Cloud Chamber Observation Exercise

Visualizing the Invisible World of Radiation

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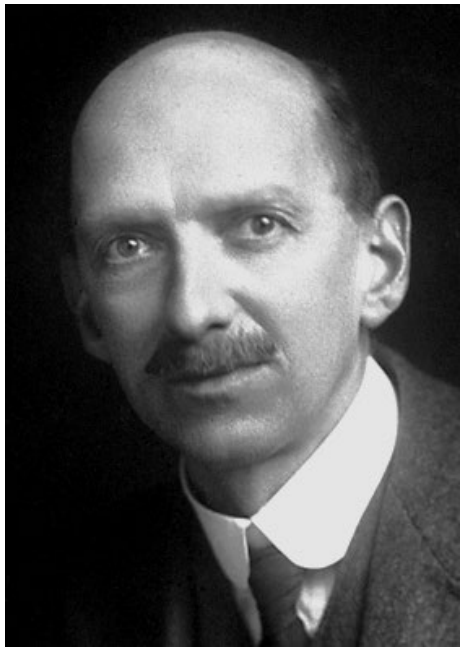
Objectives

- You will learn
  - the principle of cloud chamber
  - how to make a diffusion type cloud chamber

- You will observe radiation tracks like the vapor train of an airplane (indirect observation of radiation)

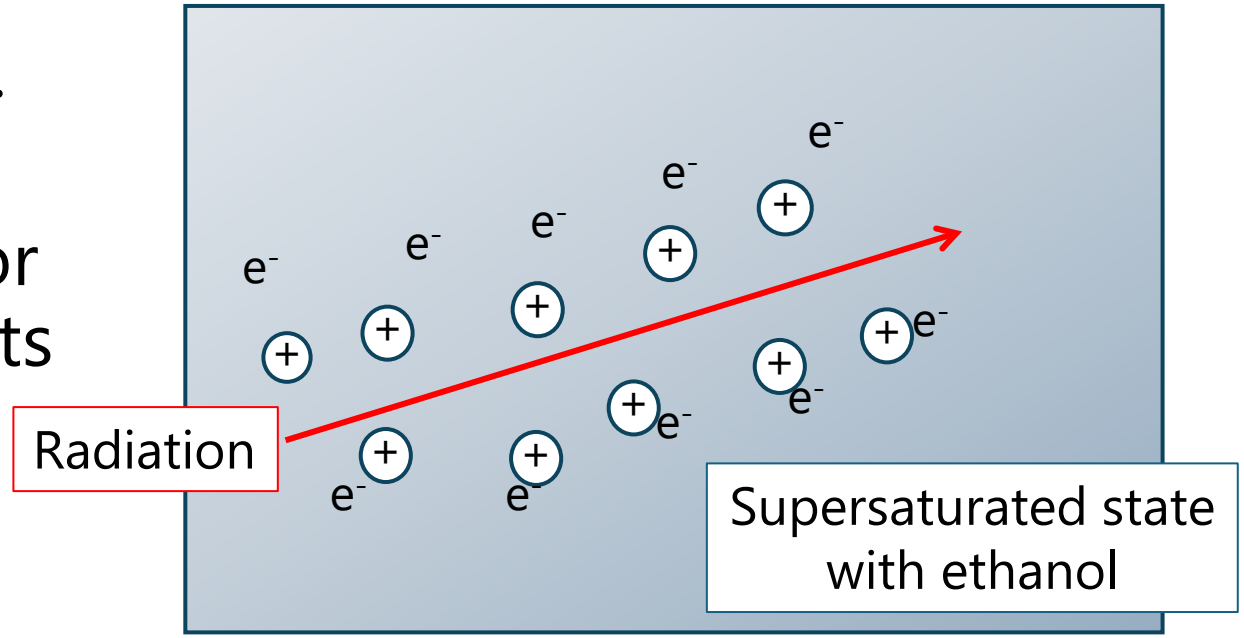
History



- The first cloud chamber was invented by Charles Thomson Rees Wilson in 1911.
- The chamber is called **Wilson cloud chamber** or expansion type cloud chamber.
- Wilson, along with Arthur Compton, received the **Novel Prize in physics** in 1927 for his work on the cloud chamber
- A diffusion type cloud chamber was developed in 1939 by Alexander Langsdorf.

