Erratum: Nuclear and neutron matter *G*-matrix calculations with a chiral effective field theory potential including effects of three-nucleon interactions [Phys. Rev. C 88, 064005 (2013)]

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Several errors were found in the program code for the nuclear-matter calculation reported in the original paper. There also were errors in the spin-orbit and tensor terms of the effective two-nucleon forces derived from the three-nucleon forces (3NFs) of the chiral effective field theory (Ch-EFT). After correcting these errors, the enhancement of the tensor-force component is reduced to be about 15% from the previous value of about 30%.

Although qualitatively important effects of the 3NFs for improving nuclear-matter saturation properties do not change, the saturation curve is modified quantitatively by the corrections. In the original paper, the low-energy constants $c_D = -4.381$ and $c_E = -1.126$ were used, referring to the nuclear-matter calculations with chiral low-momentum interactions by Hebeler *et al.* [1]. The results of the revised nuclear-matter calculation with the same c_D's and c_E's are shown in Figs. 2(a), 2(b), and 3(a).

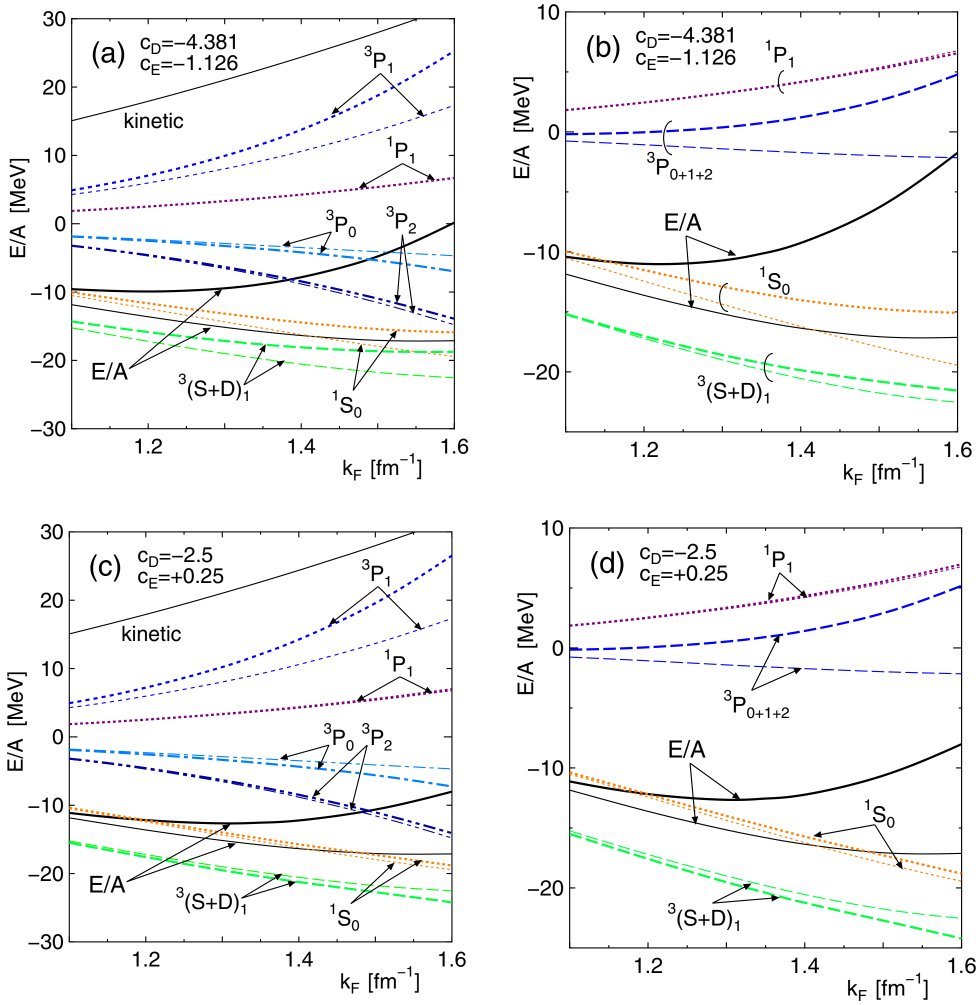

FIG. 2. Revised version of Fig. 2 in the original paper. k_F dependence of partial-wave contributions to the nuclear-matter lowest-order Brueckner theory (LOBT) energy per nucleon for the Ch-EFT interaction for $\Lambda = 550$ MeV. The thick and thin curves are with and without the 3NF effects, respectively. The results with $(c_D,c_E) = (-4.381,-1.126)$ are shown in (a) full decomposition and (b) different J's being summed. The results with $(c_D,c_E) = (-2.5,0.25)$ are shown in (c) and (d). Note that the numerical value of the partial-wave contributions in Fig. 2 of the original paper was wrongly multiplied by $\frac{2}{3}k_F^3$.

