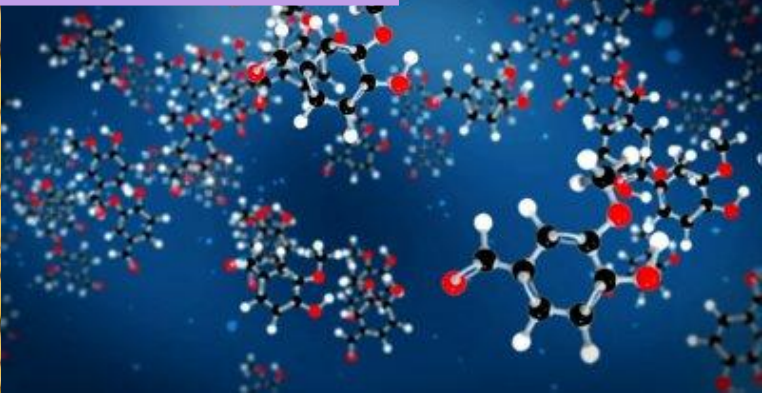
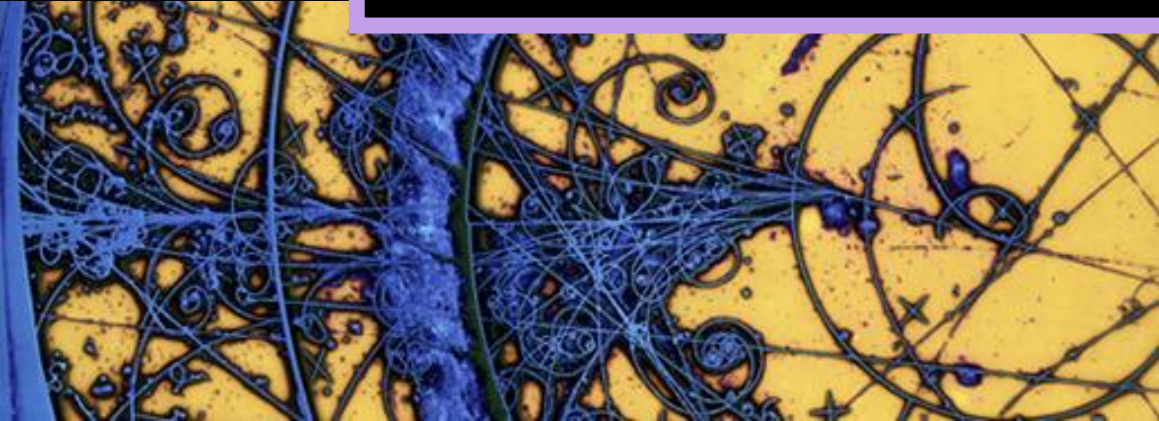
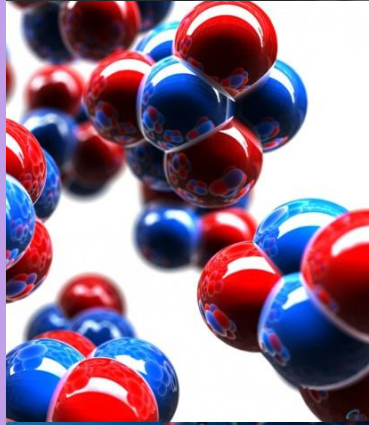


Particle Physics
with the Cloud Chamber
Jes Ford
PhD Student at UBC



WHAT IS IN THIS JAR?



Video: Particles

http://www.ted.com/talks/just_how_small_is_an_atom

Seeing particles???

How can we see these particles if they are so **tiny**?!

Seeing particles???

How can we see these particles if they are so **tiny**?!

What if we had a way to **track** the particles and see the path they had followed?

Seeing particles???

