

# B<sup>±</sup>/B<sup>0</sup> ADMIXTURE

## B DECAY MODES

The branching fraction measurements are for an admixture of  $B$  mesons at the  $\Upsilon(4S)$ . The values quoted assume that  $B(\Upsilon(4S) \rightarrow B\bar{B}) = 100\%$ .

For inclusive branching fractions, e.g.,  $B \rightarrow D^\pm$  anything, the treatment of multiple  $D$ 's in the final state must be defined. One possibility would be to count the number of events with one-or-more  $D$ 's and divide by the total number of  $B$ 's. Another possibility would be to count the total number of  $D$ 's and divide by the total number of  $B$ 's, which is the definition of average multiplicity. The two definitions are identical if only one  $D$  is allowed in the final state. Even though the "one-or-more" definition seems sensible, for practical reasons inclusive branching fractions are almost always measured using the multiplicity definition. For heavy final state particles, authors call their results inclusive branching fractions while for light particles some authors call their results multiplicities. In the  $B$  sections, we list all results as inclusive branching fractions, adopting a multiplicity definition. This means that inclusive branching fractions can exceed 100% and that inclusive partial widths can exceed total widths, just as inclusive cross sections can exceed total cross section.

$\bar{B}$  modes are charge conjugates of the modes below. Reactions indicate the weak decay vertex and do not include mixing.

Mode	Fraction ( $\Gamma_j/\Gamma$ )	Scale factor/ Confidence level
<b>Semileptonic and leptonic modes</b>		
$\Gamma_1$ $e^+ \nu_e$ anything	[a]	
$\Gamma_2$ $\mu^+ \nu_\mu$ anything	[a]	
$\Gamma_3$ $\ell^+ \nu_\ell$ anything	[a,b] ( 10.86 ± 0.16 ) %	
$\Gamma_4$ $D^- \ell^+ \nu_\ell$ anything	[b] ( 2.8 ± 0.9 ) %	
$\Gamma_5$ $\bar{D}^0 \ell^+ \nu_\ell$ anything	[b] ( 7.3 ± 1.5 ) %	
$\Gamma_6$ $\bar{D} \ell^+ \nu_\ell$	( 2.42 ± 0.12 ) %	
$\Gamma_7$ $D^{*-} \ell^+ \nu_\ell$ anything	[c] ( 6.7 ± 1.3 ) × 10 <sup>-3</sup>	
$\Gamma_8$ $D^{*0} \ell^+ \nu_\ell$ anything		
$\Gamma_9$ $D^* \ell^+ \nu_\ell$	[d] ( 4.95 ± 0.11 ) %	
$\Gamma_{10}$ $\bar{D}^{**} \ell^+ \nu_\ell$	[b,e] ( 2.7 ± 0.7 ) %	
$\Gamma_{11}$ $\bar{D}_1(2420) \ell^+ \nu_\ell$ anything	( 3.8 ± 1.3 ) × 10 <sup>-3</sup>	S=2.4
$\Gamma_{12}$ $D\pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything	( 2.6 ± 0.5 ) %	S=1.5
$\Gamma_{13}$ $D\pi \ell^+ \nu_\ell$ anything	( 1.5 ± 0.6 ) %	
$\Gamma_{14}$ $D^* \pi \ell^+ \nu_\ell$ anything	( 1.9 ± 0.4 ) %	
$\Gamma_{15}$ $\bar{D}_2^*(2460) \ell^+ \nu_\ell$ anything	( 4.4 ± 1.6 ) × 10 <sup>-3</sup>	
$\Gamma_{16}$ $D^{*-} \pi^+ \ell^+ \nu_\ell$ anything	( 1.00 ± 0.34 ) %	

$\Gamma_{17}$	$\bar{D}\pi^+\pi^-\ell^+\nu_\ell$	(	$1.62 \pm 0.32$	) $\times 10^{-3}$	
$\Gamma_{18}$	$\bar{D}^*\pi^+\pi^-\ell^+\nu_\ell$	(	$9.4 \pm 3.2$	) $\times 10^{-4}$	
$\Gamma_{19}$	$D_s^-\ell^+\nu_\ell$ anything	[b] <	7	$\times 10^{-3}$	CL=90%
$\Gamma_{20}$	$D_s^-\ell^+\nu_\ell K^+$ anything	[b] <	5	$\times 10^{-3}$	CL=90%
$\Gamma_{21}$	$D_s^-\ell^+\nu_\ell K^0$ anything	[b] <	7	$\times 10^{-3}$	CL=90%
$\Gamma_{22}$	$X_c\ell^+\nu_\ell$	(	$10.65 \pm 0.16$	) %	
$\Gamma_{23}$	$X_u\ell^+\nu_\ell$	(	$2.13 \pm 0.30$	) $\times 10^{-3}$	
$\Gamma_{24}$	$K^+\ell^+\nu_\ell$ anything	[b] (	$6.3 \pm 0.6$	) %	
$\Gamma_{25}$	$K^-\ell^+\nu_\ell$ anything	[b] (	$10 \pm 4$	) $\times 10^{-3}$	
$\Gamma_{26}$	$K^0/\bar{K}^0\ell^+\nu_\ell$ anything	[b] (	$4.6 \pm 0.5$	) %	
$\Gamma_{27}$	$\bar{D}\tau^+\nu_\tau$	(	$9.9 \pm 1.2$	) $\times 10^{-3}$	
$\Gamma_{28}$	$D^*\tau^+\nu_\tau$	(	$1.50 \pm 0.08$	) %	

**D, D\*, or D<sub>s</sub> modes**

$\Gamma_{29}$	$D^\pm$ anything	(	$23.1 \pm 1.2$	) %	
$\Gamma_{30}$	$D^0/\bar{D}^0$ anything	(	$61.5 \pm 2.9$	) %	S=1.3
$\Gamma_{31}$	$D^*(2010)^\pm$ anything	(	$22.5 \pm 1.5$	) %	
$\Gamma_{32}$	$D^*(2007)^0$ anything	(	$26.0 \pm 2.7$	) %	
$\Gamma_{33}$	$D_s^\pm$ anything	[f] (	$8.3 \pm 0.8$	) %	
$\Gamma_{34}$	$D_s^{*\pm}$ anything	(	$6.3 \pm 1.0$	) %	
$\Gamma_{35}$	$D_s^{*\pm}\bar{D}^*$	(	$3.4 \pm 0.6$	) %	
$\Gamma_{36}$	$\bar{D}D_{s0}(2317)$	seen			
$\Gamma_{37}$	$\bar{D}D_{sJ}(2457)$	seen			
$\Gamma_{38}$	$D^{(*)}\bar{D}^{(*)}K^0 + D^{(*)}\bar{D}^{(*)}K^\pm$	[f,g] (	$7.1 \pm 2.7$ $- 1.7$	) %	
$\Gamma_{39}$	$b \rightarrow c\bar{c}s$	(	$22 \pm 4$	) %	
$\Gamma_{40}$	$D_s^{(*)}\bar{D}^{(*)}$	[f,g] (	$3.9 \pm 0.4$	) %	
$\Gamma_{41}$	$D^*D^*(2010)^\pm$	[f] <	5.9	$\times 10^{-3}$	CL=90%
$\Gamma_{42}$	$DD^*(2010)^\pm + D^*D^\pm$	[f] <	5.5	$\times 10^{-3}$	CL=90%
$\Gamma_{43}$	$DD^\pm$	[f] <	3.1	$\times 10^{-3}$	CL=90%
$\Gamma_{44}$	$D_s^{(*)\pm}\bar{D}^{(*)}\chi(n\pi^\pm)$	[f,g] (	$9 \pm 5$ $- 4$	) %	
$\Gamma_{45}$	$D^*(2010)\gamma$	<	1.1	$\times 10^{-3}$	CL=90%
$\Gamma_{46}$	$D_s^+\pi^-, D_s^{*+}\pi^-, D_s^+\rho^-,$ $D_s^{*+}\rho^-, D_s^+\pi^0, D_s^{*+}\pi^0,$ $D_s^+\eta, D_s^{*+}\eta, D_s^+\rho^0,$ $D_s^{*+}\rho^0, D_s^+\omega, D_s^{*+}\omega$	[f] <	4	$\times 10^{-4}$	CL=90%
$\Gamma_{47}$	$D_{s1}(2536)^+$ anything	<	9.5	$\times 10^{-3}$	CL=90%

**Charmonium modes**

$\Gamma_{48}$	$J/\psi(1S)$ anything	(	$1.094 \pm 0.032$	) %	S=1.1
$\Gamma_{49}$	$J/\psi(1S)$ (direct) anything	(	$7.8 \pm 0.4$	) $\times 10^{-3}$	S=1.1
$\Gamma_{50}$	$\psi(2S)$ anything	(	$3.07 \pm 0.21$	) $\times 10^{-3}$	
$\Gamma_{51}$	$\chi_{c1}(1P)$ anything	(	$3.55 \pm 0.27$	) $\times 10^{-3}$	S=1.3

$\Gamma_{52}$	$\chi_{c1}(1P)$ (direct) anything	(	$3.08 \pm 0.19$	) $\times 10^{-3}$	
$\Gamma_{53}$	$\chi_{c2}(1P)$ anything	(	$10.0 \pm 1.7$	) $\times 10^{-4}$	S=1.6
$\Gamma_{54}$	$\chi_{c2}(1P)$ (direct) anything	(	$7.5 \pm 1.1$	) $\times 10^{-4}$	
$\Gamma_{55}$	$\eta_c(1S)$ anything	<	9	$\times 10^{-3}$	CL=90%
$\Gamma_{56}$	$K \chi_{c1}(3872), \chi_{c1} \rightarrow D^0 \bar{D}^0 \pi^0$	(	$1.2 \pm 0.4$	) $\times 10^{-4}$	
$\Gamma_{57}$	$K \chi_{c1}(3872), \chi_{c1} \rightarrow D^{*0} D^0$	(	$8.0 \pm 2.2$	) $\times 10^{-5}$	
$\Gamma_{58}$	$K X(3940), X \rightarrow D^{*0} D^0$	<	6.7	$\times 10^{-5}$	CL=90%
$\Gamma_{59}$	$K X(3915), X \rightarrow \omega J/\psi$ [h]	(	$7.1 \pm 3.4$	) $\times 10^{-5}$	

**K or K\* modes**

$\Gamma_{60}$	$K^\pm$ anything	[f]	(	$78.9 \pm 2.5$	) %
$\Gamma_{61}$	$K^+$ anything		(	$66 \pm 5$	) %
$\Gamma_{62}$	$K^-$ anything		(	$13 \pm 4$	) %
$\Gamma_{63}$	$K^0 / \bar{K}^0$ anything	[f]	(	$64 \pm 4$	) %
$\Gamma_{64}$	$K^*(892)^\pm$ anything		(	$18 \pm 6$	) %
$\Gamma_{65}$	$K^*(892)^0 / \bar{K}^*(892)^0$ anything	[f]	(	$14.6 \pm 2.6$	) %
$\Gamma_{66}$	$K^*(892)\gamma$		(	$4.2 \pm 0.6$	) $\times 10^{-5}$
$\Gamma_{67}$	$\eta K \gamma$		(	$8.5 \pm 1.8$	) $\times 10^{-6}$
$\Gamma_{68}$	$K_1(1400)\gamma$	<	1.27	$\times 10^{-4}$	CL=90%
$\Gamma_{69}$	$K_2^*(1430)\gamma$		(	$1.7 \pm 0.6$	) $\times 10^{-5}$
$\Gamma_{70}$	$K_2(1770)\gamma$	<	1.2	$\times 10^{-3}$	CL=90%
$\Gamma_{71}$	$K_3^*(1780)\gamma$	<	3.7	$\times 10^{-5}$	CL=90%
$\Gamma_{72}$	$K_4^*(2045)\gamma$	<	1.0	$\times 10^{-3}$	CL=90%
$\Gamma_{73}$	$K \eta'(958)$		(	$8.3 \pm 1.1$	) $\times 10^{-5}$
$\Gamma_{74}$	$K^*(892) \eta'(958)$		(	$4.1 \pm 1.1$	) $\times 10^{-6}$
$\Gamma_{75}$	$K \eta$	<	5.2	$\times 10^{-6}$	CL=90%
$\Gamma_{76}$	$K^*(892) \eta$		(	$1.8 \pm 0.5$	) $\times 10^{-5}$
$\Gamma_{77}$	$K \phi \phi$		(	$2.3 \pm 0.9$	) $\times 10^{-6}$
$\Gamma_{78}$	$\bar{b} \rightarrow \bar{s} \gamma$		(	$3.49 \pm 0.19$	) $\times 10^{-4}$
$\Gamma_{79}$	$\bar{b} \rightarrow \bar{d} \gamma$		(	$9.2 \pm 3.0$	) $\times 10^{-6}$
$\Gamma_{80}$	$\bar{b} \rightarrow \bar{s}$ gluon	<	6.8	%	CL=90%
$\Gamma_{81}$	$\eta$ anything		(	$2.6 \pm 0.5$	) $\times 10^{-4}$
$\Gamma_{82}$	$\eta'$ anything		(	$4.2 \pm 0.9$	) $\times 10^{-4}$
$\Gamma_{83}$	$K^+$ gluon (charmless)	<	1.87	$\times 10^{-4}$	CL=90%
$\Gamma_{84}$	$K^0$ gluon (charmless)		(	$1.9 \pm 0.7$	) $\times 10^{-4}$

**Light unflavored meson modes**

$\Gamma_{85}$	$\rho \gamma$		(	$1.39 \pm 0.25$	) $\times 10^{-6}$	S=1.2
$\Gamma_{86}$	$\rho / \omega \gamma$		(	$1.30 \pm 0.23$	) $\times 10^{-6}$	S=1.2
$\Gamma_{87}$	$\pi^\pm$ anything	[f,i]	(	$358 \pm 7$	) %	
$\Gamma_{88}$	$\pi^0$ anything		(	$235 \pm 11$	) %	
$\Gamma_{89}$	$\eta$ anything		(	$17.6 \pm 1.6$	) %	

$\Gamma_{90}$	$\rho^0$ anything	( 21 $\pm$ 5 ) %	
$\Gamma_{91}$	$\omega$ anything	< 81 %	CL=90%
$\Gamma_{92}$	$\phi$ anything	( 3.43 $\pm$ 0.12 ) %	
$\Gamma_{93}$	$\phi K^*(892)$	< 2.2 $\times 10^{-5}$	CL=90%
$\Gamma_{94}$	$\bar{b} \rightarrow \bar{d}$ gluon		
$\Gamma_{95}$	$\pi^+$ gluon (charmless)	( 3.7 $\pm$ 0.8 ) $\times 10^{-4}$	

**Baryon modes**

$\Gamma_{96}$	$\Lambda_c^+ / \bar{\Lambda}_c^-$ anything	( 3.6 $\pm$ 0.4 ) %	
$\Gamma_{97}$	$\Lambda_c^+$ anything	< 1.3 %	CL=90%
$\Gamma_{98}$	$\bar{\Lambda}_c^-$ anything	< 7 %	CL=90%
$\Gamma_{99}$	$\bar{\Lambda}_c^- \ell^+$ anything	< 9 $\times 10^{-4}$	CL=90%
$\Gamma_{100}$	$\bar{\Lambda}_c^- e^+$ anything	< 1.8 $\times 10^{-3}$	CL=90%
$\Gamma_{101}$	$\bar{\Lambda}_c^- \mu^+$ anything	< 1.4 $\times 10^{-3}$	CL=90%
$\Gamma_{102}$	$\bar{\Lambda}_c^- p$ anything	( 2.04 $\pm$ 0.33 ) %	
$\Gamma_{103}$	$\bar{\Lambda}_c^- p e^+ \nu_e$	< 8 $\times 10^{-4}$	CL=90%
$\Gamma_{104}$	$\bar{\Sigma}_c^{--}$ anything	( 3.3 $\pm$ 1.7 ) $\times 10^{-3}$	
$\Gamma_{105}$	$\bar{\Sigma}_c^-$ anything	< 8 $\times 10^{-3}$	CL=90%
$\Gamma_{106}$	$\bar{\Sigma}_c^0$ anything	( 3.7 $\pm$ 1.7 ) $\times 10^{-3}$	
$\Gamma_{107}$	$\bar{\Sigma}_c^0 N (N = p \text{ or } n)$	< 1.2 $\times 10^{-3}$	CL=90%
$\Gamma_{108}$	$\Xi_c^0$ anything, $\Xi_c^0 \rightarrow \Xi^- \pi^+$	( 1.93 $\pm$ 0.30 ) $\times 10^{-4}$	S=1.1
$\Gamma_{109}$	$\Xi_c^+, \Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+$	( 4.5 $\pm$ 1.3 / -1.2 ) $\times 10^{-4}$	
$\Gamma_{110}$	$p/\bar{p}$ anything	[f] ( 8.0 $\pm$ 0.4 ) %	
$\Gamma_{111}$	$p/\bar{p}$ (direct) anything	[f] ( 5.5 $\pm$ 0.5 ) %	
$\Gamma_{112}$	$\bar{p} e^+ \nu_e$ anything	< 5.9 $\times 10^{-4}$	CL=90%
$\Gamma_{113}$	$\Lambda/\bar{\Lambda}$ anything	[f] ( 4.0 $\pm$ 0.5 ) %	
$\Gamma_{114}$	$\Lambda$ anything	seen	
$\Gamma_{115}$	$\bar{\Lambda}$ anything	seen	
$\Gamma_{116}$	$\Xi^- / \bar{\Xi}^+$ anything	[f] ( 2.7 $\pm$ 0.6 ) $\times 10^{-3}$	
$\Gamma_{117}$	baryons anything	( 6.8 $\pm$ 0.6 ) %	
$\Gamma_{118}$	$p\bar{p}$ anything	( 2.47 $\pm$ 0.23 ) %	
$\Gamma_{119}$	$\Lambda\bar{p}/\bar{\Lambda}p$ anything	[f] ( 2.5 $\pm$ 0.4 ) %	
$\Gamma_{120}$	$\Lambda\bar{\Lambda}$ anything	< 5 $\times 10^{-3}$	CL=90%

**Lepton Family number (LF) violating modes or  $\Delta B = 1$  weak neutral current (B1) modes**

$\Gamma_{121}$	$s e^+ e^-$	B1	( 6.7 $\pm$ 1.7 ) $\times 10^{-6}$	S=2.0
$\Gamma_{122}$	$s \mu^+ \mu^-$	B1	( 4.3 $\pm$ 1.0 ) $\times 10^{-6}$	
$\Gamma_{123}$	$s \ell^+ \ell^-$	B1 [b]	( 5.8 $\pm$ 1.3 ) $\times 10^{-6}$	S=1.8
$\Gamma_{124}$	$\pi \ell^+ \ell^-$	B1	< 5.9 $\times 10^{-8}$	CL=90%
$\Gamma_{125}$	$\pi e^+ e^-$	B1	< 1.10 $\times 10^{-7}$	CL=90%
$\Gamma_{126}$	$\pi \mu^+ \mu^-$	B1	< 5.0 $\times 10^{-8}$	CL=90%
$\Gamma_{127}$	$K e^+ e^-$	B1	( 4.4 $\pm$ 0.6 ) $\times 10^{-7}$	

$\Gamma_{128}$	$K^*(892)e^+e^-$	<i>B1</i>	(	$1.19 \pm 0.20$	) $\times 10^{-6}$	S=1.2
$\Gamma_{129}$	$K\mu^+\mu^-$	<i>B1</i>	(	$4.4 \pm 0.4$	) $\times 10^{-7}$	
$\Gamma_{130}$	$K^*(892)\mu^+\mu^-$	<i>B1</i>	(	$1.06 \pm 0.09$	) $\times 10^{-6}$	
$\Gamma_{131}$	$K\ell^+\ell^-$	<i>B1</i>	(	$4.8 \pm 0.4$	) $\times 10^{-7}$	
$\Gamma_{132}$	$K^*(892)\ell^+\ell^-$	<i>B1</i>	(	$1.05 \pm 0.10$	) $\times 10^{-6}$	
$\Gamma_{133}$	$K\nu\bar{\nu}$	<i>B1</i>	<	1.6	$\times 10^{-5}$	CL=90%
$\Gamma_{134}$	$K^*\nu\bar{\nu}$	<i>B1</i>	<	2.7	$\times 10^{-5}$	CL=90%
$\Gamma_{135}$	$\pi\nu\bar{\nu}$	<i>B1</i>	<	8	$\times 10^{-6}$	CL=90%
$\Gamma_{136}$	$\rho\nu\bar{\nu}$	<i>B1</i>	<	2.8	$\times 10^{-5}$	CL=90%
$\Gamma_{137}$	$se^\pm\mu^\mp$	<i>LF</i>	[ <i>f</i> ] <	2.2	$\times 10^{-5}$	CL=90%
$\Gamma_{138}$	$\pi e^\pm\mu^\mp$	<i>LF</i>	<	9.2	$\times 10^{-8}$	CL=90%
$\Gamma_{139}$	$\rho e^\pm\mu^\mp$	<i>LF</i>	<	3.2	$\times 10^{-6}$	CL=90%
$\Gamma_{140}$	$Ke^\pm\mu^\mp$	<i>LF</i>	<	3.8	$\times 10^{-8}$	CL=90%
$\Gamma_{141}$	$K^*(892)e^\pm\mu^\mp$	<i>LF</i>	<	5.1	$\times 10^{-7}$	CL=90%

[a] These values are model dependent.

[b] An  $\ell$  indicates an  $e$  or a  $\mu$  mode, not a sum over these modes.

[c] Here “anything” means at least one particle observed.

[d] This is a  $B(B^0 \rightarrow D^{*-} \ell^+ \nu_\ell)$  value.

[e]  $D^{**}$  stands for the sum of the  $D(1^1P_1)$ ,  $D(1^3P_0)$ ,  $D(1^3P_1)$ ,  $D(1^3P_2)$ ,  $D(2^1S_0)$ , and  $D(2^1S_1)$  resonances.

[f] The value is for the sum of the charge states or particle/antiparticle states indicated.

[g]  $D^{(*)}\bar{D}^{(*)}$  stands for the sum of  $D^*\bar{D}^*$ ,  $D^*\bar{D}$ ,  $D\bar{D}^*$ , and  $D\bar{D}$ .

[h]  $X(3915)$  denotes a near-threshold enhancement in the  $\omega J/\psi$  mass spectrum.

[i] Inclusive branching fractions have a multiplicity definition and can be greater than 100%.

## $B^\pm/B^0$ ADMIXTURE BRANCHING RATIOS

$\Gamma(\ell^+ \nu_\ell \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_3/\Gamma$

These branching fraction values are model dependent.

“OUR EVALUATION” assumes lepton universality and is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <http://www.slac.stanford.edu/xorg/hflav/>. The averaging/rescaling procedure takes into account correlations between the measurements.

<u>VALUE (%)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>10.86±0.16 OUR EVALUATION</b>			
<b>10.49±0.20 OUR AVERAGE</b>			Error includes scale factor of 1.3. See the ideogram below.
10.34±0.04±0.26	<sup>1</sup> LEES	17B BABR	$e^+e^- \rightarrow \Upsilon(4S)$
10.28±0.18±0.24	<sup>2</sup> URQUIJO	07 BELL	$e^+e^- \rightarrow \Upsilon(4S)$
10.91±0.09±0.24	<sup>3</sup> MAHMOOD	04 CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
9.7 ±0.5 ±0.4	<sup>4</sup> ALBRECHT	93H ARG	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

9.96±0.19±0.32	<sup>5</sup> AUBERT,B	06Y	BABR	Repl. by LEES 17B
10.85±0.21±0.36	<sup>6</sup> OKABE	05	BELL	Repl. by URQUIJO 07
10.83±0.16±0.06	<sup>7</sup> AUBERT	04X	BABR	Repl. by AUBERT,B 06Y
10.36±0.06±0.23	<sup>8</sup> AUBERT,B	04A	BABR	$e^+e^- \rightarrow \Upsilon(4S)$
10.87±0.18±0.30	<sup>9</sup> AUBERT	03	BABR	Repl. by AUBERT 04X
10.90±0.12±0.49	<sup>10</sup> ABE	02Y	BELL	Repl. by OKABE 05
10.49±0.17±0.43	<sup>11</sup> BARISH	96B	CLE2	Repl. by MAHMOOD 04
10.80±0.20±0.56	<sup>12</sup> HENDERSON	92	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
10.0 ±0.4 ±0.3	<sup>13</sup> YANAGISAWA	91	CSB2	$e^+e^- \rightarrow \Upsilon(4S)$
10.3 ±0.6 ±0.2	<sup>14</sup> ALBRECHT	90H	ARG	Direct $e$ at $\Upsilon(4S)$
10.0 ±0.6 ±0.2	<sup>15</sup> ALBRECHT	90H	ARG	Direct $\mu$ at $\Upsilon(4S)$
11.7 ±0.4 ±1.0	<sup>16</sup> WACHS	89	CBAL	Direct $e$ at $\Upsilon(4S)$
12.0 ±0.7 ±0.5	CHEN	84	CLEO	Direct $e$ at $\Upsilon(4S)$
10.8 ±0.6 ±1.0	CHEN	84	CLEO	Direct $\mu$ at $\Upsilon(4S)$
11.2 ±0.9 ±1.0	LEVMAN	84	CUSB	Direct $\mu$ at $\Upsilon(4S)$
13.2 ±0.8 ±1.4	<sup>17</sup> KLOPFEN...	83B	CUSB	Direct $e$ at $\Upsilon(4S)$

<sup>1</sup> LEES 17B measurement is obtained from semileptonic decays to electrons. The result is averaged over  $B^\pm$  and  $B^0$  mesons, assuming lepton universality.

<sup>2</sup> URQUIJO 07 report a measurement of  $(10.07 \pm 0.18 \pm 0.21)\%$  for the partial branching fraction of  $B \rightarrow e\nu_e X_C$  decay with electron energy above 0.6 GeV. We converted the result to  $B \rightarrow e\nu_e X$  branching fraction.

<sup>3</sup> Uses charge and angular correlations in  $\Upsilon(4S)$  events with a high-momentum lepton and an additional electron.

<sup>4</sup> ALBRECHT 93H analysis performed using tagged semileptonic decays of the  $B$ . This technique is almost model independent for the lepton branching ratio.

<sup>5</sup> The measurements are obtained for charged and neutral  $B$  mesons partial rates of semileptonic decay to electrons with momentum above 0.6 GeV/c in the  $B$  rest frame. The best precision on the ratio is achieved for a momentum threshold of 1.0 GeV:  $B(B^+ \rightarrow e^+\nu_e X) / B(B^0 \rightarrow e^+\nu_e X) = 1.074 \pm 0.041 \pm 0.026$ .

<sup>6</sup> The measurements are obtained for charged and neutral  $B$  mesons partial rates of semileptonic decay to electrons with momentum above 0.6 GeV/c in the  $B$  rest frame, and their ratio of  $B(B^+ \rightarrow e^+\nu_e X)/B(B^0 \rightarrow e^+\nu_e X) = 1.08 \pm 0.05 \pm 0.02$ .

<sup>7</sup> The semileptonic branching ratio,  $|V_{cb}|$  and other heavy-quark parameters are determined from a simultaneous fit to moments of the hadronic-mass and lepton-energy distribution.

<sup>8</sup> Uses the high-momentum lepton tag method and requires the electron energy above 0.6 GeV.

<sup>9</sup> Uses the high-momentum lepton tag method. They also report  $|V_{cb}| = 0.0423 \pm 0.0007(\text{exp}) \pm 0.0020(\text{theo.})$ .

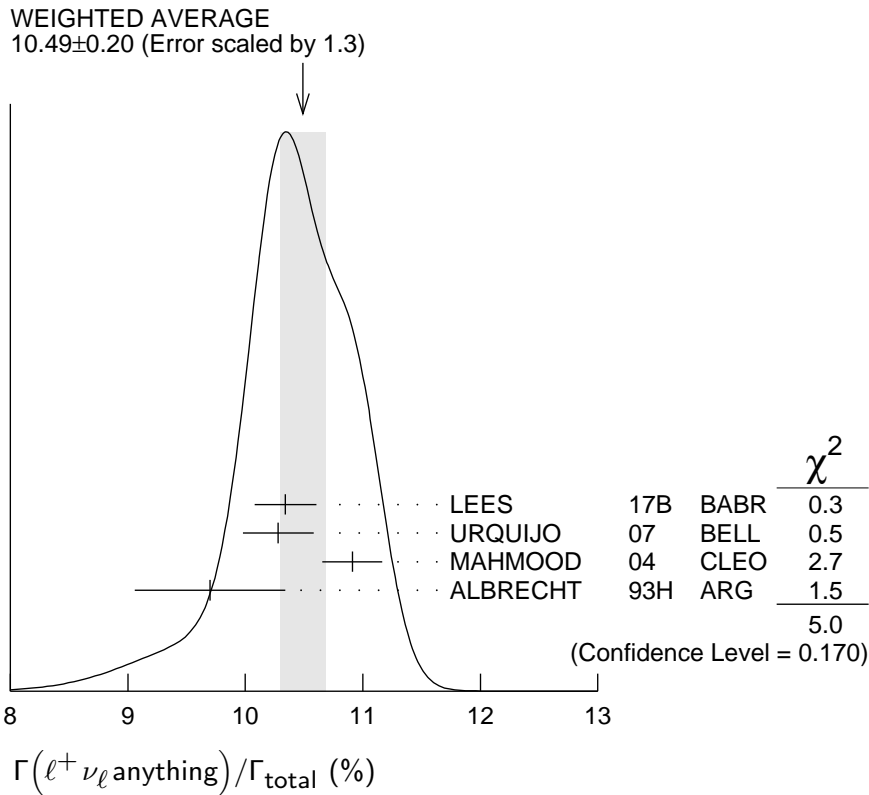
<sup>10</sup> Uses the high-momentum lepton tag method. ABE 02Y also reports  $|V_{cb}| = 0.0408 \pm 0.0010(\text{exp}) \pm 0.0025(\text{theo.})$ . The second error is due to uncertainties of theoretical inputs.

<sup>11</sup> BARISH 96B analysis performed using tagged semileptonic decays of the  $B$ . This technique is almost model independent for the lepton branching ratio.

<sup>12</sup> HENDERSON 92 measurement employs  $e$  and  $\mu$ . The systematic error contains 0.004 in quadrature from model dependence. The authors average a variation of the Isgur, Scora, Grinstein, and Wise model with that of the Altarelli-Cabibbo-Corbò-Maiani-Martinelli model for semileptonic decays to correct the acceptance.

<sup>13</sup> YANAGISAWA 91 also measures an average semileptonic branching ratio at the  $\Upsilon(5S)$  of 9.6–10.5% depending on assumptions about the relative production of different  $B$  meson species.

- 14 ALBRECHT 90H uses the model of ALTARELLI 82 to correct over all lepton momenta.  $0.099 \pm 0.006$  is obtained using ISGUR 89B.  
 15 ALBRECHT 90H uses the model of ALTARELLI 82 to correct over all lepton momenta.  $0.097 \pm 0.006$  is obtained using ISGUR 89B.  
 16 Using data above  $p(e) = 2.4$  GeV, WACHS 89 determine  $\sigma(B \rightarrow e\nu up)/\sigma(B \rightarrow e\nu charm) < 0.065$  at 90% CL.  
 17 Ratio  $\sigma(b \rightarrow e\nu up)/\sigma(b \rightarrow e\nu charm) < 0.055$  at CL = 90%.



**$\Gamma(D^- \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_4 / \Gamma_3$**   
 $\ell = e \text{ or } \mu.$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.26 \pm 0.07 \pm 0.04</math></b>	<sup>1</sup> FULTON	91	CLEO $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> FULTON 91 uses  $B(D^+ \rightarrow K^- \pi^+ \pi^+) = (9.1 \pm 1.3 \pm 0.4)\%$  as measured by MARK III.

**$\Gamma(\bar{D}^0 \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_5 / \Gamma_3$**   
 $\ell = e \text{ or } \mu.$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.67 \pm 0.09 \pm 0.10</math></b>	<sup>1</sup> FULTON	91	CLEO $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> FULTON 91 uses  $B(D^0 \rightarrow K^- \pi^+) = (4.2 \pm 0.4 \pm 0.4)\%$  as measured by MARK III.

**$\Gamma(\bar{D} \ell^+ \nu_\ell) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_6 / \Gamma_3$**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.223 \pm 0.006 \pm 0.009</math></b>	<sup>1</sup> AUBERT	10	BABR $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Uses a fully reconstructed  $B$  meson as a tag on the recoil side.

