



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

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	$p\bar{p}$ 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	$p\bar{p}$ at 1.8 TeV
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
80 to 130	68	LEE-FRANZINI90	CSB2	$e^+e^- \rightarrow \Upsilon(5S)$

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

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

B_s^0 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 (HFAG) and are described at <http://www.slac.stanford.edu/xorg/hfag/>. The averaging/rescaling procedure takes into account corrections between the measurements and asymmetric lifetime errors.

<u>VALUE (10^{-12} s)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1.461 ± 0.057 OUR EVALUATION				
1.42 $\begin{smallmatrix} +0.14 \\ -0.13 \end{smallmatrix}$ ± 0.03		³ ABREU	00Y DLPH	$e^+ e^- \rightarrow Z$
1.53 $\begin{smallmatrix} +0.16 \\ -0.15 \end{smallmatrix}$ ± 0.07		⁴ ABREU,P	00G DLPH	$e^+ e^- \rightarrow Z$
1.36 ± 0.09 $\begin{smallmatrix} +0.06 \\ -0.05 \end{smallmatrix}$		⁵ ABE	99D CDF	$p\bar{p}$ at 1.8 TeV
1.34 $\begin{smallmatrix} +0.23 \\ -0.19 \end{smallmatrix}$ ± 0.05		⁶ ABE	98B CDF	$p\bar{p}$ at 1.8 TeV
1.72 $\begin{smallmatrix} +0.20 \\ -0.19 \end{smallmatrix}$ $\begin{smallmatrix} +0.18 \\ -0.17 \end{smallmatrix}$		⁷ ACKERSTAFF	98F OPAL	$e^+ e^- \rightarrow Z$
1.50 $\begin{smallmatrix} +0.16 \\ -0.15 \end{smallmatrix}$ ± 0.04		⁵ ACKERSTAFF	98G OPAL	$e^+ e^- \rightarrow Z$
1.47 ± 0.14 ± 0.08		⁴ BARATE	98C ALEP	$e^+ e^- \rightarrow Z$
1.60 ± 0.26 $\begin{smallmatrix} +0.13 \\ -0.15 \end{smallmatrix}$		⁸ ABREU	96F DLPH	$e^+ e^- \rightarrow Z$
1.54 $\begin{smallmatrix} +0.14 \\ -0.13 \end{smallmatrix}$ ± 0.04		⁵ BUSKULIC	96M ALEP	$e^+ e^- \rightarrow Z$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
1.51 ± 0.11		⁹ BARATE	98C ALEP	$e^+ e^- \rightarrow Z$
1.34 $\begin{smallmatrix} +0.23 \\ -0.19 \end{smallmatrix}$ ± 0.05		¹⁰ ABE	96N CDF	Repl. by ABE 98B
1.56 $\begin{smallmatrix} +0.29 \\ -0.26 \end{smallmatrix}$ $\begin{smallmatrix} +0.08 \\ -0.07 \end{smallmatrix}$		⁵ ABREU	96F DLPH	Repl. by ABREU 00Y
1.65 $\begin{smallmatrix} +0.34 \\ -0.31 \end{smallmatrix}$ ± 0.12		⁴ ABREU	96F DLPH	Repl. by ABREU 00Y
1.76 ± 0.20 $\begin{smallmatrix} +0.15 \\ -0.10 \end{smallmatrix}$		¹¹ ABREU	96F DLPH	Repl. by ABREU 00Y
1.67 ± 0.14		¹² ABREU	96F DLPH	$e^+ e^- \rightarrow Z$
1.61 $\begin{smallmatrix} +0.30 \\ -0.29 \end{smallmatrix}$ $\begin{smallmatrix} +0.18 \\ -0.16 \end{smallmatrix}$	90	⁴ BUSKULIC	96E ALEP	Repl. by BARATE 98C
1.42 $\begin{smallmatrix} +0.27 \\ -0.23 \end{smallmatrix}$ ± 0.11	76	⁵ ABE	95R CDF	Repl. by ABE 99D
1.74 $\begin{smallmatrix} +1.08 \\ -0.69 \end{smallmatrix}$ ± 0.07	8	¹³ ABE	95R CDF	Sup. by ABE 96N
1.54 $\begin{smallmatrix} +0.25 \\ -0.21 \end{smallmatrix}$ ± 0.06	79	⁵ AKERS	95G OPAL	Repl. by ACKERSTAFF 98G
1.59 $\begin{smallmatrix} +0.17 \\ -0.15 \end{smallmatrix}$ ± 0.03	134	⁵ BUSKULIC	95O ALEP	Sup. by BUSKULIC 96M
0.96 ± 0.37	41	¹⁴ ABREU	94E DLPH	Sup. by ABREU 96F
1.92 $\begin{smallmatrix} +0.45 \\ -0.35 \end{smallmatrix}$ ± 0.04	31	⁵ BUSKULIC	94C ALEP	Sup. by BUSKULIC 95O
1.13 $\begin{smallmatrix} +0.35 \\ -0.26 \end{smallmatrix}$ ± 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_{sL}^0 MEAN LIFE

