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

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

Each measurement of the B mean life is an average over an admixture of various bottom mesons and baryons which decay weakly. Different techniques emphasize different admixtures of produced particles, which could result in a different B mean life.

"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/. This is a weighted average of the lifetimes of the five main b-hadron species (B^+, B^0, B^0_{sH}, B^0_{sL}, and Λ_b) that assumes the production fractions in Z decays (given at the end of this section) and equal production fractions of B^0_{sH} and B^0_{sL} mesons.

VALUE (10^{-12} s)	EVTS	DOCUMENT ID		TECN	COMMENT
1.5668±0.0028 OUR EVALUATION					
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.570 ±0.005 ±0.008		[1] ABDALLAH	04E	DLPH	$e^+e^- \rightarrow Z$
1.533 ±0.015 $^{+0.035}_{-0.031}$		[2] ABE	98B	CDF	$p\overline{p}$ at 1.8 TeV
1.549 ±0.009 ±0.015		[3] ACCIARRI	98	L3	$e^+e^- \rightarrow Z$
1.611 ±0.010 ±0.027		[4] ACKERSTAFF	97F	OPAL	$e^+e^- \rightarrow Z$
1.582 ±0.011 ±0.027		[4] ABREU	96E	DLPH	$e^+e^- \rightarrow Z$
1.575 ±0.010 ±0.026		[5] ABREU	96E	DLPH	$e^+e^- \rightarrow Z$
1.533 ±0.013 ±0.022	19.8k	[6] BUSKULIC	96F	ALEP	$e^+e^- \rightarrow Z$
1.564 ±0.030 ±0.036		[7] ABE,K	95B	SLD	$e^+e^- \rightarrow Z$
1.542 ±0.021 ±0.045		[8] ABREU	94L	DLPH	$e^+e^- \rightarrow Z$
1.50 $^{+0.24}_{-0.21}$ ±0.03		[9] ABREU	94P	DLPH	$e^+e^- \rightarrow Z$
1.46 ±0.06 ±0.06	5344	[10] ABE	93J	CDF	Repl. by ABE 98B
1.23 $^{+0.14}_{-0.13}$ ±0.15	188	[11] ABREU	93D	DLPH	Sup. by ABREU 94L
1.49 ±0.11 ±0.12	253	[12] ABREU	93G	DLPH	Sup. by ABREU 94L
1.51 $^{+0.16}_{-0.14}$ ±0.11	130	[13] ACTON	93C	OPAL	$e^+e^- \rightarrow Z$
1.523 ±0.034 ±0.038	5372	[14] ACTON	93L	OPAL	$e^+e^- \rightarrow Z$
1.535 ±0.035 ±0.028	7357	[14] ADRIANI	93K	L3	Repl. by ACCIARRI 98
1.511 ±0.022 ±0.078		[15] BUSKULIC	93O	ALEP	$e^+e^- \rightarrow Z$
1.28 ±0.10		[16] ABREU	92	DLPH	Sup. by ABREU 94L
1.37 ±0.07 ±0.06	1354	[17] ACTON	92	OPAL	Sup. by ACTON 93L
1.49 ±0.03 ±0.06		[18] BUSKULIC	92F	ALEP	Sup. by BUSKULIC 96F
1.35 $^{+0.19}_{-0.17}$ ±0.05		[19] BUSKULIC	92G	ALEP	$e^+e^- \rightarrow Z$
1.32 ±0.08 ±0.09	1386	[20] ADEVA	91H	L3	Sup. by ADRIANI 93K
1.32 $^{+0.31}_{-0.25}$ ±0.15	37	[21] ALEXANDER	91G	OPAL	$e^+e^- \rightarrow Z$

1.29	± 0.06	± 0.10	2973	[22] DECAMP	91C	ALEP	Sup. by BUSKULIC 92F
1.36	$^{+0.25}_{-0.23}$			[23] HAGEMANN	90	JADE	$E^{ee}_{\rm cm}$= 35 GeV
1.13	± 0.15			[24] LYONS	90	RVUE	
1.35	± 0.10	± 0.24		BRAUNSCH...	89B	TASS	$E^{ee}_{\rm cm}$= 35 GeV
0.98	± 0.12	± 0.13		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	± 0.20	± 0.21		[25] ASH	87	MAC	$E^{ee}_{\rm cm}$= 29 GeV
1.02	$^{+0.42}_{-0.39}$		301	[26] BROM	87	HRS	$E^{ee}_{\rm cm}$= 29 GeV

[1] Measurement performed using an inclusive reconstruction and B flavor identification technique.

[2] Measured using inclusive $J/\psi(1S) \to \mu^+\mu^-$ vertex.

[3] ACCIARRI 98 uses inclusively reconstructed secondary vertex and lepton impact parameter.

[4] ACKERSTAFF 97F uses inclusively reconstructed secondary vertices.

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

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

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

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

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

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

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

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

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

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

[15] BUSKULIC 93O analyzed using dipole method.

[16] 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.

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

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

[19] 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.

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

[21] 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 $J/\psi(1S)$.

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

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

[24] LYONS 90 combine the results of the B lifetime measurements 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.

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

[26] 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	[1] ADAM	95	DLPH	$e^+ e^- \to Z$

[1] 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	[1] ADAM	95	DLPH	$e^+ e^- \to Z$

[1] 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
$\mathbf{1.09^{+0.11}_{-0.10}\pm0.08}$	[1] ADAM	95	DLPH	$e^+ e^- \to Z$

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

$\left|\Delta\tau_b\right|/\tau_{b,\overline{b}}$

$\tau_{b,\overline{b}}$ and $\left|\Delta\tau_b\right|$ are the mean life average and difference between b and $\overline{b}$ hadrons.

VALUE	DOCUMENT ID		TECN	COMMENT
−0.001±0.012±0.008	[1] ABBIENDI	99J	OPAL	$e^+ e^- \to Z$

[1] Data analyzed using both the jet charge and the charge of secondary vertex in the opposite hemisphere.

$\overline{b}$ 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 (LHC, LEP, Tevatron, S$p\overline{p}$S) are used in the branching fraction averages. In the following, we assume that the production fractions are the same at the LHC, LEP, and at the Tevatron.

For inclusive branching fractions, *e.g.*, $B \to D^{\pm}$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

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)	Scale factor/ Confidence level

PRODUCTION FRACTIONS

The production fractions for weakly decaying b-hadrons at high energy have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by the Heavy Flavor Averaging Group (HFLAV) as described in the note "B^0-$\overline{B}^0$ Mixing" in the B^0 Particle Listings. We no longer provide world averages of the b-hadron production fractions, where results from LEP, Tevatron and LHC are averaged together; indeed the available data (from CDF and LHCb) shows that the fractions depend on the kinematics (in particular the p_T) of the produced b hadron. Hence we would like to list the fractions in Z decays instead, which are well-defined physics observables. The production fractions in $p\overline{p}$ collisions at the Tevatron are also listed at the end of the section. Values assume

$$\mathrm{B}(\overline{b} \to B^+) = \mathrm{B}(\overline{b} \to B^0)$$
$$\mathrm{B}(\overline{b} \to B^+) + \mathrm{B}(\overline{b} \to B^0) + \mathrm{B}(\overline{b} \to B_s^0) + \mathrm{B}(b \to b\text{-baryon}) = 100\%.$$

The correlation coefficients between production fractions are also reported:

$cor(B_s^0,\ b\text{-baryon}) = 0.064$
$cor(B_s^0,\ B^{\pm}{=}B^0) = -0.633$
$cor(b\text{-baryon},\ B^{\pm}{=}B^0) = -0.813.$

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

Note these production fractions are b-hadronization fractions, not the conventional branching fractions of b-quark to a B-hadron, which may have considerable dependence on the initial and final state kinematic and production environment.

Γ_1	B^+	(40.8 ± 0.7) %
Γ_2	B^0	(40.8 ± 0.7) %
Γ_3	B_s^0	(10.0 ± 0.8) %
Γ_4	B_c^+	
Γ_5	b-baryon	(8.4 ± 1.1) %

DECAY MODES

Semileptonic and leptonic modes

Γ_6	ν anything		(23.1 ± 1.5) %	
Γ_7	$\ell^+ \nu_\ell$ anything	[a]	(10.69 ± 0.22) %	
Γ_8	$e^+ \nu_e$ anything		(10.86 ± 0.35) %	
Γ_9	$\mu^+ \nu_\mu$ anything		$(10.95 ^{+0.29}_{-0.25})$ %	
Γ_{10}	$D^- \ell^+ \nu_\ell$ anything	[a]	(2.2 ± 0.4) %	S=1.9
Γ_{11}	$D^- \pi^+ \ell^+ \nu_\ell$ anything		$(4.9 \pm 1.9) \times 10^{-3}$	
Γ_{12}	$D^- \pi^- \ell^+ \nu_\ell$ anything		$(2.6 \pm 1.6) \times 10^{-3}$	
Γ_{13}	$\overline{D}^0 \ell^+ \nu_\ell$ anything	[a]	(6.79 ± 0.34) %	

Γ_{14}	$\overline{D}^0 \pi^- \ell^+ \nu_\ell$ anything		(1.07 ± 0.27) %	
Γ_{15}	$\overline{D}^0 \pi^+ \ell^+ \nu_\ell$ anything		$(2.3 \pm 1.6) \times 10^{-3}$	
Γ_{16}	$D^{*-} \ell^+ \nu_\ell$ anything	[a]	(2.75 ± 0.19) %	
Γ_{17}	$D^{*-} \pi^- \ell^+ \nu_\ell$ anything		$(6 \pm 7) \times 10^{-4}$	
Γ_{18}	$D^{*-} \pi^+ \ell^+ \nu_\ell$ anything		$(4.8 \pm 1.0) \times 10^{-3}$	
Γ_{19}	$\overline{D}^0_j \ell^+ \nu_\ell$ anything $\times$ B($\overline{D}^0_j \to D^{*+} \pi^-$)	[a,b]	$(2.6 \pm 0.9) \times 10^{-3}$	
Γ_{20}	$D^-_j \ell^+ \nu_\ell$ anything $\times$ B($D^-_j \to D^0 \pi^-$)	[a,b]	$(7.0 \pm 2.3) \times 10^{-3}$	
Γ_{21}	$\overline{D}^*_2(2460)^0 \ell^+ \nu_\ell$ anything $\times$ B($\overline{D}^*_2(2460)^0 \to D^{*-} \pi^+$)		$< 1.4 \times 10^{-3}$	CL=90%
Γ_{22}	$D^*_2(2460)^- \ell^+ \nu_\ell$ anything $\times$ B($D^*_2(2460)^- \to D^0 \pi^-$)		$(4.2 {}^{+1.5}_{-1.8}) \times 10^{-3}$	
Γ_{23}	$\overline{D}^*_2(2460)^0 \ell^+ \nu_\ell$ anything $\times$ B($\overline{D}^*_2(2460)^0 \to D^- \pi^+$)		$(1.6 \pm 0.8) \times 10^{-3}$	
Γ_{24}	charmless $\ell \overline{\nu}_\ell$	[a]	$(1.7 \pm 0.5) \times 10^{-3}$	
Γ_{25}	$\tau^+ \nu_\tau$ anything		(2.41 ± 0.23) %	
Γ_{26}	$D^{*-} \tau \nu_\tau$ anything		$(9 \pm 4) \times 10^{-3}$	
Γ_{27}	$\overline{c} \to \ell^- \overline{\nu}_\ell$ anything	[a]	(8.02 ± 0.19) %	
Γ_{28}	$c \to \ell^+ \nu$ anything		$(1.6 {}^{+0.4}_{-0.5})$ %	

