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	$e^+e^- \to Z$
5359 ±19 ±7	1	[1] AKERS	94J	OPAL	$e^+e^- \to Z$
5368.6± 5.6±1.5	2	BUSKULIC	93G	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
5370 ±40	6	[2] AKERS	94J	OPAL	$e^+e^- \to Z$
5383.3± 4.5±5.0	14	ABE	93F	CDF	Repl by ABE 96B

[1] From the decay $B_s \to J/\psi(1S)\phi$.

[2] From the decay $B_s \to D_s^- \pi^+$.

$m_{B_s^0} - m_B$

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	$e^+e^- \to \Upsilon(5S)$

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

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 Heavy Flavor Averaging Group (HFAG) 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					
$1.42\ ^{+0.14}_{-0.13}\ \pm0.03$		[3] ABREU	00Y	DLPH	$e^+e^- \to Z$
$1.53\ ^{+0.16}_{-0.15}\ \pm0.07$		[4] ABREU,P	00G	DLPH	$e^+e^- \to Z$
$1.36\ \pm0.09\ ^{+0.06}_{-0.05}$		[5] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV

$1.34\ ^{+0.23}_{-0.19}\ \pm 0.05$			[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	$e^+e^- \rightarrow Z$
$1.50\ ^{+0.16}_{-0.15}\ \pm 0.04$			[5] ACKERSTAFF	98G	OPAL	$e^+e^- \rightarrow Z$
$1.47\ \pm 0.14\ \pm 0.08$			[4] BARATE	98C	ALEP	$e^+e^- \rightarrow Z$
$1.60\ \pm 0.26\ ^{+0.13}_{-0.15}$			[8] ABREU	96F	DLPH	$e^+e^- \rightarrow Z$
$1.54\ ^{+0.14}_{-0.13}\ \pm 0.04$			[5] BUSKULIC	96M	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •						
$1.51\ \pm 0.11$			[9] BARATE	98C	ALEP	$e^+e^- \rightarrow Z$
$1.34\ ^{+0.23}_{-0.19}\ \pm 0.05$			[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
$1.65\ ^{+0.34}_{-0.31}\ \pm 0.12$			[4] ABREU	96F	DLPH	Repl. by ABREU 00Y
$1.76\ \pm 0.20\ ^{+0.15}_{-0.10}$			[11] ABREU	96F	DLPH	Repl. by ABREU 00Y
$1.67\ \pm 0.14$			[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
$1.42\ ^{+0.27}_{-0.23}\ \pm 0.11$		76	[5] ABE	95R	CDF	Repl. by ABE 99D
$1.74\ ^{+1.08}_{-0.69}\ \pm 0.07$		8	[13] ABE	95R	CDF	Sup. by ABE 96N
$1.54\ ^{+0.25}_{-0.21}\ \pm 0.06$		79	[5] AKERS	95G	OPAL	Repl. by ACKERSTAFF 98G
$1.59\ ^{+0.17}_{-0.15}\ \pm 0.03$		134	[5] BUSKULIC	95O	ALEP	Sup. by BUSKULIC 96M
$0.96\ \pm 0.37$		41	[14] ABREU	94E	DLPH	Sup. by ABREU 96F
$1.92\ ^{+0.45}_{-0.35}\ \pm 0.04$		31	[5] BUSKULIC	94C	ALEP	Sup. by BUSKULIC 95O
$1.13\ ^{+0.35}_{-0.26}\ \pm 0.09$		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	$e^+e^- \to Z$

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

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

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

The second "OUR EVALUATION," < 0.54 (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 Heavy Flavor Averaging Group (HFAG) as described in our "Review on B-$\overline{B}$ Mixing" in the B^0 Section of these Listings.

The first "OUR EVALUATION," < 0.29 (CL=95%), also provided by the HFAG, including the assumption of $\Gamma_s = \frac{1}{\tau_{B_d}}$.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.29 (CL = 95%) OUR NEW EVALUATION		First [<0.52 (CL = 95%) OUR 2002 EVALUATION]			
<0.54 (CL = 95%) OUR NEW EVALUATION		Second [<0.52 (CL = 95%) OUR 2002 EVALUATION]			
<0.46	95	[16] ABREU	00Y	DLPH	$e^+e^- \to Z$
<0.69	95	[17] ABREU,P	00G	DLPH	$e^+e^- \to Z$
$0.25^{+0.21}_{-0.14}$		[18] BARATE	00K	ALEP	$e^+e^- \to Z$
<0.83	95	[19] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV
<0.67	95	[20] ACCIARRI	98S	L3	$e^+e^- \to Z$

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

[17] Measured using D_s hadron vertices.

