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Tables Useful for the Calculation of the Molecular Integrals VIII

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In Part VIII of this series, we give formulae for the calculation of Coulomb integrals,

$$D_{\alpha\beta\gamma\delta}=(\alpha_a\gamma_a;\ \beta_b\delta_a)=\int\alpha_a(1)^*\beta_b(2)^*\frac{1}{r_{12}}\gamma_a(1)\delta_b(2)d\tau_1d\tau_2$$

and ionic integrals,

$$L_{\alpha\beta\gamma\bar{\delta}}=(\alpha_a\gamma_a;\ \beta_a\delta_b)=\int\alpha_a(1)^*\beta_a(2)^*\frac{1}{\gamma_{12}}\gamma_a(1)\delta_b(2)d\tau_1d\tau_2\,,$$

in the case of homonuclear diatomic molecules. Here α_a, β_a, $\cdots$ are the atomic orbitals with their centres at A and γ_b, δ_b, $\cdots$ are those with their centres at B. Their explicit forms are:

$$h_a(1)=(1s)_a=\sqrt{\frac{\delta_1^3}{\pi}}e^{-\delta_1\tau_{a1}}\,,$$

$$s_a(1)=(2s)_a=\sqrt{\frac{\delta_2^5}{3\pi}}r_{a1}e^{-\delta_2\tau_{a1}}\,,$$

$$\sigma_a(1)=(2p\sigma)_a=\sqrt{\frac{\delta_2^5}{\pi}}r_{a1}\cos\theta_{a1}e^{-\delta_2\tau_{a1}}\,,$$

$$\pi_a(1)=(2p\pi)_a=\sqrt{\frac{\delta_2^5}{\pi}}r_{a1}\sin\theta_{a1}\cos\varphi_1e^{-\delta_2\tau_{a1}}\,,$$

$$\pi_a'(1)=(2p\pi')_a=\sqrt{\frac{\delta_2^5}{\pi}}r_{a1}\sin\theta_{a1}\sin\varphi_1e^{-\delta_2\tau_{a1}}\,.$$

In the above, the coordinate system is chosen as follows; the position of electron is denoted by P, $r_{a1}=\overline{\mathrm{AP}}$, $r_{b1}=\overline{\mathrm{BP}}$, $\theta_{a1}=\angle\mathrm{BAP}$, $\theta_{b1}=\angle\mathrm{ABP}$. For convenience, we use the parameters

$$\alpha=\delta_1\mathrm{R}\,,\qquad\qquad \beta=\delta_2\mathrm{R}\,,$$

$$\gamma=\frac{1}{2}(\alpha+\beta), \qquad \delta=\frac{1}{2}(\alpha-\beta),$$

$$\lambda=\frac{1}{2}(\alpha+3\beta), \qquad \mu=\frac{1}{2}(3\alpha+\beta),$$

where R means internuclear distance $\overline{AB}$.

$D_{\alpha\beta\gamma\delta}$ are expressed in terms of the auxiliary functions,

$$A_n(\alpha)=\int_1^\infty e^{-\alpha\lambda}\lambda^n d\lambda,$$

$$B_n(\alpha)=\int_{-1}^1 e^{-\alpha\mu}\mu^n d\mu,$$

and are given in Table XXV.

$L_{\alpha\beta\gamma\bar{\delta}}$ can be reduced with the use of

$$\boldsymbol{P}_{n,l+\frac{1}{2}}(\kappa,\tau)=\int_0^\infty e^{-\kappa t}p_n(1,t;\tau)t^{l+\frac{1}{2}}dt,$$

$$\boldsymbol{Q}_{n,l+\frac{1}{2}}(\kappa,\tau)=\int_0^\infty e^{-\kappa t}q_n(1,t;\tau)t^{l+\frac{1}{2}}dt,$$

and are given in Table XXVI. Formulae for the calculation of $\boldsymbol{P}_{n,l+\frac{1}{2}}(\kappa,\tau)$ and $\boldsymbol{Q}_{n,l+\frac{1}{2}}(\kappa,\tau)$ are explained in Part VI of this series.[1]

When orbitals α_a and γ_a are both s type (1s or 2s), it is shown that $L_{\alpha\beta\gamma\bar{\delta}}$ can also be expressed in terms of $A_n(\alpha)$ and $B_n(\alpha)$. Since $A_n(\alpha)$ and $B_n(\alpha)$ can be calculated much more easily than $\boldsymbol{P}_{n,l+\frac{1}{2}}(\kappa,\tau)$ and $\boldsymbol{Q}_{n,l+\frac{1}{2}}(\kappa,\tau)$, we shall give in Table XXVII formulae of ionic integrals $L_{\alpha\beta\gamma\bar{\delta}}$ of this sort expressed in terms of $A_n(\alpha)$ and $B_n(\alpha)$.

Although expressions for $D_{\alpha\beta\gamma\delta}$ and $L_{\alpha\beta\gamma\bar{\delta}}$ are already given by many authors[2)-6)] in different forms and each has its own merits and demerits, we believe that our scheme will prove its usefulness among the others.

Errata to Part VI[1] and VII[7]

Part VI	Page	Line	Column			
	57	21	2	*3*	−1	
	58	4	4–6	(0,26.50)	(0,*2800.*)	(0,35.50)

Part VII

Reprint cover 1 .... Calculation of the Molecular

2 .... Integrals

4 *E*iichi Ishiguro

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Table XXV. Formulae for Coulomb Integrals $D_{\alpha\beta\gamma\delta}$ *

$$D_{hhhh}=\frac{1}{R}\left[R\times K_{hh}-\frac{\alpha^3}{6}\left\{6A_1(2\alpha)+\alpha\left(3A_2(2\alpha)-A_0(2\alpha)\right)\right\}\right]$$

$$D_{hhhs}=\frac{1}{R}\left[R\times K_{hs}-\frac{1}{4}\left(\frac{\alpha^3\beta^5}{3}\right)^{\frac{1}{2}}\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$P=A_2(\mu)B_0(\delta)-2A_1(\mu)B_1(\delta)+A_0(\mu)B_2(\delta)$$

$$Q=A_3(\mu)B_0(\delta)-A_2(\mu)B_1(\delta)-A_1(\mu)B_2(\delta)+A_0(\mu)B_3(\delta)$$

$$D_{hhh\sigma}=\frac{1}{R}\left[R\times K_{h\sigma}-\frac{1}{4}(\alpha^3\beta^5)^{\frac{1}{2}}\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$\begin{cases}P=A_1(\mu)B_0(\delta)-A_0(\mu)B_1(\delta)-A_2(\mu)B_1(\delta)+A_1(\mu)B_2(\delta)\\ Q=A_2(\mu)B_0(\delta)-A_0(\mu)B_2(\delta)-A_3(\mu)B_1(\delta)+A_1(\mu)B_3(\delta)\end{cases}$$

$$D_{hshs}=\frac{1}{R}\left[R\times K_{ss}-\frac{1}{24}\beta^5\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$\begin{cases}P=A_3(2\gamma)B_0(2\delta)-3A_2(2\gamma)B_1(2\delta)+3A_1(2\gamma)B_2(2\delta)-A_0(2\gamma)B_3(2\delta)\\ Q=A_4(2\gamma)B_0(2\delta)-2A_3(2\gamma)B_1(2\delta)+2A_1(2\gamma)B_3(2\delta)-A_0(2\gamma)B_4(2\delta)\end{cases}$$

$$D_{hsh\sigma}=\frac{1}{R}\left[R\times K_{s\sigma}-\frac{1}{8\sqrt{3}}\beta^5\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$\begin{cases}P=A_2(2\gamma)B_0(2\delta)-2A_1(2\gamma)B_1(2\delta)+A_0(2\gamma)B_2(2\delta)-A_3(2\gamma)B_1(2\delta)+2A_2(2\gamma)B_2(2\delta)\\ \quad -A_1(2\gamma)B_3(2\delta)\\ Q=A_3(2\gamma)B_0(2\delta)-A_2(2\gamma)B_1(2\delta)-A_1(2\gamma)B_2(2\delta)+A_0(2\gamma)B_3(2\delta)-A_4(2\gamma)B_1(2\delta)+A_3(2\gamma)B_2(2\delta)\\ \quad +A_2(2\gamma)B_3(2\delta)-A_1(2\gamma)B_4(2\delta)\end{cases}$$

$$D_{h\sigma h\sigma}=\frac{1}{R}\left[R\times K_{\sigma\sigma}-\frac{1}{8}\beta^5\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$\begin{cases}P=A_1(2\gamma)B_0(2\delta)-A_0(2\gamma)B_1(2\delta)-2A_2(2\gamma)B_1(2\delta)+2A_1(2\gamma)B_2(2\delta)+A_3(2\gamma)B_2(2\delta)\\ \quad -A_2(2\gamma)B_3(2\delta)\\ Q=A_2(2\gamma)B_0(2\delta)-A_0(2\gamma)B_2(2\delta)-2A_3(2\gamma)B_1(2\delta)+2A_1(2\gamma)B_3(2\delta)+A_4(2\gamma)B_2(2\delta)\\ \quad -A_2(2\gamma)B_4(2\delta)\end{cases}$$

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* In the following $K_{\alpha\beta}$ is defined by $\int\alpha_a(1)^*\frac{1}{\gamma_{b1}}\beta_a(1)d\tau_1$. Formulae for $K_{\alpha\beta}$ are given in Ref. 6).

$$D_{h\pi h\pi}=\frac{3}{2}D_{hshs}-\frac{1}{2}D_{h\sigma h\sigma}=\frac{1}{R}\left[R\times K_{\pi\pi}-\frac{1}{16}\beta^5\left(P+\frac{\alpha}{2}Q\right)\right]$$

$$\begin{cases}P=A_3(2\gamma)B_0(2\delta)-A_3(2\gamma)B_2(2\delta)-A_1(2\gamma)B_0(2\delta)+A_1(2\gamma)B_2(2\delta)-A_0(2\gamma)B_3(2\delta)+A_0(2\gamma)B_1(2\delta)\\ \quad +A_2(2\gamma)B_3(2\delta)-A_2(2\gamma)B_1(2\delta)\\ Q=A_4(2\gamma)B_0(2\delta)-A_0(2\gamma)B_4(2\delta)-A_2(2\gamma)B_0(2\delta)+A_0(2\gamma)B_2(2\delta)-A_4(2\gamma)B_2(2\delta)+A_2(2\gamma)B_4(2\delta)\end{cases}$$

$$D_{hhss}=\frac{1}{R}\left[R\times\frac{\sqrt{3}}{2}\frac{(\alpha^3\beta^5)^{\frac{1}{2}}}{\gamma^4}K_{hs}-\frac{\alpha^3\beta^5}{360\gamma^4}(30P+20\gamma Q+\gamma^2U)\right]$$

$$\begin{cases}P=3A_2(2\gamma)+A_0(2\gamma)\\ Q=3A_3(2\gamma)-A_1(2\gamma)\\ U=15A_4(2\gamma)-10A_2(2\gamma)+3A_0(2\gamma)\end{cases}$$

$$D_{hhs\sigma}=\frac{1}{R}\left[R\times\frac{\sqrt{3}}{2}\frac{(\alpha^3\beta^5)^{\frac{1}{2}}}{\gamma^4}K_{h\sigma}-\frac{\sqrt{3}\alpha^3\beta^5}{180\gamma^4}(60P+10\gamma Q+\gamma^2U)\right]$$

$$\begin{cases}P=A_1(2\gamma)\\ Q=3A_2(2\gamma)-A_0(2\gamma)\\ U=5A_3(2\gamma)-A_1(2\gamma)\end{cases}$$

$$D_{hh\sigma\sigma}=\frac{1}{R}\frac{\alpha^3\beta^5}{3\gamma^5}\left[I-\left\{P+\gamma Q+\frac{\gamma^2}{2}U+\frac{\gamma^3}{8}V\right\}\right]$$

$$\begin{cases}I-P-\gamma Q=2\left\{\frac{3}{\gamma^5}-e^{-2\gamma}-4A_4(2\gamma)-A_1(2\gamma)\right\}\\ U=3A_1(2\gamma)-A_3(2\gamma)\\ V=\frac{1}{5}\{-5A_4(2\gamma)+18A_2(2\gamma)-5A_0(2\gamma)\}\end{cases}$$

$$D_{hsss}=\frac{1}{R}\left[R\times\frac{\sqrt{3}(\alpha^3\alpha^5)^{\frac{1}{2}}}{2\gamma^4}K_{ss}-\frac{(\alpha^3\beta^{15})^{\frac{1}{2}}}{16\sqrt{3}\gamma^4}\left\{P+\frac{2}{3}\gamma Q+\frac{\gamma^2}{6}U\right\}\right]$$

$$\begin{cases}P=A_3(\lambda)B_0(\delta)-3A_2(\lambda)B_1(\delta)+3A_1(\lambda)B_2(\delta)-A_0(\lambda)B_3(\delta)\\ Q=A_4(\lambda)B_0(\delta)-2A_3(\lambda)B_1(\delta)+2A_1(\lambda)B_3(\delta)-A_0(\lambda)B_4(\delta)\\ U=A_5(\lambda)B_0(\delta)-A_4(\lambda)B_1(\delta)-2A_3(\lambda)B_2(\delta)+2A_2(\lambda)B_3(\delta)+A_1(\lambda)B_4(\delta)-A_0(\lambda)B_5(\delta)\end{cases}$$

$$D_{hss\sigma}=\frac{1}{R}\left[R\times\frac{\sqrt{3}(\alpha^3\beta^5)^{\frac{1}{2}}}{2\gamma^4}K_{s\sigma}-\frac{(\alpha^3\beta^{15})^{\frac{1}{2}}}{16\gamma^4}\left\{P+\frac{2}{3}\gamma Q+\frac{\gamma^2}{6}U\right\}\right]$$

$$\begin{cases}P=A_2(\lambda)B_0(\delta)-2A_1(\lambda)B_1(\delta)+A_0(\lambda)B_2(\delta)-A_3(\lambda)B_1(\delta)+2A_2(\lambda)B_2(\delta)-A_1(\lambda)B_3(\delta)\\ Q=A_3(\lambda)B_0(\delta)-A_2(\lambda)B_1(\delta)-A_1(\lambda)B_2(\delta)+A_0(\lambda)B_3(\delta)-A_4(\lambda)B_1(\delta)+A_3(\lambda)B_2(\delta)+A_2(\lambda)B_3(\delta)\\ \quad -A_1(\lambda)B_4(\delta)\\ U=A_4(\lambda)B_0(\delta)-2A_2(\lambda)B_2(\delta)+A_0(\lambda)B_4(\delta)-A_5(\lambda)B_1(\delta)+2A_3(\lambda)B_3(\delta)-A_1(\lambda)B_5(\delta)\end{cases}$$

$$D_{h\sigma s\sigma}=\frac{1}{R}\left[R\times\frac{\sqrt{3}(\alpha^3\beta^5)^{\frac{1}{2}}}{2\gamma^4}K_{\sigma\sigma}-\frac{\sqrt{3}}{16\gamma^4}(\alpha^3\beta^{15})^{\frac{1}{2}}\left\{P+\frac{2}{3}\gamma Q+\frac{\gamma^2}{6}U\right\}\right]$$

$$\begin{cases}P=A_1(\lambda)B_0(\delta)-A_0(\lambda)B_1(\delta)-2A_2(\lambda)B_1(\delta)+2A_1(\lambda)B_2(\delta)+A_3(\lambda)B_2(\delta)-A_2(\lambda)B_3(\delta)\\ Q=A_2(\lambda)B_0(\delta)-A_0(\lambda)B_2(\delta)-2A_3(\lambda)B_1(\delta)+2A_1(\lambda)B_3(\delta)+A_4(\lambda)B_2(\delta)-A_2(\lambda)B_4(\delta)\\ U=A_3(\lambda)B_0(\delta)+A_2(\lambda)B_1(\delta)-A_1(\lambda)B_2(\delta)-A_0(\lambda)B_3(\delta)-2A_4(\lambda)B_1(\delta)+2A_1(\lambda)B_4(\delta)\\ \quad -2A_3(\lambda)B_2(\delta)+2A_2(\lambda)B_3(\delta)+A_5(\lambda)B_2(\delta)+A_4(\lambda)B_3(\delta)-A_3(\lambda)B_4(\delta)-A_2(\lambda)B_5(\delta)\end{cases}$$

