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Influence of cluster polarization on spectrum and elastic processes in ^{6}LI

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The aim of the present report is to study nature of resonance state in ^{6}Li within an extended three-cluster model. It is well-known that the nucleus ^{6}Li has two sets of resonance states. The first set is formed by low-energy resonance states which lie close to the α+d decay threshold and are of positive parity. There are two very narrow and three broad resonance states in the first set. The second set of resonance states consists of high-energy resonance states of negative parity. They are very broad and reside above the ^{3}H+^{3}He decay threshold. Different microscopic and semi-microscopic models have been used to study resonance states in ^{6}Li. As a rule, they have been applied to investigate either low-energy or only high-energy resonance states. In the present report we study both sets of resonance states within one microscopic model. This model was formulated in Ref. [1] and is a three-cluster version of the resonating group method. To study resonance states of ^{6}Li within a large energy range the model was advanced to take into account two three-cluster configurations α+p+n and t+d+p. This allows us to involve in calculations all dominant binary channels, namely, α+d, ^{5}He+p, ^{5}Li+n and ^{3}H+^{3}He. Besides, these three-cluster configurations also allow us to describe more correctly (adequately) the internal structure of d, ^{5}He, ^{5}Li, ^{3}He which are represented as a two-cluster configuration p+n, ^{4}He+n, ^{4}He+p, d+p, respectively.
Calculations of discrete and continuous spectrum states of ^{6}Li are performed with a nucleon-nucleon potential which was suggested by Tang and coworkers and is known as the Minnesota potential [2]. Parameters of the model and the nucleon-nucleon potential were selected to reproduce the ground state energy of ^{6}Li. The present model with these parameters fairly good reproduces the energies and widths of the observed resonance states. The dominant decay channels are found for all resonance states. The hierarchy of channels depending on their impact on the energy of the ground and resonance states is established. It is shown that the cluster polarization, associated with the ability of clusters d, ^{5}He, ^{5}Li, ^{3}He to change their size and shape, plays an important role in formation of the ground state and low- and high-energy resonances in ^{6}Li.

[1] V. S. Vasilevsky, F. Arickx, J. Broeckhove, and T. P. Kovalenko, «A microscopic three-cluster model with nuclear polarization applied to the resonances of ^{7}Be and the reaction ^{6}Li(p,^{3}He)^{4}He», Nucl. Phys. A, vol. 824, pp. 37-57, 2009.

[2] D. R. Thompson, M. LeMere, and Y. C. Tang, «Systematic investigation of scattering problems with the resonating-group method», Nucl. Phys., vol. A286, pp. 53-66, 1977.

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