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Clothed-particle eigenstate problem with 2N and 3N quasipotentials

In previous research [1] devoted to the introduction of three-nucleon ($3N$) forces in the theory of few-nucleon systems, we emphasized the need to reconcile the $2N$ and $3N$ interaction operators when calculating the corresponding observables. Refs. [1, 2] inherit this inconsistency, i.e., the so-called Kharkiv $2N$ potential [3] was used together with the Tucson-Melbourne $3N$ potential [4]. In order to remove this shortcoming in the modern theory, we tried to construct the $2N$ and $3N$ interaction operators on one and the same physical basis.

We start with a primary Hamiltonian H with Yukawa couplings V between meson (π, η, ρ, ω, δ, σ) and nucleon (antinucleon) fields. Using the special unitary transformation we rewrite H in the clothed-particle representation (CPR), where all one-clothed-particle states are eigenvectors of H. In [3] it has been shown how such an approach allows us to build up Hermitian and energy–independent $2N$ potential that embodies off-energy-shell and relativistic effects. Along with the fruitful applications [1,2,3,5,6] of the Kharkiv potential we show our recent results in constructing the operators of $3N$ interaction in the CPR. In this framework, the leading order $3N$ contribution stems from the third order commutator $[R, [R, [R, V]]]$, where R is antihermitian generator of the unitary clothing transformation.

In the course of our field-theoretical treatment, we have shown that the eigenvalue equation with interaction operators between clothed nucleons can be represented by a typical Faddeev formula

$$\left(H_F + \sum_{i=1}^{3}(V_i + W_i)\right)|\Psi\rangle = E|\Psi\rangle,$$

where V_i and W_i are made up of three-nucleon matrix elements produced by our $2N$ and $3N$ interaction operators, respectively.

We also address a convenient form

$$W_1 = \sum_{k\,\kappa} \sum_{k_1\,k_{23}} \sum_{k_2\,k_3} \left\{ \{S_{k_2}(2)\otimes S_{k_3}(3)\}_{k_{23}} \otimes S_{k_1}(1) \right\}_{k\kappa} \hat{W}_{k\kappa}^{k_{23}(k_2k_3)k_1}$$

that is generated after separating the spin content of the obtained interaction.

References

1. A. Arslanaliev, J. Golak, H. Kamada, A. Shebeko, R. Skibiński, M. Stepanova, H. Witała, Phys. Part. Nucl. **53** (2022) 87-95;
2. A. Arslanaliev, P. Frolov, J. Golak, H. Kamada, A. Shebeko, R. Skibiński, M. Stepanova, H. Witała, Few-Body Syst. **62** (2021) 71;
3. I. Dubovyk, A. Shebeko, Few-Body Syst. **48** (2010) 109–142;
4. S. Coon, H. Han, Few-Body Syst. **30** (2001) 131;
5. A. Shebeko, E. Dubovik, Few-Body Syst. **54** (2013) 1513–1516;
6. H. Kamada, A. Shebeko, A. Arslanaliev, Few-Body Syst **58** (2017) 70.

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