

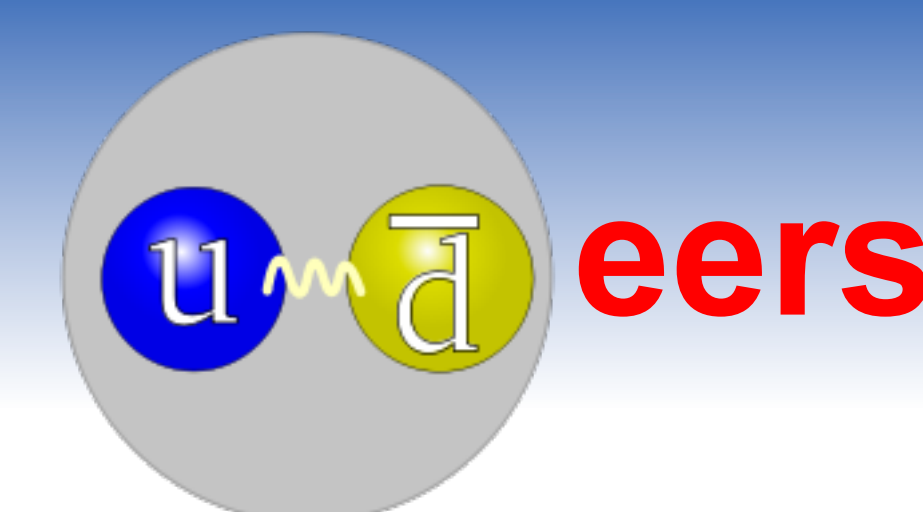


Effect of Earth's Magnetic Field on Cosmic Ray Primaries

