

Erratum: *S*-wave kaon-nucleon interactions from lattice QCD at the physical point [Phys. Rev. D **113**, 054506 (2026)]

Kotaro Murakami[✉], Sinya Aoki[✉], Takumi Doi[✉], Yan Lyu[✉], and Wren Yamada[✉]

(HAL QCD Collaboration)



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After publication of the paper, we found that the weights of the contractions involving the neutron at the sink in the kaon-nucleon (KN) four-point correlation functions were erroneously smaller by a factor of 2. Specifically, the contribution to the correlation function in Eq. (8) of the original paper arising from the second term of the sink operator in Eq. (9) was underestimated by a factor of 2. This affected all numerical results derived from the *KN* four-point correlation functions in the original paper. We have, therefore, repeated the analysis using the corrected four-point correlation functions with the same simulation setup as described in Sec. III of the original paper. Below, we present the corrected results, following the section structure of the original paper, and summarize how the conclusions are affected.

I. CORRECTED RESULTS IN SECTION IV A

In this section, we show the corrected results in Sec. IV A (“*KN* potentials”) of the original paper.

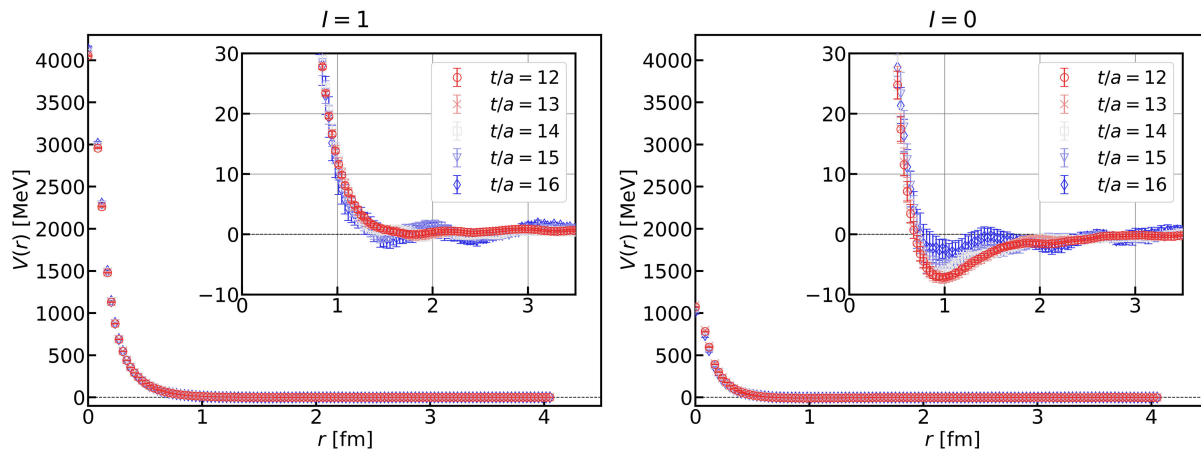


FIG. 1. Corrected leading-order potentials in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 1 of the original paper.

Compared with the original results, the corrected potential for $I = 1$ is more repulsive, whereas the corrected potential for $I = 0$ exhibits a deeper attractive pocket. The corrected results also have larger statistical fluctuations than the original results, especially at $t/a = 16$.

In the original paper, the contribution from two-pion exchange (TPE) was estimated to be small based on the fit results. In the corrected analysis, the TPE contribution is not well constrained in either isospin channel, given the statistical and systematic uncertainties. Therefore, no definitive conclusion can be drawn on the magnitude of the TPE coupling.

TABLE I. Corrected fit parameters of the KN potential at $t/a = 14$ for $V_I^{4G}(r)$, replacing Table I of the original paper. The values of $\chi^2/\text{d.o.f.} = 0.14(20)$ [0.55(24)] for $I = 1$ ($I = 0$).

I	a_1^I [MeV]	b_1^I [fm]	a_2^I [MeV]	b_2^I [fm]	a_3^I [MeV]	b_3^I [fm]	a_4^I [MeV]	b_4^I [fm]
1	1995.8(102.0)	0.113(1)	1307.4(27.6)	0.198(10)	609.6(61.7)	0.355(28)	170.2(55.9)	0.622(45)
0	781.3(33.8)	0.140(4)	275.1(34.5)	0.361(13)	-8.5(2.8)	1.059(184)	-2.9(2.3)	2.098(575)

TABLE II. Corrected fit parameters of the $I = 0$ KN potential at $t/a = 14$ for $V_I^{3GTPE}(r)$, replacing Table II of the original paper. The value of $\chi^2/\text{d.o.f.} = 0.57(25)$.

