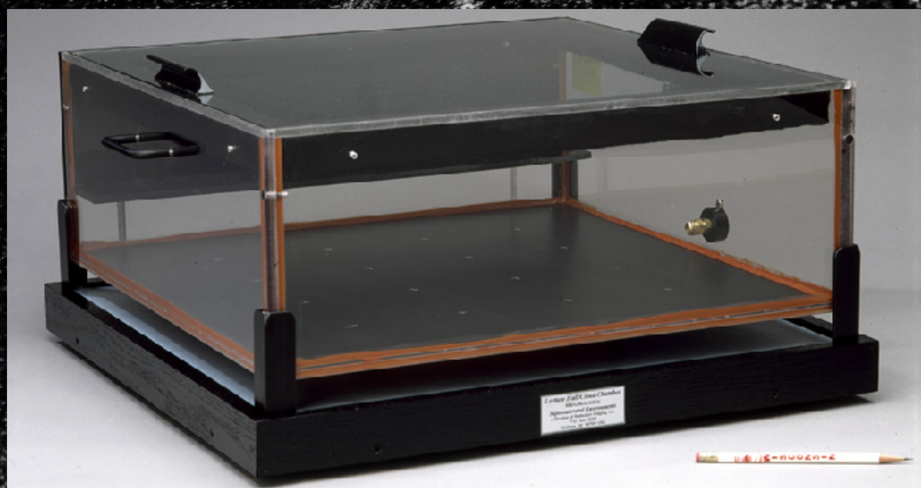
Ideal instruments for visual demonstration of the

COSMIC RAYS

and natural radioactivity all around us



www.cloudchambers.com

SUPERSATURATED ENVIRONMENTS: OVERSIZED DIFFUSION CLOUD CHAMBERS

Since introducing the Lecture Hall Chamber in 1990, Supersaturated Environments has satisfied many customers at educational institutions worldwide. We currently manufacture several oversized diffusion cloud chamber models for classroom, lecture hall, and museum use. Our chambers are crafted from quality materials using a proven design which provides maximum track visibility and reliable demonstrations. These products help educators share the discoveries of modern physics by direct visual observation.

The diffusion cloud chamber creates a volume of supersaturated alcohol vapor that condenses on ions left in the wake of charged particles. This is accomplished by establishing a steep vertical temperature gradient with dry ice, liquid nitrogen, or mechanical refrigeration. Alcohol evaporates from the warm top side and diffuses toward the cold bottom. The gravitationally stable temperature distribution permits a layer of supersaturation near the chamber bottom. Charged particles passing through the supersaturated air at close to the speed of light leave behind numerous ions along each centimeter traversed. Since each ion becomes a nucleation site for droplet condensation, tracks of alcohol droplets form in this region, indicating trajectories of the charged particles. The fine, threadlike tracks fall to the chamber bottom, leaving room for other tracks to appear in the next moment. This continuous process yields uninterrupted sensitivity to airborne ionizing events, and provides an enthralling window on the subatomic world.

The “oversized” feature of our cloud chambers aids in revealing the random ionizing radiation that perpetually surrounds us. The sensitive volume of our Lecture Hall Chamber, for example, is about 900 times that of the common “petri dish” cloud chamber. The vast majority of background radiation is not the result of human activity, but caused by natural processes that have been present throughout the existence of life on earth. This ionization can be caused by cosmic rays or environmental radionuclide decay. The cloud chamber will sometimes enable differentiation between these two sources.

Secondary cosmic rays present at ground level include muons and Compton scattered electrons. These cosmic rays result in droplet trails passing across the chamber’s entire sensitive area. Muons are often observed as long, straight, and dense condensation trails. Cosmic ray showers are occasionally recorded as simultaneous parallel tracks.

Natural radioisotopes present in the earth’s crust produce another component of background radiation. Radon-222 is a chemically inert gas emanating from the soil and stone; it diffuses through the air and decays with the emission of an alpha particle. This particle appears in the cloud chamber as a dense, straight track several centimeters long, with no connecting track on either end. Radon concentration can be measured by recording the frequency of such events.