$\Gamma(D^{*-} \ell^+ \nu_\ell \text{ anything}) / \Gamma_{\text{total}}$   $\Gamma_7 / \Gamma$

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
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**0.67 ± 0.08 ± 0.10** ABDALLAH 04D DLPH  $e^+ e^- \rightarrow Z^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.6 ± 0.3 ± 0.1 <sup>1</sup> BARISH 95 CLE2  $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> BARISH 95 use  $B(D^0 \rightarrow K^- \pi^+) = (3.91 \pm 0.08 \pm 0.17)\%$  and  $B(D^{*+} \rightarrow D^0 \pi^+) = (68.1 \pm 1.0 \pm 1.3)\%$ .

$\Gamma(D^{*0} \ell^+ \nu_\ell \text{ anything}) / \Gamma_{\text{total}}$   $\Gamma_8 / \Gamma$

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.6 ± 0.6 ± 0.1 <sup>1</sup> BARISH 95 CLE2  $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> BARISH 95 use  $B(D^0 \rightarrow K^- \pi^+) = (3.91 \pm 0.08 \pm 0.17)\%$ ,  $B(D^{*+} \rightarrow D^0 \pi^+) = (68.1 \pm 1.0 \pm 1.3)\%$ ,  $B(D^{*0} \rightarrow D^0 \pi^0) = (63.6 \pm 2.3 \pm 3.3)\%$ .

$\Gamma(\overline{D}^{**} \ell^+ \nu_\ell) / \Gamma_{\text{total}}$   $\Gamma_{10} / \Gamma$

$\overline{D}^{**}$  stands for the sum of the  $D(1^1P_1)$ ,  $D(1^3P_0)$ ,  $D(1^3P_1)$ ,  $D(1^3P_2)$ ,  $D(2^1S_0)$ , and  $D(2^1S_1)$  resonances.  $\ell = e$  or  $\mu$ , not sum over  $e$  and  $\mu$  modes.

VALUE	CL%	EVTs	DOCUMENT ID	TECN	COMMENT
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**0.027 ± 0.005 ± 0.005** 63 <sup>1</sup> ALBRECHT 93 ARG  $e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 0.028 95 <sup>2</sup> BARISH 95 CLE2  $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 93 assumes the GISW model to correct for unseen modes. Using the BHKT model, the result becomes  $0.023 \pm 0.006 \pm 0.004$ . Assumes  $B(D^{*+} \rightarrow D^0 \pi^+) = 68.1\%$ ,  $B(D^0 \rightarrow K^- \pi^+) = 3.65\%$ ,  $B(D^0 \rightarrow K^- \pi^+ \pi^- \pi^+) = 7.5\%$ . We have taken their average  $e$  and  $\mu$  value.

<sup>2</sup> BARISH 95 use  $B(D^0 \rightarrow K^- \pi^+) = (3.91 \pm 0.08 \pm 0.17)\%$ , assume all nonresonant channels are zero, and use GISW model for relative abundances of  $D^{**}$  states.

$\Gamma(\overline{D}_1(2420) \ell^+ \nu_\ell \text{ anything}) / \Gamma_{\text{total}}$   $\Gamma_{11} / \Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.0038 ± 0.0013 OUR AVERAGE** Error includes scale factor of 2.4.

0.0033 ± 0.0006 <sup>1</sup> ABAZOV 05O D0  $p\bar{p}$  at 1.96 TeV

0.0074 ± 0.0016 <sup>2</sup> BUSKULIC 97B ALEP  $e^+ e^- \rightarrow Z$

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen <sup>3</sup> BUSKULIC 95B ALEP Repl. by BUSKULIC 97B

<sup>1</sup> Assumes  $B(D_1 \rightarrow D^* \pi) = 1$ ,  $B(D_1 \rightarrow D^* \pi^\pm) = 2/3$ , and  $B(b \rightarrow B) = 0.397$ .

<sup>2</sup> BUSKULIC 97B assumes  $B(D_1(2420) \rightarrow D^* \pi) = 1$ ,  $B(D_1(2420) \rightarrow D^* \pi^\pm) = 2/3$ , and  $B(b \rightarrow B) = 0.378 \pm 0.022$ .

<sup>3</sup> BUSKULIC 95B reports  $f_B \times B(B \rightarrow \overline{D}_1(2420)^0 \ell^+ \nu_\ell \text{ anything}) \times B(\overline{D}_1(2420)^0 \rightarrow \overline{D}^*(2010)^- \pi^+) = (2.04 \pm 0.58 \pm 0.34)10^{-3}$ , where  $f_B$  is the production fraction for a single  $B$  charge state.



$[\Gamma(D\pi\ell^+\nu_\ell\text{anything}) + \Gamma(D^*\pi\ell^+\nu_\ell\text{anything})]/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.026 ± 0.005 OUR AVERAGE</b>	Error includes scale factor of 1.5.		
0.0340 ± 0.0052 ± 0.0032	<sup>1</sup> ABREU	00R	DLPH $e^+e^- \rightarrow Z$
0.0226 ± 0.0029 ± 0.0033	<sup>2</sup> BUSKULIC	97B	ALEP $e^+e^- \rightarrow Z$

<sup>1</sup> Assumes no contribution from  $B_s$  and  $b$  baryons. Further assumes contributions from single pion ( $D\pi$  and  $D^*\pi$ ) states only, allowing isospin conservation to relate the relative  $\pi^0$  and  $\pi^+$  rates.

<sup>2</sup> BUSKULIC 97B assumes  $B(b \rightarrow B) = 0.378 \pm 0.022$  and uses isospin invariance by assuming that all observed  $D^0\pi^+$ ,  $D^{*0}\pi^+$ ,  $D^+\pi^-$ , and  $D^{*+}\pi^-$  are from  $D^{**}$  states. A correction has been applied to account for the production of  $B_s^0$  and  $\Lambda_b^0$ .

$\Gamma(D\pi\ell^+\nu_\ell\text{anything})/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.0154 ± 0.0061</b>	ABREU	00R	DLPH $e^+e^- \rightarrow Z$

$\Gamma(D^*\pi\ell^+\nu_\ell\text{anything})/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.0186 ± 0.0038</b>	ABREU	00R	DLPH $e^+e^- \rightarrow Z$

$\Gamma(\bar{D}_2^*(2460)\ell^+\nu_\ell\text{anything})/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>0.0044 ± 0.0016</b>		<sup>1</sup> ABAZOV	05O	D0 $p\bar{p}$ at 1.96 TeV
• • •		We do not use the following data for averages, fits, limits, etc. • • •		
<0.0065	95	<sup>2</sup> BUSKULIC	97B	ALEP $e^+e^- \rightarrow Z$
not seen		<sup>3</sup> BUSKULIC	95B	ALEP $e^+e^- \rightarrow Z$

<sup>1</sup> Assumes  $B(D_2^* \rightarrow D^*\pi^\pm) = 0.30 \pm 0.06$  and  $B(b \rightarrow B) = 0.397$ .

<sup>2</sup> A revised number based on BUSKULIC 97B which assumes  $B(D_2^*(2460) \rightarrow D^*\pi^\pm) = 0.20$  and  $B(b \rightarrow B) = 0.378 \pm 0.022$ .

<sup>3</sup> BUSKULIC 95B reports  $f_B \times B(B \rightarrow \bar{D}_2^*(2460)^0\ell^+\nu_\ell\text{anything}) \times B(\bar{D}_2^*(2460)^0 \rightarrow \bar{D}^*(2010)^-\pi^+) \leq 0.81 \times 10^{-3}$  at CL=95%, where  $f_B$  is the production fraction for a single  $B$  charge state.

$\Gamma(B \rightarrow \bar{D}_2^*(2460)\ell^+\nu_\ell\text{anything}) \times B(D_2^*(2460) \rightarrow D^{*-}\pi^+)$

$\Gamma(B \rightarrow \bar{D}_1(2420)\ell^+\nu_\ell\text{anything}) \times B(D_1(2420) \rightarrow D^{*-}\pi^+)$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.39 ± 0.09 ± 0.12</b>	ABAZOV	05O	D0 $p\bar{p}$ at 1.96 TeV

$\Gamma(D^{*-}\pi^+\ell^+\nu_\ell\text{anything})/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma$

Includes resonant and nonresonant contributions.

VALUE (units $10^{-3}$ )	DOCUMENT ID	TECN	COMMENT
<b>10.0 ± 2.7 ± 2.1</b>	<sup>1</sup> BUSKULIC	95B	ALEP $e^+e^- \rightarrow Z$

<sup>1</sup> BUSKULIC 95B reports  $f_B \times B(B \rightarrow \bar{D}^*(2010)^-\pi^+\ell^+\nu_\ell\text{anything}) = (3.7 \pm 1.0 \pm 0.7)10^{-3}$ . Above value assumes  $f_B = 0.37 \pm 0.03$ .

$\Gamma(\overline{D}\pi^+\pi^-\ell^+\nu_\ell)/\Gamma(\overline{D}\ell^+\nu_\ell)$   $\Gamma_{17}/\Gamma_6$

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
<b>6.7±1.0±0.8</b>	<sup>1</sup> LEES	16	BABR $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measurement used electrons and muons as leptons.

$\Gamma(\overline{D}^*\pi^+\pi^-\ell^+\nu_\ell)/\Gamma(D^*\ell^+\nu_\ell)$   $\Gamma_{18}/\Gamma_9$

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
<b>1.9±0.5±0.4</b>	<sup>1</sup> LEES	16	BABR $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measurement used electrons and muons as leptons.

$\Gamma(D_s^-\ell^+\nu_\ell \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{19}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;7 × 10<sup>-3</sup></b>	90	<sup>1</sup> ALBRECHT	93E	ARG $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 93E reports < 0.012 from a measurement of  $[\Gamma(B \rightarrow D_s^-\ell^+\nu_\ell \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = 0.027$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = 4.5 \times 10^{-2}$ .

$\Gamma(D_s^-\ell^+\nu_\ell K^+ \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{20}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;5 × 10<sup>-3</sup></b>	90	<sup>1</sup> ALBRECHT	93E	ARG $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 93E reports < 0.008 from a measurement of  $[\Gamma(B \rightarrow D_s^-\ell^+\nu_\ell K^+ \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = 0.027$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = 4.5 \times 10^{-2}$ .

$\Gamma(D_s^-\ell^+\nu_\ell K^0 \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{21}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;7 × 10<sup>-3</sup></b>	90	<sup>1</sup> ALBRECHT	93E	ARG $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 93E reports < 0.012 from a measurement of  $[\Gamma(B \rightarrow D_s^-\ell^+\nu_\ell K^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = 0.027$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = 4.5 \times 10^{-2}$ .

$\Gamma(X_c\ell^+\nu_\ell)/\Gamma_{\text{total}}$   $\Gamma_{22}/\Gamma$

“OUR EVALUATION” is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <http://www.slac.stanford.edu/xorg/hflav/>. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE (%)	DOCUMENT ID	TECN	COMMENT
<b>10.65±0.16 OUR EVALUATION</b>			
<b>10.29±0.19 OUR AVERAGE</b>			
10.18±0.03±0.24	<sup>1</sup> LEES	17B	BABR $e^+e^- \rightarrow \gamma(4S)$
10.44±0.19±0.22	<sup>2</sup> URQUIJO	07	BELL $e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
10.64±0.17±0.06	<sup>3</sup> AUBERT	10A	BABR Repl. by LEES 17B

$10.61 \pm 0.16 \pm 0.06$  <sup>4</sup> AUBERT 04X BABR Repl. by AUBERT 10A

<sup>1</sup> The measurement is obtained from semileptonic decays to electrons  $B \rightarrow X e \nu$ , and using a theoretical model (GAMBINO 07, GAMBINO 11) to predict the contribution from  $B \rightarrow X_u e \nu$ . The result is averaged over  $B^\pm$  and  $B^0$  mesons, assuming lepton universality.

<sup>2</sup> Measured the independent  $B^+$  and  $B^0$  partial branching fractions with electron energy above 0.4 GeV.

<sup>3</sup> Obtained from a combined fit to the moments of observed spectra in inclusive  $B \rightarrow X_c \ell^+ \nu_\ell$  decay.

<sup>4</sup> The semileptonic branching ratio,  $|V_{cb}|$  and other heavy-quark parameters are determined from a simultaneous fit to moments of the hadronic-mass and lepton-energy distribution.

$\Gamma(X_u \ell^+ \nu_\ell) / \Gamma_{\text{total}}$   $\Gamma_{23} / \Gamma$

“OUR EVALUATION” is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <http://www.slac.stanford.edu/xorg/hflav/>. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE (units $10^{-3}$ )	DOCUMENT ID	TECN	COMMENT
<b>2.13 ± 0.30 OUR EVALUATION</b>			
$1.665 \pm 0.087^{+0.103}_{-0.094}$	<sup>1</sup> LEES	17B BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$2.01 \pm 0.15 \pm 0.25$	<sup>2</sup> LEES	12R BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$2.53 \pm 0.24 \pm 0.24$	<sup>3</sup> AUBERT,B	05X BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$2.80 \pm 0.52 \pm 0.41$	<sup>4</sup> LIMOSANI	05 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$1.77 \pm 0.29 \pm 0.38$	<sup>5</sup> BORNHEIM	02 CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$1.963 \pm 0.173 \pm 0.159$	<sup>6</sup> URQUIJO	10 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$1.18 \pm 0.09 \pm 0.07$	<sup>7</sup> AUBERT	08AS BABR	Repl. by LEES 12R
$2.27 \pm 0.26^{+0.37}_{-0.33}$	<sup>8</sup> AUBERT	06H BABR	Repl. by LEES 17B
$2.24 \pm 0.27 \pm 0.47$	<sup>9,10</sup> AUBERT	04I BABR	Repl. by AUBERT,B 05X

<sup>1</sup> Obtained from the partial rate  $\Delta B = (1.554 \pm 0.082^{+0.095}_{-0.086}) \times 10^{-3}$  for the electron momentum interval of 0.8–2.7 GeV/c based on GGOU1 method ( $X_c \ell \nu$ ,  $m_c$  constraint fit of SF parameters).

<sup>2</sup> Measures several partial branching fractions in different phase space regions. The most precise result on the full branching fraction is obtained in the region for lepton momentum in  $B$  rest frame  $p_\ell^* > 1$  GeV/c, where the measured partial branching fraction is  $\Delta B = (1.80 \pm 0.13 \pm 0.15) \times 10^{-3}$ . The acceptance in that region is reported in a private communication by the Authors to be 0.894. The corresponding  $|V_{ub}|$  from the BLNP method is  $(4.28 \pm 0.15 \pm 0.18 \pm 0.19) \times 10^{-3}$ , where the last uncertainty comes from theoretical prediction.

<sup>3</sup> Determined from the partial rate  $\Delta B = (4.41 \pm 0.42 \pm 0.42) \times 10^{-4}$  measured for electron energy  $> 2$  GeV and hadronic mass squared  $< 3.5$  GeV<sup>2</sup>, and calculated acceptance 0.174 in that region. The  $V_{ub}$  is measured as  $(4.41 \pm 0.30^{+0.65}_{-0.47} \pm 0.28) \times 10^{-3}$ .

<sup>4</sup> Uses electrons in the momentum interval 1.9–2.6 GeV/c in the center-of-mass frame. The  $V_{ub}$  is found to be  $(5.08 \pm 0.47^{+0.49}_{-0.48}) \times 10^{-3}$ .

<sup>5</sup> BORNHEIM 02 uses the observed yield of leptons from semileptonic  $B$  decays in the end-point momentum interval 2.2–2.6 GeV/c with recent CLEO-2 data on  $B \rightarrow X_s \gamma$ . The  $V_{ub}$  is found to be  $(4.08 \pm 0.34 \pm 0.53) \times 10^{-3}$ .

- <sup>6</sup> Uses a multivariate analysis method and requires lepton momentum in the  $B$  rest frame,  $p_l^{*B} > 1.0 \text{ GeV}/c$ .
- <sup>7</sup> Measures several partial branching fractions in different phase space regions. The most precise result is obtained in the region for hadronic mass  $M_X < 1.55 \text{ GeV}/c^2$ , and is  $\Delta B = (1.18 \pm 0.09 \pm 0.07) \times 10^{-3}$ . The corresponding  $|V_{ub}|$  from the BLNP method is  $(4.27 \pm 0.16 \pm 0.13 \pm 0.30) \times 10^{-3}$ , where the last uncertainty comes from the theoretical prediction of the partial rate in the given phase-space region.
- <sup>8</sup> Obtained from the partial rate  $\Delta B = (0.572 \pm 0.041 \pm 0.065) \times 10^{-3}$  for the electron momentum interval of 2.0–2.6  $\text{GeV}/c$  based on BLNP method.
- <sup>9</sup> Used BaBar measurement of Semileptonic branching fraction  $B(B \rightarrow X \ell \nu_\ell) = (10.87 \pm 0.18 \pm 0.30)\%$  to convert the ratio of rates to branching fraction.
- <sup>10</sup> The third error includes the systematics and theoretical errors summed in quadrature.

### $\Gamma(X_u \ell^+ \nu_\ell) / \Gamma(\ell^+ \nu_\ell \text{ anything})$

$\Gamma_{23} / \Gamma_3$

$\ell$  denotes  $e$  or  $\mu$ , not the sum. These experiments measure this ratio in very limited momentum intervals.

VALUE (units $10^{-2}$ )	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>2.06 ± 0.25 ± 0.42</b>			<sup>1</sup> AUBERT	04I	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
			<sup>2</sup> ALBRECHT	94C	ARG $e^+ e^- \rightarrow \Upsilon(4S)$
		107	<sup>3</sup> BARTELT	93B	CLE2 $e^+ e^- \rightarrow \Upsilon(4S)$
		77	<sup>4</sup> ALBRECHT	91C	ARG $e^+ e^- \rightarrow \Upsilon(4S)$
		41	<sup>5</sup> ALBRECHT	90	ARG $e^+ e^- \rightarrow \Upsilon(4S)$
		76	<sup>6</sup> FULTON	90	CLEO $e^+ e^- \rightarrow \Upsilon(4S)$
<4.0	90		<sup>7</sup> BEHRENDIS	87	CLEO $e^+ e^- \rightarrow \Upsilon(4S)$
<4.0	90		CHEN	84	CLEO Direct $e$ at $\Upsilon(4S)$
<5.5	90		KLOPFEN...	83B	CUSB Direct $e$ at $\Upsilon(4S)$

- <sup>1</sup> The third error includes the systematics and theoretical errors summed in quadrature.
- <sup>2</sup> ALBRECHT 94C find  $\Gamma(b \rightarrow c) / \Gamma(b \rightarrow \text{all}) = 0.99 \pm 0.02 \pm 0.04$ .
- <sup>3</sup> BARTELT 93B (CLEO II) measures an excess of  $107 \pm 15 \pm 11$  leptons in the lepton momentum interval 2.3–2.6  $\text{GeV}/c$  which is attributed to  $b \rightarrow u \ell \nu_\ell$ . This corresponds to a model-dependent partial branching ratio  $\Delta B_{ub}$  between  $(1.15 \pm 0.16 \pm 0.15) \times 10^{-4}$ , as evaluated using the KS model (KOERNER 88), and  $(1.54 \pm 0.22 \pm 0.20) \times 10^{-4}$  using the ACCMM model (ARTUSO 93). The corresponding values of  $|V_{ub}|/|V_{cb}|$  are  $0.056 \pm 0.006$  and  $0.076 \pm 0.008$ , respectively.
- <sup>4</sup> ALBRECHT 91C result supersedes ALBRECHT 90. Two events are fully reconstructed providing evidence for the  $b \rightarrow u$  transition. Using the model of ALTARELLI 82, they obtain  $|V_{ub}/V_{cb}| = 0.11 \pm 0.012$  from 77 leptons in the 2.3–2.6  $\text{GeV}$  momentum range.
- <sup>5</sup> ALBRECHT 90 observes  $41 \pm 10$  excess  $e$  and  $\mu$  (lepton) events in the momentum interval  $p = 2.3$ –2.6  $\text{GeV}$  signaling the presence of the  $b \rightarrow u$  transition. The events correspond to a model-dependent measurement of  $|V_{ub}/V_{cb}| = 0.10 \pm 0.01$ .
- <sup>6</sup> FULTON 90 observe  $76 \pm 20$  excess  $e$  and  $\mu$  (lepton) events in the momentum interval  $p = 2.4$ –2.6  $\text{GeV}$  signaling the presence of the  $b \rightarrow u$  transition. The average branching ratio,  $(1.8 \pm 0.4 \pm 0.3) \times 10^{-4}$ , corresponds to a model-dependent measurement of approximately  $|V_{ub}/V_{cb}| = 0.1$  using  $B(b \rightarrow c \ell \nu) = 10.2 \pm 0.2 \pm 0.7\%$ .
- <sup>7</sup> The quoted possible limits range from 0.018 to 0.04 for the ratio, depending on which model or momentum range is chosen. We select the most conservative limit they have calculated. This corresponds to a limit on  $|V_{ub}|/|V_{cb}| < 0.20$ . While the endpoint technique employed is more robust than their previous results in CHEN 84, these results do not provide a numerical improvement in the limit.

$\Gamma(K^+ \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_{24} / \Gamma_3$

$\ell$  denotes  $e$  or  $\mu$ , not the sum.

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.58 ± 0.05 OUR AVERAGE**

0.594 ± 0.021 ± 0.056	ALBRECHT	94C ARG	$e^+ e^- \rightarrow \gamma(4S)$
0.54 ± 0.07 ± 0.06	<sup>1</sup> ALAM	87B CLEO	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALAM 87B measurement relies on lepton-kaon correlations.

$\Gamma(K^- \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_{25} / \Gamma_3$

$\ell$  denotes  $e$  or  $\mu$ , not the sum.

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.092 ± 0.035 OUR AVERAGE**

0.086 ± 0.011 ± 0.044	ALBRECHT	94C ARG	$e^+ e^- \rightarrow \gamma(4S)$
0.10 ± 0.05 ± 0.02	<sup>1</sup> ALAM	87B CLEO	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALAM 87B measurement relies on lepton-kaon correlations.

$\Gamma(K^0 / \bar{K}^0 \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$   $\Gamma_{26} / \Gamma_3$

$\ell$  denotes  $e$  or  $\mu$ , not the sum. Sum over  $K^0$  and  $\bar{K}^0$  states.

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.42 ± 0.05 OUR AVERAGE**

0.452 ± 0.038 ± 0.056	<sup>1</sup> ALBRECHT	94C ARG	$e^+ e^- \rightarrow \gamma(4S)$
0.39 ± 0.06 ± 0.04	<sup>2</sup> ALAM	87B CLEO	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 94C assume a  $K^0 / \bar{K}^0$  multiplicity twice that of  $K_S^0$ .

<sup>2</sup> ALAM 87B measurement relies on lepton-kaon correlations.

$\Gamma(\bar{D} \tau^+ \nu_\tau) / \Gamma(\bar{D} \ell^+ \nu_\ell)$   $\Gamma_{27} / \Gamma_6$

“OUR EVALUATION” is an average using rescaled values of the data listed below.

The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <http://www.slac.stanford.edu/xorg/hflav/>. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
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**40.7 ± 4.6 OUR EVALUATION**

**41 ± 5 OUR AVERAGE**

37.5 ± 6.4 ± 2.6	<sup>1,2</sup> HUSCHLE	15 BELL	$e^+ e^- \rightarrow \gamma(4S)$
44.0 ± 5.8 ± 4.2	<sup>1,2</sup> LEES	12D BABR	$e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.16 ± 11.7 ± 5.2	<sup>1</sup> AUBERT	08N BABR	Repl. by LEES 12D
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<sup>1</sup> Uses a fully reconstructed  $B$  meson as a tag on the recoil side.

<sup>2</sup> Uses  $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$  and  $\tau^+ \rightarrow \mu^+ \nu_\mu \bar{\nu}_\tau$  and  $e^+$  or  $\mu^+$  as  $\ell^+$ . Obtained from simultaneous fit to  $B^+$  and  $B^0$  assuming isospin symmetry.

$\Gamma(D^* \tau^+ \nu_\tau) / \Gamma(D^* \ell^+ \nu_\ell)$   $\Gamma_{28} / \Gamma_9$

“OUR EVALUATION” is an average using rescaled values of the data listed below.

The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <http://www.slac.stanford.edu/xorg/hflav/>. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>30.4 \pm 1.5</math> OUR EVALUATION</b>			
<b><math>30.7 \pm 2.1</math> OUR AVERAGE</b>			
$27.0 \pm 3.5^{+2.8}_{-2.5}$	<sup>1</sup> HIROSE	17 BELL	$e^+e^- \rightarrow \gamma(4S)$
$29.3 \pm 3.8 \pm 1.5$	<sup>2</sup> HUSCHLE	15 BELL	$e^+e^- \rightarrow \gamma(4S)$
$33.2 \pm 2.4 \pm 1.8$	<sup>2</sup> LEES	12D BABR	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$29.7 \pm 5.6 \pm 1.8$	<sup>3</sup> AUBERT	08N BABR	Repl. by LEES 12D
<sup>1</sup> Uses a fully reconstructed $B$ meson as a tag on the recoil side.			
<sup>2</sup> Uses $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$ and $\tau^+ \rightarrow \mu^+ \nu_\mu \bar{\nu}_\tau$ and $e^+$ or $\mu^+$ as $\ell^+$ . Obtained from simultaneous fit to $B^+$ and $B^0$ assuming isospin symmetry. Uses a fully reconstructed $B$ meson as a tag on the recoil side.			
<sup>3</sup> Uses a fully reconstructed $B$ meson as a tag on the recoil side. The results are normalized to the $B^+$ decay rate.			

 $\langle n_c \rangle$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>1.10 \pm 0.05</math></b>	<sup>1</sup> GIBBONS	97B CLE2	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.98 \pm 0.16 \pm 0.12$	<sup>2</sup> ALAM	87B CLEO	$e^+e^- \rightarrow \gamma(4S)$
<sup>1</sup> GIBBONS 97B from charm counting using $B(D_s^+ \rightarrow \phi\pi) = 0.036 \pm 0.009$ and $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = 0.044 \pm 0.006$ .			
<sup>2</sup> From the difference between $K^-$ and $K^+$ widths. ALAM 87B measurement relies on lepton-kaon correlations. It does not consider the possibility of $B\bar{B}$ mixing. We have thus removed it from the average.			

 $\Gamma(D^\pm \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

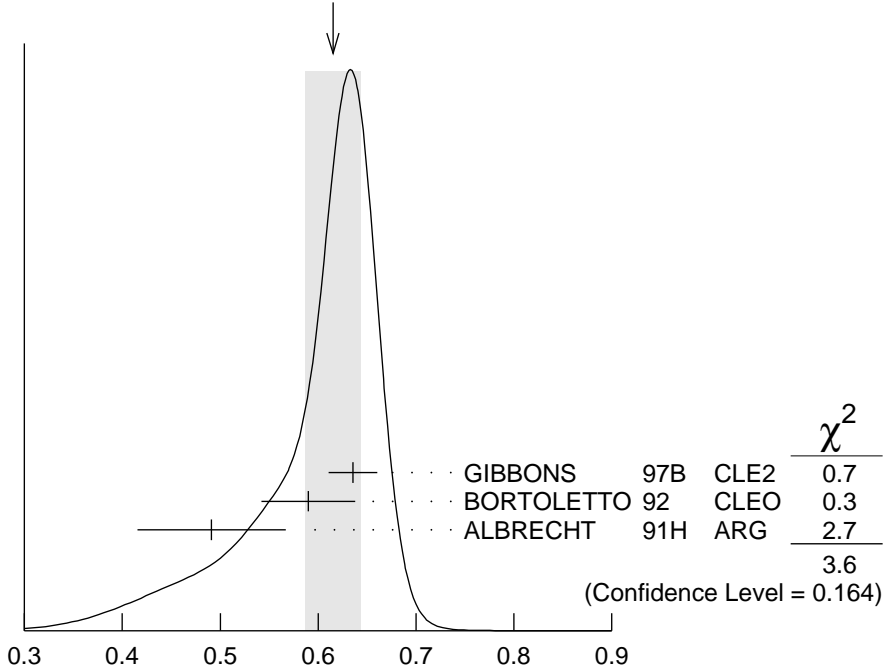
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>0.231 \pm 0.012</math> OUR AVERAGE</b>				
$0.230 \pm 0.012 \pm 0.004$		<sup>1</sup> GIBBONS	97B CLE2	$e^+e^- \rightarrow \gamma(4S)$
$0.241 \pm 0.037 \pm 0.004$		<sup>2</sup> BORTOLETTO92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
$0.223 \pm 0.051 \pm 0.004$		<sup>3</sup> ALBRECHT	91H ARG	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$0.203 \pm 0.048 \pm 0.003$	20k	<sup>4</sup> BORTOLETTO87	CLEO	Sup. by BORTOLETTO 92
<sup>1</sup> GIBBONS 97B reports $[\Gamma(B \rightarrow D^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^+ \rightarrow K^- 2\pi^+)] = 0.0216 \pm 0.0008 \pm 0.00082$ which we divide by our best value $B(D^+ \rightarrow K^- 2\pi^+) = (9.38 \pm 0.16) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.				
<sup>2</sup> BORTOLETTO 92 reports $[\Gamma(B \rightarrow D^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^+ \rightarrow K^- 2\pi^+)] = 0.0226 \pm 0.0030 \pm 0.0018$ which we divide by our best value $B(D^+ \rightarrow K^- 2\pi^+) = (9.38 \pm 0.16) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.				
<sup>3</sup> ALBRECHT 91H reports $[\Gamma(B \rightarrow D^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^+ \rightarrow K^- 2\pi^+)] = 0.0209 \pm 0.0027 \pm 0.0040$ which we divide by our best value $B(D^+ \rightarrow K^- 2\pi^+) = (9.38 \pm 0.16) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.				
<sup>4</sup> BORTOLETTO 87 reports $[\Gamma(B \rightarrow D^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^+ \rightarrow K^- 2\pi^+)] = 0.019 \pm 0.004 \pm 0.002$ which we divide by our best value $B(D^+ \rightarrow K^- 2\pi^+) = (9.38 \pm 0.16) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.				

$\Gamma(D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{30}/\Gamma$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.615±0.029 OUR AVERAGE</b>				Error includes scale factor of 1.3. See the ideogram below.
0.635±0.024±0.005	1	GIBBONS 97B	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
0.590±0.047±0.005	2	BORTOLETTO92	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
0.491±0.074±0.004	3	ALBRECHT 91H	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.532±0.065±0.004	21k	4 BORTOLETTO87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
0.608±0.183±0.005		5 GREEN 83	CLEO	Repl. by BORTOLETTO 87

WEIGHTED AVERAGE  
0.615±0.029 (Error scaled by 1.3)



$\Gamma(D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}$

- 1 GIBBONS 97B reports  $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0251 \pm 0.0006 \pm 0.00075$  which we divide by our best value  $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- 2 BORTOLETTO 92 reports  $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0233 \pm 0.0012 \pm 0.0014$  which we divide by our best value  $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- 3 ALBRECHT 91H reports  $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0194 \pm 0.0015 \pm 0.0025$  which we divide by our best value  $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- 4 BORTOLETTO 87 reports  $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0210 \pm 0.0015 \pm 0.0021$  which we divide by our best value  $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>5</sup> GREEN 83 reports  $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.024 \pm 0.006 \pm 0.004$  which we divide by our best value  $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$				$\Gamma_{31}/\Gamma$
VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.225 ± 0.015 OUR AVERAGE</b>				
0.247 ± 0.019 ± 0.01		<sup>1</sup> GIBBONS 97B	CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$
0.205 ± 0.019 ± 0.007		<sup>2</sup> ALBRECHT 96D	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$
0.230 ± 0.028 ± 0.009		<sup>3</sup> BORTOLETTO92	CLEO	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.283 ± 0.053 ± 0.002		<sup>4</sup> ALBRECHT 91H	ARG	Sup. by ALBRECHT 96D
0.22 ± 0.04 <sup>+0.07</sup> <sub>-0.04</sub>	5200	<sup>5</sup> BORTOLETTO87	CLEO	$e^+ e^- \rightarrow \Upsilon(4S)$
0.27 ± 0.06 <sup>+0.08</sup> <sub>-0.06</sub>	510	<sup>6</sup> CSORNA 85	CLEO	Repl. by BORTOLETTO 87

<sup>1</sup> GIBBONS 97B reports  $B(B \rightarrow D^*(2010)^+ \text{ anything}) = 0.239 \pm 0.015 \pm 0.014 \pm 0.009$  using CLEO measured  $D$  and  $D^*$  branching fractions. We rescale to our PDG 96 values of  $D$  and  $D^*$  branching ratios. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ALBRECHT 96D reports  $B(B \rightarrow D^*(2010)^+ \text{ anything}) = 0.196 \pm 0.019$  using CLEO measured  $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = 0.681 \pm 0.01 \pm 0.013$ ,  $B(D^0 \rightarrow K^- \pi^+) = 0.0401 \pm 0.0014$ ,  $B(D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-) = 0.081 \pm 0.005$ . We rescale to our PDG 96 values of  $D$  and  $D^*$  branching ratios. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> BORTOLETTO 92 reports  $B(B \rightarrow D^*(2010)^+ \text{ anything}) = 0.25 \pm 0.03 \pm 0.04$  using MARK II  $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = 0.57 \pm 0.06$  and  $B(D^0 \rightarrow K^- \pi^+) = 0.042 \pm 0.008$ . We rescale to our PDG 96 values of  $D$  and  $D^*$  branching ratios. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> ALBRECHT 91H reports  $0.348 \pm 0.060 \pm 0.035$  from a measurement of  $[\Gamma(B \rightarrow D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^*(2010)^+ \rightarrow D^0 \pi^+)]$  assuming  $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = 0.55 \pm 0.04$ , which we rescale to our best value  $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = (67.7 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Uses the PDG 90  $B(D^0 \rightarrow K^- \pi^+) = 0.0371 \pm 0.0025$ .

