THE $^{48}Ca(d,^3He)^{47}K$ REACTION AT 80 MeV

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Spectra of ^3He particles emitted from the $^{48}Ca(d,^3He)^{47}K$ reaction induced by 80 MeV vector-polarized deuterons, were detected over the laboratory angular range 7° to 40° in 3° steps. Spectra for incident deuteron spin up and spin down were obtained, and from these data the differential cross sections and analyzing powers were obtained for ^3He-groups leaving ^{47}K in its ground state and fifteen excited states.

The level of carbon and oxygen impurities in the ^{48}Ca target was kept as low as paracticable by transferring the 330 mg/cm^2 thick target to the scattering chamber in vacuum. As a consequence, the relative magnitude of impurity peaks was significantly less than in the most recent study of this reaction[1].

The ^3He particles were detected in the QDDM spectrograph, with particle identification being achieved by .125 inch- and .063 inch-thick scintillators following the focal plane detector. The overall resolution achieved about 55 keV.

Among the excited states of ^{47}K found in this experiment is a new state at 1.97 MeV excitation, which is very weakly populated. A sample ^3He spectrum, corresponding to low excitation in ^{47}K, is shown in Fig. 1. The differential cross section shape, shown in Fig. 2, for the ^3He-group populating this state, indicates an orbital angular momentum transfer of greater than 2, and is consistent with ℓ=3. A DWBA calculation, using ℓ=3 transfer, indicates a C^2S-value

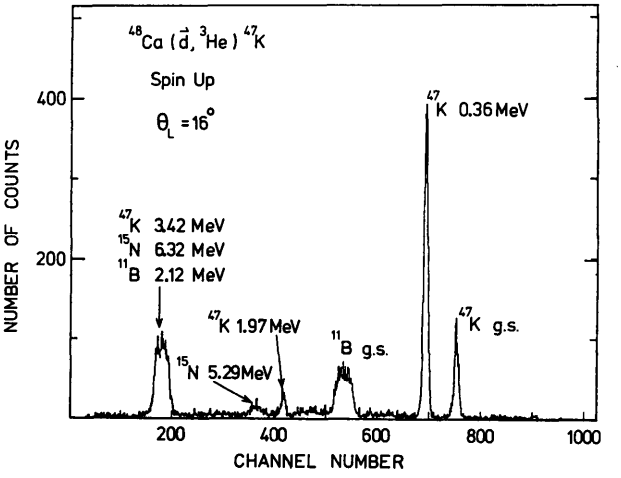

Figure 1. A sample spectrum, centered at an excitation energy of 2 MeV, taken at 16°. The ^3He groups are labelled according to the final states populated. Note in particular the state at 1.97 MeV.

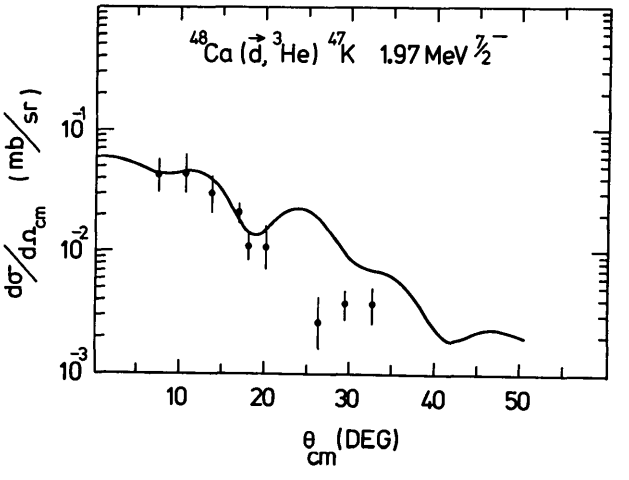

Figure 2. A preliminary DWBA calculation for the ^{47}K (1.97 MeV) state. The calculation assumes ℓ=3 transfer and gives a C^2S=0.06.