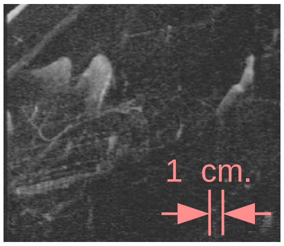
A COMPLETE LINE OF ACCESSORIES

Concepts of modern physics can be a challenge to describe with respect to the “real” world, since people do not actually live at the atomic and nuclear levels. For more predictable observations, we provide a variety of US NRC license exempt radioactive sources. These can be used to produce Compton scattered electrons, low energy beta particles, photoelectrons, and alpha particles. Also, our informative manual features background information about observations, and plots for more quantitative interpretation of what you and your students will see.

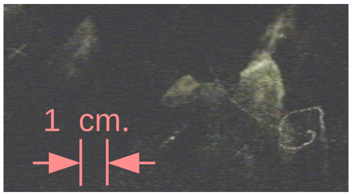
Other optional accessories include a liquid nitrogen cooling tray, dedicated light source, corona and projection field electrodes, and a rare earth magnet. The dedicated light source produces a fan beam of bright white light, and is more convenient than a slide projector for chamber side illumination. The corona electrode is designed to be inserted into the sensitive region through a source port; high voltage is applied through a standard SHV connector. Corona ions emitted by the electrode tip result in pulsating droplet clouds. The projection field electrode electrostatically forces ions from upper regions of the cloud chamber down into the sensitive layer, for enhanced sensitivity to background radiation events. Our rare earth magnet creates over 1000 Gauss; this is powerful enough to bend the trajectory of low energy beta particles, positrons, and low energy cosmic rays.

Software for virtual experiments is also available. The program will simulate a 1000 Gauss magnetic field over a 1000 cubic meter detection chamber exposed to 100 MeV particle energies.

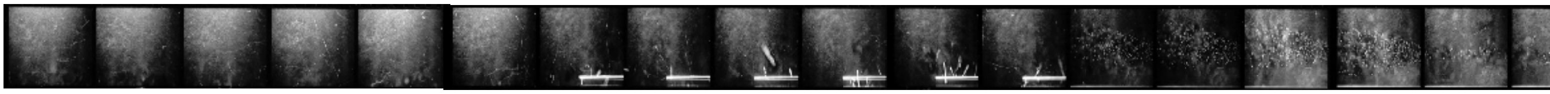
OBSERVE AND RECORD COSMIC RAY SHOWERS



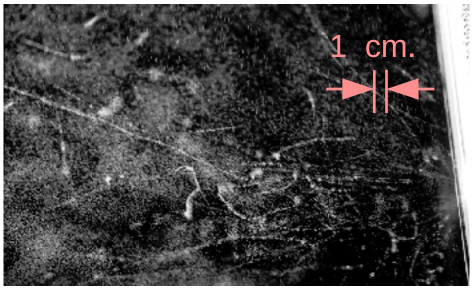
This portion of a cosmic ray shower was recorded in a Supersaturated Environments Cloud Chamber located near sea level. Note the group of parallel tracks. It is possible to observe several such events per hour with our lecture hall and museum cloud chambers, and record them on videotape.



These low energy cosmic rays were recorded in a Supersaturated Environments Cloud Chamber. Trajectories were bent by the 1000 Gauss magnetic field produced by our rare earth magnet, which was placed just below the central fiducial mark. Note the increase in curvature and ionization per unit length as the lower energy particle is slowed.



COMPTON SCATTERING EXPERIMENT

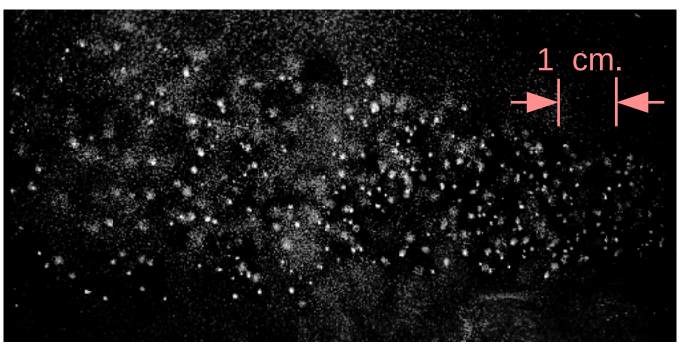


A Cesium-137 source was placed outside Supersaturated Environments' Cloud Chamber. This source produced 667 keV gamma rays, which interacted with the air filling the chamber, upon passing from right to left in the photograph. The most common mode of interaction under these conditions is Compton scattering.