B_{sL}^0 is a long-lived CP -even state of two B_s^0 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 $B_s^0 \rightarrow D_s^{(*)+} D_s^{(*)-}$.			

$|\Delta\Gamma_{B_s^0}|/\Gamma_{B_s^0}$

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

The second "OUR EVALUATION," < 0.54 (CL=95%), is an average of all available B_s semi-leptonic lifetime measurements with the $\Delta\Gamma_{B_s^0}/\Gamma_{B_s^0}$ analyses performed by the Heavy Flavor Averaging Group (HFAG) as described in our "Review on B - \bar{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 EVALUATION		First		
<0.54 (CL = 95%) OUR EVALUATION		Second		
<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	$p\bar{p}$ 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 $B_s^0 \rightarrow D_s^{(*)+} D_s^{(*)-}$.

¹⁹ ABE 99D assumes $\tau_{B_s^0} = 1.55 \pm 0.05$ ps.

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

B_s^0 DECAY MODES

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

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

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

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 $D_s^- \text{ anything}$	(94 \pm 30) %	
Γ_2 $D_s^- \ell^+ \nu_\ell \text{ anything}$	[a] (7.9 \pm 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} $\pi^+ K^-$	< 2.1 $\times 10^{-4}$	90%
Γ_{17} $K^+ K^-$	< 5.9 $\times 10^{-5}$	90%
Γ_{18} $\bar{K}^*(892)^0 \rho^0$	< 7.67 $\times 10^{-4}$	90%
Γ_{19} $\bar{K}^*(892)^0 K^*(892)^0$	< 1.681 $\times 10^{-3}$	90%
Γ_{20} $\phi K^*(892)^0$	< 1.013 $\times 10^{-3}$	90%
Γ_{21} $\rho \bar{\rho}$	< 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}	$\mu^+ \mu^-$	<i>B1</i>	< 2.0	$\times 10^{-6}$	90%
Γ_{25}	$e^+ e^-$	<i>B1</i>	< 5.4	$\times 10^{-5}$	90%
Γ_{26}	$e^\pm \mu^\mp$	<i>LF</i>	[<i>b</i>] < 6.1	$\times 10^{-6}$	90%
Γ_{27}	$\phi(1020)\mu^+ \mu^-$	<i>B1</i>	< 4.7	$\times 10^{-5}$	90%
Γ_{28}	$\phi\nu\bar{\nu}$	<i>B1</i>	< 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

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

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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 $c\bar{c}$ and $b\bar{b}$ sources of D_s^+ mesons using a lifetime tag, subtract generic $\bar{b} \rightarrow W^+ \rightarrow D_s^+$ events, and obtain $B(\bar{b} \rightarrow B_s^0) \times B(B_s^0 \rightarrow D_s^- \text{ anything}) = 0.088 \pm 0.020 \pm 0.020$ assuming $B(D_s^- \rightarrow \phi\pi) = (3.5 \pm 0.4) \times 10^{-2}$ and PDG 1994 values for the relative partial widths to other D_s channels. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ and $B(D_s^- \rightarrow \phi\pi)$.

