ALPHA-CLUSTER PICKUP REACTIONS ON EVEN Sn AND Te NUCLEI*

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Spectra (Fig.1) for Te(d,^{6}Li)Sn and Sn(d,^{6}Li)Cd have been obtained for E_d=33 MeV at BNL. Complete angular distributions were measured for ^{122}Te(d,^{6}Li)^{118}Sn. The g.s. spectroscopic strength closely follows that for (p,t) and (t,p)[1] demonstrating the close correlation[2,3] between 2- and 4-nucleon transfer reactions. For excited states, however, the (d,^{6}Li) strength sometimes exceeds that of (p,t) considerably. The proton pairing-vibration state in ^{118}Sn at 1758 keV, for example, is much stronger in (d,^{6}Li). For states with J>0 the increased strength is due to coherent combinations (L_π, L_ν) $[\vec{L}_\pi + \vec{L}_\nu = \vec{L} = \vec{J}]$, whereas in (p,t) only L_ν= J is possible.

Semi-microscopic calculations have been performed for selected transitions using BCS[4] and pairing wave functions. The equations of

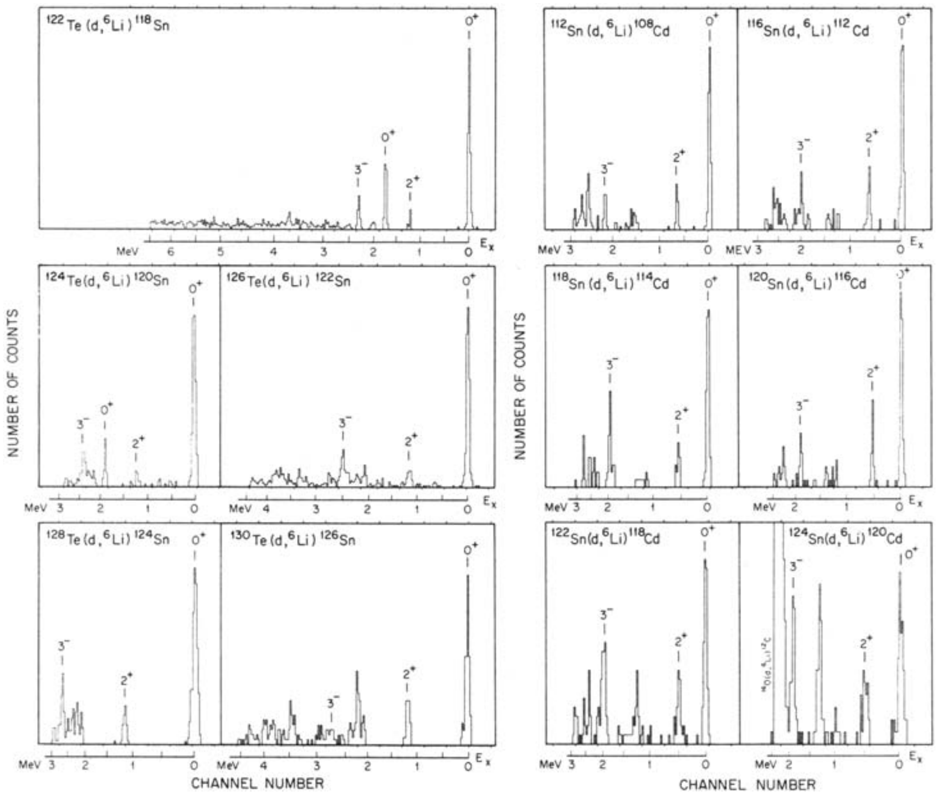

Fig.1. Spectra of ^{6}Li particles from (d,^{6}Li) reactions at Θ_{lab}=16^0.

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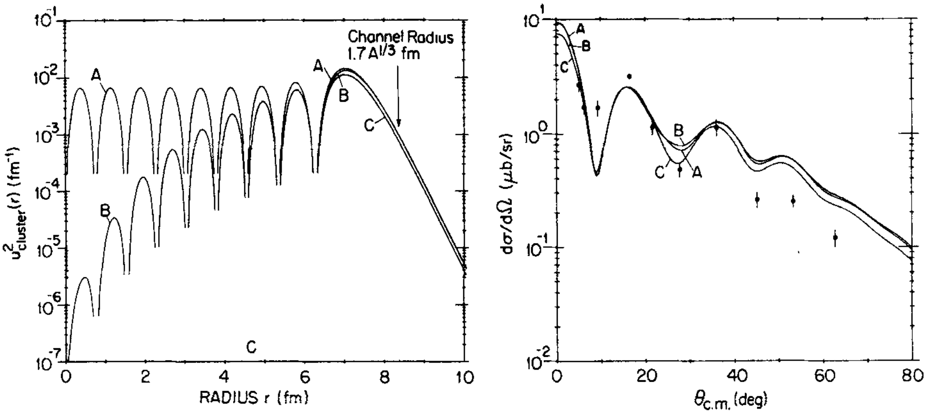

Fig.2. Cluster wave functions and angular distributions for ^{122}Te $(d,{}^{6}Li)^{118}Sn$(g.s.). A: Macroscopic; B: Microscopic; c: Macroscopic with $u^2(r)\equiv 0$ inside r=6.3 fm.

Kurath and Towner[5] were employed with α-parentage amplitudes in SU_3 notation and wave functions generated in Woods-Saxon potential wells. About 60 contributions have to be considered for 0^+ states, about 200-300 for 2^+ and 3^- states. The interaction $V_{d\alpha}$ was not treated microscopically. Fig.2 shows the microscopic cluster wave function for $^{118}Sn + \alpha$. In the exterior region it is practically identical to the macroscopic function. Enhancement factors $\varepsilon=\sigma(\exp)/\sigma(\text{calc})\approx 3.1$ and ≈ 1.1 for the g.s.transitions to ^{118}Sn and ^{114}Cd were found. The 0^+ pairing-vibration state in ^{118}Sn has $\varepsilon\approx 0.6$ in excellent agreement with the strength observed in $(^3He,n)$.[6] The weak 0^+ state at 2057 keV is well described ($\varepsilon\approx 1$) as a 2-quasi-particle state. Transitions to 2^+ and 3^- states are well described ($\varepsilon\approx 1$) assuming only contributions from $(L_\pi,L_\nu)=(0,J)$ and $(J,0)$. One might expect, though, that for J>3 additional contributions become important. The dependence on N for the observed $2^+,3^-,4^+,5^-$ and 7^- strengths is at least qualitatively understood in terms of the BCS and pairing wave functions. The pronounced increase in 7^- strength, for example, results from the stretched $(2d_{3/2}\ 1h_{11/2})_7$ configuration. The drastic decrease for the 0^+ proton pairing-vibration states is not fully understood.

Using the known α-decay of ^{148}Sm, earlier $^{148}Sm(d,{}^{6}Li)^{144}Nd$ data[3] make it possible to deduce the normalization constant N needed in zero-range DWBA calculations. Depending on the optical parameter sets used, N=3.8±25%. Finite-range calculations are in good agreement with this value.

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