<sup>5</sup> BORTOLETTO 87 uses old MARK III (BALTRUSAITIS 86E) branching ratios  $B(D^0 \rightarrow K^- \pi^+) = 0.056 \pm 0.004 \pm 0.003$  and also assumes  $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = 0.60^{+0.08}_{-0.15}$ . The product branching ratio for  $B(B \rightarrow D^*(2010)^+) B(D^*(2010)^+ \rightarrow D^0 \pi^+)$  is  $0.13 \pm 0.02 \pm 0.012$ . Superseded by BORTOLETTO 92.

<sup>6</sup>  $V-A$  momentum spectrum used to extrapolate below  $p = 1$  GeV. We correct the value assuming  $B(D^0 \rightarrow K^- \pi^+) = 0.042 \pm 0.006$  and  $B(D^{*+} \rightarrow D^0 \pi^+) = 0.6^{+0.08}_{-0.15}$ . The product branching fraction is  $B(B \rightarrow D^{*+} X) \cdot B(D^{*+} \rightarrow \pi^+ D^0) \cdot B(D^0 \rightarrow K^- \pi^+) = (68 \pm 15 \pm 9) \times 10^{-4}$ .



$\Gamma(D^*(2007)^0 \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{32}/\Gamma$ 

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.260 ± 0.023 ± 0.015</b>	<sup>1</sup> GIBBONS 97B	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> GIBBONS 97B reports  $B(B \rightarrow D^*(2007)^0 \text{ anything}) = 0.247 \pm 0.012 \pm 0.018 \pm 0.018$  using CLEO measured  $D$  and  $D^*$  branching fractions. We rescale to our PDG 96 values of  $D$  and  $D^*$  branching ratios. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma(D_s^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{33}/\Gamma$ 

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.083 ± 0.008 OUR AVERAGE</b>				
0.089 ± 0.010 ± 0.008		<sup>1</sup> ARTUSO 05B	CLE2	$e^+e^- \rightarrow \gamma(5S)$
0.087 ± 0.005 ± 0.008		<sup>2</sup> AUBERT 02G	BABR	$e^+e^- \rightarrow \gamma(4S)$
0.065 ± 0.011 ± 0.006		<sup>3</sup> ALBRECHT 92G	ARG	$e^+e^- \rightarrow \gamma(4S)$
0.068 ± 0.010 ± 0.006	257	<sup>4</sup> BORTOLETTO90	CLEO	$e^+e^- \rightarrow \gamma(4S)$
0.085 ± 0.022 ± 0.008		<sup>5</sup> HAAS 86	CLEO	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.094 ± 0.007 ± 0.008		<sup>6</sup> GIBAUT 96	CLE2	Repl. by ARTUSO 05B
0.094 ± 0.024 ± 0.008		<sup>7</sup> ALBRECHT 87H	ARG	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> ARTUSO 05B reports  $0.0905 \pm 0.0025 \pm 0.0140$  from a measurement of  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = (4.4 \pm 0.5) \times 10^{-2}$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> AUBERT 02G reports  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.00393 \pm 0.00007 \pm 0.00021$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> ALBRECHT 92G reports  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.00292 \pm 0.00039 \pm 0.00031$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> BORTOLETTO 90 reports  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.00306 \pm 0.00047$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>5</sup> HAAS 86 reports  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.0038 \pm 0.0010$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.  $64 \pm 22\%$  decays are 2-body.

<sup>6</sup> GIBAUT 96 reports  $0.1211 \pm 0.0039 \pm 0.0088$  from a measurement of  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = 0.035$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>7</sup> ALBRECHT 87H reports  $[\Gamma(B \rightarrow D_s^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.0042 \pm 0.0009 \pm 0.0006$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ .

Our first error is their experiment's error and our second error is the systematic error from using our best value.  $46 \pm 16\%$  of  $B \rightarrow D_s X$  decays are 2-body. Superseded by ALBRECHT 92G.

$\Gamma(D_s^{*\pm} \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{34}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.063 \pm 0.009 \pm 0.006</math></b>	<sup>1</sup> AUBERT	02G	BABR $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> AUBERT 02G reports  $[\Gamma(B \rightarrow D_s^{*\pm} \text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = 0.00284 \pm 0.00029 \pm 0.00025$  which we divide by our best value  $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(D_s^{*\pm} \bar{D}^{(*)})/\Gamma(D_s^{*\pm} \text{ anything})$   $\Gamma_{35}/\Gamma_{34}$   
Sum over modes

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.533 \pm 0.037 \pm 0.037</math></b>	AUBERT	02G	BABR $e^+ e^- \rightarrow \gamma(4S)$

$\Gamma(\bar{D} D_{s0}(2317))/\Gamma_{\text{total}}$   $\Gamma_{36}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
seen	<sup>1</sup> KROKOVNY	03B	BELL $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> The product branching ratio for  $B(B \rightarrow \bar{D} D_{s0}(2317)^+) \times B(D_{s0}(2317)^+ \rightarrow D_s \pi^0)$  is measured to be  $(8.5_{-1.9}^{+2.1} \pm 2.6) \times 10^{-4}$ .

$\Gamma(\bar{D} D_{sJ}(2457))/\Gamma_{\text{total}}$   $\Gamma_{37}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
seen	<sup>1</sup> KROKOVNY	03B	BELL $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> The product branching ratio for  $B(B \rightarrow \bar{D} D_{sJ}(2457)^+) \times B(D_{sJ}(2457)^+ \rightarrow D_s^{*+} \pi^0, D_s^+ \gamma)$  are measured to be  $(17.8_{-3.9}^{+4.5} \pm 5.3) \times 10^{-4}$  and  $(6.7_{-1.2}^{+1.3} \pm 2.0) \times 10^{-4}$ , respectively.

$[\Gamma(D^{(*)} \bar{D}^{(*)} K^0) + \Gamma(D^{(*)} \bar{D}^{(*)} K^\pm)]/\Gamma_{\text{total}}$   $\Gamma_{38}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.071_{-0.015}^{+0.025} + 0.010_{-0.009}</math></b>	<sup>1</sup> BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$

<sup>1</sup> The systematic error includes the uncertainties due to the charm branching ratios.

$\Gamma(b \rightarrow c \bar{c} s)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.219 \pm 0.037</math></b>	<sup>1</sup> COAN	98	CLE2 $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> COAN 98 uses  $D$ - $\ell$  correlation.

$\Gamma(D_s^{(*)} \bar{D}^{(*)})/\Gamma(D_s^\pm \text{ anything})$   $\Gamma_{40}/\Gamma_{33}$   
Sum over modes.

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.469 \pm 0.017</math> OUR AVERAGE</b>			
$0.464 \pm 0.013 \pm 0.015$	AUBERT	02G	BABR $e^+ e^- \rightarrow \gamma(4S)$
$0.56_{-0.15}^{+0.21} + 0.09_{-0.08}$	<sup>1</sup> BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$
$0.457 \pm 0.019 \pm 0.037$	GIBAUT	96	CLE2 $e^+ e^- \rightarrow \gamma(4S)$
$0.58 \pm 0.07 \pm 0.09$	ALBRECHT	92G	ARG $e^+ e^- \rightarrow \gamma(4S)$
$0.56 \pm 0.10$	BORTOLETTO	90	CLEO $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> BARATE 98Q measures  $B(B \rightarrow D_s^{(*)} \bar{D}^{(*)}) = 0.056^{+0.021+0.009+0.019}_{-0.015-0.008-0.011}$ , where the third error results from the uncertainty on the different  $D$  branching ratios and is dominated by the uncertainty on  $B(D_s^+ \rightarrow \phi\pi^+)$ . We divide  $B(B \rightarrow D_s^{(*)} \bar{D}^{(*)})$  by our best value of  $B(B \rightarrow D_s \text{ anything}) = 0.1 \pm 0.025$ .

**$\Gamma(D^* D^{*(2010)\pm})/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.9 \times 10^{-3}$	90	BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$

**$[\Gamma(D D^{*(2010)\pm}) + \Gamma(D^* D^\pm)]/\Gamma_{\text{total}}$   $\Gamma_{42}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.5 \times 10^{-3}$	90	BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$

**$\Gamma(D D^\pm)/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<3.1 \times 10^{-3}$	90	BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$

**$\Gamma(D_s^{(*)\pm} \bar{D}^{(*)} \chi(n\pi^\pm))/\Gamma_{\text{total}}$   $\Gamma_{44}/\Gamma$**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.094^{+0.040+0.034}_{-0.031-0.024}$	<sup>1</sup> BARATE	98Q	ALEP $e^+ e^- \rightarrow Z$

<sup>1</sup> The systematic error includes the uncertainties due to the charm branching ratios.

**$\Gamma(D^*(2010)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{45}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.1 \times 10^{-3}$	90	<sup>1</sup> LESIAK	92	CBAL $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> LESIAK 92 set a limit on the inclusive process  $B(b \rightarrow s\gamma) < 2.8 \times 10^{-3}$  at 90% CL for the range of masses of 892–2045 MeV, independent of assumptions about s-quark hadronization.

**$\Gamma(D_s^+ \pi^-, D_s^{*+} \pi^-, D_s^+ \rho^-, D_s^{*+} \rho^-, D_s^+ \pi^0, D_s^{*+} \pi^0, D_s^+ \eta, D_s^{*+} \eta, D_s^+ \rho^0, D_s^{*+} \rho^0, D_s^+ \omega, D_s^{*+} \omega)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$**

Sum over modes.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<4 \times 10^{-4}$	90	<sup>1</sup> ALEXANDER	93B	CLE2 $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALEXANDER 93B reports  $< 4.8 \times 10^{-4}$  from a measurement of  $[\Gamma(B \rightarrow D_s^+ \pi^-, D_s^{*+} \pi^-, D_s^+ \rho^-, D_s^{*+} \rho^-, D_s^+ \pi^0, D_s^{*+} \pi^0, D_s^+ \eta, D_s^{*+} \eta, D_s^+ \rho^0, D_s^{*+} \rho^0, D_s^+ \omega, D_s^{*+} \omega)/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)]$  assuming  $B(D_s^+ \rightarrow \phi\pi^+) = 0.037$ , which we rescale to our best value  $B(D_s^+ \rightarrow \phi\pi^+) = 4.5 \times 10^{-2}$ . This branching ratio limit provides a model-dependent upper limit  $|V_{ub}|/|V_{cb}| < 0.16$  at CL=90%.

**$\Gamma(D_{s1}(2536)^+ \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{47}/\Gamma$**

$D_{s1}(2536)^+$  is the narrow  $P$ -wave  $D_s^+$  meson with  $J^P = 1^+$ .

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<0.0095$	90	<sup>1</sup> BISHAI	98	CLE2 $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Assuming factorization, the decay constant  $f_{D_{s1}^+}$  is at least a factor of 2.5 times smaller than  $f_{D_s^+}$ .

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$  $\Gamma_{48}/\Gamma$ 

VALUE (units $10^{-2}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>1.094 ± 0.032 OUR AVERAGE</b>		Error includes scale factor of 1.1.		
1.057 ± 0.012 ± 0.040		<sup>1</sup> AUBERT	03F BABR	$e^+e^- \rightarrow \Upsilon(4S)$
1.121 ± 0.013 ± 0.042		ANDERSON	02 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
1.29 ± 0.45 ± 0.01	27	<sup>2</sup> MASCHMANN	90 CBAL	$e^+e^- \rightarrow \Upsilon(4S)$
1.24 ± 0.27 ± 0.01	120	<sup>3</sup> ALBRECHT	87D ARG	$e^+e^- \rightarrow \Upsilon(4S)$
1.35 ± 0.24 ± 0.01	52	<sup>4</sup> ALAM	86 CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.12 ± 0.06 ± 0.01	1489	<sup>5</sup> BALEST	95B CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
1.4 <sup>+0.6</sup> <sub>-0.5</sub>	7	<sup>6</sup> ALBRECHT	85H ARG	$e^+e^- \rightarrow \Upsilon(4S)$
1.1 ± 0.21 ± 0.23	46	<sup>7</sup> HAAS	85 CLEO	Repl. by ALAM 86

<sup>1</sup> AUBERT 03F also reports the momentum distribution and helicity of  $J/\psi \rightarrow \ell^+ \ell^-$  in the  $\Upsilon(4S)$  center-of-mass frame.

<sup>2</sup> MASCHMANN 90 reports  $(1.12 \pm 0.33 \pm 0.25) \times 10^{-2}$  from a measurement of  $[\Gamma(B \rightarrow J/\psi(1S)\text{anything})/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow e^+e^-)]$  assuming  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.069 \pm 0.009$ , which we rescale to our best value  $B(J/\psi(1S) \rightarrow e^+e^-) = (5.971 \pm 0.032) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> ALBRECHT 87D reports  $(1.07 \pm 0.16 \pm 0.22) \times 10^{-2}$  from a measurement of  $[\Gamma(B \rightarrow J/\psi(1S)\text{anything})/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow e^+e^-)]$  assuming  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.069 \pm 0.009$ , which we rescale to our best value  $B(J/\psi(1S) \rightarrow e^+e^-) = (5.971 \pm 0.032) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. ALBRECHT 87D find the branching ratio for  $J/\psi$  not from  $\psi(2S)$  to be  $0.0081 \pm 0.0023$ .

<sup>4</sup> ALAM 86 reports  $(1.09 \pm 0.16 \pm 0.21) \times 10^{-2}$  from a measurement of  $[\Gamma(B \rightarrow J/\psi(1S)\text{anything})/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \mu^+\mu^-)]$  assuming  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.074 \pm 0.012$ , which we rescale to our best value  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>5</sup> BALEST 95B reports  $(1.12 \pm 0.04 \pm 0.06) \times 10^{-2}$  from a measurement of  $[\Gamma(B \rightarrow J/\psi(1S)\text{anything})/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow e^+e^-)]$  assuming  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0599 \pm 0.0025$ , which we rescale to our best value  $B(J/\psi(1S) \rightarrow e^+e^-) = (5.971 \pm 0.032) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. They measure  $J/\psi(1S) \rightarrow e^+e^-$  and  $\mu^+\mu^-$  and use PDG 1994 values for the branching fractions. The rescaling is the same for either mode so we use  $e^+e^-$ .

<sup>6</sup> Statistical and systematic errors were added in quadrature. ALBRECHT 85H also report a CL = 90% limit of 0.007 for  $B \rightarrow J/\psi(1S) + X$  where  $m_X < 1$  GeV.

<sup>7</sup> Dimuon and dielectron events used.

 $\Gamma(J/\psi(1S)\text{(direct) anything})/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.0078 ± 0.0004 OUR AVERAGE</b>	Error includes scale factor of 1.1.		
0.00740 ± 0.00023 ± 0.00043	<sup>1</sup> AUBERT	03F BABR	$e^+e^- \rightarrow \Upsilon(4S)$
0.00813 ± 0.00017 ± 0.00037	<sup>2</sup> ANDERSON	02 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.0080 ± 0.0008	<sup>3</sup> BALEST	95B CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

- <sup>1</sup> AUBERT 03F also reports the helicity of  $J/\psi \rightarrow \ell^+ \ell^-$  produced directly in  $B$  decay.  
<sup>2</sup> Also reports the measurement of  $J/\psi \rightarrow \ell^+ \ell^-$  polarization produced directly from  $B$  decay.  
<sup>3</sup> BALEST 95B assume PDG 1994 values for sub mode branching ratios.  $J/\psi(1S)$  mesons are reconstructed in  $J/\psi(1S) \rightarrow e^+ e^-$  and  $J/\psi(1S) \rightarrow \mu^+ \mu^-$ . The  $B \rightarrow J/\psi(1S) X$  branching ratio contains  $J/\psi(1S)$  mesons directly from  $B$  decays and also from feeddown through  $\psi(2S) \rightarrow J/\psi(1S)$ ,  $\chi_{c1}(1P) \rightarrow J/\psi(1S)$ , or  $\chi_{c2}(1P) \rightarrow J/\psi(1S)$ . Using the measured inclusive rates, BALEST 95B corrects for the feeddown and finds the  $B \rightarrow J/\psi(1S)$ (direct)  $X$  branching ratio.

**$\Gamma(\psi(2S)\text{anything})/\Gamma_{\text{total}}$**   **$\Gamma_{50}/\Gamma$**

VALUE EVTS DOCUMENT ID TECN COMMENT

**0.00307 ± 0.00021 OUR AVERAGE**

0.00297 ± 0.00020 ± 0.00020 AUBERT 03F BABR  $e^+ e^- \rightarrow \Upsilon(4S)$

0.00316 ± 0.00014 ± 0.00028 <sup>1</sup> ANDERSON 02 CLE2  $e^+ e^- \rightarrow \Upsilon(4S)$

0.0046 ± 0.0017 ± 0.0011 8 ALBRECHT 87D ARG  $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.0034 ± 0.0004 ± 0.0003 240 <sup>2</sup> BALEST 95B CLE2  $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Also reports the measurement of  $\psi(2S) \rightarrow \ell^+ \ell^-$  polarization produced directly from  $B$  decay.

<sup>2</sup> BALEST 95B assume PDG 1994 values for sub mode branching ratios. They find  $B(B \rightarrow \psi(2S) X, \psi(2S) \rightarrow \ell^+ \ell^-) = 0.30 \pm 0.05 \pm 0.04$  and  $B(B \rightarrow \psi(2S) X, \psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = 0.37 \pm 0.05 \pm 0.05$ . Weighted average is quoted for  $B(B \rightarrow \psi(2S) X)$ .

**$\Gamma(\chi_{c1}(1P)\text{anything})/\Gamma_{\text{total}}$**   **$\Gamma_{51}/\Gamma$**

VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT

**3.55 ± 0.27 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

3.33 ± 0.05 ± 0.24 <sup>1</sup> BHARDWAJ 16 BELL  $e^+ e^- \rightarrow \Upsilon(4S)$

3.67 ± 0.35 ± 0.44 AUBERT 03F BABR  $e^+ e^- \rightarrow \Upsilon(4S)$

4.35 ± 0.29 ± 0.40 ANDERSON 02 CLE2  $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.63 ± 0.22 ± 0.34 <sup>2</sup> ABE 02L BELL Repl. by BHARDWAJ 16

3.30 ± 0.35 ± 0.09 <sup>3</sup> CHEN 01 CLE2  $e^+ e^- \rightarrow \Upsilon(4S)$

4.0 ± 0.6 ± 0.4 112 <sup>4</sup> BALEST 95B CLE2 Repl. by CHEN 01

10.5 ± 3.5 ± 2.5 <sup>5</sup> ALBRECHT 92E ARG  $e^+ e^- \rightarrow \Upsilon(4S)$

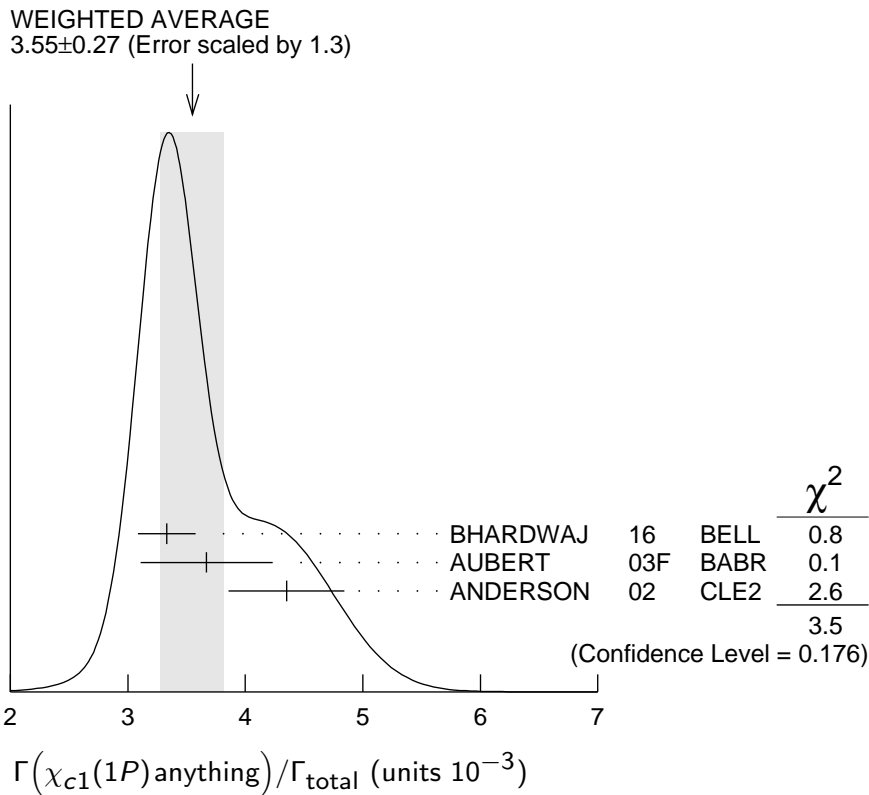
<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> ABE 02L uses PDG 01 values for  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-)$  and  $B(\chi_{c1,c2} \rightarrow J/\psi(1S)\gamma)$ .

<sup>3</sup> CHEN 01 reports  $0.00414 \pm 0.00031 \pm 0.00040$  from a measurement of  $[\Gamma(B \rightarrow \chi_{c1}(1P)\text{anything})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))]$  assuming  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = 0.273 \pm 0.016$ , which we rescale to our best value  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (34.3 \pm 1.0) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>4</sup> BALEST 95B assume  $B(\chi_{c1}(1P) \rightarrow J/\psi(1S)\gamma) = (27.3 \pm 1.6) \times 10^{-2}$ , the PDG 1994 value. Fit to  $\psi$ -photon invariant mass distribution allows for a  $\chi_{c1}(1P)$  and a  $\chi_{c2}(1P)$  component.

<sup>5</sup> ALBRECHT 92E assumes no  $\chi_{c2}(1P)$  production.



**$\Gamma(\chi_{c1}(1P) \text{ (direct) anything}) / \Gamma_{\text{total}}$**   **$\Gamma_{52} / \Gamma$**

<u>VALUE (units <math>10^{-3}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>3.08 \pm 0.19</math> OUR AVERAGE</b>			
$3.03 \pm 0.05 \pm 0.24$	<sup>1</sup> BHARDWAJ	16 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$3.41 \pm 0.35 \pm 0.42$	AUBERT	03F BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$3.1 \pm 0.4 \pm 0.1$	<sup>2</sup> CHEN	01 CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$3.32 \pm 0.22 \pm 0.34$	<sup>3</sup> ABE	02L BELL	Repl. by BHARDWAJ 16
$3.7 \pm 0.7$	<sup>4</sup> BALEST	95B CLE2	Repl. by CHEN 01

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> CHEN 01 reports  $0.00383 \pm 0.00031 \pm 0.00040$  from a measurement of  $[\Gamma(B \rightarrow \chi_{c1}(1P) \text{ (direct) anything}) / \Gamma_{\text{total}}] \times [B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))]$  assuming  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = 0.273 \pm 0.016$ , which we rescale to our best value  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (34.3 \pm 1.0) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>3</sup> ABE 02L uses PDG 01 values for  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-)$  and  $B(\chi_{c1,c2} \rightarrow J/\psi(1S) \gamma)$ .

<sup>4</sup> BALEST 95B assume PDG 1994 values.  $J/\psi(1S)$  mesons are reconstructed in the  $e^+ e^-$  and  $\mu^+ \mu^-$  modes. The  $B \rightarrow \chi_{c1}(1P) X$  branching ratio contains  $\chi_{c1}(1P)$  mesons directly from  $B$  decays and also from feeddown through  $\psi(2S) \rightarrow \chi_{c1}(1P) \gamma$ . Using the measured inclusive rates, BALEST 95B corrects for the feeddown and finds the  $B \rightarrow \chi_{c1}(1P) \text{ (direct) } X$  branching ratio.

$\Gamma(\chi_{c2}(1P)\text{anything})/\Gamma_{\text{total}}$

$\Gamma_{53}/\Gamma$

VALUE (units  $10^{-4}$ )    CL%    DOCUMENT ID    TECN    COMMENT

<b>10.0±1.7 OUR AVERAGE</b>		Error includes scale factor of 1.6. See the ideogram below.		
9.8±0.6±1.0		<sup>1</sup> BHARDWAJ	16	BELL $e^+e^- \rightarrow \Upsilon(4S)$
21.0±4.5±3.1		AUBERT	03F	BABR $e^+e^- \rightarrow \Upsilon(4S)$
7.0±3.5±0.2		<sup>2</sup> CHEN	01	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

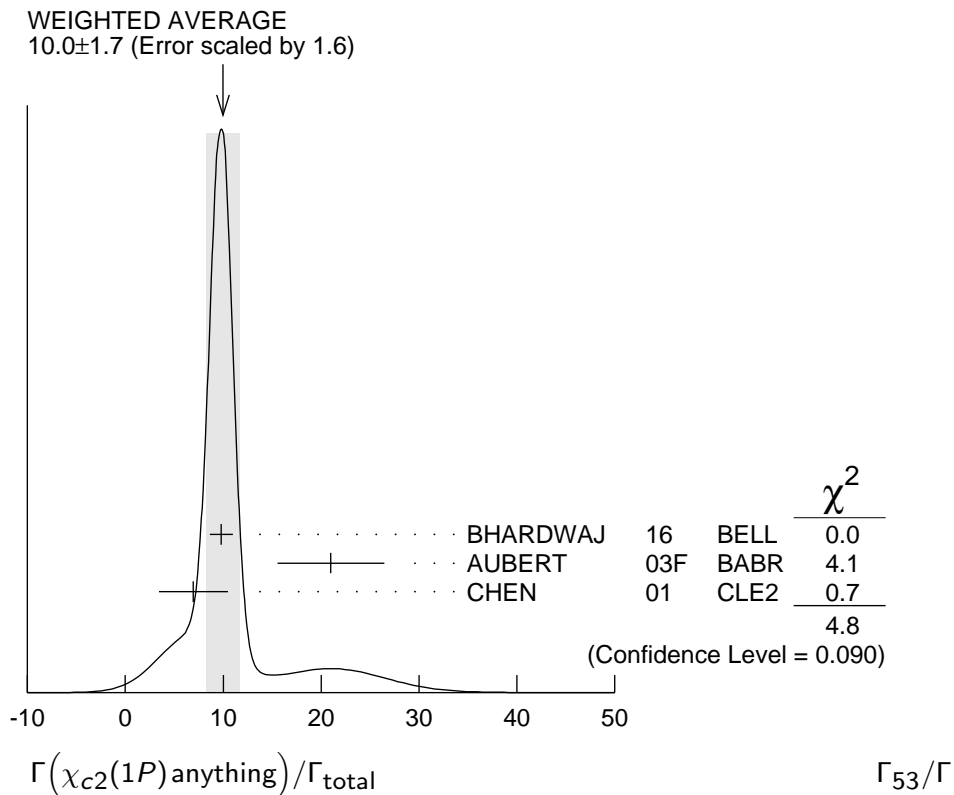
18.0 <sup>+2.3</sup> <sub>-2.8</sub> ±2.6		<sup>3</sup> ABE	02L	BELL Repl. by BHARDWAJ 16
<38	90	<sup>4</sup> BALEST	95B	CLE2 Repl. by CHEN 01

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> CHEN 01 reports  $(9.8 \pm 4.8 \pm 1.5) \times 10^{-4}$  from a measurement of  $[\Gamma(B \rightarrow \chi_{c2}(1P)\text{anything})/\Gamma_{\text{total}}] \times [B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))] / [B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))]$  assuming  $B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = 0.135 \pm 0.011$ , which we rescale to our best value  $B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = (19.0 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>3</sup> ABE 02L uses PDG 01 values for  $B(J/\psi(1S) \rightarrow \ell^+\ell^-)$  and  $B(\chi_{c1,c2} \rightarrow J/\psi(1S)\gamma)$ .

<sup>4</sup> BALEST 95B assume  $B(\chi_{c2}(1P) \rightarrow J/\psi(1S)\gamma) = (13.5 \pm 1.1) \times 10^{-2}$ , the PDG 1994 value.  $J/\psi(1S)$  mesons are reconstructed in the  $e^+e^-$  and  $\mu^+\mu^-$  modes, and PDG 1994 branching fractions are used. If interpreted as signal, the  $35 \pm 13$  events correspond to  $B(B \rightarrow \chi_{c2}(1P)X) = (0.25 \pm 0.10 \pm 0.03) \times 10^{-2}$ .



$\Gamma(\chi_{c2}(1P)(\text{direct}) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{54}/\Gamma$

<u>VALUE (units <math>10^{-3}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**0.75 $\pm$ 0.11 OUR AVERAGE**

0.70 $\pm$ 0.06 $\pm$ 0.10	<sup>1</sup> BHARDWAJ	16	BELL $e^+e^- \rightarrow \Upsilon(4S)$
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1.90 $\pm$ 0.45 $\pm$ 0.29	AUBERT	03F	BABR $e^+e^- \rightarrow \Upsilon(4S)$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

1.53 $^{+0.23}_{-0.28}$ $\pm$ 0.27	<sup>2</sup> ABE	02L	BELL Repl. by BHARDWAJ 16
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<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> ABE 02L uses PDG 01 values for  $B(J/\psi(1S) \rightarrow \ell^+\ell^-)$  and  $B(\chi_{c1,c2} \rightarrow J/\psi(1S)\gamma)$ .

$\Gamma(\eta_c(1S) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{55}/\Gamma$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<b>&lt;0.009</b>	90	<sup>1</sup> BALEST	95B	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> BALEST 95B assume PDG 1994 values for sub mode branching ratios.  $J/\psi(1S)$  mesons are reconstructed in  $J/\psi(1S) \rightarrow e^+e^-$  and  $J/\psi(1S) \rightarrow \mu^+\mu^-$ . Search region 2960  $< m_{\eta_c(1S)} < 3010$  MeV/ $c^2$ .

$\Gamma(K\chi_{c1}(3872), \chi_{c1} \rightarrow D^0\bar{D}^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{56}/\Gamma$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<b>1.22<math>\pm</math>0.31<math>^{+0.23}_{-0.30}</math></b>	<sup>1</sup> GOKHROO	06	BELL $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Measure the near-threshold enhancements in the  $(D^0\bar{D}^0\pi^0)$  system at a mass 3875.2  $\pm$  0.7 $^{+0.3}_{-1.6}$   $\pm$  0.8 MeV/ $c^2$ .

$\Gamma(K\chi_{c1}(3872), \chi_{c1} \rightarrow D^{*0}D^0)/\Gamma_{\text{total}}$   $\Gamma_{57}/\Gamma$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<b>0.80<math>\pm</math>0.20<math>\pm</math>0.10</b>	AUSHEV	10	BELL $e^+e^- \rightarrow \Upsilon(4S)$
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$\Gamma(KX(3940), X \rightarrow D^{*0}D^0)/\Gamma_{\text{total}}$   $\Gamma_{58}/\Gamma$

<u>VALUE (units <math>10^{-4}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<b>&lt;0.67</b>	90	AUSHEV	10	BELL $e^+e^- \rightarrow \Upsilon(4S)$
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$\Gamma(KX(3915), X \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{59}/\Gamma$

<u>VALUE (units <math>10^{-5}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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<b>7.1<math>\pm</math>1.3<math>\pm</math>3.1</b>	<sup>1</sup> CHOI	05	BELL $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> CHOI 05 reports the observation of a near-threshold enhancement in the  $\omega J/\psi$  mass spectrum in exclusive  $B \rightarrow K\omega J/\psi$ . The new state, denoted as  $X(3915)$ , is measured to have a mass of 3943  $\pm$  11  $\pm$  13 GeV/ $c^2$  and a width  $\Gamma = 87 \pm 22 \pm 26$  MeV.