²² ACTON 92N assume that excess of $147 \pm 48 D_s^0$ events over that expected from B^0 , B^+ , and $c\bar{c}$ is all from B_s^0 decay. The product branching fraction is measured to be $B(\bar{b} \rightarrow B_s^0)B(B_s^0 \rightarrow D_s^- \text{ anything}) \times B(D_s^- \rightarrow \phi\pi^-) = (5.9 \pm 1.9 \pm 1.1) \times 10^{-3}$. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ 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 $B(\bar{b} \rightarrow B_s^0)$. They cannot be thought of as measurements since the underlying product branching fractions were also used to determine $B(\bar{b} \rightarrow B_s^0)$ as described in the note on "Production and Decay of *b*-Flavored Hadrons."

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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 950 use $D_s \ell$ correlations. The measured product branching ratio is $B(\bar{b} \rightarrow B_s) \times B(B_s \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything}) = (0.82 \pm 0.09_{-0.14}^{+0.13})\%$ assuming $B(D_s \rightarrow \phi\pi) = (3.5 \pm 0.4) \times 10^{-2}$ 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 $B(\bar{b} \rightarrow B_s) = (11.0 \pm 1.2_{-2.6}^{+2.5})\%$. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ and $B(D_s \rightarrow \phi\pi)$.
- ²⁴ ABREU 92M measured muons only and obtained product branching ratio $B(Z \rightarrow b \text{ or } \bar{b}) \times B(\bar{b} \rightarrow B_s) \times B(B_s \rightarrow D_s \mu^+ \nu_\mu \text{ anything}) \times B(D_s \rightarrow \phi\pi) = (18 \pm 8) \times 10^{-5}$. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ and $B(D_s \rightarrow \phi\pi)$. We use $B(Z \rightarrow b \text{ or } \bar{b}) = 2B(Z \rightarrow b\bar{b}) = 2 \times (0.2212 \pm 0.0019)$.
- 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 $B(\bar{b} \rightarrow B_s^0)B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything}) \times B(D_s^- \rightarrow \phi\pi^-) = (3.9 \pm 1.1 \pm 0.8) \times 10^{-4}$. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ 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 $B(\bar{b} \rightarrow B_s^0)B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything}) = 0.020 \pm 0.0055_{-0.006}^{+0.005}$. We evaluate using our current values $B(\bar{b} \rightarrow B_s^0) = 0.107 \pm 0.014$ 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 $B(\bar{b} \rightarrow B_s^0)$ and $B(D_s \rightarrow \phi\pi)$. Superseded by BUSKULIC 950.

$\Gamma(D_s^- \pi^+)/\Gamma_{\text{total}}$

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 $f(\bar{b} \rightarrow B_s^0) \cdot B(B_s^0 \rightarrow D_s^- \pi^+) < 1.3\%$ at CL = 90%. We divide by our current value $B(\bar{b} \rightarrow B_s^0) = 0.105$.

$\Gamma(D_s^{(*)+} D_s^{(*)-})/\Gamma_{\text{total}}$

Γ_4/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$0.23 \pm 0.10_{-0.09}^{+0.19}$		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 $B_s^0 \rightarrow D_s^{(*)+} D_s^{(*)-}$.

$\Gamma(J/\psi(1S)\phi)/\Gamma_{\text{total}}$

Γ_5/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
$0.93 \pm 0.28 \pm 0.17$		29 ABE	96Q CDF	$p\bar{p}$

• • • 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	$p\bar{p}$ 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 $f(\bar{b} \rightarrow B_s^0) \cdot B(B_s^0 \rightarrow J/\psi(1S)\phi) < 7 \times 10^{-4}$ at CL = 90%. We divide by $B(\bar{b} \rightarrow B_s^0) = 0.112$.

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

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

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 ($39.5 \pm 4.0\%$) and B_s ($12.0 \pm 3.0\%$).

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

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 ($39.5 \pm 4.0\%$) and B_s ($12.0 \pm 3.0\%$).

