Heavy Flavor Averaging Group
May 2013

Compilation of B_s Rare Branching Fractions
All branching fractions are in units of 10^{-6}

In PDG2012 New since PDG2012 (preliminary) New since PDG2012 (published)

RPP#	Mode	PDG2012 Avg.	Belle	CDF	D0	LHCb	CMS	ATLAS	New Avg.
27	$\pi^+\pi^-$	< 1.2	< 12	$0.57 \pm 0.15 \pm 0.10$†		$0.95^{+0.21}_{-0.17} \pm 0.13$			0.73 ± 0.14
33	$\phi\phi$	19^{+6}_{-5}		$19 \pm 3^{+5}_{-4}$ †					19 ± 5
34	π^+K^-	$5.3 \pm 0.9 \pm 0.4$	< 26	$5.3 \pm 0.9 \pm 0.4$ †		$5.4 \pm 0.4 \pm 0.6$ †			5.4 ± 0.6
35	K^+K^-	26.4 ± 2.8	$38^{+10}_{-9} \pm 7$	$25.8 \pm 2.2 \pm 1.7$ †		$23.0 \pm 0.7 \pm 2.3$			24.5 ± 1.8
36	$K^0\overline{K}^0$	< 66	< 66						< 66
–	$K^0\pi^+\pi^-$	New				$11.9 \pm 3.0 \pm 2.1$			11.9 ± 3.7
–	$K^0K^-\pi^+$	New				$97 \pm 7 \pm 11$			97 ± 13
–	$K^0K^+K^-$	New				$4.2 \pm 1.5 \pm 0.9$			4.2 ± 1.7
38	$K^{*0}\overline{K}^{*0}$	$28.1 \pm 4.6 \pm 5.6$				$28.1 \pm 4.6 \pm 5.6$			28.1 ± 7.2
39	$\phi\overline{K}^{*0}$	New				$1.10 \pm 0.24 \pm 0.16$			1.10 ± 0.29
41	$\gamma\gamma$	< 8.7	< 8.7						< 8.7
42	$\phi\gamma$	57^{+18+12}_{-15-11}	57^{+18+12}_{-15-11}			35 ± 4			35 ± 3
43	$\mu^+\mu^-$	< 0.0064		$0.013^{+0.009}_{-0.007}$†	< 0.015†	$0.0032^{+0.0014+0.0005}_{-0.0012-0.0003}$ †	< 0.0064†	< 0.019†	0.0032 ± 0.0010
44	e^+e^-	< 0.28		< 0.28†					< 0.28†
45	$e^\pm\mu^\mp$	< 0.20		< 0.20†					< 0.20†
–	$\mu^+\mu^-\mu^+\mu^-$	New				< 0.012			< 0.012
46	$\phi\mu^+\mu^-$	$1.23^{+0.40}_{-0.34}$		$1.17 \pm 0.18 \pm 0.37$†	< 3.2 †	$0.78 \pm 0.10 \pm 0.28$†			0.91 ± 0.24

†Relative BF converted to absolute BF

Heavy Flavor Averaging Group
May 2013

Compilation of B_s Rare Relative Branching Fractions (UL 90% CL)

In PDG2012 New since PDG2012 (preliminary) New since PDG2012 (published)

RPP#	Mode	PDG2012 Avg.	CDF	D0	LHCb	New Avg.
27	$f_s\mathcal{B}(B_s^0 \to \pi^+\pi^-)/f_d\mathcal{B}(B^0 \to K^+\pi^-)$		$0.008 \pm 0.002 \pm 0.001$			0.008 ± 0.002
33	$\mathcal{B}(B_s^0 \to \phi\phi)/\mathcal{B}(B_s^0 \to J/\psi\phi)$		$(1.78 \pm 0.14 \pm 0.20) \times 10^{-2}$			1.78 ± 0.24
34	$f_s\mathcal{B}(B_s^0 \to K^+\pi^-)/f_d\mathcal{B}(B_d^0 \to K^+\pi^-)$		$0.071 \pm 0.010 \pm 0.007$		$0.074 \pm 0.006 \pm 0.006$	0.073 ± 0.007
35	$f_s\mathcal{B}(B_s^0 \to K^+K^-)/f_d\mathcal{B}(B_d^0 \to K^+\pi^-)$		$0.347 \pm 0.020 \pm 0.021$			0.347 ± 0.029
46	$\mathcal{B}(B_s^0 \to \phi\mu^+\mu^-)/\mathcal{B}(B_s^0 \to J/\psi\phi) \times 10^3$		$0.90 \pm 0.14 \pm 0.07$	< 3.5	$0.558 \pm 0.070 \pm 0.043$	0.631 ± 0.073

