SPLINE APPROXIMATION METHOD FOR SOLVING HYPERRADIAL EQUATIONS FOR 3- AND 4-BODY SYSTEMS

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New effective method for solving of the system of hyperradial equations [1] is proposed. The idea of this method is simultaneous calculation of the mesh function and its second derivative using the cubic spline interpolation expression [2]. As a result, the solving of the system of hyperradial equations is reduced to the eigenvalue problem of some matrix B [3]. The main advantage of this method is the smooth interpolation between the mesh points. For the equidistant mesh, the matrix B is symmetric, but size of the matrix B may be large. For a special choice of the non-uniform mesh, the size of the asymmetric matrix B may be small and calculations (only for the ground state) may be fast. The proposed method was tested for 3- and 4-body oscillatory systems as well as ^{3}H, ^{3,4,6}He, ^{6,7}Li, ^{12}C, and ^{16}O nuclei. The nuclei ^{3}H and ^{3,4}He were considered as consisting of protons and neutrons, whereas the nuclei ^{6}He, ^{6}Li, ^{12}C, and ^{16}O were considered as α-cluster nuclei. The agreement with the experimental data on the binding energies was obtained using the effective nucleon-nucleon interaction potentials similar to the M3Y potential. The convergence of the proposed algorithm is shown in Fig. 1.

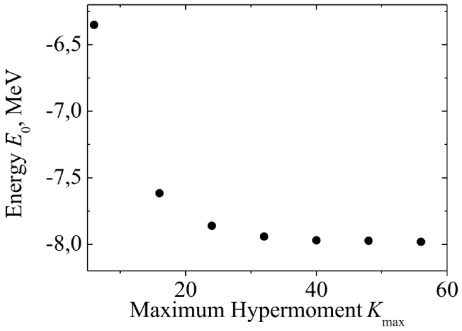

Fig. 1. Convergence of the proposed algorithm for the exactly solvable 3-body model with M3Y nuclear interaction and the exact value of the ground state energy $E_0 = -8$ MeV.

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