

COSMIC WATCH MUON DETECTOR ANDROID APPLICATION FOR MUON DETECTOR PERIPHERAL

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Application Background

- Simple Android Application pairs portable muon detector peripheral with equally portable Android-based device.
- Typical Android device envisioned is the phone – ubiquitous, portable, lightweight. Combined phone-detector system remains small, portable, and lightweight.
- Backpack portable detector, or ‘record then move’ use cases.

Application Capacities:

- Detect and Connect to Arduino based muon detector via USB-mini to USB-mini (extension cords highly recommended).
- Phone supplies 5v operating power to the detector.
- Records line-by-line muon detection events as raw data.
- Displays the tally, location, and time of each detection event.
- Save raw data and processed detection data into a CSV file on the device, for future data processing applications.
- Rapid events-per-minute updating for ‘live’ observation of the cumulative muon detection rate.
- Other data analysis features, such as charts and graphs, intended by later updates.

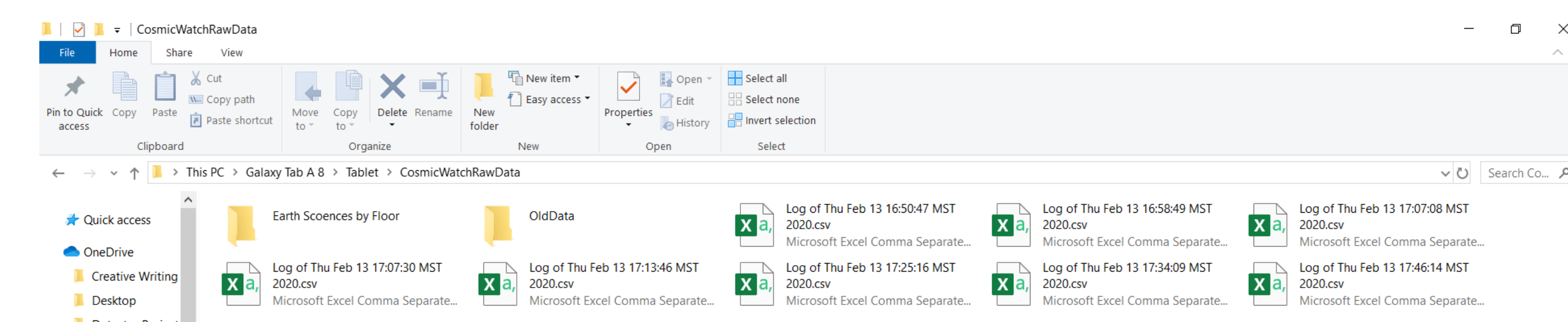
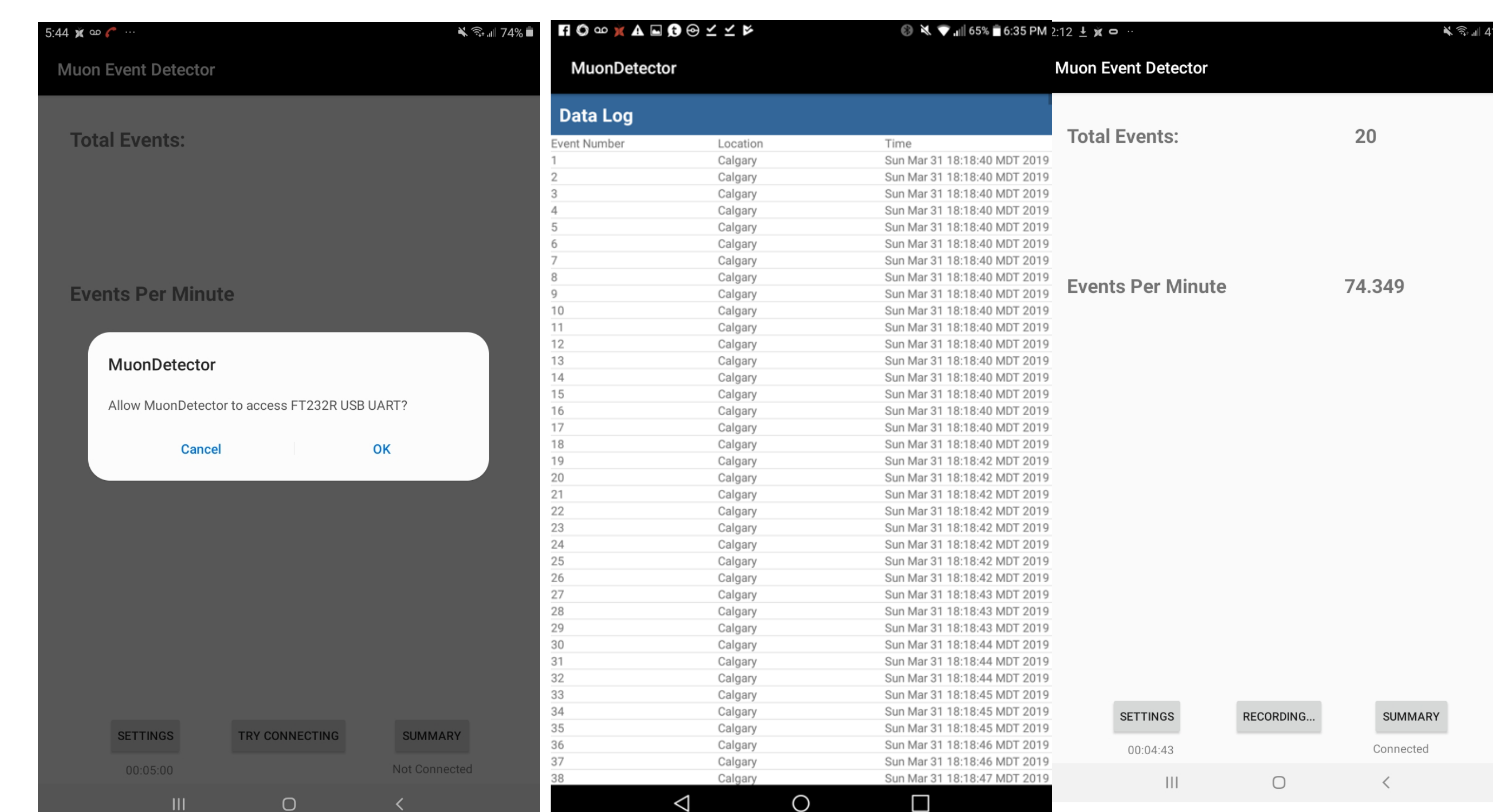


