Erratum: P -wave bottom baryons of the $SU(3)$ flavor $\mathbf{6}_F$ [Phys. Rev. D **101, 114013 (2020)]**

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Some errors have been detected when studying P -wave bottom baryons of the $SU(3)$ flavor $\mathbf{6}_F$ with the spin-parity quantum number $J^P = 5/2^-$. We present the correct results below.

To do this, we need the full expression of the $J = 5/2$ propagator [1]:

$$\begin{aligned}
 P_{\mu\nu;\lambda\rho}(p) = & \frac{\not{p} + m}{p^2 - m^2} \left[\frac{1}{2} (g_{\mu\lambda}g_{\nu\rho} + g_{\mu\rho}g_{\nu\lambda}) - \frac{1}{5} g_{\mu\nu}g_{\lambda\rho} - \frac{1}{10} (g_{\mu\lambda}\gamma_\nu\gamma_\rho + g_{\mu\rho}\gamma_\nu\gamma_\lambda + g_{\nu\lambda}\gamma_\mu\gamma_\rho + g_{\nu\rho}\gamma_\mu\gamma_\lambda) \right. \\
 & + \frac{1}{10m} (g_{\mu\lambda}(p_\nu\gamma_\rho - p_\rho\gamma_\nu) + g_{\mu\rho}(p_\nu\gamma_\lambda - p_\lambda\gamma_\nu) + g_{\nu\lambda}(p_\mu\gamma_\rho - p_\rho\gamma_\mu) + g_{\nu\rho}(p_\mu\gamma_\lambda - p_\lambda\gamma_\mu)) \\
 & + \frac{1}{5m^2} (g_{\mu\nu}p_\lambda p_\rho + g_{\lambda\rho}p_\mu p_\nu) - \frac{2}{5m^2} (g_{\mu\lambda}p_\nu p_\rho + g_{\mu\rho}p_\nu p_\lambda + g_{\nu\lambda}p_\mu p_\rho + g_{\nu\rho}p_\mu p_\lambda) \\
 & + \frac{1}{10m^2} (\gamma_\mu\gamma_\lambda p_\nu p_\rho + \gamma_\mu\gamma_\rho p_\nu p_\lambda + \gamma_\nu\gamma_\lambda p_\mu p_\rho + \gamma_\nu\gamma_\rho p_\mu p_\lambda) \\
 & \left. + \frac{1}{5m^3} (\gamma_\mu p_\nu p_\lambda p_\rho + \gamma_\nu p_\mu p_\lambda p_\rho - \gamma_\lambda p_\mu p_\nu p_\rho - \gamma_\rho p_\mu p_\nu p_\lambda) + \frac{2}{5m^4} p_\mu p_\nu p_\lambda p_\rho \right]. \quad (1)
 \end{aligned}$$

There are altogether three P -wave bottom baryons of the $SU(3)$ flavor $\mathbf{6}_F$ with $J^P = 5/2^-$. They are the Σ_b of $J^P = 5/2^-$, Ξ'_b of $J^P = 5/2^-$, and Ω_b of $J^P = 5/2^-$. They all belong to the $[\mathbf{6}_F, 2, 1, \lambda]$ doublet. Based on Eq. (1), we evaluate their decay constants to be as follows:

$$\begin{aligned}
 f_{[\Sigma_b^-(5/2^-), 2, 1, \lambda]} &= 0.061 \pm 0.016 \text{ GeV}^4, \\
 f_{[\Xi_b^-(5/2^-), 2, 1, \lambda]} &= 0.054 \pm 0.013 \text{ GeV}^4, \\
 f_{[\Omega_b^-(5/2^-), 2, 1, \lambda]} &= 0.097 \pm 0.021 \text{ GeV}^4. \quad (2)
 \end{aligned}$$

We study their D -wave decays into ground-state bottom baryons and pseudoscalar mesons, and find 12 nonzero coupling constants:

