

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 | $D^* \ell^+ \nu_\ell$ [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} | $D\pi \ell^+ \nu_\ell$ anything + $D^* \pi \ell^+ \nu_\ell$ anything (2.6 \pm 0.5) % | S=1.5 |
| Γ_{13} | $D\pi \ell^+ \nu_\ell$ anything (1.5 \pm 0.6) % | |
| Γ_{14} | $D^* \pi \ell^+ \nu_\ell$ 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} | $\overline{D}\pi^+\pi^-\ell^+\nu_\ell$ | (| 1.62 ± 0.32 |) $\times 10^{-3}$ | |
| Γ_{18} | $\overline{D}^*\pi^+\pi^-\ell^+\nu_\ell$ | (| 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} | $K^0/\overline{K}^0\ell^+\nu_\ell$ anything | [b] (| 4.6 ± 0.5 |) % | |
| Γ_{27} | $\overline{D}\tau^+\nu_\tau$ | (| 9.9 ± 1.2 |) $\times 10^{-3}$ | |
| Γ_{28} | $D^*\tau^+\nu_\tau$ | (| 1.50 ± 0.08 |) % | |

D, D*, or D_s modes

| | | | | | |
|---------------|---|---------|--------------------------|------------------|--------|
| Γ_{29} | D^\pm anything | (| 23.1 ± 1.2 |) % | |
| Γ_{30} | D^0/\overline{D}^0 anything | (| 61.5 ± 2.9 |) % | S=1.3 |
| Γ_{31} | $D^*(2010)^\pm$ anything | (| 22.5 ± 1.5 |) % | |
| Γ_{32} | $D^*(2007)^0$ 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} | $D_s^{*\pm}\overline{D}^*$ | (| 3.4 ± 0.6 |) % | |
| Γ_{36} | $\overline{D}D_{s0}(2317)$ | seen | | | |
| Γ_{37} | $\overline{D}D_{sJ}(2457)$ | seen | | | |
| Γ_{38} | $D^{(*)}\overline{D}^{(*)}K^0 + D^{(*)}\overline{D}^{(*)}K^\pm$ | [f,g] (| 7.1 ± 2.7 $- 1.7$ |) % | |
| Γ_{39} | $b \rightarrow c\overline{c}s$ | (| 22 ± 4 |) % | |
| Γ_{40} | $D_s^{(*)}\overline{D}^{(*)}$ | [f,g] (| 3.9 ± 0.4 |) % | |
| Γ_{41} | $D^*D^*(2010)^\pm$ | [f] < | 5.9 | $\times 10^{-3}$ | CL=90% |
| Γ_{42} | $DD^*(2010)^\pm + D^*D^\pm$ | [f] < | 5.5 | $\times 10^{-3}$ | CL=90% |
| Γ_{43} | DD^\pm | [f] < | 3.1 | $\times 10^{-3}$ | CL=90% |
| Γ_{44} | $D_s^{(*)\pm}\overline{D}^{(*)}\chi(n\pi^\pm)$ | [f,g] (| 9 ± 5 $- 4$ |) % | |
| Γ_{45} | $D^*(2010)\gamma$ | < | 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 |

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|---------------|--|-------|-----------------|--------------------|--------|
| 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} | $K \chi_{c1}(3872), \chi_{c1} \rightarrow D^0 \bar{D}^0 \pi^0$ | (| 1.2 ± 0.4 |) $\times 10^{-4}$ | |
| Γ_{57} | $K \chi_{c1}(3872), \chi_{c1} \rightarrow D^{*0} D^0$ | (| 8.0 ± 2.2 |) $\times 10^{-5}$ | |
| Γ_{58} | $K X(3940), X \rightarrow D^{*0} D^0$ | < | 6.7 | $\times 10^{-5}$ | CL=90% |
| Γ_{59} | $K X(3915), X \rightarrow \omega J/\psi$ | [h] (| 7.1 ± 3.4 |) $\times 10^{-5}$ | |

K or K* modes

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

Light unflavored meson modes

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

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

Baryon modes

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

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

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

| | | | | | | | |
|----------------|------------------------|------|-----|-----------------|-----|------------------|---------|
| Γ_{128} | $K^*(892)e^+e^-$ | $B1$ | (| 1.19 ± 0.20 |) | $\times 10^{-6}$ | $S=1.2$ |
| Γ_{129} | $K\mu^+\mu^-$ | $B1$ | (| 4.4 ± 0.4 |) | $\times 10^{-7}$ | |
| Γ_{130} | $K^*(892)\mu^+\mu^-$ | $B1$ | (| 1.06 ± 0.09 |) | $\times 10^{-6}$ | |
| Γ_{131} | $K\ell^+\ell^-$ | $B1$ | (| 4.8 ± 0.4 |) | $\times 10^{-7}$ | |
| Γ_{132} | $K^*(892)\ell^+\ell^-$ | $B1$ | (| 1.05 ± 0.10 |) | $\times 10^{-6}$ | |
| Γ_{133} | $K\nu\bar{\nu}$ | $B1$ | < | 1.6 | | $\times 10^{-5}$ | CL=90% |
| Γ_{134} | $K^*\nu\bar{\nu}$ | $B1$ | < | 2.7 | | $\times 10^{-5}$ | CL=90% |
| Γ_{135} | $\pi\nu\bar{\nu}$ | $B1$ | < | 8 | | $\times 10^{-6}$ | CL=90% |
| Γ_{136} | $\rho\nu\bar{\nu}$ | $B1$ | < | 2.8 | | $\times 10^{-5}$ | CL=90% |
| Γ_{137} | $se^\pm\mu^\mp$ | LF | [f] | < | 2.2 | $\times 10^{-5}$ | CL=90% |
| Γ_{138} | $\pi e^\pm\mu^\mp$ | LF | < | 9.2 | | $\times 10^{-8}$ | CL=90% |
| Γ_{139} | $\rho e^\pm\mu^\mp$ | LF | < | 3.2 | | $\times 10^{-6}$ | CL=90% |
| Γ_{140} | $Ke^\pm\mu^\mp$ | LF | < | 3.8 | | $\times 10^{-8}$ | CL=90% |
| Γ_{141} | $K^*(892)e^\pm\mu^\mp$ | 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 $e^+e^- \rightarrow \gamma(4S)$ |
| $10.28 \pm 0.18 \pm 0.24$ | ² URQUIJO | 07 | BELL $e^+e^- \rightarrow \gamma(4S)$ |
| $10.91 \pm 0.09 \pm 0.24$ | ³ MAHMOOD | 04 | CLEO $e^+e^- \rightarrow \gamma(4S)$ |
| $9.7 \pm 0.5 \pm 0.4$ | ⁴ ALBRECHT | 93H | ARG $e^+e^- \rightarrow \gamma(4S)$ |

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

| | | | | |
|-----------------|--------------------------|-----|------|-----------------------------------|
| 9.96±0.19±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 $|V_{cb}| = 0.0423 \pm 0.0007(\text{exp}) \pm 0.0020(\text{theo.})$.

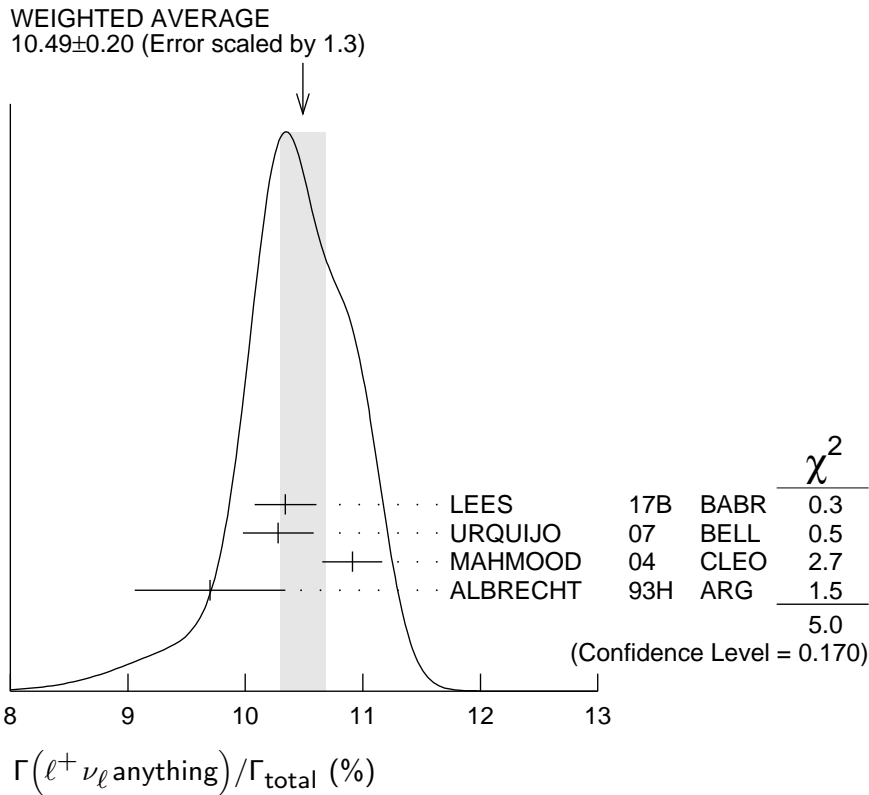
¹⁰ Uses the high-momentum lepton tag method. ABE 02Y also reports $|V_{cb}| = 0.0408 \pm 0.0010(\text{exp}) \pm 0.0025(\text{theo.})$. The second error is due to uncertainties of theoretical inputs.

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 $\sigma(B \rightarrow e\nu up)/\sigma(B \rightarrow e\nu charm) < 0.065$ at 90% CL.
 17 Ratio $\sigma(b \rightarrow e\nu up)/\sigma(b \rightarrow e\nu charm) < 0.055$ at CL = 90%.



$\Gamma(D^- \ell^+ \nu_\ell \text{ anything}) / \Gamma(\ell^+ \nu_\ell \text{ anything})$ 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 ± 0.08 ± 0.10 ABDALLAH 04D DLPH $e^+ e^- \rightarrow Z^0$

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

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

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

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 ± 0.005 ± 0.005 63 ¹ ALBRECHT 93 ARG $e^+ e^- \rightarrow \gamma(4S)$

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

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

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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------------------------|------|-----------------------------|
| 0.026 ± 0.005 OUR AVERAGE | Error includes scale factor of 1.5. | | |
| 0.0340 ± 0.0052 ± 0.0032 | ¹ ABREU | 00R | DLPH $e^+e^- \rightarrow Z$ |
| 0.0226 ± 0.0029 ± 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 .

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

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

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

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

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

| 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.

$$\frac{\Gamma(B \rightarrow \bar{D}_2^*(2460)\ell^+\nu_\ell\text{anything}) \times B(D_2^*(2460) \rightarrow D^{*-}\pi^+)}{\Gamma(B \rightarrow D_1^*(2420)\ell^+\nu_\ell\text{anything}) \times B(D_1^*(2420) \rightarrow D^{*-}\pi^+)}$$

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

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

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 $f_B = 0.37 \pm 0.03$.

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

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

¹ Measurement used electrons and muons as leptons.

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

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

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

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 × 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 × 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

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| 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 $B \rightarrow X e \nu$, 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

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| <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 ± 0.15 ± 0.25 | ² LEES | 12R BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 2.53 ± 0.24 ± 0.24 | ³ AUBERT,B | 05X BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 2.80 ± 0.52 ± 0.41 | ⁴ LIMOSANI | 05 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.77 ± 0.29 ± 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 ± 0.173 ± 0.159 | ⁶ URQUIJO | 10 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.18 ± 0.09 ± 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 ± 0.27 ± 0.47 | ^{9,10} AUBERT | 04I BABR | Repl. by AUBERT,B 05X |

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

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 $(4.41 \pm 0.30 ^{+0.65}_{-0.47} \pm 0.28) \times 10^{-3}$.

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

- 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, $p_l^{*B} > 1.0$ 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.

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

ℓ denotes e or μ , not the sum. These experiments measure this ratio in very limited momentum intervals.

Γ_{23} / Γ_3

| VALUE (units 10^{-2}) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------|-----|------|---|------|---|
| 2.06 ± 0.25 ± 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 AVERAGE0.594 ± 0.021 ± 0.056 ALBRECHT 94C ARG $e^+ e^- \rightarrow \gamma(4S)$ 0.54 ± 0.07 ± 0.06 ¹ ALAM 87B CLEO $e^+ e^- \rightarrow \gamma(4S)$ 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 AVERAGE0.086 ± 0.011 ± 0.044 ALBRECHT 94C ARG $e^+ e^- \rightarrow \gamma(4S)$ 0.10 ± 0.05 ± 0.02 ¹ ALAM 87B CLEO $e^+ e^- \rightarrow \gamma(4S)$ 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 AVERAGE0.452 ± 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

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

40.7 ± 4.6 OUR EVALUATION**41 ± 5 OUR AVERAGE**37.5 ± 6.4 ± 2.6 ^{1,2} HUSCHLE 15 BELL $e^+ e^- \rightarrow \gamma(4S)$ 44.0 ± 5.8 ± 4.2 ^{1,2} 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 ¹ AUBERT 08N BABR Repl. by LEES 12D¹ Uses a fully reconstructed B meson as a tag on the recoil side.² 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. $\Gamma(D^* \tau^+ \nu_\tau) / \Gamma(D^* \ell^+ \nu_\ell)$ 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 |
|---|----------------------|------|--|
| 30.4 ± 1.5 OUR EVALUATION | | | |
| 30.7 ± 2.1 OUR AVERAGE | | | |
| $27.0 \pm 3.5^{+2.8}_{-2.5}$ | ¹ HIROSE | 17 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
| $29.3 \pm 3.8 \pm 1.5$ | ² HUSCHLE | 15 | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |
| $33.2 \pm 2.4 \pm 1.8$ | ² LEES | 12D | BABR $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $29.7 \pm 5.6 \pm 1.8$ | ³ AUBERT | 08N | BABR Repl. by LEES 12D |
| ¹ Uses a fully reconstructed B meson as a tag on the recoil side. | | | |
| ² 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. | | | |
| ³ 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. • • • | | | |
| $0.98 \pm 0.16 \pm 0.12$ | 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 | | | | |
| $0.230 \pm 0.012 \pm 0.004$ | | ¹ GIBBONS | 97B | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.241 \pm 0.037 \pm 0.004$ | | ² BORTOLETTO92 | CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.223 \pm 0.051 \pm 0.004$ | | ³ ALBRECHT | 91H | ARG $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| $0.203 \pm 0.048 \pm 0.003$ | 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

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

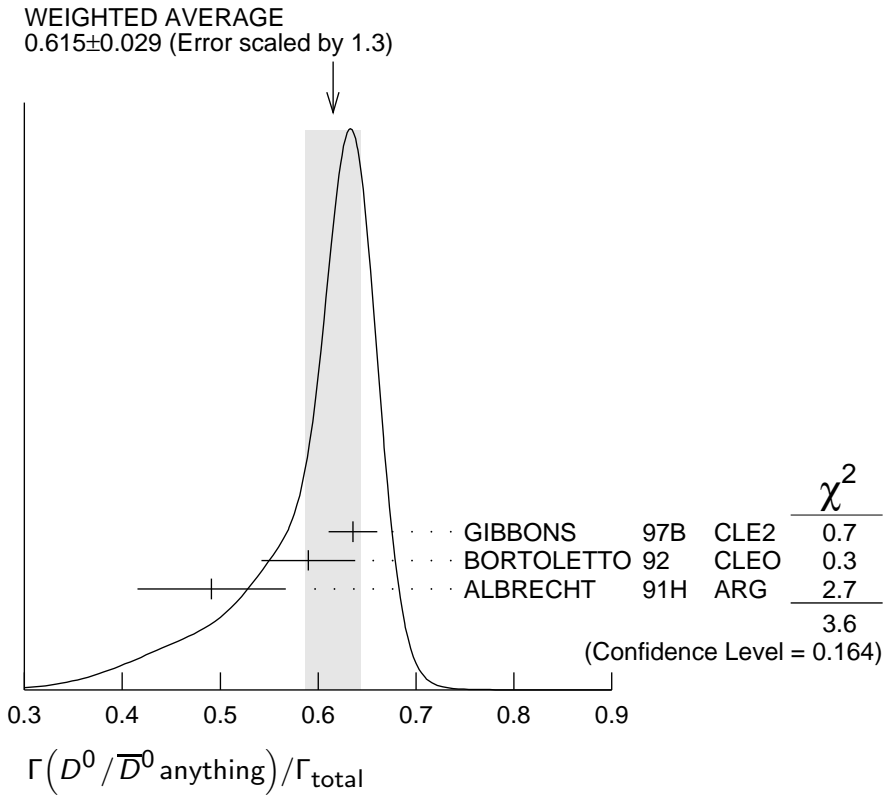
¹ GIBBONS 97B reports $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0251 \pm 0.0006 \pm 0.00075$ which we divide by our best value $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

² BORTOLETTO 92 reports $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0233 \pm 0.0012 \pm 0.0014$ which we divide by our best value $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

⁴ BORTOLETTO 87 reports $[\Gamma(B \rightarrow D^0/\bar{D}^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = 0.0210 \pm 0.0015 \pm 0.0021$ which we divide by our best value $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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 $B(D^0 \rightarrow K^- \pi^+) = (3.950 \pm 0.031) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.