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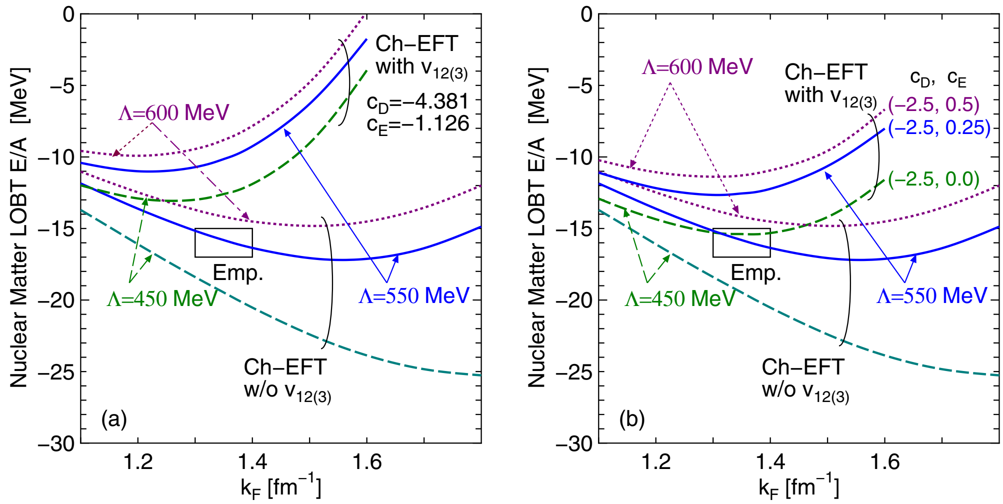

FIG. 3. Revised version of Fig. 3 in the original paper. LOBT energies per nucleon in symmetric nuclear matter for the Ch-EFT interaction with and without the 3NF effects. The left panel (a) represents the results with $(c_D, c_E) = (-4.381, -1.126)$. The right panel (b) shows the results with c_D and c_E refitted to obtain a better saturation curve.

To obtain a better saturation curve, the c_D's and c_E's have been refitted as shown in Fig. 3(b). The revised version of Fig. 2 in the original paper for partial-wave contributions is given as Figs. 2(c) and 2(d). Table II of the original paper for the spin-isospin decompositions is replaced by Table II in this Erratum. Because neutron-matter energies hardly change by the corrections, Fig. 6 of the original paper for the neutron-matter energy is not revised here.

The correction in the spin-orbit component changes the estimation of the strength of the one-body spin-orbit field in the form of the Scheerbaum factor, whereas the c_D and c_E terms do not contribute to the spin-orbit component. Table I in the original paper should be replaced by Table I, which indicates that the enhancement of the spin-orbit strength due to the 3NF is reduced to be about 20%.

Changes in the G matrices in nuclear matter including the 3NF effects affect the results of the subsequent applications of them to the description of the nucleon-nucleus and nucleus-nucleus scatterings reported in Refs. [2–4]. The corrected results are reported in separate Errata.

The author thanks S. Yoshida for finding errors in the program code and an omission of several terms in density-dependent effective two-body forces derived from the three-nucleon force of Ch-EFT.

APPENDIX A

The expression of the partial-wave expansion of the spin-orbit component of the c_3 term of V_C, Eq. (B14), should be corrected as

$$\begin{aligned}\delta_{S1}\frac{c_3 g_A^2}{2f_\pi^4}3\frac{\ell(\ell+1)+2-J(J+1)}{2\ell+1}\Bigg[\left(m_\pi^2+\frac{1}{2}\left(k_1'^2+k_1^2\right)\right)\left\{Q_{W0}^{\ell-1}(k_1',k_1)-Q_{W0}^{\ell+1}(k_1',k_1)-W_{\ell s,0}^{\ell}(k_1',k_1)\right\}\\ -\delta_{\ell 1}\frac{k_1'k_1}{2}[F_0(k_1')+F_0(k_1)-F_1(k_1')-F_1(K_1)]+k_1'k_1\left\{\frac{\ell-1}{2\ell-1}W_{\ell s,0}^{\ell-1}(k_1',k_1)+\frac{\ell+2}{2\ell+3}W_{\ell s,0}^{\ell+1}(k_1',k_1)\right\}\Bigg].\end{aligned} \tag{B14}$$

TABLE I. Revised version of Table I in the original paper. Scheerbaum factor B_S is in units of MeV fm^5.

