Experiment Notebook Format

Students are required to work individually (although doses ordered specifically for experiments may be shared). These experiments are time consuming so plan accordingly. Do not expect to complete these in 1 day!!!! Read through the experiment and make sure you have all supplies on hand before beginning. Allow time to repeat an experiment if your data is found to be inconsistent or inaccurate.

Cheating in any form will not be tolerated. Sharing data/answers with other current or former class members and/or fudging data are strictly prohibited.

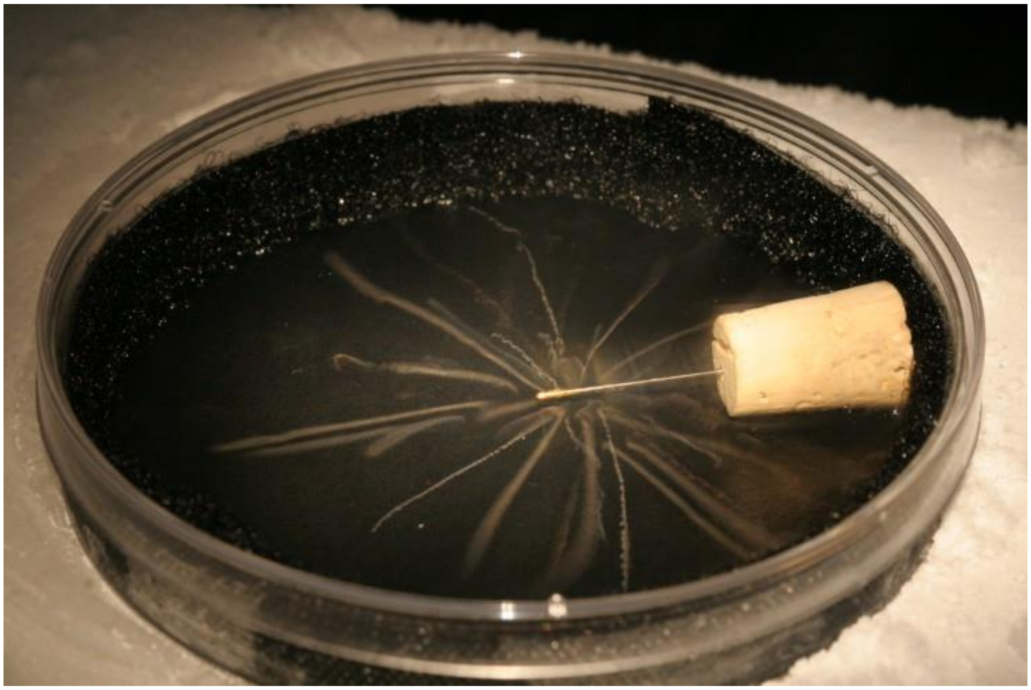
Format

Typewritten report must include:

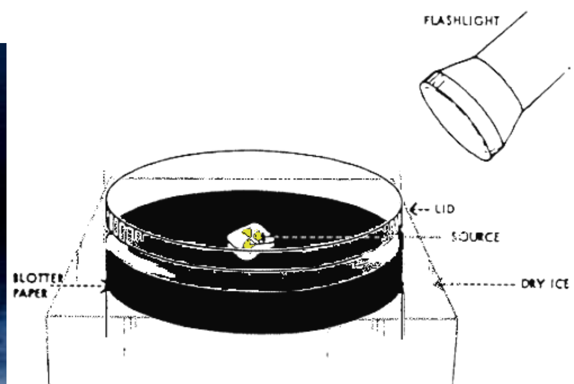
1) Title Page with Name and Date(s) of Experiment
2) Table of Contents
3) Experiment Body to include:
   - Purpose
   - Description of Procedure (do not copy the procedure in this write-up. Instead, detail the steps you took noting any problems encountered or changes made).
   - Materials/Equipment Used
   - Technique
   - Data
   - Graphs or Films
   - Discussion of Data (Answer all questions)
4) Conclusion

These experiments are designed for independent study but should always involve appropriate supervision from clinical support staff. Experiments can be completed at any institution. Labs are to be done as time permits and must not interfere with the department's responsibility to patient care.