Charmed meson and baryon modes

Γ_{29}	$\overline{D}^0$ anything		(58.7 ± 2.8) %	
Γ_{30}	$D^0 D^\pm_s$ anything	[c]	$(9.1 {}^{+4.0}_{-2.8})$ %	
Γ_{31}	$D^\mp D^\pm_s$ anything	[c]	$(4.0 {}^{+2.3}_{-1.8})$ %	
Γ_{32}	$\overline{D}^0 D^0$ anything	[c]	$(5.1 {}^{+2.0}_{-1.8})$ %	
Γ_{33}	$D^0 D^\pm$ anything	[c]	$(2.7 {}^{+1.8}_{-1.6})$ %	
Γ_{34}	$D^\pm D^\mp$ anything	[c]	$< 9 \times 10^{-3}$	CL=90%
Γ_{35}	D^0 anything			
Γ_{36}	D^+ anything			
Γ_{37}	D^- anything		(22.7 ± 1.6) %	
Γ_{38}	$D^*(2010)^+$ anything		(17.3 ± 2.0) %	
Γ_{39}	$D_1(2420)^0$ anything		(5.0 ± 1.5) %	
Γ_{40}	$D^*(2010)^\mp D^\pm_s$ anything	[c]	$(3.3 {}^{+1.6}_{-1.3})$ %	
Γ_{41}	$D^0 D^*(2010)^\pm$ anything	[c]	$(3.0 {}^{+1.1}_{-0.9})$ %	

Γ_{42}	$D^*(2010)^{\pm} D^{\mp}$ anything	[c]	(2.5 $^{+\ 1.2}_{-\ 1.0}$) %		
Γ_{43}	$D^*(2010)^{\pm} D^*(2010)^{\mp}$ anything	[c]	(1.2 ± 0.4) %		
Γ_{44}	$\overline{D} D$ anything		(10 $^{+11}_{-10}$) %		
Γ_{45}	$D_2^*(2460)^0$ anything		(4.7 ± 2.7) %		
Γ_{46}	D_s^- anything		(14.7 ± 2.1) %		
Γ_{47}	D_s^+ anything		(10.1 ± 3.1) %		
Γ_{48}	Λ_c^+ anything		(7.7 ± 1.1) %		
Γ_{49}	$\overline{c}/c$ anything	[d]	(116.2 ± 3.2) %		

Charmonium modes

Γ_{50}	$J/\psi(1S)$ anything		(1.16± 0.10) %		
Γ_{51}	$\psi(2S)$ anything		(2.86± 0.28) $\times 10^{-3}$		
Γ_{52}	$\chi_{c0}(1P)$ anything		(1.5 ± 0.6) %		
Γ_{53}	$\chi_{c1}(1P)$ anything		(1.4 ± 0.4) %		
Γ_{54}	$\chi_{c2}(1P)$ anything		(6.2 ± 2.9) $\times 10^{-3}$		
Γ_{55}	$\chi_c(2P)$ anything, $\chi_c \to \phi\phi$		$<$ 2.8	$\times 10^{-7}$	CL=95%
Γ_{56}	$\eta_c(1S)$ anything		(4.5 ± 1.9) %		
Γ_{57}	$\eta_c(2S)$ anything, $\eta_c \to \phi\phi$		(3.2 ± 1.7) $\times 10^{-6}$		
Γ_{58}	$\chi_{c1}(3872)$ anything, $\chi_{c1} \to \phi\phi$		$<$ 4.5	$\times 10^{-7}$	CL=95%
Γ_{59}	$X(3915)$ anything, $X \to \phi\phi$		$<$ 3.1	$\times 10^{-7}$	CL=95%

K or K^* modes

Γ_{60}	$\overline{s}\gamma$		(3.1 ± 1.1) $\times 10^{-4}$		
Γ_{61}	$\overline{s}\overline{\nu}\nu$	B1	$<$ 6.4	$\times 10^{-4}$	CL=90%
Γ_{62}	$K^{\pm}$ anything		(74 ± 6) %		
Γ_{63}	K_S^0 anything		(29.0 ± 2.9) %		

Pion modes

Γ_{64}	$\pi^{\pm}$ anything		(397 ±21) %		
Γ_{65}	π^0 anything	[d]	(278 ±60) %		
Γ_{66}	ϕ anything		(2.82± 0.23) %		

Baryon modes

Γ_{67}	$p/\overline{p}$ anything		(13.1 ± 1.1) %		
Γ_{68}	$\Lambda/\overline{\Lambda}$ anything		(5.9 ± 0.6) %		
Γ_{69}	b-baryon anything		(10.2 ± 2.8) %		
Γ_{70}	$\overline{\Lambda}_b^0$ anything				
Γ_{71}	Ξ_b^+ anything				

Other modes

Γ_{72}	charged anything	[d]	(497 ± 7) %		
Γ_{73}	hadron$^+$ hadron$^-$		(1.7 $^{+\ 1.0}_{-\ 0.7}$) $\times 10^{-5}$		
Γ_{74}	charmless		(7 ±21) $\times 10^{-3}$		

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

Γ_{75}	$e^+ e^-$ anything					
Γ_{76}	$\mu^+ \mu^-$ anything	$B1$	$<$	3.2	$\times 10^{-4}$	CL=90%
Γ_{77}	$\nu \overline{\nu}$ anything					

[a] An ℓ indicates an e or a μ mode, not a sum over these modes.

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

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

[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

$\Gamma(B^+)/\Gamma_{\text{total}}$ — Γ_1/Γ

"OUR EVALUATION" is an average from Z decay obtained by the Heavy Flavor Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

VALUE	DOCUMENT ID		TECN	COMMENT
0.408 ±0.007 OUR EVALUATION				
0.4099±0.0082±0.0111	[1] ABDALLAH	03K	DLPH	$e^+ e^- \to Z$

[1] The analysis is based on a neural network, to estimate the charge of the weakly-decaying b hadron by distinguishing its decay products from particles produced at the primary vertex.

$\Gamma(B^+)/\Gamma(B^0)$ — Γ_1/Γ_2

VALUE	DOCUMENT ID		TECN	COMMENT
$1.054 \pm 0.018^{+0.062}_{-0.074}$	AALTONEN	08N	CDF	$p\overline{p}$ at 1.96 TeV

$\Gamma(B^0_s)/[\Gamma(B^+)+\Gamma(B^0)]$ — $\Gamma_3/(\Gamma_1+\Gamma_2)$

"OUR EVALUATION" is an average from Z decay obtained by the Heavy Flavor Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1230±0.0115 OUR EVALUATION				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.122 ±0.006	[1] AAIJ	19AD	LHCB	pp at 13 TeV
$0.134 \pm 0.004 ^{+0.011}_{-0.010}$	[2] AAIJ	12J	LHCB	pp at 7 TeV
0.1265±0.0085±0.0131	[3] AAIJ	11F	LHCB	pp at 7 TeV
$0.128 ^{+0.011}_{-0.010} \pm 0.011$	[4] AALTONEN	08N	CDF	$p\overline{p}$ at 1.96 TeV
0.213 ±0.068	[5] AFFOLDER	00E	CDF	$p\overline{p}$ at 1.8 TeV
$0.21 \pm 0.036 ^{+0.038}_{-0.030}$	[6] ABE	99P	CDF	$\overline{p}p$ at 1.8 TeV

[1] AAIJ 19AD measured the average value using b-hadron semileptonic decays and assuming isospin symmetry for b-hadron p_T of 4 and 25 GeV and η of 2 and 5.

[2] AAIJ 12J measured this value using b-hadron semileptonic decays and assuming isospin symmetry.

[3] AAIJ 11F measured $f_s/f_d = 0.253 \pm 0.017 \pm 0.017 \pm 0.020$, where the errors are statistical, systematic, and theoretical. We divide their value by 2. Our second error combines systematic and theoretical uncertainties.

[4] AALTONEN 08N reports $[\Gamma(\overline{b} \to B^0_s)/[\Gamma(\overline{b} \to B^+) + \Gamma(\overline{b} \to B^0)]] \times [\text{B}(D^+_s \to \phi\pi^+)] = (5.76 \pm 0.18^{+0.45}_{-0.42}) \times 10^{-3}$ which we divide by our best value $\text{B}(D^+_s \to \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[5] AFFOLDER 00E uses several electron-charm final states in $b \to c e^- X$.

[6] ABE 99P uses the numbers of $K^*(892)^0$, $K^*(892)^+$, and $\phi(1020)$ events produced in association with the double semileptonic decays $b \to c\mu^- X$ with $c \to s\mu^+ X$.

$\Gamma(B^0_s)/\Gamma(B^0)$ $\quad\Gamma_3/\Gamma_2$

"OUR EVALUATION" has been provided by the Heavy Flavor Averaging Group (HFLAV, https://hflav.web.cern.ch/).

VALUE	DOCUMENT ID		TECN	COMMENT
0.246±0.023 OUR EVALUATION				
0.239±0.016 OUR AVERAGE				
0.240±0.004±0.020	[1] AAD	15CM	ATLS	pp at 7 TeV
0.238±0.004±0.015±0.021	[2] AAIJ	13P	LHCB	pp at 7 TeV

[1] The measurement is derived from the observed $B^0_s \to J/\psi\phi$ and $B^0_d \to J/\psi K^{*0}$ yields and a recent theory prediction of $\text{B}(B^0_s \to J/\psi\phi)/\text{B}(B^0_d \to J/\psi K^{*0})$. The second uncertainty combines in quadrature systematic and theoretical uncertainties.

[2] AAIJ 13P studies also separately the $p_T(B)$ and $\eta(B)$ dependency of $\Gamma(\overline{b} \to B^0_s)/\Gamma(\overline{b} \to B^0)$, finding $f_s/f_d(p_T)= (0.256 \pm 0.020) + (-2.0 \pm 0.6)\, 10^{-3}$ /GeV/c $(p_T - \langle p_T\rangle)$ and $f_s/f_d(\eta)= (0.256 \pm 0.020) + (0.005 \pm 0.006)\, (\eta - \langle\eta\rangle)$, where $\langle p_T\rangle = 10.4$ GeV/c and $\langle\eta\rangle = 3.28$.

$\Gamma(B^+_c)/[\Gamma(B^+)+\Gamma(B^0)]$ $\quad\Gamma_4/(\Gamma_1+\Gamma_2)$

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
3.7 ±0.6 OUR AVERAGE				
3.63±0.08±0.87	[1] AAIJ	19AI	LHCB	pp at 7 TeV
3.78±0.04±0.90	[1] AAIJ	19AI	LHCB	pp at 13 TeV

[1] Measured using B^+_c semileptonic decays.

$\Gamma(b\text{-baryon})/[\Gamma(B^+)+\Gamma(B^0)]$ $\quad\Gamma_5/(\Gamma_1+\Gamma_2)$

"OUR EVALUATION" is an average from Z decay obtained by the Heavy Flavor Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

VALUE	DOCUMENT ID		TECN	COMMENT
0.103±0.015 OUR EVALUATION				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.259±0.018	[1] AAIJ	19AD	LHCB	pp at 13 TeV
0.305±0.010±0.081	[2] AAIJ	12J	LHCB	pp at 7 TeV
$0.31 \pm 0.11\ ^{+0.12}_{-0.08}$	[3] AALTONEN	09E	CDF	$p\overline{p}$ at 1.8 TeV
$0.22\ ^{+0.08}_{-0.07} \pm 0.01$	[4] AALTONEN	08N	CDF	$p\overline{p}$ at 1.96 TeV

0.118±0.042	[3,5] AFFOLDER	00E	CDF	$p\overline{p}$ at 1.8 TeV

[1] AAIJ 19AD measured the average value for Λ_b^0 using semileptonic decays and assuming isospin symmetry for b-hadron p_T of 4 and 25 GeV and η of 2 and 5.