	Nuclear matter		Neutron matter	
$k_F = 1.35$ fm^{-1}	N^{3}LO	N^{3}LO + 3NF	N^{3}LO	N^{3}LO + 3NF
B_S $(T=0)$	2.5	−4.3		
B_S $(T=1)$	84.6	102.0	84.7	92.8
$k_F = 1.07$ fm^{-1}	N^{3}LO	N^{3}LO + 3NF	N^{3}LO	N^{3}LO + 3NF
B_S $(T=0)$	1.6	−1.7		
B_S $(T=1)$	86.5	99.8	87.0	91.4

TABLE II. Revised version of Table II in the original paper with c_D and c_E being tuned as in the text. Total energies and spin-isospin channel (^{1}O, ^{3}E, ^{1}E, and ^{3}O) decompositions for three instances of the cutoff energy Λ (MeV) at $k_F = 1.07, 1.35$, and 1.60 fm^{-1} for symmetric nuclear matter and at $k_F = 1.35$ and 1.80 fm^{-1} for pure neutron matter. The corresponding density ρ (fm^{-3}), kinetic-energy T, and total potential-energy contribution U also are tabulated. Energies are in units of MeV.

			Symmetric nuclear matter without 3NF							Symmetric nuclear matter with 3NF					
k_F	ρ	Λ	E/A	T	U	^{1}O	^{3}E	^{1}E	^{3}O	E/A	U	^{1}O	^{3}E	^{1}E	^{3}O
1.07	0.083	450	−13.01	14.24	−27.25	1.98	−17.61	−11.13	−0.50	−12.27	−26.52	1.99	−17.71	−10.85	0.05
		550	−11.32	14.24	−25.56	1.99	−16.17	−10.95	−0.43	−10.71	−24.96	2.00	−16.31	−10.72	0.07
		600	−10.57	14.24	−24.81	2.04	−15.38	−11.03	−0.43	−9.92	−24.16	2.04	−15.40	−10.87	0.06
1.35	0.166	450	−19.47	22.67	−42.15	4.67	−27.38	−18.28	−1.16	−15.39	−38.06	4.64	−27.06	−17.16	1.52
		550	−15.81	22.67	−38.49	4.74	−24.10	−18.25	−0.88	−12.55	−35.23	4.71	−24.12	−17.33	1.51
		600	−14.18	22.67	−36.85	4.85	−22.26	−18.60	−0.84	−11.29	−33.97	4.81	−22.26	−17.98	1.46
1.60	0.277	450	−23.87	31.85	−55.72	8.67	−37.55	−25.36	−1.48	−11.58	−43.43	8.49	−36.04	−22.68	6.80
		550	−17.12	31.85	−48.97	9.00	−31.22	−25.85	−0.89	−8.02	−39.87	8.72	−31.11	−23.68	6.21
		600	−14.52	31.85	−46.37	9.13	−27.75	−26.99	−0.75	−6.68	−38.53	8.85	−27.73	−25.49	5.84
			Pure neutron matter without 3NF							Pure neutron matter with 3NF					
1.35	0.083	450	8.25	22.67	−14.43	0.0	0.0	−13.52	−0.91	9.29	−13.39	0.0	0.0	−13.13	−0.25
		550	8.21	22.67	−14.46	0.0	0.0	−13.69	−0.78	9.13	−13.54	0.0	0.0	−13.31	−0.23
		600	8.24	22.67	−14.43	0.0	0.0	−13.68	−0.75	9.09	−13.58	0.0	0.0	−13.32	−0.27
1.80	0.197	450	17.04	40.31	−23.27	0.0	0.0	−22.49	−0.78	24.41	−15.90	0.0	0.0	−19.88	3.98
		550	15.75	40.31	−24.56	0.0	0.0	−24.03	−0.53	21.04	−19.27	0.0	0.0	−22.42	3.15
		600	14.69	40.31	−25.62	0.0	0.0	−25.32	−0.30	20.36	−19.95	0.0	0.0	−22.94	2.99

