

B^\pm/B^0 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 (Γ_j/Γ) | Scale factor/ Confidence level |
|--|--|-----------------------------------|
| Semileptonic and leptonic modes | | |
| Γ_1 | $e^+ \nu_e$ anything [a] | |
| Γ_2 | $\mu^+ \nu_\mu$ anything [a] | |
| Γ_3 | $\ell^+ \nu_\ell$ anything [a,b] (10.86 \pm 0.16) % | |
| Γ_4 | $D^- \ell^+ \nu_\ell$ anything [b] (2.6 \pm 0.5) % | |
| Γ_5 | $\bar{D}^0 \ell^+ \nu_\ell$ anything [b] (7.3 \pm 1.5) % | |
| Γ_6 | $\bar{D} \ell^+ \nu_\ell$ (2.42 \pm 0.12) % | |
| Γ_7 | $D^{*-} \ell^+ \nu_\ell$ anything [c] (6.7 \pm 1.3) $\times 10^{-3}$ | |
| Γ_8 | $D^{*0} \ell^+ \nu_\ell$ anything | |
| Γ_9 | $\bar{D}^* \ell^+ \nu_\ell$ [d] (4.95 \pm 0.11) % | |
| Γ_{10} | $\bar{D}^{**} \ell^+ \nu_\ell$ [b,e] (2.7 \pm 0.7) % | |
| Γ_{11} | $\bar{D}_1(2420) \ell^+ \nu_\ell$ anything (3.8 \pm 1.3) $\times 10^{-3}$ | S=2.4 |
| Γ_{12} | $\bar{D} \pi \ell^+ \nu_\ell$ anything + $\bar{D}^* \pi \ell^+ \nu_\ell$ anything (2.6 \pm 0.5) % | S=1.5 |
| Γ_{13} | $\bar{D} \pi \ell^+ \nu_\ell$ anything (1.5 \pm 0.6) % | |
| Γ_{14} | $\bar{D}^* \pi \ell^+ \nu_\ell$ anything (1.9 \pm 0.4) % | |
| Γ_{15} | $\bar{D}_2^*(2460) \ell^+ \nu_\ell$ anything (4.4 \pm 1.6) $\times 10^{-3}$ | |
| Γ_{16} | $D^{*-} \pi^+ \ell^+ \nu_\ell$ anything (1.00 \pm 0.34) % | |
| Γ_{17} | $\bar{D} \pi^+ \pi^- \ell^+ \nu_\ell$ (1.62 \pm 0.32) $\times 10^{-3}$ | |

| | | | | | |
|---------------|--|-------|------------------|--------------------|--------|
| Γ_{18} | $\bar{D}^* \pi^+ \pi^- \ell^+ \nu_\ell$ | (| 9.4 ± 3.2 |) $\times 10^{-4}$ | |
| Γ_{19} | $D_s^- \ell^+ \nu_\ell$ anything | [b] < | 7 | $\times 10^{-3}$ | CL=90% |
| Γ_{20} | $D_s^- \ell^+ \nu_\ell K^+$ anything | [b] < | 5 | $\times 10^{-3}$ | CL=90% |
| Γ_{21} | $D_s^- \ell^+ \nu_\ell K^0$ anything | [b] < | 7 | $\times 10^{-3}$ | CL=90% |
| Γ_{22} | $X_c \ell^+ \nu_\ell$ | (| 10.65 ± 0.16 |) % | |
| Γ_{23} | $X_u \ell^+ \nu_\ell$ | (| 2.13 ± 0.30 |) $\times 10^{-3}$ | |
| Γ_{24} | $K^+ \ell^+ \nu_\ell$ anything | [b] (| 6.3 ± 0.6 |) % | |
| Γ_{25} | $K^- \ell^+ \nu_\ell$ anything | [b] (| 10 ± 4 |) $\times 10^{-3}$ | |
| Γ_{26} | $K^0 / \bar{K}^0 \ell^+ \nu_\ell$ anything | [b] (| 4.6 ± 0.5 |) % | |
| Γ_{27} | $\bar{D} \tau^+ \nu_\tau$ | (| 8.2 ± 0.8 |) $\times 10^{-3}$ | |
| Γ_{28} | $\bar{D}^* \tau^+ \nu_\tau$ | (| 1.46 ± 0.08 |) % | |

D, D*, or D_s modes

| | | | | | |
|---------------|---|---------|--------------------------|------------------|--------|
| Γ_{29} | D^\pm anything | (| 23.1 ± 1.2 |) % | |
| Γ_{30} | D^0 / \bar{D}^0 anything | (| 61.6 ± 2.9 |) % | S=1.3 |
| Γ_{31} | $D^*(2010)^\pm$ anything | (| 22.5 ± 1.5 |) % | |
| Γ_{32} | $\bar{D}^*(2007)^0$ anything | (| 26.0 ± 2.7 |) % | |
| Γ_{33} | D_s^\pm anything | [f] (| 8.3 ± 0.8 |) % | |
| Γ_{34} | $D_s^{*\pm}$ anything | (| 6.3 ± 1.0 |) % | |
| Γ_{35} | $D_s^{*\pm} \bar{D}^*$ | (| 3.4 ± 0.6 |) % | |
| Γ_{36} | $\bar{D} D_{s0}(2317)$ | seen | | | |
| Γ_{37} | $\bar{D} D_{sJ}(2457)$ | seen | | | |
| Γ_{38} | $D^{(*)} \bar{D}^{(*)} K^0 + D^{(*)} \bar{D}^{(*)} K^\pm$ [f,g] | (| 7.1 ± 2.7 $- 1.7$ |) % | |
| Γ_{39} | $b \rightarrow c \bar{c} s$ | (| 22 ± 4 |) % | |
| Γ_{40} | $D_s^{(*)} \bar{D}^{(*)}$ | [f,g] (| 3.9 ± 0.4 |) % | |
| Γ_{41} | $D^* D^*(2010)^\pm$ | [f] < | 5.9 | $\times 10^{-3}$ | CL=90% |
| Γ_{42} | $D D^*(2010)^\pm + D^* D^\pm$ | [f] < | 5.5 | $\times 10^{-3}$ | CL=90% |
| Γ_{43} | $D D^\pm$ | [f] < | 3.1 | $\times 10^{-3}$ | CL=90% |
| Γ_{44} | $D_s^{(*)\pm} \bar{D}^{(*)} X(n\pi^\pm)$ | [f,g] (| 9 ± 5 $- 4$ |) % | |
| Γ_{45} | $\bar{D}^*(2010)\gamma$ | < | 1.1 | $\times 10^{-3}$ | CL=90% |
| Γ_{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% |
| Γ_{47} | $D_{s1}(2536)^+$ anything | < | 9.5 | $\times 10^{-3}$ | CL=90% |

Charmonium modes

| | | | | | |
|---------------|-----------------------------------|---|-------------------|--------------------|-------|
| Γ_{48} | $J/\psi(1S)$ anything | (| 1.094 ± 0.032 |) % | S=1.1 |
| Γ_{49} | $J/\psi(1S)$ (direct) anything | (| 7.8 ± 0.4 |) $\times 10^{-3}$ | S=1.1 |
| Γ_{50} | $\psi(2S)$ anything | (| 3.07 ± 0.21 |) $\times 10^{-3}$ | |
| Γ_{51} | $\chi_{c1}(1P)$ anything | (| 3.55 ± 0.27 |) $\times 10^{-3}$ | S=1.3 |
| Γ_{52} | $\chi_{c1}(1P)$ (direct) anything | (| 3.08 ± 0.19 |) $\times 10^{-3}$ | |

| | | | | | |
|---------------|--|-------|----------------|--------------------|--------|
| Γ_{53} | $\chi_{c2}(1P)$ anything | (| 10.0 ± 1.7 |) $\times 10^{-4}$ | S=1.6 |
| Γ_{54} | $\chi_{c2}(1P)$ (direct) anything | (| 7.5 ± 1.1 |) $\times 10^{-4}$ | |
| Γ_{55} | $\eta_c(1S)$ anything | < | 9 | $\times 10^{-3}$ | CL=90% |
| Γ_{56} | $K\chi_{c1}(3872)$ | (| 2.3 ± 0.7 |) $\times 10^{-4}$ | |
| Γ_{57} | $KX(3940)$, $X \rightarrow D^{*0}D^0$ | < | 6.7 | $\times 10^{-5}$ | CL=90% |
| Γ_{58} | $KX(3915)$, $X \rightarrow \omega J/\psi$ | [h] (| 7.1 ± 3.4 |) $\times 10^{-5}$ | |

K or K* modes

| | | | | | |
|---------------|--|-------|--------------------------|--------------------|--------|
| Γ_{59} | K^\pm anything | [f] (| 78.9 ± 2.5 |) % | |
| Γ_{60} | K^+ anything | (| 66 ± 5 |) % | |
| Γ_{61} | K^- anything | (| 13 ± 4 |) % | |
| Γ_{62} | K^0/\bar{K}^0 anything | [f] (| 64 ± 4 |) % | |
| Γ_{63} | $K^*(892)^\pm$ anything | (| 18 ± 6 |) % | |
| Γ_{64} | $K^*(892)^0/\bar{K}^*(892)^0$ anything | [f] (| 14.6 ± 2.6 |) % | |
| Γ_{65} | $K^*(892)\gamma$ | (| 4.2 ± 0.6 |) $\times 10^{-5}$ | |
| Γ_{66} | $\eta K\gamma$ | (| 8.5 ± 1.8 $- 1.6$ |) $\times 10^{-6}$ | |
| Γ_{67} | $K_1(1400)\gamma$ | < | 1.27 | $\times 10^{-4}$ | CL=90% |
| Γ_{68} | $K_2^*(1430)\gamma$ | (| 1.7 ± 0.6 $- 0.5$ |) $\times 10^{-5}$ | |
| Γ_{69} | $K_2(1770)\gamma$ | < | 1.2 | $\times 10^{-3}$ | CL=90% |
| Γ_{70} | $K_3^*(1780)\gamma$ | < | 3.7 | $\times 10^{-5}$ | CL=90% |
| Γ_{71} | $K_4^*(2045)\gamma$ | < | 1.0 | $\times 10^{-3}$ | CL=90% |
| Γ_{72} | $K\eta'(958)$ | (| 8.3 ± 1.1 |) $\times 10^{-5}$ | |
| Γ_{73} | $K^*(892)\eta'(958)$ | (| 4.1 ± 1.1 |) $\times 10^{-6}$ | |
| Γ_{74} | $K\eta$ | < | 5.2 | $\times 10^{-6}$ | CL=90% |
| Γ_{75} | $K^*(892)\eta$ | (| 1.8 ± 0.5 |) $\times 10^{-5}$ | |
| Γ_{76} | $K\phi\phi$ | (| 2.3 ± 0.9 |) $\times 10^{-6}$ | |
| Γ_{77} | $\bar{b} \rightarrow \bar{s}\gamma$ | (| 3.49 ± 0.19 |) $\times 10^{-4}$ | |
| Γ_{78} | $\bar{b} \rightarrow \bar{d}\gamma$ | (| 9.2 ± 3.0 |) $\times 10^{-6}$ | |
| Γ_{79} | $\bar{b} \rightarrow \bar{s}$ gluon | < | 6.8 | % | CL=90% |
| Γ_{80} | η anything | (| 2.6 ± 0.5 $- 0.8$ |) $\times 10^{-4}$ | |
| Γ_{81} | η' anything | (| 4.2 ± 0.9 |) $\times 10^{-4}$ | |
| Γ_{82} | K^+ gluon (charmless) | < | 1.87 | $\times 10^{-4}$ | CL=90% |
| Γ_{83} | K^0 gluon (charmless) | (| 1.9 ± 0.7 |) $\times 10^{-4}$ | |

Light unflavored meson modes

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|---------------|---------------------|---------|-----------------|--------------------|--------|
| Γ_{84} | $\rho\gamma$ | (| 1.39 ± 0.25 |) $\times 10^{-6}$ | S=1.2 |
| Γ_{85} | $\rho/\omega\gamma$ | (| 1.30 ± 0.23 |) $\times 10^{-6}$ | S=1.2 |
| Γ_{86} | π^\pm anything | [f,i] (| 358 ± 7 |) % | |
| Γ_{87} | π^0 anything | (| 235 ± 11 |) % | |
| Γ_{88} | η anything | (| 17.6 ± 1.6 |) % | |
| Γ_{89} | ρ^0 anything | (| 21 ± 5 |) % | |
| Γ_{90} | ω anything | < | 81 | % | CL=90% |
| Γ_{91} | ϕ anything | (| 3.43 ± 0.12 |) % | |

| | | | | | |
|---------------|-------------------------------------|---|---------------|--------------------|--------|
| Γ_{92} | $\phi K^*(892)$ | < | 2.2 | $\times 10^{-5}$ | CL=90% |
| Γ_{93} | $\bar{b} \rightarrow \bar{d}$ gluon | | | | |
| Γ_{94} | π^+ gluon (charmless) | (| 3.7 ± 0.8 |) $\times 10^{-4}$ | |

Baryon modes

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|----------------|---|-----|--------------------------|--------------------|--------------------|
| Γ_{95} | $\Lambda_c^+ / \bar{\Lambda}_c^-$ anything | (| 3.6 ± 0.4 |) % | |
| Γ_{96} | Λ_c^+ anything | < | 1.3 | % | CL=90% |
| Γ_{97} | $\bar{\Lambda}_c^-$ anything | < | 7 | % | CL=90% |
| Γ_{98} | $\bar{\Lambda}_c^- \ell^+$ anything | < | 9 | $\times 10^{-4}$ | CL=90% |
| Γ_{99} | $\bar{\Lambda}_c^- e^+$ anything | < | 1.8 | $\times 10^{-3}$ | CL=90% |
| Γ_{100} | $\bar{\Lambda}_c^- \mu^+$ anything | < | 1.4 | $\times 10^{-3}$ | CL=90% |
| Γ_{101} | $\bar{\Lambda}_c^- p$ anything | (| 2.04 ± 0.33 |) % | |
| Γ_{102} | $\bar{\Lambda}_c^- p e^+ \nu_e$ | < | 8 | $\times 10^{-4}$ | CL=90% |
| Γ_{103} | $\bar{\Sigma}_c^-$ anything | (| 3.3 ± 1.7 |) $\times 10^{-3}$ | |
| Γ_{104} | $\bar{\Sigma}_c^-$ anything | < | 8 | $\times 10^{-3}$ | CL=90% |
| Γ_{105} | $\bar{\Sigma}_c^0$ anything | (| 3.7 ± 1.7 |) $\times 10^{-3}$ | |
| Γ_{106} | $\bar{\Sigma}_c^0 N (N = p \text{ or } n)$ | < | 1.2 | $\times 10^{-3}$ | CL=90% |
| Γ_{107} | Ξ_c^0 anything, $\Xi_c^0 \rightarrow \Xi^- \pi^+$ | (| 1.93 ± 0.30 |) $\times 10^{-4}$ | S=1.1 |
| Γ_{108} | $\Xi_c^+, \Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+$ | (| 4.5 ± 1.3 $- 1.2$ |) $\times 10^{-4}$ | |
| Γ_{109} | p/\bar{p} anything | [f] | (| 8.0 ± 0.4 |) % |
| Γ_{110} | p/\bar{p} (direct) anything | [f] | (| 5.5 ± 0.5 |) % |
| Γ_{111} | $\bar{p} e^+ \nu_e$ anything | < | 5.9 | $\times 10^{-4}$ | CL=90% |
| Γ_{112} | $\Lambda/\bar{\Lambda}$ anything | [f] | (| 4.0 ± 0.5 |) % |
| Γ_{113} | Λ anything | | seen | | |
| Γ_{114} | $\bar{\Lambda}$ anything | | seen | | |
| Γ_{115} | $\Xi^- / \bar{\Xi}^+$ anything | [f] | (| 2.7 ± 0.6 |) $\times 10^{-3}$ |
| Γ_{116} | baryons anything | (| 6.8 ± 0.6 |) % | |
| Γ_{117} | $p\bar{p}$ anything | (| 2.47 ± 0.23 |) % | |
| Γ_{118} | $\Lambda\bar{p}/\bar{\Lambda}p$ anything | [f] | (| 2.5 ± 0.4 |) % |
| Γ_{119} | $\Lambda\bar{\Lambda}$ anything | < | 5 | $\times 10^{-3}$ | CL=90% |

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

| | | | | | | | |
|----------------|------------------------|----|-----|-----------------|--------------------|--------------------|-------|
| Γ_{120} | $s e^+ e^-$ | B1 | (| 6.7 ± 1.7 |) $\times 10^{-6}$ | S=2.0 | |
| Γ_{121} | $s \mu^+ \mu^-$ | B1 | (| 4.3 ± 1.0 |) $\times 10^{-6}$ | | |
| Γ_{122} | $s \ell^+ \ell^-$ | B1 | [b] | (| 5.8 ± 1.3 |) $\times 10^{-6}$ | S=1.8 |
| Γ_{123} | $\pi \ell^+ \ell^-$ | B1 | < | 5.9 | $\times 10^{-8}$ | CL=90% | |
| Γ_{124} | $\pi e^+ e^-$ | B1 | < | 1.10 | $\times 10^{-7}$ | CL=90% | |
| Γ_{125} | $\pi \mu^+ \mu^-$ | B1 | < | 5.0 | $\times 10^{-8}$ | CL=90% | |
| Γ_{126} | $K e^+ e^-$ | B1 | (| 4.4 ± 0.6 |) $\times 10^{-7}$ | | |
| Γ_{127} | $K^*(892) e^+ e^-$ | B1 | (| 1.19 ± 0.20 |) $\times 10^{-6}$ | S=1.2 | |
| Γ_{128} | $K \mu^+ \mu^-$ | B1 | (| 4.4 ± 0.4 |) $\times 10^{-7}$ | | |
| Γ_{129} | $K^*(892) \mu^+ \mu^-$ | B1 | (| 1.06 ± 0.09 |) $\times 10^{-6}$ | | |

| | | | | | | |
|----------------|--------------------------|------|-------|-----------------|--------------------|--------|
| Γ_{130} | $K \ell^+ \ell^-$ | $B1$ | (| 4.8 ± 0.4 |) $\times 10^{-7}$ | |
| Γ_{131} | $K^*(892) \ell^+ \ell^-$ | $B1$ | (| 1.05 ± 0.10 |) $\times 10^{-6}$ | |
| Γ_{132} | $K \nu \bar{\nu}$ | $B1$ | < | 1.6 | $\times 10^{-5}$ | CL=90% |
| Γ_{133} | $K^* \nu \bar{\nu}$ | $B1$ | < | 2.7 | $\times 10^{-5}$ | CL=90% |
| Γ_{134} | $\pi \nu \bar{\nu}$ | $B1$ | < | 8 | $\times 10^{-6}$ | CL=90% |
| Γ_{135} | $\rho \nu \bar{\nu}$ | $B1$ | < | 2.8 | $\times 10^{-5}$ | CL=90% |
| Γ_{136} | $s e^\pm \mu^\mp$ | LF | [f] < | 2.2 | $\times 10^{-5}$ | CL=90% |
| Γ_{137} | $\pi e^\pm \mu^\mp$ | LF | < | 9.2 | $\times 10^{-8}$ | CL=90% |
| Γ_{138} | $\rho e^\pm \mu^\mp$ | LF | < | 3.2 | $\times 10^{-6}$ | CL=90% |
| Γ_{139} | $K e^\pm \mu^\mp$ | LF | < | 3.8 | $\times 10^{-8}$ | CL=90% |
| Γ_{140} | $K^*(892) e^\pm \mu^\mp$ | LF | < | 5.1 | $\times 10^{-7}$ | CL=90% |

[a] These values are model dependent.

[b] An ℓ indicates an e or a μ 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

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

Γ_3/Γ

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 <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account correlations between the measurements.

| VALUE (%) | DOCUMENT ID | TECN | COMMENT |
|---|---|------|---|
| 10.86 ± 0.16 OUR EVALUATION | | | |
| 10.49 ± 0.20 OUR AVERAGE | Error includes scale factor of 1.3. See the ideogram below. | | |
| $10.34 \pm 0.04 \pm 0.26$ | ¹ LEES | 17B | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $10.28 \pm 0.18 \pm 0.24$ | ² URQUIJO | 07 | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $10.91 \pm 0.09 \pm 0.24$ | ³ MAHMOOD | 04 | CLEO $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $9.7 \pm 0.5 \pm 0.4$ | ⁴ ALBRECHT | 93H | ARG $e^+ e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $9.96 \pm 0.19 \pm 0.32$ | ⁵ AUBERT,B | 06Y | BABR Repl. by LEES 17B |

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

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

² 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.

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

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

⁵ 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: $B(B^+ \rightarrow e^+\nu_e X) / B(B^0 \rightarrow e^+\nu_e X) = 1.074 \pm 0.041 \pm 0.026$.

⁶ 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 $B(B^+ \rightarrow e^+\nu_e X) / B(B^0 \rightarrow e^+\nu_e X) = 1.08 \pm 0.05 \pm 0.02$.

⁷ 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.

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

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

¹⁰ 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.

