Erratum: Effective field theory for double heavy baryons at strong coupling [Phys. Rev. D 102, 014013 (2020)]

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In Sec. IV when discussing the hyperfine splittings for the $l=2$ multiplets, off diagonal terms mixing $j=3/2,5/2$ with $\ell=3/2$ and $\ell=5/2$ were overlooked. To correct this omission the following changes should be made:

(a) The text from Eq. (42) to the end of Sec. 4 should be replaced by:

For $j=1/2$ and $7/2$ the contributions are

$$M^{(1)}_{n\frac{1}{2}2\frac{3}{2}}=\frac{1}{2}\frac{\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}-\frac{1}{3}\frac{\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}-\frac{3}{2}\frac{\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}, \tag{1}$$

$$M^{(1)}_{n\frac{7}{2}2\frac{5}{2}}=\frac{1}{2}\frac{\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}-\frac{2}{21}\frac{\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}+\frac{\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}}{m_Q}. \tag{2}$$

For $j=3/2,5/2$ we have the mixing matrices for $\ell=3/2$ and $\ell=5/2$ states

$$M^{(1)}_{n\frac{3}{2}2}=\frac{1}{m_Q}\begin{pmatrix}\frac{1}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}-\frac{2}{15}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}-\frac{3}{2}\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2} & \frac{3}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{1}{10}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}\\ \frac{3}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{1}{10}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2} & -\frac{7}{10}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{2}{15}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}+\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}\end{pmatrix}, \tag{3}$$

$$M^{(1)}_{n\frac{5}{2}2}=\frac{1}{m_Q}\begin{pmatrix}-\frac{3}{10}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{1}{5}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}-\frac{3}{2}\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2} & \frac{\sqrt{14}}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{1}{15}\sqrt{\frac{7}{2}}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}\\ \frac{\sqrt{14}}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{1}{15}\sqrt{\frac{7}{2}}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2} & -\frac{1}{5}\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\frac{4}{105}\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}+\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}\end{pmatrix}. \tag{4}$$

We diagonalize to obtain the physical masses

$$\begin{aligned}M^{(1)}_{n\frac{3}{2}2\pm}=&-\frac{1}{4m_Q}\Big\{\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}+\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}\pm\frac{1}{3}[81(\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2})^2+4(\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2})^2+225(\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2})^2\\&-6\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}(27\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}-8\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2})]^{1/2}\Big\},\end{aligned} \tag{5}$$

$$\begin{aligned}{}^{n\frac{5}{2}2\pm}_{M}(1)=&-\frac{1}{84m_Q}\Big\{21\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}-10\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}+21\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}\pm[3969(\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2})^2+156(\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2})^2\\&+11025(\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2})^2+126\langle V^{s1}_{(1/2)^{\pm}}\rangle_{n2}(10\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}+7\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2})\\&-1428\langle V^{s2}_{(1/2)^{\pm}}\rangle_{n2}\langle V^{l}_{(1/2)^{\pm}}\rangle_{n2}]^{1/2}\Big\}.\end{aligned} \tag{6}$$

Let us consider the following hyperfine splittings among $l=2$ which are linear in the expectation values of the potentials

$$M_{n\frac{5}{2}2+} + M_{n\frac{5}{2}2-} - M_{n\frac{3}{2}2+} - M_{n\frac{3}{2}2-} = \frac{5}{21m_Q}\langle V^{s2}_{(1/2)^\pm}\rangle_{n2}, \tag{7}$$

$$M_{n\frac{1}{2}2\frac{3}{2}} - \frac{1}{2}(M_{n\frac{3}{2}2+} + M_{n\frac{3}{2}2-}) = \frac{1}{12m_Q}(9\langle V^{s1}_{(1/2)^\pm}\rangle_{n2} - 4\langle V^{s2}_{(1/2)^\pm}\rangle_{n2} - 15\langle V^{l}_{(1/2)^\pm}\rangle_{n2}), \tag{8}$$

$$M_{n\frac{7}{2}2\frac{5}{2}} - \frac{1}{2}(M_{n\frac{3}{2}2+} + M_{n\frac{3}{2}2-}) = \frac{1}{m_Q}\left(\frac{3}{4}\langle V^{s1}_{(1/2)^\pm}\rangle_{n2} - \frac{2}{21}\langle V^{s2}_{(1/2)^\pm}\rangle_{n2} + \frac{5}{4}\langle V^{l}_{(1/2)^\pm}\rangle_{n2}\right). \tag{9}$$

