Heavy FLavor AVeraging group (HFLAV) - November 2016

Measurements of the longitudinal polarization fraction (f_L) in B^+ decays

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

RPP#	Mode	PDG2014 Avg.	BABAR	Belle	Our Avg.
282	ωK^{*+}	$0.41 \pm 0.18 \pm 0.05$	$0.41 \pm 0.18 \pm 0.05$ [1]		0.41 ± 0.19
285	$\omega K_2^*(1430)^+$	$0.56 \pm 0.10 \pm 0.04$	$0.56 \pm 0.10 \pm 0.04$ [1]		0.56 ± 0.11
312	$K^{*+}\rho^0$	$0.78 \pm 0.12 \pm 0.03$	$0.78 \pm 0.12 \pm 0.03$ [2]		0.78 ± 0.12
316	$K^{*0}\rho^+$	0.48 ± 0.08	$0.52 \pm 0.10 \pm 0.04$ [3]	$0.43 \pm 0.11^{+0.05}_{-0.02}$ [4]	0.48 ± 0.08
338	$K^{*+}\overline{K}^{*0}$	$0.75^{+0.16}_{-0.26} \pm 0.03$	$0.75^{+0.16}_{-0.26} \pm 0.03$ [5]		$0.75^{+0.16}_{-0.26}$
349	ϕK^{*+}	0.50 ± 0.05	$0.49 \pm 0.05 \pm 0.03$ [6]	$0.52 \pm 0.08 \pm 0.03$ [7]	0.50 ± 0.05
351	$\phi K_1(1270)^+$	$0.46^{+0.12+0.06}_{-0.13-0.07}$	$0.46^{+0.12+0.06}_{-0.13-0.07}$ [8]		$0.46^{+0.13}_{-0.15}$
355	$\phi K_2^*(1430)^+$	$0.80^{+0.09}_{-0.10} \pm 0.03$	$0.80^{+0.09}_{-0.10} \pm 0.03$ [8]		0.80 ± 0.10
391	$\rho^+\rho^0$	0.950 ± 0.016	$0.950 \pm 0.015 \pm 0.006$[9]	$0.95 \pm 0.11 \pm 0.02$[10]	0.950 ± 0.016
396	$\omega\rho^+$	$0.90 \pm 0.05 \pm 0.03$	$0.90 \pm 0.05 \pm 0.03$ [1]		0.90 ± 0.06

Heavy FLavor AVeraging group (HFLAV) - November 2016

Measurements of the longitudinal polarization fraction (f_L) in B^0 decays

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

RPP#	Mode	PDG2014 Avg.	BABAR	Belle	LHCb	Our Avg.
246	ωK^{*0}	0.69 ± 0.13	$0.72 \pm 0.14 \pm 0.02$ [1]	$0.56 \pm 0.29^{+0.18}_{-0.08}$ [11]		0.70 ± 0.13
249	$\omega K_2^*(1430)^0$	$0.45 \pm 0.12 \pm 0.02$	$0.45 \pm 0.12 \pm 0.02$ [1]			0.45 ± 0.12
279	$K^{*0}\rho^0$	$0.40 \pm 0.08 \pm 0.11$	$0.40 \pm 0.08 \pm 0.11$ [12]			0.40 ± 0.14
284	$K^{*+}\rho^-$	$0.38 \pm 0.13 \pm 0.03$	$0.38 \pm 0.13 \pm 0.03$ [12]			0.38 ± 0.13
312	ϕK^{*0}	0.497 ± 0.025	$0.494 \pm 0.034 \pm 0.013$[13]	$0.499 \pm 0.030 \pm 0.018$[14]	$0.497 \pm 0.019 \pm 0.015$[15]	0.497 ± 0.017
315	$K^{*0}\overline{K}^{*0}$	$0.80^{+0.10}_{-0.12} \pm 0.06$	$0.80^{+0.10}_{-0.12} \pm 0.06$ [16]			$0.80^{+0.12}_{-0.13}$
333	$\phi K_2^*(1430)^0$	$0.901^{+0.046}_{-0.058} \pm 0.037$	$0.901^{+0.046}_{-0.058} \pm 0.037$ [13]			$0.901^{+0.059}_{-0.069}$
386	$\rho^0\rho^0$	$0.75^{+0.11}_{-0.14} \pm 0.05$	$0.75^{+0.11}_{-0.14} \pm 0.05$ [17]	$0.21^{+0.18}_{-0.22} \pm 0.15$ [18]	$0.745^{+0.048}_{-0.058} \pm 0.034$ [19]	$0.714^{+0.055}_{-0.062}$
394	$\rho^+\rho^-$	$0.977^{+0.028}_{-0.024}$	$0.992 \pm 0.024^{+0.026}_{-0.013}$ [20]	$0.941^{+0.034}_{-0.040} \pm 0.030$ [21]		$0.978^{+0.025}_{-0.022}$
405	$a_1^{\pm}a_1^{\mp}$	$0.31 \pm 0.22 \pm 0.10$	$0.31 \pm 0.22 \pm 0.10$ [22]			0.31 ± 0.24

