B_s^0

$I(J^P) = 0(0^-)$

I, J, P need confirmation. Quantum numbers shown are quark-model predictions.

B_s^0 MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
5369.6± 2.4 OUR FIT					
5369.6± 2.4 OUR AVERAGE					
5369.9± 2.3±1.3	32	[1] ABE	96B	CDF	$p\overline{p}$ at 1.8 TeV
5374 ±16 ±2	3	ABREU	94D	DLPH	$e^+e^- \rightarrow Z$
5359 ±19 ±7	1	[1] AKERS	94J	OPAL	$e^+e^- \rightarrow Z$
5368.6± 5.6±1.5	2	BUSKULIC	93G	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5370 ±40	6	[2] AKERS	94J	OPAL	$e^+e^- \rightarrow Z$
5383.3± 4.5±5.0	14	ABE	93F	CDF	Repl by ABE 96B

[1] From the decay $B_s \rightarrow J/\psi(1S)\phi$.
[2] From the decay $B_s \rightarrow D_s^- \pi^+$.

$m_{B_s^0} - m_B$

m_B is the average of our B masses $(m_{B^\pm}+m_{B^0})/2$.

VALUE (MeV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
90.4±2.4 OUR FIT					
89.7±2.7±1.2		ABE	96B	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
80 to 130	68	LEE-FRANZINI	90	CSB2	$e^+e^- \rightarrow \Upsilon(5S)$

$m_{B_{sH}^0} - m_{B_{sL}^0}$

See the B_s^0-$\overline{B}_s^0$ MIXING section near the end of these B_s^0 Listings.

B_s^0 MEAN LIFE

"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*
1.461±0.057 OUR EVALUATION					
$1.42 \ ^{+0.14}_{-0.13} \pm 0.03$		[3] ABREU	00Y	DLPH	$e^+e^- \rightarrow Z$

$1.53\ ^{+0.16}_{-0.15}\ \pm0.07$		[4] ABREU,P	00G	DLPH	$e^+e^- \rightarrow Z$
$1.36\ \pm0.09\ ^{+0.06}_{-0.05}$		[5] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV
$1.34\ ^{+0.23}_{-0.19}\ \pm0.05$		[6] ABE	98B	CDF	$p\overline{p}$ at 1.8 TeV
$1.72\ ^{+0.20}_{-0.19}\ ^{+0.18}_{-0.17}$		[7] ACKERSTAFF	98F	OPAL	$e^+e^- \rightarrow Z$
$1.50\ ^{+0.16}_{-0.15}\ \pm0.04$		[5] ACKERSTAFF	98G	OPAL	$e^+e^- \rightarrow Z$
$1.47\ \pm0.14\ \pm0.08$		[4] BARATE	98C	ALEP	$e^+e^- \rightarrow Z$
$1.60\ \pm0.26\ ^{+0.13}_{-0.15}$		[8] ABREU	96F	DLPH	$e^+e^- \rightarrow Z$
$1.54\ ^{+0.14}_{-0.13}\ \pm0.04$		[5] BUSKULIC	96M	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.51\ \pm0.11$		[9] BARATE	98C	ALEP	$e^+e^- \rightarrow Z$
$1.34\ ^{+0.23}_{-0.19}\ \pm0.05$		[10] ABE	96N	CDF	Repl. by ABE 98B
$1.56\ ^{+0.29}_{-0.26}\ ^{+0.08}_{-0.07}$		[5] ABREU	96F	DLPH	Repl. by ABREU 00Y
$1.65\ ^{+0.34}_{-0.31}\ \pm0.12$		[4] ABREU	96F	DLPH	Repl. by ABREU 00Y
$1.76\ \pm0.20\ ^{+0.15}_{-0.10}$		[11] ABREU	96F	DLPH	Repl. by ABREU 00Y
$1.67\ \pm0.14$		[12] ABREU	96F	DLPH	$e^+e^- \rightarrow Z$
$1.61\ ^{+0.30}_{-0.29}\ ^{+0.18}_{-0.16}$	90	[4] BUSKULIC	96E	ALEP	Repl. by BARATE 98C
$1.42\ ^{+0.27}_{-0.23}\ \pm0.11$	76	[5] ABE	95R	CDF	Repl. by ABE 99D
$1.74\ ^{+1.08}_{-0.69}\ \pm0.07$	8	[13] ABE	95R	CDF	Sup. by ABE 96N
$1.54\ ^{+0.25}_{-0.21}\ \pm0.06$	79	[5] AKERS	95G	OPAL	Repl. by ACKERSTAFF 98G
$1.59\ ^{+0.17}_{-0.15}\ \pm0.03$	134	[5] BUSKULIC	95O	ALEP	Sup. by BUSKULIC 96M
$0.96\ \pm0.37$	41	[14] ABREU	94E	DLPH	Sup. by ABREU 96F
$1.92\ ^{+0.45}_{-0.35}\ \pm0.04$	31	[5] BUSKULIC	94C	ALEP	Sup. by BUSKULIC 95O
$1.13\ ^{+0.35}_{-0.26}\ \pm0.09$	22	[5] ACTON	93H	OPAL	Sup. by AKERS 95G

