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Approbation of the three body model of light exotic nuclei in the direct nuclear reactions

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The properties and characteristics of light weakly bound atomic nuclei continue to attract interest against the background of the development of secondary beam accelerators. Many interesting features have been revealed in the He-6 and He-8 atomic nuclei such as halo, skin effects by I Tanihata. It is quite obvious, and very clear, that their participation in direct nuclear reactions also leaves its own inimitable traces.

In the work, the deuteron-induced reactions on a Be-9 target were studied at the collision energies 19.5 and 35 MeV. The developed theoretical model was applied successfully in describing the cross sections of elastic and inelastic scatterings, one-nucleon transfer and cluster-transfer reactions. The strong coupling effects were shown for the (d, p) and (d, t) one-nucleon transfer nuclear reactions. Furthermore, it was found that in the Be-9(d, α)Li-7 nuclear reaction the He-5 heavy cluster is transferred mainly simultaneously, and the contribution of its sequential transfer is an order of magnitude lower. The importance of taking into account the mechanism of sequential transfer of the n–p system was revealed. Based on these observations from studying the interaction of the deuteron with Be-9, it was concluded that the Be-9 nucleus has the α+α+n cluster structure.

It is interesting to apply the above highlighed theoretical approach to study the structure of the He-6 nucleus. The nucleus also attracts particular attention for its Borromian structure considered as the α + n + n three body system. The calculations are based on a three-body wave function of the ground state of He-6 with an attractive α-n potential, which excludes overlapping of forbidden s-states. The differential cross section of the elastic scattering of alpha particles with He-6 is calculated. It should be noted that the peculiarity of this reaction is the mixing of the elastic transfer of two neutrons.

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