$$D_{h\pi s\pi}=\frac{3}{2}D_{hsss}-\frac{1}{2}D_{h\sigma s\sigma}=\frac{1}{R}\left[R\times\frac{\sqrt{3}}{2\gamma^4}(\alpha^3\beta^5)^{\frac{1}{2}}K_{\pi\pi}-\frac{\sqrt{3}}{32\gamma^4}(\alpha^3\beta^{15})^{\frac{1}{2}}\left\{P+\frac{2}{3}\gamma Q+\frac{\gamma^2}{6}U\right\}\right]$$

$$\begin{cases}P=A_3(\lambda)B_0(\delta)-A_3(\lambda)B_2(\delta)-A_1(\lambda)B_0(\delta)+A_1(\lambda)B_2(\delta)-A_0(\lambda)B_3(\delta)+A_0(\lambda)B_1(\delta)+A_2(\lambda)B_3(\delta)\\ \quad -A_2(\lambda)B_1(\delta)\\ Q=A_4(\lambda)B_0(\delta)-A_0(\lambda)B_4(\delta)-A_2(\lambda)B_0(\delta)+A_0(\lambda)B_2(\delta)-A_4(\lambda)B_2(\delta)+A_2(\lambda)B_4(\delta)\end{cases}$$

$$\left|\begin{aligned}U=&A_5(\lambda)B_0(\delta)-A_0(\lambda)B_5(\delta)+A_4(\lambda)B_1(\delta)-A_1(\lambda)B_4(\delta)-A_3(\lambda)B_0(\delta)+A_0(\lambda)B_3(\delta)-A_2(\lambda)B_1(\delta)\\&+A_1(\lambda)B_2(\delta)-A_5(\lambda)B_2(\delta)+A_2(\lambda)B_5(\delta)-A_4(\lambda)B_3(\delta)+A_3(\lambda)B_4(\delta)\end{aligned}\right.$$

$$D_{hs\sigma s}=\frac{1}{R}\left[R\times K_{h\sigma}-\frac{1}{4}(\alpha^3\beta^5)^{\frac{1}{2}}\left\{P+\frac{3}{4}\beta Q+\frac{1}{4}\beta^2U+\frac{1}{24}\beta^3V\right\}\right]$$

$$\left\{\begin{aligned}P=&A_1(\lambda)B_0(\delta)+A_0(\lambda)B_1(\delta)+A_2(\lambda)B_1(\delta)+A_1(\lambda)B_2(\delta)\\Q=&A_2(\lambda)B_0(\delta)-A_0(\lambda)B_2(\delta)+A_3(\lambda)B_1(\delta)-A_1(\lambda)B_3(\delta)\\U=&A_3(\lambda)B_0(\delta)-A_1(\lambda)B_2(\delta)-A_2(\lambda)B_1(\delta)+A_0(\lambda)B_3(\delta)+A_4(\lambda)B_1(\delta)-A_2(\lambda)B_3(\delta)-A_3(\lambda)B_2(\delta)\\&+A_1(\lambda)B_4(\delta)\\V=&A_4(\lambda)B_0(\delta)-2A_3(\lambda)B_1(\delta)+2A_1(\lambda)B_3(\delta)-A_0(\lambda)B_4(\delta)+A_5(\lambda)B_1(\delta)-2A_4(\lambda)B_2(\delta)\\&+2A_2(\lambda)B_4(\delta)-A_1(\lambda)B_5(\delta)\end{aligned}\right.$$

$$D_{hs\sigma\sigma}=\frac{1}{R}\,\frac{5}{4\sqrt{3}}(\alpha^3\beta^5)^{\frac{1}{2}}\left[I-\left\{P+\beta Q+\frac{1}{2}\beta^2U+\frac{3}{20}\beta^3V+\frac{1}{40}\beta^4W\right\}\right]$$

$$\left\{\begin{aligned}I=&\frac{4}{\gamma^5}-\frac{8}{3}\{2A_4(2\gamma)+A_1(2\gamma)\}\\P+\beta Q=&\left\{\frac{1}{\lambda^3}+\frac{1}{\delta^3}-4A_2(2\delta)\right\}e^{-2\beta}-4A_2(2\lambda)e^{+2\beta}+A_2(\lambda)B_1(\delta)+A_1(\lambda)B_2(\delta)\\U=&A_1(\lambda)B_0(\delta)+A_0(\lambda)B_1(\delta)-A_3(\lambda)B_2(\delta)-A_2(\lambda)B_3(\delta)\\V=&A_2(\lambda)B_0(\delta)-A_0(\lambda)B_2(\delta)-A_4(\lambda)B_2(\delta)+A_2(\lambda)B_4(\delta)\\W=&A_3(\lambda)B_0(\delta)-A_2(\lambda)B_1(\delta)-A_1(\lambda)B_2(\delta)+A_0(\lambda)B_3(\delta)-A_5(\lambda)B_2(\delta)+A_4(\lambda)B_3(\delta)+A_3(\lambda)B_4(\delta)\\&-A_2(\lambda)B_5(\delta)\end{aligned}\right.$$

$$D_{h\sigma\sigma\sigma}=\frac{1}{R}\,\frac{1}{4\gamma^5}(\alpha^3\beta^{15})^{\frac{1}{2}}\left[I-\left\{P+\gamma Q+\frac{\gamma^2}{2}U+\frac{\gamma^3}{8}V\right\}\right]$$

$$\left\{\begin{aligned}I=&\frac{36}{\beta^7}+\frac{4}{\beta^5}-\frac{16}{15}\{6A_6(2\beta)+5A_4(2\beta)+4A_1(2\beta)\}\\P+\gamma Q=&\left\{-\frac{3}{\lambda^4}+\frac{3}{\delta^4}-8A_3(2\delta)-8B_3(2\delta)\right\}e^{-2\gamma}-8A_3(2\lambda)e^{2\gamma}\\&+\frac{1}{2}\{3A_3(\lambda)B_2(\delta)-2A_2(\lambda)B_1(\delta)-A_1(\lambda)B_0(\delta)-3A_2(\lambda)B_3(\delta)+2A_1(\lambda)B_2(\delta)+A_0(\lambda)B_1(\delta)\}\\U=&A_1(\lambda)B_0(\delta)-A_0(\lambda)B_1(\delta)-A_2(\lambda)B_1(\delta)+A_1(\lambda)B_2(\delta)-A_3(\lambda)B_2(\delta)+A_2(\lambda)B_3(\delta)+A_4(\lambda)B_3(\delta)\\&-A_3(\lambda)B_4(\delta)\\V=&A_2(\lambda)B_0(\delta)-A_0(\lambda)B_2(\delta)-A_3(\lambda)B_1(\delta)+A_1(\lambda)B_3(\delta)-A_4(\lambda)B_2(\delta)+A_2(\lambda)B_4(\delta)+A_5(\lambda)B_3(\delta)\\&-A_3(\lambda)B_5(\delta)\end{aligned}\right.$$

$$D_{h\pi\sigma\pi}=\frac{3}{2}D_{hs\sigma s}-\frac{1}{2}D_{h\sigma\sigma\sigma}$$

$$D_{hh\pi\pi}=\frac{1}{R}\,\frac{\alpha^3\beta^5}{3\gamma^5}\left[I-\left\{P+\gamma Q+\frac{\gamma^2}{2}U+\frac{\gamma^3}{8}V\right\}\right]$$

$$\left\{\begin{aligned}I-P-\gamma Q=&\frac{3}{\gamma^5}-4A_4(2\gamma)+2A_1(2\gamma)\\U=&A_3(2\gamma)-A_1(2\gamma)\\V=&\frac{1}{5}\{5A_4(2\gamma)-6A_2(2\gamma)+A_0(2\gamma)\}\end{aligned}\right.$$

$$D_{hs\pi\pi}=\frac{1}{R}\,\frac{(\alpha^3\beta^{15})^{\frac{1}{2}}}{8\sqrt{3}\,\gamma^5}\left[I-\left\{P+\gamma Q+\frac{\gamma^2}{2}U+\frac{\gamma^3}{8}V\right\}\right]$$

$$\left\{\begin{aligned}I=&\frac{20}{\beta^5}-\frac{32}{3}\{A_5(2\beta)-A_2(2\beta)\}\\P+\gamma Q=&2A_2(\lambda)B_2(\delta)-2A_1(\lambda)B_1(\delta)-A_3(\lambda)B_1(\delta)-A_1(\lambda)B_3(\delta)+A_2(\lambda)B_0(\delta)+A_0(\lambda)B_2(\delta)\end{aligned}\right.$$

$$\begin{cases} U=A_4(\lambda)B_0(\delta)+A_0(\lambda)B_4(\delta)-A_2(\lambda)B_0(\delta)-A_0(\lambda)B_2(\delta)-A_4(\lambda)B_2(\delta)-A_2(\lambda)B_4(\delta) \\ \quad +2\{A_1(\lambda)B_1(\delta)+A_2(\lambda)B_2(\delta)+A_3(\lambda)B_3(\delta)-A_3(\lambda)B_1(\delta)-A_1(\lambda)B_3(\delta)\} \\ V=A_5(\lambda)B_0(\delta)+A_0(\lambda)B_5(\delta)-A_3(\lambda)B_0(\delta)-A_0(\lambda)B_3(\delta)-A_5(\lambda)B_2(\delta)-A_2(\lambda)B_5(\delta) \\ \quad -A_1(\lambda)B_4(\delta)-A_4(\lambda)B_1(\delta)+A_1(\lambda)B_2(\delta)+A_2(\lambda)B_1(\delta)+A_3(\lambda)B_4(\delta)+A_4(\lambda)B_3(\delta) \end{cases}$$

$$D_{h\sigma\pi\pi}=\frac{1}{R}\frac{(\alpha^3\beta^{15})^{\frac{1}{2}}}{8\gamma^5}\left[I-\left\{P+\gamma Q+\frac{\gamma^2}{2}U+\frac{\gamma^3}{8}V\right\}\right]$$

$$\begin{cases} I=\dfrac{36}{\beta^7}-\dfrac{32}{5}\{A_6(2\beta)-A_1(2\beta)\} \\ P+\gamma Q=\dfrac{1}{2}\{3A_1(\lambda)B_0(\delta)-A_3(\lambda)B_0(\delta)-3A_0(\lambda)B_1(\delta)-3A_2(\lambda)B_1(\delta)+3A_3(\lambda)B_2(\delta) \\ \quad +3A_1(\lambda)B_2(\delta)-3A_2(\lambda)B_3(\delta)+A_0(\lambda)B_3(\delta)\} \\ U=A_3(\lambda)B_0(\delta)-A_1(\lambda)B_0(\delta)-A_4(\lambda)B_1(\delta)+A_4(\lambda)B_3(\delta)-A_0(\lambda)B_3(\delta)+A_0(\lambda)B_1(\delta)+A_1(\lambda)B_4(\delta) \\ \quad -A_3(\lambda)B_4(\delta) \\ V=A_4(\lambda)B_0(\delta)-A_2(\lambda)B_0(\delta)-A_4(\lambda)B_2(\delta)-A_5(\lambda)B_1(\delta)+A_3(\lambda)B_1(\delta)+A_5(\lambda)B_3(\delta)-A_0(\lambda)B_4(\delta) \\ \quad +A_0(\lambda)B_2(\delta)+A_2(\lambda)B_4(\delta)+A_1(\lambda)B_5(\delta)-A_1(\lambda)B_3(\delta)-A_3(\lambda)B_5(\delta) \end{cases}$$

Table XXVI. Formulae for Ionic Integrals $L_{\alpha\beta\gamma\bar{\delta}}$ in terms of $\boldsymbol{P}_{n,l+\frac{1}{2}}(\kappa,\tau)$ and $\boldsymbol{Q}_{n,l+\frac{1}{2}}(\kappa,\tau)$

$$L_{hhh\bar{h}}=\frac{1}{R}4\alpha^{\frac{1}{2}}\left[\boldsymbol{P}_{0,\frac{1}{2}}(1,\alpha)-\left\{\boldsymbol{P}_{0,\frac{1}{2}}(3,\alpha)+\boldsymbol{P}_{0,\frac{3}{2}}(3,\alpha)\right\}\right]$$

$$L_{hhh\bar{s}}=\frac{1}{R}\frac{4}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\left[\boldsymbol{Q}_{0,\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\boldsymbol{Q}_{0,\frac{1}{2}}\left(\frac{3\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{Q}_{0,\frac{3}{2}}\left(\frac{3\alpha}{\beta},\beta\right)\right]$$

$$L_{hshh\bar{h}}=\frac{1}{R}\frac{4}{\sqrt{3}}\frac{\beta^{\frac{5}{2}}}{\alpha^2}\left[\boldsymbol{P}_{0,\frac{3}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\boldsymbol{P}_{0,\frac{3}{2}}\left(2+\frac{\beta}{\alpha},\alpha\right)-\boldsymbol{P}_{0,\frac{5}{2}}\left(2+\frac{\beta}{\alpha},\alpha\right)\right]$$

$$\begin{aligned} L_{hhh\bar{\sigma}}=\frac{1}{R}\Bigg[&4\alpha^{\frac{3}{2}}\left\{\boldsymbol{P}_{0,\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\boldsymbol{P}_{0,\frac{1}{2}}\left(\frac{3\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{0,\frac{3}{2}}\left(3\frac{\alpha}{\beta},\beta\right)\right\} \\ &-4\frac{\alpha^{\frac{3}{2}}}{\beta}\left\{\boldsymbol{P}_{1,\frac{3}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\boldsymbol{P}_{1,\frac{3}{2}}\left(3\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{1,\frac{5}{2}}\left(3\frac{\alpha}{\beta},\beta\right)\right\}\Bigg] \end{aligned}$$

$$L_{h\sigma h\bar{h}}=\frac{1}{R}4\frac{\beta^{\frac{5}{2}}}{\alpha^2}\left[\boldsymbol{P}_{1,\frac{3}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\boldsymbol{P}_{1,\frac{3}{2}}\left(\frac{\beta}{\alpha}+2,\alpha\right)-\boldsymbol{P}_{1,\frac{5}{2}}\left(\frac{\beta}{\alpha}+2,\alpha\right)\right]$$

$$L_{hsh\bar{s}}=\frac{1}{R}\frac{4}{3}\beta^{\frac{1}{2}}\left[\boldsymbol{Q}_{0,\frac{3}{2}}\left(1,\beta\right)-\boldsymbol{Q}_{0,\frac{3}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{Q}_{0,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right]$$

$$\begin{aligned} L_{hsh\bar{\sigma}}=\frac{1}{R}\frac{4}{\sqrt{3}}\beta^{\frac{1}{2}}\Bigg[&\beta\left\{\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-\boldsymbol{P}_{0,\frac{3}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{0,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right\} \\ &-\left\{\boldsymbol{P}_{1,\frac{5}{2}}(1,\beta)-\boldsymbol{P}_{1,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{1,\frac{7}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right\}\Bigg] \end{aligned}$$

$$L_{h\sigma h\bar{s}}=\frac{1}{R}\frac{4}{\sqrt{3}}\beta^{\frac{1}{2}}\left[\boldsymbol{Q}_{1,\frac{3}{2}}(1,\beta)-\boldsymbol{Q}_{1,\frac{3}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{Q}_{1,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right]$$

$$\begin{aligned} L_{h\sigma h\bar{\sigma}}=\frac{1}{R}\Bigg[&4\beta^{\frac{3}{2}}\left\{\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\boldsymbol{P}_{1,\frac{3}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{1,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right\} \\ &-\frac{4}{3}\beta^{\frac{1}{2}}\left\{\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\boldsymbol{P}_{0,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{0,\frac{7}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right\} \\ &-\frac{8}{3}\beta^{\frac{1}{2}}\left\{\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)-\boldsymbol{P}_{2,\frac{5}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)-\frac{\alpha}{\beta}\boldsymbol{P}_{2,\frac{7}{2}}\left(1+2\frac{\alpha}{\beta},\beta\right)\right\}\Bigg] \end{aligned}$$

$$L_{h\pi h\bar{\pi}}=\frac{1}{R}\frac{4}{3}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\frac{\alpha}{\beta}\boldsymbol{P}_{0,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)-\boldsymbol{P}_{0,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)-\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)$$
$$+\frac{\alpha}{\beta}\boldsymbol{P}_{2,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+\boldsymbol{P}_{2,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big]$$