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

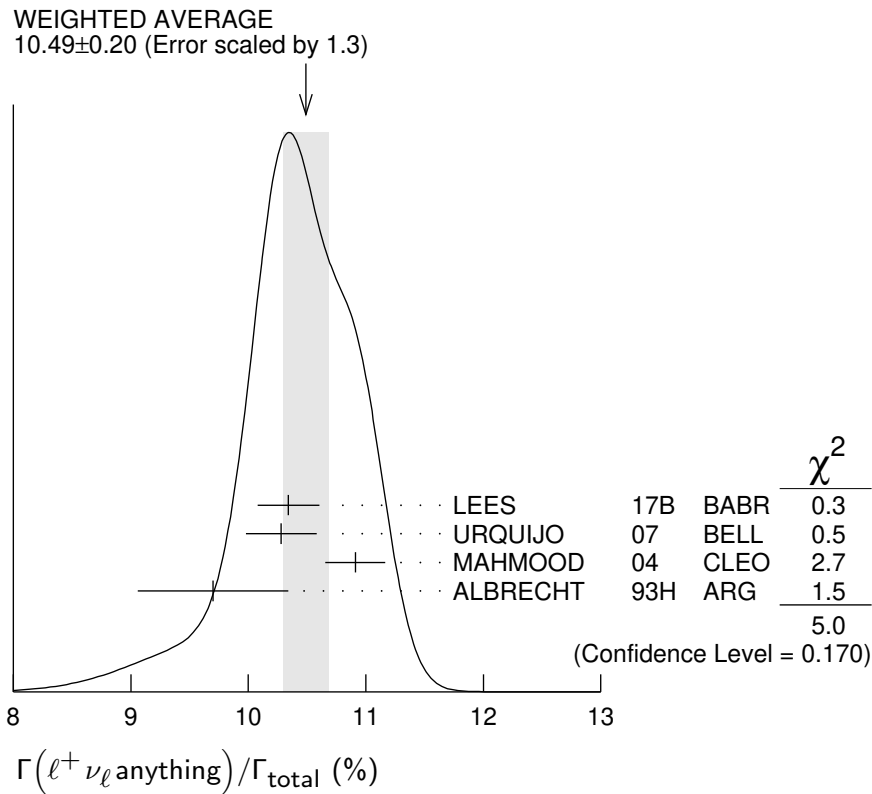
¹² HENDERSON 92 measurement employs e and μ . The systematic error contains 0.004 in quadrature from model dependence. The authors average a variation of the Isgur, Scora, Grinstein, and Wise model with that of the Altarelli-Cabibbo-Corbò-Maiani-Martinelli model for semileptonic decays to correct the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

¹³ 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 ± 0.006 is obtained using ISGUR 89B.

¹⁵ ALBRECHT 90H uses the model of ALTARELLI 82 to correct over all lepton momenta. 0.097 ± 0.006 is obtained using ISGUR 89B.

- ¹⁶ Using data above $p(e) = 2.4$ GeV, WACHS 89 determine $\sigma(B \rightarrow e\nu\text{up})/\sigma(B \rightarrow e\nu\text{charm}) < 0.065$ at 90% CL.
¹⁷ Ratio $\sigma(b \rightarrow e\nu\text{up})/\sigma(b \rightarrow e\nu\text{charm}) < 0.055$ at CL = 90%.



$\Gamma(D^- \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_4 / Γ_3
 $\ell = e \text{ or } \mu.$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|---------------------|------|--------------------------------------|
| $0.26 \pm 0.07 \pm 0.04$ | ¹ FULTON | 91 | CLEO $e^+e^- \rightarrow \gamma(4S)$ |

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

$\Gamma(\bar{D}^0 \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_5 / Γ_3
 $\ell = e \text{ or } \mu.$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|---------------------|------|--------------------------------------|
| $0.67 \pm 0.09 \pm 0.10$ | ¹ FULTON | 91 | CLEO $e^+e^- \rightarrow \gamma(4S)$ |

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

$\Gamma(\bar{D} \ell^+ \nu_\ell) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_6 / Γ_3

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---------------------|------|--------------------------------------|
| $0.223 \pm 0.006 \pm 0.009$ | ¹ AUBERT | 10 | BABR $e^+e^- \rightarrow \gamma(4S)$ |

¹ Uses a fully reconstructed B meson as a tag on the recoil side.

$\Gamma(D^{*-} \ell^+ \nu_\ell \text{ anything}) / \Gamma_{\text{total}}$ Γ_7 / Γ

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--|---------------------|------|--------------------------------------|
| $0.67 \pm 0.08 \pm 0.10$ | ABDALLAH | 04D | DLPH $e^+e^- \rightarrow Z^0$ |
| $0.6 \pm 0.3 \pm 0.1$ | ¹ BARISH | 95 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |

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

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

$\Gamma(D^{*0} \ell^+ \nu_\ell \text{ anything}) / \Gamma_{\text{total}}$ Γ_8 / Γ

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

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

| | | | |
|-----------------------|---------------------|----|---|
| $0.6 \pm 0.6 \pm 0.1$ | ¹ BARISH | 95 | CLE2 $e^+ e^- \rightarrow \Upsilon(4S)$ |
|-----------------------|---------------------|----|---|

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

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

\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 μ , not sum over e and μ modes.

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|-----|------|-------------|------|---------|
|-------|-----|------|-------------|------|---------|

| | | | | | |
|---|--|----|-----------------------|----|--|
| $0.027 \pm 0.005 \pm 0.005$ | | 63 | ¹ ALBRECHT | 93 | ARG $e^+ e^- \rightarrow \Upsilon(4S)$ |
|---|--|----|-----------------------|----|--|

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

| | | | | | |
|-----------|--|----|---------------------|----|---|
| < 0.028 | | 95 | ² BARISH | 95 | CLE2 $e^+ e^- \rightarrow \Upsilon(4S)$ |
|-----------|--|----|---------------------|----|---|

¹ 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 μ value.

² 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

0.0038 ± 0.0013 OUR AVERAGE Error includes scale factor of 2.4.

| | | | |
|---------------------|---------------------|-----|---------------------------|
| 0.0033 ± 0.0006 | ¹ ABAZOV | 05O | D0 $p\bar{p}$ at 1.96 TeV |
|---------------------|---------------------|-----|---------------------------|

| | | | |
|---------------------|-----------------------|-----|------------------------------|
| 0.0074 ± 0.0016 | ² BUSKULIC | 97B | ALEP $e^+ e^- \rightarrow Z$ |
|---------------------|-----------------------|-----|------------------------------|

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

| | | | |
|------|-----------------------|-----|-------------------------------|
| seen | ³ BUSKULIC | 95B | ALEP Repl. by BUSKULIC 97B |
|------|-----------------------|-----|-------------------------------|

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

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

³ 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

0.026 ± 0.005 OUR AVERAGE Error includes scale factor of 1.5.

| | | | |
|--------------------------------|--------------------|-----|------------------------------|
| $0.0340 \pm 0.0052 \pm 0.0032$ | ¹ ABREU | 00R | DLPH $e^+ e^- \rightarrow Z$ |
|--------------------------------|--------------------|-----|------------------------------|

| | | | |
|--------------------------------|-----------------------|-----|------------------------------|
| $0.0226 \pm 0.0029 \pm 0.0033$ | ² BUSKULIC | 97B | ALEP $e^+ e^- \rightarrow Z$ |
|--------------------------------|-----------------------|-----|------------------------------|

¹ 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 π^0 and π^+ rates.

² 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 Λ_b^0 .

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

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

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

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|----------------------|-----|---------------------|------|---------------------------|
| 0.0044±0.0016 | | ¹ 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 | ² BUSKULIC | 97B | ALEP $e^+e^- \rightarrow Z$ |
| not seen | | ³ BUSKULIC | 95B | ALEP $e^+e^- \rightarrow Z$ |

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

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

³ 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.

$\frac{\Gamma(B \rightarrow \bar{D}_2^*(2460)\ell^+\nu_\ell\text{anything}) \times B(D_2^*(2460) \rightarrow D^{*-}\pi^+)}{\Gamma(B \rightarrow \bar{D}_1(2420)\ell^+\nu_\ell\text{anything}) \times B(\bar{D}_1(2420) \rightarrow D^{*-}\pi^+)}$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-----------------------|-------------|------|---------------------------|
| 0.39±0.09±0.12 | ABAZOV | 05O | D0 $p\bar{p}$ at 1.96 TeV |

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

Includes resonant and nonresonant contributions.

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

¹ 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 $f_B = 0.37 \pm 0.03$.

$\Gamma(\bar{D}\pi^+\pi^-\ell^+\nu_\ell)/\Gamma(\bar{D}\ell^+\nu_\ell)$ Γ_{17}/Γ_6

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

¹ Measurement used electrons and muons as leptons.

$\Gamma(\bar{D}^*\pi^+\pi^-\ell^+\nu_\ell)/\Gamma(\bar{D}^*\ell^+\nu_\ell)$ Γ_{18}/Γ_9

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

¹ Measurement used electrons and muons as leptons.

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|-----|-----------------------|------|-------------------------------------|
| <7 × 10⁻³ | 90 | ¹ ALBRECHT | 93E | ARG $e^+e^- \rightarrow \gamma(4S)$ |

¹ 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 $B(D_s^+ \rightarrow \phi \pi^+) = 4.5 \times 10^{-2}$.

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|----------------------|-----|---------------------------|------|------------------------------------|
| $< 5 \times 10^{-3}$ | 90 | ¹ ALBRECHT 93E | ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $B(D_s^+ \rightarrow \phi \pi^+) = 4.5 \times 10^{-2}$.

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|----------------------|-----|---------------------------|------|------------------------------------|
| $< 7 \times 10^{-3}$ | 90 | ¹ ALBRECHT 93E | ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $B(D_s^+ \rightarrow \phi \pi^+) = 4.5 \times 10^{-2}$.

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

“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 <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account correlations between the measurements.

| VALUE (%) | DOCUMENT ID | TECN | COMMENT |
|-----------|-------------|------|---------|
|-----------|-------------|------|---------|

10.65 ± 0.16 OUR EVALUATION

10.29 ± 0.19 OUR AVERAGE

| | | | | |
|---------------------|----------------------|-----|------|------------------------------------|
| 10.18 ± 0.03 ± 0.24 | ¹ LEES | 17B | BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 10.44 ± 0.19 ± 0.22 | ² URQUIJO | 07 | BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | |
|---------------------|---------------------|-----|------|---------------------|
| 10.64 ± 0.17 ± 0.06 | ³ AUBERT | 10A | BABR | Repl. by LEES 17B |
| 10.61 ± 0.16 ± 0.06 | ⁴ AUBERT | 04X | BABR | Repl. by AUBERT 10A |

¹ The measurement is obtained from semileptonic decays to electrons $B \rightarrow X_c e \nu$, 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.

² Measured the independent B^+ and B^0 partial branching fractions with electron energy above 0.4 GeV.

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

⁴ 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.

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

“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 <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account correlations between the measurements.

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

¹ Obtained from the partial rate $\Delta B = (1.554 \pm 0.082 \pm 0.095) \times 10^{-3}$ 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).

² 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.

³ 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 GeV², and calculated acceptance 0.174 in that region. The V_{ub} is measured as $(4.41 \pm 0.30 \pm 0.65 \pm 0.28) \times 10^{-3}$.

⁴ 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 $(5.08 \pm 0.47 \pm 0.49 \pm 0.48) \times 10^{-3}$.

⁵ 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 $(4.08 \pm 0.34 \pm 0.53) \times 10^{-3}$.

⁶ Uses a multivariate analysis method and requires lepton momentum in the B rest frame, $p_\ell^{*B} > 1.0$ GeV/c.

⁷ Measures several partial branching fractions in different phase space regions. The most precise result is obtained in the region for hadronic mass $M_X < 1.55$ GeV/c², 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.

⁸ 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 GeV/c based on BLNP method.

⁹ 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.

¹⁰ The third error includes the systematics and theoretical errors summed in quadrature.

$\Gamma(X_u \ell^+ \nu_\ell) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_{23} / Γ_3 ℓ denotes e or μ , not the sum. These experiments measure this ratio in very limited momentum intervals.

| VALUE (units 10^{-2}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|------|-----------------------|----------|------------------------------------|
| $2.06 \pm 0.25 \pm 0.42$ | | | ¹ AUBERT | 04I BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | ² ALBRECHT | 94C ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| | | 107 | ³ BARTELT | 93B CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| | | 77 | ⁴ ALBRECHT | 91C ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| | | 41 | ⁵ ALBRECHT | 90 ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| | | 76 | ⁶ FULTON | 90 CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| <4.0 | 90 | | ⁷ BEHREND | 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 $\Upsilon(4S)$ |

¹ The third error includes the systematics and theoretical errors summed in quadrature.² ALBRECHT 94C find $\Gamma(b \rightarrow c) / \Gamma(b \rightarrow \text{all}) = 0.99 \pm 0.02 \pm 0.04$.³ BARTELT 93B (CLEO II) measures an excess of $107 \pm 15 \pm 11$ leptons in the lepton momentum interval 2.3–2.6 GeV/ c which is attributed to $b \rightarrow u \ell \nu_\ell$. This corresponds to a model-dependent partial branching ratio ΔB_{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 ± 0.006 and 0.076 ± 0.008 , respectively.⁴ 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 GeV momentum range.⁵ ALBRECHT 90 observes 41 ± 10 excess e and μ (lepton) events in the momentum interval $p = 2.3$ – 2.6 GeV signaling the presence of the $b \rightarrow u$ transition. The events correspond to a model-dependent measurement of $|V_{ub}/V_{cb}| = 0.10 \pm 0.01$.⁶ FULTON 90 observe 76 ± 20 excess e and μ (lepton) events in the momentum interval $p = 2.4$ – 2.6 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 $B(b \rightarrow c \ell \nu) = 10.2 \pm 0.2 \pm 0.7\%$.⁷ 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. $\Gamma(K^+ \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_{24} / Γ_3 ℓ denotes e or μ , not the sum.

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-----------------------|------|------------------------------------|
| 0.58 ± 0.05 OUR AVERAGE | | | |
| $0.594 \pm 0.021 \pm 0.056$ | ALBRECHT 94C | ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.54 \pm 0.07 \pm 0.06$ | ¹ ALAM 87B | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ ALAM 87B measurement relies on lepton-kaon correlations. $\Gamma(K^- \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_{25} / Γ_3 ℓ denotes e or μ , not the sum.

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-----------------------|------|------------------------------------|
| 0.092 ± 0.035 OUR AVERAGE | | | |
| $0.086 \pm 0.011 \pm 0.044$ | ALBRECHT 94C | ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.10 \pm 0.05 \pm 0.02$ | ¹ ALAM 87B | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ ALAM 87B measurement relies on lepton-kaon correlations.

$\Gamma(K^0/\bar{K}^0 \ell^+ \nu_\ell \text{ anything})/\Gamma(\ell^+ \nu_\ell \text{ anything})$ Γ_{26}/Γ_3

ℓ denotes e or μ , not the sum. Sum over K^0 and \bar{K}^0 states.

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

0.42 ± 0.05 OUR AVERAGE

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

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

² ALAM 87B measurement relies on lepton-kaon correlations.

$\Gamma(\bar{D}\tau^+ \nu_\tau)/\Gamma(\bar{D}\ell^+ \nu_\ell)$ Γ_{27}/Γ_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 <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account correlations between the measurements.

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

34.0 ± 3.0 OUR EVALUATION

35 ± 4 OUR AVERAGE Error includes scale factor of 1.2.

| | | | | |
|------------------|------------------------|-----|------|---------------------------------|
| 30.7 ± 3.7 ± 1.6 | ¹ CARIA | 20 | BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| 37.5 ± 6.4 ± 2.6 | ^{2,3} HUSCHLE | 15 | BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| 44.0 ± 5.8 ± 4.2 | ^{2,3} 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 | ² AUBERT | 08N | BABR | Repl. by LEES 12D |
|-------------------|---------------------|-----|------|-------------------|

¹ The tag-side B meson is reconstructed in a semileptonic decay mode and the signal-side τ is reconstructed in a purely leptonic decay. The Belle combination of HUSCHLE 15 and CARIA 20 yields $R(D) = (32.6 \pm 3.4) \times 10^{-2}$.

² Uses a fully reconstructed B meson as a tag on the recoil side.

³ Uses $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$ and $\tau^+ \rightarrow \mu^+ \nu_\mu \bar{\nu}_\tau$ and e^+ or μ^+ as ℓ^+ . Obtained from simultaneous fit to B^+ and B^0 assuming isospin symmetry.

$\Gamma(\bar{D}^* \tau^+ \nu_\tau)/\Gamma(\bar{D}^* \ell^+ \nu_\ell)$ Γ_{28}/Γ_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 <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account correlations between the measurements.

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

29.5 ± 1.4 OUR EVALUATION

29.6 ± 1.6 OUR AVERAGE

| | | | | |
|--|----------------------|-----|------|---------------------------------|
| 28.3 ± 1.8 ± 1.4 | ¹ CARIA | 20 | BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| 27.0 ± 3.5 ^{+2.8} _{-2.5} | ² HIROSE | 17 | BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| 29.3 ± 3.8 ± 1.5 | ³ HUSCHLE | 15 | BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| 33.2 ± 2.4 ± 1.8 | ³ LEES | 12D | BABR | $e^+e^- \rightarrow \gamma(4S)$ |

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

| | | | | |
|------------------|---------------------|-----|------|-------------------|
| 29.7 ± 5.6 ± 1.8 | ⁴ AUBERT | 08N | BABR | Repl. by LEES 12D |
|------------------|---------------------|-----|------|-------------------|

¹ The tag-side B meson is reconstructed in a semileptonic decay mode and the signal-side τ is reconstructed in a purely leptonic decay. The Belle combination of HUSCHLE 15, HIROSE 17, and CARIA 20 yields $R(D^*) = 0.238 \pm 0.018$.

² Uses a fully reconstructed B meson as a tag on the recoil side.

³ Uses $\tau^+ \rightarrow e^+ \nu_e \bar{\nu}_\tau$ and $\tau^+ \rightarrow \mu^+ \nu_\mu \bar{\nu}_\tau$ and e^+ or μ^+ as ℓ^+ . 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.

⁴ 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 |
|--|----------------------|----------|------------------------------------|
| 1.10 ± 0.05 | ¹ GIBBONS | 97B CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| 0.98 ± 0.16 ± 0.12 | ² ALAM | 87B CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ¹ GIBBONS 97B from charm counting using $B(D_s^+ \rightarrow \phi\pi) = 0.036 \pm 0.009$ and $B(\Lambda_c^+ \rightarrow pK^- \pi^+) = 0.044 \pm 0.006$. | | | |
| ² 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. | | | |

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

Γ_{29}/Γ

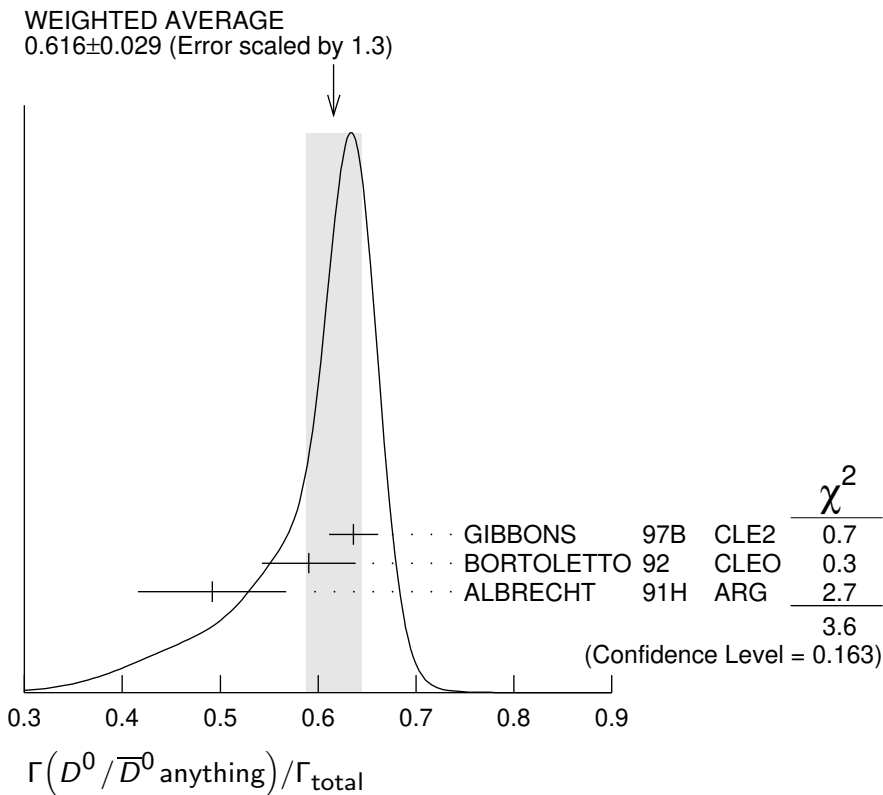
| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|--|------|---------------------------|----------|------------------------------------|
| 0.231 ± 0.012 OUR AVERAGE | | | | |
| 0.230 ± 0.012 ± 0.004 | | ¹ GIBBONS | 97B CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 0.241 ± 0.037 ± 0.004 | | ² BORTOLETTO92 | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 0.223 ± 0.051 ± 0.004 | | ³ ALBRECHT | 91H ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 0.203 ± 0.048 ± 0.003 | 20k | ⁴ BORTOLETTO87 | CLEO | Sup. by BORTOLETTO 92 |
| ¹ 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. | | | | |
| ² 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. | | | | |
| ³ 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. | | | | |
| ⁴ 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. | | | | |

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

Γ_{30}/Γ

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|---|------|---|----------|------------------------------------|
| 0.616 ± 0.029 OUR AVERAGE | | Error includes scale factor of 1.3. See the ideogram below. | | |
| 0.636 ± 0.024 ± 0.005 | | ¹ GIBBONS | 97B CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 0.591 ± 0.047 ± 0.005 | | ² BORTOLETTO92 | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 0.492 ± 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 |

- 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 $B(D^0 \rightarrow K^- \pi^+) = (3.946 \pm 0.030) \times 10^{-2}$. 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 $B(D^0 \rightarrow K^- \pi^+) = (3.946 \pm 0.030) \times 10^{-2}$. 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 $B(D^0 \rightarrow K^- \pi^+) = (3.946 \pm 0.030) \times 10^{-2}$. 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 $B(D^0 \rightarrow K^- \pi^+) = (3.946 \pm 0.030) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.
- ⁵ 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 $B(D^0 \rightarrow K^- \pi^+) = (3.946 \pm 0.030) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.



| $\Gamma(D^- \ell^+ \nu_\ell \text{ anything})/\Gamma(\bar{D}^0 \ell^+ \nu_\ell \text{ anything})$ | Γ_4/Γ_5 |
|---|---|
| <u>VALUE</u> | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u> |
| 0.359±0.006±0.009 | ¹ AAIJ 19AD LHCB <i>pp</i> at 13 TeV |

¹ AAIJ 19AD uses $D^0 \rightarrow K^- \pi^+$ and $D^+ \rightarrow K^- \pi^+ \pi^+$ modes.

| $\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{31}/Γ |
|---|------|---------------------------|------|------------------------------------|----------------------|
| VALUE | EVS | DOCUMENT ID | TECN | COMMENT | |
| 0.225 ± 0.015 OUR AVERAGE | | | | | |
| 0.247 ± 0.019 ± 0.01 | | ¹ GIBBONS 97B | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ | |
| 0.205 ± 0.019 ± 0.007 | | ² ALBRECHT 96D | ARG | $e^+ e^- \rightarrow \Upsilon(4S)$ | |
| 0.230 ± 0.028 ± 0.009 | | ³ 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 | | ⁴ ALBRECHT 91H | ARG | Sup. by ALBRECHT 96D | |
| 0.22 ± 0.04 $\begin{smallmatrix} +0.07 \\ -0.04 \end{smallmatrix}$ | 5200 | ⁵ BORTOLETTO87 | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ | |
| 0.27 ± 0.06 $\begin{smallmatrix} +0.08 \\ -0.06 \end{smallmatrix}$ | 510 | ⁶ CSORNA 85 | CLEO | Repl. by BORTOLETTO 87 | |

¹ GIBBONS 97B reports $B(B \rightarrow D^*(2010)^\pm \text{ anything}) = 0.239 \pm 0.015 \pm 0.014 \pm 0.009$ 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.

