STUDY OF THREE-PARTICLE-ONE-HOLE STATES IN ^{14}C WITH THE $^{11}B(\alpha,p)^{14}C$ REACTION AT 120 MEV

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Recently there has been considerable interest in m-particle-n-hole states. The most direct evidence that a given state has a predominant mp-nh configuration comes from multi-nucleon transfer data. If a state is strongly excited in a stripping reaction that adds m particles to a target nucleus which contains the appropriate n holes and is weakly excited in all simpler reactions, then that state clearly contains a large mp-nh component.

A recent study of the $^{13}C(\alpha,p)^{16}N$ reaction[1] (E_α=120 MeV) showed that only relatively few of the known states of ^{16}N were selectively excited. The strength of population of these states reflects at least semi-quantitatively or perhaps even quantitatively the strength of 3p-3h components in them.

We extended the investigation of mp-nh states with the (α,p) reaction to the mass-14 system by measuring angular distributions of the $^{11}B(\alpha,p)^{14}C$ reaction at 120 MeV bombarding energy. Due to the momentum mismatch in the (α,p) reaction at 120 MeV incident energy, high-spin states, 3p-1h in nature, are expected to be strongly excited. Therefore this reaction is capable of populating final states with spins up to 8^-, which result from coupling the transferred $(1d_{5/2})^3_{13/2}$ configuration to the spin $3/2^-$ of the target nucleus B.

The reaction products were momentum-analyzed and subsequently detected in the focal plane of the QDDM magnetic spectrometer with a position-sensitive helical proportional detector followed by two plastic scintillators for particle identification. The target consisted of a self-supporting ^{11}B foil, enriched to >98%, with a thickness of about 0.38 mg/cm^2. Three different magnetic field settings were required to cover the excitation energy region from 6 to 21 MeV. Figure 1 shows a composite spectrum of three such bites at Θ_{lab} = 10°. An overall resolution of about 50 keV was obtained. As one can see, only a few states are selectively excited.

Angular distributions of the strongest transitions leading to states at 6.73, 7.01, 10.74, 14.87, and 16.44 MeV in ^{14}C are shown in Fig. 2. Three different angular patterns can be recognized, representing three different orbital angular momentum transfers.

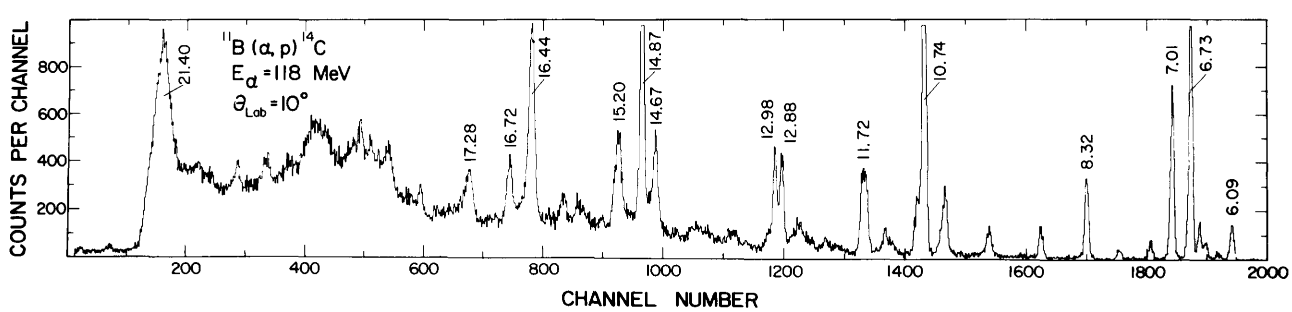

Figure 1. Composite proton spectrum of the $^{11}B(\alpha,p)^{14}C$ reaction at 120 Mev.

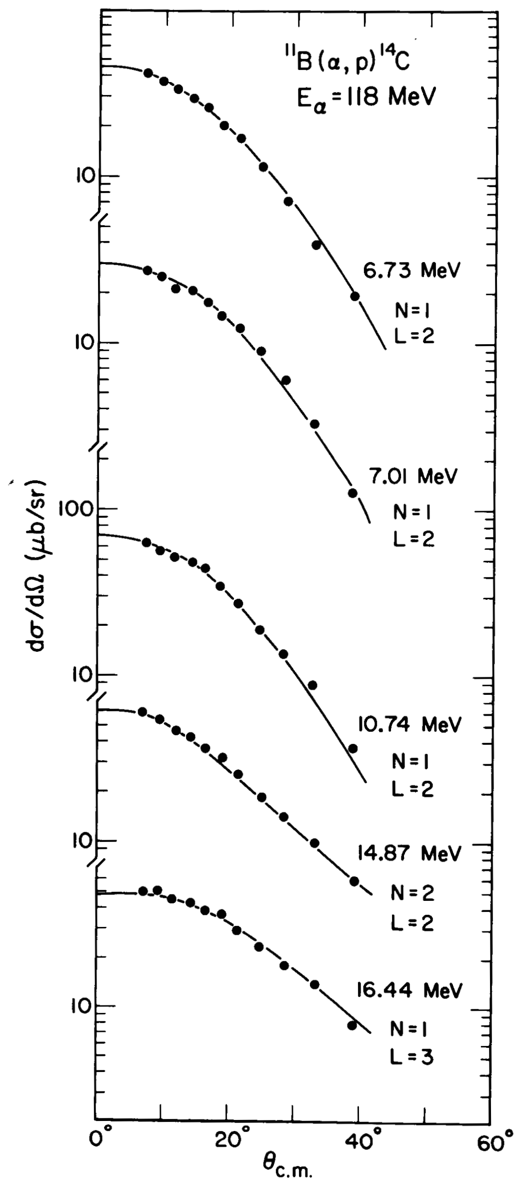

Figure 2. Angular distributions for the $^{11}B(\alpha,p)^{14}C$ reaction.

Preliminary DWBA calculations have been performed assuming a cluster transfer. The quantum numbers of the cluster were assumed to satisfy the relation $2N \pm L=4$ for a $\{(p_{1/2})^2 d_{5/2}\}$ transfer, $2N+L=5$ for a $\{p_{1/2}(d_{5/2})^2\}$ transfer and $2N+L=6$ for a $(d_{5/2})^3$ transfer. The results are shown as solid lines in Fig. 2. The experimental shapes are quite well accounted for. Microscopic DWBA calculations are in progress.

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1) H. Nann and D.W. Devins, IUCF Scientific and Technical Report, 1981 (p. 80).