Intermediate-mass-fragment yields \((IMF: 3 \leq Z \leq 15)\) have been measured for the \(E/A = 50 \text{ MeV} \) \(^4\text{He}\) + \(^{nat}\text{Ag}\) and \(^{197}\text{Au}\) reactions. Fragment charges were identified with an axial gas-ionization chamber/silicon semiconductor surface barrier \(\Delta E-E\) telescope. At selected angles discrete nuclide identification was also obtained with resolution \(\Delta A \lesssim 0.5 \mu\) by using beam rf and silicon detector timing signals for time-of-flight/energy determination.

The energy spectra, angular distributions and cross sections for each \(Z\) are found to resemble earlier data for the 200-MeV \(^3\text{He}\) + \(^{nat}\text{Ag}\) system\(^1\). IMFs from the latter system were well-described by isotropic emission from a two-source model: one involving statistical decay of a fully equilibrated source and the other originating from a fast precompound-like mechanism. For the equilibrated source (EQ) the model of Moretto\(^2\) is employed; the non-equilibrium (NEQ) source is described by a Maxwellian function with surface emission. Each source is characterized by a velocity \(v\), temperature \(T\) and Coulomb barrier fraction \(k\); in addition, the statistical fit requires determination of an amplification parameter, \(p\). Because of the distinctly precompound character of the forward-emitted fragments, an angular fitting function, \(W(\theta) \propto e^{-a\theta}\), was included in the fit. This addition served to improve the quality of the fits markedly and also provided a more systematic set of fitting parameters, especially with regard to the Coulomb barrier fractions. These results are shown in Fig. 1 where spectra from boron fragments at several representative angles are
Figure 1. Spectra for boron fragments at several angles from 200 MeV \(^4\)He bombardment of \(^{197}\)Au. Emission angles are indicated on graph. Dotted line represents \(\sigma(EQ)\), dashed line is \(\sigma(NEQ)\) and solid line is the sum of these.
shown. The dashed line represents $\sigma_{NEQ}$, the dotted line $\sigma_{EQ}$, and the solid line is the total differential cross section for a given IMF.

The relative ratios of equilibrated/total IMF yields are plotted in Fig. 2 for the $^4\text{He} + ^{197}\text{Au}$ system as a function of ejectile atomic number. It is apparent in Fig. 2 that the two sources contribute to the yields quite differently, depending on fragment $Z$. Low-$Z$ fragments are seen to arise primarily from non-equilibrated processes, whereas fragments with $Z \gtrsim 10$ appear to be emitted from an equilibrated source.

**Figure 2.** Ratio of equilibrated/total IMF yield as a function of fragment $Z$ for 200 MeV $^4\text{He} + ^{197}\text{Au}$.  

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The influence of target N/Z ratio on the fragment isotopic yields is shown in Fig. 3, where differential cross section ratios at 20° are plotted for IMFs from a silver target relative to gold. This plot shows that for a given element, the lower N/Z silver target favors the production of lower N/Z ratios for the fragments. The increased elemental ratios for a given isobar from silver relative to gold reflect the increased Coulomb barrier for emission from gold.


Figure 3. Ratio of differential cross section at 20° for fragments from \(^4\text{He} + \text{Ag}\) reaction relative to \(^4\text{He} + \text{Au}\) as a function of fragment mass.