² ALBRECHT 96D reports $B(B \rightarrow D^*(2010)^\pm \text{ anything}) = 0.196 \pm 0.019$ using CLEO measured $B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm) = 0.681 \pm 0.01 \pm 0.013$, $B(D^0 \rightarrow K^- \pi^+) = 0.0401 \pm 0.0014$, $B(D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-) = 0.081 \pm 0.005$. 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.

³ BORTOLETTO 92 reports $B(B \rightarrow D^*(2010)^\pm \text{ anything}) = 0.25 \pm 0.03 \pm 0.04$ using MARK II $B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm) = 0.57 \pm 0.06$ 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.

⁴ ALBRECHT 91H reports $0.348 \pm 0.060 \pm 0.035$ from a measurement of $[\Gamma(B \rightarrow D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}] \times [B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm)]$ assuming $B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm) = 0.55 \pm 0.04$, which we rescale to our best value $B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm) = (67.7 \pm 0.5) \times 10^{-2}$. 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 $B(D^0 \rightarrow K^- \pi^+) = 0.0371 \pm 0.0025$.

⁵ 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 $B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm) = 0.60 \begin{smallmatrix} +0.08 \\ -0.15 \end{smallmatrix}$. The product branching ratio for $B(B \rightarrow D^*(2010)^\pm) B(D^*(2010)^\pm \rightarrow D^0 \pi^\pm)$ is $0.13 \pm 0.02 \pm 0.012$. Superseded by BORTOLETTO 92.

⁶ $V-A$ 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 $B(D^{*+} \rightarrow D^0 \pi^+) = 0.6 \begin{smallmatrix} +0.08 \\ -0.15 \end{smallmatrix}$. The product branching fraction is $B(B \rightarrow D^{*+} X) \cdot B(D^{*+} \rightarrow \pi^+ D^0) \cdot B(D^0 \rightarrow K^- \pi^+) = (68 \pm 15 \pm 9) \times 10^{-4}$.

| $\Gamma(\bar{D}^*(2007)^0 \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{32}/Γ |
|--|--|--------------------------|------|------------------------------------|----------------------|
| VALUE | | DOCUMENT ID | TECN | COMMENT | |
| 0.260 ± 0.023 ± 0.015 | | | | | |
| | | ¹ GIBBONS 97B | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ | |

¹ GIBBONS 97B reports $B(B \rightarrow \bar{D}^*(2007)^0 \text{ anything}) = 0.247 \pm 0.012 \pm 0.018 \pm 0.018$ 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.

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

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

¹ 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.

² 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.

³ 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.

⁴ 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.

⁵ 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.

⁶ 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.

⁷ 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.

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------------|--------------------|-------------|-----------------------------------|
| 0.063±0.009±0.006 | 1 AUBERT 02G | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------|------|--------------------------------------|
| 0.533 ± 0.037 ± 0.037 | AUBERT | 02G | BABR $e^+e^- \rightarrow \gamma(4S)$ |

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

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

¹ 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 $(8.5^{+2.1}_{-1.9} \pm 2.6) \times 10^{-4}$.

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

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

¹ 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 $(17.8^{+4.5}_{-3.9} \pm 5.3) \times 10^{-4}$ and $(6.7^{+1.3}_{-1.2} \pm 2.0) \times 10^{-4}$, respectively.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|---------------------|------|-----------------------------|
| 0.071^{+0.025+0.010}_{-0.015-0.009} | ¹ BARATE | 98Q | ALEP $e^+e^- \rightarrow Z$ |

¹ The systematic error includes the uncertainties due to the charm branching ratios.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------|-------------------|------|--------------------------------------|
| 0.219 ± 0.037 | ¹ COAN | 98 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |

¹ COAN 98 uses D - ℓ correlation.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|---------------------|------|--------------------------------------|
| 0.469 ± 0.017 OUR AVERAGE | | | |
| 0.464 ± 0.013 ± 0.015 | AUBERT | 02G | BABR $e^+e^- \rightarrow \gamma(4S)$ |
| 0.56 ^{+0.21+0.09} _{-0.15-0.08} | ¹ BARATE | 98Q | ALEP $e^+e^- \rightarrow Z$ |
| 0.457 ± 0.019 ± 0.037 | GIBAUT | 96 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
| 0.58 ± 0.07 ± 0.09 | ALBRECHT | 92G | ARG $e^+e^- \rightarrow \gamma(4S)$ |
| 0.56 ± 0.10 | BORTOLETTO90 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |

¹ 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 $B(B \rightarrow D_s \text{ anything}) = 0.1 \pm 0.025$.

| $\Gamma(D^* D^*(2010)^\pm)/\Gamma_{\text{total}}$ | | | | | Γ_{41}/Γ |
|---|-----|-------------|------|---------|-------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $<5.9 \times 10^{-3}$ | 90 | BARATE | 98Q | ALEP | $e^+ e^- \rightarrow Z$ |

| $[\Gamma(D D^*(2010)^\pm) + \Gamma(D^* D^\pm)]/\Gamma_{\text{total}}$ | | | | | Γ_{42}/Γ |
|---|-----|-------------|------|---------|-------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $<5.5 \times 10^{-3}$ | 90 | BARATE | 98Q | ALEP | $e^+ e^- \rightarrow Z$ |

| $\Gamma(D D^\pm)/\Gamma_{\text{total}}$ | | | | | Γ_{43}/Γ |
|---|-----|-------------|------|---------|-------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $<3.1 \times 10^{-3}$ | 90 | BARATE | 98Q | ALEP | $e^+ e^- \rightarrow Z$ |

| $\Gamma(D_s^*(*)^\pm \bar{D}^*(*) \chi(n\pi^\pm))/\Gamma_{\text{total}}$ | | | | | Γ_{44}/Γ |
|--|-----|---------------------|------|---------|-------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $0.094^{+0.040+0.034}_{-0.031-0.024}$ | | ¹ BARATE | 98Q | ALEP | $e^+ e^- \rightarrow Z$ |

¹ The systematic error includes the uncertainties due to the charm branching ratios.

| $\Gamma(\bar{D}^*(2010)\gamma)/\Gamma_{\text{total}}$ | | | | | Γ_{45}/Γ |
|---|-----|---------------------|------|---------|----------------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $<1.1 \times 10^{-3}$ | 90 | ¹ LESIAK | 92 | CBAL | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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.

| $\Gamma(D_s^+ \pi^-, D_s^{*+} \pi^-, D_s^+ \rho^-, D_s^{*+} \rho^-, D_s^+ \pi^0, D_s^{*+} \pi^0, D_s^+ \eta, D_s^{*+} \eta, D_s^+ \rho^0, D_s^{*+} \rho^0, D_s^+ \omega, D_s^{*+} \omega)/\Gamma_{\text{total}}$ | | | | | Γ_{46}/Γ |
|--|-----|------------------------|------|---------|----------------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $<4 \times 10^{-4}$ | 90 | ¹ ALEXANDER | 93B | CLE2 | $e^+ e^- \rightarrow \gamma(4S)$ |

Sum over modes.
¹ 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%.

| $\Gamma(D_{s1}(2536)^+ \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{47}/Γ |
|---|-----|---------------------|------|---------|----------------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| <0.0095 | 90 | ¹ BISHAI | 98 | CLE2 | $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

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

| $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{48}/Γ |
|---|------|-------------------------------------|------|---------|----------------------------------|
| VALUE (units 10^{-2}) | EVTS | DOCUMENT ID | TECN | COMMENT | |
| 1.094 ± 0.032 OUR AVERAGE | | Error includes scale factor of 1.1. | | | |
| $1.057 \pm 0.012 \pm 0.040$ | | ¹ AUBERT | 03F | BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| $1.121 \pm 0.013 \pm 0.042$ | | ANDERSON | 02 | CLE2 | $e^+ e^- \rightarrow \gamma(4S)$ |

| | | | | |
|---|------|---------------------------|------|-----------------------------------|
| 1.29 ±0.45 ±0.01 | 27 | ² MASCHMANN 90 | CBAL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 1.24 ±0.27 ±0.01 | 120 | ³ ALBRECHT 87D | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 1.35 ±0.24 ±0.01 | 52 | ⁴ 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 | ⁵ BALEST 95B | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 1.4 ^{+0.6} _{-0.5} | 7 | ⁶ ALBRECHT 85H | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 1.1 ±0.21 ±0.23 | 46 | ⁷ HAAS 85 | CLEO | Repl. by ALAM 86 |

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

² 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.

³ 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/ψ not from $\psi(2S)$ to be 0.0081 ± 0.0023 .

⁴ 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.

⁵ 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^- .

⁶ 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.

⁷ Dimuon and dielectron events used.

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

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

¹ AUBERT 03F also reports the helicity of $J/\psi \rightarrow \ell^+\ell^-$ produced directly in B decay.

² Also reports the measurement of $J/\psi \rightarrow \ell^+\ell^-$ polarization produced directly from B decay.

³ 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) \times branching ratio.

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

| 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 | | ¹ 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 | ² BALEST | 95B CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
|--------------------------|-----|---------------------|----------|-----------------------------------|

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

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

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

| 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 | | ¹ 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 | | ² ABE | 02L BELL | Repl. by BHARDWAJ 16 |
| 3.30 ± 0.35 ± 0.09 | | ³ CHEN | 01 CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 4.0 ± 0.6 ± 0.4 | 112 | ⁴ BALEST | 95B CLE2 | Repl. by CHEN 01 |
| 10.5 ± 3.5 ± 2.5 | | ⁵ ALBRECHT | 92E ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

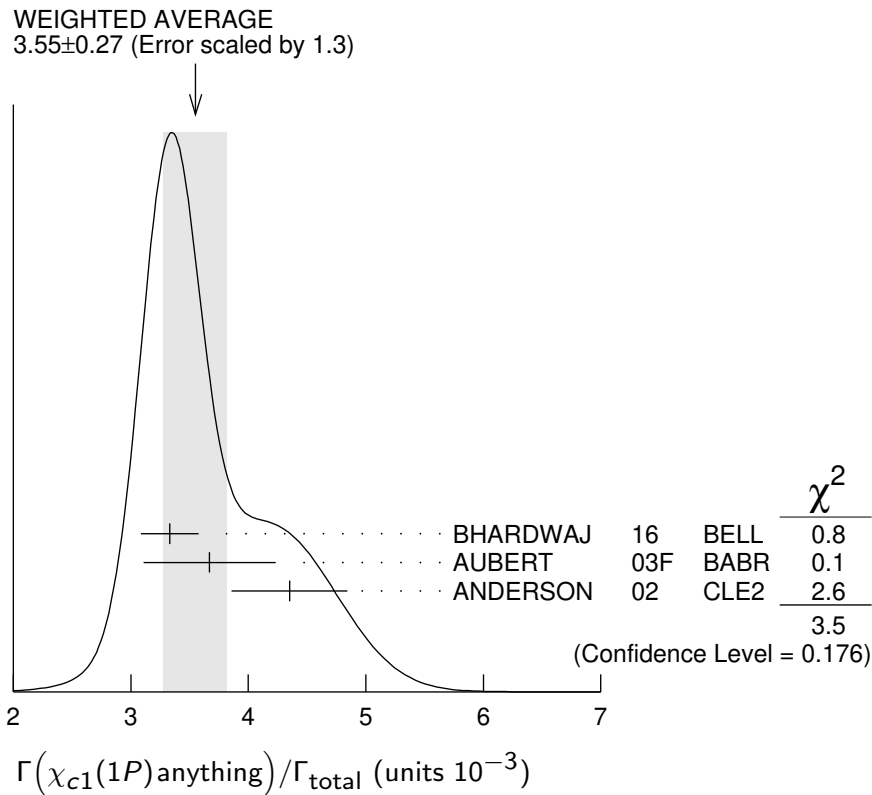
¹ Assumes equal production of B^+ and B^0 at the $\Upsilon(4S)$.

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

³ 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 $\Upsilon(4S)$.

⁴ 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 ψ -photon invariant mass distribution allows for a $\chi_{c1}(1P)$ and a $\chi_{c2}(1P)$ component.

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



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

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

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

² 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 $\Upsilon(4S)$.

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

⁴ 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.

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

Γ_{53}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|-----|--------------------------|------|---|
| 10.0±1.7 OUR AVERAGE | | | | Error includes scale factor of 1.6. See the ideogram below. |
| 9.8±0.6±1.0 | | ¹ 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 | | ² CHEN 01 | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

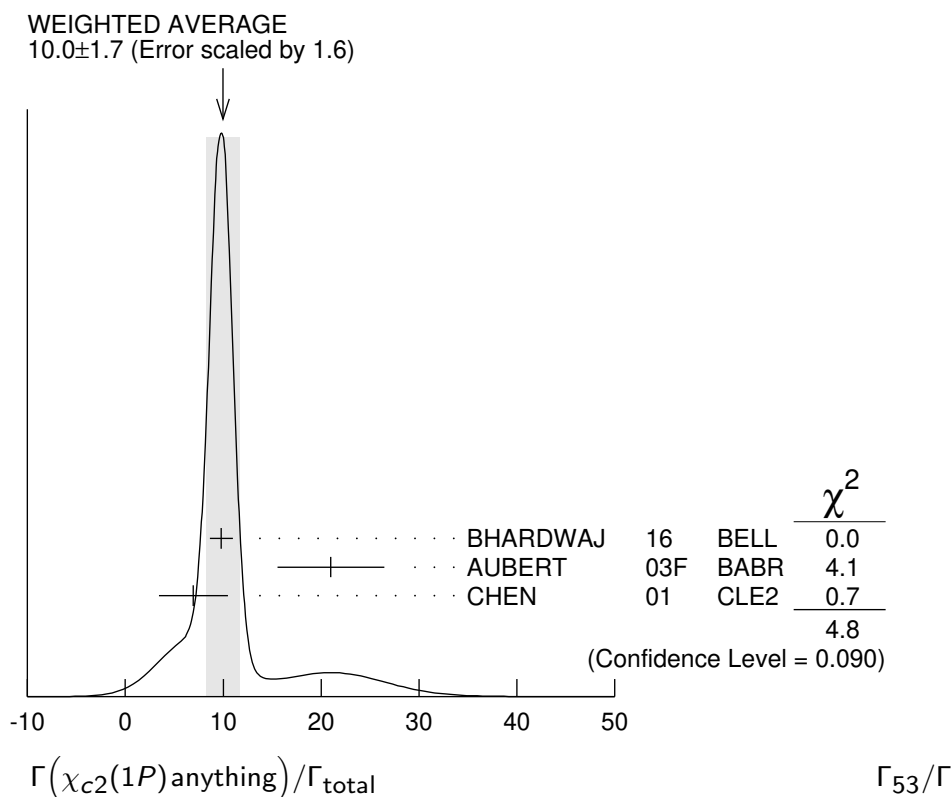
| | | | | |
|---|----|-------------------------|------|----------------------|
| 18.0 ^{+2.3} _{-2.8} ±2.6 | | ³ ABE 02L | BELL | Repl. by BHARDWAJ 16 |
| <38 | 90 | ⁴ BALEST 95B | CLE2 | Repl. by CHEN 01 |

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

² CHEN 01 reports $(9.8 \pm 4.8 \pm 1.5) \times 10^{-4}$ from a measurement of $[\Gamma(B \rightarrow \chi_{c2}(1P)\text{anything})/\Gamma_{\text{total}}] \times [B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))]$ 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 $\Upsilon(4S)$.

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

⁴ 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 ± 13 events correspond to $B(B \rightarrow \chi_{c2}(1P)X) = (0.25 \pm 0.10 \pm 0.03) \times 10^{-2}$.



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

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

0.75 ± 0.11 OUR AVERAGE

| | | | |
|--------------------|-----------------------|----|--|
| 0.70 ± 0.06 ± 0.10 | ¹ BHARDWAJ | 16 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
|--------------------|-----------------------|----|--|

| | | | |
|--------------------|--------|-----|--|
| 1.90 ± 0.45 ± 0.29 | AUBERT | 03F | BABR $e^+e^- \rightarrow \Upsilon(4S)$ |
|--------------------|--------|-----|--|

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

| | | | |
|---|------------------|-----|---------------------------|
| 1.53 ^{+0.23} _{-0.28} ± 0.27 | ² ABE | 02L | BELL Repl. by BHARDWAJ 16 |
|---|------------------|-----|---------------------------|

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

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

| | | | | |
|------------------|----|---------------------|-----|--|
| <0.009 | 90 | ¹ BALEST | 95B | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
|------------------|----|---------------------|-----|--|

¹ 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 .

$\Gamma(K\chi_{c1}(3872))/\Gamma_{\text{total}}$ Γ_{56}/Γ

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

2.3 ± 0.7 OUR AVERAGE

| | | | |
|-----------------|---------------------|----|--|
| 2.2 ± 0.6 ± 0.5 | ¹ AUSHEV | 10 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
|-----------------|---------------------|----|--|

| | | | |
|---|------------------------|----|--|
| 2.5 ^{+0.8+1.0} _{-0.9-0.9} | ^{2,3} GOKHROO | 06 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
|---|------------------------|----|--|

¹ AUSHEV 10 reports $[\Gamma(B \rightarrow K\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \bar{D}^{*0}D^0)] = (0.80 \pm 0.20 \pm 0.10) \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \bar{D}^{*0}D^0) = (37 \pm 9) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

² GOKHROO 06 reports $[\Gamma(B \rightarrow K\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow D^0\bar{D}^0\pi^0)] = (1.22 \pm 0.31^{+0.23}_{-0.30}) \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow D^0\bar{D}^0\pi^0) = (49⁺¹⁸₋₂₀) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

³ 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 .

$\Gamma(KX(3940), X \rightarrow D^{*0}D^0)/\Gamma_{\text{total}}$ Γ_{57}/Γ

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

| | | | | |
|-----------------|----|--------|----|--|
| <0.67 | 90 | AUSHEV | 10 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
|-----------------|----|--------|----|--|

$\Gamma(KX(3915), X \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$ Γ_{58}/Γ

| VALUE (units 10^{-5}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

| | | | |
|------------------------|-------------------|----|--|
| 7.1 ± 1.3 ± 3.1 | ¹ CHOI | 05 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
|------------------------|-------------------|----|--|

¹ 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.

$\Gamma(K^\pm \text{ anything})/\Gamma_{\text{total}}$ Γ_{59}/Γ

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---------------------------|-------------|-----------------------------------|
| 0.789 ± 0.025 OUR AVERAGE | | | |
| 0.82 ± 0.01 ± 0.05 | ALBRECHT 94C | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 0.775 ± 0.015 ± 0.025 | ¹ ALBRECHT 93I | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 0.85 ± 0.07 ± 0.09 | ALAM 87B | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| seen | ² BRODY 82 | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |
| seen | ³ GIANNINI 82 | CUSB | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

² 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 $1.09 \pm 0.33 \pm 0.13$.

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

$\Gamma(K^+ \text{ anything})/\Gamma_{\text{total}}$ Γ_{60}/Γ

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---------------------------|-------------|-----------------------------------|
| 0.66 ± 0.05 | ¹ 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 | ² ALBRECHT 94C | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 0.66 ± 0.05 ± 0.07 | ² ALAM 87B | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $(18.1 \pm 4.3)\%$.