$\Gamma(K^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{60}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**0.789 $\pm$ 0.025 OUR AVERAGE**

0.82 $\pm$ 0.01 $\pm$ 0.05	ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
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0.775 $\pm$ 0.015 $\pm$ 0.025	<sup>1</sup> ALBRECHT	93I	ARG $e^+e^- \rightarrow \Upsilon(4S)$
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0.85 $\pm$ 0.07 $\pm$ 0.09	ALAM	87B	CLEO $e^+e^- \rightarrow \Upsilon(4S)$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

seen	<sup>2</sup> BRODY	82	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
seen	<sup>3</sup> GIANNINI	82	CUSB	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> ALBRECHT 93I value is not independent of the sum of  $B \rightarrow K^+$  anything and  $B \rightarrow K^-$  anything ALBRECHT 94C values.

<sup>2</sup> Assuming  $\Upsilon(4S) \rightarrow B\bar{B}$ , a total of  $3.38 \pm 0.34 \pm 0.68$  kaons per  $\Upsilon(4S)$  decay is found (the second error is systematic). In the context of the standard  $B$ -decay model, this leads to a value for  $(b\text{-quark} \rightarrow c\text{-quark})/(b\text{-quark} \rightarrow \text{all})$  of  $1.09 \pm 0.33 \pm 0.13$ .

<sup>3</sup> GIANNINI 82 at CESR-CUSB observed  $1.58 \pm 0.35 K^0$  per hadronic event much higher than  $0.82 \pm 0.10$  below threshold. Consistent with predominant  $b \rightarrow cX$  decay.

### $\Gamma(K^+ \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{61}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.66 ± 0.05</b>	<sup>1</sup> ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.620 ± 0.013 ± 0.038	<sup>2</sup> ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
0.66 ± 0.05 ± 0.07	<sup>2</sup> ALAM	87B	CLEO $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Measurement relies on lepton-kaon correlations. It is for the weak decay vertex and does not include mixing of the neutral  $B$  meson. Mixing effects were corrected for by assuming a mixing parameter  $r$  of  $(18.1 \pm 4.3)\%$ .

<sup>2</sup> Measurement relies on lepton-kaon correlations. It includes production through mixing of the neutral  $B$  meson.

### $\Gamma(K^- \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{62}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.13 ± 0.04</b>	<sup>1</sup> ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.165 ± 0.011 ± 0.036	<sup>2</sup> ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
0.19 ± 0.05 ± 0.02	<sup>2</sup> ALAM	87B	CLEO $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Measurement relies on lepton-kaon correlations. It is for the weak decay vertex and does not include mixing of the neutral  $B$  meson. Mixing effects were corrected for by assuming a mixing parameter  $r$  of  $(18.1 \pm 4.3)\%$ .

<sup>2</sup> Measurement relies on lepton-kaon correlations. It includes production through mixing of the neutral  $B$  meson.

### $\Gamma(K^0/\bar{K}^0 \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{63}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.64 ± 0.04 OUR AVERAGE</b>			
0.642 ± 0.010 ± 0.042	<sup>1</sup> ALBRECHT	94C	ARG $e^+e^- \rightarrow \Upsilon(4S)$
0.63 ± 0.06 ± 0.06	ALAM	87B	CLEO $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> ALBRECHT 94C assume a  $K^0/\bar{K}^0$  multiplicity twice that of  $K_S^0$ .

### $\Gamma(K^*(892)^\pm \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{64}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.182 ± 0.054 ± 0.024</b>	ALBRECHT	94J	ARG $e^+e^- \rightarrow \Upsilon(4S)$

### $\Gamma(K^*(892)^0/\bar{K}^*(892)^0 \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{65}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.146 ± 0.016 ± 0.020</b>	ALBRECHT	94J	ARG $e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^*(892)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{66}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>4.24 \pm 0.54 \pm 0.32</math></b>		<sup>1</sup> COAN	00	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<150	90	<sup>2</sup> LESIAK	92	CBAL $e^+e^- \rightarrow \Upsilon(4S)$
< 24	90	ALBRECHT	88H	ARG $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> An average of  $B(B^+ \rightarrow K^*(892)^+\gamma)$  and  $B(B^0 \rightarrow K^*(892)^0\gamma)$  measurements reported in COAN 00 by assuming full correlated systematic errors.

<sup>2</sup> LESIAK 92 set a limit on the inclusive process  $B(b \rightarrow s\gamma) < 2.8 \times 10^{-3}$  at 90% CL for the range of masses of 892–2045 MeV, independent of assumptions about  $s$ -quark hadronization.

$\Gamma(\eta K\gamma)/\Gamma_{\text{total}}$   $\Gamma_{67}/\Gamma$

VALUE (units $10^{-6}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>8.5 \pm 1.3^{+1.2}_{-0.9}</math></b>	<sup>1</sup> NISHIDA	05	BELL $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>  $m_{\eta K} < 2.4 \text{ GeV}/c^2$

$\Gamma(K_1(1400)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{68}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 12.7 \times 10^{-5}</math></b>	90	<sup>1</sup> COAN	00	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

< $1.6 \times 10^{-3}$	90	<sup>2</sup> LESIAK	92	CBAL $e^+e^- \rightarrow \Upsilon(4S)$
< $4.1 \times 10^{-4}$	90	ALBRECHT	88H	ARG $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> LESIAK 92 set a limit on the inclusive process  $B(b \rightarrow s\gamma) < 2.8 \times 10^{-3}$  at 90% CL for the range of masses of 892–2045 MeV, independent of assumptions about  $s$ -quark hadronization.

$\Gamma(K_2^*(1430)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{69}/\Gamma$

VALUE (units $10^{-5}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>1.66^{+0.59}_{-0.53} \pm 0.13</math></b>		<sup>1</sup> COAN	00	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<83	90	ALBRECHT	88H	ARG $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> COAN 00 obtains a fitted signal yield of  $15.9^{+5.7}_{-5.2}$  events. A search for contamination by  $K^*(1410)$  yielded a rate consistent with 0; the central value assumes no contamination.

$\Gamma(K_2(1770)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{70}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 1.2 \times 10^{-3}</math></b>	90	<sup>1</sup> LESIAK	92	CBAL $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> LESIAK 92 set a limit on the inclusive process  $B(b \rightarrow s\gamma) < 2.8 \times 10^{-3}$  at 90% CL for the range of masses of 892–2045 MeV, independent of assumptions about  $s$ -quark hadronization.

$\Gamma(K_3^*(1780)\gamma)/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 3.7 \times 10^{-5}</math></b>	90	<sup>1</sup> NISHIDA	05	BELL $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$<3.0 \times 10^{-3}$       90      ALBRECHT    88H    ARG     $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Uses  $B(K_3^*(1780) \rightarrow \eta K) = 0.11_{-0.04}^{+0.05}$ .

**$\Gamma(K_4^*(2045)\gamma)/\Gamma_{\text{total}}$        $\Gamma_{72}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.0 \times 10^{-3}$	90	<sup>1</sup> LESIAK    92	CBAL	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> LESIAK 92 set a limit on the inclusive process  $B(b \rightarrow s\gamma) < 2.8 \times 10^{-3}$  at 90% CL for the range of masses of 892–2045 MeV, independent of assumptions about s-quark hadronization.

**$\Gamma(K\eta'(958))/\Gamma_{\text{total}}$        $\Gamma_{73}/\Gamma$**

VALUE	DOCUMENT ID	TECN	COMMENT
$(8.3_{-0.8}^{+0.9} \pm 0.7) \times 10^{-5}$	<sup>1</sup> RICHICHI    00	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(K^*(892)\eta'(958))/\Gamma_{\text{total}}$        $\Gamma_{74}/\Gamma$**

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$4.1_{-0.9}^{+1.0} \pm 0.5$		<sup>1</sup> AUBERT    07E	BABR	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$<22$       90      <sup>1</sup> RICHICHI    00    CLE2     $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(K\eta)/\Gamma_{\text{total}}$        $\Gamma_{75}/\Gamma$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<5.2 \times 10^{-6}$	90	<sup>1</sup> RICHICHI    00	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(K^*(892)\eta)/\Gamma_{\text{total}}$        $\Gamma_{76}/\Gamma$**

VALUE	DOCUMENT ID	TECN	COMMENT
$(1.80_{-0.43}^{+0.49} \pm 0.18) \times 10^{-5}$	<sup>1</sup> RICHICHI    00	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(K\phi\phi)/\Gamma_{\text{total}}$        $\Gamma_{77}/\Gamma$**

VALUE (units $10^{-6}$ )	DOCUMENT ID	TECN	COMMENT
$2.3_{-0.8}^{+0.9} \pm 0.3$	<sup>1</sup> HUANG    03	BELL	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of charged and neutral B meson pairs and isospin symmetry.

**$\Gamma(\bar{b} \rightarrow \bar{s}\gamma)/\Gamma_{\text{total}}$        $\Gamma_{78}/\Gamma$**

VALUE (units $10^{-4}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>3.49 \pm 0.19</math> OUR AVERAGE</b>			
$3.75 \pm 0.18 \pm 0.35$	<sup>1,2</sup> SAITO    15	BELL	$e^+e^- \rightarrow \Upsilon(4S)$
$3.52 \pm 0.20 \pm 0.51$	<sup>1,3</sup> LEES    12U	BABR	$e^+e^- \rightarrow \Upsilon(4S)$
$3.32 \pm 0.16 \pm 0.31$	<sup>1,4</sup> LEES    12V	BABR	$e^+e^- \rightarrow \Upsilon(4S)$

$3.47 \pm 0.15 \pm 0.40$	<sup>1,5</sup> LIMOSANI	09	BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$3.90 \pm 0.91 \pm 0.64$	<sup>1,6</sup> AUBERT	08O	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$3.29 \pm 0.44 \pm 0.29$	<sup>1,7</sup> CHEN	01C	CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$2.30 \pm 0.08 \pm 0.30$	<sup>8</sup> DEL-AMO-SA..10M	BABR		$e^+ e^- \rightarrow \Upsilon(4S)$
$4.3 \pm 0.3 \pm 0.7$	<sup>9</sup> AUBERT	09U	BABR	Repl. by DEL-AMO-SANCHEZ 10M
$3.92 \pm 0.31 \pm 0.47$	<sup>1,10</sup> AUBERT, BE	06B	BABR	Repl. by LEES 12V
$3.49 \pm 0.20^{+0.59}_{-0.46}$	<sup>1,11</sup> AUBERT, B	05R	BABR	Repl. by LEES 12U
$3.50 \pm 0.32 \pm 0.31$	<sup>1,12</sup> KOPPENBURG04	BELL		Repl. by LIMOSANI 09
$3.36 \pm 0.53^{+0.65}_{-0.68}$	<sup>13</sup> ABE	01F	BELL	Repl. by SAITO 15
$2.32 \pm 0.57 \pm 0.35$	ALAM	95	CLE2	Repl. by CHEN 01C

<sup>1</sup>We extrapolate the measured value to  $E_\gamma > 1.6$  GeV using the method of BUCHMUELLER 06 (average of three theoretical models).

<sup>2</sup>SAITO 15 measured  $(3.51 \pm 0.17 \pm 0.33) \times 10^{-4}$  using a sum-of-exclusive approach in which 38 of the hadronic final states with  $m_{X_s} < 2.8$  GeV/ $c^2$  are reconstructed. The cut of minimum photon energy is  $E_\gamma > 1.9$  GeV.

<sup>3</sup>Reports  $(3.29 \pm 0.19 \pm 0.48) \times 10^{-4}$  for  $E_\gamma > 1.9$  GeV.

<sup>4</sup>Reports  $(3.21 \pm 0.15 \pm 0.29 \pm 0.08) \times 10^{-4}$  for  $1.8 < E_\gamma < 2.8$  GeV, where the last systematic uncertainty is for model dependency. Results with other cutoffs are also reported.

<sup>5</sup>The measurement reported is  $(3.45 \pm 0.15 \pm 0.40) \times 10^{-4}$  for  $E_\gamma > 1.7$  GeV.

<sup>6</sup>Uses a fully reconstructed  $B$  meson as a tag on the recoil side. The measurement reported is  $(3.66 \pm 0.85 \pm 0.60) \times 10^{-4}$  for  $E_\gamma > 1.9$  GeV.

<sup>7</sup>The measurement reported is  $(3.21 \pm 0.43^{+0.32}_{-0.29}) \times 10^{-4}$  for  $E_\gamma > 2.0$  GeV.

<sup>8</sup>Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)} \gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.5–2.0 GeV/ $c^2$ .

<sup>9</sup>Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)} \gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.6–1.8 GeV/ $c^2$ .

<sup>10</sup>The measurement reported is  $(3.67 \pm 0.29 \pm 0.45) \times 10^{-4}$  for  $E_\gamma > 1.9$  GeV.

<sup>11</sup>The measurement reported is  $(3.27 \pm 0.18^{+0.55}_{-0.42}) \times 10^{-4}$  for  $E_\gamma > 1.9$  GeV.

<sup>12</sup>The measurement reported is  $(3.55 \pm 0.32 \pm 0.32) \times 10^{-4}$  for  $E_\gamma > 1.8$  GeV.

<sup>13</sup>ABE 01F reports their systematic errors  $(\pm 0.42^{+0.50}_{-0.54}) \times 10^{-4}$ , where the second error is due to the theoretical uncertainty. We combine them in quadrature.

## $\Gamma(\bar{b} \rightarrow \bar{d}\gamma)/\Gamma_{\text{total}}$

$\Gamma_{79}/\Gamma$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>9.2 \pm 2.0 \pm 2.3</math></b>	<sup>1</sup> DEL-AMO-SA..10M	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

$14 \pm 5 \pm 4$	<sup>2</sup> AUBERT	09U	BABR Repl. by DEL-AMO-SANCHEZ 10M
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<sup>1</sup>Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)} \gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.5–2.0 GeV/ $c^2$ .

<sup>2</sup>Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)} \gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.6–1.8 GeV/ $c^2$ .

$\Gamma(\bar{b} \rightarrow \bar{d}\gamma)/\Gamma(\bar{b} \rightarrow \bar{s}\gamma)$

$\Gamma_{79}/\Gamma_{78}$

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.040±0.009±0.010</b>	<sup>1</sup> DEL-AMO-SA..10M	BABR	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••			
0.033±0.013±0.009	<sup>2</sup> AUBERT	09U BABR	Repl. by DEL-AMO-SANCHEZ 10M

<sup>1</sup> Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)}\gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.5–2.0 GeV/c<sup>2</sup>.

<sup>2</sup> Measured using sums of seven exclusive final states  $B \rightarrow X_{d(s)}\gamma$  where  $X_{d(s)}$  is a nonstrange (strange) charmless hadronic system in mass range 0.6–1.8 GeV/c<sup>2</sup>.

$\Gamma(\bar{b} \rightarrow \bar{s}gluon)/\Gamma_{total}$

$\Gamma_{80}/\Gamma$

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.068</b>	90		<sup>1</sup> COAN	98 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••					
<0.08		2	<sup>2</sup> ALBRECHT	95D ARG	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> COAN 98 uses  $D$ - $\ell$  correlation.

<sup>2</sup> ALBRECHT 95D use full reconstruction of one  $B$  decay as tag. Two candidate events for charmless  $B$  decay can be interpreted as either  $b \rightarrow sgluon$  or  $b \rightarrow u$  transition. If interpreted as  $b \rightarrow sgluon$  they find a branching ratio of  $\sim 0.026$  or the upper limit quoted above. Result is highly model dependent.

$\Gamma(\eta \text{ anything})/\Gamma_{total}$

$\Gamma_{81}/\Gamma$

VALUE (units 10 <sup>-4</sup> )	CL%	DOCUMENT ID	TECN	COMMENT
<b>2.61±0.30<sup>+0.44</sup><sub>-0.74</sub></b>		<sup>1</sup> NISHIMURA	10 BELL	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••				
1.69±0.29 <sup>+0.36</sup> <sub>-0.62</sub>		<sup>2</sup> NISHIMURA	10 BELL	$e^+e^- \rightarrow \Upsilon(4S)$
<4.4	90	<sup>3</sup> BROWDER	98 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Uses  $B \rightarrow \eta X_s$  with  $0.4 < m_{X_s} < 2.6$  GeV/c<sup>2</sup>.

<sup>2</sup> Uses  $B \rightarrow \eta X_s$  with  $1.8 < m_{X_s} < 2.6$  GeV/c<sup>2</sup>.

<sup>3</sup> BROWDER 98 search for high momentum  $B \rightarrow \eta X_s$  between 2.1 and 2.7 GeV/c.

$\Gamma(\eta' \text{ anything})/\Gamma_{total}$

$\Gamma_{82}/\Gamma$

VALUE (units 10 <sup>-4</sup> )	DOCUMENT ID	TECN	COMMENT
<b>4.2±0.9 OUR AVERAGE</b>			
3.9±0.8±0.9	<sup>1</sup> AUBERT,B	04F BABR	$e^+e^- \rightarrow \Upsilon(4S)$
4.6±1.1±0.6	<sup>2</sup> BONVICINI	03 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••			
6.2±1.6 <sup>+1.3</sup> <sub>-2.0</sub>	<sup>3</sup> BROWDER	98 CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> AUBERT,B 04F reports branching ratio  $B \rightarrow \eta' X_s$  for high momentum  $\eta'$  between 2.0 and 2.7 GeV/c in the  $\Upsilon(4S)$  center-of-mass frame.  $X_s$  represents a recoil system consisting of a kaon and zero to four pions.

<sup>2</sup> BONVICINI 03 observed a signal of  $61.2 \pm 13.9$  events in  $B \rightarrow \eta' X_{nc}$  production for high momentum  $\eta'$  between 2.0 and 2.7 GeV/c in the  $\Upsilon(4S)$  center-of-mass frame. The

$X_{nc}$  denotes “charmless” hadronic states recoiling against  $\eta'$ . The second error combines systematic and background subtraction uncertainties in quadrature.

<sup>3</sup> BROWDER 98 observed a signal of  $39.0 \pm 11.6$  events in high momentum  $B \rightarrow \eta' X_S$  production between 2.0 and 2.7 GeV/c. The branching fraction is based on the interpretation of  $b \rightarrow sg$ , where the last error includes additional uncertainties due to the color-suppressed  $b \rightarrow$  backgrounds.

**$\Gamma(K^+ \text{ gluon (charmless)})/\Gamma_{\text{total}}$   $\Gamma_{83}/\Gamma$**

VALUE (units $10^{-4}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt;1.87</b>	90	<sup>1</sup> DEL-AMO-SA..11	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>  $B \rightarrow K^+ X$  with  $m_X < 1.69 \text{ GeV}/c^2$ .

**$\Gamma(K^0 \text{ gluon (charmless)})/\Gamma_{\text{total}}$   $\Gamma_{84}/\Gamma$**

VALUE (units $10^{-4}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>1.95^{+0.51}_{-0.45} \pm 0.50</math></b>	<sup>1</sup> DEL-AMO-SA..11	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>  $B \rightarrow K^0 X$  with  $m_X < 1.69 \text{ GeV}/c^2$ .

**$\Gamma(\rho\gamma)/\Gamma_{\text{total}}$   $\Gamma_{85}/\Gamma$**

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>1.39 \pm 0.25</math> OUR AVERAGE</b>		Error includes scale factor of 1.2.		
$1.73^{+0.34}_{-0.32} \pm 0.17$		<sup>1,2</sup> AUBERT	08BH BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$1.21^{+0.24}_{-0.22} \pm 0.12$		<sup>1,2</sup> TANIGUCHI	08 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.36^{+0.29}_{-0.27} \pm 0.10$		<sup>1,3</sup> AUBERT	07L BABR	Repl. by AUBERT 08BH
< 1.9	90	<sup>1,3</sup> AUBERT	04C BABR	Repl. by AUBERT 07L
<14	90	<sup>1,4</sup> COAN	00 CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> Assumes  $\Gamma(B \rightarrow \rho\gamma) = \Gamma(B^+ \rightarrow \rho^+\gamma) = 2 \Gamma(B^0 \rightarrow \rho^0\gamma)$  and uses lifetime ratio of  $\tau_{B^+}/\tau_{B^0} = 1.071 \pm 0.009$ .

<sup>3</sup> Assumes  $\Gamma(B \rightarrow \rho\gamma) = \Gamma(B^+ \rightarrow \rho^+\gamma) = 2 \Gamma(B^0 \rightarrow \rho^0\gamma)$  and uses lifetime ratio of  $\tau_{B^+}/\tau_{B^0} = 1.083 \pm 0.017$ .

<sup>4</sup> COAN 00 reports  $B(B \rightarrow \rho\gamma)/B(B \rightarrow K^*(892)\gamma) < 0.32$  at 90%CL and scaled by the central value of  $B(B \rightarrow K^*(892)\gamma) = (4.24 \pm 0.54 \pm 0.32) \times 10^{-5}$ .

**$\Gamma(\rho\gamma)/\Gamma(K^*(892)\gamma)$   $\Gamma_{85}/\Gamma_{66}$**

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
<b><math>3.02^{+0.60+0.26}_{-0.55-0.28}</math></b>	TANIGUCHI	08 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

**$\Gamma(\rho/\omega\gamma)/\Gamma_{\text{total}}$   $\Gamma_{86}/\Gamma$**

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>1.30 \pm 0.23</math> OUR AVERAGE</b>		Error includes scale factor of 1.2.		
$1.63^{+0.30}_{-0.28} \pm 0.16$		<sup>1,2,3</sup> AUBERT	08BH BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$1.14 \pm 0.20^{+0.10}_{-0.12}$		<sup>1,3</sup> TANIGUCHI	08 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.25^{+0.25}_{-0.24} \pm 0.09$	4	AUBERT	07L	BABR	Repl. by AUBERT 08BH
$1.32^{+0.34+0.10}_{-0.31-0.09}$	4	MOHAPATRA	06	BELL	Repl. by TANIGUCHI 08
$0.6 \pm 0.3 \pm 0.1$	4	AUBERT	05	BABR	Repl. by AUBERT 07L
<1.4	90	4 MOHAPATRA	05	BELL	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes  $\Gamma(B \rightarrow \rho\gamma) = \Gamma(B^+ \rightarrow \rho^+\gamma) = 2 \Gamma(B^0 \rightarrow \rho^0\gamma)$  and uses lifetime ratio of  $\tau_{B^+}/\tau_{B^0} = 1.071 \pm 0.009$ .

<sup>2</sup> Also reports  $|V_{td}/V_{ts}| = 0.233^{+0.025+0.022}_{-0.024-0.021}$ .

<sup>3</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>4</sup> Assumes  $\Gamma(B \rightarrow \rho\gamma) = \Gamma(B^+ \rightarrow \rho^+\gamma) = 2 \Gamma(B^0 \rightarrow \rho^0\gamma)$  and uses lifetime ratio of  $\tau_{B^+}/\tau_{B^0} = 1.083 \pm 0.017$ .

### $\Gamma(\rho/\omega\gamma)/\Gamma(K^*(892)\gamma)$

$\Gamma_{86}/\Gamma_{66}$

VALUE (units $10^{-2}$ )	CL%	DOCUMENT ID	TECN	COMMENT
$2.84 \pm 0.50^{+0.27}_{-0.29}$		<sup>1</sup> TANIGUCHI	08	BELL $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<3.5	90	MOHAPATRA	05	BELL	Repl. by TANIGUCHI 08
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<sup>1</sup> Also reports  $|V_{td}/V_{ts}| = 0.195^{+0.020}_{-0.019} \pm 0.015$ .

### $\Gamma(\pi^\pm \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{87}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$3.585 \pm 0.025 \pm 0.070$	<sup>1</sup> ALBRECHT	93I	ARG $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> ALBRECHT 93 excludes  $\pi^\pm$  from  $K_S^0$  and  $\Lambda$  decays. If included, they find  $4.105 \pm 0.025 \pm 0.080$ .

### $\Gamma(\pi^0 \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{88}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$2.35 \pm 0.02 \pm 0.11$	<sup>1</sup> ABE	01J	BELL $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> From fully inclusive  $\pi^0$  yield with no corrections from decays of  $K_S^0$  or other particles.

### $\Gamma(\eta \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{89}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$0.176 \pm 0.011 \pm 0.012$	KUBOTA	96	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

### $\Gamma(\rho^0 \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{90}/\Gamma$

VALUE	DOCUMENT ID	TECN	COMMENT
$0.208 \pm 0.042 \pm 0.032$	ALBRECHT	94J	ARG $e^+e^- \rightarrow \Upsilon(4S)$

### $\Gamma(\omega \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_{91}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.81	90	ALBRECHT	94J	ARG $e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{92}/\Gamma$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.0343±0.0012 OUR AVERAGE</b>			
0.0353±0.0005±0.0030	HUANG 07	CLEO	$e^+e^- \rightarrow \gamma(4S)$
0.0341±0.0006±0.0012	AUBERT 04S	BABR	$e^+e^- \rightarrow \gamma(4S)$
0.0390±0.0030±0.0035	ALBRECHT 94J	ARG	$e^+e^- \rightarrow \gamma(4S)$
0.023 ±0.006 ±0.005	BORTOLETTO86	CLEO	$e^+e^- \rightarrow \gamma(4S)$

$\Gamma(\phi K^*(892))/\Gamma_{\text{total}}$   $\Gamma_{93}/\Gamma$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
<b>&lt;2.2 × 10<sup>-5</sup></b>	90	<sup>1</sup> BERGFELD 98	CLE2

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

$\Gamma(\pi^+ \text{ gluon (charmless)})/\Gamma_{\text{total}}$   $\Gamma_{95}/\Gamma$

<u>VALUE (units 10<sup>-4</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>3.72<sup>+0.50</sup><sub>-0.47</sub>±0.59</b>	<sup>1</sup> DEL-AMO-SA...11	BABR	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup>  $B \rightarrow \pi^+ X$  with  $m_X < 1.71 \text{ GeV}/c^2$ .

$\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{96}/\Gamma$

<u>VALUE (%)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>3.59±0.32<sup>+0.19</sup><sub>-0.18</sub></b>		<sup>1</sup> AUBERT 07C	BABR	$e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

6.4 ±0.8 ±0.8	<sup>2</sup> CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
14 ±9	<sup>3</sup> ALBRECHT 88E	ARG	$e^+e^- \rightarrow \gamma(4S)$
<11.2	90 <sup>4</sup> ALAM 87	CLEO	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> AUBERT 07C reports  $0.045 \pm 0.003 \pm 0.012$  from a measurement of  $[\Gamma(B \rightarrow \Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow pK^- \pi^+)]$  assuming  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = (5.0 \pm 1.3) \times 10^{-2}$ , which we rescale to our best value  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = (6.28 \pm 0.32) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> CRAWFORD 92 result derived from lepton baryon correlations. Assumes all charmed baryons in  $B^0$  and  $B^\pm$  decay are  $\Lambda_c$ .

<sup>3</sup> ALBRECHT 88E measured  $B(B \rightarrow \Lambda_c^+ X) \cdot B(\Lambda_c^+ \rightarrow pK^- \pi^+) = (0.30 \pm 0.12 \pm 0.06)\%$  and used  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = (2.2 \pm 1.0)\%$  from ABRAMS 80 to obtain above number.

<sup>4</sup> Assuming all baryons result from charmed baryons, ALAM 86 conclude the branching fraction is  $7.4 \pm 2.9\%$ . The limit given above is model independent.

$\Gamma(\Lambda_c^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{97}/\Gamma_{98}$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.19±0.13±0.04</b>	<sup>1</sup> AMMAR 97	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> AMMAR 97 uses a high-momentum lepton tag ( $P_\ell > 1.4 \text{ GeV}/c^2$ ).

$\Gamma(\bar{\Lambda}_c^- \mu^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{101}/\Gamma_{98}$

<u>VALUE (units 10<sup>-2</sup>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>-2.0±2.0±1.9</b>	LEES 12	BABR	$e^+e^- \rightarrow \gamma(4S)$



$\Gamma(\bar{\Lambda}_c^- \ell^+ \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{99}/\Gamma_{96}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.5 \times 10^{-2}$	90	<sup>1</sup> LEES	12	BABR $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> LEES 12 quotes also the measurement  $\Gamma(B \rightarrow \bar{\Lambda}_c^- \ell^+ \text{ anything})/\Gamma(B \rightarrow \Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything}) = (1.2 \pm 0.7 \pm 0.4) \times 10^{-2}$ .

$\Gamma(\bar{\Lambda}_c^- e^+ \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{100}/\Gamma_{96}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<0.05$	90	<sup>1</sup> BONVICINI	98	CLE2 $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> BONVICINI 98 uses the electron with momentum above 0.6 GeV/c.

$\Gamma(\bar{\Lambda}_c^- e^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{100}/\Gamma_{98}$

VALUE (units $10^{-2}$ )	DOCUMENT ID	TECN	COMMENT
$2.5 \pm 1.1 \pm 0.6$	<sup>1</sup> LEES	12	BABR $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Uses the full reconstruction of the recoiling  $B$  in a hadronic decay as a tag.

$\Gamma(\bar{\Lambda}_c^- \ell^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{99}/\Gamma_{98}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<3.5 \times 10^{-2}$	90	<sup>1</sup> LEES	12	BABR $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> LEES 12 quotes also the measurement  $\Gamma(B \rightarrow \bar{\Lambda}_c^- \ell^+ \text{ anything})/\Gamma(B \rightarrow \bar{\Lambda}_c^- \text{ anything}) = (1.7 \pm 1.0 \pm 0.6) \times 10^{-2}$ .

$\Gamma(\bar{\Lambda}_c^- p \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$   $\Gamma_{102}/\Gamma_{96}$

VALUE	DOCUMENT ID	TECN	COMMENT
$0.57 \pm 0.05 \pm 0.05$	BONVICINI	98	CLE2 $e^+e^- \rightarrow \gamma(4S)$

$\Gamma(\bar{\Lambda}_c^- p e^+ \nu_e)/\Gamma(\bar{\Lambda}_c^- p \text{ anything})$   $\Gamma_{103}/\Gamma_{102}$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<0.04$	90	<sup>1</sup> BONVICINI	98	CLE2 $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> BONVICINI 98 uses the electron with momentum above 0.6 GeV/c.

$\Gamma(\bar{\Sigma}_c^{--} \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{104}/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$0.0033 \pm 0.0017 \pm 0.0002$	77	<sup>1</sup> PROCARIO	94	CLE2 $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> PROCARIO 94 reports  $[\Gamma(B \rightarrow \bar{\Sigma}_c^{--} \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow p K^- \pi^+)] = 0.00021 \pm 0.00008 \pm 0.00007$  which we divide by our best value  $B(\Lambda_c^+ \rightarrow p K^- \pi^+) = (6.28 \pm 0.32) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\bar{\Sigma}_c^- \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{105}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<8 \times 10^{-3}$	90	<sup>1</sup> PROCARIO	94	CLE2 $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> PROCARIO 94 reports  $[\Gamma(B \rightarrow \bar{\Sigma}_c^- \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow p K^- \pi^+)] < 0.00048$  which we divide by our best value  $B(\Lambda_c^+ \rightarrow p K^- \pi^+) = 6.28 \times 10^{-2}$ .

$\Gamma(\overline{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{106}/\Gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.0037 ± 0.0017 ± 0.0002</b>	76	<sup>1</sup> PROCARIO 94	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> PROCARIO 94 reports  $[\Gamma(B \rightarrow \overline{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow pK^- \pi^+)] = 0.00023 \pm 0.00008 \pm 0.00007$  which we divide by our best value  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = (6.28 \pm 0.32) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\overline{\Sigma}_c^0 N(N = p \text{ or } n))/\Gamma_{\text{total}}$   $\Gamma_{107}/\Gamma$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 1.2 × 10<sup>-3</sup></b>	90	<sup>1</sup> PROCARIO 94	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> PROCARIO 94 reports  $< 0.0017$  from a measurement of  $[\Gamma(B \rightarrow \overline{\Sigma}_c^0 N(N = p \text{ or } n))/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow pK^- \pi^+)]$  assuming  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = 0.043$ , which we rescale to our best value  $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = 6.28 \times 10^{-2}$ .

$\Gamma(\Xi_c^0 \text{ anything, } \Xi_c^0 \rightarrow \Xi^- \pi^+)/\Gamma_{\text{total}}$   $\Gamma_{108}/\Gamma$

VALUE (units 10 <sup>-3</sup> )	DOCUMENT ID	TECN	COMMENT
<b>0.193 ± 0.030 OUR AVERAGE</b>	Error includes scale factor of 1.1.		
0.211 ± 0.019 ± 0.025	<sup>1</sup> AUBERT,B 05M	BABR	$e^+e^- \rightarrow \gamma(4S)$
0.144 ± 0.048 ± 0.021	<sup>2</sup> BARISH 97	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> The yield is obtained by requiring the momentum  $P < 2.15 \text{ GeV}/c$ .

