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ANALYTIC CONTINUATION OF EXPERIMENTAL DATA ON SCATTERING AND REACTION PROCESSES AS A WAY TO OBTAIN INFORMATION ON CHARACTERISTICS OF BOUND NUCLEAR STATES

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Asymptotic normalization coefficients (ANC) determine the asymptotic behavior of nuclear wave functions in binary channels at distances between fragments exceeding the radius of nuclear interaction (see the recent review paper [1] and references therein). ANCs are of particular importance for nuclear astrophysics. They determine the overall normalization of cross sections of radiative capture reactions at astrophysical energies [2]. In terms of ANCs, the cross sections of peripheral nuclear transfer reactions are parameterized. ANCs should be included in the number of important nuclear characteristics along with such quantities as binding energies, probabilities of electromagnetic transitions, etc.

Unlike binding energies, ANCs cannot be directly measured. In the present work, we discuss two ways to obtain information about ANCs by analytic continuation of experimental data. The first method is based on the analytic continuation of the experimental differential cross sections (DCS) of nuclear transfer reactions in the variable z = cos θ, where θ is the scattering angle in the center-of-mass system. The idea of the method goes back to the work of G.F. Chew [3], in which it was stated that the extrapolation in cos θ of the DCS of the elastic NN scattering to the pole corresponding to the exchanged virtual pion can be used to determine the pion-nucleon coupling constant. When applying this method, it is very important to take into account the Coulomb interaction in the initial, final and intermediate states [4].

The second approach uses the analytic continuation in energy of the partial-wave amplitudes of elastic scattering, determined from the phase-shift analysis of experimental data, to the pole point located in the nonphysical region of negative energies. In this way, ANCs were determined for a number of light nuclei. As an example, we present the recently obtained by us average values of the ANCs C(Jπ) for the virtual decay of the excited bound states of the 16O nucleus, which are important for nuclear astrophysics: $^{16}O^{*}(J\pi) \rightarrow \alpha + ^{12}C(g.s.)$. We got: C(0+) = 1.01·103 fm-1/2; C(3−) = 3.53·102 fm-1/2; C(2+) = 1.57·105 fm-1/2; C(1−) = 2.55·1014 fm-1/2.

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2. A. M. Mukhamedzhanov and N. K. Timofeyuk, Sov. J. Nucl. Phys. 51, 679 (1990).
3. G. F. Chew, Phys. Rev. 112, 1380 (1958).
4. L. D. Blokhintsev and D. A. Savin, Phys. At. Nucl., 85, 154 (2022).

The speaker is a student or young scientist

No

Section

1. Experimental and theoretical studies of nuclear reactions

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