NaRiKa

Operating Instructions Manual

Cloud Chamber (Cold Plate Type)
KK-01, KK-02

Cat No. B10-7764-01,-02

Thank you very much for choosing NaRiKa products. Before using the apparatus, be sure to carefully read this operating instructions manual to use the apparatus correctly and safely. In addition, keep this manual in a safe place so that you can refer to it whenever necessary.

Safety Precautions

⚠ WARNING: Statement that may result in death or serious injury

○ Do not disassemble, repair, or remodel the product. Neglecting this warning may result in breakage of product, etc.

○ Caution: Low Temperature; The temperature of the frozen cold plate is as low as -10℃(14°F) or below.
Do not touch it with bare hands.

○ Caution: High Temperature; Boiling water is used for experiments. Pay careful attention to burn injuries.

○ Handle with Care: When handling a radiant source, the teacher/instructor must explain precautions to students. For handling the radiant source, the teacher/instructor shall be assigned to the person responsible for handling and pay careful attention to handling of the radiant source.

○ Whenever you experience an abnormality/failure, do not use the apparatus.
For repairs, etc., contact our distributor.

○ Before executing the experiment, the teacher/instructor must explain the operating procedures, etc., to students.

⚠ CAUTION: Statement that may be slightly injured or result in property damage

○ Do not use the apparatus on an unstable place or non-horizontal place.

○ The teacher/instructor must attend the experiment, and do not allow the apparatus to be used only by students.

○ When carrying around the apparatus, do not move it under the unstable condition.

○ Do not drop the apparatus nor give strong shock to it.

○ Disposal of chemicals, etc. used in the experiment shall be done according to the specified SDS.

○ Check the product condition before and after storing it for a long period of time and, if any abnormality is detected, immediately stop using the apparatus.

Introduction

Purpose and features of the apparatus

The apparatus is a cloud chamber designed for observing tracks of radioactive rays using a cold plate that is capable of retaining a low temperature for about one hour by freezing the plate in a freezer. Tracks of radiation can be observed for about 20 minutes (until ethanol is vaporized) in a room at 25℃(77°F). The cold plate can be used repeatedly by freezing it again.

Items that you should know in advance

[Cold Plate]

A liquid-type refrigerant is sealed inside. Low temperatures cannot be retained unless the refrigerant is fully frozen.

Use the apparatus under the fully frozen condition after refrigerating it for at least 24 hours in a freezer (freezing compartment of refrigerator) whose temperature can be set to -20℃(-68°F) or below.

For checking the frozen condition, visually check the hole provided at the back center of the cold plate.

When the plate is frozen, the color will be stark white. If not, you will see a transparent liquid.

Should the contents leak, immediately stop using the apparatus. There will be no health problem even if the contents adhere to the skin or get in the mouth because all of the contents are food additives. When the contents adhere to the skin, immediately wash them away. If they get in the mouth, drink water, milk or the like, and submit the victim to medical treatment.

[Items other than the apparatus required for experiment]

[Mandatory item]