BETA DEFLECTION EXPERIMENT

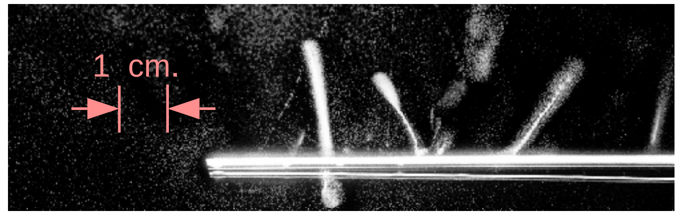
Low energy beta particle tracks can be observed in a Supersaturated Environments Cloud Chamber. Particles emitted from a Carbon-14 source placed at a source port will follow trajectories that are deflected by the 1000 Gauss magnetic field produced by our Rare Earth Magnet. Carbon-14 yields a maximum particle energy of 156 keV, resulting in frequent scattering in STP air. An increase in deflection curvature and ionization per unit length is observed as each particle is slowed in air.

PHOTOELECTRON EXPERIMENT



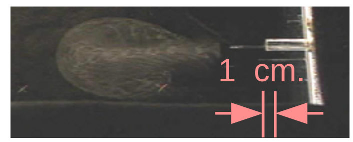
These condensation trails from photoelectrons were produced in a Supersaturated Environments Cloud Chamber. An Iron-55 source of 5.9 keV K-shell capture X-rays was located to the right of the photograph field, and slightly above the chamber's sensitive plane. The low energy X-rays interact with air primarily through the photoelectric effect. Each dot was caused by a single photoelectron, often accompanied by a lower energy Auger electron. Because the X-rays typically travel many centimeters before interacting, and the photoelectron range is much shorter, a fairly uniform array of dots were observed. Point source divergence (inverse square law) and air attenuation account for decreased photoelectron density on the left side of the photograph.

ALPHA PARTICLE EXPERIMENT



The horizontal metal rod in this photograph is alloyed with 2% natural thorium. Alpha particles produced along its length left thick condensation trails in the Supersaturated Environments Cloud Chamber. The large alpha particle mass is primarily responsible for a spectacular ionization density.

CORONA EXPERIMENT

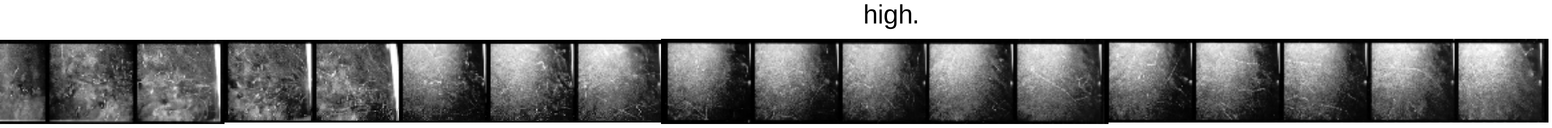


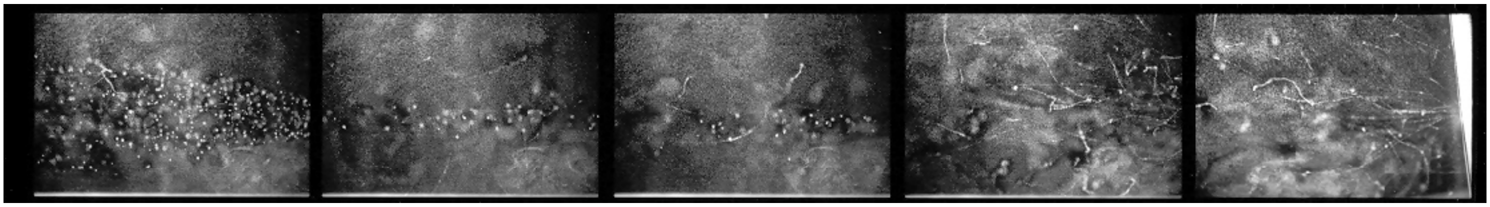
The electrode on the right is at a positive potential of about two kilovolts with respect to the Supersaturated Environments Cloud Chamber bottom. The electric field at the tip is sufficient to produce corona ionization. It is believed that the positive ions reduce the electric field and ionization, causing the pulsed cloud of droplets. Pulse frequency is proportional to electrode potential.