[2] AAIJ 12J measured the ratio to be $(0.404 \pm 0.017 \pm 0.027 \pm 0.105) \times [1 - (0.031 \pm 0.004 \pm 0.003) \times \mathrm{P}_T]$using b-hadron semileptonic decays where the P_T is the momentum of charmed hadron-muon pair in GeV/c.We quote their weighted average value where the second error combines systematic and the error on $\mathrm{B}(\Lambda_c^+ \to pK^-\pi^+)$.

[3] AALTONEN 09E errata to the measurement reported in AFFOLDER 00E using the p_T spectra from fully reconstructed B^0 and Λ_b decays.

[4] AALTONEN 08N reports $[\Gamma(\overline{b} \to b\text{-baryon})/\left[\Gamma(\overline{b} \to B^+) + \Gamma(\overline{b} \to B^0)\right]] \times [\mathrm{B}(\Lambda_c^+ \to pK^-\pi^+)] = (14.1 \pm 0.6^{+5.3}_{-4.4}) \times 10^{-3}$ which we divide by our best value $\mathrm{B}(\Lambda_c^+ \to pK^-\pi^+) = (6.28 \pm 0.32) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[5] AFFOLDER 00E uses several electron-charm final states in $b \to c e^- X$.

$\Gamma(\nu\,\text{anything})/\Gamma_{\text{total}}$ — Γ_6/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.2308±0.0077±0.0124	[1,2] ACCIARRI	96C	L3	$e^+e^- \to Z$

[1] ACCIARRI 96C assumes relative b semileptonic decay rates e:μ:τ of 1:1:0.25. Based on missing-energy spectrum.

[2] Assumes Standard Model value for R_B.

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

"OUR EVALUATION" is an average of the data listed below, excluding all asymmetry measurements, performed by the LEP Electroweak Working Group as described in the "Note on the Z boson" in the Z Particle Listings.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1069±0.0022 OUR EVALUATION				
0.1064±0.0016 OUR AVERAGE				
0.1070±0.0010±0.0035	[1] HEISTER	02G	ALEP	$e^+e^- \to Z$
$0.1070 \pm 0.0008^{+0.0037}_{-0.0049}$	[2] ABREU	01L	DLPH	$e^+e^- \to Z$
$0.1083 \pm 0.0010^{+0.0028}_{-0.0024}$	[3] ABBIENDI	00E	OPAL	$e^+e^- \to Z$
0.1016±0.0013±0.0030	[4] ACCIARRI	00	L3	$e^+e^- \to Z$
0.1085±0.0012±0.0047	[5,6] ACCIARRI	96C	L3	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.1106±0.0039±0.0022	[7] ABREU	95D	DLPH	$e^+e^- \to Z$
0.114 ±0.003 ±0.004	[8] BUSKULIC	94G	ALEP	$e^+e^- \to Z$
0.100 ±0.007 ±0.007	[9] ABREU	93C	DLPH	$e^+e^- \to Z$
0.105 ±0.006 ±0.005	[10] AKERS	93B	OPAL	Repl. by ABBIENDI 00E

[1] Uses the combination of lepton transverse momentum spectrum and the correlation between the charge of the lepton and opposite jet charge. The first error is statistic and the second error is the total systematic error including the modeling.

[2] The experimental systematic and model uncertainties are combined in quadrature.

[3] ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \to b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.

[4] ACCIARRI 00 result obtained from a combined fit of $R_b = \Gamma(Z \to b\overline{b})/\Gamma(Z \to \text{hadrons})$ and B($b \to \ell \nu$X), using double-tagging method.
[5] ACCIARRI 96C result obtained by a fit to the single lepton spectrum.
[6] Assumes Standard Model value for R_B.
[7] ABREU 95D give systematic errors ± 0.0019 (model) and 0.0012 (R_c). We combine these in quadrature.
[8] 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.
[9] ABREU 93C event count includes ee events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.
[10] AKERS 93B analysis performed using single and dilepton events.

$\Gamma(e^+ \nu_e \text{anything})/\Gamma_{\text{total}}$ $\qquad\qquad$ Γ_8/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1086±0.0035 OUR AVERAGE					
$0.1078 \pm 0.0008 {}^{+0.0050}_{-0.0046}$		[1] ABBIENDI	00E	OPAL	$e^+e^- \to Z$
$0.1089 \pm 0.0020 \pm 0.0051$		[2,3] ACCIARRI	96C	L3	$e^+e^- \to Z$
$0.107 \pm 0.015 \pm 0.007$	260	[4] ABREU	93C	DLPH	$e^+e^- \to Z$
$0.138 \pm 0.032 \pm 0.008$		[5] ADEVA	91C	L3	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.086 \pm 0.027 \pm 0.008$		[6] ABE	93E	VNS	$E^{ee}_{\text{cm}} = 58$ GeV
$0.109 {}^{+0.014}_{-0.013} \pm 0.0055$	2719	[7] AKERS	93B	OPAL	Repl. by ABBIENDI 00E
$0.111 \pm 0.028 \pm 0.026$		BEHREND	90D	CELL	$E^{ee}_{\text{cm}} = 43$ GeV
$0.150 \pm 0.011 \pm 0.022$		BEHREND	90D	CELL	$E^{ee}_{\text{cm}} = 35$ GeV
$0.112 \pm 0.009 \pm 0.011$		ONG	88	MRK2	$E^{ee}_{\text{cm}} = 29$ GeV
$0.149 {}^{+0.022}_{-0.019}$		PAL	86	DLCO	$E^{ee}_{\text{cm}} = 29$ GeV
$0.110 \pm 0.018 \pm 0.010$		AIHARA	85	TPC	$E^{ee}_{\text{cm}} = 29$ GeV
$0.111 \pm 0.034 \pm 0.040$		ALTHOFF	84J	TASS	$E^{ee}_{\text{cm}} = 34.6$ GeV
0.146 ± 0.028		KOOP	84	DLCO	Repl. by PAL 86
$0.116 \pm 0.021 \pm 0.017$		NELSON	83	MRK2	$E^{ee}_{\text{cm}} = 29$ GeV

[1] ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \to b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.
[2] ACCIARRI 96C result obtained by a fit to the single lepton spectrum.
[3] Assumes Standard Model value for R_B.
[4] ABREU 93C event count includes ee events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.
[5] ADEVA 91C measure the average B($b \to e$X) 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.
[6] ABE 93E experiment also measures forward-backward asymmetries and fragmentation functions for b and c.
[7] AKERS 93B analysis performed using single and dilepton events.

$\Gamma(\mu^+ \nu_\mu \text{anything})/\Gamma_{total}$ Γ_9/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$0.1095^{+0.0029}_{-0.0025}$ OUR AVERAGE					
$0.1096 \pm 0.0008^{+0.0034}_{-0.0027}$		[1] ABBIENDI	00E	OPAL	$e^+ e^- \to Z$
$0.1082 \pm 0.0015 \pm 0.0059$		[2,3] ACCIARRI	96C	L3	$e^+ e^- \to Z$
$0.110 \pm 0.012 \pm 0.007$	656	[4] ABREU	93C	DLPH	$e^+ e^- \to Z$
$0.113 \pm 0.012 \pm 0.006$		[5] ADEVA	91C	L3	$e^+ e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$0.122 \pm 0.006 \pm 0.007$		[3] UENO	96	AMY	$e^+ e^-$ at 57.9 GeV
$0.101 ^{+0.010}_{-0.009} \pm 0.0055$	4248	[6] AKERS	93B	OPAL	Repl. by ABBIENDI 00E
$0.104 \pm 0.023 \pm 0.016$		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

[1] ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \to b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.

[2] ACCIARRI 96C result obtained by a fit to the single lepton spectrum.

[3] Assumes Standard Model value for R_B.

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

[5] ADEVA 91C measure the average B($b \to eX$) 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.

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.022 ±0.004 OUR AVERAGE	Error includes scale factor of 1.9.			
$0.0272 \pm 0.0028 \pm 0.0018$	[1] ABREU	00R	DLPH	$e^+ e^- \to Z$
$0.0194 \pm 0.0025 \pm 0.0003$	[2] AKERS	95Q	OPAL	$e^+ e^- \to Z$

[1] ABREU 00R reports their experiment's uncertainties $\pm 0.0019 \pm 0.0016 \pm 0.0018$, where the first error is statistical, the second is systematic, and the third is the uncertainty due to the D branching fraction. We combine first two in quadrature.

[2] AKERS 95Q reports $[\Gamma(\overline{b} \to D^- \ell^+ \nu_\ell \text{anything})/\Gamma_{total}] \times [B(D^+ \to K^- 2\pi^+)] = (1.82 \pm 0.20 \pm 0.12) \times 10^{-3}$ which we divide by our best value $B(D^+ \to K^- 2\pi^+) = (9.38 \pm 0.16) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0049±0.0018±0.0007	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0026±0.0015±0.0004	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0679±0.0034 OUR AVERAGE				
0.0704±0.0040±0.0017	[1] ABREU	00R	DLPH	$e^+e^- \rightarrow Z$
0.0638±0.0056±0.0005	[2] AKERS	95Q	OPAL	$e^+e^- \rightarrow Z$

[1] ABREU 00R reports their experiment's uncertainties $\pm 0.0034 \pm 0.0036 \pm 0.0017$, where the first error is statistical, the second is systematic, and the third is the uncertainty due to the D branching fraction. We combine first two in quadrature.

[2] AKERS 95Q reports $[\Gamma(\overline{b} \rightarrow \overline{D}^0 \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)] = (2.52 \pm 0.14 \pm 0.17) \times 10^{-3}$ 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.

$\Gamma(\overline{D}^0 \pi^- \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{14}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0107±0.0025±0.0011	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

$\Gamma(\overline{D}^0 \pi^+ \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{15}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0023±0.0015±0.0004	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.0275±0.0019 OUR AVERAGE				
0.0275±0.0021±0.0009	[1] ABREU	00R	DLPH	$e^+e^- \rightarrow Z$
0.0276±0.0027±0.0011	[2] AKERS	95Q	OPAL	$e^+e^- \rightarrow Z$

[1] ABREU 00R reports their experiment's uncertainties $\pm 0.0017 \pm 0.0013 \pm 0.0009$, where the first error is statistical, the second is systematic, and the third is the uncertainty due to the D branching fraction. We combine first two in quadrature.

[2] AKERS 95Q reports $[B(\overline{b} \rightarrow D^* \ell^+ \nu_\ell X) \times B(D^{*+} \rightarrow D^0 \pi^+) \times B(D^0 \rightarrow K^- \pi^+)] = ((7.53 \pm 0.47 \pm 0.56) \times 10^{-4})$ and uses $B(D^{*+} \rightarrow D^0 \pi^+) = 0.681 \pm 0.013$ and $B(D^0 \rightarrow K^- \pi^+) = 0.0401 \pm 0.0014$ 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.