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B^+ \to \phi K^{*+}$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	BABAR	Belle	Our Avg.
$f_\perp = \Lambda_{\perp\perp}$	0.20 ± 0.05	$0.21 \pm 0.05 \pm 0.02$[6]	$0.19 \pm 0.08 \pm 0.02$[7]	0.20 ± 0.05
$\phi_\parallel$	2.34 ± 0.18	$2.47 \pm 0.20 \pm 0.07$	$2.10 \pm 0.28 \pm 0.04$	2.34 ± 0.17
$\phi_\perp$	2.58 ± 0.17	$2.69 \pm 0.20 \pm 0.03$	$2.31 \pm 0.30 \pm 0.07$	2.58 ± 0.17
δ_0	$3.07 \pm 0.18 \pm 0.06$	$3.07 \pm 0.18 \pm 0.06$		3.07 ± 0.19
A_{CP}^0	$0.17 \pm 0.11 \pm 0.02$	$0.17 \pm 0.11 \pm 0.02$		0.17 ± 0.11
$A_{CP}^\perp$	$0.22 \pm 0.24 \pm 0.08$	$0.22 \pm 0.24 \pm 0.08$		0.22 ± 0.25
$\Delta\phi_\parallel$	$0.07 \pm 0.20 \pm 0.05$	$0.07 \pm 0.20 \pm 0.05$		0.07 ± 0.21
$\Delta\phi_\perp$	$0.19 \pm 0.20 \pm 0.07$	$0.19 \pm 0.20 \pm 0.07$		0.19 ± 0.21
$\Delta\delta_0$	$0.20 \pm 0.18 \pm 0.03$	$0.20 \pm 0.18 \pm 0.03$		0.20 ± 0.18

Angles (ϕ, δ) are in radians. BF, f_L and A_{CP} are tabulated separately.