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

[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($\overline{b} \rightarrow B_s^0$), the LEP B_s^0 production fraction. The first four were evaluated using B($\overline{b} \rightarrow B_s^0$) = (10.7 ± 1.4)% and the rest assume B($\overline{b} \rightarrow B_s^0$) = 12%.

The branching fraction B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) is not a pure measurement since the measured product branching fraction B($\overline{b} \rightarrow B_s^0$) × B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) was used to determine B($\overline{b} \rightarrow B_s^0$), 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	$J/\psi(1S)\phi$		$(9.3 \pm 3.3) \times 10^{-4}$	
Γ_6	$J/\psi(1S)\pi^0$		$< 1.2 \times 10^{-3}$	90%
Γ_7	$J/\psi(1S)\eta$		$< 3.8 \times 10^{-3}$	90%
Γ_8	$\psi(2S)\phi$		seen	
Γ_9	$\pi^+\pi^-$		$< 1.7 \times 10^{-4}$	90%
Γ_{10}	$\pi^0\pi^0$		$< 2.1 \times 10^{-4}$	90%
Γ_{11}	$\eta\pi^0$		$< 1.0 \times 10^{-3}$	90%
Γ_{12}	$\eta\eta$		$< 1.5 \times 10^{-3}$	90%
Γ_{13}	$\rho^0\rho^0$		$< 3.20 \times 10^{-4}$	90%
Γ_{14}	$\phi\rho^0$		$< 6.17 \times 10^{-4}$	90%
Γ_{15}	$\phi\phi$		$< 1.183 \times 10^{-3}$	90%
Γ_{16}	π^+K^-		$< 2.1 \times 10^{-4}$	90%
Γ_{17}	K^+K^-		$< 5.9 \times 10^{-5}$	90%
Γ_{18}	$\overline{K}^*(892)^0\rho^0$		$< 7.67 \times 10^{-4}$	90%
Γ_{19}	$\overline{K}^*(892)^0 K^*(892)^0$		$< 1.681 \times 10^{-3}$	90%
Γ_{20}	$\phi K^*(892)^0$		$< 1.013 \times 10^{-3}$	90%
Γ_{21}	$p\overline{p}$		$< 5.9 \times 10^{-5}$	90%
Γ_{22}	$\gamma\gamma$		$< 1.48 \times 10^{-4}$	90%
Γ_{23}	$\phi\gamma$		$< 1.2 \times 10^{-4}$	90%

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

Γ_{24}	$\mu^+\mu^-$	$B1$		$< 2.0 \times 10^{-6}$	90%
Γ_{25}	e^+e^-	$B1$		$< 5.4 \times 10^{-5}$	90%
Γ_{26}	$e^\pm\mu^\mp$	LF	[b]	$< 6.1 \times 10^{-6}$	90%
Γ_{27}	$\phi(1020)\mu^+\mu^-$	$B1$		$< 4.7 \times 10^{-5}$	90%
Γ_{28}	$\phi\nu\overline{\nu}$	$B1$		$< 5.4 \times 10^{-3}$	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

$\Gamma(D_s^- \text{anything})/\Gamma_{total}$ — 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	$e^+e^- \to Z$
1.56±0.58±0.44	147	[22] ACTON	92N	OPAL	$e^+e^- \to Z$

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

[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 $B(\overline{b} \to B_s^0)B(B_s^0 \to D_s^- \text{anything}) \times B(D_s^- \to \phi\pi^-) = (5.9 \pm 1.9 \pm 1.1) \times 10^{-3}$. We evaluate using our current values $B(\overline{b} \to B_s^0) = 0.107 \pm 0.014$ and $B(D_s \to \phi\pi) = 0.036 \pm 0.009$. Our first error is their experiment's and our second error is that due to $B(\overline{b} \to B_s^0)$ and $B(D_s \to \phi\pi)$.

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

The values and averages in this section serve only to show what values result if one assumes our $B(\overline{b} \to B_s^0)$. They cannot be thought of as measurements since the underlying product branching fractions were also used to determinine $B(\overline{b} \to B_s^0)$ 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	$e^+e^- \to Z$
0.107±0.043±0.029		[24] ABREU	92M	DLPH	$e^+e^- \to Z$
0.103±0.036±0.028	18	[25] ACTON	92N	OPAL	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.13 ±0.04 ±0.04	27	[26] BUSKULIC	92E	ALEP	$e^+e^- \to Z$

[23] BUSKULIC 95O use $D_s\ell$ correlations. The measured product branching ratio is $B(\overline{b} \to B_s) \times B(B_s \to D_s^- \ell^+ \nu_\ell \text{anything}) = (0.82 \pm 0.09^{+0.13}_{-0.14})\%$ assuming $B(D_s \to \phi\pi) = (3.5 \pm 0.4) \times 10^{-2}$ 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 $B(\overline{b} \to B_s) = (11.0 \pm 1.2^{+2.5}_{-2.6})\%$. We evaluate using our current values $B(\overline{b} \to B_s^0) = 0.107 \pm 0.014$ and $B(D_s \to \phi\pi) = 0.036 \pm 0.009$. Our first error is their experiment's and our second error is that due to $B(\overline{b} \to B_s^0)$ and $B(D_s \to \phi\pi)$.