$\Gamma(D^{*-} \pi^- \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{17}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0006±0.0007±0.0002	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

$\Gamma(D^{*-} \pi^+ \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ — Γ_{18}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0048±0.0009±0.0005	ABREU	00R	DLPH	$e^+e^- \rightarrow Z$

$\Gamma\big(\overline{D}{}^0_j \ell^+ \nu_\ell \text{anything} \times B(\overline{D}{}^0_j \to D^{*+}\pi^-)\big)/\Gamma_{total}$ — Γ_{19}/Γ

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

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
2.64±0.79±0.39	ABBIENDI	03M	OPAL	$e^+ e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
6.1 ±1.3 ±1.3	AKERS	95Q	OPAL	Repl. by ABBIENDI 03M

$\Gamma\big(D^-_j \ell^+ \nu_\ell \text{anything} \times B(D^-_j \to D^0\pi^-)\big)/\Gamma_{total}$ — Γ_{20}/Γ

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

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
$7.0\pm1.9^{+1.2}_{-1.3}$	AKERS	95Q	OPAL	$e^+ e^- \to Z$

$\Gamma\big(\overline{D}{}^*_2(2460)^0 \ell^+ \nu_\ell \text{anything} \times B(\overline{D}{}^*_2(2460)^0 \to D^{*-}\pi^+)\big)/\Gamma_{total}$ — Γ_{21}/Γ

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<1.4	90	ABBIENDI	03M	OPAL	$e^+ e^- \to Z$

$\Gamma\big(D^*_2(2460)^- \ell^+ \nu_\ell \text{anything} \times B(D^*_2(2460)^- \to D^0\pi^-)\big)/\Gamma_{total}$ — Γ_{22}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
$4.2\pm1.3^{+0.7}_{-1.2}$	AKERS	95Q	OPAL	$e^+ e^- \to Z$

$\Gamma\big(\overline{D}{}^*_2(2460)^0 \ell^+ \nu_\ell \text{anything} \times B(\overline{D}{}^*_2(2460)^0 \to D^-\pi^+)\big)/\Gamma_{total}$ — Γ_{23}/Γ

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
1.6±0.7±0.3	AKERS	95Q	OPAL	$e^+ e^- \to Z$

$\Gamma\big(\text{charmless } \ell\overline{\nu}_\ell\big)/\Gamma_{total}$ — Γ_{24}/Γ

"OUR EVALUATION" is an average of the data listed below performed by the LEP Heavy Flavour Steering Group. The averaging procedure takes into account correlations between the measurements.

VALUE	DOCUMENT ID		TECN	COMMENT
0.00171±0.00052 OUR EVALUATION				
0.0017 ±0.0004 OUR AVERAGE				
$0.00163\pm0.00053^{+0.00055}_{-0.00062}$	[1] ABBIENDI	01R	OPAL	$e^+ e^- \to Z$
0.00157±0.00035±0.00055	[2] ABREU	00D	DLPH	$e^+ e^- \to Z$
0.00173±0.00055±0.00055	[3] BARATE	99G	ALEP	$e^+ e^- \to Z$
0.0033 ±0.0010 ±0.0017	[4] ACCIARRI	98K	L3	$e^+ e^- \to Z$

[1] Obtained from the best fit of the MC simulated events to the data based on the $b \to X_u \ell\nu$ neutral network output distributions.

[2] ABREU 00D result obtained from a fit to the numbers of decays in $b \to u$ enriched and depleted samples and their lepton spectra, and assuming $|V_{cb}|= 0.0384 \pm 0.0033$ and $\tau_b= 1.564 \pm 0.014$ ps.

[3] Uses lifetime tagged $b\overline{b}$ sample.

[4] ACCIARRI 98K assumes $R_b= 0.2174 \pm 0.0009$ at Z decay.

$\Gamma(\tau^+\nu_\tau \text{anything})/\Gamma_{\text{total}}$ Γ_{25}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.41±0.23 OUR AVERAGE					
2.78±0.18±0.51		[1] ABBIENDI	01Q	OPAL	$e^+e^- \to Z$
2.43±0.20±0.25		[2] BARATE	01E	ALEP	$e^+e^- \to Z$
2.19±0.24±0.39		[3] ABREU	00C	DLPH	$e^+e^- \to Z$
1.7 ±0.5 ±1.1		[4,5] ACCIARRI	96C	L3	$e^+e^- \to Z$
2.4 ±0.7 ±0.8	1032	[6] ACCIARRI	94C	L3	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2.75±0.30±0.37	405	[7] BUSKULIC	95	ALEP	Repl. by BARATE 01E
4.08±0.76±0.62		BUSKULIC	93B	ALEP	Repl. by BUSKULIC 95

[1] ABBIENDI 01Q uses a missing energy technique.
[2] The energy-flow and b-tagging algorithms were used.
[3] Uses the missing energy in $Z \to b\overline{b}$ decays without identifying leptons.
[4] ACCIARRI 96C result obtained from missing energy spectrum.
[5] Assumes Standard Model value for R_B.
[6] This is a direct result using tagged $b\overline{b}$ events at the Z, but species are not separated.
[7] BUSKULIC 95 uses missing-energy technique.

$\Gamma(D^{*-}\tau\nu_\tau \text{anything})/\Gamma_{\text{total}}$ Γ_{26}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$(0.88\pm0.31\pm0.28)\times10^{-2}$	[1] BARATE	01E	ALEP	$e^+e^- \to Z$

[1] The energy-flow and b-tagging algorithms were used.

$\Gamma(\overline{b} \to \overline{c} \to \ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}$ Γ_{27}/Γ

"OUR EVALUATION" is an average of the data listed below, excluding all asymmetry measurements, performed by the LEP Electroweak Working Group as described in the "Note on the Z boson" in the Z Particle Listings.

VALUE	DOCUMENT ID		TECN	COMMENT
0.0802±0.0019 OUR EVALUATION				
0.0817±0.0020 OUR AVERAGE				
$0.0818\pm0.0015^{+0.0024}_{-0.0026}$	[1] HEISTER	02G	ALEP	$e^+e^- \to Z$
$0.0798\pm0.0022^{+0.0025}_{-0.0029}$	[2] ABREU	01L	DLPH	$e^+e^- \to Z$
$0.0840\pm0.0016^{+0.0039}_{-0.0036}$	[3] ABBIENDI	00E	OPAL	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0770±0.0097±0.0046	[4] ABREU	95D	DLPH	$e^+e^- \to Z$
0.082 ±0.003 ±0.012	[5] BUSKULIC	94G	ALEP	$e^+e^- \to Z$
0.077 ±0.004 ±0.007	[6] AKERS	93B	OPAL	Repl. by ABBIENDI 00E

[1] Uses the combination of lepton transverse momentum spectrum and the correlation between the charge of the lepton and opposite jet charge. The first error is statistic and the second error is the total systematic error including the modeling.
[2] The experimental systematic and model uncertainties are combined in quadrature.
[3] ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \to b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.

[4] 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 $\Gamma(\overline{b} \rightarrow \ell^+ \nu_\ell X)$ data.

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

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

$\Gamma(c \rightarrow \ell^+ \nu \text{anything})/\Gamma_{\text{total}}$ — Γ_{28}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.0161 \pm 0.0020 ^{+0.0034}_{-0.0047}}$	[1] ABREU	01L	DLPH	$e^+ e^- \rightarrow Z$

[1] The experimental systematic and model uncertainties are combined in quadrature.

$\Gamma(\overline{D}^0 \text{anything})/\Gamma_{\text{total}}$ — Γ_{29}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.587 \pm 0.028 \pm 0.005}$	[1] BUSKULIC	96Y	ALEP	$e^+ e^- \rightarrow Z$

[1] BUSKULIC 96Y reports $0.605 \pm 0.024 \pm 0.016$ from a measurement of $[\Gamma(\overline{b} \rightarrow \overline{D}^0 \text{anything})/\Gamma_{\text{total}}] \times [B(D^0 \rightarrow K^- \pi^+)]$ assuming $B(D^0 \rightarrow K^- \pi^+) = 0.0383$, which we rescale to 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.

$\Gamma(D^0 D_s^\pm \text{anything})/\Gamma_{\text{total}}$ — Γ_{30}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.091 ^{+0.020}_{-0.018} {}^{+0.034}_{-0.022}}$	[1] BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

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

$\Gamma(D^\mp D_s^\pm \text{anything})/\Gamma_{\text{total}}$ — Γ_{31}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.040 ^{+0.017}_{-0.014} {}^{+0.016}_{-0.011}}$	[1] BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

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

$[\Gamma(D^0 D_s^\pm \text{anything}) + \Gamma(D^\mp D_s^\pm \text{anything})]/\Gamma_{\text{total}}$ — $(\Gamma_{30}+\Gamma_{31})/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.131 ^{+0.026}_{-0.022} {}^{+0.048}_{-0.031}}$	[1] BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

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

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

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.051 ^{+0.016}_{-0.014} {}^{+0.012}_{-0.011}}$	[1] BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

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

$\Gamma(D^0 D^\pm \text{anything})/\Gamma_{\text{total}}$ — Γ_{33}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.027 ^{+0.015}_{-0.013} {}^{+0.010}_{-0.009}}$	[1] BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

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

$\left[\Gamma(\overline{D}^0 D^0 \text{anything}) + \Gamma(D^0 D^{\pm} \text{anything})\right]/\Gamma_{\text{total}}$ $(\Gamma_{32}+\Gamma_{33})/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.078^{+0.020}_{-0.018}{}^{+0.018}_{-0.016}}$	[1] BARATE	98Q	ALEP	$e^+e^- \rightarrow Z$

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.009	90	BARATE	98Q	ALEP	$e^+e^- \rightarrow Z$

$\left[\Gamma(D^0 \text{anything}) + \Gamma(D^+ \text{anything})\right]/\Gamma_{\text{total}}$ $(\Gamma_{35}+\Gamma_{36})/\Gamma$

VALUE	DOCUMENT ID		TECN	COMMENT
0.093±0.017±0.014	[1] ABDALLAH	03E	DLPH	$e^+e^- \rightarrow Z$

[1] The second error is the total of systematic uncertainties including the branching fractions used in the measurement.

$\Gamma(D^- \text{anything})/\Gamma_{\text{total}}$ Γ_{37}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.227±0.016±0.004	[1] BUSKULIC	96Y	ALEP	$e^+e^- \rightarrow Z$

[1] BUSKULIC 96Y reports $0.234 \pm 0.013 \pm 0.010$ from a measurement of $[\Gamma(\overline{b} \rightarrow D^- \text{anything})/\Gamma_{\text{total}}] \times [B(D^+ \rightarrow K^- 2\pi^+)]$ assuming $B(D^+ \rightarrow K^- 2\pi^+) = 0.091$, which we rescale to 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.

$\Gamma(D^*(2010)^+ \text{anything})/\Gamma_{\text{total}}$ Γ_{38}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.173±0.016±0.012	[1] ACKERSTAFF	98E	OPAL	$e^+e^- \rightarrow Z$

[1] Uses lepton tags to select $Z \rightarrow b\overline{b}$ events.

$\Gamma(D_1(2420)^0 \text{anything})/\Gamma_{\text{total}}$ Γ_{39}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.050±0.014±0.006	[1] ACKERSTAFF	97W	OPAL	$e^+e^- \rightarrow Z$

[1] ACKERSTAFF 97W assumes $B(D_2^*(2460)^0 \rightarrow D^{*+}\pi^-) = 0.21 \pm 0.04$ and $\Gamma_{b\overline{b}}/\Gamma_{\text{hadrons}} = 0.216$ at Z decay.

