Laboratory and Shop Notes

Operation of a Diffusion Cloud Chamber with Hydrogen at Pressures up to 15 Atmospheres*

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RECENTLY, diffusion cloud chambers similar to A. Langsdorf's,[1] but of greater simplicity, have been described.[2] At this laboratory such chambers have been operated,[3] the work being directed toward attaining continuous sensitivity in a large volume of hydrogen at a pressure of 10 atmospheres or more.

The simplest chamber used here was similar in design to that described by Cowan.[2] Its performance was quite sensitive to changes in the temperature distribution along the walls induced by placing various metal collars around the chamber. To obtain better control over this temperature distribution and to make the investigation of higher pressures possible, a metal chamber for use up to 15 atmospheres has been constructed and heating wires soldered to its stainless steel side walls. In order to enable one to control the temperature of the vapor source electrically, methyl alcohol is carried in three concentric copper troughs connected thermally to the heated aluminum top plate. Wide variations of the top temperature and side gradient are thus possible.

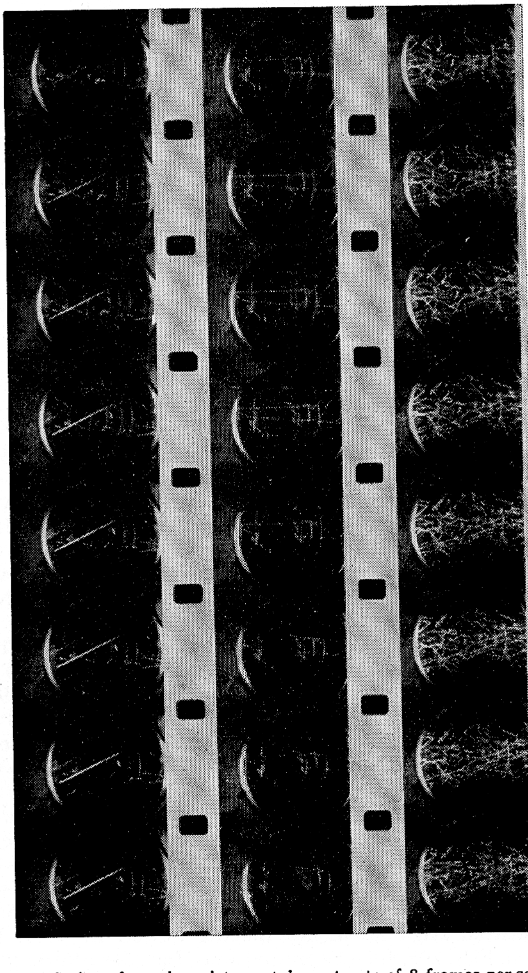

FIG. 1. Strips of moving pictures taken at rate of 8 frames per sec with 1000-watt projector lamp beamed by condensing lens. Gas: 12 atmos of hydrogen Vapor: methanol. First strip shows formation of proton recoils caused by neutron source. Second strip shows maximum tolerable continuous radiation from γ-source. Third strip shows build-up of burst of radiation from γ-source.

With the bottom of the chamber immersed in a dry ice-alcohol mixture the optimum conditions for good operation with several gases and pressures have been investigated and are listed in Table I. By good operation we mean that the cosmic radiation at sea level produces undistorted tracks of good definition over the full diameter of the chamber through a depth of 2 to 3 inches at the bottom.

TABLE I.

Gas	Pressure (atmos)	Top temperature (°C)	Gradient (°C/cm)
H_2	12	10	3.6
	16.5	10	4.6
He	3.1	−1	3.3
	8.9	15	5.0
Air	1	11.5	3.9
	3.1	20	6.6

With H_2 or He, violent convection occurs up to a pressure at which the density gradient from top to bottom becomes positive. Above this pressure, the top temperature is limited by the onset of vertical eddy currents probably produced by the transference of the large amounts of heat necessary to maintain a satisfactory gradient in the lighter gases. Here the track-sensitive volume assumes a cellular appearance with regions of varying sensitivity. For the heavier gases, operation above 3 atmospheres is unsatisfactory because it is not possible to obtain the large top temperature required to maintain sensitivity without producing many uncharged droplets which remove part of the vapor supply. Since the available temperature difference is used up in a small distance by the large gradient necessary, the sensitive layer is reduced to a few centimeters.

Because the vapor supply is limited, the ionization in the chamber may readily be made so high that no tracks can be seen. By taking motion pictures (Fig. 1) of the cosmic-ray background together with tracks produced by a 96-μ curie cobalt source at varying distances from the chamber, it was possible to ascertain that, when operated with 12 atmospheres of H_2, the chamber would continuously record ionizing radiation of 2–3 times sea level cosmic-ray intensity. There is no limitation in the chamber's ability to record bursts of radiation if an electric sweeping field is applied during the intervals.

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[1] A. Langsdorf, Rev. Sci. Instr. **10**, 91 (1939).
[2] T. S. Needels and C. E. Nielsen, Rev. Sci. Instr. **21**, 976 (1950); E. W. Cowan, *ibid.* 991 (1950).
[3] Miller, Fowler, and Shutt, Bulletin, Am. Phys. Soc. **26**, No. 1, 30.

Source Discharger for Magnetic Lens Beta-Ray Spectrometers

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AS Braden and co-workers[1] have pointed out, an electrically insulated beta-ray source placed in an evacuated chamber will acquire a potential different from that of the surrounding conductors because of the continuous loss of electrons by radioactive decay. Present-day source mounting techniques employed in beta-ray spectroscopy permit the generation of high potential differences, since very thin plastic materials of high resistivity are often used for the mountings. In addition, to reduce scattering, the source is placed far away from surrounding material, resulting