[1] Proc. Int. Conf. Low Temp. Phys., Oxford, 1951, p. 119; W. Buckel and R. Hilsch, Z. Physik **138**, 109 (1954); N. V. Zavaritskii, Dokl. Akad. Nauk SSSR **86**, 687 (1952).

[2] A. I. Shal'nikov, Nature **142**, 74 (1938), J. Exptl. Theoret. Phys. (U.S.S.R.) **10**, 630 (1940); N. E. Alakseevski, Dokl. Akad. Nauk SSSR **24**, 27 (1939), J. Exptl. Theoret. Phys. (U.S.S.R.) **10**, 1392 (1940).

Translated by J. G. Adashko
214

COMPARISON OF CALORIMETRIC AND IONIZATION MEASUREMENTS OF THE ENERGY FLUX OF SYNCHROTRON GAMMA RAYS

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Submitted to JETP editor July 11, 1957

J. Exptl. Theoret. Phys. (U.S.S.R.) **33**, 1060-1062 (October, 1957)

THE comparison of the different methods of measurement with the identical spectrum is of interest not only for the determination of the energy flux of the γ-rays but also is useful in relating data obtained from ionization measurements to the actual energy absorption in matter. According to the literature,[1] various methods give results that differ up to 25%.

TABLE I

Cylinder length cm	Percent fraction of absorbed energy according to transition curves	Energy for one coulomb of the standard, U_K, Mev/coulomb	Maximum error %
11	99.5	$4.65 \cdot 10^{18}$	4.0
4	82	$4.55 \cdot 10^{18}$	2.5

The energy flux in the γ-ray beam of the 85-Mev synchrotron of the Leningrad Physico-Technical Institute was determined both with a calorimeter and with ionization chambers. The energy in the γ-ray beam required to produce a charge of one Coulomb in a special copper ionization chamber was determined by both methods. The copper chamber served as a standard.

In the calorimetric measurement the γ-rays were absorbed in a lead cylinder. The temperature change of the cylinder was determined with a thermistor which had a temperature coefficient of about -6% at 20° C. The cylinders had a diameter of 5.5 cm and lengths of 11 and 4 cm respectively. The correction for incomplete absorption of the γ-rays in the cylinders was obtained from the transition curves of lead. The final results (at 20° C and 760 mm Hg) are given in Table I. They were obtained with a beam diameter of 3 cm. The energy losses due to neutron emission[2] were also taken into account. The result obtained with the 4 cm and the 11 cm long cylinders differ by 2%. This difference lies within the limits of the errors. It indicates, however, that the actual absorption of energy in lead is not given completely by the depth dose curve.

The energy flux of the γ-rays was also determined by the method of the depth dose curve.[3] In this method the ionization in a thin walled chamber is determined as a function of the thickness of absorbers placed in front of it. The depth dose curves for C, Al, Cu, and Pb were obtained. The curves reproduced in several runs. The exponential decrease at large depths agreed well with the minimum of the γ-ray absorption coefficient in the particular material. The energy was obtained from the area under the transition curves. The results, particularly for light elements, depend strongly on the choice of the ratio (averaged properly over the energy of the electrons)

$$\rho = (dE/dX)_Z / (dE/dX)_{\text{Air}}$$

where dE/dX is the energy loss of the electrons. The choice of ρ and the results of the determination by the method of transition curves relative to the calorimetric determination (U_Z/U_K) are shown in Table II. A possible error of ρ of 2.5% has been

TABLE II

Material	C	Al	Cu	Pb
ρ	0.840	0.820	0.740	0.610
(U_Z/U_K) %	96	90.3	91.6	84
Total error %	6.5	7.3	9.0	5.5

included in the total error shown. Evidently only the results for lead cannot be reconciled with the calorimetric results.

A similar comparison was performed with thick-walled chambers.[4] The ionization in an air-filled cavity inside a block made of different materials was measured. The sensitivity of this chamber was determined theoretically for each wall thickness and material used in the experiment. The accuracy of this calculation is ± 5% and the possible error in ρ of ± 2.5% enter into the total error of the method. The results of this determination are given in Table III relative to the calorimetric results.

TABLE III

Thickness of front wall	2 cm Al	12 cm Al	4 cm graphite	22 cm graphite
used ρ'	0.820	0.820	0.840	0.840
(U/U_K), %	105.0	104.0	102.0	92.4
Total error %	8	8.5	8	8.5

Thus the results of the calorimetric determination, the ionization measurement, and the depth dose curve agree (except for the case of lead) within the total errors. However, the errors of the method of the transition curves can be decreased to 3%. For this purpose at the present time the method of the determination of the transition curves is being improved and the accuracy of the knowledge of ρ is being increased. In order to increase the sensitivity of the calorimetric method a calorimeter is being worked on which will allow measurements at low temperatures.

The author thanks Z. Kovarzh and I. V. Lopatin for their help in performing the measurements and A. P. Komar for his interest in the work.

[1] Proceedings of the Third Annual Rochester Conference (Dec. 18 — 20, 1952) pp. 23 and 26.
[2] P. D. Edwards and D. W. Kerst, Rev. Sci. Instr. 24, 490 (1953).
[3] Blocker, Kenney, and Panofsky, Phys. Rev. 79, 419 (1950).
[4] Flowers, Lawson, and Fossey, Proc. Roy. Phys. Soc. 66B, 286 (1952).

Translated by M. Danos
215

ON THE QUESTION OF THE FLUCTUATIONS OF ELECTRON CONCENTRATION IN THE F-LAYER OF THE IONOSPHERE

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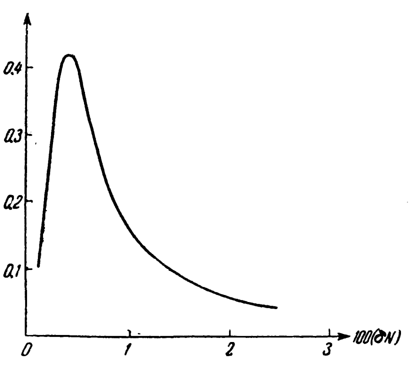
Submitted to JETP editor June 12, 1957

J. Exptl. Theoret. Phys. (U.S.S.R.) 33, 1062 (October, 1957)

IT is known that the ionosphere is a statistically non-uniform medium, in which irregularities continually appear and disappear. The mechanism by which these irregularities arise is not yet known. At this time an investigation of the inhomogeneous structure of the ionosphere is necessary for an understanding of a number of processes that take place in the ionosphere.

Experimental investigations of the inhomogeneous structure of the ionosphere can be divided into two groups, the investigation of the fine structure of the ionosphere by vertical soundings, and the investigation by the forward scatter of uhf waves. Up to the present the forward scatter of uhf waves is in fact not explained. Therefore, great interest attaches to the mechanism of scattering of radio waves by inhomogeneities in the ionosphere, suggested by Al'pert.[1]



Distribution of values of δN