$\Gamma(D^- \ell^+ \nu_\ell \text{ anything})/\Gamma(\bar{D}^0 \ell^+ \nu_\ell \text{ anything})$ Γ_4/Γ_5

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------------|------|---------------------|
| $0.359 \pm 0.006 \pm 0.009$ | ¹ AAIJ | 19AD | LHCB pp 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 | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|-------------------------|------|---|
| 0.225 ± 0.015 OUR AVERAGE | | | | |
| $0.247 \pm 0.019 \pm 0.01$ | | ¹ GIBBONS | 97B | CLE2 $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.205 \pm 0.019 \pm 0.007$ | | ² ALBRECHT | 96D | ARG $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.230 \pm 0.028 \pm 0.009$ | | ³ BORTOLETTO | 92 | CLEO $e^+ e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $0.283 \pm 0.053 \pm 0.002$ | | ⁴ ALBRECHT | 91H | ARG Sup. by ALBRECHT 96D |
| $0.22 \pm 0.04 \begin{smallmatrix} +0.07 \\ -0.04 \end{smallmatrix}$ | 5200 | ⁵ BORTOLETTO | 087 | CLEO $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.27 \pm 0.06 \begin{smallmatrix} +0.08 \\ -0.06 \end{smallmatrix}$ | 510 | ⁶ CSORNA | 85 | CLEO Repl. by BORTOLETTO 87 |

¹ GIBBONS 97B reports $B(B \rightarrow D^*(2010)^+ \text{ anything}) = 0.239 \pm 0.015 \pm 0.014 \pm 0.009$ 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 $B(B \rightarrow D^*(2010)^+ \text{ anything}) = 0.196 \pm 0.019$ using CLEO measured $B(D^*(2010)^+ \rightarrow D^0 \pi^+) = 0.681 \pm 0.01 \pm 0.013$, $B(D^0 \rightarrow K^- \pi^+) = 0.0401 \pm 0.0014$, $B(D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-) = 0.081 \pm 0.005$. We rescale to our PDG 96 values of D and D^* branching ratios. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

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

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

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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------|--------------------------|------|----------------------------------|
| 0.260±0.023±0.015 | ¹ GIBBONS 97B | CLE2 | $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|-------------|------|---------|
| 0.083±0.008 OUR AVERAGE | | | | |

| | | | | |
|-------------------|-----|---------------------------|------|----------------------------------|
| 0.089±0.010±0.008 | | ¹ ARTUSO 05B | CLE2 | $e^+ e^- \rightarrow \gamma(5S)$ |
| 0.087±0.005±0.008 | | ² AUBERT 02G | BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| 0.065±0.011±0.006 | | ³ ALBRECHT 92G | ARG | $e^+ e^- \rightarrow \gamma(4S)$ |
| 0.068±0.010±0.006 | 257 | ⁴ BORTOLETTO90 | CLEO | $e^+ e^- \rightarrow \gamma(4S)$ |
| 0.085±0.022±0.008 | | ⁵ HAAS 86 | CLEO | $e^+ e^- \rightarrow \gamma(4S)$ |

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

| | | | | |
|-------------------|--|---------------------------|------|----------------------------------|
| 0.094±0.007±0.008 | | ⁶ GIBAUT 96 | CLE2 | Repl. by ARTUSO 05B |
| 0.094±0.024±0.008 | | ⁷ ALBRECHT 87H | ARG | $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

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

$\Gamma(\bar{D} D_{sJ}(2457))/\Gamma_{\text{total}}$ 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 $(17.8_{-3.9}^{+4.5} \pm 5.3) \times 10^{-4}$ and $(6.7_{-1.2}^{+1.3} \pm 2.0) \times 10^{-4}$, respectively.

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

| 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.

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

| 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.

$$\frac{\Gamma(D_s^{(*)}\bar{D}^{(*)})}{\Gamma(D_s^\pm \text{ anything})} \quad \Gamma_{40}/\Gamma_{33}$$

Sum over modes.

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---------------------|------|--------------------------------------|
| 0.469 ± 0.017 OUR AVERAGE | | | |
| $0.464 \pm 0.013 \pm 0.015$ | AUBERT | 02G | BABR $e^+e^- \rightarrow \gamma(4S)$ |
| $0.56^{+0.21+0.09}_{-0.15-0.08}$ | ¹ BARATE | 98Q | ALEP $e^+e^- \rightarrow Z$ |
| $0.457 \pm 0.019 \pm 0.037$ | GIBAUT | 96 | CLE2 $e^+e^- \rightarrow \gamma(4S)$ |
| $0.58 \pm 0.07 \pm 0.09$ | ALBRECHT | 92G | ARG $e^+e^- \rightarrow \gamma(4S)$ |
| 0.56 ± 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 $B(B \rightarrow D_s \text{ anything}) = 0.1 \pm 0.025$.

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

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

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

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

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

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

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

| VALUE | 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.

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

| 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.

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

Sum over modes.

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

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%.

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

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

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

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

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

| VALUE (units 10^{-2}) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---|------|-------------------------------------|------|------------------------------------|
| 1.094 ± 0.032 OUR AVERAGE | | Error includes scale factor of 1.1. | | |
| 1.057 ± 0.012 ± 0.040 | | ¹ AUBERT 03F | BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.121 ± 0.013 ± 0.042 | | ANDERSON 02 | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.29 ± 0.45 ± 0.01 | 27 | 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 ± 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.

$\Gamma(J/\psi(1S)\text{(direct) anything})/\Gamma_{\text{total}}$ 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 $B \rightarrow J/\psi(1S)\text{(direct) } X$ branching ratio.

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

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-------------|-----------------------|-------------|------------------------------------|
| 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 $B(B \rightarrow \psi(2S)X, \psi(2S) \rightarrow \ell^+ \ell^-) = 0.30 \pm 0.05 \pm 0.04$ and $B(B \rightarrow \psi(2S)X, \psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = 0.37 \pm 0.05 \pm 0.05$. Weighted average is quoted for $B(B \rightarrow \psi(2S)X)$.

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

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. |
| $3.33 \pm 0.05 \pm 0.24$ | | ¹ BHARDWAJ 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $3.67 \pm 0.35 \pm 0.44$ | | AUBERT 03F | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $4.35 \pm 0.29 \pm 0.40$ | | ANDERSON 02 | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| $3.63 \pm 0.22 \pm 0.34$ | | ² ABE 02L | BELL | Repl. by BHARDWAJ 16 |
| $3.30 \pm 0.35 \pm 0.09$ | | ³ CHEN 01 | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $4.0 \pm 0.6 \pm 0.4$ | 112 | ⁴ BALEST 95B | CLE2 | Repl. by CHEN 01 |
| $10.5 \pm 3.5 \pm 2.5$ | | ⁵ ALBRECHT 92E | ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

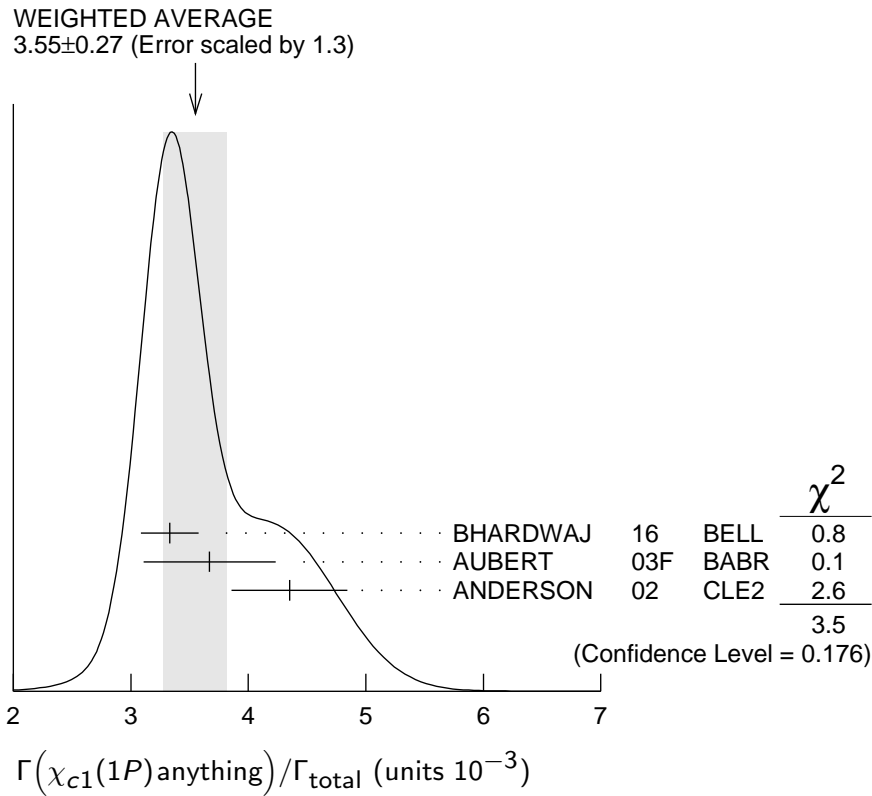
¹ Assumes equal production of B^+ and B^0 at the $\Upsilon(4S)$.

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.



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

| VALUE (units 10^{-3}) | DOCUMENT ID | TECN | COMMENT |
|---|-----------------------|----------|-----------------------------------|
| 3.08±0.19 OUR AVERAGE | | | |
| 3.03±0.05±0.24 | ¹ BHARDWAJ | 16 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.41±0.35±0.42 | AUBERT | 03F BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 3.1 ±0.4 ±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±0.22±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 $[\Gamma(B \rightarrow \chi_{c1}(1P)(\text{direct}) \text{ anything})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))]$ 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 $\Upsilon(4S)$.

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

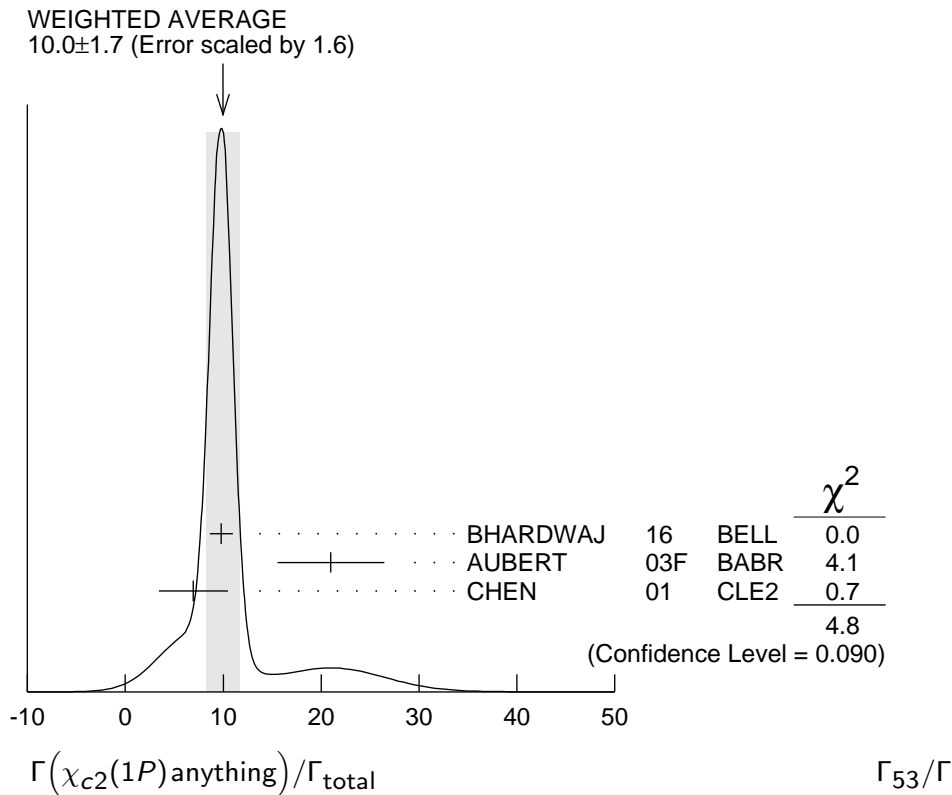
| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-----------------------|----------|-----------------------------------|
| 10.0±1.7 OUR AVERAGE | | | | |
| Error includes scale factor of 1.6. See the ideogram below. | | | | |
| 9.8±0.6±1.0 | | ¹ BHARDWAJ | 16 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 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 $B(B \rightarrow \chi_{c2}(1P)X) = (0.25 \pm 0.10 \pm 0.03) \times 10^{-2}$.



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

| VALUE (units 10^{-3}) | DOCUMENT ID | TECN | COMMENT |
|---|--------------------------|----------|-----------------------------------|
| 0.75 ± 0.11 OUR AVERAGE | | | |
| $0.70 \pm 0.06 \pm 0.10$ | ¹ BHARDWAJ 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $1.90 \pm 0.45 \pm 0.29$ | AUBERT 03F | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $1.53^{+0.23}_{-0.28} \pm 0.27$ | 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 $2960 < m_{\eta_c(1S)} < 3010 \text{ MeV}/c^2$.

