B^0 – THIS IS PART 2 OF 3

To reduce the size of this section's PostScript file, we have divided it into three PostScript files. We present the following index:

PART 1

PART 2

PART 3

<2.6 × 10^−3	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^0K^+K^-)/\Gamma_{total}$ — Γ_{83}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.3 × 10^−3	90	ALBRECHT	91E	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^0\phi)/\Gamma_{total}$ — Γ_{84}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<8.8 × 10^−5	90	ASNER	96	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<7.2 × 10^−4	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
<4.2 × 10^−4	90	[197] AVERY	89B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
<1.0 × 10^−3	90	[198] AVERY	87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

[197] AVERY 89B reports $< 4.9 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

[198] AVERY 87 reports $< 1.3 \times 10^{-3}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K^-\pi^+\pi^+\pi^-)/\Gamma_{total}$ — Γ_{85}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.3 × 10^−4	90	[199] ADAM	96D	DLPH	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<2.1 × 10^−4	90	[200] ABREU	95N	DLPH	Sup. by ADAM 96D

[199] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$. Contributions from B^0 and B_s decays cannot be separated. Limits are given for the weighted average of the decay rates for the two neutral B mesons.

[200] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12. Contributions from B^0 and B_s^0 decays cannot be separated. Limits are given for the weighted average of the decay rates for the two neutral B mesons.

$\Gamma(K^*(892)^0\pi^+\pi^-)/\Gamma_{total}$ — Γ_{86}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.4 × 10^−3	90	ALBRECHT	91E	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^*(892)^0\rho^0)/\Gamma_{total}$ — Γ_{87}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<4.6 × 10^−4	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<5.8 × 10^−4	90	[201] AVERY	89B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
<9.6 × 10^−4	90	[202] AVERY	87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

[201] AVERY 89B reports $< 6.7 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

[202] AVERY 87 reports $< 1.2 \times 10^{-3}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K^*(892)^0 f_0(980))/\Gamma_{total}$ — Γ_{88}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.7 × 10^−4	90	[203] AVERY	89B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

[203] AVERY 89B reports $< 2.0 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_1(1400)^+ \pi^-)/\Gamma_{total}$ — Γ_{89}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1 × 10⁻³	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^- a_1(1260)^+)/\Gamma_{total}$ — Γ_{90}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.3 \times 10^{-4}$	90	[204] ADAM	96D	DLPH	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.9 \times 10^{-4}$	90	[205] ABREU	95N	DLPH	Sup. by ADAM 96D

[204] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$. Contributions from B^0 and B_s decays cannot be separated. Limits are given for the weighted average of the decay rates for the two neutral B mesons.

[205] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12. Contributions from B^0 and B^0_s decays cannot be separated. Limits are given for the weighted average of the decay rates for the two neutral B mesons.

$\Gamma(K^*(892)^0 K^+ K^-)/\Gamma_{total}$ — Γ_{91}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.1 \times 10^{-4}$	90	ALBRECHT	91E	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^*(892)^0 \phi)/\Gamma_{total}$ — Γ_{92}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.3 \times 10^{-5}$	90	ASNER	96	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.2 \times 10^{-4}$	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
$<3.8 \times 10^{-4}$	90	[206] AVERY	89B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
$<3.8 \times 10^{-4}$	90	[207] AVERY	87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

[206] AVERY 89B reports $< 4.4 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

[207] AVERY 87 reports $< 4.7 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_1(1400)^0 \rho^0)/\Gamma_{total}$ — Γ_{93}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.0 \times 10^{-3}$	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K_1(1400)^0 \phi)/\Gamma_{total}$ — Γ_{94}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.0 \times 10^{-3}$	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K_2^*(1430)^0 \rho^0)/\Gamma_{total}$ — Γ_{95}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.1 \times 10^{-3}$	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K_2^*(1430)^0 \phi)/\Gamma_{total}$ — Γ_{96}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.4 \times 10^{-3}$	90	ALBRECHT	91B	ARG	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(K^*(892)^0\gamma)/\Gamma_{total}$ Γ_{97}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
4.0±1.7±0.8		8	[208] AMMAR	93	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<$ 21	90		[209] ADAM	96D	DLPH	$e^+e^- \to Z$
$<$ 42	90		ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$
$<$ 24	90		[210] AVERY	89B	CLEO	$e^+e^- \to \Upsilon(4S)$
$<$210	90		AVERY	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[208] AMMAR 93 observed 6.6 ± 2.8 events above background.
[209] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.
[210] AVERY 89B reports $< 2.8 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_1(1270)^0\gamma)/\Gamma_{total}$ Γ_{98}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0070	90	[211] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[211] ALBRECHT 89G reports < 0.0078 assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_1(1400)^0\gamma)/\Gamma_{total}$ Γ_{99}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0043	90	[212] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[212] ALBRECHT 89G reports < 0.0048 assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_2^*(1430)^0\gamma)/\Gamma_{total}$ Γ_{100}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.0 \times 10^{-4}$	90	[213] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[213] ALBRECHT 89G reports $< 4.4 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K^*(1680)^0\gamma)/\Gamma_{total}$ Γ_{101}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0020	90	[214] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[214] ALBRECHT 89G reports < 0.0022 assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_3^*(1780)^0\gamma)/\Gamma_{total}$ Γ_{102}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.010	90	[215] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[215] ALBRECHT 89G reports < 0.011 assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K_4^*(2045)^0\gamma)/\Gamma_{total}$ Γ_{103}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0043	90	[216] ALBRECHT	89G	ARG	$e^+e^- \to \Upsilon(4S)$

[216] ALBRECHT 89G reports < 0.0048 assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\phi\phi)/\Gamma_{total}$ Γ_{104}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.9 \times 10^{-5}$	90	ASNER	96	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ Γ_{105}/Γ