$c_1^{I=0}$ [MeV]	$d_1^{I=0}$ [fm]	$c_2^{I=0}$ [MeV]	$d_2^{I=0}$ [fm]	$c_3^{I=0}$ [MeV]	$d_3^{I=0}$ [fm]	$\alpha^{I=0}$ [MeV fm ²]
783.9(35.4)	0.140(5)	263.6(34.6)	0.363(15)	-3.5(2.9)	1.961(428)	-16.8(7.9)

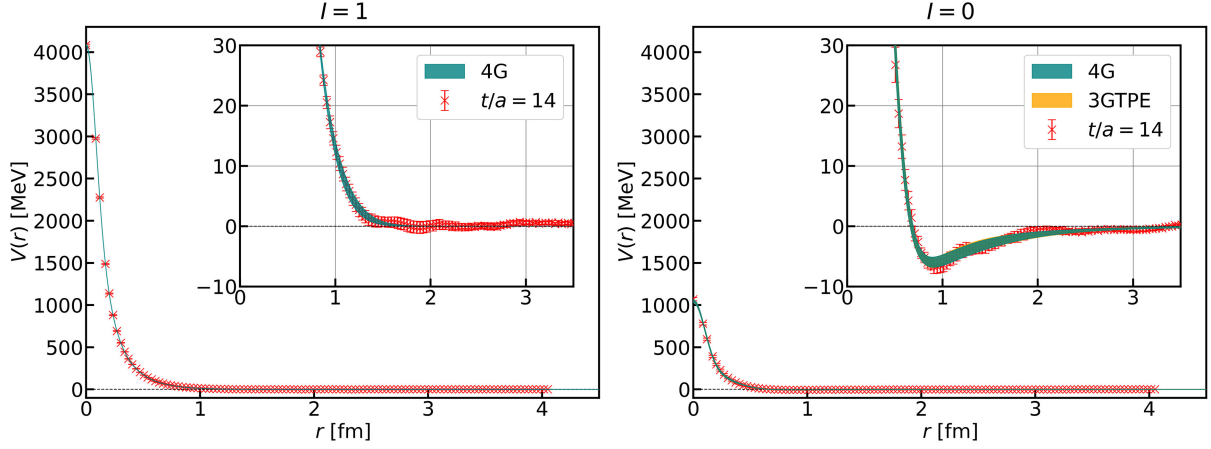


FIG. 2. Corrected fit results and corrected potential data for the $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 2 of the original paper.

II. CORRECTED RESULTS IN SECTION IV B

We next present the corrected results in Sec. IV B (“ KN scattering observables”) of the original paper.

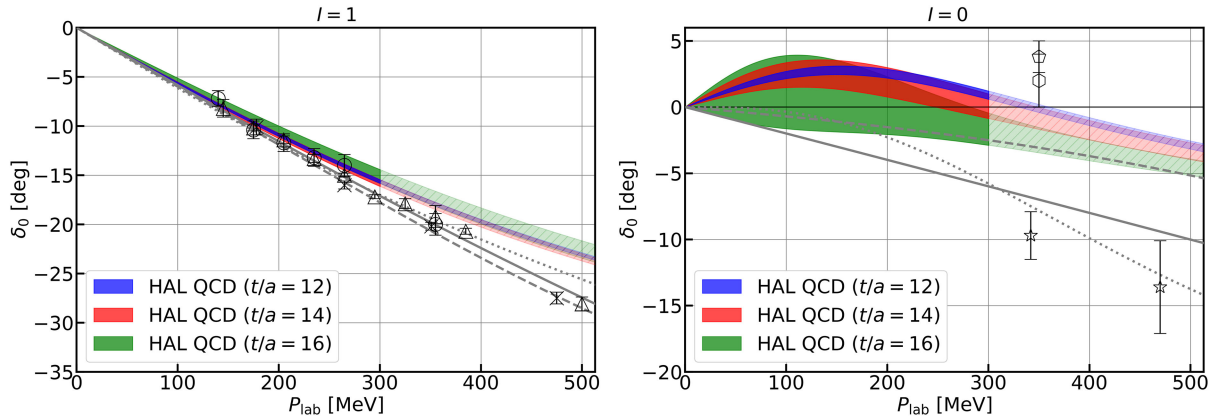


FIG. 3. Corrected phase shifts for the S-wave KN scatterings in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 3 of the original paper.

