

# Heavy Flavor Averaging Group

August 2012

## Compilation of $B^+$ Semi-leptonic and Radiative 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.	BABAR	Belle	CLEO	CDF	LHCb	New Avg.
337	$K^{*\gamma}$	$42.1 \pm 1.8$	$42.2 \pm 1.4 \pm 1.6$	$42.5 \pm 3.1 \pm 2.4$	$37.6^{+8.9}_{-8.3} \pm 2.8$			$42.1 \pm 1.8$
338	$K_1^+(1270)\gamma$	$43 \pm 13$		$43 \pm 9 \pm 9$				$43 \pm 12$
339	$K^+\eta\gamma$	$7.9 \pm 0.9$	$7.7 \pm 1.0 \pm 0.4$	$8.4^{+1.5}_{-1.2} \pm 0.9$				$7.9 \pm 0.9$
340	$K^+\eta'\gamma$	$2.9^{+1.0}_{-0.9}$	$1.9^{+1.5}_{-1.2} \pm 0.1$	$3.6 \pm 1.2 \pm 0.4$				$2.9^{+1.0}_{-0.9}$
341	$K^+\phi\gamma$	$2.7 \pm 0.4$	$3.5 \pm 0.6 \pm 0.4$	$2.48 \pm 0.30 \pm 0.24$				$2.71 \pm 0.34$
342	$K^+\pi^-\pi^+\gamma$	$27.6 \pm 2.2$	$29.5 \pm 1.3 \pm 2.0$ †	$25.0 \pm 1.8 \pm 2.2$ ‡				$27.6 \pm 1.8$
343	$K^{*0}\pi^+\gamma$ §	$20^{+7}_{-6}$		$20^{+7}_{-6} \pm 2$				$20^{+7}_{-6}$
344	$K^+\rho^0\gamma$ §	$< 20$		$< 20$				$< 20$
345	$K^+\pi^-\pi^+\gamma$ (N.R.) §	$< 9.2$		$< 9.2$				$< 9.2$
346	$K^0\pi^+\pi^0\gamma$	$46 \pm 5$	$45.6 \pm 4.2 \pm 3.1$ †					$45.6 \pm 5.2$
347	$K_1^+(1400)\gamma$	$< 15$		$< 15$				$< 15$
348	$K_2^*(1430)^+\gamma$	$14 \pm 4$	$14.5 \pm 4.0 \pm 1.5$					$14.5 \pm 4.3$
350	$K_3^*(1780)^+\gamma$	$< 39$		$< 39$				$< 39$
352	$\rho^+\gamma$	$0.98 \pm 0.25$	$1.20^{+0.42}_{-0.37} \pm 0.20$	$0.87^{+0.29+0.09}_{-0.27-0.11}$	$< 13$			$0.98^{+0.25}_{-0.24}$
402	$p\bar{\Lambda}\gamma$	$2.4^{+0.5}_{-0.4}$		$2.45^{+0.44}_{-0.38} \pm 0.22$				$2.45^{+0.49}_{-0.44}$
406	$p\bar{\Sigma}^0\gamma$	$< 4.6$		$< 4.6$				$< 4.6$
437	$\pi^+\ell^+\ell^-$	$< 0.049$	$< 0.12$	$< 0.049$				$< 0.049$
438	$\pi^+e^+e^-$	$< 0.080$	$< 0.18$	$< 0.080$				$< 0.080$
439	$\pi^+\mu^+\mu^-$	$< 0.069$	$< 0.28$	$< 0.069$				$< 0.069$
440	$\pi^+\nu\bar{\nu}$	$< 100$	$< 100$	$< 170$				$< 100$
441	$K^+\ell^+\ell^-$	$0.51 \pm 0.05$	$0.47 \pm 0.06 \pm 0.02$	$0.53^{+0.06}_{-0.05} \pm 0.03$				$0.50 \pm 0.04$
442	$K^+e^+e^-$	$0.55 \pm 0.07$	$0.51^{+0.12}_{-0.11} \pm 0.02$	$0.57^{+0.09}_{-0.08} \pm 0.03$	$< 2.4$			$0.55 \pm 0.07$
443	$K^+\mu^+\mu^-$	$0.48 \pm 0.04$	$0.41^{+0.11}_{-0.15} \pm 0.02$	$0.53 \pm 0.08^{+0.07}_{-0.03}$	$< 3.68$	$0.45 \pm 0.03 \pm 0.02$		$0.46 \pm 0.03$
444	$K^+\nu\bar{\nu}$	$< 13$	$< 13$	$< 14$	$< 240$			$< 13$
445	$\rho^+\nu\bar{\nu}$	$< 150$		$< 150$				$< 150$
446	$K^{*+}\ell^+\ell^-$	$1.29 \pm 0.21$	$1.40^{+0.40}_{-0.37} \pm 0.09$	$1.24^{+0.23}_{-0.21} \pm 0.13$				$1.29^{+0.22}_{-0.21}$
447	$K^{*+}e^+e^-$	$1.55^{+0.40}_{-0.31}$	$1.38^{+0.47}_{-0.42} \pm 0.08$	$1.73^{+0.50}_{-0.42} \pm 0.20$				$1.55^{+0.35}_{-0.32}$
448	$K^{*+}\mu^+\mu^-$	$1.07 \pm 0.22$	$1.46^{+0.79}_{-0.75} \pm 0.12$	$1.11^{+0.32}_{-0.27} \pm 0.10$		$0.89 \pm 0.25 \pm 0.09$	$1.16 \pm 0.19$	$1.09^{+0.14}_{-0.13}$
449	$K^{*+}\nu\bar{\nu}$	$< 80$	$< 80$	$< 140$				$< 80$
452	$\pi^+e^\pm\mu^\mp$	$< 0.17$	$< 0.17$					$< 0.17$
–	$\pi^+e^+\tau^-$	New	$< 74$					$< 74$
–	$\pi^+e^-\tau^+$	New	$< 20$					$< 20$
–	$\pi^+e^\pm\tau^\mp$	New	$< 75$					$< 75$
–	$\pi^+\mu^+\tau^-$	New	$< 62$					$< 62$
–	$\pi^+\mu^-\tau^+$	New	$< 45$					$< 45$
–	$\pi^+\mu^\pm\tau^\mp$	New	$< 72$					$< 72$
453	$K^+e^+\mu^-$	$< 0.091$	$< 0.091$					$< 0.091$
454	$K^+e^-\mu^+$	$< 0.13$	$< 0.13$					$< 0.13$
455	$K^+e^\pm\mu^\mp$	$< 0.091$	$< 0.091$					$< 0.091$
–	$K^+e^+\tau^-$	New	$< 43$					$< 43$
–	$K^+e^-\tau^+$	New	$< 15$					$< 15$
–	$K^+e^\pm\tau^\mp$	New	$< 30$					$< 30$
–	$K^+\mu^+\tau^-$	New	$< 45$					$< 45$
–	$K^+\mu^-\tau^+$	New	$< 28$					$< 28$
456	$K^+\mu^\pm\tau^\mp$	$< 77$	$< 48$					$< 48$
457	$K^{*+}e^+\mu^-$	$< 1.3$	$< 1.3$					$< 1.3$
458	$K^{*+}e^-\mu^+$	$< 0.99$	$< 0.99$					$< 0.99$
459	$K^{*+}e^\pm\mu^\mp$	$< 1.4$	$< 1.4$					$< 1.4$
460	$\pi^-e^+e^+$	$< 1.6$	$< 0.023$		$< 1.6$			$< 0.023$
461	$\pi^-\mu^+\mu^+$	$< 0.04$	$< 0.107$		$< 1.4$		$< 0.044$	$< 0.044$
462	$\pi^-e^+\mu^+$	$< 1.3$			$< 1.3$			$< 1.3$
463	$\rho^-e^+e^+$	$< 2.6$			$< 2.6$			$< 2.6$
464	$\rho^-\mu^+\mu^+$	$< 5.0$			$< 5.0$			$< 5.0$
465	$\rho^-e^+\mu^+$	$< 3.3$			$< 3.3$			$< 3.3$
466	$K^-e^+e^+$	$< 1.0$	$< 0.03$		$< 1.0$			$< 0.03$
467	$K^-\mu^+\mu^+$	$< 0.04$	$< 0.067$		$< 1.8$		$< 0.041$	$< 0.041$
468	$K^-e^+\mu^+$	$< 2.0$			$< 2.0$			$< 2.0$
469	$K^{*-}e^+e^+$	$< 2.8$			$< 2.8$			$< 2.8$
470	$K^{*-}\mu^+\mu^+$	$< 8.3$			$< 8.3$			$< 8.3$
471	$K^{*-}e^+\mu^+$	$< 4.4$			$< 4.4$			$< 4.4$