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

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------|------|-----------------------------------|
| $1.22 \pm 0.31^{+0.23}_{-0.30}$ | ¹ GOKHROO 06 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ Measure the near-threshold enhancements in the $(D^0\bar{D}^0\pi^0)$ system at a mass $3875.2 \pm 0.7^{+0.3}_{-1.6} \pm 0.8 \text{ MeV}/c^2$.

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

| <u>VALUE (units 10^{-4})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|------------------------------------|
| 0.80 ± 0.20 ± 0.10 | AUSHEV 10 | BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

 $\Gamma(K X(3940), X \rightarrow D^{*0} D^0)/\Gamma_{\text{total}}$ Γ_{58}/Γ

| <u>VALUE (units 10^{-4})</u> | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|------------|--------------------|-------------|------------------------------------|
| <0.67 | 90 | AUSHEV 10 | BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

 $\Gamma(K X(3915), X \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$ Γ_{59}/Γ

| <u>VALUE (units 10^{-5})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|----------------------|-------------|------------------------------------|
| 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_{60}/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_{61}/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_{62}/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---------------------------|------|-----------------------------------|
| 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_{63}/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|---------------------------|------|-----------------------------------|
| 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_{64}/Γ

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

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

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

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

| VALUE (units 10^{-5}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|------------------------|------|-----------------------------------|
| 4.24 ± 0.54 ± 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_{67}/Γ

| VALUE (units 10^{-6}) | DOCUMENT ID | TECN | COMMENT |
|--|-------------------------|------|-----------------------------------|
| 8.5 ± 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_{68}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|------------------------|-----|---------------------|------|--|
| $<12.7 \times 10^{-5}$ | 90 | ¹ COAN | 00 | CLE2 $e^+e^- \rightarrow \Upsilon(4S)$ |
| $< 1.6 \times 10^{-3}$ | 90 | ² LESIAK | 92 | CBAL $e^+e^- \rightarrow \Upsilon(4S)$ |
| $< 4.1 \times 10^{-4}$ | 90 | ALBRECHT | 88H | ARG $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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_{69}/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_{70}/Γ

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

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_{71}/Γ

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

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

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

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

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

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

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_{73}/Γ

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

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

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

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

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

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

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

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

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

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

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

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

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

 $\Gamma(K\phi\phi)/\Gamma_{\text{total}}$ Γ_{77}/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_{78}/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 $0.5\text{--}2.0$ 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 $0.6\text{--}1.8$ 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_{79}/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 $\pm 5 \pm 4$ | 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 $0.5\text{--}2.0$ 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 $0.6\text{--}1.8$ GeV/ c^2 . | | |

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

Γ_{79}/Γ_{78}

| 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. • • • | | |
| $0.033 \pm 0.013 \pm 0.009$ | 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 $0.5\text{--}2.0$ 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 $0.6\text{--}1.8$ GeV/ c^2 . | | |

$\Gamma(\bar{b} \rightarrow \bar{s} \text{gluon})/\Gamma_{\text{total}}$ Γ_{80}/Γ

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------|-----|------|-----------------------|---------|-----------------------------------|
| <0.068 | 90 | | ¹ COAN | 98 CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| <0.08 | | 2 | ² ALBRECHT | 95D ARG | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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 $b \rightarrow s\text{gluon}$ or $b \rightarrow u$ transition. If interpreted as $b \rightarrow s\text{gluon}$ 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_{81}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|------------------------|---------|-----------------------------------|
| $2.61 \pm 0.30^{+0.44}_{-0.74}$ | | ¹ NISHIMURA | 10 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $1.69 \pm 0.29^{+0.36}_{-0.62}$ | | ² NISHIMURA | 10 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| <4.4 | 90 | ³ BROWDER | 98 CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

² Uses $B \rightarrow \eta X_S$ with $1.8 < m_{X_S} < 2.6 \text{ GeV}/c^2$.

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_{82}/Γ

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------|----------|-----------------------------------|
| 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_{83}/Γ

| VALUE (units 10^{-4}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-----------------------------|------|-----------------------------------|
| <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_{84}/Γ

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|--|-----------------------------|------|-----------------------------------|
| $1.95^{+0.51}_{-0.45} \pm 0.50$ | 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_{85}/Γ

| VALUE (units 10^{-6}) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-------------------------------------|-----------|-----------------------------------|
| 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 | 90 | 1,3 AUBERT | 04C BABR | Repl. by AUBERT 07L |
| < 14 | 90 | 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_{85}/Γ_{66}

| VALUE (units 10^{-2}) | 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_{86}/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_{86}/Γ_{66}

| 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_{87}/Γ

| VALUE | 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_{88}/Γ

| VALUE | 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_{89}/Γ

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

 $\Gamma(\rho^0 \text{ anything})/\Gamma_{\text{total}}$ Γ_{90}/Γ

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

 $\Gamma(\omega \text{ anything})/\Gamma_{\text{total}}$ Γ_{91}/Γ

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

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

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------------------|-----|--------------------------|------|---------|
| <2.2 × 10 ⁻⁵ | 90 | ¹ BERGFELD 98 | CLE2 | |

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

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

| VALUE (units 10^{-4}) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----------------------------|------|-----------------------------------|
| $3.72^{+0.50}_{-0.47} \pm 0.59$ | ¹ DEL-AMO-SA..11 | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

| VALUE (%) | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-----------------------|----------|---------------------------------|
| $3.59 \pm 0.32^{+0.19}_{-0.18}$ | | 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.

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------|--------------------|---------|---------------------------------|
| $0.19 \pm 0.13 \pm 0.04$ | ¹ AMMAR | 97 CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

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

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

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|---------|---------------------------------|
| $-2.0 \pm 2.0 \pm 1.9$ | LEES | 12 BABR | $e^+e^- \rightarrow \gamma(4S)$ |

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

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

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

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

| 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 $0.6 \text{ GeV}/c$.

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

| VALUE (units 10^{-2}) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------------|---------|---------------------------------|
| $2.5 \pm 1.1 \pm 0.6$ | 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_{99}/Γ_{98}

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------|-----|-------------------|---------|---------------------------------|
| $<3.5 \times 10^{-2}$ | 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_{102}/Γ_{96}

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---------|-----|---------------------------|------|---------------------------------|
| <0.04 | 90 | 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_{104}/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|--------------------------|------|---------------------------------|
| $0.0033 \pm 0.0017 \pm 0.0002$ | 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_{105}/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 $[\Gamma(B \rightarrow \bar{\Sigma}_c^- \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow p K^- \pi^+)] < 0.00048$ which we divide by our best value $B(\Lambda_c^+ \rightarrow p K^- \pi^+) = 6.28 \times 10^{-2}$.

$\Gamma(\bar{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}$ Γ_{106}/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 $[\Gamma(B \rightarrow \bar{\Sigma}_c^0 \text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow p K^- \pi^+)] = 0.00023 \pm 0.00008 \pm 0.00007$ 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.

$\Gamma(\bar{\Sigma}_c^0 N(N = p \text{ or } n))/\Gamma_{\text{total}}$ Γ_{107}/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 $[\Gamma(B \rightarrow \bar{\Sigma}_c^0 N(N = p \text{ or } n))/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \rightarrow p K^- \pi^+)]$ assuming $B(\Lambda_c^+ \rightarrow p K^- \pi^+) = 0.043$, which we rescale to our best value $B(\Lambda_c^+ \rightarrow p K^- \pi^+) = 6.28 \times 10^{-2}$.

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

| VALUE (units 10^{-3}) | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------------------------|----------|---------------------------------|
| 0.193 ± 0.030 OUR AVERAGE | Error includes scale factor of 1.1. | | |
| 0.211 ± 0.019 ± 0.025 | ¹ AUBERT,B | 05M BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.144 ± 0.048 ± 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_{109}/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_{110}/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 ± 0.005 ± 0.005 | | ALBRECHT 93i | ARG | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.080 ± 0.005 ± 0.003 | | CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.082 ± 0.005 ^{+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_{111}/Γ

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|------|---------------------------|------|---------------------------------|
| 0.055 ± 0.005 OUR AVERAGE | | | | |
| 0.055 ± 0.005 ± 0.0035 | | ALBRECHT 93i | ARG | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.056 ± 0.006 ± 0.005 | | CRAWFORD 92 | CLEO | $e^+e^- \rightarrow \gamma(4S)$ |
| 0.055 ± 0.016 | 1220 | ¹ ALBRECHT 89k | ARG | $e^+e^- \rightarrow \gamma(4S)$ |

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_{112}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------|-----|-----------------------|------|---------------------------------|
| < 5.9 × 10⁻⁴ | 90 | ¹ ADAM 03B | CLE2 | $e^+e^- \rightarrow \gamma(4S)$ |

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

<16 × 10⁻⁴ 90 ALBRECHT 90H ARG $e^+e^- \rightarrow \gamma(4S)$ ¹ Based on $V-A$ model.

$\Gamma(\Lambda/\bar{\Lambda} \text{ anything})/\Gamma_{\text{total}}$ Γ_{113}/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>i.e.</i> , 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, $B(B \rightarrow \Lambda X) = 0.03$. | | | | |

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

| <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 ($P_\ell > 1.4 \text{ GeV}/c^2$). | | | |

 $\Gamma(\Xi^-/\bar{\Xi}^+ \text{ anything})/\Gamma_{\text{total}}$ Γ_{116}/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_{117}/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 92O 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±1.6)% for direct protons and (4.2±0.5±0.6)% for inclusive Λ production. They then assume (5.5±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±1.4)%. | | | |

 $\Gamma(p\bar{p} \text{ anything})/\Gamma_{\text{total}}$ Γ_{118}/Γ Includes p and \bar{p} from Λ and $\bar{\Lambda}$ decay.

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

 $\Gamma(p\bar{p} \text{ anything})/\Gamma(p/\bar{p} \text{ anything})$ $\Gamma_{118}/\Gamma_{110}$ Includes p and \bar{p} from Λ and $\bar{\Lambda}$ decay.

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-----------------------|-------------|-----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.30±0.02±0.05 | ¹ CRAWFORD | 92 CLEO | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ¹ CRAWFORD 92 value is not independent of their $\Gamma(p\bar{p} \text{ anything})/\Gamma_{\text{total}}$ value. | | | |

$\Gamma(\Lambda\bar{p}/\bar{\Lambda}p \text{ anything})/\Gamma_{\text{total}}$ Γ_{119}/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 | $e^+e^- \rightarrow \gamma(4S)$ |

 $\Gamma(\Lambda\bar{p}/\bar{\Lambda}p \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$ $\Gamma_{119}/\Gamma_{113}$ 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_{120}/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 $e^+e^- \rightarrow \gamma(4S)$ $\Gamma(\Lambda\bar{\Lambda} \text{ anything})/\Gamma(\Lambda/\bar{\Lambda} \text{ anything})$ $\Gamma_{120}/\Gamma_{113}$

| 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_{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 |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

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 14D5.0 ± 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 $M_{\ell^+\ell^-} > 0.2 \text{ GeV}/c^2$.

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

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

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

4.3 ± 1.0 OUR AVERAGE

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

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

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

| | | | | |
|-----------------------|--|----------|-----|------------------------|
| $5.0 \pm 2.8 \pm 1.2$ | | AUBERT,B | 04i | BABR Repl. by LEES 14D |
|-----------------------|--|----------|-----|------------------------|

| | | | | |
|-----------------------------|--|--------|----|--------------------------|
| $7.9 \pm 2.1^{+2.1}_{-1.5}$ | | 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 $M_{\ell^+\ell^-} > 0.2 \text{ GeV}/c^2$.

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

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

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

| | | | | |
|-----------------------------------|----|-------|----|--------------------------------------|
| < 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.

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

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

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

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

| | | | |
|-----------------------|-----------------------|-----|------------------------|
| $5.6 \pm 1.5 \pm 1.3$ | ³ AUBERT,B | 04i | BABR Repl. by LEES 14D |
|-----------------------|-----------------------|-----|------------------------|

| | | | |
|-----------------------------|---------------------|----|--------------------------|
| $6.1 \pm 1.4^{+1.4}_{-1.1}$ | 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_{124}/Γ

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|--|-----|---------------------|-----------|-----------------------------------|
| $<5.9 \times 10^{-8}$ | 90 | ¹ LEES | 13M BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $<6.2 \times 10^{-8}$ | 90 | ¹ WEI | 08A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $<9.1 \times 10^{-8}$ | 90 | ¹ AUBERT | 07AG BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|---|-----|-------------------|----------|-----------------------------------|
| $<11.0 \times 10^{-8}$ | 90 | ¹ LEES | 13M BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|--|-----|-------------------|----------|-----------------------------------|
| $<5.0 \times 10^{-8}$ | 90 | ¹ LEES | 13M BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

 $\Gamma(K e^+ e^-)/\Gamma_{\text{total}}$ Γ_{127}/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 | | | | |
| $3.9^{+0.9}_{-0.8} \pm 0.2$ | | ¹ AUBERT | 09T BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $4.8^{+0.8}_{-0.7} \pm 0.3$ | | ¹ WEI | 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $3.3^{+0.9}_{-0.8} \pm 0.2$ | | ¹ AUBERT,B | 06J BABR | Repl. by AUBERT 09T |
| $7.4^{+1.8}_{-1.6} \pm 0.5$ | | ¹ AUBERT | 03U BABR | Repl. by AUBERT,B 06J |
| $4.8^{+1.5}_{-1.3} \pm 0.3$ | | ^{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_{128}/Γ

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

| VALUE (units 10^{-7}) | CL% | DOCUMENT ID | TECN | COMMENT |
|--|-----|---------------------|----------|-------------------------------------|
| 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_{129}/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.

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
| 1.01 ± 0.15 OUR AVERAGE | | | |

| | | | | |
|---------------------------------|-------------------|-----|------|-----------------------------------|
| $1.00^{+0.31}_{-0.25} \pm 0.07$ | ¹ LEES | 12S | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.96^{+0.44}_{-0.34} \pm 0.05$ | AUBERT | 09T | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $1.03 \pm 0.19 \pm 0.06$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | |
|--------------------------|----------|-----|------|---------------------|
| $1.06 \pm 0.48 \pm 0.08$ | AUBERT,B | 06J | BABR | Repl. by AUBERT 09T |
|--------------------------|----------|-----|------|---------------------|

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 $\Gamma(B \rightarrow K\mu^+\mu^-)/\Gamma(B \rightarrow Ke^+e^-) = 0.74^{+0.40}_{-0.31} \pm 0.06$ 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 $q^2 > 10.11 \text{ GeV}^2/c^4$.

$$\Gamma(K^*(892)\mu^+\mu^-)/\Gamma_{\text{total}} \qquad \Gamma_{130}/\Gamma$$

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> |
|---|------------|-----------------------|-------------|---------------------------------|
| 10.6 ± 0.9 OUR AVERAGE | | | | |
| 10.1 ± 1.0 ± 0.5 | | AALTONEN | 11A1 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.