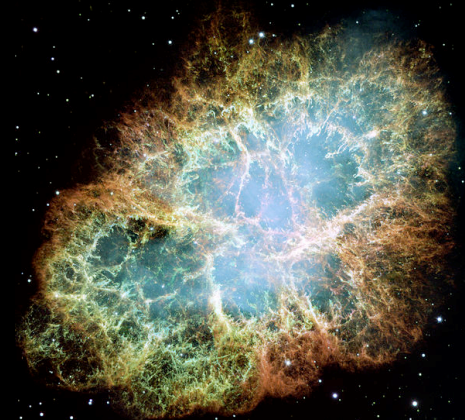
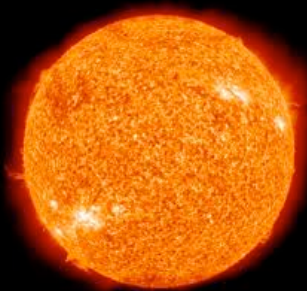
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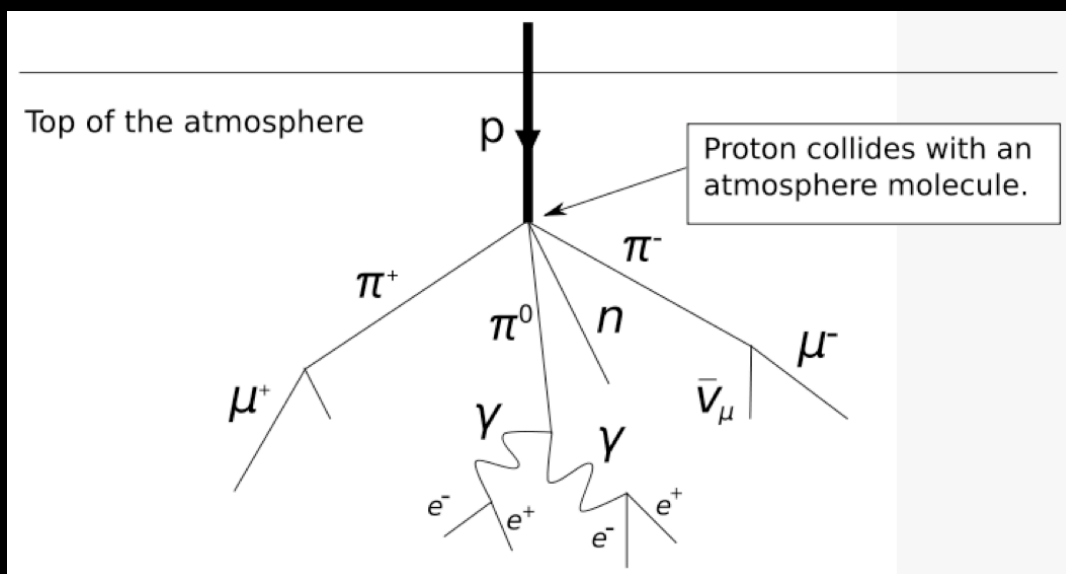
This is where the **Cloud Chamber** comes in!

Cosmic Rays

Particles from the sun & other stars, the moon, galaxies, black holes, supernovae...

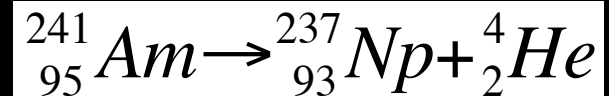
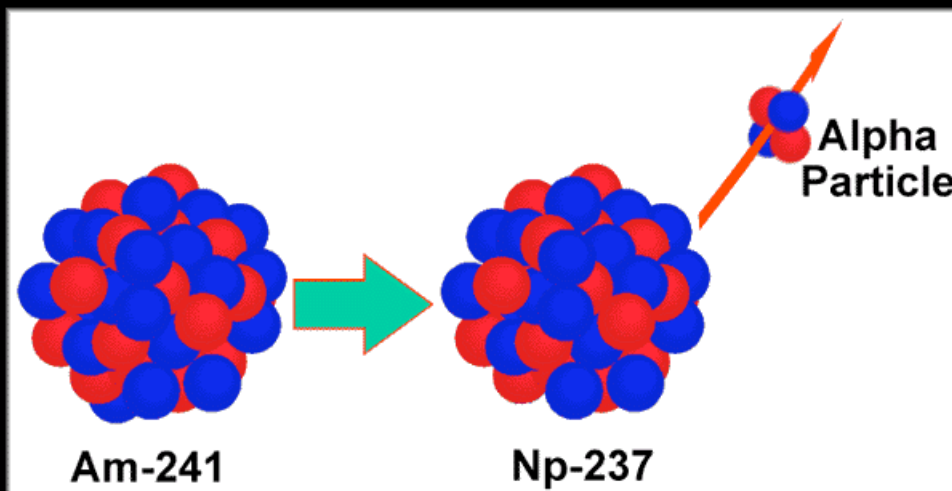
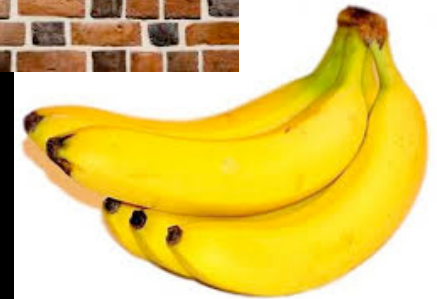
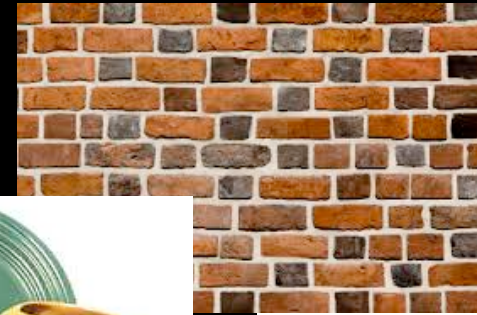