[3] Uses $D_s^-\ell^+$, and $\phi\ell^+$ vertices.
[4] Measured using D_s hadron vertices.
[5] Measured using $D_s^-\ell^+$ vertices.
[6] Measured using fully reconstructed $B_s \rightarrow J/\psi(1S)\phi$ decay.
[7] ACKERSTAFF 98F use fully reconstructed $D_s^- \rightarrow \phi\pi^-$ and $D_s^- \rightarrow K^{*0}K^-$ in the inclusive B_s^0 decay.
[8] Measured using inclusive D_s vertices.
[9] Combined results from $D_s^-\ell^+$ and D_s hadron.
[10] ABE 96N uses 58 ± 12 exclusive $B_s \rightarrow J/\psi(1S)\phi$ events.
[11] Measured using $\phi\ell$ vertices.
[12] Combined result for the four ABREU 96F methods.
[13] Exclusive reconstruction of $B_s \rightarrow \psi\phi$.

[14] ABREU 94E uses the flight-distance distribution of D_s vertices, ϕ-lepton vertices, and $D_s\,\mu$ vertices.

B^0_{sL} MEAN LIFE

B^0_{sL} is a long-lived CP-even state of two B^0_s CP eigenstates.

VALUE (10^{-12} s)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.27±0.33±0.08	[15] BARATE	00K	ALEP	$e^+e^- \rightarrow Z$

[15] Uses $\phi\phi$ correlations from $B^0_s \rightarrow D^{(*)+}_s D^{(*)-}_s$.

$\left|\Delta\Gamma_{B^0_s}\right|/\Gamma_{B^0_s}$

$\Gamma_{B^0_s}$ and $\left|\Delta\Gamma_{B^0_s}\right|$ are the decay rate average and difference between two B^0_s CP eigenstates.

The second "OUR EVALUATION," < 0.52 (CL=95%), is an average of all available B_s semi-leptonic lifetime measurements with the $\Delta\Gamma_{B^0_s}/\Gamma_s$ analyses performed by the LEP B Osciallation Working Group as described in our "Review on B-$\overline{B}$ Mixing" in the B^0 Section of these Listings.

The first "OUR EVALUATION," < 0.31 (CL=95%), also provided by the LEP B Oscillation Working Group, including the assumption of $\Gamma_s = \frac{1}{\tau_{B_d}}$.

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.31 (CL = 95%) OUR EVALUATION					
<0.52 (CL = 95%) OUR EVALUATION					
<0.46	95	[16] ABREU	00Y	DLPH	$e^+e^- \rightarrow Z$
<0.69	95	[17] ABREU,P	00G	DLPH	$e^+e^- \rightarrow Z$
$0.25^{+0.21}_{-0.14}$		[18] BARATE	00K	ALEP	$e^+e^- \rightarrow Z$
<0.83	95	[19] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV
<0.67	95	[20] ACCIARRI	98S	L3	$e^+e^- \rightarrow Z$

[16] Uses $D^-_s\,\ell^+$, and $\phi\ell^+$ vertices.

[17] Measured using D_s hadron vertices.

[18] Uses $\phi\phi$ correlations from $B^0_s \rightarrow D^{(*)+}_s D^{(*)-}_s$.

[19] ABE 99D assumes $\tau_{B^0_s} = 1.55 \pm 0.05$ ps.

[20] ACCIARRI 98S assumes $\tau_{B^0_s} = 1.49 \pm 0.06$ ps and PDG 98 values of b production fraction.

B_s^0 DECAY MODES

These branching fractions all scale with B($\overline{b} \to B_s^0$), the LEP B_s^0 production fraction. The first four were evaluated using B($\overline{b} \to B_s^0$) = (10.7 ± 1.4)% and the rest assume B($\overline{b} \to B_s^0$) = 12%.

The branching fraction B($B_s^0 \to D_s^- \ell^+ \nu_\ell$ anything) is not a pure measurement since the measured product branching fraction B($\overline{b} \to B_s^0$) × B($B_s^0 \to D_s^- \ell^+ \nu_\ell$ anything) was used to determine B($\overline{b} \to B_s^0$), as described in the note on "Production and Decay of *b*-Flavored Hadrons."