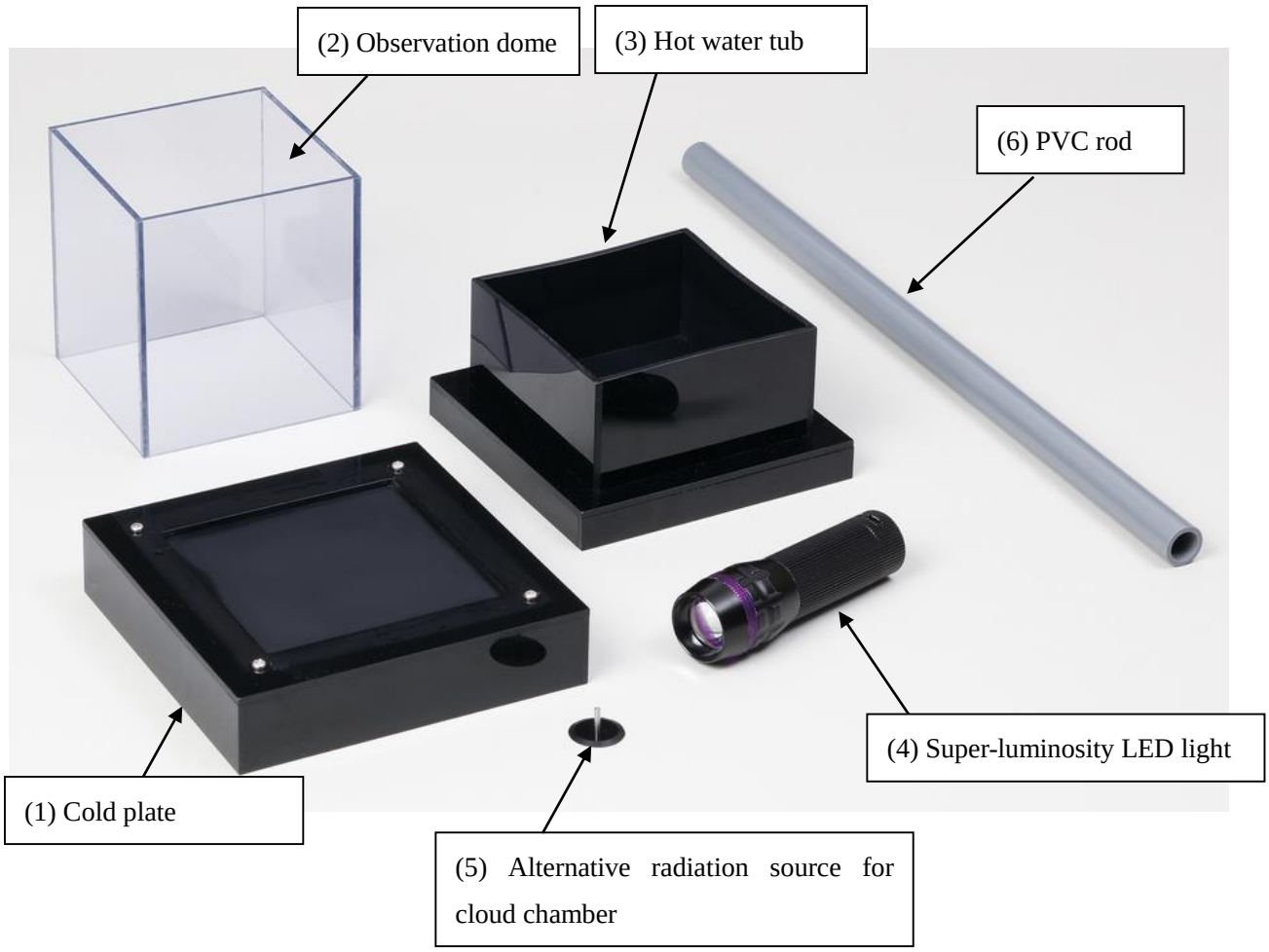
- Ethanol (99.5%), CAS No. 64-17-5

[Convenient items if available]

- Iron stand (for fixing the light source)
- Alternative radiation source [→Reference: Monazite (Mineral sample containing radioactive substance)]

Product Specifications, etc.

Name of Each Part



(1) Cold plate

The cold plate is used as the cryogen after being frozen in the freezer. The apparatus is assembled on the cold plate by mounting other components on the plate.

[Specifications]

○ Size: 150 x 150 x Thickness 35 mm ○ Exterior: Resin (PVC)

○ Inside of upper recess: Aluminum (Black alumite-treated)

!!CAUTION: Low Temperature!!

The temperature of the frozen cold plate is as low as -10℃(-50°F) or below.

Do not touch it with bare hands.

(2) Observation dome

This a square dome made of transparent PVC. It is used by placing it on the cold plate.

[Specifications]

○ Size: 100 x 100 x Height 110 mm ○ Material: Transparent resin (PVC)

(3) Hot water tub

This component is located on top of other components, including the cold plate, observation dome, and hot water tub that are mounted in that order from the bottom. Felt fabric is attached on the underside of the tub and ethanol (99.5%) is to be impregnated into the felt fabric. Hot water (50 to 80℃) (122 to 176°F) is applied from the top side and a certain difference in temperature is to be generated in the observation layer between the cold plate and the hot water tub.

[Specifications]

○ Size: 130 x 130 x 70 mm ○ Material: Resin (PVC)

○ Fabric on the bottom back-surface: Felt fabric ○ Charging metal of intermediate layer: Aluminum

(4) Super-luminosity LED light

This is a super-luminous white LED light. This is used for easier observation by emitting a strong light onto the tracks of radioactive rays generated in the observation layer. It is installed so that the light will radiate on the top surface of the cold plate from the side of the observation dome.

[Specifications]

○ Light source: Super-luminous white LED light

○ Power supply: 3 pieces of AAA battery

* Batteries come with the product are for operation check use only.