for this state of about 0.06. An ℓ=3 proton pick-up reaction can only occur if there is an $(f_{7/2})^2$ component in the wave function of the ^{48}Ca. They are very weak, and this finding is in direct conflict with a suggestion made by Fujiwara et al.[2]. These authors postulate "that there is a significant proton two particle-two hole component in the ground state of ^{48}Ca" in order to account for their "identification of a 1^+ state at 9.0 MeV which has one tenth of the strength of the 10.22 MeV 1^+ state". The existence of the 1^+ state at 9.0 MeV is in doubt, however, as the Orsay-MSU collaboration[3] did not see such a state in the same inelastic proton scattering reaction at 200 MeV (rather than the 65 MeV incident energy used by Fujiwara et al.[2]). The finding of this experiment is in agreement with Crawley et al.,[3] and not Fujiwara et al.[2]

A broad peak, seen by Doll et al.[1] at 3.83 MeV and from their analysis found to be a superposition of ℓ=0 and ℓ=2 transfers, was resolved in this experiment into a triplet of states at 3.68, 3.80 and 3.88 MeV. The state at 3.68 MeV is due to $2s_{1/2}$ pick-up, since its differential cross section behaves qualitatively like that of the ground state group, known from previous work[1] to be due to $2s_{1/2}$ pick-up. The 3.80 and 3.88 MeV states are most probably a part of the very fragmented $d_{5/2}$-hole strength.

Also, new final states at excitations of 6.03, 6.81 and 7.26 MeV were found, in addition to those noted above. Preliminary values for excitation energies and probably ℓ-transfer values for all states observed are given in Table I. Where they have been evaluted, C^2S-values are given also. Analysis of the data is proceeding.

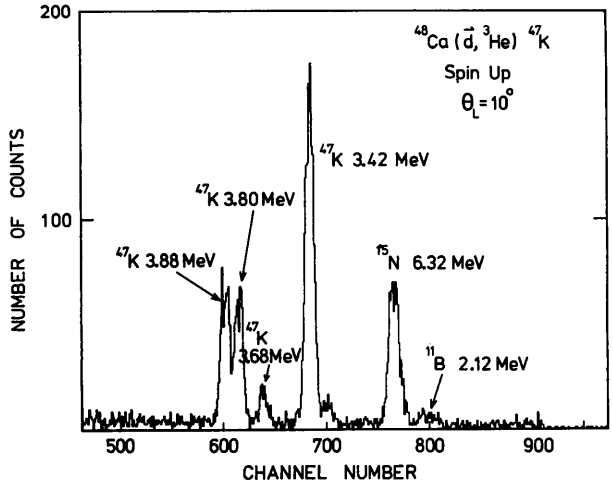

Figure 3. Part of a spectrum, centered at an excitation energy of 5 MeV, taken at 10°. Note the separation of the 3 states centered at 3.80 MeV.

TABLE I

Preliminary excitation energies and probable ℓ-transfers for states observed in this work.

Excitation Energy (MeV)	ℓ-value	C^2S
0	0	1.42
0.36	2	3.93
1.97	3	0.06
3.42	2	1.02
3.68	2	
3.80	2	
3.88	2	
5.20	2	
5.44	2	
6.03	2	
6.44	2	
6.81	2	
7.26	2	
7.48	2	
7.73	2	
8.02	2	

1) P. Doll, G.J. Wagner, K.T. Knopfle and G. Mairle, Nucl. Phys. A263, 210 (1976).

2) M. Fujiwara, S. Imanishi, Y. Fujita, S. Morinobu, T. Yamazaki, K. Katori, S.I. Hayakawa and H. Ikegami, Contribution to the Conference on Spin Excitations in Nuclei, Telluride, Colorado, March 1982.

3) G.M. Crawley, N. Anantaraman, A. Galonsky, C. Djalali, N. Marty, M. Morlet, A. Willis and J.C. Jourdain, Proceedings of the International Conference on Nuclear Structure, Amsterdam 1982, Volume I, p. 73.