Heavy Flavor Averaging Group
May 2013
Partial Branching Fraction

In PDG2012 New since PDG2012 (preliminary) New since PDG2012 (published)

All branching fractions are in units of 10^{-7}

RPP#	Mode	q^2 [(GeV/c^2)^2] †	PDG2012 Avg.	CDF	LHCb	New Avg.
46	$\phi\mu^+\mu^-$	< 2.0	$2.78 \pm 0.95 \pm 0.89$	$3.16 \pm 0.92 \pm 1.00$	0.81 ± 0.38	1.11 ± 0.35
	$\phi\mu^+\mu^-$	$[2.0, 4.3]$	$0.58 \pm 0.55 \pm 0.19$	$0.27 \pm 0.41 \pm 0.09$	0.63 ± 0.34	0.50 ± 0.24
	$\phi\mu^+\mu^-$	$[4.3, 8.68]$	$1.34 \pm 0.83 \pm 0.43$	$0.64 \pm 0.68 \pm 0.20$	1.34 ± 0.60	1.10 ± 0.41
	$\phi\mu^+\mu^-$	$[10.09, 12.86]$	$2.98 \pm 0.95 \pm 0.95$	$2.25 \pm 0.69 \pm 0.71$	1.29 ± 0.59	1.72 ± 0.47
	$\phi\mu^+\mu^-$	$[14.18, 16.00]$	$1.86 \pm 0.66 \pm 0.59$	$1.11 \pm 0.42 \pm 0.35$	1.32 ± 0.60	1.32 ± 0.37
	$\phi\mu^+\mu^-$	> 16.00	$2.32 \pm 0.76 \pm 0.74$	$2.31 \pm 0.59 \pm 0.73$	1.47 ± 0.67	1.87 ± 0.49
	$\phi\mu^+\mu^-$	$[1.00, 6.00]$	$1.14 \pm 0.79 \pm 0.36$	$1.03 \pm 0.70 \pm 0.33$	1.33 ± 0.38	1.25 ± 0.32

† see the original paper for the exact q^2 selection.

Charmless B_s Decays: CDF References

[1] CDF Collaboration (A. Aaltonen *et al.*), Phys. Rev. Lett. **87**, 072003 (2013).

[2] CDF Collaboration, (A. Aaltonen *et al.*), Phys. Rev. Lett. **103**, 031801 (2009).

[3] CDF Collaboration (A. Aaltonen *et al.*), Phys. Rev. Lett. **102**, 201801 (2009).

[4] CDF Collaboration, CDF public note 10894, July 2012.

[5] CDF Collaboration, (A. Aaltonen *et al.*), Phys. Rev. Lett. **107**, 261802 (2011).

[6] CDF Collaboration, (A. Aaltonen *et al.*), Phys. Rev. Lett. **108**, 211803 (2012).

[7] CDF Collaboration, (T. Aaltonen *et al.*), Phys. Rev. Lett. **106**, 181802 (2011).

[8]

[9]

DØ References

[10] DØ Collaboration (V. Abazov *et al.*), Phys. Rev. D **87**, 072006 (2013).

[11] DØ Collaboration (V. Abazov *et al.*), Phys. Rev. D **74**, 031107 (2006).

Belle References

[12] Belle Collaboration (J. Wicht *et al.*), Phys. Rev. Lett. **100**, 121801 (2008).

[13] Belle Collaboration (C.-C. Peng, P. Chang) Phys. Rev. D **82**, 072007 (2010).

LHCb References

[14] LHCb Collaboration, (R. Aaij *et al.*), Phys. Rev. Lett. **110**, 021801 (2013).

[15] LHCb Collaboration, (R. Aaij *et al.*), Phys. Lett. B **709**, 50 (2012).

[16] LHCb Collaboration, (R. Aaij *et al.*), J. High Energ. Phys. **1210**, 037 (2012).

[17] LHCb Collaboration, (R. Aaij *et al.*), Nucl. Phys. B **867**, 1 (2013).

[18] LHCb Collaboration, LHCb-CONF-2012-003 (2012).

[19] LHCb Collaboration, (R. Aaij *et al.*), Phys. Rev. Lett. **110**, 211801 (2013).

[20] LHCb Collaboration, LHCb-CONF-2012-023 (2012).

[21] LHCb Collaboration (R. Aaij *et al.*), arXiv:1306.2239 (2013).

[22]

[23]

[24]

CMS/ATLAS References

[25] CMS Collaboration (S. Chatrchyan *et al.*), J. High Energ. Phys. **1204**, 033 (2012).

[26] ATLAS Collaboration (G. Aad *et al.*), Phys. Lett. B **713**, 387 (2012).