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|---------------------------------|
| 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 $q^2 > 10.11 \text{ GeV}^2/c^4$.

$$\Gamma(K\ell^+\ell^-)/\Gamma_{\text{total}} \qquad \Gamma_{131}/\Gamma$$

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> |
|---|------------|--------------------|-------------|---------------------------------|
| 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. • • •

| | | | | | |
|-----------------------------|----|-----------------------|-----|------|-----------------------------------|
| $3.9 \pm 0.7 \pm 0.2$ | | ¹ AUBERT | 09T | BABR | Repl. by LEES 12S |
| $3.4 \pm 0.7 \pm 0.2$ | | ¹ AUBERT,B | 06J | BABR | Repl. by AUBERT 09T |
| $6.5^{+1.4}_{-1.3} \pm 0.4$ | | ² AUBERT | 03U | BABR | Repl. by AUBERT,B 06J |
| $4.8^{+1.0}_{-0.9} \pm 0.3$ | | ³ ISHIKAWA | 03 | BELL | Repl. by WEI 09A |
| $7.5^{+2.5}_{-2.1} \pm 0.6$ | | ⁴ ABE | 02 | BELL | Repl. by ISHIKAWA 03 |
| < 5.1 | 90 | ¹ AUBERT | 02L | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| < 17 | 90 | ⁵ ANDERSON | 01B | CLE2 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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_{132}/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 | | | | |
| $10.2^{+1.4}_{-1.3} \pm 0.5$ | | LEES | 12S | BABR $e^+e^- \rightarrow \Upsilon(4S)$ |
| $10.7^{+1.1}_{-1.0} \pm 0.9$ | | WEI | 09A | BELL $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | | |
|------------------------------|----|-----------------------|-----|------|-----------------------------------|
| $11.1^{+1.9}_{-1.8} \pm 0.7$ | | ¹ AUBERT | 09T | BABR | Repl. by LEES 12S |
| $7.8^{+1.9}_{-1.7} \pm 1.1$ | | ¹ AUBERT,B | 06J | BABR | Repl. by AUBERT 09T |
| $8.8^{+3.3}_{-2.9} \pm 1.0$ | | ² AUBERT | 03U | BABR | Repl. by AUBERT,B 06J |
| $11.5^{+2.6}_{-2.4} \pm 0.8$ | | 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 | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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_{133}/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 | $e^+e^- \rightarrow \gamma(4S)$ |
| $<1.7 \times 10^{-5}$ | 90 | ^{1,2} LEES 13l | BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| $<1.4 \times 10^{-5}$ | 90 | ¹ DEL-AMO-SA..10Q | BABR | Repl. by LEES 13l |

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

¹ Assumes equal production of B^+ and B^0 at the $\gamma(4S)$.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_{134}/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 | $e^+e^- \rightarrow \gamma(4S)$ |
| $<7.6 \times 10^{-5}$ | 90 | ^{1,2} LEES 13l | BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| $<8 \times 10^{-5}$ | 90 | AUBERT 08BC | BABR | Repl. by LEES 13l |

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

¹ Assumes equal production of B^+ and B^0 at the $\gamma(4S)$.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_{135}/Γ

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

¹ Assumes equal production of B^+ and B^0 at the $\gamma(4S)$. $\Gamma(\rho\nu\bar{\nu})/\Gamma_{\text{total}}$ Γ_{136}/Γ

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

¹ Assumes equal production of B^+ and B^0 at the $\gamma(4S)$. $\Gamma(se^\pm\mu^\mp)/\Gamma_{\text{total}}$ Γ_{137}/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 | $e^+e^- \rightarrow \gamma(4S)$ |

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

Test of lepton family number conservation.

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

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

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

$\Gamma(\rho e^\pm \mu^\mp)/\Gamma_{\text{total}}$ Γ_{139}/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_{140}/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_{141}/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 |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|----------------|
| $0.34^{+0.08}_{-0.07}$ OUR AVERAGE | | | |

| | | | |
|----------------------------------|------|----------|-------------------------------------|
| $0.37^{+0.10+0.04}_{-0.09-0.03}$ | AAIJ | 13Y LHCb | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
|----------------------------------|------|----------|-------------------------------------|

| | | | |
|--------------------------|----------|---------|------------------------|
| $0.30 \pm 0.16 \pm 0.02$ | AALTONEN | 12I CDF | $p\bar{p}$ at 1.96 TeV |
|--------------------------|----------|---------|------------------------|

| | | | |
|---------------------------------|-----|----------|------------------------------------|
| $0.29^{+0.21}_{-0.18} \pm 0.02$ | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
|---------------------------------|-----|----------|------------------------------------|

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

| | | | |
|----------------------------------|------|----------|-------------------------------------|
| $0.74^{+0.10+0.02}_{-0.09-0.03}$ | AAIJ | 13Y LHCb | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
|----------------------------------|------|----------|-------------------------------------|

| | | | |
|--------------------------|---------------------|--|---------------|
| $0.65 \pm 0.17 \pm 0.03$ | CHATRCHYAN 13BL CMS | | pp at 7 TeV |
|--------------------------|---------------------|--|---------------|

| | | | |
|---------------------------------|----------|---------|------------------------|
| $0.37^{+0.25}_{-0.24} \pm 0.10$ | AALTONEN | 12I CDF | $p\bar{p}$ at 1.96 TeV |
|---------------------------------|----------|---------|------------------------|

| | | | |
|--------------------------|-----|----------|------------------------------------|
| $0.71 \pm 0.24 \pm 0.05$ | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
|--------------------------|-----|----------|------------------------------------|

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

| | | | |
|--------------------------|------|----------|-------------------|
| $0.77 \pm 0.15 \pm 0.03$ | AAIJ | 12U LHCb | Repl. by AAIJ 13Y |
|--------------------------|------|----------|-------------------|

| | | | |
|---------------------------------|----------|---------|-----------------------|
| $0.40^{+0.32}_{-0.33} \pm 0.08$ | AALTONEN | 11L CDF | Repl. by AALTONEN 12I |
|---------------------------------|----------|---------|-----------------------|

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> |
|---|--------------------|-------------|------------------|
| $0.611^{+0.052}_{-0.053} \pm 0.017$ | 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> |
|---|--------------------|-------------|------------------|
| $0.579 \pm 0.046 \pm 0.015$ | 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, $K^{*0} \mu^+ \mu^-$ |
| $0.45^{+0.10}_{-0.11} \pm 0.04$ | CHATRCHYAN13BL | 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 ± 0.039 ± 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} ± 0.025 | AAIJ | 16B | LHCB | pp at 7, 8 TeV |
|--|------|-----|------|------------------|

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

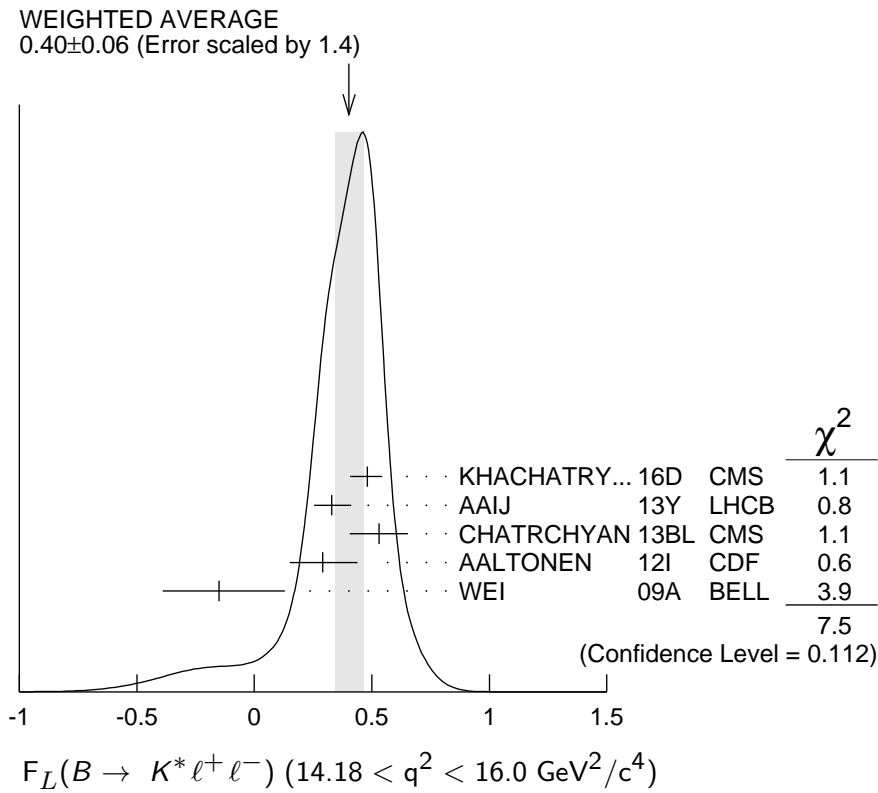
| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|--------------------|-------------|----------------|
|--------------|--------------------|-------------|----------------|

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 |
| $0.33^{+0.08}_{-0.07} + 0.02_{-0.03}$ | AAIJ | 13Y | LHCB | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $0.53 \pm 0.12 \pm 0.03$ | CHATRCHYAN13BL | 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 |
|---|-------------------|----------|-------------------------------------|
| 0.353 ± 0.024 OUR AVERAGE | | | |
| $0.344^{+0.028}_{-0.030} \pm 0.008$ | ¹ AAIJ | 16B LHCb | pp at 7, 8 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. • • •

| | | | |
|---------------------------------|----------|----------|-----------------------|
| $0.26^{+0.10}_{-0.08} \pm 0.03$ | 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 $15.0 < q^2 < 19.0 \text{ GeV}^2/c^4$.

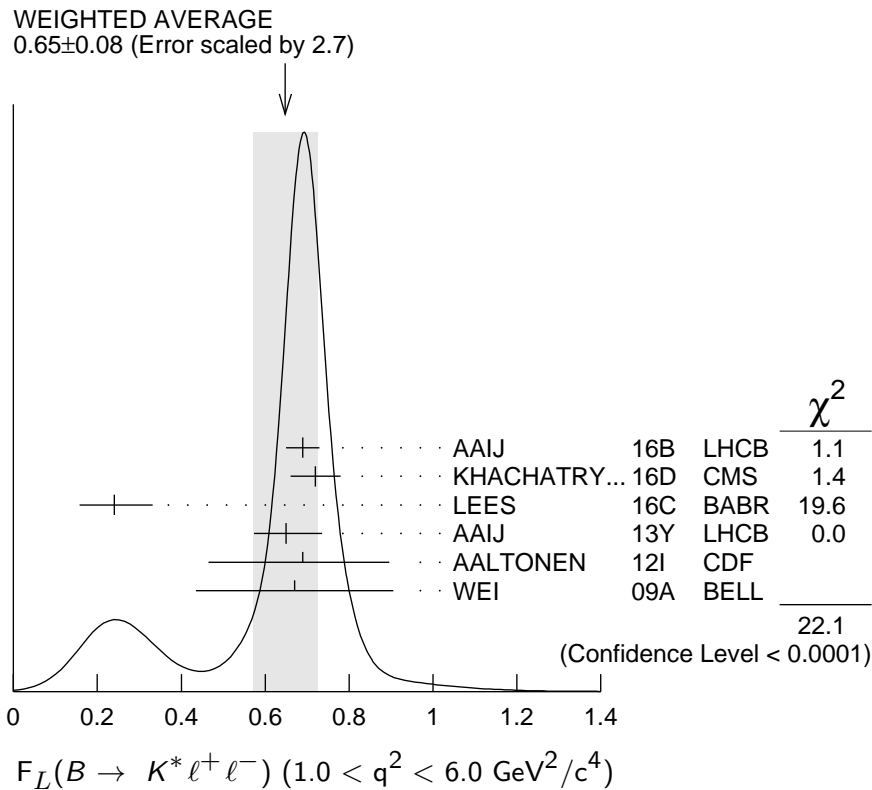
$F_L(B \rightarrow K^* \ell^+ \ell^-) (1.0 < q^2 < 6.0 \text{ GeV}^2/c^4)$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------------|----------|---|
| 0.65 ± 0.08 OUR AVERAGE | | | Error includes scale factor of 2.7. See the ideogram below. |
| $0.690^{+0.035}_{-0.036} \pm 0.017$ | ¹ AAIJ | 16B LHCb | pp at 7, 8 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 | $p\bar{p}$ 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. ● ● ● | | | | | |
| 0.68 | $\pm 0.10 \pm 0.02$ | 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^+ .



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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|------|----------------------------|
| $0.33^{+0.14}_{-0.13} \pm 0.03$ | 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.

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---------------------|------|---------------------------------------|
| $-0.38 \pm 0.51 \begin{smallmatrix} +0.21 \\ -0.16 \end{smallmatrix}$ | ¹ HIROSE | 17 | BELL $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

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

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

$0.98 \pm 0.40 \pm 0.09$ AALTONEN 11L CDF Repl. by AALTONEN 11AI

¹ The value reported here from LEES 12S refers to $0.1 < q^2 < 2.0 \text{ GeV}^2/c^2$.

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

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

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

$1.00 \pm 0.38 \pm 0.09$ AALTONEN 11L CDF Repl. by AALTONEN 11AI

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

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

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

$1.69 \pm 0.57 \pm 0.15$ AALTONEN 11L CDF Repl. by AALTONEN 11AI

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 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.77 ± 0.34 ± 0.11 | AALTONEN | 11AI CDF | $\rho\bar{p}$ at 1.96 TeV |
| 2.24 ^{+0.44} _{-0.40} ± 0.19 | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

• • • 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 $10.11 < q^2 < 12.89 \text{ GeV}^2/c^2$.

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

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|------------------------------------|
| 1.21 ± 0.17 OUR AVERAGE | | | |
| 1.46 ^{+0.41} _{-0.36} ± 0.06 | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.21 ± 0.24 ± 0.07 | AALTONEN | 11AI CDF | $\rho\bar{p}$ at 1.96 TeV |
| 1.05 ^{+0.29} _{-0.26} ± 0.08 | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

1.51 ± 0.36 ± 0.13 AALTONEN 11L CDF Repl. by AALTONEN 11AI

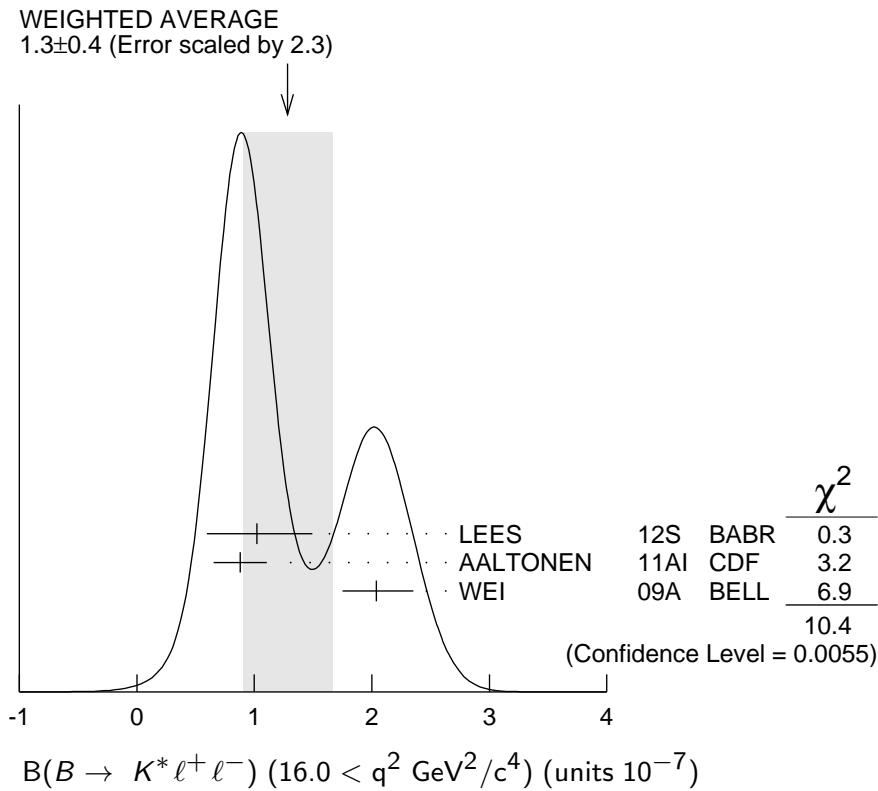
¹ The value reported here from LEES 12S refers to $14.21 < q^2 < 16.0 \text{ GeV}^2/c^2$.

