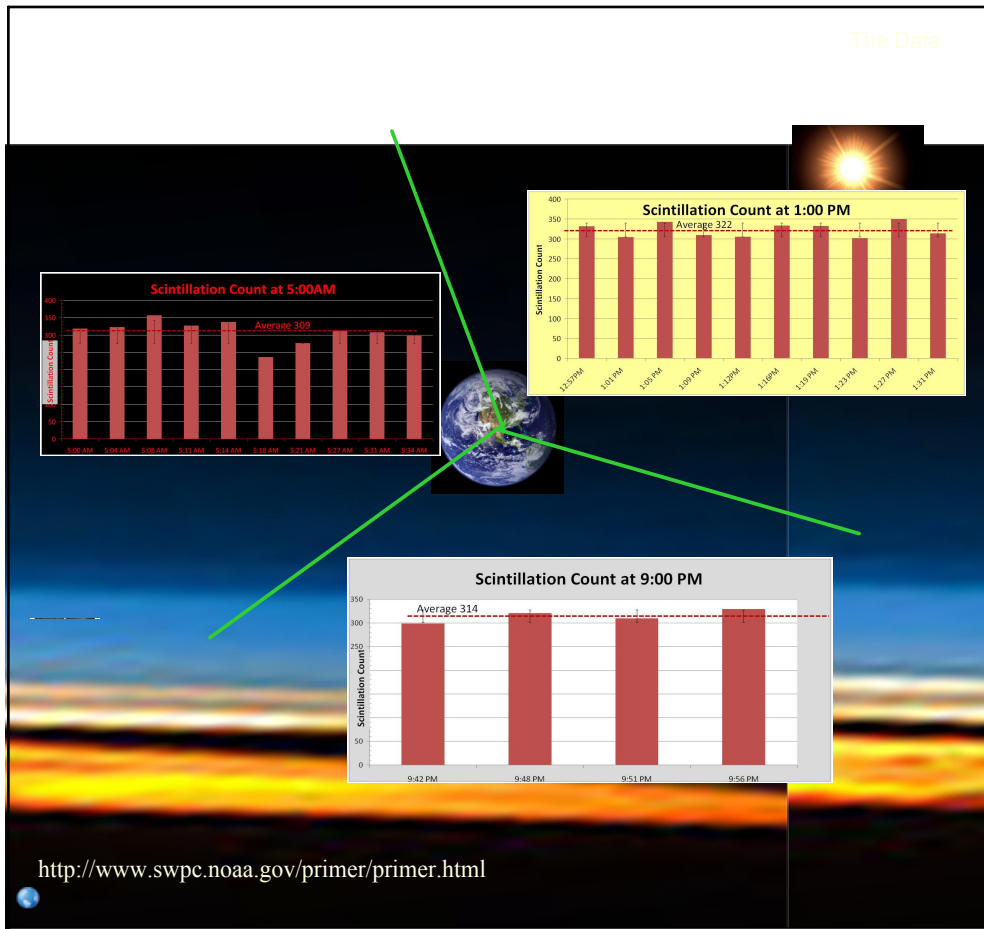


The Scintillator Counter

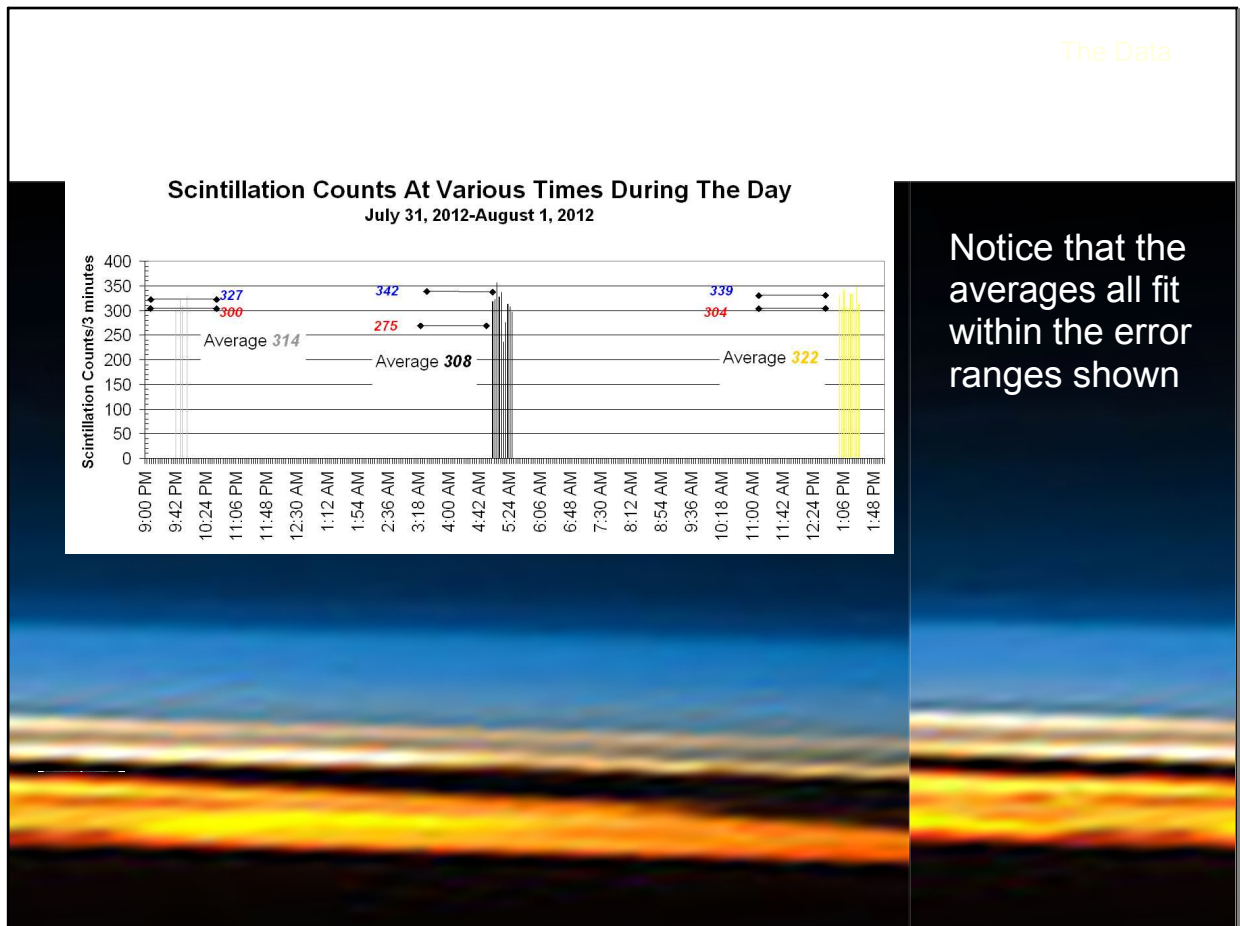


View of one of the scintillating panels wrapped in aluminum foil

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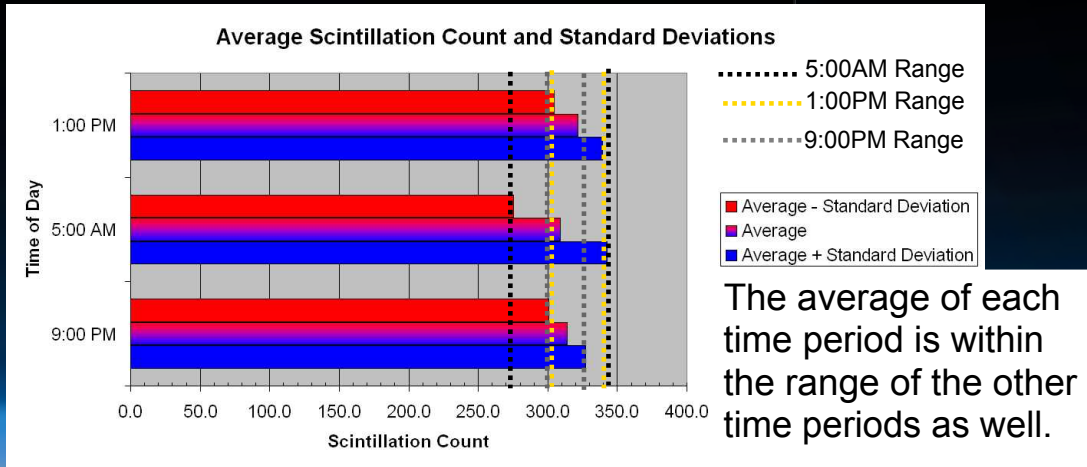


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Analysis



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Conclusion

cannot
 radiation levels are higher during the day than they are during the night. This agrees with other sources that suggest very little (0.2% Blanco, et. al.) differences exist between the amounts of cosmic radiation reaching the Earth at various times of the day.

