

Heavy FLavor AVeraging group (HFLAV) - April 2019
 Measurements of the longitudinal polarization fraction (f_L) in B^+ decays
 Preliminary Updated results not included in PDG Live as of Dec. 31, 2017

Mode	PDG2017 Avg.	BABAR	Belle	Our Avg.
ωK^{*+}	0.41 ± 0.19	$0.41 \pm 0.18 \pm 0.05$ [1]		0.41 ± 0.19
$\omega K_2^*(1430)^+$	0.56 ± 0.11	$0.56 \pm 0.10 \pm 0.04$ [1]		0.56 ± 0.11
$K^{*+}\bar{K}^{*0}$	$0.82_{-0.21}^{+0.15}$	$0.75_{-0.26}^{+0.16} \pm 0.03$ [2]	$1.06 \pm 0.30 \pm 0.14$ [3]	$0.82_{-0.18}^{+0.13}$
ϕK^{*+}	0.50 ± 0.05	$0.49 \pm 0.05 \pm 0.03$ [4]	$0.52 \pm 0.08 \pm 0.03$ [5]	0.50 ± 0.05
$\phi K_1(1270)^+$	0.46 ± 0.14	$0.46_{-0.13-0.07}^{+0.12+0.06}$ [6]		$0.46_{-0.15}^{+0.13}$
$\phi K_2^*(1430)^+$	0.80 ± 0.10	$0.80_{-0.10}^{+0.09} \pm 0.03$ [6]		0.80 ± 0.10
$K^{*+}\rho^0$	0.78 ± 0.12	$0.78 \pm 0.12 \pm 0.03$ [7]		0.78 ± 0.12
$K^{*0}\rho^+$	0.48 ± 0.08	$0.52 \pm 0.10 \pm 0.04$ [8]	$0.43 \pm 0.11_{-0.02}^{+0.05}$ [9]	0.48 ± 0.08
$\rho^+\rho^0$	0.950 ± 0.016	$0.950 \pm 0.015 \pm 0.006$ [10]	$0.95 \pm 0.11 \pm 0.02$ [11]	0.950 ± 0.016
$\omega\rho^+$	0.90 ± 0.06	$0.90 \pm 0.05 \pm 0.03$ [1]		0.90 ± 0.06
$p\bar{p}K^{*+}$	0.32 ± 0.19		$0.32 \pm 0.17 \pm 0.09$ [12]	0.32 ± 0.19

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Mode	PDG2017 Avg.	BABAR	Belle	LHCb	Our Avg.
ωK^{*0}	0.69 ± 0.13	$0.72 \pm 0.14 \pm 0.02$ [1]	$0.56 \pm 0.29_{-0.08}^{+0.18}$ [13]		0.70 ± 0.13
$\omega K_2^*(1430)^0$	0.45 ± 0.12	$0.45 \pm 0.12 \pm 0.02$ [1]			0.45 ± 0.12
$K^{*0}\bar{K}^{*0}$	$0.80_{-0.13}^{+0.12}$	$0.80_{-0.12}^{+0.10} \pm 0.06$ [14]			$0.80_{-0.13}^{+0.12}$
ϕK^{*0}	0.497 ± 0.017	$0.494 \pm 0.034 \pm 0.013$ [15]	$0.499 \pm 0.030 \pm 0.018$ [16]	$0.497 \pm 0.019 \pm 0.015$ [17]	0.497 ± 0.017
$\phi K_2^*(1430)^0$	$0.913_{-0.050}^{+0.028}$	$0.901_{-0.058}^{+0.046} \pm 0.037$ [15]	$0.918_{-0.060}^{+0.029} \pm 0.012$ [16]		$0.913_{-0.048}^{+0.029}$
$K^{*0}\rho^0$	0.40 ± 0.14	$0.40 \pm 0.08 \pm 0.11$ [18]			0.40 ± 0.14
$K^{*+}\rho^-$	0.38 ± 0.13	$0.38 \pm 0.13 \pm 0.03$ [18]			0.38 ± 0.13
$\rho^+\rho^-$	$0.990_{-0.019}^{+0.021}$	$0.992 \pm 0.024_{-0.013}^{+0.026}$ [19]	$0.988 \pm 0.012 \pm 0.023$ [20]		$0.990_{-0.018}^{+0.021}$
$\rho^0\rho^0$	$0.71_{-0.09}^{+0.08}$	$0.75_{-0.14}^{+0.11} \pm 0.05$ [21]	$0.21_{-0.22}^{+0.18} \pm 0.15$ [22]	$0.745_{-0.058}^{+0.048} \pm 0.034$ [23]	$0.714_{-0.062}^{+0.055}$
$a_1^+ a_1^-$	0.31 ± 0.24	$0.31 \pm 0.22 \pm 0.10$ [24]			0.31 ± 0.24
$p\bar{p}K^{*0}$	1.01 ± 0.13		$1.01 \pm 0.13 \pm 0.03$ [12]		1.01 ± 0.13
$\lambda\bar{\lambda}K^{*0}$	0.60 ± 0.23		$0.60 \pm 0.22 \pm 0.08$ [25]		0.60 ± 0.23
$K^{*0}e^+e^-$	0.16 ± 0.07			$0.16 \pm 0.06 \pm 0.03$ † [25]	0.16 ± 0.07