The corrected scattering lengths and effective range are

$$a_0^{I=1} = -0.302(8)_{(-14)}^{(+14)} \text{ fm}, \quad r_{\text{eff}}^{I=1} = -0.149(26)_{(-24)}^{(+23)} \text{ fm}, \quad a_0^{I=0} = +0.177(69)_{(-84)}^{(+0)} \text{ fm}, \quad (1)$$

replacing the values given in Eq. (13) of the original paper. Note that, in accordance with the original paper, systematic errors are estimated from the differences between the central values at $t/a = 14$ and the results at $t/a = 12$ – 16 . Other uncertainties, including those associated with fit function dependence, are discussed separately in Sec. III below, following the structure of the original paper.

As in the original paper, the corrected phase shifts in both isospin channels start from 0 degrees at the threshold and show neither a sudden rise nor a crossing of 90 degrees. They, therefore, continue to indicate the absence of bound or resonant states corresponding to the $\Theta^+(1540)$ pentaquark in the S-wave KN system, as concluded in the original paper. In the $I = 1$ channel, the corrected phase shifts agree with experiments at small momenta, thereby resolving the discrepancy reported in the original paper. The corresponding S-wave cross section, 11.5 ± 0.6 mb at the threshold, is also consistent with the experimental data. In the $I = 0$ channel, the corrected phase shifts move toward positive values at small momenta, leading to a positive central value for the scattering length and to a larger S-wave contribution to the total cross section in this region. The corrected results appear to differ from the partial-wave analyses near threshold, though the difference may partly reflect the lack of low-energy experimental data available to constrain those analyses. Above $P_{\text{lab}} = 300$ MeV, the corrected S-wave total cross section remains too small to account for the experimental data, and the results, therefore, still suggest that the experimental $I = 0$ cross section is dominated by P-wave contributions, as noted in the original paper. We note that the present analysis follows the original paper by considering only the S-wave contributions to the total cross sections and by estimating the statistical errors using the same jackknife analysis. Higher partial-wave contributions and the statistical uncertainties in the total cross sections will be investigated in more detail elsewhere.

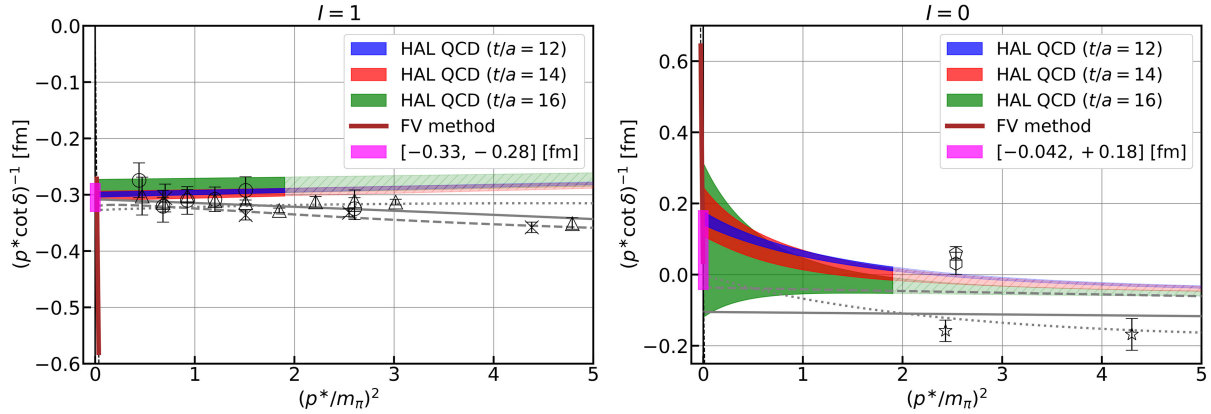


FIG. 4. Corrected $(p^* \cot \delta_0(p^*))^{-1}$ for the S-wave KN scatterings in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 4 of the original paper.