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	D_s^- anything		(94 ±30) %	
Γ_2	$D_s^- \ell^+ \nu_\ell$ anything	[a]	(7.9 ± 2.4) %	
Γ_3	$D_s^- \pi^+$		< 13 %	
Γ_4	$D_s^{(*)+} D_s^{(*)-}$		(23 $^{+21}_{-13}$) %	
Γ_5	$J/\psi(1S)\phi$		(9.3 ± 3.3) × 10^{-4}	
Γ_6	$J/\psi(1S)\pi^0$		< 1.2 × 10^{-3}	90%
Γ_7	$J/\psi(1S)\eta$		< 3.8 × 10^{-3}	90%
Γ_8	$\psi(2S)\phi$		seen	
Γ_9	$\pi^+\pi^-$		< 1.7 × 10^{-4}	90%
Γ_{10}	$\pi^0\pi^0$		< 2.1 × 10^{-4}	90%
Γ_{11}	$\eta\pi^0$		< 1.0 × 10^{-3}	90%
Γ_{12}	$\eta\eta$		< 1.5 × 10^{-3}	90%
Γ_{13}	$\rho^0\rho^0$		< 3.20 × 10^{-4}	90%
Γ_{14}	$\phi\rho^0$		< 6.17 × 10^{-4}	90%
Γ_{15}	$\phi\phi$		< 1.183 × 10^{-3}	90%
Γ_{16}	$\pi^+ K^-$		< 2.1 × 10^{-4}	90%
Γ_{17}	$K^+ K^-$		< 5.9 × 10^{-5}	90%
Γ_{18}	$\overline{K}^*(892)^0 \rho^0$		< 7.67 × 10^{-4}	90%
Γ_{19}	$\overline{K}^*(892)^0 K^*(892)^0$		< 1.681 × 10^{-3}	90%
Γ_{20}	$\phi K^*(892)^0$		< 1.013 × 10^{-3}	90%
Γ_{21}	$p\overline{p}$		< 5.9 × 10^{-5}	90%
Γ_{22}	$\gamma\gamma$		< 1.48 × 10^{-4}	90%
Γ_{23}	$\phi\gamma$		< 7 × 10^{-4}	90%

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

	Mode			Fraction (Γ_i/Γ)	Confidence level
Γ_{24}	$\mu^+\mu^-$	*B1*		< 2.0 × 10^{-6}	90%
Γ_{25}	$e^+ e^-$	*B1*		< 5.4 × 10^{-5}	90%
Γ_{26}	$e^\pm \mu^\mp$	*LF*	[b]	< 6.1 × 10^{-6}	90%
Γ_{27}	$\phi\nu\overline{\nu}$	*B1*		< 5.4 × 10^{-3}	90%

[*a*] Not a pure measurement. See note at head of B_s^0 Decay Modes.

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

B_s^0 BRANCHING RATIOS

$\Gamma(D_s^- \text{anything})/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.93±0.30 OUR AVERAGE					
0.81±0.24±0.22	90	[21] BUSKULIC	96E	ALEP	$e^+ e^- \rightarrow Z$
1.56±0.58±0.44	147	[22] ACTON	92N	OPAL	$e^+ e^- \rightarrow Z$

[21] BUSKULIC 96E separate $c\overline{c}$ and $b\overline{b}$ sources of D_s^+ mesons using a lifetime tag, subtract generic $\overline{b} \rightarrow W^+ \rightarrow D_s^+$ events, and obtain B($\overline{b} \rightarrow B_s^0$) × B($B_s^0 \rightarrow D_s^-$ anything) = 0.088 ± 0.020 ± 0.020 assuming B($D_s \rightarrow \phi\pi$) = (3.5 ± 0.4) × 10^{-2} and PDG 1994 values for the relative partial widths to other D_s channels. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B_s^0$) and B($D_s \rightarrow \phi\pi$).

[22] ACTON 92N assume that excess of 147 ± 48 D_s^0 events over that expected from B^0, B^+, and $c\overline{c}$ is all from B_s^0 decay. The product branching fraction is measured to be B($\overline{b} \rightarrow B_s^0$)B($B_s^0 \rightarrow D_s^-$ anything)×B($D_s^- \rightarrow \phi\pi^-$) = (5.9 ± 1.9 ± 1.1) × 10^{-3}. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B_s^0$) and B($D_s \rightarrow \phi\pi$).

$\Gamma(D_s^- \ell^+ \nu_\ell \text{anything})/\Gamma_{\text{total}}$ Γ_2/Γ

The values and averages in this section serve only to show what values result if one assumes our B($\overline{b} \rightarrow B_s^0$). They cannot be thought of as measurements since the underlying product branching fractions were also used to determinine B($\overline{b} \rightarrow B_s^0$) as described in the note on "Production and Decay of *b*-Flavored Hadrons."