$$L_{h h s\bar{h}}=\frac{1}{R}\frac{16}{\sqrt{3}}\frac{\alpha^2\beta^{\frac{5}{2}}}{(2\gamma)^4}\Big[6\boldsymbol{P}_{0,\frac{1}{2}}(1,\alpha)-6\boldsymbol{P}_{0,\frac{1}{2}}\Big(2+\frac{\beta}{\alpha},\alpha\Big)-4\Big(\frac{2\gamma}{\alpha}\Big)\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\beta}{\alpha},\alpha\Big)$$
$$-\Big(\frac{2\gamma}{\alpha}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\beta}{\alpha},\alpha\Big)\Big]$$

$$L_{h h s\bar{s}}=\frac{1}{R}\frac{16}{3}\frac{\alpha^3\beta^{\frac{3}{2}}}{(2\gamma)^4}\Big[6\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-6\boldsymbol{Q}_{0,\frac{1}{2}}\Big(1+\frac{2\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{Q}_{0,\frac{3}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{0,\frac{5}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)\Big]$$

$$L_{h s s\bar{h}}=\frac{1}{R}\frac{16}{3}\frac{\alpha^{-\frac{1}{2}}\beta^{\frac{7}{2}}}{(2\gamma)^4}\Big[6\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-6\boldsymbol{P}_{0,\frac{3}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)-4\frac{2\gamma}{\alpha}\boldsymbol{P}_{0,\frac{5}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)$$
$$-\Big(\frac{2\gamma}{\alpha}\Big)^2\boldsymbol{P}_{0,\frac{7}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)\Big]$$

$$L_{h h s\bar{\sigma}}=\frac{1}{R}\frac{16}{\sqrt{3}}\frac{\alpha^3\beta^{\frac{3}{2}}}{(2\gamma)^4}\Big[\beta\Big\{6\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-6\boldsymbol{P}_{0,\frac{1}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{3}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)\Big\}-\Big\{6\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-6\boldsymbol{P}_{1,\frac{3}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{1,\frac{5}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(1+2\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{h\sigma s\bar{h}}=\frac{1}{R}\frac{16}{\sqrt{3}}\frac{\alpha^{-\frac{1}{2}}\beta^{\frac{7}{2}}}{(2\gamma)^4}\Big[6\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-6\boldsymbol{P}_{1,\frac{3}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)-4\frac{2\gamma}{\alpha}\boldsymbol{P}_{1,\frac{5}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)$$
$$-\Big(\frac{2\gamma}{\alpha}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)\Big]$$

$$L_{h s s\bar{s}}=\frac{1}{R}\frac{16}{\sqrt{27}}\frac{\alpha^{\frac{3}{2}}\beta^3}{(2\gamma)^4}\Big[6\boldsymbol{Q}_{0,\frac{3}{2}}(1,\beta)-6\boldsymbol{Q}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{Q}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big]$$

$$L_{h s s\bar{\sigma}}=\frac{1}{R}\frac{16}{3}\frac{\alpha^{\frac{3}{2}}\beta^3}{(2\gamma)^4}\Big[\beta\Big\{6\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-6\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}-\Big\{6\boldsymbol{P}_{1,\frac{5}{2}}(1,\beta)-6\boldsymbol{P}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-4\frac{2\gamma}{\beta}\boldsymbol{P}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{h\sigma s\bar{s}}=\frac{1}{R}\frac{16}{3}\frac{\alpha^{\frac{3}{2}}\beta^3}{(2\gamma)^4}\Big[6\boldsymbol{Q}_{1,\frac{3}{2}}(1,\beta)-6\boldsymbol{Q}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{Q}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big]$$

$$L_{h\sigma s\bar{\sigma}}=\frac{1}{R}\frac{16}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^3}{(2\gamma)^4}\Big[\beta\Big\{6\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-6\boldsymbol{P}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}-\frac{1}{3}\Big\{6\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-6\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}-\frac{2}{3}\Big\{6\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)-6\boldsymbol{P}_{2,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-4\frac{2\gamma}{\beta}\boldsymbol{P}_{2,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{h\pi s\bar{\pi}}=\frac{1}{R}\frac{16}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^{3}}{(2\gamma)^{4}}\Big[6P_{0,\frac{5}{2}}(1,\beta)-\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{2}P_{0,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\frac{2\gamma}{\beta}P_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+6P_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}-6P_{2,\frac{5}{2}}(1,\beta)+\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{2}P_{2,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\frac{2\gamma}{\beta}P_{2,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+6P_{2,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{h\hbar\sigma\bar{h}}=\frac{1}{R}128\frac{\alpha^{3}\beta^{\frac{5}{2}}}{(2\gamma)^{5}}\Big[P_{1,-\frac{1}{2}}(1,\alpha)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^{3}P_{1,\frac{5}{2}}\Big(1+\frac{2\gamma}{\alpha},\alpha\Big)+4\Big(\frac{2\gamma}{\alpha}\Big)^{2}P_{1,\frac{3}{2}}\Big(1+\frac{2\gamma}{\alpha},\alpha\Big)$$
$$+8\frac{2\gamma}{\alpha}P_{1,\frac{1}{2}}\Big(1+\frac{2\gamma}{\alpha},\alpha\Big)+8P_{1,-\frac{1}{2}}\Big(1+\frac{2\gamma}{\alpha},\alpha\Big)\Big\}\Big]$$

$$L_{h\hbar\sigma\bar{s}}=\frac{1}{R}\frac{128}{\sqrt{3}}\frac{\alpha^{3}\beta^{\frac{5}{2}}}{(2\gamma)^{5}}\Big[Q_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}Q_{1,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\ \beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^{2}Q_{1,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+8\frac{2\gamma}{\beta}Q_{1,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8Q_{1,-\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}\Big]$$

$$L_{hs\sigma\bar{h}}=\frac{1}{R}\frac{128}{\sqrt{3}}\frac{\alpha^{\frac{1}{2}}\beta^{5}}{(2\gamma)^{5}}\Big[P_{1,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^{3}P_{1,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+4\Big(\frac{2\gamma}{\alpha}\Big)^{2}P_{1,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$
$$+8\frac{2\gamma}{\alpha}P_{1,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8P_{1,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]$$

$$L_{h\hbar\sigma\bar{\sigma}}=\frac{1}{R}\Big[128\frac{\alpha^{3}\beta^{\frac{7}{2}}}{(2\gamma)^{5}}\Big[P_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}P_{1,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^{2}P_{1,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)P_{1,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8P_{1,-\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}\Big]$$
$$-\frac{128}{3}\frac{\alpha^{3}\alpha^{\frac{5}{2}}}{(2\gamma)^{5}}\Big[P_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}P_{0,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^{2}P_{0,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)P_{0,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8P_{0,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}+2P_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{4}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}P_{2,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^{2}P_{2,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)P_{2,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8P_{2,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}\Big]\Big]$$

$$L_{h\sigma\sigma\bar{h}}=\frac{1}{R}\Big[\frac{128}{3}\frac{\alpha^{\frac{1}{2}}\beta^{5}}{(2\gamma)^{5}}\Big[P_{0,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^{3}P_{0\,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+4\Big(\frac{2\gamma}{\alpha}\Big)^{2}P_{0,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$
$$+8\frac{2\gamma}{\alpha}P_{0,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8P_{0,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]$$
$$+\frac{256}{3}\frac{\alpha^{\frac{1}{2}}\beta^{5}}{(2\gamma)^{5}}\Big[P_{2,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^{3}P_{2,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+4\Big(\frac{2\gamma}{\alpha}\Big)^{2}P_{2,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$
$$+8\frac{2\gamma}{\alpha}P_{2,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8P_{2,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]\Big]$$

$$L_{hs\sigma\bar{s}}=\frac{1}{R}\frac{128}{3}\frac{\alpha^{\frac{3}{2}}\beta^{4}}{(2\gamma)^{5}}\Big[Q_{1,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}Q_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^{2}Q_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)Q_{1\,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8Q_{1,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{hs\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{128}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^{5}}{(2\gamma)^{5}}\Big[P_{1,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^{3}P_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^{3}P_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)P_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8P_{1,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$-\frac{128}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0\ \frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}+2\boldsymbol{P}_{2,\frac{3}{2}}(1,\beta)-\frac{1}{4}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{2,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{2,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{2,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]\Big]$$

$$L_{h\,\sigma\,\sigma\,\bar{s}}=\frac{1}{R}\frac{128}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{Q}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{Q}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{Q}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{Q}_{0,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}+2\boldsymbol{Q}_{2\ \frac{1}{2}}(1,\beta)-\frac{1}{4}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{Q}_{2,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{2,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{Q}_{2,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{Q}_{2,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{h\sigma\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{128}{3}\frac{\alpha^{\frac{3}{2}}\beta^5}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{0,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}+2\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\frac{1}{4}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{2,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{2,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{2,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$
$$-\frac{128}{5}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[3\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\frac{3}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{1,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}+2\boldsymbol{P}_{3,\frac{3}{2}}(1,\beta)-\frac{1}{4}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{3,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{3,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{3,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{3,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]\Big]$$

$$L_{h\pi\sigma\bar{\pi}}=\frac{1}{R}\frac{128}{5}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{1,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}-\boldsymbol{P}_{3,\frac{3}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{3,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{3,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{3\ \frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+8\boldsymbol{P}_{3,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]=L_{h\sigma\pi\bar{\pi}}$$

$$L_{s\,h\,s\,\bar{h}}=\frac{1}{R}4\alpha^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\alpha)-\frac{1}{6}\Big\{6\boldsymbol{P}_{0,\frac{1}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)+9\frac{\beta}{\alpha}\boldsymbol{P}_{0,\frac{3}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)$$
$$+6\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)+2\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$L_{s\,h\,s\,\bar{s}}=\frac{1}{R}\frac{4}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{6\boldsymbol{Q}_{0,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+9\boldsymbol{Q}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+6\boldsymbol{Q}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+2\boldsymbol{Q}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{s\,s\,s\,\bar{h}}=\frac{1}{R}\frac{4}{\sqrt{3}}\frac{\beta^{\frac{5}{2}}}{\alpha^2}\Big[\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{6}\Big\{6\boldsymbol{P}_{0,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+9\frac{\beta}{\alpha}\boldsymbol{P}_{0,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{0,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$
$$+2\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{0,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$L_{s\,h\,s\,\bar{\sigma}}=\frac{1}{R}\frac{1}{6}\alpha^{\frac{3}{2}}\Big[24\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-24\boldsymbol{P}_{0,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-36\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$-24\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)-8\boldsymbol{P}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$

$$-\frac{1}{\beta}\left\{24\boldsymbol{P}_{1,\frac{3}{2}}\left(\frac{\alpha}{\beta},\beta\right)-24\boldsymbol{P}_{1,\frac{3}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)-36\boldsymbol{P}_{1,\frac{5}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)-24\boldsymbol{P}_{1,\frac{7}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)\right.$$
$$\left.-8\boldsymbol{P}_{1,\frac{9}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)\right\}\Big]$$

$$L_{s\sigma s\bar{h}}=\frac{1}{R}4\frac{\beta^{\frac{5}{2}}}{\alpha^2}\Big[\boldsymbol{P}_{1,\frac{3}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{6}\left\{6\boldsymbol{P}_{1,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+9\frac{\beta}{\alpha}\boldsymbol{P}_{1,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^2\boldsymbol{P}_{1,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\right.$$
$$\left.+2\left(\frac{\beta}{\alpha}\right)^3\boldsymbol{P}_{1,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\right\}\Big]$$

$$L_{s\,s\,s\bar{s}}=\frac{1}{R}\frac{1}{18}\beta^{\frac{1}{2}}\Big[24\boldsymbol{Q}_{0,\frac{3}{2}}(1,\beta)-\Big\{24\boldsymbol{Q}_{0,\frac{3}{2}}(3,\beta)+36\boldsymbol{Q}_{0,\frac{5}{2}}(3,\beta)+24\boldsymbol{Q}_{0,\frac{7}{2}}(3,\beta)+8\boldsymbol{Q}_{0,\frac{9}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\,s\,s\bar{\sigma}}=\frac{1}{R}\frac{\beta^{\frac{1}{2}}}{6\sqrt{3}}\Big[\beta\Big[24\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+36\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)+24\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+8\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)\Big\}\Big]$$
$$-\Big[24\boldsymbol{P}_{1,\frac{5}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+36\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+24\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+8\boldsymbol{P}_{1,\frac{11}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{s\sigma s\bar{s}}=\frac{1}{R}\frac{1}{6\sqrt{3}}\beta^{\frac{1}{2}}\Big[24\boldsymbol{Q}_{1,\frac{3}{2}}(1,\beta)-\Big\{24\boldsymbol{Q}_{1,\frac{3}{2}}(3,\beta)+36\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+24\boldsymbol{Q}_{1,\frac{7}{2}}(3,\beta)+8\boldsymbol{Q}_{1,\frac{9}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\sigma s\bar{\sigma}}=\frac{1}{R}\frac{\beta^{\frac{1}{2}}}{18}\Big[3\beta\Big[24\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)+36\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+24\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+8\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)\Big\}\Big]$$
$$-\Big[24\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)+36\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+24\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+8\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$-2\Big[24\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)+36\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+24\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+8\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{s\pi s\bar{\pi}}=\frac{1}{R}\frac{4}{3}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)\Big\}$$
$$-\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)+\frac{1}{6}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)\Big\}\Big]$$

$$L_{\sigma h\sigma\bar{h}}=\frac{1}{R}\Big[4\alpha^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\alpha)-\frac{1}{6}\Big\{2\left(\frac{\beta}{\alpha}\right)^3\boldsymbol{P}_{0,\frac{7}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^2\boldsymbol{P}_{0,\frac{5}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)$$
$$+9\frac{\beta}{\alpha}\boldsymbol{P}_{0,\frac{3}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)+6\boldsymbol{P}_{0,\frac{1}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$
$$+12\frac{\alpha^{\frac{5}{2}}}{\beta^2}\Big[\boldsymbol{P}_{2,-\frac{3}{2}}(1,\alpha)-\frac{1}{9}\Big\{2\left(\frac{\beta}{\alpha}\right)^5\boldsymbol{P}_{2,\frac{7}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^4\boldsymbol{P}_{2,\frac{5}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)$$
$$+12\left(\frac{\beta}{\alpha}\right)^3\boldsymbol{P}_{2,\frac{3}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)^2\boldsymbol{P}_{2,\frac{1}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)+18\frac{\beta}{\alpha}\boldsymbol{P}_{2,-\frac{1}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)$$
$$+9\boldsymbol{P}_{2,-\frac{3}{2}}\left(1+2\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]\Big]$$

$$L_{\sigma h\sigma\bar{s}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{0,\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\frac{1}{6}\Big\{2\boldsymbol{Q}_{0,\frac{7}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+6\boldsymbol{Q}_{0,\frac{5}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+9\boldsymbol{Q}_{0,\frac{3}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)$$
$$+6\boldsymbol{Q}_{0,\frac{1}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)\Big\}\Big]+\frac{12}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{2,-\frac{3}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\frac{1}{9}\Big\{2\boldsymbol{Q}_{2,\frac{7}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+6\boldsymbol{Q}_{2,\frac{5}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)$$
$$+12\boldsymbol{Q}_{2,\frac{3}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+18\boldsymbol{Q}_{2,\frac{1}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+18\boldsymbol{Q}_{2,-\frac{1}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+9\boldsymbol{Q}_{2,-\frac{3}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)\Big\}\Big]\Big]$$

$$L_{\sigma s\sigma\bar{h}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\frac{\beta^{\frac{5}{2}}}{\alpha^2}\Big[\boldsymbol{P}_{0,\frac{3}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{6}\Big\{2\left(\frac{\beta}{\alpha}\right)^3\boldsymbol{P}_{0,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^2\boldsymbol{P}_{0,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+9\frac{\beta}{\alpha}\boldsymbol{P}_{0\,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\boldsymbol{P}_{0,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$+\frac{12}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{2,-\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{9}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^5\boldsymbol{P}_{2,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^4\boldsymbol{P}_{2,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+12\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{2,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{2,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},x\Big)+18\frac{\beta}{\alpha}\boldsymbol{P}_{2,\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+9\boldsymbol{P}_{2,-\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]\Big]$$