†  $M_{K\pi\pi} < 1.8 \text{ GeV}/c^2$ ; ‡  $1.0 < M_{K\pi\pi} < 2.0 \text{ GeV}/c^2$ ; §  $M_{K\pi\pi} < 2.4 \text{ GeV}/c^2$

# Heavy Flavor Averaging Group

## August 2012

### Compilation of $B^0$ Semi-leptonic and Radiative 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.	BABAR	Belle	CLEO	CDF	LHCb	New Avg.
310	$K^0\eta\gamma$	$7.6 \pm 1.8$	$7.1^{+2.1}_{-2.0} \pm 0.4$	$8.7^{+3.1+1.9}_{-2.7-1.6}$				$7.6^{+1.8}_{-1.7}$
311	$K^0\eta'\gamma$	$< 6.4$	$< 6.6$	$< 6.4$				$< 6.4$
312	$K^0\phi\gamma$	$2.7 \pm 0.7$	$< 2.7$	$2.74 \pm 0.60 \pm 0.32$				$2.74 \pm 0.68$
313	$K^+\pi^-\gamma$ §	$4.6 \pm 1.4$		$4.6^{+1.3+0.5}_{-1.2-0.7}$				$4.6 \pm 1.4$
314	$K^{*0}\gamma$	$43.3 \pm 1.5$	$44.7 \pm 1.0 \pm 1.6$	$40.1 \pm 2.1 \pm 1.7$	$45.5^{+7.2}_{-6.8} \pm 3.4$			$43.3 \pm 1.5$
315	$K^*(1410)^0\gamma$	$< 130$		$< 130$				$< 130$
316	$K^+\pi^-\gamma$ (N.R.) §	$< 2.6$		$< 2.6$				$< 2.6$
318	$K^0\pi^+\pi^-\gamma$	$19.5 \pm 2.2$	$18.5 \pm 2.1 \pm 1.2$ †	$24 \pm 4 \pm 3$ ‡				$19.5 \pm 2.2$
319	$K^+\pi^-\pi^0\gamma$	$41 \pm 4$	$40.7 \pm 2.2 \pm 3.1$ †					$40.7 \pm 3.8$
320	$K_1^0(1270)\gamma$	$< 58$		$< 58$				$< 58$
321	$K_1^0(1400)\gamma$	$< 12$		$< 15$				$< 15$
322	$K_2^{*0}(1430)^0\gamma$	$12.4 \pm 2.4$	$12.2 \pm 2.5 \pm 1.0$	$13 \pm 5 \pm 1$				$12.4 \pm 2.4$
324	$K_3^{*0}(1780)^0\gamma$	$< 83$		$< 83$				$< 83$
326	$\rho^0\gamma$	$0.86 \pm 0.15$	$0.97^{+0.24}_{-0.22} \pm 0.06$	$0.78^{+0.17+0.09}_{-0.16-0.10}$	$< 17$			$0.86^{+0.15}_{-0.14}$
328	$\omega\gamma$	$0.44^{+0.18}_{-0.16}$	$0.50^{+0.27}_{-0.23} \pm 0.09$	$0.40^{+0.19}_{-0.17} \pm 0.13$	$< 9.2$			$0.44^{+0.18}_{-0.16}$
329	$\phi\gamma$	$< 0.85$	$< 0.85$		$< 3.3$			$< 0.85$
435	$\pi^0\ell^+\ell^-$	$< 0.12$	$< 0.12$	$< 0.154$				$< 0.12$
436	$\pi^0e^+e^-$	$< 0.14$	$< 0.14$	$< 0.227$				$< 0.14$
437	$\pi^0\mu^+\mu^-$	$< 0.18$	$< 0.51$	$< 0.184$				$< 0.184$
438	$\pi^0\nu\bar{\nu}$	$< 220$		$< 220$				$< 220$
439	$K^0\ell^+\ell^-$	$0.31^{+0.08}_{-0.07}$	$0.21^{+0.15}_{-0.13} \pm 0.02$	$0.34^{+0.09}_{-0.08} \pm 0.02$				$0.31^{+0.08}_{-0.07}$
440	$K^0e^+e^-$	$0.16^{+0.10}_{-0.08}$	$0.08^{+0.15}_{-0.12} \pm 0.01$	$0.20^{+0.14}_{-0.10} \pm 0.01$	$< 8.45$			$0.16^{+0.10}_{-0.08}$
441	$K^0\mu^+\mu^-$	$0.38 \pm 0.08$	$0.49^{+0.29}_{-0.25} \pm 0.03$	$0.44^{+0.13}_{-0.10} \pm 0.03$	$< 6.64$	<span style="color: blue;"><math>0.33 \pm 0.08 \pm 0.03</math></span>	<span style="color: red;"><math>0.31^{+0.07}_{-0.06}</math></span>	$0.35^{+0.05}_{-0.04}$
442	$K^0\nu\bar{\nu}$	$< 56$	$< 56$	$< 160$				$< 56$
443	$\rho^0\nu\bar{\nu}$	$< 440$		$< 440$				$< 440$
444	$K^{*0}\ell^+\ell^-$	$0.99^{+0.12}_{-0.11}$	$1.03^{+0.22}_{-0.21} \pm 0.07$	$0.97^{+0.13}_{-0.11} \pm 0.07$				$0.99^{+0.13}_{-0.11}$
445	$K^{*0}e^+e^-$	$1.03^{+0.19}_{-0.17}$	$0.86^{+0.26}_{-0.24} \pm 0.05$	$1.18^{+0.27}_{-0.22} \pm 0.09$				$1.03^{+0.19}_{-0.17}$
446	$K^{*0}\mu^+\mu^-$	$1.06 \pm 0.10$	$1.35^{+0.40}_{-0.37} \pm 0.10$	$1.06^{+0.19}_{-0.14} \pm 0.07$		<span style="color: blue;"><math>1.14 \pm 0.09 \pm 0.06</math></span>		$1.13^{+0.10}_{-0.09}$
447	$K^{*0}\nu\bar{\nu}$	$< 120$	$< 120$	$< 340$				$< 120$
448	$\phi\nu\bar{\nu}$	$< 58$		$< 58$				$< 58$
450	$\pi^0e^\pm\mu^\mp$	$< 0.14$	$< 0.14$					$< 0.14$
451	$K^0e^\pm\mu^\mp$	$< 0.27$	$< 0.27$					$< 0.27$
452	$K^{*0}e^\pm\mu^\mp$	$< 0.53$	$< 0.58$					$< 0.58$

