Comments

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Charge-symmetry-breaking considerations for the hypertriton

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Clarifications have been provided regarding the remarks made by Gibson and Lehman concerning our results on the Λ separation energy (B_Λ) in ${}^{3}_{\Lambda}$H.

[NUCLEAR STRUCTURE ${}^{3}_{\Lambda}$H, Y-N potentials, separable potential three-body calculation, B_Λ.]

The statement made in Ref. 1 about our work[2] is not fully correct, because the ΛN parameters of Herndon and Tang[3] which appear in tables of both the references[1,2] are charge symmetric (CS). They, when used in a Λnp three-body formulation based on the ΛN (CS) potential as done in Ref. 2, do produce a result which is not going to be modified by ΛN charge-symmetry-breaking (CSB) effects. To emphasize, it may be remarked that ${}^{3}_{\Lambda}$H is an isosinglet and therefore the ΛN CSB effects do not show up for this system. Thus, working with five coupled integral equations[1] for the Λnp system with different Λn and Λp potentials or using three coupled integral equations[2] for this system with the corresponding ΛN (CS) parameters, the Λ separation energy will turn out to be the same.

Working within the formulation of Ref. 2, ΛN (CS) potentials should be supplied for the correct three-body calculations. Thus, the use of ΛN (CS) parameters of Herndon and Tang[3] in Ref. 2 amounts to an exact evaluation of B_Λ. Instead of ΛN (CS) parameters, when one uses Λp parameters it is definitely an approximation (say approximation A). On the other hand, in the equations of Ref. 1, Λp and Λn potentials are separately needed as input. In place of these two, if one uses the Λp potentials,

TABLE I. The types of approximation used in the calculations of B_Λ (Refs. 1 and 2) for various sets of ΛN low energy parameters.

Ref.	Low energy parameters (fm)	B_Λ (MeV) Ref. 1[a]	Ref. 2
3	$a_s=-2.76$, $r_s=3.05$, $a_t=-1.96$, $r_t=3.50$	0.51 (approx. C)	0.625 (exact)
4	$a_s^p=-2.16$, $r_s^p=2.03$, $a_t^p=-1.32$, $r_t^p=2.31$ $a_s^n=-2.67$, $r_s^n=2.04$, $a_t^n=-1.02$, $r_t^n=2.55$	0.70 (exact)	
5	$a_s^p=-2.11$, $r_s^p=3.19$, $a_t^p=-1.88$, $r_t^p=3.16$ $a_s^n=-2.47$, $r_s^n=3.09$, $a_t^n=-1.66$, $r_t^n=3.33$	0.28 (exact)	
6	$a_s^p=-2.46$, $r_s^p=3.87$, $a_t^p=-2.07$, $r_t^p=4.50$	0.16 (approx. B)	0.203 (approx. A)
7	$a_s^p=-1.80$, $r_s^p=2.80$, $a_t^p=-1.60$, $r_t^p=3.30$	0.12 (approx. B)	0.188 (approx. A)
8	$a_s^p=-1.80$, $r_s^p=2.06$, $a_t^p=-0.40$, $r_t^p=4.00$	0.004 (approx. B)	0.05 (approx. A)

[a]There are some numerical errors in Ref. 1 (private communication from B. F. Gibson). The revised values of B_Λ obtained by Gibson and Lehman are close to those of ours (Ref. 2). This does not change our discussion in the present work.

this is not the same approximation as described earlier. Let us call this approximation B. Further, using the set of ΛN (CS) parameters in place of both Λp and Λn parameters is altogether a different approximation (say approximation C). These three types of approximation are expected to give three different types of error in the three-body calculations of the binding energy.

The results for B_Λ obtained in Refs. 1 and 2 are given in Table I for comparison. There we have also specified the type of approximation used. By the side of the B_Λ values is mentioned the approximation made in the three-body calculations for the two-body potentials.

As indicated earlier, the value of B_Λ quoted in Ref. 1 for the Herndon and Tang[3] ΛN (CS) parameters, has been evaluated under the approximation C while the B_Λ value corresponding to these parameters was evaluated in Ref. 2 without any approximation, i.e., in this calculation proper ΛN, CSB effects have been considered. Thus, the difference in the B_Λ values given in Refs. 1 and 2 cannot be said to be originating only because of the different np triplet parameters used in these two papers, but the root cause is the different forms of approximation creeping into the calculations.

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