Particle Showers



Earthly sources of radiation

- Dirt, rocks, bricks, pottery
- People
- Bananas (Potassium)
- Smoke detectors: Americium-241



WE'RE GONNA MAKE A CLOUD CHAMBER
(YOUR STUFF - DON'T TOUCH YET!)



WEARING GLOVES AND USING THE MAT, MAKE THE FOLLOWING...



1. PUT THE SPONGE IN FIRST.

2. MAKE SURE THE PLASTICINE SEAL IS NOT TOO THIN, NOT TOO THICK.

3. TRY NOT TO SMUDGE THE GLASS WITH YOUR OILY HANDS.



1. WE'RE GOING TO DISPENSE THE ISOPROPANOL ONE GROUP AT A TIME.

2. ONCE YOU GET THE ISOPROPANOL, SECURE THE GLASS TO THE FOIL, LIKE IN THE PICTURE.

3. MAKE SURE THERE ARE NO HOLES IN THE SEAL (THIS IS REALLY IMPORTANT!)

4. ONCE THIS IS DONE, YOU ARE NOW READY FOR THE DRY ICE, WHICH WILL BE DONE IN THE DARK LECTURE HALL. YOU CAN FLIP IT FOIL SIDE UP AS WE WAIT FOR THE REST OF THE CLASS.

Video: Cloud Chamber

<https://www.youtube.com/watch?v=E9335CW2V5M>



LAB RULES

1. FOLLOW INSTRUCTIONS - **SAFETY FIRST**
 - a) EQUIPMENT
 - b) CHEMICALS
 - c) PROTOCOL
2. NO EATING OR DRINKING IN LAB
3. NO GOOFING ON THE CHAIRS
4. IF YOU'RE NOT SURE, ASK SOMEONE

WEARING GLOVES AND USING THE MAT, MAKE THE FOLLOWING...



1. PUT THE SPONGE IN FIRST.

2. MAKE SURE THE PLASTICINE SEAL IS NOT TOO THIN, NOT TOO THICK.

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READY?

Types of Particle Tracks

α - Thick, short, straight (smoke-detector source)

alpha particles are Helium nuclei (2 protons + 2 neutrons)

β - thin, wispy, irregular

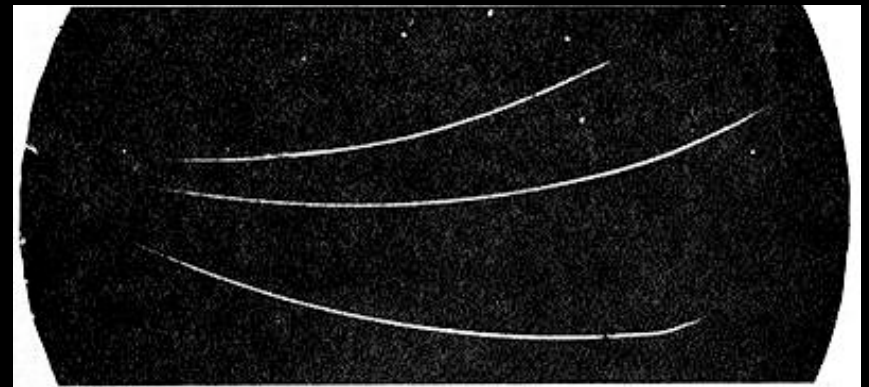
beta particles are just electrons

γ - long, thin, straight

gamma particles are high energy photons (light particles)

μ - longest thin tracks (most common)

muons are basically heavy electrons (same electric charge but about 200 times more massive)



