$B^{\pm}/B^0/B^0_s/b$-baryon ADMIXTURE

$B^{\pm}/B^0/B^0_s/b$-baryon ADMIXTURE MEAN LIFE

These measurements of the B mean life are averages over bottom particles produced, weighted by their semileptonic branching ratios, unless otherwise stated. Only the measurements at high energy are averaged since it is expected that the admixtures of b hadrons from Z decay and 1.8 TeV $p\overline{p}$ collisions should should not differ significantly.

"OUR EVALUATION" is an average of the data listed below performed by the LEP B Lifetimes Working Group as described in our review "Production and Decay of b-flavored Hadrons" in the $B^{\pm}$ Section of the Listings. The averaging procedure takes into account correlations between the measurements and asymmetric lifetime errors.

VALUE (10^{-12} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.549±0.020 OUR EVALUATION					
$1.582\pm0.011\pm0.027$		[1] ABREU	96E	DLPH	$e^+e^- \rightarrow Z$
$1.533\pm0.013\pm0.022$	19.8k	[2] BUSKULIC	96F	ALEP	$e^+e^- \rightarrow Z$
$1.564\pm0.030\pm0.036$		[3] ABE,K	95B	SLD	$e^+e^- \rightarrow Z$
$1.542\pm0.021\pm0.045$		[4] ABREU	94L	DLPH	$e^+e^- \rightarrow Z$
$1.46\ \pm0.06\ \pm0.06$	5344	[5] ABE	93J	CDF	$p\overline{p}$ at 1.8 TeV
$1.523\pm0.034\pm0.038$	5372	[6] ACTON	93L	OPAL	$e^+e^- \rightarrow Z$
$1.535\pm0.035\pm0.028$	7357	[6] ADRIANI	93K	L3	$e^+e^- \rightarrow Z$
$1.511\pm0.022\pm0.078$		[7] BUSKULIC	93O	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.575\pm0.010\pm0.026$		[8] ABREU	96E	DLPH	$e^+e^- \rightarrow Z$
$1.50\ {}^{+0.24}_{-0.21}\ \pm0.03$		[9] ABREU	94P	DLPH	$e^+e^- \rightarrow Z$
$1.23\ {}^{+0.14}_{-0.13}\ \pm0.15$	188	[10] ABREU	93D	DLPH	Sup. by ABREU 94L
$1.49\ \pm0.11\ \pm0.12$	253	[11] ABREU	93G	DLPH	Sup. by ABREU 94L
$1.51\ {}^{+0.16}_{-0.14}\ \pm0.11$	130	[12] ACTON	93C	OPAL	$e^+e^- \rightarrow Z$
$1.28\ \pm0.10$		[13] ABREU	92	DLPH	Sup. by ABREU 94L
$1.37\ \pm0.07\ \pm0.06$	1354	[14] ACTON	92	OPAL	Sup. by ACTON 93L
$1.49\ \pm0.03\ \pm0.06$		[15] BUSKULIC	92F	ALEP	Sup. by BUSKULIC 96F
$1.35\ {}^{+0.19}_{-0.17}\ \pm0.05$		[16] BUSKULIC	92G	ALEP	$e^+e^- \rightarrow Z$
$1.32\ \pm0.08\ \pm0.09$	1386	[17] ADEVA	91H	L3	Sup. by ADRIANI 93K
$1.32\ {}^{+0.31}_{-0.25}\ \pm0.15$	37	[18] ALEXANDER	91G	OPAL	$e^+e^- \rightarrow Z$
$1.29\ \pm0.06\ \pm0.10$	2973	[19] DECAMP	91C	ALEP	Sup. by BUSKULIC 92F
$1.36\ {}^{+0.25}_{-0.23}$		[20] HAGEMANN	90	JADE	$E^{ee}_{\rm cm}$= 35 GeV
$1.13\ \pm0.15$		[21] LYONS	90	RVUE	
$1.35\ \pm0.10\ \pm0.24$		BRAUNSCH...	89B	TASS	$E^{ee}_{\rm cm}$= 35 GeV
$0.98\ \pm0.12\ \pm0.13$		ONG	89	MRK2	$E^{ee}_{\rm cm}$= 29 GeV
$1.17\ {}^{+0.27}_{-0.22}\ {}^{+0.17}_{-0.16}$		KLEM	88	DLCO	$E^{ee}_{\rm cm}$= 29 GeV
$1.29\ \pm0.20\ \pm0.21$		[22] ASH	87	MAC	$E^{ee}_{\rm cm}$= 29 GeV
$1.02\ {}^{+0.42}_{-0.39}$	301	[23] BROM	87	HRS	$E^{ee}_{\rm cm}$= 29 GeV

[1] Uses inclusively reconstructed secondary vertices.

[2] BUSKULIC 96F analyzed using 3D impact parameter.

[3] ABE,K 95B uses an inclusive topological technique.

