Study of Few-body and Cluster Nuclei by Feynman's Continual Integrals and Hyperspherical Functions

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The wave functions of the ground states of ^{3}He, ^{4}He nuclei were calculated in Refs. [1, 2] by Feynman's continual integrals method in Euclidean time [3, 4]. The present work is devoted to studying other light nuclei using the same approach. The nuclei ^{3}H, ^{3,4}He were considered as consisting of protons and neutrons, whereas the nuclei ^{6}He,^{6,7}Li, ^{9,10}Be, ^{12}C, ^{16}O were considered as α-cluster nuclei. The agreement with the experimental data on binding energies and charge distributions was achieved using the nucleon-nucleon interaction potentials similar to the M3Y potential. The superpositions of the Woods-Saxon type functions were used for the approximation of nucleon-α-cluster and cluster-cluster potentials. The correctness of calculations was checked by comparison with the results of the expansion in hyperspherical functions (K-harmonics) [5]. New effective method for the solution of the system of hyperradial equations is proposed. The obtained probability densities may be used for the correct definition of the initial conditions in the time-dependent calculations of reactions with the considered nuclei [1].

References

[1] V.V. Samarin and M.A. Naumenko, *Bull. Russ. Acad. Sci. Phys.* **80** (2016) 283-289.

[2] M.A. Naumenko and V.V. Samarin, *Supercomp. Front. Innov.* **3** (2016) 80-95.

[3] R.P. Feynman and A.R. Hibbs, *Quantum Mechanics and Path Integrals*, McGraw-Hill, New York (1965).

[4] E.V. Shuryak and O.V. Zhirov, *Nucl. Phys. B* **242** (1984) 393-406.

[5] R.I. Dzhibuti and K.V. Shitikova, *Metod gipersfericheskikh funktsiy v atomnoy i yadernoy fizike [Method of Hyperspherical Functions in Atomic and Nuclear Physics]*, Energoatomizdat, Moscow (1993).