(5) Alternative radiation source for cloud chamber

This is a tungsten rod containing thorium. It can be used safely as the experimental radiation source since it features low dose and is solidified.

[Specifications]

○ Size of tungsten rod containing thorium: φ2.5 x 10 mm (Fixed on resin board)

○ Resin board: PVC; Thickness 1 mm

(6) PVC rod

The rod is used to apply a high voltage to the observation layer. Application of a high voltage enables the removal of miscellaneous ions in the observation layer and generates the super-saturation layer of ethanol through which the tracks of radioactive rays can be observed. The rod is charged by rubbing it with a flock paper, tissue paper, etc., and is then rubbed on the screw at the side of hot water tub, thereby charging the internal aluminum of the hot water tub.

[Specifications]

○ Size: φ13 x 24 mm

(7) Defrosting plate

[Specifications]

○ Size: 80 x 80 mm; Thickness 1 mm ○ Material: Resin (PVC)

How to Use the Apparatus

Operating Procedures

1. Preparation before experiment

[Preparation of Cold Plate]

Refrigerate the apparatus for at least 24 hours in a freezer (freezing compartment of refrigerator) whose temperature can be set to -20℃(-68°F) or below to freeze the cold plate.

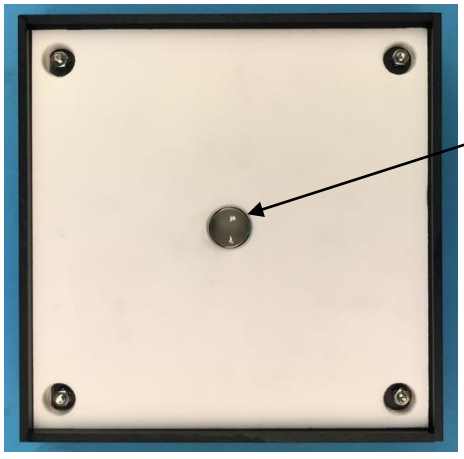
[CAUTION]

It is necessary to refrigerate the apparatus in the freezer for 24 hours from the room-temperature condition.

For checking the frozen condition, visually check the hole provided at the back center of the cold plate. *1

[Knack of Experiment]

*1 Check of condition if the cold plate is frozen.



Visually check the hole provided at the back center of the cold plate. When the plate is frozen, the color will be stark white. If not, you will see a transparent liquid.

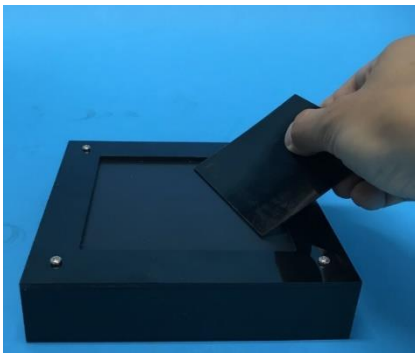
[Back surface of Cold Plate]

2. Operations during experiment

2-1 Install the cold plate at a stable and horizontal place.

[Knack of Experiment]

On the surface of cold plate, moisture in the air appears in the form of frost. If an ice layer exists on the cold plate, the experiment may not result in success. Execute the experiment after removing the surface ice robustly by using the defrosting plate that comes with the apparatus.



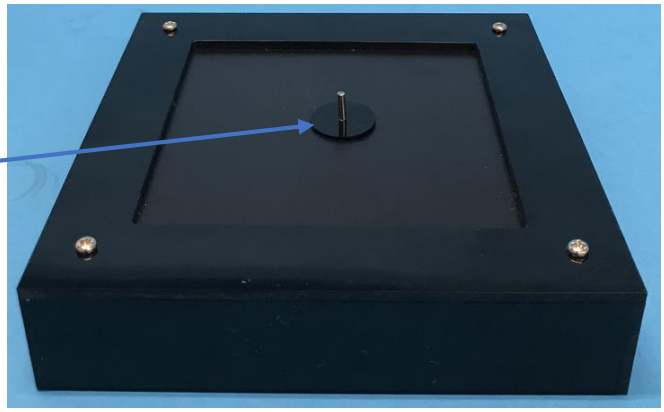
← Frost on the cold plate surface is being removed.

⚠ [CAUTION]

For defrosting, be sure to use the plate comes with the apparatus or a resin plate or the like. Use of a metal plate result in damage to the cold plate surface.