[4] ABREU 94L uses charged particle impact parameters. Their result from inclusively reconstructed secondary vertices is superseded by ABREU 96E.

[5] ABE 93J analyzed using $J/\psi(1S) \rightarrow \mu\mu$ vertices.

[6] ACTON 93L and ADRIANI 93K analyzed using lepton (e and μ) impact parameter at Z.

[7] BUSKULIC 93O analyzed using dipole method.

[8] Combines ABREU 96E secondary vertex result with ABREU 94L impact parameter result.

[9] From proper time distribution of $b \rightarrow J/\psi(1S)$anything.

[10] ABREU 93D data analyzed using $D\,/\,D^*\ell$anything event vertices.

[11] ABREU 93G data analyzed using charged and neutral vertices.

[12] ACTON 93C analysed using $D\,/\,D^*\ell$anything event vertices.

[13] ABREU 92 is combined result of muon and hadron impact parameter analyses. Hadron tracks gave $(12.7 \pm 0.4 \pm 1.2) \times 10^{-13}$ s for an admixture of B species weighted by production fraction and mean charge multiplicity, while muon tracks gave $(13.0 \pm 1.0 \pm 0.8) \times$

10^{-13} s for an admixture weighted by production fraction and semileptonic branching fraction.

[14] ACTON 92 is combined result of muon and electron impact parameter analyses.

[15] BUSKULIC 92F uses the lepton impact parameter distribution for data from the 1991 run.

[16] BUSKULIC 92G use $J/\psi(1S)$ tags to measure the average b lifetime. This is comparable to other methods only if the $J/\psi(1S)$ branching fractions of the different b-flavored hadrons are in the same ratio.

[17] Using $Z \to e^+ X$ or $\mu^+ X$, ADEVA 91H determined the average lifetime for an admixture of B hadrons from the impact parameter distribution of the lepton.

[18] Using $Z \to J/\psi(1S)X$, $J/\psi(1S) \to \ell^+ \ell^-$, ALEXANDER 91G determined the average lifetime for an admixture of B hadrons from the decay point of the $J/\psi(1S)$.

[19] Using $Z \to eX$ or μX, DECAMP 91C determines the average lifetime for an admixture of B hadrons from the signed impact parameter distribution of the lepton.

[20] HAGEMANN 90 uses electrons and muons in an impact parameter analysis.

[21] LYONS 90 combine the results of the B lifetime measuresments of ONG 89, BRAUNSCHWEIG 89B, KLEM 88, and ASH 87, and JADE data by private communication. They use statistical techniques which include variation of the error with the mean life, and possible correlations between the systematic errors. This result is not independent of the measured results used in our average.

[22] We have combined an overall scale error of 15% in quadrature with the systematic error of ± 0.7 to obtain ± 2.1 systematic error.

[23] Statistical and systematic errors were combined by BROM 87.

CHARGED *b*-HADRON ADMIXTURE MEAN LIFE

VALUE (10^{-12} s)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.72±0.08±0.06	[24] ADAM	95	DLPH	$e^+ e^- \to Z$

[24] ADAM 95 data analyzed using vertex-charge technique to tag b-hadron charge.

NEUTRAL *b*-HADRON ADMIXTURE MEAN LIFE

VALUE (10^{-12} s)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.58±0.11±0.09	[25] ADAM	95	DLPH	$e^+ e^- \to Z$

[25] ADAM 95 data analyzed using vertex-charge technique to tag b-hadron charge.

MEAN LIFE RATIO $\tau_{\text{charged } b-\text{hadron}}/\tau_{\text{neutral } b-\text{hadron}}$

VALUE	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{1.09^{+0.11}_{-0.10}\pm0.08}$	[26] ADAM	95	DLPH	$e^+ e^- \to Z$

[26] ADAM 95 data analyzed using vertex-charge technique to tag b-hadron charge.

$\overline{b}$ PRODUCTION FRACTIONS AND DECAY MODES

The branching fraction measurements are for an admixture of B mesons and baryons at energies above the $\Upsilon(4S)$. Only the highest energy results (LEP, Tevatron, S$p\overline{p}$S) are used in the branching fraction averages. The production fractions give our best current estimate of the admixture at LEP.

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 possiblity 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 when only one of the specified particles 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 sections.

The modes below are listed for a $\overline{b}$ initial state. b modes are their charge conjugates. Reactions indicate the weak decay vertex and do not include mixing.