$\Gamma(D^*(2010)^{\mp} D_s^{\pm} \text{anything})/\Gamma_{\text{total}}$ Γ_{40}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.033^{+0.010}_{-0.009}{}^{+0.012}_{-0.009}}$	[1] BARATE	98Q	ALEP	$e^+e^- \rightarrow Z$

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

$\Gamma(D^0 D^*(2010)^{\pm} \text{anything})/\Gamma_{\text{total}}$ Γ_{41}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.030^{+0.009}_{-0.008}{}^{+0.007}_{-0.005}}$	[1] BARATE	98Q	ALEP	$e^+e^- \rightarrow Z$

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

$\Gamma(D^*(2010)^{\pm} D^{\mp}\text{ anything})/\Gamma_{\text{total}}$ Γ_{42}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.025^{+0.010}_{-0.009}{}^{+0.006}_{-0.005}}$	[1] BARATE	98Q	ALEP	$e^+e^- \to Z$

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

$\Gamma(D^*(2010)^{\pm} D^*(2010)^{\mp}\text{ anything})/\Gamma_{\text{total}}$ Γ_{43}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.012^{+0.004}_{-0.003}\pm0.002}$	[1] BARATE	98Q	ALEP	$e^+e^- \to Z$

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

$\Gamma(\overline{D}D\text{ anything})/\Gamma_{\text{total}}$ Γ_{44}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.10\pm0.032^{+0.107}_{-0.095}}$	[1] ABBIENDI	04I	OPAL	$e^+e^- \to Z$

[1] Measurement performed using an inclusive identification of B mesons and the D candidates.

$\Gamma(D_2^*(2460)^0\text{ anything})/\Gamma_{\text{total}}$ Γ_{45}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.047\pm0.024\pm0.013}$	[1] ACKERSTAFF	97W	OPAL	$e^+e^- \to Z$

[1] ACKERSTAFF 97W assumes $B(D_2^*(2460)^0 \to D^{*+}\pi^-) = 0.21 \pm 0.04$ and $\Gamma_{b\overline{b}}/\Gamma_{\text{hadrons}} = 0.216$ at Z decay.

$\Gamma(D_s^-\text{ anything})/\Gamma_{\text{total}}$ Γ_{46}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.147\pm0.017\pm0.013}$	[1] BUSKULIC	96Y	ALEP	$e^+e^- \to Z$

[1] BUSKULIC 96Y reports $0.183 \pm 0.019 \pm 0.009$ from a measurement of $[\Gamma(\overline{b} \to D_s^-\text{ anything})/\Gamma_{\text{total}}] \times [B(D_s^+ \to \phi\pi^+)]$ assuming $B(D_s^+ \to \phi\pi^+) = 0.036$, which we rescale to our best value $B(D_s^+ \to \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(D_s^+\text{ anything})/\Gamma_{\text{total}}$ Γ_{47}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.101\pm0.010\pm0.029}$	[1] ABDALLAH	03E	DLPH	$e^+e^- \to Z$

[1] The second error is the total of systematic uncertainties including the branching fractions used in the measurement.

$\Gamma(b \to \Lambda_c^+\text{ anything})/\Gamma_{\text{total}}$ Γ_{48}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.077\pm0.011\pm0.004}$	[1] BUSKULIC	96Y	ALEP	$e^+e^- \to Z$

[1] BUSKULIC 96Y reports $0.110 \pm 0.014 \pm 0.006$ from a measurement of $[\Gamma(b \to \Lambda_c^+\text{ anything})/\Gamma_{\text{total}}] \times [B(\Lambda_c^+ \to pK^-\pi^+)]$ assuming $B(\Lambda_c^+ \to pK^-\pi^+) = 0.044$, which we rescale to our best value $B(\Lambda_c^+ \to pK^-\pi^+) = (6.28 \pm 0.32) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\overline{c}/c \text{ anything})/\Gamma_{\text{total}}$ Γ_{49}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
1.162±0.032 OUR AVERAGE				
$1.12\ {}^{+0.11}_{-0.10}$	[1] ABBIENDI	04I	OPAL	$e^+e^- \rightarrow Z$
1.166±0.031±0.080	[2] ABREU	00	DLPH	$e^+e^- \rightarrow Z$
1.147±0.041	[3] ABREU	98D	DLPH	$e^+e^- \rightarrow Z$
1.230±0.036±0.065	[4] BUSKULIC	96Y	ALEP	$e^+e^- \rightarrow Z$

[1] Measurement performed using an inclusive identification of B mesons and the D candidates.

[2] Evaluated via summation of exclusive and inclusive channels.

[3] ABREU 98D results are extracted from a fit to the b-tagging probability distribution based on the impact parameter.

[4] BUSKULIC 96Y assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons, and PDG 96 branching ratios for charm decays. This is sum of their inclusive $\overline{D}^0$, D^-, $\overline{D}_s$, and Λ_c branching ratios, corrected to include inclusive Ξ_c and charmonium.

$\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$ Γ_{50}/Γ

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
1.16±0.10 OUR AVERAGE						
1.12±0.12±0.10			[1] ABREU	94P	DLPH	$e^+e^- \rightarrow Z$
1.16±0.16±0.14		121	[2] ADRIANI	93J	L3	$e^+e^- \rightarrow Z$
1.21±0.13±0.08			BUSKULIC	92G	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.3 ±0.2 ±0.2			[3] ADRIANI	92	L3	$e^+e^- \rightarrow Z$
<4.9	90		MATTEUZZI	83	MRK2	E^{ee}_{cm}= 29 GeV

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

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

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

$\Gamma(\psi(2S)\text{anything})/\Gamma_{\text{total}}$ Γ_{51}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0048±0.0022±0.0010	[1] ABREU	94P	DLPH	$e^+e^- \rightarrow Z$

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

$\Gamma(\psi(2S)\text{anything})/\Gamma(J/\psi(1S)\text{anything})$ Γ_{51}/Γ_{50}

VALUE	DOCUMENT ID		TECN	COMMENT
0.245±0.013 OUR AVERAGE				
0.240±0.015±0.005	[1,2] AAIJ	12BD	LHCB	pp at 7 TeV
0.257±0.015±0.019	[3,4] CHATRCHYAN	12AK	CMS	pp at 7 TeV

[1] AAIJ 12BD reports $0.235 \pm 0.005 \pm 0.015$ from a measurement of $[\Gamma(\overline{b} \rightarrow \psi(2S)\text{anything})/\Gamma(\overline{b} \rightarrow J/\psi(1S)\text{anything})] \times [\text{B}(J/\psi(1S) \rightarrow \mu^+\mu^-)]$ / $[\text{B}(\psi(2S) \rightarrow e^+e^-)]$ assuming $\text{B}(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.93 \pm 0.06) \times 10^{-2}$,$\text{B}(\psi(2S) \rightarrow e^+e^-) = (7.72 \pm 0.17) \times 10^{-3}$, which we rescale to our best values $\text{B}(J/\psi(1S) \rightarrow \mu^+\mu^-)$

$= (5.961 \pm 0.033) \times 10^{-2}$, B($\psi(2S) \to e^+ e^-$) $= (7.93 \pm 0.17) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

[2] Assumes lepton universality imposing B($\psi(2s) \to \mu^+ \mu^-$) = B($\psi(2s) \to e^+ e^-$).

[3] CHATRCHYAN 12AK really reports $\Gamma_{51}/\Gamma = (3.08 \pm 0.12 \pm 0.13 \pm 0.42) \times 10^{-3}$ assuming PDG 10 value of $\Gamma_{50}/\Gamma = (1.16 \pm 0.10) \times 10^{-2}$ which we present as a ratio of Γ_{51}/Γ_{50} $= (26.5 \pm 1.0 \pm 1.1 \pm 2.8) \times 10^{-2}$.

[4] CHATRCHYAN 12AK reports $(26.5 \pm 1.0 \pm 1.1 \pm 2.8) \times 10^{-2}$ from a measurement of [$\Gamma(\overline{b} \to \psi(2S)$ anything)/$\Gamma(\overline{b} \to J/\psi(1S)$ anything)] × [B($\psi(2S) \to \mu^+ \mu^-$)] / [B($J/\psi(1S) \to \mu^+ \mu^-$)] assuming B($\psi(2S) \to \mu^+ \mu^-$) $= (7.7 \pm 0.8) \times 10^{-3}$,B($J/\psi(1S) \to \mu^+ \mu^-$) $= (5.93 \pm 0.06) \times 10^{-2}$, which we rescale to our best values B($\psi(2S) \to \mu^+ \mu^-$) $= (8.0 \pm 0.6) \times 10^{-3}$, B($J/\psi(1S) \to \mu^+ \mu^-$) $= (5.961 \pm 0.033) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c0}(1P)$ anything$)/\Gamma(\eta_c(1S)$ anything$)$ — Γ_{52}/Γ_{56}

VALUE	DOCUMENT ID		TECN	COMMENT
0.33±0.06±0.05	[1] AAIJ	17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports [$\Gamma(\overline{b} \to \chi_{c0}(1P)$ anything)/$\Gamma(\overline{b} \to \eta_c(1S)$ anything)] / [B($\eta_c(1S) \to \phi\phi$)] × [B($\chi_{c0}(1P) \to \phi\phi$)] $= 0.147 \pm 0.023 \pm 0.011$ which we multiply or divide by our best values B($\eta_c(1S) \to \phi\phi$) $= (1.77 \pm 0.19) \times 10^{-3}$, B($\chi_{c0}(1P) \to \phi\phi$) $= (8.0 \pm 0.7) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c1}(1P)$ anything$)/\Gamma_{total}$ — Γ_{53}/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.014 ±0.004 OUR AVERAGE					
$0.0112^{+0.0057}_{-0.0050} \pm 0.0003$		[1] ABREU	94P	DLPH	$e^+ e^- \to Z$
0.019 ±0.007 ±0.001	19	[2] ADRIANI	93J	L3	$e^+ e^- \to Z$

[1] ABREU 94P reports $0.014 \pm 0.006^{+0.004}_{-0.002}$ from a measurement of [$\Gamma(\overline{b} \to \chi_{c1}(1P)$ anything)/Γ_{total}] × [B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$)] assuming B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$) $= 0.273 \pm 0.016$, which we rescale to our best value B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$) $= (34.3 \pm 1.0) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Assumes no $\chi_{c2}(1P)$ and $\Gamma(Z \to b\overline{b})/\Gamma_{hadron}$=0.22.

[2] ADRIANI 93J reports $0.024 \pm 0.009 \pm 0.002$ from a measurement of [$\Gamma(\overline{b} \to \chi_{c1}(1P)$ anything)/Γ_{total}] × [B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$)] assuming B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$) $= 0.273 \pm 0.016$, which we rescale to our best value B($\chi_{c1}(1P) \to \gamma J/\psi(1S)$) $= (34.3 \pm 1.0) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\chi_{c1}(1P)$ anything$)/\Gamma(J/\psi(1S)$ anything$)$ — Γ_{53}/Γ_{50}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.92±0.82	121	[1] ADRIANI	93J	L3	$e^+ e^- \to Z$

[1] 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.