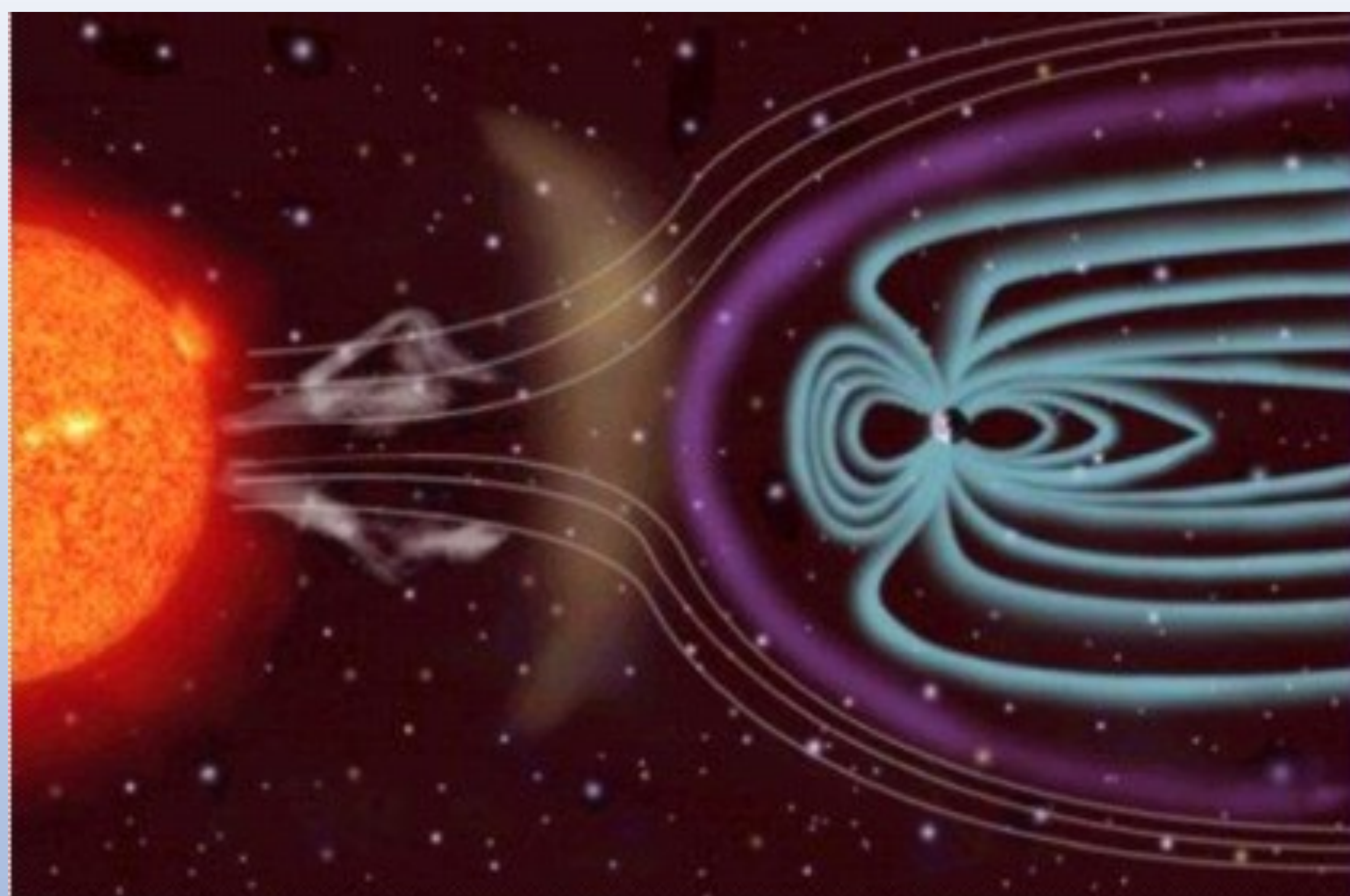
A PIONeering Experiment

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