† $0.002 < q^2 < 1.120 \text{ GeV}^2/c^4$

Heavy FLavor AVeraging group (HFLAV) - April 2019
 Full angular analysis of $B^+ \rightarrow \phi K^{*+}$
 Preliminary Updated results not included in PDG Live as of Dec. 31, 2017

Parameter	PDG2017 Avg.	BABAR	Belle	Our Avg.
$f_{\perp} = \Lambda_{\perp\perp}$	0.20 ± 0.05	$0.21 \pm 0.05 \pm 0.02$ [4]	$0.19 \pm 0.08 \pm 0.02$ [5]	0.20 ± 0.05
ϕ_{\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
ϕ_{\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 ± 19	$3.07 \pm 0.18 \pm 0.06$		3.07 ± 0.19
A_{CP}^0	0.17 ± 0.11	$0.17 \pm 0.11 \pm 0.02$		0.17 ± 0.11
A_{CP}^{\perp}	0.22 ± 0.25	$0.22 \pm 0.24 \pm 0.08$		0.22 ± 0.25
$\Delta\phi_{\parallel}$	0.07 ± 0.21	$0.07 \pm 0.20 \pm 0.05$		0.07 ± 0.21
$\Delta\phi_{\perp}$	0.19 ± 0.21	$0.19 \pm 0.20 \pm 0.07$		0.19 ± 0.21
$\Delta\delta_0$	0.20 ± 0.18	$0.20 \pm 0.18 \pm 0.03$		0.20 ± 0.18

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

Heavy FLavor AVeraging group (HFLAV) - April 2019

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

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

Parameter	PDG2017 Avg.	BABAR	Belle	LHCb	Our Avg.
$f_{\perp} = \Lambda_{\perp\perp}$	0.224 ± 0.015	$0.212 \pm 0.032 \pm 0.013$ [15]	$0.238 \pm 0.026 \pm 0.008$ [16]	$0.221 \pm 0.016 \pm 0.013$ [17]	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
ϕ_{\parallel}	2.43 ± 0.11	$2.40 \pm 0.13 \pm 0.08$	$2.23 \pm 0.10 \pm 0.02$	$2.562 \pm 0.069 \pm 0.040$	2.430 ± 0.058
ϕ_{\perp}	2.53 ± 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
$\phi_S(K\pi)^\dagger$				$2.222 \pm 0.063 \pm 0.081$	2.222 ± 0.103
$\phi_S(KK)^\dagger$				$2.481 \pm 0.072 \pm 0.048$	2.481 ± 0.087
A_{CP}^0	-0.007 ± 0.030	$0.01 \pm 0.07 \pm 0.02$	$-0.03 \pm 0.06 \pm 0.01$	$-0.003 \pm 0.038 \pm 0.005$	-0.007 ± 0.030
A_{CP}^{\perp}	-0.02 ± 0.06	$-0.04 \pm 0.15 \pm 0.06$	$-0.14 \pm 0.11 \pm 0.01$	$0.047 \pm 0.072 \pm 0.009$	-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
$\Delta\phi_{\parallel}$	0.05 ± 0.05	$0.22 \pm 0.12 \pm 0.08$	$-0.02 \pm 0.10 \pm 0.01$	$0.045 \pm 0.068 \pm 0.015$	0.051 ± 0.053
$\Delta\phi_{\perp}$	0.08 ± 0.05	$0.21 \pm 0.13 \pm 0.08$	$0.05 \pm 0.10 \pm 0.02$	$0.062 \pm 0.062 \pm 0.006$	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
$\Delta\phi_S(K\pi)^\dagger$				$0.062 \pm 0.062 \pm 0.022$	0.062 ± 0.066
$\Delta\phi_S(KK)^\dagger$				$0.022 \pm 0.072 \pm 0.004$	0.022 ± 0.072

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

\dagger Original LHCb notation adapted to match similar existing quantities.

