

Heavy FLavor AVeraging group (HFLAV) - April 2019
 Compilation of B_s^0 Branching Fractions ($\times 10^{-6}$) - UL at 90% CL

Preliminary Updated results not included in PDG Live as of Dec. 31, 2017

RPP#	Mode	PDG2017 Avg.	Belle	CDF	D0	LHCb	CMS	ATLAS	Our Avg.
85	$\pi^+\pi^-$	0.68 ± 0.08	< 12	[1]	0.60 ± 0.17 ± 0.04 † [2]	0.691 ± 0.083 ± 0.044 † [3]			0.671 ± 0.083
90	$\eta'\eta'$	33 ± 7				33.1 ± 7.0 ± 1.2 † [4]			33.1 ± 7.1
91	$\phi f_0(980), f_0(980) \rightarrow \pi^+\pi^-$	1.12 ± 0.21				1.12 ± 0.18 ± 0.11 [5]			1.12 ± 0.21
92	$\phi f_2(1270), f_2(1270) \rightarrow \pi^+\pi^-$	0.61 $^{+0.18}_{-0.15}$				0.61 $^{+0.13}_{-0.11} \pm 0.06$ [5]			0.61 $^{+0.19}_{-0.15}$
93	$\phi\pi^0(770)$	0.27 ± 0.08				0.27 ± 0.07 ± 0.02 [5]			0.27 ± 0.07
94	$\phi\pi^+\pi^-$	3.5 ± 0.5				3.48 ± 0.29 ± 0.35 † [5]			3.48 ± 0.46
95	$\phi\phi$	18.7 ± 1.5			19.1 ± 2.6 ± 1.6 † [6]	18.4 ± 0.5 ± 1.8 † [7]			18.6 ± 1.6
96	π^+K^-	5.6 ± 0.6	< 26	[1]	5.3 ± 0.9 ± 0.3 † [8]	5.6 ± 0.6 ± 0.3 † [9]			5.5 ± 0.5
97	K^+K^-	25.4 ± 1.6	38 $^{+10}_{-9} \pm 7$	[1]	25.9 ± 2.2 ± 1.7 † [10]	23.7 ± 1.6 ± 1.5 † [9]			24.8 ± 1.7
98	$K^0\bar{K}^0$	20 ± 6	19.6 $^{+5.8}_{-5.1} \pm 1.0 \pm 2.0$ † [11]						19.6 $^{+6.2}_{-5.5}$
99	$K^0\pi^+\pi^-$	15 ± 4				9.5 ± 1.3 ± 1.5 ± 0.4 † [12]			9.5 ± 2.0
100	$K^0K^-\pi^+$ ¶	77 ± 10				84.3 ± 3.5 ± 7.4 ± 3.4 † [12]			84.3 ± 8.9
101	$K^+\pi^+$	3.3 ± 1.2				3.3 ± 1.1 ± 0.5 [13]			3.3 ± 1.2
102	$K^+\pi^+K^\mp$	12.5 ± 2.6				18.6 ± 1.2 ± 0.8 ± 4.0 ± 2.0 † [14]			18.6 ± 4.7
	$K_1^+(1430)^\pm K^\mp$					31.3 ± 2.3 ± 0.7 ± 25.1 ± 3.3 † [14]			31.3 ± 25.4
	$K_2^+(1430)^\pm K^\mp$					10.3 ± 2.5 ± 1.1 ± 16.3 ± 1.1 † [14]			10.3 ± 16.6
103	$K^0\bar{K}^0$ ¶	16 ± 4				19.8 ± 2.8 ± 1.2 ± 4.4 ± 2.1 † [14]			19.8 ± 5.7
	$K^0\bar{K}_1^0(1430)^0$ ¶					33.0 ± 2.5 ± 0.9 ± 9.1 ± 3.5 † [14]			33.0 ± 10.1
	$K^0\bar{K}_2^0(1430)^0$ ¶					16.8 ± 4.5 ± 1.7 ± 21.2 ± 1.8 † [14]			16.8 ± 21.8
104	$K^0K^+K^-$	< 3.5				< 2.5 [12]			< 2.5
106	$K^{*0}\bar{K}^{*0}$	11.1 ± 2.7				10.8 ± 2.1 ± 1.4 ± 0.6 † [15]			10.8 ± 2.6
107	$\phi\bar{K}^{*0}$	1.14 ± 0.3				1.13 ± 0.29 ± 0.06 † [16]			1.13 ± 0.30
108	$p\bar{p}$	0.028 $^{+0.022}_{-0.017}$				< 0.015 [17]			< 0.015
111	$\gamma\gamma$	< 3.1	< 3.1	[18]					< 3.1
112	$\phi\gamma$	35.2 ± 3.4	36 ± 5 ± 7	[18]		35.1 ± 3.5 ± 1.2 † [19]			35.2 ± 3.4
113	$\mu^+\mu^-$	0.0024 $^{+0.0009}_{-0.0007}$			0.013 $^{+0.009}_{-0.007}$ [20]	< 0.012 [21]	0.0030 ± 0.0006 $^{+0.0003}_{-0.0002}$ [22]	0.0028 $^{+0.0011}_{-0.0009}$ [23]	0.0031 ± 0.0006
114	e^+e^-	< 0.28			< 0.28 [25]			0.0028 $^{+0.0008}_{-0.0007}$ [24]	< 0.28
115	$\mu^+\mu^-\mu^+\mu^-$	< 0.012				< 5200 [26]			< 5200
117	$\phi\mu^+\mu^-$	0.83 ± 0.12				< 0.0025 † [27]			< 0.0025 †
118	$\pi^+\pi^-\mu^+\mu^-$	0.084 ± 0.017				0.797 $^{+0.045}_{-0.033} \pm 0.068$ [29]			0.797 $^{+0.082}_{-0.080}$
120	$e^\pm\mu^\mp$	< 0.011			< 0.20 [25]	0.086 ± 0.015 ± 0.010 † [30]			0.086 ± 0.018
	$\bar{p}\Lambda K^- + \bar{p}\Lambda K^+$					< 0.0054 [31]			< 0.0054
	$p\bar{p}K^+K^-$					5.46 ± 0.61 ± 0.57 ± 0.50 ± 0.32 † [32]			5.46 ± 1.02
	$p\bar{p}K^+\pi^-$					4.2 ± 0.3 ± 0.2 ± 0.3 ± 0.2 † [33]			4.2 ± 0.5
	$p\bar{p}\pi^+\pi^-$					1.30 ± 0.21 ± 0.11 ± 0.09 ± 0.08 † [33]			1.30 ± 0.27
	$\eta'\phi$					< 0.66 [33]			< 0.66
	$\bar{K}^{*0}\mu^+\mu^-$					< 0.82 [34]			< 0.82
						0.029 ± 0.010 ± 0.002 ± 0.003 † [35]			0.029 ± 0.011