†  $M_{K\pi\pi} < 1.8 \text{ GeV}/c^2$ ; ‡  $1.0 < M_{K\pi\pi} < 2.0 \text{ GeV}/c^2$ ; §  $1.25 \text{ GeV}/c^2 < M_{K\pi} < 1.6 \text{ GeV}/c^2$

Heavy Flavor Averaging Group  
August 2012

Compilation of  $B$  Semi-leptonic and Radiative 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.	BABAR	Belle	CLEO	New Avg.
65	$K\eta\gamma$	$8.5^{+1.8}_{-1.6}$		$8.5^{+1.3}_{-1.2} \pm 0.9$		$8.5^{+1.6}_{-1.5}$
67	$K_2^*(1430)\gamma$	$1.7^{+0.6}_{-0.5}$			$1.7 \pm 0.6 \pm 0.1$	$1.7 \pm 0.6$
69	$K_3^*(1780)\gamma$	$< 37$		$< 2.8$		$< 2.8$
76	$s\gamma$	$360 \pm 23$	$300 \pm 14 \pm 20$	$345 \pm 15 \pm 40$	$321 \pm 43^{+32}_{-29}$	$343 \pm 21 \pm 7$
77	$d\gamma$	$9.2 \pm 3.0$	$9.2 \pm 2.0 \pm 2.3$			$9.2 \pm 3.0$
83	$\rho\gamma$	$1.39 \pm 0.25$	$1.73^{+0.34}_{-0.32} \pm 0.17$	$1.21^{+0.24}_{-0.22} \pm 0.12$	$< 14$	$1.39^{+0.22}_{-0.21}$
84	$\rho/\omega\gamma$	$1.30 \pm 0.23$	$1.63^{+0.30}_{-0.28} \pm 0.16$	$1.14 \pm 0.20^{+0.10}_{-0.12}$	$< 14$	$1.30^{+0.18}_{-0.19}$
116	$se^+e^- \ddagger$	$4.7 \pm 1.3$	$6.0 \pm 1.7 \pm 1.3$	$4.56 \pm 1.15^{+0.33}_{-0.40}$	$< 57$	$4.91^{+1.04}_{-1.06}$
117	$s\mu^+\mu^-$	$4.3 \pm 1.2$	$5.0 \pm 2.8 \pm 1.2$	$1.91 \pm 1.02^{+0.16}_{-0.18}$	$< 58$	$2.23^{+0.97}_{-0.98}$
118	$s\ell^+\ell^- \ddagger$	$4.5 \pm 1.0$	$5.6 \pm 1.5 \pm 1.3$	$3.33 \pm 0.80^{+0.19}_{-0.24}$	$< 42$	$3.66^{+0.76}_{-0.77}$
119	$\pi\ell^+\ell^-$	$< 0.062$	$< 0.091$	$< 0.062$		$< 0.062$
120	$Ke^+e^-$	$0.44 \pm 0.06$	$0.39^{+0.09}_{-0.08} \pm 0.02$	$0.48^{+0.08}_{-0.07} \pm 0.03$		$0.44 \pm 0.06$
121	$K^*e^+e^-$	$1.19 \pm 0.20$	$0.99^{+0.23}_{-0.21} \pm 0.06$	$1.39^{+0.23}_{-0.20} \pm 0.12$		$1.19^{+0.17}_{-0.16}$
122	$K\mu^+\mu^-$	$0.44 \pm 0.04$	$0.41^{+0.13}_{-0.12} \pm 0.02$	$0.50 \pm 0.06 \pm 0.03$		$0.48 \pm 0.06$
123	$K^*\mu^+\mu^-$	$1.06 \pm 0.09$	$1.35^{+0.35}_{-0.33} \pm 0.10$	$1.10^{+0.16}_{-0.14} \pm 0.08$		$1.15^{+0.16}_{-0.15}$
124	$K\ell^+\ell^-$	$0.45 \pm 0.04$	<span style="color: red;"><math>0.47 \pm 0.06 \pm 0.02</math></span>	$0.48^{+0.05}_{-0.04} \pm 0.03$	$< 1.7$	$0.48 \pm 0.04$
125	$K^*\ell^+\ell^-$	$1.08 \pm 0.11$	<span style="color: red;"><math>1.02^{+0.14}_{-0.13} \pm 0.05</math></span>	$1.07^{+0.11}_{-0.10} \pm 0.09$	$< 3.3$	$1.05 \pm 0.10$
126	$K\nu\bar{\nu}$	$< 14$	$< 14$			$< 14$
127	$K^*\nu\bar{\nu}$	$< 80$	$< 80$			$< 80$
129	$\pi e^\pm\mu^\mp$	$< 0.092$	$< 0.092$		$< 1.6$	$< 0.092$
130	$\rho e^\pm\mu^\mp$	$< 3.2$			$< 3.2$	$< 3.2$
131	$Ke^\pm\mu^\mp$	$< 0.038$	$< 0.038$		$< 1.6$	$< 0.038$
132	$K^*e^\pm\mu^\mp$	$< 0.51$	$< 0.51$		$< 6.2$	$< 0.51$
–	$s\gamma$ with baryons	New			$< 38 \ddagger$	$< 38 \ddagger$