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

Γ_8/Γ

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

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

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	$e^+e^- \rightarrow Z$
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³⁵ BUSKULIC 96V assumes PDG 96 production fractions for B^0 , B^+ , B_s , b baryons.

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

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$

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 $f_{B_s} = 12.0 \pm 3.0\%$.

$\Gamma(\eta\pi^0)/\Gamma_{\text{total}}$ 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 $f_{B_s} = 12.0 \pm 3.0\%$.

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

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

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

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

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

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

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

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

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

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

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

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

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<2.1 \times 10^{-4}$	90	43 BUSKULIC	96V ALEP	$e^+ e^- \rightarrow Z$

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

$<2.61 \times 10^{-4}$	90	44 ABE	00C SLD	$e^+ e^- \rightarrow Z$
$<2.6 \times 10^{-4}$	90	45 AKERS	94L OPAL	$e^+ e^- \rightarrow Z$

⁴³ BUSKULIC 96V assumes PDG 96 production fractions for B^0 , B^+ , B_s , b baryons.
⁴⁴ ABE 00C assumes $B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\%$ 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 $B(Z \rightarrow b\bar{b}) = 0.217$ and B_d^0 (B_s^0) fraction 39.5% (12%).

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<5.9 \times 10^{-5}$	90	46 BUSKULIC	96V ALEP	$e^+ e^- \rightarrow Z$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$<2.83 \times 10^{-4}$	90	47 ABE	00C SLD	$e^+ e^- \rightarrow Z$
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$<1.4 \times 10^{-4}$	90	48 AKERS	94L OPAL	$e^+ e^- \rightarrow Z$
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46 BUSKULIC 96V assumes PDG 96 production fractions for B^0 , B^+ , B_s , b baryons.

47 ABE 00C assumes $B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\%$ 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 $B(Z \rightarrow b\bar{b}) = 0.217$ and B_d^0 (B_s^0) fraction 39.5% (12%).

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<7.67 \times 10^{-4}$	90	49 ABE	00C SLD	$e^+ e^- \rightarrow Z$
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49 ABE 00C assumes $B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\%$ and the B fractions $f_{B^0} = f_{B^+} = (39.7^{+1.8}_{-2.2})\%$ and $f_{B_s} = (10.5^{+1.8}_{-2.2})\%$.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<16.81 \times 10^{-4}$	90	50 ABE	00C SLD	$e^+ e^- \rightarrow Z$
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50 ABE 00C assumes $B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\%$ and the B fractions $f_{B^0} = f_{B^+} = (39.7^{+1.8}_{-2.2})\%$ and $f_{B_s} = (10.5^{+1.8}_{-2.2})\%$.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<10.13 \times 10^{-4}$	90	51 ABE	00C SLD	$e^+ e^- \rightarrow Z$
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51 ABE 00C assumes $B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\%$ and the B fractions $f_{B^0} = f_{B^+} = (39.7^{+1.8}_{-2.2})\%$ and $f_{B_s} = (10.5^{+1.8}_{-2.2})\%$.

$\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$ Γ_{21}/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<5.9 \times 10^{-5}$	90	52 BUSKULIC	96V ALEP	$e^+ e^- \rightarrow Z$
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52 BUSKULIC 96V assumes PDG 96 production fractions for B^0 , B^+ , B_s , b baryons.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<14.8 \times 10^{-5}$	90	53 ACCIARRI	95I L3	$e^+ e^- \rightarrow Z$
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53 ACCIARRI 95I assumes $f_{B^0} = 39.5 \pm 4.0$ and $f_{B_s} = 12.0 \pm 3.0\%$.

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

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<1.2 \times 10^{-4}$	90	ACOSTA	02G CDF	$\rho\bar{\rho}$ at 1.8 TeV
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• • • We do not use the following data for averages, fits, limits, etc. • • •

$<7 \times 10^{-4}$	90	54 ADAM	96D DLPH	$e^+ e^- \rightarrow Z$
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54 ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.

$\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}}$ **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	$p\bar{p}$ 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 $\sigma(B^0, p_T(B) > 6, |y| < 1.0) = 2.39 \pm 0.32 \pm 0.44 \mu\text{b}$.