$$L_{\sigma h\sigma\bar{\sigma}}=\frac{1}{R}\Big[4\alpha^{\frac{3}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+6\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-4\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{1,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{1,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+6\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$+12\alpha^{\frac{3}{2}}\Big[\boldsymbol{P}_{2,-\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{2,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+12\boldsymbol{P}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+18\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+18\boldsymbol{P}_{2,-\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{2,-\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-\frac{12}{5}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[2\boldsymbol{P}_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{2}{9}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{1,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+12\boldsymbol{P}_{1,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+18\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+18\boldsymbol{P}_{1,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-\frac{12}{5}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[3\boldsymbol{P}_{3,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{3}\Big\{2\boldsymbol{P}_{3,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{3,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+12\boldsymbol{P}_{3,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+18\boldsymbol{P}_{3,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+18\boldsymbol{P}_{3,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{3,-\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]\Big]$$

$$L_{\sigma\sigma\sigma\bar{h}}=\frac{1}{R}\Big[4\frac{\beta^{\frac{5}{2}}}{\alpha^2}\Big[\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{6}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{1,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+9\Big(\frac{\beta}{\alpha}\Big)\boldsymbol{P}_{1,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\boldsymbol{P}_{1,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$+\frac{12}{5}\beta^{\frac{1}{2}}\Big[2\boldsymbol{P}_{1,-\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{2}{9}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^5\boldsymbol{P}_{1,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^4\boldsymbol{P}_{1,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+12\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{1,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{1,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)\boldsymbol{P}_{1,\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+9\boldsymbol{P}_{1,-\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}+3\boldsymbol{P}_{3,-\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{3}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^5\boldsymbol{P}_{3,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^4\boldsymbol{P}_{3,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+12\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{3,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{3,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)\boldsymbol{P}_{3,\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+9\boldsymbol{P}_{3,-\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]\Big]$$

$$L_{\sigma s\sigma\bar{s}}=\frac{1}{R}\Big[\frac{4}{3}\beta^{\frac{1}{2}}\Big[\boldsymbol{Q}_{0,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{Q}_{0,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{0,\frac{7}{2}}(3,\beta)+9\boldsymbol{Q}_{0,\frac{5}{2}}(3,\beta)+6\boldsymbol{Q}_{0,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$+4\beta^{\frac{1}{2}}\Big[\boldsymbol{Q}_{2,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{Q}_{2,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{2,\frac{7}{2}}(3,\beta)+12\boldsymbol{Q}_{2,\frac{5}{2}}(3,\beta)+18\boldsymbol{Q}_{2,\frac{3}{2}}(3,\beta)$$

$$+18\boldsymbol{Q}_{2,\frac{1}{2}}(3,\beta)+9\boldsymbol{Q}_{2,-\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma s\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\beta^{\frac{3}{2}}\Big[\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+9\boldsymbol{P}_{0\ \frac{5}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{4}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{1,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{1,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{12}{\sqrt{3}}\beta^{\frac{3}{2}}\Big[\boldsymbol{P}_{2,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+12\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)+9\boldsymbol{P}_{2,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{12}{5\sqrt{3}}\beta^{\frac{1}{2}}\Big[2\boldsymbol{P}_{1,\frac{1}{2}}(1,\beta)-\frac{2}{9}\Big\{2\boldsymbol{P}_{1,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{1,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{12}{5\sqrt{3}}\beta^{\frac{1}{2}}\Big[3\boldsymbol{P}_{3,\frac{1}{2}}(1,\beta)-\frac{1}{3}\Big\{2\boldsymbol{P}_{3,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{3,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{3,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{3,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{3,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma\sigma\sigma\bar{s}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[\boldsymbol{Q}_{1,\frac{9}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{Q}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{1,\frac{7}{2}}(3,\beta)+9\boldsymbol{Q}_{1,\frac{5}{2}}(3,\beta)+6\boldsymbol{Q}_{1,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{12}{5\sqrt{3}}\beta^{\frac{1}{2}}\Big[2\boldsymbol{Q}_{1,-\frac{1}{2}}(1,\beta)-\frac{2}{9}\Big\{2\boldsymbol{Q}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{1,\frac{7}{2}}(3,\beta)+12\boldsymbol{Q}_{1,\frac{5}{2}}(3,\beta)+18\boldsymbol{Q}_{1,\frac{3}{2}}(3,\beta)$$

$$+18\boldsymbol{Q}_{1,\frac{1}{2}}(3,\beta)+9\boldsymbol{Q}_{1,-\frac{1}{2}}(3,\beta)\Big\}+3\boldsymbol{Q}_{3,-\frac{1}{2}}(1,\beta)-\frac{1}{3}\Big\{2\boldsymbol{Q}_{3,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{3,\frac{7}{2}}(3,\beta)+12\boldsymbol{Q}_{3,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{Q}_{3,\frac{3}{2}}(3,\beta)+18\boldsymbol{Q}_{3,\frac{1}{2}}(3,\beta)+9\boldsymbol{Q}_{3,-\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma\sigma\sigma\bar{\sigma}}=\frac{1}{R}\Big[4\beta^{\frac{3}{2}}\Big[\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+9\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{4}{3}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)\Big\}+2\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)$$

$$-\frac{1}{3}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{12}{5}\beta^{\frac{3}{2}}\Big[2\boldsymbol{P}_{1,-\frac{1}{2}}(1,\beta)-\frac{2}{9}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+12\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{1,\frac{1}{2}}(3,\beta)+9\boldsymbol{P}_{1,-\frac{1}{2}}(3,\beta)\Big\}+3\boldsymbol{P}_{3,-\frac{1}{2}}(1,\beta)-\frac{1}{3}\Big\{2\boldsymbol{P}_{3,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{3,\frac{7}{2}}(3,\beta)+12\boldsymbol{P}_{3,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{3,\frac{3}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{1}{2}}(3,\beta)+9\boldsymbol{P}_{3,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{4}{35}\beta^{\frac{1}{2}}\Big[14\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{14}{9}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)\Big\}+55\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\frac{55}{9}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)\Big\}+36\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-4\Big\{2\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)$$

$$+12\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{4,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{4,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma\pi\sigma\bar{\pi}}=\frac{1}{R}\Big[\frac{4}{3}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)\Big\}$$

$$-\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)+\frac{1}{6}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{4}{5}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{20}{7}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{72}{35}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{4,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi h\pi\bar{h}}=\frac{1}{R}\Big[4\alpha^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{6}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^{3}\boldsymbol{P}_{0,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^{2}\boldsymbol{P}_{0,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$

$$+9\frac{\beta}{\alpha}\boldsymbol{P}_{0,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+6\boldsymbol{P}_{0,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]$$

$$-6\frac{\alpha^{\frac{5}{2}}}{\beta^{2}}\Big[\boldsymbol{P}_{2,-\frac{3}{2}}(1,\alpha)-\frac{1}{9}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^{5}\boldsymbol{P}_{2,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^{4}\boldsymbol{P}_{2,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$

$$+12\Big(\frac{\beta}{\alpha}\Big)^{3}\boldsymbol{P}_{2,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)^{2}\boldsymbol{P}_{2,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+18\frac{\beta}{\alpha}\boldsymbol{P}_{2,-\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$

$$+9\boldsymbol{P}_{2,-\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]$$

$$L_{\pi h\pi\bar{s}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{2\boldsymbol{Q}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{Q}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+9\boldsymbol{Q}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-\frac{6}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{2,-\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{9}\Big\{2\boldsymbol{Q}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{Q}_{2,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+12\boldsymbol{Q}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+18\boldsymbol{Q}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+18\boldsymbol{Q}_{2,-\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{Q}_{2,-\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]\Big]$$

$$L_{\pi s\pi\bar{h}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\frac{\beta^{\frac{5}{2}}}{\alpha^{2}}\Big[\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{6}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^{3}\boldsymbol{P}_{0,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^{2}\boldsymbol{P}_{0,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+9\frac{\beta}{\alpha}\boldsymbol{P}_{0,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\boldsymbol{P}_{0,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$-2\sqrt{3}\,\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{2,-\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{9}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^{5}\boldsymbol{P}_{2,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^{4}\boldsymbol{P}_{2,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$

$$+12\Big(\frac{\beta}{\alpha}\Big)^{3}\boldsymbol{P}_{2,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\Big(\frac{\beta}{\alpha}\Big)^{2}\boldsymbol{P}_{2,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+18\frac{\beta}{\alpha}\boldsymbol{P}_{2,\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+9\boldsymbol{P}_{2,-\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]\Big]$$

$$L_{\pi h\pi\bar{\sigma}}=\frac{1}{R}\Big[4\alpha^{\frac{3}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{2\boldsymbol{P}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+6\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-4\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{6}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{1,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+9\boldsymbol{P}_{1,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+6\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$-6\alpha^{\frac{3}{2}}\Big[\boldsymbol{P}_{2,-\frac{3}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{2,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+12\boldsymbol{P}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+18P_{2,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+18P_{2,-\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+9P_{2,-\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}\Big]$$

$$+\frac{12}{5}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[P_{1,-\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\frac{1}{9}\Big\{2P_{1,\frac{9}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+6P_{1,\frac{7}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+12P_{1,\frac{5}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)$$

$$+18P_{1,\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+18P_{1,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+9P_{1,-\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}\Big]$$

$$+\frac{18}{5}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[P_{3,-\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\frac{1}{9}\Big\{2P_{3,\frac{9}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+6P_{3,\frac{7}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+12P_{3,\frac{5}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)$$

$$+18P_{3,\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+18P_{3,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+9P_{3,-\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}\Big]\Big]$$

$$L_{\pi\sigma\pi\bar{h}}=\frac{1}{R}\Big[4\frac{\alpha^{\frac{5}{2}}}{\alpha^2}\Big[P_{1,\frac{3}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{6}\Big\{2\left(\frac{\beta}{\alpha}\right)^3P_{1,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^2P_{1,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$

$$+9\frac{\beta}{\alpha}P_{1,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6P_{1,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$-\frac{12}{5}\beta^{\frac{1}{2}}\Big[P_{1,-\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{9}\Big\{2\left(\frac{\beta}{\alpha}\right)^5P_{1,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^4P_{1,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$

$$+12\left(\frac{\beta}{\alpha}\right)^3P_{1,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)^2P_{1,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)P_{1,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+9P_{1,-\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$-\frac{18}{5}\beta^{\frac{1}{2}}\Big[P_{3,-\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{9}\Big\{2\left(\frac{\beta}{\alpha}\right)^5P_{3,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^4P_{3,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$

$$+12\left(\frac{\beta}{\alpha}\right)^3P_{3,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)^2P_{3,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)P_{3,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$

$$+9P_{3,-\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]\Big]$$

$$L_{\pi s\pi\bar{s}}=\frac{1}{R}\Big[\frac{4}{3}\beta^{\frac{1}{2}}\Big[Q_{0,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2Q_{0,\frac{9}{2}}(3,\beta)+6Q_{0,\frac{7}{2}}(3,\beta)+9Q_{0,\frac{5}{2}}(3,\beta)+6Q_{0,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$-2\beta^{\frac{1}{2}}\Big[Q_{2,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2Q_{2,\frac{9}{2}}(3,\beta)+6Q_{2,\frac{7}{2}}(3,\beta)+12Q_{2,\frac{5}{2}}(3,\beta)+18Q_{2,\frac{3}{2}}(3,\beta)$$

$$+18Q_{2,\frac{1}{2}}(3,\beta)+9Q_{2,-\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi s\pi\bar{\sigma}}=\frac{1}{R}\Big[\frac{4}{\sqrt{3}}\beta^{\frac{3}{2}}\Big[P_{0,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2P_{0,\frac{9}{2}}(3,\beta)+6P_{0,\frac{7}{2}}(3,\beta)+9P_{0,\frac{5}{2}}(3,\beta)+6P_{0,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$-\frac{4}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[P_{1,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+9P_{1,\frac{7}{2}}(3,\beta)+6P_{1,\frac{5}{2}}(3,\beta)\Big\}\Big]$$

$$-2\sqrt{3}\beta^{\frac{3}{2}}\Big[P_{2,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{2,\frac{9}{2}}(3,\beta)+6P_{2,\frac{7}{2}}(3,\beta)+12P_{2,\frac{5}{2}}(3,\beta)+18P_{2,\frac{3}{2}}(3,\beta)$$

$$+18P_{2,\frac{1}{2}}(3,\beta)+9P_{2,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{4\sqrt{3}}{5}\beta^{\frac{1}{2}}\Big[P_{1,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+12P_{1,\frac{7}{2}}(3,\beta)+18P_{1,\frac{5}{2}}(3,\beta)$$

$$+18P_{1,\frac{3}{2}}(3,\beta)+9P_{1,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{6\sqrt{3}}{5}\beta^{\frac{1}{2}}\Big[P_{3,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{3,\frac{11}{2}}(3,\beta)+6P_{3,\frac{9}{2}}(3,\beta)+12P_{3,\frac{7}{2}}(3,\beta)+18P_{3,\frac{5}{2}}(3,\beta)$$

$$+18P_{3,\frac{3}{2}}(3,\beta)+9P_{3,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi\sigma\pi\bar{\sigma}}=\frac{1}{R}\frac{1}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[-6Q_{1,-\frac{1}{2}}(1,\beta)+4Q_{1,\frac{3}{2}}(1,\beta)+6Q_{1,-\frac{1}{2}}(3,\beta)+12Q_{1,\frac{1}{2}}(3,\beta)+8Q_{1,\frac{3}{2}}(3,\beta)$$
$$+2Q_{1,\frac{5}{2}}(3,\beta)+\frac{1}{5}\Big\{18Q_{1,-\frac{1}{2}}(1,\beta)-18Q_{1,-\frac{1}{2}}(3,\beta)-36Q_{1,\frac{1}{2}}(3,\beta)-36Q_{1,\frac{3}{2}}(3,\beta)$$
$$-24Q_{1,\frac{5}{2}}(3,\beta)-12Q_{1,\frac{7}{2}}(3,\beta)-4Q_{1,\frac{9}{2}}(3,\beta)-18Q_{3,-\frac{1}{2}}(1,\beta)+18Q_{3,-\frac{1}{2}}(3,\beta)+36Q_{3,\frac{1}{2}}(3,\beta)$$
$$+36Q_{3,\frac{3}{2}}(3,\beta)+24Q_{3,\frac{5}{2}}(3,\beta)+12Q_{3,\frac{7}{2}}(3,\beta)+4Q_{3,\frac{9}{2}}(3,\beta)\Big\}\Big]$$