$\Gamma(\chi_{c1}(1P)\,\text{anything})/\Gamma(\chi_{c0}(1P)\,\text{anything})$ Γ_{53}/Γ_{52}

VALUE	DOCUMENT ID	TECN	COMMENT
0.96±0.21±0.15	[1] AAIJ 17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $[\Gamma(\overline{b} \to \chi_{c1}(1P)\,\text{anything})/\Gamma(\overline{b} \to \chi_{c0}(1P)\,\text{anything})]$ / $[B(\chi_{c0}(1P) \to \phi\phi)] \times [B(\chi_{c1}(1P) \to \phi\phi)] = 0.50 \pm 0.11 \pm 0.01$ which we multiply or divide by our best values $B(\chi_{c0}(1P) \to \phi\phi) = (8.0 \pm 0.7) \times 10^{-4}$, $B(\chi_{c1}(1P) \to \phi\phi) = (4.2 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c1}(1P)\,\text{anything})/\Gamma(\eta_c(1S)\,\text{anything})$ Γ_{53}/Γ_{56}

VALUE	DOCUMENT ID	TECN	COMMENT
0.31±0.07±0.05	[1] AAIJ 17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $[\Gamma(\overline{b} \to \chi_{c1}(1P)\,\text{anything})/\Gamma(\overline{b} \to \eta_c(1S)\,\text{anything})]$ / $[B(\eta_c(1S) \to \phi\phi)] \times [B(\chi_{c1}(1P) \to \phi\phi)] = 0.073 \pm 0.016 \pm 0.006$ which we multiply or divide by our best values $B(\eta_c(1S) \to \phi\phi) = (1.77 \pm 0.19) \times 10^{-3}$, $B(\chi_{c1}(1P) \to \phi\phi) = (4.2 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c2}(1P)\,\text{anything})/\Gamma(\chi_{c0}(1P)\,\text{anything})$ Γ_{54}/Γ_{52}

VALUE	DOCUMENT ID	TECN	COMMENT
0.42±0.08±0.05	[1] AAIJ 17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $[\Gamma(\overline{b} \to \chi_{c2}(1P)\,\text{anything})/\Gamma(\overline{b} \to \chi_{c0}(1P)\,\text{anything})]$ / $[B(\chi_{c0}(1P) \to \phi\phi)] \times [B(\chi_{c2}(1P) \to \phi\phi)] = 0.56 \pm 0.10 \pm 0.01$ which we multiply or divide by our best values $B(\chi_{c0}(1P) \to \phi\phi) = (8.0 \pm 0.7) \times 10^{-4}$, $B(\chi_{c2}(1P) \to \phi\phi) = (1.06 \pm 0.09) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c2}(1P)\,\text{anything})/\Gamma(\eta_c(1S)\,\text{anything})$ Γ_{54}/Γ_{56}

VALUE	DOCUMENT ID	TECN	COMMENT
0.135±0.023±0.018	[1] AAIJ 17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $[\Gamma(\overline{b} \to \chi_{c2}(1P)\,\text{anything})/\Gamma(\overline{b} \to \eta_c(1S)\,\text{anything})]$ / $[B(\eta_c(1S) \to \phi\phi)] \times [B(\chi_{c2}(1P) \to \phi\phi)] = 0.081 \pm 0.013 \pm 0.005$ which we multiply or divide by our best values $B(\eta_c(1S) \to \phi\phi) = (1.77 \pm 0.19) \times 10^{-3}$, $B(\chi_{c2}(1P) \to \phi\phi) = (1.06 \pm 0.09) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_c(2P)\,\text{anything},\ \chi_c \to \phi\phi)/\Gamma_{\text{total}}$ Γ_{55}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.8 \times 10^{-7}$	95	AAIJ 17BB	LHCB	pp at 7, 8 TeV

$\Gamma(\eta_c(2S)\,\text{anything},\ \eta_c \to \phi\phi)/\Gamma(\eta_c(1S)\,\text{anything})$ Γ_{57}/Γ_{56}

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
7.1±2.1±0.8	[1] AAIJ 17BB	LHCB	pp at 7, 8 TeV

[1] AAIJ 17BB reports $[\Gamma(\overline{b} \to \eta_c(2S)\,\text{anything},\ \eta_c \to \phi\phi)/\Gamma(\overline{b} \to \eta_c(1S)\,\text{anything})]$ / $[B(\eta_c(1S) \to \phi\phi)] = 0.040 \pm 0.011 \pm 0.004$ which we multiply by our best value $B(\eta_c(1S) \to \phi\phi) = (1.77 \pm 0.19) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\chi_{c1}(3872)\text{anything},\ \chi_{c1} \to \phi\phi)/\Gamma_{\text{total}}$ — Γ_{58}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.5 \times 10^{-7}$	95	AAIJ	17BB	LHCB	pp at 7, 8 TeV

$\Gamma(X(3915)\text{anything},\ X \to \phi\phi)/\Gamma_{\text{total}}$ — Γ_{59}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<3.1 \times 10^{-7}$	95	AAIJ	17BB	LHCB	pp at 7, 8 TeV

$\Gamma(\overline{s}\gamma)/\Gamma_{\text{total}}$ — Γ_{60}/Γ

VALUE (units 10^{-4})	CL%	DOCUMENT ID		TECN	COMMENT
$3.11 \pm 0.80 \pm 0.72$		[1] BARATE	98I	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<5.4	90	[2] ADAM	96D	DLPH	$e^+e^- \to Z$
<12	90	[3] ADRIANI	93L	L3	$e^+e^- \to Z$

[1] BARATE 98I uses lifetime tagged $Z \to b\overline{b}$ sample.
[2] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.
[3] ADRIANI 93L result is for $\overline{b} \to \overline{s}\gamma$ is performed inclusively.

$\Gamma(\overline{s}\overline{\nu}\nu)/\Gamma_{\text{total}}$ — Γ_{61}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.4 \times 10^{-4}$	90	[1] BARATE	01E	ALEP	$e^+e^- \to Z$

[1] The energy-flow and b-tagging algorithms were used.

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

VALUE	DOCUMENT ID		TECN	COMMENT
0.74 ± 0.06 OUR AVERAGE				
$0.72 \pm 0.02 \pm 0.06$	BARATE	98V	ALEP	$e^+e^- \to Z$
$0.88 \pm 0.05 \pm 0.18$	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma(K^0_S\text{anything})/\Gamma_{\text{total}}$ — Γ_{63}/Γ

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

$\Gamma(\pi^{\pm}\text{anything})/\Gamma_{\text{total}}$ — Γ_{64}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$3.97 \pm 0.02 \pm 0.21$	BARATE	98V	ALEP	$e^+e^- \to Z$

$\Gamma(\pi^0\text{anything})/\Gamma_{\text{total}}$ — Γ_{65}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$2.78 \pm 0.15 \pm 0.60$	[1] ADAM	96	DLPH	$e^+e^- \to Z$

[1] ADAM 96 measurement obtained from a fit to the rapidity distribution of $\pi^{0'}s$ in $Z \to bb$ events.

$\Gamma(\phi\text{anything})/\Gamma_{\text{total}}$ — Γ_{66}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
$0.0282 \pm 0.0013 \pm 0.0019$	ABBIENDI	00Z	OPAL	$e^+e^- \to Z$

$\Gamma\big(p/\overline{p}\text{anything}\big)/\Gamma_{\text{total}}$ — Γ_{67}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.131±0.011 OUR AVERAGE				
0.131±0.004±0.011	BARATE	98V	ALEP	$e^+e^- \to Z$
0.141±0.018±0.056	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma\big(\Lambda/\overline{\Lambda}\text{anything}\big)/\Gamma_{\text{total}}$ — Γ_{68}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.059 ±0.006 OUR AVERAGE				
0.0587±0.0046±0.0048	ACKERSTAFF	97N	OPAL	$e^+e^- \to Z$
0.059 ±0.007 ±0.009	ABREU	95C	DLPH	$e^+e^- \to Z$

$\Gamma\big(b\text{-baryon anything}\big)/\Gamma_{\text{total}}$ — Γ_{69}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.102±0.007±0.027	[1] BARATE	98V	ALEP	$e^+e^- \to Z$

[1] BARATE 98V assumes B($B_s \to pX$) = 8 ± 4% and B(b-baryon $\to pX$) = 58 ± 6%.

$\Gamma\big(\Xi_b^+\text{anything}\big)/\Gamma\big(\overline{\Lambda}_b^0\text{anything}\big)$ — Γ_{71}/Γ_{70}

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
7.3±1.7 OUR AVERAGE				
6.7±0.5±2.1	[1] AAIJ	19AB	LHCB	pp at 7 and 8 TeV
8.2±0.7±2.6	[1] AAIJ	19AB	LHCB	pp at 13 TeV

[1] Measured from R = [B($\overline{b} \to \Xi_b^+$)×B($\Xi_b \to J/\psi\,\Xi^+$)]/[B($\overline{b} \to \overline{\Lambda}_b^0$)×B($\overline{\Lambda}_b^0 \to J/\psi\,\overline{\Lambda}^0$)] and assumes $\Gamma_{\Xi_b^+ \to J/\psi\,\Xi^+}/\Gamma_{\overline{\Lambda}_b^0 \to J/\psi\,\overline{\Lambda}^0}$ = 3/2 related through SU(3) flavor symmetry.

$\Gamma\big(\text{charged anything}\big)/\Gamma_{\text{total}}$ — Γ_{72}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
4.97±0.03±0.06	[1] ABREU	98H	DLPH	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5.84±0.04±0.38	ABREU	95C	DLPH	Repl. by ABREU 98H

[1] ABREU 98H measurement excludes the contribution from K^0 and Λ decay.

$\Gamma\big(\text{hadron}^+\ \text{hadron}^-\big)/\Gamma_{\text{total}}$ — Γ_{73}/Γ

VALUE (units 10^{-5})	DOCUMENT ID		TECN	COMMENT
$1.7^{+1.0}_{-0.7}\pm0.2$	[1,2] BUSKULIC	96V	ALEP	$e^+e^- \to Z$

[1] BUSKULIC 96V assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons.

[2] Average branching fraction of weakly decaying B hadrons into two long-lived charged hadrons, weighted by their production cross section and lifetimes.

$\Gamma\big(\text{charmless}\big)/\Gamma_{\text{total}}$ — Γ_{74}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.007±0.021	[1] ABREU	98D	DLPH	$e^+e^- \to Z$

[1] ABREU 98D results are extracted from a fit to the b-tagging probability distribution based on the impact parameter. The expected hidden charm contribution of 0.026 ± 0.004 has been subtracted.

$\Gamma(\mu^+\mu^- \text{anything})/\Gamma_{\text{total}}$ — Γ_{76}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<3.2 × 10^{-4}	90	ABBOTT	98B	D0	$p\overline{p}$ 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<5.0 × 10^{-5}	90	[1] ALBAJAR	91C	UA1	$E^{p\overline{p}}_{\text{cm}}$= 630 GeV
<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

[1] Both ABBOTT 98B and GLENN 98 claim that the efficiency quoted in ALBAJAR 91C was overestimated by a large factor.

$[\Gamma(e^+e^- \text{anything}) + \Gamma(\mu^+\mu^- \text{anything})]/\Gamma_{\text{total}}$ — $(\Gamma_{75}+\Gamma_{76})/\Gamma$

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_{77}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<3.9 × 10^{-4}	[1] GROSSMAN	96	RVUE	$e^+e^- \rightarrow Z$

[1] 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.

χ_b AT HIGH ENERGY

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

χ_b is the average B-$\overline{B}$ mixing parameter at high-energy $\chi_b = f'_d \chi_d + f'_s \chi_s$ where f'_d and f'_s are the fractions of B^0 and B^0_s hadrons in an unbiased sample of semileptonic b-hadron decays.