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
$<1.5 \times 10^{-5}$	90		GODANG	98	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$<4.5 \times 10^{-5}$	90		[217] ADAM	96D	DLPH	$e^+e^- \to Z$
$<2.0 \times 10^{-5}$	90		ASNER	96	CLE2	Repl. by GODANG 98
$<4.1 \times 10^{-5}$	90		[218] BUSKULIC	96V	ALEP	$e^+e^- \to Z$
$<5.5 \times 10^{-5}$	90		[219] ABREU	95N	DLPH	Sup. by ADAM 96D
$<4.7 \times 10^{-5}$	90		[220] AKERS	94L	OPAL	$e^+e^- \to Z$
$<2.9 \times 10^{-5}$	90		[221] BATTLE	93	CLE2	$e^+e^- \to \Upsilon(4S)$
$<1.3 \times 10^{-4}$	90		[221] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$
$<7.7 \times 10^{-5}$	90		[222] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
$<2.6 \times 10^{-4}$	90		[222] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$
$<5 \times 10^{-4}$	90	4	GILES	84	CLEO	$e^+e^- \to \Upsilon(4S)$

[217] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.
[218] BUSKULIC 96V assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons.
[219] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12.
[220] Assumes B($Z \to b\overline{b}$) = 0.217 and B_d^0 (B_s^0) fraction 39.5% (12%).
[221] Assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.
[222] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\pi^0\pi^0)/\Gamma_{total}$ Γ_{106}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9.3 \times 10^{-6}$	90	GODANG	98	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<0.91 \times 10^{-5}$	90	ASNER	96	CLE2	Repl. by GODANG 98
$<6.0 \times 10^{-5}$	90	[223] ACCIARRI	95H	L3	$e^+e^- \to Z$

[223] ACCIARRI 95H assumes $f_{B^0} = 39.5 \pm 4.0$ and $f_{B_s} = 12.0 \pm 3.0\%$.

$\Gamma(\eta\pi^0)/\Gamma_{total}$ Γ_{107}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8 \times 10^{-6}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.5 \times 10^{-4}$	90	[224] ACCIARRI	95H	L3	$e^+e^- \to Z$
$<1.8 \times 10^{-3}$	90	[225] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[224] ACCIARRI 95H assumes $f_{B^0} = 39.5 \pm 4.0$ and $f_{B_s} = 12.0 \pm 3.0\%$.
[225] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(\eta\eta)/\Gamma_{total}$ — Γ_{108}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.8 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.1 \times 10^{-4}$	90	[226] ACCIARRI	95H	L3	$e^+e^- \to Z$

[226] ACCIARRI 95H assumes $f_{B^0} = 39.5 \pm 4.0$ and $f_{B_s} = 12.0 \pm 3.0\%$.

$\Gamma(\eta'\pi^0)/\Gamma_{total}$ — Γ_{109}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.1 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\eta'\eta')/\Gamma_{total}$ — Γ_{110}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.7 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\eta'\eta)/\Gamma_{total}$ — Γ_{111}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.7 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\eta'\rho^0)/\Gamma_{total}$ — Γ_{112}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.3 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\eta\rho^0)/\Gamma_{total}$ — Γ_{113}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.3 \times 10^{-5}$	90	BEHRENS	98	CLE2	$e^+e^- \to \Upsilon(4S)$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ — Γ_{114}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<7.2 \times 10^{-4}$	90	[227] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[227] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(\rho^0\pi^0)/\Gamma_{total}$ — Γ_{115}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4 \times 10^{-5}$	90	ASNER	96	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.0 \times 10^{-4}$	90	[228] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[228] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(\rho^\mp\pi^\pm)/\Gamma_{total}$ — Γ_{116}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.8 \times 10^{-5}$	90	ASNER	96	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<5.2 \times 10^{-4}$	90	[229] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$
$<5.2 \times 10^{-3}$	90	[230] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[229] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.
[230] BEBEK 87 reports $< 6.1 \times 10^{-3}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{total}$ — Γ_{117}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.3 \times 10^{-4}$	90	[231] ADAM	96D	DLPH	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.8 \times 10^{-4}$	90	[232] ABREU	95N	DLPH	Sup. by ADAM 96D
$<6.7 \times 10^{-4}$	90	[233] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[231] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.
[232] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12.
[233] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(\rho^0\rho^0)/\Gamma_{total}$ — Γ_{118}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.8 \times 10^{-4}$	90	[234] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.9 \times 10^{-4}$	90	[235] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
$<4.3 \times 10^{-4}$	90	[235] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[234] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.
[235] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(a_1(1260)^{\mp}\pi^{\pm})/\Gamma_{total}$ — Γ_{119}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.9 \times 10^{-4}$	90	[236] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<6.3 \times 10^{-4}$	90	[237] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$
$<1.0 \times 10^{-3}$	90	[236] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[236] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.
[237] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(a_2(1320)^{\mp}\pi^{\pm})/\Gamma_{total}$ — Γ_{120}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.0 \times 10^{-4}$	90	[238] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.4 \times 10^{-3}$	90	[238] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[238] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{total}$ — Γ_{121}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.1 \times 10^{-3}$	90	[239] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[239] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(\rho^+\rho^-)/\Gamma_{total}$ — Γ_{122}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.2 \times 10^{-3}$	90	[240] ALBRECHT	90B	ARG	$e^+e^- \to \Upsilon(4S)$

[240] ALBRECHT 90B limit assumes equal production of $B^0\overline{B}^0$ and B^+B^- at $\Upsilon(4S)$.

$\Gamma(a_1(1260)^0 \pi^0)/\Gamma_{total}$ — Γ_{123}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.1 \times 10^{-3}$	90	[241] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[241] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(\omega \pi^0)/\Gamma_{total}$ — Γ_{124}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.6 \times 10^{-4}$	90	[242] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[242] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(\pi^+ \pi^+ \pi^- \pi^- \pi^0)/\Gamma_{total}$ — Γ_{125}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<9.0 \times 10^{-3}$	90	[243] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[243] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(a_1(1260)^+ \rho^-)/\Gamma_{total}$ — Γ_{126}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.4 \times 10^{-3}$	90	[244] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[244] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(a_1(1260)^0 \rho^0)/\Gamma_{total}$ — Γ_{127}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.4 \times 10^{-3}$	90	[245] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[245] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^-)/\Gamma_{total}$ — Γ_{128}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.0 \times 10^{-3}$	90	[246] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[246] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(a_1(1260)^+ a_1(1260)^-)/\Gamma_{total}$ — Γ_{129}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.8 \times 10^{-3}$	90	[247] BORTOLETTO	89	CLEO	$e^+ e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<6.0 \times 10^{-3}$	90	[248] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[247] BORTOLETTO 89 reports $< 3.2 \times 10^{-3}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0 \overline{B}^0$. We rescale to 50%.

