\[ I(J^P) = 0(0^-) \]

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

### \( B_s^0 \) MASS

<table>
<thead>
<tr>
<th>Value (MeV)</th>
<th>EVT's</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5366.82 ± 0.22 OUR FIT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5366.7 ± 0.4 OUR AVERAGE</td>
<td>Error includes scale factor of 1.3. See the ideogram below.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5366.90 ± 0.28 ± 0.23</td>
<td>1</td>
<td>AAIJ</td>
<td>12E</td>
<td>LHCB</td>
</tr>
<tr>
<td>5364.4 ± 1.3 ± 0.7</td>
<td>2</td>
<td>LOUVOT</td>
<td>09</td>
<td>BELL</td>
</tr>
<tr>
<td>5366.01 ± 0.73 ± 0.33</td>
<td>3</td>
<td>ACOSTA</td>
<td>06</td>
<td>CDF</td>
</tr>
<tr>
<td>5369.9 ± 2.3 ± 1.3</td>
<td>4</td>
<td>ABREU</td>
<td>96B</td>
<td>CDF</td>
</tr>
<tr>
<td>5374 ± 16 ± 2</td>
<td>5</td>
<td>ABE</td>
<td>94J</td>
<td>OPAL</td>
</tr>
<tr>
<td>5359 ± 19 ± 7</td>
<td>6</td>
<td>DRUTSKOY</td>
<td>07A</td>
<td>BELL</td>
</tr>
<tr>
<td>5368.6 ± 5.6 ± 1.5</td>
<td>7</td>
<td>BUSHKULIC</td>
<td>93G</td>
<td>ALEP</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Value (MeV)</th>
<th>EVT's</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5366.7 ± 0.4 (Error scaled by 1.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**WEIGHTED AVERAGE**

Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

\[ \chi^2 = 3.5 \]

(Confidence Level = 0.177)
\[ m_{B^0_s} - m_B \]

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

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>CL%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>87.35 ± 0.20 OUR FIT</strong></td>
<td></td>
</tr>
<tr>
<td>87.45 ± 0.44 ± 0.09</td>
<td>1 AAJ</td>
</tr>
<tr>
<td>87.42 ± 0.30 ± 0.09</td>
<td>2 AAJ</td>
</tr>
<tr>
<td>86.64 ± 0.80 ± 0.08</td>
<td>3 COSTA</td>
</tr>
</tbody>
</table>

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

1 Uses the mode \( B^0_s \to \psi (2S) K^- \pi^+ \).
2 The reported result is \( m_{B^0_s} - m_{B^+} = 87.52 \pm 0.30 \pm 0.12 \) MeV. We convert it to the mass difference with respect to the average of \( (m_{B^\pm} + m_{B^0})/2 \).
3 The reported result is \( m_{B^0_s} - m_{B^0} = 86.38 \pm 0.90 \pm 0.06 \) MeV. We convert it to the mass difference with respect to the average of \( (m_{B^\pm} + m_{B^0})/2 \).

\[ m_{B^0_{sH}} - m_{B^0_{sL}} \]

See the \( B^0_s \) MIXING section near the end of these \( B^0_s \) Listings.

**\( B^0_s \) 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 correlations between the measurements and asymmetric lifetime errors.

“OUR EVALUATION” is an average of \( 1 / [0.5 (\Gamma_{B^0_{sL}} + \Gamma_{B^0_{sH}})] \).

<table>
<thead>
<tr>
<th>VALUE ((10^{-12} \text{ s}))</th>
<th>EVTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.510 ± 0.005 OUR EVALUATION</strong></td>
<td></td>
</tr>
<tr>
<td>1.518 ± 0.041 ± 0.027</td>
<td>1 AALTONEN</td>
</tr>
<tr>
<td>1.398 ± 0.044 ± 0.025</td>
<td>2 ABAZOV</td>
</tr>
<tr>
<td>1.42 (+0.14) (-0.13) ± 0.03</td>
<td>3 ABREU</td>
</tr>
<tr>
<td>1.53 (+0.16) (-0.15) ± 0.07</td>
<td>4 ABREU,P</td>
</tr>
<tr>
<td>1.36 (+0.09) (-0.06) (-0.05)</td>
<td>5 ABE</td>
</tr>
<tr>
<td>1.72 (+0.20) (-0.19) (-0.17)</td>
<td>6 ACKERSTAFF</td>
</tr>
</tbody>
</table>
\begin{table}[h]
\centering
\begin{tabular}{lrr}
\hline
\textbf{VALUE} & \textbf{DOCU-MEAN LIFE (Flavor specific) nt ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
$1.51\pm0.16$ & 5 ACKERSTAFF 98G & OPAL & $e^+e^\rightarrow Z$ \\
$1.47\pm0.14$ & 4 BARATE 98C & ALEP & $e^+e^\rightarrow Z$ \\
$1.51\pm0.11$ & 7 BARATE 98C & ALEP & $e^+e^\rightarrow Z$ \\
$1.56\pm0.29$ & 5 ABREU 96f & DLPH & Repl. by ABREU 00Y \\
$1.65\pm0.34$ & 4 ABREU 96f & DLPH & Repl. by ABREU 00Y \\
$1.76\pm0.20$ & 8 ABREU 96f & DLPH & Repl. by ABREU 00Y \\
$1.60\pm0.26$ & 9 ABREU 96f & DLPH & Repl. by ABREU,P 00G \\
$1.67\pm0.14$ & 10 ABREU 96f & DLPH & $e^+e^\rightarrow Z$ \\
$1.61\pm0.30$ & 4 BUSKULIC 96e & ALEP & Repl. by BARATE 98C \\
$1.54\pm0.14$ & 5 BUSKULIC 96m & ALEP & $e^+e^\rightarrow Z$ \\
$1.42\pm0.27$ & 5 ABE 95r & CDF & Repl. by ABE 99D \\
$1.74\pm1.08$ & 8 ABE 95r & CDF & Sup. by ABE 96n \\
$1.54\pm0.25$ & 5 AKERS 95g & OPAL & Repl. by ACKERSTAFF 98G \\
$1.59\pm0.17$ & 5 BUSKULIC 95o & ALEP & Sup. by BUSKULIC 96M \\
$0.96\pm0.37$ & 12 ABREU 94e & DLPH & Sup. by ABREU 96f \\
$1.92\pm0.45$ & 5 BUSKULIC 94c & ALEP & Sup. by BUSKULIC 95o \\
$1.13\pm0.35$ & 22 ACTON 93h & OPAL & Sup. by AKERS 95G \\
\hline
\end{tabular}
\caption{Value (10^{-12} s)}
\end{table}

$1.51\pm0.014$ OUR EVALUATION
$1.50\pm0.019$ OUR AVERAGE

Error includes scale factor of 1.3. See the ideogram below.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{ideogram.png}
\caption{IDEOM}
\end{figure}

HTTP://PDG.LBL.GOV Page 3 Created: 10/1/2016 20:06
1.535 ± 0.015 ± 0.014
1.52 ± 0.15 ± 0.01
1.518 ± 0.041 ± 0.027
1.42 ± 0.14 ± 0.13 ± 0.03
1.36 ± 0.09 ± 0.06
1.50 ± 0.16 ± 0.15
1.54 ± 0.14 ± 0.13 ± 0.04
1.60 ± 0.06 ± 0.01
1.398 ± 0.044 ± 0.028

1. Measured using $B_s^0 \rightarrow D^- \mu^+ \nu X$ decays.
2. Measured using the $B_s^0 \rightarrow D^- \pi^+$ decays.
3. Measured using $B_s^0 \rightarrow D^+ D_s^-$.
4. AALTONEN 11AP combines the fully reconstructed $B_s^0 \rightarrow D_s^- \pi^+$ decays and partially reconstructed $B_s^0 \rightarrow D_s^- X$ decays.
5. Uses $D_s^- \ell^+$ and $\phi \ell^+$ vertices.
6. Measured using $D_s^- \ell^+$ vertices.
7. Measured using $B_s^0 \rightarrow \pi^+ K^-$ decays. May not be flavor specific.
8. Measured using $D_s^- \mu^+$ vertices.

WEIGHTED AVERAGE
1.508 ± 0.019 (Error scaled by 1.3)
**B_s^0** MEAN LIFE (B_s \rightarrow J/\psi \phi)

<table>
<thead>
<tr>
<th>VALUE (10^{-12} s)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.479±0.012</strong> OUR EVALUATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.479±0.012 OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.480±0.011±0.005</td>
<td>1 AAIJ</td>
<td>14E LHCb</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>1.444±0.098±0.020</td>
<td>1 ABAZOV</td>
<td>05B D0</td>
<td>(p\overline{p}) at 1.96 TeV</td>
</tr>
<tr>
<td>1.34±0.23±0.05</td>
<td>2 ABE</td>
<td>98B CDF</td>
<td>(p\overline{p}) at 1.8 TeV</td>
</tr>
<tr>
<td>• • • We do not use the following data for averages, fits, limits, etc. • • •</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.39±0.13±0.01</td>
<td>2 ABAZOV</td>
<td>05W D0</td>
<td>(p\overline{p}) at 1.96 TeV</td>
</tr>
<tr>
<td>1.34±0.23±0.05</td>
<td>3 ABE</td>
<td>96n CDF</td>
<td>Repl. by ABE 98B</td>
</tr>
</tbody>
</table>

1 Measured using fully reconstructed \(B_s \rightarrow J/\psi \phi\) decays.
2 Measured using the time-dependent angular analysis of \(B_s^0 \rightarrow J/\psi \phi\) decays.
3 ABE 96n uses 58 ± 12 exclusive \(B_s \rightarrow J/\psi \phi\) events.

**B_{sH}^0** MEAN LIFE

\(B_{sH}^0\) is the heavy mass state of two \(B_s^0\) CP eigenstates.

"OUR EVALUATION" has been obtained by the Heavy Flavor Averaging Group (HFAG) using the constraint of the flavor-specific lifetime average in a way similar to \(\Delta \Gamma_{B_s^0}/\Gamma_{B_s^0}\).

<table>
<thead>
<tr>
<th>VALUE (10^{-12} s)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.610±0.012</strong> OUR EVALUATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1.70 ±0.04</strong> OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.75 ±0.12±0.07</td>
<td>1 AAIJ</td>
<td>13AB LHCb</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>1.700±0.040±0.026</td>
<td>2 AAJ</td>
<td>12AN LHCb</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>1.70±0.12±0.11</td>
<td>2 AALTONEN</td>
<td>11AB CDF</td>
<td>(p\overline{p}) at 1.96 TeV</td>
</tr>
<tr>
<td>• • • We do not use the following data for averages, fits, limits, etc. • • •</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.613±0.123</td>
<td>4, 5 AALTONEN</td>
<td>08J CDF</td>
<td>Repl. by AALTONEN 12D</td>
</tr>
<tr>
<td>1.58±0.39±0.01</td>
<td>5 ABAZOV</td>
<td>05W D0</td>
<td>Repl. by ABAZOV 08AM</td>
</tr>
<tr>
<td>2.07±0.58±0.03</td>
<td>5 ACOSTA</td>
<td>05 CDF</td>
<td>Repl. by AALTONEN 08J</td>
</tr>
</tbody>
</table>

1 Measured using a pure CP-odd final state \(J/\psi K_s^0\) with the assumption that contributions from penguin diagrams are small.
2 Measured using a pure CP-odd final state \(J/\psi f_0(980)\).
3 Uses the time-dependent angular analysis of \(B_s^0 \rightarrow J/\psi \phi\) decays assuming CP-violating angle \(\beta_s(B_s^0 \rightarrow J/\psi \phi) = 0.02\).
4 Obtained from \(\Delta \Gamma_s\) and \(\Gamma_s\) fit with a correlation of 0.6.
5 Measured using the time-dependent angular analysis of \(B_s^0 \rightarrow J/\psi \phi\) decays.
**$B_{sL}^0$ MEAN LIFE**

$B_{sL}^0$ is the light mass state of two $B_s^0$ CP eigenstates.

“OUR EVALUATION” has been obtained by the Heavy Flavor Averaging Group (HFAG) using the constraint of the flavor-specific lifetime average in a way similar to $\Delta \Gamma_{B_s^0}/\Gamma_{B_s^0}$.

<table>
<thead>
<tr>
<th>VALUE ($10^{-12}$ s)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.422±0.008 OUR EVALUATION</td>
<td>AAIJ</td>
<td>14F</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
<tr>
<td>1.379±0.026±0.017</td>
<td>2</td>
<td>AAIJ</td>
<td>14R</td>
</tr>
<tr>
<td>• • • We do not use the following data for averages, fits, limits, etc. • • •</td>
<td>2</td>
<td>AAIJ</td>
<td>12</td>
</tr>
<tr>
<td>1.407±0.016±0.007</td>
<td>2</td>
<td>AAIJ</td>
<td>12</td>
</tr>
<tr>
<td>1.440±0.096±0.009</td>
<td>2</td>
<td>AAIJ</td>
<td>12R</td>
</tr>
<tr>
<td>1.455±0.046±0.006</td>
<td>AALTONEN</td>
<td>12D</td>
<td>CDF $p\overline{p}$ at 1.96 TeV</td>
</tr>
<tr>
<td>1.437±0.054</td>
<td>4</td>
<td>AALTONEN</td>
<td>08J</td>
</tr>
<tr>
<td>1.24 ±0.14 ±0.01</td>
<td>5</td>
<td>ABAZOV</td>
<td>05W</td>
</tr>
<tr>
<td>1.05 ±0.16 ±0.02</td>
<td>5</td>
<td>ACOSTA</td>
<td>05</td>
</tr>
<tr>
<td>1.27 ±0.33 ±0.08</td>
<td>6</td>
<td>BARATE</td>
<td>00K</td>
</tr>
</tbody>
</table>

1 Measured using $B_{s}^{0} \rightarrow D_{s}^{-} D_{s}^{+}$. The effective lifetime is translated into a decay width of $\Gamma_{L} = 0.725 \pm 0.014 \pm 0.009$ ps$^{-1}$.

2 Measured using $B_{s}^{0} \rightarrow K^{+} K^{-}$ decays. There may still be CPV in the decay.

3 Uses the time-dependent angular analysis of $B_{s}^{0} \rightarrow J/\psi\phi$ decays and assuming CP-violating angle $\beta_{s}(B_{s}^{0} \rightarrow J/\psi\phi) = 0.02$.

4 Obtained from $\Delta \Gamma_{s}$ and $\Gamma_{s}$ fit with a correlation of 0.6.

5 Measured using the time-dependent angular analysis of $B_{s}^{0} \rightarrow J/\psi\phi$ decays.

6 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 (light $\rightarrow$ heavy).

“OUR EVALUATION” is an average of all available $B_s$ flavor-specific 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-$\overline{B}$ Mixing” in the $B^0$ Section of these Listings.

