LETTERS TO THE EDITOR


Translated by J. G. Adashko

214

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

S. P. KRUGLOV

Leningrad Physico-Technical Institute, Academy of Sciences, U.S.S.R.

Submitted to JETP editor July 11, 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 \( \gamma \)-rays but also is useful in relating data obtained from ionization measurements to the actual energy absorption in matter. According to the literature, various methods give results that differ up to 25%.

**TABLE I**

<table>
<thead>
<tr>
<th>Cylinder length</th>
<th>Percent fraction of absorbed energy according to transition curves</th>
<th>Energy for one coulomb of standard, ( U_K ), Mev/coulomb</th>
<th>Maximum error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 cm</td>
<td>99.5</td>
<td>4.65·10¹⁸</td>
<td>4.0</td>
</tr>
<tr>
<td>4 cm</td>
<td>82</td>
<td>4.55·10¹⁸</td>
<td>2.5</td>
</tr>
</tbody>
</table>

The energy flux in the \( \gamma \)-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 \( \gamma \)-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 \( \gamma \)-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 \( \gamma \)-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 were also taken into account.

The energy flux of the \( \gamma \)-rays was also determined by the method of the depth dose curve. 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 \( \gamma \)-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)

\[
\rho = \frac{(dE/dX)_z}{(dE/dX)_{Air}}
\]

where \( dE/dX \) is the energy loss of the electrons. The choice of \( \rho \) 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 \( \rho \) of 2.5% has been

**TABLE II**

<table>
<thead>
<tr>
<th>Material</th>
<th>C</th>
<th>Al</th>
<th>Cu</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>( (U_Z/U_K) ) %</td>
<td>0.840</td>
<td>0.820</td>
<td>0.740</td>
<td>0.610</td>
</tr>
<tr>
<td>( (dE/dX)_z ) (MeV/Em)</td>
<td>96</td>
<td>90.3</td>
<td>91.8</td>
<td>84</td>
</tr>
<tr>
<td>Total error %</td>
<td>6.5</td>
<td>7.3</td>
<td>9.0</td>
<td>5.5</td>
</tr>
</tbody>
</table>
included in the total error shown. Evidently only the results for lead cannot be reconciled with the cal-
orimetric results.

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

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. How-
ever, 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 tran-
sition 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.


Translated by M. Danos

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

E. G. PROSHKIN and B. L. KASHCHEEV
Kharkov Polytechnic Institute
Submitted to JETP editor June 12, 1957

It is known that the ionosphere is a statistically non-uniform med-
ium, 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 ion-
osphere 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 inves-
tigation 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