[248] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(\pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^0)/\Gamma_{total}$ — Γ_{130}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.1 \times 10^{-2}$	90	[249] ALBRECHT	90B	ARG	$e^+ e^- \rightarrow \Upsilon(4S)$

[249] ALBRECHT 90B limit assumes equal production of $B^0 \overline{B}^0$ and $B^+ B^-$ at $\Upsilon(4S)$.

$\Gamma(p\overline{p})/\Gamma_{total}$ — Γ_{131}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.8 × 10^−5	90	[250] BUSKULIC	96V	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.5 \times 10^{-4}$	90	[251] ABREU	95N	DLPH	Sup. by ADAM 96D
$<3.4 \times 10^{-5}$	90	[252] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
$<1.2 \times 10^{-4}$	90	[253] ALBRECHT	88F	ARG	$e^+e^- \to \Upsilon(4S)$
$<1.7 \times 10^{-4}$	90	[252] BEBEK	87	CLEO	$e^+e^- \to \Upsilon(4S)$

[250] BUSKULIC 96V assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons.
[251] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12.
[252] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.
[253] ALBRECHT 88F reports $< 1.3 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(p\overline{p}\pi^+\pi^-)/\Gamma_{total}$ — Γ_{132}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
<2.5	90	[254] BEBEK	89	CLEO	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<9.5	90	[255] ABREU	95N	DLPH	Sup. by ADAM 96D
$5.4 \pm 1.8 \pm 2.0$		[256] ALBRECHT	88F	ARG	$e^+e^- \to \Upsilon(4S)$

[254] BEBEK 89 reports $< 2.9 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.
[255] Assumes a B^0, B^- production fraction of 0.39 and a B_s production fraction of 0.12.
[256] ALBRECHT 88F reports $6.0 \pm 2.0 \pm 2.2$ assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(p\overline{\Lambda}\pi^-)/\Gamma_{total}$ — Γ_{133}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.8 × 10^−4	90	[257] ALBRECHT	88F	ARG	$e^+e^- \to \Upsilon(4S)$

[257] ALBRECHT 88F reports $< 2.0 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\Delta^0\overline{\Delta}^0)/\Gamma_{total}$ — Γ_{134}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0015	90	[258] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$

[258] BORTOLETTO 89 reports < 0.0018 assuming $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\Delta^{++}\Delta^{--})/\Gamma_{total}$ — Γ_{135}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<1.1 × 10^−4	90	[259] BORTOLETTO	89	CLEO	$e^+e^- \to \Upsilon(4S)$

[259] BORTOLETTO 89 reports $< 1.3 \times 10^{-4}$ assuming $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(\overline{\Sigma}_c^{--}\Delta^{++})/\Gamma_{total}$ — Γ_{136}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0010	90	[260] PROCARIO	94	CLE2	$e^+e^- \to \Upsilon(4S)$

[260] PROCARIO 94 reports < 0.0012 for $B(\Lambda_c^+ \to pK^-\pi^+) = 0.043$. We rescale to our best value $B(\Lambda_c^+ \to pK^-\pi^+) = 0.050$.

$\Gamma(\Lambda_c^- p \pi^+ \pi^-)/\Gamma_{total}$ — Γ_{137}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
$\mathbf{1.33^{+0.46}_{-0.42} \pm 0.37}$	[261] FU	97	CLE2	$e^+e^- \to \Upsilon(4S)$

[261] FU 97 uses PDG 96 values of Λ_c branching fraction.

$\Gamma(\Lambda_c^- p)/\Gamma_{total}$ — Γ_{138}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<2.1 \times 10^{-4}}$	90	[262] FU	97	CLE2	$e^+e^- \to \Upsilon(4S)$

[262] FU 97 uses PDG 96 values of Λ_c branching ratio.

$\Gamma(\Lambda_c^- p \pi^0)/\Gamma_{total}$ — Γ_{139}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<5.9 \times 10^{-4}}$	90	[263] FU	97	CLE2	$e^+e^- \to \Upsilon(4S)$

[263] FU 97 uses PDG 96 values of Λ_c branching ratio.

$\Gamma(\Lambda_c^- p \pi^+ \pi^- \pi^0)/\Gamma_{total}$ — Γ_{140}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<5.07 \times 10^{-3}}$	90	[264] FU	97	CLE2	$e^+e^- \to \Upsilon(4S)$

[264] FU 97 uses PDG 96 values of Λ_c branching ratio.

$\Gamma(\Lambda_c^- p \pi^+ \pi^- \pi^+ \pi^-)/\Gamma_{total}$ — Γ_{141}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<2.74 \times 10^{-3}}$	90	[265] FU	97	CLE2	$e^+e^- \to \Upsilon(4S)$

[265] FU 97 uses PDG 96 values of Λ_c branching ratio.

$\Gamma(\gamma\gamma)/\Gamma_{total}$ — Γ_{142}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<3.9 \times 10^{-5}}$	90	[266] ACCIARRI	95I	L3	$e^+e^- \to Z$

[266] ACCIARRI 95I assumes $f_{B^0} = 39.5 \pm 4.0$ and $f_{B_s} = 12.0 \pm 3.0\%$.

$\Gamma(e^+e^-)/\Gamma_{total}$ — Γ_{143}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$\mathbf{<5.9 \times 10^{-6}}$	90	AMMAR	94	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.4 \times 10^{-5}$	90	[267] ACCIARRI	97B	L3	$e^+e^- \to Z$
$<2.6 \times 10^{-5}$	90	[268] AVERY	89B	CLEO	$e^+e^- \to \Upsilon(4S)$
$<7.6 \times 10^{-5}$	90	[269] ALBRECHT	87D	ARG	$e^+e^- \to \Upsilon(4S)$
$<6.4 \times 10^{-5}$	90	[270] AVERY	87	CLEO	$e^+e^- \to \Upsilon(4S)$
$<3 \times 10^{-4}$	90	GILES	84	CLEO	Repl. by AVERY 87

[267] ACCIARRI 97B assume PDG 96 production fractions for B^+, B^0, B_s, and Λ_b.

