Serrata Cloud Chamber
Cat. No. 1085008

Introduction:

The **cloud chamber**, also known as the Wilson chamber, is used for detecting particles of ionizing radiation. In its most basic form, a cloud chamber is a sealed environment containing a supercooled, supersaturated water vapour. When an alpha particle or beta particle interacts with the mixture, it ionises it. The resulting ions act as condensation nuclei, around which a mist will form (because the mixture is on the point of condensation). The high energies of alpha and beta particles mean that a trail is left, due to many ions being produced along the path of the charged particle.

These tracks have distinctive shapes (for example an alpha particle's track is broad and straight, while an electron's is thinner and shows more evidence of deflection).

When a vertical magnetic field is applied, positively and negatively charged particles will curve in opposite directions.

That is how the positron; an electron that curves the other way, was discovered.

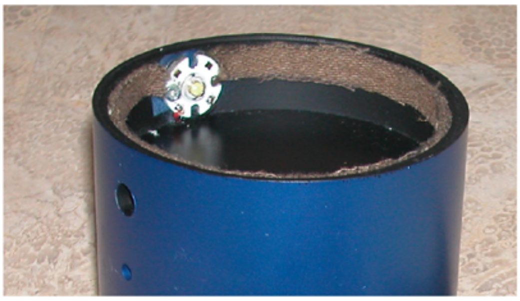

Fig. 1

Charles Thomson Rees Wilson (1869-1959), a Scottish physicist, is credited with inventing the cloud chamber. In Wilson's original chamber the air inside the sealed device was saturated with water vapour, then a diaphragm is used to expand the air inside the chamber (adiabatic expansion). This cools the air and water vapour starts to condense. When an ionizing particle passes through the chamber, water vapour condenses on the resulting ions and the trail of the particle is visible in the vapour cloud. Wilson, along with Arthur Compton, received the Nobel Prize for Physics in 1927 for his work on the cloud chamber.

The diffusion cloud chamber was later developed in 1936 by Alexander Langsdorf. This chamber differs from the expansion cloud chamber in that it is continuously sensitized to radiation and that the bottom must be cooled to a rather low temperature, generally as cold as or colder than dry ice. Alcohol vapour is also used due to its different phase transition temperatures.

Fig. 2

The diffusion cloud chamber consist of two main parts, the top section being the actual cloud chamber **(Fig.1)** where radioactive particle tracks can be observed.

The bottom section **(Fig.2)** provides the cooling mechanism which consist of a second chamber for dry ice.

The heart of the diffusion cloud chamber is a small chamber that is at atmospheric pressure. Liquid methyl alcohol has been introduced into the chamber by saturating a sponge on the top interior of the chamber. The chamber is then sealed. The bottom of the chamber is maintained at a much cooler temperature by being in contact with dry ice. The temperature gradient that is set up by the difference in temperature allows for the continuous evaporation of the methyl alcohol off of the top interior of the chamber and the continuous production of a supersaturated methyl alcohol solution in air towards the bottom of the chamber as the alcohol diffuses downwards into the very cold air.

The cloud chamber is very simple to use. Safety precautions should be observed.

Safety Precautions:

- Radioactive sources should not be handled with bare hands. Touch only the cork.
- Sources should be clearly labelled and properly stored in their container.
- Replacement of school sources every 10 years is recommended.
- Avoid touching the dry ice with your fingers.

Setting Up and Using the Cloud Chamber:

It is worth checking the following items before an experiment is set up:

- Ensure that the base is black
- If necessary repaint the surface with hobby enamel paint and allow to dry.
- Ensure that dry ice has been ordered for the required time. Dry ice will last a maximum of 2 days in an ordinary freezer. It can be purchased from the warehouses of the major ice-cream manufacturers. Some companies will also delivers block of dry ice to the school, providing they already supply the school canteen.

