Continuously Sensitive Bubble Chamber*

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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 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.

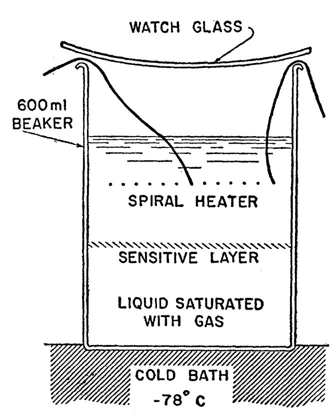

FIG. 1. Continuously sensitive bubble chamber.

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

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[1] Brown, 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, *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. 29; Nuovo cimento **2**, 1334 (1955).

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

[3] The solubility of CO_2 in amyl acetate may be estimated roughly on the basis of Raoult's law. See J. H. Hildebrand and R. S. Scott, *The Solubility of Nonelectrolytes* (Reinhold Publishing Corporation, New York, 1950), third edition, p. 241.

Collective Effects in O^{17}†

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THE very short lifetime of the first excited state of O^{17} at 0.872 Mev[1] can be easily accounted for by the introduction of small collective effects.[2] If the assumption is made that the parameters of the theory are the same for all levels of a given nucleus, the lifetime of the first excited state determines theoretically the quadrupole moment of the ground state. This prediction of the value of the quadrupole moment was much larger than the experimentally measured value[3] of $Q=-0.005\times10^{-24}$ cm^2. Recently this quantity has been remeasured[4] and the new experimental value is in excellent agreement with the prediction based on the lifetime[1] of the first excited state.

$$\tau=(2.5\pm1)\times10^{-10}\text{ sec}, \qquad (1)$$

$$Q(\text{theory})=(-0.030\pm0.006)\times10^{-24}\text{ cm}^2, \qquad (2)$$

$$Q(\text{experiment})=(-0.026\pm0.009)\times10^{-24}\text{ cm}^2. \qquad (3)$$

This relationship between τ and Q is calculated by using perturbation theory, since the collective effects are small. If the assumption is made that $(\hbar\omega)^2$ is much