[268] AVERY 89B reports $< 3 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0 \overline{B}^0$. We rescale to 50%.

[269] ALBRECHT 87D reports $< 8.5 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0 \overline{B}^0$. We rescale to 50%.

[270] AVERY 87 reports $< 8 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0 \overline{B}^0$. We rescale to 50%.

$\Gamma(\mu^+\mu^-)/\Gamma_{total}$ Γ_{144}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<6.8 × 10⁻⁷	90	[271] ABE	98	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.0 \times 10^{-5}$	90	ABBOTT	98B	D0	$p\overline{p}$ 1.8 TeV
$<1.0 \times 10^{-5}$	90	[272] ACCIARRI	97B	L3	$e^+e^- \rightarrow Z$
$<1.6 \times 10^{-6}$	90	[273] ABE	96L	CDF	Repl. by ABE 98
$<5.9 \times 10^{-6}$	90	AMMAR	94	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
$<8.3 \times 10^{-6}$	90	[274] ALBAJAR	91C	UA1	$E_{cm}^{p\overline{p}}$= 630 GeV
$<1.2 \times 10^{-5}$	90	[275] ALBAJAR	91C	UA1	$E_{cm}^{p\overline{p}}$= 630 GeV
$<4.3 \times 10^{-5}$	90	[276] AVERY	89B	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
$<4.5 \times 10^{-5}$	90	[277] ALBRECHT	87D	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
$<7.7 \times 10^{-5}$	90	[278] AVERY	87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$
$<2 \times 10^{-4}$	90	GILES	84	CLEO	Repl. by AVERY 87

[271] ABE 98 assumes production of $\sigma(B^0) = \sigma(B^+)$ and $\sigma(B_s)/\sigma(B^0) = 1/3$. They normalize to their measured $\sigma(B^0, p_T(B) > 6, |y| < 1.0) = 2.39 \pm 0.32 \pm 0.44\,\mu$b.

[272] ACCIARRI 97B assume PDG 96 production fractions for B^+, B^0, B_s, and Λ_b.

[273] ABE 96L assumes equal B^0 and B^+ production. They normalize to their measured $\sigma(B^+,\ p_T(B) > 6$ GeV/c, $|y| < 1) = 2.39 \pm 0.54\,\mu$b.

[274] B^0 and B_s^0 are not separated.

[275] Obtained from unseparated B^0 and B_s^0 measurement by assuming a B^0:B_s^0 ratio 2:1.

[276] AVERY 89B reports $< 5 \times 10^{-3}$ assuming the $\Upsilon(4S)$ decays 43% to $B^0 \overline{B}^0$. We rescale to 50%.

[277] ALBRECHT 87D reports $< 5 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0 \overline{B}^0$. We rescale to 50%.

[278] AVERY 87 reports $< 9 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0 \overline{B}^0$. We rescale to 50%.

$\Gamma(K^0 e^+ e^-)/\Gamma_{total}$ Γ_{145}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.0 × 10⁻⁴	90	ALBRECHT	91E	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<5.2 \times 10^{-4}$	90	[279] AVERY	87	CLEO	$e^+e^- \rightarrow \Upsilon(4S)$

[279] AVERY 87 reports $< 6.5 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0 \overline{B}^0$. We rescale to 50%.

$\Gamma(K^0\mu^+\mu^-)/\Gamma_{total}$ — Γ_{146}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.6 \times 10^{-4}$	90	[280] AVERY	87	CLEO	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<5.2 \times 10^{-4}$	90	ALBRECHT	91E	ARG	$e^+e^- \to \Upsilon(4S)$

[280] AVERY 87 reports $< 4.5 \times 10^{-4}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(K^*(892)^0 e^+e^-)/\Gamma_{total}$ — Γ_{147}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.9 \times 10^{-4}$	90	ALBRECHT	91E	ARG	$e^+e^- \to \Upsilon(4S)$

$\Gamma(K^*(892)^0\mu^+\mu^-)/\Gamma_{total}$ — Γ_{148}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<2.3 \times 10^{-5}$	90	[281] ALBAJAR	91C	UA1	$E_{cm}^{p\overline{p}} = 630$ GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.5 \times 10^{-5}$	90	[282] ABE	96L	CDF	$p\overline{p}$ at 1.8 TeV
$<3.4 \times 10^{-4}$	90	ALBRECHT	91E	ARG	$e^+e^- \to \Upsilon(4S)$

[281] ALBAJAR 91C assumes 36% of $\overline{b}$ quarks give B^0 mesons.

[282] ABE 96L measured relative to $B^0 \to J/\psi(1S)K^*(892)^0$ using PDG 94 branching ratios.

$\Gamma(K^*(892)^0\nu\overline{\nu})/\Gamma_{total}$ — Γ_{149}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.0 \times 10^{-3}$	90	[283] ADAM	96D	DLPH	$e^+e^- \to Z$

[283] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.

$\Gamma(e^\pm\mu^\mp)/\Gamma_{total}$ — Γ_{150}/Γ

Test of lepton family number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.9 \times 10^{-6}$	90	AMMAR	94	CLE2	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<1.6 \times 10^{-5}$	90	[284] ACCIARRI	97B	L3	$e^+e^- \to Z$
$<3.4 \times 10^{-5}$	90	[285] AVERY	89B	CLEO	$e^+e^- \to \Upsilon(4S)$
$<4.5 \times 10^{-5}$	90	[286] ALBRECHT	87D	ARG	$e^+e^- \to \Upsilon(4S)$
$<7.7 \times 10^{-5}$	90	[287] AVERY	87	CLEO	$e^+e^- \to \Upsilon(4S)$
$<3 \times 10^{-4}$	90	GILES	84	CLEO	Repl. by AVERY 87

[284] ACCIARRI 97B assume PDG 96 production fractions for B^+, B^0, B_s, and Λ_b.

[285] Paper assumes the $\Upsilon(4S)$ decays 43% to $B^0\overline{B}^0$. We rescale to 50%.

[286] ALBRECHT 87D reports $< 5 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 45% to $B^0\overline{B}^0$. We rescale to 50%.

[287] AVERY 87 reports $< 9 \times 10^{-5}$ assuming the $\Upsilon(4S)$ decays 40% to $B^0\overline{B}^0$. We rescale to 50%.