$\ddagger E_\gamma > 2.0$  GeV;  $\ddagger M(\ell^+\ell^-) > 0.2$  GeV/ $c^2$

Heavy Flavor Averaging Group  
August 2012  
Isospin Asymmetry

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

RPP#	Parameter	PDG2012 Avg.	BABAR	Belle	New Avg.
64	$\Delta_{0^-}(K^*\gamma)$	$0.052 \pm 0.026$	$0.066 \pm 0.021 \pm 0.022$	$0.012 \pm 0.044 \pm 0.026$	$0.052 \pm 0.026$
76	$\Delta_{0^-}(X_s\gamma)$	$-0.01 \pm 0.06$	$-0.01 \pm 0.06$		$-0.01 \pm 0.06$
83	$\Delta_{\rho\gamma}$	$-0.46 \pm 0.17$	$-0.43^{+0.25}_{-0.22} \pm 0.10$	$-0.48^{+0.21+0.08}_{-0.19-0.09}$	$-0.46^{+0.17}_{-0.16}$
124	$\Delta_{0^-}(K\ell\ell)\dagger$	$-0.40^{+0.34}_{-0.30}$	$-1.43^{+0.56}_{-0.85} \pm 0.05$	$-0.31^{+0.17}_{-0.14} \pm 0.08$	$-0.40^{+0.16}_{-0.15}$
125	$\Delta_{0^-}(K^*\ell\ell)\dagger$	$-0.44 \pm 0.13$	$-0.56^{+0.17}_{-0.15} \pm 0.03$	$-0.29 \pm 0.16 \pm 0.09$	$-0.44^{+0.13}_{-0.12}$
	$\Delta_{0^-}(K^{(*)}\ell\ell)\dagger$	$-0.45 \pm 0.17$	$-0.64^{+0.15}_{-0.14} \pm 0.03$	$-0.30^{+0.12}_{-0.11} \pm 0.08$	$-0.45 \pm 0.10$

$\dagger m_{\ell\ell} < m_{J/\psi}$

Heavy Flavor Averaging Group  
August 2012  
Isospin Asymmetry ( $A_I$ )

In PDG2010    New since PDG2010 (preliminary)    New since PDG2010 (published)

RPP#	Mode	$q^2$ [(GeV/c <sup>2</sup> ) <sup>2</sup> ]	PDG2012 Avg.	BABAR	Belle	CDF ‡	LHCb ‡	New Avg.
124	$K\ell^+\ell^-$	$< 2.0$	New	$-0.51^{+0.49}_{-0.95}$	$-0.33^{+0.34}_{-0.26}$	$0.19 \pm 0.34 \pm 0.05$	$-0.55^{+0.40}_{-0.56}$	$-0.24^{+0.18}_{-0.19}$
	$K\ell^+\ell^-$	[2.0, 4.3]	New	$-0.73^{+0.48}_{-0.55}$	$-0.47^{+0.50}_{-0.39}$	$-0.07 \pm 0.34 \pm 0.07$	$-0.76^{+0.45}_{-0.79}$	$-0.42^{+0.20}_{-0.22}$
	$K\ell^+\ell^-$	[4.3, 8.68]	New	$-0.32^{+0.27}_{-0.30}$	$-0.19^{+0.26}_{-0.22}$	$-0.20 \pm 0.26 \pm 0.08$	$0.00^{+0.14}_{-0.15}$	$-0.11 \pm 0.11$
	$K\ell^+\ell^-$	[10.09, 12.86]	New	$-0.05^{+0.25}_{-0.29}$	$-0.29^{+0.37}_{-0.29}$	$-0.27 \pm 0.37 \pm 0.08$	$-0.15^{+0.19}_{-0.22}$	$-0.16^{+0.14}_{-0.15}$
	$K\ell^+\ell^-$	[14.18, 16.00]	New	$0.05^{+0.32}_{-0.43}$	$-0.40^{+0.61}_{-0.69}$	$0.04 \pm 0.23 \pm 0.05$	$-0.40 \pm 0.22$	$-0.17^{+0.14}_{-0.15}$
	$K\ell^+\ell^-$	$> 16.00$	New	$-0.93^{+0.83}_{-4.99}$	$0.11^{+0.25}_{-0.22}$	$-0.29 \pm 0.28 \pm 0.06$	$-0.52^{+0.18}_{-0.22}$	$-0.28^{+0.12}_{-0.13}$
	$K\ell^+\ell^-$	[1.00, 6.00]	New	$-0.41^{+0.25}_{-0.01}$	$-0.41^{+0.26}_{-0.21}$	$-0.06 \pm 0.24 \pm 0.07$	$-0.35^{+0.23}_{-0.27}$	$-0.30 \pm 0.12$
125	$K^*\ell^+\ell^-$	$< 2.0$	New	$-0.17^{+0.29}_{-0.24}$	$-0.67^{+0.19}_{-0.17}$	$0.15 \pm 0.32 \pm 0.06$	$0.05^{+0.27}_{-0.21}$	$-0.25^{+0.12}_{-0.11}$
	$K^*\ell^+\ell^-$	[2.0, 4.3]	New	$-0.06^{+0.56}_{-0.36}$	$1.45^{+1.04}_{-1.15}$	$0.00 \pm 0.39 \pm 0.07$	$-0.27^{+0.29}_{-0.18}$	$-0.12^{+0.23}_{-0.17}$
	$K^*\ell^+\ell^-$	[4.3, 8.68]	New	$0.03^{+0.43}_{-0.32}$	$-0.34^{+0.32}_{-0.30}$	$0.29 \pm 0.41 \pm 0.13$	$-0.06^{+0.19}_{-0.14}$	$-0.06^{+0.14}_{-0.11}$
	$K^*\ell^+\ell^-$	[10.09, 12.86]	New	$-0.48^{+0.23}_{-0.19}$	$0.00^{+0.22}_{-0.23}$	$0.43 \pm 0.35 \pm 0.10$	$-0.16^{+0.14}_{-0.16}$	$-0.14 \pm 0.11$
	$K^*\ell^+\ell^-$	[14.18, 16.00]	New	$0.24^{+0.61}_{-0.39}$	$0.16^{+0.31}_{-0.36}$	$0.17 \pm 0.29 \pm 0.07$	$0.02^{+0.23}_{-0.21}$	$0.11^{+0.15}_{-0.14}$
	$K^*\ell^+\ell^-$	$> 16.00$	New	$1.07^{+4.28}_{-1.01}$	$-0.02^{+0.22}_{-0.23}$	$-0.23 \pm 0.23 \pm 0.06$	$0.02^{+0.21}_{-0.20}$	$-0.05 \pm 0.13$
	$K^*\ell^+\ell^-$	[1.00, 6.00]	New	$-0.20^{+0.30}_{-0.23}$	$0.33^{+0.38}_{-0.44}$	$-0.26 \pm 0.21 \pm 0.07$	$-0.15 \pm 0.16$	$-0.16^{+0.12}_{-0.11}$

† see the original paper for the exact  $q^2$  selection.    ‡ muon mode only ( $\ell = \mu$ ).