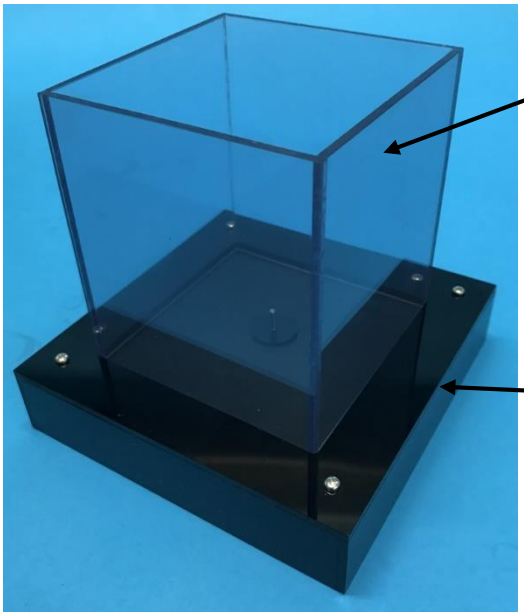
2-2 Install the alternative radiation source for cloud chamber on the cold plate.

Alternative radiation source for cloud chamber



There is no problem if other types of radiation sources (mineral samples containing radiative substance, etc.) are used.
Even if no radiation source is placed, it is possible to observe tracks of natural radiation of the background.

2-3 Install the observation dome so that it will align with the recess of the cold plate.



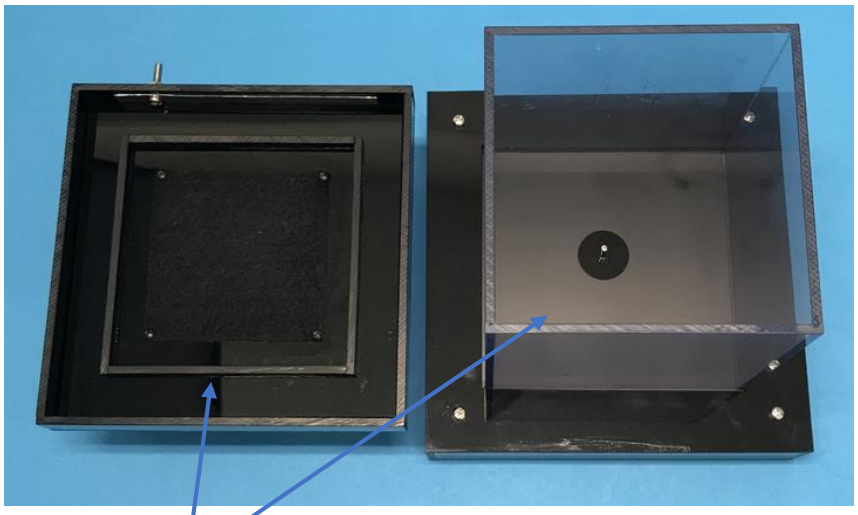
> [CAUTION]
> Check that the dome is installed robustly.

2-4 Impregnate the felt fabric of the hot water tub with ethanol (99.5%).

[Knack of Experiment]

The adequate ethanol quantity is about 5 mL. When the quantity is 10 mL or over, ethanol will seep from the felt fabric. If this is the case, the ethanol quantity is too much. Wipe off the excessive ethanol in a manner of slightly dabbing the felt fabric with tissue paper or the like. If the quantity is excessive, it will take time until the super-saturation layer of ethanol is formed, or more specifically, until the condition that the observation layer becomes stable and tracks of radioactive rays can be observed is established.

2-5 Install the hot water tub on the observation dome.

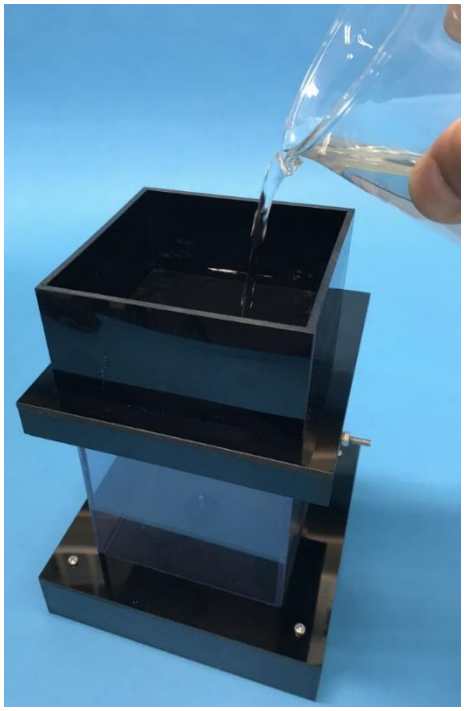


It is so designed that the protruded part at the back of the hot water tub will be positioned just inside the observation dome.