$$L_{\pi\bar{\sigma}\pi\bar{\sigma}}=\frac{1}{R}\Big[4\beta^{\frac{3}{2}}\Big[P_{1,\frac{3}{2}}(1,\beta)-\frac{1}{6}\Big\{2P_{1,\frac{9}{2}}(3,\beta)+6P_{1,\frac{7}{2}}(3,\beta)+9P_{1,\frac{5}{2}}(3,\beta)+6P_{1,\frac{3}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{4}{3}\beta^{\frac{1}{2}}\Big[P_{0,\frac{5}{2}}(1,\beta)-\frac{1}{6}\Big\{2P_{0,\frac{11}{2}}(3,\beta)+6P_{0,\frac{9}{2}}(3,\beta)+9P_{0,\frac{7}{2}}(3,\beta)+6P_{0,\frac{5}{2}}(3,\beta)\Big\}$$
$$+2P_{2,\frac{5}{2}}(1,\beta)-\frac{1}{3}\Big\{2P_{2,\frac{11}{2}}(3,\beta)+6P_{2,\frac{9}{2}}(3,\beta)+9P_{2,\frac{7}{2}}(3,\beta)+6P_{2,\frac{5}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{12}{5}\beta^{\frac{3}{2}}\Big[P_{1,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{1,\frac{9}{2}}(3,\beta)+6P_{1,\frac{7}{2}}(3,\beta)+12P_{1,\frac{5}{2}}(3,\beta)+18P_{1,\frac{3}{2}}(3,\beta)$$
$$+18P_{1,\frac{1}{2}}(3,\beta)+9P_{1,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{4}{5}\beta^{\frac{1}{2}}\Big[P_{0,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{0,\frac{11}{2}}(3,\beta)+6P_{0,\frac{9}{2}}(3,\beta)+12P_{0,\frac{7}{2}}(3,\beta)+18P_{0,\frac{5}{2}}(3,\beta)$$
$$+18P_{0,\frac{3}{2}}(3,\beta)+9P_{0,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{22}{7}\beta^{\frac{1}{2}}\Big[P_{2,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{2,\frac{11}{2}}(3,\beta)+6P_{2,\frac{9}{2}}(3,\beta)+12P_{2,\frac{7}{2}}(3,\beta)+18P_{2,\frac{5}{2}}(3,\beta)$$
$$+18P_{2,\frac{3}{2}}(3,\beta)+9P_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{18}{5}\beta^{\frac{3}{2}}\Big[P_{3,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{3,\frac{9}{2}}(3,\beta)+6P_{3,\frac{7}{2}}(3,\beta)+12P_{3,\frac{5}{2}}(3,\beta)+18P_{3,\frac{3}{2}}(3,\beta)$$
$$+18P_{3,\frac{1}{2}}(3,\beta)+9P_{3,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{72}{35}\beta^{\frac{1}{2}}\Big[P_{4,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2P_{4,\frac{11}{2}}(3,\beta)+6P_{4,\frac{9}{2}}(3,\beta)+12P_{4,\frac{7}{2}}(3,\beta)+18P_{4,\frac{5}{2}}(3,\beta)$$
$$+18P_{4,\frac{3}{2}}(3,\beta)+9P_{4,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi\pi\pi\bar{\pi}}=\frac{1}{R}\Big[\frac{1}{12}\beta^{\frac{1}{2}}\Big[16P_{0,\frac{5}{2}}(1,\beta)+32P_{0,\frac{5}{2}}(3,\beta)+8P_{0,\frac{7}{2}}(3,\beta)-16P_{2,\frac{5}{2}}(1,\beta)-32P_{2,\frac{5}{2}}(3,\beta)$$
$$-8P_{2,\frac{7}{2}}(3,\beta)\Big]$$
$$+\frac{1}{5}\beta^{\frac{1}{2}}\Big[8P_{0,\frac{1}{2}}(1,\beta)-\Big\{8P_{0,\frac{1}{2}}(3,\beta)+16P_{0,\frac{3}{2}}(3,\beta)+36P_{0,\frac{5}{2}}(3,\beta)+24P_{0,\frac{7}{2}}(3,\beta)$$
$$+12P_{0,\frac{9}{2}}(3,\beta)+4P_{0,\frac{11}{2}}(3,\beta)\Big\}-8P_{2,\frac{1}{2}}(1,\beta)+\Big\{8P_{2,\frac{1}{2}}(3,\beta)+16P_{2,\frac{3}{2}}(3,\beta)+36P_{2,\frac{5}{2}}(3,\beta)$$
$$+24P_{2,\frac{7}{2}}(3,\beta)+12P_{2,\frac{9}{2}}(3,\beta)+4P_{2,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{3}{35}\beta^{\frac{1}{2}}\Big[18P_{2,\frac{1}{2}}(1,\beta)-\Big\{18P_{2,\frac{1}{2}}(3,\beta)+36P_{2,\frac{3}{2}}(3,\beta)+36P_{2,\frac{5}{2}}(3,\beta)+24P_{2,\frac{7}{2}}(3,\beta)$$
$$+12P_{2,\frac{9}{2}}(3,\beta)+4P_{2,\frac{11}{2}}(3,\beta)\Big\}-18P_{4,\frac{1}{2}}(1,\beta)+\Big\{18P_{4,\frac{1}{2}}(3,\beta)+36P_{4,\frac{3}{2}}(3,\beta)$$
$$+36P_{4,\frac{5}{2}}(3,\beta)+24P_{4,\frac{7}{2}}(3,\beta)+12P_{4,\frac{9}{2}}(3,\beta)+4P_{4,\frac{11}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi\pi'\bar{\pi}\bar{\pi}'}=\frac{1}{R}\Big[\frac{1}{12}\beta^{\frac{1}{2}}\Big[-24\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)+16\boldsymbol{P}_{0,\frac{5}{2}}(1,\beta)+\Big\{24\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)+48\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+32\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$
$$+8\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)\Big\}+24\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)-16\boldsymbol{P}_{2,\frac{5}{2}}(1,\beta)-\Big\{24\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)+48\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+32\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$
$$+8\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{1}{120}\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)+288\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)+192\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)$$
$$+96\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$-\Big[\frac{1}{120}+\frac{1}{280}\Big]\cdot\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)+288\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$
$$+192\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+96\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{1}{280}\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{4,\frac{1}{2}}(3,\beta)+288_{4,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)+192\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)$$
$$+96\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\pi\pi\pi'\bar{\pi}'}=\frac{1}{R}\Big[\frac{1}{120}\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)+288\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$
$$+192\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+96\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$-\Big(\frac{1}{120}+\frac{1}{280}\Big)\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)+288\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$
$$+192\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+96\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{1}{280}\beta^{\frac{1}{2}}\Big[144\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-\Big\{144\boldsymbol{P}_{4,\frac{1}{2}}(3,\beta)+288\boldsymbol{P}_{4,\frac{3}{2}}(3,\beta)+288\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)$$
$$+192\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)+96\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)+32\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{s\hbar\sigma\bar{h}}=\frac{1}{R}\frac{10}{\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{P}_{1,-\frac{1}{2}}(1,\alpha)-\frac{1}{5}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^4\boldsymbol{P}_{1,\frac{7}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{1,\frac{5}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)$$
$$+10\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{1,\frac{3}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)+10\frac{\beta}{\alpha}\boldsymbol{P}_{1,\frac{1}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)+5\boldsymbol{P}_{1,-\frac{1}{2}}\Big(1+2\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$L_{s\hbar\sigma\bar{s}}=\frac{1}{R}\frac{10}{3}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{Q}_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{5}\Big\{2\boldsymbol{Q}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+6\boldsymbol{Q}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+10\boldsymbol{Q}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+10\boldsymbol{Q}_{1,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+5\boldsymbol{Q}_{1,-\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$

$$L_{ss\sigma\bar{h}}=\frac{1}{R}\frac{10}{3}\frac{\beta^{\frac{3}{2}}}{\alpha}\Big[\boldsymbol{P}_{1,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{5}\Big\{2\Big(\frac{\beta}{\alpha}\Big)^4\boldsymbol{P}_{1,\frac{9}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+6\Big(\frac{\beta}{\alpha}\Big)^3\boldsymbol{P}_{1,\frac{7}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)$$
$$+10\Big(\frac{\beta}{\alpha}\Big)^2\boldsymbol{P}_{1,\frac{5}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+10\frac{\beta}{\alpha}\boldsymbol{P}_{1,\frac{3}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)+5\boldsymbol{P}_{1,\frac{1}{2}}\Big(3\frac{\beta}{\alpha},\alpha\Big)\Big\}\Big]$$

$$L_{s\hbar\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{10}{\sqrt{3}}\alpha^{\frac{3}{2}}\Big[\boldsymbol{P}_{1,-\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{5}\Big\{2\boldsymbol{P}_{1,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+6\boldsymbol{P}_{1,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+10\boldsymbol{P}_{1,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+10\boldsymbol{P}_{1,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+5\boldsymbol{P}_{1,-\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}\Big]$$
$$-\frac{10}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{5}\Big\{2\boldsymbol{P}_{0,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+6\boldsymbol{P}_{0,\frac{7}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+10\boldsymbol{P}_{0,\frac{5}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$
$$+10\boldsymbol{P}_{0,\frac{3}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)+5\boldsymbol{P}_{0,\frac{1}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)\Big\}+2\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{2}{5}\Big\{2\boldsymbol{P}_{2,\frac{9}{2}}\Big(2+\frac{\alpha}{\beta},\beta\Big)$$

$$+6P_{2,\frac{7}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+10P_{2,\frac{5}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+10P_{2,\frac{3}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)+5P_{2,\frac{1}{2}}\left(2+\frac{\alpha}{\beta},\beta\right)\Big\}\Big]\Big]$$

$$L_{s\sigma\sigma\bar{h}}=\frac{1}{R}\frac{10}{3\sqrt{3}}\frac{\beta^{\frac{3}{2}}}{\alpha}\Big[P_{0,\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{5}\Big\{2\left(\frac{\beta}{\alpha}\right)^4P_{0,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^3P_{0,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+10\left(\frac{\beta}{\alpha}\right)^2P_{0,\frac{5}{2}}\left(3\frac{\beta}{x},\alpha\right)+10\frac{\beta}{\alpha}P_{0,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+5P_{0,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}+2P_{2,\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)$$
$$-\frac{2}{5}\Big\{2\left(\frac{\beta}{\alpha}\right)^4P_{2,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^3P_{2,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+10\left(\frac{\beta}{\alpha}\right)^2P_{2,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+10\frac{\beta}{\alpha},\ P_{2,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+5P_{2,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$L_{ss\sigma\bar{s}}=\frac{1}{R}\frac{10}{3\sqrt{3}}\beta^{\frac{1}{2}}\Big[Q_{1,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2Q_{1,\frac{9}{2}}(3,\beta)+6Q_{1,\frac{7}{2}}(3,\beta)+10Q_{1,\frac{5}{2}}(3,\beta)+10Q_{1,\frac{3}{2}}(3,\beta)$$
$$+5Q_{1,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$L_{ss\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{10}{3}\beta^{\frac{3}{2}}\Big[P_{1,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{1,\frac{9}{2}}(3,\beta)+6P_{1,\frac{7}{2}}(3,\beta)+10P_{1,\frac{5}{2}}(3,\beta)+10P_{1,\frac{3}{2}}(3,\beta)$$
$$+5P_{1,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{10}{9}\beta^{\frac{1}{2}}\Big[P_{0,\frac{3}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{0,\frac{11}{2}}(3,\beta)+6P_{0,\frac{9}{2}}(3,\beta)+10P_{0,\frac{7}{2}}(3,\beta)+10P_{0,\frac{5}{2}}(3,\beta)$$
$$+5P_{0,\frac{3}{2}}(3,\beta)\}+2P_{2,\frac{3}{2}}(1,\beta)-\frac{2}{5}\Big\{2P_{2,\frac{11}{2}}(3,\beta)+6P_{2,\frac{9}{2}}(3,\beta)+10P_{2,\frac{7}{2}}(3,\beta)$$
$$+10P_{2,\frac{5}{2}}(3,\beta)+5P_{2,\frac{3}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{s\sigma\sigma\bar{s}}=\frac{1}{R}\frac{10}{9}\beta^{\frac{1}{2}}\Big[Q_{0,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2Q_{0,\frac{9}{2}}(3,\beta)+6Q_{0,\frac{7}{2}}(3,\beta)+10Q_{0,\frac{5}{2}}(3,\beta)+10Q_{0,\frac{3}{2}}(3,\beta)$$
$$+5Q_{0,\frac{1}{2}}(3,\beta)\Big\}+2Q_{2,\frac{1}{2}}(1,\beta)-\frac{2}{5}\Big\{2Q_{2,\frac{9}{2}}(3,\beta)+6Q_{2,\frac{7}{2}}(3,\beta)+10Q_{2,\frac{5}{2}}(3,\beta)$$
$$+10Q_{2,\frac{3}{2}}(3,\beta)+5Q_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\sigma\sigma\bar{\sigma}}=\frac{1}{R}\Big[\frac{10}{3\sqrt{3}}\beta^{\frac{3}{2}}\Big[P_{0,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{0,\frac{9}{2}}(3,\beta)+6P_{0,\frac{7}{2}}(3,\beta)+10P_{0,\frac{5}{2}}(3,\beta)+10P_{0,\frac{3}{2}}(3,\beta)$$
$$+5P_{0,\frac{1}{2}}(3,\beta)\Big\}+2P_{2,\frac{1}{2}}(1,\beta)-\frac{2}{5}\Big\{2P_{2,\frac{9}{2}}(3,\beta)+6P_{2,\frac{7}{2}}(3,\beta)+10P_{2,\frac{5}{2}}(3,\beta)$$
$$+10P_{2,\frac{3}{2}}(3,\beta)+5P_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{2}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[3P_{1,\frac{3}{2}}(1,\beta)-\frac{3}{5}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+10P_{1,\frac{7}{2}}(3,\beta)+10P_{1,\frac{5}{2}}(3,\beta)$$
$$+5P_{1,\frac{3}{2}}(3,\beta)\Big\}+2P_{3,\frac{3}{2}}(1,\beta)-\frac{2}{5}\Big\{2P_{3,\frac{11}{2}}(3,\beta)+6P_{2,\frac{9}{2}}(3,\beta)+10P_{3,\frac{7}{2}}(3,\beta)$$
$$+10P_{3,\frac{5}{2}}(3,\beta)+5P_{3,\frac{3}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{s\pi\sigma\bar{\pi}}=\frac{1}{R}\frac{2}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[P_{1,\frac{3}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+10P_{1,\frac{7}{2}}(3,\beta)+10P_{1,\frac{5}{2}}(3,\beta)$$
$$+5P_{1,\frac{3}{2}}(3,\beta)\Big\}-P_{3,\frac{3}{2}}(1,\beta)+\frac{1}{5}\Big\{2P_{3,\frac{11}{2}}(3,\beta)+6P_{3,\frac{9}{2}}(3,\beta)+10P_{3,\frac{7}{2}}(3,\beta)$$
$$+10P_{3,\frac{5}{2}}(3,\beta)+5P_{3,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$L_{hh\pi\bar{\pi}}=\frac{1}{R}\frac{128}{3}\frac{\alpha^3\beta^{\frac{5}{2}}}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+8\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8\boldsymbol{P}_{0,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}-\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{2,\frac{7}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{5}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8\frac{2\gamma}{\beta}\boldsymbol{P}_{2,\frac{3}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)+8\boldsymbol{P}_{2,\frac{1}{2}}\Big(2\frac{\alpha}{\beta}+1,\beta\Big)\Big\}\Big]$$

$$L_{h\pi\pi\bar{h}}=\frac{1}{R}\frac{128}{3}\frac{\alpha^{\frac{1}{2}}\beta^5}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+4\Big(\frac{2\gamma}{\alpha}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$
$$+8\frac{2\gamma}{\alpha}\boldsymbol{P}_{0,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8\boldsymbol{P}_{0,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}-\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\beta}{\alpha},\alpha\Big)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\alpha}\Big)^3\boldsymbol{P}_{2,\frac{7}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)$$
$$+4\Big(\frac{2\gamma}{\alpha}\Big)^2\boldsymbol{P}_{2,\frac{5}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8\frac{2\gamma}{\alpha}\boldsymbol{P}_{2,\frac{3}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)+8\boldsymbol{P}_{2,\frac{1}{2}}\Big(2\frac{\beta}{\alpha}+1,\alpha\Big)\Big\}\Big]$$

$$L_{hs\pi\bar{\pi}}=\frac{1}{R}\frac{128}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{3}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+8\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{P}_{2\,\frac{3}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$L_{h\pi\pi\bar{s}}=\frac{1}{R}\frac{128}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{Q}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{Q}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{Q}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{Q}_{2,\frac{1}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{Q}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{Q}_{2,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{Q}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{Q}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$

$$L_{h\sigma\pi\bar{\pi}}=\frac{1}{R}\frac{128}{5}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{1,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{P}_{3,\frac{3}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{8}\Big)^3\boldsymbol{P}_{3,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{3,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\Big(\frac{2\gamma}{\beta}\Big)\boldsymbol{P}_{3,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{3,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]=L_{h\pi\sigma\bar{\pi}}$$

$$L_{h\pi\pi\bar{\sigma}}=\frac{1}{R}\Big[\frac{128}{3}\frac{\alpha^{\frac{3}{2}}\beta^5}{(2\gamma)^5}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+8\frac{2\gamma}{\beta}\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{2,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{2,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\frac{2\gamma}{\beta}\boldsymbol{P}_{2,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]$$
$$-\frac{128}{5}\frac{\alpha^{\frac{3}{2}}\beta^4}{(2\gamma)^5}\Big[\boldsymbol{P}_{1,\frac{3}{2}}(1,\beta)-\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{1,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+8\frac{2\gamma}{\beta}\boldsymbol{P}_{1,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{1,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{P}_{3,\frac{3}{2}}(1,\beta)+\frac{1}{8}\Big\{\Big(\frac{2\gamma}{\beta}\Big)^3\boldsymbol{P}_{3,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+4\Big(\frac{2\gamma}{\beta}\Big)^2\boldsymbol{P}_{3,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\frac{2\gamma}{\beta}\boldsymbol{P}_{3,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+8\boldsymbol{P}_{3,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}\Big]\Big]$$