$\Gamma(e^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$ Γ_{151}/Γ

Test of lepton family number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.3 \times 10^{-4}$	90	AMMAR	94	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

$\Gamma(\mu^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$ Γ_{152}/Γ

Test of lepton family number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<8.3 \times 10^{-4}$	90	AMMAR	94	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$

POLARIZATION IN B^0 DECAY

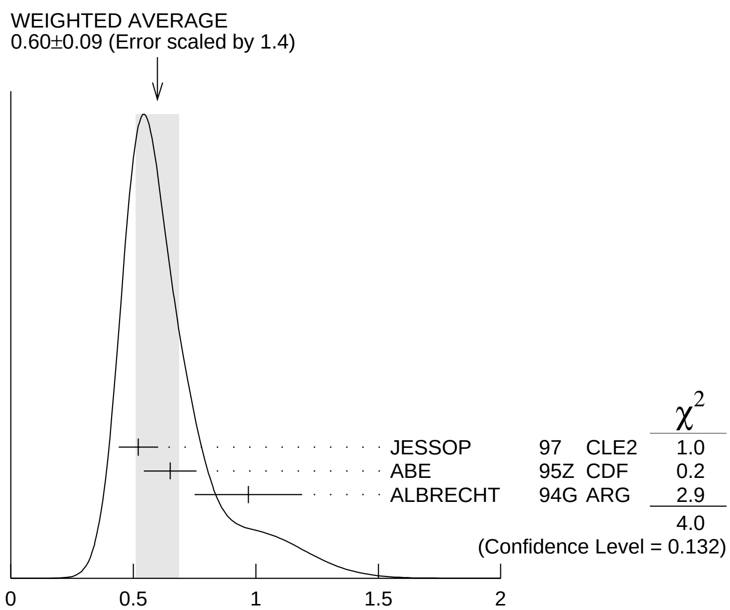
Γ_L/Γ in $B^0 \rightarrow J/\psi(1S)K^*(892)^0$

$\Gamma_L/\Gamma = 1[0]$ would indicate that $B^0 \rightarrow J/\psi(1S)K^*(892)^0$ followed by $K^*(892)^0 \rightarrow K^0_S\pi^0$ is a pure CP eigenstate with $CP = -1[+1]$.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.60±0.09 OUR AVERAGE	Error includes scale factor of 1.4. See the ideogram below.				
0.52±0.07±0.04		[288] JESSOP	97	CLE2	$e^+e^- \rightarrow \Upsilon(4S)$
0.65±0.10±0.04	65	ABE	95Z	CDF	$p\overline{p}$ at 1.8 TeV
0.97±0.16±0.15	13	[289] ALBRECHT	94G	ARG	$e^+e^- \rightarrow \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.80±0.08±0.05	42	[289] ALAM	94	CLE2	Sup. by JESSOP 97

[288] JESSOP 97 is the average over a mixture of B^0 and B^+ decays. The P-wave fraction is found to be $0.16 \pm 0.08 \pm 0.04$.

[289] Averaged over an admixture of B^0 and B^+ decays.



Γ_L/Γ in $B^0 \rightarrow J/\psi(1S)K^*(892)^0$

Γ_L/Γ in $B^0 \to D^{*-}\rho^+$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.93±0.05±0.05	76	ALAM	94	CLE2	$e^+e^- \to \Upsilon(4S)$

B^0–$\overline{B}^0$ MIXING

Revised December 1997 by H. Quinn (SLAC)

There are two neutral B meson systems which are like the neutral kaon system, in that two CP-conjugate states exist: the states $B^0 = \overline{b}d$, and $\overline{B}^0 = \overline{d}b$, which we will call the B_d system; and the states $B^0_s = \overline{b}s$, and $\overline{B}^0_s = \overline{s}b$, which we call the B_s system. For early work on CP violation in the B systems, chiefly the B_d system, see Ref. 1. In both these systems the mass eigenstates are not CP eigenstates, but are mixtures of the two CP-conjugate quark states. The fact that the mixing, due to box diagrams, shown in Fig. 1, produces non-CP eigenstates means that there is a CP-violating phase that enters in the amplitude for these diagrams. The two mass eigenstates can be written, for example for the B_d system,

$$|B_L\rangle = p|B^0\rangle + q|\overline{B}^0\rangle \ ,$$
$$|B_H\rangle = p|B^0\rangle - q|\overline{B}^0\rangle \ . \quad (1)$$

Here H and L stand for Heavy and Light, respectively.

The complex coefficients p and q obey the normalization condition

$$|q|^2 + |p|^2 = 1 \ . \quad (2)$$

We define the mass difference ΔM and width difference $\Delta\Gamma$ between the neutral B mesons:

$$\Delta M \equiv M_H - M_L \ ,$$
$$\Delta\Gamma \equiv \Gamma_H - \Gamma_L \ , \quad (3)$$

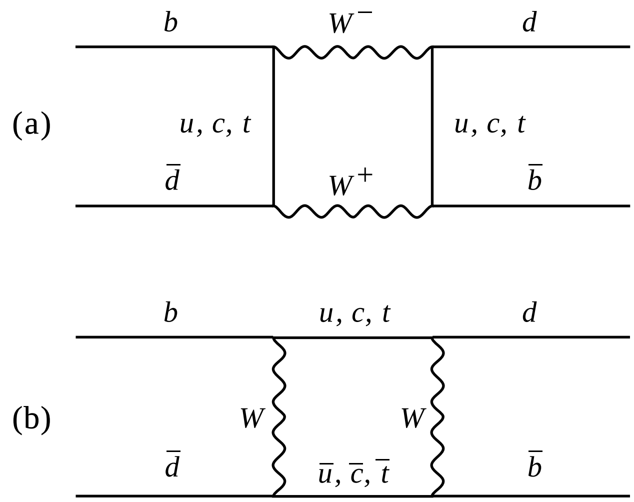


Figure 1: Mixing Diagrams.

