

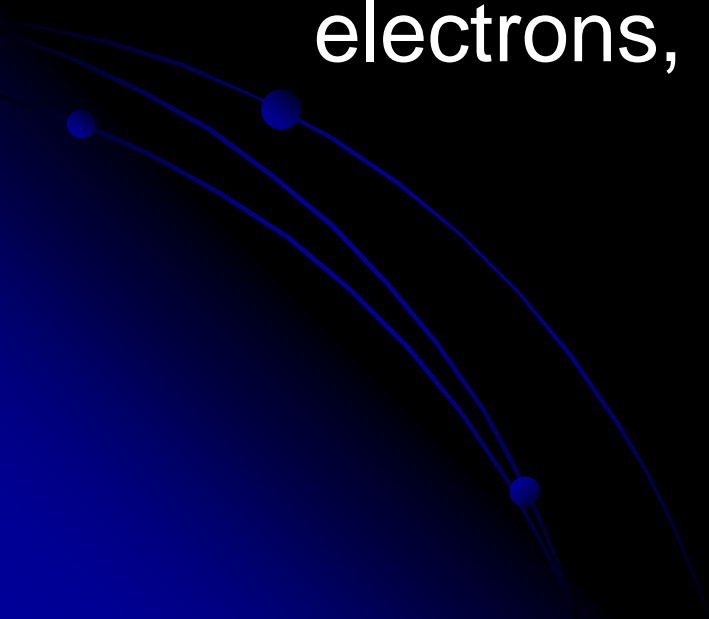
Muon Showers



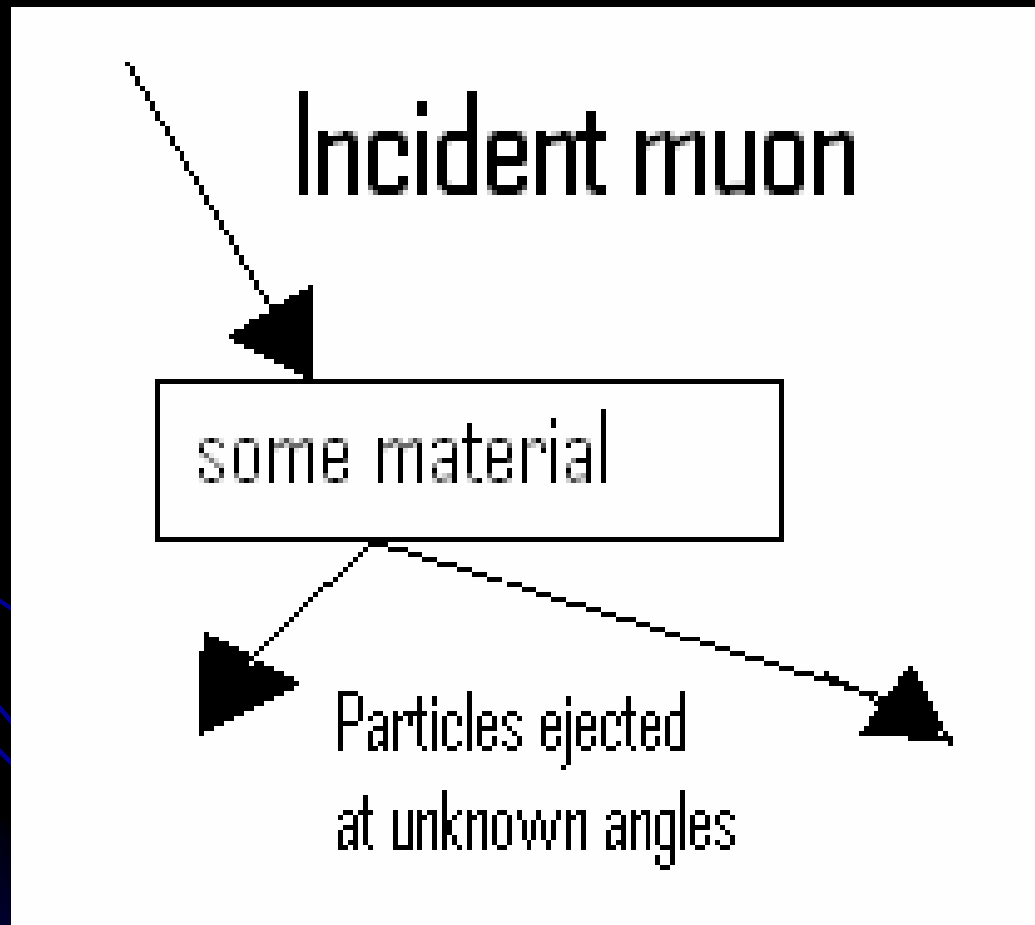
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What are muon showers?

