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LETTER TO THE EDITOR

DETERMINATION OF EXCITATION FUNCTION FOR THE REACTION $^{39}K(\gamma, n)\,^{38g}K$

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Absolute yields of the reaction $^{39}K(\gamma, n)\,^{38g}K$ were measured by irradiating potassium borohydride (KBH_4) samples in the bremsstrahlung beam of 24-MeV betatron energy and detecting the annihilation radiation from the positron decay of long period activity (7.7 min) in ^{38g}K. The results were compared with those already reported.

The absolute activation for the ground state of ^{38}K ($T = 0$, $J = 3^+$) in the reaction $^{39}K(\gamma, n)\,^{38g}K$ has been studied by a number of investigators[1,2]. The relevant literature indicates that in their experiments, the authors used KCl and potassium metal, covered with wax, as samples, respectively. Evidently the additional elements chlorine and carbon in those targets were creating an unnecessary background due to activities other than that of ^{38g}K. Moreover in the first experiment *Geiger tube* detection method, with a number of disadvantages, was applied. As a result the author could find the absolute yield of the aforesaid reaction at 18 MeV betatron energy only. In the second case background due to an activity of ^{11}C in the reaction $^{12}C(\gamma, n)\,^{11}C$ made it possible only to take the observations from MeV instead of threshold of the relevant reaction i. e., 13 MeV[3]. Due to the same reason the values of the reduced yield in the energy range beyond 20 MeV came out to be higher than those found in the present work as shown in Fig. 2.

In view of the aforementioned difficulties faced by the researchers of these experiments and inspired by the novelty of the sample (KBH_4), the present investigations were carried out. The chemical compound KBH_4 does not involve any competing activity in the reaction $^{39}K(\gamma, n)\,^{38g}K$, in addition to its special characteristics e. g. stability, non-hygroscopic nature etc. described elsewhere[4].

In this experiment the residual activity of ^{38g}K was measured by the single channel detection method for the annihilation radiation using a $2 \times 2 \times$ NaI (Tl) scintillator. The samples of KBH_4 were made circular discs of almost the same mass and shape. The γ-ray intensity was monitored with an ionization chamber whose output was partially integrated by an *RC*-circuit with time constant being equal to the decay time of the activity in ^{38g}K. The results obtained by such a technique are not affected by the time instabilities of the intensity of the betatron beam. For this purpose the weighted mean value of half-life of the aforesaid activity was taken to be 7.62 min[5].

When one of the samples was irradiated at a maximum betatron energy of 24 MeV and the relevant decay curve was determined, it showed a single activity of ^{38g}K as in Fig. 1, proving thereby the purity of the sample.

The reduced yield of ^{38g}K was obtained from the simultaneously measured yield of ^{62}Cu whose absolute yield at 22 MeV was taken to be 2.25×10^8 disinte-

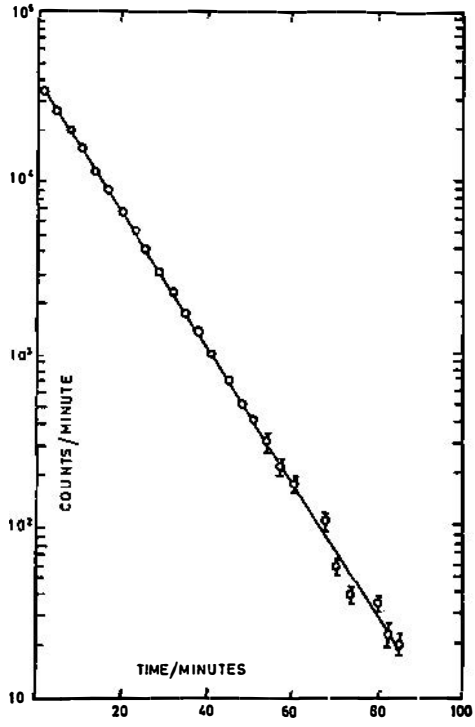

Fig. 1. Decay curve showing no other activities except that of long-period (7.7 min) positron activity in ^{38g}K.

grations/g-atom-100 r[6]. First the ratio of relative yields of (γ, n) reaction of the two substances were determined by applying a method of mixtures[7]. According to that method both the substances are mixed in a finely powered form in a suitable proportion and are irradiated by the same dose of γ-rays. This method is suitable for activities differing appreciably in their half-lives. But in the present case half-lives of the positron activity in ^{62}Cu and ^{38g}K are close to each other i. e., 9.72 min and 7.62 min, respectively. So the aforesaid method was slightly modified by applying the same dose of γ-rays to appropriately made samples of both the substances and places together just behind the monitor in the direction of the beam. The masses of the two kind of samples were such that the attenuation of 0.51 MeV annihilation quanta for both of them was the same. In the first observation the potassium sample was towards the betatron target while copper sample was in contact with it in the direction away from the target. In order to see the different effect of attenuation on the intensity of γ-ray beam falling upon each sample, their positions were interchanged while taking second and third measurements.