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B^0 \to \phi K^{*0}$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	BABAR	Belle	LHCb	Our Avg.
$f_\perp = \Lambda_{\perp\perp}$	0.228 ± 0.021	$0.212 \pm 0.032 \pm 0.013$[13]	$0.238 \pm 0.026 \pm 0.008$[14]	$0.221 \pm 0.016 \pm 0.013$ [15]	0.225 ± 0.015
$f_S(K\pi)$				$0.143 \pm 0.013 \pm 0.012$	0.143 ± 0.018
$f_S(KK)$				$0.122 \pm 0.013 \pm 0.008$	0.122 ± 0.015
$\phi_\parallel$	2.28 ± 0.08	$2.40 \pm 0.13 \pm 0.08$	$2.23 \pm 0.10 \pm 0.02$	$2.562 \pm 0.069 \pm 0.040$	2.430 ± 0.058
$\phi_\perp$	2.36 ± 0.09	$2.35 \pm 0.13 \pm 0.09$	$2.37 \pm 0.10 \pm 0.04$	$2.633 \pm 0.062 \pm 0.037$	2.527 ± 0.056
δ_0	2.88 ± 0.10	$2.82 \pm 0.15 \pm 0.09$	$2.91 \pm 0.10 \pm 0.08$		2.88 ± 0.10
$\phi_S(K\pi)$ †				$2.222 \pm 0.063 \pm 0.081$	2.222 ± 0.103
$\phi_S(KK)$ †				$2.481 \pm 0.072 \pm 0.048$	2.481 ± 0.087
A_{CP}^0	-0.01 ± 0.05	$0.01 \pm 0.07 \pm 0.02$	$-0.03 \pm 0.06 \pm 0.01$	$-0.003 \pm 0.038 \pm 0.005$	-0.007 ± 0.030
$A_{CP}^\perp$	-0.11 ± 0.09	$-0.04 \pm 0.15 \pm 0.06$	$-0.14 \pm 0.11 \pm 0.01$	$0.047 \pm 0.072 \pm 0.009$	-0.014 ± 0.057
$\mathcal{A}_{CP}^S(K\pi)$				$0.073 \pm 0.091 \pm 0.035$	0.073 ± 0.097
$\mathcal{A}_{CP}^S(KK)$				$-0.209 \pm 0.105 \pm 0.012$	-0.209 ± 0.106
$\Delta\phi_\parallel$	0.06 ± 0.11	$0.22 \pm 0.12 \pm 0.08$	$-0.02 \pm 0.10 \pm 0.01$	$0.045 \pm 0.068 \pm 0.015$	0.051 ± 0.053
$\Delta\phi_\perp$	0.10 ± 0.08	$0.21 \pm 0.13 \pm 0.08$	$0.05 \pm 0.10 \pm 0.02$	$0.062 \pm 0.062 \pm 0.006$	0.075 ± 0.050
$\Delta\delta_0$	0.13 ± 0.09	$0.27 \pm 0.14 \pm 0.08$	$0.08 \pm 0.10 \pm 0.01$		0.13 ± 0.08
$\Delta\phi_S(K\pi)$ †				$0.062 \pm 0.062 \pm 0.022$	0.062 ± 0.066
$\Delta\phi_S(KK)$ †				$0.022 \pm 0.072 \pm 0.004$	0.022 ± 0.072

Angles (ϕ, δ) are in radians. BF, f_L and A_{CP} are tabulated separately.
† Original LHCb notation adapted to match similar existing quantities.

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B^0 \to \phi K_2^{*0}(1430)$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	BABAR	Belle	Our Avg.
$f_\perp = \Lambda_{\perp\perp}$	$0.027^{+0.031}_{-0.025}$	$0.002^{+0.018}_{-0.002} \pm 0.031$ [13]	$0.056^{+0.050}_{-0.035} \pm 0.009$ [14]	$0.027^{+0.027}_{-0.024}$
$\phi_\parallel$	4.0 ± 0.4	$3.96 \pm 0.38 \pm 0.06$	$3.76 \pm 2.88 \pm 1.32$	3.96 ± 0.38
$\phi_\perp$	4.5 ± 0.4		$4.45^{+0.43}_{-0.38} \pm 0.13$	$4.45^{+0.45}_{-0.40}$
δ_0	3.46 ± 0.14	$3.41 \pm 0.13 \pm 0.13$	$3.53 \pm 0.11 \pm 0.19$	3.46 ± 0.14
A_{CP}^0	-0.03 ± 0.04	$-0.05 \pm 0.06 \pm 0.01$	$-0.016^{+0.066}_{-0.051} \pm 0.008$	$-0.032^{+0.043}_{-0.038}$
$A_{CP}^\perp$	$0.0^{+0.9}_{-0.7}$		$-0.01^{+0.85}_{-0.67} \pm 0.09$	$-0.01^{+0.85}_{-0.68}$
$\Delta\phi_\parallel$	-0.9 ± 0.4	$-1.00 \pm 0.38 \pm 0.09$	$-0.02 \pm 1.08 \pm 1.01$	-0.94 ± 0.38
$\Delta\phi_\perp$	-0.2 ± 0.4		$-0.19 \pm 0.42 \pm 0.11$	-0.19 ± 0.43
$\Delta\delta_0$	0.08 ± 0.09	$0.11 \pm 0.13 \pm 0.06$	$0.06 \pm 0.11 \pm 0.02$	0.08 ± 0.09

Angles (ϕ, δ) are in radians. BF, f_L and A_{CP} are tabulated separately.