² Measurement relies on lepton-kaon correlations. It includes production through mixing of the neutral B meson.

$\Gamma(K^- \text{ anything})/\Gamma_{\text{total}}$ Γ_{61}/Γ

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---------------------------|-------------|-----------------------------------|
| 0.13 ± 0.04 | ¹ 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 | ² ALBRECHT 94C | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 0.19 ± 0.05 ± 0.02 | ² ALAM 87B | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $(18.1 \pm 4.3)\%$.

² Measurement relies on lepton-kaon correlations. It includes production through mixing of the neutral B meson.

$\Gamma(K^0/\bar{K}^0 \text{ anything})/\Gamma_{\text{total}}$ Γ_{62}/Γ

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

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

$\Gamma(K^*(892)^\pm \text{ anything})/\Gamma_{\text{total}}$ Γ_{63}/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|--------------|------|-----------------------------------|
| $0.182 \pm 0.054 \pm 0.024$ | ALBRECHT 94J | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

$\Gamma(K^*(892)^0/\bar{K}^*(892)^0 \text{ anything})/\Gamma_{\text{total}}$ Γ_{64}/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|--------------|------|-----------------------------------|
| $0.146 \pm 0.016 \pm 0.020$ | ALBRECHT 94J | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

$\Gamma(K^*(892)\gamma)/\Gamma_{\text{total}}$ Γ_{65}/Γ

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

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

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

¹ 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.

² 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.

$\Gamma(\eta K \gamma)/\Gamma_{\text{total}}$ Γ_{66}/Γ

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

¹ $m_{\eta K} < 2.4 \text{ GeV}/c^2$

$\Gamma(K_1(1400)\gamma)/\Gamma_{\text{total}}$ Γ_{67}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------------------|-----|----------------------|------|-----------------------------------|
| < 12.7×10^{-5} | 90 | ¹ COAN 00 | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

² 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.

$\Gamma(K_2^*(1430)\gamma)/\Gamma_{\text{total}}$ Γ_{68}/Γ

| VALUE (units 10^{-5}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|----------------------|------|-----------------------------------|
| $1.66^{+0.59}_{-0.53} \pm 0.13$ | | ¹ 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 | $e^+e^- \rightarrow \Upsilon(4S)$ |
|------|----|--------------|-----|-----------------------------------|

¹ 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.

$\Gamma(K_2(1770)\gamma)/\Gamma_{\text{total}}$ Γ_{69}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------|-----|---------------------|---------|---------------------------------|
| $<1.2 \times 10^{-3}$ | 90 | ¹ LESIAK | 92 CBAL | $e^+e^- \rightarrow \gamma(4S)$ |

¹ 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.

$\Gamma(K_3^*(1780)\gamma)/\Gamma_{\text{total}}$ Γ_{70}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------|-----|----------------------|---------|---------------------------------|
| $<3.7 \times 10^{-5}$ | 90 | ¹ NISHIDA | 05 BELL | $e^+e^- \rightarrow \gamma(4S)$ |

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

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

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

$\Gamma(K_4^*(2045)\gamma)/\Gamma_{\text{total}}$ Γ_{71}/Γ

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

¹ 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.

$\Gamma(K\eta'(958))/\Gamma_{\text{total}}$ Γ_{72}/Γ

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

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

$\Gamma(K^*(892)\eta'(958))/\Gamma_{\text{total}}$ Γ_{73}/Γ

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

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

| | | | | |
|-------|----|-----------------------|---------|---------------------------------|
| <22 | 90 | ¹ RICHICHI | 00 CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |
|-------|----|-----------------------|---------|---------------------------------|

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

$\Gamma(K\eta)/\Gamma_{\text{total}}$ Γ_{74}/Γ

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

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

$\Gamma(K^*(892)\eta)/\Gamma_{\text{total}}$ Γ_{75}/Γ

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

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

| $\Gamma(K\phi\phi)/\Gamma_{\text{total}}$ | | | | Γ_{76}/Γ |
|---|--------------------|------|---------|-----------------------------------|
| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT | |
| $2.3^{+0.9}_{-0.8} \pm 0.3$ | ¹ HUANG | 03 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ Assumes equal production of charged and neutral B meson pairs and isospin symmetry.

| $\Gamma(\bar{b} \rightarrow \bar{s}\gamma)/\Gamma_{\text{total}}$ | | | | Γ_{77}/Γ |
|---|-------------|------|---------|----------------------|
| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT | |
| 3.49 ± 0.19 OUR AVERAGE | | | | |

| | | | | |
|---|------------------------------|------|------|-----------------------------------|
| 3.75 ± 0.18 ± 0.35 | ^{1,2} SAITO | 15 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.52 ± 0.20 ± 0.51 | ^{1,3} LEES | 12U | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.32 ± 0.16 ± 0.31 | ^{1,4} LEES | 12V | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.47 ± 0.15 ± 0.40 | ^{1,5} LIMOSANI | 09 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.90 ± 0.91 ± 0.64 | ^{1,6} AUBERT | 08O | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.29 ± 0.44 ± 0.29 | ^{1,7} CHEN | 01C | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 2.30 ± 0.08 ± 0.30 | ⁸ DEL-AMO-SA..10M | BABR | | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 4.3 ± 0.3 ± 0.7 | ⁹ AUBERT | 09U | BABR | Repl. by DEL-AMO-SANCHEZ 10M |
| 3.92 ± 0.31 ± 0.47 | ^{1,10} AUBERT,BE | 06B | BABR | Repl. by LEES 12V |
| 3.49 ± 0.20 ^{+0.59} _{-0.46} | ^{1,11} AUBERT,B | 05R | BABR | Repl. by LEES 12U |
| 3.50 ± 0.32 ± 0.31 | ^{1,12} KOPPENBURG04 | BELL | | Repl. by LIMOSANI 09 |
| 3.36 ± 0.53 ^{+0.65} _{-0.68} | ¹³ ABE | 01F | BELL | Repl. by SAITO 15 |
| 2.32 ± 0.57 ± 0.35 | ALAM | 95 | CLE2 | Repl. by CHEN 01C |

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

² 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.

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

⁴ 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.

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

⁶ 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.

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

⁸ 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 .

⁹ 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 .

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

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

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

¹³ 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.

$\Gamma(\bar{b} \rightarrow \bar{d}\gamma)/\Gamma_{\text{total}}$ Γ_{78}/Γ

| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------------|------|-----------------------------------|
| $9.2 \pm 2.0 \pm 2.3$ | ¹ DEL-AMO-SA..10M | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 14 ± 5 ± 4 | ² AUBERT | 09U | BABR Repl. by DEL-AMO-SANCHEZ 10M |
| ¹ 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 . | | | |
| ² 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 . | | | |

$\Gamma(\bar{b} \rightarrow \bar{d}\gamma)/\Gamma(\bar{b} \rightarrow \bar{s}\gamma)$ Γ_{78}/Γ_{77}

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|------------------------------|------|-----------------------------------|
| $0.040 \pm 0.009 \pm 0.010$ | ¹ 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 | ² AUBERT | 09U | BABR Repl. by DEL-AMO-SANCHEZ 10M |
| ¹ 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 . | | | |
| ² 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 . | | | |

$\Gamma(\bar{b} \rightarrow \bar{s}g\text{luon})/\Gamma_{\text{total}}$ Γ_{79}/Γ

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--|-----|------|-----------------------|------|--|
| <0.068 | 90 | | ¹ COAN | 98 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| <0.08 | | 2 | ² ALBRECHT | 95D | ARG $e^+e^- \rightarrow \Upsilon(4S)$ |
| ¹ COAN 98 uses D - ℓ correlation. | | | | | |
| ² ALBRECHT 95D use full reconstruction of one B decay as tag. Two candidate events for charmless B decay can be interpreted as either $b \rightarrow sg\text{luon}$ or $b \rightarrow u$ transition. If interpreted as $b \rightarrow sg\text{luon}$ they find a branching ratio of ~ 0.026 or the upper limit quoted above. Result is highly model dependent. | | | | | |

$\Gamma(\eta \text{ anything})/\Gamma_{\text{total}}$ Γ_{80}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--|-----|------------------------|------|--|
| $2.61 \pm 0.30^{+0.44}_{-0.74}$ | | ¹ NISHIMURA | 10 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 1.69 ± 0.29 ^{+0.36} / _{-0.62} | | ² NISHIMURA | 10 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
| <4.4 | 90 | ³ BROWDER | 98 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
| ¹ Uses $B \rightarrow \eta X_S$ with $0.4 < m_{X_S} < 2.6$ GeV/c ² . | | | | |
| ² Uses $B \rightarrow \eta X_S$ with $1.8 < m_{X_S} < 2.6$ GeV/c ² . | | | | |
| ³ BROWDER 98 search for high momentum $B \rightarrow \eta X_S$ between 2.1 and 2.7 GeV/c. | | | | |

$\Gamma(\eta' \text{ anything})/\Gamma_{\text{total}}$ Γ_{81}/Γ

| <u>VALUE (units 10^{-4})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------------------|-------------|--|
| 4.2 ± 0.9 OUR AVERAGE | | | |
| $3.9 \pm 0.8 \pm 0.9$ | ¹ AUBERT,B | 04F | BABR $e^+e^- \rightarrow \Upsilon(4S)$ |
| $4.6 \pm 1.1 \pm 0.6$ | ² BONVICINI | 03 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
| $6.2 \pm 1.6^{+1.3}_{-2.0}$ | ³ BROWDER | 98 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |

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

¹ AUBERT,B 04F reports branching ratio $B \rightarrow \eta' X_S$ for high momentum η' 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.

² BONVICINI 03 observed a signal of 61.2 ± 13.9 events in $B \rightarrow \eta' X_{nc}$ production for high momentum η' 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 η' . The second error combines systematic and background subtraction uncertainties in quadrature.

³ BROWDER 98 observed a signal of 39.0 ± 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.

 $\Gamma(K^+ \text{ gluon (charmless)})/\Gamma_{\text{total}}$ Γ_{82}/Γ

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

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

 $\Gamma(K^0 \text{ gluon (charmless)})/\Gamma_{\text{total}}$ Γ_{83}/Γ

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

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

 $\Gamma(\rho\gamma)/\Gamma_{\text{total}}$ Γ_{84}/Γ

| <u>VALUE (units 10^{-6})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|-------------------------------------|
| 1.39 ± 0.25 OUR AVERAGE | | | | Error includes scale factor of 1.2. |

$1.73^{+0.34}_{-0.32} \pm 0.17$ ^{1,2} AUBERT 08BH BABR $e^+e^- \rightarrow \Upsilon(4S)$

$1.21^{+0.24}_{-0.22} \pm 0.12$ ^{1,2} TANIGUCHI 08 BELL $e^+e^- \rightarrow \Upsilon(4S)$

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

$1.36^{+0.29}_{-0.27} \pm 0.10$ ^{1,3} AUBERT 07L BABR Repl. by AUBERT 08BH

< 1.9 ^{1,3} AUBERT 04C BABR Repl. by AUBERT 07L

< 14 ^{1,4} COAN 00 CLE2 $e^+e^- \rightarrow \Upsilon(4S)$

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

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

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

⁴ 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 $B(B \rightarrow K^*(892)\gamma) = (4.24 \pm 0.54 \pm 0.32) \times 10^{-5}$.

| $\Gamma(\rho\gamma)/\Gamma(K^*(892)\gamma)$ | | | | | Γ_{84}/Γ_{65} |
|--|-----|-------------|------|---------|-----------------------------------|
| VALUE (units 10^{-2}) | CL% | DOCUMENT ID | TECN | COMMENT | |
| $3.02^{+0.60+0.26}_{-0.55-0.28}$ | | TANIGUCHI | 08 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

| $\Gamma(\rho/\omega\gamma)/\Gamma_{\text{total}}$ | | | | | Γ_{85}/Γ |
|---|-------|---|------|---------|-----------------------------------|
| VALUE (units 10^{-6}) | CL% | DOCUMENT ID | TECN | COMMENT | |
| 1.30 ± 0.23 | | OUR AVERAGE Error includes scale factor of 1.2. | | | |
| $1.63^{+0.30}_{-0.28} \pm 0.16$ | 1,2,3 | AUBERT | 08BH | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $1.14 \pm 0.20^{+0.10}_{-0.12}$ | 1,3 | 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 $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

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

| $\Gamma(\rho/\omega\gamma)/\Gamma(K^*(892)\gamma)$ | | | | | Γ_{85}/Γ_{65} |
|--|-----|-------------|-----------|---------|--|
| VALUE (units 10^{-2}) | CL% | DOCUMENT ID | TECN | COMMENT | |
| $2.84 \pm 0.50^{+0.27}_{-0.29}$ | | 1 | 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 |
|--------|----|-----------|----|------|-----------------------|

¹ Also reports $|V_{td}/V_{ts}| = 0.195^{+0.020}_{-0.019} \pm 0.015$.

| $\Gamma(\pi^\pm \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{86}/Γ |
|--|-----|-------------|----------|---------|---------------------------------------|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $3.585 \pm 0.025 \pm 0.070$ | | 1 | ALBRECHT | 93I | ARG $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ ALBRECHT 93 excludes π^\pm from K_S^0 and Λ decays. If included, they find $4.105 \pm 0.025 \pm 0.080$.

| $\Gamma(\pi^0 \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{87}/Γ |
|--|-----|-------------|------|---------|--|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $2.35 \pm 0.02 \pm 0.11$ | | 1 | ABE | 01J | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ From fully inclusive π^0 yield with no corrections from decays of K_S^0 or other particles.

| $\Gamma(\eta \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{88}/Γ |
|---|-----|-------------|--------|---------|--|
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT | |
| $0.176 \pm 0.011 \pm 0.012$ | | | KUBOTA | 96 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |

| $\Gamma(\rho^0 \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{89}/Γ |
|---|--|--------------------|-------------|----------------|---------------------------------|
| <u>VALUE</u> | | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| $0.208 \pm 0.042 \pm 0.032$ | | ALBRECHT | 94J | ARG | $e^+e^- \rightarrow \gamma(4S)$ |

| $\Gamma(\omega \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{90}/Γ |
|---|------------|--------------------|-------------|----------------|---------------------------------|
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| <0.81 | 90 | ALBRECHT | 94J | ARG | $e^+e^- \rightarrow \gamma(4S)$ |

| $\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{91}/Γ |
|---|--|--------------------|-------------|----------------|---------------------------------|
| <u>VALUE</u> | | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| 0.0343 ± 0.0012 OUR AVERAGE | | | | | |
| $0.0353 \pm 0.0005 \pm 0.0030$ | | HUANG | 07 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| $0.0341 \pm 0.0006 \pm 0.0012$ | | AUBERT | 04S | BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| $0.0390 \pm 0.0030 \pm 0.0035$ | | ALBRECHT | 94J | ARG | $e^+e^- \rightarrow \gamma(4S)$ |
| $0.023 \pm 0.006 \pm 0.005$ | | BORTOLETTO | 86 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |

| $\Gamma(\phi K^*(892))/\Gamma_{\text{total}}$ | | | | | Γ_{92}/Γ |
|---|------------|-----------------------|-------------|----------------|----------------------|
| <u>VALUE</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| $<2.2 \times 10^{-5}$ | 90 | ¹ BERGFELD | 98 | CLE2 | |

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

| $\Gamma(\pi^+ \text{ gluon (charmless)})/\Gamma_{\text{total}}$ | | | | | Γ_{94}/Γ |
|---|--|-----------------------------|-------------|----------------|---------------------------------|
| <u>VALUE (units 10^{-4})</u> | | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| $3.72^{+0.50}_{-0.47} \pm 0.59$ | | ¹ DEL-AMO-SA..11 | | BABR | $e^+e^- \rightarrow \gamma(4S)$ |

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

| $\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})/\Gamma_{\text{total}}$ | | | | | Γ_{95}/Γ |
|--|------------|---------------------|-------------|----------------|---------------------------------|
| <u>VALUE (%)</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> | |
| $3.59 \pm 0.32^{+0.19}_{-0.18}$ | | ¹ AUBERT | 07C | BABR | $e^+e^- \rightarrow \gamma(4S)$ |

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

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

¹ 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.

² CRAWFORD 92 result derived from lepton baryon correlations. Assumes all charmed baryons in B^0 and B^\pm decay are Λ_c .

³ 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.

⁴ 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.

$\Gamma(\Lambda_c^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$ Γ_{96}/Γ_{97}

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

| | | | |
|-----------------------|--------------------|----|--------------------------------------|
| 0.19±0.13±0.04 | ¹ AMMAR | 97 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
|-----------------------|--------------------|----|--------------------------------------|

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

$\Gamma(\bar{\Lambda}_c^- \mu^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$ Γ_{100}/Γ_{97}

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

| | | | |
|---------------------|------|----|--------------------------------------|
| -2.0±2.0±1.9 | LEES | 12 | BABR $e^+e^- \rightarrow \gamma(4S)$ |
|---------------------|------|----|--------------------------------------|

$\Gamma(\bar{\Lambda}_c^- \ell^+ \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$ Γ_{98}/Γ_{95}

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

| | | | | |
|----------------------------------|----|-------------------|----|--------------------------------------|
| <2.5 × 10⁻² | 90 | ¹ LEES | 12 | BABR $e^+e^- \rightarrow \gamma(4S)$ |
|----------------------------------|----|-------------------|----|--------------------------------------|

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

$\Gamma(\bar{\Lambda}_c^- e^+ \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$ Γ_{99}/Γ_{95}

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

| | | | | |
|-----------------|----|------------------------|----|--------------------------------------|
| <0.05 | 90 | ¹ BONVICINI | 98 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
|-----------------|----|------------------------|----|--------------------------------------|

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

$\Gamma(\bar{\Lambda}_c^- e^+ \text{ anything})/\Gamma(\bar{\Lambda}_c^- \text{ anything})$ Γ_{99}/Γ_{97}

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

| | | | |
|--------------------|-------------------|----|--------------------------------------|
| 2.5±1.1±0.6 | ¹ LEES | 12 | BABR $e^+e^- \rightarrow \gamma(4S)$ |
|--------------------|-------------------|----|--------------------------------------|

¹ Uses the full reconstruction of the recoiling B in a hadronic decay as a tag.

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

| | | | | |
|----------------------------------|----|-------------------|----|--------------------------------------|
| <3.5 × 10⁻² | 90 | ¹ LEES | 12 | BABR $e^+e^- \rightarrow \gamma(4S)$ |
|----------------------------------|----|-------------------|----|--------------------------------------|

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

$\Gamma(\bar{\Lambda}_c^- p \text{ anything})/\Gamma(\Lambda_c^+ / \bar{\Lambda}_c^- \text{ anything})$ Γ_{101}/Γ_{95}

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

| | | | |
|-----------------------|-----------|----|--------------------------------------|
| 0.57±0.05±0.05 | BONVICINI | 98 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
|-----------------------|-----------|----|--------------------------------------|

$\Gamma(\bar{\Lambda}_c^- p e^+ \nu_e)/\Gamma(\bar{\Lambda}_c^- p \text{ anything})$ $\Gamma_{102}/\Gamma_{101}$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

| | | | | |
|-----------------|----|------------------------|----|--------------------------------------|
| <0.04 | 90 | ¹ BONVICINI | 98 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
|-----------------|----|------------------------|----|--------------------------------------|

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

$\Gamma(\bar{\Sigma}_c^{--} \text{ anything})/\Gamma_{\text{total}}$ Γ_{103}/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

| | | | | |
|-----------------------------|----|-----------------------|----|--------------------------------------|
| 0.0033±0.0017±0.0002 | 77 | ¹ PROCARIO | 94 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
|-----------------------------|----|-----------------------|----|--------------------------------------|

¹ 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.

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

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

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

$\Gamma(\bar{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}$ Γ_{105}/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|--------------------------|------|---------------------------------|
| $0.0037 \pm 0.0017 \pm 0.0002$ | 76 | ¹ PROCARIO 94 | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

¹ PROCARIO 94 reports $[\Gamma(B \rightarrow \bar{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow pK^- \pi^+)] = 0.00023 \pm 0.00008 \pm 0.00007$ 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.

$\Gamma(\bar{\Sigma}_c^0 N(N = p \text{ or } n))/\Gamma_{\text{total}}$ Γ_{106}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------|-----|--------------------------|------|---------------------------------|
| $<1.2 \times 10^{-3}$ | 90 | ¹ PROCARIO 94 | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

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

$\Gamma(\Xi_c^0 \text{ anything}, \Xi_c^0 \rightarrow \Xi^- \pi^+)/\Gamma_{\text{total}}$ Γ_{107}/Γ

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

¹ The yield is obtained by requiring the momentum $P < 2.15$ GeV/c.
² BARISH 97 find $79 \pm 27 \Xi_c^0$ events.

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

| VALUE (units 10^{-3}) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------|------|---------------------------------|
| 0.453 ± 0.096 $^{+0.085}_{-0.065}$ | ¹ BARISH 97 | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

¹ BARISH 97 find $125 \pm 28 \Xi_c^+$ events.

$\Gamma(p/\bar{p} \text{ anything})/\Gamma_{\text{total}}$ Γ_{109}/Γ

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

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|---------------------------|------|---------------------------------|
| 0.080 ± 0.004 OUR AVERAGE | | | | |
| $0.080 \pm 0.005 \pm 0.005$ | | ALBRECHT 93I | ARG | $e^+e^- \rightarrow \gamma(4S)$ |
| $0.080 \pm 0.005 \pm 0.003$ | | CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.082 ± 0.005 $^{+0.013}_{-0.010}$ | 2163 | ¹ ALBRECHT 89K | ARG | $e^+e^- \rightarrow \gamma(4S)$ |

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

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

¹ ALBRECHT 89K include direct and nondirect protons.