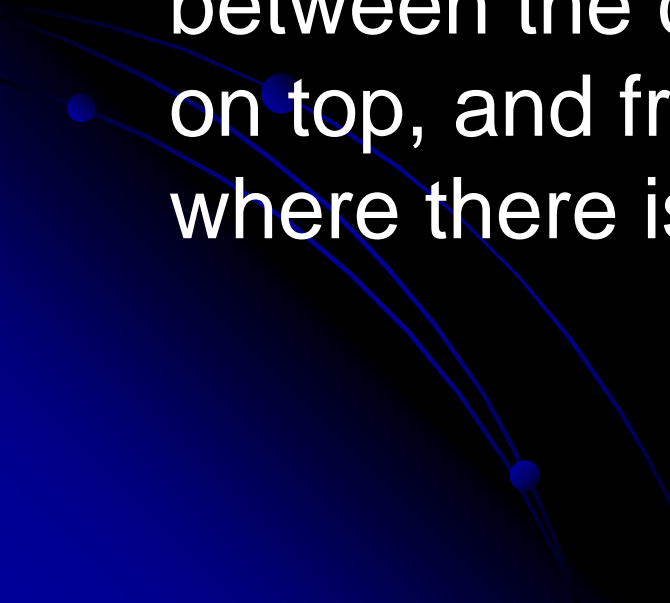
Muon showers occur when high-energy muons strike the surface of a material, collide with orbital electrons, and eject them from the atoms.



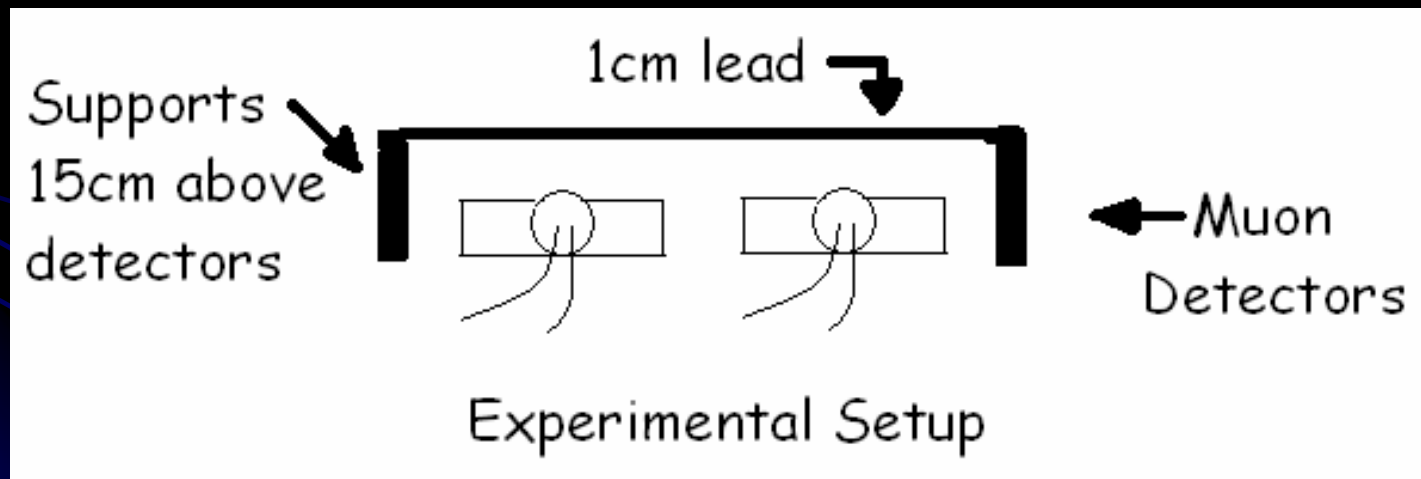
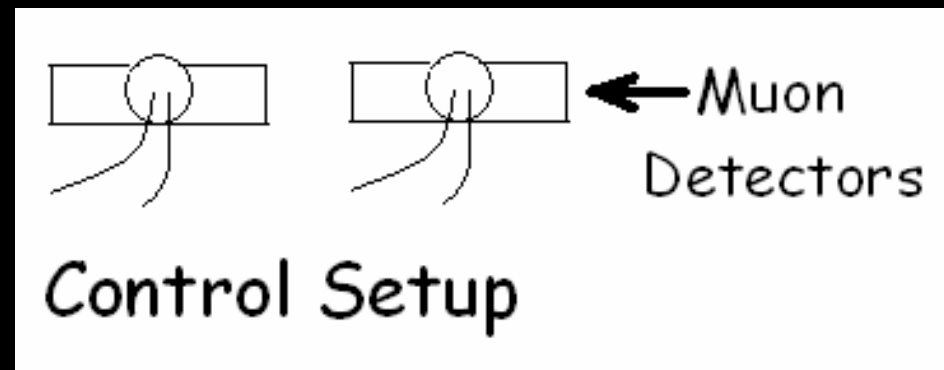
How a muon shower happens?