The spin-orbit component of the c_4 term of V_C, Eq. (A10), is absent in the original paper but present. The expression after the partial-wave expansion is

$$\begin{aligned}&\delta_{S1}\frac{c_4 g_A^2}{2f_\pi^4}(\boldsymbol{\tau}_1\cdot\boldsymbol{\tau}_2)\frac{\ell(\ell+1)+2-J(J+1)}{2\ell+1}\left[\left(m_\pi^2+\frac{1}{2}\left(k_1'^2+k_1^2\right)\right)\left\{Q_{W0}^{\ell-1}(k_1',k_1)-Q_{W0}^{\ell+1}(k_1',k_1)-W_{\ell s,0}^{\ell}(k_1',k_1)\right\}\right.\\&\left.-\delta_{\ell 1}\frac{k_1'k_1}{2}[F_0(k_1')+F_0(k_1)-F_1(k_1')-F_1(K_1)]+k_1'k_1\left\{\frac{\ell-1}{2\ell-1}W_{\ell s,0}^{\ell-1}(k_1',k_1)+\frac{\ell+2}{2\ell+3}W_{\ell s,0}^{\ell+1}(k_1',k_1)\right\}\right].\end{aligned} \tag{A10}$$

APPENDIX B

In the original paper, tensor components in the form of $[[\boldsymbol{\sigma}_1\times\boldsymbol{\sigma}_2]^2\times[Y_\ell(\theta_1,\phi_1)\times Y_\ell(\theta_2,\phi_2)]^2]^0$ with $\ell\geqslant 2$ were ignored. Including them, the expression (B16) for the tensor components of the c_4 term of V_C, Eq. (A10) of the original paper, is replaced by

$$\begin{aligned}&2\frac{c_4 g_A^2}{4f_\pi^4}\frac{2}{3}(S_{12})_{\ell 1J}^{\ell'}(\boldsymbol{\tau}_1\cdot\boldsymbol{\tau}_2)\left[\frac{1}{2k_1'k_1}\left[k_1'^2Q_\ell(z)+k_1^2Q_{\ell'}(z)-2k_1'k_1Q_J(z)\right]\left(\frac{1}{2}\rho_0-m_\pi^2[F_0(k_1')+F_0(k_1)]\right)\right.\\&+\frac{k_1'k_1}{2J+1}\left[Q_{W0}^{J+1}(k_1',k_1)-Q_{W0}^{J-1}(k_1',k_1)\right]\\&+[F_0(k_1')-2F_1(k_1')]\left\{\frac{k_1'^2}{4k_1'k_1}\left(-k_1'^2+k_1^2+m_\pi^2\right)Q_\ell(z)-\frac{1}{4}\left(-k_1'^2+k_1^2+m_\pi^2\right)Q_J(z)-\frac{1}{2}k_1'^2\delta_{\ell 0}+\frac{1}{2}k_1'k_1\delta_{J0}\right\}\\&+[F_0(k_1)-2F_1(k_1)]\left\{\frac{k_1^2}{4k_1'k_1}\left(k_1'^2-k_1^2+m_\pi^2\right)Q_{\ell'}(z)-\frac{1}{4}\left(k_1'^2-k_1^2+m_\pi^2\right)Q_J(z)-\frac{1}{2}k_1^2\delta_{\ell 0}+\frac{1}{2}k_1'k_1\delta_{J0}\right\}\\&+\frac{1}{3}F_3(k_1')\left\{-\frac{3}{2}k_1'^2\delta_{\ell 0}+\frac{3}{2}k_1'k_1\delta_{J0}+\frac{k_1'^2}{4k_1'k_1}\left(-k_1'^2+3k_1^2+3m_\pi^2\right)Q_\ell(z)-\frac{1}{4}\left(k_1'^2+3k_1^2+3m_\pi^2\right)Q_J(z)+\frac{1}{2}k_1'k_1Q_{\ell'}(z)\right\}\\&+\frac{1}{3}F_3(k_1)\left\{-\frac{3}{2}k_1^2\delta_{\ell 0}+\frac{3}{2}k_1'k_1\delta_{J0}+\frac{k_1^2}{4k_1'k_1}\left(-k_1^2+3k_1'^2+3m_\pi^2\right)Q_{\ell'}(z)-\frac{1}{4}\left(k_1^2+3k_1'^2+3m_\pi^2\right)Q_J(z)+\frac{1}{2}k_1'k_1Q_\ell(z)\right\}\\&\left.-\frac{1}{3}F_2(k_1')\frac{k_1'^2}{2k_1'k_1}\left\{k_1'^2Q_\ell(z)+k_1^2Q_{\ell'}(z)-2k_1'k_1Q_J(z)\right\}-\frac{1}{3}F_2(k_1)\frac{k_1^2}{2k_1'k_1}\left\{k_1^2Q_{\ell'}(z)+k_1'^2Q_\ell(z)-2k_1'k_1Q_J(z)\right\}\right]\\&+\sqrt{\frac{5}{6}}\frac{(-1)^J}{(\ell',2,\ell)}\left(k_1'^2+k_1^2\right)\left\{Q_{W1}^{\ell'J}(k_1',k_1)+Q_{W1}^{\ell J}(k_1,k_1')\right\}(\ell'010|J0)(\ell 010|J0)\begin{Bmatrix}1&2&1\\\ell'&J&\ell\end{Bmatrix}\end{aligned}$$