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$$\begin{aligned}
(c1) g_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Lambda_b[\frac{1}{2}^+] \pi} &= 7.57^{+4.50}_{-3.18} \text{ GeV}^{-2}, \\
(c2) g_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Sigma_b[\frac{1}{2}^+] \pi} &= 2.86^{+2.09}_{-1.26} \text{ GeV}^{-2}, \\
(c3) g_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Sigma_b^*[\frac{3}{2}^+] \pi} &= 2.20^{+1.31}_{-0.97} \text{ GeV}^{-2}, \\
(f1) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b[\frac{1}{2}^+] \pi} &= 4.92^{+2.68}_{-2.24} \text{ GeV}^{-2}, \\
(f2) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Lambda_b[\frac{1}{2}^+] K} &= 5.79^{+3.36}_{-2.38} \text{ GeV}^{-2}, \\
(f3) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b'[\frac{1}{2}^+] \pi} &= 2.10^{+1.18}_{-0.91} \text{ GeV}^{-2}, \\
(f4) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Sigma_b[\frac{1}{2}^+] K} &= 1.62^{+1.02}_{-0.84} \text{ GeV}^{-2}, \\
(f5) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b^*[\frac{3}{2}^+] \pi} &= 1.62^{+0.88}_{-0.67} \text{ GeV}^{-2}, \\
(f6) g_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Sigma_b^*[\frac{3}{2}^+] K} &= 1.25^{+0.78}_{-0.64} \text{ GeV}^{-2}, \\
(i1) g_{\Omega_b[\frac{5}{2}^-] \rightarrow \Xi_b[\frac{1}{2}^+] K} &= 7.27^{+3.92}_{-2.83} \text{ GeV}^{-2}, \\
(i2) g_{\Omega_b[\frac{5}{2}^-] \rightarrow \Xi_b'[\frac{1}{2}^+] K} &= 2.52^{+1.40}_{-1.14} \text{ GeV}^{-2}, \\
(i3) g_{\Omega_b[\frac{5}{2}^-] \rightarrow \Xi_b^*[\frac{3}{2}^+] K} &= 1.94^{+1.08}_{-0.87} \text{ GeV}^{-2}.
\end{aligned} \tag{3}$$

Based on them, we further find eight D -wave decay channels that are kinematically allowed:

$$\begin{aligned}
(c1) \Gamma_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Lambda_b[\frac{1}{2}^+] \pi} &= 20.8^{+23.7}_{-13.8} \text{ MeV}, \\
(c2) \Gamma_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Sigma_b[\frac{1}{2}^+] \pi} &= 0.36^{+0.71}_{-0.24} \text{ MeV}, \\
(c3) \Gamma_{\Sigma_b[\frac{5}{2}^-] \rightarrow \Sigma_b^*[\frac{3}{2}^+] \pi} &= 1.1^{+1.8}_{-0.8} \text{ MeV}, \\
(f1) \Gamma_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b[\frac{1}{2}^+] \pi} &= 8.1^{+11.2}_{-5.7} \text{ MeV}, \\
(f2) \Gamma_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Lambda_b[\frac{1}{2}^+] K} &= 3.4^{+5.1}_{-2.2} \text{ MeV}, \\
(f3) \Gamma_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b'[\frac{1}{2}^+] \pi} &= 0.17^{+0.24}_{-0.11} \text{ MeV}, \\
(f5) \Gamma_{\Xi_b'[\frac{5}{2}^-] \rightarrow \Xi_b^*[\frac{3}{2}^+] \pi} &= 0.58^{+0.80}_{-0.38} \text{ MeV}, \\
(i1) \Gamma_{\Omega_b[\frac{5}{2}^-] \rightarrow \Xi_b[\frac{1}{2}^+] K} &= 2.5^{+3.5}_{-1.6} \text{ MeV}.
\end{aligned} \tag{4}$$

FIG. 1. Branching ratios of P -wave bottom baryons of the $SU(3)$ flavor $\mathbf{6}_F$ with $J^P = 5/2^-$, with limited but nonzero widths ($0 < \Gamma < 100 \text{ MeV}$). See the caption of Table I for detailed explanations.