Experimental problem.

- To see if muon showers are created when lead is placed over the muon detectors.
 - Evaluate if there is a significant difference between the controlled set up with no lead on top, and from the experimental set up where there is lead above the detectors.
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What the experiment looked like-

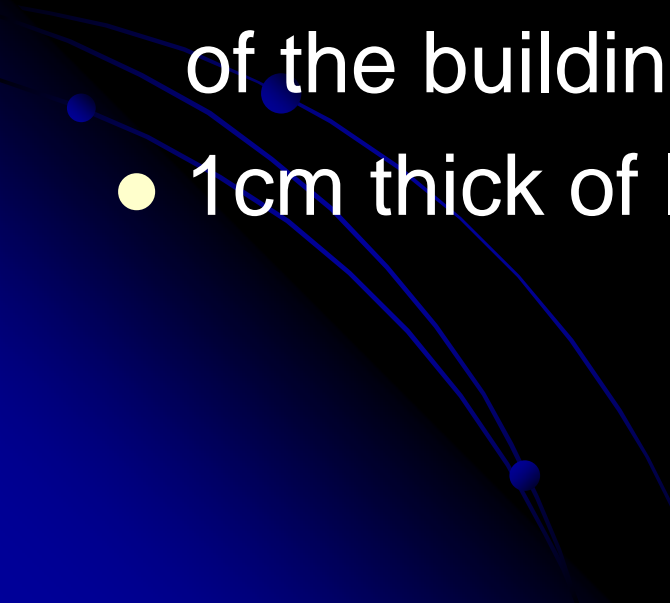


-1 cm of lead was used so muons would not be absorbed
-Height is 15 cm above so angles are shorter

Set up

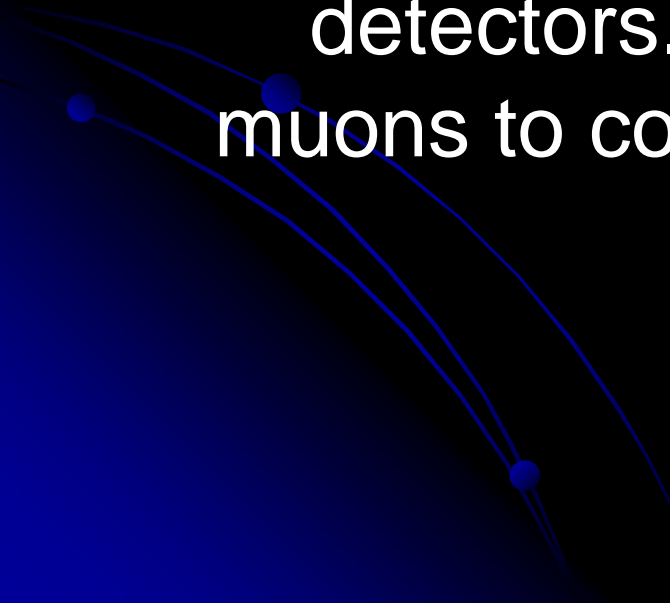


The experiment

- Multiple trials were done for both the controlled and non-controlled experiments.
 - All trials were set for three hours.
 - All the trials were set up in the same area of the building.
 - 1cm thick of lead 15cm above detectors.
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Hypothesis

We believed that when we placed lead over the detectors there would be more counts of muons or electrons passing through the detectors. The lead would cause the muons to collide with electrons creating a showering effect.



Results-

Avg	Control (no lead)	Experimental (1 cm of lead)	Differences
Counts	599 ± 24.5	3386 ± 58.2	2787
Rate	3.36 Hz	13.86 Hz	10.5 Hz

% difference = 465.3%

Conclusion-

- Muon showers were created when the lead was placed above the detectors.
- There was a significant difference between the controlled and the experimental setups.
- Our hypothesis was justified by having many more muons pass through the detectors in the experimental setup.
- The number of hits in the controlled setup was more than expected. This was most likely caused by a Muon shower from the roof of the building. Also it is possible that two muons traveled through the detectors at the same time.

Possible follow up experiments

- Change lead height above detector
 - Change thickness of lead
 - Use different material other than lead
 - Change area
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