Structure of ^{7}He*

A. H. Wuosmaa[1], K. E. Rehm[2], J. P. Greene[2], D. J. Henderson[2], R. V. F. Janssens[2], C. L.Jiang[2], L.Jisonna[3], J. C. Lighthall[1], S. T. Marley[1], E. F. Moore[2], R. C. Pardo[2], N. Patel[4], M. Paul[5], D. Peterson[2], S. C. Pieper[2],G. Savard[2], J. P. Schiffer[2], R. E. Segel[3], R. H. Siemssen[6], X. Tang[2], R. B. Wiringa[2]

[1] Physics Department, Western Michigan University, Kalamazoo MI 49008-5252, USA

[2] Physics Division, Argonne National Laboratory, Argonne IL 60439, USA

[3] Physics Department, Northwestern University, Evanston IL, 60208, USA

[4] Physics Department, Colorado School of Mines, Golden, CO 80401, USA

[5] Hebrew University, Jerusalem, Israel 91904

[6] Kernfysich Versneller Instituut, 9747 AA Groningen, The Netherlands

The light, unbound nucleus ^{7}He provides an ideal laboratory to test modern *ab-initio* theories of nuclear structure. A number of earlier experiments have given conflicting information about the nature of the excited states of ^{7}He, in some cases in contradiction to theoretical expectations. Recent work from the ATLAS facility at Argonne National Laboratory suggested a broad $1/2^-$ first-excited state at 2.6 MeV [1]. The (*d,p*) reaction studied in [1] populates only the ground and first-excited $1/2^-$ states of ^{7}He. Complementary reactions must be studied to obtain information about other states, such as a possible $5/2^-$ level suggested by neutron pickup work with the (*p,d*) reaction [2]. We have studied the proton pickup reaction ^{2}H(^{8}Li,^{3}He)^{7}He using a radioactive ^{8}Li beam from the "In-flight" facility at Argonne National Laboratory. This reaction is expected to populate the ground and second-excited $5/2^-$ states in ^{7}He. In combination with the earlier (*d,p*) work these data present a consistent picture of the low-lying level structure of ^{7}He.

Figure 1 shows Q-value spectra from the ^{2}H(^{8}Li,^{3}He)^{7}He reaction, requiring an identified ^{6}He (a) or ^{4}He (b) particle in coincidence with the ^{3}He, signifying decays to the ^{6}He ground or first-excited 2^+ state, respectively. In contrast to (*d,p*), the (*d*,^{3}He) reaction populates an excited state that decays completely through the ^{6}He(2^+) excited state, as expected for a $5/2^-$ resonance. Excitation-energy spectra, transfer angular distributions, and a comparison of the measured cross sections with the predictions of the Quantum Monte Carlo approach will be presented.

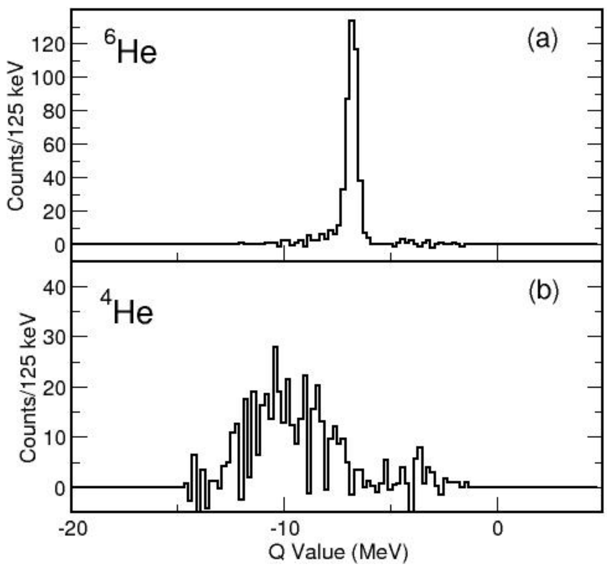

Figure 1. Q-value spectra for ^{2}H(^{8}Li,^{3}He)^{7}He reaction.

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[1] A. H. Wuosmaa *et al.*, Phys. Rev. C **72**, 061301(R) (2005).

[2] A. Korshinnenikov et al., Phys. Rev. Lett. **82**, 3581 (1999); F. Skaza et al., Phys. Rev. C **73**, 044301 (2006).