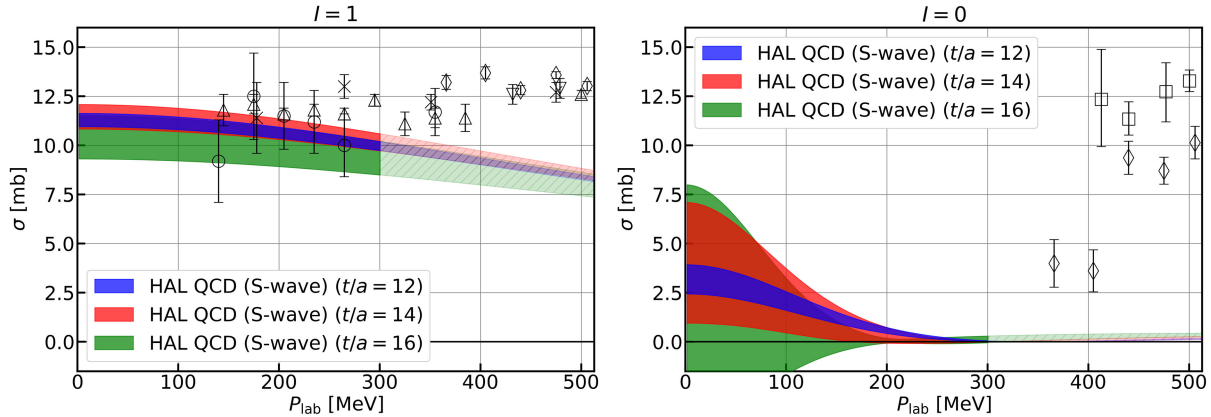


FIG. 5. Corrected S-wave total cross sections in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 5 of the original paper.

III. CORRECTED RESULTS IN SECTION IV C

We then present the corrected results in Sec. IV C (“Discussions on systematic uncertainties”) of the original paper.

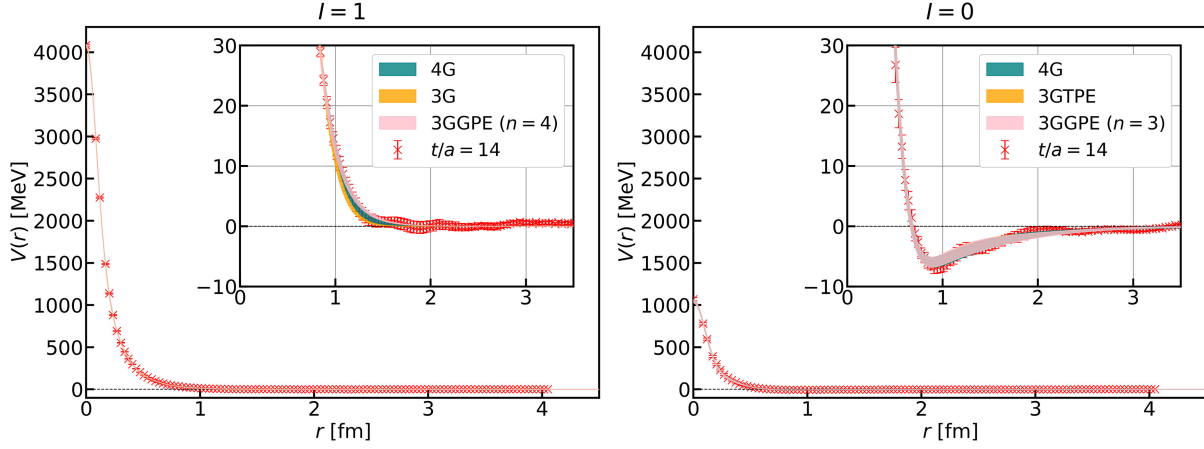


FIG. 6. Corrected fit results for different fit ansatz as well as corrected potential data in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 6 of the original paper.

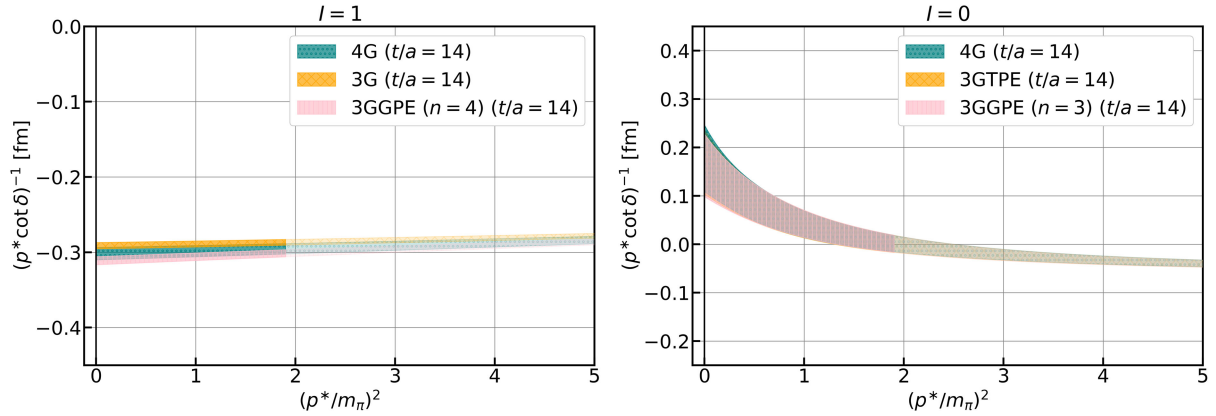


FIG. 7. Corrected $(p^* \cot \delta_0(p^*))^{-1}$ for different fit ansatz in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 7 of the original paper.

