



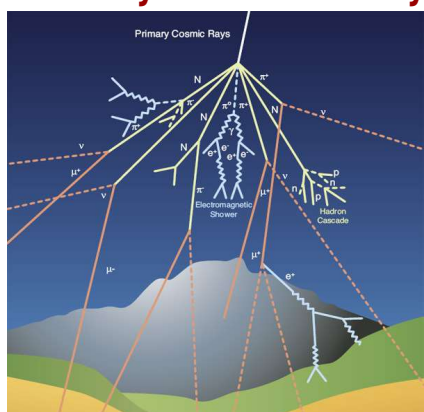
The Moon and Cosmic Rays

IU Eclipse Workshop 2024

What Are Cosmic Rays?

Cosmic Rays are energetic elementary charged particles (like neutrons and muons) that travel through space at just under the speed of light. There are two types of Cosmic Rays that interact with earth: Primary and secondary. Primary rays hit earth's atmosphere, and secondaries are created by interacting with interstellar gas.

Primary Cosmic Rays:

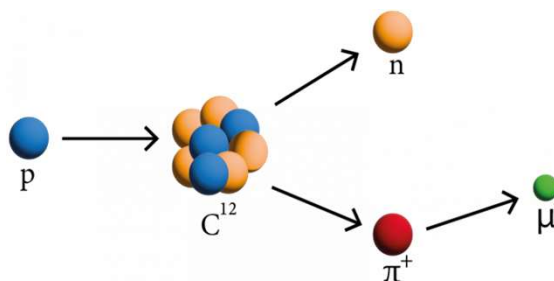


Specifically, neutrons are created when the high energy cosmic rays react with the atomic nuclei of oxygen and nitrogen, along with a few other molecules.

References:

Betty, J.J., 2019, Indiana
my.sharepoint.com/personal/rtayloe_iu_edu/_layouts/15/onedrive.aspx, Accessed May, 2024
David L. Chichester, James T. Johnson, Scott M. Watson, Jay D. Hix, Scott J. Thompson, Observation of natural background radiation during the Great American Eclipse, Applied Radiation and Isotopes, Volume 142, 2018, Pages 151-159, ISSN 0969-8043, <https://doi.org/10.1016/j.apradiso.2018.09.008>.

Muons And Neutrons:

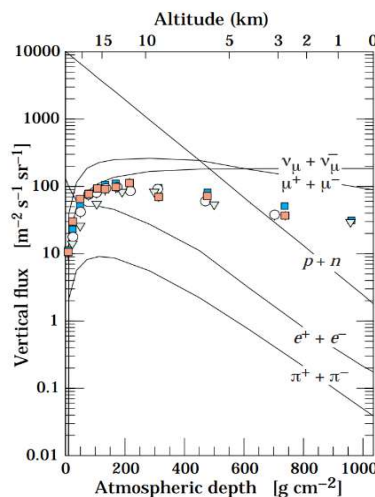


When a cosmic ray interacts with atomic nuclei of molecules in the air, a neutron and muon can be created. The rates of muons are

$$100 \mu^+ \text{s}^{-1} \text{sr}^{-1}$$

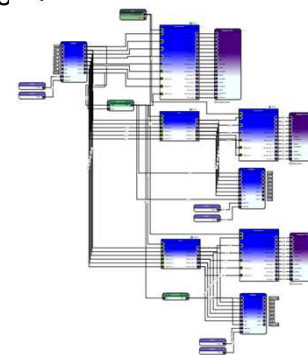
(0.01 muons per second per steradian) which should be about 10-12 Hz on average with our counter. Our neutrons rates should also be about 1 Hz on average from our prior experiments.

Cosmic Ray Rates:



Our Counter:

The counter that we constructed uses two panels to detect when a muon interacts with them and with two neutron counters in the middle of those two panels. Those create an electrical signal that is sent to our PLU (programmable logic unit) that does the logic necessary logic with the four inputs to determine if a muon or a neutron has hit, and then outputs that to our graphic software. Our logic is shown below.



Background:

A similar experiment has been conducted before and can be summarized in the diagram below. This tested neutrons up to 7MeV, which we would have to tune for if we were to match.