	Mode		Fraction (Γ_i/Γ)	Confidence level

PRODUCTION FRACTIONS

The production fractions for weakly decaying b-hadrons at the Z have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by O. Hayes (CERN) and M. Jimack (U. Birmingham) as described in the note "Production and Decay of b-Flavored Hadrons" in the $B^{\pm}$ Particle Listings. Values assume

$$\mathrm{B}(\overline{b} \rightarrow B^+) = \mathrm{B}(\overline{b} \rightarrow B^0)$$
$$\mathrm{B}(\overline{b} \rightarrow B^+) + \mathrm{B}(\overline{b} \rightarrow B^0) + \mathrm{B}(\overline{b} \rightarrow B^0_s) + \mathrm{B}(b \rightarrow \Lambda_b) = 100\ \%.$$

The notation for production fractions varies in the literature (f_{B^0}, $f(b \rightarrow \overline{B}^0)$, $\mathrm{Br}(b \rightarrow \overline{B}^0)$). We use our own branching fraction notation here, $\mathrm{B}(\overline{b} \rightarrow B^0)$.

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\overline{b} \rightarrow B^+$		(37.8 ± 2.2) %	
Γ_2	$\overline{b} \rightarrow B^0$		(37.8 ± 2.2) %	
Γ_3	$\overline{b} \rightarrow B^0_s$		$(11.2 ^{+1.8}_{-1.9})$ %	
Γ_4	$b \rightarrow \Lambda_b$		(13.2 ± 4.1) %	

DECAY MODES

Semileptonic and leptonic modes

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_5	$\overline{b} \rightarrow e^+ \nu_e$ anything	[a]	(11.1 ± 1.0) %	
Γ_6	$\overline{b} \rightarrow \mu^+ \nu_\mu$ anything	[a]	(10.7 ± 0.7) %	
Γ_7	$\overline{b} \rightarrow \ell^+ \nu_\ell$ anything	[a,b]	(11.13 ± 0.29) %	
Γ_8	$\overline{b} \rightarrow D^- \ell^+ \nu_\ell$ anything	[b]	(2.01 ± 0.29) %	
Γ_9	$\overline{b} \rightarrow \overline{D}^0 \ell^+ \nu_\ell$ anything	[b]	(6.6 ± 0.6) %	
Γ_{10}	$\overline{b} \rightarrow D^{*-} \ell^+ \nu_\ell$ anything	[b]	(2.76 ± 0.29) %	
Γ_{11}	$\overline{b} \rightarrow \overline{D}^0_j \ell^+ \nu_\ell$ anything	[b,c]	seen	
Γ_{12}	$\overline{b} \rightarrow D^-_j \ell^+ \nu_\ell$ anything	[b,c]	seen	
Γ_{13}	$\overline{b} \rightarrow \overline{D}^*_2(2460)^0 \ell^+ \nu_\ell$ anything		seen	
Γ_{14}	$\overline{b} \rightarrow D^*_2(2460)^- \ell^+ \nu_\ell$ anything		seen	
Γ_{15}	$\overline{b} \rightarrow \tau^+ \nu_\tau$ anything		(2.7 ± 0.4) %	
Γ_{16}	$\overline{b} \rightarrow \overline{b} \rightarrow \overline{c} \rightarrow \ell^- \overline{\nu}_\ell$ anything	[b]	(7.9 ± 0.8) %	

Charmonium modes

Γ_{17}	$\overline{b} \to J/\psi(1S)$anything			$(1.16\pm 0.10)\ \%$	
Γ_{18}	$\overline{b} \to \psi(2S)$anything			$(4.8 \pm 2.4) \times 10^{-3}$	
Γ_{19}	$\overline{b} \to \chi_{c1}(1P)$anything			$(1.8 \pm 0.5)\ \%$	

***K* or *K** modes**

Γ_{20}	$\overline{b} \to \overline{s}\gamma$			$< 1.2 \times 10^{-3}$	90%
Γ_{21}	$\overline{b} \to K^{\pm}$anything			$(88 \pm 19)\ \%$	
Γ_{22}	$\overline{b} \to K^0_S$anything			$(29.0 \pm 2.9)\ \%$	

Baryon modes

Γ_{23}	$\overline{b} \to p/\overline{p}$anything			$(14 \pm 6)\ \%$	
Γ_{24}	$\overline{b} \to \Lambda/\overline{\Lambda}$anything			$(5.9 \pm 1.1)\ \%$	

Other modes

Γ_{25}	$\overline{b} \to$ charged anything		[*d*]	$(584 \pm 40)\ \%$	

$\Delta B = 1$ weak neutral current (*B1*) modes

Γ_{26}	$\overline{b} \to e^+e^-$ anything				
Γ_{27}	$\overline{b} \to \mu^+\mu^-$ anything	*B1*		$< 5.0 \times 10^{-5}$	90%
Γ_{28}	$\overline{b} \to \nu\overline{\nu}$anything	*B1*		$< 3.9 \times 10^{-4}$	

[*a*] These values are model dependent. See 'Note on Semileptonic Decays' in the B^+ Particle Listings.

[*b*] ℓ indicates e or μ mode, not sum over modes.

[*c*] D_j represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.