# Heavy Flavor Averaging Group

## August 2012

### 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 <sup>2</sup> ) <sup>2</sup> ]	†	PDG2012 Avg.	BABAR	Belle	CDF ‡	LHCb ‡	New Avg.
124	$K\ell^+\ell^-$	< 2.0		$0.46 \pm 0.22$	$0.71^{+0.20}_{-0.18} \pm 0.02$	$0.81^{+0.18}_{-0.16} \pm 0.05$	$0.35 \pm 0.09 \pm 0.02$		$0.49 \pm 0.07$
	$K\ell^+\ell^-$	[2.0, 4.3]		$0.61 \pm 0.15$	$0.49^{+0.15}_{-0.13} \pm 0.01$	$0.46^{+0.14}_{-0.12} \pm 0.03$	$0.67 \pm 0.11 \pm 0.04$		$0.57 \pm 0.07$
	$K\ell^+\ell^-$	[4.3, 8.68]		$1.03 \pm 0.13$	$0.94^{+0.20}_{-0.19} \pm 0.02$	$1.00^{+0.19}_{-0.18} \pm 0.06$	$1.19 \pm 0.15 \pm 0.07$		$1.05 \pm 0.08$
	$K\ell^+\ell^-$	[10.09, 12.86]		$0.50 \pm 0.09$	$0.90^{+0.20}_{-0.19} \pm 0.04$	$0.55^{+0.16}_{-0.14} \pm 0.03$	$0.44 \pm 0.09 \pm 0.03$		$0.52 \pm 0.06$
	$K\ell^+\ell^-$	[14.18, 16.00]		$0.49^{+0.08}_{-0.07}$	$0.49^{+0.15}_{-0.14} \pm 0.02$	$0.38^{+0.19}_{-0.12} \pm 0.02$	$0.40 \pm 0.07 \pm 0.02$		$0.45^{+0.05}_{-0.04}$
	$K\ell^+\ell^-$	> 16.00		$0.49 \pm 0.24$	$0.67^{+0.23}_{-0.21} \pm 0.05$	$0.98^{+0.20}_{-0.18} \pm 0.06$	$0.41 \pm 0.08 \pm 0.02$		$0.52 \pm 0.07$
	$K\ell^+\ell^-$	[1.00, 6.00]			$1.36^{+0.27}_{-0.24} \pm 0.03$	$1.36^{+0.23}_{-0.21} \pm 0.08$	$1.24 \pm 0.16 \pm 0.07$		$1.30 \pm 0.12$
125	$K^*\ell^+\ell^-$	< 2.0		$1.61 \pm 0.26$	$1.89^{+0.52}_{-0.46} \pm 0.06$	$1.46^{+0.31}_{-0.35} \pm 0.11$	$1.82 \pm 0.35 \pm 0.10$	$1.16 \pm 0.23 \pm 0.11$	$1.51^{+0.15}_{-0.14}$
	$K^*\ell^+\ell^-$	[2.0, 4.3]		$0.84 \pm 0.20$	$0.95^{+0.35}_{-0.30} \pm 0.04$	$0.86^{+0.31}_{-0.27} \pm 0.07$	$1.06 \pm 0.27 \pm 0.06$	$0.78 \pm 0.21 \pm 0.05$	$0.88 \pm 0.11$
	$K^*\ell^+\ell^-$	[4.3, 8.68]		$1.60 \pm 0.35$	$1.82^{+0.56}_{-0.52} \pm 0.09$	$1.37^{+0.47}_{-0.42} \pm 0.39$	$2.08 \pm 0.41 \pm 0.15$	$3.02 \pm 0.35 \pm 0.22$	$2.03 \pm 0.20$
	$K^*\ell^+\ell^-$	[10.09, 12.86]		$1.95 \pm 0.28$	$1.86^{+0.52}_{-0.48} \pm 0.10$	$2.24^{+0.44}_{-0.40} \pm 0.19$	$1.85 \pm 0.31 \pm 0.11$	$1.52 \pm 0.25 \pm 0.19$	$1.85 \pm 0.16$
	$K^*\ell^+\ell^-$	[14.18, 16.00]		$1.14 \pm 0.19$	$1.46^{+0.41}_{-0.36} \pm 0.06$	$1.05^{+0.29}_{-0.26} \pm 0.08$	$1.31 \pm 0.20 \pm 0.07$	$1.15 \pm 0.20 \pm 0.09$	$1.20^{+0.11}_{-0.10}$
	$K^*\ell^+\ell^-$	> 16.00		$1.3 \pm 0.6$	$1.02^{+0.47}_{-0.42} \pm 0.06$	$2.04^{+0.27}_{-0.24} \pm 0.16$	$1.03 \pm 0.21 \pm 0.06$	$1.50 \pm 0.24 \pm 0.15$	$1.38 \pm 0.14$
	$K^*\ell^+\ell^-$	[1.00, 6.00]		New	$2.05^{+0.53}_{-0.48} \pm 0.07$	$1.49^{+0.45}_{-0.40} \pm 0.12$	$2.12 \pm 0.46 \pm 0.13$	$2.10 \pm 0.30 \pm 0.15$	$1.97 \pm 0.21$
441	$K^0\ell^+\ell^-$	< 2.0		New			$0.49 \pm 0.32 \pm 0.04$	$0.21^{+0.27}_{-0.23}$	$0.32^{+0.21}_{-0.20}$
	$K^0\ell^+\ell^-$	[2.0, 4.3]		New			$0.59 \pm 0.39 \pm 0.08$	$0.07^{+0.25}_{-0.21}$	$0.21^{+0.22}_{-0.20}$
	$K^0\ell^+\ell^-$	[4.3, 8.68]		New			$0.83 \pm 0.43 \pm 0.12$	$1.23 \pm 0.31$	$1.10 \pm 0.25$
	$K^0\ell^+\ell^-$	[10.09, 12.86]		New			$0.28 \pm 0.22 \pm 0.04$	$0.50^{+0.22}_{-0.19}$	$0.40^{+0.15}_{-0.14}$
	$K^0\ell^+\ell^-$	[14.18, 16.00]		New			$0.43 \pm 0.18 \pm 0.04$	$0.20^{+0.13}_{-0.09}$	$0.27^{+0.12}_{-0.10}$
	$K^0\ell^+\ell^-$	> 16.00		New			$0.26 \pm 0.15 \pm 0.03$	$0.35^{+0.21}_{-0.14}$	$0.30^{+0.12}_{-0.10}$
	$K^0\ell^+\ell^-$	[1.00, 6.00]		New			$1.11 \pm 0.52 \pm 0.14$	$0.65^{+0.45}_{-0.35}$	$0.82^{+0.36}_{-0.32}$
448	$K^{*+}\ell^+\ell^-$	< 2.0		New			$1.50 \pm 0.94 \pm 0.18$	$1.37^{+0.60}_{-0.58}$	$1.41^{+0.51}_{-0.50}$
	$K^{*+}\ell^+\ell^-$	[2.0, 4.3]		New			$1.14 \pm 0.82 \pm 0.15$	$1.24^{+0.60}_{-0.55}$	$1.21^{+0.48}_{-0.46}$
	$K^{*+}\ell^+\ell^-$	[4.3, 8.68]		New			$1.30 \pm 1.13 \pm 0.37$	$2.50^{+0.55}_{-0.74}$	$2.14^{+0.67}_{-0.61}$
	$K^{*+}\ell^+\ell^-$	[10.09, 12.86]		New			$0.89 \pm 0.74 \pm 0.20$	$2.13^{+0.72}_{-0.66}$	$1.60^{+0.51}_{-0.49}$
	$K^{*+}\ell^+\ell^-$	[14.18, 16.00]		New			$1.02 \pm 0.58 \pm 0.13$	$1.00^{+0.47}_{-0.38}$	$1.01^{+0.37}_{-0.32}$
	$K^{*+}\ell^+\ell^-$	> 16.00		New			$1.68 \pm 0.74 \pm 0.19$	$1.25 \pm 0.46$	$1.36 \pm 0.40$
	$K^{*+}\ell^+\ell^-$	[1.00, 6.00]		New			$3.56 \pm 1.38 \pm 0.43$	$2.90^{+0.90}_{-0.85}$	$3.08^{+0.77}_{-0.74}$