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

| <u>VALUE (units 10^{-7})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|---|-------------|------------------------------------|
| 1.3 ± 0.4 OUR AVERAGE | Error includes scale factor of 2.3. See the ideogram below. | | |
| 1.02 ^{+0.47} _{-0.42} ± 0.06 | LEES | 12S BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 0.88 ± 0.22 ± 0.05 | AALTONEN | 11AI CDF | $\rho\bar{p}$ at 1.96 TeV |
| 2.04 ^{+0.27} _{-0.24} ± 0.16 | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

1.35 ± 0.37 ± 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 | $e^+ e^- \rightarrow \gamma(4S)$ |
| $1.48 \pm 0.39 \pm 0.12$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $1.49^{+0.45}_{-0.40} \pm 0.12$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $1.60 \pm 0.54 \pm 0.14$ | AALTONEN | 11L CDF | Repl. by AALTONEN 11AI |

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

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

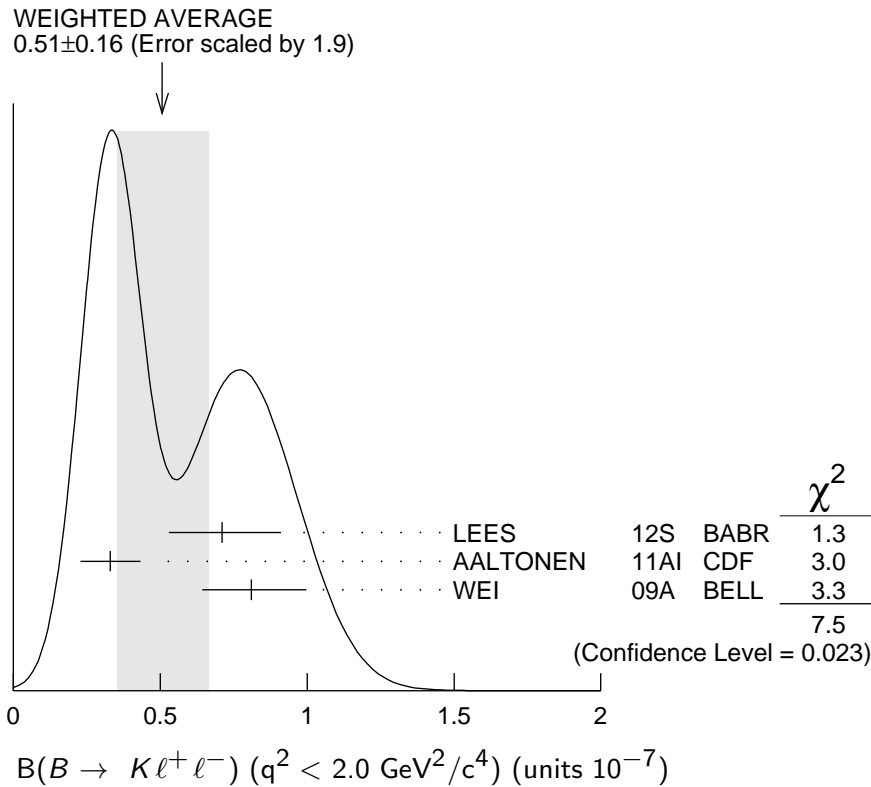
$B(B \rightarrow K \ell^+ \ell^-) (q^2 < 2.0 \text{ GeV}^2/c^4)$

| <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 | $e^+ e^- \rightarrow \gamma(4S)$ |
| $0.33 \pm 0.10 \pm 0.02$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $0.81^{+0.18}_{-0.16} \pm 0.05$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

$0.38 \pm 0.16 \pm 0.03$ AALTONEN 11L CDF Repl. by AALTONEN 11AI

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> |
|---|--------------------|-------------|----------------|
|---|--------------------|-------------|----------------|

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

| | | | |
|---------------------------------|----------|----------|----------------------------------|
| $0.49^{+0.15}_{-0.13} \pm 0.01$ | LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| $0.77 \pm 0.14 \pm 0.05$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $0.46^{+0.14}_{-0.12} \pm 0.03$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

$0.58 \pm 0.19 \pm 0.04$ AALTONEN 11L CDF Repl. by AALTONEN 11AI

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

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

1.00 ± 0.11 OUR AVERAGE

| | | | |
|---------------------------------|-------------------|----------|----------------------------------|
| $0.94^{+0.20}_{-0.19} \pm 0.02$ | ¹ LEES | 12S BABR | $e^+ e^- \rightarrow \gamma(4S)$ |
| $1.05 \pm 0.17 \pm 0.07$ | AALTONEN | 11AI CDF | $\rho \bar{\rho}$ at 1.96 TeV |
| $1.00^{+0.19}_{-0.18} \pm 0.06$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |

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

$0.93 \pm 0.25 \pm 0.06$ 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> |
|---|--------------------|-------------|----------------|
|---|--------------------|-------------|----------------|

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

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

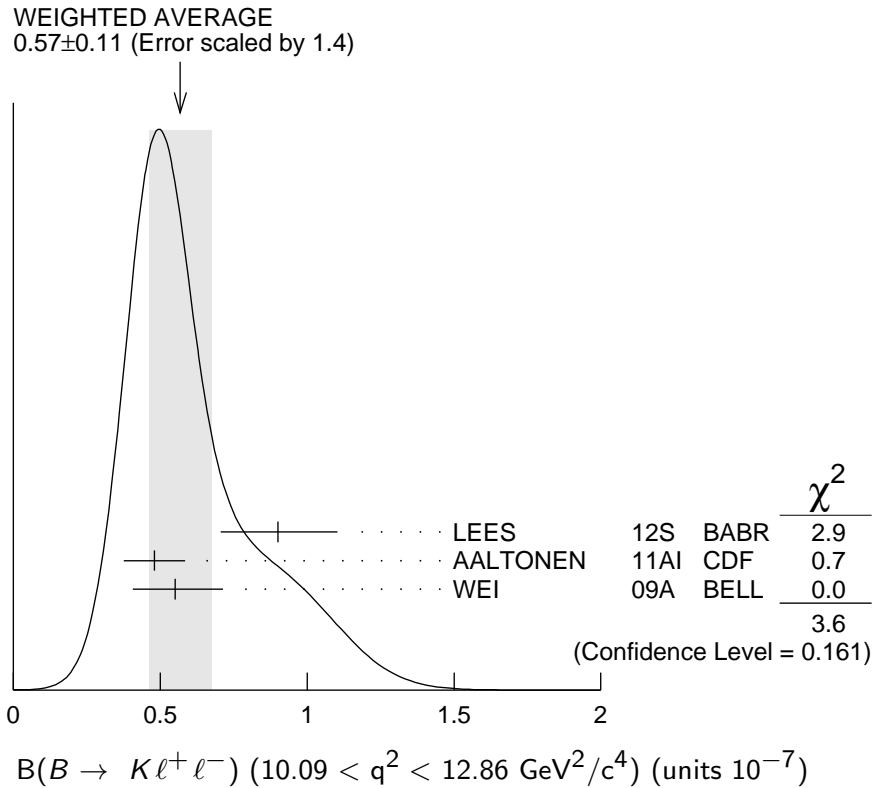
| | | | |
|--------------------------|----------|------|----------------------------|
| $0.48 \pm 0.10 \pm 0.03$ | AALTONEN | 11AI | CDF $p\bar{p}$ at 1.96 TeV |
|--------------------------|----------|------|----------------------------|

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

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

| | | | |
|--------------------------|----------|-----|----------------------------|
| $0.72 \pm 0.17 \pm 0.05$ | AALTONEN | 11L | CDF Repl. by AALTONEN 11AI |
|--------------------------|----------|-----|----------------------------|

¹ The value reported here from LEES 12S refers to $10.11 < q^2 < 12.89 \text{ GeV}^2/c^2$.



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

| <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 $p\bar{p}$ at 1.96 TeV |
|--------------------------|----------|------|----------------------------|

| | | | |
|---------------------------------|-----|-----|---------------------------------------|
| $0.38^{+0.19}_{-0.12} \pm 0.02$ | WEI | 09A | BELL $e^+ e^- \rightarrow \gamma(4S)$ |
|---------------------------------|-----|-----|---------------------------------------|

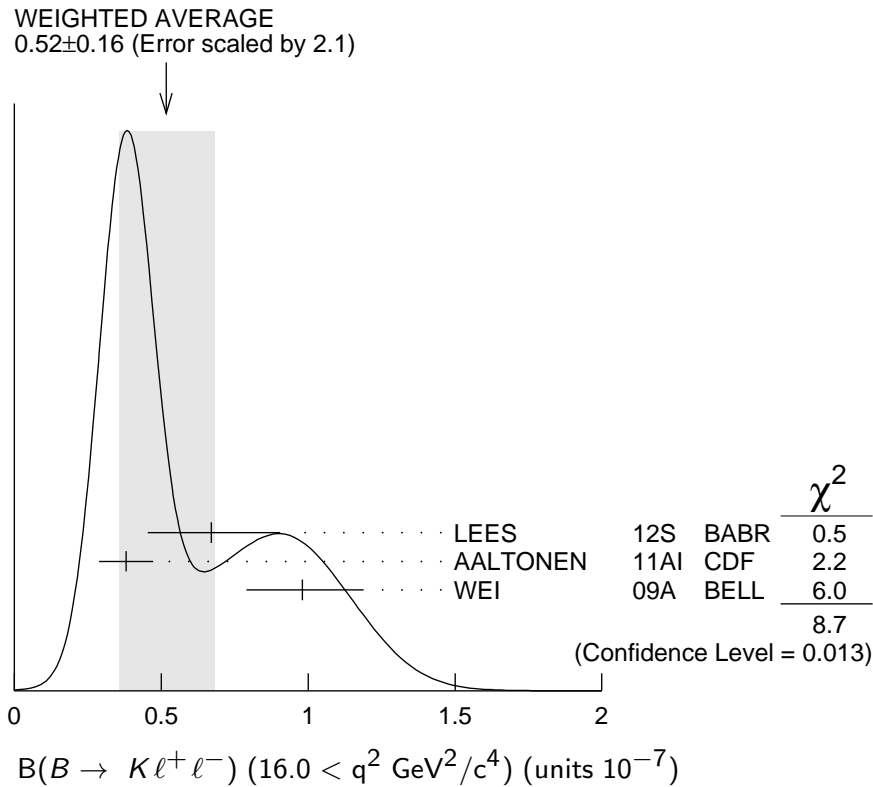
• • • We do not use the following data for averages, fits, limits, etc. • • •

| | | | |
|--------------------------|----------|-----|----------------------------|
| $0.38 \pm 0.12 \pm 0.03$ | 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 | $\rho \bar{p}$ 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 | $\rho \bar{p}$ at 1.96 TeV |
| $1.36^{+0.23}_{-0.21} \pm 0.08$ | WEI | 09A BELL | $e^+ e^- \rightarrow \gamma(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $1.01 \pm 0.26 \pm 0.07$ | AALTONEN | 11L CDF | Repl. by AALTONEN 11AI |

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

| <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 | $\rho \bar{p}$ at 1.96 TeV |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $0.96 \pm 0.25 \pm 0.06$ | AALTONEN | 11L CDF | Repl. by AALTONEN 11AI |

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

| <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.

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| $1.93^{+0.47+0.28}_{-0.45-0.24}$ | 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.

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| $0.66^{+0.82+0.31}_{-0.76-0.25}$ | 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.

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| $0.57^{+0.16+0.03}_{-0.15-0.02}$ | 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.

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| $0.56^{+0.19+0.03}_{-0.18-0.03}$ | 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.

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

| <u>VALUE (units 10^{-6})</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------------------------|
| $0.60^{+0.31+0.05}_{-0.29-0.04}$ | 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 ℓ^- (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 | $p p$ at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $-0.35^{+0.26}_{-0.23} \pm 0.10$ | AALTONEN | 12I CDF | $p \bar{p}$ at 1.96 TeV |
| $0.47^{+0.26}_{-0.32} \pm 0.03$ | WEI | 09A BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

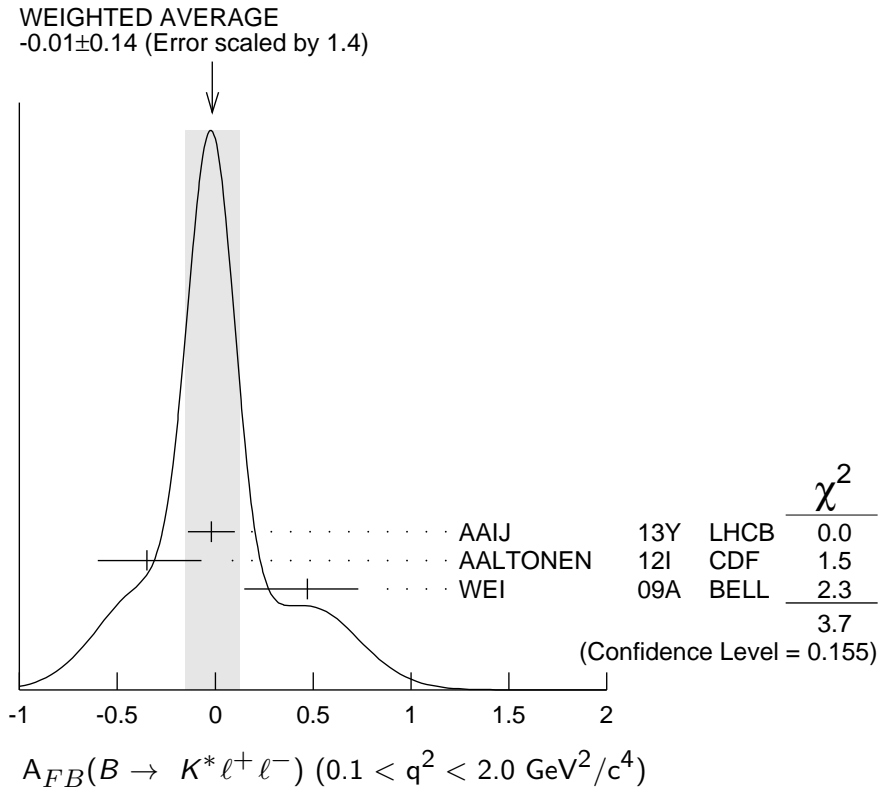
• • • We do not use the following data for averages, fits, limits, etc. • • •