so that ΔM is positive by definition. Finding the eigenvalues of the mass-mixing matrix, one gets

$$(\Delta M)^2 - \frac{1}{4}(\Delta\Gamma)^2 = 4(|M_{12}|^2 - \frac{1}{4}|\Gamma_{12}|^2) \tag{4}$$

and

$$\Delta M \Delta\Gamma = 4\mathrm{Re}\,(M_{12}\Gamma^*_{12}) \ , \tag{5}$$

where the off-diagonal term of the mixing matrix is written as $M_{12} + i\Gamma_{12}$. Note that both M_{12} and Γ_{12} may be complex quantities; the separation is defined by the fact that Γ_{12} is given by the absorbtive part of the diagrams (cut contributions). The ratio q/p is given by

$$\frac{q}{p} = -\frac{\Delta M - \frac{i}{2}\Delta\Gamma}{2(M_{12} - \frac{i}{2}\Gamma_{12})} = -\frac{2(M^*_{12} - \frac{i}{2}\Gamma^*_{12})}{\Delta M - \frac{i}{2}\Delta\Gamma} \ . \tag{6}$$

Whereas in the kaon case the lifetimes of the two eigenstates are significantly different and the difference in masses between them is small, in the B_d system it is the mass differences that dominate the physics, and the two states have nearly equal predicted widths (and thus lifetimes). We define, for $q = d, s$

$$x_q = \frac{\Delta M_q}{\Gamma_q} \ , \qquad\qquad y_q = \frac{\Delta\Gamma_q}{\Gamma_q} \ . \tag{7}$$

The value of x_d is about 0.7, not very different from the similar quantity for the K^0 which is 0.48. The difference between the widths of the two B_d eigenstates is produced by the contributions from channels to which both B^0 and $\overline{B}^0$ can decay. These have branching ratios of $\mathcal{O}(10^{-3})$ [2]. Furthermore there are contributions of both signs to the difference, so there is no reason that the net effect should be much larger than the individual terms. Conservatively, one expects $y_d \leq 10^{-2}$and thus also $|q/p|_d$ equal to 1 to a very good approximation. Experimentally no effect of a difference in lifetimes has been observed.

For B_s there is currently only a lower bound on the value of x_s. Theoretical expectation is that it may be as large as 20 or more, which makes it quite difficult to measure. A significant difference in widths is possible, due to the fact that a number of the simplest two-body channels contribute only to a single CP (like the two-pion state which dominates K-decays and is the source of the large width difference in that system). The difference in widths could be as much as 20% of the total width in the B_s system [3]. Note that this still gives a small ratio, of order a few percent, for $\Delta\Gamma/\Delta M$.

The proper time evolution of an initially ($t = 0$) pure B^0 or $\overline{B}^0$ is given by

$$|B^0_{\rm phys}(t)\rangle = g_+(t)|B^0\rangle + (q/p)g_-(t)|\overline{B}^0\rangle \ ,$$
$$|\overline{B}^0_{\rm phys}(t)\rangle = (p/q)g_-(t)|B^0\rangle + g_+(t)|\overline{B}^0\rangle \ . \tag{8}$$

where

$$g_{\pm} = \tfrac{1}{2}\exp(-\Gamma t/2)\exp(-iMt)$$
$$\times\left\{e^{-(\Delta\Gamma/2-\Delta M)t} \pm e^{+(\Delta\Gamma/2-\Delta M)t}\right\} \ . \qquad (9)$$

The rate at which an initial B_q^0 ($\overline{B}_q^0$) decays as a $\overline{B}_q^0$ (B_q^0) is thus

$$R_q(t) = q/p \ (\text{or } p/q)\Gamma|g_-(t)|^2 \ . \qquad (10)$$

The quantity χ_q measures the total probability that a created B^0 decays as a $\overline{B}^0$; it is given by

$$\chi_q = \int_0^\infty R_q(t)dt = \tfrac{1}{2}|q/p|^2\frac{x_q^2 - y_q^2/4}{(1+x_q^2)(1-y_q^2/4)} \ , \qquad (11)$$

Time-dependent mixing measurements are now being done for the B_d system; earlier experiments measured only the time-integrated mixing, which is parameterized by a parameter χ_d. In this case to a good approximation we can set $|q/p| = 1$ and $|y_d| \ll x_d < 1$ so that the simpler form $\chi_d = \frac{1}{2}\frac{x_d^2}{1+x_d^2}$ applies, and a measurement of χ_d implies a value of x_d .

In the B^0–$\overline{B}^0$ mixing section of the B^0 Particle Listings, we list the χ_d measurements, most of which come from $\Upsilon(4S)$ data, and the Δm_{B^0} measurements, which come from Z data. We average these sections separately, but then include the results from both sections in "OUR EVALUATION" of χ_s and $\Delta M_{B_s^0}$. We convert both of these sets of measurements and list them in the x_d section. The x_d values obtained from Δm_{B^0} measurements have a common systematic error due to the error on τ_{B^0}. The averaging takes this common systematic error into account.

Because of the large value of x_s the quantity χ_s will be close to its upper limit of 0.5. This means that one cannot determine

x_s accurately by measuring χ_s. It will require excellent time resolution to resolve the time-dependent mixing of the B_s^0 system, and thereby determine $\Delta M_{B_s^0}$.

In the B_s^0–$\overline{B}_s^0$ mixing section of the B_s^0 Particle Listings, we give measurements of χ_B, the mixing parameter for a high-energy admixture of b-hadrons

$$\chi_B = f_d \, \frac{\mathcal{B}_d}{\langle \mathcal{B} \rangle} \chi_d + f_s \, \frac{\mathcal{B}_s}{\langle \mathcal{B} \rangle} \chi_s \ . \tag{12}$$

Here f_d and f_s are the fractions of b hadrons that are produced as B^0 and B_s^0 mesons respectively, and $\mathcal{B}_d$, $\mathcal{B}_s$, and $\langle \mathcal{B} \rangle$ are branching fractions for B_d, B_s, and the b-hadron admixture respectively decaying to the observed mode. If we assume that $\chi_s = 0.5$ and $\mathcal{B}_d/\langle \mathcal{B} \rangle = \mathcal{B}_s/\langle \mathcal{B} \rangle = 1$, Eq. (12) can be used to determine f_s as discussed in the note on "Production and Decay of b-Flavored Hadrons."

References

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   M. Beneke, G. Buchalla, I. Dunietz, Phys. Rev. **D54**, 4419 (1996).