[CAUTION]

Check that the entire assembly is not inclined or loose.

2-6 Pour hot water into the hot water tub.



[Knack of Experiment]

Quantity of hot water: **300 mL** or over

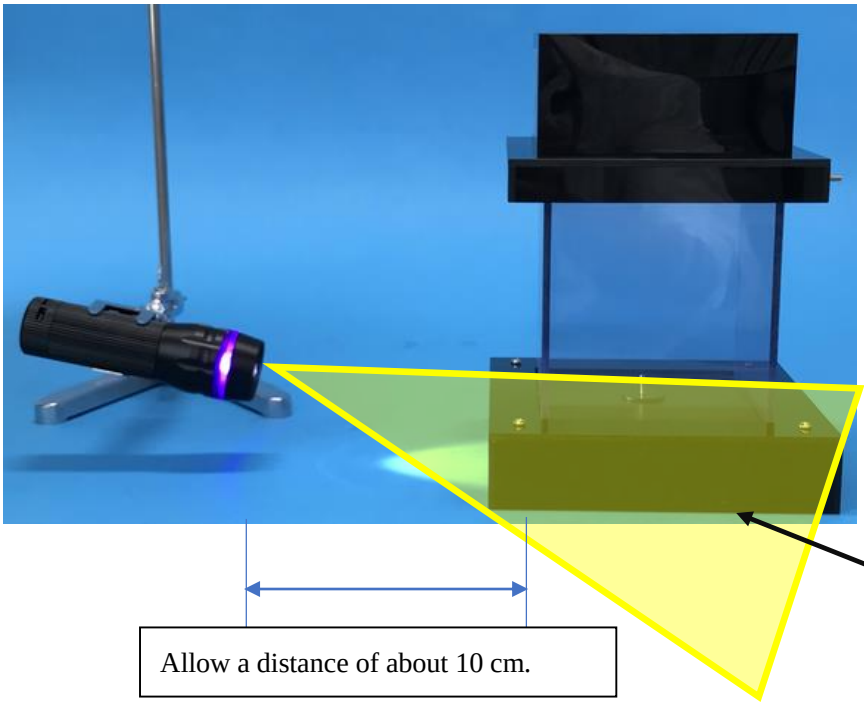
* Note: If the quantity is excessively small, the experiment will not result in success.

Temperature of hot water: **50 to 80℃**(122 to 176°F)

The temperature 80℃ can be achieved when boiled water in an electric pot is poured into a beaker or the like.

2-7 Set the light source.

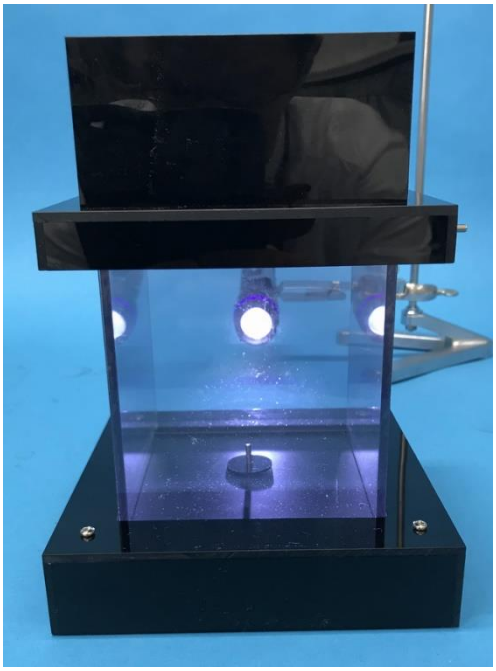
Refer to the figure shown below for the setting of the light source. Fix the light source by using a stand provided with a flexible clamp at your hand.



Adjust the height and the angle of the light source by referring to the triangle area shown in the figure.

It should be arranged so that the upper-end side of the beam illuminates the area around the top surface of cold plate. Be careful that visibility will be impaired when the entire observation dome is illuminated.

[The state where the light source is installed]



[Knack of Experiment]

The visibility of the track will vary depending on the angle of the light source. If the visibility is not good, adjustment of the angle will result in easier observation. If you feel observation is not possible, try to adjust the angle of the light source first.

[Knack of Experiment]

[Illumination mode of LED light]

With the LED light that comes with the apparatus, the illumination mode switches each time the power switch is pressed.

Three modes (lighter, darker, and blinking) are provided. Use the lighter mode for observation in this experiment.