² 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 Λ decays.

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

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------------|-------------|---------------------------|-------------|-----------------------------------|
| 0.055 ± 0.005 OUR AVERAGE | | | | |
| 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 | ¹ ALBRECHT 89K | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ ALBRECHT 89K subtract contribution of Λ decay from the inclusive proton yield.

$\Gamma(\bar{p}e^+ \nu_e \text{ anything})/\Gamma_{\text{total}}$ Γ_{111}/Γ

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

¹ Based on $V-A$ model.

$\Gamma(\Lambda/\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$ Γ_{112}/Γ

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|----------------------------------|-------------|--------------------|-------------|-----------------------------------|
| 0.040 ± 0.005 OUR AVERAGE | | | | |
| 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 | | ¹ ACKERSTAFF 97N | OPAL | $e^+e^- \rightarrow Z$ |
| >0.011 | | ² ALAM 83B | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

² 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, $B(B \rightarrow \Lambda X) = 0.03$.

$\Gamma(\Lambda \text{ anything})/\Gamma(\bar{\Lambda} \text{ anything})$ $\Gamma_{113}/\Gamma_{114}$

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

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

$\Gamma(\Xi^-/\Xi^+ \text{ anything})/\Gamma_{\text{total}}$ Γ_{115}/Γ

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

$\Gamma(\text{baryons anything})/\Gamma_{\text{total}}$ Γ_{116}/Γ

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---------------------------|-------------|-----------------------------------|
| 0.068 ± 0.005 ± 0.003 | ¹ ALBRECHT 92O | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.076 ± 0.014 | ² ALBRECHT 89K | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

² 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 Λ 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 $(7.6 \pm 1.4)\%$.

$\Gamma(p\bar{p} \text{ anything})/\Gamma_{\text{total}}$ Γ_{117}/Γ

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

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

$\Gamma(p\bar{p} \text{ anything})/\Gamma(p/\bar{p} \text{ anything})$ $\Gamma_{117}/\Gamma_{109}$

Includes p and \bar{p} from Λ 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 | ¹ CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| ¹ CRAWFORD 92 value is not independent of their $\Gamma(p\bar{p} \text{ anything})/\Gamma_{\text{total}}$ value. | | | |

$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$ Γ_{118}/Γ

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

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

$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$ $\Gamma_{118}/\Gamma_{112}$

Includes p and \bar{p} from Λ 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 | ¹ CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| ¹ CRAWFORD 92 value is not independent of their $[\Gamma(\Lambda\bar{p} \text{ anything}) + \Gamma(\bar{\Lambda}p \text{ anything})]/\Gamma_{\text{total}}$ value. | | | |

$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$ Γ_{119}/Γ

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|-----|------|--------------|------|---------------------------------|
| <0.005 | 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 | $e^+e^- \rightarrow \gamma(4S)$ |

$\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$ $\Gamma_{119}/\Gamma_{112}$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|--------------------------|------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| <0.13 | 90 | ¹ CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| ¹ CRAWFORD 92 value is not independent of their $\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$ value. | | | | |

$\Gamma(se^+e^-)/\Gamma_{\text{total}}$ **Γ_{120}/Γ**

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

| VALUE (units 10^{-6}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

6.7 ± 1.7 OUR AVERAGE Error includes scale factor of 2.0.

7.69^{+0.82+0.71}_{-0.77-0.60} 1 LEES 14D BABR $e^+e^- \rightarrow \gamma(4S)$

4.04 ± 1.30^{+0.87}_{-0.83} 2 IWASAKI 05 BELL $e^+e^- \rightarrow \gamma(4S)$

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

6.0 ± 1.7 ± 1.3 2 AUBERT,B 04i BABR Repl. by LEES 14D

5.0 ± 2.3 ^{+1.3}_{-1.1} 2 KANEKO 03 BELL Repl. by IWASAKI 05

< 57 90 GLENN 98 CLEO $e^+e^- \rightarrow \gamma(4S)$

< 50000 90 BEBEK 81 CLEO $e^+e^- \rightarrow \gamma(4S)$

¹ 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.

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

$\Gamma(s\mu^+\mu^-)/\Gamma_{\text{total}}$ **Γ_{121}/Γ**

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

| VALUE (units 10^{-6}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

4.3 ± 1.0 OUR AVERAGE

4.41^{+1.31+0.63}_{-1.17-0.50} 1 LEES 14D BABR $e^+e^- \rightarrow \gamma(4S)$

4.13 ± 1.05^{+0.85}_{-0.81} 2 IWASAKI 05 BELL $e^+e^- \rightarrow \gamma(4S)$

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

5.0 ± 2.8 ± 1.2 AUBERT,B 04i BABR Repl. by LEES 14D

7.9 ± 2.1 ^{+2.1}_{-1.5} KANEKO 03 BELL Repl. by IWASAKI 05

< 58 90 GLENN 98 CLEO $e^+e^- \rightarrow \gamma(4S)$

< 17000 90 CHADWICK 81 CLEO $e^+e^- \rightarrow \gamma(4S)$

¹ 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.

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

$[\Gamma(se^+e^-) + \Gamma(s\mu^+\mu^-)]/\Gamma_{\text{total}}$ **$(\Gamma_{120} + \Gamma_{121})/\Gamma$**

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

< 4.2 × 10⁻⁵ 90 GLENN 98 CLEO $e^+e^- \rightarrow \gamma(4S)$

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

< 0.0024 90 1 BEAN 87 CLEO Repl. by GLENN 98

< 0.0062 90 2 AVERY 84 CLEO Repl. by BEAN 87

¹ BEAN 87 reports $[(\mu^+\mu^-) + (e^+e^-)]/2$ and we converted it.

² Determine ratio of B^+ to B^0 semileptonic decays to be in the range 0.25–2.9.

$\Gamma(s\ell^+\ell^-)/\Gamma_{\text{total}}$ Γ_{122}/Γ
 Test for $\Delta B = 1$ weak neutral current.

VALUE (units 10^{-6}) DOCUMENT ID TECN COMMENT
5.8 ± 1.3 OUR AVERAGE Error includes scale factor of 1.8.

6.73^{+0.70+0.60}_{-0.64-0.56} 1 LEES 14D BABR $e^+e^- \rightarrow \gamma(4S)$

4.11 ± 0.83^{+0.85}_{-0.81} 2 IWASAKI 05 BELL $e^+e^- \rightarrow \gamma(4S)$

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

5.6 ± 1.5 ± 1.3 3 AUBERT,B 04I BABR Repl. by LEES 14D

6.1 ± 1.4^{+1.4}_{-1.1} 3 KANEKO 03 BELL Repl. by IWASAKI 05

¹ 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.

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

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

$\Gamma(\pi\ell^+\ell^-)/\Gamma_{\text{total}}$ Γ_{123}/Γ

VALUE CL% DOCUMENT ID TECN COMMENT

<5.9 × 10⁻⁸ 90 1 LEES 13M BABR $e^+e^- \rightarrow \gamma(4S)$

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

<6.2 × 10⁻⁸ 90 1 WEI 08A BELL $e^+e^- \rightarrow \gamma(4S)$

<9.1 × 10⁻⁸ 90 1 AUBERT 07AG BABR $e^+e^- \rightarrow \gamma(4S)$

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

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

VALUE CL% DOCUMENT ID TECN COMMENT

<11.0 × 10⁻⁸ 90 1 LEES 13M BABR $e^+e^- \rightarrow \gamma(4S)$

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

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

VALUE CL% DOCUMENT ID TECN COMMENT

<5.0 × 10⁻⁸ 90 1 LEES 13M BABR $e^+e^- \rightarrow \gamma(4S)$

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

$\Gamma(K e^+e^-)/\Gamma_{\text{total}}$ Γ_{126}/Γ
 Test for $\Delta B = 1$ weak neutral current. Allowed by higher-order electroweak interactions.

VALUE (units 10^{-7}) CL% DOCUMENT ID TECN COMMENT

4.4 ± 0.6 OUR AVERAGE

3.9^{+0.9}_{-0.8} ± 0.2 1 AUBERT 09T BABR $e^+e^- \rightarrow \gamma(4S)$

4.8^{+0.8}_{-0.7} ± 0.3 1 WEI 09A BELL $e^+e^- \rightarrow \gamma(4S)$

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

3.3^{+0.9}_{-0.8} ± 0.2 1 AUBERT,B 06J BABR Repl. by AUBERT 09T

7.4^{+1.8}_{-1.6} ± 0.5 1 AUBERT 03U BABR Repl. by AUBERT,B 06J

4.8^{+1.5}_{-1.3} ± 0.3 1,2 ISHIKAWA 03 BELL Repl. by WEI 09A

<13 90 ABE 02 BELL Repl. by ISHIKAWA 03

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

² The second error is a total of systematic uncertainties including model dependence.

$\Gamma(K^*(892)e^+e^-)/\Gamma_{\text{total}}$ Γ_{127}/Γ

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

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

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

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

$\Gamma(K\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{128}/Γ

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

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

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

² The second error is a total of systematic uncertainties including model dependence.

$\Gamma(K\mu^+\mu^-)/\Gamma(Ke^+e^-)$ $\Gamma_{128}/\Gamma_{126}$

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------------------|-------------|-----------------------------------|
| 1.01^{+0.19}_{-0.16} OUR AVERAGE | | | |
| $1.03^{+0.28}_{-0.24} \pm 0.01$ | ¹ CHOUDHURY | 21 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $1.00^{+0.31}_{-0.25} \pm 0.07$ | ² LEES | 12s BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.96^{+0.44}_{-0.34} \pm 0.05$ | AUBERT | 09T BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

1.03±0.19±0.06 ³WEI 09A BELL $e^+e^- \rightarrow \gamma(4S)$
 1.06±0.48±0.08 AUBERT,B 06J BABR Repl. by AUBERT 09T

¹ For $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$. Measurements in other q^2 bins are also reported.

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

³ Superseded by CHOUDHURY 21.

$\Gamma(K^*(892)\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_{129}/Γ

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

| VALUE (units 10^{-7}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|---------------------|----------|---------------------------------|
| 10.6±0.9 OUR AVERAGE | | | | |
| 10.1±1.0±0.5 | | AALTONEN | 11AI CDF | $p\bar{p}$ at 1.96 TeV |
| 13.5 ^{+3.5} _{-3.3} ±1.0 | | ¹ AUBERT | 09T BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| 11.0 ^{+1.6} _{-1.4} ±0.8 | | ¹ WEI | 09A BELL | $e^+e^- \rightarrow \gamma(4S)$ |

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

8.8^{+3.5}_{-3.0}±1.2 ¹ AUBERT,B 06J BABR Repl. by AUBERT 09T
 12.7^{+7.6}_{-6.1}±1.6 ¹ AUBERT 03U BABR Repl. by AUBERT,B 06J
 11.7^{+3.6}_{-3.1}±1.0 ² ISHIKAWA 03 BELL Repl. by WEI 09A
 <31 90 ABE 02 BELL Repl. by ISHIKAWA 03

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

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

$\Gamma(K^*(892)\mu^+\mu^-)/\Gamma(K^*(892)e^+e^-)$ $\Gamma_{129}/\Gamma_{127}$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|-------------------|----------|---------------------------------|
| 0.98±0.15 OUR AVERAGE | | | |
| 1.13 ^{+0.34} _{-0.26} ±0.10 | ¹ LEES | 12S BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| 1.37 ^{+0.53} _{-0.40} ±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

¹ 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 $\Gamma(B \rightarrow K^*(892)\mu^+\mu^-)/\Gamma(B \rightarrow K^*(892)e^+e^-)$
 = $1.06^{+0.48}_{-0.33} \pm 0.08$ for $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$ and $\Gamma(B \rightarrow K^*(892)\mu^+\mu^-)/\Gamma(B \rightarrow K^*(892)e^+e^-)$
 = $1.18^{+0.55}_{-0.37} \pm 0.11$ for $q^2 > 10.11 \text{ GeV}^2/c^4$.

$\Gamma(K\ell^+\ell^-)/\Gamma_{\text{total}}$ Γ_{130}/Γ

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

| VALUE (units 10^{-7}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

4.8 ± 0.4 OUR AVERAGE

| | | | | |
|---|--|------|-----|--------------------------------------|
| 4.7 ± 0.6 ± 0.2 | | LEES | 12S | BABR $e^+e^- \rightarrow \gamma(4S)$ |
| 4.8 ^{+0.5} _{-0.4} ± 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 | | 1 AUBERT | 09T | BABR Repl. by LEES 12S |
| 3.4 ± 0.7 ± 0.2 | | 1 AUBERT,B | 06J | BABR Repl. by AUBERT 09T |
| 6.5 ^{+1.4} _{-1.3} ± 0.4 | | 2 AUBERT | 03U | BABR Repl. by AUBERT,B 06J |
| 4.8 ^{+1.0} _{-0.9} ± 0.3 | | 3 ISHIKAWA | 03 | BELL Repl. by WEI 09A |
| 7.5 ^{+2.5} _{-2.1} ± 0.6 | | 4 ABE | 02 | BELL Repl. by ISHIKAWA 03 |
| < 5.1 | 90 | 1 AUBERT | 02L | BABR $e^+e^- \rightarrow \gamma(4S)$ |
| < 17 | 90 | 5 ANDERSON | 01B | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |

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

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

³ 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.

⁴ Assumes lepton universality.

⁵ The result is for di-lepton masses above 0.5 GeV.

$\Gamma(K^*(892)\ell^+\ell^-)/\Gamma_{\text{total}}$ Γ_{131}/Γ

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

| VALUE (units 10^{-7}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

10.5 ± 1.0 OUR AVERAGE

| | | | | |
|--|--|------|-----|--------------------------------------|
| 10.2 ^{+1.4} _{-1.3} ± 0.5 | | LEES | 12S | BABR $e^+e^- \rightarrow \gamma(4S)$ |
| 10.7 ^{+1.1} _{-1.0} ± 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} ± 0.7 | | 1 AUBERT | 09T | BABR Repl. by LEES 12S |
| 7.8 ^{+1.9} _{-1.7} ± 1.1 | | 1 AUBERT,B | 06J | BABR Repl. by AUBERT 09T |
| 8.8 ^{+3.3} _{-2.9} ± 1.0 | | 2 AUBERT | 03U | BABR Repl. by AUBERT,B 06J |
| 11.5 ^{+2.6} _{-2.4} ± 0.8 | | 3 ISHIKAWA | 03 | BELL Repl. by WEI 09A |
| < 31 | 90 | 1,4 AUBERT | 02L | BABR Repl. by AUBERT 03U |
| < 33 | 90 | 5 ANDERSON | 01B | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |

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

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

³ 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.

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

⁵ The result is for di-lepton masses above 0.5 GeV.

$\Gamma(K\nu\bar{\nu})/\Gamma_{\text{total}}$ Γ_{132}/Γ

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|------------------------------|----------|-----------------------------------|
| $<1.6 \times 10^{-5}$ | 90 | ¹ GRYGIER | 17 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $<1.7 \times 10^{-5}$ | 90 | ^{1,2} LEES | 13i BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $<1.4 \times 10^{-5}$ | 90 | ¹ DEL-AMO-SA..10Q | BABR | Repl. by LEES 13i |

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

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

$\Gamma(K^*\nu\bar{\nu})/\Gamma_{\text{total}}$ Γ_{133}/Γ

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|----------------------|-----------|-----------------------------------|
| $<2.7 \times 10^{-5}$ | 90 | ¹ 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 | ^{1,2} LEES | 13i BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $<8 \times 10^{-5}$ | 90 | AUBERT | 08BC BABR | Repl. by LEES 13i |

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

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

$\Gamma(\pi\nu\bar{\nu})/\Gamma_{\text{total}}$ Γ_{134}/Γ

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

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

$\Gamma(\rho\nu\bar{\nu})/\Gamma_{\text{total}}$ Γ_{135}/Γ

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

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

$\Gamma(se^\pm\mu^\mp)/\Gamma_{\text{total}}$ Γ_{136}/Γ

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

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

$\Gamma(\pi e^\pm\mu^\mp)/\Gamma_{\text{total}}$ Γ_{137}/Γ

Test of lepton family number conservation.

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|----------------------|-----------|-----------------------------------|
| $<9.2 \times 10^{-8}$ | 90 | ¹ 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 | ¹ EDWARDS | 02B CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

$\Gamma(\rho e^\pm \mu^\mp)/\Gamma_{\text{total}}$ Γ_{138}/Γ

Test of lepton family number conservation.

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

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

$\Gamma(K e^\pm \mu^\mp)/\Gamma_{\text{total}}$ Γ_{139}/Γ

Test of lepton family number conservation.

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

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

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

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

$\Gamma(K^*(892) e^\pm \mu^\mp)/\Gamma_{\text{total}}$ Γ_{140}/Γ

Test of lepton family number conservation.

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

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

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

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

CP VIOLATION

A_{CP} is defined as

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

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 |
|--|-------------|------|---------|
| -0.003 ± 0.011 OUR AVERAGE | | | |

| | | | |
|------------------------------|------------------------|---------|------------------------------------|
| $-0.004 \pm 0.014 \pm 0.003$ | ¹ HORIGUCHI | 17 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
|------------------------------|------------------------|---------|------------------------------------|

| | | | |
|------------------------------|---------------------|-----------|------------------------------------|
| $-0.003 \pm 0.017 \pm 0.007$ | ² AUBERT | 09AO BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
|------------------------------|---------------------|-----------|------------------------------------|

| | | | |
|--------------------------|-------------------|---------|------------------------------------|
| $0.08 \pm 0.13 \pm 0.03$ | ³ COAN | 00 CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
|--------------------------|-------------------|---------|------------------------------------|

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

| | | | |
|------------------------------|------------------------|----------|----------------------|
| $-0.013 \pm 0.036 \pm 0.010$ | ⁴ AUBERT,BE | 04A BABR | Repl. by AUBERT 09AO |
|------------------------------|------------------------|----------|----------------------|

| | | | |
|------------------------------|--------------------|---------|-----------------------|
| $-0.015 \pm 0.044 \pm 0.012$ | ³ NAKAO | 04 BELL | Repl. by HORIGUCHI 17 |
|------------------------------|--------------------|---------|-----------------------|

| | | | |
|------------------------------|---------------------|----------|------------------------|
| $-0.044 \pm 0.076 \pm 0.012$ | ⁵ AUBERT | 02C BABR | Repl. by AUBERT,BE 04A |
|------------------------------|---------------------|----------|------------------------|

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

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

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

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

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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-----------------------|-----------|-----------------------------------|
| 0.015 ± 0.011 OUR AVERAGE | | | |
| 0.0144 ± 0.0128 ± 0.0011 | ¹ WATANUKI | 19 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 0.017 ± 0.019 ± 0.010 | ² 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 | ³ AUBERT | 08BJ BABR | Repl. by LEES 14K |
| 0.025 ± 0.050 ± 0.015 | ⁴ AUBERT,B | 04E BABR | Repl. by AUBERT 08BJ |
| 0.002 ± 0.050 ± 0.030 | ⁵ NISHIDA | 04 BELL | Repl. by WATANUKI 19 |

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

² 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).

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

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

⁵ 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-----------------------|----------|-----------------------------------|
| 0.010 ± 0.031 OUR AVERAGE | | | |
| 0.022 ± 0.039 ± 0.009 | ¹ 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 | ² 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 | ³ COAN | 01 CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------|-------------------|----------|-----------------------------------|
| 0.04 ± 0.11 ± 0.01 | | | |
| | ¹ 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 ² AUBERT,B 04I BABR Repl. by LEES 14D

¹ 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 $K_S^0\pi^+\pi^0$.

² 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------------|----------|-----------------------------------|
| -0.06 ± 0.22 ± 0.01 | | | |
| | ¹ LEES | 14D BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $K_S^0\pi^+\pi^0$.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------------|------|---------------------------------------|
| $0.19^{+0.18}_{-0.17} \pm 0.01$ | ¹ LEES | 14D | BABR $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 $K_S^0 \pi^-$ (π^-)⁰.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------|-------------|------|---------------------------------------|
| $-0.18 \pm 0.15 \pm 0.01$ | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|-------------------|------|---------------------------------------|
| -0.04 ± 0.07 OUR AVERAGE | | | |
| $0.03 \pm 0.13 \pm 0.01$ | ¹ LEES | 12S | BABR $e^+ e^- \rightarrow \gamma(4S)$ |
| $+0.01^{+0.16}_{-0.15} \pm 0.01$ | AUBERT | 09T | BABR $e^+ e^- \rightarrow \gamma(4S)$ |
| $-0.10 \pm 0.10 \pm 0.01$ | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 |
|----------------------------------|------------------------|------|---------------------------------------|
| $-0.13 \pm 0.04^{+0.02}_{-0.03}$ | ¹ NISHIMURA | 10 | BELL $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 |
|---|-----------------------|------|---------------------------------------|
| 0.041 ± 0.023 OUR AVERAGE | | | |
| $0.0369 \pm 0.0265 \pm 0.0076$ | ¹ WATANUKI | 19 | BELL $e^+ e^- \rightarrow \gamma(4S)$ |
| $0.050 \pm 0.039 \pm 0.015$ | ² LEES | 14K | BABR $e^+ e^- \rightarrow \gamma(4S)$ |

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

² 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 |
|--|-----------------------|------|---------------------------------------|
| $0.0091 \pm 0.0121 \pm 0.0013$ | ¹ WATANUKI | 19 | BELL $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 |
|-----------------------------|------------------------|------|---|
| $0.024 \pm 0.028 \pm 0.005$ | ¹ Horiguchi | 17 | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ 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 |
|------------------------------|------------------------|------|---|
| $-0.001 \pm 0.014 \pm 0.003$ | ¹ Horiguchi | 17 | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ 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 Γ_L/Γ , Γ_\perp/Γ , and the relative phases ϕ_\parallel and ϕ_\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 |
|---------------------------------|------------------------|------|---|
| $0.63^{+0.18}_{-0.19} \pm 0.05$ | ¹ Aubert, B | 06J | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ 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 $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

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

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

| 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 | | | |

| | | | |
|--|------|-----|--|
| $0.37^{+0.10}_{-0.09} \pm 0.04 \pm 0.03$ | 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 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | |
|---------------------------------|------------------------------|-----|---------------------------|
| $0.60^{+0.00}_{-0.28} \pm 0.19$ | ¹ 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 |

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

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

0.77 ± 0.05 OUR AVERAGE

| | | | |
|-------------------------------------|-------------------|-----|--|
| $0.876^{+0.109}_{-0.097} \pm 0.017$ | ¹ AAIJ | 16B | LHCB pp at 7, 8 TeV |
| $0.80 \pm 0.08 \pm 0.06$ | KHACHATRY...16D | CMS | pp at 8 TeV |
| $0.74^{+0.10}_{-0.09} \pm 0.02$ | 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 |

¹ Measured in $2.5 < q^2 < 4.0 \text{ GeV}^2/c^4$.

