Abstracts of Papers

The following 25 papers are the second parts out of eighty papers read before the semi-annual meeting of the Institute on June 6 and 7, 1952.

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1. Absolute β-ray Counting. (I)

On the Sensitive Volume of the Counter and the Geometrical Arrangement of the Sample

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1. Sensitive volume. Many researches have been attempted on the absolute measurement of the point β-ray source by the use of the end-window type G-M counter correcting the influence of the geometrical arrangement, absorption, scattering, and the mass or thickness of the source, etc.

Referring these measurements we studied, at first, the sensitive volume of the counter for β-particles. The end-window type G-M counter, having a center wire of 0.2 mm. in diameter and of 20 mm. in length and a cylindrical cathode 25 mm. in inner diameter, was used. One mm. broad and 25 mm. long slit was bored in the cathode parallel to the axis. Collimated β-rays from Sr^{89} were introduced into the counter through this slit perpendicular to the center wire. The observed counts showed that the counting sensitivity was almost uniform on about two thirds portion of the center wire but decreased at the other portion. This was considered to be due to the disturbance of the electric field by the supporting bar of the wire. When β-rays were introduced from the side of the end-window, the sensitivity was almost constant. Moreover, we could assure that the end plane of the sensitive volume existed just behind the glass bead attached to the top of the center wire.

2. Geometrical arrangement. The solid angle, subtended by the end plane of the sensitive volume in the counter to an arbitrary point, is very complex, but we derived the following expression by a simple approximation of the geometry. When the inner radius of the wall is a and the point source is located at b from the end plane and at c from the axis line, the solid angle is expressed approximately as

$$\omega = 2\pi\left\{1 - \frac{1}{\left(\left(\frac{a}{b'}\right)^2+1\right)^{\frac{1}{2}}}\right\} \equiv 2\pi f\,(c),$$

where

$$b' = \left\{(\alpha^2+4a^2)^{\frac{1}{2}}+\alpha\right\}/2$$

and

$$\alpha=(b^2+c^2-a^2)/b$$

Good coincidence was found between the experiments and this formula. Therefore, the counting ratio of of the circular source of radius c and the point source of equal intensity was easily shown as

$$R=\frac{\textit{Counts of a circular source}}{\textit{Counts of a point source}}=\frac{2\int_0^C f(c)\cdot c\cdot dc}{f(0)\cdot c^2}$$

Two examples of this ratio are shown in Table 1 which shows that the counts with a circular source of larger radius deviate greatly from those with a point source; care must be taken on the absolute counting of a β-ray source with planar extension.

Table 1.

	R				
b \ c	0	4	8	12	16
9	1.000	0.968	0.868	0.708	0.541
34	1.000	0.981	0.935	0.888	0.827

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2. Absolute β-ray Counting. (II)

Analysis of Specific Activities

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In order to measure an absolute number of β-particles from samples, the effect of the self-absorption and self-backscattering should be eliminated. Usually, a curve of specific activity *versus* thickness of samples shows a maximum point. Considering that it was due to the self-absorption and self-backscattering of β-rays, we analysed this curve and obtained satisfactory result.

Silver discs of various thicknesses and of same diameter (21 mm.) were activated by slow neutrons in a paraffin pile. The thickness of samples varied from 218.0 mg./cm^2. to 10.2 mg./cm^2. Silver monitors of the same diameter were used. Samples and monitors were irradiated during five minutes, and four minutes later β-activities produced in samples and monitors were observed for seven minutes by a 2π-type β-counter respectively. Since, in the present case, β-activities of Ag^{110} with a half life shorter than 30 sec.