<table>
<thead>
<tr>
<th>VALUE $\pm$ CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.124±0.011 OUR EVALUATION</td>
<td>AAIJ</td>
<td>12D</td>
<td>LHCb $pp$ at 7 TeV</td>
</tr>
<tr>
<td>1</td>
<td>ABAZOV</td>
<td>12D</td>
<td>D0 $p\overline{p}$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

HTTP://PDG.LBL.GOV Page 6 Created: 10/1/2016 20:06
\[ \Delta \Gamma_{B_s^0} \]

“Our evaluation” has been obtained by the Heavy Flavor Averaging Group (HFAG) using the constraint of the flavor-specific lifetime average in a way similar to \[ \Delta \Gamma_{B_s^0}/\Gamma_{B_s^0} \].

<table>
<thead>
<tr>
<th>VALUE ((10^{12} \text{s}^{-1}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0.082 ± 0.007</strong> OUR EVALUATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>0.077 ± 0.008</strong> OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0805± 0.0091± 0.0032</td>
<td>(^1) AAII</td>
<td>15I LHCb</td>
<td>( pp ) at 7, 8 TeV</td>
</tr>
<tr>
<td>0.053 ± 0.021 ± 0.010</td>
<td>(^2) AAD</td>
<td>14U ATLS</td>
<td>( pp ) at 7 TeV</td>
</tr>
<tr>
<td>0.068 ± 0.026 ± 0.007</td>
<td>(^3) AALTONEN</td>
<td>12AJ CDF</td>
<td>( p\bar{p} ) at 1.96 TeV</td>
</tr>
<tr>
<td>0.163 +0.065 −0.064</td>
<td>(^4,5) ABAZOV</td>
<td>12D D0</td>
<td>( p\bar{p} ) at 1.96 TeV</td>
</tr>
</tbody>
</table>

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

| 0.106 ± 0.011 ± 0.007 | \(^6\) AAII | 13AR LHCb | Repl. by AAII 15I |
| 0.053 ± 0.021 ± 0.010 | \(^3\) AAD | 12CV ATLS | Repl. by AAD 14U |
| 0.123 ± 0.029 ± 0.011 | \(^3\) AAII | 12D LHCb | Repl. by AAII 13AR |
| 0.075 ± 0.035 ± 0.006 | \(^7\) AALTONEN | 12D CDF | Repl. by AALTONEN 12AJ |
| 0.085 +0.072 −0.078 ± 0.001 | \(^8\) ABAZOV | 09E D0 | Repl. by ABAZOV 08AM |
0.076 $\pm 0.059 \pm 0.063$ $\pm 0.006$ 9 AALTONEN 08J CDF Repl. by AALTONEN 12D
0.19 $\pm 0.07 \pm 0.02 \pm 0.01$ 5.10 ABAZOV 08AMD0 Repl. by ABAZOV 12D
0.12 $\pm 0.08 \pm 0.10 \pm 0.02$ 9.11 ABAZOV 07 D0 Repl. by ABAZOV 07N
0.13 $\pm 0.09$ 12 ABAZOV 07N D0 Repl. by ABAZOV 09E
0.47 $\pm 0.19 \pm 0.24 \pm 0.01$ 9 ACOSTA 05 CDF Repl. by AALTONEN 08J

1 Measured using time-dependent angular analysis of $B_s^0 \to J/\psi K^+ K^-$ decays.
2 Measured using the flavor tagged time-dependent angular analysis of $B_s^0 \to J/\psi \phi$ decays.
3 Measured using the time-dependent angular analysis of $B_s^0 \to J/\psi \phi$ decays.
4 The error includes both statistical and systematic uncertainties.
5 Measured using fully reconstructed $B_s \to J/\psi \phi$ decays.
6 AAIJ 13AR result comes from a combined fit to $B_s^0 \to J/\psi K^+ K^-$ and $B_s^0 \to J/\psi \pi^+ \pi^-$ data sets. Also reports $\Delta \Gamma_s = 0.100 \pm 0.016 \pm 0.003 \text{ps}^{-1}$ from a fit to $B_s^0 \to J/\psi K^+ K^-$ decays.
7 Uses the time-dependent angular analysis of $B_s^0 \to J/\psi \phi$ decays and assuming CP-violating angle $\beta_s (B^0 \to J/\psi \phi) = 0.02$.
8 Measured the angular and lifetime parameters for the time-dependent angular untagged decays $B_d^0 \to J/\psi K^{*0}$ and $B_s^0 \to J/\psi \phi$.
9 Measured using the time-dependent angular analysis of $B_s^0 \to J/\psi \phi$ decays and assuming CP-violating phase $\phi_s = 0$.
10 Obtains 90% CL interval $-0.06 < \Delta \Gamma_s < 0.30$.
11 ABAZOV 07 reports $0.17 \pm 0.09 \pm 0.02$ with CP-violating phase $\phi_s$ as a free parameter.
12 Combines $D^0$ measurements of time-dependent angular distributions in $B_s^0 \to J/\psi \phi$ and charge asymmetry in semileptonic decays. There is a 4-fold ambiguity in the solution.

\[ \Delta \Gamma_s^{CP} / \Gamma_s \]

$\Gamma_s$ and $\Delta \Gamma_s^{CP}$ are the decay rate average and difference between even, $\Gamma_s^{CP-even}$, and odd, $\Gamma_s^{CP-odd}$, CP eigenstates.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.072 \pm 0.021 \pm 0.022$</td>
<td>1</td>
<td>ABAZOV 09I</td>
<td>D0</td>
<td>$\rho \overline{\rho}$ at 1.96 TeV</td>
</tr>
<tr>
<td>$0.012$</td>
<td>95</td>
<td>AALTONEN 08F</td>
<td>CDF</td>
<td>$\rho \overline{\rho}$ at 1.96 TeV</td>
</tr>
<tr>
<td>$0.079^{+0.038}<em>{-0.035}^{+0.031}</em>{-0.030}$</td>
<td>1</td>
<td>ABAZOV 07Y</td>
<td>D0</td>
<td>Repl. by ABAZOV 09I</td>
</tr>
<tr>
<td>$0.25^{+0.21}_{-0.14}$</td>
<td>2</td>
<td>BARATE 00K</td>
<td>ALEP</td>
<td>$e^+ e^- \to Z$</td>
</tr>
</tbody>
</table>

1 Assumes $2 \mathcal{B}(B_s^0 \to D_s^{(*)} D_s^{(*)} \not\to \Delta \Gamma_s^{CP} / \Gamma_s$.
2 Uses $\phi \phi$ correlations from $B_s^0 \to D_s^{(*)} D_s^{(*)} \not\to$.
\[ 1 / \Gamma_{B^0_s} \]

"OUR EVALUATION" has been obtained by the Heavy Flavor Averaging Group (HFAG) using the constraint of the flavor-specific lifetime average in a way similar to \( \Delta \Gamma_{B^0_s} / \Gamma_{B^0_s} \).

\[
\begin{array}{l|c|c|c}
\text{VALUE (10^{-12} s)} & \text{DOCUMENT ID} & \text{TECN} & \text{COMMENT} \\
\hline
1.510 \pm 0.005 & \text{OUR EVALUATION} & & \\
1.509 \pm 0.010 & \text{OUR AVERAGE} & \text{Error includes scale factor of 1.5. See the ideogram below.} & \\
1.5145 \pm 0.0062 & 1 & \text{AAIJ} & 15I \, \text{LHC} \, \text{pp at 7, 8 TeV} \\
1.477 \pm 0.015 & 2 & \text{AAD} & 14U \, \text{ATLS} \, \text{pp at 7 TeV} \\
1.528 \pm 0.019 & 3 & \text{AAALTONEN} & 12A1 \, \text{CDF} \, \bar{p} \bar{p} \text{at 1.96 TeV} \\
1.443 \pm 0.038 & 3, 4 & \text{ABAZOV} & 12D \, D0 \, \bar{p} \bar{p} \text{at 1.96 TeV} \\
\hline
\end{array}
\]

\( \bullet \bullet \bullet \) We do not use the following data for averages, fits, limits, etc. \( \bullet \bullet \bullet \)

1.513 \pm 0.009 \pm 0.014 & 5 & \text{AAIJ} & 13AR \, \text{LHC} \, \text{Repl. by AAIJ 15I} \\
1.477 \pm 0.015 \pm 0.009 & 6 & \text{AAD} & 12C1 \, \text{ATLS} \, \text{Repl. by AAD 14U} \\
1.522 \pm 0.021 \pm 0.019 & 7 & \text{AAIJ} & 12D \, \text{LHC} \, \text{Repl. by AAIJ 13AR} \\
1.529 \pm 0.025 \pm 0.012 & 3 & \text{AAALTONEN} & 12D \, \text{CDF} \, \text{Repl. by AAALTONEN 12AJ} \\
1.487 \pm 0.060 \pm 0.028 & 3 & \text{ABAZOV} & 09E \, \text{D0} \, \text{Repl. by ABAZOV 08AM} \\
1.52 \pm 0.04 \pm 0.02 & 3 & \text{AAALTONEN} & 08J \, \text{CDF} \, \text{Repl. by AAALTONEN 12D} \\
1.52 \pm 0.05 \pm 0.01 & 3 & \text{ABAZOV} & 08AMD0 \, \text{Repl. by ABAZOV 12D} \\
1.40 \pm 0.15 \pm 0.02 & 3 & \text{ACOSTA} & 05 \, \text{CDF} \, \bar{p} \bar{p} \text{at 1.96 TeV} \\
\hline
\end{array}
\]

1. AAIJ 15I reports \( \Gamma_{B^0_s} = 0.6630 \pm 0.0027 \pm 0.0015 \text{ ps}^{-1} \) obtained from time-dependent angular analysis of \( B^0_s \rightarrow J/\psi K^+ K^- \) decays.

2. AAD 14U reports \( \Gamma_{B^0_s} = 0.677 \pm 0.007 \pm 0.004 \text{ ps}^{-1} \) measured using a tagged, time-dependent angular analysis of \( B^0_s \rightarrow J/\psi \phi \) decays.

3. Measured using the time-dependent angular analysis of \( B^0_s \rightarrow J/\psi \phi \) decays.

4. The error includes both statistical and systematic uncertainties.

5. AAIJ 13AR reports \( \Gamma_s = 0.661 \pm 0.004 \pm 0.006 \text{ ps}^{-1} \) obtained from combined fit to \( B^0_s \rightarrow J/\psi K^+ K^- \) and \( B^0_s \rightarrow J/\psi \pi^+ \pi^- \) data sets. Also reports a separate measurement of \( \Gamma_s = 0.663 \pm 0.005 \pm 0.006 \text{ ps}^{-1} \) from \( B^0_s \rightarrow J/\psi K^+ K^- \) decays.

6. AAD 12CV reports \( \Gamma_{B^0_s} = 0.677 \pm 0.007 \pm 0.004 \text{ ps}^{-1} \) measured using a time-dependent angular analysis of \( B^0_s \rightarrow J/\psi \phi \) decays.

7. AAIJ 12D reports average decay width of \( B^0_s \), \( \Gamma_{B^0_s} = 0.657 \pm 0.009 \pm 0.008 \text{ ps}^{-1} \) that we converted to \( 1/\Gamma_{B^0_s} \).
These branching fractions all scale with $\mathcal{B}(\bar{b} \to B^0_s)$.

The branching fraction $\mathcal{B}(B^0_s \to D^-_s \ell^+ \nu_\ell \text{ anything})$ is not a pure measurement since the measured product branching fraction $\mathcal{B}(\bar{b} \to B^0_s) \times \mathcal{B}(B^0_s \to D^-_s \ell^+ \nu_\ell \text{ anything})$ was used to determine $\mathcal{B}(\bar{b} \to B^0_s)$, as described in the note on “$B^0$-$\bar{B}^0$ Mixing”.

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

<table>
<thead>
<tr>
<th>Mode</th>
<th>Fraction ($\Gamma_i/\Gamma$)</th>
<th>Scale factor/Confidence level</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Gamma_1$</td>
<td>$D^-_s$ anything</td>
<td>(93 ± 25)%</td>
</tr>
<tr>
<td>$\Gamma_2$</td>
<td>$\ell \nu_\ell X$</td>
<td>(9.6 ± 0.8)%</td>
</tr>
<tr>
<td>$\Gamma_3$</td>
<td>$e^+ \nu X^-$</td>
<td>(9.1 ± 0.8)%</td>
</tr>
<tr>
<td>$\Gamma_4$</td>
<td>$\mu^+ \nu X^-$</td>
<td>(10.2 ± 1.0)%</td>
</tr>
<tr>
<td>$\Gamma_5$</td>
<td>$D^-<em>s \ell^+ \nu</em>\ell \text{ anything}$</td>
<td>[a] (8.1 ± 1.3)%</td>
</tr>
<tr>
<td>$\Gamma_6$</td>
<td>$D_{s1}^\pm \ell^+ \nu_\ell \text{ anything}$</td>
<td>(5.4 ± 1.1)%</td>
</tr>
<tr>
<td>$\Gamma_7$</td>
<td>$D_{s1}(2536)^- \mu^+ \nu_\mu$, (D^-_s \to D^{*-} K_S^0)</td>
<td>(2.6 ± 0.7) × 10^-3</td>
</tr>
</tbody>
</table>
\[ \Gamma_8 \quad D_{s1}(2536)^- X \mu^+ \nu, \quad D_{s1}^- \rightarrow \overline{D}^0 K^+ \quad (4.4 \pm 1.3) \times 10^{-3} \]

\[ \Gamma_9 \quad D_{s2}(2573)^- X \mu^+ \nu, \quad D_{s2}^- \rightarrow \overline{D}^0 K^+ \quad (2.7 \pm 1.0) \times 10^{-3} \]

\[ \Gamma_{10} \quad D_s^- \pi^+ \quad (3.00 \pm 0.23) \times 10^{-3} \]

\[ \Gamma_{11} \quad D_s^0 \rho^+ \quad (6.9 \pm 1.4) \times 10^{-3} \]

\[ \Gamma_{12} \quad D_s^0 \pi^+ \pi^+ \pi^- \quad (6.1 \pm 1.0) \times 10^{-3} \]

\[ \Gamma_{13} \quad D_{s1}(2536)^- \pi^+, \quad D_{s1}^- \rightarrow \overline{D}_s^- \pi^+ \pi^- \quad (2.5 \pm 0.8) \times 10^{-5} \]

\[ \Gamma_{14} \quad D_s^+ K_{\pm} \quad (2.27 \pm 0.19) \times 10^{-4} \]

\[ \Gamma_{15} \quad D_s^- K^+ \pi^+ \pi^- \quad (3.2 \pm 0.6) \times 10^{-4} \]

\[ \Gamma_{16} \quad D_s^+ D_s^- \quad (4.4 \pm 0.5) \times 10^{-3} \]

\[ \Gamma_{17} \quad D_s^- D^+ \quad (2.8 \pm 0.5) \times 10^{-4} \]

\[ \Gamma_{18} \quad D^+ D^- \quad (2.2 \pm 0.6) \times 10^{-4} \]

\[ \Gamma_{19} \quad D^0 \overline{D}^0 \quad (1.9 \pm 0.5) \times 10^{-4} \]

\[ \Gamma_{20} \quad D_s^* \pi^+ \quad (2.0 \pm 0.5) \times 10^{-3} \]

\[ \Gamma_{21} \quad D_s^+ K_{\pm} \quad (1.33 \pm 0.35) \times 10^{-4} \]

\[ \Gamma_{22} \quad D_s^- \rho^+ \quad (9.6 \pm 2.1) \times 10^{-3} \]