$$+\frac{\sqrt{2}}{3}\frac{(-1)^{J+1}}{(\ell',2,\ell)}\sum_{j'jk}k_1'k_1\big[Q_{W1}^{j'k}(k_1',k_1)+Q_{W1}^{jk}(k_1,k_1')\big]\hat{k}(10k0|j'0)(10k0|j0)\begin{Bmatrix}1&2&1\\j'&k&j\end{Bmatrix}\begin{Bmatrix}j'&j&2\\\ell&\ell'&1\end{Bmatrix}(10\ell'0|j'0)(10\ell0|j0)$$

$$+\frac{1}{3}\bigg\{k_1'^2\bigg\{Q_{X1}^{\ell}(k_1,k_1')+Q_{X1}^{\ell}(k_1',k_1)-\delta_{\ell 0}\frac{1}{2}[F_0(k_1')+F_0(k_1)]\bigg\}+k_1^2\big(Q_{X1}^{\ell'}\bigg\{k_1,k_1'\big)+Q_{X1}^{\ell'}(k_1',k_1)-\delta_{\ell' 0}\frac{1}{2}[F_0(k_1')+F_0(k_1)]\bigg\}$$

$$-2k_1'k_1\bigg\{Q_{X1}^{J}(k_1,k_1')+Q_{X1}^{J}(k_1',k_1)-\delta_{J0}\frac{1}{2}[F_0(k_1')+F_0(k_1)]\bigg\}\bigg\}$$

$$+\sqrt{\frac{35}{3}}\frac{(-1)^{J}}{(\ell',2,\ell)}\sum_{jk}k_1'^2\big[Q_{W1}^{jk}(k_1',k_1)+Q_{W1}^{\ell k}(k_1,k_1')\big]\hat{j}(j010|k0)(10\ell 0|k0)\begin{Bmatrix}1&2&1\\j&k&\ell\end{Bmatrix}\begin{Bmatrix}2&j&\ell'\\\ell&2&2\end{Bmatrix}(20j0|\ell'0)$$

$$+\sqrt{\frac{35}{3}}\frac{(-1)^{J}}{(\ell',2,\ell)}\sum_{jk}k_1^2\big[Q_{W1}^{jk}(k_1,k_1')+Q_{W1}^{\ell' k}(k_1',k_1)\big]\hat{j}(j010|k0)(10\ell' 0|k0)\begin{Bmatrix}1&2&1\\j&k&\ell'\end{Bmatrix}\begin{Bmatrix}2&j&\ell\\\ell'&2&2\end{Bmatrix}(20j0||\ell 0)$$

$$+\sqrt{\frac{35}{2}}\frac{(-1)^{J}}{(\ell',2,\ell)}\sum_{j'jk}\hat{j}'\hat{j}(10j'0|k0)(10j0|k0)\begin{Bmatrix}1&2&1\\j'&k&j\end{Bmatrix}\begin{Bmatrix}1&j'&\ell'\\1&j&\ell\\2&2&2\end{Bmatrix}(10j'0|\ell'0)(10j0|\ell 0)2k_1'k_1\big[Q_{W1}^{j'k}(k_1',k_1)+Q_{W1}^{j'j}(k_1,k_1')\big]$$

$$-\frac{2}{3}\big\{k_1'^2Q_{W2}^{\ell}(k_1',k_1)+k_1^2Q_{W2}^{\ell'}(k_1',k_1)-2k_1'k_1Q_{W2}^{J}(k_1',k_1)\big\}-\frac{1}{3\sqrt{5}}\frac{1}{(\ell',2,\ell)}Q_{W2}^{\ell'\ell}(k_1',k_1)(\ell'0\ell 0|20)\big(k_1'^2+k_1^2\big)$$

$$-\frac{1}{15\sqrt{3\hat{\ell}'\hat{\ell}}}\frac{1}{(\ell',2,\ell)}\sum_{j'j}\hat{j}'\hat{j}Q_{W2}^{j'j}(k_1',k_1)\frac{1}{5}(j'0j0|20)2k_1'k_1\begin{Bmatrix}j'&j&2\\\ell&\ell'&1\end{Bmatrix}(10j'0|\ell'0)(10j0|\ell 0)$$