Figure 1: Raw Reading Data saved to CSV files for later usage



Figures 2, 3, 4: Detecting and Connecting, Line-by-line Display, Live Recording Features

Simple Experiments: Educational Uses and Convenience Potential

These ‘High School’ level sample experiments represent simple scientific inquiries easily conducted by anyone with an android phone and the detector.

Sample Experiment 1: Muon Detections over a Day

Purpose: Determining if the time of day can vary the number of muon detection events, and thus if the sun or other celestial bodies matter.

Methods: Single location, Five-Minute Readings, Once Per Hour. 12+ hour timespan, significant time before and after sunset to investigate the influence of the sun with regards to cosmic muons.

Results: No statistically significant effect; cosmic rays and their generated muons do not come from the sun, but rather from all around.

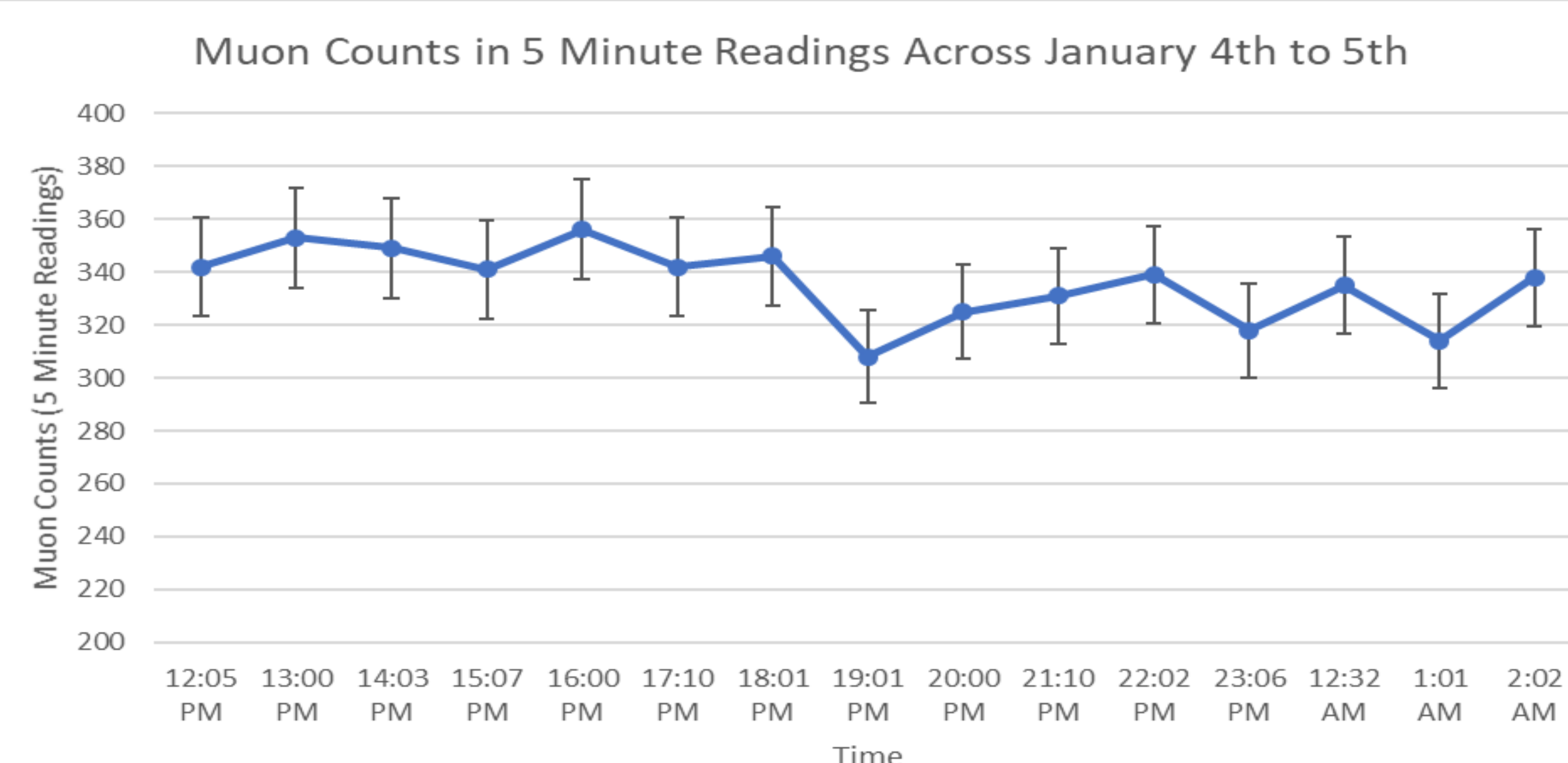


Figure 7: Experimental Results for ‘High School level’ Hourly Readings Experiment.

Sample Experiment 2: Muon Detections by Floor Level

Purpose: Investigating the impact of material cover on muon detection rates, with an expectation that matter shields the detector from muons.

Methods: Cosmic muons come from the sky above, so the number of floors between the sky should serve as a good proxy. Several-minute readings across ascending floors in a tall building.

Result: A significant upward trend observed, indicating that material cover does indeed shield people from cosmic ray generated muon radiation.