Heavy FLavor AVeraging group (HFLAV) - November 2016

Measurements of the longitudinal polarization fraction (f_L) in B_s^0 decays

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

RPP#	Mode	PDG2014 Avg.	CDF	LHCb	Our Avg.
51	$\phi\phi$	0.361 ± 0.022	$0.348 \pm 0.041 \pm 0.021$[23]	$0.365 \pm 0.022 \pm 0.012$[24]	0.361 ± 0.022
59	$K^{*0}\overline{K}^{*0}$	0.31 ± 0.13		$0.201 \pm 0.057 \pm 0.040$[25]	0.201 ± 0.070
60	$\phi\overline{K}^{*0}$	0.51 ± 0.17		$0.51 \pm 0.15 \pm 0.07$ [26]	0.51 ± 0.17

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B_s^0 \to \phi\phi$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	CDF	LHCb	Our Avg.
$f_\perp = \Lambda_{\perp\perp}$	0.306 ± 0.030	$0.365 \pm 0.044 \pm 0.027$[23]	$0.291 \pm 0.024 \pm 0.010$[24]	0.306 ± 0.023
$\phi_\parallel$	2.59 ± 0.15	$2.71^{+0.31}_{-0.36} \pm 0.22$	$2.57 \pm 0.15 \pm 0.06$	2.59 ± 0.15

The parameter ϕ is in radians. BF, f_L and A_{CP} are tabulated separately.

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B_s^0 \to \phi\overline{K}^{*0}$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	LHCb	Our Avg.
$f_\perp = \Lambda_{\perp\perp}$		$0.28 \pm 0.12 \pm 0.03$[26]	0.28 ± 0.12
f_0		$0.51 \pm 0.15 \pm 0.07$	0.51 ± 0.17
$f_\parallel$	0.21 ± 0.11	$0.21 \pm 0.11 \pm 0.02$	0.21 ± 0.11
$\phi_\parallel$ †	$1.75 \pm 0.53 \pm 0.29$	$1.75^{+0.59+0.38}_{-0.53-0.30}$	$1.75^{+0.70}_{-0.61}$

The parameter ϕ is in radians. BF, f_L and A_{CP} are tabulated separately.

† Converted from the measurement of $\cos(\phi_\parallel)$. PDG takes the smallest resulting asymmetric error as parabolic.

Heavy FLavor AVeraging group (HFLAV) - November 2016

Full angular analysis of $B_s^0 \to K^{*0}\overline{K}^{*0}$

In PDG2014 New since PDG2014 (preliminary) New since PDG2014 (published)

Parameter	PDG2014 Avg.	LHCb	Our Avg.
f_L	$0.31 \pm 0.12 \pm 0.04$	$0.201 \pm 0.057 \pm 0.040$[25]	0.201 ± 0.070
$f_\parallel$		$0.215 \pm 0.046 \pm 0.015$	0.215 ± 0.048
$\lvert A_s^+\rvert^2$		$0.114 \pm 0.037 \pm 0.023$	0.114 ± 0.044
$\lvert A_s^-\rvert^2$		$0.485 \pm 0.051 \pm 0.019$	0.485 ± 0.054
$\lvert A_{ss}\rvert^2$		$0.066 \pm 0.022 \pm 0.007$	0.066 ± 0.023
$\delta_\parallel$		$5.31 \pm 0.24 \pm 0.14$	5.31 ± 0.28
$\delta_\perp - \delta_s^+$		$1.95 \pm 0.21 \pm 0.04$	1.95 ± 0.21
δ_s^-		$1.79 \pm 0.19 \pm 0.19$	1.79 ± 0.27
δ_{ss}		$1.06 \pm 0.27 \pm 0.23$	1.06 ± 0.35

References

[1] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D79**, 052005, (2009), arXiv:0901.3703 [hep-ex].