These formulas fix $\langle V^{s1}_{(1/2)^\pm}\rangle_{n2}$, $\langle V^{s2}_{(1/2)^\pm}\rangle_{n2}$ and $\langle V^{l}_{(1/2)^\pm}\rangle_{n2}$ in terms of physical masses. Then, we have the following model-independent predictions

$$M^{(1)}_{n\frac{3}{2}2+} - M^{(1)}_{n\frac{3}{2}2-} = -\frac{1}{6m_Q}[81(\langle V^{s1}_{(1/2)^\pm}\rangle_{n2})^2 + 4(\langle V^{s2}_{(1/2)^\pm}\rangle_{n2})^2 + 225(\langle V^{l}_{(1/2)^\pm}\rangle_{n2})^2 - 6\langle V^{l}_{(1/2)^\pm}\rangle_{n2}(27\langle V^{s1}_{(1/2)^\pm}\rangle_{n2} - 8\langle V^{s2}_{(1/2)^\pm}\rangle_{n2})]^{1/2}, \tag{10}$$

$$M^{(1)}_{n\frac{5}{2}2+} - M^{(1)}_{n\frac{5}{2}2-} = -\frac{1}{42m_Q}[3969(\langle V^{s1}_{(1/2)^\pm}\rangle_{n2})^2 + 156(\langle V^{s2}_{(1/2)^\pm}\rangle_{n2})^2 + 11025(\langle V^{l}_{(1/2)^\pm}\rangle_{n2})^2 + 126\langle V^{s1}_{(1/2)^\pm}\rangle_{n2} \times (10\langle V^{s2}_{(1/2)^\pm}\rangle_{n2} + 7\langle V^{l}_{(1/2)^\pm}\rangle_{n2}) - 1428\langle V^{s2}_{(1/2)^\pm}\rangle_{n2}\langle V^{l}_{(1/2)^\pm}\rangle_{n2}]^{1/2}. \tag{11}$$

(b) In the third paragraph of Sec. V replace the following sentence:
"Both formulas turn out to be fulfilled extremely well, within 2 MeV."
by
"Both formulas are compatible with the lattice masses of Ref. [36]. Recall however that the uncertainties in the masses of the states involved are large."

(c) From Sec. VI (the Conclusions) remove the last sentence of the fifth paragraph:
"The data of Ref. [36] also allows us to check the relations in Eqs. (54) and (55) with agreement under 2 MeV."

Furthermore, the following misprints should also be corrected:

(1) In the second paragraph of the introduction "quark-antiquark duality" should be changed to "quark-diquark duality".
(2) In Eqs. (2), (3), and (4): $q^l(t,\boldsymbol{x}) \to q^l(t,\boldsymbol{R})$ and the P_+ in the left-hand sides should be removed.
(3) In the text below Eq. (4) and above Eq. (5) $q^l_\alpha(t,\boldsymbol{x}) \to q^l_\alpha(t,\boldsymbol{R})$.
(4) In Table 2 the entry for η_P for $\kappa^p = (1/2)^\pm$ and $l = 3$ should read as $\mp$ instead of $\pm$.
(5) In the third line of Sec. 5: $M^*_{\Xi^{++}_{cc}} \to M_{\Xi^*_{cc}}$.
(6) In Eq. (18) replace $\mathcal{O} \to \mathcal{Q}$, remove its dependence on $\boldsymbol{r}$, change the final dot for a comma and add following sentence after it:
"where $\mathcal{Q}_{\kappa^p}$ is the light-quark piece of the interpolating operator $\mathcal{O}_{\kappa^p}$."
(7) Below Eq. (18) replace "$r \gg \Lambda_{\mathrm{QCD}}$" with "$r \gg 1/\Lambda_{\mathrm{QCD}}$".
(8) In Eq. (19) replace "σ_{QQq}" with "σ".