Channels with no RPP# were not included in PDG Live as of Dec. 31, 2017.

Results for CDF, D0, LHCb, CMS and ATLAS are relative BF's converted to absolute BF's.

† The first error is experimental, and the second is from the reference BF.

‡ Last error represents the uncertainty due to the total number of $B_s^0\bar{B}_s^0$ pairs.

§ Last error takes into account error the reference BF and f_d/f_s .

¶ Includes two distinct decay processes: $\mathcal{B}(B_s^0 \rightarrow f) + \mathcal{B}(B_s^0 \rightarrow \bar{f})$.

◇ Uncertainties are statistical, systematic related to experimental and model uncertainties, and due to the reference BF.

1 UL at 95% CL.

2 Muon pairs do not originate from resonances and $0.5 < m(\pi^+\pi^-) < 1.3$ GeV/ c^2 .

3 In the mass range $400 < m(\pi^+\pi^-) < 1600$ GeV/ c^2 .

4 The third error is due to the reference BF and the fourth to f_d/f_s .

5 Results are more than 3σ significant when only statistical uncertainties are included.

Heavy FLavor AVeraging group (HFLAV) - April 2019

Compilation of B_s^0 Relative Branching Fractions

Preliminary Updated results not included in PDG Live as of Dec. 31, 2017

RPP#	Mode	PDG2017 Avg.	CDF	LHCb	Our Avg.
85/257	$f_s \mathcal{B}(B_s^0 \rightarrow \pi^+ \pi^-) / f_d \mathcal{B}(B^0 \rightarrow K^+ \pi^-)$		$0.008 \pm 0.002 \pm 0.001$ [2]	$0.00915 \pm 0.00071 \pm 0.00083$ [3]	0.00880 ± 0.00090
85/387	$f_s \mathcal{B}(B_s^0 \rightarrow \pi^+ \pi^-) / f_d \mathcal{B}(B^0 \rightarrow \pi^+ \pi^-)$			$0.050_{-0.009}^{+0.011} \pm 0.004$ [9]	$0.050_{-0.016}^{+0.012}$
95/46	$\mathcal{B}(B_s^0 \rightarrow \phi \phi) / \mathcal{B}(B_s^0 \rightarrow J/\psi \phi)$		$0.0178 \pm 0.0014 \pm 0.0020$ [6]		0.0180 ± 0.0020
95/343	$\mathcal{B}(B_s^0 \rightarrow \phi \phi) / \mathcal{B}(B^0 \rightarrow \phi K^*)$			$1.84 \pm 0.05 \pm 0.13$ [30]	1.84 ± 0.14
96/257	$f_s \mathcal{B}(B_s^0 \rightarrow K^+ \pi^-) / f_d \mathcal{B}(B_d^0 \rightarrow K^+ \pi^-)$		$0.071 \pm 0.010 \pm 0.007$ [8]	$0.074 \pm 0.006 \pm 0.006$ [9]	0.073 ± 0.007
97/257	$f_s \mathcal{B}(B_s^0 \rightarrow K^+ K^-) / f_d \mathcal{B}(B_d^0 \rightarrow K^+ \pi^-)$		$0.347 \pm 0.020 \pm 0.021$ [10]	$0.316 \pm 0.009 \pm 0.019$ [9]	0.327 ± 0.017
99/291	$\mathcal{B}(B_s^0 \rightarrow K^0 \pi^+ \pi^-) / \mathcal{B}(B^0 \rightarrow K^0 \pi^+ \pi^-)$			$0.191 \pm 0.027 \pm 0.031 \pm 0.011$ [12]	0.191 ± 0.043
100/322	$\mathcal{B}(B_s^0 \rightarrow K^0 K^- \pi^+) / \mathcal{B}(B^0 \rightarrow K^0 K^- \pi^+)$ †			$1.70 \pm 0.07 \pm 0.11 \pm 0.10$ [12]	1.70 ± 0.16