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 $\sigma(B^+, p_T(B) > 6 \text{ GeV}/c, |y| < 1) = 2.39 \pm 0.54 \mu\text{b}$.

$\Gamma(e^+ e^-)/\Gamma_{\text{total}}$ **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	$e^+ e^- \rightarrow Z$

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

$\Gamma(e^\pm \mu^\mp)/\Gamma_{\text{total}}$ **Γ_{26}/Γ**
 Test of lepton family number conservation.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
$<6.1 \times 10^{-6}$	90	ABE	98V CDF	$p\bar{p}$ 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	$e^+ e^- \rightarrow Z$
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⁵⁹ ACCIARRI 97B assume PDG 96 production fractions for B^+ , B^0 , B_s , and Λ_b .

$\Gamma(\phi(1020)\mu^+ \mu^-)/\Gamma_{\text{total}}$ **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	$p\bar{p}$ at 1.8 TeV

$\Gamma(\phi\nu\bar{\nu})/\Gamma_{\text{total}}$ **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	$e^+ e^- \rightarrow Z$

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 $B_s^0 \rightarrow J/\psi(1S)\phi$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.59 ± 0.12 OUR AVERAGE				
$0.61 \pm 0.14 \pm 0.02$		⁶¹ AFFOLDER	00N CDF	$p\bar{p}$ at 1.8 TeV
$0.56 \pm 0.21^{+0.02}_{-0.04}$	19	ABE	95Z CDF	$p\bar{p}$ 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 $0.23 \pm 0.19 \pm 0.04$.

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

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

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

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

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

where H, L stand for heavy and light states of two B_s^0 CP eigenstates and

$$\tau_{B_s^0} = \frac{1}{0.5(\Gamma_{B_{sH}^0} + \Gamma_{B_{sL}^0})}.$$

$$\Delta m_{B_s^0} = m_{B_{sH}^0} - m_{B_{sL}^0}$$

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

“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 (HFAG) and are described at <http://www.slac.stanford.edu/xorg/hfag/>. The averaging/rescaling procedure takes into account corrections between the measurements.

VALUE ($10^{12} \text{ } \hbar \text{ s}^{-1}$)	CL%	DOCUMENT ID	TECN	COMMENT
>14.4 (CL = 95%) OUR EVALUATION				
> 5.0	95	62 ABDALLAH	03B DLPH	$e^+ e^- \rightarrow Z$
>10.3	95	63 ABE	03 SLD	$e^+ e^- \rightarrow Z$
>10.9	95	64 HEISTER	03E ALEP	$e^+ e^- \rightarrow Z$
> 5.3	95	65 ABE	02V SLD	$e^+ e^- \rightarrow Z$
> 1.0	95	66 ABBIENDI	01D OPAL	$e^+ e^- \rightarrow Z$
> 7.4	95	67 ABREU	00Y DLPH	$e^+ e^- \rightarrow Z$
> 4.0	95	68 ABREU,P	00G DLPH	$e^+ e^- \rightarrow Z$
> 5.2	95	69 ABBIENDI	99S OPAL	$e^+ e^- \rightarrow Z$
> 5.8	95	70 ABE	99J CDF	$p\bar{p}$ at 1.8 TeV
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
<96	95	71 ABE	99D CDF	$p\bar{p}$ at 1.8 TeV
> 9.6	95	72 BARATE	99J ALEP	$e^+ e^- \rightarrow Z$
> 7.9	95	73 BARATE	98C ALEP	Repl. by BARATE 99J
> 3.1	95	74 ACKERSTAFF	97U OPAL	Repl. by ABBIENDI 99S
> 2.2	95	75 ACKERSTAFF	97V OPAL	Repl. by ABBIENDI 99S
> 6.5	95	76 ADAM	97 DLPH	Repl. by ABREU 00Y
> 6.6	95	77 BUSKULIC	96M ALEP	Repl. by BARATE 98C
> 2.2	95	75 AKERS	95J OPAL	Sup. by ACKER-STAFF 97V
> 5.7	95	78 BUSKULIC	95J ALEP	$e^+ e^- \rightarrow Z$
> 1.8	95	75 BUSKULIC	94B ALEP	$e^+ e^- \rightarrow Z$