[24] ABREU 92M measured muons only and obtained product branching ratio B($Z \rightarrow b$ or $\overline{b}$) $\times$ B($\overline{b} \rightarrow B_s$) $\times$ B($B_s \rightarrow D_s \mu^+ \nu_\mu$ anything) $\times$ B($D_s \rightarrow \phi\pi$) = $(18 \pm 8) \times 10^{-5}$. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 $\pm$ 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 $\pm$ 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($D_s \rightarrow \phi\pi$). We use B($Z \rightarrow b$ or $\overline{b}$) = 2B($Z \rightarrow b\overline{b}$) = 2$\times$(0.2212 $\pm$ 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($\overline{b} \rightarrow B_s^0$)B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) $\times$B($D_s^- \rightarrow \phi\pi^-$) = $(3.9 \pm 1.1 \pm 0.8) \times 10^{-4}$. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 $\pm$ 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 $\pm$ 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($D_s \rightarrow \phi\pi$).

[26] BUSKULIC 92E is measured using $D_s \rightarrow \phi\pi^+$ and $K^*(892)^0 K^+$ events. They use 2.7 $\pm$ 0.7% for the $\phi\pi^+$ branching fraction. The average product branching fraction is measured to be B($\overline{b} \rightarrow B_s^0$)B($B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell$ anything) =0.020 $\pm$ 0.0055$^{+0.005}_{-0.006}$. We evaluate using our current values B($\overline{b} \rightarrow B_s^0$) = 0.107 $\pm$ 0.014 and B($D_s \rightarrow \phi\pi$) = 0.036 $\pm$ 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($D_s \rightarrow \phi\pi$). 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 $\leq$ 6 events and measures the limit on the product branching fraction $f(\overline{b} \rightarrow B_s^0)$·B($B_s^0 \rightarrow D_s^- \pi^+$) < 1.3% at CL = 90%. We divide by our current value B($\overline{b} \rightarrow B_s^0$) = 0.105.

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
0.23 $\pm$0.10$^{+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 $B_s^0 \rightarrow D_s^{(*)+} D_s^{(*)-}$.

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

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.93$\pm$0.28$\pm$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 $f(\overline{b} \rightarrow B_s^0)\cdot B(B_s^0 \rightarrow J/\psi(1S)\phi) < 7 \times 10^{-4}$ at CL = 90%. We divide by $B(\overline{b} \rightarrow B_s^0) = 0.112$.

[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 $f(\overline{b} \rightarrow B_s^0)\cdot B(B_s^0 \rightarrow J/\psi(1S)\phi) \leq 0.22 \times 10^{-2}$.

$\Gamma(J/\psi(1S)\pi^0)/\Gamma_{total}$ — 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 ± 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 ± 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 ± 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 ± 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 ± 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
$<7.67 \times 10^{-4}$	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
$<16.81 \times 10^{-4}$	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
$<10.13 \times 10^{-4}$	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
$<5.9 \times 10^{-5}$	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
$<14.8 \times 10^{-5}$	90	[53] ACCIARRI	95I	L3	$e^+ e^- \rightarrow Z$

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

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<1.2 \times 10^{-4}$ (CL = 90%)	[$<7 \times 10^{-4}$ (CL = 90%) OUR 2002 BEST LIMIT]				
$<1.2 \times 10^{-4}$	90	ACOSTA	02G	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<7 \times 10^{-4}$	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
$<2.0 \times 10^{-6}$	90	[55] ABE	98	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.8 \times 10^{-5}$	90	[56] ACCIARRI	97B	L3	$e^+ e^- \rightarrow Z$
$<8.4 \times 10^{-6}$	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.

$\Gamma(\phi(1020)\mu^+ \mu^-)/\Gamma_{total}$ — Γ_{27}/Γ

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

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
$<4.7 \times 10^{-5}$	90	ACOSTA	02D	CDF	$p\overline{p}$ at 1.8 TeV

$\Gamma(\phi \nu \overline{\nu})/\Gamma_{total}$ — Γ_{28}/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^0_s-$\overline{B}^0_s$ MIXING

For a discussion of B^0_s-$\overline{B}^0_s$ 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^0_s-$\overline{B}^0_s$ mixing probability that produced $B^0_s(\overline{B}^0_s)$ decays as a $\overline{B}^0_s(B^0_s)$. Mixing violates $\Delta B \neq 2$ rule.