Principle of cloud chamber

- When a charged radiation particle travels in a matter, it makes ions along its trajectory.
- In the **supersaturated state**, these ions gather ethanol vapor around them and make droplets
- The trajectory of the particle appears as cloud.



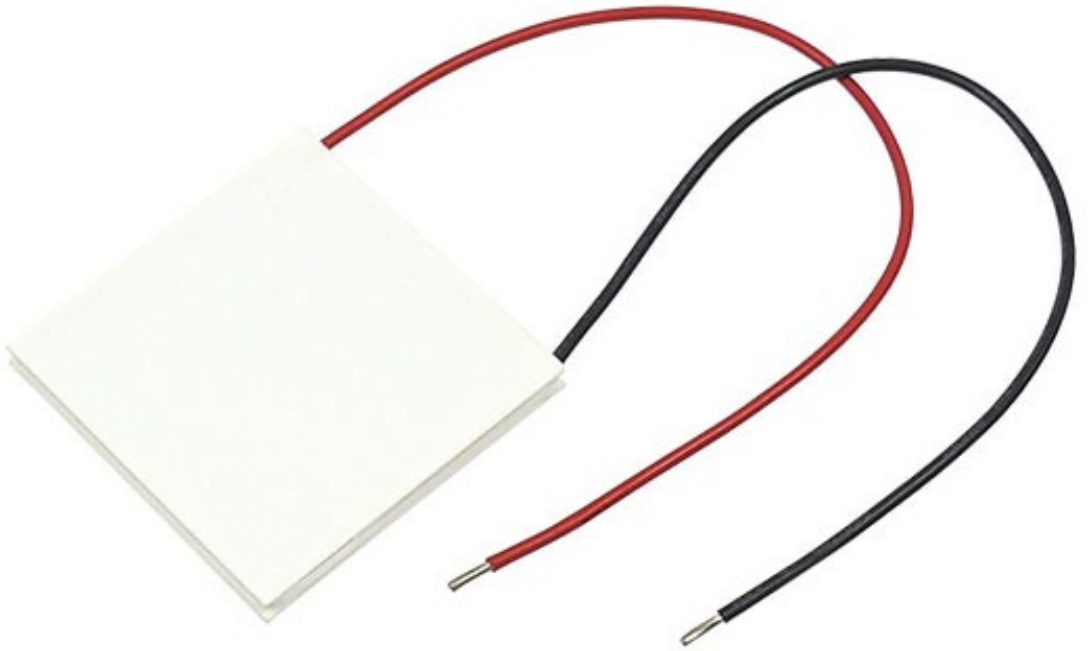
Peltier Effect Principles

- Thermoelectric Effect