TABLE I. Among all the possible P -wave bottom baryons of the flavor $\mathbf{6}_F$, we find altogether four Σ_b , four Ξ'_b , and six Ω_b baryons, with limited widths (< 100 MeV) and so capable of being observed. Their masses, mass splittings within the same multiplets, and decay properties are extracted for future experimental searches. We note that there are considerable uncertainties in our results for the absolute values of the bottom baryon masses due to their significant dependence on the bottom quark mass [3,4]; however, their mass splittings within the same doublets do not depend much on this, so they are produced quite well with much less uncertainties and give more useful information; moreover, we can extract even more useful information from S - and D -wave strong decay properties of P -wave bottom baryons.

B	Multiplet	Baryon (J^P)	Mass (GeV)	Difference (MeV)	Decay channel	Total width (MeV)	Candidate
Σ_b	$[\mathbf{6}_F, 1, 1, \lambda]$	$\Sigma_b(\frac{1}{2}^-)$	6.06 ± 0.13	6 ± 3	$\Gamma(\Sigma_b(\frac{1}{2}^-) \rightarrow \Sigma_b \pi) = 14.1^{+21.2}_{-10.9}$ MeV	$14.3^{+21.2}_{-10.9}$	...
					$\Gamma(\Sigma_b(\frac{1}{2}^-) \rightarrow \Sigma_b^* \pi) = 0.076^{+0.144}_{-0.076}$ MeV		
		$\Sigma_b(\frac{3}{2}^-)$	6.07 ± 0.13		$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Lambda_b \rho \rightarrow \Lambda_b \pi \pi) = 0.087$ MeV	$4.8^{+5.9}_{-2.9}$	...
					$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Sigma_b \pi) = 0.55^{+0.74}_{-0.36}$ MeV		
	$[\mathbf{6}_F, 2, 1, \lambda]$	$\Sigma_b(\frac{3}{2}^-)$	6.11 ± 0.16	12 ± 5	$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Sigma_b^* \pi) = 4.0^{+5.8}_{-2.9}$ MeV	$51.4^{+76.5}_{-32.9}$	$\Sigma_b(6097)^\pm$
					$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Lambda_b \rho \rightarrow \Lambda_b \pi \pi) = 0.23$ MeV		
					$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Lambda_b \pi) = 49.6^{+76.4}_{-32.9}$ MeV		
					$\Gamma(\Sigma_b(\frac{3}{2}^-) \rightarrow \Sigma_b \pi) = 1.6^{+3.2}_{-1.1}$ MeV		
		$\Sigma_b(\frac{5}{2}^-)$	6.12 ± 0.15		$\Gamma(\Sigma_b(\frac{5}{2}^-) \rightarrow \Sigma_b^* \pi) = 0.25^{+0.37}_{-0.16}$ MeV	$22.3^{+23.8}_{-13.8}$	...
					$\Gamma(\Sigma_b(\frac{5}{2}^-) \rightarrow \Sigma_b \rho \rightarrow \Sigma_b \pi \pi) = 1.4 \times 10^{-4}$ MeV		
					$\Gamma(\Sigma_b(\frac{5}{2}^-) \rightarrow \Lambda_b \pi) = 20.8^{+23.7}_{-13.8}$ MeV		
					$\Gamma(\Sigma_b(\frac{5}{2}^-) \rightarrow \Sigma_b \pi) = 0.36^{+0.71}_{-0.24}$ MeV		
