INFLUENCE OF CLUSTER POLARIZATION ON SPECTRUM AND ELASTIC PROCESSES IN 6LI

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The aim of the present report is to study nature of resonance state in 6Li within an extended three-cluster model. It is well-known that the nucleus 6Li 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 3H + 3He decay threshold. Different microscopic and semi-microscopic models have been used to study resonance states in 6Li. 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 6Li 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, 5He + p, 5Li + n and 3H + 3He. Besides, these three-cluster configurations also allow us to describe more correctly (adequately) the internal structure of d, 5He, 5Li, 3He which are represented as a two-cluster configuration p + n, 4He + n, 4He + p, d + p, respectively.

Calculations of discrete and continuous spectrum states of 6Li 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 6Li. 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, 5He, 5Li, 3He to change their size and shape, plays an important role in formation of the ground state and low- and high-energy resonances in 6Li.

[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 7Be and the reaction 6Li(p,3He)4He», 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.