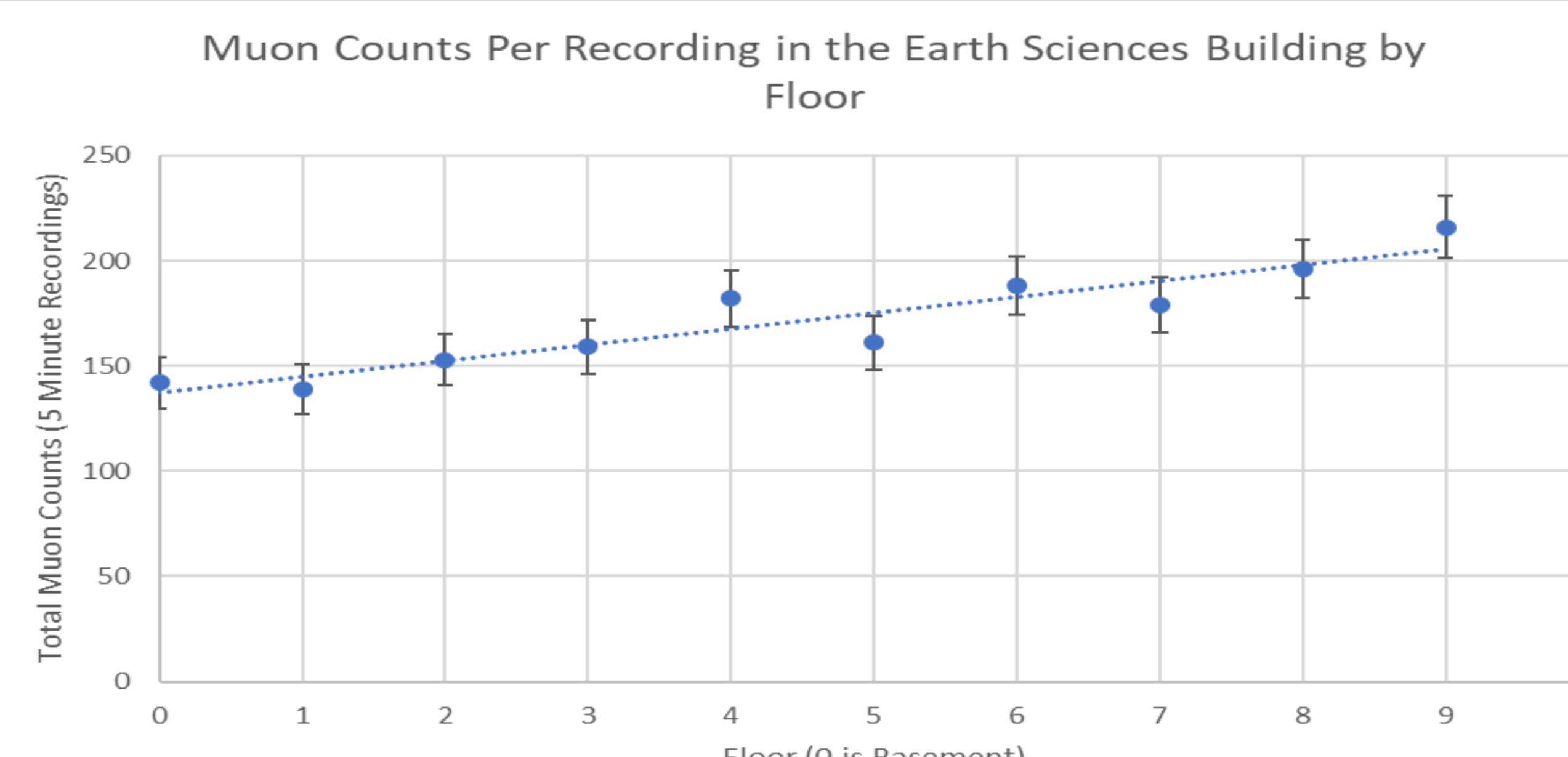


Figure 8: Experimental Results for ‘High School Level’ Different Floors Experiment