$-0.29^{+0.37}_{-0.00} \pm 0.18$ ¹ CHATRCHYAN 13BL CMS $p p$ 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

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



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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------------------------------------|
| $0.24^{+0.18}_{-0.23} \pm 0.05$ | AUBERT | 09N | BABR $e^+ e^- \rightarrow \gamma(4S)$ |

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

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

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------------------|-------------|------|-----------------------|
| $-0.003^{+0.058}_{-0.057} \pm 0.009$ | AAIJ | 16B | LHCb pp at 7, 8 TeV |

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--------------------------------------|-------------|------|-----------------------|
| $-0.191^{+0.068}_{-0.080} \pm 0.012$ | AAIJ | 16B | LHCb pp at 7, 8 TeV |

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

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|-------------------|------|--|
| -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 |
| $0.29 \begin{smallmatrix} +0.32 \\ -0.35 \end{smallmatrix} \pm 0.15$ | AALTONEN | 12I | CDF | $p\bar{p}$ at 1.96 TeV |
| $0.11 \begin{smallmatrix} +0.31 \\ -0.36 \end{smallmatrix} \pm 0.07$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | |
|--|----------|-----|------|-----------------------|
| $0.05 \begin{smallmatrix} +0.16 \\ -0.20 \end{smallmatrix} \pm 0.04$ | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| $0.19 \begin{smallmatrix} +0.40 \\ -0.41 \end{smallmatrix} \pm 0.14$ | 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 |
|---|-------------|------|----------------------------|
| $-0.08 \begin{smallmatrix} +0.21 \\ -0.20 \end{smallmatrix} \pm 0.05$ | AALTONEN | 12I | CDF $p\bar{p}$ at 1.96 TeV |

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

| | | | | |
|--|----------|-----|-----|-----------------------|
| $0.21 \begin{smallmatrix} +0.31 \\ -0.33 \end{smallmatrix} \pm 0.05$ | 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 |
|--|-------------|------|-----------------------|
| $0.025 \begin{smallmatrix} +0.051 \\ -0.052 \end{smallmatrix} \pm 0.004$ | 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 |
|--|-------------|------|-----------------------|
| $0.152 \begin{smallmatrix} +0.041 \\ -0.040 \end{smallmatrix} \pm 0.008$ | 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 |
|---------------------------------------|---|------|---------|
| -0.085 ± 0.035 OUR AVERAGE | Error includes scale factor of 1.3. See the ideogram below. | | |

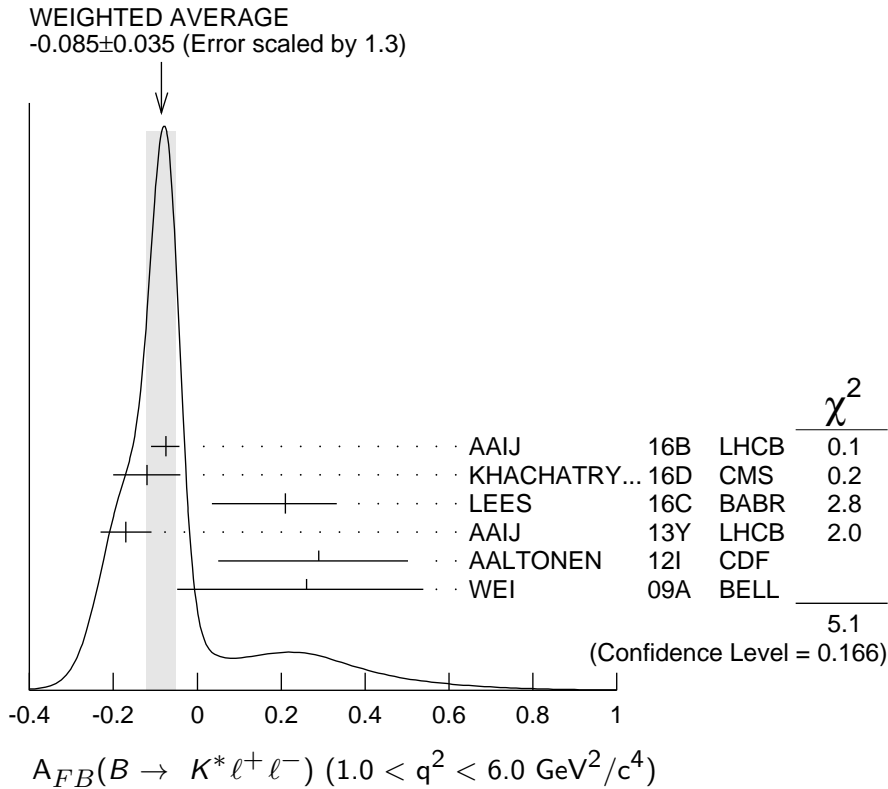
| | | | | |
|--|-------------------|-----|------|-------------------------------------|
| $-0.075 \begin{smallmatrix} +0.032 \\ -0.034 \end{smallmatrix} \pm 0.007$ | ¹ AAIJ | 16B | LHCB | pp at 7, 8 TeV |
| -0.12 ± 0.08 | KHACHATRY...16D | CMS | pp | at 7, 8 TeV |
| $0.21 \begin{smallmatrix} +0.10 \\ -0.15 \end{smallmatrix} \begin{smallmatrix} +0.07 \\ -0.09 \end{smallmatrix}$ | ² LEES | 16C | BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $-0.17 \pm 0.06 \pm 0.01$ | AAIJ | 13Y | LHCB | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $0.29 \begin{smallmatrix} +0.20 \\ -0.23 \end{smallmatrix} \pm 0.07$ | AALTONEN | 12I | CDF | $p\bar{p}$ at 1.96 TeV |
| $0.26 \begin{smallmatrix} +0.27 \\ -0.30 \end{smallmatrix} \pm 0.07$ | WEI | 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | | | |
|---|-------------------|-----|--------------------------|-----------------------------------|
| 0.55 ± 0.43 | ³ SATO | 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $-0.07 \pm 0.12 \pm 0.01$ | CHATRCHYAN 13BL | CMS | Repl. by KHACHATRYAN 16D | |
| $-0.06 \begin{smallmatrix} +0.13 \\ -0.14 \end{smallmatrix} \pm 0.07$ | AAIJ | 12U | LHCB | Repl. by AAIJ 13Y |
| $0.43 \begin{smallmatrix} +0.36 \\ -0.37 \end{smallmatrix} \pm 0.06$ | 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 |

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

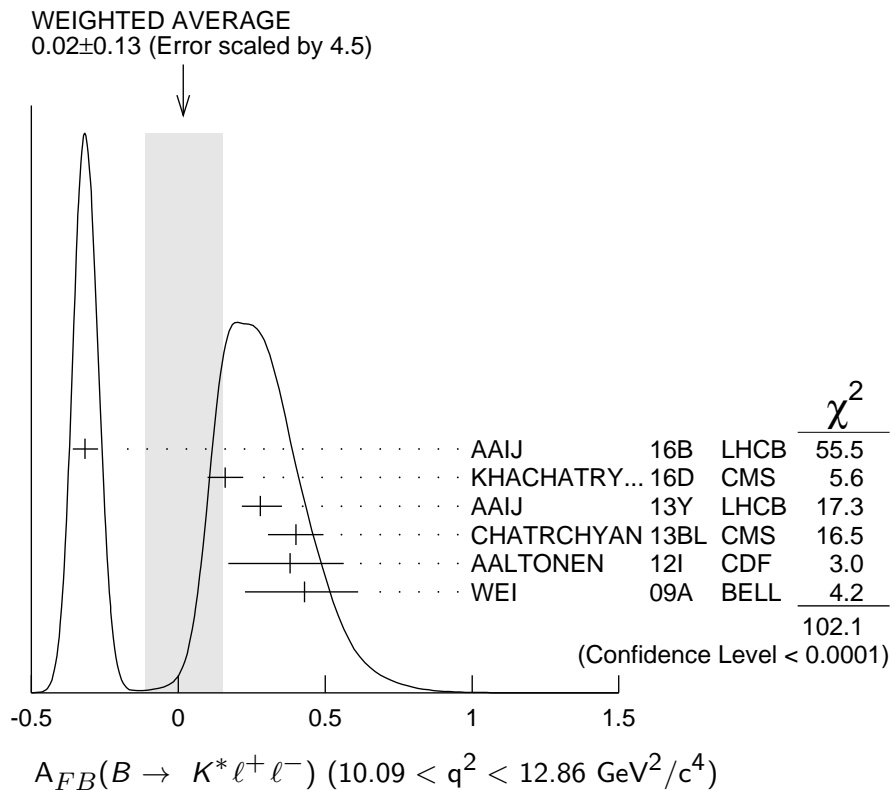
| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|---|------|---------|
| 0.02 ± 0.13 OUR AVERAGE | Error includes scale factor of 4.5. See the ideogram below. | | |

| | | | |
|--------------------------------------|-------------------|------|--|
| $-0.318^{+0.044}_{-0.040} \pm 0.009$ | ¹ AAIJ | 16B | LHCB pp at 7, 8 TeV |
| $0.16 \pm 0.06 \pm 0.01$ | KHACHATRY... | 16D | CMS pp at 8 TeV |
| $0.28^{+0.07}_{-0.06} \pm 0.02$ | AAIJ | 13Y | LHCB pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |
| $0.40 \pm 0.08 \pm 0.05$ | CHATRCHYAN | 13BL | CMS pp at 7 TeV |
| $0.38^{+0.16}_{-0.19} \pm 0.09$ | AALTONEN | 12I | CDF $p\bar{p}$ at 1.96 TeV |
| $0.43^{+0.18}_{-0.20} \pm 0.03$ | WEI | 09A | BELL $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

| | | | |
|---------------------------------|----------|-----|---------------------------|
| $0.27^{+0.11}_{-0.13} \pm 0.02$ | AAIJ | 12U | LHCB Repl. by AAIJ 13Y |
| $0.66^{+0.23}_{-0.20} \pm 0.07$ | AALTONEN | 11L | CDF Repl. by AALTONEN 12I |

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

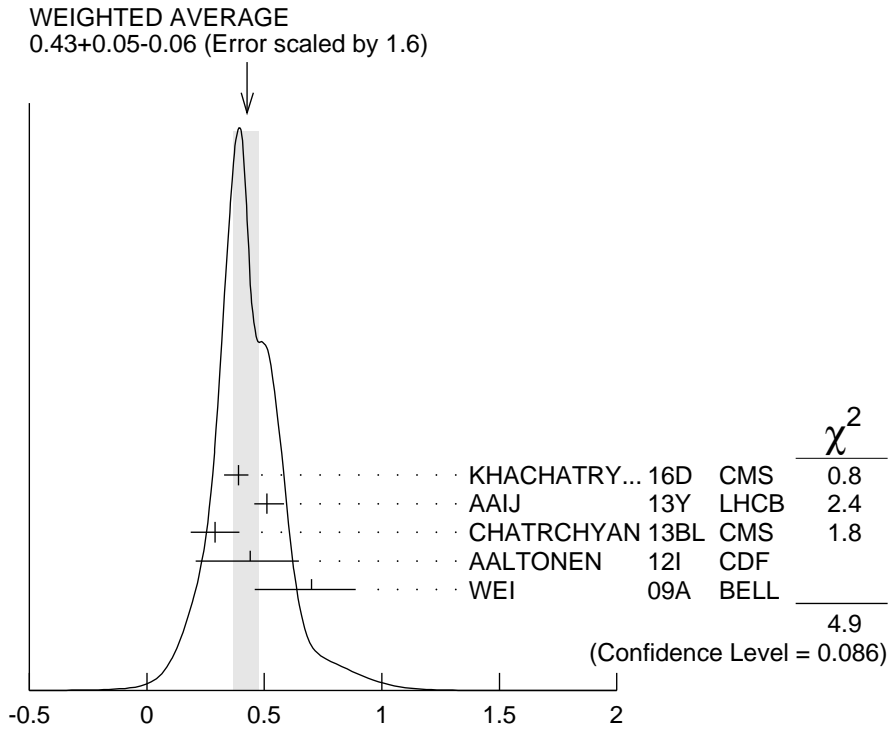


$A_{FB}(B \rightarrow K^* \ell^+ \ell^-)$ ($14.18 < q^2 < 16.0 \text{ GeV}^2/c^4$)

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|---|------|---------|
| $0.43^{+0.05}_{-0.06}$ OUR AVERAGE | Error includes scale factor of 1.6. See the ideogram below. | | |

| | | | |
|---------------------------------|--------------|-----|--|
| $0.39^{+0.04}_{-0.06} \pm 0.01$ | KHACHATRY... | 16D | CMS pp at 8 TeV |
| $0.51^{+0.07}_{-0.05} \pm 0.02$ | AAIJ | 13Y | LHCB pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |

| | | |
|---|---------------------|-----------------------------------|
| $0.29 \pm 0.09 \pm 0.05$ | CHATRCHYAN 13BL CMS | pp at 7 TeV |
| $0.44^{+0.18}_{-0.21} \pm 0.10$ | AALTONEN 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $0.70^{+0.16}_{-0.22} \pm 0.10$ | WEI 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | |
| $0.47^{+0.06}_{-0.08} \pm 0.03$ | AAIJ 12U LHCb | Repl. by AAJ 13Y |
| $0.42 \pm 0.16 \pm 0.09$ | AALTONEN 11L CDF | Repl. by AALTONEN 12I |



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

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

| 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 |
|---|-------------------------------------|----------|-------------------------------------|
| 0.367 ± 0.024 OUR AVERAGE | Error includes scale factor of 1.1. | | |
| $0.355 \pm 0.027 \pm 0.009$ | ¹ AAJ | 16B LHCb | pp at 7, 8 TeV |
| $0.35 \pm 0.07 \pm 0.01$ | KHACHATRY... | 16D CMS | pp at 8 TeV |
| $0.30 \pm 0.08^{+0.01}_{-0.02}$ | AAIJ | 13Y LHCb | pp at 7 TeV, $K^{*0} \mu^+ \mu^-$ |

| | | |
|--|---------------------|-----------------------------------|
| $0.41 \pm 0.05 \pm 0.03$ | CHATRCHYAN 13BL CMS | $p\bar{p}$ at 7 TeV |
| $0.65 \begin{smallmatrix} +0.17 \\ -0.18 \end{smallmatrix} \pm 0.16$ | AALTONEN 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $0.66 \begin{smallmatrix} +0.11 \\ -0.16 \end{smallmatrix} \pm 0.04$ | WEI 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

| | | |
|--|------------------|-----------------------|
| $0.16 \begin{smallmatrix} +0.11 \\ -0.13 \end{smallmatrix} \pm 0.06$ | AAIJ 12U LHCb | Repl. by AAIJ 13Y |
| $0.70 \begin{smallmatrix} +0.16 \\ -0.25 \end{smallmatrix} \pm 0.10$ | AALTONEN 11L CDF | Repl. by AALTONEN 12I |

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

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

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

0.11 ± 0.12 OUR AVERAGE

| | | |
|--|--------------------------------|-----------------------------------|
| $0.15 \begin{smallmatrix} +0.21 \\ -0.23 \end{smallmatrix} \pm 0.08$ | 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 $\cos\theta < 0$.

