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THE CONTRACTION OF THE DEUTERON CLUSTER IN ^{6}Li

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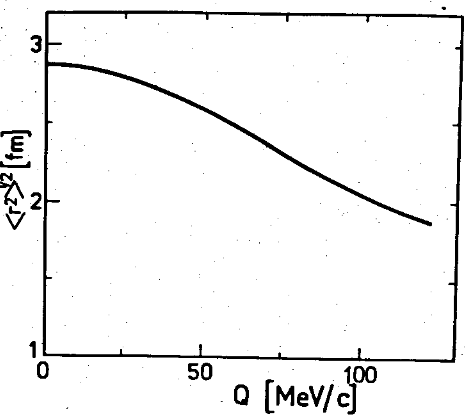
The nucleus of ^6Li is one of the best examples for the cluster model. Using α–d clusterization it has been possible to explain the binding energy, the low lying energy levels [1], the charge form factors [2] and the Coulomb disintegration results [3]. However the cluster knock-out reaction of type A(a, ab) B can provide the most direct information about the cluster structure of light nuclei. There are discrepancies between the results of different knock-out reactions [4] and the explanation has been sought in terms of the contraction of deuteron cluster in the ^6Li nucleus [5,6]. In the analysis of $^6Li(d, tp)^4He$ reaction a drastic shrinkage of the deuteron cluster has been estimated [6]. For the residual ^4He momenta Q=0 and Q = 30 MeV/c the $\langle r^2\rangle^{1/2}$ ($\vec{r}$ is the relative coordinate of the p–n cluster) rms size of the deuteron cluster are given as ~ 3.3 fm and ~2.4 fm, respectively, in contrast the free-deuteron rms size of ~ 3.8 fm.

Using the $\psi(\vec{Q}, \vec{r})$ three-body wave function of Rai, Lehman and Ghovanlou [7] obtained by solving the Faddeev's equation with separable potentials, we have calculated the rms value of the deuteron cluster in the following form:

$$\langle r^2\rangle^{1/2} = \left[\frac{\int |\psi(\vec{Q},\vec{r})|^2 r^2 d\vec{r}}{\int |\psi(\vec{Q},\vec{r})|^2 d\vec{r}}\right]^{1/2} .$$

Only the L=0 and ℓ=0 orbital momentum components were taken into account in the α–<pn> and p–n systems, respectively. The contributions of other components may be neglected. The dependence of $\langle r^2\rangle^{1/2}$ from Q is plotted in the figure.



This result can be a strong argument against the application of the cluster model product wave function $\psi(\vec{Q},\vec{r}) \sim \phi_1(\vec{Q})\,\phi_2(\vec{r})$ for the analysis of cluster knock-out reactions

$^{6}Li(a, ad)^{4}He$. The cross section of the elementary process $a\langle pn\rangle \to ad$ may depend sensitively on the rms value of the $\langle pn\rangle$ cluster. In this case the use of an overlap integral $\int \psi^*(\vec{Q},\vec{r})\, \phi_d(\vec{r})\, d\vec{r}$ with a free $\sigma(ad \to ad)$ cross section gives a wrong form and width for the spectator functions of ^{4}He. Similar arguments have been obtained also from the analysis of $^{6}Li(e,ed)^{4}He$ experiments using three body wave function /8/ and from the results of a recent experiment on $^{6}Li(p,pd)^{4}He$ quasi-free scattering /9/.

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