4.5.1 Absolute Efficiency

The number of recorded counts, \( A \), divided by the number of photons emitted by the source, \( A_0 \).

\[ E_a = \frac{A}{A_0} \]

If \( A \) is the net photopeak area, then \( E_a \) is called the absolute photopeak or absolute full-energy peak efficiency.

4.5.2 Intrinsic Efficiency

The number of recorded counts, \( A \), as above, divided by the number of photons actually striking the detector, \( A_d \).

\[ E_i = \frac{A}{A_d} \]

4.5.3 Relative Efficiency

The number of recorded counts in one detector, \( A_1 \), divided by the number of recorded counts in a second reference detector \( A_r \).

\[ E_r = \frac{A_1}{A_r} \]

![Diagram showing source, detector, and spectrum](image)

Figure 4.6

The "IEEE Standard Test Procedure for Germanium Gamma-Ray Detector, St. 325-1971" defines the relative efficiency of a germanium spectrometer referenced against a 3" x 3" NaI(Tl) detector, (which has an absolute efficiency of \( 1.2 \times 10^{-3} \) at 1.33 MeV of Co\( ^{60} \)), where the source to detector distance is 25 cm. A point source is used.

The relative percent efficiency of a germanium spectrometer can also be calculated from the formula

\[ E_r = \frac{C \times 100}{t \times 44.4 \times A_{Co}} \]

where

- \( C \) = net counts in the 1.33 MeV photopeak,
- \( t \) = live acquire time of the MCA (seconds),
- 44.4 = cps from 1 uCi of Co\( ^{60} \) in a 3" x 3" NaI(Tl) detector at 25 cm, and
- \( A_{Co} \) = source activity in uCi at time of measurement.

Note that the IEEE test procedure for relative efficiency specifies a source to detector distance of 25 cm, not source to endcap distance. The detector to endcap distance is normally 5 mm.