\[ \Gamma_{23} \quad D_s^0 \pi^0 \quad (1.29 \pm 0.22) \% \quad S=1.1 \]

\[ \Gamma_{24} \quad D_s^+ D_s^- \quad (1.86 \pm 0.30) \% \]

\[ \Gamma_{25} \quad D_s^*(\pm) D_s^*(\mp) \quad (4.5 \pm 1.4) \% \]

\[ \Gamma_{26} \quad D_s^0 K^- \pi^+ \quad (1.04 \pm 0.13) \times 10^{-3} \]

\[ \Gamma_{27} \quad D_{s2}(892)^0 \quad (4.4 \pm 0.6) \times 10^{-4} \]

\[ \Gamma_{28} \quad D_{s2}(1410)^0 \quad (3.9 \pm 3.5) \times 10^{-4} \]

\[ \Gamma_{29} \quad D_{s2}(1430)^0 \quad (3.0 \pm 0.7) \times 10^{-4} \]

\[ \Gamma_{30} \quad D_{s2}(1430)^0 \quad (1.1 \pm 0.4) \times 10^{-4} \]

\[ \Gamma_{31} \quad D_{s2}(1680)^0 \quad < 7.8 \times 10^{-5} \quad CL=90\% \]

\[ \Gamma_{32} \quad D_{s2}(1950)^0 \quad < 1.1 \times 10^{-4} \quad CL=90\% \]

\[ \Gamma_{33} \quad D_{s2}(1780)^0 \quad < 2.6 \times 10^{-5} \quad CL=90\% \]

\[ \Gamma_{34} \quad D_{s2}(2045)^0 \quad < 3.1 \times 10^{-5} \quad CL=90\% \]

\[ \Gamma_{35} \quad D_s^0 K^- \pi^+ \quad (2.1 \pm 0.8) \times 10^{-4} \]

\[ \Gamma_{36} \quad D_{s2}(2573)^- \pi^+, \quad D_{s2}^* \rightarrow \overline{D}_s^0 K^- \quad (2.6 \pm 0.4) \times 10^{-4} \]

\[ \Gamma_{37} \quad D_{s3}(2700)^- \pi^+, \quad D_{s3}^* \rightarrow \overline{D}_s^0 K^- \quad (1.6 \pm 0.8) \times 10^{-5} \]

\[ \Gamma_{38} \quad D_{s1}(2860)^- \pi^+, \quad D_{s1}^* \rightarrow \overline{D}_s^0 K^- \quad (5 \pm 4) \times 10^{-5} \]

\[ \Gamma_{39} \quad D_{s3}(2860)^- \pi^+, \quad D_{s3}^* \rightarrow \overline{D}_s^0 K^- \quad (2.2 \pm 0.6) \times 10^{-5} \]

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
$\Gamma_{40} \quad \overline{D}^0 K^+ K^-$

$\Gamma_{41} \quad \overline{D}^0 f_0(980)$

$\Gamma_{42} \quad \overline{D}^0 \phi$

$\Gamma_{43} \quad D^* \pi^\pm$

$\Gamma_{44} \quad J/\psi(1S) \phi$

$\Gamma_{45} \quad J/\psi(1S) \pi^0$

$\Gamma_{46} \quad J/\psi(1S) \eta$

$\Gamma_{47} \quad J/\psi(1S) K_S^0$

$\Gamma_{48} \quad J/\psi(1S) \overline{K}^+(892)0$

$\Gamma_{49} \quad J/\psi(1S) \eta'$

$\Gamma_{50} \quad J/\psi(1S) \pi^+ \pi^-$

$\Gamma_{51} \quad J/\psi(1S) f_0(500), \quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{52} \quad J/\psi(1S) \rho, \quad \rho \rightarrow \pi^+ \pi^-$

$\Gamma_{53} \quad J/\psi(1S) f_0(980), \quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{54} \quad J/\psi(1S) f_0(980)_0,$

$\quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{55} \quad J/\psi(1S) f_2(1270),$

$\quad f_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{56} \quad J/\psi(1S) f_2(1270)_0,$

$\quad f_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{57} \quad J/\psi(1S) f_2(1270)_{\parallel},$

$\quad f_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{58} \quad J/\psi(1S) f_2(1270)_{\perp},$

$\quad f_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{59} \quad J/\psi(1S) f_0(1370),$

$\quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{60} \quad J/\psi(1S) f_0(1500),$

$\quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{61} \quad J/\psi(1S) f'_2(1525)_0,$

$\quad f'_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{62} \quad J/\psi(1S) f'_2(1525)_{\parallel},$

$\quad f'_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{63} \quad J/\psi(1S) f'_2(1525)_{\perp},$

$\quad f'_2 \rightarrow \pi^+ \pi^-$

$\Gamma_{64} \quad J/\psi(1S) f_0(1790),$

$\quad f_0 \rightarrow \pi^+ \pi^-$

$\Gamma_{65} \quad J/\psi(1S) \pi^+ \pi^-(\text{nonresonant})$

$\Gamma_{66} \quad J/\psi(1S) \overline{K}^0 \pi^+ \pi^-$

$\Gamma_{67} \quad J/\psi(1S) K^+ K^-$

- $\Gamma_{40} \quad (4.4 \pm 2.0) \times 10^{-5}$
- $\Gamma_{41} \quad < 3.1 \times 10^{-6}$ CL=90%
- $\Gamma_{42} \quad (3.0 \pm 0.8) \times 10^{-5}$
- $\Gamma_{43} \quad < 6.1 \times 10^{-6}$ CL=90%
- $\Gamma_{44} \quad (1.07 \pm 0.08) \times 10^{-3}$
- $\Gamma_{45} \quad < 1.2 \times 10^{-3}$ CL=90%
- $\Gamma_{46} \quad (3.9 \pm 0.7) \times 10^{-4}$ S=1.4
- $\Gamma_{47} \quad (1.89 \pm 0.12) \times 10^{-5}$
- $\Gamma_{48} \quad (4.1 \pm 0.4) \times 10^{-5}$
- $\Gamma_{49} \quad (3.3 \pm 0.4) \times 10^{-4}$
- $\Gamma_{50} \quad (2.13 \pm 0.18) \times 10^{-4}$
- $\Gamma_{51} \quad < 1.7 \times 10^{-6}$ CL=90%
- $\Gamma_{52} \quad < 1.2 \times 10^{-6}$ CL=90%
- $\Gamma_{53} \quad (1.34 \pm 0.15) \times 10^{-4}$
- $\Gamma_{54} \quad (5.1 \pm 0.9) \times 10^{-5}$
- $\Gamma_{55} \quad (2.6 \pm 0.7) \times 10^{-7}$
- $\Gamma_{56} \quad (3.8 \pm 1.3) \times 10^{-7}$
- $\Gamma_{57} \quad (4.6 \pm 2.7) \times 10^{-7}$
- $\Gamma_{58} \quad (7.3 \pm 1.6 \pm 1.4) \times 10^{-6}$
- $\Gamma_{59} \quad (3.7 \pm 1.0) \times 10^{-7}$
- $\Gamma_{60} \quad (4.3 \pm 9.0 \pm 3.1) \times 10^{-8}$
- $\Gamma_{61} \quad (1.9 \pm 1.4) \times 10^{-7}$
- $\Gamma_{62} \quad (1.7 \pm 4.0 \pm 0.4) \times 10^{-6}$
- $\Gamma_{63} \quad < 4.4 \times 10^{-5}$ CL=90%
- $\Gamma_{64} \quad (7.9 \pm 0.7) \times 10^{-4}$
\( \Gamma_{68} \) \( J/\psi(1S) K^0 K^- \pi^+ \pi^- + \text{c.c.} \)
\( \Gamma_{69} \) \( J/\psi(1S) K^0 K^+ K^- \)
\( \Gamma_{70} \) \( J/\psi(1S) f'_2(1525) \)
\( \Gamma_{71} \) \( J/\psi(1S) \rho \bar{\rho} \)
\( \Gamma_{72} \) \( J/\psi(1S) \gamma \)
\( \Gamma_{73} \) \( J/\psi(1S) \pi^+ \pi^- \pi^+ \pi^- \)
\( \Gamma_{74} \) \( J/\psi(1S) f_1(1285) \)
\( \Gamma_{75} \) \( \psi(2S) \eta \)
\( \Gamma_{76} \) \( \psi(2S) \eta' \)
\( \Gamma_{77} \) \( \psi(2S) \pi^+ \pi^- \)
\( \Gamma_{78} \) \( \psi(2S) \phi \)
\( \Gamma_{79} \) \( \psi(2S) K^- \pi^+ \)
\( \Gamma_{80} \) \( \psi(2S) K^* (892)^0 \)
\( \Gamma_{81} \) \( \chi_{c1} \phi \)
\( \Gamma_{82} \) \( \pi^+ \pi^- \)
\( \Gamma_{83} \) \( \pi^0 \pi^0 \)
\( \Gamma_{84} \) \( \eta \pi^0 \)
\( \Gamma_{85} \) \( \eta \eta \)
\( \Gamma_{86} \) \( \rho^0 \rho^0 \)
\( \Gamma_{87} \) \( \eta \eta' \)
\( \Gamma_{88} \) \( \phi \rho \)
\( \Gamma_{89} \) \( \phi \phi \)
\( \Gamma_{90} \) \( \pi^+ K^- \)
\( \Gamma_{91} \) \( K^+ K^- \)
\( \Gamma_{92} \) \( K^0 K^0 \)
\( \Gamma_{93} \) \( K^0 \pi^+ \pi^- \)
\( \Gamma_{94} \) \( K^0 K^\pm \pi^\mp \)
\( \Gamma_{95} \) \( K^* (892)^- \pi^+ \)
\( \Gamma_{96} \) \( K^* (892)^\pm K^\mp \)
\( \Gamma_{97} \) \( K^0 \bar{S} K^* (892)^0 + \text{c.c.} \)
\( \Gamma_{98} \) \( K^0 K^+ K^- \)
\( \Gamma_{99} \) \( \bar{K}^* (892)^0 \rho^0 \)
\( \Gamma_{100} \) \( \bar{K}^* (892)^0 K^+ (892)^0 \)
\( \Gamma_{101} \) \( \phi K^* (892)^0 \)
\( \Gamma_{102} \) \( \rho \bar{\rho} \)
\( \Gamma_{103} \) \( \Lambda^- \Lambda^\pi^+ \)
\( \Gamma_{104} \) \( \Lambda^- \Lambda^+ \)
\( \Gamma_{105} \) \( \gamma \gamma \)
\( \Gamma_{106} \) \( \phi \gamma \)

\( B1 \) \( \gamma \gamma \)

\( \frac{9.3 \pm 1.3}{10^{-4}} \)
\( < 1.2 \times 10^{-5} \) \( \text{CL}=90\% \)
\( \frac{2.6 \pm 0.6}{10^{-4}} \)
\( < 4.8 \times 10^{-6} \) \( \text{CL}=90\% \)
\( < 7.3 \times 10^{-6} \) \( \text{CL}=90\% \)
\( \frac{7.9 \pm 0.9}{10^{-5}} \)
\( \frac{7.1 \pm 1.4}{10^{-5}} \)
\( \frac{3.3 \pm 0.9}{10^{-4}} \)
\( \frac{1.29 \pm 0.35}{10^{-4}} \)
\( \frac{7.2 \pm 1.2}{10^{-5}} \)
\( \frac{5.4 \pm 0.5}{10^{-4}} \)
\( \frac{3.12 \pm 0.30}{10^{-5}} \)
\( \frac{3.3 \pm 0.5}{10^{-5}} \)
\( \frac{2.03 \pm 0.29}{10^{-4}} \)
\( \frac{7.7 \pm 2.0}{10^{-7}} \) \( S=1.4 \)
\( < 2.1 \times 10^{-4} \) \( \text{CL}=90\% \)
\( < 1.0 \times 10^{-3} \) \( \text{CL}=90\% \)
\( < 1.5 \times 10^{-3} \) \( \text{CL}=90\% \)
\( < 3.20 \times 10^{-4} \) \( \text{CL}=90\% \)
\( \frac{3.3 \pm 0.7}{10^{-5}} \)
\( < 6.17 \times 10^{-4} \) \( \text{CL}=90\% \)
\( \frac{1.87 \pm 0.15}{10^{-5}} \)
\( \frac{5.6 \pm 0.6}{10^{-6}} \)
\( \frac{2.52 \pm 0.17}{10^{-5}} \)
\( < 6.6 \times 10^{-5} \) \( \text{CL}=90\% \)
\( \frac{1.5 \pm 0.4}{10^{-5}} \)
\( \frac{7.7 \pm 1.0}{10^{-5}} \)
\( \frac{3.3 \pm 1.2}{10^{-6}} \)
\( \frac{1.25 \pm 0.26}{10^{-5}} \)
\( \frac{1.6 \pm 0.4}{10^{-5}} \)
\( < 3.5 \times 10^{-6} \) \( \text{CL}=90\% \)
\( < 7.67 \times 10^{-4} \) \( \text{CL}=90\% \)
\( \frac{1.11 \pm 0.27}{10^{-5}} \)
\( \frac{1.14 \pm 0.30}{10^{-6}} \)
\( \frac{2.8 \pm 2.2}{10^{-8}} \)
\( \frac{3.6 \pm 1.6}{10^{-4}} \)
\( < 8.0 \times 10^{-5} \) \( \text{CL}=95\% \)
\( < 3.1 \times 10^{-6} \) \( \text{CL}=90\% \)
\( \frac{3.52 \pm 0.34}{10^{-5}} \)
Lepton Family number (LF) violating modes or
$\Delta B = 1$ weak neutral current ($B1$) modes

$\Gamma_{107} \mu^+\mu^- \quad B1 \quad (2.9 \pm 0.7) \times 10^{-9}$
$\Gamma_{108} e^+e^- \quad B1 \quad < 2.8 \times 10^{-7} \quad CL=90\%$
$\Gamma_{109} \mu^+\mu^-\mu^+\mu^- \quad B1 \quad < 1.2 \times 10^{-8} \quad CL=90\%$
$\Gamma_{110} SP, S \to \mu^+\mu^-, \quad B1 \quad [b] < 1.2 \times 10^{-8} \quad CL=90\%$
$\Gamma_{111} \phi(1020)\mu^+\mu^- \quad B1 \quad (8.2 \pm 1.2) \times 10^{-7}$
$\Gamma_{112} \pi^+\pi^-\mu^+\mu^- \quad B1 \quad (8.4 \pm 1.7) \times 10^{-8}$
$\Gamma_{113} \phi\nu\overline{\nu} \quad B1 \quad < 5.4 \times 10^{-3} \quad CL=90\%$
$\Gamma_{114} e^\pm\mu^\mp \quad LF \quad [c] < 1.1 \times 10^{-8} \quad CL=90\%$

[a] Not a pure measurement. See note at head of $B_s^0$ Decay Modes.
[b] Here $S$ and $P$ are the hypothetical scalar and pseudoscalar particles with
masses of 2.5 GeV/c$^2$ and 214.3 MeV/c$^2$, respectively.
[c] The value is for the sum of the charge states or particle/antiparticle
states indicated.