<sup>2</sup> BARISH 97 find  $79 \pm 27 \Xi_c^0$  events.

$\Gamma(\Xi_c^+, \Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+)/\Gamma_{\text{total}}$   $\Gamma_{109}/\Gamma$

VALUE (units 10 <sup>-3</sup> )	DOCUMENT ID	TECN	COMMENT
<b>0.453 ± 0.096<sup>+0.085</sup><sub>-0.065</sub></b>	<sup>1</sup> BARISH 97	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> BARISH 97 find  $125 \pm 28 \Xi_c^+$  events.

$\Gamma(p/\bar{p} \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{110}/\Gamma$

Includes  $p$  and  $\bar{p}$  from  $\Lambda$  and  $\bar{\Lambda}$  decay.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.080 ± 0.004 OUR AVERAGE</b>				
0.080 ± 0.005 ± 0.005		ALBRECHT 93I	ARG	$e^+e^- \rightarrow \gamma(4S)$
0.080 ± 0.005 ± 0.003		CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
0.082 ± 0.005 <sup>+0.013</sup> <sub>-0.010</sub>	2163	<sup>1</sup> ALBRECHT 89K	ARG	$e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

>0.021 <sup>2</sup> ALAM 83B CLEO  $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> ALBRECHT 89K include direct and nondirect protons.

<sup>2</sup> ALAM 83B reported their result as  $> 0.036 \pm 0.006 \pm 0.009$ . Data are consistent with equal yields of  $p$  and  $\bar{p}$ . Using assumed yields below cut,  $B(B \rightarrow p + X) = 0.03$  not including protons from  $\Lambda$  decays.

$\Gamma(p/\bar{p} \text{ (direct) anything})/\Gamma_{\text{total}}$   $\Gamma_{111}/\Gamma$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.055±0.005 OUR AVERAGE</b>				
0.055±0.005±0.0035		ALBRECHT 93I	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
0.056±0.006±0.005		CRAWFORD 92	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
0.055±0.016	1220	<sup>1</sup> ALBRECHT 89K	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>ALBRECHT 89K subtract contribution of  $\Lambda$  decay from the inclusive proton yield.

 $\Gamma(\bar{p}e^+\nu_e \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{112}/\Gamma$ 

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b>&lt; 5.9 × 10<sup>-4</sup></b>	90	<sup>1</sup> ADAM 03B	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••				
<16 × 10 <sup>-4</sup>	90	ALBRECHT 90H	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>Based on  $V-A$  model.

 $\Gamma(\Lambda/\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{113}/\Gamma$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.040±0.005 OUR AVERAGE</b>				
0.038±0.004±0.006	2998	CRAWFORD 92	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
0.042±0.005±0.006	943	ALBRECHT 89K	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••				
0.022±0.003±0.0022		<sup>1</sup> ACKERSTAFF 97N	OPAL	$e^+e^- \rightarrow Z$
>0.011		<sup>2</sup> ALAM 83B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>ACKERSTAFF 97N assumes  $B(b \rightarrow B) = 0.868 \pm 0.041$ , *i.e.*, an admixture of  $B^0$ ,  $B^\pm$ , and  $B_s$ .

<sup>2</sup>ALAM 83B reported their result as  $> 0.022 \pm 0.007 \pm 0.004$ . Values are for  $(B(\Lambda X)+B(\bar{\Lambda} X))/2$ . Data are consistent with equal yields of  $p$  and  $\bar{p}$ . Using assumed yields below cut,  $B(B \rightarrow \Lambda X) = 0.03$ .

 $\Gamma(\Lambda \text{ anything})/\Gamma(\bar{\Lambda} \text{ anything})$   $\Gamma_{114}/\Gamma_{115}$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.43±0.09±0.07</b>	<sup>1</sup> AMMAR 97	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>AMMAR 97 uses a high-momentum lepton tag ( $P_\ell > 1.4 \text{ GeV}/c^2$ ).

 $\Gamma(\Xi^-/\bar{\Xi}^+ \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{116}/\Gamma$ 

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.0027±0.0006 OUR AVERAGE</b>				
0.0027±0.0005±0.0004	147	CRAWFORD 92	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
0.0028±0.0014	54	ALBRECHT 89K	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

 $\Gamma(\text{baryons anything})/\Gamma_{\text{total}}$   $\Gamma_{117}/\Gamma$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.068±0.005±0.003</b>	<sup>1</sup> ALBRECHT 920	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
••• We do not use the following data for averages, fits, limits, etc. •••			
0.076±0.014	<sup>2</sup> ALBRECHT 89K	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup>ALBRECHT 920 result is from simultaneous analysis of  $p$  and  $\Lambda$  yields,  $p\bar{p}$  and  $\Lambda\bar{\Lambda}$  correlations, and various lepton-baryon and lepton-baryon-antibaryon correlations. Supersedes ALBRECHT 89K.

<sup>2</sup>ALBRECHT 89K obtain this result by adding their their measurements  $(5.5 \pm 1.6)\%$  for direct protons and  $(4.2 \pm 0.5 \pm 0.6)\%$  for inclusive  $\Lambda$  production. They then assume  $(5.5 \pm 1.6)\%$  for neutron production and add it in also. Since each  $B$  decay has two baryons, they divide by 2 to obtain  $(7.6 \pm 1.4)\%$ .

**$\Gamma(p\bar{p} \text{ anything})/\Gamma_{\text{total}}$**   **$\Gamma_{118}/\Gamma$**

Includes  $p$  and  $\bar{p}$  from  $\Lambda$  and  $\bar{\Lambda}$  decay.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.0247 ± 0.0023 OUR AVERAGE</b>				
0.024 ± 0.001 ± 0.004		CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
0.025 ± 0.002 ± 0.002	918	ALBRECHT 89K	ARG	$e^+e^- \rightarrow \gamma(4S)$

**$\Gamma(p\bar{p} \text{ anything})/\Gamma(p/\bar{p} \text{ anything})$**   **$\Gamma_{118}/\Gamma_{110}$**

Includes  $p$  and  $\bar{p}$  from  $\Lambda$  and  $\bar{\Lambda}$  decay.

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.30 ± 0.02 ± 0.05	<sup>1</sup> CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> CRAWFORD 92 value is not independent of their  $\Gamma(p\bar{p}\text{anything})/\Gamma_{\text{total}}$  value.

**$\Gamma(\Lambda\bar{\Lambda}/\bar{\Lambda}p \text{ anything})/\Gamma_{\text{total}}$**   **$\Gamma_{119}/\Gamma$**

Includes  $p$  and  $\bar{p}$  from  $\Lambda$  and  $\bar{\Lambda}$  decay.

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
<b>0.025 ± 0.004 OUR AVERAGE</b>				
0.029 ± 0.005 ± 0.005		CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
0.023 ± 0.004 ± 0.003	165	ALBRECHT 89K	ARG	$e^+e^- \rightarrow \gamma(4S)$

**$\Gamma(\Lambda\bar{\Lambda}/\bar{\Lambda}p \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$**   **$\Gamma_{119}/\Gamma_{113}$**

Includes  $p$  and  $\bar{p}$  from  $\Lambda$  and  $\bar{\Lambda}$  decay.

VALUE	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.76 ± 0.11 ± 0.08	<sup>1</sup> CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> CRAWFORD 92 value is not independent of their  $[\Gamma(\Lambda\bar{p}\text{anything})+\Gamma(\bar{\Lambda}p\text{anything})]/\Gamma_{\text{total}}$  value.

**$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$**   **$\Gamma_{120}/\Gamma$**

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<b>&lt;0.005</b>	90		CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.0088	90	12	ALBRECHT 89K	ARG	$e^+e^- \rightarrow \gamma(4S)$

**$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$**   **$\Gamma_{120}/\Gamma_{113}$**

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<0.13	90	<sup>1</sup> CRAWFORD 92	CLEO	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> CRAWFORD 92 value is not independent of their  $\Gamma(\Lambda\bar{\Lambda}\text{anything})/\Gamma_{\text{total}}$  value.

**$\Gamma(se^+e^-)/\Gamma_{\text{total}}$**   **$\Gamma_{121}/\Gamma$**

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b>6.7 ± 1.7 OUR AVERAGE</b>				
6.69 <sup>+0.82+0.71</sup> <sub>-0.77-0.60</sub>		<sup>1</sup> LEES 14D	BABR	$e^+e^- \rightarrow \gamma(4S)$
4.04 ± 1.30 <sup>+0.87</sup> <sub>-0.83</sub>		<sup>2</sup> IWASAKI 05	BELL	$e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$6.0 \pm 1.7 \pm 1.3$	<sup>2</sup> AUBERT,B	04I	BABR	Repl. by LEES 14D
$5.0 \pm 2.3 \begin{smallmatrix} +1.3 \\ -1.1 \end{smallmatrix}$	<sup>2</sup> KANEKO	03	BELL	Repl. by IWASAKI 05
< 57	90	GLENN	98	CLEO $e^+e^- \rightarrow \gamma(4S)$
<50000	90	BEBEK	81	CLEO $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.  
<sup>2</sup> Requires  $M_{\ell^+\ell^-} > 0.2 \text{ GeV}/c^2$ .

**$\Gamma(s\mu^+\mu^-)/\Gamma_{\text{total}}$**   **$\Gamma_{122}/\Gamma$**

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

VALUE (units $10^{-6}$ )	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>4.3 \pm 1.0</math> OUR AVERAGE</b>				
$4.41 \begin{smallmatrix} +1.31+0.63 \\ -1.17-0.50 \end{smallmatrix}$	1	LEES	14D	BABR $e^+e^- \rightarrow \gamma(4S)$
$4.13 \pm 1.05 \begin{smallmatrix} +0.85 \\ -0.81 \end{smallmatrix}$	2	IWASAKI	05	BELL $e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$5.0 \pm 2.8 \pm 1.2$	AUBERT,B	04I	BABR	Repl. by LEES 14D
$7.9 \pm 2.1 \begin{smallmatrix} +2.1 \\ -1.5 \end{smallmatrix}$	KANEKO	03	BELL	Repl. by IWASAKI 05
< 58	90	GLENN	98	CLEO $e^+e^- \rightarrow \gamma(4S)$
<17000	90	CHADWICK	81	CLEO $e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.  
<sup>2</sup> Requires  $M_{\ell^+\ell^-} > 0.2 \text{ GeV}/c^2$ .

**$[\Gamma(se^+e^-) + \Gamma(s\mu^+\mu^-)]/\Gamma_{\text{total}}$**   **$(\Gamma_{121} + \Gamma_{122})/\Gamma$**

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<b><math>&lt; 4.2 \times 10^{-5}</math></b>	90	GLENN	98	CLEO $e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.0024	90	<sup>1</sup> BEAN	87	CLEO Repl. by GLENN 98
<0.0062	90	<sup>2</sup> AVERY	84	CLEO Repl. by BEAN 87

<sup>1</sup> BEAN 87 reports  $[(\mu^+\mu^-) + (e^+e^-)]/2$  and we converted it.  
<sup>2</sup> Determine ratio of  $B^+$  to  $B^0$  semileptonic decays to be in the range 0.25–2.9.

**$\Gamma(sl^+\ell^-)/\Gamma_{\text{total}}$**   **$\Gamma_{123}/\Gamma$**

Test for  $\Delta B = 1$  weak neutral current.

VALUE (units $10^{-6}$ )	DOCUMENT ID	TECN	COMMENT	
<b><math>5.8 \pm 1.3</math> OUR AVERAGE</b>	Error includes scale factor of 1.8.			
$6.73 \begin{smallmatrix} +0.70+0.60 \\ -0.64-0.56 \end{smallmatrix}$	1	LEES	14D	BABR $e^+e^- \rightarrow \gamma(4S)$
$4.11 \pm 0.83 \begin{smallmatrix} +0.85 \\ -0.81 \end{smallmatrix}$	2	IWASAKI	05	BELL $e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$5.6 \pm 1.5 \pm 1.3$	<sup>3</sup> AUBERT,B	04I	BABR	Repl. by LEES	14D
$6.1 \pm 1.4 \begin{smallmatrix} +1.4 \\ -1.1 \end{smallmatrix}$	<sup>3</sup> KANEKO	03	BELL	Repl. by IWASAKI	05

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.

<sup>2</sup> Requires  $M_{\ell^+\ell^-} > 0.2 \text{ GeV}/c^2$ .

<sup>3</sup> Requires  $M_{e^+e^-} > 0.2 \text{ GeV}/c^2$ .

$\Gamma(\pi\ell^+\ell^-)/\Gamma_{\text{total}}$   $\Gamma_{124}/\Gamma$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>&lt;5.9 \times 10^{-8}</math></b>	90	<sup>1</sup> LEES	13M BABR	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$<6.2 \times 10^{-8}$	90	<sup>1</sup> WEI	08A BELL	$e^+e^- \rightarrow \Upsilon(4S)$
$<9.1 \times 10^{-8}$	90	<sup>1</sup> AUBERT	07AG BABR	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

$\Gamma(\pi e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{125}/\Gamma$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>&lt;11.0 \times 10^{-8}</math></b>	90	<sup>1</sup> LEES	13M BABR	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

$\Gamma(\pi\mu^+\mu^-)/\Gamma_{\text{total}}$   $\Gamma_{126}/\Gamma$

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>&lt;5.0 \times 10^{-8}</math></b>	90	<sup>1</sup> LEES	13M BABR	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

$\Gamma(K e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{127}/\Gamma$

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>4.4 \pm 0.6</math> OUR AVERAGE</b>				

$3.9 \begin{smallmatrix} +0.9 \\ -0.8 \end{smallmatrix} \pm 0.2$  <sup>1</sup> AUBERT 09T BABR  $e^+e^- \rightarrow \Upsilon(4S)$

$4.8 \begin{smallmatrix} +0.8 \\ -0.7 \end{smallmatrix} \pm 0.3$  <sup>1</sup> WEI 09A BELL  $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$3.3 \begin{smallmatrix} +0.9 \\ -0.8 \end{smallmatrix} \pm 0.2$  <sup>1</sup> AUBERT,B 06J BABR Repl. by AUBERT 09T

$7.4 \begin{smallmatrix} +1.8 \\ -1.6 \end{smallmatrix} \pm 0.5$  <sup>1</sup> AUBERT 03U BABR Repl. by AUBERT,B 06J

$4.8 \begin{smallmatrix} +1.5 \\ -1.3 \end{smallmatrix} \pm 0.3$  <sup>1,2</sup> ISHIKAWA 03 BELL Repl. by WEI 09A

$<13$  90 ABE 02 BELL Repl. by ISHIKAWA 03

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> The second error is a total of systematic uncertainties including model dependence.

$$\Gamma(K^*(892)e^+e^-)/\Gamma_{\text{total}} \qquad \Gamma_{128}/\Gamma$$

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>11.9±2.0 OUR AVERAGE</b>		Error includes scale factor of 1.2.		
$9.9^{+2.3}_{-2.1} \pm 0.6$		<sup>1</sup> AUBERT	09T BABR	$e^+e^- \rightarrow \gamma(4S)$
$13.9^{+2.3}_{-2.0} \pm 1.2$		<sup>1</sup> WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$9.7^{+3.0}_{-2.7} \pm 1.4$		<sup>1</sup> AUBERT,B	06J BABR	Repl. by AUBERT 09T
$9.8^{+5.0}_{-4.2} \pm 1.1$		<sup>1</sup> AUBERT	03U BABR	Repl. by AUBERT,B 06J
$14.9^{+5.2+1.2}_{-4.6-1.3}$		<sup>2</sup> ISHIKAWA	03 BELL	Repl. by WEI 09A
<56	90	ABE	02 BELL	Repl. by ISHIKAWA 03

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

<sup>2</sup> Assumes equal production of  $B^0$  and  $B^+$  at  $\gamma(4S)$ . The second error is a total of systematic uncertainties including model dependence.

$$\Gamma(K\mu^+\mu^-)/\Gamma_{\text{total}} \qquad \Gamma_{129}/\Gamma$$

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>4.4±0.4 OUR AVERAGE</b>			
$4.2 \pm 0.4 \pm 0.2$	AALTONEN	11Al CDF	$p\bar{p}$ at 1.96 TeV
$4.1^{+1.3}_{-1.2} \pm 0.2$	<sup>1</sup> AUBERT	09T BABR	$e^+e^- \rightarrow \gamma(4S)$
$5.0 \pm 0.6 \pm 0.3$	<sup>1</sup> WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$3.5^{+1.3}_{-1.1} \pm 0.3$	<sup>1</sup> AUBERT,B	06J BABR	Repl. by AUBERT 09T
$4.5^{+2.3}_{-1.9} \pm 0.4$	<sup>1</sup> AUBERT	03U BABR	Repl. by AUBERT,B 06J
$4.8^{+1.2}_{-1.1} \pm 0.4$	<sup>1,2</sup> ISHIKAWA	03 BELL	Repl. by WEI 09A
$9.9^{+4.0+1.3}_{-3.2-1.0}$	ABE	02 BELL	Repl. by ISHIKAWA 03

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

<sup>2</sup> The second error is a total of systematic uncertainties including model dependence.

$$\Gamma(K\mu^+\mu^-)/\Gamma(Ke^+e^-) \qquad \Gamma_{129}/\Gamma_{127}$$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>1.01±0.15 OUR AVERAGE</b>			
$1.00^{+0.31}_{-0.25} \pm 0.07$	<sup>1</sup> LEES	12S BABR	$e^+e^- \rightarrow \gamma(4S)$
$0.96^{+0.44}_{-0.34} \pm 0.05$	AUBERT	09T BABR	$e^+e^- \rightarrow \gamma(4S)$
$1.03 \pm 0.19 \pm 0.06$	WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$1.06 \pm 0.48 \pm 0.08$	AUBERT,B	06J BABR	Repl. by AUBERT 09T

<sup>1</sup> Measured in the union of  $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$  and  $q^2 > 10.11 \text{ GeV}^2/c^4$ . LEES 12S reports also individual measurements  $\Gamma(B \rightarrow K\mu^+\mu^-)/\Gamma(B \rightarrow Ke^+e^-)$

$$= 0.74_{-0.31}^{+0.40} \pm 0.06 \text{ for } 0.10 < q^2 < 8.12 \text{ GeV}^2/c^4 \text{ and } \Gamma(B \rightarrow K\mu^+\mu^-)/\Gamma(B \rightarrow Ke^+e^-) = 1.43_{-0.44}^{+0.65} \pm 0.12 \text{ for } q^2 > 10.11 \text{ GeV}^2/c^4.$$

**$\Gamma(K^*(892)\mu^+\mu^-)/\Gamma_{\text{total}}$**   **$\Gamma_{130}/\Gamma$**   
 Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>10.6±0.9 OUR AVERAGE</b>				
10.1±1.0±0.5		AALTONEN	11A1 CDF	$p\bar{p}$ at 1.96 TeV
13.5 <sup>+3.5</sup> <sub>-3.3</sub> ±1.0		<sup>1</sup> AUBERT	09T BABR	$e^+e^- \rightarrow \gamma(4S)$
11.0 <sup>+1.6</sup> <sub>-1.4</sub> ±0.8		<sup>1</sup> WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8.8 <sup>+3.5</sup> <sub>-3.0</sub> ±1.2		<sup>1</sup> AUBERT,B	06J BABR	Repl. by AUBERT 09T
12.7 <sup>+7.6</sup> <sub>-6.1</sub> ±1.6		<sup>1</sup> AUBERT	03U BABR	Repl. by AUBERT,B 06J
11.7 <sup>+3.6</sup> <sub>-3.1</sub> ±1.0		<sup>2</sup> ISHIKAWA	03 BELL	Repl. by WEI 09A
<31	90	ABE	02 BELL	Repl. by ISHIKAWA 03

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

<sup>2</sup> Assumes equal production of  $B^0$  and  $B^+$  at  $\gamma(4S)$ . The second error is a total of systematic uncertainties including model dependence.

**$\Gamma(K^*(892)\mu^+\mu^-)/\Gamma(K^*(892)e^+e^-)$**   **$\Gamma_{130}/\Gamma_{128}$**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.98±0.15 OUR AVERAGE</b>			
1.13 <sup>+0.34</sup> <sub>-0.26</sub> ±0.10	<sup>1</sup> LEES	12S BABR	$e^+e^- \rightarrow \gamma(4S)$
1.37 <sup>+0.53</sup> <sub>-0.40</sub> ±0.09	AUBERT	09T BABR	$e^+e^- \rightarrow \gamma(4S)$
0.83±0.17±0.08	WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.91±0.45±0.06	AUBERT,B	06J BABR	Repl. by AUBERT 09T
<sup>1</sup> Measured in the union of $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$ and $q^2 > 10.11 \text{ GeV}^2/c^4$ . LEES 12S reports also individual measurements $\Gamma(B \rightarrow K^*(892)\mu^+\mu^-)/\Gamma(B \rightarrow K^*(892)e^+e^-) = 1.06_{-0.33}^{+0.48} \pm 0.08$ for $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$ and $\Gamma(B \rightarrow K^*(892)\mu^+\mu^-)/\Gamma(B \rightarrow K^*(892)e^+e^-) = 1.18_{-0.37}^{+0.55} \pm 0.11$ for $q^2 > 10.11 \text{ GeV}^2/c^4$ .			

**$\Gamma(K\ell^+\ell^-)/\Gamma_{\text{total}}$**   **$\Gamma_{131}/\Gamma$**   
 Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>4.8±0.4 OUR AVERAGE</b>				
4.7±0.6±0.2		LEES	12S BABR	$e^+e^- \rightarrow \gamma(4S)$
4.8 <sup>+0.5</sup> <sub>-0.4</sub> ±0.3		WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.9±0.7±0.2	<sup>1</sup> AUBERT	09T BABR	Repl. by LEES 12S
3.4±0.7±0.2	<sup>1</sup> AUBERT,B	06J BABR	Repl. by AUBERT 09T



$6.5^{+1.4}_{-1.3} \pm 0.4$		<sup>2</sup> AUBERT	03U	BABR	Repl. by AUBERT,B 06J
$4.8^{+1.0}_{-0.9} \pm 0.3$		<sup>3</sup> ISHIKAWA	03	BELL	Repl. by WEI 09A
$7.5^{+2.5}_{-2.1} \pm 0.6$		<sup>4</sup> ABE	02	BELL	Repl. by ISHIKAWA 03
< 5.1	90	<sup>1</sup> AUBERT	02L	BABR	$e^+e^- \rightarrow \gamma(4S)$
< 17	90	<sup>5</sup> ANDERSON	01B	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

<sup>2</sup> Assumes all four  $B \rightarrow K\ell^+\ell^-$  modes having equal partial widths in the fit.

<sup>3</sup> Assumes equal production rate for charge and neutral  $B$  meson pairs, isospin invariance, lepton universality for  $B \rightarrow K\ell^+\ell^-$ , and  $B(B \rightarrow K^*(892)\mu^+\mu^-) = 1.33$ . The second error is total systematic uncertainties including model dependence.

<sup>4</sup> Assumes lepton universality.

<sup>5</sup> The result is for di-lepton masses above 0.5 GeV.

### $\Gamma(K^*(892)\ell^+\ell^-)/\Gamma_{\text{total}}$ $\Gamma_{132}/\Gamma$

Test for  $\Delta B = 1$  weak neutral current. Allowed by higher-order electroweak interactions.

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>10.5 ± 1.0 OUR AVERAGE</b>				
$10.2^{+1.4}_{-1.3} \pm 0.5$		LEES	12S	BABR $e^+e^- \rightarrow \gamma(4S)$
$10.7^{+1.1}_{-1.0} \pm 0.9$		WEI	09A	BELL $e^+e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$11.1^{+1.9}_{-1.8} \pm 0.7$		<sup>1</sup> AUBERT	09T	BABR	Repl. by LEES 12S
$7.8^{+1.9}_{-1.7} \pm 1.1$		<sup>1</sup> AUBERT,B	06J	BABR	Repl. by AUBERT 09T
$8.8^{+3.3}_{-2.9} \pm 1.0$		<sup>2</sup> AUBERT	03U	BABR	Repl. by AUBERT,B 06J
$11.5^{+2.6}_{-2.4} \pm 0.8$		<sup>3</sup> ISHIKAWA	03	BELL	Repl. by WEI 09A
< 31	90	<sup>1,4</sup> AUBERT	02L	BABR	Repl. by AUBERT 03U
< 33	90	<sup>5</sup> ANDERSON	01B	CLE2	$e^+e^- \rightarrow \gamma(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

<sup>2</sup> Assumes the partial width ratio of electron and muon modes to be  $\Gamma(B \rightarrow K^*(892)e^+e^-)/\Gamma(B \rightarrow K^*(892)\mu^+\mu^-) = 1.33$ .

<sup>3</sup> Assumes equal production rate for charge and neutral  $B$  meson pairs, isospin invariance, lepton universality for  $B \rightarrow K\ell^+\ell^-$ , and  $B(B \rightarrow K^*(892)\mu^+\mu^-) = 1.33$ . The second error is total systematic uncertainties including model dependence.

<sup>4</sup> For averaging  $K^*(892)\mu^+\mu^-$  and  $K^*(892)e^+e^-$  modes, AUBERT 02L assumed  $B(B \rightarrow K^*(892)e^+e^-)/B(B \rightarrow K^*(892)\mu^+\mu^-) = 1.2$ .

<sup>5</sup> The result is for di-lepton masses above 0.5 GeV.

### $\Gamma(K\nu\bar{\nu})/\Gamma_{\text{total}}$ $\Gamma_{133}/\Gamma$

Test for  $\Delta B = 1$  weak neutral current.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>&lt; 1.6 × 10<sup>-5</sup></b>				
	90	<sup>1</sup> GRYGIER	17	BELL $e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 1.7 × 10 <sup>-5</sup>	90	<sup>1,2</sup> LEES	13i	BABR $e^+e^- \rightarrow \gamma(4S)$
< 1.4 × 10 <sup>-5</sup>	90	<sup>1</sup> DEL-AMO-SA..10Q	BABR	Repl. by LEES 13i

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> Also reported a limit  $< 3.2 \times 10^{-5}$  at 90% CL obtained using a fully reconstructed hadronic  $B$ -tag evnets.

**$\Gamma(K^* \nu \bar{\nu})/\Gamma_{\text{total}}$**   **$\Gamma_{134}/\Gamma$**

Test for  $\Delta B = 1$  weak neutral current.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 2.7 \times 10^{-5}$	90	<sup>1</sup> GRYGIER 17	BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$< 7.6 \times 10^{-5}$	90	<sup>1,2</sup> LEES 131	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$< 8 \times 10^{-5}$	90	AUBERT 08BC	BABR	Repl. by LEES 131

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>2</sup> Also reported a limit  $< 7.9 \times 10^{-5}$  at 90% CL obtained using a fully reconstructed hadronic  $B$ -tag evnets.

**$\Gamma(\pi \nu \bar{\nu})/\Gamma_{\text{total}}$**   **$\Gamma_{135}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 0.8 \times 10^{-5}$	90	<sup>1</sup> GRYGIER 17	BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(\rho \nu \bar{\nu})/\Gamma_{\text{total}}$**   **$\Gamma_{136}/\Gamma$**

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 2.8 \times 10^{-5}$	90	<sup>1</sup> GRYGIER 17	BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(s e^\pm \mu^\mp)/\Gamma_{\text{total}}$**   **$\Gamma_{137}/\Gamma$**

Test for lepton family number conservation. Allowed by higher-order electroweak interactions.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 2.2 \times 10^{-5}$	90	GLENN 98	CLEO	$e^+ e^- \rightarrow \Upsilon(4S)$

**$\Gamma(\pi e^\pm \mu^\mp)/\Gamma_{\text{total}}$**   **$\Gamma_{138}/\Gamma$**

Test of lepton family number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 9.2 \times 10^{-8}$	90	<sup>1</sup> AUBERT 07AG	BABR	$e^+ e^- \rightarrow \Upsilon(4S)$

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

$< 1.6 \times 10^{-6}$	90	<sup>1</sup> EDWARDS 02B	CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**$\Gamma(\rho e^\pm \mu^\mp)/\Gamma_{\text{total}}$**   **$\Gamma_{139}/\Gamma$**

Test of lepton family number conservation.

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$< 3.2 \times 10^{-6}$	90	<sup>1</sup> EDWARDS 02B	CLE2	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

$\Gamma(K e^\pm \mu^\mp)/\Gamma_{\text{total}}$   $\Gamma_{140}/\Gamma$

Test of lepton family number conservation.

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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**< 0.38** 90 <sup>1</sup> AUBERT,B 06J BABR  $e^+e^- \rightarrow \Upsilon(4S)$

••• We do not use the following data for averages, fits, limits, etc. •••

<16 90 <sup>1</sup> EDWARDS 02B CLE2  $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

$\Gamma(K^*(892) e^\pm \mu^\mp)/\Gamma_{\text{total}}$   $\Gamma_{141}/\Gamma$

Test of lepton family number conservation.

VALUE (units $10^{-7}$ )	CL%	DOCUMENT ID	TECN	COMMENT
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**< 5.1** 90 <sup>1</sup> AUBERT,B 06J BABR  $e^+e^- \rightarrow \Upsilon(4S)$

••• We do not use the following data for averages, fits, limits, etc. •••

<62 90 <sup>1</sup> EDWARDS 02B CLE2  $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

**CP VIOLATION**

$A_{CP}$  is defined as

$$\frac{B(\bar{B} \rightarrow \bar{f}) - B(B \rightarrow f)}{B(\bar{B} \rightarrow f) + B(B \rightarrow f)},$$

the CP-violation charge asymmetry of inclusive  $B^\pm$  and  $B^0$  decay.

**$A_{CP}(B \rightarrow K^*(892)\gamma)$**

VALUE	DOCUMENT ID	TECN	COMMENT
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**-0.003 ± 0.011 OUR AVERAGE**

-0.004 ± 0.014 ± 0.003 <sup>1</sup> HORIGUCHI 17 BELL  $e^+e^- \rightarrow \Upsilon(4S)$

-0.003 ± 0.017 ± 0.007 <sup>2</sup> AUBERT 09A0 BABR  $e^+e^- \rightarrow \Upsilon(4S)$

0.08 ± 0.13 ± 0.03 <sup>3</sup> COAN 00 CLE2  $e^+e^- \rightarrow \Upsilon(4S)$

••• We do not use the following data for averages, fits, limits, etc. •••

-0.013 ± 0.036 ± 0.010 <sup>4</sup> AUBERT,BE 04A BABR Repl. by AUBERT 09A0

-0.015 ± 0.044 ± 0.012 <sup>3</sup> NAKAO 04 BELL Repl. by HORIGUCHI 17

-0.044 ± 0.076 ± 0.012 <sup>5</sup> AUBERT 02C BABR Repl. by AUBERT,BE 04A

<sup>1</sup> Uses  $B(\Upsilon(4S) \rightarrow B^+B^-) = (51.4 \pm 0.6)\%$  and  $B(\Upsilon(4S) \rightarrow B^0\bar{B}^0) = (48.6 \pm 0.6)\%$ .

<sup>2</sup> Corresponds to a 90% CL interval  $-0.033 < A_{CP} < 0.028$ .

<sup>3</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ .

<sup>4</sup> Corresponds to a 90% CL allowed region,  $-0.074 < A_{CP} < 0.049$ .

<sup>5</sup> A 90% CL range is  $-0.170 < A_{CP} < 0.082$ .

**$A_{CP}(B \rightarrow s\gamma)$**

VALUE	DOCUMENT ID	TECN	COMMENT
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**0.015 ± 0.011 OUR AVERAGE**

0.0144 ± 0.0128 ± 0.0011 <sup>1</sup> WATANUKI 19 BELL  $e^+e^- \rightarrow \Upsilon(4S)$

0.017 ± 0.019 ± 0.010 <sup>2</sup> LEES 14K BABR  $e^+e^- \rightarrow \Upsilon(4S)$

••• We do not use the following data for averages, fits, limits, etc. •••

-0.011 ± 0.030 ± 0.014 <sup>3</sup> AUBERT 08BJ BABR Repl. by LEES 14K

0.025 ± 0.050 ± 0.015 <sup>4</sup> AUBERT,B 04E BABR Repl. by AUBERT 08BJ

0.002 ± 0.050 ± 0.030 <sup>5</sup> NISHIDA 04 BELL Repl. by WATANUKI 19

<sup>1</sup> Using a sum-of-exclusive technique with  $m_{X_S} < 2.8 \text{ GeV}/c^2$ .

<sup>2</sup> Measured with 16 exclusively reconstructed  $B \rightarrow X_S \gamma$  decays with  $0.6 < m_{X_S} < 2.0 \text{ GeV}/c^2$  (ten charged and six neutral self-tagging  $B$  modes).

<sup>3</sup> Uses a sum of exclusively reconstructed  $B \rightarrow X_S$  decay modes, with  $X_S$  mass between 0.6 and  $2.8 \text{ GeV}/c^2$ .