$$+\frac{\sqrt{14}}{3}\frac{(-1)^{\ell+1}}{(\ell',2,\ell)}\sum_{j}(\ell'020|j0)(\ell 020|j0)\begin{Bmatrix}\ell'&\ell&2\\2&2&j\end{Bmatrix}\big\{\sqrt{\hat{\ell}'}k_1'^2Q_{W2}^{j'\ell}(k_1',k_1)+\sqrt{\hat{\ell}}k_1^2Q_{W2}^{\ell' j}(k_1',k_1)\big\}$$

$$+\sqrt{\frac{7}{15}}\frac{1}{(\ell',2,\ell)}\sum_{j'j}\hat{j}'\hat{j}2k_1'k_1Q_{W2}^{j'j}(k_1',k_1)(j'0j0|20)\begin{Bmatrix}1&j'&\ell'\\1&j&\ell\\2&2&2\end{Bmatrix}(10j'0|\ell'0)(10j0|\ell 0)\qquad\text{(B16)}$$

for $\ell'=\ell\pm 2$ $(J=\ell\pm 1)$ and

$$2\frac{c_4g_A^2}{4f_\pi^4}\frac{2}{3}(S_{12})_{\ell 1J}^{\ell'}(\boldsymbol{\tau}_1\cdot\boldsymbol{\tau}_2)\Bigg[\bigg(\frac{1}{2}\rho_0-m_\pi^2[F_0(k_1')+F_0(k_1)]\bigg)\bigg\{\frac{k_1^2+k_1^2}{2k_1'k_1}Q_\ell(z)-\frac{1}{2}\frac{2\ell+3}{2\ell+1}Q_{\ell-1}(z)-\frac{1}{2}\frac{2\ell-1}{2\ell+1}Q_{\ell+1}(z)\bigg\}$$

$$+k_1'k_1\bigg\{\bigg(\frac{(2\ell+1)^2}{(2\ell-1)(2\ell+3)}-2\bigg)Q_{W0}^{\ell}(k_1',k_1)+\frac{(2\ell+3)(\ell-1)}{(2\ell+1)(2\ell-1)}Q_{W0}^{\ell-2}(k_1',k_1)+\frac{(2\ell-1)(\ell+1)}{(2\ell+1)(2\ell+3)}Q_{W0}^{\ell+2}(k_1',k_1)\bigg\}$$

$$+[F_0(k_1')-2F_1(k_1')]\bigg\{-\frac{1}{2}k_1'^2\delta_{\ell 0}+\frac{5}{12}k_1'k_1\delta_{\ell 1}+\frac{k_1'^2}{4k_1'k_1}\big(-k_1'^2+k_1^2+m_\pi^2\big)Q_\ell(z)$$

$$-\frac{1}{8(2\ell+1)}\big(-k_1'^2+k_1^2+m_\pi^2\big)[(2\ell+3)Q_{\ell-1}(z)+(2\ell-1)Q_{\ell+1}(z)]\bigg\}$$

$$+\frac{1}{3}F_3(k_1')\bigg\{-\frac{3}{2}k_1'^2\delta_{\ell 0}+\frac{5}{4}k_1'k_1\delta_{\ell 1}+\frac{k_1'^2}{4k_1'k_1}\big[\big(-k_1'^2+5k_1^2+3m_\pi^2\big)Q_\ell(z)\big]$$

$$-\frac{1}{8(2\ell+1)}\big(k_1'^2+3k_1^2+3m_\pi^2\big)[(2\ell+3)Q_{\ell-1}(z)+(2\ell-1)Q_{\ell+1}(z)]\bigg\}$$

$$+[F_0(k_1)-2F_1(k_1)]\bigg\{-\frac{1}{2}k_1^2\delta_{\ell 0}+\frac{5}{12}k_1'k_1\delta_{\ell 1}+\frac{k_1^2}{4k_1'k_1}\big(k_1'^2-k_1^2+m_\pi^2\big)Q_\ell(z)$$

$$-\frac{1}{8(2\ell+1)}\big(k_1'^2-k_1^2+m_\pi^2\big)[(2\ell+3)Q_{\ell-1}(z)+(2\ell-1)Q_{\ell+1}(z)]\bigg\}+\frac{1}{3}F_3(k_1)\bigg\{-\frac{3}{2}k_1^2\delta_{\ell 0}+\frac{5}{4}k_1'k_1\delta_{\ell 1}$$