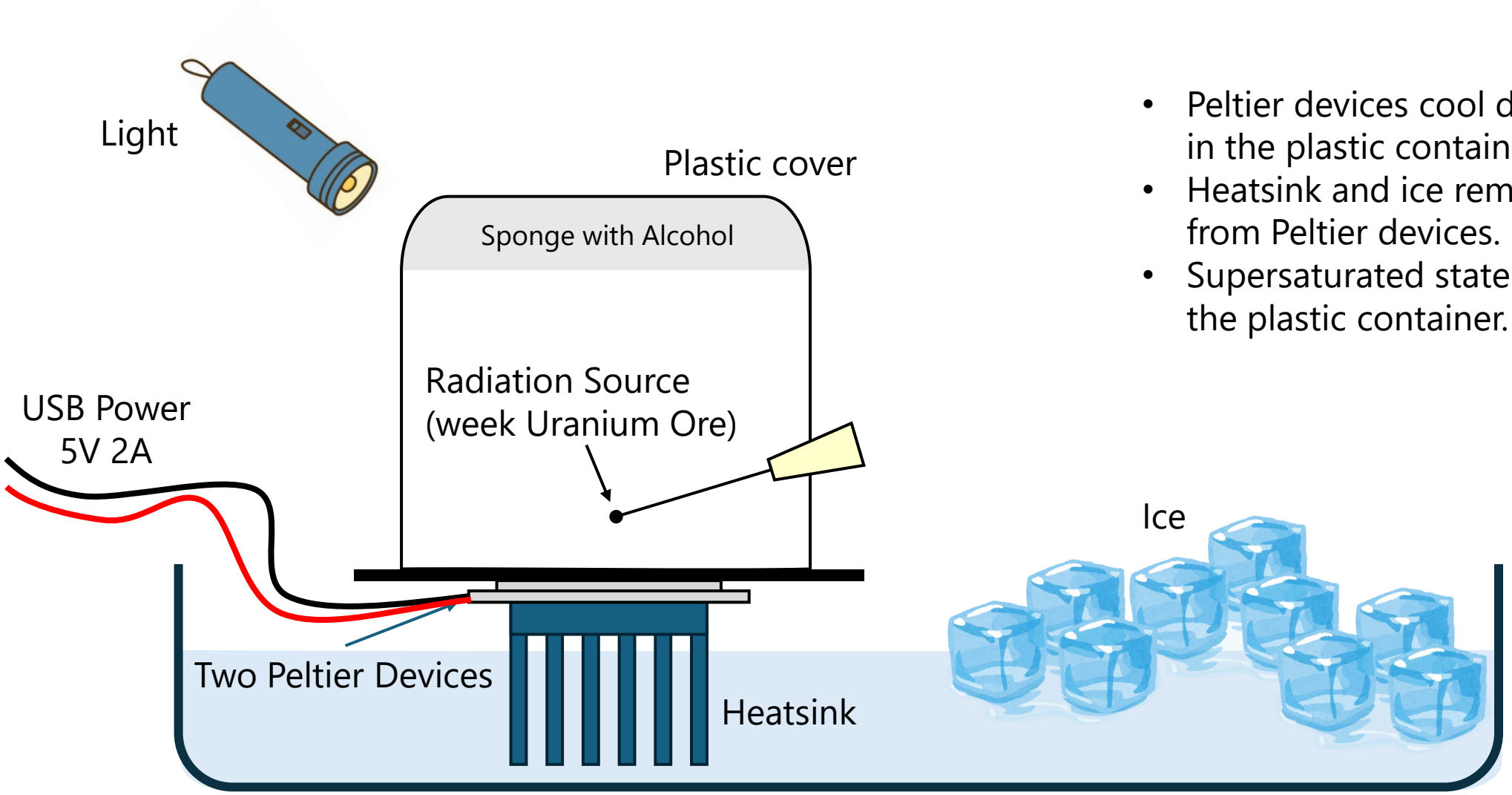
➢When electric current flows through junction of two different semiconductors:

  - One junction absorbs heat (cooling)
  - Other junction releases heat (heating)
  - Effect is reversible by changing current direction

- In this exercise, two stacked Peltier Devices are used to accelerate cooling.