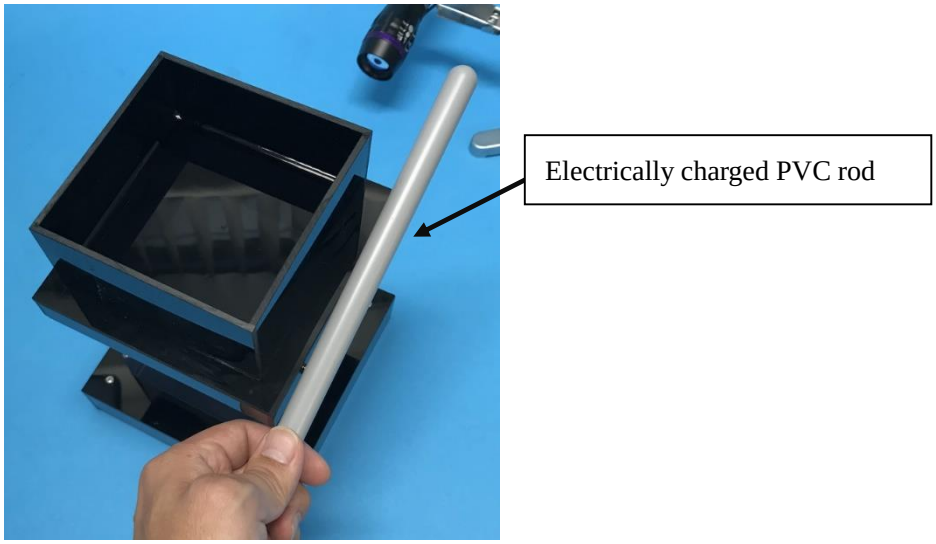
2-8-a

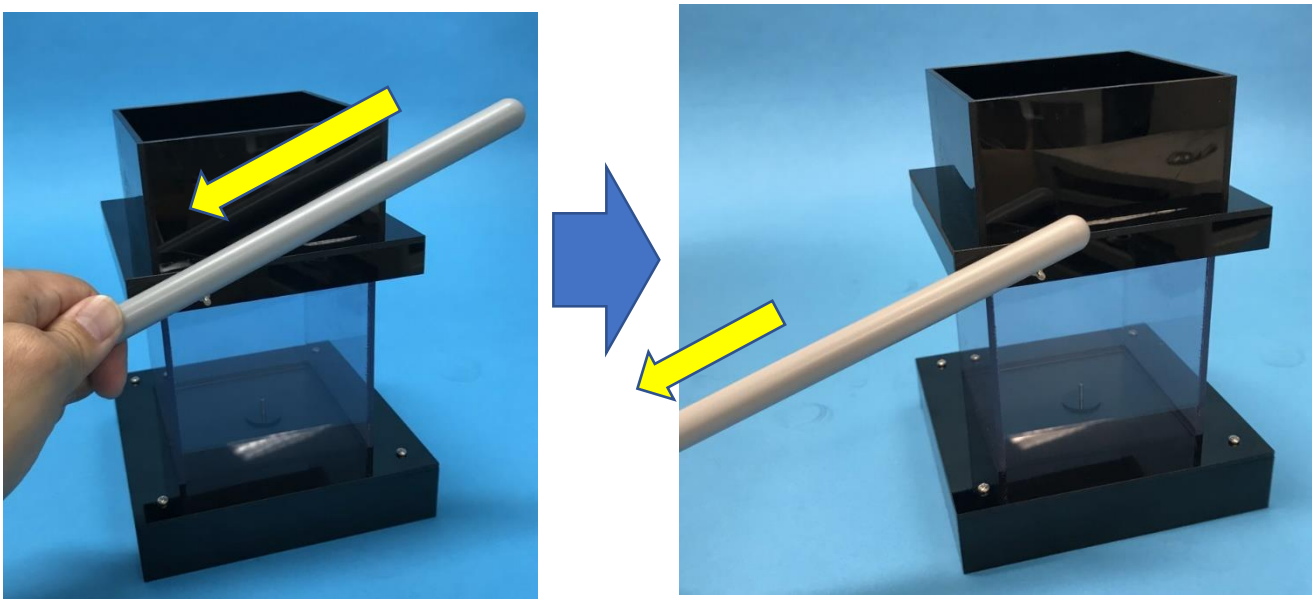
[Removal of miscellaneous ions with PVC rod]

Electrically charge the PVC rod by rubbing it with tissue paper or the like.