"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	EVTS	DOCUMENT ID		TECN	COMMENT
0.1284±0.0069 OUR EVALUATION					
0.129 ±0.004 OUR AVERAGE					
0.132 ±0.001 ±0.024		[1] ABAZOV	06S	D0	$p\overline{p}$ at 1.96 TeV
0.152 ±0.007 ±0.011		[2] ACOSTA	04A	CDF	$p\overline{p}$ at 1.8 TeV
0.1312±0.0049±0.0042		[3] ABBIENDI	03P	OPAL	$e^+e^- \rightarrow Z$
0.127 ±0.013 ±0.006		[4] ABREU	01L	DLPH	$e^+e^- \rightarrow Z$
0.1192±0.0068±0.0051		[5] ACCIARRI	99D	L3	$e^+e^- \rightarrow Z$

0.121	±0.016	±0.006		[6] ABREU	94J	DLPH	$e^+e^- \to Z$
0.114	±0.014	±0.008		[7] BUSKULIC	94G	ALEP	$e^+e^- \to Z$
0.129	±0.022			[8] BUSKULIC	92B	ALEP	$e^+e^- \to Z$
0.176	±0.031	±0.032	1112	[9] ABE	91G	CDF	$p\overline{p}$ 1.8 TeV
0.148	±0.029	±0.017		[10] ALBAJAR	91D	UA1	$p\overline{p}$ 630 GeV

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

0.131	±0.020	±0.016		[11] ABE	97I	CDF	Repl. by ACOSTA 04A
0.1107	±0.0062	±0.0055		[12] ALEXANDER	96	OPAL	Rep. by ABBIENDI 03P
0.136	±0.037	±0.040		[13] UENO	96	AMY	e^+e^- at 57.9 GeV
0.144	±0.014	$^{+0.017}_{-0.011}$		[14] ABREU	94F	DLPH	Sup. by ABREU 94J
0.131	±0.014			[15] ABREU	94J	DLPH	$e^+e^- \to Z$
0.123	±0.012	±0.008		ACCIARRI	94D	L3	Repl. by ACCIARRI 99D
0.157	±0.020	±0.032		[16] ALBAJAR	94	UA1	$\sqrt{s}$ = 630 GeV
0.121	$^{+0.044}_{-0.040}$	±0.017	1665	[17] ABREU	93C	DLPH	Sup. by ABREU 94J
0.143	$^{+0.022}_{-0.021}$	±0.007		[18] AKERS	93B	OPAL	Sup. by ALEXANDER 96
0.145	$^{+0.041}_{-0.035}$	±0.018		[19] ACTON	92C	OPAL	$e^+e^- \to Z$
0.121	±0.017	±0.006		[20] ADEVA	92C	L3	Sup. by ACCIARRI 94D
0.132	±0.22	$^{+0.015}_{-0.012}$	823	[21] DECAMP	91	ALEP	$e^+e^- \to Z$
0.178	$^{+0.049}_{-0.040}$	±0.020		[22] ADEVA	90P	L3	$e^+e^- \to Z$
0.17	$^{+0.15}_{-0.08}$			[23,24] WEIR	90	MRK2	e^+e^- 29 GeV
0.21	$^{+0.29}_{-0.15}$			[23] BAND	88	MAC	$E^{ee}_{\rm cm}$= 29 GeV
>0.02 at 90%CL				[23] BAND	88	MAC	$E^{ee}_{\rm cm}$= 29 GeV
0.121	±0.047			[23,25] ALBAJAR	87C	UA1	Repl. by ALBAJAR 91D
<0.12 at 90%CL				[23,26] SCHAAD	85	MRK2	$E^{ee}_{\rm cm}$= 29 GeV

[1] Uses the dimuon charge asymmetry. Averaged over the mix of b-flavored hadrons.
[2] Measurement performed using events containing a dimuon or an e/μ pair.
[3] The average B mixing parameter is determined simultaneously with b and c forward-backward asymmetries in the fit.
[4] The experimental systematic and model uncertainties are combined in quadrature.
[5] ACCIARRI 99D uses maximum-likelihood fits to extract χ_b as well as the A^b_{FB} in $Z \to b\overline{b}$ events containing prompt leptons.
[6] This ABREU 94J result is from 5182 $\ell\ell$ and 279 $\Lambda\ell$ events. The systematic error includes 0.004 for model dependence.
[7] BUSKULIC 94G data analyzed using ee, $e\mu$, and $\mu\mu$ events.
[8] BUSKULIC 92B uses a jet charge technique combined with electrons and muons.
[9] ABE 91G measurement of χ is done with $e\mu$ and ee events.
[10] ALBAJAR 91D measurement of χ is done with dimuons.
[11] Uses di-muon events.
[12] ALEXANDER 96 uses a maximum likelihood fit to simultaneously extract χ as well as the forward-backward asymmetries in $e^+e^- \to Z \to b\overline{b}$ and $c\overline{c}$.
[13] UENO 96 extracted χ from the energy dependence of the forward-backward asymmetry.

[14] ABREU 94F uses the average electric charge sum of the jets recoiling against a b-quark jet tagged by a high p_T muon. The result is for $\overline{\chi} = f_d \chi_d + 0.9 f_s \chi_s$.
[15] This ABREU 94J result combines $\ell\ell$, $\Lambda\ell$, and jet-charge ℓ (ABREU 94F) analyses. It is for $\overline{\chi} = f_d \chi_d + 0.96 f_s \chi_s$.
[16] ALBAJAR 94 uses dimuon events. Not independent of ALBAJAR 91D.
[17] ABREU 93C data analyzed using ee, $e\mu$, and $\mu\mu$ events.
[18] AKERS 93B analysis performed using dilepton events.
[19] ACTON 92C uses electrons and muons. Superseded by AKERS 93B.
[20] ADEVA 92C uses electrons and muons.
[21] DECAMP 91 done with opposite and like-sign dileptons. Superseded by BUSKULIC 92B.
[22] ADEVA 90P measurement uses ee, $\mu\mu$, and $e\mu$ events from 118k events at the Z. Superseded by ADEVA 92C.
[23] These experiments are not in the average because the combination of B_s and B_d mesons which they see could differ from those at higher energy.
[24] The WEIR 90 measurement supersedes the limit obtained in SCHAAD 85. The 90% CL are 0.06 and 0.38.
[25] ALBAJAR 87C measured $\chi = (\overline{B}^0 \rightarrow B^0 \rightarrow \mu^+ X)$ divided by the average production weighted semileptonic branching fraction for B hadrons at 546 and 630 GeV.
[26] Limit is average probability for hadron containing B quark to produce a positive lepton.

CP VIOLATION PARAMETERS in semileptonic *b*-hadron decays.

Re(ϵ_b) / (1 + $|\epsilon_b|^2$)

CP impurity in semileptonic b-hadron decays.

VALUE (units 10^{-3})	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$-6.2 \pm 5.2 \pm 4.7$	[1] AABOUD	17E	ATLS	pp at 8 TeV
$-1.24 \pm 0.38 \pm 0.18$	[2] ABAZOV	14	D0	$p\overline{p}$ at 1.96 TeV
$-1.97 \pm 0.43 \pm 0.23$	[3] ABAZOV	11U	D0	Repl. by ABAZOV 14
$-2.39 \pm 0.63 \pm 0.37$	[4] ABAZOV	10H	D0	Repl. by ABAZOV 11U

[1] AABOUD 17E reports a measurement of charge asymmetry of $A^b_{SL} = (-25 \pm 21 \pm 19) \times 10^{-3}$ in lepton + jets $t\overline{t}$ events in which a b-hadron decays semileptonically to a soft muon.
[2] ABAZOV 14 reports a measurement of like-sign dimuon charge asymmetry of $A^b_{SL} = (-4.96 \pm 1.53 \pm 0.72) \times 10^{-3}$ in semileptonic b-hadron decays.
[3] ABAZOV 11U reports a measurement of like-sign dimuon charge asymmetry of $A^b_{SL} = (-7.87 \pm 1.72 \pm 0.93) \times 10^{-3}$ in semileptonic b-hadron decays.
[4] ABAZOV 10H reports a measurement of like-sign dimuon charge asymmetry of $A^b_{SL} = (-9.57 \pm 2.51 \pm 1.46) \times 10^{-3}$ in semileptonic b-hadron decays. Using the measured production ratio of B^0_d and B^0_s, and the asymmetry of B^0_d $A^d_{SL} = (-4.7 \pm 4.6) \times 10^{-3}$ measured from B-factories, they obtain the asymmetry for B^0_s as $A^s_{SL} = (-14.6 \pm 7.5) \times 10^{-3}$.

B-HADRON PRODUCTION FRACTIONS IN $p\overline{p}$ COLLISIONS AT Tevatron

The production fractions for b-hadrons in $p\overline{p}$ collisions at the Tevatron have been calculated from the best values of mean lifetimes, mixing parameters, and branching fractions in this edition by the Heavy Flavor Averaging Group (HFLAV) (see https://hflav.web.cern.ch/).

The values reported below assume:

$f(\overline{b} \to B^+) = f(\overline{b} \to B^0)$

$f(\overline{b} \to B^+) + f(\overline{b} \to B^0) + f(\overline{b} \to B^0_s) + f(b \to b\text{-baryon}) = 1$

The values are:

$f(\overline{b} \to B^+) = f(\overline{b} \to B^0) = 0.344 \pm 0.021$

$f(\overline{b} \to B^0_s) = 0.115 \pm 0.013$

$f(b \to b\text{-baryon}) = 0.198 \pm 0.046$

$f(\overline{b} \to B^0_s)\ /\ f(\overline{b} \to B^0_d) = 0.334 \pm 0.041$

and their correlation coefficients are:

$cor(B^0_s,\ b\text{-baryon}) = -0.429$

$cor(B^0_s,\ B^+{=}B^0) = +0.159$

$cor(b\text{-baryon},\ B^+{=}B^0) = -0.960$

as obtained with the Tevatron average of time-integrated mixing parameter $\overline{\chi} = 0.147 \pm 0.011$.

PRODUCTION ASYMMETRIES

$A_C^{b\overline{b}}$

$A_C^{b\overline{b}} = [N(\Delta y > 0) - N(\Delta y < 0)]\ /\ [N(\Delta y > 0) + N(\Delta y < 0)]$ with $\Delta y = |y_b| - |y_{\overline{b}}|$ where $y_{b/\overline{b}}$ is rapidity of b or $\overline{b}$ quarks.

VALUE (units 10^{-2})	DOCUMENT ID		TECN	COMMENT
Average is meaningless.				
$0.4 \pm 0.4 \pm 0.3$	[1] AAIJ	14AS	LHCB	pp at 7 TeV
$2.0 \pm 0.9 \pm 0.6$	[2] AAIJ	14AS	LHCB	pp at 7 TeV
$1.6 \pm 1.7 \pm 0.6$	[3] AAIJ	14AS	LHCB	pp at 7 TeV

[1] Measured for $40 < M(b\overline{b}) < 75$ GeV/c^2.
[2] Measured for $75 < M(b\overline{b}) < 105$ GeV/c^2.
[3] Measured for $M(b\overline{b}) > 105$ GeV/c^2.

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

AAIJ	19AB	PR D99 052006	R. Aaij et al.	(LHCb Collab.)
AAIJ	19AD	PR D100 031102	R. Aaij et al.	(LHCb Collab.)
AAIJ	19AI	PR D100 112006	R. Aaij et al.	(LHCb Collab.)
AABOUD	17E	JHEP 1702 071	M. Aaboud et al.	(ATLAS Collab.)
AAIJ	17BB	EPJ C77 609	R. Aaij et al.	(LHCb Collab.)
AAD	15CM	PRL 115 262001	G. Aad et al.	(ATLAS Collab.)
AAIJ	14AS	PRL 113 082003	R. Aaij et al.	(LHCb Collab.)
ABAZOV	14	PR D89 012002	V.M. Abazov et al.	(D0 Collab.)
AAIJ	13P	JHEP 1304 001	R. Aaij et al.	(LHCb Collab.)
AAIJ	12BD	EPJ C72 2100	R. Aaij et al.	(LHCb Collab.)
AAIJ	12J	PR D85 032008	R. Aaji et al.	(LHCb Collab.)
CHATRCHYAN	12AK	JHEP 1202 011	S. Chatrchyan et al.	(CMS Collab.)
AAIJ	11F	PRL 107 211801	R. Aaij et al.	(LHCb Collab.)
ABAZOV	11U	PR D84 052007	V.M. Abazov et al.	(D0 Collab.)
ABAZOV	10H	PRL 105 081801	V.M. Abazov et al.	(D0 Collab.)
Also		PR D82 032001	V.M. Abazov et al.	(D0 Collab.)