$F_L(B \rightarrow K^* \ell^+ \ell^-) (4.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

0.611^{+0.052}_{-0.053} ± 0.017 AAIJ 16B LHCB pp at 7, 8 TeV

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

0.579 ± 0.046 ± 0.015 AAIJ 16B LHCB pp at 7, 8 TeV

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

0.64 ± 0.06 OUR AVERAGE

| | | | |
|---------------------------------|-----------------|-----|--|
| $0.57 \pm 0.07 \pm 0.03$ | 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 |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|-------------------------------------|
| 0.448 ± 0.033 OUR AVERAGE | | | |
| $0.493^{+0.049}_{-0.047} \pm 0.013$ | ¹ 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 |

¹ Measured in $11.0 < q^2 < 12.5 \text{ GeV}^2/c^4$. **$F_L(B \rightarrow K^* \ell^+ \ell^-)$ ($15.0 < q^2 < 17.0 \text{ GeV}^2/c^4$)**

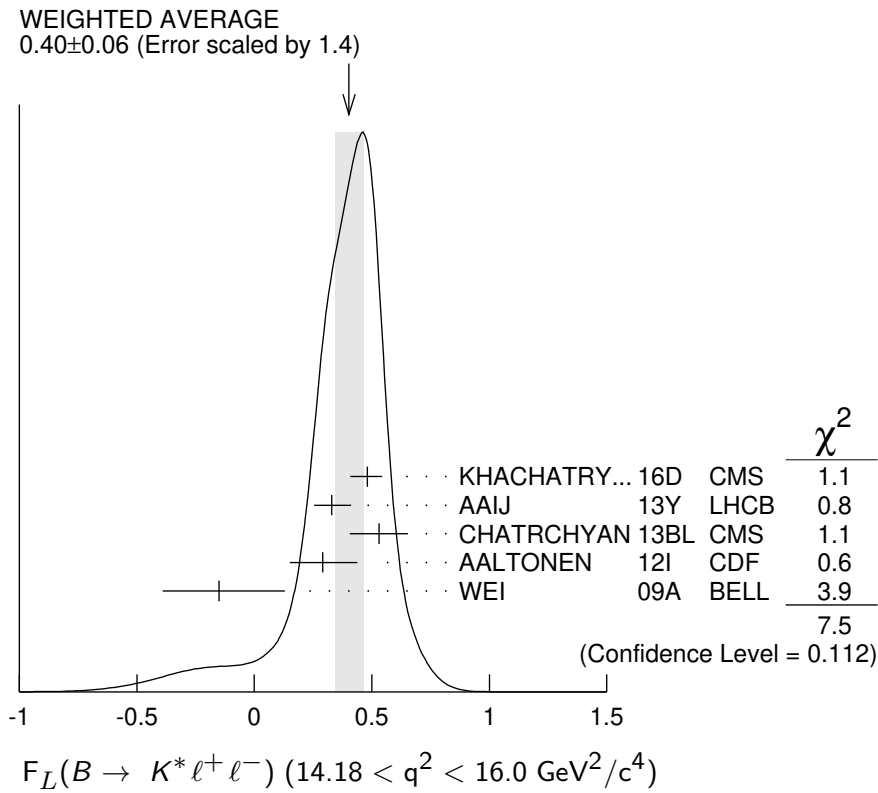
| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|------------------|
| $0.349 \pm 0.039 \pm 0.009$ | AAIJ | 16B LHCb | pp at 7, 8 TeV |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|------------------|
| $0.354^{+0.049}_{-0.048} \pm 0.025$ | AAIJ | 16B LHCb | pp at 7, 8 TeV |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---|-------------|-------------------------------------|
| 0.40 ± 0.06 OUR AVERAGE | 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 |



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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------------|----------|-------------------------------------|
| 0.350 ± 0.019 OUR AVERAGE | | | |
| $0.345 \pm 0.020 \pm 0.007$ | ¹ AAIJ | 20Y LHCb | pp at 7, 8, 13 TeV |
| $0.38^{+0.05}_{-0.06} \pm 0.04$ | KHACHATRY...16D | CMS | pp at 8 TeV |
| $0.38^{+0.09}_{-0.07} \pm 0.03$ | AAIJ | 13Y LHCb | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $0.44 \pm 0.07 \pm 0.03$ | CHATRCHYAN 13BL | CMS | pp at 7 TeV |
| $0.20^{+0.19}_{-0.17} \pm 0.05$ | AALTONEN | 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $0.12^{+0.15}_{-0.13} \pm 0.02$ | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

| | | | |
|-------------------------------------|-------------------|----------|-----------------------|
| $0.344^{+0.028}_{-0.030} \pm 0.008$ | ¹ AAIJ | 16B LHCb | Repl. by AAIJ 20Y |
| $0.26^{+0.10}_{-0.08} \pm 0.03$ | AAIJ | 12U LHCb | Repl. by AAIJ 13Y |
| $0.09^{+0.18}_{-0.14} \pm 0.03$ | AALTONEN | 11L CDF | Repl. by AALTONEN 12I |

¹ Measured in $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$.

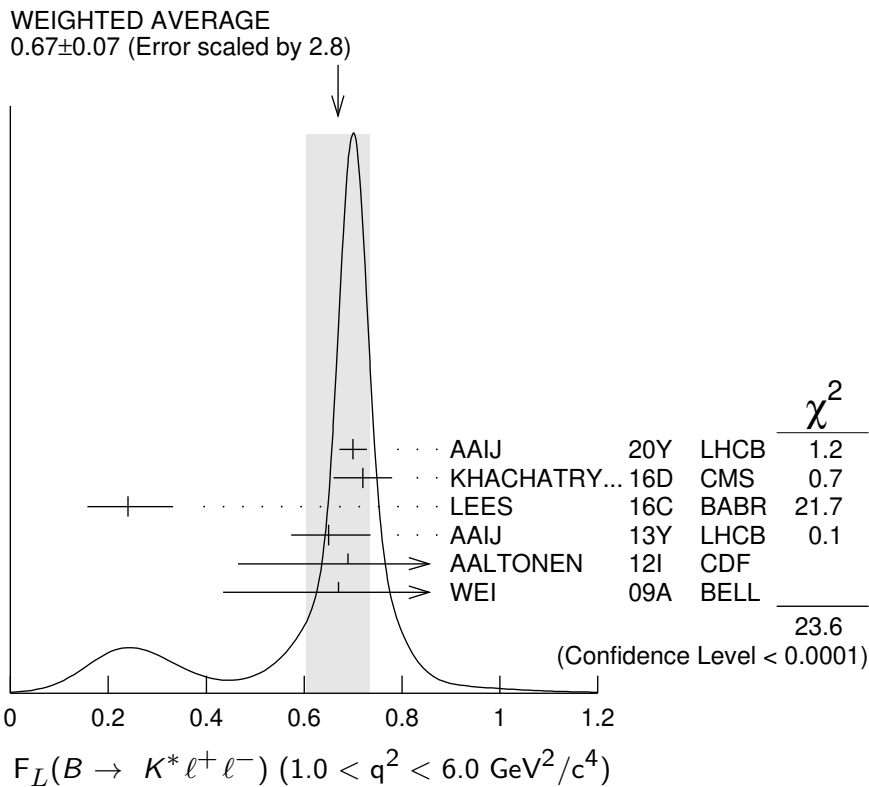
$F_L(B \rightarrow K^* \ell^+ \ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------------|----------|---|
| 0.67 ± 0.07 OUR AVERAGE | | | Error includes scale factor of 2.8. See the ideogram below. |
| $0.700 \pm 0.025 \pm 0.013$ | ¹ AAIJ | 20Y LHCb | pp at 7, 8, 13 TeV |
| 0.72 ± 0.06 | KHACHATRY...16D | CMS | pp at 7, 8 TeV |
| $0.24^{+0.09}_{-0.08} \pm 0.02$ | ² LEES | 16C BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |

| | | | | |
|---|-------------------|------|------|--------------------------------------|
| 0.65 $^{+0.08}_{-0.07} \pm 0.03$ | AAIJ | 13Y | LHCB | $p p$ at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| 0.69 $^{+0.19}_{-0.21} \pm 0.08$ | AALTONEN | 12I | CDF | $p \bar{p}$ at 1.96 TeV |
| 0.67 $\pm 0.23 \pm 0.05$ | WEI | 09A | BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 0.690 $^{+0.035}_{-0.036} \pm 0.017$ | ¹ AAIJ | 16B | LHCB | Repl. by AAIJ 20Y |
| 0.68 $\pm 0.10 \pm 0.02$ | CHATRCHYAN | 13BL | CMS | Repl. by KHACHATRYAN 16D |
| 0.55 $\pm 0.10 \pm 0.03$ | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| 0.50 $^{+0.27}_{-0.30} \pm 0.03$ | AALTONEN | 11L | CDF | Repl. by AALTONEN 12I |

¹ Measured in $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$.

² Measured by combining B^0 and B^+ with e and μ as leptons. Results are also provided separately for B^0 and B^+ .



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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|-----------------------------|
| 0.33$^{+0.14}_{-0.13} \pm 0.03$ | AALTONEN | 12I | CDF $p \bar{p}$ 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 τ^+ helicities normalized to the sum of those decay widths.

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

¹ Uses a fully reconstructed B meson as a tag on the recoil side.**PARTIAL BRANCHING FRACTIONS IN $B \rightarrow K^{(*)} \ell^+ \ell^-$** **$B(B \rightarrow K^* \ell^+ \ell^-) (q^2 < 2.0 \text{ GeV}^2/c^4)$**

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 1.68 ± 0.23 OUR AVERAGE | | | |
| 1.89 ^{+0.52} _{-0.46} ± 0.06 | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 1.73 ± 0.33 ± 0.10 | AALTONEN | 11AI CDF | $\rho\bar{\rho}$ at 1.96 TeV |
| 1.46 ^{+0.40} _{-0.35} ± 0.11 | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

0.98 ± 0.40 ± 0.09 AALTONEN 11L CDF Repl. by AALTONEN 11AI

¹ 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 0.87 ± 0.17 OUR AVERAGE | | | |
| 0.95 ^{+0.35} _{-0.30} ± 0.04 | LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 0.82 ± 0.26 ± 0.06 | AALTONEN | 11AI CDF | $\rho\bar{\rho}$ at 1.96 TeV |
| 0.86 ^{+0.31} _{-0.27} ± 0.07 | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

1.00 ± 0.38 ± 0.09 AALTONEN 11L CDF Repl. by AALTONEN 11AI

 $B(B \rightarrow K^* \ell^+ \ell^-) (4.3 < q^2 < 8.68 \text{ GeV}^2/c^4)$

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 1.67 ± 0.29 OUR AVERAGE | | | |
| 1.82 ^{+0.56} _{-0.52} ± 0.09 | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 1.72 ± 0.41 ± 0.14 | AALTONEN | 11AI CDF | $\rho\bar{\rho}$ at 1.96 TeV |
| 1.37 ^{+0.47} _{-0.42} ± 0.39 | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

1.69 ± 0.57 ± 0.15 AALTONEN 11L CDF Repl. by AALTONEN 11AI

¹ 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 1.93 ± 0.25 OUR AVERAGE | | | |
| 1.86 ^{+0.52} _{-0.48} ± 0.10 | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 1.77 ± 0.34 ± 0.11 | AALTONEN | 11AI CDF | $\rho\bar{\rho}$ at 1.96 TeV |
| 2.24 ^{+0.44} _{-0.40} ± 0.19 | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

1.97 ± 0.47 ± 0.17 AALTONEN 11L CDF Repl. by AALTONEN 11AI

¹ 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 |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

1.21 ± 0.17 OUR AVERAGE

| | | | |
|---------------------------------|-------------------|------|---|
| $1.46^{+0.41}_{-0.36} \pm 0.06$ | ¹ 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 |
|--------------------------|----------|-----|----------------------------|

¹ The value reported here from LEES 12S refers to $14.21 < q^2 < 16.0 \text{ GeV}^2/c^2$.

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

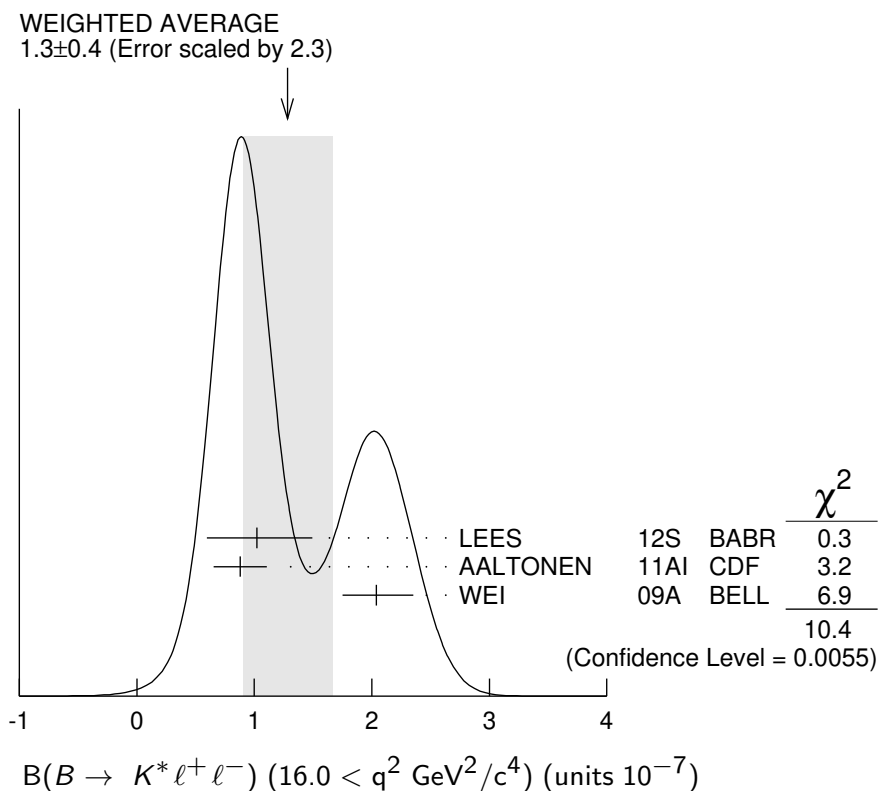
| VALUE (units 10^{-7}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

1.3 ± 0.4 OUR AVERAGE Error includes scale factor of 2.3. See the ideogram below.

| | | | |
|---------------------------------|----------|------|---|
| $1.02^{+0.47}_{-0.42} \pm 0.06$ | LEES | 12S | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.88 \pm 0.22 \pm 0.05$ | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
| $2.04^{+0.27}_{-0.24} \pm 0.16$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

• • • 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
| 1.64 ± 0.26 OUR AVERAGE | | | |

| | | | |
|---------------------------------|----------|------|---|
| $2.05^{+0.53}_{-0.48} \pm 0.07$ | LEES | 12S | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $1.48 \pm 0.39 \pm 0.12$ | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
| $1.49^{+0.45}_{-0.40} \pm 0.12$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

• • • 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|----------------------------|
| $2.53 \pm 0.43 \pm 0.15$ | AALTONEN | 11AI | CDF $p\bar{p}$ 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 |
|--------------------------|----------|-----|----------------------------|

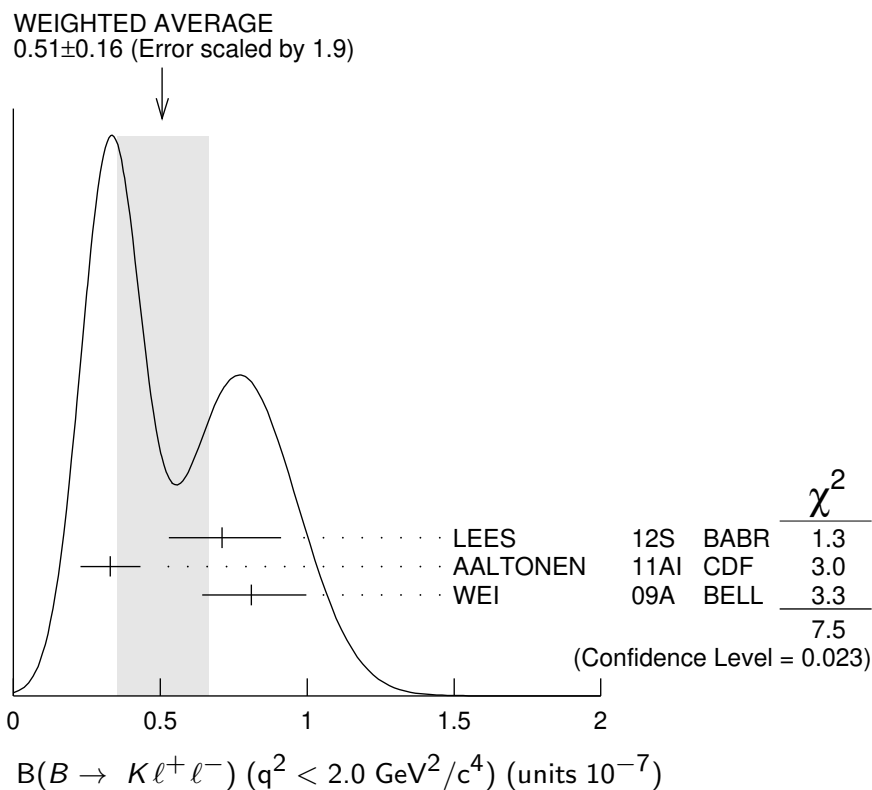
$B(B \rightarrow K \ell^+ \ell^-) (q^2 < 2.0 \text{ GeV}^2/c^4)$

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---|-------------|----------------|
| 0.51 ± 0.16 OUR AVERAGE | Error includes scale factor of 1.9. See the ideogram below. | | |

| | | | |
|---------------------------------|-------------------|------|---|
| $0.71^{+0.20}_{-0.18} \pm 0.02$ | ¹ LEES | 12S | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.33 \pm 0.10 \pm 0.02$ | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
| $0.81^{+0.18}_{-0.16} \pm 0.05$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

• • • 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 |
|--------------------------|----------|-----|----------------------------|



¹The 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
|---|--------------------|-------------|----------------|

0.57^{+0.10}_{-0.09} OUR AVERAGE Error includes scale factor of 1.2.

| | | | |
|---|------|-----|---------------------------------------|
| 0.49 ^{+0.15} _{-0.13} ± 0.01 | LEES | 12S | BABR $e^+ e^- \rightarrow \gamma(4S)$ |
|---|------|-----|---------------------------------------|

| | | | |
|--------------------|----------|------|----------------------------|
| 0.77 ± 0.14 ± 0.05 | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
|--------------------|----------|------|----------------------------|

| | | | |
|---|-----|-----|---------------------------------------|
| 0.46 ^{+0.14} _{-0.12} ± 0.03 | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |
|---|-----|-----|---------------------------------------|

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

| | | | |
|--------------------|----------|-----|----------------------------|
| 0.58 ± 0.19 ± 0.04 | AALTONEN | 11L | CDF Repl. by AALTONEN 11AI |
|--------------------|----------|-----|----------------------------|

$B(B \rightarrow K \ell^+ \ell^-) (4.3 < q^2 < 8.68 \text{ GeV}^2/c^4)$

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
|---|--------------------|-------------|----------------|

1.00 ± 0.11 OUR AVERAGE

| | | | |
|---|-------------------|-----|---------------------------------------|
| 0.94 ^{+0.20} _{-0.19} ± 0.02 | ¹ LEES | 12S | BABR $e^+ e^- \rightarrow \gamma(4S)$ |
|---|-------------------|-----|---------------------------------------|

| | | | |
|--------------------|----------|------|----------------------------|
| 1.05 ± 0.17 ± 0.07 | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
|--------------------|----------|------|----------------------------|

| | | | |
|---|-----|-----|---------------------------------------|
| 1.00 ^{+0.19} _{-0.18} ± 0.06 | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |
|---|-----|-----|---------------------------------------|

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

| | | | |
|--------------------|----------|-----|----------------------------|
| 0.93 ± 0.25 ± 0.06 | AALTONEN | 11L | CDF Repl. by AALTONEN 11AI |
|--------------------|----------|-----|----------------------------|

¹The 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
|---|--------------------|-------------|----------------|

0.57 ± 0.11 OUR AVERAGE Error includes scale factor of 1.4. See the ideogram below.

