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UNIVERSITY OF CALIFORNIA

Radiation Laboratory
Berkeley, California

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June 17, 1957

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A continuously sensitive bubble chamber operating at atmospheric pressure has been constructed and found to be sensitive to fast-neutron irradiation. It is easy to build and to operate and may with further development have applications in research involving cosmic rays or projected high-energy accelerators, where ordinary bubble chambers are restricted by counter-control requirements.¹ It employs a solution of a gas, carbon dioxide, in a liquid, isoamyl acetate;² methanol, ethanol, acetone, and tributyrin with carbon dioxide produce similar results. The chamber (see Fig. 1) consists of a beaker (600 ml) containing the liquid, a watch-glass cover, and a heating coil (nichrome V, five feet wound in a flat spiral; No. 18 wire requires approximately 10 amperes) which is immersed near the upper surface of the liquid. The liquid is saturated with the gas at dry ice temperature; the bottom of the beaker is then placed in a dry-ice-methanol bath, while the top is heated to the boiling point of the liquid. The solubility of the gas decreases considerably upon heating,³ so that, if there are no liquid-air surfaces or particles of dirt on which the gas can escape, large internal gas pressures build up within the liquid, resulting in radiation sensitivity. When a neutron source such as polonium-beryllium, giving about 10^6 neutrons per second, is brought close to the chamber, bubbles form in a narrow sensitive layer and rise to the surface of the liquid. Sensitivity to gamma irradiation has not been observed. Bubble growth is much slower than that found in ordinary bubble chambers because the rate of growth is limited by diffusion of the dissolved gas through the liquid, a slow process; it should be possible to vary the rate of growth by altering the amount of gas dissolved in the liquid.

The chamber as here described will not remain radiation-sensitive for more than a few hours even if provision is made for continuous solution of gas at the bottom of the chamber, because gas is removed from the sensitive

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region and above faster than it can be supplied by diffusion from below; however, it would be possible to add saturated liquid continuously at the bottom of the chamber, removing depleted liquid at the top, thus maintaining radiation sensitivity indefinitely. It is conceivable that addition of suitable glass-enclosed heaters for regulation of the thermal gradient might result in continuous radiation sensitivity over large volumes.

No special precautions have been taken to avoid dirt in the chamber or scratches in the walls.

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¹Brown, Dodd, Glaser, Perl, and Rahm, Proceedings of the CERN Symposium on High-Energy Accelerators and Pion Physics, Geneva, 1956 (CERN European Organization for Nuclear Research, Geneva, 1956), Vol. 2 p. 3; Bertanza, Franzini, Martelli, and Tallini, *op. cit.*, p. 29; *Nuovo cimento* (10) 2, 1334 (1955).

²See P. E. Argan and A. Gigli, *Nuovo cimento* (10) 3, 1171 (1956) for discussion of the properties of another type of gas bubble chamber.

³The solubility of CO₂ in amyl acetate may be estimated roughly on the basis of Raoult's law. See Hildebrand and Scott, The Solubility of Nonelectrolytes, 3rd ed (Reinhold, New York, 1950) p. 241.

FIGURE CAPTION

Fig. 1. Continuously sensitive bubble chamber.