The corrected scattering lengths evaluated from the ground-state energies on a finite volume via the $1/L$ expansion are

$$a_{0,\text{FV}}^{I=1} = -0.434(153) \text{ fm}, \quad a_{0,\text{FV}}^{I=0} = +0.313(299) \text{ fm}, \quad (2)$$

replacing the values given below Eq. (15) of the original paper.

In the corrected results, it is found that all the functions introduced in the original paper, V_I^{4G} , V_I^{3G} , V_I^{3GTPE} , and $V_{I,n}^{3GGPE}$ with $n = 3$ and 4 , provide reasonable fit results for both isospins at $t/a = 14$. The corrected phase shifts obtained using these fit functions are consistent with each other considering the statistical uncertainties. A more detailed examination of the dependence of the phase shifts on the fit functions, together with an estimate of the associated systematic uncertainty, is left for future work.

For the systematic checks on remaining uncertainties in the original paper, the corrected results also lead to the same conclusions. The consistency between the scattering lengths from the potentials and those from the energy shifts holds also in the corrected results, as in the case of the original paper. In addition, for the small difference in the kaon and nucleon masses between our setup and nature, and the lattice discretization effect at short distances, the estimates using the same methods as in the original paper continue to indicate no significant effect after the correction.

IV. CORRECTED RESULTS IN APPENDIXES A AND B

In this section, we show the corrected results in Appendixes A (“Plots of the comparison of the leading-order (LO) KN potentials between different pion masses”) and B (“Energy shifts on finite volume from KN temporal correlation functions with optimized operators”) of the original paper.

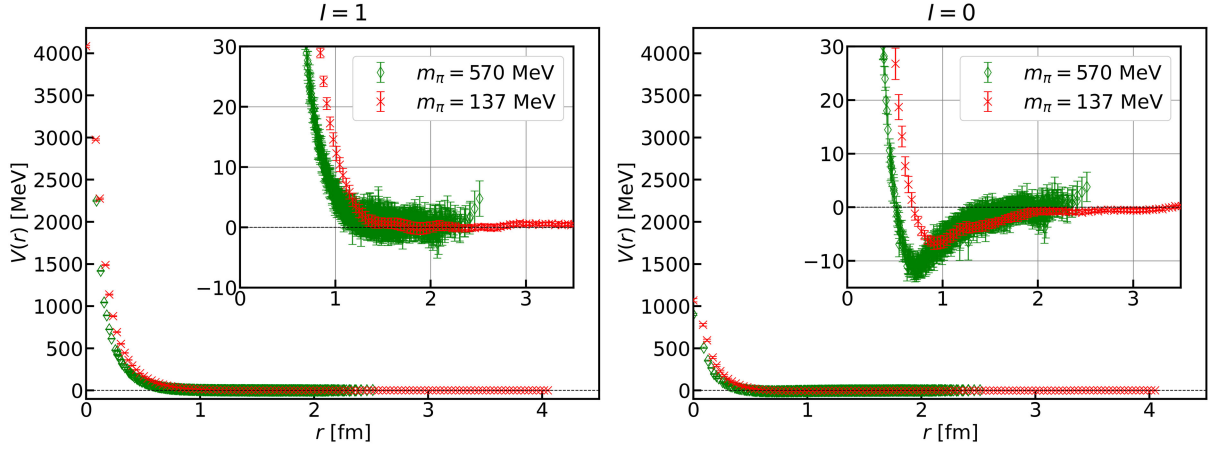


FIG. 8. Corrected comparison between the LO potentials at $m_\pi \approx 137$ MeV with those obtained in the previous study at $m_\pi \approx 570$ MeV, for $I = 1$ (left panel) and $I = 0$ (right panel), replacing Fig. 8 of the original paper.