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.079±0.024 OUR AVERAGE					
0.076±0.012±0.021	134	[23] BUSKULIC	95O	ALEP	$e^+ e^- \rightarrow Z$
0.107±0.043±0.029		[24] ABREU	92M	DLPH	$e^+ e^- \rightarrow Z$
0.103±0.036±0.028	18	[25] ACTON	92N	OPAL	$e^+ e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.13 ±0.04 ±0.04	27	[26] BUSKULIC	92E	ALEP	$e^+ e^- \rightarrow Z$

[23] BUSKULIC 95O use $D_s \ell$ correlations. The measured product branching ratio is B($\overline{b} \rightarrow B_s$) × B($B_s \rightarrow D_s^- \ell^+ \nu_\ell$ anything) = $(0.82 \pm 0.09^{+0.13}_{-0.14})$% assuming B($D_s \rightarrow \phi\pi$) = (3.5 ± 0.4) × 10^{-2} and PDG 1994 values for the relative partial widths to the six other D_s channels used in this analysis. Combined with results from $\Upsilon(4S)$ experiments this can be used to extract B($\overline{b} \rightarrow B_s$) = $(11.0 \pm 1.2^{+2.5}_{-2.6})$%. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B_s^0$) and B($D_s \rightarrow \phi\pi$).

[24] ABREU 92M measured muons only and obtained product branching ratio B($Z \rightarrow$ b or $\overline{b}$) × B($\overline{b} \rightarrow B_s$) × B($B_s \rightarrow D_s \mu^+ \nu_\mu$ anything) × B($D_s \rightarrow \phi\pi$) = $(18 \pm 8) \times 10^{-5}$. We evaluate using our current values B($\overline{b} \rightarrow B^0_s$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B^0_s$) and B($D_s \rightarrow \phi\pi$). We use B($Z \rightarrow$ b or $\overline{b}$) = 2B($Z \rightarrow b\overline{b}$) = 2×(0.2212 ± 0.0019).

[25] ACTON 92N is measured using $D_s \rightarrow \phi\pi^+$ and $K^*(892)^0 K^+$ events. The product branching fraction measured is measured to be B($\overline{b} \rightarrow B^0_s$)B($B^0_s \rightarrow D^-_s \ell^+ \nu_\ell$ anything) ×B($D^-_s \rightarrow \phi\pi^-$) = $(3.9 \pm 1.1 \pm 0.8) \times 10^{-4}$. We evaluate using our current values B($\overline{b} \rightarrow B^0_s$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B^0_s$) and B($D_s \rightarrow \phi\pi$).

[26] BUSKULIC 92E is measured using $D_s \rightarrow \phi\pi^+$ and $K^*(892)^0 K^+$ events. They use 2.7 ± 0.7% for the $\phi\pi^+$ branching fraction. The average product branching fraction is measured to be B($\overline{b} \rightarrow B^0_s$)B($B^0_s \rightarrow D^-_s \ell^+ \nu_\ell$ anything) =$0.020 \pm 0.0055^{+0.005}_{-0.006}$. We evaluate using our current values B($\overline{b} \rightarrow B^0_s$) = 0.107 ± 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 ± 0.009. Our first error is their experiment's and our second error is that due to B($\overline{b} \rightarrow B^0_s$) and B($D_s \rightarrow \phi\pi$). Superseded by BUSKULIC 95O.

$\Gamma(D^-_s \pi^+)/\Gamma_{total}$ — Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
<0.13	6	[27] AKERS	94J	OPAL	$e^+ e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	1	BUSKULIC	93G	ALEP	$e^+ e^- \rightarrow Z$

[27] AKERS 94J sees ≤ 6 events and measures the limit on the product branching fraction $f(\overline{b} \rightarrow B^0_s)$·B($B^0_s \rightarrow D^-_s \pi^+$) < 1.3% at CL = 90%. We divide by our current value B($\overline{b} \rightarrow B^0_s$) = 0.105.

$\Gamma(D_s{}^{(*)+} D_s{}^{(*)-})/\Gamma_{total}$ — Γ_4/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.23 ±0.10$^{+0.19}_{-0.09}$		[28] BARATE	00K	ALEP	$e^+ e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.218	90	BARATE	98Q	ALEP	$e^+ e^- \rightarrow Z$

[28] Uses $\phi\phi$ correlations from $B^0_s \rightarrow D^{(*)+}_s D^{(*)-}_s$.

$\Gamma(J/\psi(1S)\phi)/\Gamma_{total}$ — Γ_5/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.93±0.28±0.17		[29] ABE	96Q	CDF	$p\overline{p}$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<6	1	[30] AKERS	94J	OPAL	$e^+ e^- \rightarrow Z$
seen	14	[31] ABE	93F	CDF	$p\overline{p}$ at 1.8 TeV
seen	1	[32] ACTON	92N	OPAL	Sup. by AKERS 94J

[29] ABE 96Q assumes $f_u = f_d$ and $f_s/f_u = 0.40 \pm 0.06$. Uses $B \rightarrow J/\psi(1S)K$ and $B \rightarrow J/\psi(1S)K^*$ branching fractions from PDG 94. They quote two systematic errors, ± 0.10 and ± 0.14 where the latter is the uncertainty in f_s. We combine in quadrature.