- 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 $\Delta m_s < 4.9 \text{ ps}^{-1}$ and $7.9 < \Delta m_s < 10.3 \text{ ps}^{-1}$.
- 64 Three analyses based on complementary event selections: (1) fully-reconstructed hadronic decays; (2) semileptonic decays with D_s exclusively reconstructed; (3) inclusive semileptonic decays.
- 65 ABE 02V uses exclusively reconstructed D_s^- mesons and excludes $\Delta m_s < 1.4 \text{ ps}^{-1}$ and $2.4 < \Delta m_s < 5.3 \text{ ps}^{-1}$ at 95%CL.
- 66 Uses fully or partially reconstructed $D_s \ell$ vertices and a mixing tag as a flavor tagging.
- 67 Uses $D_s^- \ell^+$, and $\phi \ell^+$ vertices, and a multi-variable discriminant as a flavor tagging.
- 68 Uses inclusive D_s vertices and fully reconstructed B_s decays and a multi-variable discriminant as a flavor tagging.
- 69 Uses $l-Q_{\text{hem}}$ and $l-l$.
- 70 ABE 99J uses ϕ $l-l$ correlation.
- 71 ABE 99D assumes $\tau_{B_s^0} = 1.55 \pm 0.05 \text{ ps}$ and $\Delta\Gamma/\Delta m = (5.6 \pm 2.6) \times 10^{-3}$.
- 72 BARATE 99J uses combination of an inclusive lepton and D_s^- -based analyses.
- 73 BARATE 98C combines results from $D_s h-l/Q_{\text{hem}}$, $D_s h-K$ in the same side, $D_s l-l/Q_{\text{hem}}$ and $D_s l-K$ in the same side.
- 74 Uses $l-Q_{\text{hem}}$.
- 75 Uses $l-l$.
- 76 ADAM 97 combines results from $D_s l-Q_{\text{hem}}$, $l-Q_{\text{hem}}$, and $l-l$.
- 77 BUSKULIC 96M uses D_s lepton correlations and lepton, kaon, and jet charge tags.
- 78 BUSKULIC 95J uses $l-Q_{\text{hem}}$. 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 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 _____
>20.6 (CL = 95%) OUR EVALUATION