Scrape the side part of the electrically charged PVC rod from end to end on the screw at the side of the hot water tub.

The screw is connected to the aluminum attached inside the hot water tub.





Contact the part of electrically charged PVC rod closer to your hand on the screw, move and scrape the rod as shown in the figure with the rod contacted, which electrically charges the aluminum inside the hot water tub.

[Knack of Experiment]

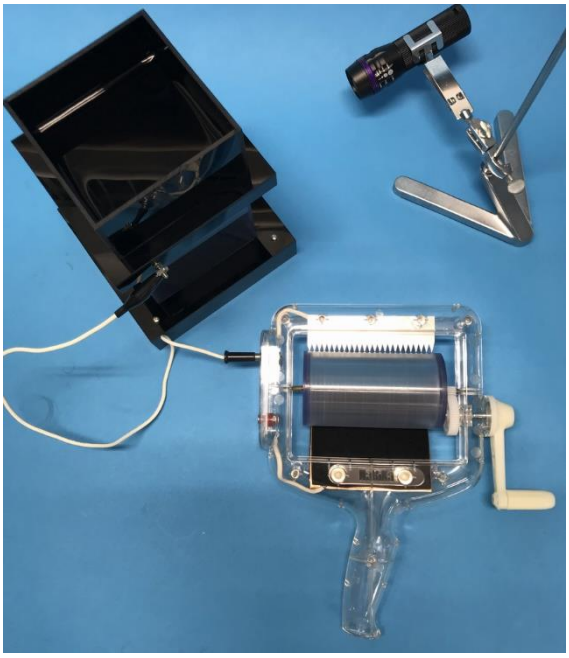
It is not necessary to do the procedures frequently. Observation of tracks of radioactive rays is possible just by executing Sections up to 2-7 and finally executing this procedure one time or so. If you feel it becomes harder to see tracks, execute this procedure again. Frequent application of high voltage may result in the state where tracks are hard to see because the condition in the observation layer varies. Even when this happens, the tracks will become visible again when a given time elapses.

2-8-b

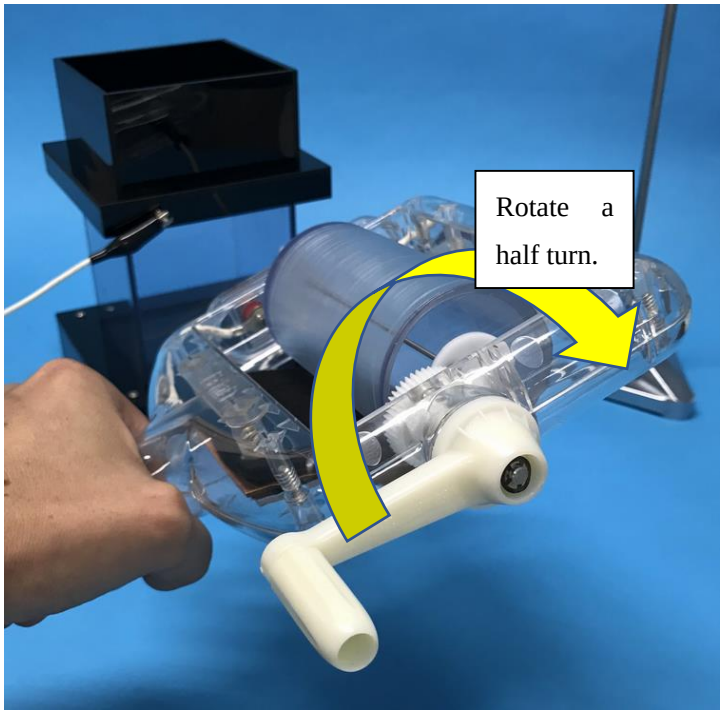
[Removal of miscellaneous ions with B10-7764-02 (with electrostatic high-voltage Genecon)]

It is also possible to apply a high voltage by using the hand-held electrostatic generator (hereinafter referred to as Static Genecon), not by using the PVC rod.

Connect the cable from the minus terminal of Genecon to the screw at the side of the hot water tub, and then rotate the handle for about a half turn.



Connecting the cable from the minus terminal of Static Genecon to the screw of the hot water tub.



Rotate the handle to apply a high voltage.

[Knack of Experiment]

About a half turn of the handle is sufficient. Note that rotating the handle several times result in more-than-necessary electrostatic charge, which may make the observation layer condition unstable.

3.Knack of Experiment

3-1 Time required before observation of tracks becomes possible

Approx. 5 minutes from the completion of preparation

When the observation of radiation is not possible even after five minutes elapses, apply the high voltage again by referring to Section 2-8.

