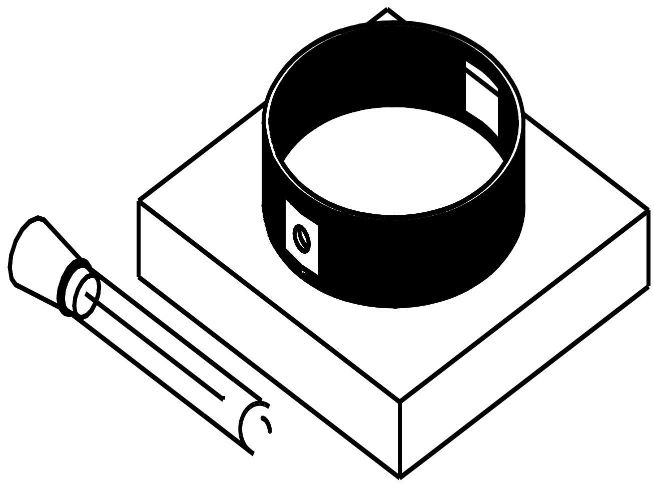
16760 CLOUD CHAMBER WITH SOURCE

Purpose:

To detect and observe the paths of particles emitted from radio active sources.

Additional Required Materials:



Alcohol (Ethyl or Methyl)
High intensity light source (or flashlight)
Dry Ice, OR
- Liquid nitrogen (welding supply stores)
- Plastic dish (or paper plate lined with plastic)

Styrofoam or cardboard container

The enclosed Coupon must be mailed away before the apparatus can be used for demonstration. Be sure to include your return address on both parts of the form. When the actual fresh radioactive source arrives by return mail, it will include appropriate cautions for the user.

Background:

Many devices have been constructed to detect and observe ionizing radiation. The Geiger counter is a gas filled tube with a charged wire along its axis. When a high energy particle enters the tube, the gas is ionized and begins to conduct electricity. This causes an electrical "short" between the charged wire and the case of the tube. Thus the high energy particles entering the tube can be counted electronically.

The scintillation detector also counts individual high energy particles, however, when this counter is struck by such a particle a flash of light is emitted. This light is then detected and recorded on a counter. A diode detector will produce a small pulse of current when a high energy particle forces charge to move across the diode junction against the normal bias of the diode.

These types of detectors provide the experimenter with accurate data regarding the number of high energy particles detected but provide little information regarding the charge or motion of the particle.

Three other types of detectors rely upon the high energy particle creating a visible trail. Ordinary photographic emulsion will record the ions left behind by the interaction of the high energy particle as it passes through the film.

The bubble chamber uses a liquid heated to a temperature near its boiling point. Charged particles passing through the liquid produce a trail of bubbles that can be photographed to show the particle's path.

The cloud chamber uses a gas vapor cooled to a temperature just below its condensation temperature to detect particles. As a high energy particle passes through the gas, ions are created and condensation is initiated on these ions. This condensation track can be photographed to obtain a permanent record.

Procedure:

Remove the paper blotters from the clear plastic chamber. Leave black cardboard base in the chamber. Soak the blotters in alcohol then return them to the chamber. The blotters must be adjusted so the hole in the side of the chamber is not blocked but the gap between blotters must also be as small as possible. The viewing will be better sooner and last longer if alcohol is also poured on the black cardboard to the extent that it will be absorbed and not form a "lake." Cover the chamber with it's lid and warm in the hands for a minute or so. The point is to allow the alcohol to vaporize well, displacing water vapor.

Carefully remove the stopper containing the alpha and beta particle sources from its container and insert the stopper into the hole in the side of the chamber. Position the tip of the source near the center of the chamber and as close to the bottom of the chamber as possible.

With Liquid Nitrogen:

Place the chamber in the plastic dish then slowly pour a small amount of liquid nitrogen into the dish around the base of the chamber. This will cool the alcohol vapor within the chamber. If wisps of fog develop around the edges and bottom of the chamber, remove the chamber from the liquid nitrogen to prevent cooling the chamber too much. It is at this stage when the alpha and beta particles will begin to leave visible trails. You should be looking for thin white lines of condensation that originate near the tip of the radio active source and travel outward in all directions. These trails may be difficult to see at first. A little patience and experimentation will be required to obtain successful results. In general, alpha tracks are thicker and of shorter range than beta tracks, but tracks might be short because the particle passed outside of the susceptible layer. The condensation droplets immediately settle, which clears the field of view so the subsequent tracks can be seen.

If the wisps of fog disappear, return the chamber to the liquid nitrogen to chill the vapor again. If the chamber becomes too cold, the vapor will cloud and the best approach at this point is to start over. Open the lid and air out the chamber. Add more alcohol if necessary and replace the lid. Begin cooling the chamber again and look for evidence of fogging.

With Dry Ice:

Place a slab of dry ice in the bottom of a shallow Styrofoam or cardboard tray to cut down on room air circulation. Place the chamber on the slab, and proceed as described above.

Helpful Hints:

- Extinguish any overhead room lights, and close blinds and drapes.
- Shine the high intensity light ***horizontally*** through the chamber (not from the top down!).
- The sensitive volume will form a definite layer parallel with the black cardboard.
- Place the needle tip close to the base of the chamber (1/16 to 1/8 inch from chamber floor).
- Avoid icing by lifting the chamber out of the coolant when the chamber begins to fog.
- Avoid breathing on the chamber, as this will fog the top.
- Avoid touching the end of the needle to anything, especially the alcohol soaked parts.
- Patience! It takes a little practice to get it right!
- A very sensitive video camera may be used to feed a large monitor or for recording results.

Time Allocation:

Allow at least twenty minutes to prepare this product for each use. On the other hand, when it is ready, it is truly ready and may then give satisfactory viewing for only the next five or ten minutes before needing to be initialized all over again. Individual experiment times will vary depending on methods of instruction, needs of students, and the facility one has developed, but a useful range of observations normally will not exceed one class period.

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