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PHYS307 Applied Modern Physics

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Exp. MP-SA The Energy Spectra of Alpha Particles

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Peak (channel no)	Source of α -particles	Energy (in keV)
76	^{226}Ra	4780
118	^{222}Rn	5551
146	^{218}Po	6065
234	^{214}Po	7680

Table 1: The resolved peaks in the spectrum of ^{226}Ra in the vacuum

Peak (channel no)	Energy (in keV)
52	4340
100	5221
140	5954
230	7606

Table 2: The resolved peaks in the spectrum of ^{226}Ra in the air

Peak (channel no)	Total Pulses	Energy (in keV)	Source of α -particle
151	4280	6156	^{244}Cm

Table 3: Data for unknown α -source in the vacuum

1. Calculate the activity of the unknown α -source.

$$Activity(\alpha/s) = (\frac{\sum \alpha}{t})(\frac{4\pi S^2}{A}) \quad (1)$$

where $S=0.02$ m, $A=4.0 \times 10^{-6} \text{m}^2$, $\sum \alpha = 4280$ and $t=300$ secs.

$$Activity(\alpha/s) = (\frac{4280}{300})(\frac{4 \cdot \pi \cdot 0.02^2}{4.0 \times 10^{-6}}) \quad (2)$$

$$Activity(\alpha/s) = 17928 \text{decay/s} \quad (3)$$

$$Activity(\alpha/s) = 0.48 \mu\text{Ci} \quad (4)$$

2. Write at least five different reasons for observing only a few peaks rather than nine peaks in the spectrum of ^{226}Ra in the vacuum and make suggestions to improve the resolving of the peaks in the spectrum with the present system.

- 1- We could not vacuumed the detector 100%.
- 2- Noise and vibration
- 3- ^{216}At , ^{218}Rn , ^{210}Tl and ^{206}Tl in the decay sequence of ^{226}Ra only occur with very low activities.
- 4- Loss of radon daughters [1].
- 5- The detector does not have high sensitivity.
- 6- In the experiment we used five different experimental setups and each one have it's own calculation error.

To be more accurate in the experiment my suggestion is splitting vacuum chamber and other experiment setups because noise and vibration are very effective to distort the data. Using an high tech detector will give more accurate solutions. In laboratory, other radioactive decays may cause to distortion in data. Some researchers state that a calibration before the experiment may reduce to error in experiment. ^{210}Po , ^{238}U , ^{238}Pu , ^{239}Pu and ^{241}Am is strongly preferred over pulser-calibration techniques [2].

3. Describe the physical significance of any peak on energy spectra of α -particles.

Each peak is a α decay of ^{226}Ra . In each peak ^{226}Ra is turned to his isotopes in the order of as stated in Table 1. By using these peaks we can calculate the energy of α decays, we can detect the type of radioactive isotopes.

Discussion and Conclusion

In this experiment we observe the α decay of ^{226}Ra in both vacuum and air. After this experiment we can realize the behaviour of α decays in different environment. Another significant observation in this experiment is the decays of unknown sample. By using decay rate of unknown sample we tried to predict that name of radioactive isotope. In this experiment we have very low percentage error. For instance for ^{222}Rn which is took in vacuumed chamber:

$$Per.Error = \frac{|5480 - 5550|}{5480} \times 100\% \quad (5)$$

$$Per.Error = 1.3\% \quad (6)$$

References

- [1] *Alpha-, Beta-, and Gamma-Ray Spectroscopy*, Ed.: Kai Siegbahn, Vol. 1, North-Holland Publ. Co., Amsterdam, New York (1968)
- [2] *Nuclear Spectroscopy and Reactions*, Ed.: J. Cerny, Academic Press, New York and London (1974)