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Total Nuclear Reaction Cross Section Induced by Halo Nuclei and Stable Nuclei

GUO Wen-Jun,[1,2] JIANG Huan-Qing,[1,3] LIU Jian-Ye,[1,2] ZUO Wei,[1,2] REN Zhong-Zhou,[1,4] and LEE Xi-Guo[1,2]

[1] Center of Theoretical Nuclear Physics, National Laboratory of Heavy Ion Accelerator, Lanzhou 730000, China
[2] Institute of Modern Physics, the Chinese Academy of Sciences, Lanzhou 730000, China
[3] Institute of High Energy Physics, the Chinese Academy of Sciences, Beijing 100039, China
[4] Physics Department, Nanjing University, Nanjing 210008, China
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Abstract: We develop a method for calculation of the total reaction cross sections induced by the halo nuclei and stable nuclei. This approach is based on the Glauber theory, which is valid for nuclear reactions at high energies. It is extended for nuclear reactions at low energies and intermediate energies by including both the quantum correction and Coulomb correction under the assumption of the effective nuclear density distribution. The calculated results of the total reaction cross section induced by stable nuclei agree well with 30 experimental data within 10 percent accuracy.The comparison between the numerical results and 20 experimental data for the total nuclear reaction cross section induced by the neutron halo nuclei and the proton halo nuclei indicates a satisfactory agreement after considering the halo structure of these nuclei, which implies quite different mean fields for the nuclear reactions induced by halo nuclei and stable nuclei. The halo nucleon distributions and the root-mean-square radii of these nuclei can be extracted from the above comparison based on the improved Glauber model, which indicates clearly the halo structures of these nuclei. Especially, it is clear to see that the medium correction of the nucleon-nucleon collision has little effect on the total reaction cross sections induced by the halo nuclei due to the very weak binding and the very extended density distribution.

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