## Experiment No. 3

## Study of the alpha-energies of radium-226

Aim of the experiment:

Measure the alpha particle energy distribution with a semiconductor spectrometer; test some properties of the alpha energy spectrum (discrete character of the alpha particle spectrum, typical energies of alpha particles emitted by radioactive nuclides, proportionality of the detector pulse height to the energy of the incident particle), investigate influence of interaction of alpha particles with matter on the shape of their energy spectrum.

Tasks:

1. Measure the energy spectrum of alpha particles emitted by the isotope of radium $^{226}$Ra, which is in radioactive equilibrium with its decay products.
2. Measure the calibration spectrum using an unsealed source consisting of the isotope of americium $^{241}$Am, under the same conditions as in Task 1.
3. Calculate particle energies corresponding to the peaks of the $^{226}$Ra spectrum.
4. Calculate the differences of alpha particle energies corresponding to various pairs of peaks in the $^{226}$Ra spectrum.
5. Compare the obtained differences of energies with differences of true (initial) energies corresponding to various pairs of nuclides in the decay chain of $^{226}$Ra. Under the assumption that all alpha particles lose the same energy amount in the source cover, the measured energy differences should be equal to differences of corresponding initial energies. Based on that comparison, determine the nuclides corresponding each peak in the measured $^{226}$Ra spectrum.
6. Discuss the shape of the spectra (difference of peak widths in $^{241}$Am and $^{226}$Ra spectra, positions of peaks in the $^{226}$Ra spectrum, similarities and differences of peak heights), explain the observed features of the spectrum on the basis of the theory of radioactive equilibrium.

Control questions:

1. Define the concept of radioactivity. Formulate the law of radioactive decay.
2. Define the concept of a decay chain. What is radioactive equilibrium? How are amounts of radioactive nuclides related to each other under conditions of radioactive equilibrium?
3. What is alpha decay? What are its main properties?
4. Explain the concept of detector pulse height spectrum and its relation to the particle energy spectrum.

Recommended reading:


1. Krane K. S. Introductory Nuclear Physics. New York: John Wiley & Sons, 1988. p. 160 – 165, 193 – 198, 246 – 254.
2. Lilley J. Nuclear Physics: Principles and Applications. New York: John Wiley & Sons, 2001. p. 14 – 15, 18 – 22, 84 – 88, 129 – 136.
3. Knoll G. F. Radiation Detection and Measurement. 3rd Edition. New York: John Wiley & Sons, 2000. p. 30 – 34, 353 – 378, 382 – 384, 387 – 389, 391 – 393.