† see the original paper for the exact  $q^2$  selection.    ‡ muon mode only ( $\ell = \mu$ ).

Heavy Flavor Averaging Group  
August 2012  
Forward-backward Asymmetry ( $A_{FB}$ )

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

RPP#	Mode	$q^2$ [(GeV/c <sup>2</sup> ) <sup>2</sup> ] †	PDG2012 Avg.	BABAR	Belle	CDF ‡	LHCb ‡	New Avg.
124	$K\ell^+\ell^-$	< 2.0	$-0.02 \pm 0.26$		$0.06^{+0.32}_{-0.35} \pm 0.02$	$-0.19^{+0.37}_{-0.45} \pm 0.09$		$-0.03^{+0.18}_{-0.19}$
	$K\ell^+\ell^-$	[2.0, 4.3]	$0.2 \pm 0.6$		$-0.43^{+0.38}_{-0.40} \pm 0.09$	$0.32^{+0.17}_{-0.13} \pm 0.10$		$0.20^{+0.15}_{-0.14}$
	$K\ell^+\ell^-$	[4.3, 8.68]	$-0.20^{+0.10}_{-0.13}$		$-0.20^{+0.12}_{-0.14} \pm 0.03$	$0.08^{+0.08}_{-0.09} \pm 0.01$		$-0.08 \pm 0.06$
	$K\ell^+\ell^-$	[10.09, 12.86]	$-0.15^{+0.13}_{-0.12}$		$-0.21^{+0.17}_{-0.15} \pm 0.06$	$-0.04^{+0.12}_{-0.10} \pm 0.03$		$-0.11^{+0.08}_{-0.07}$
	$K\ell^+\ell^-$	[14.18, 16.00]	$0.03^{+0.27}_{-0.14}$		$0.04^{+0.32}_{-0.26} \pm 0.05$	$-0.07^{+0.08}_{-0.08} \pm 0.01$		$-0.04^{+0.07}_{-0.06}$
	$K\ell^+\ell^-$	> 16.00	$0.03^{+0.10}_{-0.08}$		$0.02^{+0.11}_{-0.08} \pm 0.02$	$0.05^{+0.18}_{-0.10} \pm 0.05$		$0.03^{+0.07}_{-0.05}$
	$K\ell^+\ell^-$	[1.00, 6.00]			$0.26^{+0.27}_{-0.30} \pm 0.07$	$0.13^{+0.11}_{-0.10} \pm 0.02$		$0.14^{+0.11}_{-0.10}$
125	$K^*\ell^+\ell^-$	< 2.0	$0.45^{+0.26}_{-0.30}$		$0.47^{+0.26}_{-0.32} \pm 0.03$	$0.05^{+0.28}_{-0.27} \pm 0.10$	$-0.15 \pm 0.20 \pm 0.06$	$0.12 \pm 0.13$
	$K^*\ell^+\ell^-$	[2.0, 4.3]	$0.14 \pm 0.27$		$0.11^{+0.31}_{-0.36} \pm 0.07$	$-0.11^{+0.34}_{-0.41} \pm 0.16$	$-0.05^{+0.16}_{-0.20} \pm 0.04$	$0.01^{+0.12}_{-0.14}$
	$K^*\ell^+\ell^-$	[4.3, 8.68]	$0.24 \pm 0.24$		$0.45^{+0.15}_{-0.18} \pm 0.15$	$0.09^{+0.14}_{-0.14} \pm 0.04$	$0.27^{+0.06}_{-0.08} \pm 0.02$	$0.25^{+0.06}_{-0.07}$
	$K^*\ell^+\ell^-$	[10.09, 12.86]	$0.53 \pm 0.15$		$0.43^{+0.18}_{-0.20} \pm 0.03$	$0.44^{+0.12}_{-0.13} \pm 0.08$	$0.27^{+0.11}_{-0.13} \pm 0.02$	$0.39 \pm 0.07$
	$K^*\ell^+\ell^-$	[14.18, 16.00]	$0.53^{+0.13}_{-0.15}$		$0.70^{+0.16}_{-0.22} \pm 0.10$	$0.53^{+0.09}_{-0.09} \pm 0.07$	$-0.47^{+0.06}_{-0.08} \pm 0.03$	$-0.08 \pm 0.05$
	$K^*\ell^+\ell^-$	> 16.00	$0.67^{+0.10}_{-0.14}$		$0.66^{+0.11}_{-0.16} \pm 0.04$	$0.35^{+0.17}_{-0.19} \pm 0.06$	$-0.16^{+0.11}_{-0.13} \pm 0.06$	$0.32^{+0.07}_{-0.08}$
	$K^*\ell^+\ell^-$	[1.00, 6.00]			$0.26^{+0.27}_{-0.30} \pm 0.07$	$0.19^{+0.17}_{-0.21} \pm 0.05$	$-0.06^{+0.13}_{-0.14} \pm 0.04$	$0.05^{+0.10}_{-0.11}$

† see the original paper for the exact  $q^2$  selection.    ‡ muon mode only ( $\ell = \mu$ ).

