Structure study of ^{10}He by ^{11}Li(d,^{3}He) transfer reaction

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All studies in which ^{10}He has been populated by proton removal from ^{11}Li and observed in invariant-mass spectroscopy agree that E $\sim$ 1.2-1.6 MeV[1–4]. Recently, the analysis of the missing-mass spectrum from the transfer reaction ^{8}He(t,p)^{10}He[5] lead to a sizeably higher value, E $\sim$ 2.1 MeV.

Our experiment, performed in July 2010 at the RIKEN RIPS facility, used a secondary beam of ^{11}Li at 50 AMeV on a CD_2 target. At forward angle, a wall of four MUST2 telescopes[6] were coupled with four 20 μm thick silicon detectors in order to perform an E-ΔE identification of the light particles, and separation of ^{4}He and ^{3}He. At zero degree, a fifth MUST2 telescope and a two stages plastic detector were used for identification of heavy residues of reaction in coincidences. In addition a ^{9}Li beam at 50 A.MeV was used to perform a reference experiment populating the ground state of ^{8}He.

The final excitation spectrum of the unbound ^{10}He, reconstructed in coincidence with ^{8}He decay products (Fig.1), exhibits two clean resonances located respectively at 1.3(3) MeV and 6.3(6) MeV above the two neutron threshold, with natural widths of 1.1(6) MeV and 2.7(7) MeV respectively. The associated differential cross sections have been extracted. They are about one order of magnitude smaller than those predicted in standard DWBA calculations. The implication of this reduction and possible explanations, such as the influences of different neutron binding energies, are explored and put into perspective with the measured cross section of the ^{8}He ground state via the ^{9}Li(d,^{3}He) reaction.

The spectrum obtained in coincidence with the ^{6}He decay products (Fig.1) is showing a preferred decay to the ^{6}He+4n channel when possible. This could be inferred to the important role played by the ^{8}He(2+) excited state in the ^{10}He structure, arguing for the development of models beyond the three-body approach.

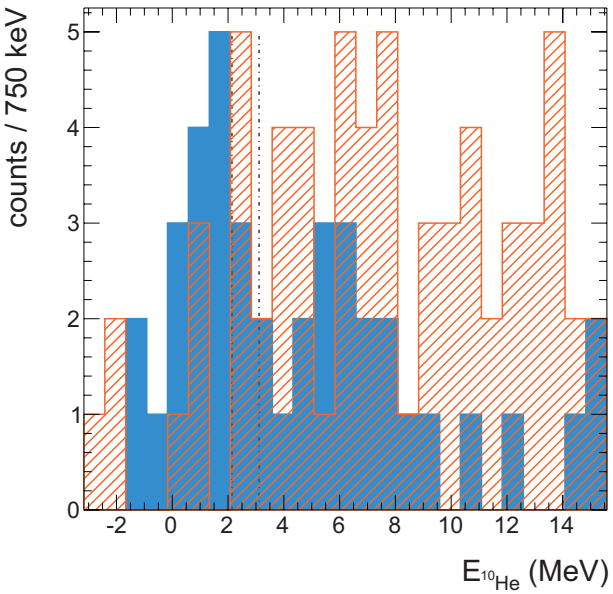

Fig. 1. The ^{10}He spectrum measured from ^{11}Li(d,^{3}He) reaction data in coincidences between ^{3}He and ^{8}He *(solid blue)* and ^{6}He *(dashed orange)*. The two vertical dashed lines indicate the positions of the ^{6}He+4n and ^{4}He+6n thresholds.

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