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

$B^{\pm}/B^0/B^0_s/b$-baryon ADMIXTURE BRANCHING RATIOS

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

These branching fraction values are model dependent. See the note on "Semileptonic Decays of D and B Mesons, Part II" at the beginning of the B^+ Particle Listings.

VALUE	*DOCUMENT ID*	*TECN*	*COMMENT*
0.1113±0.0029 OUR AVERAGE	Includes data from the 2 datablocks that follow this one.		
0.1106±0.0039±0.0022	[27] ABREU 95D	DLPH	$e^+e^- \to Z$
0.114 ±0.003 ±0.004	[28] BUSKULIC 94G	ALEP	$e^+e^- \to Z$

[27] ABREU 95D give systematic errors ±0.0019 (model) and 0.0012 (R_c). We combine these in quadrature.

[28] BUSKULIC 94G uses e and μ events. This value is from a global fit to the lepton p and p_T (relative to jet) spectra which also determines the b and c production fractions, the fragmentation functions, and the forward-backward asymmetries. This branching ratio depends primarily on the ratio of dileptons to single leptons at high p_T, but the lower p_T portion of the lepton spectrum is included in the global fit to reduce the model dependence. The model dependence is ±0.0026 and is included in the systematic error.

$\Gamma(e^+\nu_e$ anything$)/\Gamma_{\text{total}}$ — Γ_5/Γ

These branching fraction values are model dependent. See the note on "Semileptonic Decays of D and B Mesons, Part II" at the beginning of the B^+ Particle Listings.

VALUE	*EVTS*	*DOCUMENT ID*	*TECN*	*COMMENT*
The data in this block is included in the average printed for a previous datablock.				
0.111±0.010 OUR AVERAGE				
0.107±0.015±0.007	260	[29] ABREU 93C	DLPH	$e^+e^- \to Z$
$0.109^{+0.014}_{-0.013}\pm0.0055$	2719	[30] AKERS 93B	OPAL	$e^+e^- \to Z$
0.138±0.032±0.008		[31] ADEVA 91C	L3	$e^+e^- \to Z$

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

$0.086 \pm 0.027 \pm 0.008$	[32] ABE	93E	VNS	E^{ee}_{cm}= 58 GeV
$0.111 \pm 0.028 \pm 0.026$	BEHREND	90D	CELL	E^{ee}_{cm}= 43 GeV
$0.150 \pm 0.011 \pm 0.022$	BEHREND	90D	CELL	E^{ee}_{cm}= 35 GeV
$0.112 \pm 0.009 \pm 0.011$	ONG	88	MRK2	E^{ee}_{cm}= 29 GeV
$0.149^{+0.022}_{-0.019}$	PAL	86	DLCO	E^{ee}_{cm}= 29 GeV
$0.110 \pm 0.018 \pm 0.010$	AIHARA	85	TPC	E^{ee}_{cm}= 29 GeV
$0.111 \pm 0.034 \pm 0.040$	ALTHOFF	84J	TASS	E^{ee}_{cm}= 34.6 GeV
0.146 ± 0.028	KOOP	84	DLCO	Repl. by PAL 86
$0.116 \pm 0.021 \pm 0.017$	NELSON	83	MRK2	E^{ee}_{cm}= 29 GeV

[29] ABREU 93C event count includes ee events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.

[30] AKERS 93B analysis performed using single and dilepton events.

[31] ADEVA 91C measure the average B($b \rightarrow eX$) branching ratio using single and double tagged b enhanced Z events. Combining e and μ results, they obtain $0.113 \pm 0.010 \pm 0.006$. Constraining the initial number of b quarks by the Standard Model prediction (378 ± 3 MeV) for the decay of the Z into $b\overline{b}$, the electron result gives $0.112 \pm 0.004 \pm 0.008$. They obtain $0.119 \pm 0.003 \pm 0.006$ when e and μ results are combined. Used to measure the $b\overline{b}$ width itself, this electron result gives $370 \pm 12 \pm 24$ MeV and combined with the muon result gives $385 \pm 7 \pm 22$ MeV.

[32] ABE 93E experiment also measures forward-backward asymmetries and fragmentation functions for b and c.