CLOUD CHAMBER MODELS FOR EVERY SETTING

The Lecture Hall Cloud Chamber produces a sensitive area measuring 51 by 51 cm. This is large enough to produce a continuously active display of tracks from natural background radiation. It can be set up in about fifteen minutes. Fourteen kg of dry ice and 500 mL of ethanol will operate this display for over eight hours. Fiducial marks are spaced ten centimeters apart, facilitating quantitative measurements. Overall dimensions are 57 by 57 by 30 cm. The Classroom Chamber is similar to our Lecture Hall Chamber, except that the sensitive area is 25 by 25 cm. Seven kg of dry ice and 250 mL of ethanol will operate this display for about eight hours. With our optional cooling tray assembly, 1.5 L of liquid nitrogen will cool the classroom chamber for about one hour.

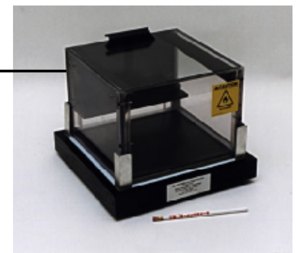
Our Museum Chambers provide low maintenance, floor mounted displays in public settings, such as government or industrial information centers and science museums. The sensitive area of the MCC-50 is 50 by 50 cm. A seven day timer controls ethanol recirculation and evening shutdown for automatic operation. Power consumption is less than 15 Amps at 120 V and 60 Hz. Overall dimensions do not exceed 100 cm wide, by 160 cm deep, by 185 cm high. The MCC-100 features a sensitive area of 100 x 50 cm. Specifications and power consumption are the same as the smaller model described above, except overall dimensions do not exceed 185 cm wide, by 100 cm deep, and 185 cm high.





OVERSIZED CLOUD CHAMBERS
PRODUCT SPECIFICATIONS

Portable Cloud Chambers:
LHC-DC: Lecture Hall Cloud Chamber, dry ice cooled.
(Shown with optional source port installed)
Includes insulated leveling base, removable glass top and informative manual.
Fiducial marks are standard. 50 x 50 cm sensitive area
CRC-DC: Classroom Cloud Chamber, dry ice cooled.
Fiducial marks are available upon request. Includes insulated leveling base, removable glass top and informative manual. 25 x 25 cm sensitive area



Optional Accessories:
LN2-LHC: Liquid Nitrogen Cooling Tray for Lecture Hall Cloud Chamber.
LN2-CRC: Liquid Nitrogen Cooling Tray for Classroom Cloud Chamber.
REM-5CM: Rare Earth Magnet, 5 x 5 x 1 cm.
SCM-18P: Spare Cloud Chamber Manual, 18 pages.
AFR-4OZ: Anti-Fog Compound Refill, 4 ounces.
DLS-FL: Dedicated Light Source (replaces slide projector), fluorescent.
CPE-SHV: Corona and Projection Electrodes w/ SHV cable, Installed.
HVS-3KV: High Voltage Power Supply for corona or projection field, +3kV.
PSI-1IN: Port for Source, installed, for one inch or 3/8 inch sources.
APS-NTH: Alpha Particle Source,* 2% alloy natural thorium, 3/8 inch holder.
BPS-C14: Beta Particle Source*, 156 keV Max. (10 microcurie carbon-14).
GRS-CS137: Gamma Ray Source*, 662 keV (5 microcurie cesium-137).
XRS-FE55: X-ray Source*, 5.9 keV K-shell capture (50 microcurie iron-55).
CWS-PC: Detector simulation software,** PC version, single seat.
CWS-MAC: Detector simulation software,** MAC version, single seat.

Complete Experiment Packages:
Please specify PC or MAC operating system.
LHC-CEP: Lecture Hall Cloud Chamber, with one of each from above accessories.
CRC-CEP: Classroom Cloud Chamber, with one of each from above accessories.

Museum Cloud Chambers:
Mechanically refrigerated, timer controlled, floor mounted displays include light source, heater, projection field, and ambient light shield. Power consumption is less than 15A at 115VAC.
Optional features are available upon request.
MCC-50: Museum Cloud Chamber, 50 x 50 cm sensitive area.
(Shown with ambient light shield removed.)
1000 LB shipping weight, cabinet dimensions 32"W 60"L 70"H
MCC-100: Museum Cloud Chamber, 100 x 50 cm sensitive area.
1400 LB shipping weight, cabinet dimensions 32"W 72"L 70"H

*Sources provided as a convenience to US cloud chamber customers; exemption from NRC license requirements per 10CFR parts 30.18 or 40.13.
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Revised 9/1/02; specifications subject to change without notice.
 MCC-100 photographs appear courtesy of The Science Place.

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