Heavy FLavor AVeraging group (HFLAV) - April 2019

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

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

Parameter	PDG2017 Avg.	BABAR	Belle	Our Avg.
$f_{\perp} = \Lambda_{\perp\perp}$	$0.027^{+0.031}_{-0.025}$	$0.002^{+0.018}_{-0.002} \pm 0.031$ [15]	$0.056^{+0.050}_{-0.035} \pm 0.009$ [16]	$0.027^{+0.027}_{-0.024}$
ϕ_{\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
ϕ_{\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) - April 2019

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

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

Mode	PDG2017 Avg.	CDF	LHCb	Our Avg.
$\phi\phi$	0.362 ± 0.014	$0.348 \pm 0.041 \pm 0.021$ [26]	$0.382 \pm 0.008 \pm 0.011$ [27]	0.379 ± 0.013
$K^{*0}\bar{K}^{*0}$	0.20 ± 0.07		$0.201 \pm 0.057 \pm 0.040$ [28]	0.201 ± 0.070
$\phi\bar{K}^{*0}$	0.51 ± 0.17		$0.51 \pm 0.15 \pm 0.07$ [29]	0.51 ± 0.17

Heavy FLavor AVeraging group (HFLAV) - April 2019
 Full angular analysis of $B_s^0 \rightarrow \phi\phi$

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

Parameter	PDG2017 Avg.	CDF	LHCb	Our Avg.
$f_{\perp} = \Lambda_{\perp\perp}$	0.309 ± 0.015	$0.305 \pm 0.013 \pm 0.005$ [26]	$0.287 \pm 0.008 \pm 0.005$ [27]	0.292 ± 0.008
ϕ_{\parallel}	2.55 ± 0.11	$2.71_{-0.36}^{+0.31} \pm 0.22$	$2.52 \pm 0.05 \pm 0.07$	2.53 ± 0.08
ϕ_{\perp}	2.67 ± 0.24		$2.81 \pm 0.21 \pm 0.10$	2.81 ± 0.23

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

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 Full angular analysis of $B_s^0 \rightarrow \phi\bar{K}^{*0}$

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Parameter	PDG2017 Avg.	LHCb	Our Avg.
f_L	0.51 ± 0.17	$0.51 \pm 0.15 \pm 0.07$ [29]	0.51 ± 0.17
f_{\parallel}	0.21 ± 0.11	$0.21 \pm 0.11 \pm 0.02$	0.21 ± 0.11
$\phi_{\parallel}^{\dagger}$	1.8 ± 0.6	$1.75_{-0.53-0.30}^{+0.59+0.38}$	$1.75_{-0.61}^{+0.70}$

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) - April 2019
 Full angular analysis of $B_s^0 \rightarrow K^{*0}\bar{K}^{*0}$

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

Parameter	PDG2017 Avg.	LHCb	Our Avg.
f_L	0.20 ± 0.07	$0.201 \pm 0.057 \pm 0.040$ [28]	0.201 ± 0.070
f_{\perp}	0.38 ± 0.12	$0.38 \pm 0.11 \pm 0.004$	0.380 ± 0.110
f_{\parallel}	0.21 ± 0.05	$0.215 \pm 0.046 \pm 0.015$	0.215 ± 0.048
$ A_s^+ ^2$		$0.114 \pm 0.037 \pm 0.023$	0.114 ± 0.044
$ A_s^- ^2$		$0.485 \pm 0.051 \pm 0.019$	0.485 ± 0.054
$ A_{ss} ^2$		$0.066 \pm 0.022 \pm 0.007$	0.066 ± 0.023
δ_{\parallel}	5.31 ± 0.28	$5.31 \pm 0.24 \pm 0.14$	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

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