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New variational method in quantum few-body theory

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A new variation method for solving the bound-state problem for a system of few particles is proposed. Unlike the traditional variational approach, where the expectation value of the Hamiltonian is minimized, i.e. just a single quantity, in the proposed method the approximate solution is constructed by fitting a continuum of quantities, namely, the entire function that describes the interaction potential in one of the two-body subsystems. Another advantage of the new method is that the resulting approximate wave function of the few-body system satisfies the corresponding Schroedinger equation with a given (experimental) binding energy. As an example, an approximate analytic expression of the ground-state wave function of ^{9}Be nucleus is obtained. This nucleus is treated as a bound system of two α-particles and one neutron. Within the new variational method the problem is solved by postulating a trial wave function, using which in the three-body Schroedinger equation with experimental value of the energy, the corresponding $\alpha\alpha$-potential is recovered. The parameters of the trial function are varied in order to minimize the difference between the exact and recovered $\alpha\alpha$-potentials.

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