$\Gamma(\mu^+ \nu_\mu \text{anything})/\Gamma_{\text{total}}$ Γ_6/Γ

These branching fraction values are model dependent. See the note on "Semileptonic Decays of D and B Mesons, Part II" at the beginning of the B^+ Particle Listings.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
The data in this block is included in the average printed for a previous datablock.					
0.107±0.007 OUR AVERAGE					
$0.110 \pm 0.012 \pm 0.007$	656	[33] ABREU	93C	DLPH	$e^+e^- \rightarrow Z$
$0.101^{+0.010}_{-0.009} \pm 0.0055$	4248	[34] AKERS	93B	OPAL	$e^+e^- \rightarrow Z$
$0.113 \pm 0.012 \pm 0.006$		[35] ADEVA	91C	L3	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.104 \pm 0.023 \pm 0.016$		BEHREND	90D	CELL	E^{ee}_{cm}= 43 GeV
$0.148 \pm 0.010 \pm 0.016$		BEHREND	90D	CELL	E^{ee}_{cm}= 35 GeV
$0.118 \pm 0.012 \pm 0.010$		ONG	88	MRK2	E^{ee}_{cm}= 29 GeV
$0.117 \pm 0.016 \pm 0.015$		BARTEL	87	JADE	E^{ee}_{cm}= 34.6 GeV
$0.114 \pm 0.018 \pm 0.025$		BARTEL	85J	JADE	Repl. by BARTEL 87
$0.117 \pm 0.028 \pm 0.010$		ALTHOFF	84G	TASS	E^{ee}_{cm}= 34.5 GeV
$0.105 \pm 0.015 \pm 0.013$		ADEVA	83B	MRKJ	E^{ee}_{cm}= 33–38.5 GeV
$0.155^{+0.054}_{-0.029}$		FERNANDEZ	83D	MAC	E^{ee}_{cm}= 29 GeV

[33] ABREU 93C event count includes $\mu\mu$ events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.

[34] AKERS 93B analysis performed using single and dilepton events.

[35] ADEVA 91C measure the average B($b \rightarrow eX$) branching ratio using single and double tagged b enhanced Z events. Combining e and μ results, they obtain $0.113 \pm 0.010 \pm 0.006$. Constraining the initial number of b quarks by the Standard Model prediction (378 ± 3 MeV) for the decay of the Z into $b\overline{b}$, the muon result gives $0.123 \pm 0.003 \pm 0.006$. They obtain $0.119 \pm 0.003 \pm 0.006$ when e and μ results are combined. Used to measure the $b\overline{b}$ width itself, this muon result gives $394 \pm 9 \pm 22$ MeV and combined with the electron result gives $385 \pm 7 \pm 22$ MeV.

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

VALUE	DOCUMENT ID		TECN	COMMENT
$0.0201 \pm 0.0026 \pm 0.0013$	[36] AKERS	95Q	OPAL	$e^+e^- \rightarrow Z$

[36] AKERS 95Q reports [B($\overline{b} \rightarrow D^- \ell^+ \nu_\ell$ anything) $\times$ B($D^+ \rightarrow K^- \pi^+ \pi^+$)] = $(1.82 \pm 0.20 \pm 0.12) \times 10^{-3}$. We divide by our best value B($D^+ \rightarrow K^- \pi^+ \pi^+$) = $(9.1 \pm 0.6) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\overline{D}^0 \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_9/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
0.066±0.006±0.002	[37] AKERS 95Q	OPAL	$e^+e^- \to Z$

[37] AKERS 95Q reports $[B(\overline{b} \to \overline{D}^0 \ell^+ \nu_\ell \text{anything}) \times B(D^0 \to K^- \pi^+)] = (2.52 \pm 0.14 \pm 0.17) \times 10^{-3}$. We divide by our best value $B(D^0 \to K^- \pi^+) = (3.83 \pm 0.12) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE	DOCUMENT ID	TECN	COMMENT
0.0276±0.0027±0.0011	[38] AKERS 95Q	OPAL	$e^+e^- \to Z$

[38] AKERS 95Q reports $[B(\overline{b} \to D^* \ell^+ \nu_\ell X) \times B(D^{*+} \to D^0 \pi^+) \times B(D^0 \to K^- \pi^+)] = ((7.53 \pm 0.47 \pm 0.56) \times 10^{-4})$ and uses $B(D^{*+} \to D^0 \pi^+) = 0.681 \pm 0.013$ and $B(D^0 \to K^- \pi^+) = 0.0401 \pm 0.0014$ to obtain the above result. The first error is the experiments error and the second error is the systematic error from the D^{*+} and D^0 branching ratios.

$\Gamma(\overline{D}{}^0_j \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{11}/Γ

D_j represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[39] AKERS 95Q	OPAL	$e^+e^- \to Z$

[39] AKERS 95Q quotes the product branching ratio $B(\overline{b} \to \overline{D}{}^0_j \ell^+ \nu_\ell X)\ B(\overline{D}{}^0_j \to D^{*+} \pi^-) = ((6.1 \pm 1.3 \pm 1.3) \times 10^{-3})$.

$\Gamma(D^-_j \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{12}/Γ

D_j represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[40] AKERS 95Q	OPAL	$e^+e^- \to Z$

[40] AKERS 95Q quotes the product branching ratio $B(\overline{b} \to D^-_j \ell^+ \nu_\ell \text{anything})\ B(D^-_j \to D^0 \pi^-) = ((7.0 \pm 1.9^{+1.2}_{-1.3}) \times 10^{-3})$.

