A neutron spectrum of a Ra-Be source was measured and investigated and a satisfactory interpretation of the spectrum shape was given. The second part includes a study on the Li (d, n) reaction on a thick target. Both the spectra were measured by using the nuclear emulsion method.

1) Ra-Be Neutron Spectrum. The Ra-Be source contained 50 mg Ra in the form of RaCl₂. The spectrum was measured for a period of 90 hours at a distance of 13 cm from a 10 em thick lead shielding. The total number of tracks measured amounted to 2,020. A correction was made with respect to an inelastic neutron scattering on Pb. The spectrum measured by us was compared with those measured by Demers and Teucher. It may be noticed that the measurements are identical in their principal courses. In all the measurements two broad maxima can be observed which, for different measurements, are more or less resolved and are shifted at different degrees. We made an attempt at interpreting these differences. Ra-Be source neutrons are produced, as is well known, by Be 9 (s, n) C 12 reaction. In this case we assumed that the infinitely thick RaCl₂ and Be planes were set together. In this case the alpha particle spectrum emitted to Be is given by the relation

\[ \sum_{E_a} \frac{P(E)}{dE} = \sum_{E_a} \frac{K}{N} \left( E_a - E_{\text{res}} \right) V E dE, \]
with $P(E)\, dE$ being the probability of an alpha particle emission from RaCl$_2$ with energy $E$, while $E_0^s$ is its initial energy, and $K$ and $N$ its constants. Summation is carried out over all the values of the initial energy $E_0$ in our case over five alpha groups. The probability of realising the reaction Be$_9$ ($\alpha$, $n$) C$_{12}$ with energy $E$ is given by the product $B(E)\, P(E)\, dE$, with $B(E)$ being the reaction yield on a thick target. In order to predict the neutron energy spectrum, the alpha particle spectrum was divided into sections at $0.8$ MeV; for the mean value of these intervals the neutron energy $E_n\left(\frac{3}{2}\right)$ with an angle $\theta$ between the alpha particle direction and the emitted neutron was calculated. On the assumption of an angular distribution isotropy of the Be$_9$ ($\alpha$, $n$) C$_{12}$ reaction, we determined a width of the energy interval $\Delta E_n = E_n^s(0) - E_n^s(\pi)$, wherein neutrons produced by monoenergetic alpha particles from the mean value of the intervals are homogeneously distributed. The $\Delta E_n$ mean value is $E_n\left(\frac{1}{2}\right)$. The neutron counting rate in a given interval is expressed by $B(E)\, P(E)\, dE$. The summation of all these counting rates for a given energy provides us with a neutron spectrum shape. The neutron spectrum was determined in an analogous way in yet another case where the layer thickness RaCl$_2$ was $d = \frac{D}{20}$, with $D$ as the alpha particle path length in RaCl$_2$.

Thus in this case \[ \sum E_0^s \frac{P(E)\, dE}{E_0} = \sum K \left(\frac{E_n^s(\pi) - E_n^s(0)}{E_0}\right)^2 E_0\, dE \] with $\kappa = \frac{D}{20}$. In comparing the two predicted spectra we arrive at the conclusion that the different shapes of the neutron spectra from Ra-Be are due to the production procedure of their sources, with an obviously varying effective thickness $d_p$ of the layer RaCl$_2$ round beryllium grains. This fact results in the non-reproducibility of the spectrum shape with various Ra-Be sources.

2) Li ($d$, $n$) reaction was used in investigating the energy spectrum shape and the energy levels of a Be$_8$ nucleus. For Be$_8$ the following levels are given: 2.90; (4.2 ?); (5.4 ?); 7.55; 10.8; 14.7 MeV. In this paper one more level, 5.4 MeV, was found. Furthermore, there have found been also levels with 3.4 and 12.7 MeV which are in accordance with some other recent measurements.

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Литература — References