CONSTRAINED FIT INFORMATION

An overall fit to 10 branching ratios uses 16 measurements and
one constraint to determine 7 parameters. The overall fit has a
$\chi^2 = 3.3$ for 10 degrees of freedom.

The following off-diagonal array elements are the correlation coefficients
$\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the $x_i$ whose labels appear in this array to sum to
one.

$$
\begin{array}{c|c}
\text{x}_{12} & 28 \\
\text{x}_{14} & 92 \quad 25 \\
\text{x}_{44} & 0 \quad 0 \quad 0 \\
\text{x}_{53} & 0 \quad 0 \quad 0 \quad 62 \\
\text{x}_{89} & 0 \quad 0 \quad 0 \quad 28 \quad 17 \\
\end{array}
$$

$B_s^0$ BRANCHING RATIOS

$\Gamma(D_s^-\text{anything}) / \Gamma_{\text{total}} \quad \Gamma_1 / \Gamma$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.93±0.25 OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.91±0.18±0.41</td>
<td>1</td>
<td>DRUTSKOY</td>
<td>07</td>
<td>BELL</td>
</tr>
<tr>
<td>0.81±0.24±0.22</td>
<td>2</td>
<td>BUSKULIC</td>
<td>96e</td>
<td>ALEP</td>
</tr>
<tr>
<td>1.56±0.58±0.44</td>
<td>3</td>
<td>ACTON</td>
<td>92n</td>
<td>OPAL</td>
</tr>
</tbody>
</table>

1 The extraction of this result takes into account the correlation between the measurements
of $B(\Upsilon(5S) \to D_s^- X)$ and $B(\Upsilon(5S) \to D_s^0 X)$.
\[ \Gamma(\ell\nu X)/\Gamma_{\text{total}} \]

\[ \Gamma_2/\Gamma \]

\begin{tabular}{l|c|c|c}
\hline
\textbf{VALUE (units 10^{-2})} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
9.6 ± 0.8 OUR AVERAGE & & & \\
9.6 + 0.4 ± 0.7 & 1 OSWALD 13 & BELL & \ell^+\ell^- \rightarrow \Upsilon(5S) \\
9.5 + 2.5 + 1.1 ± 2.0 ± 1.0 & 2 LEES 12A & BABR & \ell^+\ell^- \\
\hline
\end{tabular}

1 The measurement corresponds to the average of the electron and muon branching fractions.
2 The measurement corresponds to a branching fraction where the lepton originates from bottom decay and is the average between the electron and muon branching fractions. LEES 12A uses the correlation of the production of \( \phi \) mesons in association with a lepton in \( \ell^+\ell^- \) data taken at center-of-mass energies between 10.54 and 11.2 GeV.

\[ \Gamma(e^{\pm}\nu X)/\Gamma_{\text{total}} \]

\[ \Gamma_3/\Gamma \]

\begin{tabular}{l|c|c|c}
\hline
\textbf{VALUE (units 10^{-2})} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
9.1 ± 0.5 ± 0.6 & OSWALD 13 & BELL & \ell^+\ell^- \rightarrow \Upsilon(5S) \\
\hline
\end{tabular}

\[ \Gamma(\mu^{\pm}\nu X)/\Gamma_{\text{total}} \]

\[ \Gamma_4/\Gamma \]

\begin{tabular}{l|c|c|c}
\hline
\textbf{VALUE (units 10^{-2})} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
10.2 ± 0.6 ± 0.8 & OSWALD 13 & BELL & \ell^+\ell^- \rightarrow \Upsilon(5S) \\
\hline
\end{tabular}

\[ \Gamma(D_s^-\ell^+\nu_\ell\text{anything})/\Gamma_{\text{total}} \]

\[ \Gamma_5/\Gamma \]

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

\begin{tabular}{l|c|c|c}
\hline
\textbf{VALUE (units 10^{-2})} & \textbf{EVTS} & \textbf{DOCUMENT ID} & \textbf{TECN} & \textbf{COMMENT} \\
\hline
8.1 ± 1.3 OUR AVERAGE & & 1 OSWALD 15 & BELL & \ell^+\ell^- \rightarrow \Upsilon(5S) \\
8.2 ± 0.2 ± 1.5 & & 2 BUKSULIC 950 & ALEP & \ell^+\ell^- \rightarrow Z \\
7.6 ± 1.2 ± 2.1 & 134 & ALEP & \ell^+\ell^- \rightarrow Z \\
10.7 ± 4.3 ± 2.9 & 3 ABREU 92M & DLPH & \ell^+\ell^- \rightarrow Z \\
10.3 ± 3.6 ± 2.8 & 18 & 4 ACTON 92N & OPAL & \ell^+\ell^- \rightarrow Z \\
\hline
\end{tabular}

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

13 ± 4 ± 4 & 27 & 5 BUKSULIC 92E & ALEP & \ell^+\ell^- \rightarrow Z \\

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Obtains \( B_s \rightarrow D_s \ell e \nu \), and \( D_s X \mu \nu \) separately, then combines them by assuming systematic uncertainties are fully correlated, except for the one on lepton identification. The third uncertainty adds in quadrature systematic uncertainties from external sources (number of \( B_s \) events, and \( D_s^{(*)} \) branching fractions). OSWALD 15 also measures the cross-section \( \sigma(e^+ e^- \rightarrow B_s^{(*)} \overline{B}_s^{(*)}) = 53.8 \pm 1.4 \pm 5.3 \text{ pb at } \sqrt{s} = 10.86 \text{ GeV}. \)

**BUSKULIC 95O** use \( D_s \ell \) correlations. The measured product branching ratio is \( B(B \rightarrow B_s) \times B(B_s \rightarrow D_s \ell^+ \nu_\ell \text{ anything}) \times B(D_s \rightarrow \phi \pi) = (3.5 \pm 0.4) \times 10^{-2} \) 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 \( B(B \rightarrow B_s) = (11.0 \pm 1.2 \pm 2.5) \% \). We evaluate using our current values \( B(B \rightarrow B_s^0) = 0.107 \pm 0.014 \) 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 \( B(B \rightarrow B_s^0) \) and \( B(D_s \rightarrow \phi \pi) \).

**ABREU 92M** measured muons only and obtained product branching ratio \( B(Z \rightarrow b \bar{b}) \times B(B \rightarrow B_s) \times B(B_s \rightarrow D_s \mu^+ \nu_\mu \text{ anything}) \times B(D_s \rightarrow \phi \pi) = (18 \pm 8) \times 10^{-5}. \) We evaluate using our current values \( B(B \rightarrow B_s^0) = 0.107 \pm 0.014 \) 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 \( B(B \rightarrow B_s^0) \) and \( B(D_s \rightarrow \phi \pi) \). We use \( B(Z \rightarrow b \bar{b}) = 2B(Z \rightarrow b \bar{b}) = 2 \times (0.02212 \pm 0.0019). \)

**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 \( B(B \rightarrow B_s^0)B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything}) = (3.9 \pm 1.1 \pm 0.8) \times 10^{-4}. \) We evaluate using our current values \( B(B \rightarrow B_s^0) = 0.107 \pm 0.014 \) 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 \( B(B \rightarrow B_s^0) \) and \( B(D_s \rightarrow \phi \pi) \).

**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 \( B(B \rightarrow B_s^0)B(B_s^0 \rightarrow D_s^- \ell^+ \nu_\ell \text{ anything}) = 0.020 \pm 0.005 \pm 0.006. \) We evaluate using our current values \( B(B \rightarrow B_s^0) = 0.107 \pm 0.014 \) 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 \( B(B \rightarrow B_s^0) \) and \( B(D_s \rightarrow \phi \pi) \). Superseded by BUSKULIC 950.
\[ \Gamma(D_{s1}(2536)^- X \mu^+ \nu, D_{s1}^- \rightarrow \Delta^0 K^+)/\Gamma(D_s^- \ell^+ \nu_{\ell} \text{anything}) \quad \Gamma_{8}/\Gamma_{5} \]

\begin{tabular}{lccc}
VALUE (units \(10^{-2}\)) & DOCUMENT ID & TECN & COMMENT
\hline
5.4 ± 1.2 ± 0.5 & AAIJ 11A & LHCb & \(pp\) at 7 TeV
\hline
\end{tabular}

\[ \Gamma(D_{s2}(2573)^- X \mu^+ \nu, D_{s2}^- \rightarrow \Delta^0 K^+)/\Gamma(D_s^- \ell^+ \nu_{\ell} \text{anything}) \quad \Gamma_{9}/\Gamma_{5} \]

\begin{tabular}{lccc}
VALUE (units \(10^{-2}\)) & DOCUMENT ID & TECN & COMMENT
\hline
3.3 ± 1.0 ± 0.4 & AAIJ 11A & LHCb & \(pp\) at 7 TeV
\hline
\end{tabular}

\[ \Gamma(D_{s1}(2536)^- X \mu^+ \nu, D_{s1}^- \rightarrow \Delta^0 K^+)/\Gamma(D_{s2}(2573)^- X \mu^+ \nu, D_{s2}^- \rightarrow \Delta^0 K^+) \quad \Gamma_{8}/\Gamma_{9} \]

\begin{itemize}
  \item We do not use the following data for averages, fits, limits, etc.
  \item 0.61 ± 0.14 ± 0.05
  \item 1 AAIJ 11A
  \item \(pp\) at 7 TeV
\end{itemize}

1 Not independent of other AAIJ 11A measurements.

\[ \Gamma(D_s^- \pi^+)/\Gamma_{\text{total}} \quad \Gamma_{10}/\Gamma \]

\begin{tabular}{lccc}
VALUE (units \(10^{-3}\)) & EVTS & DOCUMENT ID & TECN & COMMENT
\hline
3.00 ± 0.23 OUR FIT & & & & \\
2.99 ± 0.24 OUR AVERAGE & & & & \\
2.95 ± 0.05 ± 0.25 & AAIJ 12AG & LHCb & \(pp\) at 7 TeV
\hline
3.6 ± 0.5 ± 0.5 & LOUVOT 09 & BELL & \(e^+ e^- \rightarrow \Upsilon(5S)\)
\hline
2.8 ± 0.6 ± 0.1 & ABULENCIA 07C & CDF & \(p\bar{p}\) at 1.96 TeV
\hline
6.8 ± 2.2 ± 1.6 & DRUTSKOY 07A & BELL & Repl. by LOUVOT 09
\hline
3.3 ± 1.1 ± 0.2 & ABULENCIA 06J & CDF & Repl. by ABULENCIA 07C
\hline
<130 & AKERS 94J & OPAL & \(e^+ e^- \rightarrow Z\)
\hline
seen & BUSKULIC 93G & ALEP & \(e^+ e^- \rightarrow Z\)
\hline
\end{tabular}

1 AAIJ 12AG reports \((2.95 \pm 0.05 \pm 0.17^{+0.18}_{-0.22}) \times 10^{-3}\) where the last uncertainty comes from the semileptonic \(f_s/f_d\) measurement. We combined the systematics in quadrature.

2 LOUVOT 09 reports \((3.67^{+0.35}_{-0.33} \pm 0.65_{-0.64}) \times 10^{-3}\) from a measurement of \([\Gamma(B_s^0 \rightarrow D_s^- \pi^+)/\Gamma_{\text{total}}] \times [B(\Upsilon(10860) \rightarrow B_{s}^{(*)} B_{s}^{(*)})] \) assuming \(B(\Upsilon(10860) \rightarrow B_{s}^{(*)} B_{s}^{(*)}) = (19.5 \pm 2.6) \times 10^{-2}\), which we rescale to our best value \(B(\Upsilon(10860) \rightarrow B_{s}^{(*)} B_{s}^{(*)}) = (20.1 \pm 3.1) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

3 ABULENCIA 07C reports \([\Gamma(B_s^0 \rightarrow D_s^- \pi^+)/\Gamma_{\text{total}}] / [B(B_s^0 \rightarrow D^- \pi^+)] = 1.13 \pm 0.08 \pm 0.23\) which we multiply by our best value \(B(B_s^0 \rightarrow D^- \pi^+) = (2.52 \pm 0.13) \times 10^{-3}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

4 ABULENCIA 06J reports \([\Gamma(B_s^0 \rightarrow D_s^- \pi^+)/\Gamma_{\text{total}}] / [B(B_s^0 \rightarrow D^- \pi^+)] = 1.32 \pm 0.18 \pm 0.38\) which we multiply by our best value \(B(B_s^0 \rightarrow D^- \pi^+) = (2.52 \pm 0.13) \times 10^{-3}\).
Our first error is their experiment’s error and our second error is the systematic error from using our best value.

AKERS 94J sees \( \leq 6 \) events and measures the limit on the product branching fraction
\[
f(\bar{\tau} \rightarrow B_s^0) B(B_s^0 \rightarrow D_s^- \pi^+) < 1.3% \text{ at CL = 90\%.}
\]
We divide by our current value
\[
B(\bar{\tau} \rightarrow B_s^0) = 0.105.
\]

\[
\Gamma(D_s^- \rho^+)/\Gamma_{\text{total}}\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-3}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.9(\pm 1.3)(\pm 0.5)</td>
<td>1 LOUVOT 10 BELL</td>
<td>(e^+e^- \rightarrow \Upsilon(5S))</td>
<td></td>
</tr>
</tbody>
</table>

1 LOUVOT 10 reports \([\Gamma(B_s^0 \rightarrow D_s^- \rho^+)/\Gamma_{\text{total}}]/[B(B_s^0 \rightarrow D_s^- \pi^+)] = 2.3 \pm 0.4 \pm 0.2\) which we multiply by our best value \(B(B_s^0 \rightarrow D_s^- \pi^+) = (3.00 \pm 0.23) \times 10^{-3}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

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

<table>
<thead>
<tr>
<th>VALUE (units (10^{-3}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1(\pm 1.0) OUR FIT</td>
<td>1 ABULENCIA 07C</td>
<td>CDF</td>
<td>(p\bar{p} \text{ at } 1.96 \text{ TeV})</td>
</tr>
</tbody>
</table>

1 ABULENCIA 07C reports \([\Gamma(B_s^0 \rightarrow D_s^- \pi^+\pi^+\pi^-)/\Gamma_{\text{total}}]/[B(B_s^0 \rightarrow D^-\pi^+\pi^+\pi^-)] = 1.05 \pm 0.10 \pm 0.22\) which we multiply by our best value \(B(B_s^0 \rightarrow D^-\pi^+\pi^+\pi^-) = (6.0 \pm 0.7) \times 10^{-3}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\[
\Gamma(D_s^- \pi^+\pi^+\pi^-)/\Gamma(D_s^- \pi^+)\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-3}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.05(\pm 0.34) OUR FIT</td>
<td>2.01(\pm 0.37)(\pm 0.20)</td>
<td>AAIJ 11E</td>
<td>LHCB (pp \text{ at } 7 \text{ TeV})</td>
</tr>
</tbody>
</table>

\[
\Gamma(D_s(2536)^-\pi^+, D_s^- \rightarrow D_s^- \pi^+\pi^-)/\Gamma(D_s^- \pi^+\pi^+\pi^-)\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-3}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6(\pm 1.0)(\pm 0.6)</td>
<td>AAIJ 12AX</td>
<td>LHCB</td>
<td>(pp \text{ at } 7 \text{ TeV})</td>
</tr>
</tbody>
</table>

\[
\Gamma(D_s^0 K^+)/\Gamma_{\text{total}}\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-4}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.27(\pm 0.19) OUR FIT</td>
<td>2.3(\pm 1.2)(\pm 0.4)(\pm 1.0)(\pm 0.3)</td>
<td>1 LOUVOT 09 BELL</td>
<td>(e^+e^- \rightarrow \Upsilon(5S))</td>
</tr>
</tbody>
</table>