<sup>4</sup> Corresponds to  $-0.06 < A_{CP} < 0.11$  at 90% CL.

<sup>5</sup> This measurement is performed inclusively for recoil mass  $X_S$  less than 2.1 GeV, which corresponds to  $-0.093 < A_{CP} < 0.096$  at 90% CL.

### $A_{CP}(B \rightarrow (s + d)\gamma)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.010±0.031 OUR AVERAGE</b>			
0.022±0.039±0.009	<sup>1</sup> PESANTEZ	15	BELL $e^+e^- \rightarrow \Upsilon(4S)$
0.057±0.060±0.018	LEES	12V	BABR $e^+e^- \rightarrow \Upsilon(4S)$
-0.10 ±0.18 ±0.05	<sup>2</sup> AUBERT	08O	BABR $e^+e^- \rightarrow \Upsilon(4S)$
-0.110±0.115±0.017	AUBERT,BE	06B	BABR $e^+e^- \rightarrow \Upsilon(4S)$
-0.079±0.108±0.022	<sup>3</sup> COAN	01	CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\Upsilon(4S)$ . Uses an opposite side lepton tag. Requires center-of-mass frame  $E_\gamma > 2.1 \text{ GeV}$ .

<sup>2</sup> Uses a fully reconstructed  $B$  meson as a tag on the recoil side. Requires  $E_\gamma > 2.2 \text{ GeV}$ .

<sup>3</sup> Corresponds to  $-0.27 < A_{CP} < 0.10$  at 90% CL.

### $A_{CP}(B \rightarrow X_S \ell^+ \ell^-)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.04±0.11±0.01</b>	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
-0.22±0.26±0.02	<sup>2</sup> AUBERT,B	04I	BABR Repl. by LEES 14D

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0\pi^+$ , and  $K_S^0\pi^+\pi^0$ .

<sup>2</sup> The final state flavor is determined by the kaon and pion charges where modes with  $X_S = K_S^0$ ,  $K_S^0\pi^0$  or  $K_S^0\pi^+\pi^-$  are not used.

### $A_{CP}(B \rightarrow X_S \ell^+ \ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>-0.06±0.22±0.01</b>	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0\pi^+$ , and  $K_S^0\pi^+\pi^0$ .

### $A_{CP}(B \rightarrow X_S \ell^+ \ell^-) (10.1 < q^2 < 12.9 \text{ or } q^2 > 14.2 \text{ GeV}^2/c^4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.19<sup>+0.18</sup><sub>-0.17</sub>±0.01</b>	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0\pi^+$ , and  $K_S^0\pi^+ (p_i^-)^0$ .

### $A_{CP}(B \rightarrow K^* e^+ e^-)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>-0.18±0.15±0.01</b>	WEI	09A	BELL $e^+e^- \rightarrow \Upsilon(4S)$

### $A_{CP}(B \rightarrow K^* \mu^+ \mu^-)$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.03 \pm 0.13 \pm 0.02$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

### $A_{CP}(B \rightarrow K^* \ell^+ \ell^-)$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.04 \pm 0.07</math> OUR AVERAGE</b>			

$0.03 \pm 0.13 \pm 0.01$	<sup>1</sup> LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$+0.01^{+0.16}_{-0.15} \pm 0.01$	AUBERT	09T	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$-0.10 \pm 0.10 \pm 0.01$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Measured in the union of  $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$  and  $q^2 > 10.11 \text{ GeV}^2/c^4$ .  
 LEES 12S reports also individual measurements  $A_{CP}(B \rightarrow K^* \ell^+ \ell^-) = -0.13^{+0.18}_{-0.19} \pm 0.01$  for  $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$  and  $A_{CP}(B \rightarrow K^* \ell^+ \ell^-) = 0.16^{+0.18}_{-0.19} \pm 0.01$  for  $q^2 > 10.11 \text{ GeV}^2/c^4$ .

### $A_{CP}(B \rightarrow \eta \text{ anything})$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.13 \pm 0.04^{+0.02}_{-0.03}$	<sup>1</sup> NISHIMURA	10	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Uses  $B \rightarrow \eta X_s$  with  $0.4 < m_{X_s} < 2.6 \text{ GeV}/c^2$ .

### $\Delta A_{CP}(X_s \gamma) = A_{CP}(B^\pm \rightarrow X_s \gamma) - A_{CP}(B^0 \rightarrow X_s \gamma)$

This is the isospin difference of the  $CP$  asymmetries.

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.041 \pm 0.023</math> OUR AVERAGE</b>			
$0.0369 \pm 0.0265 \pm 0.0076$	<sup>1</sup> WATANUKI	19	BELL $e^+ e^- \rightarrow \Upsilon(4S)$
$0.050 \pm 0.039 \pm 0.015$	<sup>2</sup> LEES	14K	BABR $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Using a sum-of-exclusive technique with  $m_{X_s} < 2.8 \text{ GeV}/c^2$ .

<sup>2</sup> Measured with 16 exclusively reconstructed  $B \rightarrow X_s \gamma$  decays with  $0.6 < m_{X_s} < 2.0 \text{ GeV}/c^2$  (ten charged and six neutral self-tagging  $B$  modes).

### $\bar{A}_{CP}(B \rightarrow X_s \gamma) = (A_{CP}(B^+ \rightarrow X_s \gamma) + A_{CP}(B^0 \rightarrow X_s \gamma))/2$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.0091 \pm 0.0121 \pm 0.0013</math></b>	<sup>1</sup> WATANUKI	19	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Using a sum-of-exclusive technique with  $m_{X_s} < 2.8 \text{ GeV}/c^2$ .

### $\Delta A_{CP}(B \rightarrow K^* \gamma) = A_{CP}(B^+ \rightarrow K^{*+} \gamma) - A_{CP}(B^0 \rightarrow K^{*0} \gamma)$

This is the isospin difference of the  $CP$  asymmetries.

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.024 \pm 0.028 \pm 0.005</math></b>	<sup>1</sup> HORIGUCHI	17	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Uses  $B(\Upsilon(4S) \rightarrow B^+ B^-) = (51.4 \pm 0.6)\%$  and  $B(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = (48.6 \pm 0.6)\%$ .

### $\bar{A}_{CP}(B \rightarrow K^* \gamma) = (A_{CP}(B^+ \rightarrow K^{*+} \gamma) + A_{CP}(B^0 \rightarrow K^{*0} \gamma))/2$

This is the average  $CP$  asymmetry.

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.001 \pm 0.014 \pm 0.003</math></b>	<sup>1</sup> HORIGUCHI	17	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Uses  $B(\Upsilon(4S) \rightarrow B^+ B^-) = (51.4 \pm 0.6)\%$  and  $B(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = (48.6 \pm 0.6)\%$ .

POLARIZATION IN  $B$  DECAY

In decays involving two vector mesons, one can distinguish among the states in which meson polarizations are both longitudinal ( $L$ ) or both are transverse and parallel ( $\parallel$ ) or perpendicular ( $\perp$ ) to each other with the parameters  $\Gamma_L/\Gamma$ ,  $\Gamma_\perp/\Gamma$ , and the relative phases  $\phi_\parallel$  and  $\phi_\perp$ . See the definitions in the note on “Polarization in  $B$  Decays” review in the  $B^0$  Particle Listings.

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (q^2 > 0.1 \text{ GeV}^2/c^4)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.63^{+0.18}_{-0.19} \pm 0.05$	<sup>1</sup> AUBERT,B	06J	BABR $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Results with different  $q^2$  cuts are also reported.

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (m_{\ell\ell} < 2.5 \text{ GeV}/c^2)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.35 \pm 0.16 \pm 0.04$	AUBERT	09N	BABR $e^+ e^- \rightarrow \gamma(4S)$

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (m_{\ell\ell} > 3.2 \text{ GeV}/c^2)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.71^{+0.20}_{-0.22} \pm 0.04$	AUBERT	09N	BABR $e^+ e^- \rightarrow \gamma(4S)$

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (0.10 < q^2 < 0.98 \text{ GeV}^2/c^4)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.263^{+0.045}_{-0.044} \pm 0.017$	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (1.1 < q^2 < 2.5 \text{ GeV}^2/c^4)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.660^{+0.083}_{-0.077} \pm 0.022$	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

 $F_L(B \rightarrow K^* \ell^+ \ell^-) (0.1 < q^2 < 2.0 \text{ GeV}^2/c^4)$ 

VALUE	DOCUMENT ID	TECN	COMMENT
$0.34^{+0.08}_{-0.07}$ OUR AVERAGE			

$0.37^{+0.10+0.04}_{-0.09-0.03}$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.30 \pm 0.16 \pm 0.02$	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV
$0.29^{+0.21}_{-0.18} \pm 0.02$	WEI	09A	BELL $e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.60^{+0.00}_{-0.28} \pm 0.19$	<sup>1</sup> CHATRCHYAN	13BL	CMS $pp$ at 7 TeV
$0.00^{+0.13}_{-0.00} \pm 0.02$	AAIJ	12U	LHCB Repl. by AAIJ 13Y
$0.53^{+0.32}_{-0.34} \pm 0.07$	AALTONEN	11L	CDF Repl. by AALTONEN 12I

<sup>1</sup> CHATRCHYAN 13BL uses, for this bin,  $1.0 < q^2 < 2.0 \text{ GeV}^2/c^4$ .

**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $2.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.77 \pm 0.05</math> OUR AVERAGE</b>			
$0.876^{+0.109}_{-0.097} \pm 0.017$	<sup>1</sup> AAIJ	16B LHCb	$pp$ at 7, 8 TeV
$0.80 \pm 0.08 \pm 0.06$	KHACHATRY...16D	CMS	$pp$ at 8 TeV
$0.74^{+0.10}_{-0.09} \pm 0.02_{-0.03}$	AAIJ	13Y LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.65 \pm 0.17 \pm 0.03$	CHATRCHYAN 13BL	CMS	$pp$ at 7 TeV
$0.37^{+0.25}_{-0.24} \pm 0.10$	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
$0.71 \pm 0.24 \pm 0.05$	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.77 \pm 0.15 \pm 0.03$	AAIJ	12U LHCb	Repl. by AAIJ 13Y
$0.40^{+0.32}_{-0.33} \pm 0.08$	AALTONEN	11L CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $2.5 < q^2 < 4.0 \text{ GeV}^2/c^4$ . **$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $4.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.611^{+0.052}_{-0.053} \pm 0.017</math></b>	AAIJ	16B LHCb	$pp$ at 7, 8 TeV

 **$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $6.0 < q^2 < 8.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.579 \pm 0.046 \pm 0.015</math></b>	AAIJ	16B LHCb	$pp$ at 7, 8 TeV

 **$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $4.3 < q^2 < 8.6 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.64 \pm 0.06</math> OUR AVERAGE</b>			
$0.57 \pm 0.07 \pm 0.03$	AAIJ	13Y LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.81^{+0.13}_{-0.12} \pm 0.05$	CHATRCHYAN 13BL	CMS	$pp$ at 7 TeV
$0.68^{+0.15}_{-0.17} \pm 0.09$	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
$0.64^{+0.23}_{-0.24} \pm 0.07$	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.60^{+0.06}_{-0.07} \pm 0.01$	AAIJ	12U LHCb	Repl. by AAIJ 13Y
$0.82^{+0.19}_{-0.23} \pm 0.07$	AALTONEN	11L CDF	Repl. by AALTONEN 12I

 **$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $10.09 < q^2 < 12.86 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.448 \pm 0.033</math> OUR AVERAGE</b>			
$0.493^{+0.049}_{-0.047} \pm 0.013$	<sup>1</sup> AAIJ	16B LHCb	$pp$ at 7, 8 TeV
$0.39 \pm 0.05 \pm 0.04$	KHACHATRY...16D	CMS	$pp$ at 8 TeV
$0.48^{+0.08}_{-0.09} \pm 0.03$	AAIJ	13Y LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.45^{+0.10}_{-0.11} \pm 0.04$	CHATRCHYAN 13BL	CMS	$pp$ at 7 TeV
$0.47 \pm 0.14 \pm 0.03$	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
$0.17^{+0.17}_{-0.15} \pm 0.03$	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.41 \pm 0.11 \pm 0.03$	AAIJ	12U	LHCB	Repl. by AAIJ 13Y
$0.31^{+0.19}_{-0.18} \pm 0.02$	AALTONEN	11L	CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $11.0 < q^2 < 12.5 \text{ GeV}^2/c^4$ .

**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $15.0 < q^2 < 17.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.349 \pm 0.039 \pm 0.009$	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $17.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.354^{+0.049}_{-0.048} \pm 0.025$	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$ )**

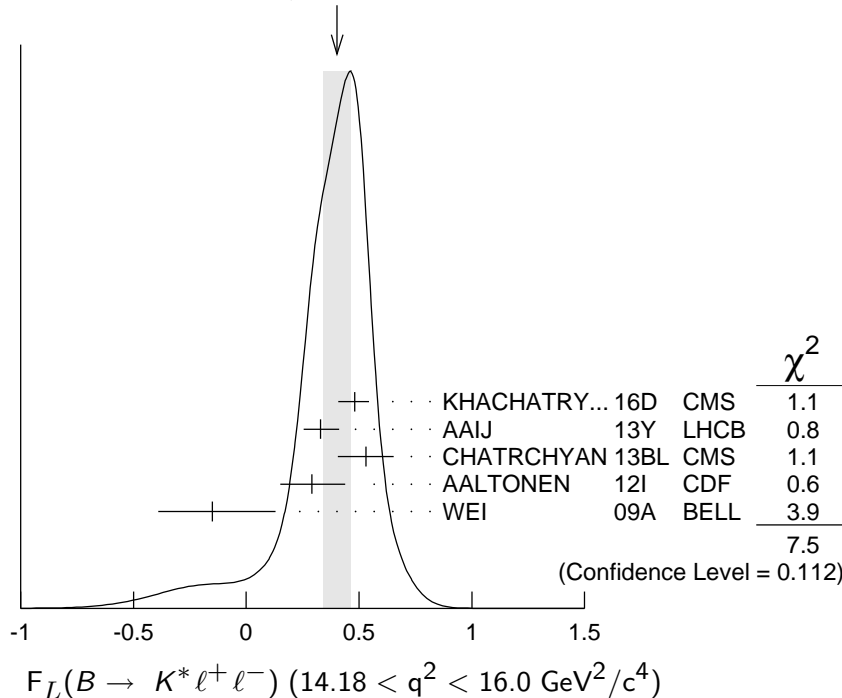
VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.40 \pm 0.06</math> OUR AVERAGE</b>	Error includes scale factor of 1.4. See the ideogram below.		

$0.48^{+0.05}_{-0.06} \pm 0.04$	KHACHATRY...16D	CMS	$pp$ at 8 TeV
$0.33^{+0.08+0.02}_{-0.07-0.03}$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.53 \pm 0.12 \pm 0.03$	CHATRCHYAN 13BL	CMS	$pp$ at 7 TeV
$0.29^{+0.14}_{-0.13} \pm 0.05$	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV
$-0.15^{+0.27}_{-0.23} \pm 0.07$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.37 \pm 0.09 \pm 0.05$	AAIJ	12U	LHCB	Repl. by AAIJ 13Y
$0.55^{+0.17}_{-0.18} \pm 0.02$	AALTONEN	11L	CDF	Repl. by AALTONEN 12I

WEIGHTED AVERAGE  
 $0.40 \pm 0.06$  (Error scaled by 1.4)





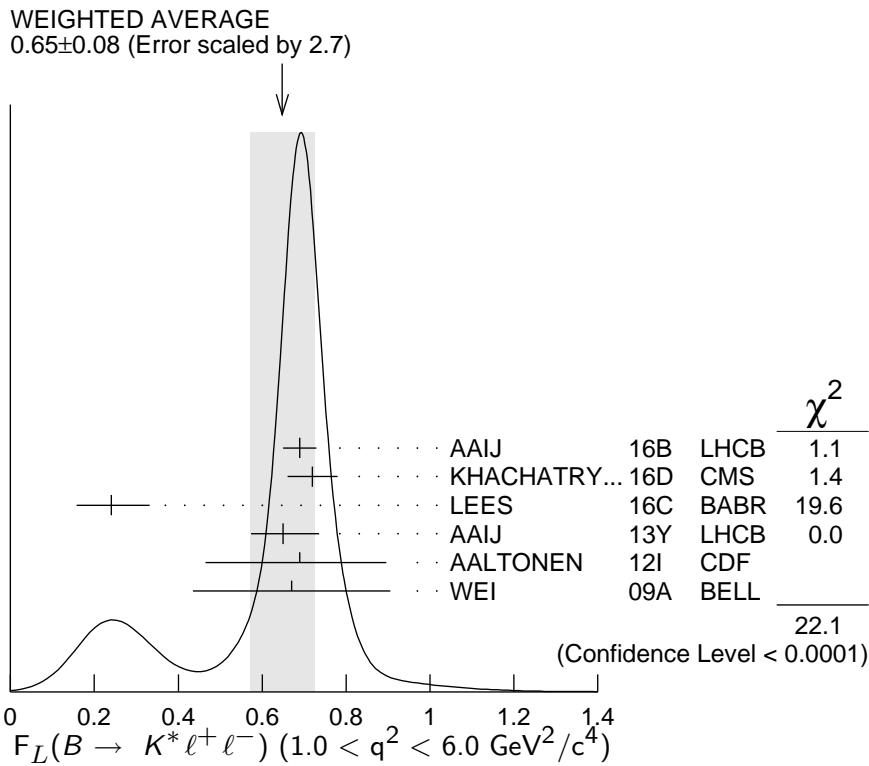
**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $16.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.353 ± 0.024 OUR AVERAGE</b>			
0.344 <sup>+0.028</sup> <sub>-0.030</sub> ± 0.008	<sup>1</sup> AAIJ	16B LHCb	$pp$ at 7, 8 TeV
0.38 <sup>+0.05</sup> <sub>-0.06</sub> ± 0.04	KHACHATRYAN...16D	CMS	$pp$ at 8 TeV
0.38 <sup>+0.09</sup> <sub>-0.07</sub> ± 0.03	AAIJ	13Y LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
0.44 ± 0.07 ± 0.03	CHATRCHYAN13BL	CMS	$pp$ at 7 TeV
0.20 <sup>+0.19</sup> <sub>-0.17</sub> ± 0.05	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
0.12 <sup>+0.15</sup> <sub>-0.13</sub> ± 0.02	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.26 <sup>+0.10</sup> <sub>-0.08</sub> ± 0.03	AAIJ	12U LHCb	Repl. by AAIJ 13Y
0.09 <sup>+0.18</sup> <sub>-0.14</sub> ± 0.03	AALTONEN	11L CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ . **$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>0.65 ± 0.08 OUR AVERAGE</b> Error includes scale factor of 2.7. See the ideogram below.			
0.690 <sup>+0.035</sup> <sub>-0.036</sub> ± 0.017	<sup>1</sup> AAIJ	16B LHCb	$pp$ at 7, 8 TeV
0.72 ± 0.06	KHACHATRYAN...16D	CMS	$pp$ at 7, 8 TeV
0.24 <sup>+0.09</sup> <sub>-0.08</sub> ± 0.02	<sup>2</sup> LEES	16C BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
0.65 <sup>+0.08</sup> <sub>-0.07</sub> ± 0.03	AAIJ	13Y LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
0.69 <sup>+0.19</sup> <sub>-0.21</sub> ± 0.08	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
0.67 ± 0.23 ± 0.05	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
0.68 ± 0.10 ± 0.02	CHATRCHYAN13BL	CMS	Repl. by KHACHATRYAN 16D
0.55 ± 0.10 ± 0.03	AAIJ	12U LHCb	Repl. by AAIJ 13Y
0.50 <sup>+0.27</sup> <sub>-0.30</sub> ± 0.03	AALTONEN	11L CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$ .<sup>2</sup> Measured by combining  $B^0$  and  $B^+$  with  $e$  and  $\mu$  as leptons. Results are also provided separately for  $B^0$  and  $B^+$ .



**$F_L(B \rightarrow K^* \ell^+ \ell^-)$  ( $0.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
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$0.33^{+0.14}_{-0.13} \pm 0.03$  AALTONEN 12I CDF  $\rho\bar{p}$  at 1.96 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.47^{+0.23}_{-0.24} \pm 0.03$  AALTONEN 11L CDF Repl. by AALTONEN 12I

**$P_\tau(B \rightarrow D^* \tau^+ \nu_\tau)$**

Measures difference in decay widths with positive and negative  $\tau^+$  helicities normalized to the sum of those decay widths.

VALUE	DOCUMENT ID	TECN	COMMENT
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$-0.38 \pm 0.51^{+0.21}_{-0.16}$  <sup>1</sup> HIROSE 17 BELL  $e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Uses a fully reconstructed  $B$  meson as a tag on the recoil side.

**PARTIAL BRANCHING FRACTIONS IN  $B \rightarrow K^{(*)} \ell^+ \ell^-$**

**$B(B \rightarrow K^* \ell^+ \ell^-)$  ( $q^2 < 2.0 \text{ GeV}^2/c^4$ )**

VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
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**$1.68 \pm 0.23$  OUR AVERAGE**

$1.89^{+0.52}_{-0.46} \pm 0.06$  <sup>1</sup> LEES 12S BABR  $e^+ e^- \rightarrow \gamma(4S)$

$1.73 \pm 0.33 \pm 0.10$  AALTONEN 11AI CDF  $\rho\bar{p}$  at 1.96 TeV

$1.46^{+0.40}_{-0.35} \pm 0.11$  WEI 09A BELL  $e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.98 \pm 0.40 \pm 0.09$  AALTONEN 11L CDF Repl. by AALTONEN 11AI

<sup>1</sup> The value reported here from LEES 12S refers to  $0.1 < q^2 < 2.0 \text{ GeV}^2/c^2$ .

**$B(B \rightarrow K^* \ell^+ \ell^-)$  ( $2.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**0.87 ± 0.17 OUR AVERAGE**

$0.95^{+0.35}_{-0.30} \pm 0.04$	LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$0.82 \pm 0.26 \pm 0.06$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$0.86^{+0.31}_{-0.27} \pm 0.07$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.00 \pm 0.38 \pm 0.09$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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 **$B(B \rightarrow K^* \ell^+ \ell^-)$  ( $4.3 < q^2 < 8.68 \text{ GeV}^2/c^4$ )**

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**1.67 ± 0.29 OUR AVERAGE**

$1.82^{+0.56}_{-0.52} \pm 0.09$	<sup>1</sup> LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$1.72 \pm 0.41 \pm 0.14$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$1.37^{+0.47}_{-0.42} \pm 0.39$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.69 \pm 0.57 \pm 0.15$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $4.3 < q^2 < 8.12 \text{ GeV}^2/c^2$ .

 **$B(B \rightarrow K^* \ell^+ \ell^-)$  ( $10.09 < q^2 < 12.86 \text{ GeV}^2/c^4$ )**

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**1.93 ± 0.25 OUR AVERAGE**

$1.86^{+0.52}_{-0.48} \pm 0.10$	<sup>1</sup> LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$1.77 \pm 0.34 \pm 0.11$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$2.24^{+0.44}_{-0.40} \pm 0.19$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.97 \pm 0.47 \pm 0.17$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $10.11 < q^2 < 12.89 \text{ GeV}^2/c^2$ .

 **$B(B \rightarrow K^* \ell^+ \ell^-)$  ( $14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$ )**

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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**1.21 ± 0.17 OUR AVERAGE**

$1.46^{+0.41}_{-0.36} \pm 0.06$	<sup>1</sup> LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$1.21 \pm 0.24 \pm 0.07$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$1.05^{+0.29}_{-0.26} \pm 0.08$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

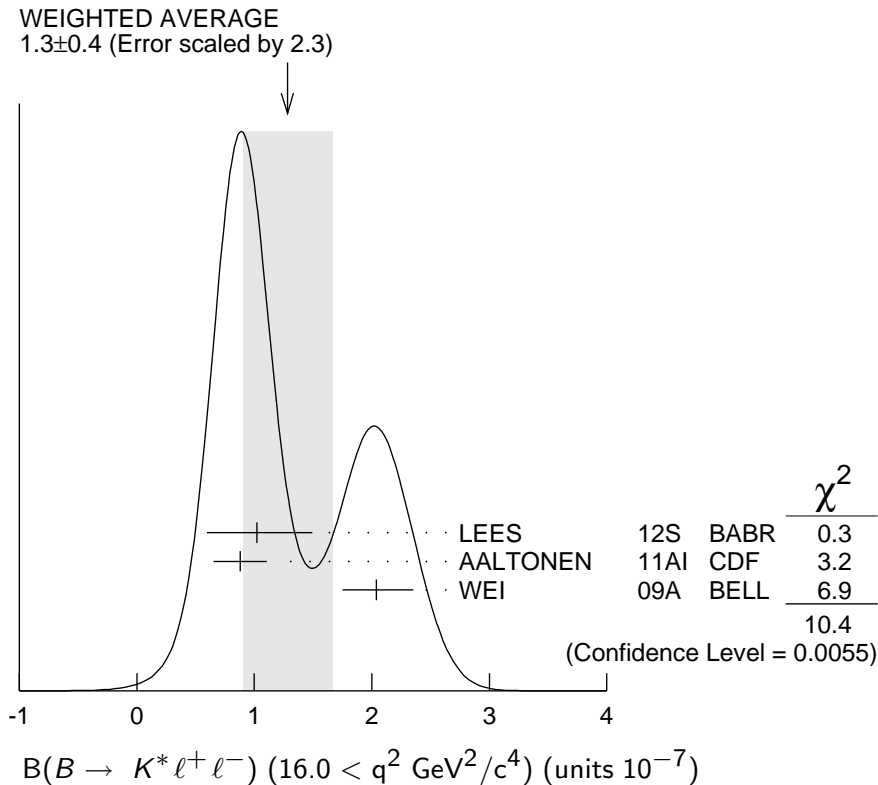
• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.51 \pm 0.36 \pm 0.13$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $14.21 < q^2 < 16.0 \text{ GeV}^2/c^2$ .

### $B(B \rightarrow K^* \ell^+ \ell^-) (16.0 < q^2 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.3 \pm 0.4</math> OUR AVERAGE</b>	Error includes scale factor of 2.3. See the ideogram below.		
$1.02^{+0.47}_{-0.42} \pm 0.06$	LEES	12S BABR	$e^+ e^- \rightarrow \gamma(4S)$
$0.88 \pm 0.22 \pm 0.05$	AALTONEN	11AI CDF	$\rho\bar{p}$ at 1.96 TeV
$2.04^{+0.27}_{-0.24} \pm 0.16$	WEI	09A BELL	$e^+ e^- \rightarrow \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$1.35 \pm 0.37 \pm 0.12$	AALTONEN	11L CDF	Repl. by AALTONEN 11AI



### $B(B \rightarrow K^* \ell^+ \ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>1.64 \pm 0.26</math> OUR AVERAGE</b>			
$2.05^{+0.53}_{-0.48} \pm 0.07$	LEES	12S BABR	$e^+ e^- \rightarrow \gamma(4S)$
$1.48 \pm 0.39 \pm 0.12$	AALTONEN	11AI CDF	$\rho\bar{p}$ at 1.96 TeV
$1.49^{+0.45}_{-0.40} \pm 0.12$	WEI	09A BELL	$e^+ e^- \rightarrow \gamma(4S)$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$1.60 \pm 0.54 \pm 0.14$	AALTONEN	11L CDF	Repl. by AALTONEN 11AI

### $B(B \rightarrow K^* \ell^+ \ell^-) (0.0 < q^2 < 4.3 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>2.53 \pm 0.43 \pm 0.15</math></b>	AALTONEN	11AI CDF	$\rho\bar{p}$ at 1.96 TeV
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
$1.98 \pm 0.55 \pm 0.18$	AALTONEN	11L CDF	Repl. by AALTONEN 11AI

### $B(B \rightarrow K \ell^+ \ell^-) (q^2 < 2.0 \text{ GeV}^2/c^4)$

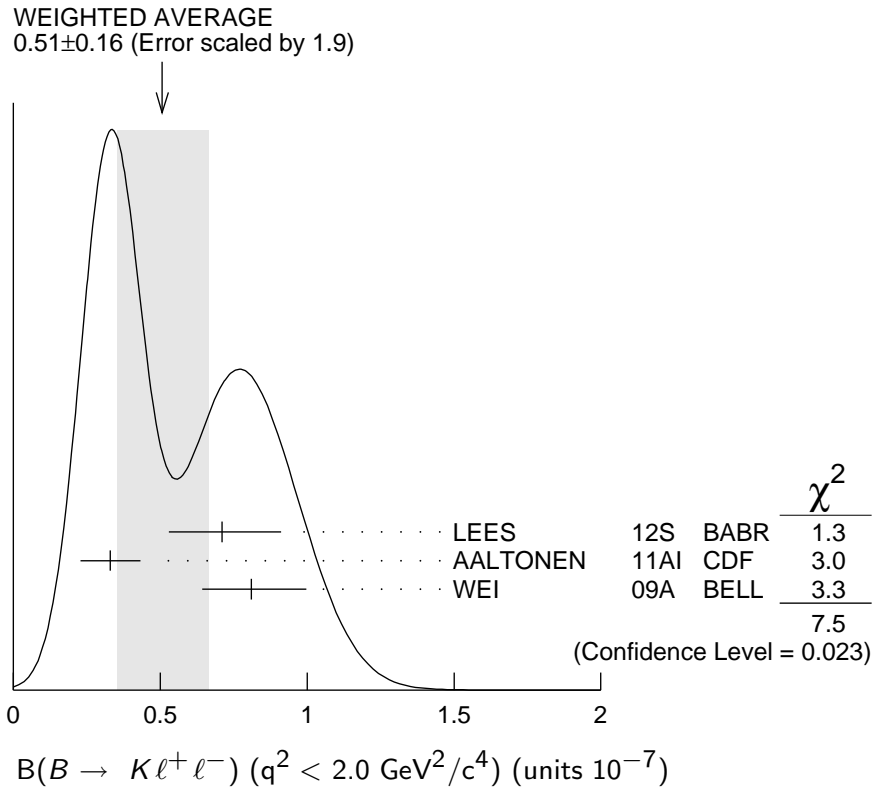
<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.51 \pm 0.16</math> OUR AVERAGE</b>	Error includes scale factor of 1.9. See the ideogram below.		

$0.71^{+0.20}_{-0.18} \pm 0.02$	<sup>1</sup> LEES	12S	BABR	$e^+ e^- \rightarrow \gamma(4S)$
$0.33 \pm 0.10 \pm 0.02$	AALTONEN	11AI	CDF	$p\bar{p}$ at 1.96 TeV
$0.81^{+0.18}_{-0.16} \pm 0.05$	WEI	09A	BELL	$e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.38 \pm 0.16 \pm 0.03$	AALTONEN	11L	CDF	Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $0.1 < q^2 < 2.0 \text{ GeV}^2/c^2$ .



### $B(B \rightarrow K \ell^+ \ell^-) (2.0 < q^2 < 4.3 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.57^{+0.10}_{-0.09}</math> OUR AVERAGE</b>	Error includes scale factor of 1.2.		

$0.49^{+0.15}_{-0.13} \pm 0.01$	LEES	12S	BABR	$e^+ e^- \rightarrow \gamma(4S)$
$0.77 \pm 0.14 \pm 0.05$	AALTONEN	11AI	CDF	$p\bar{p}$ at 1.96 TeV
$0.46^{+0.14}_{-0.12} \pm 0.03$	WEI	09A	BELL	$e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.58 \pm 0.19 \pm 0.04$	AALTONEN	11L	CDF	Repl. by AALTONEN 11AI
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### $B(B \rightarrow K \ell^+ \ell^-) (4.3 < q^2 < 8.68 \text{ GeV}^2/c^4)$

VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
<b>1.00 ± 0.11 OUR AVERAGE</b>			
$0.94^{+0.20}_{-0.19} \pm 0.02$	<sup>1</sup> LEES	12S BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$1.05 \pm 0.17 \pm 0.07$	AALTONEN	11AI CDF	$p\bar{p}$ at 1.96 TeV
$1.00^{+0.19}_{-0.18} \pm 0.06$	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.93 \pm 0.25 \pm 0.06$	AALTONEN	11L CDF	Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $4.3 < q^2 < 8.12 \text{ GeV}^2/c^2$ .