Heavy Flavor Averaging Group  
August 2012  
Fraction of the Longitudinal Polarization ( $F_L$ )

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

RPP#	Mode	$q^2$ [(GeV/c <sup>2</sup> ) <sup>2</sup> ] †	PDG2012 Avg.	BABAR	Belle	CDF ‡	LHCb ‡	New Avg.
125	$K^*\ell^+\ell^-$	< 2.0	$0.35 \pm 0.17$		$0.29^{+0.21}_{-0.18} \pm 0.02$	$0.25^{+0.14}_{-0.13} \pm 0.04$	$0.00^{+0.13}_{-0.00} \pm 0.02$	$0.19^{+0.08}_{-0.07}$
	$K^*\ell^+\ell^-$	[2.0, 4.3]	$0.60 \pm 0.20$		$0.71 \pm 0.24 \pm 0.05$	$0.71^{+0.15}_{-0.17} \pm 0.07$	$0.77 \pm 0.15 \pm 0.03$	$0.71 \pm 0.09$
	$K^*\ell^+\ell^-$	[4.3, 8.68]	$0.74^{+0.15}_{-0.17}$		$0.64^{+0.23}_{-0.24} \pm 0.07$	$0.72^{+0.12}_{-0.13} \pm 0.05$	$0.60^{+0.06}_{-0.07} \pm 0.01$	$0.63 \pm 0.05$
	$K^*\ell^+\ell^-$	[10.09, 12.86]	$0.23 \pm 0.12$		$0.17^{+0.17}_{-0.15} \pm 0.03$	$0.38^{+0.11}_{-0.11} \pm 0.04$	$0.41 \pm 0.11 \pm 0.03$	$0.32 \pm 0.06$
	$K^*\ell^+\ell^-$	[14.18, 16.00]	$0.34 \pm 0.31$		$-0.15^{+0.27}_{-0.23} \pm 0.07$	$0.40^{+0.11}_{-0.11} \pm 0.04$	$0.37 \pm 0.09 \pm 0.05$	$0.34 \pm 0.07$
	$K^*\ell^+\ell^-$	> 16.00	$0.11^{+0.12}_{-0.10}$		$0.12^{+0.15}_{-0.13} \pm 0.02$	$0.19^{+0.12}_{-0.11} \pm 0.07$	$0.26^{+0.10}_{-0.08} \pm 0.03$	$0.19^{+0.06}_{-0.05}$
	$K^*\ell^+\ell^-$	[1.00, 6.00]			$0.67 \pm 0.23 \pm 0.05$	$0.76^{+0.12}_{-0.14} \pm 0.07$	$0.55 \pm 0.10 \pm 0.03$	$0.62 \pm 0.08$

† see the original paper for the exact  $q^2$  selection.    ‡ muon mode only ( $\ell = \mu$ ).

Heavy Flavor Averaging Group  
August 2012  
Compilation of  $B$  Inclusive 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.	BABAR	Belle	CLEO	New Avg.
79	$s\eta$	$261^{+53}_{-79}$		$261 \pm 30^{+44}_{-74}$ §	< 440	$261^{+53}_{-79}$
80	$s\eta'$	$420 \pm 90$	$390 \pm 80 \pm 90$ ‡		$460 \pm 110 \pm 60$ ‡	$423 \pm 86$
81	$K^+X$	< 187	< 187 †			< 187 †
82	$K^0X$	$195^{+71}_{-67}$	$195^{+51}_{-45} \pm 50$ †			$195^{+71}_{-67}$
93	$\pi^+X$	$370 \pm 80$	$372^{+50}_{-47} \pm 59$ †			$372^{+77}_{-75}$

†  $p^* > 2.34$  GeV; §  $0.4 < M_{X_s} < 2.6$  GeV; ‡  $2.0 < p^* < 2.7$  GeV

Heavy Flavor Averaging Group  
 August 2012  
 Compilation of  $B$  Leptonic 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.	BABAR	Belle	CLEO	CDF	LHCb	CMS	New Avg.
25	$e^+\nu$	< 0.98	< 1.9	< 1.0	< 15				< 1.0
26	$\mu^+\nu$	< 1.0	< 1.0	< 1.7	< 21				< 1.0
27	$\tau^+\nu$	$165 \pm 34$	<span style="color: blue;"><math>179 \pm 48</math></span>	$154^{+38+29}_{-37-31}\dagger$	< 840				$166 \pm 33$
28	$\ell^+\nu\ell\gamma$	< 15.6	< 15.6						< 15.6
29	$e^+\nu_e\gamma$	< 17	< 17		< 200				< 17
30	$\mu^+\nu_\mu\gamma$	< 24	< 26		< 52				< 26
429	$\gamma\gamma$	< 0.32	< 0.32	< 0.62					< 0.32
430	$e^+e^-$	< 0.083	< 0.113	< 0.19	< 0.83	< 0.083			< 0.083
431	$e^+e^-\gamma$	< 0.12	< 0.12						< 0.12
432	$\mu^+\mu^-$	< 0.0014	< 0.052	< 0.16	< 0.61	<span style="color: blue;">&lt; 0.0038</span>	<span style="color: red;">&lt; 0.00081</span>	<span style="color: red;">&lt; 0.0014</span>	< 0.00081
433	$\mu^+\mu^-\gamma$	< 0.16	< 0.16						< 0.16
–	$\mu^+\mu^-\mu^+\mu^-$	New					<span style="color: blue;">&lt; 0.0054</span>		< 0.0054
434	$\tau^+\tau^-$	< 4100	< 4100						< 4100
449	$e^\pm\mu^\mp$	< 0.064	< 0.092	< 0.17	< 1.5	< 0.064			< 0.064
455	$e^\pm\tau^\mp$	< 28	< 28		< 110				< 28
456	$\mu^\pm\tau^\mp$	< 22	< 22		< 38				< 22
457	$\nu\bar{\nu}$	< 220	< 220	<span style="color: red;">&lt; 130</span>					< 130
458	$\nu\bar{\nu}\gamma$	< 47	< 47						< 47

$\dagger$ This result has been averaged with the earlier PRL 97, 251802 (2006).