1 LOUVOT 09 reports \((2.4 \pm 1.2 \pm 0.42) \times 10^{-4}\) from a measurement of \([\Gamma(B_s^0 \rightarrow D_s^0 K^+)/\Gamma_{\text{total}}]/[B(\Upsilon(10860) \rightarrow B_s^{(*)} B_s^{(*)})]\) assuming \(B(\Upsilon(10860) \rightarrow B_s^{(*)} B_s^{(*)}) = (19.5 \pm 2.6) \times 10^{-2}\), which we rescale to our best value \(B(\Upsilon(10860) \rightarrow B_s^{(*)} B_s^{(*)}) = (20.1 \pm 3.1) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.
\[
\frac{\Gamma(D_s^+ K^\pm)}{\Gamma(D_s^- \pi^\mp)} \quad \Gamma_{14}/\Gamma_{10}
\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-2}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.55 ± 0.24 OUR FIT</td>
<td>AAIJ 15AC LHCb</td>
<td>pp at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>7.55 ± 0.24 OUR AVERAGE</td>
<td>AALTONEN 09AQ CDF</td>
<td>(p\bar{p}) at 1.96 TeV</td>
<td></td>
</tr>
</tbody>
</table>

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

6.46 ± 0.43 ± 0.25

\[
\frac{\Gamma(D_s^+ K^{\pm} \pi^\mp)}{\Gamma(D_s^- \pi^+ \pi^-)} \quad \Gamma_{15}/\Gamma_{12}
\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-2}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2 ± 0.5 ± 0.3</td>
<td>AAIJ 12AX LHCb</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

\[
\frac{\Gamma(D_s^+ D^-)}{\Gamma_{\text{total}}} \quad \Gamma_{16}/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-3}))</th>
<th>CL%</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4 ± 0.5 OUR AVERAGE</td>
<td>1 AAIJ 13AP LHCb</td>
</tr>
<tr>
<td>5.8 ± 1.1 ± 0.9</td>
<td>2 ESEN 13 BELL</td>
</tr>
<tr>
<td>5.1 ± 0.8 ± 0.6</td>
<td>3 AALTONEN 12C CDF</td>
</tr>
</tbody>
</table>

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

10.3 ± 3.9 ± 2.6

<67 90 DRUTSKOY 07A BELL | repl. by ESEN 13

\[
\Gamma(D_s^- D^+) / \Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-4}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.8 ± 0.4 ± 0.3</td>
<td>AAIJ 14AA LHCb</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

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

3.6 ± 0.6 ± 0.5

1. Uses \(B(B^0 \rightarrow D^- D^+_s) = (7.2 \pm 0.8) \times 10^{-3}\).
2. Use \(\gamma(5S) \rightarrow B_s^+ B_s^−\) decays assuming \(B(\gamma(5S) \rightarrow B_s^+ B_s^-) = (17.1 \pm 3.0)\%\) and \(\Gamma(\gamma(5S) \rightarrow B_s^+ B_s^-) / \Gamma(\gamma(5S) \rightarrow B_s^{(*)} B_s^{(*)}) = (87.0 \pm 1.7)\%\).
3. AALTONEN 12C reports \((f_s/f_d) B(B_s^0 \rightarrow D^- D^+_s) / B(B_s^0 \rightarrow D^- D^+_s) = 0.183 \pm 0.021 \pm 0.017\). We multiply this result by our best value of \(B(B^0 \rightarrow D^- D^+_s) = (7.2 \pm 0.8) \times 10^{-3}\) and divide by our best value of \(f_s/f_d\), where \(1/2 f_s/f_d = 0.130 \pm 0.008\). Our first quoted uncertainty is the combined experiment’s uncertainty and our second is the systematic uncertainty from using our best values.
4. Uses \(\gamma(10860) \rightarrow B_s^+ B_s^-\) assuming \(B(\gamma(10860) \rightarrow B_s^{(*)} B_s^{(*)}) = (19.3 \pm 2.9)\%\) and \(\Gamma(\gamma(10860) \rightarrow B_s^+ B_s^-) / \Gamma(\gamma(10860) \rightarrow B_s^{(*)} B_s^{(*)}) = (90.1 \pm 3.8)\%\).
5. AALTONEN 08F reports \[\Gamma(B_s^0 \rightarrow D^+ D^-)/\Gamma_{\text{total}}] / [B(B_s^0 \rightarrow D^- D^+_s)] = 1.44 \pm 0.43\) which we multiply by our best value \(B(B_s^0 \rightarrow D^- D^+_s) = (7.2 \pm 0.8) \times 10^{-3}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.
$\Gamma(D^+ D^-)/\Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units $10^{-4}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2±0.4±0.4</td>
<td>AAIJ</td>
<td>13AP LHCb</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Uses $B(B^0 \to D^- D^+) = (2.11 \pm 0.31) \times 10^{-4}$ and $B(B^+ \to \overline{D}^0 D^+_s) = (10.1 \pm 1.7) \times 10^{-3}$.

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

<table>
<thead>
<tr>
<th>VALUE (units $10^{-4}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9±0.3±0.4</td>
<td>AAIJ</td>
<td>13AP LHCb</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Uses $B(B^0 \to D^- D^+) = (2.11 \pm 0.31) \times 10^{-4}$ and $B(B^+ \to \overline{D}^0 D^+_s) = (10.1 \pm 1.7) \times 10^{-3}$.

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

<table>
<thead>
<tr>
<th>VALUE (units $10^{-3}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0±0.5±0.1</td>
<td>LOUVOT</td>
<td>10 BELL</td>
<td>$e^+ e^- \to \gamma(55)$</td>
</tr>
</tbody>
</table>

1 LOUVOT 10 reports $[\Gamma(B^0_\text{s} \to D^s_- \pi^+)/\Gamma_{\text{total}}] / [B(B^0_\text{s} \to D^s_- \pi^+)] = 0.65 \pm 0.15 \pm 0.07$ which we multiply by our best value $B(B^0_\text{s} \to D^s_- \pi^+) = (3.00 \pm 0.23) \times 10^{-3}$. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

$\Gamma(D^s_+ K^\pm)/\Gamma(D^s_- \pi^+)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.068±0.005±0.003−0.002</td>
<td>AAIJ</td>
<td>15AP LHCb</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$\Gamma(D^s_+ \rho^+)/\Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units $10^{-3}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.6±2.0±0.7</td>
<td>LOUVOT</td>
<td>10 BELL</td>
<td>$e^+ e^- \to \gamma(55)$</td>
</tr>
</tbody>
</table>

1 LOUVOT 10 reports $[\Gamma(B^0_\text{s} \to D^s_- \rho^+)/\Gamma_{\text{total}}] / [B(B^0_\text{s} \to D^s_- \pi^+)] = 3.2 \pm 0.6 \pm 0.3$ which we multiply by our best value $B(B^0_\text{s} \to D^s_- \pi^+) = (3.00 \pm 0.23) \times 10^{-3}$. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

$\Gamma(D^s_- \rho^+)/\Gamma(D^s_- \rho^+)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4±0.3±0.1</td>
<td>LOUVOT</td>
<td>10 BELL</td>
<td>$e^+ e^- \to \gamma(55)$</td>
</tr>
</tbody>
</table>

1 We do not use the following data for averages, fits, limits, etc. • • • •
\[ \frac{\Gamma(D_{s}^{*+} D_{s}^{-}) + \Gamma(D_{s}^{*-} D_{s}^{+})}{\Gamma_{\text{total}}} \]

\( \Gamma_{23}/\Gamma \)

**VALUE (units 10^{-3})** | **CL%** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | --- | ---
12.9 ± 2.2 OUR AVERAGE | Error includes scale factor of 1.1. | | |
17.6 ^{+2.3}_{-2.2} ± 4.0 | 1 ESEN 13 BELL | e^+e^- → \( \Upsilon(5S) \) |
11.8 ± 1.6 ± 1.4 | 2 AALTONEN 12C CDF | \( \rho\Phi \) at 1.96 TeV

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

| 27.5 ^{+8.3}_{-7.1} ± 6.9 | 3 ESEN 10 BELL | Repl. by ESEN 13 |

<121 | DRUTSKOY 07A BELL | Repl. by ESEN 10 |

1 Use \( \Upsilon(5S) \) → \( B_{s}^{+} \overline{B}_{s}^{*} \) decays assuming \( \mathcal{B}(\Upsilon(5S) \to B_{s}^{+} \overline{B}_{s}^{*}) = (17.1 \pm 3.0)\% \) and \( \Gamma(\Upsilon(5S) \to B_{s}^{+} \overline{B}_{s}^{*}) / \Gamma(\Upsilon(5S) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (87.0 \pm 1.7)\% \).

2 AALTONEN 12C reports \( (f_{s}/f_{d}) (B(B_{s}^{0} \to D_{s}^{*+} D_{s}^{-} + D_{s}^{*-} D_{s}^{+}) / B(B_{s}^{0} \to D_{s}^{-} D_{s}^{+})) = 0.424 \pm 0.046 \pm 0.035 \). We multiply this result by our best value of \( B(B_{s}^{0} \to D_{s}^{-} D_{s}^{+}) = (7.2 \pm 0.8) \times 10^{-3} \) and divide by our best value of \( f_{s}/f_{d} \), where \( 1/2 f_{s}/f_{d} = 0.130 \pm 0.008 \). Our first quoted uncertainty is the combined experiment’s uncertainty and our second is the systematic uncertainty from using out best values.

3 Uses \( \Upsilon(10860) \) → \( B_{s}^{+} \overline{B}_{s}^{*} \) assuming \( \mathcal{B}(\Upsilon(10860) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (19.3 \pm 2.9)\% \) and \( \Gamma(\Upsilon(10860) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (90.1 \pm 3.8)\% \).

\[ \frac{\Gamma(D_{s}^{*+} D_{s}^{-})}{\Gamma_{\text{total}}} \]

\( \Gamma_{24}/\Gamma \)

**VALUE (units 10^{-3})** | **CL%** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | --- | ---
18.6 ± 3.0 OUR AVERAGE | | | |
19.8 ^{+3.3}_{-3.1} + 5.2 | 1 ESEN 13 BELL | e^+e^- → \( \Upsilon(5S) \) |
18.2 ± 2.7 ± 2.2 | 2 AALTONEN 12C CDF | \( \rho\Phi \) at 1.96 TeV

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

| 30.8 ^{+12.2}_{-10.4} + 8.5 | 3 ESEN 10 BELL | Repl. by ESEN 13 |

<257 | DRUTSKOY 07A BELL | Repl. by ESEN 10 |

1 Use \( \Upsilon(5S) \) → \( B_{s}^{+} \overline{B}_{s}^{*} \) decays assuming \( \mathcal{B}(\Upsilon(5S) \to B_{s}^{+} \overline{B}_{s}^{*}) = (17.1 \pm 3.0)\% \) and \( \Gamma(\Upsilon(5S) \to B_{s}^{+} \overline{B}_{s}^{*}) / \Gamma(\Upsilon(5S) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (87.0 \pm 1.7)\% \).

2 AALTONEN 12C reports \( (f_{s}/f_{d}) (B(B_{s}^{0} \to D_{s}^{*+} D_{s}^{-} + D_{s}^{*-} D_{s}^{+}) / B(B_{s}^{0} \to D_{s}^{-} D_{s}^{+})) = 0.654 \pm 0.072 \pm 0.065 \). We multiply this result by our best value of \( B(B_{s}^{0} \to D_{s}^{-} D_{s}^{+}) = (7.2 \pm 0.8) \times 10^{-3} \) and divide by our best value of \( f_{s}/f_{d} \), where \( 1/2 f_{s}/f_{d} = 0.130 \pm 0.008 \). Our first quoted uncertainty is the combined experiment’s uncertainty and our second is the systematic uncertainty from using out best values.

3 Uses \( \Upsilon(10860) \) → \( B_{s}^{+} \overline{B}_{s}^{*} \) assuming \( \mathcal{B}(\Upsilon(10860) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (19.3 \pm 2.9)\% \) and \( \Gamma(\Upsilon(10860) \to B_{s}^{(*)} \overline{B}_{s}^{(*)}) = (90.1 \pm 3.8)\% \).
\[ \Gamma(D_s^{(*)}\ell^\pm\ell^-) / \Gamma_{\text{total}} \]

“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 correlations between the measurements.

<table>
<thead>
<tr>
<th>VALUE (%)</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5 ±1.4</td>
<td>OUR EVALUATION</td>
<td>4.32 ±0.42 ±1.04</td>
<td>ESEN 13</td>
<td>BELL e^+e^- → \Upsilon(5S)</td>
</tr>
<tr>
<td>3.7 ±0.5</td>
<td>OUR AVERAGE</td>
<td>3.5 ±0.4 ±0.4</td>
<td>AALTONEN 12C</td>
<td>CDF ( \rho\pi ) at 1.96 TeV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.5 ±1.0 ±1.1</td>
<td>ABAZOV 09I</td>
<td>D0 ( \rho\pi ) at 1.96 TeV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 ±6 ±3</td>
<td>BARATE 00k</td>
<td>ALEP ( e^+e^- \rightarrow Z )</td>
</tr>
</tbody>
</table>

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

6.85 ±1.53 ±1.79 | ESEN 10 | BELL Repl. by ESEN 13 |
| 3.9 ±1.9 ±1.6 | ABAZOV 07Y | D0 Repl. by ABAZOV 09I |
| <0.218 | BARATE 98Q | ALEP \( e^+e^- \rightarrow Z \) |

1 Use \( \Upsilon(5S) \rightarrow B^*_s B^*_s \) decays assuming \( B(\Upsilon(5S) \rightarrow B^*_s B^*_s) = (17.1 \pm 3.0)\% \) and
\[ \Gamma(\Upsilon(5S) \rightarrow B^*_s B^*_s) / \Gamma(\Upsilon(5S) \rightarrow B^{(*)}_s B^{(*)}_s) = (87.0 \pm 1.7)\% \].

2 AALTONEN 12C reports \( (f_s/f_d) (B(B^0 \rightarrow D^{(*)}_s D^{(*)}_s) / B(B^0 \rightarrow D^- D^+_s)) = 1.261 \pm 0.095 \pm 0.112 \). We multiply this result by our best value of \( B(B^0 \rightarrow D^- D^+_s) = (7.2 \pm 0.8) \times 10^{-3} \) and divide by our best value of \( f_s/f_d \), where \( 1/2 f_s/f_d = 0.130 \pm 0.008 \).

Our first quoted uncertainty is the combined experiment’s uncertainty and our second is the systematic uncertainty from using our best values.