[30] AKERS 94J sees one event and measures the limit on the product branching fraction $f(\overline{b} \rightarrow B^0_s)\cdot B(B^0_s \rightarrow J/\psi(1S)\phi) < 7 \times 10^{-4}$ at CL = 90%. We divide by $B(\overline{b} \rightarrow B^0_s) = 0.112$.

[31] ABE 93F measured using $J/\psi(1S) \rightarrow \mu^+\mu^-$ and $\phi \rightarrow K^+K^-$.

[32] In ACTON 92N a limit on the product branching fraction is measured to be $f(\overline{b} \rightarrow B^0_s)\cdot B(B^0_s \rightarrow J/\psi(1S)\phi) \leq 0.22 \times 10^{-2}$.

$\Gamma(J/\psi(1S)\pi^0)/\Gamma_{total}$ Γ_6/Γ

VALUE	CL%	DOCUMENT ID	TECN
$<1.2 \times 10^{-3}$	90	[33] ACCIARRI 97C	L3

[33] ACCIARRI 97C assumes B^0 production fraction (39.5 ± 4.0%) and B_s (12.0 ± 3.0%).

$\Gamma(J/\psi(1S)\eta)/\Gamma_{total}$ Γ_7/Γ

VALUE	CL%	DOCUMENT ID	TECN
$<3.8 \times 10^{-3}$	90	[34] ACCIARRI 97C	L3

[34] ACCIARRI 97C assumes B^0 production fraction (39.5 ± 4.0%) and B_s (12.0 ± 3.0%).

$\Gamma(\psi(2S)\phi)/\Gamma_{total}$ Γ_8/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
seen	1	BUSKULIC 93G	ALEP	$e^+e^- \rightarrow Z$

$\Gamma(\pi^+\pi^-)/\Gamma_{total}$ Γ_9/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.7 \times 10^{-4}$	90	[35] BUSKULIC 96V	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<2.32 \times 10^{-4}$	90	[36] ABE 00C	SLD	$e^+e^- \rightarrow Z$

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

[36] ABE 00C assumes $B(Z \rightarrow b\overline{b})$=(21.7 ± 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\pi^0\pi^0)/\Gamma_{total}$ Γ_{10}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.1 \times 10^{-4}$	90	[37] ACCIARRI 95H	L3	$e^+e^- \rightarrow Z$

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

$\Gamma(\eta\pi^0)/\Gamma_{total}$ Γ_{11}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<1.0 \times 10^{-3}$	90	[38] ACCIARRI 95H	L3	$e^+e^- \rightarrow Z$

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

$\Gamma(\eta\eta)/\Gamma_{total}$ Γ_{12}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<1.5 \times 10^{-3}$	90	[39] ACCIARRI	95H	L3	$e^+e^- \to Z$

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

$\Gamma(\rho^0\rho^0)/\Gamma_{total}$ Γ_{13}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<3.20 \times 10^{-4}$	90	[40] ABE	00C	SLD	$e^+e^- \to Z$

[40] ABE 00C assumes B($Z \to b\overline{b}$)=(21.7 $\pm$ 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\phi\rho^0)/\Gamma_{total}$ Γ_{14}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<6.17 \times 10^{-4}$	90	[41] ABE	00C	SLD	$e^+e^- \to Z$

[41] ABE 00C assumes B($Z \to b\overline{b}$)=(21.7 $\pm$ 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\phi\phi)/\Gamma_{total}$ Γ_{15}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<11.83 \times 10^{-4}$	90	[42] ABE	00C	SLD	$e^+e^- \to Z$

[42] ABE 00C assumes B($Z \to b\overline{b}$)=(21.7 $\pm$ 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\pi^+K^-)/\Gamma_{total}$ Γ_{16}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<2.1 \times 10^{-4}$	90	[43] BUSKULIC	96V	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.61 \times 10^{-4}$	90	[44] ABE	00C	SLD	$e^+e^- \to Z$
$<2.6 \times 10^{-4}$	90	[45] AKERS	94L	OPAL	$e^+e^- \to Z$

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

[44] ABE 00C assumes B($Z \to b\overline{b}$)=(21.7 $\pm$ 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

[45] Assumes B($Z \to b\overline{b}$) = 0.217 and B^0_d (B^0_s) fraction 39.5% (12%).

$\Gamma(K^+K^-)/\Gamma_{total}$ Γ_{17}/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<5.9 \times 10^{-5}$	90	[46] BUSKULIC	96V	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<2.83 \times 10^{-4}$	90	[47] ABE	00C	SLD	$e^+e^- \to Z$
$<1.4 \times 10^{-4}$	90	[48] AKERS	94L	OPAL	$e^+e^- \to Z$

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

[47] ABE 00C assumes B($Z \to b\overline{b}$)=(21.7 $\pm$ 0.1)% and the B fractions f_{B^0}=f_{B^+}=$(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

[48] Assumes B($Z \to b\overline{b}$) = 0.217 and B^0_d (B^0_s) fraction 39.5% (12%).