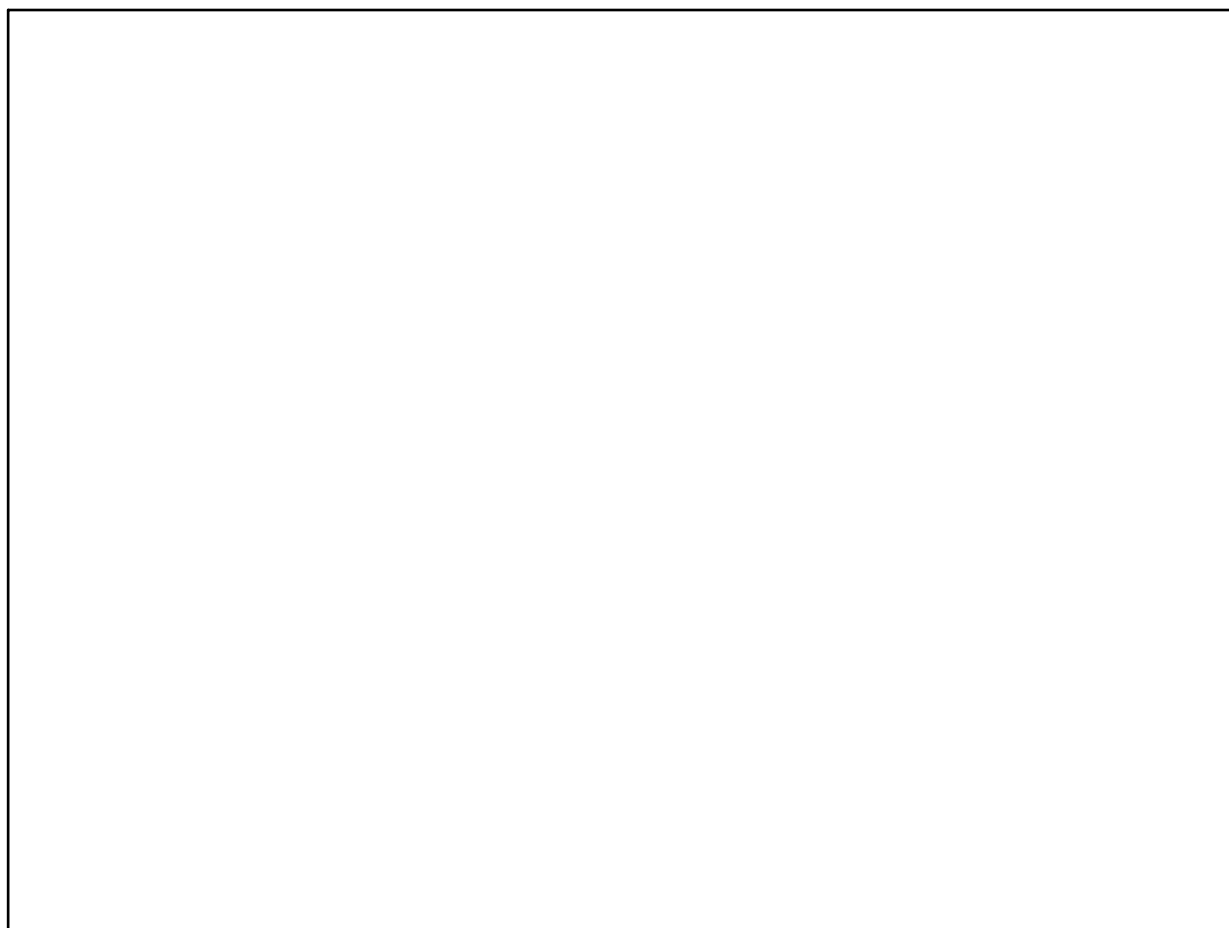


<http://www.eurekalert.org/multimedia/pub/2413.php?from=86777>
http://oldweb.et.infn.it/~rivel/cosmic/Documents/Publications/NOVA_Publisher.pdf

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