

Multinucleon transfer reactions in ${}^7\text{Li}$, ${}^{12}\text{C}$, ${}^{40}\text{Ar}$, ${}^{40,48}\text{Ca}$ + ${}^{197}\text{Au}$

A. V. Shakhov^{1*}, A. K. Azhibekov^{1,2}, S. M. Lukyanov¹

¹ Joint Institute for Nuclear Research, Dubna, Russia

² Korkyt Ata Kyzylorda University, Kyzylorda, Kazakhstan

*e-mail: Shahov@jinr.ru

In the present work, multinucleon transfer reactions in interactions of ${}^7\text{Li}$, ${}^{12}\text{C}$, ${}^{40}\text{Ar}$, ${}^{40}\text{Ca}$ and ${}^{48}\text{Ca}$ projectiles with ${}^{197}\text{Au}$ target nuclei at energies near the Coulomb barrier have been investigated. Particular attention is paid to the influence of projectile structure, one-neutron separation energy, and transfer reaction Q - values on nucleon transfer probabilities.

It is shown that the probability of neutron transfer strongly depends on the one-neutron separation energy S_{1n} of the projectile, as well as on the Q - values of the transfer channels. Weakly bound nuclei such as ${}^7\text{Li}$, exhibit enhanced neutron-transfer probabilities due to the low binding energy of the valence neutron and the extended spatial distribution of its wave function [1], [2]. In contrast, tightly bound nuclei including ${}^{12}\text{C}$, ${}^{40}\text{Ca}$ and ${}^{40}\text{Ar}$, are characterized by smaller one-neutron transfer cross sections and a more pronounced contribution from direct peripheral processes [3], [4]. A comparison between reactions induced by ${}^{40}\text{Ca}$ and ${}^{48}\text{Ca}$ projectiles has also been performed. For the neutron-rich ${}^{48}\text{Ca}$ nucleus, an enhancement of transfer channels is observed due to the neutron excess and favorable transfer Q -values [5].

The experimental results are compared with calculations performed within the framework of the semiclassical GRAZING model [6], which takes into account the peripheral character of the collision, excitation of collective states, and nucleon exchange between interacting nuclei. The analysis demonstrates that the model satisfactorily reproduces the energy dependence of one-neutron transfer cross sections near the Coulomb barrier.

In addition, experimental data for multinucleon transfer channels, including multiple-neutron transfer, have been obtained for the considered systems. This makes it possible to investigate sequential neutron transfer probabilities, pairing correlations, and collective effects in multinucleon exchange dynamics [7]. The obtained experimental data on one-neutron and multinucleon transfer reactions were analyzed within a unified approach using reduced interaction radii and barriers, see Eqs. (1) and (2) [8–10]. Such an approach makes it possible to trace the evolution of transfer mechanisms in reactions involving weakly bound and neutron-rich nuclei.

$$\sigma_{Red} = \sigma_{1n} / (A_P^{\frac{1}{3}} + A_T^{\frac{1}{3}})^{\frac{1}{2}}, \quad (1)$$

$$E_{Red} = E_{c.m.} / (Z_P Z_T / (A_P^{\frac{1}{3}} + A_T^{\frac{1}{3}})). \quad (2)$$

Список источников

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