| | | | |
|---|-------------------|-----|---------------------------------------|
| 0.90 ^{+0.20} _{-0.19} ± 0.04 | ¹ LEES | 12S | BABR $e^+ e^- \rightarrow \gamma(4S)$ |
|---|-------------------|-----|---------------------------------------|

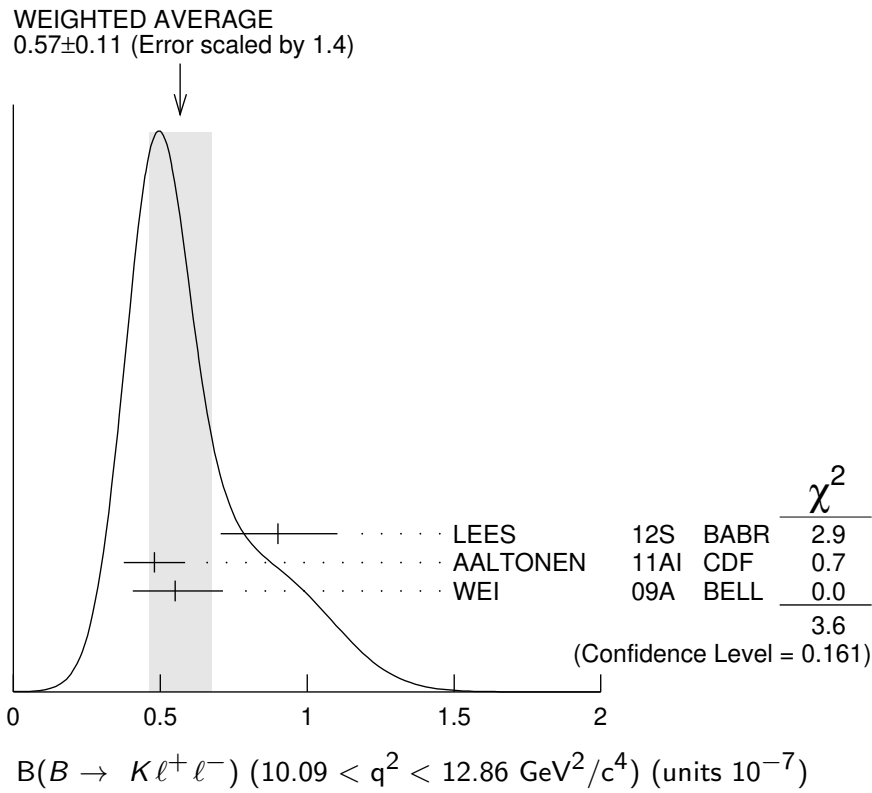
| | | | |
|--------------------|----------|------|----------------------------|
| 0.48 ± 0.10 ± 0.03 | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
|--------------------|----------|------|----------------------------|

| | | | |
|---|-----|-----|---------------------------------------|
| 0.55 ^{+0.16} _{-0.14} ± 0.03 | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |
|---|-----|-----|---------------------------------------|

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

| | | | |
|--------------------|----------|-----|----------------------------|
| 0.72 ± 0.17 ± 0.05 | AALTONEN | 11L | CDF Repl. by AALTONEN 11AI |
|--------------------|----------|-----|----------------------------|

¹The 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 0.49 ± 0.07 OUR AVERAGE | | | |
| $0.49^{+0.15}_{-0.14} \pm 0.02$ | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| $0.52 \pm 0.09 \pm 0.03$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $0.38^{+0.19}_{-0.12} \pm 0.02$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

• • • 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 |
|--------------------------|----------|---------|------------------------|

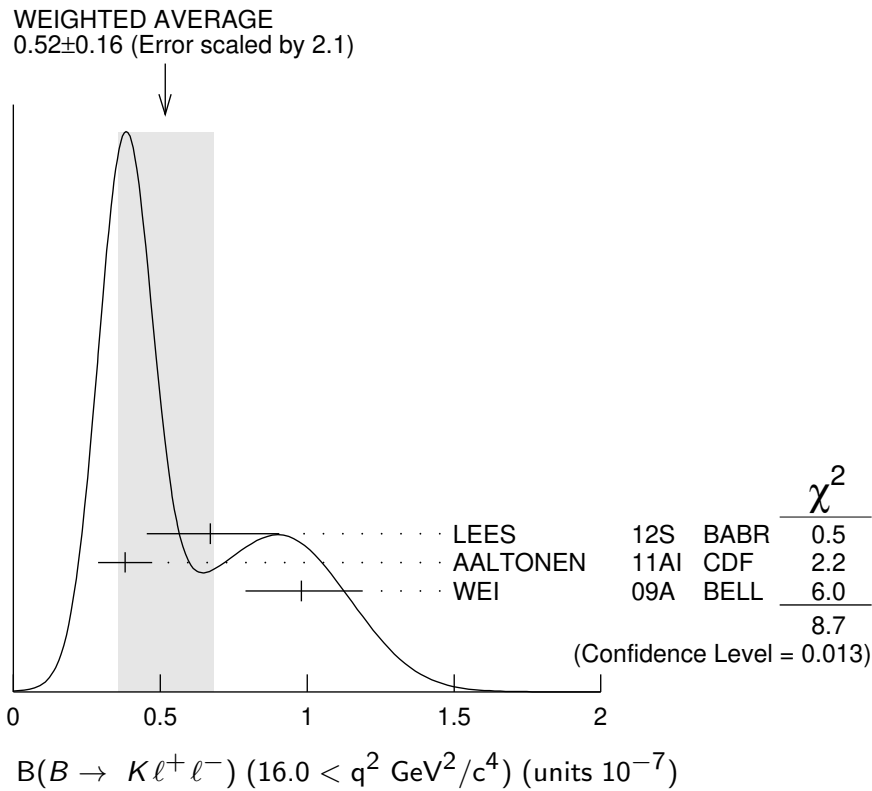
¹ The value reported here from LEES 12S refers to $14.21 < q^2 < 16.0 \text{ GeV}^2/c^2$.

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

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---|-------------|----------------------------------|
| 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 | $e^+ e^- \rightarrow \gamma(4S)$ |
| $0.38 \pm 0.09 \pm 0.02$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $0.98^{+0.20}_{-0.18} \pm 0.06$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

• • • 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 |
|--------------------------|----------|---------|------------------------|



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

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 1.33 ± 0.13 OUR AVERAGE | | | |
| $1.36^{+0.27}_{-0.24} \pm 0.03$ | LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| $1.29 \pm 0.18 \pm 0.08$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $1.36^{+0.23}_{-0.21} \pm 0.08$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |
| $1.01 \pm 0.26 \pm 0.07$ | 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 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|-------------------------------|
| $1.07 \pm 0.17 \pm 0.07$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $0.96 \pm 0.25 \pm 0.06$ | AALTONEN | 11L CDF | Repl. by AALTONEN 11AI |

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|----------------------------------|
| $1.60^{+0.41+0.25}_{-0.39-0.22}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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.

$B(B \rightarrow X_s e^+ e^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------|----------|----------------------------------|
| $1.93^{+0.47+0.28}_{-0.45-0.24}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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.

$B(B \rightarrow X_s \mu^+ \mu^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------|----------|----------------------------------|
| $0.66^{+0.82+0.31}_{-0.76-0.25}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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.

$B(B \rightarrow X_s \ell^+ \ell^-) (14.2 < q^2 \text{ GeV}^2/c^4)$

| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------|----------|----------------------------------|
| $0.57^{+0.16+0.03}_{-0.15-0.02}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 |
|----------------------------------|-------------------|----------|----------------------------------|
| $0.56^{+0.19+0.03}_{-0.18-0.03}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 |
|----------------------------------|-------------------|----------|----------------------------------|
| $0.60^{+0.31+0.05}_{-0.29-0.04}$ | ¹ LEES | 14D BABR | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ 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 θ 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.

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

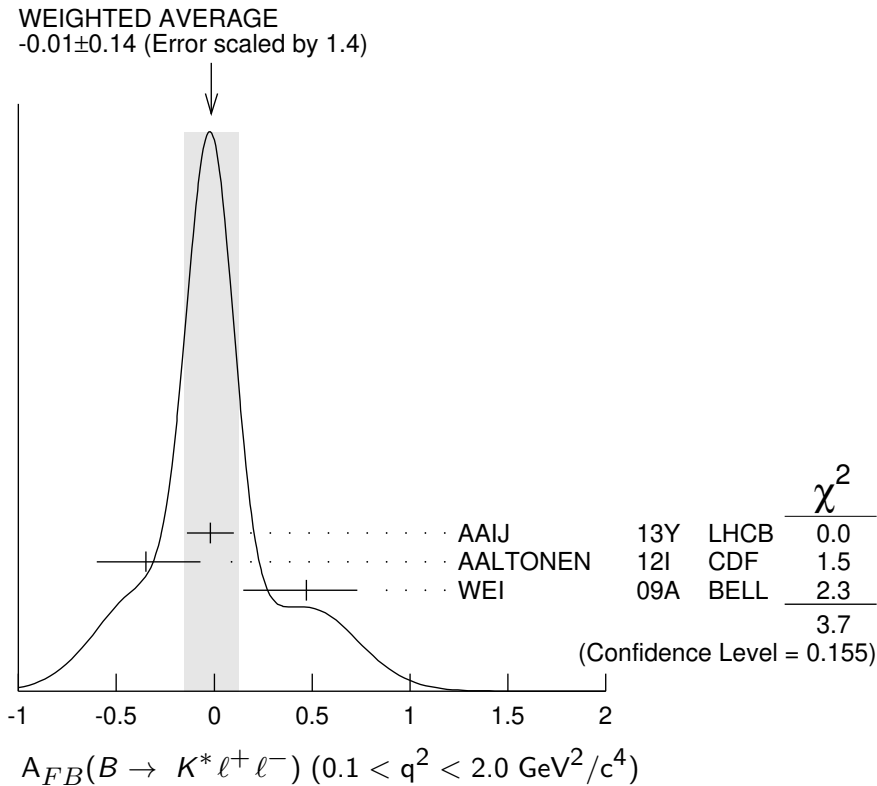
| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-----------------------|----------|------------------------------------|
| $0.50 \pm 0.15 \pm 0.02$ | | ¹ ISHIKAWA | 06 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| >0.55 | 95 | ² AUBERT,B | 06J BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ Using an unbinned max. likelihood fits to the M_{bc} distribution in five q^2 bins for $\cos \theta > 0$ and $\cos \theta < 0$.

² 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 ± 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 | pp 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 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $-0.29^{+0.37}_{-0.00} \pm 0.18$ | ¹ 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 |



¹CHATRCHYAN 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 | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|----------|------------------------------------|
| $0.76^{+0.52}_{-0.32} \pm 0.07$ | AUBERT | 09N BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

| 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 |
|--|-------------------|----------|-------------------------------------|
| -0.14 ± 0.05 OUR AVERAGE | | | |
| $-0.118^{+0.082}_{-0.090} \pm 0.007$ | ¹ 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 |

¹ 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 |
|----------------------------------|-------------|---------|------------------------|
| $-0.08^{+0.21}_{-0.20} \pm 0.05$ | 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 |
|---------------------------------|----------|---------|-----------------------|

$A_{FB}(B \rightarrow K^* \ell^+ \ell^-) (4.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------|-------------|----------|------------------|
| $0.025^{+0.051}_{-0.052} \pm 0.004$ | 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 |
|-------------------------------------|-------------|------|-----------------------|
| $0.152^{+0.041}_{-0.040} \pm 0.008$ | 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 |
|--|-------------------------------------|------|--|
| -0.078 ± 0.022 OUR AVERAGE | Error includes scale factor of 1.1. | | |
| $-0.073 \pm 0.021 \pm 0.002$ | ¹ AAIJ | 20Y | LHCB pp at 7, 8, 13 TeV |
| -0.12 ± 0.08 | KHACHATRY...16D | CMS | pp at 7, 8 TeV |
| $0.21^{+0.10}_{-0.15} \pm 0.07$ | ² 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. • • •

| | | | | |
|--------------------------------------|-------------------|-----|------|-----------------------------------|
| $-0.075^{+0.032}_{-0.034} \pm 0.007$ | ¹ AAIJ | 16B | LHCB | Repl. by AAIJ 20Y |
| 0.55 ± 0.43 | ³ SATO | 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $-0.07 \pm 0.12 \pm 0.01$ | CHATRCHYAN 13BL | CMS | | Repl. by KHACHATRYAN 16D |
| $-0.06^{+0.13}_{-0.14} \pm 0.07$ | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| $0.43^{+0.36}_{-0.37} \pm 0.06$ | AALTONEN | 11L | CDF | Repl. by AALTONEN 12I |

¹ Measured in $1.1 < q^2 < 6.0 \text{ GeV}^2/c^4$.

² Measured by combining B^0 and B^+ with e and μ as leptons. Results are also provided separately for B^0 and B^+ .

³ 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 |
|--|-------------------------------------|------|--|
| $0.13^{+0.06}_{-0.05}$ OUR AVERAGE | Error includes scale factor of 1.1. | | |
| $0.16^{+0.06}_{-0.05} \pm 0.01$ | AAIJ | 13Y | LHCB pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $-0.01 \pm 0.11 \pm 0.03$ | CHATRCHYAN 13BL | CMS | pp at 7 TeV |
| $0.01 \pm 0.20 \pm 0.09$ | AALTONEN | 12I | CDF $p\bar{p}$ at 1.96 TeV |
| $0.45^{+0.15}_{-0.21} \pm 0.15$ | WEI | 09A | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | |
|----------------------------------|----------|-----|------|-----------------------|
| $0.27^{+0.06}_{-0.08} \pm 0.02$ | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| $-0.06^{+0.30}_{-0.28} \pm 0.05$ | 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 |
|---|---|------|---------|
| 0.02 ± 0.13 OUR AVERAGE | Error includes scale factor of 4.5. See the ideogram below. | | |

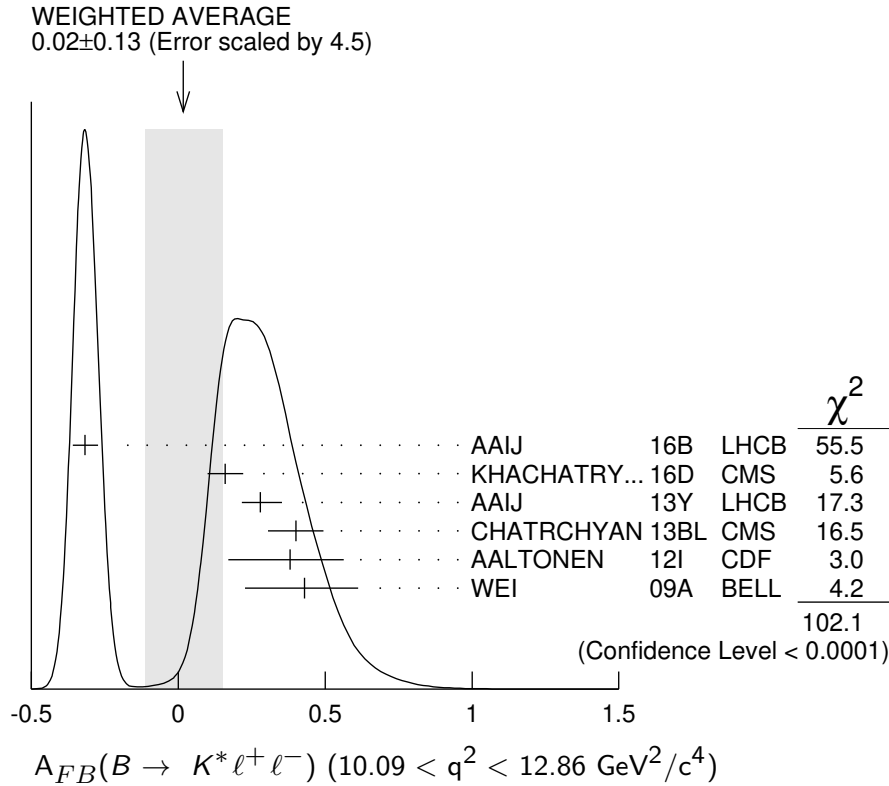
| | | | | |
|--------------------------------------|-------------------|-----|------|------------------|
| $-0.318^{+0.044}_{-0.040} \pm 0.009$ | ¹ AAIJ | 16B | LHCB | pp at 7, 8 TeV |
| $0.16 \pm 0.06 \pm 0.01$ | KHACHATRY...16D | CMS | | pp at 8 TeV |

| | | | | | | |
|------|--------------------|------------|------------|------|------|-------------------------------------|
| 0.28 | $+0.07$ -0.06 | ± 0.02 | AAIJ | 13Y | LHCB | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| 0.40 | ± 0.08 | ± 0.05 | CHATRCHYAN | 13BL | CMS | pp at 7 TeV |
| 0.38 | $+0.16$ -0.19 | ± 0.09 | AALTONEN | 12I | CDF | $p\bar{p}$ at 1.96 TeV |
| 0.43 | $+0.18$ -0.20 | ± 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 | ± 0.02 | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| 0.66 | $+0.23$ -0.20 | ± 0.07 | AALTONEN | 11L | CDF | Repl. by AALTONEN 12I |

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



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

| | | | |
|--------------|--------------------|-------------|----------------|
| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|

0.43^{+0.05}_{-0.06} OUR AVERAGE Error includes scale factor of 1.6. See the ideogram below.

| | | | | | | |
|------|--------------------|------------|--------------|------|------|-------------------------------------|
| 0.39 | $+0.04$ -0.06 | ± 0.01 | KHACHATRY... | 16D | CMS | pp at 8 TeV |
| 0.51 | $+0.07$ -0.05 | ± 0.02 | AAIJ | 13Y | LHCB | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| 0.29 | ± 0.09 | ± 0.05 | CHATRCHYAN | 13BL | CMS | pp at 7 TeV |
| 0.44 | $+0.18$ -0.21 | ± 0.10 | AALTONEN | 12I | CDF | $p\bar{p}$ at 1.96 TeV |
| 0.70 | $+0.16$ -0.22 | ± 0.10 | WEI | 09A | BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

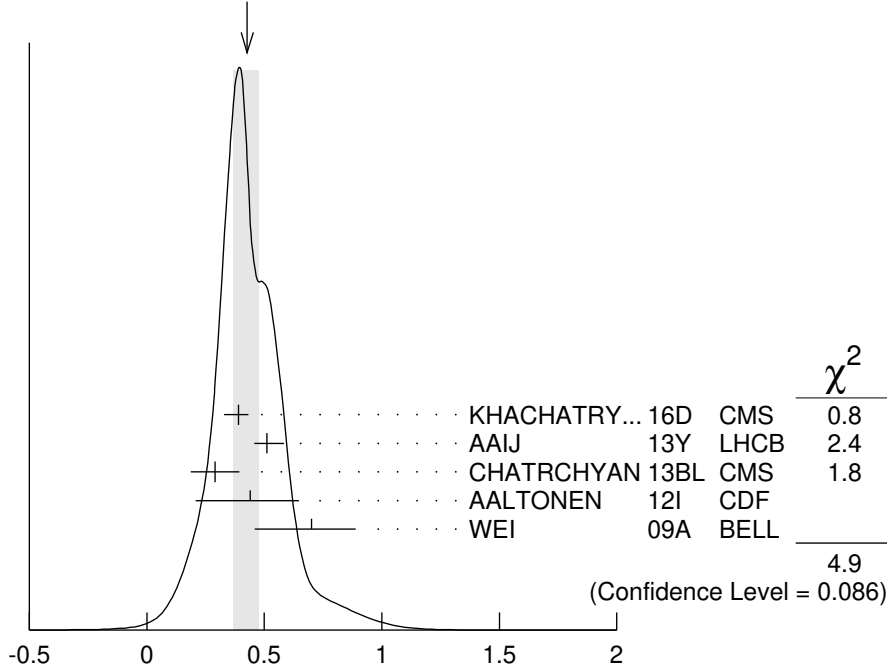
• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | | | | |
|------|--------------------|------------|------|-----|------|-------------------|
| 0.47 | $+0.06$ -0.08 | ± 0.03 | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
|------|--------------------|------------|------|-----|------|-------------------|

0.42±0.16±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 |
|--|-------------------|----------|-------------------------------------|
| 0.362 ± 0.019 OUR AVERAGE | | | |
| $0.353 \pm 0.020 \pm 0.010$ | ¹ AAIJ | 20Y LHCb | pp at 7, 8, 13 TeV |
| $0.35 \pm 0.07 \pm 0.01$ | KHACHATRY...16D | CMS | pp at 8 TeV |
| $0.30 \pm 0.08 \begin{smallmatrix} +0.01 \\ -0.02 \end{smallmatrix}$ | AAIJ | 13Y LHCb | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $0.41 \pm 0.05 \pm 0.03$ | CHATRCHYAN 13BL | CMS | pp 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 | $e^+ e^- \rightarrow \gamma(4S)$ |

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

| | | | |
|--|-------------------|----------|-------------------|
| $0.355 \pm 0.027 \pm 0.009$ | ¹ AAIJ | 16B LHCb | Repl. by AAIJ 20Y |
| $0.16 \begin{smallmatrix} +0.11 \\ -0.13 \end{smallmatrix} \pm 0.06$ | AAIJ | 12U LHCb | Repl. by AAIJ 13Y |

$0.70^{+0.16}_{-0.25} \pm 0.10$ AALTONEN 11L CDF Repl. by AALTONEN 12I

¹ Measured in $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

0.11 ± 0.12 OUR AVERAGE

| | | | |
|---------------------------------|-----------------------|-----|---|
| $0.15^{+0.21}_{-0.23} \pm 0.08$ | ¹ AUBERT,B | 06J | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
|---------------------------------|-----------------------|-----|---|

| | | | |
|--------------------------|-----------------------|----|---|
| $0.10 \pm 0.14 \pm 0.01$ | ² ISHIKAWA | 06 | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |
|--------------------------|-----------------------|----|---|

¹ Results with different q^2 cuts are also reported.