3 Uses the final states where \( D_s^+ \rightarrow \phi \pi^+ \) and \( D_s \rightarrow \phi \mu^- \nu_\mu \).

4 Reports \( B(B^0_{\text{short}} \rightarrow D^{(*)}_s D^{(*)}_s) = (0.23 \pm 0.10 \pm 0.05) \cdot [0.17/B(D_s \rightarrow \phi \chi)]^2 \) assuming \( B(B^0_{\text{short}} \rightarrow B^0_{\text{short}}) = 50\% \). We use our best value of \( B(D_s \rightarrow \phi \chi) = 15.7 \pm 1.0 \% \) to obtain the quoted result.

5 Uses \( \phi \phi \) correlations from \( B^0_{\text{short}} \rightarrow D^{(*)}_s D^{(*)}_s \).

6 Sum of exclusive \( B_s \rightarrow D_s^+ D_s^- \), \( B_s \rightarrow D_s^\pm D_s^\mp \), and \( B_s \rightarrow D_s^{(*)} D_s^{(*)} \).

7 Uses \( \Upsilon(10860) \rightarrow B^*_s B^*_s \) assuming \( B(\Upsilon(10860) \rightarrow B^*_s B^*_s) = (19.3 \pm 2.9)\% \) and
\[ \Gamma(\Upsilon(10860) \rightarrow B^*_s B^*_s) / \Gamma(\Upsilon(10860) \rightarrow B^*_s B^*_s) = (90.1 \pm 3.8)\% \].

\[ \Gamma(B^0 \rightarrow K^- \pi^+) / \Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
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<tbody>
<tr>
<td>10.4 ±1.1 ±0.5</td>
<td>AAIJ 13AQ</td>
<td>LHCb</td>
<td>pp at 7 TeV</td>
</tr>
</tbody>
</table>

1 AAIJ 13AQ reports \( [\Gamma(B^0 \rightarrow D^- K^- \pi^+) / \Gamma_{\text{total}}] / [B(B^0 \rightarrow D^- K^- \pi^+ \pi^-)] = 1.18 \pm 0.05 \pm 0.12 \) which we multiply by our best value \( B(B^0 \rightarrow D^- K^- \pi^+ \pi^-) = (8.8 \pm 0.5) \times 10^{-4} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.
\[ \Gamma(\bar{D}^0 K^*(892)^0)/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
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<tbody>
<tr>
<td>4.4 ± 0.6 OUR AVERAGE</td>
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<td></td>
<td></td>
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<tr>
<td>4.29 ± 0.09 ± 0.65</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>4.7 ± 1.2 ± 0.3</td>
<td>2 AAIJ</td>
<td>11D LHCb</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>-</td>
<td></td>
<td></td>
<td>We do not use the following data for averages, fits, limits, etc. -</td>
</tr>
<tr>
<td>3.5 ± 0.4 ± 0.4</td>
<td>3 AAIJ</td>
<td>13BX LHCb</td>
<td>Repl. by AAIJ 14BH</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of \( B^0 \to \bar{D}^0 K^- \pi^+ \) decays.
2 AAIJ 11D reports \[ \Gamma(\bar{B}^0 \to \bar{D}^0 K^*(892)^0)/\Gamma_{\text{total}} \] / \[ B(\bar{B}^0 \to \bar{D}^0 \rho^0) \] = 1.48 ± 0.34 ± 0.19 which we multiply by our best value \( B(\bar{B}^0 \to \bar{D}^0 \rho^0) \) = (3.21 ± 0.21) \times 10^{-4}. Our first error is their experiment’s error and our second error is the systematic error from using our best value.
3 AAIJ 13BX reports \[ \Gamma(\bar{B}^0_s \to \bar{D}^0 K^*(892)^0)/\Gamma_{\text{total}} \] / \[ B(B^0 \to \bar{D}^0 K^*(892)^0) \] = 7.8 ± 0.7 ± 0.3 ± 0.6 which we multiply by our best value \( B(B^0 \to \bar{D}^0 K^*(892)^0) \) = (4.5 ± 0.6) \times 10^{-5}. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\[ \Gamma(\bar{D}^0 K^*(1410))/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.6 ± 11.4 ± 33.3</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of \( B_s^0 \to \bar{D}^0 K^- \pi^+ \) decays.

\[ \Gamma(\bar{D}^0 K^*_2(1430))/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.0 ± 2.4 ± 6.8</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of \( B_s^0 \to \bar{D}^0 K^- \pi^+ \) decays. Corresponds to the resonant \( K^*_2(1430) \) part of LASS parametrisation.

\[ \Gamma(\bar{D}^0 K^*_2(1680))/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>&lt;7.8</td>
<td>90</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
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</tbody>
</table>

1 Uses Dalitz plot analysis of \( B_s^0 \to \bar{D}^0 K^- \pi^+ \) decays.

\[ \Gamma(\bar{D}^0 K^*_0(1950))/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>&lt;11</td>
<td>90</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of \( B_s^0 \to \bar{D}^0 K^- \pi^+ \) decays.
$\Gamma (B^0 K_s^0(1780)) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>&lt;2.6</td>
<td>90</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of $B^0_s \rightarrow D^0 K^- \pi^+$ decays.

$\Gamma (B^0 K_s^0(2045)) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.1</td>
<td>90</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of $B^0_s \rightarrow D^0 K^- \pi^+$ decays.

$\Gamma (D_s^0 K^- (\text{non-resonant})) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
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<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.6 ± 3.8 ± 7.3</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of $B^0_s \rightarrow D^0 K^- \pi^+$ decays. Corresponds to the non-resonant part of the LASS parametrisation.

$\Gamma (D_s^0 K^- K^- (\text{non-resonant})) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 ± 1.2 ± 3.4</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of $B^0_s \rightarrow D^0 K^- \pi^+$ decays.

$\Gamma (D_s^0 K^- K^- (\text{non-resonant})) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>2.2 ± 0.1 ± 0.6</td>
<td>1 AAIJ</td>
<td>14BH LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Uses Dalitz plot analysis of $B^0_s \rightarrow D^0 K^- \pi^+$ decays.

$\Gamma (B^0 K^+ K^-) / \Gamma_{\text{total}}$

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4 ± 1.7 ± 1.1</td>
<td>1,2 AAIJ</td>
<td>12AM LHCb</td>
<td>pp at 7 TeV</td>
</tr>
</tbody>
</table>

1 AAIJ 12AM reports [$\Gamma (B^0_s \rightarrow D^0 K^+ K^-) / \Gamma_{\text{total}}] / [B(B^0 \rightarrow D^0 K^+ K^-)] = 0.90 \pm 0.27 \pm 0.20$ which we multiply by our best value $B(B^0 \rightarrow D^0 K^+ K^-) = (4.9 \pm 1.2) \times 10^{-5}$. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2 Uses $B(b \rightarrow B^0_s) / B(b \rightarrow B^0) = 0.267 \pm 0.023$ measured by the same authors.
\[\Gamma(D^0 f_0(980))/\Gamma_{\text{total}}\]  \[\Gamma_{41}/\Gamma\]

**VALUE**  |  **CL\%**  |  **DOCUMENT ID**  |  **TECN**  |  **COMMENT**
---|---|---|---|---
\(<3.1 \times 10^{-6}\)  |  90  |  AAIJ  |  15AG LHCB  |  \(pp\) at 7, 8 TeV

\[\Gamma(D^0 \phi)/\Gamma(D^0 \pi^*(892)^0)\]  \[\Gamma_{42}/\Gamma_{27}\]

**VALUE**  |  **CL\%**  |  **DOCUMENT ID**  |  **TECN**  |  **COMMENT**
---|---|---|---|---
\(0.069\pm0.013\pm0.007\)  |  1  |  AAIJ  |  13BX LHCB  |  \(pp\) at 7 TeV

1 Uses \(f_s/f_d = 0.256 \pm 0.020\) and \(B(B^0 \rightarrow D^*\pi^0) = (2.76 \pm 0.13) \times 10^{-3}\).

\[\Gamma(J/\psi(1S))/\Gamma_{\text{total}}\]  \[\Gamma_{44}/\Gamma\]

**VALUE** (units \(10^{-3}\))  |  **EVTS**  |  **DOCUMENT ID**  |  **TECN**  |  **COMMENT**
---|---|---|---|---
\(1.07\pm0.08\)  |  **OUR FIT**  |  1  |  AAIJ  |  13AN LHCB  |  \(pp\) at 7 TeV
\(1.10\pm0.09\)  |  **OUR AVERAGE**  |  1  |  AAIJ  |  13AN LHCB  |  \(pp\) at 7 TeV
\(1.050\pm0.013\pm0.104\)  |  2  |  THORNE  |  13B  |  BELL  |  \(e^+ e^- \rightarrow \gamma(5S)\)
\(1.25\pm0.07\pm0.23\)  |  3  |  ABE  |  96Q  |  CDF  |  \(\rho\rho\)
\(1.4 \pm 0.5 \pm 0.1\)  |  4  |  AKERS  |  94J  |  OPAL  |  \(e^+ e^- \rightarrow Z\)
\(<6\)  |  14  |  ABE  |  94J  |  OPAL  |  \(\rho\rho\)
\(\text{seen}\)  |  1  |  ACTON  |  92N  |  OPAL Sup. by AKERS 94J  |  \(\rho\rho\)

1 Uses \(f_s/f_d = 0.256 \pm 0.020\) and \(B(B^+ \rightarrow J/\psi K^+) = (10.18 \pm 0.42) \times 10^{-4}\).

2 Uses \(f_s = (17.2 \pm 3.0)\)% as the fraction of \(\gamma(5S)\) decaying to \(B_{s}^{(+)} B_{s}^{(+)}/B_{s}^{(+)} B_{s}^{(+)}/\).

3 ABE 96Q reports \([\Gamma(B_{s}^{(0)} \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}] \times [\Gamma(B \rightarrow B_{s}^{0})/\Gamma(B \rightarrow B_{s}^{0})] = (0.185 \pm 0.055 \pm 0.020) \times 10^{-3}\) which we divide by our best value \(\Gamma(B \rightarrow B_{s}^{0})/\Gamma(B \rightarrow B_{s}^{0})\). \([\Gamma(B \rightarrow B_{s}^{+}) + \Gamma(B \rightarrow B_{s}^{0})]\) = 0.130 \pm 0.008. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

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

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

6 In ACTON 92N a limit on the product branching fraction is measured to be \(f(B \rightarrow B_{s}^{0}) B(B_{s}^{0} \rightarrow J/\psi(1S)\phi) \leq 0.22 \times 10^{-2}\).

\[\Gamma(J/\psi(1S)\pi^0)/\Gamma_{\text{total}}\]  \[\Gamma_{45}/\Gamma\]

**VALUE**  |  **CL\%**  |  **DOCUMENT ID**  |  **TECN**
---|---|---|---
\(<1.2 \times 10^{-3}\)  |  90  |  ACCIARRI  |  97c L3

1 ACCIARRI 97C assumes \(B^0\) production fraction \((39.5 \pm 4.0)\)% and \(B_s\) \((12.0 \pm 3.0)\)%.
\[ \Gamma(J/\psi(1S)\eta)/\Gamma_{\text{total}} \]

\[ \Gamma_{46}/\Gamma \]

<table>
<thead>
<tr>
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<th>DOCUMENT ID</th>
<th>TECN</th>
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<tbody>
<tr>
<td>3.9 ± 0.7 OUR AVERAGE</td>
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<td></td>
<td>Error includes scale factor of 1.4.</td>
</tr>
<tr>
<td>3.6 ± 0.5 ± 0.2</td>
<td>1 AAIJ</td>
<td>13A</td>
<td>LHCB pp at 7 TeV</td>
</tr>
<tr>
<td>5.10 ± 0.50 (+1.17) (-0.83)</td>
<td>2 LI</td>
<td>12</td>
<td>BELL (e^+e^- \rightarrow \gamma(4S))</td>
</tr>
</tbody>
</table>

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

<38   90 3 ACCIARRI 97C L3

1 AAIJ 13A reports \[\Gamma(B^0_s \rightarrow J/\psi(1S)\eta)/\Gamma_{\text{total}}\] / [B(B^0 \rightarrow J/\psi(1S)\rho^0)] = 14.0 ± 1.2±1.1±1.1, \(1.5 \pm 1.0\) which we multiply by our best value \(B(B^0 \rightarrow J/\psi(1S)\rho^0) = (2.54 ± 0.14) \times 10^{-5}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2 Observed for the first time with significances over 10 \(\sigma\). The second error are total systematic uncertainties including the error on \(N(B^0_s/B^0_s)\).

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

\[ \Gamma(J/\psi(1S)K^0_S)/\Gamma_{\text{total}} \]

\[ \Gamma_{47}/\Gamma \]

<table>
<thead>
<tr>
<th>VALUE (units (10^{-5}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
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</tr>
<tr>
<td>1.88 ± 0.14 ± 0.07</td>
<td>1 AAIJ</td>
<td>15A</td>
<td>LHCB pp at 7, 8 TeV</td>
</tr>
<tr>
<td>1.91 ± 0.15 ± 0.13</td>
<td>2 AAIJ</td>
<td>13AB</td>
<td>LHCB pp at 7 TeV</td>
</tr>
<tr>
<td>1.9 ± 0.4 ± 0.1</td>
<td>3 AALTONEN</td>
<td>11A</td>
<td>CDF (p\bar{p} \rightarrow \gamma(1S)) at 1.96 TeV</td>
</tr>
</tbody>
</table>

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

1.91\(+0.25\)\(-0.24\) ± 0.13   4 AAIJ 120 LHCB Repl. by AAIJ 13AB

1 AAIJ 15AL reports \[\Gamma(B^0_s \rightarrow J/\psi(1S)K^0_S)/\Gamma_{\text{total}}\] / [B(B^0 \rightarrow J/\psi(1S)K^0_S)] = (4.31 ± 0.17 ± 0.12 ± 0.25) \times 10^{-2}\) which we multiply by our best value \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (4.36 ± 0.16) \times 10^{-4}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2 AAIJ 13AB reports \(1.97 ± 0.14 ± 0.07 ± 0.15 ± 0.08\) \times 10^{-5}\) from a measurement of \[\Gamma(B^0_s \rightarrow J/\psi(1S)K^0_S)/\Gamma_{\text{total}}\] / [B(B^0 \rightarrow J/\psi(1S)K^0_S)] \times \[\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0)]\) assuming \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (8.98 ± 0.35) \times 10^{-4}\), \(\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.256 ± 0.020\), which we rescale to our best values \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (8.73 ± 0.32) \times 10^{-4}\), \(\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.256 ± 0.014\). Our first error is their experiment’s error and our second error is the systematic error from using our best values.

3 AALTONEN 11A reports \[\Gamma(B^0 \rightarrow J/\psi(1S)K^0_S)/\Gamma_{\text{total}}\] \times [B(B \rightarrow B^0)/B(B \rightarrow B^0)] / [B(B \rightarrow J/\psi(1S)K^0_S)] = (1.09 ± 0.19 ± 0.11) \times 10^{-2}\) which we multiply or divide by our best values \(B(B \rightarrow B^0) = (10.3 ± 0.5) \times 10^{-2}\), \(B(B \rightarrow B^0) = (40.4 ± 0.6) \times 10^{-2}\), \(B(B \rightarrow J/\psi(1S)K^0_S) = 1/2 \times B(B \rightarrow J/\psi(1S)K^0_S) = 1/2 \times \Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.267\(+0.021\)\(-0.02\) , which we rescale to our best values \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (8.71 ± 0.32) \times 10^{-4}\), \(\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.256 ± 0.014\). Our first error is their experiment’s error and our second error is the systematic error from using our best values.