PDG	10	JP G37 075021	K. Nakamura *et al.*	(PDG Collab.)
AALTONEN	09E	PR D79 032001	T. Aaltonen *et al.*	(CDF Collab.)
AALTONEN	08N	PR D77 072003	T. Aaltonen *et al.*	(CDF Collab.)
ABAZOV	06S	PR D74 092001	V.M. Abazov *et al.*	(D0 Collab.)
ABBIENDI	04I	EPJ C35 149	G. Abbiendi *et al.*	(OPAL Collab.)
ABDALLAH	04E	EPJ C33 307	J. Abdallah *et al.*	(DELPHI Collab.)
ACOSTA	04A	PR D69 012002	D. Acosta *et al.*	(CDF Collab.)
ABBIENDI	03M	EPJ C30 467	G. Abbiendi *et al.*	(OPAL Collab.)
ABBIENDI	03P	PL B577 18	G. Abbiendi *et al.*	(OPAL Collab.)
ABDALLAH	03E	PL B561 26	J. Abdallah *et al.*	(DELPHI Collab.)
ABDALLAH	03K	PL B576 29	J. Abdallah *et al.*	(DELPHI Collab.)
HEISTER	02G	EPJ C22 613	A. Heister *et al.*	(ALEPH Collab.)
ABBIENDI	01Q	PL B520 1	G. Abbiendi *et al.*	(OPAL Collab.)
ABBIENDI	01R	EPJ C21 399	G. Abbiendi *et al.*	(OPAL Collab.)
ABREU	01L	EPJ C20 455	P. Abreu *et al.*	(DELPHI Collab.)
BARATE	01E	EPJ C19 213	R. Barate *et al.*	(ALEPH Collab.)
ABBIENDI	00E	EPJ C13 225	G. Abbiendi *et al.*	(OPAL Collab.)
ABBIENDI	00Z	PL B492 13	G. Abbiendi *et al.*	(OPAL Collab.)
ABREU	00	EPJ C12 225	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	00C	PL B496 43	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	00D	PL B478 14	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	00R	PL B475 407	P. Abreu *et al.*	(DELPHI Collab.)
ACCIARRI	00	EPJ C13 47	M. Acciarri *et al.*	(L3 Collab.)
AFFOLDER	00E	PRL 84 1663	T. Affolder *et al.*	(CDF Collab.)
ABBIENDI	99J	EPJ C12 609	G. Abbiendi *et al.*	(OPAL Collab.)
ABE	99P	PR D60 092005	F. Abe *et al.*	(CDF Collab.)
ACCIARRI	99D	PL B448 152	M. Acciarri *et al.*	(L3 Collab.)
BARATE	99G	EPJ C6 555	R. Barate *et al.*	(ALEPH Collab.)
ABBOTT	98B	PL B423 419	B. Abbott *et al.*	(D0 Collab.)
ABE	98B	PR D57 5382	F. Abe *et al.*	(CDF Collab.)
ABREU	98D	PL B426 193	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	98H	PL B425 399	P. Abreu *et al.*	(DELPHI Collab.)
ACCIARRI	98	PL B416 220	M. Acciarri *et al.*	(L3 Collab.)
ACCIARRI	98K	PL B436 174	M. Acciarri *et al.*	(L3 Collab.)
ACKERSTAFF	98E	EPJ C1 439	K. Ackerstaff *et al.*	(OPAL Collab.)
BARATE	98I	PL B429 169	R. Barate *et al.*	(ALEPH Collab.)
BARATE	98Q	EPJ C4 387	R. Barate *et al.*	(ALEPH Collab.)
BARATE	98V	EPJ C5 205	R. Barate *et al.*	(ALEPH Collab.)
GLENN	98	PRL 80 2289	S. Glenn *et al.*	(CLEO Collab.)
ABE	97I	PR D55 2546	F. Abe *et al.*	(CDF Collab.)
ACKERSTAFF	97F	ZPHY C73 397	K. Ackerstaff *et al.*	(OPAL Collab.)
ACKERSTAFF	97N	ZPHY C74 423	K. Ackerstaff *et al.*	(OPAL Collab.)
ACKERSTAFF	97W	ZPHY C76 425	K. Ackerstaff *et al.*	(OPAL Collab.)
ABREU	96E	PL B377 195	P. Abreu *et al.*	(DELPHI Collab.)
ACCIARRI	96C	ZPHY C71 379	M. Acciarri *et al.*	(L3 Collab.)
ADAM	96	ZPHY C69 561	W. Adam *et al.*	(DELPHI Collab.)
ADAM	96D	ZPHY C72 207	W. Adam *et al.*	(DELPHI Collab.)
ALEXANDER	96	ZPHY C70 357	G. Alexander *et al.*	(OPAL Collab.)
BUSKULIC	96F	PL B369 151	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	96V	PL B384 471	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	96Y	PL B388 648	D. Buskulic *et al.*	(ALEPH Collab.)
GROSSMAN	96	NP B465 369	Y. Grossman, Z. Ligeti, E. Nardi	(REHO, CIT)
Also		NP B480 753 (erratum)	Y. Grossman, Z. Ligeti, E. Nardi	
PDG	96	PR D54 1	R. M. Barnett *et al.*	(PDG Collab.)
UENO	96	PL B381 365	K. Ueno *et al.*	(AMY Collab.)
ABE,K	95B	PRL 75 3624	K. Abe *et al.*	(SLD Collab.)
ABREU	95C	PL B347 447	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	95D	ZPHY C66 323	P. Abreu *et al.*	(DELPHI Collab.)
ADAM	95	ZPHY C68 363	W. Adam *et al.*	(DELPHI Collab.)
AKERS	95Q	ZPHY C67 57	R. Akers *et al.*	(OPAL Collab.)
BUSKULIC	95	PL B343 444	D. Buskulic *et al.*	(ALEPH Collab.)
ABREU	94F	PL B322 459	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	94J	PL B332 488	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	94L	ZPHY C63 3	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	94P	PL B341 109	P. Abreu *et al.*	(DELPHI Collab.)
ACCIARRI	94C	PL B332 201	M. Acciarri *et al.*	(L3 Collab.)
ACCIARRI	94D	PL B335 542	M. Acciarri *et al.*	(L3 Collab.)
ALBAJAR	94	ZPHY C61 41	C. Albajar *et al.*	(UA1 Collab.)
BUSKULIC	94G	ZPHY C62 179	D. Buskulic *et al.*	(ALEPH Collab.)
ABE	93E	PL B313 288	K. Abe *et al.*	(VENUS Collab.)
ABE	93J	PRL 71 3421	F. Abe *et al.*	(CDF Collab.)

ABREU	93C	PL B301 145	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	93D	ZPHY C57 181	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	93G	PL B312 253	P. Abreu *et al.*	(DELPHI Collab.)
ACTON	93C	PL B307 247	P.D. Acton *et al.*	(OPAL Collab.)
ACTON	93L	ZPHY C60 217	P.D. Acton *et al.*	(OPAL Collab.)
ADRIANI	93J	PL B317 467	O. Adriani *et al.*	(L3 Collab.)
ADRIANI	93K	PL B317 474	O. Adriani *et al.*	(L3 Collab.)
ADRIANI	93L	PL B317 637	O. Adriani *et al.*	(L3 Collab.)
AKERS	93B	ZPHY C60 199	R. Akers *et al.*	(OPAL Collab.)
BUSKULIC	93B	PL B298 479	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	93O	PL B314 459	D. Buskulic *et al.*	(ALEPH Collab.)
ABREU	92	ZPHY C53 567	P. Abreu *et al.*	(DELPHI Collab.)
ACTON	92	PL B274 513	D.P. Acton *et al.*	(OPAL Collab.)
ACTON	92C	PL B276 379	D.P. Acton *et al.*	(OPAL Collab.)
ADEVA	92C	PL B288 395	B. Adeva *et al.*	(L3 Collab.)
ADRIANI	92	PL B288 412	O. Adriani *et al.*	(L3 Collab.)
BUSKULIC	92B	PL B284 177	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	92F	PL B295 174	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	92G	PL B295 396	D. Buskulic *et al.*	(ALEPH Collab.)
ABE	91G	PRL 67 3351	F. Abe *et al.*	(CDF Collab.)
ADEVA	91C	PL B261 177	B. Adeva *et al.*	(L3 Collab.)
ADEVA	91H	PL B270 111	B. Adeva *et al.*	(L3 Collab.)
ALBAJAR	91C	PL B262 163	C. Albajar *et al.*	(UA1 Collab.)
ALBAJAR	91D	PL B262 171	C. Albajar *et al.*	(UA1 Collab.)
ALEXANDER	91G	PL B266 485	G. Alexander *et al.*	(OPAL Collab.)
DECAMP	91	PL B258 236	D. Decamp *et al.*	(ALEPH Collab.)
DECAMP	91C	PL B257 492	D. Decamp *et al.*	(ALEPH Collab.)
ADEVA	90P	PL B252 703	B. Adeva *et al.*	(L3 Collab.)
BEHREND	90D	ZPHY C47 333	H.J. Behrend *et al.*	(CELLO Collab.)
HAGEMANN	90	ZPHY C48 401	J. Hagemann *et al.*	(JADE Collab.)
LYONS	90	PR D41 982	L. Lyons, A.J. Martin, D.H. Saxon	(OXF, BRIS+)
WEIR	90	PL B240 289	A.J. Weir *et al.*	(Mark II Collab.)
BRAUNSCH...	89B	ZPHY C44 1	R. Braunschweig *et al.*	(TASSO Collab.)
ONG	89	PRL 62 1236	R.A. Ong *et al.*	(Mark II Collab.)
BAND	88	PL B200 221	H.R. Band *et al.*	(MAC Collab.)
KLEM	88	PR D37 41	D.E. Klem *et al.*	(DELCO Collab.)
ONG	88	PRL 60 2587	R.A. Ong *et al.*	(Mark II Collab.)
ALBAJAR	87C	PL B186 247	C. Albajar *et al.*	(UA1 Collab.)
ASH	87	PRL 58 640	W.W. Ash *et al.*	(MAC Collab.)
BARTEL	87	ZPHY C33 339	W. Bartel *et al.*	(JADE Collab.)
BROM	87	PL B195 301	J.M. Brom *et al.*	(HRS Collab.)
PAL	86	PR D33 2708	T. Pal *et al.*	(DELCO Collab.)
AIHARA	85	ZPHY C27 39	H. Aihara *et al.*	(TPC Collab.)
BARTEL	85J	PL 163B 277	W. Bartel *et al.*	(JADE Collab.)
SCHAAD	85	PL 160B 188	T. Schaad *et al.*	(Mark II Collab.)
ALTHOFF	84G	ZPHY C22 219	M. Althoff *et al.*	(TASSO Collab.)
ALTHOFF	84J	PL 146B 443	M. Althoff *et al.*	(TASSO Collab.)
KOOP	84	PRL 52 970	D.E. Koop *et al.*	(DELCO Collab.)
ADEVA	83	PRL 50 799	B. Adeva *et al.*	(Mark-J Collab.)
ADEVA	83B	PRL 51 443	B. Adeva *et al.*	(Mark-J Collab.)
BARTEL	83B	PL 132B 241	W. Bartel *et al.*	(JADE Collab.)
FERNANDEZ	83D	PRL 50 2054	E. Fernandez *et al.*	(MAC Collab.)
MATTEUZZI	83	PL 129B 141	C. Matteuzzi *et al.*	(Mark II Collab.)
NELSON	83	PRL 50 1542	M.E. Nelson *et al.*	(Mark II Collab.)