In corrected Fig. 8, we compare the LO KN potentials at two different quark masses. Note that the correction was required only for the new results at $m_\pi \approx 137$ MeV, whereas the results at $m_\pi \approx 570$ MeV obtained in our previous study remain unchanged. In the corrected results for $I = 1$, the quark mass dependence is more clearly observed, as the corrected potential at $m_\pi \approx 137$ MeV is more repulsive.

The corrected energy shifts of the KN ground states on the finite volume are

$$E_{\text{gs}}^{I=1} - m_N - m_K = +0.716(295) \text{ MeV}, \quad E_{\text{gs}}^{I=0} - m_N - m_K = -0.392(342) \text{ MeV}, \quad (3)$$

replacing the values given in Eq. (B2) of the original paper. Compared with the original results, the magnitudes of the energy shifts are larger for both isospins. These energy shifts are consistent with the eigenenergies, ΔE_0 , shown in the legends of the corrected Fig. 9.

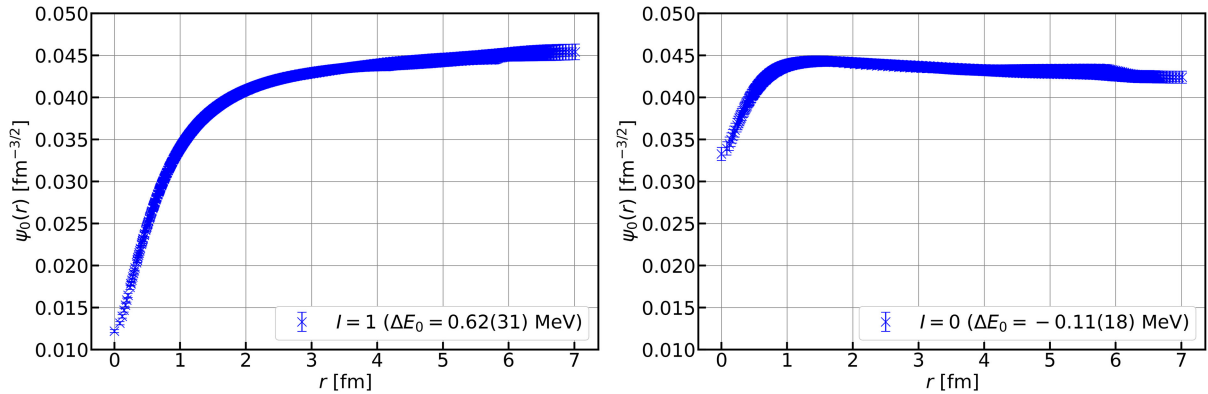


FIG. 9. Corrected wave function of the ground state on the lattice in the finite volume with the potential in $I = 1$ (left panel) and $I = 0$ channels (right panel), replacing Fig. 9 of the original paper.

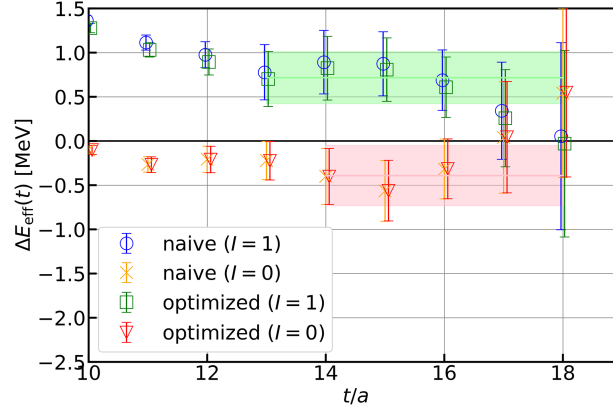


FIG. 10. Corrected effective energy for the two-point correlation functions with the optimized and naive sink operators, replacing Fig. 10 of the original paper.

V. SUMMARY OF CHANGES TO THE CENTRAL CONCLUSIONS

Finally, changes to and unchanged aspects of the central conclusions of the original paper are summarized. The conclusion regarding the absence of a bound or resonant state corresponding to the pentaquark $\Theta^+(1540)$ in the S-wave kaon-nucleon system remains unchanged. In the $I = 1$ channel, the discrepancy between our results and the experimental data reported in the original paper is now resolved by the correction. In the $I = 0$ channel, the phase shifts move toward positive values at small momenta, leading to an enhanced S-wave cross section near threshold. Nevertheless, the corrected results still suggest P-wave dominance in the scattering amplitude, as in the original paper. Finally, unlike in the original paper, the corrected fit results do not allow a robust conclusion about the magnitude of the TPE contribution.