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

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

$0.00 \begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix}$ OUR AVERAGE

| | | |
|--|------------------|-----------------------------------|
| $0.00 \begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix} \pm 0.03$ | AAIJ 13H LHCb | $p\bar{p}$ at 7 TeV |
| $0.13 \begin{smallmatrix} +0.42 \\ -0.43 \end{smallmatrix} \pm 0.07$ | AALTONEN 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $0.06 \begin{smallmatrix} +0.32 \\ -0.35 \end{smallmatrix} \pm 0.02$ | WEI 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

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

$0.09 \begin{smallmatrix} +0.10 \\ -0.07 \end{smallmatrix}$ OUR AVERAGE Error includes scale factor of 1.4.

| | | |
|---|------------------|-----------------------------------|
| $0.07 \begin{smallmatrix} +0.08 \\ -0.05 \end{smallmatrix} \pm 0.02$ | AAIJ 13H LHCb | $p\bar{p}$ at 7 TeV |
| $0.32 \begin{smallmatrix} +0.15 \\ -0.16 \end{smallmatrix} \pm 0.05$ | AALTONEN 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $-0.43 \begin{smallmatrix} +0.38 \\ -0.40 \end{smallmatrix} \pm 0.09$ | WEI 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

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

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

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|---------------------------|
| $0.31 \pm 0.16 \pm 0.04$ | AALTONEN 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $0.36^{+0.24}_{-0.26} \pm 0.06$ | AALTONEN 11L | CDF | Repl. by AALTONEN 12I |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|----------------------|-------------|-----------------------------------|
| $0.034^{+0.040}_{-0.029}$ OUR AVERAGE | | | |
| $0.02^{+0.05}_{-0.03} +0.02_{-0.01}$ | AAIJ 13H | LHCB | pp at 7 TeV |
| $0.13 \pm 0.09 \pm 0.02$ | AALTONEN 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.04^{+0.13}_{-0.16} \pm 0.05$ | WEI 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.00 ± 0.13 | ¹ SATO 16 | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| $0.08^{+0.27}_{-0.22} \pm 0.07$ | 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> |
|---|--------------------|-------------|-----------------------------------|
| $-0.04^{+0.04}_{-0.05}$ OUR AVERAGE | | | |
| $-0.02^{+0.03}_{-0.05} \pm 0.03$ | AAIJ 13H | LHCB | pp at 7 TeV |
| $0.01^{+0.13}_{-0.10} \pm 0.01$ | AALTONEN 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.20^{+0.12}_{-0.14} \pm 0.03$ | WEI 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $-0.20^{+0.17}_{-0.28} \pm 0.03$ | AALTONEN 11L | CDF | Repl. by AALTONEN 12I |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|-----------------------------------|
| -0.05 ± 0.06 OUR AVERAGE | | | |
| $-0.03 \pm 0.07 \pm 0.01$ | AAIJ 13H | LHCB | pp at 7 TeV |
| $-0.03^{+0.11}_{-0.10} \pm 0.04$ | AALTONEN 12I | CDF | $\rho\bar{p}$ at 1.96 TeV |
| $-0.21^{+0.17}_{-0.15} \pm 0.06$ | WEI 09A | BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $-0.10^{+0.17}_{-0.15} \pm 0.07$ | AALTONEN 11L | CDF | Repl. by AALTONEN 12I |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|-----------------------------------|
| $-0.02^{+0.07}_{-0.05}$ OUR AVERAGE | | | |
| $-0.01^{+0.12}_{-0.06} \pm 0.01$ | AAIJ | 13H LHCB | pp at 7 TeV |
| $-0.05^{+0.09}_{-0.11} \pm 0.03$ | AALTONEN | 12I CDF | $p\bar{p}$ at 1.96 TeV |
| $0.04^{+0.32}_{-0.26} \pm 0.05$ | WEI | 09A BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $0.03^{+0.49}_{-0.16} \pm 0.04$ | AALTONEN | 11L CDF | Repl. by AALTONEN 12I |

 $A_{FB}(B \rightarrow K\ell^+\ell^-)$ ($16.0 < q^2 < 18.0 \text{ GeV}^2/c^4$)

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|----------------|
| $-0.09^{+0.07+0.02}_{-0.09-0.01}$ | AAIJ | 13H LHCB | pp at 7 TeV |

 $A_{FB}(B \rightarrow K\ell^+\ell^-)$ ($18.0 < q^2 < 22.0 \text{ GeV}^2/c^4$)

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|----------------|
| $0.02 \pm 0.11 \pm 0.01$ | AAIJ | 13H LHCB | pp at 7 TeV |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|-----------------------------------|
| $0.04^{+0.09}_{-0.07}$ 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 | $e^+e^- \rightarrow \Upsilon(4S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| $0.07^{+0.30}_{-0.23} \pm 0.02$ | AALTONEN | 11L CDF | Repl. by AALTONEN 12I |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--|--------------------|-------------|-----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.74 ± 0.54 | ¹ SATO | 16 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |
| 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. | | | |

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

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|-----------------------|-------------|-----------------------------------|
| $0.81^{+0.58}_{-0.61} \pm 0.46$ | ¹ AUBERT,B | 06J BABR | $e^+e^- \rightarrow \Upsilon(4S)$ |

¹ Results with different q^2 cuts are also reported. **$A_{FB}(B \rightarrow K\rho\bar{p})$ ($m_{\rho\bar{p}} < 2.85 \text{ GeV}/c^2$)**

| <u>VALUE</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|---|--------------------|-------------|------------------|
| $0.495 \pm 0.012 \pm 0.007$ | ¹ AAIJ | 14AF LHCB | pp at 7, 8 TeV |

¹ Measured in $B^+ \rightarrow K^+\rho\bar{p}$ decays.

$A_{FB}(B \rightarrow \pi p \bar{p}) (m_{p\bar{p}} < 2.85 \text{ GeV}/c^2)$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|--|-------------------|-----------|------------------------|
| $-0.409 \pm 0.033 \pm 0.006$ | ¹ AAIJ | 14AF LHCB | $p\bar{p}$ at 7, 8 TeV |

¹ Measured in $B^+ \rightarrow \pi^+ p \bar{p}$ 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 | | | |
| $-0.0048 \pm 0.0149 \pm 0.0150$ | ¹ WATANUKI | 19 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $-0.006 \pm 0.058 \pm 0.026$ | AUBERT,B | 05R BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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 |
|---|---------------------|----------|------------------------------------|
| $-0.06 \pm 0.15 \pm 0.07$ | ¹ AUBERT | 08O 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 | | | |
| $0.062 \pm 0.015 \pm 0.013$ | ¹ HORIGUCHI | 17 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.066 \pm 0.021 \pm 0.022$ | ² AUBERT | 09AO BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.050 \pm 0.045 \pm 0.037$ | ³ AUBERT,BE | 04A BABR | Repl. by AUBERT 09AO |
| $0.012 \pm 0.044 \pm 0.026$ | NAKAO | 04 BELL | Repl. by HORIGUCHI 17 |

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

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 | | | |
| $-0.43^{+0.25}_{-0.22} \pm 0.10$ | AUBERT | 08BH BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $-0.48^{+0.21+0.08}_{-0.19-0.09}$ | TANIGUCHI | 08 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |

$\Delta_0(B(B \rightarrow K\ell^+\ell^-))$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------------------------------|-----------|---------------------------------|
| -0.13 ± 0.06 OUR AVERAGE | Error includes scale factor of 1.1. | | |
| $-0.10^{+0.08}_{-0.09} \pm 0.02$ | 1 AAIJ | 14M LHCB | pp at 7, 8 TeV |
| $-0.09^{+0.08}_{-0.08} \pm 0.02$ | 2 AAIJ | 14M LHCB | pp at 7, 8 TeV |
| $-0.58^{+0.29}_{-0.37} \pm 0.02$ | 3 LEES | 12S BABR | $e^+e^- \rightarrow \gamma(4S)$ |
| $-0.31^{+0.17}_{-0.14} \pm 0.08$ | 4 WEI | 09A BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| $-0.35^{+0.23}_{-0.27}$ | 5 AAIJ | 12AH LHCB | Repl. by AAIJ 14M |
| $-1.43^{+0.56}_{-0.85} \pm 0.05$ | 6,7 AUBERT | 09T BABR | Repl. by LEES 12S |

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 $B \rightarrow J/\psi(1S)K$. Measurements in other q^2 bins are also reported.

² 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.

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 $\gamma(4S)$.

 $\Delta_0(B(B \rightarrow K^*\ell^+\ell^-))$

| 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 | $e^+e^- \rightarrow \gamma(4S)$ |
| $-0.29 \pm 0.16 \pm 0.09$ | 4 WEI | 09A BELL | $e^+e^- \rightarrow \gamma(4S)$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | |
| -0.15 ± 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 $\gamma(4S)$.

$\Delta_0(B(B \rightarrow K^{(*)} \ell^+ \ell^-))$

| 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. | | |
| $0.467 \pm 0.038 \pm 0.068$ | ¹ ACOSTA | 05F CDF | $p\bar{p}$ at 1.96 TeV |
| $0.293 \pm 0.012 \pm 0.058$ | ² CSORNA | 04 CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.251 \pm 0.023 \pm 0.062$ | ³ CRONIN-HEN..01B | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

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 $E_\ell > 1.0 \text{ GeV}$.

³ The leptons are required to have $P_\ell > 1.5 \text{ GeV}/c$.

 $\langle M_X^2 \rangle$ (First Moments)

| VALUE (GeV^2) | DOCUMENT ID | TECN | COMMENT |
|---|-----------------------|---------|------------------------------------|
| 4.156 ± 0.029 OUR AVERAGE | | | |
| $4.144 \pm 0.028 \pm 0.022$ | ¹ SCHWANDA | 07 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $4.18 \pm 0.04 \pm 0.03$ | ¹ AUBERT,B | 04 BABR | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5 \text{ GeV}/c$.

 $\langle (M_X^2 - \overline{M}_X^2)^2 \rangle$ (Second Moments)

| VALUE (GeV^4) | DOCUMENT ID | TECN | COMMENT |
|---|------------------------------|---------|------------------------------------|
| 0.55 ± 0.08 OUR AVERAGE | | | |
| $0.515 \pm 0.061 \pm 0.064$ | ¹ SCHWANDA | 07 BELL | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $0.629 \pm 0.031 \pm 0.143$ | ² CSORNA | 04 CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| $1.05 \pm 0.26 \pm 0.13$ | ³ ACOSTA | 05F CDF | $p\bar{p}$ at 1.96 TeV |
| $0.576 \pm 0.048 \pm 0.168$ | ¹ CRONIN-HEN..01B | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |

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

¹ The leptons are required to have $E_\ell > 1.5 \text{ GeV}/c$.

² Uses minimum lepton energy of 1.5 GeV and also reports moments with $E_\ell > 1.0 \text{ GeV}$.

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

¹ The leptons are required to have $E_\ell > 1.5$ GeV/c.

$B \rightarrow X_c \ell \nu$ LEPTON MOMENTUM MOMENTS

$R_0 (\Gamma_{E_\ell > 1.7 \text{ GeV}} / \Gamma_{E_\ell > 1.5 \text{ GeV}})$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------------------|------|------------------------------------|
| 0.6187 ± 0.0014 ± 0.0016 | ¹ MAHMOOD 03 | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5$ GeV in the B rest frame.

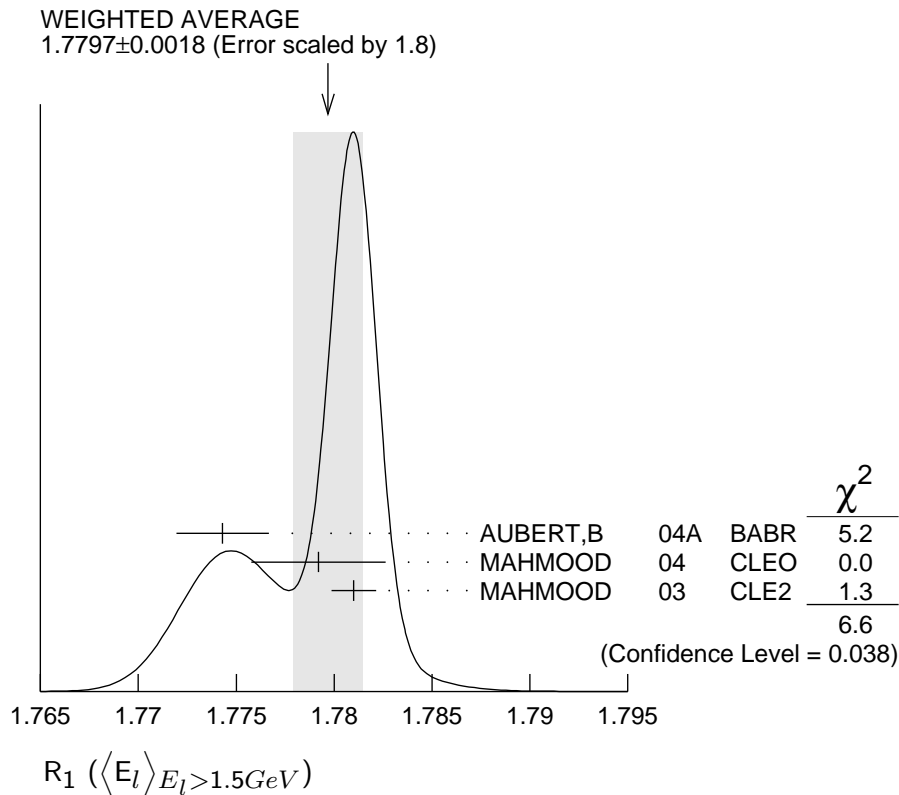
$R_1 (\langle E_\ell \rangle_{E_\ell > 1.5 \text{ GeV}})$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|------------------------------------|---|------|------------------------------------|
| 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 | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.7792 ± 0.0021 ± 0.0027 | ² MAHMOOD 04 | CLEO | $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 1.7810 ± 0.0007 ± 0.0009 | ³ MAHMOOD 03 | CLE2 | $e^+ e^- \rightarrow \Upsilon(4S)$ |

¹ The leptons are required to have $E_\ell > 1.5$ GeV in the B rest frame. The result with $E_\ell > 0.6$ 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 $E_\ell > 1.5$ GeV in the B rest frame.



$R_2 (\langle E_l^2 - \bar{E}_l^2 \rangle_{E_l > 1.5 \text{ GeV}})$

| VALUE (10^{-3} GeV^2) | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------|-----------------------|------|---|
| 30.8 ± 0.8 OUR AVERAGE | | | |
| 30.3 ± 0.9 ± 0.5 | ¹ AUBERT,B | 04A | BABR $e^+ e^- \rightarrow \Upsilon(4S)$ |
| 31.6 ± 0.8 ± 1.0 | ² MAHMOOD | 04 | CLEO $e^+ e^- \rightarrow \Upsilon(4S)$ |

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.

² Uses $E_e > 1.5 \text{ GeV}$ and also reports moments with other minimum minimum E_e conditions, as low as $E_e > 0.6 \text{ GeV}$.

