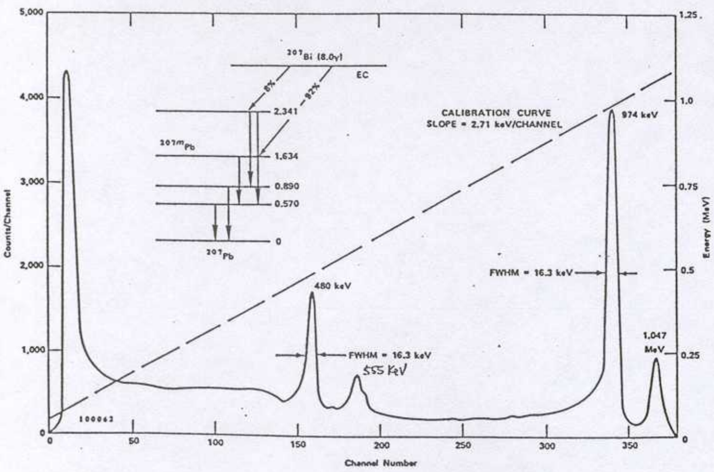

Fig. 6.2. ^{207}Bi Conversion Electron Spectrum.

EXPERIMENT 6.3: CONVERSION ELECTRON RATIOS

THEORY

In the internal conversion process the energy of excitation can be given to one of the orbiting electrons as discussed at the beginning of Experiment 6. The electrons that are usually involved are in the K, L, and M shells that are closest to the nucleus. The energy of the conversion electron is given by

$$E_e = E_x - E_B \, , \qquad (6)$$

where

E_e = the measured energy of the conversion electron,
E_x = the excitation energy available in the decay,
E_B = the binding energy of the electron in the atom.

The conversion electron spectrum for ^{207}Bi is shown in Fig. 6.2. It shows lines at 1.047 and 0.974 MeV. These are the lines that come from the K and L conversion processes, respectively.

The decay scheme of ^{207}Bi, also shown in Fig. 6.2, shows a gamma transition from the 1.634-MeV level to the 0.570-MeV level. This difference in energy is 1.064 MeV. In Eq. (6) this is the excitation energy E_x which is available for the conversion process.

The K binding energy E_B for ^{207}Bi is 90 keV. For this conversion, E_e = 1.064 - 0.090 MeV = 0.974 MeV, or 974 keV. The L_I binding energy for ^{207}Bi is 16 keV. For this conversion, E_e = 1.064 - 0.016 MeV = 1.047 MeV.

In a similar manner the conversion electron energies for the 570-keV excitation can be calculated. These are 480 and 554 keV. The binding energies for all elements are listed in ref. 6, pp. 556-569. In this experiment the K/L ratios will be measured.

PROCEDURE

1. Use the system of Experiment 6.1, including the calibration.

2. Be sure to use a detector with 18-keV resolution or better.

3. Accumulate a spectrum for ^{207}Bi for a period of time long enough to obtain about 1000 counts in the 1.047-MeV peak. Print the data from the multichannel analyzer.

Exercise a. Find the sum under the 1.047-MeV peak. Define this quantity to be $\Sigma L_{1.064}$. Find the sum under the 974-keV peak, and define this quantity to be $\Sigma K_{1.064}$. Calculate the K/L ratio, which is $(\Sigma K/\Sigma L)_{1.064}$. Repeat these steps for the 480-keV and 554-keV lines and calculate the ratio $(\Sigma K/\Sigma L + M)_{0.570}$. Note that the L and M lines are not quite resolved in Fig. 6.2, and probably will not be resolved in your spectrum. How do your values compare to those in ref. 6, p. 398?

Exercise b. Repeat the measurements and calculations for ^{113}Sn and ^{137}Cs. Your spectra should look like Figs. 6.3 and 6.4, respectively. How do your values compare to those in ref. 6 for these isotopes?