

The final parameter necessary to evaluate in selecting a detector is the depletion depth of the detector. In the next experiment, we will study the energy loss and range of charged particles in matter. Alpha particles from radioactive sources have a range of energies from 1.83 MeV for ^{144}Nd to 11.65 MeV for $^{212\text{m}}\text{Po}$. Most of the alpha sources that are convenient to use for this experiment have energies around 5.0 MeV. Figure 3.3 shows the theoretical range of five different charged particles in Silicon. From the figure, it can be seen that the 5 MeV alphas that we use for this experiment have a range of approximately 20 microns (μ). These alphas can easily be stopped in any of the partially depleted detectors that Tennelec manufactures since the minimum depletion region of all of these detectors is at least 100 μ . The detector recommended for this experiment is Tennelec model PD-050-100-014-CM. Figure 3.4 explains the significance of this number.

In summary, the detectors are small, easy to use, relatively inexpensive, have excellent resolution, and can be used to measure virtually any charged particle.

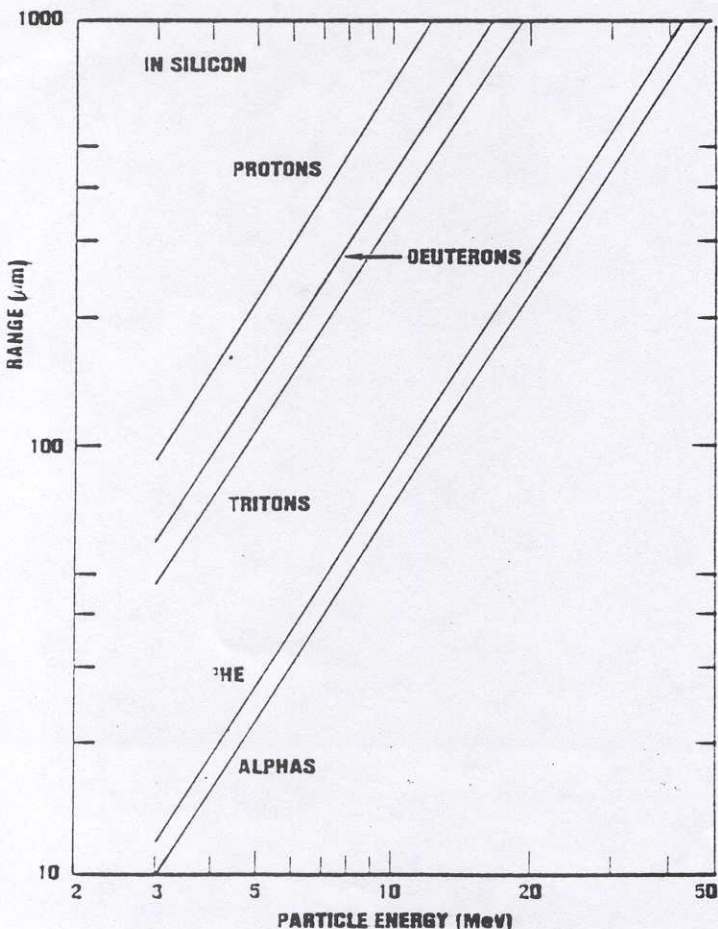


Figure 3.3. Calculations of range vs energy curves for different charged particles in Silicon (from D. J. Skyrme, Ref 2).

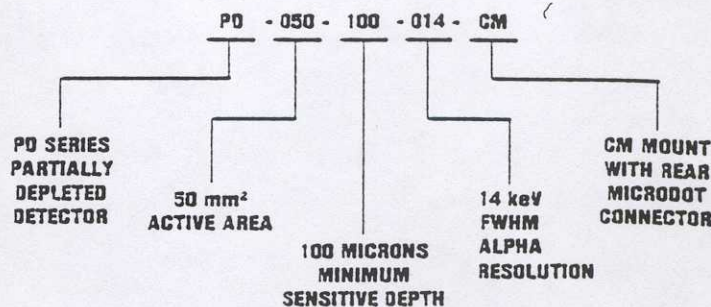


Figure 3.4. Explanation of the nomenclature used to define the model numbers of Tennelec Surface Barrier Detectors.

Health Physics Considerations for Alpha Sources

The alpha sources that are used for this experiment have been either electrodeposited or evaporated onto a metal disk. If you look very carefully, the deposited spot, which is usually about 1 mm in diameter, can be seen in the center of the disk. The spot should never be touched with the fingers because some of the evaporated material might break loose and contaminate your hand and/or the work area. Always handle these sources by holding the edge of the disk. In the case of the ^{210}Po source, the radioactive material is evaporated onto a silver disk. The disk is then completely encapsulated with plastic, except for a small hole on the front surface to emit the 5.31 MeV alphas from the source.

EXPERIMENT 3.1

Energy Calibration with a Pulser for Alpha Spectroscopy

Scope

The electronics shown in fig. 3.5 will be calibrated. An energy versus pulse height curve will be constructed with the aid of the Pulse generator. The resolution of the system will be determined for alphas from ^{210}Po .

Experimental Procedure

1. Set up the equipment as shown in fig. 3.5. Place the ^{210}Po source in the vacuum chamber approximately 1 cm from the face of the detector. Evacuate the chamber for about 2 minutes. If there are no leaks, the fore pump will run very quietly after this period of time.
2. Set the Bias Supply to positive and adjust its value to the recommended value for the Silicon Surface Barrier Detector, correcting for the voltage drop on the series