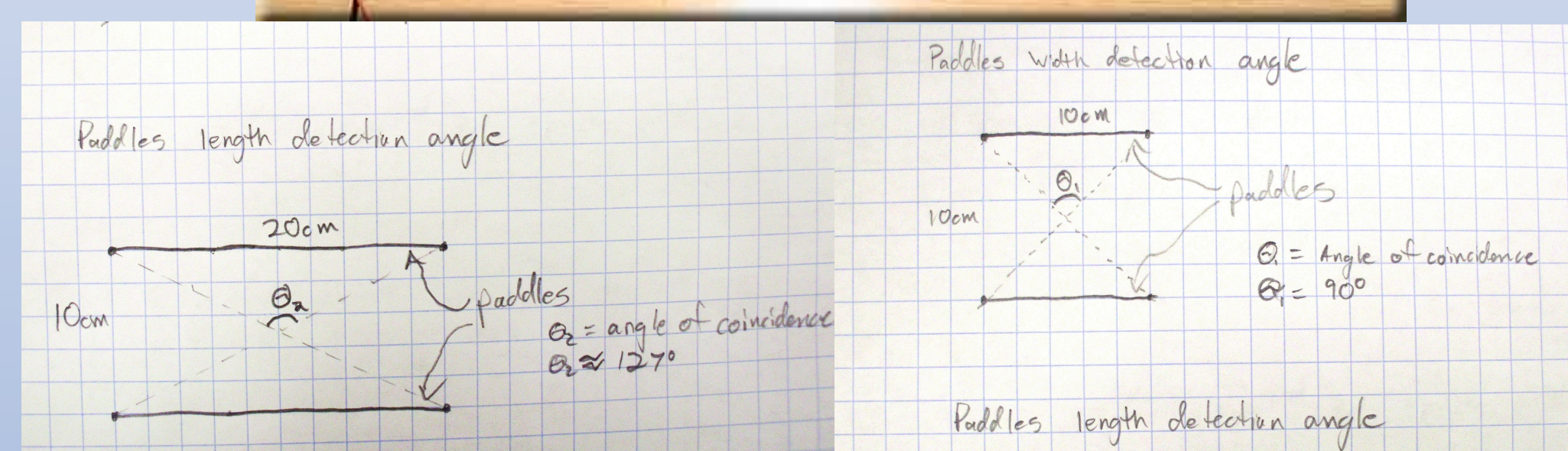
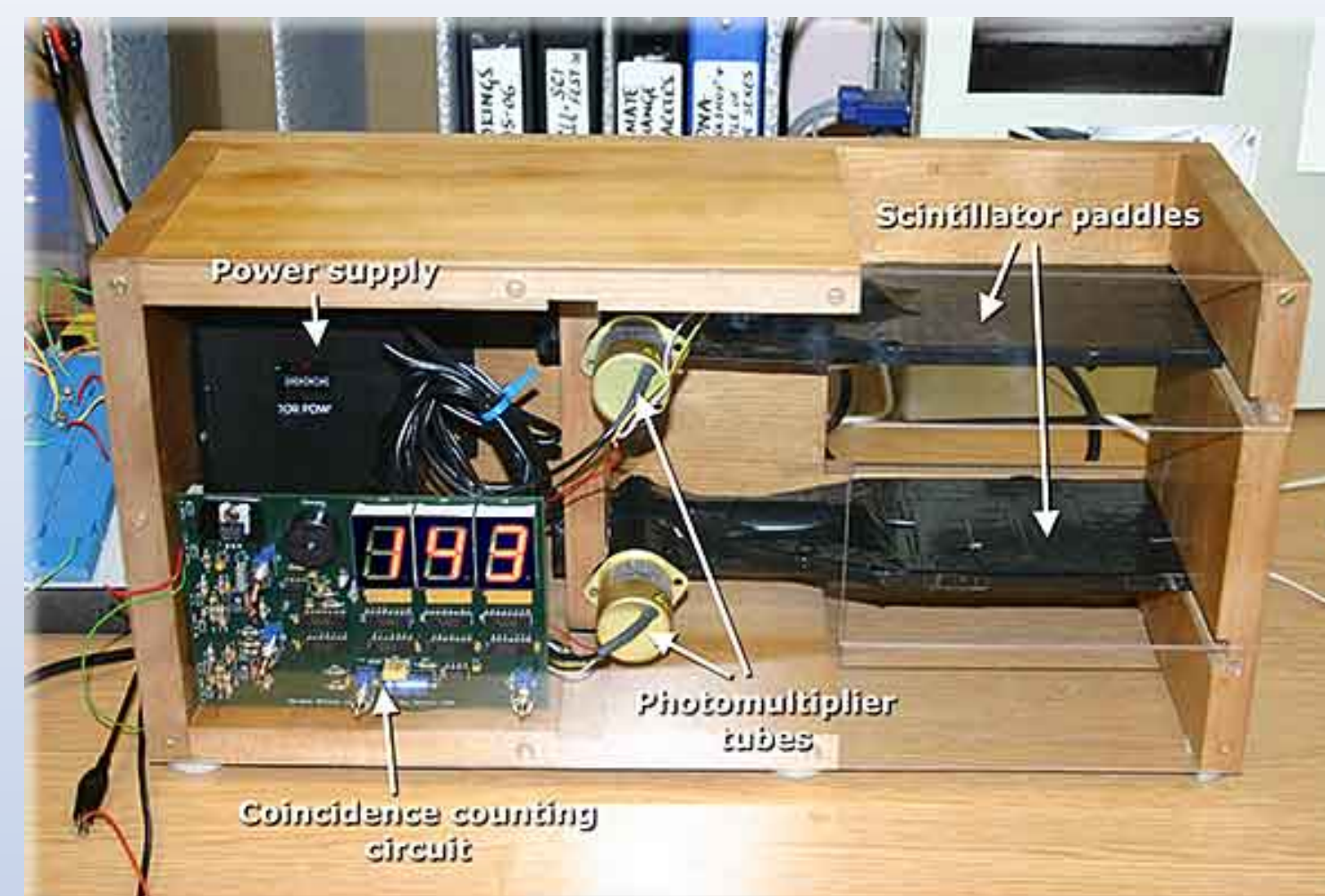


