

Warranty

The Model 400 Diffusion Cloud Chamber is warranted by A.U. Physics Enterprises for a period of one year from date of purchase. This warranty covers any defects in workmanship or materials. It does not cover accidental damage, damage as a result of operator error, negligence, or abuse.

The included 12V DC power supply is warranted for one year by VECTOR® provided that the registration card is completed and returned to the manufacturer in a timely manner.

Liability

This product has been designed for educational demonstration purposes and for use with exempt quantity radioactive sources only! Use in research, medical, commercial, or industrial application is prohibited. Any use of this product outside of its intended purpose is done so at the risk of the end user, who shall assume full liability, and fully indemnify A.U. Physics Enterprises and its agents, for any and all damages resulting from such prohibited use.

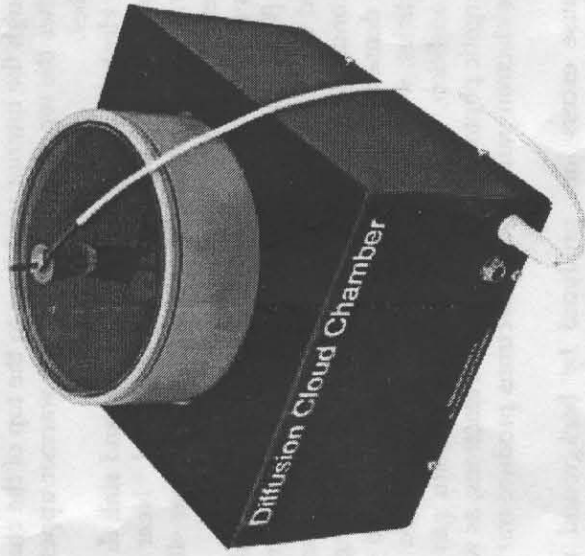
About A.U. Physics Enterprises

Started in 1977 by Bruce Lee, of the Andrews University Physics Department, Physics Enterprises began as a way to bring affordable teaching equipment to colleges and high schools at a time when most demonstration tools and lab equipment were very expensive or had to be hand-made. Now, over 25 years later, the business continues to produce quality affordable equipment that is used world wide in all levels of education!

Even more important, proceeds from the business are put right back into the educational system! Whether it is purchasing new scientific instruments and equipment, or providing scholarships and grants, A.U. Physics Enterprises is dedicated to the continuing education of tomorrow's scientists and teachers!

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Diffusion Cloud Chamber Model 400



Display nuclear particle tracks without the need for dry ice!

Includes:

- Cloud Chamber
- 12V DC Power Supply and Cable
- Circulation Pump
- 2 Rubber Hoses
- Extraction Pipette and Funnel
- Source Holder and Rubber Stopper
- High Voltage Connecting Cable

Optional:

- Pb 210 Source Needle^{†1}

Not Supplied:

- Alcohol 90% (Isopropyl recommended)
- Styrofoam Ice Chest

^{†1}Needle available from Spectech™ with coupon.

^{†1}Use only exempt quantity radioactive sources!

Operating Principle

Alcohol placed in the cloud chamber is wicked up from the bottom through the interior wall liner to the top of the chamber. As the alcohol reaches the top, it evaporates in the warmer upper region of the cloud chamber.

The alcohol vapor then begins to cool and sink to the bottom of the chamber, becoming more and more saturated. Near the bottom of the chamber, where the alcohol has been cooled to near -40°C , the vapor forms a super-saturated region.

This super-saturated region is highly unstable. As energetic α (alpha) and β (beta) particles are emitted from a radioactive source, ions are produced which serve as nuclei for the vapor to condense on. These droplets of condensation appear in the strong cross-lighting as tracks.

The dense straight tracks are produced by α and other massive charged particles, while the β particles produce faint and often crooked tracks. In addition, γ (gamma) rays interact with gas molecules to produce energetic photo electrons, Compton electrons, as well as positive and negative electron pairs. These electrons produce tracks identical to β tracks.

Because excess ions produced by background radiation and other natural sources interfere in the display of the particle tracks, a high-voltage supply (≈ 1000 Volts) which, when connected to the brass source holder, supplies a clearing field between it and the base. This removes the unwanted ions.

High voltage is protected by a resistance of $10^8 \Omega$ for your safety!

Instructions

1. Using the included funnel, pour about 30 - 40 ml of alcohol into the chamber. After approximately 30 minutes, the interior wall liner should be saturated (liner color will turn dark). There should still be at least 2 - 3 mm of alcohol on the bottom of the chamber.
2. Place the source rod with stopper into the hole in the viewing window. Adjust the rod up or down so that the position of the needle's eye is about 1 - 1.5 cm above the surface of the alcohol.
3. Connect the two rubber hoses to the cloud chamber. Depending on your situation, follow one of the two methods below:
 - A. Using Cold Tap Water
If your tap water is 15°C or colder, connect one hose to the water tap and let the other hose drain into a sink or waste line. Start a flow of water of approximately $\frac{1}{2}$ to 1 liter per minute.

B. Using Ice

If your tap water isn't cold enough or a supply of water isn't readily available, you can use ice to cool the water.

Connect one hose to the included circulation pump and place it on the bottom of a styrofoam chest (not provided). The second hose should drain back into the chest. Fill the chest with ice (2 lbs. For every hour of operation). Add just enough water to cover the pump inlet.

Connect the pump to AC power. If water does not start flowing, you may need to start a siphon by sucking on the drain hose to remove air trapped around the pump impeller.

WARNING!

The cloud chamber may be permanently damaged if it is not cooled sufficiently with a steady flow of cold water! If for any reason, the circulation of water should stop, or the water warms up above 40°C , unplug the power to the cloud chamber immediately!!

4. Now connect the 12V power supply to the cloud chamber and then connect it to AC power. The cross-lights in the chamber should turn on and cooling begin. In about 15-30 minutes, the first tracks should appear! Tracks are best observed if room lighting is dimmed or the chamber is shielded from exposure to overhead lights.

5. When finished, unplug the 12V power supply from the AC power. To prevent water from freezing and damaging the heat exchanger, continue to run water through the cloud chamber for 5 minutes, or blow through the outlet tube to remove the circulation water.

Notes On Operation

To observe radioactivity from other sources such as cosmic rays or background radiation, remove the needle source and store it in the tube it was shipped with. Insert the other brass rod and stopper into the viewing window and connect the high voltage cable to it. Tracks will be observed less frequently than with the needle source.

A γ source can be placed on the observation window or near the chamber to produce electron tracks as described under Operating Principle.

If at some point you observe a continuous stream of condensation emanating from a single spot on the brass rod or needle source, remove the rod/needle and very gently wipe the spot clean. Lint or dust on the rod/needle can cause ions to be produced due to the high voltage of the clearing field.