3-2 Brightness of the surrounding environment

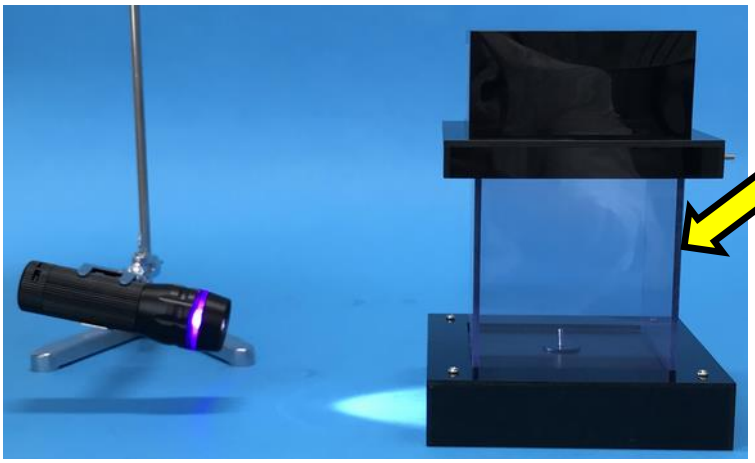
Tracks of radiation are easier to see when the brightness of the surrounding environment is as dark as possible.

Under the environment where the blackout curtain is applied and the illumination is reduced, the observation will be easier only with the brightness of the light source set in Section 2-7.

3-3 Direction and angle for looking into the observation layer

The position directly facing with the light source will be the location at which good visibility of the tracks can be ensured.

Refer to the figure shown below for the angle for looking into the layer.



The angle for looking down of the cold plate from the obliquely upward position will ensure easier visibility. In addition, the angle for preventing the light source from directly entering the eye will also ensure good visibility.

The observation direction that ensures the maximum visibility is the direction directly facing with the light source.

3-4 Adjustment of the light source

The visibility of tracks significantly varies depending on the angle for emitting the light source.

Easier observation will be ensured when the light source is set so that it can illuminates only the top surface of the cold plate. If you feel the visibility is not sufficient, adjust the illumination angle of the light source first.

Refer to the figure shown in Section 2-7 for the illumination angle.

3-5 Duration of observation time

Observation of tracks is possible for 20 to 30 minutes after the completion of preparation.

The time period will be the time that the ethanol impregnated with the felt fabric is completely vaporized.

[Knack of Experiment]

The cold plate can retain the low temperature for about one hour. Observation becomes possible again by refilling ethanol and replacing the hot water. At this time, wipe off the ethanol accumulated on the cold plate with tissue paper or the like to remove it. Accumulation of ethanol results in unsuccessful experiment.

4. Operation after experiment and cleanup/storage

4-1 Discard the hot water in the hot water tub.

4-2 Clean off ethanol and moisture that remain on the entire apparatus.

4-3 Storage of the apparatus should be done after checking that it was dried completely in shade for an adequate time period.

[Knack of Experiment]

Although it is possible to execute the next experiment quickly again when the cold plate is put in the refrigerator right after finishing an experiment, pay attention to the following items when you do so:

- The cold plate will be frozen unless moisture is cleaned up sufficiently.

Note that the experiment will be unsuccessful when ice exists on the cold plate.

- Be careful ethanol may drip into the freezer if it is not fully cleaned up.

When you face problems

Troubleshooting

Phenomenon	Cause	Action to be Taken
Tracks of radiation cannot be observed.	Ethanol is not refilled.	Check that ethanol is refilled in the felt fabric.
	The temperature distribution within the observation layer is inadequate.	Check that the cold plate is frozen and the temperature and the quantity of hot water are adequate. Refer to Section 1 “Preparation before experiment” and Section 2-6.
	Emitting way of the light source is inadequate.	Check that the height of the light source is near the top surface of the cold plate (the light is not emitted from a high position), and the angle of the light source is adequate. Also, adjust the angle and check if a position enabling observation exists. Refer to Section 2-7 for the illumination angle.
	Miscellaneous ions are not removed.	Electrically charge the aluminum in the hot water tub. Refer to Sections 2-8-a and 2-8-b.
The cold plate cannot be frozen.	The temperature in the freezer has not reached -20℃(-68°F) .	There may be a case that the temperature has not reached -20℃(-68°F) for the reason that the freezer has been deteriorated or the like. Check the temperature in the freezer.