$$L_{sh\pi\bar{\pi}}=\frac{1}{R}\frac{10}{3\sqrt{3}}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)-\frac{1}{5}\Big\{2\boldsymbol{P}_{0,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+6\boldsymbol{P}_{0,\frac{7}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+10\boldsymbol{P}_{0,\frac{5}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$
$$+10\boldsymbol{P}_{0,\frac{3}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)+5\boldsymbol{P}_{0,\frac{1}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)\Big\}-\boldsymbol{P}_{2,\frac{1}{2}}\Big(\frac{\alpha}{\beta},\beta\Big)+\frac{1}{5}\Big\{2\boldsymbol{P}_{2,\frac{9}{2}}\Big(\frac{\alpha}{\beta}+2,\beta\Big)$$

$$+6P_{2,\frac{7}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+10P_{2,\frac{5}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+10P_{2,\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+5P_{2,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}\Big]$$

$$L_{s\pi\pi\bar{h}}=\frac{1}{R}\frac{10}{3\sqrt{3}}\frac{\beta^{\frac{3}{2}}}{\alpha}\Big[P_{0,\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{5}\Big\{2\left(\frac{\beta}{\alpha}\right)^4P_{0,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^3P_{0,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+10\left(\frac{\beta}{\alpha}\right)^2P_{0,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+10\frac{\beta}{\alpha}P_{0,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+5P_{0,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}$$
$$-P_{2,\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)+\frac{1}{5}\Big\{2\left(\frac{\beta}{\alpha}\right)^4P_{2,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^3P_{2,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+10\left(\frac{\beta}{\alpha}\right)^2P_{2,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+10\frac{\beta}{\alpha}P_{2,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+5P_{2,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$L_{s\,s\,\pi\bar{\pi}}=\frac{1}{R}\frac{10}{9}\beta^{\frac{1}{2}}\Big[P_{0,\frac{3}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{0,\frac{11}{2}}(3,\beta)+6P_{0,\frac{9}{2}}(3,\beta)+10P_{0,\frac{7}{2}}(3,\beta)+10P_{0,\frac{5}{2}}(3,\beta)$$
$$+5P_{0\frac{3}{2}},(3,\beta)\Big\}-P_{2,\frac{3}{2}}(1,\beta)+\frac{1}{5}\Big\{2P_{2,\frac{11}{2}}(3,\beta)+6P_{2,\frac{9}{2}}(3,\beta)+10P_{2,\frac{7}{2}}(3,\beta)$$
$$+10P_{2,\frac{5}{2}}(3,\beta)+5P_{2,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\pi\pi\bar{s}}=\frac{1}{R}\frac{10}{9}\beta^{\frac{1}{2}}\Big[Q_{0,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2Q_{0,\frac{9}{2}}(3,\beta)+6Q_{0,\frac{7}{2}}(3,\beta)+10Q_{0,\frac{5}{2}}(3,\beta)+10Q_{0,\frac{3}{2}}(3,\beta)$$
$$+5Q_{0,\frac{1}{2}}(3,\beta)\Big\}-Q_{2,\frac{1}{2}}(1,\beta)+\frac{1}{5}\Big\{2Q_{2,\frac{9}{2}}(3,\beta)+6Q_{2,\frac{7}{2}}(3,\beta)+10Q_{2,\frac{5}{2}}(3,\beta)$$
$$+10Q_{2,\frac{3}{2}}(3,\beta)+5Q_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\sigma\pi\bar{\pi}}=\frac{1}{R}\frac{2}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[P_{1,\frac{3}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+10P_{1,\frac{7}{2}}(3,\beta)+10P_{1,\frac{5}{2}}(3,\beta)$$
$$+5P_{1,\frac{3}{2}}(3,\beta)\Big\}-P_{3,\frac{3}{2}}(1,\beta)+\frac{1}{5}\Big\{2P_{3,\frac{11}{2}}(3,\beta)+6P_{3,\frac{9}{2}}(3,\beta)+10P_{3,\frac{7}{2}}(3,\beta)$$
$$+10P_{3,\frac{5}{2}}(3,\beta)+5P_{3,\frac{3}{2}}(3,\beta)\Big\}\Big]$$

$$L_{s\pi\pi\bar{\sigma}}=\frac{1}{R}\Big[\frac{10}{3\sqrt{3}}\beta^{\frac{3}{2}}\Big[P_{0,\frac{1}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{0,\frac{9}{2}}(3,\beta)+6P_{0,\frac{7}{2}}(3,\beta)+10P_{0,\frac{5}{2}}(3,\beta)+10P_{0,\frac{3}{2}}(3,\beta)$$
$$+5P_{0,\frac{1}{2}}(3,\beta)\Big\}-P_{2,\frac{1}{2}}(1,\beta)+\frac{1}{5}\Big\{2P_{2,\frac{9}{2}}(3,\beta)+6P_{2,\frac{7}{2}}(3,\beta)+10P_{2,\frac{5}{2}}(3,\beta)$$
$$+10P_{2,\frac{3}{2}}(3,\beta)+5P_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{2}{\sqrt{3}}\beta^{\frac{1}{2}}\Big[P_{1,\frac{3}{2}}(1,\beta)-\frac{1}{5}\Big\{2P_{1,\frac{11}{2}}(3,\beta)+6P_{1,\frac{9}{2}}(3,\beta)+10P_{1,\frac{7}{2}}(3,\beta)+10P_{1,\frac{5}{2}}(3,\beta)$$
$$+5P_{1,\frac{3}{2}}(3,\beta)\Big\}-P_{3,\frac{3}{2}}(1,\beta)+\frac{1}{5}\Big\{2P_{3,\frac{11}{2}}(3,\beta)+6P_{3,\frac{9}{2}}(3,\beta)+10P_{3,\frac{7}{2}}(3,\beta)$$
$$+10P_{3,\frac{5}{2}}(3,\beta)+5P_{3,\frac{3}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma h\pi\bar{\pi}}=\frac{1}{R}\frac{18}{5}\frac{\alpha^{\frac{3}{2}}}{\beta}\Big[P_{1,-\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)-\frac{1}{9}\Big\{2P_{1,\frac{9}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+6P_{1,\frac{7}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+12P_{1,\frac{5}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)$$
$$+18P_{1,\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+18P_{1,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+9P_{1,-\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}-P_{3,-\frac{1}{2}}\left(\frac{\alpha}{\beta},\beta\right)$$
$$+\frac{1}{9}\Big\{2P_{3,\frac{9}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+6P_{3,\frac{7}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+12P_{3,\frac{5}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+18P_{3,\frac{3}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)$$

$$+18\boldsymbol{P}_{3,\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)+9\boldsymbol{P}_{3,-\frac{1}{2}}\left(\frac{\alpha}{\beta}+2,\beta\right)\Big\}\Big]$$

$$L_{\sigma\pi\pi\bar{h}}=\frac{1}{R}\frac{18}{5}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{1,-\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)-\frac{1}{9}\Big\{2\left(\frac{\beta}{\alpha}\right)^{5}\boldsymbol{P}_{1,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^{4}\boldsymbol{P}_{1,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+12\left(\frac{\beta}{\alpha}\right)^{3}\boldsymbol{P}_{1,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\left(\frac{\beta}{\alpha}\right)^{2}\boldsymbol{P}_{1,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\frac{\beta}{\alpha}\boldsymbol{P}_{1,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+9\boldsymbol{P}_{1,-\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}$$
$$-\boldsymbol{P}_{3,-\frac{1}{2}}\left(\frac{\beta}{\alpha},\alpha\right)+\frac{1}{9}\Big\{2\left(\frac{\beta}{\alpha}\right)^{5}\boldsymbol{P}_{3,\frac{9}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+6\left(\frac{\beta}{\alpha}\right)^{4}\boldsymbol{P}_{3,\frac{7}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+12\left(\frac{\beta}{\alpha}\right)^{3}\boldsymbol{P}_{3,\frac{5}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)$$
$$+18\left(\frac{\beta}{\alpha}\right)^{2}\boldsymbol{P}_{3,\frac{3}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+18\frac{\beta}{\alpha}\boldsymbol{P}_{3,\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)+9\boldsymbol{P}_{3,-\frac{1}{2}}\left(3\frac{\beta}{\alpha},\alpha\right)\Big\}\Big]$$

$$L_{\sigma s\pi\bar{\pi}}=\frac{1}{R}\frac{18}{5\sqrt{3}}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{1,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{1,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{1,\frac{1}{2}}(3,\beta)\Big\}-\boldsymbol{P}_{3,\frac{1}{2}}(1,\beta)+\frac{1}{9}\Big\{2\boldsymbol{P}_{3,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{3,\frac{9}{2}}(3,\beta)$$
$$+12\boldsymbol{P}_{3,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{3,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$L_{\bar{\sigma}\pi\pi\bar{s}}=\frac{1}{R}\frac{18}{5\sqrt{3}}\beta^{\frac{1}{2}}\Big[\boldsymbol{Q}_{1,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{Q}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{1,\frac{7}{2}}(3,\beta)+12\boldsymbol{Q}_{1,\frac{5}{2}}(3,\beta)+18\boldsymbol{Q}_{1,\frac{3}{2}}(3,\beta)$$
$$+18\boldsymbol{Q}_{1,\frac{1}{2}}(3,\beta)+9\boldsymbol{Q}_{1,-\frac{1}{2}}(3,\beta)\Big\}-\boldsymbol{Q}_{3,-\frac{1}{2}}(1,\beta)+\frac{1}{9}\Big\{2\boldsymbol{Q}_{3,\frac{9}{2}}(3,\beta)+6\boldsymbol{Q}_{3,\frac{7}{2}}(3,\beta)$$
$$+12\boldsymbol{Q}_{3,\frac{5}{2}}(3,\beta)+18\boldsymbol{Q}_{3,\frac{3}{2}}(3,\beta)+18\boldsymbol{Q}_{3,\frac{1}{2}}(3,\beta)+9\boldsymbol{Q}_{3,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$L_{\bar{\sigma}\sigma\pi\bar{\pi}}=\frac{1}{R}\Big[\frac{6}{5}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$+\frac{6}{7}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{72}{35}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{4,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{4,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

$$L_{\sigma\pi\pi\bar{\sigma}}=\frac{1}{R}\Big[\frac{18}{5\sqrt{3}}\beta^{\frac{9}{2}}\Big[\boldsymbol{P}_{1,-\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{1,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{1,\frac{7}{2}}(3,\beta)+12\boldsymbol{P}_{1,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{1,\frac{3}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{1,\frac{1}{2}}(3,\beta)+9\boldsymbol{P}_{1,-\frac{1}{2}}(3,\beta)\Big\}\Big]-\boldsymbol{P}_{3,-\frac{1}{2}}(1,\beta)+\frac{1}{9}\Big\{2\boldsymbol{P}_{3,\frac{9}{2}}(3,\beta)+6\boldsymbol{P}_{3,\frac{7}{2}}(3,\beta)$$
$$+12\boldsymbol{P}_{3,\frac{5}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{3}{2}}(3,\beta)+18\boldsymbol{P}_{3,\frac{1}{2}}(3,\beta)+9\boldsymbol{P}_{3,-\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{6}{5}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{0,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{0,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{0,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{0,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{0,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{0,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{0,\frac{1}{2}}(3,\beta)\Big\}\Big]$$
$$-\frac{6}{7}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{2,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{2,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{2,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{2,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{2,\frac{5}{2}}(3,\beta)$$
$$+18\boldsymbol{P}_{2,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{2,\frac{1}{2}}(3,\beta)\Big\}\Big]$$

$$+\frac{72}{35}\beta^{\frac{1}{2}}\Big[\boldsymbol{P}_{4,\frac{1}{2}}(1,\beta)-\frac{1}{9}\Big\{2\boldsymbol{P}_{4,\frac{11}{2}}(3,\beta)+6\boldsymbol{P}_{4,\frac{9}{2}}(3,\beta)+12\boldsymbol{P}_{4,\frac{7}{2}}(3,\beta)+18\boldsymbol{P}_{4,\frac{5}{2}}(3,\beta)$$

$$+18\boldsymbol{P}_{4,\frac{3}{2}}(3,\beta)+9\boldsymbol{P}_{4,\frac{1}{2}}(3,\beta)\Big\}\Big]\Big]$$

Table XXVII Formulae for Ionic Integrals $L_{\alpha\beta\gamma\bar{\delta}}$ in terms of $A_n(\alpha)$ and $B_n(\alpha)$

$$L_{h\,h\,h\,\bar{h}}=\frac{1}{R}\,\frac{1}{2}\,\alpha^{3}\Big[2A_1(\alpha)-\frac{1}{2}\Big\{\alpha\Big(A_2(2\alpha)B_0(\alpha)-A_0(2\alpha)B_2(\alpha)\Big)+2\Big(A_1(2\alpha)B_0(\alpha)-A_0(2\alpha)B_1(\alpha)\Big)\Big\}\Big]$$

$$L_{h\,h\,h\,\bar{s}}=\frac{1}{R}\,\frac{1}{4\sqrt{3}}\,\alpha^{\frac{9}{2}}\beta^{\frac{5}{2}}\Big[A_2(\gamma)B_0(\delta)-2A_1(\gamma)B_1(\delta)+A_0(\gamma)B_2(\delta)-\frac{1}{2}\Big\{\alpha\Big(A_3(\mu)B_0(\alpha+\delta)$$

$$-A_2(\mu)B_1(\alpha+\delta)-A_1(\mu)B_2(\alpha+\delta)+A_0(\mu)B_3(\alpha+\delta)\Big)+2\Big(A_2(\mu)B_0(\alpha+\delta)$$

$$-2A_1(\mu)B_1(\alpha+\delta)+A_0(\mu)B_2(\alpha+\delta)\Big)\Big\}\Big]$$

$$L_{h\,s\,h\,\bar{h}}=\frac{1}{R}\,\frac{1}{4\sqrt{3}}\,\alpha^{\frac{9}{2}}\beta^{\frac{5}{2}}\Big[A_2(\gamma)B_0(-\delta)-A_0(\gamma)B_2(-\delta)-\frac{1}{2}\Big\{\alpha\Big(A_3(\mu)B_0(\gamma)+A_2(\mu)B_1(\gamma)-A_1(\mu)B_2(\gamma)$$

$$-A_0(\mu)B_3(\gamma)\Big)+2\Big(A_2(\mu)B_0(\gamma)-A_0(\mu)B_2(\gamma)\Big)\Big\}\Big]$$

$$L_{h\,h\,h\,\bar{\sigma}}=\frac{1}{R}\,\frac{1}{4}\,\alpha^{\frac{9}{2}}\beta^{\frac{5}{2}}\Big[-A_0(\gamma)B_1(\delta)+A_1(\gamma)\Big\{B_0(\delta)+B_2(\delta)\Big\}-A_2(\gamma)B_1(\delta)-\frac{\alpha}{2}\Big\{-A_0(\mu)B_2(\alpha+\delta)$$

$$+A_1(\mu)B_3(\alpha+\delta)+A_2(\mu)B_0(\alpha+\delta)-A_3(\mu)B_1(\alpha+\delta)\Big\}-\Big\{-A_0(\mu)B_1(\alpha+\delta)$$

$$+A_1(\mu)\Big(B_0(\alpha+\delta)+B_2(\alpha+\delta)\Big)-A_2(\mu)B_1(\alpha+\delta)\Big\}\Big]$$

$$L_{h\,\bar{\sigma}\,h\,\bar{h}}=\frac{1}{R}\,\frac{1}{4}\,\alpha^{\frac{9}{2}}\beta^{\frac{5}{2}}\Big[-A_0(\gamma)B_1(-\delta)+A_1(\gamma)\Big\{B_1(-\delta)-B_2(-\delta)\Big\}+A_2(\gamma)B_1(-\delta)$$

$$-\frac{\alpha}{2}\Big\{-A_0(\mu)B_2(\gamma)-A_1(\mu)B_3(\gamma)+A_2(\mu)B_0(\gamma)+A_3(\mu)B_1(\gamma)\Big\}$$