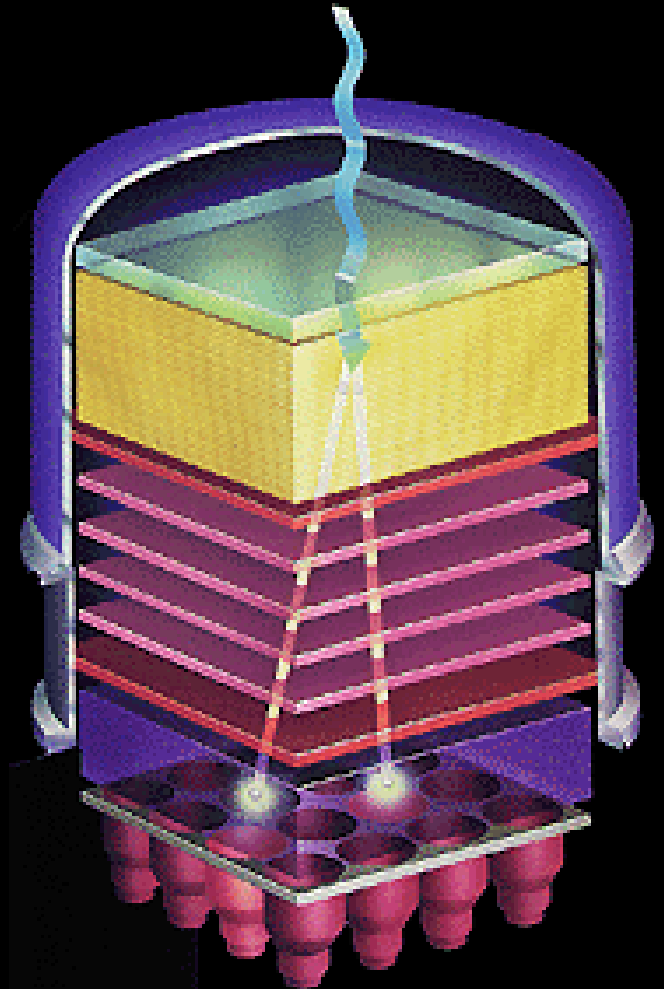
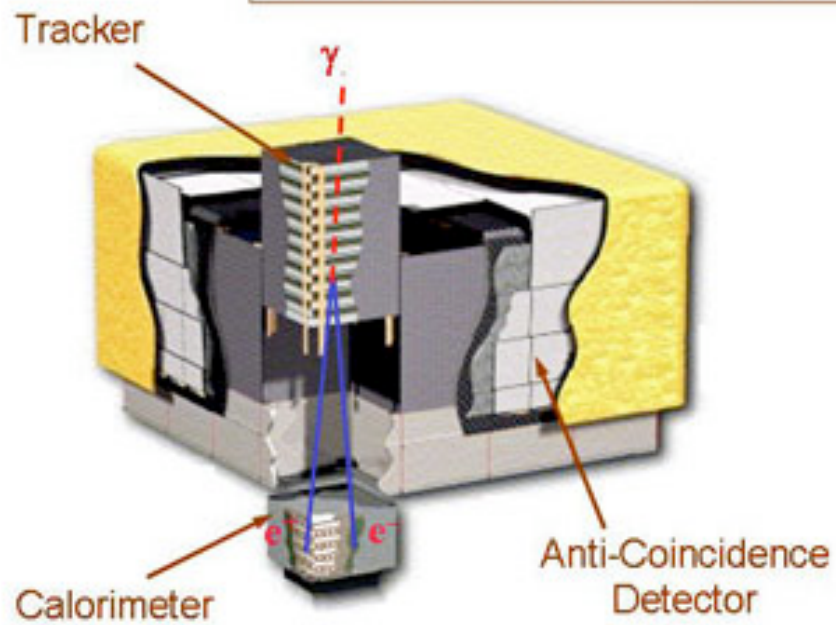
Indirect Measurements

- In science we often rely on are **indirect measurements** like the cloud chamber





Cutaway of the Large-Area Telescope of the Fermi Gamma-ray Space Telescope





Evidence for Dark Matter: **The Bullet Cluster**



Hot gas (normal matter)
Galaxies (normal matter)
Dark Matter

What is Dark Matter?

- **We don't know what it is...**
- **What we know:**
 - Its invisible
 - It has a lot of gravity
 - It is all around us



Video:
Fly Through the Universe

<http://www.youtube.com/watch?v=08LBItEpdZw>