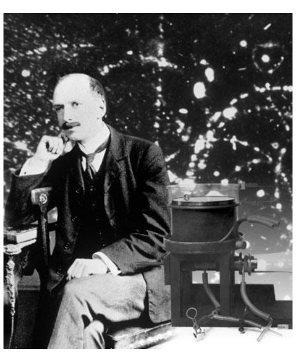
LAB A – Building A Cloud Chamber



Dry Ice



Cloud Chamber in a petri dish



Charles Thomson Rees Wilson (1869–1959)

BACKGROUND

Charles Thomson Rees Wilson (1869–1959), a Scottish physicist, is credited with inventing the cloud chamber. The cloud chamber is a particle detector used for detecting ionizing radiation in the form of water vapor trails.

Cloud chambers played a prominent role in the experimental particle physics from 1920s to the 1950s. In particular, the discoveries of the positron in 1932, the muon in 1936, both by Carl Anderson (awarded a Nobel Prize in Physics in 1936), and the kaon in 1947 were made using cloud chambers as detectors.

OBJECTIVE

In this experiment you build a simple ion chamber from a petri dish super-saturated with alcohol atop a block of dry ice. Using a radiation source provided by the Program Director, test the system and photograph the results.

MATERIALS

- Petri dish (Supplied by the Program Director)
- Black construction paper
- 91% (or higher) isopropyl alcohol (do not use 70% isopropyl alcohol)
- Scissors
- Sticky-back felt
- Pb-201 radiation source (Supplied by your Program Director)
- Flashlight
- Digital Camera with video capture capabilities (Smart phones will work)
- Small block (5 - 10 lb) of dry ice* transported in an ice chest. Dry Ice can be purchased from Save Mart or Lucky's Supermarkets. Some Safeway stores carry it as well. Be sure to bring a small cooler and oven mitts for safe handling. Dry Ice normally comes in 10-inch squares, 2 inches thick weighing about 10 pounds each square. A 5-pound brick will work as well, but you'll be under greater time constraints to complete your experiments.

IMPORTANT INFORMATION ON DRY ICE

- Dry ice is frozen CO_2, the same gas that we exhale. As it warms it skips the liquid phase and instead sublimates from a -109.3°F solid state directly into the gas stage. When transporting, make sure there is fresh air.
- Do not handle dry ice with your bare hands. Instead, use heavily insulated oven mitts.
- Dry ice will keep longer if wrapped in newspaper and stored in a cooler. The newspaper acts both as an insulator and reduces the amount of air on

the surface minimizing the rate of sublimation. If properly stored in a cooler, dry ice will last for 18-24 hours. If left outside, exposed to air, it will only last 3-5 hours. If it touches liquid, it will sublimate in minutes. Therefore, the ice chest you use to transport needs to be dry inside.

PROCEDURE

1) Cut a circle out of the construction paper that will fit inside the bottom of the petri dish.
2) Cut a strip of sticky-back felt to line the inside edge of the petri dish.
3) Thoroughly soak the felt with the isopropyl alcohol. A syringe without the needle can be used to minimize spillage onto the construction paper
4) Position the radiation source roughly in the center of the dish.
5) Put the lid on the petri dish.
6) Hold the petri dish between your hands for 10-15sec, warming to body temperature.
7) Place the petri dish atop the dry ice.
8) Turn off the lights in the room (a windowless room will minimize ambient light).
9) Shine the flashlight at an oblique angle upon the the petri dish. You will need to adjust the angle to maximize your view of the ion tracks.
10) Use your phone or camera to video the ion trails. You should also take still pictures (be sure to turn the flash off).

DATA TREATMENT

In your Discussion Section, answer the following questions:

1) What is occurring within the petri dish to produce these trails?

2) How can alpha trails be differentiated from beta trails?

3) Lead-210 mainly decays by β-. So, what is the source of the alpha trails?

4) Why can't we see gamma trails?

5) What are the daughter and granddaughter decay products of Pb-210?

6) Lead-210, its daughter and granddaughter are all _______ of one another (Isotopes, isotones, isobars, isomers).

7) The source being used for this experiment contains 0.01 microcuries of Polonium-210. Using a Geiger counter, what is the reading at the surface (in

mR/hr)? What is the 1-meter reading (in mR/hr)? What labeling or package designation is required if this source were to be shipped/mailed to another student?

8) Up until the 1950s this device was used widely in research. Propose your own suggestion of how this might be used to widen our knowledge of radiation physics.

9) In addition to your lab write-up, post your video of the chamber in action to a private YouTube link (or other online site that we can access) and copy your peers.

Source: http://education.jlab.org/frost/cloud_chamber.html