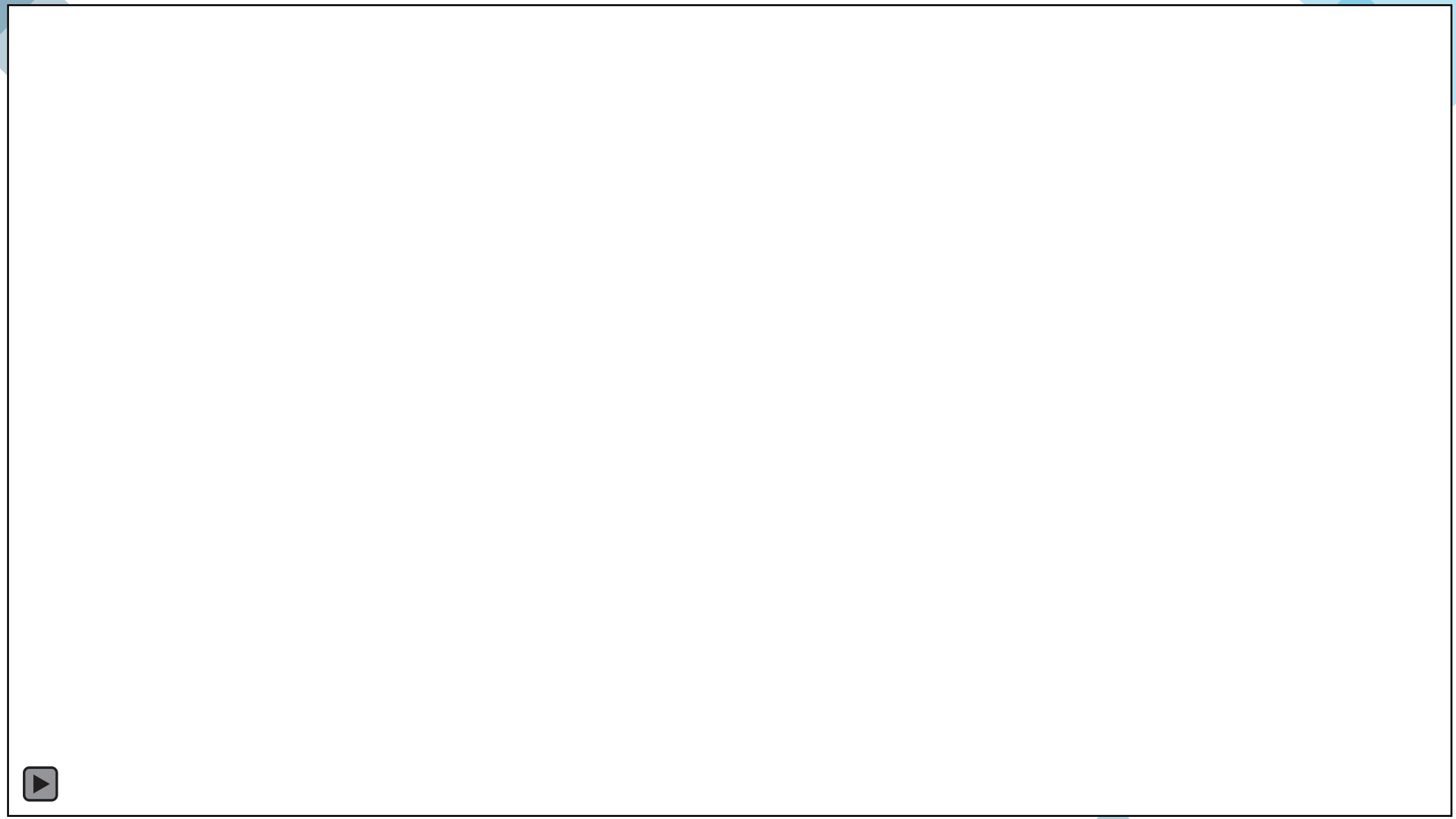


Principle of cloud chamber



- Peltier devices cool down the air in the plastic container.
- Heatsink and ice remove the heat from Peltier devices.
- Supersaturated state is formed in the plastic container.

Let’s observe the radiation!



What kinds of particles can be seen in a cloud chamber? (1/3)

1. Alpha particles

An alpha particle = a helium nucleus (He^{2+})

- An alpha particle can ionize thousands of air atoms in a short distance
- Usually, only a few cm long
- Relatively short and relatively thick tracks are observed
- Alpha tracks are the easiest to see

What kinds of particles can be seen in a cloud chamber? (2/3)

2. Beta particles

A beta particle = an electron (e^-)

- A beta particle is much smaller than an alpha particle (α is 7000 times heavier than β)
- A low energy beta particle makes a thin track that has a tortuous path

→a beta particle hits atoms, it changes the direction

What kinds of particles can be seen in a cloud chamber? (3/3)

γ rays = high energy photons

- Gamma rays have no charge

→no interaction with air inside the chamber

→you can not observe the tracks of gamma rays

- When gamma rays interact with matter, they may produce low energy free electrons

→you can observe those electrons