$$+\frac{k_1^2}{4k_1'k_1}\big(-k_1^2+5k_1'^2+3m_\pi^2\big)Q_\ell(z)-\frac{1}{8(2\ell+1)}\big(k_1^2+3k_1'^2+3m_\pi^2\big)[(2\ell+3)Q_{\ell-1}(z)+(2\ell-1)Q_{\ell+1}(z)]\bigg\}$$

$$
\begin{aligned}
&-\frac{1}{3}\big[k_1'^2F_2(k_1')+k_1^2F_2(k_1)\big]\left\{\frac{k_1'^2+k_1^2}{2k_1'k_1}Q_\ell(z)-\frac{1}{\hat\ell}[(2\ell+3)Q_{\ell-1}(z)+(2\ell-1)Q_{\ell+1}(z)]\right\}\\
&+\frac{1}{3}\big(k_1'^2+k_1^2\big)\left\{\frac{(2\ell+3)}{2\hat\ell}\big[Q_{W1}^{\ell\ell-1}(k_1',k_1)+Q_{W1}^{\ell\ell-1}(k_1,k_1')\big]+\frac{(2\ell-1)}{2\hat\ell}\big[Q_{W1}^{\ell\ell+1}(k_1',k_1)+Q_{W1}^{\ell\ell+1}(k_1,k_1')\big]\right\}\\
&+\frac{\sqrt2}{3}\frac{(-1)^\ell}{(\ell,2,\ell)}\sum_{j'jk}k_1'k_1\big\{Q_{W1}^{j'k}(k_1',k_1)+Q_{W1}^{j'k}(k_1,k_1')\big\}\sqrt{\hat j'\hat j}(10j'0|k0)(10j0|k0)\begin{Bmatrix}1&2&1\\j'&k&j\end{Bmatrix}\begin{Bmatrix}j'&j&2\\\ell&\ell&1\end{Bmatrix}(10\ell0|j'0)(10\ell0|j0)\\
&+\frac{1}{3}\left\{\big(k_1'^2+k_1^2\big)\left(Q_{X1}^{\ell}(k_1,k_1')+Q_{X1}^{\ell}(k_1',k_1)-\delta_{\ell0}\frac{1}{2}[F_0(k_1')+F_0(k_1)]\right)+\frac{5}{6}k_1'k_1\delta_{\ell1}[F_0(k_1')+F_0(k_1)]\right.\\
&\left.-2k_1'k_1\frac{1}{2\hat\ell}\left\{(2\ell+3)\big[Q_{X1}^{\ell-1}(k_1,k_1')+Q_{X1}^{\ell-1}(k_1',k_1)\big]+(2\ell-1)\big[Q_{X1}^{\ell+1}(k_1,k_1')+Q_{X1}^{\ell+1}(k_1',k_1)\big]\right\}\right\}\\
&+\sqrt{\frac{35}{3}}\frac{1}{(\ell,2,\ell)}\sum_{j'j}\big\{k_1'^2Q_{W1}^{j'j}(k_1',k_1)+k_1^2Q_{W1}^{j'j}(k_1,k_1')\big\}\hat j'(-1)^j(j'010|j0)(10\ell0|j0)\begin{Bmatrix}1&2&1\\j'&j&\ell\end{Bmatrix}\begin{Bmatrix}2&j'&\ell\\\ell&2&2\end{Bmatrix}(20j'0|\ell0)\\
&+\sqrt{\frac{35}{3}}\frac{1}{(\ell,2,\ell)}\sum_{j'j}\big\{k_1^2Q_{W1}^{\ell j}(k_1',k_1)+k_1'^2Q_{W1}^{\ell j}(k_1,k_1')\big\}\hat j'(-1)^j(\ell010|j0)(10j'0|j0)\begin{Bmatrix}1&2&1\\\ell&j&j'\end{Bmatrix}\begin{Bmatrix}2&j'&\ell\\\ell&2&2\end{Bmatrix}(20j'0|\ell0)\\
&-\sqrt{\frac{35}{2}}\frac{(-1)^\ell}{(\ell,2,\ell)}\sum_{j'jk}2k_1'k_1\big\{Q_{W1}^{j'k}(k_1',k_1)+Q_{W1}^{j'k}(k_1,k_1')\big\}\hat j'\hat j(10j'0|k0)(10j0|k0)\begin{Bmatrix}1&2&1\\j'&k&j\end{Bmatrix}\begin{Bmatrix}1&j'&\ell\\1&j&\ell\\2&2&2\end{Bmatrix}(10j'0|\ell0)(10j0|\ell0)\\
&-\frac{1}{3}\left\{2\big(k_1'^2+k_1^2\big)Q_{W2}^{\ell}(k_1',k_1)-2k_1'k_1\frac{1}{2\hat\ell}\big\{(2\ell+3)Q_{W2}^{\ell-1}(k_1',k_1)+(2\ell-1)Q_{W2}^{\ell+1}(k_1',k_1)\big\}\right\}\\
&-\frac{1}{15\sqrt3}\frac{1}{(\ell,2,\ell)}\sum_{j'j}2k_1'k_1Q_{W2}^{j'j}(k_1',k_1)\sqrt{\hat j'\hat j}(j'0j0|20)\begin{Bmatrix}j'&j&2\\\ell&\ell&1\end{Bmatrix}(10\ell0|j'0)(10\ell0|j0)\\
&-\frac{1}{3}\sqrt{\frac{14}{5}}\frac{1}{(\ell,2,\ell)}\sum_{j}\big\{k_1'^2Q_{W2}^{j\ell}(k_1',k_1)+k_1^2Q_{W2}^{\ell j}(k_1',k_1)\big\}\hat j(j0\ell0|20)\begin{Bmatrix}2&j&\ell\\\ell&2&2\end{Bmatrix}(20j0|\ell0)\\
&\left.+\sqrt{\frac{7}{15}}\frac{1}{(\ell,2,\ell)}\sum_{j'j}2k_1'k_1Q_{W2}^{j'j}(k_1',k_1)\hat j'\hat j(j'0j0|20)\begin{Bmatrix}1&j'&\ell\\1&j&\ell\\2&2&2\end{Bmatrix}(10j'0|\ell0)(10j0|\ell0)\right]
\end{aligned}
\tag{B17}
$$