EFFECT OF MAGNETIC FIELDS ON CHARGED PARTICLES



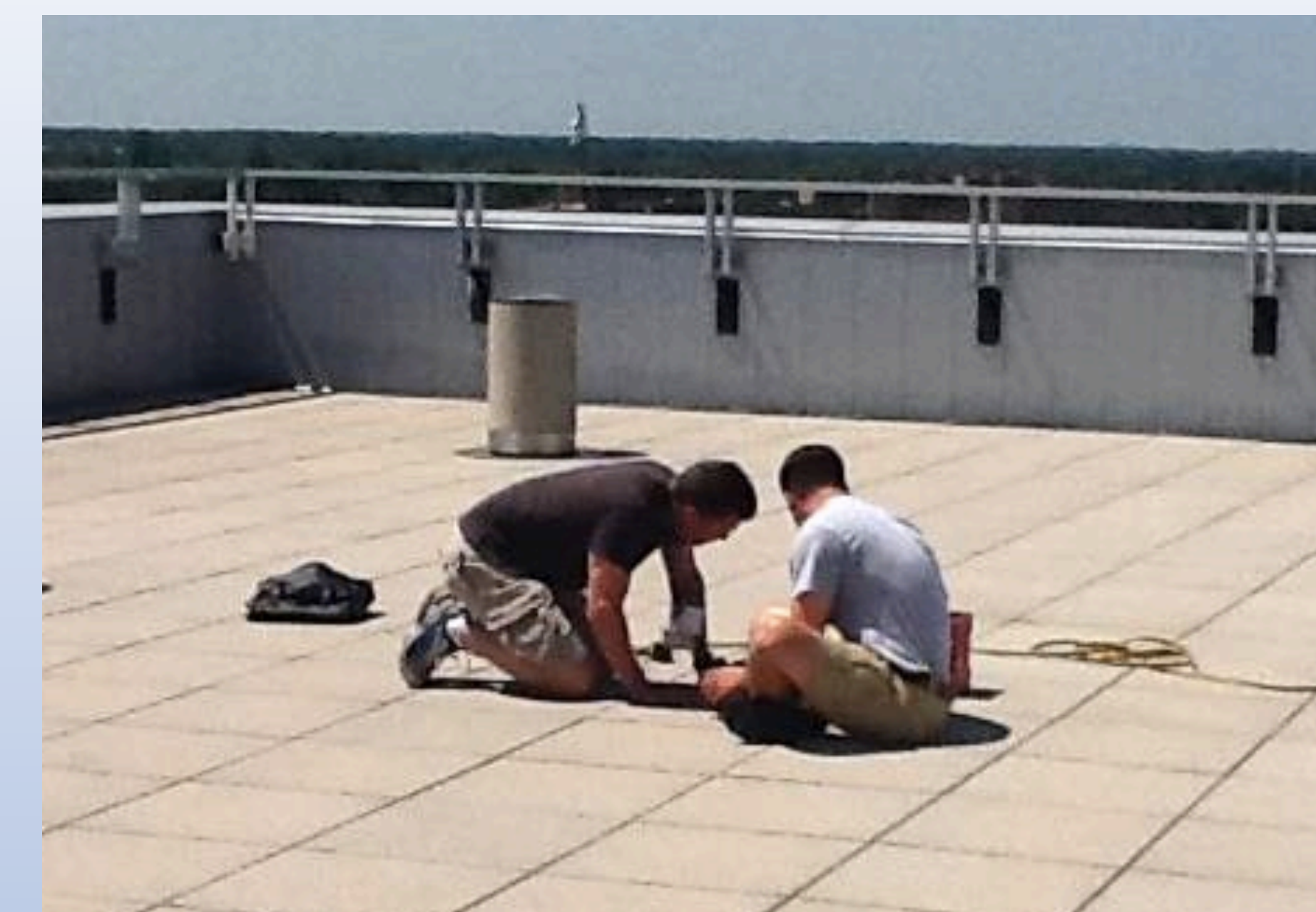
Charged particles in the solar wind are deflected by the Earth's magnetic field. The speeds of these particles are approximately 4×10^5 m/s (three orders of magnitude less than the speed of light).

THE COSMIC RAY DETECTOR



The cosmic ray detector consisted of two parallel-mounted scintillators, spaced 10 cm apart. Set to count in coincidence, this limited the detection of cosmic rays through an angle of 90° through the width and 127° through the length.