$$-\Big\{-A_0(\mu)B_1(\gamma)+A_1(\mu)\Big(B_0(\gamma)-B_2(\gamma)\Big)+A_2(\mu)B_1(\gamma)\Big\}\Big]$$

$$L_{h\,s\,h\,\bar{s}}=\frac{1}{R}\,\frac{1}{24}\,\beta^{5}\Big[2A_3(\beta)-\frac{2}{3}A_1(\beta)-\frac{1}{2}\Big\{\alpha\Big(A_4(2\gamma)B_0(\alpha)-2A_2(2\gamma)B_2(\alpha)+A_0(2\gamma)B_4(\alpha)\Big)$$

$$+2\Big(A_3(2\gamma)B_0(\alpha)-A_2(2\gamma)B_1(\alpha)-A_1(2\gamma)B_2(\alpha)+A_0(2\gamma)B_3(\alpha)\Big)\Big\}\Big]$$

$$L_{h\,s\,h\,\bar{\sigma}}=\frac{1}{R}\,\frac{1}{8\sqrt{3}}\,\beta^{5}\Big[-\frac{2}{3}A_0(\beta)+2A_2(\beta)-\frac{\alpha}{2}\Big\{-A_0(2\gamma)B_3(\alpha)-A_1(2\gamma)\Big(B_2(\alpha)-B_4(\alpha)\Big)$$

$$+A_2(2\gamma)\Big(B_1(\alpha)+B_3(\alpha)\Big)+A_3(2\gamma)\Big(B_0(\alpha)-B_2(\alpha)\Big)-A_4(2\gamma)B_1(\alpha)\Big\}-\Big\{-A_0(2\gamma)B_2(\alpha)$$

$$+A_1(2\gamma)B_3(\alpha)+A_2(2\gamma)B_0(\alpha)-A_3(2\gamma)B_1(\alpha)\Big\}\Big]$$

$$L_{h\,\sigma\,h\,\bar{s}}=\frac{1}{R}\,\frac{1}{8\sqrt{3}}\,\beta^{5}\Big[\frac{2}{3}A_0(\beta)+\frac{2}{3}A_2(\beta)-\frac{\alpha}{2}\Big\{A_0(2\gamma)B_3(\alpha)-A_1(2\gamma)\Big(B_2(\alpha)-B_4(\alpha)\Big)$$

$$-A_2(2\gamma)\Big(B_1(\alpha)+B_3(\alpha)\Big)+A_3(2\gamma)\Big(B_0(\alpha)-B_2(\alpha)\Big)+A_4(2\gamma)B_1(\alpha)\Big\}-\Big\{A_0(2\gamma)B_2(\alpha)$$

$$-A_1(2\gamma)\Big(2B_1(\alpha)-B_3(\alpha)\Big)+A_2(2\gamma)\Big(B_0(\alpha)-2B_2(\alpha)\Big)+A_3(2\gamma)B_1(\alpha)\Big\}\Big]$$

$$L_{h\sigma h\bar{\sigma}}=\frac{1}{R}\frac{1}{8}\beta^5\Big[2A_1(\beta)-\frac{2}{3}A_3(\beta)-\frac{\alpha}{2}\Big\{-A_0(2\gamma)B_2(\alpha)+A_2(2\gamma)\Big(B_0(\alpha)+B_4(\alpha)\Big)-A_4(2\gamma)B_2(\alpha)\Big\}$$
$$-\Big\{-A_0(2\gamma)B_1(\alpha)+A_1(2\gamma)B_0(\alpha)+A_2(2\gamma)B_3(\alpha)-A_3(2\gamma)B_2(\alpha)\Big\}\Big]$$

$$L_{h\pi h\bar{\pi}}=\frac{1}{R}\frac{1}{16}\beta^5\Big[\frac{4}{3}A_3(\beta)-\frac{4}{3}A_1(\beta)-\frac{\alpha}{2}\Big\{\Big(B_0(\alpha)-B_2(\alpha)\Big)\Big(A_4(2\gamma)-A_2(2\gamma)\Big)$$
$$-\Big(B_2(\alpha)-B_4(\alpha)\Big)\Big(A_2(2\gamma)-A_0(2\gamma)\Big)\Big\}-\Big\{\Big(B_0(\alpha)-B_2(\alpha)\Big)\Big(A_3(2\gamma)-A_1(2\gamma)\Big)$$
$$-\Big(B_1(\alpha)-B_3(\alpha)\Big)\Big(A_2(2\gamma)-A_0(2\gamma)\Big)\Big\}\Big]$$

$$L_{h h s\bar{h}}=\frac{1}{R}\,4\sqrt{3}\,\frac{\alpha^{\frac{9}{2}}\beta^{\frac{5}{2}}}{(2\gamma)^4}\Big[2A_1(\alpha)-\frac{1}{6}\Big\{\gamma^2\Big(A_3(\mu)B_0(\gamma)+A_2(\mu)B_1(\gamma)-A_1(\mu)B_2(\gamma)-A_0(\mu)B_3(\gamma)\Big)$$
$$+4\gamma\Big(A_2(\mu)B_0(\gamma)-A_0(\mu)B_2(\gamma)\Big)+6\Big(A_1(\mu)B_0(\gamma)-A_0(\mu)B_1(\gamma)\Big)\Big\}\Big]$$

$$L_{h h s\bar{s}}=\frac{1}{R}\frac{1}{3}\frac{\alpha^3\beta^5}{(2\gamma)^4}\Big[6A_2(\gamma)B_0(\delta)-12A_1(\gamma)B_1(\delta)+6A_0(\gamma)B_2(\delta)-\Big\{\gamma^2\Big(A_4(2\gamma)B_0(\alpha)-2A_2(2\gamma)B_2(\alpha)$$
$$+A_0(2\gamma)B_4(\alpha)\Big)+4\gamma\Big(A_3(2\gamma)B_0(\alpha)-A_2(2\gamma)B_1(\alpha)-A_1(2\gamma)B_2(\alpha)+A_0(2\gamma)B_3(\alpha)\Big)$$
$$+6\Big(A_2(2\gamma)B_0(\alpha)-2A_1(2\gamma)B_1(\alpha)+A_0(2\gamma)B_2(\alpha)\Big)\Big\}\Big]$$

$$L_{h s s\bar{h}}=\frac{1}{R}\frac{1}{3}\frac{\alpha^3\beta^5}{(2\gamma)^4}\Big[6A_2(\gamma)B_0(-\delta)-6A_0(\gamma)B_2(-\delta)-\Big\{\gamma^2\Big(A_4(2\gamma)B_0(\beta)+2A_3(2\gamma)B_1(\beta)-2A_1(2\gamma)B_3(\beta)$$
$$-A_0(2\gamma)B_4(\beta)\Big)+4\gamma\Big(A_3(2\gamma)B_0(\beta)+A_2(2\gamma)B_1(\beta)-A_1(2\gamma)B_2(\beta)-A_0(2\gamma)B_3(\beta)\Big)$$
$$+6\Big(A_2(2\gamma)B_0(\beta)-A_0(2\gamma)B_2(\beta)\Big)\Big\}\Big]$$

$$L_{h h s\bar{\sigma}}=\frac{1}{R}\,2\sqrt{3}\,\frac{\alpha^3\beta^5}{(2\gamma)^4}\Big[-A_0(\gamma)B_1(\delta)+A_1(\gamma)\Big\{B_0(\delta)+B_2(\delta)\Big\}-A_2(\gamma)B_1(\delta)-\frac{\gamma^2}{6}\Big\{-A_0(2\gamma)B_3(\alpha)$$
$$-A_1(2\gamma)\Big(B_2(\alpha)-B_4(\alpha)\Big)+A_2(2\gamma)\Big(B_1(\alpha)+B_3(\alpha)\Big)+A_3(2\gamma)\Big(B_0(\alpha)-B_2(\alpha)\Big)-A_4(2\gamma)B_1(\alpha)\Big\}$$
$$-\frac{2}{3}\gamma\Big\{-A_0(2\gamma)B_2(\alpha)-A_1(2\gamma)B_3(\alpha)+A_2(2\gamma)B_0(\alpha)-A_3(2\gamma)B_1(\alpha)\Big\}-\Big\{-A_0(2\gamma)B_1(\alpha)$$
$$+A_1(2\gamma)\Big(B_0(\alpha)+B_2(\alpha)\Big)-A_2(2\gamma)B_1(\alpha)\Big\}\Big]$$

$$L_{h\sigma s\bar{h}}=\frac{1}{R}\,2\sqrt{3}\,\frac{\alpha^3\beta^5}{(2\gamma)^4}\Big[-A_0(\gamma)B_1(-\delta)+A_1(\gamma)\Big(B_0(-\delta)-B_2(-\delta)\Big)+A_2(\gamma)B_1(-\delta)$$
$$-\frac{\gamma^2}{6}\Big\{-A_0(2\gamma)B_3(\beta)-A_1(2\gamma)\Big(B_2(\beta)+B_4(\beta)\Big)+A_2(2\gamma)\Big(B_1(\beta)-B_3(\beta)\Big)$$
$$+A_3(2\gamma)\Big(B_0(\beta)+B_2(\beta)\Big)+A_4(2\gamma)B_1(\beta)\Big\}-\frac{2}{3}\gamma\Big\{-A_0(2\gamma)B_2(\beta)-A_1(2\gamma)B_3(\beta)+A_2(2\gamma)B_0(\beta)$$
$$+A_3(2\gamma)B_1(\beta)\Big\}-\Big\{-A_0(2\gamma)B_1(\beta)+A_1(2\gamma)\Big(B_0(\beta)-B_2(\beta)\Big)+A_2(2\gamma)B_1(\beta)\Big\}\Big]$$

$$L_{h s s\bar{s}}=\frac{1}{R}\frac{1}{6\sqrt{3}}\frac{\alpha^{\frac{9}{2}}\beta^{\frac{15}{2}}}{(2\gamma)^4}\Big[12A_3(\beta)-4A_1(\beta)-\Big\{\gamma^2\Big((A_5(\lambda)B_0(\gamma)+A_4(\lambda)B_1(\gamma)-2A_3(\lambda)B_2(\gamma)$$
$$-2A_2(\lambda)B_3(\gamma)+A_1(\lambda)B_4(\gamma)+A_0(\lambda)B_5(\gamma)\Big)+4\gamma\Big(A_4(\lambda)B_0(\gamma)-2A_2(\lambda)B_2(\gamma)+A_0(\lambda)B_4(\gamma)\Big)$$
$$+6\Big(A_3(\lambda)B_0(\gamma)-A_2(\lambda)B_1(\gamma)-A_1(\lambda)B_2(\gamma)+A_0(\lambda)B_3(\gamma)\Big)\Big\}\Big]$$

$$L_{h s s\bar{\sigma}}=\frac{1}{R}\frac{\alpha^{\frac{9}{2}}\beta^{\frac{15}{2}}}{(2\gamma)^4}\Big[-\frac{2}{3}A_0(\beta)+2A_2(\beta)-\frac{\gamma^2}{6}\Big\{-A_0(\lambda)B_4(\gamma)-A_1(\lambda)\Big(2B_3(\gamma)-B_5(\gamma)\Big)+2A_2(\lambda)B_4(\gamma)$$

$$+2A_3(\lambda)B_1(\gamma)+A_4(\lambda)\Big(B_0(\gamma)-2B_2(\gamma)\Big)-A_5(\beta+\gamma)B_1(\gamma)\Big\}-\frac{2}{3}\gamma\Big\{-A_0(\lambda)B_3(\gamma)$$
$$-A_1(\lambda)\Big(B_2(\gamma)-B_4(\gamma)\Big)+A_2(\lambda)\Big(B_1(\gamma)+B_3(\gamma)\Big)+A_3(\lambda)\Big(B_0(\gamma)-B_2(\gamma)\Big)-A_4(\lambda)B_1(\gamma)\Big\}$$
$$-\Big\{-A_0(\lambda)B_2(\gamma)+A_1(\lambda)B_3(\gamma)+A_2(\lambda)B_0(\gamma)-A_3(\lambda)B_1(\gamma)\Big\}\Big]$$

$$L_{h\,\sigma\,s\,\bar{s}}=\frac{1}{R}\frac{\alpha^{\frac{3}{2}}\beta^{\frac{15}{2}}}{(2\gamma)^4}\Big[\frac{2}{3}A_0(\beta)+\frac{2}{3}A_2(\beta)-\frac{\gamma^2}{6}\Big\{A_5(\lambda)B_1(\gamma)+A_4(\lambda)B_0(\gamma)-2A_3(\lambda)B_3(\gamma)-2A_2(\lambda)B_2(\gamma)$$
$$+A_1(\lambda)B_5(\gamma)+A_0(\lambda)B_4(\gamma)\Big\}-\frac{2}{3}\gamma\Big\{A_0(\lambda)\beta_3(\gamma)-A_1(\lambda)\Big(B_2(\gamma)-B_4(\gamma)\Big)-A_2(\lambda)\Big(B_1(\gamma)+B_3(\gamma)\Big)$$
$$+A_3(\lambda)\Big(B_0(\gamma)-B_2(\gamma)\Big)+A_4(\lambda)B_1(\gamma)\Big\}-\Big\{A_0(\lambda)B_2(\gamma)-A_1(\lambda)\Big(2B_1(\gamma)-B_3(\gamma)\Big)$$
$$+A_2(\lambda)\Big(B_0(\gamma)-2B_2(\gamma)\Big)+A_3(\lambda)B_1(\gamma)\Big\}\Big]$$

$$L_{h\,\sigma\,s\,\bar{\sigma}}=\frac{1}{R}\sqrt{3}\,\frac{\alpha^{\frac{3}{2}}\beta^{\frac{15}{2}}}{(2\gamma)^4}\Big[2A_1(\beta)-\frac{2}{3}A_3(\beta)-\frac{\gamma^2}{6}\Big\{-A_0(\lambda)B_3(\gamma)-A_1(\lambda)B_2(\gamma)+A_2(\lambda)\Big(B_1(\gamma)+B_5(\gamma)\Big)$$
$$+A_3(\lambda)\Big(B_0(\gamma)+B_4(\gamma)\Big)-A_4(\lambda)B_3(\gamma)-A_5(\lambda)B_2(\gamma)\Big\}-\frac{2}{3}\gamma\Big\{-A_0(\lambda)B_2(\gamma)$$
$$+A_2(\lambda)\Big(B_0(\gamma)+B_4(\gamma)\Big)-A_4(\lambda)B_2(\gamma)\Big\}-\Big\{-A_0(\lambda)B_1(\gamma)+A_1(\lambda)B_0(\gamma)+A_2(\lambda)B_3(\gamma)$$
$$-A_3(\lambda)B_2(\gamma)\Big\}\Big]$$

$$L_{h\,\pi\,s\,\bar{\pi}}=\frac{1}{R}\frac{\sqrt{3}}{2}\frac{\alpha^{\frac{3}{2}}\beta^{\frac{15}{2}}}{(2\gamma)^4}\Big[\frac{4}{3}A_3(\beta)-\frac{4}{3}A_1(\beta)-\frac{\gamma^2}{6}\Big\{B_0(\gamma)\Big(A_5(\lambda)-A_3(\lambda)\Big)+B_1(\gamma)\Big(A_4(\lambda)-A_2(\lambda)\Big)$$
$$-B_2(\gamma)\Big(A_5(\lambda)-A_1(\lambda)\Big)-B_3(\gamma)\Big(A_4(\lambda)-A_0(\lambda)\Big)+B_4(\gamma)\Big(A_3(\lambda)-A_1(\lambda)\Big)$$
$$+B_5(\gamma)\Big(A_2(\lambda)-A_0(\lambda)\Big)\Big\}-\frac{2}{3}\gamma\Big\{\Big(B_0(\gamma)-B_2(\gamma)\Big)\Big(A_4(\lambda)-A_2(\lambda)\Big)$$
$$-\Big(B_2(\gamma)-B_4(\gamma)\Big)\Big(A_2(\lambda)-A_0(\lambda)\Big)\Big\}-\Big\{\Big(B_0(\gamma)-B_2(\gamma)\Big)\Big(A_3(\lambda)-A_1(\lambda)\Big)$$
$$-\Big(B_1(\gamma)-B_3(\gamma)\Big)\Big(A_2(\lambda)-A_0(\lambda)\Big)\Big\}\Big]$$

