

Cloud Chamber Experiment

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Description:

The cloud chamber that we are building is based on a design that is described at the following address:

www.scidiv.bcc.ctc.edu/Physics/Cloudchmbr.htm

We will use a large plastic pickle jar to make a low tech cloud chamber. The metal lid of the jar will become the bottom of the detector. We will use a piece of Plexiglas as a cover. Silicone aquarium adhesive will be used as a sealant between the Plexiglas cover and the jar. We will use black color fast cotton bonded paper to line the sides of the jar. A Styrofoam cooler will be used to hold the dry ice and the detector.

Very pure ethanol mixed with black ink will be the medium used to see the cosmic rays. The ethanol will evaporate in the warm top end of the chamber and condense on particles that have been ionized by radiation in the cold bottom end of the chamber.

Materials:

- large plastic or glass jar with a metal lid: if using plastic, the jar should be #1 plastic which will not be degraded by ethanol
- flat cover: glass, Plexiglas or a clear #1 plastic should work
- silicone: 'aquarium adhesive'
- black color fast paper
- solid CO_2 (dry ice)
- very pure ethanol: 98% pure
- black ink
- wax paper
- light source: 150W or better, a maglite flashlight works well
- radioactive sources: optional

Construction

1. Cut the jar 10 cm from the metal lid. The cut should be parallel to the flat surface of the lid. Apply silicone adhesive to the cut edge of the jar. Place this edge of the jar on a flat surface lined with wax paper to dry.
2. Cut the black paper to the appropriate size so that it will line the edge of the jar. Leave a 2.5 cm narrow slot on the side of the jar. You may use a second strip of paper if you wish. The first strip will be the height of the chamber and have a length that is the circumference of the lid minus 2.5 cm. The second strip, if used, will be the circumference of the container minus 2.5 cm.
3. Cut a hole in the top of the Styrofoam cooler the diameter of the lid of the jar. Cut the cooler to a height where the lid can fit upside down on the cooler.

Assembly:

1. Wearing gloves trim the dry ice to fit in the cooler.
2. Place the cooler lid over the ice. Place the jar upside down on the ice so that the metal lid is touching the surface of the ice. The lid should be nestled in the hold cut for it.
3. Place the paper inside the jar. Add enough ethanol into the chamber so that it wets the paper and pools in the bottom of the chamber. Add black ink to the ethanol in the bottom of the chamber. *ALTERNATIVE TO BLACK INK: You may also use a piece of black paper to line the bottom of the chamber (i.e. the metal lid).*
4. Position the light source so that it comes in at a low angle through the gap in the paper. A small, very bright light source (such as a maglite flashlight) works best.
5. Turn off lights in the room.
6. Look for naturally occurring radiation in the room.

Trouble Shooting:

1. Be sure there is enough alcohol in the chamber.
2. Be sure the chamber is cold enough. The bottom of the chamber needs to be cold.
3. Be sure the chamber is not too cold. The top of the chamber needs to be warm. If the chamber is too cold, try warming the top with your hands.
4. Be sure the chamber is level. If it is not, convection currents could interfere with cloud paths.

5. Make sure the seal between the cover and jar is tight. If there are gaps, ethanol vapors could escape. If the seal is not tight, try using some petroleum jelly on top of the adhesive to help seal any gaps.
6. Play with the light angle. Horizontal seems to work best.
7. Try charging the chamber. Use a statically charged balloon or a piece of fur.