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TO STUDY AND DETERMINATION OF RANGE AND END POINT ENERGY FOR THALLIUM AND STRONTIUM FOR BETA PARTICLE (BY HALF THICKNESS METHOD)

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ABSTRACT

To carry out the observation studies on Beta-rays with the aid of a GM counter and hence to determine the end point energy of nuclear radiations.

INTRODUCTION

The study the properties of radioactive particles emitted by the natural and artificial radioactive nuclides have added greatly to our knowledge of the structure and properties of atomic nuclei. At present, the main interest that the information for emission gives about the theory its relation. The radioactive processes yield information about hundreds of nuclear species not limited to those with large masses this is an important part of nuclear radiations. The emission of radioactive particles differs, the most characteristic feature of the spontaneous radioactive disintegration of a nucleus is the continues distribution energy of the emitted electrons. The continuous energy distribution leads as will be seen to few theoretical problems. These problems have been treated with considerable success only because of its relationship to the practical and conceptual problems of nuclear physics.

THEORY

The velocity or momentum by means of deflection of path emitted by naturally radioactive nuclides may have energies smaller than 4 Mev. Suppose the kinetic energy of the particles will about 3 Mev there are smaller its mass but faster travels and penetrating it has a range in air over 1000cm and produces only about 4 ion pairs/mm of path. For in G.M counter gives count rate as a function of the thickness and plotted on a scale and it is decreases linearly. So that number of nuclear particles decreases exponentially with difference of thickness to good approximations.

The activity does not decrease to zero as the distant becomes very large but practically constant which are called “Background counts” (BC). There is always some radiation present which contributes to the counting rate even though it does not represent nuclear particles from the source.

Therefore nuclear particles may lose a large fraction of its energy, in a single collision straggling is much heavier particles and also scattered easily by nuclei and their paths are not straight. Consequently even if a beam of nuclear particles is initially monenergistic, the straggling and scattering make possible of widely different path lengths and theory predicts. For high energy nuclear particles, when an electron passes through the electric (Colombo) field of a nucleus, it loses energy by radiation.

According Fermi theory, based on the neutrino hypothesis has succeeded in accounting for all features. Although it may at first, seem strange and arbitrary. When a nucleus emits a nuclear particle now its charge changes by one unit, while its mass is practically unchanged. And the number of protons and electrons in the nucleus is increased by one, as well as number of neutrons is decreased by one. But positron emission the number of neutrons increased by one. The exponential form of the curve is accidental and also includes the effects of the continuous energy distribution. And the range R_g is the distance traveled by most energetic particles emitted is measurements are often units per square centimeter.

In any case the curve approaches the background very slowly it is difficult to obtain good accuracy, and this kind of absorption curve is meet often. To avoid the difficulties of the visual and comparison methods have been developed in which the range of the nuclear particles. If the counting rate curve closely approximates a straight line over most of the thickness with a small tail at the end of the curve.

OBJECTIVES

To compute

- The relation between count rate with thickness of the absorber
- Range of the Beta-rays
- End point energy of Beta- rays.

EQUIPMENT

- G.M Counting System with A.C main chord.
- Detector (End window) stand and source holder bench
- Radioactive source Thulium(^{204}Tl) and Strontium (^{90}Sr)
- Aluminum absorber set.

PROCEDURE

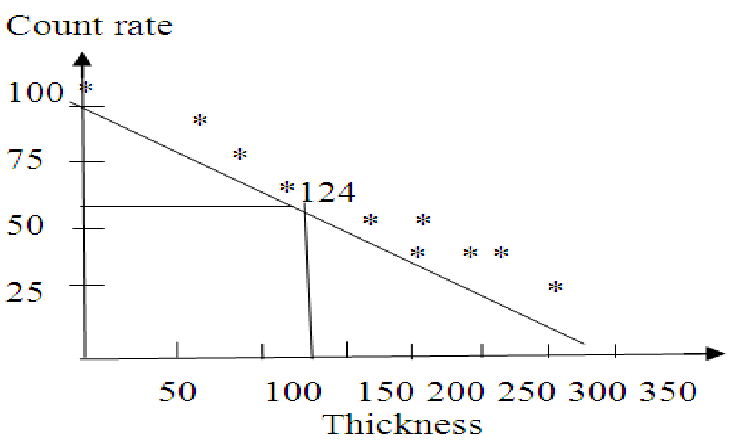
- Make connections and arrangement between G.M. Counting system, detector, absorber and source
- Set the operating voltage about 600 volts (say)
- Without source take about 5 readings per minute for preset time.
- Compute Average background counts = About 17/minute
- Compute Background count rate= 17/60=0.226count rate
- Place Thallium Beta source about 3 cm from the end window of the GM tube.
- Take the aluminum absorber set containing 10 absorbers in the thickness range of 0 cm to 0.1 cm. one by one.
- Place the aluminum absorber in the absorber holder at about 2 cm from the end window.
- The required for on an average 2200 counts with 0.1cm absorber thickness and record. and net count rate is calculated.
- The absorber thickness is increased in steps until the count rate becomes Lesser for both sources.
- Here in this case the anther source is ^{204} Tl and second source is ^{90} Sr.
- Plot a graph of Net count rate Vs absorber thickness mg/cm^2 for both sources.