$\Gamma(\overline{K}^*(892)^0 \rho^0)/\Gamma_{total}$ Γ_{18}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<7.67 × 10^{-4}	90	[49] ABE	00C	SLD	$e^+ e^- \rightarrow Z$

[49] ABE 00C assumes B($Z \rightarrow b\overline{b}$)=(21.7 ± 0.1)% and the B fractions f_{B^0}=f_{B^+}= $(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\overline{K}^*(892)^0 K^*(892)^0)/\Gamma_{total}$ Γ_{19}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<16.81 × 10^{-4}	90	[50] ABE	00C	SLD	$e^+ e^- \rightarrow Z$

[50] ABE 00C assumes B($Z \rightarrow b\overline{b}$)=(21.7 ± 0.1)% and the B fractions f_{B^0}=f_{B^+}= $(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(\phi K^*(892)^0)/\Gamma_{total}$ Γ_{20}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<10.13 × 10^{-4}	90	[51] ABE	00C	SLD	$e^+ e^- \rightarrow Z$

[51] ABE 00C assumes B($Z \rightarrow b\overline{b}$)=(21.7 ± 0.1)% and the B fractions f_{B^0}=f_{B^+}= $(39.7^{+1.8}_{-2.2})$% and f_{B_s}=$(10.5^{+1.8}_{-2.2})$%.

$\Gamma(p\overline{p})/\Gamma_{total}$ Γ_{21}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<5.9 × 10^{-5}	90	[52] BUSKULIC	96V	ALEP	$e^+ e^- \rightarrow Z$

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

$\Gamma(\gamma\gamma)/\Gamma_{total}$ Γ_{22}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<14.8 × 10^{-5}	90	[53] ACCIARRI	95I	L3	$e^+ e^- \rightarrow Z$

[53] ACCIARRI 95I assumes f_{B^0} = 39.5 ± 4.0 and f_{B_s} = 12.0 ± 3.0%.

$\Gamma(\phi\gamma)/\Gamma_{total}$ Γ_{23}/Γ

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<7 × 10^{-4}	90	[54] ADAM	96D	DLPH	$e^+ e^- \rightarrow Z$

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

$\Gamma(\mu^+ \mu^-)/\Gamma_{total}$ Γ_{24}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<2.0 × 10^{-6}	90	[55] ABE	98	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<3.8 × 10^{-5}	90	[56] ACCIARRI	97B	L3	$e^+ e^- \rightarrow Z$
<8.4 × 10^{-6}	90	[57] ABE	96L	CDF	Repl. by ABE 98

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

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

[57] ABE 96L assumes B^+/B_s production ratio 3/1. They normalize to their measured $\sigma(B^+, p_T(B) > 6$ GeV/c, $|y| < 1) = 2.39 \pm 0.54\ \mu$b.

$\Gamma(e^+e^-)/\Gamma_{total}$ — Γ_{25}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.4 \times 10^{-5}$	90	[58] ACCIARRI	97B	L3	$e^+e^- \to Z$

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

$\Gamma(e^\pm \mu^\mp)/\Gamma_{total}$ — Γ_{26}/Γ

test of lepton family number conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<6.1 \times 10^{-6}$	90	ABE	98V	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<4.1 \times 10^{-5}$	90	[59] ACCIARRI	97B	L3	$e^+e^- \to Z$

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

$\Gamma(\phi \nu \overline{\nu})/\Gamma_{total}$ — Γ_{27}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<5.4 \times 10^{-3}$	90	[60] ADAM	96D	DLPH	$e^+e^- \to Z$

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

POLARIZATION IN B_s^0 DECAY

Γ_L/Γ in $B_s^0 \to J/\psi(1S)\phi$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.59±0.12 OUR AVERAGE					
$0.61 \pm 0.14 \pm 0.02$		[61] AFFOLDER	00N	CDF	$p\overline{p}$ at 1.8 TeV
$0.56 \pm 0.21 ^{+0.02}_{-0.04}$	19	ABE	95Z	CDF	$p\overline{p}$ at 1.8 TeV

[61] AFFOLDER 00N measurements are based on 40 B_s^0 candidates obtained from a data sample of 89 pb^{-1}. The P-wave fraction is found to be $0.23 \pm 0.19 \pm 0.04$.

B_s^0-$\overline{B}_s^0$ MIXING

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

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

$$\chi_s = \frac{x_s^2}{2(1+x_s^2)}$$

$$x_s = \frac{\Delta m_{B_s^0}}{\Gamma_{B_s^0}} = (m_{B^0_{sH}} - m_{B^0_{sL}})\, \tau_{B_s^0} \,,$$

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

$\Delta m_{B^0_s} = m_{B^0_{sH}} - m_{B^0_{sL}}$

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

"OUR EVALUATION" is an average of the data listed below performed by the LEP B Oscillation Working Group as described in our "Review of B-$\overline{B}$ Mixing" in the B^0 Section of these Listings. The averaging procedure takes into account correlations between the measurements.