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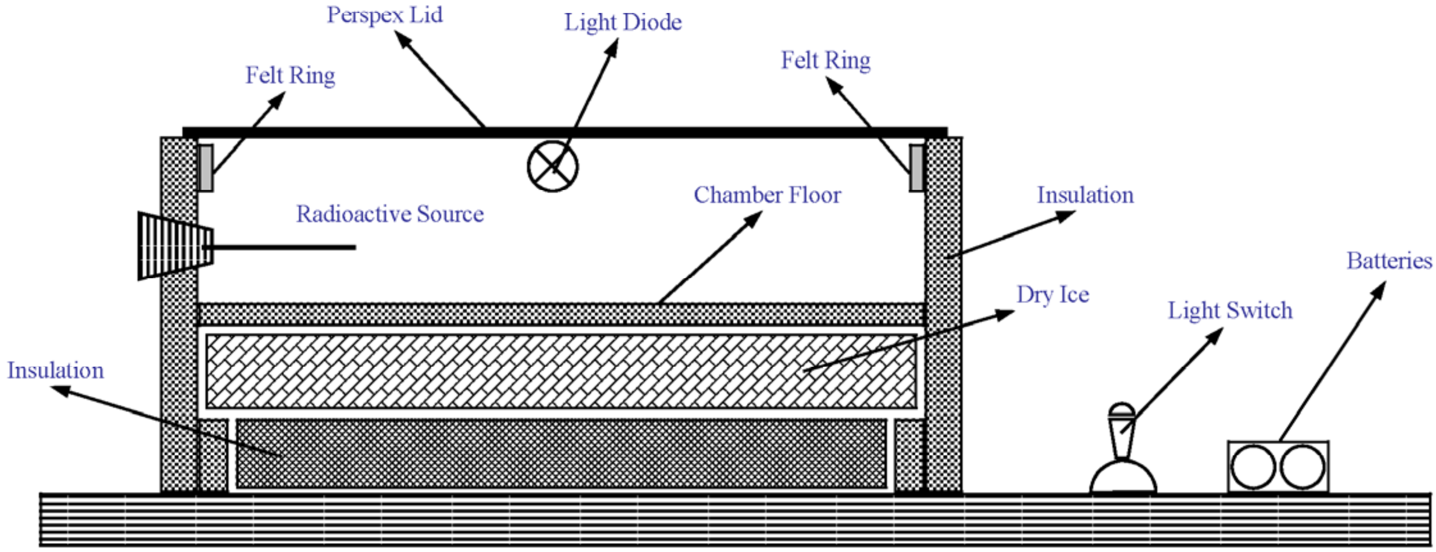
Extra equipment for the suggested learning experiences includes:

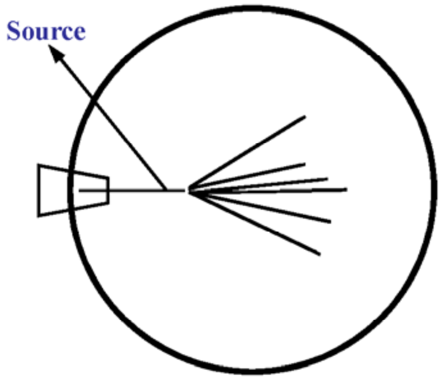
- dry ice
- gloves or tongs to handle the dry ice.
- hammer
- alcohol (Methyl Alcohol/Methylated Spirit) and dropper
- flannel cloth
- radioactive source - supplied with the chamber



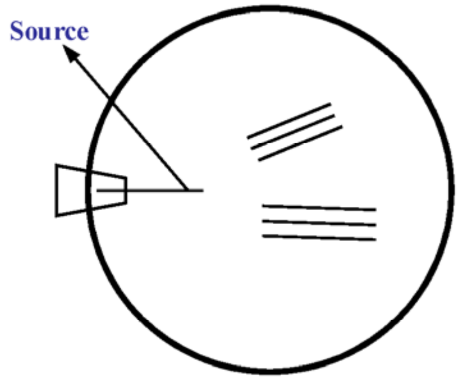
- Place the dry ice between sheets of newspaper and, using a hammer. break the ice into small pieces (not crushed).
- Place the (dry ice into the lower section of your cloud chamber and set it up to ensure there is maximum surface area contact with the upper chamber.
- Close the bottom section.
- Open the Perspex lid of the top chamber and soak the felt ring with alcohol so that the air inside the chamber is super-saturated. (If in doubt, use more rather than less alcohol.)
- Replace the lid and wait 1-2 minutes.
- Turn the light on. The light is bright but not hot.
- Insert the radioactive source into the small hole in the side of the chamber. On the background of the chamber floor tiny vapour trails will appear into the mist, close to the end of the radioactive source.
- Repeatedly rub the Perspex lid with a flannel cloth in order to give it an electrostatic charge.

Suggested Learning Experiences:

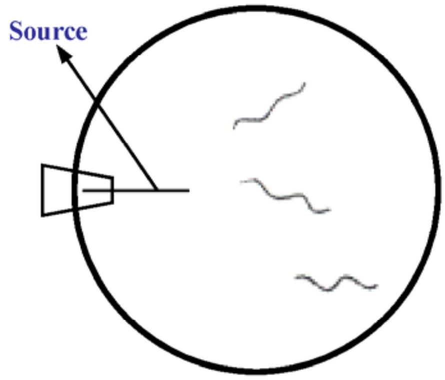
1. Observe α (alpha) particle tracks as short, shooting lines radiating from an α source such as Americium-241 (see below).
2. Observe the tracks from a β (beta) source such as Strontium-90 or Caesium-137. These are seen as faint wavelike, parallel lines visible only for a short period of time (see below).
3. Observe γ (gamma) or X-ray tracks from a source such as Cobalt-60. These are seen very obvious squiggly lines that follow a short. random path (see below).



α Particles Tracks



β Particles Tracks



γ Particles Tracks