

Anonymous Report 1 on 2020-1-13 Contributed Report
Report

The proceedings contribution "Effect of isospin averaging for ppK- kaonic cluster" by Vlahovic and Filikhin presents a series of calculations associated to isospin averaging in 3-body calculations of hadronic systems. In particular, it discusses two different physics issues: mass polarization in 3-body systems (eg whether trimer binding energies are above or below 2 x dimer energies) and the role of isospin degrees of freedom. The contribution is mostly descriptive and based on a series of specific numerical, theoretical results rather than acting as a wide-ranging discussion of previous literature.

While this is fine for a proceedings contribution, I feel the write-up needs to be improved for clarity and readability. I suggest that the authors discuss more clearly why averaged and non-averaged calculations differ so much in their trimer energy predictions in physically motivated terms.

Requested changes

I provide below a series of minor issues that need to be considered before the paper is published as a proceedings contribution in SciPost:

1) Page 1: I assume s_{NN} refers to the spin of the two-nucleon system? I suggest the authors clarify the meaning of this variable that is used throughout the paper for clarity.

Comment: it is corrected to "The quasi-bound states in the kaonic cluster ${}^A\bar{K}(s_{NN}=0)$ defined by the spin s_{NN} of nucleon pair"

2) Page 1, middle of paragraph 1: "There are two potential models for the $N\bar{K}$...". The authors describe in this paragraph only one potential (the AY potential) and then move to discuss "more complicated models [3,4]". Is the second potential of the "two potential models" here the sHW used later on and introduced here simply as Ref 6? I suggest the authors clarify this point.

Comment: it is corrected to "The first one is the AY model based on the Akaishi-Yamazaki (AY) $N\bar{K}$ potential that takes into account the $\pi\Sigma$ coupling effectively, explained in Ref. \cite{YA07}."

Also, we have corrected the sentence, "Comparable results have been obtained within similar phenomenological models \cite{D17,RS14} taking into account the $\pi\Sigma$ coupling directly." And we have corrected the sentence, "The second model proposed for the $N\bar{K}$ interaction (see HW potential in Ref.\cite{HW}) is the chiral model. This model" to avoid confusing readers.

3) Page 1, paragraph 2, typo: "due to a relations" > "relation"

Comment: it is corrected.

4) Page 2, paragraph 2, typo: "two types averaging" > "these two types OF averaging". A bit below, "deference" should presumably read "difference".

Comment: it is corrected.

5) Page 2, paragraph 2: why is the "t-averaging" discussed here? As far as I can tell, this is not used in the calculations presented here?

Comment: it is corrected: "Another type of the averaging noted in Ref. \cite{MAY14} as "t-averaging" is applied for two-body T -matrix within an impulse representation for treatment of the system." to show, that the t-averaging is related to the impulse representation. We used the coordinate representation, and such averaging is not possible.

6) Page 2, paragraph 3: "Faddeev equations" > can the authors provide more details or, ideally, more references that discuss explicitly the numerical techniques in the solution of these equations as they implement them? Accuracy will presumably be necessary for the detailed energy differences discussed here.

Comment: Due to the 6-page limit for the presentation we here include only the references in the text: "the set of the Faddeev equations is presented by two equations for the components U and W \cite{K2015,FKSV17,14}:" and added the references in the list of references:
\bibitem{FaddeevConfigurSpace} L.D. Faddeev and S.P. Merkuriev, { Quantum Scattering Theory for Several Particle Systems} (Kluwer Academic, Dordrecht, 1993) pp. 398, \doi{10.1007/978-94-017-2832-4}.
\bibitem{14} I. Filikhin, A. Gal and V.M. Suslov, Phys. Rev. C {\bf 68} 024002 (2003), \doi{10.1103/PhysRevC.68.024002}.

7) Please rewrite the final sentence before the start of section 2.2 - there are typos and it reads awkwardly.

Comment: it is corrected to "The strength, and range parameters of the A_B potential and mass ratio m_B/m_A have importance here. The evaluations of the mass polarization term for different systems one can find in Ref. \cite{FKSV17}."

8) Page 3, between Eqs. (2) and (3): "isopin" > "isospin". Below Eq. (3), this is misspelled again as "isopsin"

Comment: it is corrected.

9) sHW is introduced as an acronym in page 3, but has been used before. More importantly, I don't think the sHW potential has been discussed in the introduction either (where AY is in fact mentioned).

Comment: it was corrected. We have added the acronym HW in introduction "(please see HW potential in Ref.\cite{HW})" where the HW potential was mentioned. The reference for the potential is included (see in the text: "This energy depended model reduces the isospin singlet component of $N(\bar{K})$ potential due to the strong coupling $N(\bar{K})$ and $\pi\Sigma$ channels. The value about 20~MeV for $|E_{NN(\bar{K})}|$ was obtained with the two-body threshold about 11~MeV. Discussion about the experimental background and theoretical interpretations can be found in Ref. \cite{G2016,GHM}). The sHW potential is a restriction for the HW potential (see in the text: "the simulating Hyodo-Weise (sHW) effective potentials \cite{JK} of $N(\bar{K})$ interactions, which are energy independent and include the coupled-channel dynamics into a single channel $N(\bar{K})$ interaction."). The main property (small binding energy of NK singlet state) of the HW potentials is kept by the sHW potentials.

10) Page 4, paragraph 1: the variable Δ is introduced here, but I don't think it is discussed elsewhere in the paper. Why is it introduced in the first place, and what is its order of magnitude?

Comment: the Δ accompanies the main conclusion of the manuscript proposed for the isospin model and is presented as the relation between E_2 and E_3 .

We added the sentence to the text (see “We calculated the difference Δ of the two-body E_2 and three-body E_3 energies related to Eq. (11) as $\Delta = 2E_2 - E_3$ to evaluate the relation (11) for different $N(\bar{K})$ potentials. For both models (AY and SHW), the relation is satisfied.”).

The magnitude of Δ is defined in the caption to Table 1 and evaluated in the table.

11) Section 3: "is larger the" > "is larger than the". A bit below, I don't think I understand the meaning of "exited the values"

Comment: we corrected to the sentence “As an example, for the phenomenological $N(\bar{K})$ potentials calculated values $|E_3|$ do not exceed the value of 60 MeV, as it is reported in Ref. [14] they are 47--54 MeV.”

12) Page 4: "becomes lower than one is in Fig. 1" needs rewritings

Comment: we corrected to “The attractive NN interaction affects the E_3 , and the corresponding curves become lower in comparison with the curves in Fig. 2.”