VALUE (10^{12} $\hbar$ s^{-1})	CL%	DOCUMENT ID		TECN	COMMENT
>13.1 (CL = 95%) OUR EVALUATION					
$>$ 1.0	95	[62] ABBIENDI	01D	OPAL	$e^+e^- \rightarrow Z$
$>$ 7.4	95	[63] ABREU	00Y	DLPH	$e^+e^- \rightarrow Z$
$>$ 4.0	95	[64] ABREU,P	00G	DLPH	$e^+e^- \rightarrow Z$
$>$ 5.2	95	[65] ABBIENDI	99S	OPAL	$e^+e^- \rightarrow Z$
$>$ 5.8	95	[66] ABE	99J	CDF	$p\overline{p}$ at 1.8 TeV
$>$ 9.6	95	[67] BARATE	99J	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<$96	95	[68] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV
$>$ 7.9	95	[69] BARATE	98C	ALEP	Repl. by BARATE 99J
$>$ 3.1	95	[70] ACKERSTAFF	97U	OPAL	Repl. by ABBIENDI 99S
$>$ 2.2	95	[71] ACKERSTAFF	97V	OPAL	Repl. by ABBIENDI 99S
$>$ 6.5	95	[72] ADAM	97	DLPH	Repl. by ABREU 00Y
$>$ 6.6	95	[73] BUSKULIC	96M	ALEP	Repl. by BARATE 98C
$>$ 2.2	95	[71] AKERS	95J	OPAL	Sup. by ACKERSTAFF 97V
$>$ 5.7	95	[74] BUSKULIC	95J	ALEP	$e^+e^- \rightarrow Z$
$>$ 1.8	95	[71] BUSKULIC	94B	ALEP	$e^+e^- \rightarrow Z$

[62] Uses fully or partially reconstructed $D_s \ell$ vertices and a mixing tag as a flavor tagging.

[63] Uses $D_s^- \ell^+$, and $\phi \ell^+$ vertices, and a multi-variable discrimant as a flavor tagging.

[64] Uses inclusive D_s vertices and fully reconstructed B_s decays and a multi-variable discriminant as a flavor tagging.

[65] Uses ℓ-Q_{hem} and ℓ-ℓ.

[66] ABE 99J uses ϕ ℓ-ℓ correlation.

[67] BARATE 99J uses combination of an inclusive lepton and D_s^--based analyses.

[68] ABE 99D assumes $\tau_{B^0_s} = 1.55 \pm 0.05$ ps and $\Delta\Gamma/\Delta m = (5.6 \pm 2.6) \times 10^{-3}$.

[69] BARATE 98C combines results from $D_s h$-ℓ/Q_{hem}, $D_s h$-K in the same side, $D_s \ell$-ℓ/Q_{hem} and $D_s \ell$-K in the same side.

[70] Uses ℓ-Q_{hem}.

[71] Uses ℓ-ℓ.

[72] ADAM 97 combines results from $D_s \ell$-Q_{hem}, ℓ-Q_{hem}, and ℓ-ℓ.

[73] BUSKULIC 96M uses D_s lepton correlations and lepton, kaon, and jet charge tags.

[74] BUSKULIC 95J uses ℓ-Q_{hem}. They find $\Delta m_s > 5.6$ [> 6.1] for f_s=10% [12%]. We interpolate to our central value f_s=10.5%.

$x_s = \Delta m_{B_s^0}/\Gamma_{B_s^0}$

This is derived by the LEP B Oscillation Working Group from the results on $\Delta m_{B_s^0}$ and "OUR EVALUATION" of the B_s^0 mean lifetime.

VALUE	*CL%*	*DOCUMENT ID*
>19.0 (CL = 95%) OUR EVALUATION		

χ_s

This B_s^0-$\overline{B}_s^0$ integrated mixing parameter is derived from x_s above.

