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ABSTRACT

This report outlines the development of a large-diameter scintillation counter suitable for measurement of such soft beta emitters as C^{14}, S^{35}, and Ca^{45}. This counter offers a solution to the problems of geometry in counting the irregular radioactive areas of paper chromatograms.

A SCINTILLATION COUNTER FOR PAPER CHROMATOGRAMS

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Accurate radioactivity measurements on paper chromatograms demand uniform absorption and geometry corrections. The use of large-diameter end-window Geiger-Mueller tubes minimizes errors due to variations in shape and size of the radioactive area but is not an entirely satisfactory solution.[1] We wish to report a development of a large-diameter scintillation counter suitable for measurement of the soft beta emitters C^{14}, S^{35}, and Ca^{45}.

One-mil-thick terphenyl-polystyrene scintillators were prepared by compression between two glass plates at the softening temperature.[2] These were attached to standard photomultiplier tubes DuMont 6292 (2-in. diam.) or 6393 (3-in. diam.) with high-viscosity optical silicone oil (Dow Corning 200 fluid). The scintillator, photomultiplier tube, and preamplifier were mounted in an aluminum cylinder so that the system was sufficiently light-tight when standing on a chromatogram in a semidarkened room. Attempts to increase efficiency and allow operation in the light by aluminizing the scintillator surface were unsuccessful. The counter may be safely moved (in the light) when the high voltage is off, however.

The counting rate for this counter under proper voltage and pulse discrimination was 70% to 80% higher and the background was 50% less than for a similar size mica end-window G-M counter (2.25-in. diam., 1.5 mg/cm^2). The geometry was tested with a point source and found practically linear except near the edges. This property can be tested with a small light source when the phototube is being chosen.

Figure 1 describes the counting rates observed as a function of the relative discriminator[3] setting for C^{14} with various voltages on the photomultiplier tube. Background counts, with and without phosphor, are seen to coincide for the lower discriminator settings. The activity measured was a C^{14} sample

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1. Andrew A. Benson et al., J. Am. Chem. Soc. 72, 1750 (1950).

2. We are indebted to Mr. Richard Perkins and Mr. Arthur Hartwig of this laboratory for the development of this technique.

3. The polystyrene phosphor contained 3% to 5% terphenyl, λp = 4150 Å, and was prepared according to the method of Dr. Louis Wouters of this laboratory, Livermore Site.

on Whatman No. 1 filter paper giving 1800 counts per min. with the large diameter mica window counter (background 80 counts per min.). Phosphor thicknesses of 1 to 10 mils gave identical efficiency, while a 100-mil phosphor was less effective. For counting P^{32} areas on paper the thicker phosphors are more efficient. The longer range of the P^{32} beta results in higher pulses and requires lower tube voltage which further reduces the background counts. As seen from Fig. 1, most of the background arises from the tube noise. The use of two phototubes with a coincidence circuit did not compensate for the inherent optical losses.

This counter offers a solution to the problems of geometry errors in counting the irregular radioactive areas of paper chromatograms.

This work was done under the auspices of the U. S. Atomic Energy Commission.

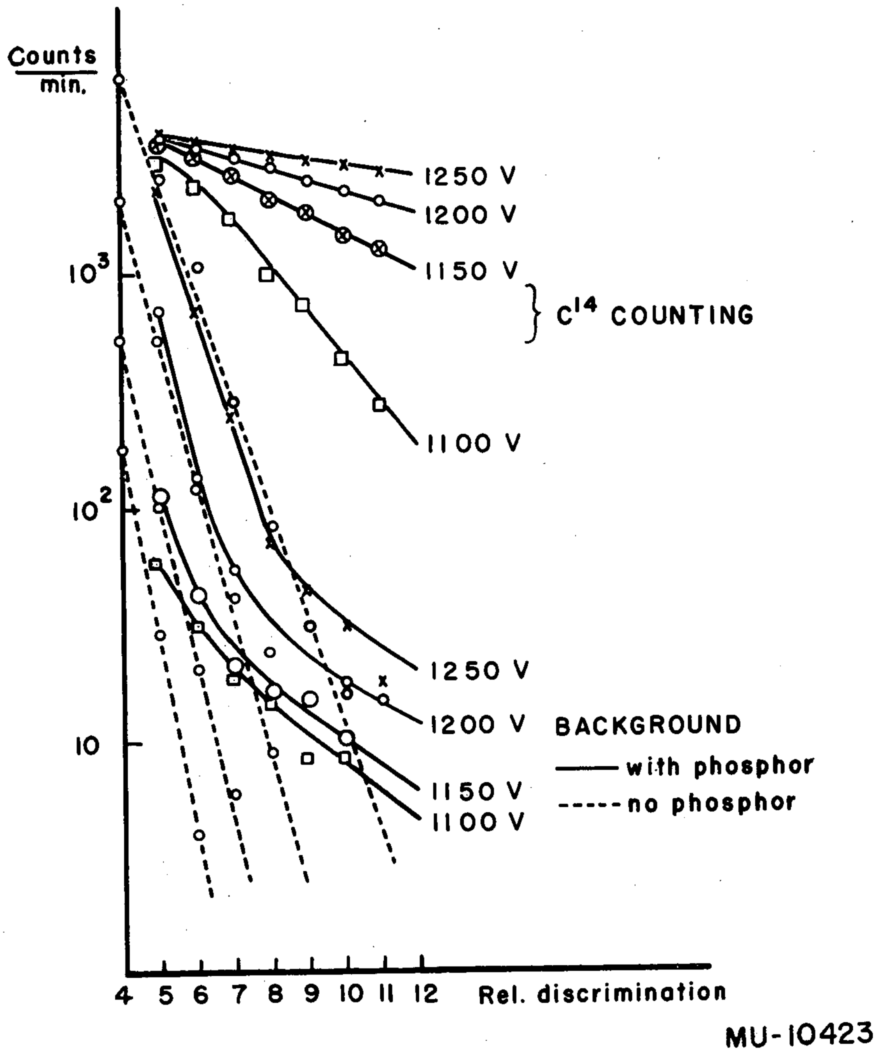

Fig. 1. Counting rate for C^{14} sample as a function of relative discrimination of pulse height. Upper curves are for 1800-cpm. sample (G-M tube with 6 dis./ct. efficiency) and lower curves are background.

________ with phosphor; ------- without phosphor.