[2] P. del Amo Sanchez *et al.*, (*BABAR* collaboration), Phys. Rev. **D83**, 051101, (2011), arXiv:1012.4044 [hep-ex].

[3] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. Lett. **97**, 201801, (2006), arXiv:hep-ex/0607057 [hep-ex].

[4] J. Zhang *et al.*, (Belle collaboration), Phys. Rev. Lett. **95**, 141801, (2005), arXiv:hep-ex/0408102 [hep-ex].

[5] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D79**, 051102, (2009), arXiv:0901.1223 [hep-ex].

[6] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. Lett. **99**, 201802, (2007), arXiv:0705.1798 [hep-ex].

[7] K. F. Chen *et al.*, (Belle collaboration), Phys. Rev. Lett. **94**, 221804, (2005), arXiv:hep-ex/0503013 [hep-ex].

[8] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. Lett. **101**, 161801, (2008), arXiv:0806.4419 [hep-ex].

[9] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. Lett. **102**, 141802, (2009), arXiv:0901.3522 [hep-ex].

[10] J. Zhang *et al.*, (Belle collaboration), Phys. Rev. Lett. **91**, 221801, (2003), arXiv:hep-ex/0306007 [hep-ex].

[11] P. Goldenzweig *et al.*, (Belle collaboration), Phys. Rev. Lett. **101**, 231801, (2008), arXiv:0807.4271 [hep-ex].

[12] J. P. Lees *et al.*, (*BABAR* collaboration), Phys. Rev. **D85**, 072005, (2012), arXiv:1112.3896 [hep-ex].

[13] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D78**, 092008, (2008), arXiv:0808.3586 [hep-ex].

[14] M. Prim *et al.*, (Belle collaboration), Phys. Rev. **D88**, 072004, (2013), arXiv:1308.1830 [hep-ex].

[15] R. Aaij *et al.*, (LHCb collaboration), JHEP **05**, 069, (2014), arXiv:1403.2888 [hep-ex].

[16] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. Lett. **100**, 081801, (2008), arXiv:0708.2248 [hep-ex].

[17] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D78**, 071104, (2008), arXiv:0807.4977 [hep-ex].

[18] I. Adachi *et al.*, (Belle collaboration), Phys. Rev. **D89**, 072008, (2014), arXiv:1212.4015 [hep-ex], Addendum ibid. **D89**, 119903, (2014).

[19] R. Aaij *et al.*, (LHCb collaboration), Phys. Lett. **B747**, 468, (2015), arXiv:1503.07770 [hep-ex].

[20] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D76**, 052007, (2007), arXiv:0705.2157 [hep-ex].

[21] A. Somov *et al.*, (Belle collaboration), Phys. Rev. Lett. **96**, 171801, (2006), arXiv:hep-ex/0601024 [hep-ex].

[22] B. Aubert *et al.*, (*BABAR* collaboration), Phys. Rev. **D80**, 092007, (2009), arXiv:0907.1776 [hep-ex].

[23] T. Aaltonen *et al.*, (CDF collaboration), Phys. Rev. Lett. **107**, 261802, (2011), arXiv:1107.4999 [hep-ex].

[24] R. Aaij *et al.*, (LHCb collaboration), Phys. Lett. **B713**, 369, (2012), arXiv:1204.2813 [hep-ex].

[25] R. Aaij *et al.*, (LHCb collaboration), JHEP **07**, 166, (2015), arXiv:1503.05362 [hep-ex].

[26] R. Aaij *et al.*, (LHCb collaboration), JHEP **11**, 092, (2013), arXiv:1306.2239 [hep-ex].