VALUE	*CL%*	*DOCUMENT ID*
>0.49862 (CL = 95%) OUR EVALUATION		

B_s^0 REFERENCES

ABBIENDI	01D	EPJ C19 241	G. Abbiendi *et al.*	(OPAL Collab.)
ABE	00C	PR D62 071101R	K. Abe *et al.*	(SLD Collab.)
ABREU	00Y	EPJ C16 555	P. Abreu *et al.*	(DELPHI Collab.)
ABREU,P	00G	EPJ C18 229	P. Abreu *et al.*	(DELPHI Collab.)
AFFOLDER	00N	PRL 85 4668	T. Affolder *et al.*	(CDF Collab.)
BARATE	00K	PL B486 286	R. Barate *et al.*	(ALEPH Collab.)
ABBIENDI	99S	EPJ C11 587	G. Abbiendi *et al.*	(OPAL Collab.)
ABE	99D	PR D59 032004	F. Abe *et al.*	(CDF Collab.)
ABE	99J	PRL 82 3576	F. Abe *et al.*	(CDF Collab.)
BARATE	99J	EPJ C7 553	R. Barate *et al.*	(ALEPH Collab.)
Also	00	EPJ C12 181 (erratum)	R. Barate *et al.*	(ALEPH Collab.)
ABE	98	PR D57 R3811	F. Abe *et al.*	(CDF Collab.)
ABE	98B	PR D57 5382	F. Abe *et al.*	(CDF Collab.)
ABE	98V	PRL 81 5742	F. Abe *et al.*	(CDF Collab.)
ACCIARRI	98S	PL B438 417	M. Acciarri *et al.*	(L3 Collab.)
ACKERSTAFF	98F	EPJ C2 407	K. Ackerstaff *et al.*	(OPAL Collab.)
ACKERSTAFF	98G	PL B426 161	K. Ackerstaff *et al.*	(OPAL Collab.)
BARATE	98C	EPJ C4 367	R. Barate *et al.*	(ALEPH Collab.)
BARATE	98Q	EPJ C4 387	R. Barate *et al.*	(ALEPH Collab.)
PDG	98	EPJ C3 1	C. Caso *et al.*	
ACCIARRI	97B	PL B391 474	M. Acciarri *et al.*	(L3 Collab.)
ACCIARRI	97C	PL B391 481	M. Acciarri *et al.*	(L3 Collab.)
ACKERSTAFF	97U	ZPHY C76 401	K. Ackerstaff *et al.*	(OPAL Collab.)
ACKERSTAFF	97V	ZPHY C76 417	K. Ackerstaff *et al.*	(OPAL Collab.)
ADAM	97	PL B414 382	W. Adam *et al.*	(DELPHI Collab.)
ABE	96B	PR D53 3496	F. Abe *et al.*	(CDF Collab.)
ABE	96L	PRL 76 4675	F. Abe *et al.*	(CDF Collab.)
ABE	96N	PRL 77 1945	F. Abe *et al.*	(CDF Collab.)
ABE	96Q	PR D54 6596	F. Abe *et al.*	(CDF Collab.)
ABREU	96F	ZPHY C71 11	P. Abreu *et al.*	(DELPHI Collab.)
ADAM	96D	ZPHY C72 207	W. Adam *et al.*	(DELPHI Collab.)
BUSKULIC	96E	ZPHY C69 585	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	96M	PL B377 205	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	96V	PL B384 471	D. Buskulic *et al.*	(ALEPH Collab.)
PDG	96	PR D54 1	R. M. Barnett *et al.*	
ABE	95R	PRL 74 4988	F. Abe *et al.*	(CDF Collab.)
ABE	95Z	PRL 75 3068	F. Abe *et al.*	(CDF Collab.)
ACCIARRI	95H	PL B363 127	M. Acciarri *et al.*	(L3 Collab.)
ACCIARRI	95I	PL B363 137	M. Acciarri *et al.*	(L3 Collab.)
AKERS	95G	PL B350 273	R. Akers *et al.*	(OPAL Collab.)
AKERS	95J	ZPHY C66 555	R. Akers *et al.*	(OPAL Collab.)
BUSKULIC	95J	PL B356 409	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	95O	PL B361 221	D. Buskulic *et al.*	(ALEPH Collab.)
ABREU	94D	PL B324 500	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	94E	ZPHY C61 407	P. Abreu *et al.*	(DELPHI Collab.)
Also	92M	PL B289 199	P. Abreu *et al.*	(DELPHI Collab.)

AKERS	94J	PL B337 196	R. Akers *et al.*	(OPAL Collab.)
AKERS	94L	PL B337 393	R. Akers *et al.*	(OPAL Collab.)
BUSKULIC	94B	PL B322 441	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	94C	PL B322 275	D. Buskulic *et al.*	(ALEPH Collab.)
PDG	94	PR D50 1173	L. Montanet *et al.*	(CERN, LBL, BOST+)
ABE	93F	PRL 71 1685	F. Abe *et al.*	(CDF Collab.)
ACTON	93H	PL B312 501	P.D. Acton *et al.*	(OPAL Collab.)
BUSKULIC	93G	PL B311 425	D. Buskulic *et al.*	(ALEPH Collab.)
ABREU	92M	PL B289 199	P. Abreu *et al.*	(DELPHI Collab.)
ACTON	92N	PL B295 357	P.D. Acton *et al.*	(OPAL Collab.)
BUSKULIC	92E	PL B294 145	D. Buskulic *et al.*	(ALEPH Collab.)
LEE-FRANZINI	90	PRL 65 2947	J. Lee-Franzini *et al.*	(CUSB II Collab.)