# Radiative and Leptonic Decays:

## *BABAR* References

- [1] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **103**, 211802 (2009).
- [2] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **78**, 112001 (2008).
- [3] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **73**, 092001 (2006).
- [4] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **94**, 101801 (2005).
- [5] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **77**, 032007 (2008).
- [6] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **74**, 031102 (2006).
- [7] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **70**, 091105 (2004).
- [8] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **93**, 081802 (2004).
- [9] *BABAR* Collaboration (J.P. Lees *et al.*), arXiv:1207.0698 (2012).
- [10] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **77**, 091104 (2008).
- [11] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **72**, 091103 (2005).
- [12] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **93**, 091802 (2004).
- [13] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **72**, 052004 (2005).
- [14] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **83**, 032006 (2011).
- [15] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **98**, 211804 (2007).
- [16] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **96**, 241802 (2006).
- [17] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **75**, 051102 (2007).
- [18] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **99**, 051801 (2007).
- [19] *BABAR* Collaboration (P. del Amo Sanchez *et al.*), Phys. Rev. D **83**, 031103 (2011).
- [20] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **77**, 011104 (2008).
- [21] *BABAR* Collaboration (J. P. Lees *et al.*), Phys. Rev. D **86**, 012004 (2012).
- [22] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **79**, 011102 (2009).
- [23] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **79**, 091101 (2009).
- [24] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **78**, 072007 (2008).
- [25] *BABAR* Collaboration (P. del Amo Sanchez *et al.*), Phys. Rev. D **82**, 051101 (2010).
- [26] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. D **80**, 111105 (2009).
- [27] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **102**, 091803 (2009).
- [28] *BABAR* Collaboration (J. P. Lees *et al.*), Phys. Rev. D **85**, 071103 (2012).
- [29] *BABAR* Collaboration (P. del Amo Sanchez *et al.*), Phys. Rev. D **82**, 112002 (2010).



- [30] *BABAR* Collaboration (B. Aubert *et al.*), Phys. Rev. Lett. **93**, 061801 (2004).
- [31] *BABAR* Collaboration (J. P. Lees *et al.*), Phys. Rev. D **86**, 032012 (2012).
- [32] *BABAR* Collaboration (J. P. Lees *et al.*), arXiv:1207.5772 (2012).
- [33]
- [34]
- [35]
- [36]
- [37]
- [38]
- [39]
- [40]

# Belle References

- [41] Belle Collaboration (J.-T. Wei, P. Chang *et al.*), Phys. Rev. Lett. **103**, 171801 (2009).
- [42] Belle Collaboration (M. Nakao *et al.*), Phys. Rev. D **69**, 112001 (2004).
- [43] Belle Collaboration (S. Nishida *et al.*), Phys. Rev. Lett. **89**, 231801 (2002).
- [44] Belle Collaboration (K. Hara, T. Iijima *et al.*), Phys. Rev. D **82**, 071101 (2010).
- [45] Belle Collaboration (K. Abe *et al.*), Phys. Lett. B **647**, 67 (2007).
- [46] Belle Collaboration (M.-C. Chang *et al.*), Phys. Rev. D **68**, 111101 (2003).
- [47] Belle Collaboration (A. Limosani *et al.*), Phys. Rev. Lett. **103**, 241801 (2009).
- [48] Belle Collaboration, talk by T. Iijima presented at Lepton Photon (2009).
- [49] Belle Collaboration (H. Sahoo, T.E. Browder *et al.*), Phys. Rev. D **84**, 071101 (2011).
- [50] Belle Collaboration (K.-F. Chen *et al.*), Phys. Rev. Lett. **99**, 221802 (2007).
- [51] Belle Collaboration (Y.-J. Lee, M.-Z. Wang *et al.*), Phys. Rev. Lett. **95**, 061802 (2005).
- [52] Belle Collaboration (H. Yang *et al.*), Phys. Rev. Lett. **94**, 111802 (2005).
- [53] Belle Collaboration (S. Nishida *et al.*), Phys. Lett. B **610**, 23 (2005).
- [54] Belle Collaboration (N. Taniguchi, M. Nakao, S. Nishida *et al.*), Phys. Rev. Lett. **101**, 111801 (2008).
- [55] Belle Collaboration (M.-Z. Wang, Y.-J. Lee *et al.*), Phys. Rev. D **76**, 052004 (2007).
- [56] Belle Collaboration (J.-T. Wei, K.-F. Chen *et al.*), Phys. Rev. D **78**, 011101 (2008).
- [57] Belle Collaboration (R. Wedd *et al.*), Phys. Rev. D **81**, 111104 (2010).
- [58] Belle Collaboration (S. Villa *et al.*), Phys. Rev. D **73**, 051107 (2006).
- [59] Belle Collaboration (K. Nishimura, T.E. Browder *et al.*), Phys. Rev. Lett. **105**, 191803 (2010).
- [60] Belle Collaboration (C.-L. Hsu, P. Chang *et al.*), Phys. Rev. D **86**, 032002 (2012).

## CLEO References

- [61] CLEO Collaboration (M. Artuso *et al.*), Phys. Rev. Lett. **75**, 785 (1995).
- [62] CLEO Collaboration (T.E. Coan *et al.*), Phys. Rev. Lett. **84**, 5283 (2000).
- [63] CLEO Collaboration (S. Anderson *et al.*), Phys. Rev. Lett. **87**, 181803 (2001).
- [64] CLEO Collaboration (T. Browder *et al.*), Phys. Rev. Lett. **86**, 2950 (2001).
- [65] CLEO Collaboration (K.W. Edwards *et al.*), Phys. Rev. D **65**, 111102R (2002).
- [66] CLEO Collaboration (T. Bergfeld *et al.*), Phys. Rev. D **62**, 091102R (2000).
- [67] CLEO Collaboration (S. Chen *et al.*), Phys. Rev. Lett. **87**, 251807 (2002).
- [68] CLEO Collaboration (S. Glenn *et al.*), Phys. Rev. Lett. **80**, 2289 (1998).
- [69] CLEO Collaboration (K.W. Edwards *et al.*), Phys. Rev. D **65**, 111102 (2002).
- [70] CLEO Collaboration (K.W. Edwards *et al.*), Phys. Rev. D **68**, 011102 (2003).
- [71] CLEO Collaboration (T. Browder *et al.*), Phys. Rev. D **56**, 11 (1997).
- [72] CLEO Collaboration (A. Bornheim *et al.*), Phys. Rev. Lett. **93**, 241802 (2004).
- [73] CLEO Collaboration (G. Bonvicini *et al.*), Phys. Rev. D **68**, 011101 (2003).
- [74]
- [75]

## CDF References

- [76] Mirco Dorigo for the CDF Collaboration, presented at Moriond, March 2012.
- [77] CDF Collaboration (A. Aaltonen *et al.*), Phys. Rev. Lett. **102**, 201801 (2009).
- [78]
- [79] Hideki Miyake for the CDF Collaboration, presented at ICHEP, July 2012.
- [80]

## LHCb References

- [81] LHCb Collaboration, (R. Aaij *et al.*), Phys. Rev. Lett. **108**, 231801 (2012).
- [82] LHCb Collaboration (R. Aaij *et al.*), Phys. Rev. Lett. **108**, 181806 (2012).
- [83] LHCb Collaboration (R. Aaij *et al.*), Phys. Rev. Lett. **108**, 101601 (2012).
- [84] LHCb Collaboration, LHCb-CONF-2012-010 (2012).
- [85] LHCb Collaboration (R. Aaij *et al.*), J. High Energ. Phys. **1207**, 133 (2012).
- [86]
- [87]
- [88]
- [89]
- [90]

## CMS References

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