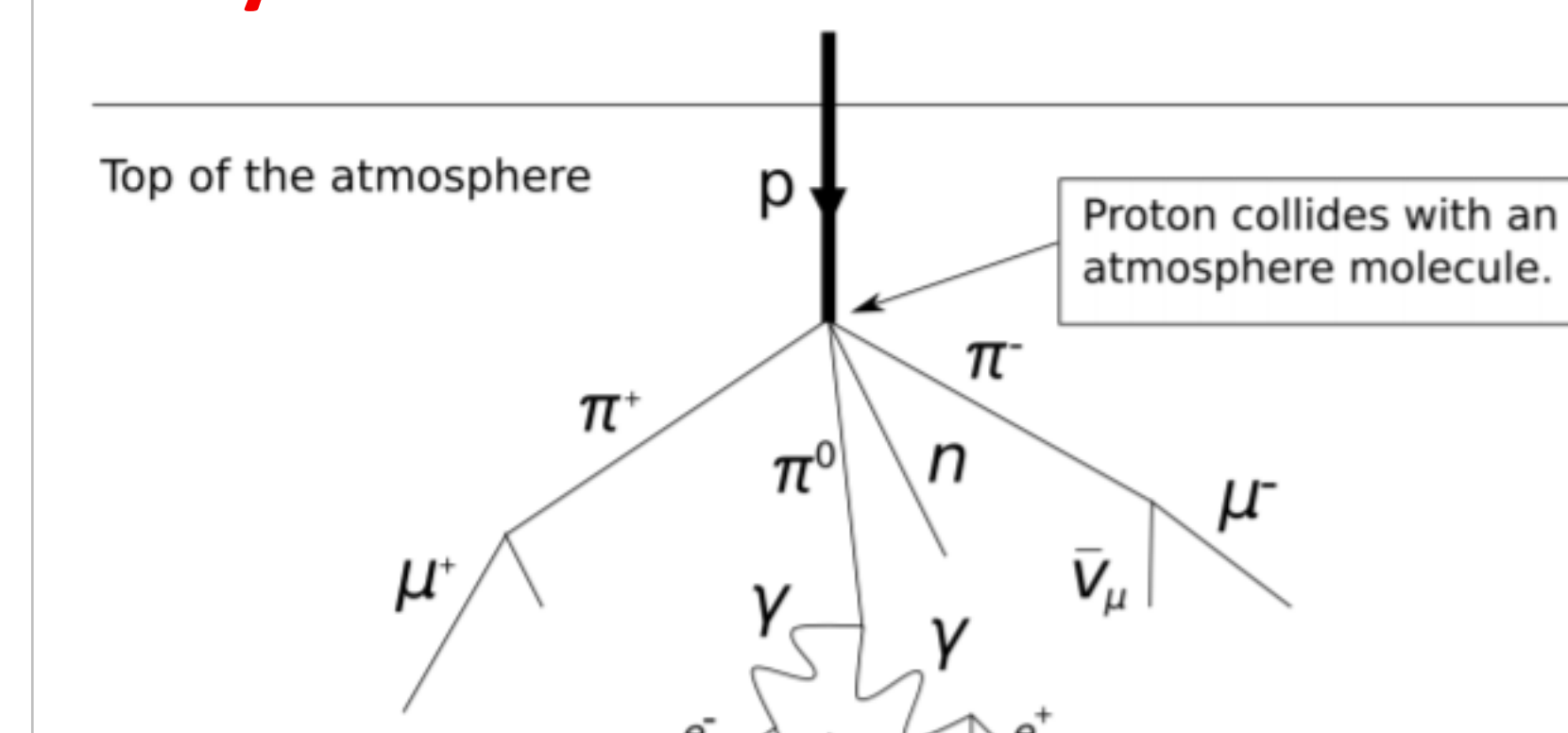
Project Motivation

- Cheap (<\$400), lightweight and portable Arduino-based muon detector by Jordan Hanania [1] with inspiration from MIT’s related project [2].
- Hamstrung by required connection to large laptops with unintuitive GUI; phones and apps are an ideal replacement for these large laptops.
- Increased convenience and portability enables use at a ‘high school’ level educational setting and makes field research more convenient.



Figure 5: The Muon Detector with Android Phone setup. The phone supplies the 5v operating power for the detector through the USB cable, with the entire package remaining small and easily portable, with little setup.

Why Cosmic Muons: Theoretical Background



- Cosmic ray muons come from all directions in space, generated in collisions between cosmic rays and the Earth.
- A major source of natural background radiation.
- Short muon lifetime illustrates Einstein’s theory of relativity.

Figure 6: Muon Generation from Cosmic Rays [3].



Figure 9: The Earth Sciences Building, Upper Half, Where Experiment 2 Was Conducted [4].

References:

- [1] J. Hanania, “Development of a desktop muon detector,”. University of Calgary 2016
- [2] S. Axani, J. Conrad, and C. Kirby, “The Desktop Muon Detector: A simple, physics-motivated machine- and electronics-shop project for university students,”. Available: <https://arxiv.org/pdf/1801.03029.pdf>
- [3] Wikipedia. (2020, May 6). Cosmic ray. Retrieved May 20, 2020, from https://en.wikipedia.org/wiki/Cosmic_ray
- [4] University of Calgary. (2020, January 30). Earth Sciences Building. Retrieved May 20, 2020, from <https://www.ucalgary.ca/ancillary/accommodations-and-events/conference-and-events/classrooms/earth-sciences-building>