B^0-$\overline{B}^0$ MIXING PARAMETERS

For a discussion of B^0-$\overline{B}^0$ mixing see the note on "B^0-$\overline{B}^0$ Mixing" in the B^0 Particle Listings above.

χ_d is a measure of the time-integrated B^0-$\overline{B}^0$ mixing probability that a produced $B^0(\overline{B}^0)$ decays as a $\overline{B}^0(B^0)$. Mixing violates $\Delta B \neq 2$ rule.

$$\chi_d = \frac{x_d^2}{2(1+x_d^2)}$$

$$x_d = \frac{\Delta m_{B^0}}{\Gamma_{B^0}} = (m_{B^0_H} - m_{B^0_L})\,\tau_{B^0}\ ,$$

where H, L stand for heavy and light states of two B^0 CP eigenstates and $\tau_{B^0} = \frac{1}{0.5(\Gamma_{B^0_H}+\Gamma_{B^0_L})}$.

χ_d

This B^0-$\overline{B}^0$ mixing parameter is the the probability (integrated over time) that a produced B^0 (or $\overline{B}^0$) decays as a $\overline{B}^0$ (or B^0), e.g. for inclusive lepton decays

$$\chi_d = \Gamma(B^0 \to \ell^- X \text{ (via } \overline{B}^0))/\Gamma(B^0 \to \ell^\pm X)$$
$$= \Gamma(\overline{B}^0 \to \ell^+ X \text{ (via } B^0))/\Gamma(\overline{B}^0 \to \ell^\pm X)$$

Where experiments have measured the parameter $r = \chi/(1-\chi)$, we have converted to χ. Mixing violates the $\Delta B \neq 2$ rule.

Note that the measurement of χ at energies higher than the $\Upsilon(4S)$ have not separated χ_d from χ_s where the subscripts indicate $B^0(\overline{b}d)$ or $B^0_s(\overline{b}s)$. They are listed in the B^0_s-$\overline{B}^0_s$ MIXING section.

The experiments at $\Upsilon(4S)$ make an assumption about the $B^0\overline{B}^0$ fraction and about the ratio of the $B^\pm$ and B^0 semileptonic branching ratios (usually that it equals one).

OUR EVALUATION, provided by the LEP B Oscillation Working Group, includes χ_d calculated from Δm_{B^0} and τ_{B^0}.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.172±0.010 OUR EVALUATION					
0.156±0.024 OUR AVERAGE					
0.16 ±0.04 ±0.04		[290] ALBRECHT	94	ARG	$e^+e^- \to \Upsilon(4S)$
0.149±0.023±0.022		[291] BARTELT	93	CLE2	$e^+e^- \to \Upsilon(4S)$
0.171±0.048		[292] ALBRECHT	92L	ARG	$e^+e^- \to \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.20 ±0.13 ±0.12		[293] ALBRECHT	96D	ARG	$e^+e^- \to \Upsilon(4S)$
0.19 ±0.07 ±0.09		[294] ALBRECHT	96D	ARG	$e^+e^- \to \Upsilon(4S)$
0.24 ±0.12		[295] ELSEN	90	JADE	e^+e^- 35–44 GeV
$0.158^{+0.052}_{-0.059}$		ARTUSO	89	CLEO	$e^+e^- \to \Upsilon(4S)$
0.17 ±0.05		[296] ALBRECHT	87I	ARG	$e^+e^- \to \Upsilon(4S)$
<0.19	90	[297] BEAN	87B	CLEO	$e^+e^- \to \Upsilon(4S)$
<0.27	90	[298] AVERY	84	CLEO	$e^+e^- \to \Upsilon(4S)$

[290] ALBRECHT 94 reports r=0.194 ± 0.062 ± 0.054. We convert to χ for comparison. Uses tagged events (lepton + pion from D^*).

[291] BARTELT 93 analysis performed using tagged events (lepton+pion from D^*). Using dilepton events they obtain 0.157 ± $0.016^{+0.033}_{-0.028}$.

[292] ALBRECHT 92L is a combined measurement employing several lepton-based techniques. It uses all previous ARGUS data in addition to new data and therefore supersedes ALBRECHT 87I. A value of r = 20.6 ± 7.0% is directly measured. The value can be used to measure $x = \Delta M/\Gamma = 0.72 \pm 0.15$ for the B_d meson. Assumes $f_{+-}/f_0 = 1.0 \pm 0.05$ and uses $\tau_{B^\pm}/\tau_{B^0} = (0.95 \pm 0.14)\ (f_{+-}/f_0)$.

[293] Uses $D^{*+} K^{\pm}$ correlations.

[294] Uses $(D^{*+} \ell^-)\ K^{\pm}$ correlations.

[295] These experiments see a combination of B_s and B_d mesons.

[296] ALBRECHT 87I is inclusive measurement with like-sign dileptons, with tagged B decays plus leptons, and one fully reconstructed event. Measures r=0.21 ± 0.08. We convert to χ for comparison. Superseded by ALBRECHT 92L.

[297] BEAN 87B measured $r <$ 0.24; we converted to χ.

[298] Same-sign dilepton events. Limit assumes semileptonic BR for B^+ and B^0 equal. If $B^0/B^{\pm}$ ratio <0.58, no limit exists. The limit was corrected in BEAN 87B from $r <$ 0.30 to $r <$ 0.37. We converted this limit to χ.

$\Delta m_{B^0} = m_{B^0_H} - m_{B^0_L}$

$\Delta m_{B^0_s}$ is a measure of 2π times the B^0-$\overline{B}^0$ oscillation frequency in time-dependent mixing experiments.

The second "OUR EVALUATION" (0.470 ± 0.019) is an average of the data listed below performed by the LEP B Oscillation Working Group as described in our review "Production and Decays of B-flavored Hadrons" in the $B^{\pm}$ Section of these Listings. The averaging procedure takes into account correlations between the measurements.

The first "OUR EVALUATION" (0.464 ± 0.018), also provided by the LEP B Oscillation Working Group, includes Δm_d calculated from χ_d measured at $\Upsilon(4S)$.