4 AAIJ 120 reports \(1.83 ± 0.21 ± 0.10 ± 0.14 ± 0.07\) \times 10^{-5}\) from a measurement of \[\Gamma(B^0 \rightarrow J/\psi(1S)K^0_S)/\Gamma_{\text{total}}\] / [B(B \rightarrow J/\psi(1S)K^0_S)] \times \[\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0)]\) assuming \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (8.71 ± 0.32) \times 10^{-4}\), \(\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.267\(+0.021\)\(-0.02\) , which we rescale to our best values \(B(B^0 \rightarrow J/\psi(1S)K^0_S) = (8.71 ± 0.32) \times 10^{-4}\), \(\Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.256 ± 0.014\). Our first error is their experiment’s error and our second error is the systematic error from using our best values.

\[ HTTP://PDG.LBL.GOV \] Page 26 Created: 10/1/2016 20:06
\((8.73 \pm 0.32) \times 10^{-4}\), \(\Gamma(\bar{B} \to B_s^0) / \Gamma(B \to B^0) = 0.256 \pm 0.014\). Our first error is their experiment’s error and our second error is the systematic error from using our best values.

\[
\Gamma(J/\psi(1S)K^*(892)^0)/\Gamma_{\text{total}} \quad \quad \Gamma_{48}/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.14 \pm 0.18 \pm 0.35</td>
<td>AAIJ 15AV LHCB</td>
<td>pp at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>4.4 \pm 0.5 \pm 0.8</td>
<td>AAIJ 12AP LHCB</td>
<td>Repl. by AAIJ 15AV</td>
<td></td>
</tr>
<tr>
<td>8 \pm 4 \pm 1</td>
<td>AALTONEN 11A CDF</td>
<td>(p \bar{p}) at 1.96 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. AAIJ 15AV result combines two measurements with different normalizing modes of \(B^0 \to J/\psi K^*(892)^0\) and \(B^0 \to J/\psi \phi\).

2. AAIJ 12AP reports \(B(B_s^0 \to J/\psi(1S)K^*(892)^0)/B(B \to J/\psi(1S)K^*(892)^0) = (3.43^{+0.34}_{-0.36} \pm 0.50) \times 10^{-2}\) and \(B(B \to J/\psi(1S)K^*(892)^0) = (1.29 \pm 0.05 \pm 0.13) \times 10^{-3}\) after correcting for the contribution from \(K\pi\) S-wave peak.

3. AALTONEN 11A reports \(\Gamma(B_s^0 \to J/\psi(1S)K^*(892)^0)/\Gamma_{\text{total}}\) of \(\Gamma(\bar{B} \to B_s^0)\) at 

\[
[\Gamma(B_s^0 \to J/\psi(1S)K^*(892)^0)/\Gamma_{\text{total}}] \times [B(\bar{B} \to B_s^0)] / [B(\bar{B} \to B^0)] = 0.0168 \pm 0.0024 \pm 0.0068 \text{ which we multiply or divide by our best values } B(\bar{B} \to B_s^0) = (10.3 \pm 0.5) \times 10^{-2}, B(\bar{B} \to B^0) = (40.4 \pm 0.6) \times 10^{-2}, B(B \to J/\psi(1S)K^*(892)^0) = (1.28 \pm 0.05 \times 10^{-3}.\) Our first error is their experiment’s error and our second error is the systematic error from using our best values.

\[
\Gamma(J/\psi(1S)\eta)/\Gamma_{\text{total}} \quad \quad \Gamma_{49}/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 \pm 0.4</td>
<td>AAIJ 13A LHCB</td>
<td>(pp) at 7 TeV</td>
<td></td>
</tr>
<tr>
<td>3.71 \pm 0.61 \pm 0.85</td>
<td>Li 12 BELL</td>
<td>(e^+e^- \to \Upsilon(4S))</td>
<td></td>
</tr>
</tbody>
</table>

1. AAIJ 13A reports \(\Gamma(B_s^0 \to J/\psi(1S)\eta)/\Gamma_{\text{total}} = 12.7 \pm 1.1^{+0.5+1.0}_{-1.3-0.9}\) which we multiply by our best value \(B(B \to J/\psi(1S)\rho^0) = (2.54 \pm 0.14) \times 10^{-5}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2. Observed for the first time with significances over 10 \(\sigma\). The second error are total systematic uncertainties including the error on \(N(B_s^0)(B_s^0)\).

\[
\Gamma(J/\psi(1S)\eta')/\Gamma(J/\psi(1S)\eta) \quad \quad \Gamma_{49}/\Gamma_{46}
\]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>0.87 \pm 0.06</td>
<td>AAIJ 15D LHCB</td>
<td>(pp) at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>0.90 \pm 0.09 \pm 0.06</td>
<td>AAIJ 13A LHCB</td>
<td>(pp) at 7 TeV</td>
<td></td>
</tr>
<tr>
<td>0.73 \pm 0.14 \pm 0.02</td>
<td>Li 12 BELL</td>
<td>(e^+e^- \to \Upsilon(4S))</td>
<td></td>
</tr>
</tbody>
</table>

1. Uses \(J/\psi \to \mu^+\mu^-\), \(\eta' \to \rho^0\gamma\), and \(\eta \to \eta\pi^+\pi^-\) decays.

2. Strongly correlated with measurements of \(\Gamma(J/\psi(1S)\eta)/\Gamma\) and \(\Gamma(J/\psi(1S)\eta)/\Gamma\) reported in the same reference.
\( \Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma(J/\psi(1S)\phi) \)  \( \Gamma_{50}/\Gamma_{44} \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-2})</th>
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<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.8±0.5±0.5</td>
<td>AAJJ</td>
<td>12AO LHCb</td>
<td>pp at 7 TeV</td>
</tr>
</tbody>
</table>

1 AAIJ 12AO reports (19.79 ± 0.47 ± 0.52) \( \times 10^{-2} \) from a measurement of \( [\Gamma(B_s^0 \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)] / [B(\phi(1020) \rightarrow K^+K^-)] \) assuming \( B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2} \).

\( \Gamma(J/\psi(1S)f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma(\text{total}) \)  \( \Gamma_{53}/\Gamma \)

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.34±0.15±0.25</td>
<td>LI</td>
<td>11 BELL</td>
<td>e^+e^- \rightarrow \gamma(5S)</td>
</tr>
</tbody>
</table>

1 The second error includes both the detector systematic and the uncertainty in the number of produced \( Y(5S) \rightarrow B_s^{(*)}\bar{B}_s^{(*)} \) pairs.

\( \Gamma(J/\psi(1S)f_0(500), f_0 \rightarrow \pi^+\pi^-)/\Gamma(J/\psi(1S)f_0(980); f_0 \rightarrow \pi^+\pi^-) \)  \( \Gamma_{51}/\Gamma_{54} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.034</td>
<td>90</td>
<td>AAJJ</td>
<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Reported first of two solutions using the full Dalitz analysis.

\( \Gamma(J/\psi(1S)\rho, \rho \rightarrow \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-) \)  \( \Gamma_{52}/\Gamma_{77} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.017</td>
<td>90</td>
<td>AAJJ</td>
<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Reported first of two solutions using the full Dalitz analysis.

\( \Gamma(J/\psi(1S)f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-) \)  \( \Gamma_{54}/\Gamma_{77} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.703±0.015±0.004</td>
<td>AAJJ</td>
<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Reported first of two solutions using the full Dalitz analysis.

\( \Gamma(J/\psi(1S)f_2(1270), f_2 \rightarrow \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-) \)  \( \Gamma_{56}/\Gamma_{77} \)

<table>
<thead>
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<tr>
<td>0.36±0.07±0.03</td>
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<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
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</table>

1 Reported first of two solutions using the full Dalitz analysis.

\( \Gamma(J/\psi(1S)f_2(1270)_{II}, f_2 \rightarrow \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-) \)  \( \Gamma_{57}/\Gamma_{77} \)

<table>
<thead>
<tr>
<th>VALUE (%)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.52±0.15±0.05</td>
<td>AAJJ</td>
<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Reported first of two solutions using the full Dalitz analysis.

\( \Gamma(J/\psi(1S)f_2(1270)_{I}, f_2 \rightarrow \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-) \)  \( \Gamma_{58}/\Gamma_{77} \)

<table>
<thead>
<tr>
<th>VALUE (%)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>0.63±0.34±0.16</td>
<td>AAJJ</td>
<td>14BR LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

1 Reported first of two solutions using the full Dalitz analysis.
<table>
<thead>
<tr>
<th>$\Gamma(J/\psi(1S)f_0(1500), f_0 \to \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-)$</th>
<th>$\Gamma_{60}/\Gamma_{77}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td>$0.101 \pm 0.008^{+0.011}_{-0.003}$</td>
<td>1 AAIJ</td>
</tr>
<tr>
<td>1 Reported first of two solutions using the full Dalitz analysis.</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(J/\psi(1S)f'_2(1525)_0, f'_2 \to \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-)$</td>
<td>$\Gamma_{61}/\Gamma_{77}$</td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td>$0.51 \pm 0.09^{+0.05}_{-0.04}$</td>
<td>1 AAIJ</td>
</tr>
<tr>
<td>1 Reported first of two solutions using the full Dalitz analysis.</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(J/\psi(1S)f'<em>2(1525)</em>{</td>
<td></td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td>$0.06^{+0.13}_{-0.04} \pm 0.01$</td>
<td>1 AAIJ</td>
</tr>
<tr>
<td>1 Reported first of two solutions using the full Dalitz analysis.</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(J/\psi(1S)f'<em>2(1525)</em>{\perp}, f'_2 \to \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-)$</td>
<td>$\Gamma_{63}/\Gamma_{77}$</td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td>$0.26 \pm 0.18^{+0.06}_{-0.04}$</td>
<td>1 AAIJ</td>
</tr>
<tr>
<td>1 Reported first of two solutions using the full Dalitz analysis.</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(J/\psi(1S)f_0(1790), f_0 \to \pi^+\pi^-)/\Gamma(\psi(2S)\pi^+\pi^-)$</td>
<td>$\Gamma_{64}/\Gamma_{77}$</td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td>$0.024 \pm 0.004^{+0.050}_{-0.002}$</td>
<td>1 AAIJ</td>
</tr>
<tr>
<td>1 Reported first of two solutions using the full Dalitz analysis.</td>
<td></td>
</tr>
<tr>
<td>$\Gamma(J/\psi(1S)f_0(980), f_0 \to \pi^+\pi^-)/\Gamma(J/\psi(1S)\phi)$</td>
<td>$\Gamma_{53}/\Gamma_{44}$</td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
</tr>
<tr>
<td><strong>OUR FIT</strong></td>
<td>0.125 $\pm 0.011$</td>
</tr>
<tr>
<td>0.135 $\pm 0.036 \pm 0.001$</td>
<td>1 ABAZOV</td>
</tr>
<tr>
<td>0.126 $\pm 0.012 \pm 0.001$</td>
<td>2 AALTONEN</td>
</tr>
<tr>
<td>● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●</td>
<td></td>
</tr>
<tr>
<td>$0.139 \pm 0.006^{+0.025}_{-0.012}$</td>
<td>3,4 AAIJ</td>
</tr>
<tr>
<td>$0.123^{+0.026}_{-0.022} \pm 0.001$</td>
<td>5 AAIJ</td>
</tr>
</tbody>
</table>
| 1 ABAZOV 12C reports \[\Gamma(B^0 \to J/\psi(1S)f_0(980), f_0 \to \pi^+\pi^-)/\Gamma(B^0 \to J/\psi(1S)\phi)\] \[/ [B(\phi(1020) \to K^+K^-)] = 0.275 \pm 0.041 \pm 0.061 \text{ which we multiply by our best value} \]
| $\text{B}(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. |
| 2 AALTONEN 11AB reports \[\Gamma(B^0 \to J/\psi(1S)f_0(980), f_0 \to \pi^+\pi^-)/\Gamma(B^0 \to J/\psi(1S)\phi)\] \[/ [B(\phi(1020) \to K^+K^-)] = 0.257 \pm 0.020 \pm 0.014 \text{ which we multiply by our best value} \]
| $\text{B}(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}$. Our first error is
their experiment’s error and our second error is the systematic error from using our best value.

3 AAIJ 12AO reports \((13.9 \pm 0.6^{+2.5}_{-1.2}) \times 10^{-2}\) from a measurement of \([\Gamma(B_s^0 \rightarrow J/\psi(1S)f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)]/ [B(\phi(1020) \rightarrow K^+K^-)]\) assuming \(B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}\).

4 Measured in Dalitz plot like analysis of \(B_s \rightarrow J/\psi\pi^+\pi^-\) decays.

5 AAIJ 11 reports \([\Gamma(B_s^0 \rightarrow J/\psi(1S)f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)]/ [B(\phi(1020) \rightarrow K^+K^-)]\) assuming \(B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\[
\Gamma(J/\psi(1S)f_0(1370), f_0 \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{59}/\Gamma
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>(66\pm9) (4) (9)</td>
<td>1 LI</td>
<td></td>
<td>e^+e^- (\rightarrow) (\gamma(5S))</td>
</tr>
</tbody>
</table>

1 The second error includes both the detector systematic and the uncertainty in the number of produced \(Y(5S) \rightarrow B_s^{(*)}\overline{B_s}^{(*)}\) pairs.

\[
\Gamma(J/\psi(1S)f_0(1370), f_0 \rightarrow \pi^+\pi^-)/\Gamma(J/\psi(1S)\phi) \quad \Gamma_{59}/\Gamma_{44}
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-2})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4.2\pm0.5) (4) (4)</td>
<td>1.2 AAIJ</td>
<td></td>
<td>AAIJ 14</td>
</tr>
</tbody>
</table>

1 AAIJ 12AO reports \((4.19 \pm 0.53^{+0.12}_{-3.7}) \times 10^{-2}\) from a measurement of \([\Gamma(B_s^0 \rightarrow J/\psi(1S)f_0(1370), f_0 \rightarrow \pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)]/ [B(\phi(1020) \rightarrow K^+K^-)]\) assuming \(B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}\).

2 Measured in Dalitz plot like analysis of \(B_s \rightarrow J/\psi\pi^+\pi^-\) decays.

\[
\Gamma(J/\psi(1S)f_2(1270), f_2 \rightarrow \pi^+\pi^-)/\Gamma(J/\psi(1S)\phi) \quad \Gamma_{55}/\Gamma_{44}
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
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<td>(9.8\pm3.3) (7) (7)</td>
<td>1.2 AAIJ</td>
<td></td>
<td>AAIJ 14</td>
</tr>
</tbody>
</table>

1 AAIJ 12AO reports \((0.989 \pm 0.033^{+0.006}_{-0.015}) \times 10^{-2}\) from a measurement of \([\Gamma(B_s^0 \rightarrow J/\psi(1S)f_2(1270), f_2 \rightarrow \pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)]/ [B(\phi(1020) \rightarrow K^+K^-)]\) assuming \(B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}\).