for $\ell'=\ell=J\pm1$. The notation (j_1,j_2,j_3) stands for an abbreviation of a 3-J symbol of $\begin{pmatrix}j_1&j_2&j_3\\0&0&0\end{pmatrix}$. $\hat\ell$ and z mean $\hat\ell\equiv2\ell+1$ and $z\equiv\frac{k_1'^2+k_1^2+m_\pi^2}{2k_1'k_1}$. Definitions of $F_0,\ F_1,\ Q_{W1}^{\ell},\ Q_{W2}^{\ell}$, and $W_{\ell s,0}$ are found in the original paper as Eqs. (A13), (A14), (B1), (B2), and (B10), respectively. $Q_{W1}^{\ell'\ell}$, $Q_{W2}^{\ell'\ell}$, and Q_{X1}^{ℓ} represent the following integrals involving a second kind of Legendre function Q_ℓ:

$$Q_{W1}^{\ell'\ell}(k_1',k_1)\equiv\frac{1}{(2\pi)^2}\frac{1}{2k_1'}\int_0^{k_F}dk_3k_3Q_{\ell'}(x')Q_\ell(x),\tag{B1}$$

$$Q_{W2}^{\ell'\ell}(k_1',k_1)\equiv\frac{1}{(2\pi)^2}\frac{1}{2k_1'k_1}\int_0^{k_F}dk_3k_3^2Q_{\ell'}(x')Q_\ell(x),\tag{B2}$$

$$Q_{X1}^{\ell}(k_1',k_1)\equiv\frac{\ell}{2\ell+1}Q_{W1}^{\ell\ell-1}(k_1,k_1')+\frac{\ell+1}{2\ell+1}Q_{W1}^{\ell\ell+1}(k_1,k_1'),\tag{B10}$$

where $x'\equiv\frac{k_1'^2+k_3^2+m_\pi^2}{2k_1'k_3}$ and $x\equiv\frac{k_1^2+k_3^2+m_\pi^2}{2k_1k_3}$. $Q_{W1}^{\ell\ell}(k_1',k_1)$ is equal to $Q_{W1}^{\ell}(k_1',k_1)$ defined by Eq. (B5) in the original paper.

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[1] K. Hebeler, S. K. Bogner, R. J. Furnstahl, A. Nogga, and A. Schwenk, Phys. Rev. C **83**, 031301(R) (2011).
[2] K. Minomo, M. Toyokawa, M. Kohno, and M. Yahiro, Phys. Rev. C **90**, 051601 (2014).
[3] M. Toyokawa, M. Yahiro, T. Matsumoto, K. Minomo, K. Ogata, and M. Kohno, Phys. Rev. C **92**, 024618 (2015).
[4] K. Minomo, M. Kohno, and K. Ogata, Phys. Rev. C **93**, 014607 (2016).