101/294	$\mathcal{B}(B_s^0 \rightarrow K^+ \pi^+) / \mathcal{B}(B^0 \rightarrow K^{*+} \pi^-)$			$0.39 \pm 0.13 \pm 0.05$ [13]	0.39 ± 0.14
104/329	$\mathcal{B}(B_s^0 \rightarrow K^0 K^+ K^-) / \mathcal{B}(B^0 \rightarrow K^0 K^+ K^-)$			< 0.051 [12]	< 0.051
106/294	$\mathcal{B}(B_s^0 \rightarrow K^{*0} \bar{K}^{*0}) / \mathcal{B}(B^0 \rightarrow K^{*+} \pi^-)$			$1.11 \pm 0.22 \pm 0.13$ [15]	1.11 ± 0.26
107/343	$\mathcal{B}(B_s^0 \rightarrow \phi \bar{K}^{*0}) / \mathcal{B}(B^0 \rightarrow \phi K^{*0})$			$0.113 \pm 0.024 \pm 0.016$ [16]	0.113 ± 0.029
112/371	$\mathcal{B}(B_s^0 \rightarrow \phi \gamma) / \mathcal{B}(B^0 \rightarrow K^{*0} \gamma)$			$0.81 \pm 0.04 \pm 0.07$ [19]	0.81 ± 0.08
117/46	$\mathcal{B}(B^0 \rightarrow \phi \mu^+ \mu^-) / \mathcal{B}(B_s^0 \rightarrow J/\psi \phi) \times 10^3$	0.76 ± 0.09 °	$1.13_{-0.07}^{+0.19}$ [36]	$0.741_{-0.040}^{+0.042} \pm 0.029$ [29]	0.876 ± 0.041
	$\mathcal{B}(B_s^0 \rightarrow p \bar{p} K^+ \pi^-) / \mathcal{B}(B^0 \rightarrow p \bar{p} K^+ \pi^-)$			$0.22 \pm 0.04 \pm 0.02 \pm 0.01$ [33]	0.22 ± 0.05
	$\mathcal{B}(B_s^0 \rightarrow p \bar{p} K^+ \pi^-) / \mathcal{B}(B_s^0 \rightarrow p \bar{p} K^+ K^-)$			$0.31 \pm 0.05 \pm 0.02$ [33]	0.31 ± 0.05
	$\mathcal{B}(B_s^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-) / \mathcal{B}(B_s^0 \rightarrow J/\psi \bar{K}^{*0})$ ¶			$0.014 \pm 0.004 \pm 0.001 \pm 0.001$ ‡ [35]	0.014 ± 0.004
	$\mathcal{B}(B_s^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-) / (\mathcal{B}(\bar{B}^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-))$ §			$0.033 \pm 0.011 \pm 0.003 \pm 0.002$ § [35]	0.033 ± 0.012

Channels with no RPP# were not included in PDG Live as of Dec. 31, 2017.

† Numerator includes two distinct decay processes: $\mathcal{B}(B_s^0 \rightarrow f) + \mathcal{B}(B_s^0 \rightarrow \bar{f})$.

¶ The denominator is multiplied by $\mathcal{B}(J/\psi \rightarrow \mu^+ \mu^-)$.

‡ Last error is from the S-wave fraction in $B_s^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-$ and $B_s^0 \rightarrow J/\psi \bar{K}^{*0}$.

§ Last error is from the S-wave fraction in $B_s^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-$ and $\bar{B}^0 \rightarrow \bar{K}^{*0} \mu^+ \mu^-$, and f_d/f_s .

° PDG also uses the denominator as input when computing the average.

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