² Using an unbinned max. likelihood fits to the M_{bc} distribution in five q^2 bins for $\cos \theta > 0$ and $\cos \theta < 0$.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.00^{+0.06}_{-0.05}$ OUR AVERAGE

| | | | |
|--------------------------------------|------|-----|---------------------|
| $0.00^{+0.06}_{-0.05} +0.03_{-0.01}$ | AAIJ | 13H | LHCB $p p$ at 7 TeV |
|--------------------------------------|------|-----|---------------------|

| | | | |
|---------------------------------|----------|-----|-----------------------------|
| $0.13^{+0.42}_{-0.43} \pm 0.07$ | AALTONEN | 12I | CDF $p \bar{p}$ at 1.96 TeV |
|---------------------------------|----------|-----|-----------------------------|

| | | | |
|---------------------------------|-----|-----|---|
| $0.06^{+0.32}_{-0.35} \pm 0.02$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |
|---------------------------------|-----|-----|---|

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

| | | | |
|----------------------------------|----------|-----|---------------------------|
| $-0.15^{+0.46}_{-0.39} \pm 0.08$ | AALTONEN | 11L | CDF Repl. by AALTONEN 12I |
|----------------------------------|----------|-----|---------------------------|

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.09^{+0.10}_{-0.07}$ OUR AVERAGE Error includes scale factor of 1.4.

| | | | |
|--------------------------------------|------|-----|---------------------|
| $0.07^{+0.08}_{-0.05} +0.02_{-0.01}$ | AAIJ | 13H | LHCB $p p$ at 7 TeV |
|--------------------------------------|------|-----|---------------------|

| | | | |
|---------------------------------|----------|-----|-----------------------------|
| $0.32^{+0.15}_{-0.16} \pm 0.05$ | AALTONEN | 12I | CDF $p \bar{p}$ at 1.96 TeV |
|---------------------------------|----------|-----|-----------------------------|

| | | | |
|----------------------------------|-----|-----|---|
| $-0.43^{+0.38}_{-0.40} \pm 0.09$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |
|----------------------------------|-----|-----|---|

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

| | | | |
|---------------------------------|----------|-----|---------------------------|
| $0.72^{+0.40}_{-0.35} \pm 0.07$ | AALTONEN | 11L | CDF Repl. by AALTONEN 12I |
|---------------------------------|----------|-----|---------------------------|

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.31 \pm 0.16 \pm 0.04$ AALTONEN 12I CDF $p \bar{p}$ 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 |
|---------------------------------|----------|-----|---------------------------|

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.034^{+0.040}_{-0.029}$ OUR AVERAGE

| | | | |
|--------------------------------------|------|-----|---------------------|
| $0.02^{+0.05}_{-0.03} +0.02_{-0.01}$ | AAIJ | 13H | LHCB $p p$ at 7 TeV |
|--------------------------------------|------|-----|---------------------|

| | | | | |
|---|-------------------|-----|------|-----------------------------------|
| $0.13 \pm 0.09 \pm 0.02$ | AALTONEN | 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.04 \begin{smallmatrix} +0.13 \\ -0.16 \end{smallmatrix} \pm 0.05$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 0.00 ± 0.13 | ¹ SATO | 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.08 \begin{smallmatrix} +0.27 \\ -0.22 \end{smallmatrix} \pm 0.07$ | AALTONEN | 11L | CDF | Repl. by AALTONEN 12I |

¹Statistical 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> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

$-0.04 \begin{smallmatrix} +0.04 \\ -0.05 \end{smallmatrix}$ OUR AVERAGE

| | | | | |
|---|----------|-----|------|-----------------------------------|
| $-0.02 \begin{smallmatrix} +0.03 \\ -0.05 \end{smallmatrix} \pm 0.03$ | AAIJ | 13H | LHCB | pp at 7 TeV |
| $0.01 \begin{smallmatrix} +0.13 \\ -0.10 \end{smallmatrix} \pm 0.01$ | AALTONEN | 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.20 \begin{smallmatrix} +0.12 \\ -0.14 \end{smallmatrix} \pm 0.03$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.20 \begin{smallmatrix} +0.17 \\ -0.28 \end{smallmatrix} \pm 0.03$ | 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> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

-0.05 ± 0.06 OUR AVERAGE

| | | | | |
|---|----------|-----|------|-----------------------------------|
| $-0.03 \pm 0.07 \pm 0.01$ | AAIJ | 13H | LHCB | pp at 7 TeV |
| $-0.03 \begin{smallmatrix} +0.11 \\ -0.10 \end{smallmatrix} \pm 0.04$ | AALTONEN | 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.21 \begin{smallmatrix} +0.17 \\ -0.15 \end{smallmatrix} \pm 0.06$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $-0.10 \begin{smallmatrix} +0.17 \\ -0.15 \end{smallmatrix} \pm 0.07$ | 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> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

$-0.02 \begin{smallmatrix} +0.07 \\ -0.05 \end{smallmatrix}$ OUR AVERAGE

| | | | | |
|---|----------|-----|------|-----------------------------------|
| $-0.01 \begin{smallmatrix} +0.12 \\ -0.06 \end{smallmatrix} \pm 0.01$ | AAIJ | 13H | LHCB | pp at 7 TeV |
| $-0.05 \begin{smallmatrix} +0.09 \\ -0.11 \end{smallmatrix} \pm 0.03$ | AALTONEN | 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $0.04 \begin{smallmatrix} +0.32 \\ -0.26 \end{smallmatrix} \pm 0.05$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $0.03 \begin{smallmatrix} +0.49 \\ -0.16 \end{smallmatrix} \pm 0.04$ | 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> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

$-0.09 \begin{smallmatrix} +0.07 +0.02 \\ -0.09 -0.01 \end{smallmatrix}$ AAIJ 13H LHCB pp at 7 TeV

$A_{FB}(B \rightarrow K\ell^+\ell^-)$ ($18.0 < q^2 < 22.0 \text{ GeV}^2/c^4$)

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|--------------------|
| $0.02 \pm 0.11 \pm 0.01$ | AAIJ | 13H | LHCB pp at 7 TeV |

$A_{FB}(B \rightarrow K\ell^+\ell^-)$ ($q^2 > 16.0 \text{ GeV}^2/c^4$)

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|---------|
| $0.04^{+0.09}_{-0.07}$ OUR AVERAGE | | | |

$0.09^{+0.17}_{-0.13} \pm 0.03$ AALTONEN 12I CDF $p\bar{p}$ at 1.96 TeV

$0.02^{+0.11}_{-0.08} \pm 0.02$ WEI 09A BELL $e^+e^- \rightarrow \gamma(4S)$

• • • 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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

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

0.74 ± 0.54 ¹SATO 16 BELL $e^+e^- \rightarrow \gamma(4S)$

¹ 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.81^{+0.58}_{-0.61} \pm 0.46$ ¹AUBERT,B 06J BABR $e^+e^- \rightarrow \gamma(4S)$

¹ Results with different q^2 cuts are also reported.

$A_{FB}(B \rightarrow K\rho\bar{\rho})$ ($m_{\rho\bar{\rho}} < 2.85 \text{ GeV}/c^2$)

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$0.495 \pm 0.012 \pm 0.007$ ¹AAIJ 14AF LHCB pp at 7, 8 TeV

¹ Measured in $B^+ \rightarrow K^+\rho\bar{\rho}$ decays.

$A_{FB}(B \rightarrow \pi\rho\bar{\rho})$ ($m_{\rho\bar{\rho}} < 2.85 \text{ GeV}/c^2$)

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$-0.409 \pm 0.033 \pm 0.006$ ¹AAIJ 14AF LHCB pp at 7, 8 TeV

¹ Measured in $B^+ \rightarrow \pi^+\rho\bar{\rho}$ decays.

ISOSPIN ASYMMETRY

Δ_{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 |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

-0.005 ± 0.020 **OUR AVERAGE**

$-0.0048 \pm 0.0149 \pm 0.0150$ ¹WATANUKI 19 BELL $e^+e^- \rightarrow \gamma(4S)$

$-0.006 \pm 0.058 \pm 0.026$ AUBERT,B 05R BABR $e^+e^- \rightarrow \gamma(4S)$

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

$\Delta_{0-}(B(B \rightarrow X_{s+d}\gamma))$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|------------------------|---------------------|----------|-----------------------------------|
| -0.06±0.15±0.07 | ¹ AUBERT | 080 BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ Uses a fully reconstructed B meson as a tag on the recoil side. The result is for $E_\gamma > 2.2 \text{ GeV}$.

$\Delta_{0+}(B \rightarrow K^*(892)\gamma)$

Δ_{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±0.017 OUR AVERAGE | | | |

0.062±0.015±0.013 ¹ Horiguchi 17 BELL $e^+e^- \rightarrow \Upsilon(4S)$

0.066±0.021±0.022 ² AUBERT 09AO BABR $e^+e^- \rightarrow \Upsilon(4S)$

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

0.050±0.045±0.037 ³ AUBERT,BE 04A BABR Repl. by AUBERT 09AO

0.012±0.044±0.026 NAKAO 04 BELL Repl. by Horiguchi 17

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

² 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 $0.017 < \Delta_{0+} < 0.116$

³ 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 $-0.046 < \Delta_{0+} < 0.146$.

$\Delta_{\rho\gamma} = \Gamma(B^+ \rightarrow \rho^+\gamma) / (2 \cdot \Gamma(B^0 \rightarrow \rho^0\gamma)) - 1$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------------|------|---------|
| -0.46±0.17 OUR AVERAGE | | | |

-0.43^{+0.25}_{-0.22}±0.10 AUBERT 08BH BABR $e^+e^- \rightarrow \Upsilon(4S)$

-0.48^{+0.21}_{-0.19}^{+0.08}_{-0.09} TANIGUCHI 08 BELL $e^+e^- \rightarrow \Upsilon(4S)$

$\Delta_{0-}(B(B \rightarrow K\ell^+\ell^-))$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|-------------------------------------|------|---------|
| -0.15±0.06 OUR AVERAGE | Error includes scale factor of 1.2. | | |

-0.31^{+0.13}_{-0.11}±0.01 ¹ CHOUDHURY 21 BELL $e^+e^- \rightarrow \Upsilon(4S)$

-0.10^{+0.08}_{-0.09}±0.02 ² AAIJ 14M LHCB pp at 7, 8 TeV

-0.09^{+0.08}_{-0.08}±0.02 ³ AAIJ 14M LHCB pp at 7, 8 TeV

-0.58^{+0.29}_{-0.37}±0.02 ⁴ LEES 12S BABR $e^+e^- \rightarrow \Upsilon(4S)$

••• 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}±0.05 ^{6,7} AUBERT 09T BABR Repl. by LEES 12S

-0.31^{+0.17}_{-0.14}±0.08 ^{8,9} WEI 09A BELL $e^+e^- \rightarrow \Upsilon(4S)$

- ¹ For $1.0 < q^2 < 6.0 \text{ GeV}^2/c^4$ using both $\mu^+\mu^-$ and e^+e^- as a lepton pair. Measurements in other q^2 bins are also reported.
- ² 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.
- ³ 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.
- ⁴ For $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$. Measurements in other q^2 bins are also reported.
- ⁵ For $1 < q^2 < 6 \text{ GeV}^2/c^4$.
- ⁶ For $0.1 < m_{\ell^+\ell^-}^2 < 7.02 \text{ GeV}^2/c^4$.
- ⁷ Assumes equal production of B^+ and B^0 at the $\Upsilon(4S)$.
- ⁸ Superseded by CHOUDHURY 21.
- ⁹ For $q^2 < 8.68 \text{ GeV}^2/c^4$.

$\Delta_0(B(B \rightarrow K^*\ell^+\ell^-))$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

$-0.03^{+0.08}_{-0.07}$ OUR AVERAGE 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 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $-0.29 \pm 0.16 \pm 0.09$ | 4 WEI | 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| -0.15 ± 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 |

- ¹ 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.
- ² 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.
- ³ For $0.10 < q^2 < 8.12 \text{ GeV}^2/c^4$. Measurements in other q^2 bins are also reported.
- ⁴ For $q^2 < 8.68 \text{ GeV}^2/c^4$.
- ⁵ For $1 < q^2 < 6 \text{ GeV}^2/c^4$.
- ⁶ For $0.1 < m_{\ell^+\ell^-}^2 < 7.02 \text{ GeV}^2/c^4$.
- ⁷ Assumes equal production of B^+ and B^0 at the $\Upsilon(4S)$.

$\Delta_0(B(B \rightarrow K^{(*)}\ell^+\ell^-))$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

-0.45 ± 0.17 OUR AVERAGE Error includes scale factor of 1.7.

| | | | |
|----------------------------------|------------|----------|-----------------------------------|
| $-0.64^{+0.15}_{-0.14} \pm 0.03$ | 1,2 AUBERT | 09T BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $-0.30^{+0.12}_{-0.11} \pm 0.08$ | 3 WEI | 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

- ¹ For $0.1 < m_{\ell^+\ell^-}^2 < 7.02 \text{ GeV}^2/c^4$.
- ² Assumes equal production of B^+ and B^0 at the $\Upsilon(4S)$.
- ³ 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 ²) | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|------|--------------------------------------|
| 0.36 ± 0.08 OUR AVERAGE | Error includes scale factor of 1.8. | | |
| 0.467 ± 0.038 ± 0.068 | ¹ ACOSTA | 05F | CDF $p\bar{p}$ at 1.96 TeV |
| 0.293 ± 0.012 ± 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 ± 0.023 ± 0.062 | ³ CRONIN-HEN..01B | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

¹ Moments are measured with a minimum lepton momentum of 0.7 GeV/c in the B rest frame;

² Uses minimum lepton energy of 1.5 GeV and also reports moments with $E_\ell > 1.0$ GeV.

³ The leptons are required to have $P_\ell > 1.5$ GeV/c.

 $\langle M_X^2 \rangle$ (First Moments)

| VALUE (GeV ²) | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-----------------------|------|--------------------------------------|
| 4.156 ± 0.029 OUR AVERAGE | | | |
| 4.144 ± 0.028 ± 0.022 | ¹ SCHWANDA | 07 | BELL $e^+e^- \rightarrow \gamma(4S)$ |
| 4.18 ± 0.04 ± 0.03 | ¹ AUBERT,B | 04 | BABR $e^+e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5$ GeV/c.

 $\langle (M_X^2 - \overline{M}_X^2)^2 \rangle$ (Second Moments)

| VALUE (GeV ⁴) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------------|------|--------------------------------------|
| 0.55 ± 0.08 OUR AVERAGE | | | |
| 0.515 ± 0.061 ± 0.064 | ¹ SCHWANDA | 07 | BELL $e^+e^- \rightarrow \gamma(4S)$ |
| 0.629 ± 0.031 ± 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 ± 0.26 ± 0.13 | ³ ACOSTA | 05F | CDF $p\bar{p}$ at 1.96 TeV |
| 0.576 ± 0.048 ± 0.168 | ¹ CRONIN-HEN..01B | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5$ GeV/c.

² Uses minimum lepton energy of 1.5 GeV and also reports moments with $E_\ell > 1.0$ GeV.

³ 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 ⁴) | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------------------------------|------|---------------------------------|
| 0.639 ± 0.056 ± 0.178 | ¹ CRONIN-HEN..01B | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5$ GeV/c.

 $B \rightarrow X_c \ell \nu$ LEPTON MOMENTUM MOMENTS **$R_0 (\Gamma_{E_l > 1.7\text{GeV}} / \Gamma_{E_l > 1.5\text{GeV}})$**

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|----------------------|------|--------------------------------------|
| 0.6187 ± 0.0014 ± 0.0016 | ¹ MAHMOOD | 03 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_l > 1.5$ GeV in the B rest frame.

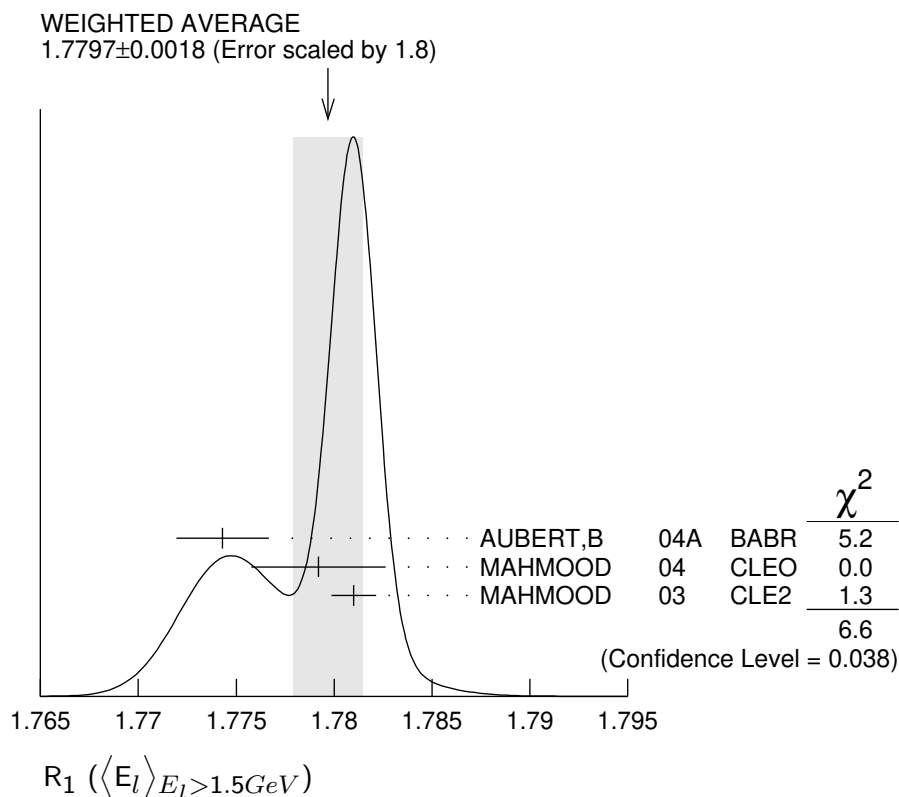
$R_1 (\langle E_l \rangle_{E_l > 1.5 \text{ GeV}})$

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|------------------------------------|---|-------------|----------------------------------|
| 1.7797 ± 0.0018 OUR AVERAGE | Error includes scale factor of 1.8. See the ideogram below. | | |
| 1.7743 ± 0.0019 ± 0.0014 | 1 AUBERT,B | 04A BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 1.7792 ± 0.0021 ± 0.0027 | 2 MAHMOOD | 04 CLEO | $e^+ e^- \rightarrow \gamma(4S)$ |
| 1.7810 ± 0.0007 ± 0.0009 | 3 MAHMOOD | 03 CLE2 | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_l > 1.5$ GeV in the B rest frame. The result with $E_l > 0.6$ GeV is also given.

² Uses $E_e > 1.5$ GeV and also reports moments with other minimum minimum E_e conditions, as low as $E_e > 0.6$ GeV.

³ The leptons are required to have $E_l > 1.5$ GeV in the B rest frame.



$R_2 (\langle E_l^2 - \bar{E}_l^2 \rangle_{E_l > 1.5 \text{ GeV}})$

| <u>VALUE (10^{-3} GeV^2)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| 30.8 ± 0.8 OUR AVERAGE | | | |
| 30.3 ± 0.9 ± 0.5 | 1 AUBERT,B | 04A BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 31.6 ± 0.8 ± 1.0 | 2 MAHMOOD | 04 CLEO | $e^+ e^- \rightarrow \gamma(4S)$ |

¹ The leptons are required to have $E_l > 1.5$ GeV in the B rest frame. The result with $E_l > 0.6$ GeV is also given.

² Uses $E_e > 1.5$ GeV and also reports moments with other minimum minimum E_e conditions, as low as $E_e > 0.6$ GeV.

$R_3 (\langle E_l^3 - \bar{E}_l^3 \rangle_{E_l > 1.5 \text{ GeV}})$

| VALUE (10^{-3} GeV^3) | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------|-----------------------|------|--|
| 2.12 ± 0.47 ± 0.20 | ¹ AUBERT,B | 04A | BABR $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ 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 |
|---|------------------------|------|--|
| 2.314 ± 0.011 OUR AVERAGE | | | |
| 2.346 ± 0.018 ^{+0.027} _{-0.022} | 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 | ³ 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 | ³ AUBERT,BE | 06B | BABR Repl. by LEES 12V |

¹ 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.

² Results for different E_γ threshold values are also measured.

³ The result is for $E_\gamma > 1.9 \text{ GeV}$.

⁴ 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} GeV^2) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------|------|--|
| 3.03 ± 0.25 OUR AVERAGE | | | |
| 2.11 ± 0.57 ^{+0.55} _{-0.69} | 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 | ³ 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 | ³ AUBERT,BE | 06B | BABR Repl. by LEES 12V |

¹ 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.

² Results for different E_γ threshold values are also measured.

³ The result is for $E_\gamma > 1.9 \text{ GeV}$.

⁴ Uses a fully reconstructed B meson as a tag on the recoil side.

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| BORTOLETTO | 86 | PRL 56 800 | D. Bortoletto <i>et al.</i> | (CLEO Collab.) |
| HAAS | 86 | PRL 56 2781 | J. Haas <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 85H | PL 162B 395 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| 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) |