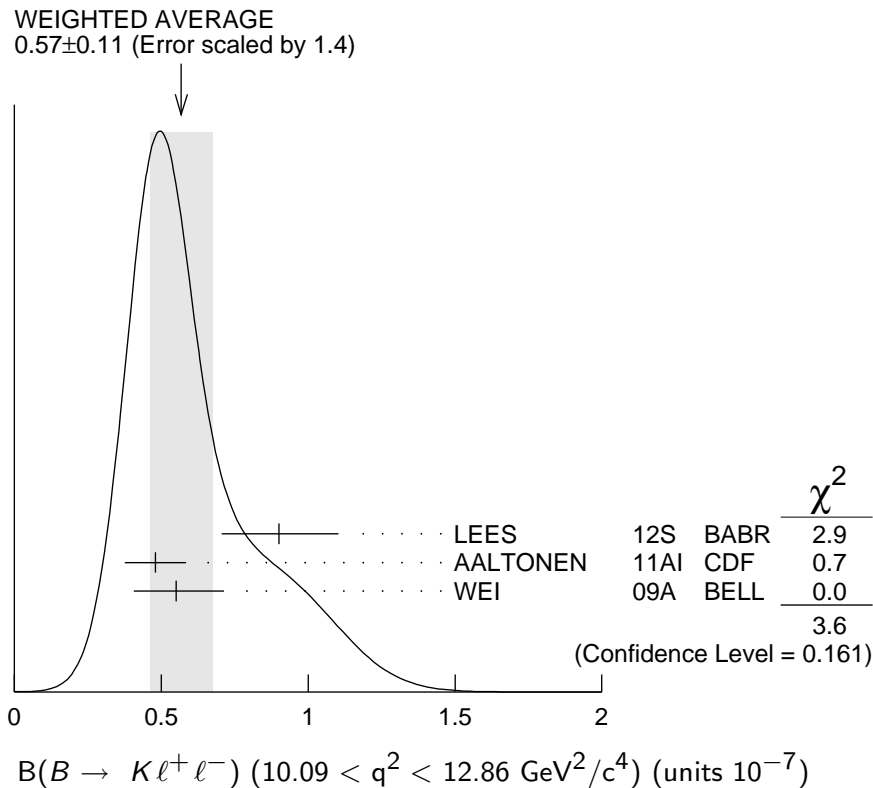
### $B(B \rightarrow K \ell^+ \ell^-) (10.09 < q^2 < 12.86 \text{ GeV}^2/c^4)$

VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
<b>0.57 ± 0.11 OUR AVERAGE</b> Error includes scale factor of 1.4. See the ideogram below.			
$0.90^{+0.20}_{-0.19} \pm 0.04$	<sup>1</sup> LEES	12S BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$0.48 \pm 0.10 \pm 0.03$	AALTONEN	11AI CDF	$p\bar{p}$ at 1.96 TeV
$0.55^{+0.16}_{-0.14} \pm 0.03$	WEI	09A BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.72 \pm 0.17 \pm 0.05$	AALTONEN	11L CDF	Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $10.11 < q^2 < 12.89 \text{ GeV}^2/c^2$ .



### $B(B \rightarrow K \ell^+ \ell^-) (14.18 < q^2 < 16.0 \text{ GeV}^2/c^4)$

VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
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**0.49 ± 0.07 OUR AVERAGE**

$0.49^{+0.15}_{-0.14} \pm 0.02$	<sup>1</sup> LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$0.52 \pm 0.09 \pm 0.03$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$0.38^{+0.19}_{-0.12} \pm 0.02$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.38 \pm 0.12 \pm 0.03$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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<sup>1</sup> The value reported here from LEES 12S refers to  $14.21 < q^2 < 16.0 \text{ GeV}^2/c^2$ .

### $B(B \rightarrow K \ell^+ \ell^-) (16.0 < q^2 \text{ GeV}^2/c^4)$

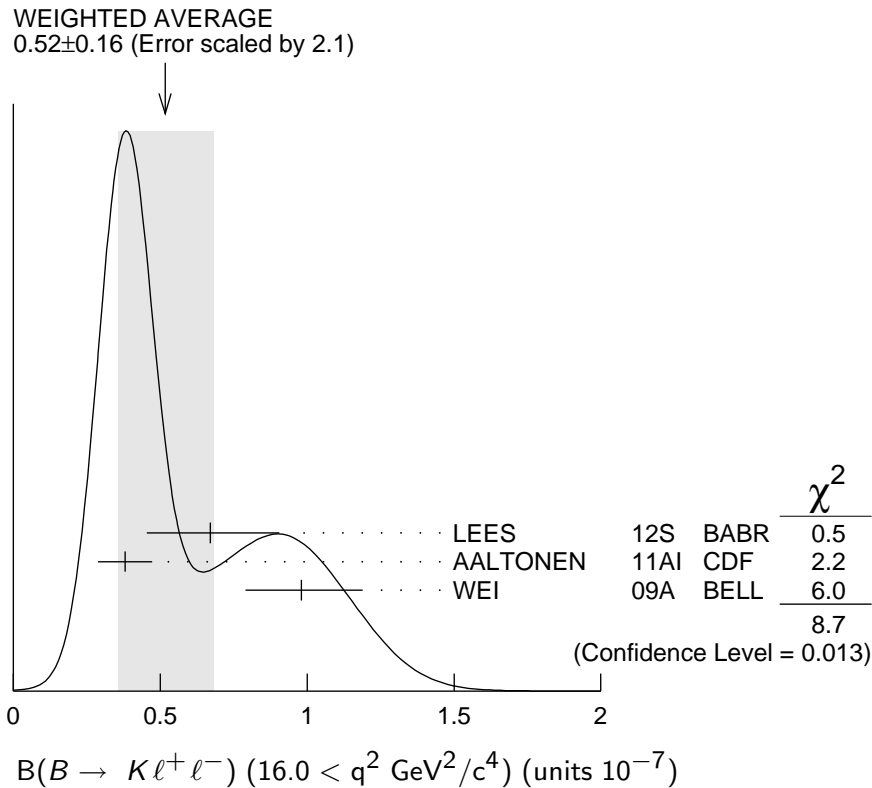
VALUE (units $10^{-7}$ )	DOCUMENT ID	TECN	COMMENT
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**0.52 ± 0.16 OUR AVERAGE** Error includes scale factor of 2.1. See the ideogram below.

$0.67^{+0.23}_{-0.21} \pm 0.05$	LEES	12S	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$0.38 \pm 0.09 \pm 0.02$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$0.98^{+0.20}_{-0.18} \pm 0.06$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.35 \pm 0.13 \pm 0.02$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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### $B(B \rightarrow K\ell^+\ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### **1.33±0.13 OUR AVERAGE**

$1.36^{+0.27}_{-0.24} \pm 0.03$	LEES	12S	BABR $e^+e^- \rightarrow \Upsilon(4S)$
$1.29 \pm 0.18 \pm 0.08$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
$1.36^{+0.23}_{-0.21} \pm 0.08$	WEI	09A	BELL $e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.01 \pm 0.26 \pm 0.07$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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### $B(B \rightarrow K\ell^+\ell^-) (0.0 < q^2 < 4.3 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-7}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### **1.07±0.17±0.07**

$1.07 \pm 0.17 \pm 0.07$	AALTONEN	11AI	CDF $p\bar{p}$ at 1.96 TeV
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.96 \pm 0.25 \pm 0.06$	AALTONEN	11L	CDF Repl. by AALTONEN 11AI
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### $B(B \rightarrow X_s\ell^+\ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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$1.60^{+0.41+0.25}_{-0.39-0.22}$	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.

### $B(B \rightarrow X_s e^+e^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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$1.93^{+0.47+0.28}_{-0.45-0.24}$	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.

### $B(B \rightarrow X_s\mu^+\mu^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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$0.66^{+0.82+0.31}_{-0.76-0.25}$	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.

### $B(B \rightarrow X_s\ell^+\ell^-) (14.2 < q^2 \text{ GeV}^2/c^4)$

<u>VALUE (units <math>10^{-6}</math>)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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$0.57^{+0.16+0.03}_{-0.15-0.02}$	<sup>1</sup> LEES	14D	BABR $e^+e^- \rightarrow \Upsilon(4S)$
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<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+\pi^0$ ,  $K^+\pi^-$ ,  $K^+\pi^-\pi^0$ ,  $K^+\pi^-\pi^+$ ,  $K_S^0$ ,  $K_S^0\pi^0$ ,  $K_S^0\pi^+$ ,  $K_S^0\pi^+\pi^0$ , and  $K_S^0\pi^+\pi^-$  corrected for unobserved modes.



### $B(B \rightarrow X_S e^+ e^-) (14.2 < q^2 \text{ GeV}^2/c^4)$

VALUE (units $10^{-6}$ )	DOCUMENT ID	TECN	COMMENT
$0.56^{+0.19+0.03}_{-0.18-0.03}$	<sup>1</sup> LEES	14D BABR	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+ \pi^0$ ,  $K^+ \pi^-$ ,  $K^+ \pi^- \pi^0$ ,  $K^+ \pi^- \pi^+$ ,  $K_S^0$ ,  $K_S^0 \pi^0$ ,  $K_S^0 \pi^+$ ,  $K_S^0 \pi^+ \pi^0$ , and  $K_S^0 \pi^+ \pi^-$  corrected for unobserved modes.

### $B(B \rightarrow X_S \mu^+ \mu^-) (14.2 < q^2 \text{ GeV}^2/c^4)$

VALUE (units $10^{-6}$ )	DOCUMENT ID	TECN	COMMENT
$0.60^{+0.31+0.05}_{-0.29-0.04}$	<sup>1</sup> LEES	14D BABR	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Measured from sum of exclusive modes through  $K^+$ ,  $K^+ \pi^0$ ,  $K^+ \pi^-$ ,  $K^+ \pi^- \pi^0$ ,  $K^+ \pi^- \pi^+$ ,  $K_S^0$ ,  $K_S^0 \pi^0$ ,  $K_S^0 \pi^+$ ,  $K_S^0 \pi^+ \pi^0$ , and  $K_S^0 \pi^+ \pi^-$  corrected for unobserved modes.

## LEPTON (HADRON) FORWARD-BACKWARD ASYMMETRY IN $B \rightarrow K^{(*)} \ell^+ \ell^-$ ( $B \rightarrow K/\pi h^+ h^-$ ) DECAY

The forward-backward angular asymmetry of the lepton pair in  $B \rightarrow K^{(*)} \ell^+ \ell^-$  ( $B \rightarrow K/\pi h^+ h^-$ ) decay is defined as

$$A_{FB}(s) = \frac{N(\cos\theta > 0) - N(\cos\theta < 0)}{N(\cos\theta > 0) + N(\cos\theta < 0)},$$

where  $s = q^2/m_B^2$ , and  $\theta$  is the angle of the  $\ell^-$  ( $h^-$ ) with respect to the flight direction of the  $B$  meson, measured in the dilepton (dihadron) rest frame. In addition, the fraction of longitudinal polarization  $F_L$  of the  $K^*$  and  $F_S$ , the relative contribution from scalar and pseudoscalar penguin amplitudes in  $B \rightarrow K \ell^+ \ell^-$ , can be measured from the angular distribution of its decay products.

### $A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (q^2 > 0.1 \text{ GeV}^2/c^4)$

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$0.50 \pm 0.15 \pm 0.02$		<sup>1</sup> ISHIKAWA	06 BELL	$e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

>0.55	95	<sup>2</sup> AUBERT,B	06J BABR	$e^+ e^- \rightarrow \gamma(4S)$
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<sup>1</sup> Using an unbinned max. likelihood fits to the  $M_{bc}$  distribution in five  $q^2$  bins for  $\cos\theta > 0$  and  $\cos\theta < 0$ .

<sup>2</sup> Results with different  $q^2$  cuts are also reported.

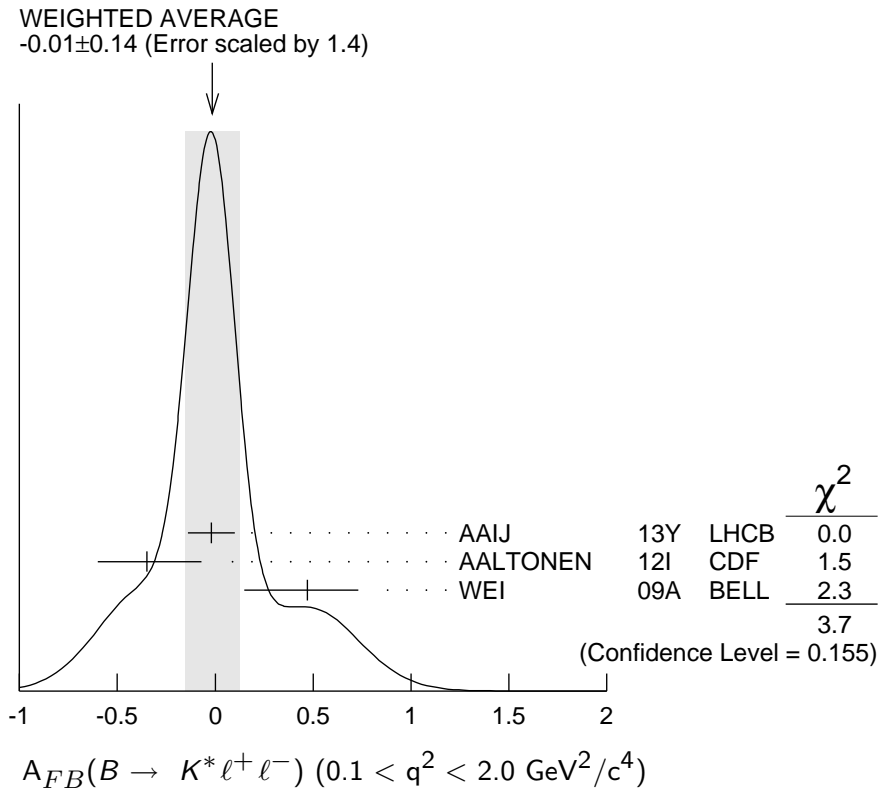
### $A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (0.1 < q^2 < 2.0 \text{ GeV}^2/c^4)$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.01 \pm 0.14$ OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.		
$-0.02 \pm 0.12 \pm 0.01$	AAIJ	13Y LHCb	$p p$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$-0.35^{+0.26}_{-0.23} \pm 0.10$	AALTONEN	12I CDF	$p \bar{p}$ at 1.96 TeV
$0.47^{+0.26}_{-0.32} \pm 0.03$	WEI	09A BELL	$e^+ e^- \rightarrow \gamma(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$-0.29^{+0.37}_{-0.00} \pm 0.18$	<sup>1</sup> CHATRCHYAN 13BL CMS	$pp$ at 7 TeV
$-0.15 \pm 0.20 \pm 0.06$	AAIJ	12U LHCb Repl. by AAIJ 13Y
$0.13^{+1.65}_{-0.75} \pm 0.25$	AALTONEN	11L CDF Repl. by AALTONEN 12I

<sup>1</sup> CHATRCHYAN 13BL uses, for this bin,  $1.0 < q^2 < 2.0 \text{ GeV}^2/c^4$ .



**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (m_{\ell\ell} < 2.5 \text{ GeV}/c^2)$**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.24^{+0.18}_{-0.23} \pm 0.05$	AUBERT	09N BABR	$e^+ e^- \rightarrow \gamma(4S)$

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (m_{\ell\ell} > 3.2 \text{ GeV}/c^2)$**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.76^{+0.52}_{-0.32} \pm 0.07$	AUBERT	09N BABR	$e^+ e^- \rightarrow \gamma(4S)$

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (0.10 < q^2 < 0.98 \text{ GeV}^2/c^4)$**

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.003^{+0.058}_{-0.057} \pm 0.009$	AAIJ	16B LHCb	$pp$ at 7, 8 TeV

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (1.1 < q^2 < 2.5 \text{ GeV}^2/c^4)$**

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.191^{+0.068}_{-0.080} \pm 0.012$	AAIJ	16B LHCb	$pp$ at 7, 8 TeV

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $2.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.14 \pm 0.05</math> OUR AVERAGE</b>			
$-0.118^{+0.082}_{-0.090} \pm 0.007$	<sup>1</sup> AAIJ	16B	LHCB $pp$ at 7, 8 TeV
$-0.12^{+0.15}_{-0.17} \pm 0.05$	KHACHATRY...16D	CMS	$pp$ at 8 TeV
$-0.20 \pm 0.08 \pm 0.01$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$-0.07 \pm 0.20 \pm 0.02$	CHATRCHYAN 13BL	CMS	$pp$ at 7 TeV
$0.29^{+0.32}_{-0.35} \pm 0.15$	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV
$0.11^{+0.31}_{-0.36} \pm 0.07$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.05^{+0.16}_{-0.20} \pm 0.04$	AAIJ	12U	LHCB Repl. by AAIJ 13Y
$0.19^{+0.40}_{-0.41} \pm 0.14$	AALTONEN	11L	CDF Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $2.5 < q^2 < 4.0 \text{ GeV}^2/c^4$ .

 **$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $0.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.08^{+0.21}_{-0.20} \pm 0.05</math></b>	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.21^{+0.31}_{-0.33} \pm 0.05$	AALTONEN	11L	CDF Repl. by AALTONEN 12I
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 **$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $4.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.025^{+0.051}_{-0.052} \pm 0.004</math></b>	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

 **$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $6.0 < q^2 < 8.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.152^{+0.041}_{-0.040} \pm 0.008</math></b>	AAIJ	16B	LHCB $pp$ at 7, 8 TeV

 **$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.085 \pm 0.035</math> OUR AVERAGE</b>	Error includes scale factor of 1.3. See the ideogram below.		

$-0.075^{+0.032}_{-0.034} \pm 0.007$	<sup>1</sup> AAIJ	16B	LHCB $pp$ at 7, 8 TeV
$-0.12 \pm 0.08$	KHACHATRY...16D	CMS	$pp$ at 7, 8 TeV
$0.21^{+0.10}_{-0.15} \pm 0.07$	<sup>2</sup> LEES	16C	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
$-0.17 \pm 0.06 \pm 0.01$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.29^{+0.20}_{-0.23} \pm 0.07$	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV
$0.26^{+0.27}_{-0.30} \pm 0.07$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

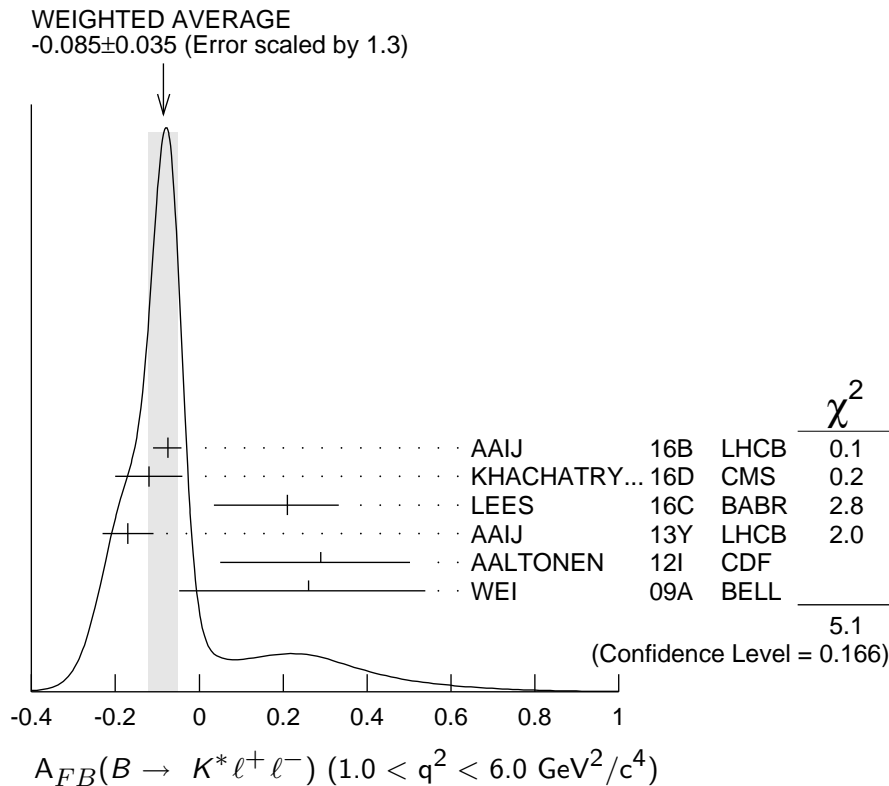
• • • We do not use the following data for averages, fits, limits, etc. • • •

0.55 ± 0.43	<sup>3</sup> SATO	16	BELL	$e^+e^- \rightarrow \Upsilon(4S)$
-0.07 ± 0.12 ± 0.01	CHATRCHYAN	13BL	CMS	Repl. by KHACHATRYAN 16D
-0.06 $\begin{smallmatrix} +0.13 \\ -0.14 \end{smallmatrix}$ ± 0.07	AAIJ	12U	LHCB	Repl. by AAIJ 13Y
0.43 $\begin{smallmatrix} +0.36 \\ -0.37 \end{smallmatrix}$ ± 0.06	AALTONEN	11L	CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$ .

<sup>2</sup> Measured by combining  $B^0$  and  $B^+$  with  $e$  and  $\mu$  as leptons. Results are also provided separately for  $B^0$  and  $B^+$ .

<sup>3</sup> Uses  $K^* \rightarrow K^- \pi^+$ ,  $K^- \pi^0$ ,  $K_S^0 \pi^-$  in the range  $M(K\pi) < 1.1 \text{ GeV}/c^2$ . Uncertainty is statistical only.



**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (4.3 < q^2 < 8.6 \text{ GeV}^2/c^4)$**

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.13 <math>\begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix}</math></b>	<b>OUR AVERAGE</b>		Error includes scale factor of 1.1.

0.16 $\begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix}$ ± 0.01	AAIJ	13Y	LHCB	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
-0.01 ± 0.11 ± 0.03	CHATRCHYAN	13BL	CMS	$pp$ at 7 TeV
0.01 ± 0.20 ± 0.09	AALTONEN	12I	CDF	$p\bar{p}$ at 1.96 TeV
0.45 $\begin{smallmatrix} +0.15 \\ -0.21 \end{smallmatrix}$ ± 0.15	WEI	09A	BELL	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.27 $\begin{smallmatrix} +0.06 \\ -0.08 \end{smallmatrix}$ ± 0.02	AAIJ	12U	LHCB	Repl. by AAIJ 13Y
-0.06 $\begin{smallmatrix} +0.30 \\ -0.28 \end{smallmatrix}$ ± 0.05	AALTONEN	11L	CDF	Repl. by AALTONEN 12I

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $10.09 < q^2 < 12.86 \text{ GeV}^2/c^4$ )**

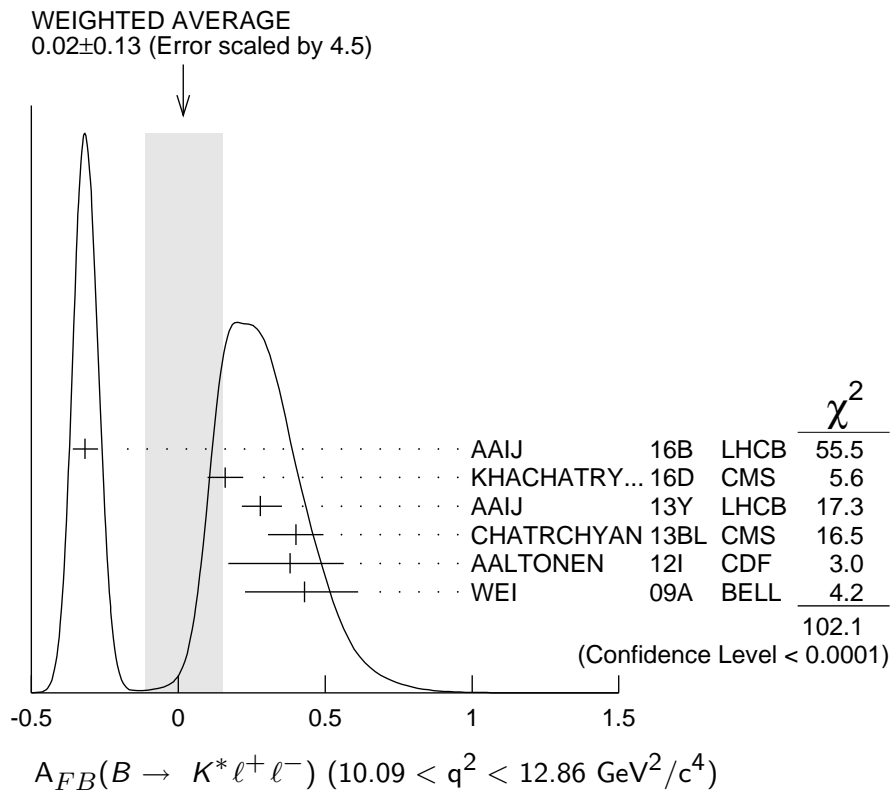
VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.02 \pm 0.13</math> OUR AVERAGE</b>	Error includes scale factor of 4.5. See the ideogram below.		

$-0.318^{+0.044}_{-0.040} \pm 0.009$	<sup>1</sup> AAIJ	16B	LHCB $pp$ at 7, 8 TeV
$0.16 \pm 0.06 \pm 0.01$	KHACHATRY...	16D	CMS $pp$ at 8 TeV
$0.28^{+0.07}_{-0.06} \pm 0.02$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$
$0.40 \pm 0.08 \pm 0.05$	CHATRCHYAN	13BL	CMS $pp$ at 7 TeV
$0.38^{+0.16}_{-0.19} \pm 0.09$	AALTONEN	12I	CDF $p\bar{p}$ at 1.96 TeV
$0.43^{+0.18}_{-0.20} \pm 0.03$	WEI	09A	BELL $e^+ e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.27^{+0.11}_{-0.13} \pm 0.02$	AAIJ	12U	LHCB Repl. by AAIJ 13Y
$0.66^{+0.23}_{-0.20} \pm 0.07$	AALTONEN	11L	CDF Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $11.0 < q^2 < 12.5 \text{ GeV}^2/c^4$ .



**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.43^{+0.05}_{-0.06}</math> OUR AVERAGE</b>	Error includes scale factor of 1.6. See the ideogram below.		

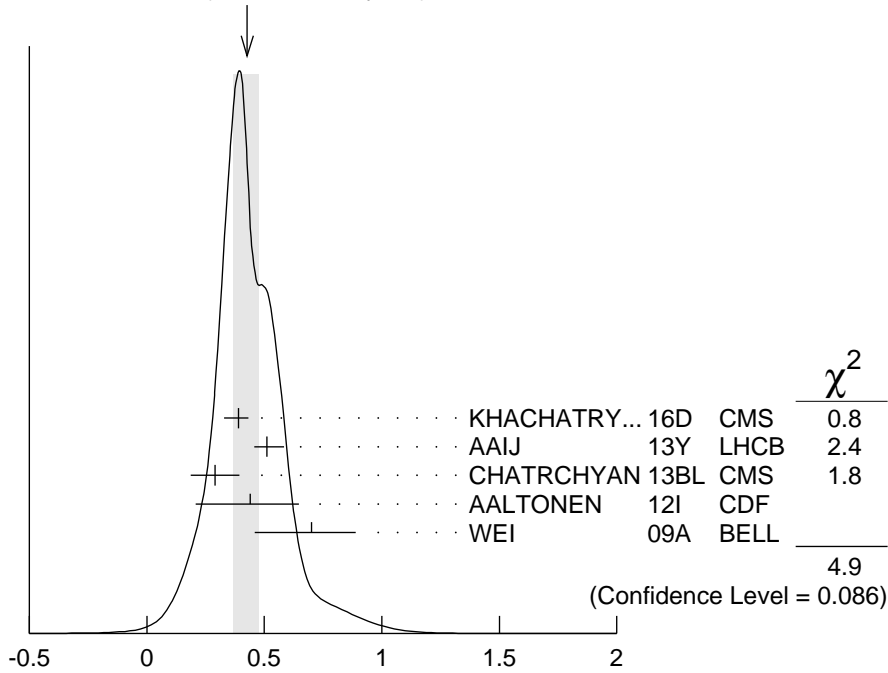
$0.39^{+0.04}_{-0.06} \pm 0.01$	KHACHATRY...	16D	CMS $pp$ at 8 TeV
$0.51^{+0.07}_{-0.05} \pm 0.02$	AAIJ	13Y	LHCB $pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$

$0.29 \pm 0.09 \pm 0.05$	CHATRCHYAN 13BL CMS	$pp$ at 7 TeV
$0.44^{+0.18}_{-0.21} \pm 0.10$	AALTONEN 12I CDF	$p\bar{p}$ at 1.96 TeV
$0.70^{+0.16}_{-0.22} \pm 0.10$	WEI 09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.47^{+0.06}_{-0.08} \pm 0.03$	AAIJ 12U LHCb	Repl. by AAIJ 13Y
$0.42 \pm 0.16 \pm 0.09$	AALTONEN 11L CDF	Repl. by AALTONEN 12I

WEIGHTED AVERAGE  
 $0.43^{+0.05}_{-0.06}$  (Error scaled by 1.6)



$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$ )

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $15.0 < q^2 < 17.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.411^{+0.41}_{-0.037} \pm 0.008$	AAIJ 16B	LHCb	$pp$ at 7, 8 TeV

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $17.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
$0.305^{+0.049}_{-0.048} \pm 0.013$	AAIJ 16B	LHCb	$pp$ at 7, 8 TeV

**$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$  ( $16.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ )**

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>0.367 \pm 0.024</math> OUR AVERAGE</b>	Error includes scale factor of 1.1.		
$0.355 \pm 0.027 \pm 0.009$	<sup>1</sup> AAIJ 16B	LHCb	$pp$ at 7, 8 TeV
$0.35 \pm 0.07 \pm 0.01$	KHACHATRY...16D	CMS	$pp$ at 8 TeV
$0.30 \pm 0.08^{+0.01}_{-0.02}$	AAIJ 13Y	LHCb	$pp$ at 7 TeV, $K^{*0} \mu^+ \mu^-$

$0.41 \pm 0.05 \pm 0.03$	CHATRCHYAN 13BL CMS	$p\bar{p}$ at 7 TeV
$0.65 \begin{smallmatrix} +0.17 \\ -0.18 \end{smallmatrix} \pm 0.16$	AALTONEN 12I CDF	$p\bar{p}$ at 1.96 TeV
$0.66 \begin{smallmatrix} +0.11 \\ -0.16 \end{smallmatrix} \pm 0.04$	WEI 09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.16 \begin{smallmatrix} +0.11 \\ -0.13 \end{smallmatrix} \pm 0.06$	AAIJ 12U LHCb	Repl. by AAIJ 13Y
$0.70 \begin{smallmatrix} +0.16 \\ -0.25 \end{smallmatrix} \pm 0.10$	AALTONEN 11L CDF	Repl. by AALTONEN 12I

<sup>1</sup> Measured in  $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$ .

### $A_{FB}(B \rightarrow K\ell^+\ell^-) (q^2 > 0.1 \text{ GeV}^2/c^4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### **$0.11 \pm 0.12$ OUR AVERAGE**

$0.15 \begin{smallmatrix} +0.21 \\ -0.23 \end{smallmatrix} \pm 0.08$	<sup>1</sup> AUBERT,B 06J BABR	$e^+e^- \rightarrow \Upsilon(4S)$
$0.10 \pm 0.14 \pm 0.01$	<sup>2</sup> ISHIKAWA 06 BELL	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Results with different  $q^2$  cuts are also reported.

<sup>2</sup> Using an unbinned max. likelihood fits to the  $M_{bc}$  distribution in five  $q^2$  bins for  $\cos\theta > 0$  and  $\cos\theta < 0$ .

### $A_{FB}(B \rightarrow K\ell^+\ell^-) (q^2 < 2.0 \text{ GeV}^2/c^4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### **$0.00 \begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix}$ OUR AVERAGE**

$0.00 \begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix} \begin{smallmatrix} +0.03 \\ -0.01 \end{smallmatrix}$	AAIJ 13H LHCb	$p\bar{p}$ at 7 TeV
$0.13 \begin{smallmatrix} +0.42 \\ -0.43 \end{smallmatrix} \pm 0.07$	AALTONEN 12I CDF	$p\bar{p}$ at 1.96 TeV
$0.06 \begin{smallmatrix} +0.32 \\ -0.35 \end{smallmatrix} \pm 0.02$	WEI 09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$-0.15 \begin{smallmatrix} +0.46 \\ -0.39 \end{smallmatrix} \pm 0.08$	AALTONEN 11L CDF	Repl. by AALTONEN 12I
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### $A_{FB}(B \rightarrow K\ell^+\ell^-) (2.0 < q^2 < 4.3 \text{ GeV}^2/c^4)$

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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#### **$0.09 \begin{smallmatrix} +0.10 \\ -0.07 \end{smallmatrix}$ OUR AVERAGE** Error includes scale factor of 1.4.

