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Analysis of the $^{13}\text{C}(\text{d},\text{p})^{14}\text{C}$ reaction in the energy range of 13–18 MeV: determination of empirical form factors and ANC

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New differential cross sections for the single proton transfer reaction $^{13}\text{C}(\text{d},\text{p})^{14}\text{C}$ at a deuteron energy of 18 MeV are presented for the ground state 0^+ and three excited states: 6.094 MeV (1^-); 6.728 MeV (3^-); 7.341 MeV (2^-) of the product nucleus. The experimental measurements were carried out at the U 150M isochronous cyclotron of the Institute of Nuclear Physics in Almaty. The analysis of the obtained data, together with previously published results, was carried out within the framework of the distorted wave method with a finite interaction radius (FRDWBA), using precisely selected parameters of local optical potentials.

Based on a phenomenological approach, the values of nuclear vertex constants (NVCs) for the excited states of the ^{14}C nucleus were experimentally determined for the first time. The NVC value for the ground state demonstrated excellent agreement with independent theoretical calculations. Modeling of angular distributions showed a high quality of the experiment description in the region of forward angles (up to 60°), which confirms the reliability of the proposed methodology.

Analysis of radial dependencies revealed important structural features of the exotic states of the ^{14}C nucleus. It was found that the form factor of the excited state 1^- (6.094 MeV) has a nodal structure that is fundamentally different from the behavior of the ground state. Furthermore, increased root mean square radii were observed for all the investigated excited levels, which directly indicate an excessive spatial extent of nuclear matter and is a clear sign of the formation of a neutron halo.

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