Ξ'_b	$[\mathbf{6}_F, 1, 1, \lambda]$	$\Xi'_b(\frac{1}{2}^-)$	6.21 ± 0.11	7 ± 2	$\Gamma(\Xi'_b(\frac{1}{2}^-) \rightarrow \Xi'_b \pi) = 1.1^{+1.8}_{-0.8}$ MeV	$4.7^{+5.8}_{-3.3}$	...
					$\Gamma(\Xi'_b(\frac{1}{2}^-) \rightarrow \Xi'_b \pi) = 4.5^{+5.8}_{-3.3}$ MeV		
		$\Xi'_b(\frac{3}{2}^-)$	6.22 ± 0.11		$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Xi'_b \pi) = 0.16^{+0.18}_{-0.10}$ MeV	$1.8^{+1.1}_{-1.0}$	...
					$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Xi'_b \rho \rightarrow \Xi'_b \pi \pi) = 0.043$ MeV		
	$[\mathbf{6}_F, 2, 1, \lambda]$	$\Xi'_b(\frac{3}{2}^-)$	6.23 ± 0.15	11 ± 5	$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Xi'_b \pi) = 0.34^{+0.35}_{-0.20}$ MeV	$27.3^{+28.5}_{-14.2}$	$\Xi'_b(6227)^-$
					$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Lambda_b K) = 7.4^{+11.0}_{-4.8}$ MeV		
					$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Xi'_b \pi) = 0.79^{+1.13}_{-0.79}$ MeV		
					$\Gamma(\Xi'_b(\frac{3}{2}^-) \rightarrow \Xi'_b \pi) = 0.13^{+0.17}_{-0.08}$ MeV		
		$\Xi'_b(\frac{5}{2}^-)$	6.24 ± 0.14		$\Gamma(\Xi'_b(\frac{5}{2}^-) \rightarrow \Xi'_b \rho \rightarrow \Xi'_b \pi \pi) = 5.6 \times 10^{-4}$ MeV	$12.3^{+12.3}_{-6.1}$	...
					$\Gamma(\Xi'_b(\frac{5}{2}^-) \rightarrow \Xi'_b \pi) = 8.1^{+11.2}_{-5.7}$ MeV		
					$\Gamma(\Xi'_b(\frac{5}{2}^-) \rightarrow \Lambda_b K) = 3.4^{+5.1}_{-2.2}$ MeV		
					$\Gamma(\Xi'_b(\frac{5}{2}^-) \rightarrow \Xi'_b \pi) = 0.17^{+0.24}_{-0.11}$ MeV		
Ω_b	$[\mathbf{6}_F, 1, 0, \rho]$	$\Omega_b(\frac{1}{2}^-)$	6.32 ± 0.11	2 ± 1	...	~ 0	$\Omega_b(6316)^-$
		$\Omega_b(\frac{3}{2}^-)$	6.32 ± 0.11		...	~ 0	
	$[\mathbf{6}_F, 1, 1, \lambda]$	$\Omega_b(\frac{1}{2}^-)$	6.34 ± 0.10	6 ± 2	...	~ 0	$\Omega_b(6330)^-$
		$\Omega_b(\frac{3}{2}^-)$	6.34 ± 0.09		...	~ 0	$\Omega_b(6340)^-$
	$[\mathbf{6}_F, 2, 1, \lambda]$	$\Omega_b(\frac{3}{2}^-)$	6.35 ± 0.13	10 ± 4	$\Gamma(\Omega_b(\frac{3}{2}^-) \rightarrow \Xi_b K) = 4.6^{+3.3}_{-1.9}$ MeV	$4.6^{+3.3}_{-1.9}$	$\Omega_b(6350)^-$
		$\Omega_b(\frac{5}{2}^-)$	6.36 ± 0.12		$\Gamma(\Omega_b(\frac{5}{2}^-) \rightarrow \Xi_b K) = 2.5^{+3.5}_{-1.6}$ MeV	$2.5^{+3.5}_{-1.6}$	...
					$\Gamma(\Xi'_b(\frac{5}{2}^-) \rightarrow \Xi'_b \rho \rightarrow \Xi'_b \pi \pi) = 6.4 \times 10^{-5}$ MeV		
					...		

We summarize the above results in Table I together with other unchanged results of Ref. [2], which replaces the original Table VI of Ref. [2]. We also show branching ratios of these $J^P = 5/2^-$ bottom baryons in Fig. 1 using pie charts.

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