After each irradiation first the potassium sample was transferred into a closed aluminium cylinder with walls 1 cm thick. As the ranges of positron in both the activities i. e. ^{38g}K and ^{62}Cu are less than 1 cm in aluminium, hence no positron could escape. The counts due to residual activity of ^{38g}K were taken in the interval

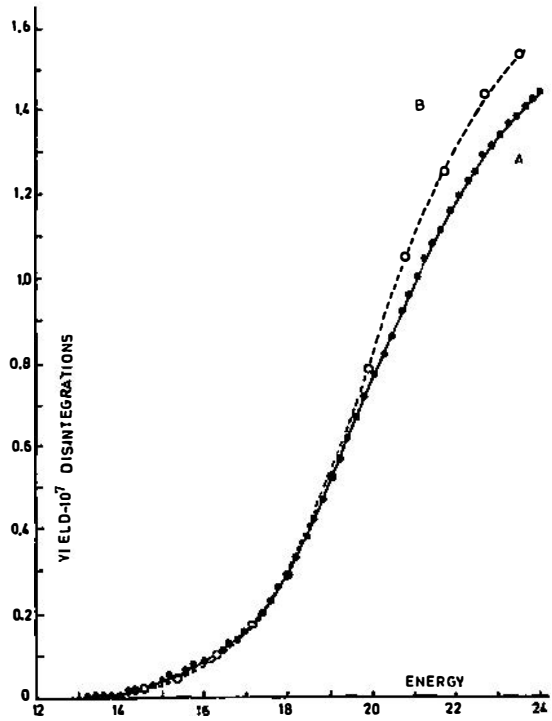

Fig. 2. Absolute activation curves for the reaction ^{39}K (γ, n) ^{38g}K
A — Present work
B — Goldman et al.[2].

from 2 min to 7 min. The process was repeated with the copper sample following its decay for about 2 hours so that the background due to 12. 8 h positron activity in ^{64}Cu might be established. While taking these measurements the time of irradiation for both the substances was kept the same. After applying the proper corrections for the resolving time of the detection system and the attenuation and self-absorption of γ-rays by the samples, the ratio of the relative yield of ^{38g}K to ^{62}Cu came out to be 0.054 when the potassium sample was towards the betatron target and 0.053 when the positions of the samples were interchanged.

In the second method the samples were irradiated separetely and corresponding appropriate *RC*-circuits were applied at the time of irradiation. The procedure for the measurement of residual activity was the same as for the first method. In this case the number of active atoms just at the end of each irradiation perunit dose per g/atom was calculated for ^{39}K and ^{63}Cu. After necessary corrections the ratio of the relative yield of ^{38g}K to ^{62}Cu came out to be 0.053 which is in excellent agreement with the result of first set of observations mentioned above.

Taking the average of the ratios of the relative yields obtained in both the methods the value of absolute yield for ^{39}K (γ, n) ^{38g}K reaction at 22 MeV betatron energy was calculated as 1.20×10^7 disintegrations/g-atom-100 r. Using this value the reduced yields corresponding to different other betatron energies were calculated. The resultant activation curve is shown as in Fig. 2.

A comparison of the results of the present work with those already reported show that in this case the absolute yield at 18 MeV bremsstrahlung energy comes out to be 0.30×10^7 neutrons/g-atom-100 r, whereas Borello et al's[1] result was 0.46×10^7 neutrons/g-atom-100 r. Also from the curves A and B of Fig. 2 it can be infered that the yield values as determined by Goldman et al.[2] are also higher beyond about 20 MeV betatron energy. The reasons for these deviations have been already discussed.

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ODREĐENJE EKSCITACIJSKE FUNKCIJE ZA REAKCIJU $^{39}K(\gamma, n)^{38g}K$

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Apsolutan doprinos reakcije $^{39}K(\gamma, n)^{38g}K$ mjeren je ozračavanjem uzoraka kalijevog borohidrida (KBH_4) snopom zakočnog zračenja betatronske energije od 24 MeV-a i detekcijom anihilacijskog zračenja pozitronskog zračenja perioda aktivnosti 7,7 min u ^{38g}K. Rezultati su uspoređeni s rezultatima drugih autora.