Table: 1. Thallium (^{204}Tl)

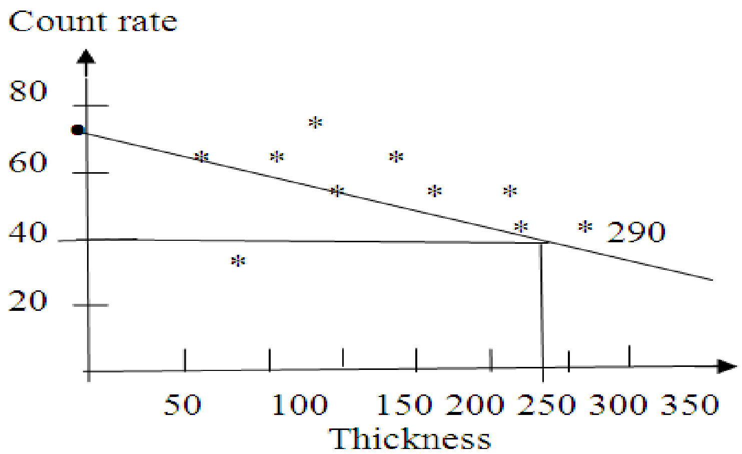
Absorber Thickness cm	Absorber Thickness Mg/cm	Counts/min NC	Corrected Counts/min N=NC-BC	Count rate
0	0	7020	7003	116.7
0.01	27.1	6300	6284	104.7
0.02	54.2	5280	5264	87.7
0.03	81.3	4500	4484	74.7
0.04	108.4	3840	3824	63.7
0.05	135.5	3480	3464	57.7
0.06	162.5	3180	3164	52.7
0.07	189.7	2460	2444	40.7
0.08	216.8	2220	2204	36.7
0.09	243.9	1980	1964	32.7
0.10	271.0	1680	1664	27.7

Table: 2. Strontium (^{90}Sr)

Absorber Thickness cm	Absorber Thickness Mg/cm^2	Counts/min NC	Corrected Counts/min N=NC-BC	Count rate
0	0	4560	4544	76.6
0.01	27.1	4200	4184	70.0
0.02	54.2	3840	3824	64.0
0.03	81.3	3660	3644	61.0
0.04	108.4	3420	4004	57.0
0.05	135.5	3240	3224	54.0
0.06	162.5	3120	3104	52.0
0.07	189.7	3060	3044	51.0
0.08	216.8	2880	2864	48.0
0.09	243.9	2760	2744	46.0
0.10	271.0	2640	2624	44.0



Graph-1: Thallium (^{204}Tl) Source.



Graph -2: Strontium (^{90}Sr) Source.

Calculation

For THALLIUM (^{204}Tl)

The range of Beta-particles is given by R=0.52 E X 0.09g/cm^2

Where E is the end point energy

Therefore E = 0.764 MeV (standard value)

Range of ^{204}Tl = R_1 = (0.52 X E X 0 0.09)gm/cm^2

= 0.52 X 0.764 X 0.09

= 0.30728 gm/cm^2

From Graph

The graph extrapolate and obtain thickness of aluminum absorber required to reduce the count rate of Thallium and Strontium by half source $t_1{}^1/_2$ and $t_2{}^1/_2$.

Aluminum absorber required to reduce the count rate of ^{204} Tl by half, $t_1$1/2 = 124mg/cm^2

Aluminum absorber required to reduce the count rate of ^{90}Sr by half, $t_2$1/2 =290mg/cm^2

These graphical values to use calculated by

Range of Strontium (^{90}sr)

$$\frac{t_1 1/2}{t_2 1/2} = \frac{R_1}{R_2}$$

$$R_2 = R_1 \text{ X } \frac{t_1 1/2}{t_2 1/2} = \frac{0.30728 \text{ X } 290 \text{ X } 10^{-3}}{124 \text{ X } 10^{-3}} = 0.966 \text{ gm/cm}^2$$

And

End point energy of (^{90}sr)

$$E_2 = \frac{R_2 + 0.09}{0.52} = \frac{0.966445 + 0.09}{0.52} = 2.28 \text{ MeV}$$

RESULT

The ratio of thickness required to reduce the number of radiations. Thus the end point energy ^{90} Sr = 2.28 Mev.

CONCLUSION

The nuclear radiations are depending upon source, count rate, range and end point energy. All are depends on absorber material and the distance between source and window. To postulate the existence of an undetected particle, this hypothesis has lead to a great real of experimental and theoretical work. It is also found that the measured value is precise (exact).

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