THE INTERPLAY OF CLUSTER STRUCTURE IN LIGHT NUCLEI

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The structure of light nuclei is considered as a superposition of different cluster structures[1]. The wave function of a nucleus contains the components which describe two-cluster structures constracted ou of 1p shell and/or 1s shell clusters. The model is used to study the low-lying energy levels of the nucleus ^{7}Li, whose structure is treated as a superposition of the cluster structures (^{4}He+^{3}H) and (^{6}Li+n).

The space of the wave functions is spanned by antisymmetrized products of shell-model wave functions describing separated clusters, the separation S of the two shell-model potentials is taken as the generator coordinate:

$$\Psi^{JM\pi}(x) = \sum_{\ell,K} \int ds_1 f^{He,\ell}_{\ell,K}(s_1) P^{JM\pi} [\mathcal{A}\{\Phi_{He}(x_1,\dots,x_4,s_{He})\Phi_{H}(x_5,\dots,x_7,s_H)\}]$$

$$+ \sum_{\ell,K} \int ds_2 f^{Li,n}_{\ell,K}(s_2) P^{JM\pi} [\mathcal{A}\{\Phi_{Li}(x_1,\dots,x_6,s_{Li})\Phi_{n}(x_7,s_n)\}]$$

$s_1 = s_{He} - s_H$, $s_2 = s_{Li} - s_n$, $x = (x_1,\dots,x_7)$, $P^{JM\pi}$ is the projection operator of angular momentum and parity. runs over different configurations.

The application of the model to the nucleons ^{7}Li has shown the sensibility of the calculation with 1p shell clusters. The Volkov potentials are used in the calculations. The minimal energy of ^{7}Li in the state described by the modal function with fixed separation S=3,5fm of the clusters ^{4}He and ^{3}H is lowered by 1.64 MeV by solving the Hill-Wheeler equation for the cluster structure (^{4}He+^{3}H). The coupling influences the shape of the nucleus as follows: In the single cluster structure (^{4}He+^{3}H) the optimal separation of the clusters in the ground state (3.5 fm) is 0.[illegible] fm larger than that in the first excited state 5/2$^-$. However, when both cluster structures are considered simultaneously, the optimal separation between the cluster ^{4}He and ^{3}H and the separation between the clusters ^{6}Li and n in the ground state are equal to the corresponding separation in the excited state.

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1) M.V.Mihailović and M.Poljšak, Nucl.Phys. [illegible]