We have begun a study of the \(^{(6\text{Li},d)}\) \(\alpha\)-transfer reaction at high bombarding energy. The reactions \(^{12}\text{C}\) \((6\text{Li},d)^{16}\text{O}\) and \(^{208}\text{Pb}(6\text{Li},d)^{212}\text{Po}\) have been investigated thus far and rather complete data obtained for the former (Figs. 1 and 2). One observes a more selective population of "\(\alpha\)-cluster" levels in \(^{16}\text{O}\) (e.g. 6.9 MeV \(2^+\), 10.4 MeV \(4^+\), Fig.1) than is observed with \((6\text{Li},d)\) at lower bombarding energies\(^1,2\). Also the angular distributions to \(\alpha\)-cluster levels are much more forward-peaked (Fig.2) including a large enhancement at \(\theta=0^\circ\). The study of \(^{12}\text{C}(6\text{Li},d)^{16}\text{O}\) is of particular interest in that the \(\alpha\)-widths of the \(J^\pi = 1^-\) levels at \(E_X = 7.1\) MeV and 9.6 MeV (Fig.1) are important in stellar helium fusion\(^3,4\). The data at \(E(\text{Li}) = 90\) MeV should greatly help to clarify some anomalies observed at lower bombarding energies\(^2\)

including the \(\alpha\)-decay width of the 9.6 MeV \(1^-\) level. Limited data have also been obtained for \(^{208}\text{Pb}(6\text{Li},d)^{212}\text{Po}\). A ground state cross section of about 0.15 \(\mu\text{b/sr}\) is observed at \(\theta=11^\circ\). There appears to be considerable \(\alpha\)-transfer strength (\(52\ \mu\text{b/sr}\)) to excited levels in \(^{212}\text{Po}\) at \(E_X = 2.2\) to 3.0 MeV (Fig. 3). These may correspond to certain preferred high-spin levels with "stretched" configurations. Unfortunately contaminant buildup is a problem for heavy targets. Improvements of the targets and spectrometer vacuum system are planned and should permit further work on \(^{208}\text{Pb}\) and other heavy nuclei.

\*Department of Physics, University of Michigan, Ann Arbor, MI 48109

Figure 1. Portions of a deuteron spectrum from \(^{12}\text{C}(6\text{Li},d)^{16}\text{O}\) in the vicinity of the \(0^+(6.0\ \text{MeV})\), \(2^+(6.8\ \text{MeV})\) and \(4^+(10.4\ \text{MeV})\) \(\alpha\)-cluster rotational band in \(^{16}\text{O}\). Note strength to \(3^+(6.9\ \text{MeV})\) and \(1^- (7.1\ \text{MeV})\) levels relative to \(2^- (9.9\ \text{MeV})\) level. The latter is not allowed in a simple direct \(\alpha\)-transfer.


Figure 2. Experimental angular distributions. The curves shown connect data points and have no theoretical significance.

Figure 3. Spectrum from $^{208}\text{Pb} (^6\text{Li},d)^{212}\text{Po}$. The shaded regions represent contributions from contaminants in the target, mainly $^{12}\text{C} (^6\text{Li},d)$ and $^{16}\text{O} (^6\text{Li},d)$.