χ_s

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

VALUE _____ CL% _____ DOCUMENT ID _____
>0.49883 (CL = 95%) OUR EVALUATION

B_s^0 REFERENCES

ABDALLAH	03B	EPJ C28 155	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
ABE	03	PR D67 012006	K. Abe <i>et al.</i>	(SLD Collab.)
HEISTER	03E	EPJ C29 143	A. Heister <i>et al.</i>	(ALEPH Collab.)
ABE	02V	PR D66 032009	K. Abe <i>et al.</i>	(SLD Collab.)
ACOSTA	02D	PR D65 111101R	D. Acosta <i>et al.</i>	(CDF Collab.)
ACOSTA	02G	PR D66 112002	D. Acosta <i>et al.</i>	(CDF Collab.)
ABBIENDI	01D	EPJ C19 241	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABE	00C	PR D62 071101R	K. Abe <i>et al.</i>	(SLD Collab.)
ABREU	00Y	EPJ C16 555	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ABREU,P	00G	EPJ C18 229	P. Abreu <i>et al.</i>	(DELPHI Collab.)
AFFOLDER	00N	PRL 85 4668	T. Affolder <i>et al.</i>	(CDF Collab.)
BARATE	00K	PL B486 286	R. Barate <i>et al.</i>	(ALEPH Collab.)
ABBIENDI	99S	EPJ C11 587	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABE	99D	PR D59 032004	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	99J	PRL 82 3576	F. Abe <i>et al.</i>	(CDF Collab.)
BARATE	99J	EPJ C7 553	R. Barate <i>et al.</i>	(ALEPH Collab.)
Also	00	EPJ C12 181 (erratum)	R. Barate <i>et al.</i>	(ALEPH Collab.)
ABE	98	PR D57 R3811	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	98B	PR D57 5382	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	98V	PRL 81 5742	F. Abe <i>et al.</i>	(CDF Collab.)
ACCIARRI	98S	PL B438 417	M. Acciari <i>et al.</i>	(L3 Collab.)
ACKERSTAFF	98F	EPJ C2 407	K. Ackerstaff <i>et al.</i>	(OPAL Collab.)
ACKERSTAFF	98G	PL B426 161	K. Ackerstaff <i>et al.</i>	(OPAL Collab.)
BARATE	98C	EPJ C4 367	R. Barate <i>et al.</i>	(ALEPH Collab.)
BARATE	98Q	EPJ C4 387	R. Barate <i>et al.</i>	(ALEPH Collab.)
PDG	98	EPJ C3 1	C. Caso <i>et al.</i>	
ACCIARRI	97B	PL B391 474	M. Acciari <i>et al.</i>	(L3 Collab.)
ACCIARRI	97C	PL B391 481	M. Acciari <i>et al.</i>	(L3 Collab.)
ACKERSTAFF	97U	ZPHY C76 401	K. Ackerstaff <i>et al.</i>	(OPAL Collab.)
ACKERSTAFF	97V	ZPHY C76 417	K. Ackerstaff <i>et al.</i>	(OPAL Collab.)
ADAM	97	PL B414 382	W. Adam <i>et al.</i>	(DELPHI Collab.)
ABE	96B	PR D53 3496	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	96L	PRL 76 4675	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	96N	PRL 77 1945	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	96Q	PR D54 6596	F. Abe <i>et al.</i>	(CDF Collab.)
ABREU	96F	ZPHY C71 11	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ADAM	96D	ZPHY C72 207	W. Adam <i>et al.</i>	(DELPHI Collab.)
BUSKULIC	96E	ZPHY C69 585	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
BUSKULIC	96M	PL B377 205	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
BUSKULIC	96V	PL B384 471	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
PDG	96	PR D54 1	R. M. Barnett <i>et al.</i>	
ABE	95R	PRL 74 4988	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	95Z	PRL 75 3068	F. Abe <i>et al.</i>	(CDF Collab.)
ACCIARRI	95H	PL B363 127	M. Acciari <i>et al.</i>	(L3 Collab.)
ACCIARRI	95I	PL B363 137	M. Acciari <i>et al.</i>	(L3 Collab.)
AKERS	95G	PL B350 273	R. Akers <i>et al.</i>	(OPAL Collab.)
AKERS	95J	ZPHY C66 555	R. Akers <i>et al.</i>	(OPAL Collab.)
BUSKULIC	95J	PL B356 409	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
BUSKULIC	95O	PL B361 221	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
ABREU	94D	PL B324 500	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ABREU	94E	ZPHY C61 407	P. Abreu <i>et al.</i>	(DELPHI Collab.)
Also	92M	PL B289 199	P. Abreu <i>et al.</i>	(DELPHI Collab.)
AKERS	94J	PL B337 196	R. Akers <i>et al.</i>	(OPAL Collab.)
AKERS	94L	PL B337 393	R. Akers <i>et al.</i>	(OPAL Collab.)
BUSKULIC	94B	PL B322 441	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
BUSKULIC	94C	PL B322 275	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
PDG	94	PR D50 1173	L. Montanet <i>et al.</i>	(CERN, LBL, BOST+)
ABE	93F	PRL 71 1685	F. Abe <i>et al.</i>	(CDF Collab.)
ACTON	93H	PL B312 501	P.D. Acton <i>et al.</i>	(OPAL Collab.)
BUSKULIC	93G	PL B311 425	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
ABREU	92M	PL B289 199	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ACTON	92N	PL B295 357	P.D. Acton <i>et al.</i>	(OPAL Collab.)
BUSKULIC	92E	PL B294 145	D. Buskalic <i>et al.</i>	(ALEPH Collab.)
LEE-FRANZINI	90	PRL 65 2947	J. Lee-Franzini <i>et al.</i>	(CUSB II Collab.)