INTERACÇÃO DE γs COM A MATÉRIA: EFEITOS FOTOELÉCTRICO, DE COMPTON E PRODUÇÃO DE PARES e^+e^-

References

1. C.E. Crouthamel, editor, *Applied Gamma-Ray Spectrometry*, Pergamon, New York, 1960; in Appendix IV of this work the gamma-ray sources are listed in terms of increasing energy.

2. K. Siegbahn, editor, *Alpha-, Beta- and Gamma-Ray Spectroscopy,* Vol 1, North Holland Publishing Co., Amsterdam, 1965.

3. R.L. Heath, *Scintillation Spectrometry. Gamma Ray Spectrum Catalog,* 2d ed., Vols 1 and 2, IDO-16880, August 1964; available from Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.

4. W.J. Price, *Nuclear Radiation Detection,* 2d ed., McGraw-Hill, New York, 1964.

5. *Radiological Health Handbook,* U.S. Dept. of Health, Education, and Welfare, PHS Publ. 2016, Washington, 1970.

6. C.M. Lederer, J.M. Hollander, and I. Perlman, *Table of Isotopes,* 6th ed., Wiley, New York, 1967.

Equipment Needed for Experiments 3.1 Through 3.7

1. ORTEC 401A/402B Bin and Power Supply
2. ORTEC 905-1 NaI(Tl) Crystal and Phototube Assembly
3. ORTEC 266 Photomultiplier Tube Base
4. ORTEC 456 High Voltage Power Supply
5. ORTEC 113 Scintillation Preamplifier
6. ORTEC 485 Amplifier
7. ^{137}Cs gamma source, 5 μCi ±5%
8. ORTEC SK1 Source Kit
9. Eight sheets of 1/16-in.-thick lead plate, 3 x 3 in.
10. Connecting cables
11. Multichannel Analyzer (usually 100 channels or greater) with Teletype or typewriter readout

Note: If a multichannel analyzer is not available, this experiment can be done with items 12 through 17 in place of item 11

12. ORTEC 406A Single-Channel Analyzer
13. ORTEC 487 Digital Spectrum Scanner
14. ORTEC 484 Scaler
15. ORTEC 719 Timer
16. ORTEC 441 Ratemeter
17. Strip Chart Recorder such as HP-680

Additional Equipment Needed for Experiment 3.8

1. ORTEC 489-1 Delay Amplifier
2. ORTEC 488 Timing Single-Channel Analyzer
3. ORTEC 426 Linear Gate
4. ORTEC 484 Scaler

PURPOSE

The purpose of this experiment is to acquaint the student with some of the basic techniques used for measuring gamma rays. It is based on the use of a sodium iodide (NaI) detector that is thallium-activated (Tl).

GAMMA EMISSION

Most isotopes that are used for gamma measurements also have betas in their decay schemes. The typical decay scheme for the isotope will include a beta decay to a particular level followed by gamma emission to the ground state of the final isotope. The beta particles will usually be absorbed in the surrounding material and not enter the scintillator at all. This absorption is normally assured with aluminum absorbers.[1-3] For this experiment the betas offer no real problem and so absorbers are not specified. There will be some beta absorption by the light shield over the phototube. The gammas, however, are quite penetrating and hence will pass easily through the aluminum light shield.

Generally there are two unknowns that we would like to investigate about a gamma source. One is the energies of the gammas from the source. The other is the number of gammas that leave the source per unit of time. In this experiment the student will become familiar with some of the basic NaI(Tl) measurements associated with gamma-emitting unknowns.

A total time of approximately 6 hr is required to complete all the parts of Experiment 3 (3.1 through 3.8). The complete series can be done in two 3-hr lab periods, since each is written to be fairly independent of the others.

EXPERIMENT 3.1: ENERGY CALIBRATION

SETUP OF EQUIPMENT

Set up the electronics in the arrangement shown in Fig. 3.1. There are two parameters that ultimately determine the overall gain of the system: the high voltage that is furnished to the phototube and the gain of the linear amplifier. The gain of the photomultiplier tube is quite dependent upon its high voltage. A rule of thumb for most phototubes is that a 10% change of the high voltage will change the gain by a factor of 2. The high-voltage value depends on the phototube being used; consult your instruction manual for the phototube and select a value in the middle of its normal operating range. (The instructor may wish to recommend a value.)