$\Gamma(\overline{D}{}^*_2(2460)^0 \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{13}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[41] AKERS 95Q	OPAL	$e^+e^- \to Z$

[41] AKERS 95Q quotes the product branching ratio $B(\overline{b} \to \overline{D}{}^*_2(2460)^0 \ell^+ \nu_\ell \text{anything})\ B(D^*_2(2460)^0 \to D^+ \pi^-) = (1.6 \pm 0.7 \pm 0.3) \times 10^{-3}$.

$\Gamma(D^*_2(2460)^- \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{14}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
seen	[42] AKERS 95Q	OPAL	$e^+e^- \to Z$

[42] AKERS 95Q quotes the product branching ratio $B(\overline{b} \to D^*_2(2460) \ell^+ \nu_\ell \text{anything})\ B(D^*_2(2460)^+ \to D^0 \pi^-) = 4.2 \pm 1.3^{+0.7}_{-1.2}$.

$\Gamma(\tau^+ \nu_\tau \text{anything})/\Gamma_{\text{total}}$ — Γ_{15}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	COMMENT
2.7 ±0.4 OUR AVERAGE				
2.75±0.30±0.37	405	[43] BUSKULIC 95	ALEP	$e^+e^- \to Z$
2.4 ±0.7 ±0.8	1032	[44] ACCIARRI 94C	L3	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4.08±0.76±0.62		BUSKULIC 93B	ALEP	Repl. by BUSKULIC 95

[43] BUSKULIC 95 uses missing-energy technique.

[44] This is a direct result using tagged $b\overline{b}$ events at the Z, but species are not separated.

$\Gamma(\overline{b} \to \overline{c} \to \ell^- \overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{16}/Γ

VALUE	DOCUMENT ID	TECN	COMMENT
0.079 ±0.008 OUR AVERAGE			
0.0770±0.0097±0.0046	[45] ABREU 95D	DLPH	$e^+e^- \to Z$
0.082 ±0.003 ±0.012	[46] BUSKULIC 94G	ALEP	$e^+e^- \to Z$

[45] ABREU 95D give systematic errors ±0.0033 (model) and 0.0032 (R_c). We combine these in quadrature. This result is from the same global fit as their $\Gamma(\overline{b} \to \ell^+ \nu_\ell X)$ data.

[46] BUSKULIC 94G uses e and μ events. This value is from the same global fit as their $\Gamma(\overline{b} \to \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ data.

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$ — Γ_{17}/Γ

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.16±0.10 OUR AVERAGE						
1.12±0.12±0.10			[47] ABREU	94P	DLPH	$e^+e^- \to Z$
1.16±0.16±0.14		121	[48] ADRIANI	93J	L3	$e^+e^- \to Z$
1.21±0.13±0.08			BUSKULIC	92G	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.3 ±0.2 ±0.2			[49] ADRIANI	92	L3	$e^+e^- \to Z$
<4.9	90		MATTEUZZI	83	MRK2	E^{ee}_{cm}= 29 GeV

[47] ABREU 94P is an inclusive measurement from b decays at the Z. Uses $J/\psi(1S) \to e^+e^-$ and $\mu^+\mu^-$ channels. Assumes $\Gamma(Z \to b\overline{b})/\Gamma_{\text{hadron}}$=0.22.

[48] ADRIANI 93J is an inclusive measurement from b decays at the Z. Uses $J/\psi(1S) \to \mu^+\mu^-$ and $J/\psi(1S) \to e^+e^-$ channels.

[49] ADRIANI 92 measurement is an inclusive result for $B(Z \to J/\psi(1S)X) = (4.1 \pm 0.7 \pm 0.3) \times 10^{-3}$ which is used to extract the b-hadron contribution to $J/\psi(1S)$ production.

$\Gamma(\psi(2S)\text{anything})/\Gamma_{\text{total}}$ — Γ_{18}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0048±0.0022±0.0010	[50] ABREU	94P	DLPH	$e^+e^- \to Z$

[50] ABREU 94P is an inclusive measurement from b decays at the Z. Uses $\psi(2S) \to J/\psi(1S)\pi^+\pi^-$, $J/\psi(1S) \to \mu^+\mu^-$ channels. Assumes $\Gamma(Z \to b\overline{b})/\Gamma_{\text{hadron}}$=0.22.

$\Gamma(\chi_{c1}(1P)\text{anything})/\Gamma_{\text{total}}$ — Γ_{19}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.018±0.005 OUR AVERAGE					
$0.014\pm0.006^{+0.004}_{-0.002}$		[51] ABREU	94P	DLPH	$e^+e^- \to Z$
0.024±0.009±0.002	19	[52] ADRIANI	93J	L3	$e^+e^- \to Z$

[51] ABREU 94P is an inclusive measurement from b decays at the Z. Uses $\chi_{c1}(1P) \to J/\psi(1S)\gamma$, $J/\psi(1S) \to \mu^+\mu^-$ channels. Assumes no $\chi_{c2}(1P)$ and $\Gamma(Z \to b\overline{b})/\Gamma_{\text{hadron}}$=0.22.