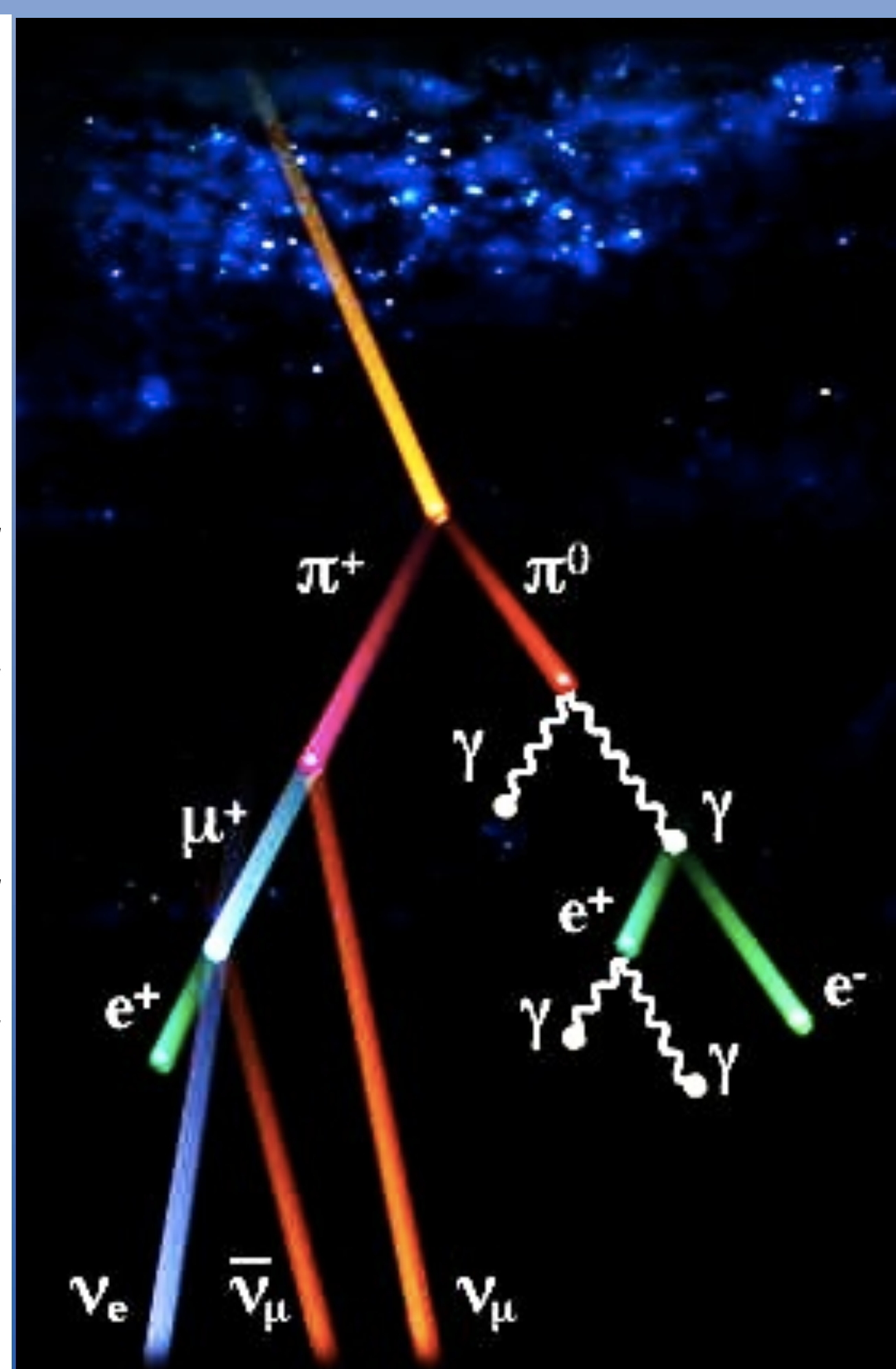
THE EXPERIMENT ATOP THE BPS



The cosmic ray detector was placed on the top of the roof of the six-story BPS building in order to eliminate absorption of cosmic rays by building materials. Three ten-minute counts were done for each orientation of the rectangular scintillator. The performance of the detector was good during the first three trials and poor through the last three trials (missing events, counting multiples for single events and stopping altogether).

A COSMIC RAY CASCADE

- Cosmic ray primaries consist principally of charged particles (usually protons).
- Atmospheric collisions lead to secondaries, which are pions decaying to muons and electrons.
- Cosmic ray primaries, move nearly 1000 times the speed of solar wind particles.
- The much higher speed of cosmic ray primaries should cause the Earth's magnetic field to have far less effect on the deviation of their paths.
- Therefore, measurements of cosmic ray intensity should not depend on the orientation of the detector scintillators as they are rotated within the same plane.



EXPERIMENTAL DATA

Orientation	Trial 1	Trial 2	Trial 3	Average Counts	Average Count Rate (cps)	Uncertainty
North – South	221	215	216	217	0.362	0.0246
East – West	187	140	164	163.67	0.272	0.0213

Analysis:

- The data shows an average cosmic ray detection rate of 0.362 ± 0.0246 cps when the orientation of the length of the scintillator in the detector is north – south. When oriented east – west, the count rate dropped to 0.272 ± 0.0213 cps.
- Given the indicated uncertainty in count measurement, we have not shown that the count rate is irrespective of the orientation of the detector in the Earth's magnetic field.
- However, the uncertainty specified only accounts for the uncertainty in the counts ($N \pm N^{1/2}$). This does not include additional errors that were obviously present during the east – west trials. Given this weak confidence in the equipment, it is doubtful that a conclusive statement can be made with the present data.
- Improvements to this experiment could be realized through the use of more reliable equipment and taking data collection over longer time periods. Additionally, adding an angle of inclination would be interesting to investigate.