$0.07 \begin{smallmatrix} +0.08 \\ -0.05 \end{smallmatrix} \begin{smallmatrix} +0.02 \\ -0.01 \end{smallmatrix}$	AAIJ 13H LHCb	$p\bar{p}$ at 7 TeV
$0.32 \begin{smallmatrix} +0.15 \\ -0.16 \end{smallmatrix} \pm 0.05$	AALTONEN 12I CDF	$p\bar{p}$ at 1.96 TeV
$-0.43 \begin{smallmatrix} +0.38 \\ -0.40 \end{smallmatrix} \pm 0.09$	WEI 09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.72 \begin{smallmatrix} +0.40 \\ -0.35 \end{smallmatrix} \pm 0.07$	AALTONEN 11L CDF	Repl. by AALTONEN 12I
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**$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $0.0 < q^2 < 4.3 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.31 \pm 0.16 \pm 0.04</math></b>	AALTONEN 12I	CDF	$\rho\bar{p}$ at 1.96 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.36^{+0.24}_{-0.26} \pm 0.06$	AALTONEN 11L	CDF	Repl. by AALTONEN 12I

 **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.034^{+0.040}_{-0.029}</math> OUR AVERAGE</b>			
$0.02^{+0.05}_{-0.03} \pm 0.02$	AAIJ	13H LHCb	$pp$ at 7 TeV
$0.13 \pm 0.09 \pm 0.02$	AALTONEN 12I	CDF	$\rho\bar{p}$ at 1.96 TeV
$-0.04^{+0.13}_{-0.16} \pm 0.05$	WEI 09A	BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.00 \pm 0.13$	<sup>1</sup> SATO 16	BELL	$e^+e^- \rightarrow \gamma(4S)$
$0.08^{+0.27}_{-0.22} \pm 0.07$	AALTONEN 11L	CDF	Repl. by AALTONEN 12I

<sup>1</sup>Statistical uncertainty only. **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $4.3 < q^2 < 8.6 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>-0.04^{+0.04}_{-0.05}</math> OUR AVERAGE</b>			
$-0.02^{+0.03}_{-0.05} \pm 0.03$	AAIJ	13H LHCb	$pp$ at 7 TeV
$0.01^{+0.13}_{-0.10} \pm 0.01$	AALTONEN 12I	CDF	$\rho\bar{p}$ at 1.96 TeV
$-0.20^{+0.12}_{-0.14} \pm 0.03$	WEI 09A	BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.20^{+0.17}_{-0.28} \pm 0.03$	AALTONEN 11L	CDF	Repl. by AALTONEN 12I

 **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $10.09 < q^2 < 12.86 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>-0.05 \pm 0.06</math> OUR AVERAGE</b>			
$-0.03 \pm 0.07 \pm 0.01$	AAIJ	13H LHCb	$pp$ at 7 TeV
$-0.03^{+0.11}_{-0.10} \pm 0.04$	AALTONEN 12I	CDF	$\rho\bar{p}$ at 1.96 TeV
$-0.21^{+0.17}_{-0.15} \pm 0.06$	WEI 09A	BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.10^{+0.17}_{-0.15} \pm 0.07$	AALTONEN 11L	CDF	Repl. by AALTONEN 12I



**$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>-0.02^{+0.07}_{-0.05}</math> OUR AVERAGE</b>			
$-0.01^{+0.12}_{-0.06} \pm 0.01$	AAIJ	13H LHCB	$pp$ at 7 TeV
$-0.05^{+0.09}_{-0.11} \pm 0.03$	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
$0.04^{+0.32}_{-0.26} \pm 0.05$	WEI	09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.03^{+0.49}_{-0.16} \pm 0.04$	AALTONEN	11L CDF	Repl. by AALTONEN 12I

 **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $16.0 < q^2 < 18.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>-0.09^{+0.07+0.02}_{-0.09-0.01}</math></b>	AAIJ	13H LHCB	$pp$ at 7 TeV

 **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $18.0 < q^2 < 22.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.02 \pm 0.11 \pm 0.01</math></b>	AAIJ	13H LHCB	$pp$ at 7 TeV

 **$A_{FB}(B \rightarrow K\ell^+\ell^-)$  ( $q^2 > 16.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.04^{+0.09}_{-0.07}</math> OUR AVERAGE</b>			
$0.09^{+0.17}_{-0.13} \pm 0.03$	AALTONEN	12I CDF	$p\bar{p}$ at 1.96 TeV
$0.02^{+0.11}_{-0.08} \pm 0.02$	WEI	09A BELL	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.07^{+0.30}_{-0.23} \pm 0.02$	AALTONEN	11L CDF	Repl. by AALTONEN 12I

 **$A_{FB}(B \rightarrow X_s\ell^+\ell^-)$  ( $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.74 \pm 0.54$	<sup>1</sup> SATO	16 BELL	$e^+e^- \rightarrow \Upsilon(4S)$
<sup>1</sup> Uses the sum of 10 exclusive $X_s$ modes in the range $M(X_s) > 1.1 \text{ GeV}/c^2$ . Uncertainty is statistical only.			

 **$F_S(B \rightarrow K\ell^+\ell^-)$  ( $q^2 > 0.1 \text{ GeV}^2/c^4$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.81^{+0.58}_{-0.61} \pm 0.46</math></b>	<sup>1</sup> AUBERT,B	06J BABR	$e^+e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Results with different  $q^2$  cuts are also reported. **$A_{FB}(B \rightarrow K\rho\bar{\rho})$  ( $m_{\rho\bar{\rho}} < 2.85 \text{ GeV}/c^2$ )**

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b><math>0.495 \pm 0.012 \pm 0.007</math></b>	<sup>1</sup> AAIJ	14AF LHCB	$pp$ at 7, 8 TeV

<sup>1</sup> Measured in  $B^+ \rightarrow K^+\rho\bar{\rho}$  decays.

### $A_{FB}(B \rightarrow \pi p \bar{p}) (m_{p\bar{p}} < 2.85 \text{ GeV}/c^2)$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.409 \pm 0.033 \pm 0.006$	<sup>1</sup> AAIJ	14AF LHCB	$pp$ at 7, 8 TeV

<sup>1</sup> Measured in  $B^+ \rightarrow \pi^+ p \bar{p}$  decays.

### ISOSPIN ASYMMETRY

$\Delta_{0-}$  is defined as

$$\frac{\Gamma(\bar{B}^0 \rightarrow f_d) - \Gamma(B^- \rightarrow f_u)}{\Gamma(\bar{B}^0 \rightarrow f_d) + \Gamma(B^- \rightarrow f_u)},$$

the isospin asymmetry of inclusive neutral and charged B decay.

### $\Delta_{0-}(B(B \rightarrow X_s \gamma))$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.006 \pm 0.020$ <b>OUR AVERAGE</b>			
$-0.0048 \pm 0.0149 \pm 0.0150$	<sup>1</sup> WATANUKI	19 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$-0.06 \pm 0.15 \pm 0.07$	<sup>2,3</sup> AUBERT	08O BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$-0.006 \pm 0.058 \pm 0.026$	AUBERT,B	05R BABR	$e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> Using a sum-of-exclusive technique with  $m_{X_s} < 2.8 \text{ GeV}/c^2$ .

<sup>2</sup> The result is for  $E_\gamma > 2.2 \text{ GeV}$ .

<sup>3</sup> Uses a fully reconstructed B meson as a tag on the recoil side.

### $\Delta_{0+}(B \rightarrow K^*(892)\gamma)$

$\Delta_{0+}$  describes the isospin asymmetry between  $\Gamma(B^0 \rightarrow K^*(892)^0 \gamma)$  and  $\Gamma(B^+ \rightarrow K^*(892)^+ \gamma)$ .

VALUE	DOCUMENT ID	TECN	COMMENT
$0.063 \pm 0.017$ <b>OUR AVERAGE</b>			
$0.062 \pm 0.015 \pm 0.013$	<sup>1</sup> HORIGUCHI	17 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$
$0.066 \pm 0.021 \pm 0.022$	<sup>2</sup> AUBERT	09AO BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$0.050 \pm 0.045 \pm 0.037$	<sup>3</sup> AUBERT,BE	04A BABR	Repl. by AUBERT 09AO
$0.012 \pm 0.044 \pm 0.026$	NAKAO	04 BELL	Repl. by HORIGUCHI 17

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> Uses  $B(\Upsilon(4S) \rightarrow B^+ B^-) = (51.4 \pm 0.6)\%$  and  $B(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = (48.6 \pm 0.6)\%$ .

<sup>2</sup> Uses the production ratio of charged and neutral B from  $\Upsilon(4S)$  decays and the lifetime ratio  $\tau_{B^+}/\tau_{B^0} = 1.071 \pm 0.009$ . The 90% CL interval is  $0.017 < \Delta_{0+} < 0.116$

<sup>3</sup> Uses the production ratio of charged and neutral B from  $\Upsilon(4S)$  decays  $R^{+/0} = 1.006 \pm 0.048$  and the lifetime ratio of  $\tau_{B^+}/\tau_{B^0} = 1.083 \pm 0.017$ . The 90% CL interval is  $-0.046 < \Delta_{0+} < 0.146$ .

### $\Delta_{\rho\gamma} \equiv \Gamma(B^+ \rightarrow \rho^+ \gamma) / (2 \cdot \Gamma(B^0 \rightarrow \rho^0 \gamma)) - 1$

VALUE	DOCUMENT ID	TECN	COMMENT
$-0.46 \pm 0.17$ <b>OUR AVERAGE</b>			
$-0.43^{+0.25}_{-0.22} \pm 0.10$	AUBERT	08BH BABR	$e^+ e^- \rightarrow \Upsilon(4S)$
$-0.48^{+0.21+0.08}_{-0.19-0.09}$	TANIGUCHI	08 BELL	$e^+ e^- \rightarrow \Upsilon(4S)$

$\Delta_0(B(B \rightarrow K\ell^+\ell^-))$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.13 \pm 0.06</math> OUR AVERAGE</b>	Error includes scale factor of 1.1.		
$-0.10^{+0.08}_{-0.09} \pm 0.02$	1 AAIJ	14M LHCB	$pp$ at 7, 8 TeV
$-0.09^{+0.08}_{-0.08} \pm 0.02$	2 AAIJ	14M LHCB	$pp$ at 7, 8 TeV
$-0.58^{+0.29}_{-0.37} \pm 0.02$	3 LEES	12S BABR	$e^+e^- \rightarrow \gamma(4S)$
$-0.31^{+0.17}_{-0.14} \pm 0.08$	4 WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.35^{+0.23}_{-0.27}$	5 AAIJ	12AH LHCB	Repl. by AAIJ 14M
$-1.43^{+0.56}_{-0.85} \pm 0.05$	6,7 AUBERT	09T BABR	Repl. by LEES 12S

<sup>1</sup> For  $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$  using  $\mu^+\mu^-$  as a lepton pair and assuming isospin symmetry for the  $B \rightarrow J/\psi(1S)K$ . Measurements in other  $q^2$  bins are also reported.

<sup>2</sup> For  $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$  using  $\mu^+\mu^-$  as a lepton pair and assuming isospin symmetry for the  $B \rightarrow J/\psi(1S)K$ . Measurements in other  $q^2$  bins are also reported.

<sup>3</sup> For  $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$ . Measurements in other  $q^2$  bins are also reported.

<sup>4</sup> For  $q^2 < 8.68 \text{ GeV}^2/c^4$ .

<sup>5</sup> For  $1 < q^2 < 6 \text{ GeV}^2/c^4$ .

<sup>6</sup> For  $0.1 < m_{\ell^+\ell^-}^2 < 7.02 \text{ GeV}^2/c^4$ .

<sup>7</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

 $\Delta_0(B(B \rightarrow K^*\ell^+\ell^-))$ 

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.03^{+0.08}_{-0.07}</math> OUR AVERAGE</b>	Error includes scale factor of 1.2.		
$0.00^{+0.12}_{-0.10} \pm 0.02$	1 AAIJ	14M LHCB	$pp$ at 7, 8 TeV
$0.06^{+0.10}_{-0.09} \pm 0.02$	2 AAIJ	14M LHCB	$pp$ at 7, 8 TeV
$-0.25^{+0.20}_{-0.17} \pm 0.03$	3 LEES	12S BABR	$e^+e^- \rightarrow \gamma(4S)$
$-0.29 \pm 0.16 \pm 0.09$	4 WEI	09A BELL	$e^+e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$-0.15 \pm 0.16$	5 AAIJ	12AH LHCB	Repl. by AAIJ 14M
$-0.56^{+0.17}_{-0.15} \pm 0.03$	6,7 AUBERT	09T BABR	Repl. by LEES 12S

<sup>1</sup> For  $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$  using  $\mu^+\mu^-$  as a lepton pair and assuming isospin symmetry for the  $B(B \rightarrow J/\psi(1S)K^*(892))$ . Measurements in other  $q^2$  bins are also reported.

<sup>2</sup> For  $15.0 < q^2 < 22.0 \text{ GeV}^2/c^4$  using  $\mu^+\mu^-$  as a lepton pair and assuming isospin symmetry for the  $B(B \rightarrow J/\psi(1S)K^*(892))$ . Measurements in other  $q^2$  bins are also reported.

<sup>3</sup> For  $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$ . Measurements in other  $q^2$  bins are also reported.

<sup>4</sup> For  $q^2 < 8.68 \text{ GeV}^2/c^4$ .

<sup>5</sup> For  $1 < q^2 < 6 \text{ GeV}^2/c^4$ .

<sup>6</sup> For  $0.1 < m_{\ell^+\ell^-}^2 < 7.02 \text{ GeV}^2/c^4$ .

<sup>7</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .

### $\Delta_0(B(B \rightarrow K^{(*)} \ell^+ \ell^-))$

VALUE	DOCUMENT ID	TECN	COMMENT
<b><math>-0.45 \pm 0.17</math> OUR AVERAGE</b>	Error includes scale factor of 1.7.		
$-0.64^{+0.15}_{-0.14} \pm 0.03$	1,2 AUBERT	09T BABR	$e^+ e^- \rightarrow \gamma(4S)$
$-0.30^{+0.12}_{-0.11} \pm 0.08$	3 WEI	09A BELL	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> For  $0.1 < m_{\ell^+ \ell^-}^2 < 7.02 \text{ GeV}^2/c^4$ .  
<sup>2</sup> Assumes equal production of  $B^+$  and  $B^0$  at the  $\gamma(4S)$ .  
<sup>3</sup> For  $q^2 < 8.68 \text{ GeV}^2/c^2$ .

## $B \rightarrow X_c \ell \nu$ HADRONIC MASS MOMENTS

### $\langle M_X^2 - \overline{M}_D^2 \rangle$ (First Moments)

VALUE (GeV <sup>2</sup> )	DOCUMENT ID	TECN	COMMENT
<b><math>0.36 \pm 0.08</math> OUR AVERAGE</b>	Error includes scale factor of 1.8.		
$0.467 \pm 0.038 \pm 0.068$	1 ACOSTA	05F CDF	$p\bar{p}$ at 1.96 TeV
$0.293 \pm 0.012 \pm 0.058$	2 CSORNA	04 CLE2	$e^+ e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$0.251 \pm 0.023 \pm 0.062$	3 CRONIN-HEN..01B	CLE2	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> Moments are measured with a minimum lepton momentum of 0.7 GeV/c in the  $B$  rest frame;  
<sup>2</sup> Uses minimum lepton energy of 1.5 GeV and also reports moments with  $E_\ell > 1.0 \text{ GeV}$ .  
<sup>3</sup> The leptons are required to have  $P_\ell > 1.5 \text{ GeV}/c$ .

### $\langle M_X^2 \rangle$ (First Moments)

VALUE (GeV <sup>2</sup> )	DOCUMENT ID	TECN	COMMENT
<b><math>4.156 \pm 0.029</math> OUR AVERAGE</b>			
$4.144 \pm 0.028 \pm 0.022$	1 SCHWANDA	07 BELL	$e^+ e^- \rightarrow \gamma(4S)$
$4.18 \pm 0.04 \pm 0.03$	1 AUBERT,B	04 BABR	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> The leptons are required to have  $E_\ell > 1.5 \text{ GeV}/c$ .

### $\langle (M_X^2 - \overline{M}_X^2)^2 \rangle$ (Second Moments)

VALUE (GeV <sup>4</sup> )	DOCUMENT ID	TECN	COMMENT
<b><math>0.55 \pm 0.08</math> OUR AVERAGE</b>			
$0.515 \pm 0.061 \pm 0.064$	1 SCHWANDA	07 BELL	$e^+ e^- \rightarrow \gamma(4S)$
$0.629 \pm 0.031 \pm 0.143$	2 CSORNA	04 CLE2	$e^+ e^- \rightarrow \gamma(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
$1.05 \pm 0.26 \pm 0.13$	3 ACOSTA	05F CDF	$p\bar{p}$ at 1.96 TeV
$0.576 \pm 0.048 \pm 0.168$	1 CRONIN-HEN..01B	CLE2	$e^+ e^- \rightarrow \gamma(4S)$

<sup>1</sup> The leptons are required to have  $E_\ell > 1.5 \text{ GeV}/c$ .  
<sup>2</sup> Uses minimum lepton energy of 1.5 GeV and also reports moments with  $E_\ell > 1.0 \text{ GeV}$ .  
<sup>3</sup> Moments are measured with a minimum lepton momentum of 0.7 GeV/c in the  $B$  rest frame;

### $\langle (M_X^2 - \overline{M}_D^2)^2 \rangle$ (Second Moments)

VALUE (GeV <sup>4</sup> )	DOCUMENT ID	TECN	COMMENT
<b>0.639 ± 0.056 ± 0.178</b>	<sup>1</sup> CRONIN-HEN..01B	CLE2	e <sup>+</sup> e <sup>-</sup> → γ(4S)

<sup>1</sup> The leptons are required to have E<sub>ℓ</sub> > 1.5 GeV/c.

### B → X<sub>c</sub>ℓν LEPTON MOMENTUM MOMENTS

#### R<sub>0</sub> (Γ<sub>E<sub>ℓ</sub>>1.7GeV</sub> / Γ<sub>E<sub>ℓ</sub>>1.5GeV</sub>)

VALUE	DOCUMENT ID	TECN	COMMENT
<b>0.6187 ± 0.0014 ± 0.0016</b>	<sup>1</sup> MAHMOOD 03	CLE2	e <sup>+</sup> e <sup>-</sup> → γ(4S)

<sup>1</sup> The leptons are required to have E<sub>ℓ</sub> > 1.5 GeV in the B rest frame.

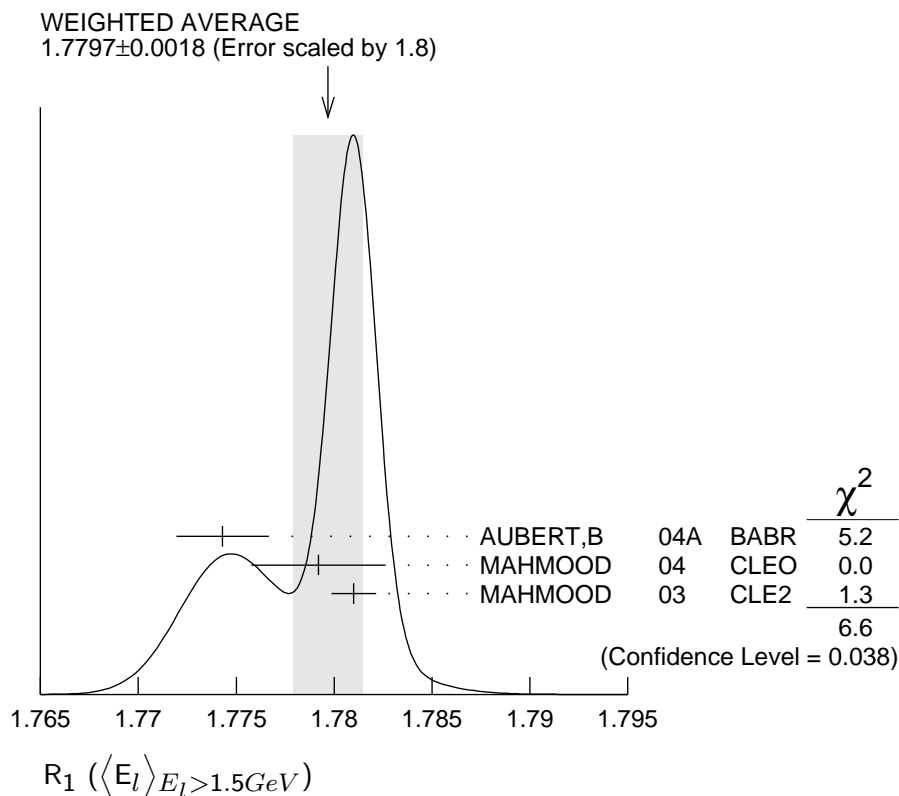
#### R<sub>1</sub> (⟨E<sub>ℓ</sub>⟩<sub>E<sub>ℓ</sub>>1.5GeV</sub>)

VALUE	DOCUMENT ID	TECN	COMMENT
<b>1.7797 ± 0.0018 OUR AVERAGE</b>	Error includes scale factor of 1.8. See the ideogram below.		
1.7743 ± 0.0019 ± 0.0014	<sup>1</sup> AUBERT,B 04A	BABR	e <sup>+</sup> e <sup>-</sup> → γ(4S)
1.7792 ± 0.0021 ± 0.0027	<sup>2</sup> MAHMOOD 04	CLEO	e <sup>+</sup> e <sup>-</sup> → γ(4S)
1.7810 ± 0.0007 ± 0.0009	<sup>3</sup> MAHMOOD 03	CLE2	e <sup>+</sup> e <sup>-</sup> → γ(4S)

<sup>1</sup> The leptons are required to have E<sub>ℓ</sub> > 1.5 GeV in the B rest frame. The result with E<sub>ℓ</sub> > 0.6 GeV is also given.

<sup>2</sup> Uses E<sub>e</sub> > 1.5 GeV and also reports moments with other minimum minimum E<sub>e</sub> conditions, as low as E<sub>e</sub> > 0.6 GeV.

<sup>3</sup> The leptons are required to have E<sub>ℓ</sub> > 1.5 GeV in the B rest frame.



### $R_2 (\langle E_l^2 - \bar{E}_l^2 \rangle_{E_l > 1.5 \text{ GeV}})$

VALUE ( $10^{-3} \text{ GeV}^2$ )	DOCUMENT ID	TECN	COMMENT
<b>30.8 ± 0.8 OUR AVERAGE</b>			
30.3 ± 0.9 ± 0.5	<sup>1</sup> AUBERT,B	04A	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
31.6 ± 0.8 ± 1.0	<sup>2</sup> MAHMOOD	04	CLEO $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> The leptons are required to have  $E_l > 1.5 \text{ GeV}$  in the B rest frame. The result with  $E_l > 0.6 \text{ GeV}$  is also given.

<sup>2</sup> Uses  $E_e > 1.5 \text{ GeV}$  and also reports moments with other minimum minimum  $E_e$  conditions, as low as  $E_e > 0.6 \text{ GeV}$ .

### $R_3 (\langle E_l^3 - \bar{E}_l^3 \rangle_{E_l > 1.5 \text{ GeV}})$

VALUE ( $10^{-3} \text{ GeV}^3$ )	DOCUMENT ID	TECN	COMMENT
<b>2.12 ± 0.47 ± 0.20</b>			
	<sup>1</sup> AUBERT,B	04A	BABR $e^+ e^- \rightarrow \Upsilon(4S)$

<sup>1</sup> The leptons are required to have  $E_l > 1.5 \text{ GeV}$  in the B rest frame. The result with  $E_l > 0.6 \text{ GeV}$  is also given.

## $B \rightarrow X_s \gamma$ PHOTON ENERGY MOMENTS

### $\langle E_\gamma \rangle$

VALUE (GeV)	DOCUMENT ID	TECN	COMMENT
<b>2.314 ± 0.011 OUR AVERAGE</b>			
2.346 ± 0.018 <sup>+0.027</sup> <sub>-0.022</sub>	1,2 LEES	12U	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
2.304 ± 0.014 ± 0.017	2,3 LEES	12V	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
2.311 ± 0.009 ± 0.015	<sup>3</sup> LIMOSANI	09	BELL $e^+ e^- \rightarrow \Upsilon(4S)$
2.289 ± 0.058 ± 0.027	3,4 AUBERT	08O	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
2.309 ± 0.023 ± 0.023	2,3 SCHWANDA	08	BELL $e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.288 ± 0.025 ± 0.023	<sup>3</sup> AUBERT,BE	06B	BABR Repl. by LEES 12V

<sup>1</sup> LEES 12U uses  $E_\gamma > 1.897 \text{ GeV}$  to calculate the moments; the moments are used to calculate the HQET parameters  $m_b = 4.579^{+0.032}_{-0.029} \text{ GeV}/c^2$  and  $\mu_\pi^2 = 0.257^{+0.034}_{-0.039} \text{ GeV}^2$  in the shape function model. The same HQET parameters are also determined in the kinetic model.

<sup>2</sup> Results for different  $E_\gamma$  threshold values are also measured.

<sup>3</sup> The result is for  $E_\gamma > 1.9 \text{ GeV}$ .

<sup>4</sup> Uses a fully reconstructed B meson as a tag on the recoil side.

### $\langle E_\gamma^2 \rangle - \langle E_\gamma \rangle^2$

VALUE ( $10^{-2} \text{ GeV}^2$ )	DOCUMENT ID	TECN	COMMENT
<b>3.03 ± 0.25 OUR AVERAGE</b>			
2.11 ± 0.57 <sup>+0.55</sup> <sub>-0.69</sub>	1,2 LEES	12U	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
3.62 ± 0.33 ± 0.33	2,3 LEES	12V	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
3.02 ± 0.19 ± 0.30	<sup>3</sup> LIMOSANI	09	BELL $e^+ e^- \rightarrow \Upsilon(4S)$
3.34 ± 1.24 ± 0.62	3,4 AUBERT	08O	BABR $e^+ e^- \rightarrow \Upsilon(4S)$
2.17 ± 0.60 ± 0.55	2,3 SCHWANDA	08	BELL $e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
3.28 ± 0.40 ± 0.43	<sup>3</sup> AUBERT,BE	06B	BABR Repl. by LEES 12V

- <sup>1</sup> LEES 12U uses  $E_\gamma > 1.897$  GeV to calculate the moments; the moments are used to calculate the HQET parameters  $m_b = 4.579_{-0.029}^{+0.032}$  GeV/ $c^2$  and  $\mu_\pi^2 = 0.257_{-0.039}^{+0.034}$  GeV<sup>2</sup> in the shape function model. The same HQET parameters are also determined in the kinetic model.
- <sup>2</sup> Results for different  $E_\gamma$  threshold values are also measured.
- <sup>3</sup> The result is for  $E_\gamma > 1.9$  GeV.
- <sup>4</sup> Uses a fully reconstructed  $B$  meson as a tag on the recoil side.

## $B^\pm/B^0$ ADMIXTURE REFERENCES

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GRYGIER	17	PR D96 091101	J. Grygier <i>et al.</i>	(BELLE Collab.)
HIROSE	17	PRL 118 211801	S. Hirose <i>et al.</i>	(BELLE Collab.)
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HORIGUCHI	17	PRL 119 191802	T. Horiguchi <i>et al.</i>	(BELLE Collab.)
LEES	17B	PR D95 072001	J.P. Lees <i>et al.</i>	(BABAR Collab.)
AAIJ	16B	JHEP 1602 104	R. Aaij <i>et al.</i>	(LHCb Collab.)
BHARDWAJ	16	PR D93 052016	V. Bhardwaj <i>et al.</i>	(BELLE Collab.)
KHACHATRYAN...	16D	PL B753 424	V. Khachatryan <i>et al.</i>	(CMS Collab.)
LEES	16	PRL 116 041801	J.P. Lees <i>et al.</i>	(BABAR Collab.)
LEES	16C	PR D93 052015	J.P. Lees <i>et al.</i>	(BABAR Collab.)
SATO	16	PR D93 032008	Y. Sato <i>et al.</i>	(BELLE Collab.)
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HUSCHLE	15	PR D92 072014	M. Huschle <i>et al.</i>	(BELLE Collab.)
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SAITO	15	PR D91 052004	T. Saito <i>et al.</i>	(BELLE Collab.)
AAIJ	14AF	PRL 113 141801	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	14M	JHEP 1406 133	R. Aaij <i>et al.</i>	(LHCb Collab.)
LEES	14D	PRL 112 211802	J.P. Lees <i>et al.</i>	(BABAR Collab.)
LEES	14K	PR D90 092001	J.P. Lees <i>et al.</i>	(BABAR Collab.)
AAIJ	13H	JHEP 1302 105	R. Aaij <i>et al.</i>	(LHCb Collab.)
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AAIJ	12AH	JHEP 1207 133	R. Aaij <i>et al.</i>	(LHCb Collab.)
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LEES	12S	PR D86 032012	J.P. Lees <i>et al.</i>	(BABAR Collab.)
LEES	12U	PR D86 052012	J.P. Lees <i>et al.</i>	(BABAR Collab.)
LEES	12V	PRL 109 191801	J.P. Lees	(BABAR Collab.)
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AALTONEN	11AI	PRL 107 201802	T. Aaltonen <i>et al.</i>	(CDF Collab.)
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AUBERT	10	PRL 104 011802	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	10A	PR D81 032003	B. Aubert <i>et al.</i>	(BABAR Collab.)
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AUBERT	07AG	PRL 99 051801	B. Aubert <i>et al.</i>	(BABAR Collab.)
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AUBERT	03F	PR D67 032002	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	03U	PRL 91 221802	B. Aubert <i>et al.</i>	(BABAR Collab.)
BONVICINI	03	PR D68 011101	G. Bonvicini <i>et al.</i>	(CLEO Collab.)
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EDWARDS	02B	PR D65 111102	K.W. Edwards <i>et al.</i>	(CLEO Collab.)
ABE	01F	PL B511 151	K. Abe <i>et al.</i>	(BELLE Collab.)
ABE	01J	PR D64 072001	K. Abe <i>et al.</i>	(BELLE Collab.)
ANDERSON	01B	PRL 87 181803	S. Anderson <i>et al.</i>	(CLEO Collab.)
CHEN	01	PR D63 031102	S. Chen <i>et al.</i>	(CLEO Collab.)
CHEN	01C	PRL 87 251807	S. Chen <i>et al.</i>	(CLEO Collab.)
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ALBRECHT	92E	PL B277 209	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
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BORTOLETTO	92	PR D45 21	D. Bortoletto <i>et al.</i>	(CLEO Collab.)
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ALBRECHT	91C	PL B255 297	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
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MASCHMANN	90	ZPHY C46 555	W.S. Maschmann <i>et al.</i>	(Crystal Ball Collab.)
PDG	90	PL B239 1	J.J. Hernandez <i>et al.</i>	(IFIC, BOST, CIT+)
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WACHS	89	ZPHY C42 33	K. Wachs <i>et al.</i>	(Crystal Ball Collab.)
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ALBRECHT	88H	PL B210 258	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
KOERNER	88	ZPHY C38 511	J.G. Korner, G.A. Schuler	(MANZ, DESY)
ALAM	87	PRL 59 22	M.S. Alam <i>et al.</i>	(CLEO Collab.)

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ALBRECHT	87D	PL B199 451	H. Albrecht <i>et al.</i>	(ARGUS Collab.)
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CSORNA	85	PRL 54 1894	S.E. Csorna <i>et al.</i>	(CLEO Collab.)
HAAS	85	PRL 55 1248	J. Haas <i>et al.</i>	(CLEO Collab.)
AVERY	84	PRL 53 1309	P. Avery <i>et al.</i>	(CLEO Collab.)
CHEN	84	PRL 52 1084	A. Chen <i>et al.</i>	(CLEO Collab.)
LEVMAN	84	PL 141B 271	G.M. Levman <i>et al.</i>	(CUSB Collab.)
ALAM	83B	PRL 51 1143	M.S. Alam <i>et al.</i>	(CLEO Collab.)
GREEN	83	PRL 51 347	J. Green <i>et al.</i>	(CLEO Collab.)
KLOPFEN...	83B	PL 130B 444	C. Klopfenstein <i>et al.</i>	(CUSB Collab.)
ALTARELLI	82	NP B208 365	G. Altarelli <i>et al.</i>	(ROMA, INFN, FRAS)
BRODY	82	PRL 48 1070	A.D. Brody <i>et al.</i>	(CLEO Collab.)
GIANNINI	82	NP B206 1	G. Giannini <i>et al.</i>	(CUSB Collab.)
BEBEK	81	PRL 46 84	C. Bebek <i>et al.</i>	(CLEO Collab.)
CHADWICK	81	PRL 46 88	K. Chadwick <i>et al.</i>	(CLEO Collab.)
ABRAMS	80	PRL 44 10	G.S. Abrams <i>et al.</i>	(SLAC, LBL)

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