[52] ADRIANI 93J is an inclusive measurement and assumes χ_{c1} come from b decays at Z. Uses $J/\psi(1S) \to \mu^+\mu^-$ channel.

$\Gamma(\chi_{c1}(1P)\text{anything})/\Gamma(J/\psi(1S)\text{anything})$ — Γ_{19}/Γ_{17}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.92±0.82	121	[53] ADRIANI	93J	L3	$e^+e^- \to Z$

[53] ADRIANI 93J is a ratio of inclusive measurements from b decays at the Z using only the $J/\psi(1S) \to \mu^+\mu^-$ channel since some systematics cancel.

$\Gamma(\overline{s}\gamma)/\Gamma_{\text{total}}$ — Γ_{20}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.0012	90	[54] ADRIANI	93L	L3	$e^+e^- \to Z$

[54] ADRIANI 93L result is for $\overline{b} \to \overline{s}\gamma$ is performed inclusively.

$\Gamma(K^\pm\text{anything})/\Gamma_{\text{total}}$ — Γ_{21}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.88±0.05±0.18	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(K^0_S\text{anything})/\Gamma_{\text{total}}$ — Γ_{22}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.290±0.011±0.027	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(p/\overline{p}\text{anything})/\Gamma_{\text{total}}$ — Γ_{23}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.141±0.018±0.056	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(\Lambda/\overline{\Lambda}\text{anything})/\Gamma_{\text{total}}$ — Γ_{24}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.059±0.007±0.009	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(\text{charged anything})/\Gamma_{\text{total}}$ — Γ_{25}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
5.84±0.04±0.38	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(\mu^+\mu^- \text{anything})/\Gamma_{\text{total}}$ Γ_{27}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<5.0 × 10^{-5}	90	ALBAJAR	91C	UA1	$E^{p\overline{p}}_{\text{cm}}$= 630 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.02	95	ALTHOFF	84G	TASS	E^{ee}_{cm}= 34.5 GeV
<0.007	95	ADEVA	83	MRKJ	E^{ee}_{cm}= 30–38 GeV
<0.007	95	BARTEL	83B	JADE	E^{ee}_{cm}= 33–37 GeV

$\left[\Gamma(e^+e^- \text{anything}) + \Gamma(\mu^+\mu^- \text{anything})\right]/\Gamma_{\text{total}}$ $(\Gamma_{26}+\Gamma_{27})/\Gamma$

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.008	90	MATTEUZZI	83	MRK2	E^{ee}_{cm}= 29 GeV

$\Gamma(\nu\overline{\nu} \text{anything})/\Gamma_{\text{total}}$ Γ_{28}/Γ

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

VALUE	DOCUMENT ID		TECN	COMMENT
<3.9 × 10^{-4}	[55] GROSSMAN	96	RVUE	$e^+e^- \rightarrow Z$

[55] GROSSMAN 96 limit is derived from the ALEPH BUSKULIC 95 limit B($B^+ \rightarrow \tau^+\nu_\tau$) $< 1.8 \times 10^{-3}$ at CL=90% using conservative simplifying assumptions.