$$L_{\bar{s}\,h\,s\,\bar{h}}=\frac{1}{R}\frac{1}{48}\alpha^3\Big[48A_1(\alpha)-\Big\{\beta^3\Big(A_4(2\gamma)B_0(\beta)+2A_3(2\gamma)B_1(\beta)-2A_1(2\gamma)B_3(\beta)-A_0(2\gamma)B_4(\beta)\Big)$$
$$+6\beta^2\Big(A_3(2\gamma)B_0(\beta)+A_2(2\gamma)B_1(\beta)-A_1(2\gamma)B_2(\beta)-A_0(2\gamma)B_3(\beta)\Big)+18\beta\Big(A_2(2\gamma)\,B_0(\beta)$$
$$-A_0(2\gamma)B_2(\beta)\Big)+24\Big(A_1(2\gamma)B_0(\beta)-A_0(2\gamma)B_1(\beta)\Big)\Big\}\Big]$$

$$L_{s\,h\,s\,\bar{s}}=\frac{1}{R}\frac{1}{96\sqrt{3}}\alpha^{\frac{3}{2}}\beta^{\frac{5}{2}}\Big[24A_2(\gamma)B_0(\delta)-48A_1(\gamma)B_1(\delta)+24A_0(\gamma)B_2(\delta)-\Big\{\beta^3\Big(A_5(\lambda)B_0(\gamma)$$
$$+A_4(\lambda)B_1(\gamma)-2A_3(\lambda)B_2(\gamma)-2A_2(\lambda)B_3(\gamma)+A_1(\lambda)B_4(\gamma)+A_0(\lambda)B_5(\gamma)\Big)$$
$$+6\beta^2\Big(A_4(\lambda)B_0(\gamma)-2A_2(\lambda)B_2(\gamma)+A_0(\lambda)B_4(\gamma)\Big)+18\beta\Big(A_3(\lambda)B_0(\gamma)-A_2(\lambda)B_1(\gamma)$$
$$-A_1(\lambda)B_2(\gamma)+A_0(\lambda)B_3(\gamma)\Big)+24\Big(A_2(\lambda)B_0(\gamma)-2A_1(\lambda)B_1(\gamma)+A_0(\lambda)B_2(\gamma)\Big)\Big\}\Big]$$

$$L_{\bar{s}\,s\,s\,\bar{h}}=\frac{1}{R}\frac{1}{96\sqrt{3}}\alpha^{\frac{3}{2}}\beta^{\frac{5}{2}}\Big[24A_2(\gamma)B_0(-\delta)-24A_0(\gamma)B_2(-\delta)-\Big\{\beta^3\Big(A_5(\lambda)B_0(\beta-\delta)$$
$$+3A_4(\lambda)B_1(\beta-\delta)+2A_3(\lambda)B_2(\beta-\delta)-2A_2(\lambda)B_3(\beta-\delta)-3A_1(\lambda)B_4(\beta-\delta)-A_0(\lambda)B_5(\beta-\delta)\Big)$$

$$+6\beta^2\Big(A_4(\lambda)B_0(\beta-\delta)+2A_3(\lambda)B_1(\beta-\delta)-2A_1(\lambda)B_3(\beta-\delta)-A_0(\lambda)B_4(\beta-\delta)\Big)$$
$$+18\beta\Big(A_3(\lambda)B_0(\beta-\delta)+A_2(\lambda)B_1(\beta-\delta)-A_1(\lambda)B_2(\beta-\delta)-A_0(\lambda)B_3(\beta-\delta)\Big)$$
$$+24\Big(A_2(\lambda)B_0(\beta-\delta)-A_0(\lambda)B_2(\beta-\delta)\Big)\Big\}\Big]$$

$$L_{shs\bar{\sigma}}=\frac{1}{R}\frac{1}{4}\alpha^{\frac{3}{2}}\beta^{\frac{5}{2}}\Big[-A_0(\gamma)B_1(\delta)+A_1(\gamma)\Big\{B_0(\delta)+B_2(\delta)\Big\}-A_2(\gamma)B_1(\delta)-\frac{\beta^3}{24}\Big\{-A_0(\lambda)B_4(\gamma)$$
$$-A_1(\lambda)\Big(2B_3(\gamma)-B_5(\gamma)\Big)+2A_2(\lambda)B_4(\gamma)+2A_3(\lambda)B_1(\lambda)+A_4(\lambda)\Big(B_0(\gamma)-2B_2(\gamma)\Big)-A_5(\lambda)B_1(\gamma)\Big\}$$
$$-\frac{\beta^2}{4}\Big\{-A_0(\lambda)B_3(\gamma)-A_1(\lambda)\Big(B_2(\gamma)-B_4(\gamma)\Big)+A_2(\lambda)\Big(B_1(\gamma)+B_3(\gamma)\Big)+A_3(\lambda)\Big(B_0(\gamma)-B_2(\gamma)\Big)$$
$$-A_4(\lambda)B_1(\gamma)\Big\}-\frac{3}{4}\beta\Big\{-A_0(\lambda)B_2(\gamma)+A_1(\lambda)B_3(\gamma)+A_2(\lambda)B_0(\gamma)-A_3(\lambda)B_1(\gamma)\Big\}$$
$$-\Big\{-A_0(\lambda)B_1(\gamma)+A_1(\lambda)\Big(B_0(\gamma)+B_2(\gamma)\Big)-A_2(\lambda)B_1(\gamma)\Big\}\Big]$$

$$L_{s\sigma s\bar{h}}=\frac{1}{R}\frac{1}{4}\alpha^{\frac{3}{2}}\beta^{\frac{5}{2}}\Big[-A_0(\gamma)B_1(-\delta)+A_1(\gamma)\Big\{B_0(-\delta)-B_2(-\delta)\Big\}+A_2(\gamma)B_1(-\delta)$$
$$-\frac{\beta^3}{24}\Big\{-A_0(\lambda)B_4(\beta-\delta)-A_1(\lambda)\Big(2B_3(\beta-\delta)+B_5(\beta-\delta)\Big)-2A_2(\lambda)B_4(\beta-\delta)+2A_3(\lambda)B_1(\beta-\delta)$$
$$+A_4(\lambda)\Big(B_0(\beta-\delta)+2B_2(\beta-\delta)\Big)+A_5(\lambda)B_1(\beta-\delta)\Big\}-\frac{\beta^2}{4}\Big\{-A_0(\lambda)B_3(\beta-\delta)$$
$$-A_1(\lambda)\Big(B_2(\beta-\delta)+B_4(\beta-\delta)\Big)+A_2(\lambda)\Big(B_1(\beta-\delta)-B_3(\beta-\delta)\Big)+A_3(\lambda)\Big(B_0(\beta-\delta)+B_2(\beta-\delta)\Big)$$
$$+A_4(\lambda)B_1(\beta-\delta)\Big\}-\frac{3}{4}\beta\Big\{-A_0(\lambda)B_2(\beta-\delta)-A_1(\lambda)B_3(\beta-\delta)+A_2(\lambda)B_0(\beta-\delta)+A_3(\lambda)B_1(\beta-\delta)\Big\}$$
$$-\Big\{-A_0(\lambda)B_1(\beta-\delta)+A_1(\lambda)\Big(B_0(\beta-\delta)-B_2(\beta-\delta)\Big)+A_2(\lambda)B_1(\beta-\delta)\Big\}\Big]$$

$$L_{ssss}=\frac{1}{R}\Big(\frac{1}{24}\Big)^2\beta^5\Big[48A_3(\beta)-16A_1(\beta)-\Big\{\beta^3\Big(A_6(2\beta)B_0(\beta)+2A_5(2\beta)B_1(\beta)-A_4(2\beta)B_2(\beta)$$
$$-4A_3(2\beta)B_3(\beta)-A_2(2\beta)B_4(\beta)+2A_1(2\beta)B_5(\beta)+A_0(2\beta)B_6(\beta)\Big)+6\beta^2\Big(A_5(2\beta)B_0(\beta)$$
$$+A_4(2\beta)B_1(\beta)-2A_3(2\beta)B_2(\beta)-2A_2(2\beta)B_3(\beta)+A_1(2\beta)B_4(\beta)+A_0(2\beta)B_5(\beta)\Big)$$
$$+18\beta\Big(A_4(2\beta)B_0(\beta)-2A_2(2\beta)B_2(\beta)+A_0(2\beta)B_4(\beta)\Big)+24\Big(A_3(2\beta)B_0(\beta)-A_2(2\beta)B_1(\beta)$$
$$-A_1(2\beta)B_2(\beta)+A_0(2\beta)B_3(\beta)\Big)\Big\}\Big]$$

$$L_{sss\bar{\sigma}}=\frac{1}{R}\frac{1}{8\sqrt{3}}\beta^5\Big[-\frac{2}{3}A_0(\beta)+2A_2(\beta)-\frac{\beta^3}{24}\Big\{-A_0(2\beta)B_5(\beta)-A_1(2\beta)\Big(3B_4(\beta)-B_6(\beta)\Big)$$
$$-A_2(2\beta)\Big(2B_3(\beta)-3B_5(\beta)\Big)+2A_3(2\beta)\Big(B_2(\beta)+B_4(\beta)\Big)+A_4(2\beta)\Big(3B_1(\beta)-2B_5(\beta)\Big)$$
$$+A_5(2\beta)\Big(B_0(\beta)-3B_2(\beta)\Big)-A_6(2\beta)B_1(\beta)\Big\}$$
$$-\frac{\beta^2}{4}\Big\{-A_0(2\beta)B_4(\beta)-A_1(2\beta)\Big(2B_3(\beta)-B_5(\beta)\Big)+2A_2(2\beta)B_4(\beta)+2A_3(2\beta)B_1(\beta)$$
$$+A_4(2\beta)\Big(B_0(\beta)-2B_2(\beta)\Big)-A_5(2\beta)B_1(\beta)\Big\}$$
$$-\frac{3}{4}\beta\Big\{-A_0(2\beta)B_3(\beta)-A_1(2\beta)\Big(B_2(\beta)-B_4(\beta)\Big)+A_2(2\beta)\Big(B_1(\beta)+B_3(\beta)\Big)$$

$$+A_3(2\beta)\Big(B_0(\beta)-B_2(\beta)\Big)-A_4(2\beta)B_1(\beta)\Big\}-\Big\{-A_0(2\beta)B_2(\beta)+A_1(2\beta)B_3(\beta)+A_2(2\beta)B_0(\beta)$$
$$-A_3(2\beta)B_1(\beta)\Big\}\Big]$$

$$L_{s\sigma s\bar{s}}=\frac{1}{R}\frac{1}{8\sqrt{3}}\beta^5\Big[\frac{2}{3}A_0(\beta)+\frac{2}{3}A_2(\beta)-\frac{\beta^3}{24}\Big\{A_0(2\beta)B_5(\beta)+A_1(2\beta)\Big(B_4(\beta)+B_6(\beta)\Big)$$
$$-A_2(2\beta)\Big(2B_3(\beta)-B_5(\beta)\Big)-2A_3(2\beta)\Big(B_4(\beta)+B_2(\beta)\Big)+A_4(2\beta)\Big(B_1(\beta)-2B_3(\beta)\Big)$$
$$+A_5(2\beta)\Big(B_0(\beta)+B_2(\beta)\Big)+A_6(2\beta)B_1(\beta)\Big\}$$
$$-\frac{\beta^2}{4}\Big\{A_0(2\beta)B_4(\beta)+A_1(2\beta)B_5(\beta)-2A_2(2\beta)B_2(\beta)-2A_3(2\beta)B_3(\beta)+A_4(2\beta)B_0(\beta)$$
$$+A_5(2\beta)B_1(\beta)\Big\}-\frac{3}{4}\beta\Big\{A_0(2\beta)B_3(\beta)-A_1(2\beta)\Big(B_2(\beta)-B_4(\beta)\Big)-A_2(2\beta)\Big(B_1(\beta)+B_3(\beta)\Big)$$
$$+A_3(2\beta)\Big(B_0(\beta)-B_2(\beta)\Big)+A_4(2\beta)B_1(\beta)\Big\}-\Big\{A_0(2\beta)B_2(\beta)-A_1(2\beta)\Big(2B_1(\beta)-B_3(\beta)\Big)$$
$$+A_2(2\beta)\Big(B_0(\beta)-2B_2(\beta)\Big)+A_3(2\beta)B_1(\beta)\Big\}\Big]$$

$$L_{s\sigma s\bar{\sigma}}=\frac{1}{R}\frac{1}{8}\beta^5\Big[2A_1(\beta)-\frac{2}{3}A_3(\beta)-\frac{\beta^3}{24}\Big\{-A_0(2\beta)B_4(\beta)-2A_1(2\beta)B_3(\beta)+A_2(2\beta)B_6(\beta)$$
$$+2A_3(2\beta)\Big(B_1(\beta)+B_5(\beta)\Big)+A_4(2\beta)B_0(\beta)-2A_5(2\beta)B_3(\beta)-A_6(2\beta)B_2(\beta)\Big\}-\frac{\beta^2}{4}\Big\{-A_0(2\beta)B_3(\beta)$$
$$-A_1(2\beta)B_2(\beta)+A_2(2\beta)\Big(B_1(\beta)+B_5(\beta)\Big)+A_3(2\beta)\Big(B_0(\beta)+B_4(\beta)\Big)-A_4(2\beta)B_3(\beta)$$
$$-A_5(2\beta)B_2(\beta)\Big\}-\frac{3}{4}\beta\Big\{-A_0(2\beta)B_2(\beta)+A_2(2\beta)\Big(B_0(\beta)+B_4(\beta)\Big)-A_4(2\beta)B_2(\beta)\Big\}$$
$$-\Big\{-A_0(2\beta)B_1(\beta)+A_1(2\beta)B_0(\beta)+A_2(2\beta)B_3(\beta)-A_3(2\beta)B_2(\beta)\Big\}\Big]$$

$$L_{s\pi s\bar{\pi}}=\frac{1}{R}\frac{\beta^5}{16}\Big[\frac{4}{3}\Big\{A_3(\beta)-A_1(\beta)\Big\}$$
$$-\frac{\beta^3}{24}\Big\{\Big(A_6(2\beta)-A_4(2\beta)\Big)B_0(\beta)+2\Big(A_5(2\beta)-A_3(2\beta)\Big)B_1(\beta)-\Big(A_6(2\beta)-A_4(2\beta)\Big)B_2(\beta)$$
$$-2\Big(A_5(2\beta)-A_1(2\beta)\Big)B_3(\beta)-\Big(A_2(2\beta)-\mathrm{A}_0(2\beta)\Big)B_4(\beta)$$
$$+2\Big(A_3(2\beta)-A_1(2\beta)\Big)B_5(\beta)+\Big(A_2(2\beta)-A_0(2\beta)\Big)B_6(\beta)\Big\}$$
$$-\frac{\beta^2}{4}\Big\{\Big(A_5(2\beta)-A_3(2\beta)\Big)B_0(\beta)+\Big(A_4(2\beta)-A_2(2\beta)\Big)B_1(\beta)-\Big(A_5(2\beta)-A_1(2\beta)\Big)B_2(\beta)$$
$$-\Big(A_4(2\beta)-A_0(2\beta)\Big)B_3(\beta)+\Big(A_3(2\beta)-A_1(2\beta)\Big)B_4(\beta)+\Big(A_2(2\beta)-A_0(2\beta)\Big)B_5(\beta)\Big\}$$
$$-\frac{3}{4}\beta\Big\{\Big(A_4(2\beta)-A_2(2\beta)\Big)B_0(\beta)-\Big(A_4(2\beta)-A_2(2\beta)\Big)B_2(\beta)+\Big(A_2(2\beta)-A_0(2\beta)\Big)B_4(\beta)\Big\}$$
$$-\Big\{\Big(A_3(2\beta)-A_1(2\beta)\Big)B_0(\beta)-\Big(A_2(2\beta)-A_0(2\beta)\Big)B_1(\beta)-\Big(A_3(2\beta)-A_1(2\beta)\Big)B_2(\beta)$$
$$+\Big(A_2(2\beta)-A_0(2\beta)\Big)B_3(\beta)\Big\}\Big]$$