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

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

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

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

$\Delta m_{B^0_s}$ 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 Heavy Flavor Averaging Group (HFAG) 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
>14.1 (CL = 95%) OUR NEW EVALUATION [>13.1 × 10^{12} $\hbar$ s^{-1} (CL = 95%) OUR 2002 EVALUATION]					
> 5.0	95	[62] ABDALLAH	03B	DLPH	$e^+e^- \to Z$
>10.3	95	[63] ABE	03	SLD	$e^+e^- \to Z$
> 5.3	95	[64] ABE	02V	SLD	$e^+e^- \to Z$
> 1.0	95	[65] ABBIENDI	01D	OPAL	$e^+e^- \to Z$
> 7.4	95	[66] ABREU	00Y	DLPH	$e^+e^- \to Z$
> 4.0	95	[67] ABREU,P	00G	DLPH	$e^+e^- \to Z$
> 5.2	95	[68] ABBIENDI	99S	OPAL	$e^+e^- \to Z$
> 5.8	95	[69] ABE	99J	CDF	$p\overline{p}$ at 1.8 TeV
> 9.6	95	[70] BARATE	99J	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<96	95	[71] ABE	99D	CDF	$p\overline{p}$ at 1.8 TeV
> 7.9	95	[72] BARATE	98C	ALEP	Repl. by BARATE 99J
> 3.1	95	[73] ACKERSTAFF	97U	OPAL	Repl. by ABBIENDI 99S
> 2.2	95	[74] ACKERSTAFF	97V	OPAL	Repl. by ABBIENDI 99S
> 6.5	95	[75] ADAM	97	DLPH	Repl. by ABREU 00Y
> 6.6	95	[76] BUSKULIC	96M	ALEP	Repl. by BARATE 98C
> 2.2	95	[74] AKERS	95J	OPAL	Sup. by ACKERSTAFF 97V
> 5.7	95	[77] BUSKULIC	95J	ALEP	$e^+e^- \to Z$
> 1.8	95	[74] BUSKULIC	94B	ALEP	$e^+e^- \to Z$

[62] Events with a high transverse momentum lepton were removed and an inclusively reconstructed vertex was required.

[63] ABE 03 uses the novel "charge dipole" technique to reconstruct separate secondary and tertiary vertices originating from the $B \rightarrow D$ decay chain. The analysis excludes Δm_s <4.9 ps^{-1} and 7.9< Δm_s <10.3 ps^{-1}.

[64] ABE 02V uses exclusively reconstructed D_s^- mesons and excludes Δm_s <1.4 ps^{-1} and 2.4< Δm_s <5.3 ps^{-1} at 95%CL.

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

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

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

[68] Uses ℓ-$Q_{\rm hem}$ and ℓ-ℓ.

[69] ABE 99J uses ϕ ℓ-ℓ correlation.

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

[71] ABE 99D assumes $\tau_{B_s^0}$= 1.55 ± 0.05 ps and $\Delta\Gamma/\Delta m$= (5.6 ± 2.6) × 10^{-3}.

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

[73] Uses ℓ-$Q_{\rm hem}$.

[74] Uses ℓ-ℓ.

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

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

[77] BUSKULIC 95J uses ℓ-$Q_{\rm hem}$. They find Δm_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 Heavy Flavor Averaging Group (HFAG) from the results on $\Delta m_{B_s^0}$ and "OUR EVALUATION" of the B_s^0 mean lifetime.

VALUE	CL%	DOCUMENT ID
>20.0 (CL = 95%) OUR NEW EVALUATION		[>19.0 (CL = 95%) OUR 2002 EVALUATION]

χ_s

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

VALUE	CL%	DOCUMENT ID
>0.49876 (CL = 95%) OUR NEW EVALUATION		[>0.49862 (CL = 95%) OUR 2002 EVALUATION]

B_s^0 REFERENCES

ABDALLAH 03B EPJ C (to be publ.) J. Abdallah et al. (DELPHI Collab.)
CERN-EP-2002-078, hep-ex/0303032
ABE 03 PR D67 012006 K. Abe et al. (SLD Collab.)
ABE 02V PR D66 032009 K. Abe et al. (SLD Collab.)
ACOSTA 02D PR D65 111101R D. Acosta et al. (CDF Collab.)
ACOSTA 02G PR D66 112002 D. Acosta et al. (CDF Collab.)
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.)