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Time-dependent calculation for processes of neutron transfer and nuclear breakup in ^{11}Li+^{28}Si reaction

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The results of theoretical calculation of the neutron transfer and nuclear breakup for the ^{11}Li+^{28}Si reaction at energy range 1–55 MeV/nucleon are presented. The total cross sections for the ^{11}Li+^{28}Si reaction are calculated based on a numerical solving of the time-dependent Schrödinger equation for the external weakly bound neutrons of the projectile nucleus ^{11}Li. Based on probabilities of neutron transfer and nuclear breakup obtained from an exact solving of time-dependent Schrodinger equation, we calculated two-neutron removal cross sections σ_{-2n}. In the low-energy region for the nuclear reaction with weakly bound nucleus ^{11}Li, the neutron transfer process gives a large contribution to the two-neutron removal cross sections σ_{-2n} [1]. Contributions of reaction channels to the total cross sections were defined.
The shell model of spherical nuclei without spin-orbit interaction was used for description of outer neutrons in the ^{11}Li nucleus and states of transferred neutron in the target nucleus ^{28}Si. To confirm the applicability of this principle for calculating reaction cross sections with weakly bound nuclei, we compare calculations taking into account the spin-orbit interaction [2] and without it. The approach without taking into account the spin-orbit interaction does not lead to significant differences in the results.
Enhancement of the total cross section for reactions with light weakly bound lithium nuclei ^{8,9,11}Li nuclei as compared to with reactions with ^{6,7}Li arouse great interest. Mechanisms leading to increase in the total cross section at low energies for ^{11}Li+^{28}Si reaction will enable us to explain important problems of nucleosynthesis (nuclear astrophysics) [2-6]. This effect is especially strongly manifested for light nuclei with a neutron halo [7].

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