$B^\pm/B^0/B^0_s/b$-baryon ADMIXTURE REFERENCES

ABREU	96E	PL B377 195	+Adam, Adye, Agasi+	(DELPHI Collab.)
BUSKULIC	96F	PL B369 151	+Casper, De Bonis, Decamp+	(ALEPH Collab.)
GROSSMAN	96	NP B465 369	+Ligeti, Nardi	(REHO, CIT)
ABE,K	95B	PRL 75 3624	Abe, Abt, Ahn, Akagi+	(SLD Collab.)
ABREU	95C	PL B347 447	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95D	ZPHY C66 323	+Adam, Adye, Agasi+	(DELPHI Collab.)
ADAM	95	ZPHY C68 363	+Adye, Agasi, Ajinenko+	(DELPHI Collab.)
AKERS	95Q	ZPHY C67 57	+Alexander, Allison, Ametewee+	(OPAL Collab.)
BUSKULIC	95	PL B343 444	+Casper, De Bonis, Decamp, Ghez, Goy+	(ALEPH Collab.)
ABREU	94L	ZPHY C63 3	+Adam, Adye, Agasi, Aleksan+	(DELPHI Collab.)
ABREU	94P	PL B341 109	+Adam, Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ACCIARRI	94C	PL B332 201	+Adam, Adriani, Aguilar-Benitez, Ahlen+	(L3 Collab.)
BUSKULIC	94G	ZPHY C62 179	+Casper, De Bonis, Decamp, Ghez+	(ALEPH Collab.)
ABE	93E	PL B313 288	+Amako, Arai, Arima, Asano+	(VENUS Collab.)
ABE	93J	PRL 71 3421	+Albrow, Amidei, Anway-Wiese+	(CDF Collab.)
ABREU	93C	PL B301 145	+Adam, Adye, Agasi, Aleksan+	(DELPHI Collab.)
ABREU	93D	ZPHY C57 181	+Adam, Adye, Agasi, Alekseev+	(DELPHI Collab.)
ABREU	93G	PL B312 253	+Adam, Adye, Agasi, Ajinenko+	(DELPHI Collab.)
ACTON	93C	PL B307 247	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ACTON	93L	ZPHY C60 217	+Akers, Alexander, Allison, Anderson+	(OPAL Collab.)
ADRIANI	93J	PL B317 467	+Aguilar-Benitez, Ahlen, Alcaraz+	(L3 Collab.)
ADRIANI	93K	PL B317 474	+Aguilar-Benitez, Ahlen, Alcaraz+	(L3 Collab.)
ADRIANI	93L	PL B317 637	+Aguilar-Benitez, Ahlen, Alcaraz+	(L3 Collab.)
AKERS	93B	ZPHY C60 199	+Alexander, Allison, Anderson, Arcelli+	(OPAL Collab.)
BUSKULIC	93B	PL B298 479	+Decamp, Goy, Lees, Minard+	(ALEPH Collab.)
BUSKULIC	93O	PL B314 459	+De Bonis, Decamp, Ghez, Goy+	(ALEPH Collab.)
ABREU	92	ZPHY C53 567	+Adam, Adami, Adye+	(DELPHI Collab.)
ACTON	92	PL B274 513	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ADRIANI	92	PL B288 412	+Aguilar-Benitez, Ahlen, Akbari+	(L3 Collab.)
BUSKULIC	92F	PL B295 174	+Decamp, Goy, Lees, Minard+	(ALEPH Collab.)
BUSKULIC	92G	PL B295 396	+Decamp, Goy, Lees, Minard+	(ALEPH Collab.)
ADEVA	91C	PL B261 177	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
ADEVA	91H	PL B270 111	+Adrani, Aguilar-Benitez, Akbari, Alcaraz+	(L3 Collab.)
ALBAJAR	91C	PL B262 163	+Albrow, Allkofer, Ankoviak, Apsimon+	(UA1 Collab.)
ALEXANDER	91G	PL B266 485	+Allison, Allport+	(OPAL Collab.)
DECAMP	91C	PL B257 492	+Deschizeaux, Goy, Lees, Minard+	(ALEPH Collab.)
BEHREND	90D	ZPHY C47 333	+Criegee, Field, Franke, Jung+	(CELLO Collab.)
HAGEMANN	90	ZPHY C48 401	+Ramcke, Allison, Ambrus, Barlow+	(JADE Collab.)
LYONS	90	PR D41 982	+Martin, Saxon	(OXF, BRIS, RAL)
BRAUNSCH...	89B	ZPHY C44 1	Braunschweig, Gerhards, Kirschfink+	(TASSO Collab.)
ONG	89	PRL 62 1236	+Jaros, Abrams, Amidei, Baden+	(Mark II Collab.)
KLEM	88	PR D37 41	+Atwood, Barish+	(DELCO Collab.)
ONG	88	PRL 60 2587	+Weir, Abrams, Amidei+	(Mark II Collab.)
ASH	87	PRL 58 640	+Band, Bloom, Bosman+	(MAC Collab.)
BARTEL	87	ZPHY C33 339	+Becker, Felst, Haidt+	(JADE Collab.)
BROM	87	PL B195 301	+Abachi, Akerlof, Baringer+	(HRS Collab.)
PAL	86	PR D33 2708	+Atwood, Barish, Bonneaud+	(DELCO Collab.)
AIHARA	85	ZPHY C27 39	+Alston-Garnjost, Badtke, Bakken+	(TPC Collab.)
BARTEL	85J	PL 163B 277	+Becker, Cords, Felst+	(JADE Collab.)
ALTHOFF	84G	ZPHY C22 219	+Braunschweig, Kirschfink+	(TASSO Collab.)
ALTHOFF	84J	PL 146B 443	+Branschweig, Kirschfink+	(TASSO Collab.)
KOOP	84	PRL 52 970	+Sakuda, Atwood, Baillon+	(DELCO Collab.)
ADEVA	83	PRL 50 799	+Barber, Becker, Berdugo+	(Mark-J Collab.)
ADEVA	83B	PRL 51 443	+Barber, Becker, Berdugo+	(Mark-J Collab.)
BARTEL	83B	PL 132B 241	+Becker, Bowdery, Cords+	(JADE Collab.)
FERNANDEZ	83D	PRL 50 2054	+Ford, Read, Smith+	(MAC Collab.)
MATTEUZZI	83	PL 129B 141	+Abrams, Amidei, Blocker+	(Mark II Collab.)
NELSON	83	PRL 50 1542	+Blondel, Trilling, Abrams+	(Mark II Collab.)