 $R_3 (\langle E_l^3 - \bar{E}_l^3 \rangle_{E_l > 1.5 \text{ GeV}})$

| VALUE (10^{-3} 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. • • •

$3.28 \pm 0.40 \pm 0.43$ ³ AUBERT, BE 06B BABR Repl. by LEES 12V

¹ LEES 12U uses $E_\gamma > 1.897$ GeV to calculate the moments; the moments are used to calculate the HQET parameters $m_b = 4.579_{-0.029}^{+0.032}$ GeV/ c^2 and $\mu_\pi^2 = 0.257_{-0.039}^{+0.034}$ GeV² 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 $E_\gamma > 1.9$ GeV.

⁴ Uses a fully reconstructed B meson as a tag on the recoil side.

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| AUSHEV | 10 | PR D81 031103 | T. Aushev <i>et al.</i> | (BELLE Collab.) |
| DEL-AMO-SANCHEZ... | 10M | PR D82 051101 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
| DEL-AMO-SANCHEZ... | 10Q | PR D82 112002 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
| NISHIMURA | 10 | PRL 105 191803 | K. Nishimura <i>et al.</i> | (BELLE Collab.) |
| URQUIJO | 10 | PRL 104 021801 | P. Urquijo <i>et al.</i> | (BELLE Collab.) |
| AUBERT | 09AO | PRL 103 211802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 09N | PR D79 031102 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 09T | PRL 102 091803 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| Also | | EPAPS Document No. E-PRLTAO-102-060910 | | (BABAR Collab.) |

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| AUBERT | 09U | PRL 102 161803 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| LIMOSANI | 09 | PRL 103 241801 | A. Limosani <i>et al.</i> | (BELLE Collab.) |
| WEI | 09A | PRL 103 171801 | J.-T. Wei <i>et al.</i> | (BELLE Collab.) |
| Also | | EPAPS Supplement EPAPS_appendix.pdf | | (BELLE Collab.) |
| AUBERT | 08AS | PRL 100 171802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 08BC | PR D78 072007 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 08BH | PR D78 112001 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 08BJ | PRL 101 171804 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 08N | PRL 100 021801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| Also | | PR D79 092002 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 08O | PR D77 051103 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| SCHWANDA | 08 | PR D78 032016 | C. Schwanda <i>et al.</i> | (BELLE Collab.) |
| TANIGUCHI | 08 | PRL 101 111801 | N. Taniguchi <i>et al.</i> | (BELLE Collab.) |
| WEI | 08A | PR D78 011101 | J.-T. Wei <i>et al.</i> | (BELLE Collab.) |
| AUBERT | 07AG | PRL 99 051801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 07C | PR D75 012003 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 07E | PRL 98 051802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 07L | PRL 98 151802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| GAMBINO | 07 | JHEP 0710 058 | P. Gambino <i>et al.</i> | |
| HUANG | 07 | PR D75 012002 | G.S. Huang <i>et al.</i> | (CLEO Collab.) |
| SCHWANDA | 07 | PR D75 032005 | C. Schwanda <i>et al.</i> | (BELLE Collab.) |
| URQUIJO | 07 | PR D75 032001 | P. Urquijo <i>et al.</i> | (BELLE Collab.) |
| AUBERT | 06H | PR D73 012006 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 06J | PR D73 092001 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 06Y | PR D74 091105 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,BE | 06B | PRL 97 171803 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| BUCHMUEL... | 06 | PR D73 073008 | O.L. Buchmueller, H.U. Flacher | (RHBL) |
| GOKHROO | 06 | PRL 97 162002 | G. Gokhroo <i>et al.</i> | (BELLE Collab.) |
| ISHIKAWA | 06 | PRL 96 251801 | A. Ishikawa <i>et al.</i> | (BELLE Collab.) |
| MOHAPATRA | 06 | PRL 96 221601 | D. Mohapatra <i>et al.</i> | (BELLE Collab.) |
| ABAZOV | 05O | PRL 95 171803 | V.M. Abazov <i>et al.</i> | (D0 Collab.) |
| ACOSTA | 05F | PR D71 051103 | D. Acosta <i>et al.</i> | (CDF Collab.) |
| ARTUSO | 05B | PRL 95 261801 | M. Artuso <i>et al.</i> | (CLEO Collab.) |
| AUBERT | 05 | PRL 94 011801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 05M | PRL 95 142003 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 05R | PR D72 052004 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 05X | PRL 95 111801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| Also | | PRL 97 019903 (errat.) | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| CHOI | 05 | PRL 94 182002 | S.-K. Choi <i>et al.</i> | (BELLE Collab.) |
| IWASAKI | 05 | PR D72 092005 | M. Iwasaki <i>et al.</i> | (BELLE Collab.) |
| LIMOSANI | 05 | PL B621 28 | A. Limosani <i>et al.</i> | (BELLE Collab.) |
| MOHAPATRA | 05 | PR D72 011101 | D. Mohapatra <i>et al.</i> | (BELLE Collab.) |
| NISHIDA | 05 | PL B610 23 | S. Nishida <i>et al.</i> | (BELLE Collab.) |
| OKABE | 05 | PL B614 27 | T. Okabe <i>et al.</i> | (BELLE Collab.) |
| ABDALLAH | 04D | EPJ C33 213 | J. Abdallah <i>et al.</i> | (DELPHI Collab.) |
| AUBERT | 04C | PRL 92 111801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 04I | PRL 92 071802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 04S | PR D69 052005 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 04X | PRL 93 011803 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
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| AUBERT,B | 04E | PRL 93 021804 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 04F | PRL 93 061801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,B | 04I | PRL 93 081802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT,BE | 04A | PR D70 112006 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| CSORNA | 04 | PR D70 032002 | S.E. Csorna <i>et al.</i> | (CLEO Collab.) |
| KOPPENBURG | 04 | PRL 93 061803 | P. Koppenburg <i>et al.</i> | (BELLE Collab.) |
| MAHMOOD | 04 | PR D70 032003 | A.H. Mahmood <i>et al.</i> | (CLEO Collab.) |
| NAKAO | 04 | PR D69 112001 | M. Nakao <i>et al.</i> | (BELLE Collab.) |
| NISHIDA | 04 | PRL 93 031803 | S. Nishida <i>et al.</i> | (BELLE Collab.) |
| ADAM | 03B | PR D68 012004 | N.E. Adam <i>et al.</i> | (CLEO Collab.) |
| AUBERT | 03 | PR D67 031101 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 03F | PR D67 032002 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 03U | PRL 91 221802 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| BONVICINI | 03 | PR D68 011101 | G. Bonvicini <i>et al.</i> | (CLEO Collab.) |
| HUANG | 03 | PRL 91 241802 | H.-C. Huang <i>et al.</i> | (BELLE Collab.) |
| ISHIKAWA | 03 | PRL 91 261601 | A. Ishikawa <i>et al.</i> | (BELLE Collab.) |
| KANEKO | 03 | PRL 90 021801 | J. Kaneko <i>et al.</i> | (BELLE Collab.) |
| KROKOVNY | 03B | PRL 91 262002 | P. Krokovny <i>et al.</i> | (BELLE Collab.) |
| MAHMOOD | 03 | PR D67 072001 | A.H. Mahmood <i>et al.</i> | (CLEO Collab.) |
| ABE | 02 | PRL 88 021801 | K. Abe <i>et al.</i> | (BELLE Collab.) |

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| ABE | 02L | PRL 89 011803 | K. Abe <i>et al.</i> | (BELLE Collab.) |
| ABE | 02Y | PL B547 181 | K. Abe <i>et al.</i> | (BELLE Collab.) |
| ANDERSON | 02 | PRL 89 282001 | S. Anderson <i>et al.</i> | (CLEO Collab.) |
| AUBERT | 02C | PRL 88 101805 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 02G | PR D65 091104 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| AUBERT | 02L | PRL 88 241801 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| BORNHEIM | 02 | PRL 88 231803 | A. Bornheim <i>et al.</i> | (CLEO Collab.) |
| EDWARDS | 02B | PR D65 111102 | K.W. Edwards <i>et al.</i> | (CLEO Collab.) |
| ABE | 01F | PL B511 151 | K. Abe <i>et al.</i> | (BELLE Collab.) |
| ABE | 01J | PR D64 072001 | K. Abe <i>et al.</i> | (BELLE Collab.) |
| ANDERSON | 01B | PRL 87 181803 | S. Anderson <i>et al.</i> | (CLEO Collab.) |
| CHEN | 01 | PR D63 031102 | S. Chen <i>et al.</i> | (CLEO Collab.) |
| CHEN | 01C | PRL 87 251807 | S. Chen <i>et al.</i> | (CLEO Collab.) |
| COAN | 01 | PRL 86 5661 | T.E. Coan <i>et al.</i> | (CLEO Collab.) |
| CRONIN-HENNESSY | 01B | PRL 87 251808 | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.) |
| PDG | 01 | Unofficial 2001 WWW edition | | |
| ABREU | 00R | PL B475 407 | P. Abreu <i>et al.</i> | (DELPHI Collab.) |
| COAN | 00 | PRL 84 5283 | T.E. Coan <i>et al.</i> | (CLEO Collab.) |
| RICHICHI | 00 | PRL 85 520 | S.J. Richichi <i>et al.</i> | (CLEO Collab.) |
| BARATE | 98Q | EPJ C4 387 | R. Barate <i>et al.</i> | (ALEPH Collab.) |
| BERGFELD | 98 | PRL 81 272 | T. Bergfeld <i>et al.</i> | (CLEO Collab.) |
| BISHAI | 98 | PR D57 3847 | M. Bishai <i>et al.</i> | (CLEO Collab.) |
| BONVICINI | 98 | PR D57 6604 | G. Bonvicini <i>et al.</i> | (CLEO Collab.) |
| BROWDER | 98 | PRL 81 1786 | T.E. Browder <i>et al.</i> | (CLEO Collab.) |
| COAN | 98 | PRL 80 1150 | T.E. Coan <i>et al.</i> | (CLEO Collab.) |
| GLENN | 98 | PRL 80 2289 | S. Glenn <i>et al.</i> | (CLEO Collab.) |
| ACKERSTAFF | 97N | ZPHY C74 423 | K. Ackerstaff <i>et al.</i> | (OPAL Collab.) |
| AMMAR | 97 | PR D55 13 | R. Ammar <i>et al.</i> | (CLEO Collab.) |
| BARISH | 97 | PRL 79 3599 | B. Barish <i>et al.</i> | (CLEO Collab.) |
| BUSKULIC | 97B | ZPHY C73 601 | D. Buskulic <i>et al.</i> | (ALEPH Collab.) |
| GIBBONS | 97B | PR D56 3783 | L. Gibbons <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 96D | PL B374 256 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| BARISH | 96B | PRL 76 1570 | B.C. Barish <i>et al.</i> | (CLEO Collab.) |
| GIBAUT | 96 | PR D53 4734 | D. Gibaut <i>et al.</i> | (CLEO Collab.) |
| KUBOTA | 96 | PR D53 6033 | Y. Kubota <i>et al.</i> | (CLEO Collab.) |
| PDG | 96 | PR D54 1 | R. M. Barnett <i>et al.</i> | (PDG Collab.) |
| ALAM | 95 | PRL 74 2885 | M.S. Alam <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 95D | PL B353 554 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| BALEST | 95B | PR D52 2661 | R. Balest <i>et al.</i> | (CLEO Collab.) |
| BARISH | 95 | PR D51 1014 | B.C. Barish <i>et al.</i> | (CLEO Collab.) |
| BUSKULIC | 95B | PL B345 103 | D. Buskulic <i>et al.</i> | (ALEPH Collab.) |
| ALBRECHT | 94C | ZPHY C62 371 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 94J | ZPHY C61 1 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| PROCARIO | 94 | PRL 73 1472 | M. Procario <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 93 | ZPHY C57 533 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 93E | ZPHY C60 11 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 93H | PL B318 397 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 93I | ZPHY C58 191 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALEXANDER | 93B | PL B319 365 | J. Alexander <i>et al.</i> | (CLEO Collab.) |
| ARTUSO | 93 | PL B311 307 | M. Artuso | (SYRA) |
| BARTELT | 93B | PRL 71 4111 | J.E. Bartelt <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 92E | PL B277 209 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 92G | ZPHY C54 1 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 92O | ZPHY C56 1 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| BORTOLETTO | 92 | PR D45 21 | D. Bortoletto <i>et al.</i> | (CLEO Collab.) |
| CRAWFORD | 92 | PR D45 752 | G. Crawford <i>et al.</i> | (CLEO Collab.) |
| HENDERSON | 92 | PR D45 2212 | S. Henderson <i>et al.</i> | (CLEO Collab.) |
| LESIK | 92 | ZPHY C55 33 | T. Lesiak <i>et al.</i> | (Crystal Ball Collab.) |
| ALBRECHT | 91C | PL B255 297 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 91H | ZPHY C52 353 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| FULTON | 91 | PR D43 651 | R. Fulton <i>et al.</i> | (CLEO Collab.) |
| YANAGISAWA | 91 | PRL 66 2436 | C. Yanagisawa <i>et al.</i> | (CUSB II Collab.) |
| ALBRECHT | 90 | PL B234 409 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 90H | PL B249 359 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| BORTOLETTO | 90 | PRL 64 2117 | D. Bortoletto <i>et al.</i> | (CLEO Collab.) |
| Also | | PR D45 21 | D. Bortoletto <i>et al.</i> | (CLEO Collab.) |
| FULTON | 90 | PRL 64 16 | R. Fulton <i>et al.</i> | (CLEO Collab.) |
| MASCHMANN | 90 | ZPHY C46 555 | W.S. Maschmann <i>et al.</i> | (Crystal Ball Collab.) |
| PDG | 90 | PL B239 1 | J.J. Hernandez <i>et al.</i> | (IFIC, BOST, CIT+) |
| ALBRECHT | 89K | ZPHY C42 519 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ISGUR | 89B | PR D39 799 | N. Isgur <i>et al.</i> | (TNT0, CIT) |

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| WACHS | 89 | ZPHY C42 33 | K. Wachs <i>et al.</i> | (Crystal Ball Collab.) |
| ALBRECHT | 88E | PL B210 263 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 88H | PL B210 258 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| KOERNER | 88 | ZPHY C38 511 | J.G. Korner, G.A. Schuler | (MANZ, DESY) |
| ALAM | 87 | PRL 59 22 | M.S. Alam <i>et al.</i> | (CLEO Collab.) |
| ALAM | 87B | PRL 58 1814 | M.S. Alam <i>et al.</i> | (CLEO Collab.) |
| ALBRECHT | 87D | PL B199 451 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| ALBRECHT | 87H | PL B187 425 | H. Albrecht <i>et al.</i> | (ARGUS Collab.) |
| BEAN | 87 | PR D35 3533 | A. Bean <i>et al.</i> | (CLEO Collab.) |
| BEHREND'S | 87 | PRL 59 407 | S. Behrends <i>et al.</i> | (CLEO Collab.) |
| BORTOLETTO | 87 | PR D35 19 | D. Bortoletto <i>et al.</i> | (CLEO Collab.) |
| ALAM | 86 | PR D34 3279 | M.S. Alam <i>et al.</i> | (CLEO Collab.) |
| BALTRUSAIT... | 86E | PRL 56 2140 | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.) |
| 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) |