VALUE ($10^{12}\ \hbar\ s^{-1}$)	EVTS	DOCUMENT ID		TECN	COMMENT
0.464±0.018 OUR EVALUATION					
0.470±0.019 OUR EVALUATION					
$0.471^{+0.078}_{-0.068}{}^{+0.033}_{-0.034}$		[299] ABE	98C	CDF	$p\overline{p}$ at 1.8 TeV
0.458±0.046±0.032		[300] ACCIARRI	98D	L3	$e^+e^- \rightarrow Z$
0.437±0.043±0.044		[301] ACCIARRI	98D	L3	$e^+e^- \rightarrow Z$
0.472±0.049±0.053		[302] ACCIARRI	98D	L3	$e^+e^- \rightarrow Z$
0.523±0.072±0.043		[303] ABREU	97N	DLPH	$e^+e^- \rightarrow Z$
0.493±0.042±0.027		[301] ABREU	97N	DLPH	$e^+e^- \rightarrow Z$
0.499±0.053±0.015		[304] ABREU	97N	DLPH	$e^+e^- \rightarrow Z$
0.480±0.040±0.051		[300] ABREU	97N	DLPH	$e^+e^- \rightarrow Z$
$0.444 \pm 0.029^{+0.020}_{-0.017}$		[301] ACKERSTAFF	97U	OPAL	$e^+e^- \rightarrow Z$
$0.430 \pm 0.043^{+0.028}_{-0.030}$		[300] ACKERSTAFF	97V	OPAL	$e^+e^- \rightarrow Z$
0.482±0.044±0.024		[305] BUSKULIC	97D	ALEP	$e^+e^- \rightarrow Z$
0.404±0.045±0.027		[301] BUSKULIC	97D	ALEP	$e^+e^- \rightarrow Z$
0.452±0.039±0.044		[300] BUSKULIC	97D	ALEP	$e^+e^- \rightarrow Z$
0.539±0.060±0.024		[306] ALEXANDER	96V	OPAL	$e^+e^- \rightarrow Z$
$0.567 \pm 0.089^{+0.029}_{-0.023}$		[307] ALEXANDER	96V	OPAL	$e^+e^- \rightarrow Z$

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

$0.444 \pm 0.028 \pm 0.028$		[308] ACCIARRI	98D	L3	$e^+ e^- \to Z$
0.497 ± 0.035		[309] ABREU	97N	DLPH	$e^+ e^- \to Z$
$0.467 \pm 0.022 {}^{+0.017}_{-0.015}$		[310] ACKERSTAFF	97V	OPAL	$e^+ e^- \to Z$
0.446 ± 0.032		[311] BUSKULIC	97D	ALEP	$e^+ e^- \to Z$
$0.531 {}^{+0.050}_{-0.046} \pm 0.078$		[312] ABREU	96Q	DLPH	Sup. by ABREU 97N
$0.496 {}^{+0.055}_{-0.051} \pm 0.043$		[300] ACCIARRI	96E	L3	Repl. by ACCIARRI 98D
$0.548 \pm 0.050 {}^{+0.023}_{-0.019}$		[313] ALEXANDER	96V	OPAL	$e^+ e^- \to Z$
0.496 ± 0.046		[314] AKERS	95J	OPAL	Repl. by ACKER-STAFF 97V
$0.462 {}^{+0.040}_{-0.053} {}^{+0.052}_{-0.035}$		[300] AKERS	95J	OPAL	Repl. by ACKER-STAFF 97V
$0.50 \pm 0.12 \pm 0.06$		[303] ABREU	94M	DLPH	Sup. by ABREU 97N
$0.508 \pm 0.075 \pm 0.025$		[306] AKERS	94C	OPAL	Repl. by ALEXAN-DER 96V
$0.57 \pm 0.11 \pm 0.02$	153	[307] AKERS	94H	OPAL	Repl. by ALEXAN-DER 96V
$0.50 {}^{+0.07}_{-0.06} {}^{+0.11}_{-0.10}$		[300] BUSKULIC	94B	ALEP	Sup. by BUSKULIC 97D
$0.52 {}^{+0.10}_{-0.11} {}^{+0.04}_{-0.03}$		[307] BUSKULIC	93K	ALEP	Sup. by BUSKULIC 97D

[299] Uses π-B in the same side.
[300] Uses ℓ-ℓ.
[301] Uses ℓ-Q_{hem}.
[302] Uses ℓ-ℓ with impact parameters.
[303] Uses $D^{*\pm}$-Q_{hem}.
[304] Uses $\pi_s^{\pm}\,\ell$-Q_{hem}.
[305] Uses $D^{*\pm}$-ℓ/Q_{hem}.
[306] Uses $D^{*\pm}\,\ell$-Q_{hem}.
[307] Uses $D^{*\pm}$-ℓ.
[308] ACCIARRI 98D combines results from ℓ-ℓ, ℓ-Q_{hem}, and ℓ-ℓ with impact parameters.
[309] ABREU 97N combines results from $D^{*\pm}$-Q_{hem}, ℓ-Q_{hem}, $\pi_s^{\pm}\,\ell$-Q_{hem}, and ℓ-ℓ.
[310] ACKERSTAFF 97V combines results from ℓ-ℓ, ℓ-Q_{hem}, D^*-ℓ, and $D^{*\pm}$-Q_{hem}.
[311] BUSKULIC 97D combines results from $D^{*\pm}$-ℓ/Q_{hem}, ℓ-Q_{hem}, and ℓ-ℓ.
[312] ABREU 96Q analysis performed using lepton, kaon, and jet-charge tags.
[313] ALEXANDER 96V combines results from $D^{*\pm}$-ℓ and $D^{*\pm}\,\ell$-Q_{hem}.
[314] AKERS 95J combines results fromt charge measurement, $D^{*\pm}\,\ell$-Q_{hem} and ℓ-ℓ.

$x_d = \Delta m_{B^0}/\Gamma_{B^0}$

The second "OUR EVALUATION" (0.734 ± 0.035) is an average of the data listed in Δm_{B^0} section performed by the LEP B Oscillation Working Group as described in our review "Production and Decays of B-flavored Hadrons" in the $B^{\pm}$ Section of these Listings. The averaging procedure takes into account correlations between the measurements.

The first "OUR EVALUATION" (0.723 ± 0.032), also provided by the LEP B Oscillation Working Group, includes χ_d measured at $\Upsilon(4S)$.

VALUE	*DOCUMENT ID*
0.723±0.032 OUR EVALUATION	
0.734±0.035 OUR EVALUATION	