2 Measured in Dalitz plot like analysis of \(B_s \rightarrow J/\psi\pi^+\pi^-\) decays for the \(f_2\) helicity state \(\lambda = 0\).

\[
\Gamma(J/\psi(1S)\pi^+\pi^- (\text{nonresonant}))/\Gamma(J/\psi(1S)\phi) \quad \Gamma_{65}/\Gamma_{44}
\]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-2})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>(1.66\pm0.31) (4) (4)</td>
<td>1.2 AAIJ</td>
<td></td>
<td>AAIJ 14</td>
</tr>
</tbody>
</table>

1 AAIJ 12AO reports \((1.66 \pm 0.31^{+0.96}_{-0.08}) \times 10^{-2}\) from a measurement of \([\Gamma(B_s^0 \rightarrow J/\psi(1S)f_2(1270), f_2 \rightarrow \pi^+\pi^-)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi)]/ [B(\phi(1020) \rightarrow K^+K^-)]\) assuming \(B(\phi(1020) \rightarrow K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}\).

2 Measured in Dalitz plot like analysis of \(B_s \rightarrow J/\psi\pi^+\pi^-\) decays for the \(f_2\) helicity state \(\lambda = 0\).

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1 AAIJ 12A0 reports $(1.66 \pm 0.31^{+0.96}_{-0.08}) \times 10^{-2}$ from a measurement of $[\Gamma(B_s^0 \to J/\psi(1S)\pi^+\pi^- (\text{nonresonant}))/\Gamma(B_s^0 \to J/\psi(1S)\phi)]$ assuming $B(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}$.

2 Measured in Dalitz plot like analysis of $B_s \to J/\psi\pi^+\pi^-$ decays.

\[
\frac{\Gamma(J/\psi(1S)K^0 K^-)}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{66}/\Gamma}{\Gamma}\n\]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;4.4 \times 10^{-5}$</td>
<td>90</td>
<td>AAIJ 14L</td>
<td>LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Measured with $B(B_s^0 \to J/\psi K_s^0 \pi^+\pi^-)/B(B_s^0 \to J/\psi K_s^0 \pi^+\pi^-)$ using PDG 12 values for the involved branching fractions.

\[
\frac{\Gamma(J/\psi(1S)K^0 K^-)}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{67}/\Gamma}{\Gamma}\n\]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-4}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$7.9 \pm 0.7$ OUR AVERAGE</td>
<td>AAIJ 13AN</td>
<td>LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
<tr>
<td>$10.1 \pm 0.9 \pm 2.1$</td>
<td>THORNE 13</td>
<td>BELL</td>
<td>$e^+e^- \to \gamma(5S)$</td>
</tr>
</tbody>
</table>

1 Uses $f_s/f_d = 0.256 \pm 0.020$ and $B(B^+ \to J/\psi K^+)(10.18 \pm 0.42) \times 10^{-4}$.

2 Uses $f_s = (17.2 \pm 3.0)\%$ as the fraction of $\Upsilon(5S)$ decaying to $B_s^0 \bar{B}_s^0$.

\[
\frac{\Gamma(J/\psi(1S)K^0 K^- \pi^+ + \text{c.c.})}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{68}/\Gamma}{\Gamma}\n\]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-4}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9.3 \pm 1.0 \pm 0.9$</td>
<td>AAIJ 14L</td>
<td>LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 AAIJ 14L reports $[\Gamma(B_s^0 \to J/\psi(1S)K^0 K^- \pi^+ \text{ c.c.})/\Gamma_{\text{total}}]/[B(B_s^0 \to J/\psi(1S)K^0 \pi^+ \pi^-) = 2.12 \pm 0.15 \pm 0.18$ which we multiply by our best value $B(B_s^0 \to J/\psi(1S)K^0 \pi^+ \pi^-) = (44.4 \pm 0.4) \times 10^{-4}$. Our first error is their experiment’s error and our second error is the systematic error from using our best value. This is an observation of $B_s^0 \to J/\psi K^0 S K^- \pi^+$ with more than 10 standard deviations.

\[
\frac{\Gamma(J/\psi(1S)K^0 K^-)}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{69}/\Gamma}{\Gamma}\n\]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;12 \times 10^{-6}$</td>
<td>90</td>
<td>AAIJ 14L</td>
<td>LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Measured with $B(B_s^0 \to J/\psi K_s^0 K^+ K^-)/B(B_s^0 \to J/\psi K_s^0 \pi^+ \pi^-)$ using PDG 12 values for the involved branching fractions.

\[
\frac{\Gamma(J/\psi(1S)f_2'(1525))}{\Gamma(J/\psi(1S)\phi)} \quad \frac{\Gamma_{70}/\Gamma_{44}}{\Gamma}\n\]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-2}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$21 \pm 4$ OUR AVERAGE</td>
<td>THORNE 13</td>
<td>BELL</td>
<td>$e^+e^- \to \Upsilon(5S)$</td>
</tr>
<tr>
<td>$21 \pm 7 \pm 1$</td>
<td>ABAZOV 12AF</td>
<td>D0</td>
<td>$pp$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

1 We do not use the following data for averages, fits, limits, etc. $\ldots$ $\ldots$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$26.4 \pm 3.5 \pm 0.7$</td>
<td>AAIJ 12S</td>
<td>LHCB</td>
<td>Repl. by AAIJ 13AN</td>
</tr>
</tbody>
</table>

1 Uses $B(f_2'(1525) \to K^+K^-) = (44.4 \pm 1.1)\%$.

2 ABAZOV 12AF reports $[\Gamma(B_s^0 \to J/\psi(1S)f_2'(1525))/\Gamma(B_s^0 \to J/\psi(1S)\phi)] \times B(f_2'(1525) \to K^+K^-) / B(\phi(1020) \to K^+K^-) = 0.19 \pm 0.05 \pm 0.04$ which we divide and multiply by our best values $B(f_2'(1525) \to K^+K^-) = \frac{1}{2}(88.7 \pm 2.2) \times 10^{-2}$.

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B(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}. \text{ Our first error is their experiment's error and our second error is the systematic error from using our best values.}

3 ABAZOV 12af fits the invariant masses of the $K^+K^-$ pair in the range $1.35 < M(K^+K^-) < 2 \text{ GeV}.

4 AAIJ 12s reports $[26.4 \pm 2.7 \pm 2.4] \times 10^{-2}$ from a measurement of $\Gamma(B_0^0 \to J/\psi(1S)f_2'(1525)) / \Gamma(B_0^0 \to J/\psi(1S)\phi) \times B(f_2'(1525) \to K^+K^-) / B(\phi(1020) \to K^+K^-)$ assuming $B(f_2'(1525) \to K^+K^-) = (44.4 \pm 1.1) \times 10^{-2}$, $B(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}$, which we rescale to our best values $B(f_2'(1525) \to K^+K^-) = \frac{1}{2} (88.7 \pm 2.2) \times 10^{-2}$, $B(\phi(1020) \to K^+K^-) = (48.9 \pm 0.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

\[ \Gamma(J/\psi(1S)f_2'(1525)) / \Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-4}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.61$^{+0.56}_{-0.50}$</td>
<td>AAIJ</td>
<td>13AN LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

$^1$ Uses $f_s/f_d = 0.256 \pm 0.020$ and $B(B^+ \to J/\psi K^+) = (10.18 \pm 0.42) \times 10^{-4}$.

\[ \Gamma(J/\psi(1S)\eta) / \Gamma(J/\psi(1S)\eta') \]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-2}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.83$^{+0.14}_{-0.12}$</td>
<td>AAIJ</td>
<td>13AA LHCB</td>
<td>$pp$ at 7 TeV</td>
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</tbody>
</table>

$^1$ Assuming lepton universality for dimuon decay modes of $J/\psi$ and $\psi(2S)$ mesons, the ratio $B(J/\psi \to \mu^+\mu^-)/B(\psi(2S) \to \mu^+\mu^-) = B(J/\psi \to e^+e^-)/B(\psi(2S) \to e^+e^-) = 7.69 \pm 0.19$ was used.

\[ \Gamma(J/\psi(1S)\rho\gamma) / \Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-6}$)</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4.8$^{+1.3}_{-1.4}$</td>
<td>90</td>
<td>AAIJ</td>
<td>13B LHCB</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

$^1$ Uses $B(B^0_s \to J/\psi(1S)\pi^+\pi^-) = (1.98 \pm 0.20) \times 10^{-4}$.

\[ \Gamma(J/\psi(1S)\gamma) / \Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-6}$)</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7.3$^{+1.6}_{-1.7}$</td>
<td>90</td>
<td>AAIJ</td>
<td>15B8 LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$^1$ Branching fractions of normalization modes $B^0_s \to J/\psi\gamma X$ taken from PDG 14. Uses $f_s/f_d = 0.259 \pm 0.015$.

\[ \Gamma(J/\psi(1S)\pi^+\pi^-) / \Gamma(J/\psi(1S)\pi^+\pi^-) \]

<table>
<thead>
<tr>
<th>VALUE (units $10^{-6}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.371$^{+0.22}_{-0.015}$</td>
<td>AAIJ</td>
<td>14Y LHCB</td>
<td>$pp$ at 7.8 TeV</td>
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</tbody>
</table>

$^1$ Excludes contributions from $\psi(2S)$ and $X(3872)$ decaying to $J/\psi(1S)\pi^+\pi^-$. 

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
\[ \Gamma(J/\psi(1S)f_1(1285))/\Gamma_{total} \]

**VALUE (units 10^{-5})** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | ---
7.1 \(\pm\) 1.0 | 1 AAIJ 14Y | LHCb | \( pp \) at 7, 8 TeV

1 AAIJ 14Y reports \( (7.14 \pm 0.99^{+0.83}_{-0.91} \pm 0.41) \times 10^{-5} \) from a measurement of \( \Gamma(B_s^0 \rightarrow J/\psi(1S)f_1(1285))/\Gamma_{total} \times \Gamma(B_s^0 \rightarrow 2\pi^+ 2\pi^-) \) assuming \( \Gamma(f_1(1285) \rightarrow 2\pi^+ 2\pi^-) = 0.11^{+0.007}_{-0.006} \).

\[ \Gamma(\psi(2S)\phi)/\Gamma_{total} \]

**VALUE (units 10^{-4})** | **EVTS** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | --- | ---
\( 1.1 \) \( \pm \) 0.3 | 1 AAIJ 12L | LHCb | \( pp \) at 7 TeV

\( 0.501 \pm 0.034 \) OUR AVERAGE

0.497 \(\pm\) 0.034 \(\pm\) 0.011 | 1,2 AAIJ 12L | LHCb | \( pp \) at 7 TeV

0.53 \(\pm\) 0.10 \(\pm\) 0.09 | ABAZOV 09Y | D0 | \( p\bar{p} \) at 1.96 TeV

0.52 \(\pm\) 0.13 \(\pm\) 0.07 | ABULENCIA 06N | CDF | \( p\bar{p} \) at 1.96 TeV

1 AAIJ 12L reports \( 0.489 \pm 0.026 \pm 0.021 \pm 0.012 \) from a measurement of \( \Gamma(B_s^0 \rightarrow \psi(2S)\phi)/\Gamma(B_s^0 \rightarrow J/\psi(1S)\phi) \times \Gamma(B(B_s^0 \rightarrow J/\psi(1S) \rightarrow e^+ e^-))/\Gamma(B(B_s^0 \rightarrow e^+ e^-)) = (7.72 \pm 0.17) \times 10^{-3} \) which we rescale to our best values \( \Gamma(J/\psi(1S) \rightarrow e^+ e^-) = (5.971 \pm 0.032) \times 10^{-2} \) and \( \Gamma(B(\psi(2S) \rightarrow e^+ e^-) = (7.89 \pm 0.17) \times 10^{-3} \). Our first error is their experiment’s error and our second error is the systematic error from using our best values.

2 Assumes \( B(J/\psi \rightarrow \mu^+ \mu^-) / B(\psi(2S) \rightarrow \mu^+ \mu^-) = B(J/\psi \rightarrow e^+ e^-) / B(\psi(2S) \rightarrow e^+ e^-) = 7.69 \pm 0.19 \).

\[ \Gamma(\psi(2S)K^- \pi^+)/\Gamma_{total} \]

**VALUE (units 10^{-5})** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | ---
3.12 \(\pm\) 0.30 \(\pm\) 0.21 | 1 AAIJ 15U | LHCb | \( pp \) at 7, 8 TeV

1 AAIJ 15U reports \( \Gamma(B_s^0 \rightarrow \psi(2S)K^- \pi^+)/\Gamma_{total} \times \Gamma(B(B_s^0 \rightarrow \psi(2S)K^+ \pi^-)) = (5.38 \pm 0.36 \pm 0.22 \pm 0.31) \times 10^{-2} \) which we multiply by our best value \( \Gamma(B_s^0 \rightarrow \psi(2S)K^- \pi^+) = (5.8 \pm 0.4) \times 10^{-4} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\[ \Gamma(\psi(2S)K^*(892)^0)/\Gamma_{total} \]

**VALUE (units 10^{-5})** | **DOCUMENT ID** | **TECN** | **COMMENT**
--- | --- | --- | ---
3.3 \(\pm\) 0.5 \(\pm\) 0.2 | 1 AAIJ 15U | LHCb | \( pp \) at 7, 8 TeV

1 AAIJ 15U reports \( \Gamma(B_s^0 \rightarrow \psi(2S)K^*(892)^0)/\Gamma_{total} \times \Gamma(B(B_s^0 \rightarrow \psi(2S)K^*(892)^0)) = (5.58 \pm 0.57 \pm 0.40 \pm 0.32) \times 10^{-2} \) which we multiply by our best value \( \Gamma(B_s^0 \rightarrow \psi(2S)K^*(892)^0) = (5.9 \pm 0.4) \times 10^{-4} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.
\[ \Gamma_{81}/\Gamma_{44} \]

<table>
<thead>
<tr>
<th>Value (units $10^{-2}$)</th>
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<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.9 $\pm 1.8 \pm 1.5$</td>
<td>AAIJ</td>
<td>13AC LHCb</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Uses $B(\chi_{c1} \rightarrow J/\psi \gamma) = (34.4 \pm 1.5)\%$. 

\[ \Gamma_{77}/\Gamma_{50} \]

<table>
<thead>
<tr>
<th>Value $0.34 \pm 0.04 \pm 0.03$</th>
<th>Document ID</th>
<th>TECN</th>
<th>Comment</th>
</tr>
</thead>
</table>

1 Assuming lepton universality for dimuon decay modes of $J/\psi$ and $\psi(2S)$ mesons, the ratio $B(J/\psi \rightarrow \mu^+\mu^-)/B(\psi(2S) \rightarrow \mu^+\mu^-) = B(J/\psi \rightarrow e^+e^-)/B(\psi(2S) \rightarrow e^+e^-) = 7.69 \pm 0.19$ was used.

\[ \Gamma_{82}/\Gamma \]

<table>
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<tr>
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<th>CL%</th>
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<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>0.77 $\pm 0.20$ OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 AAIJ 12AR reports $[\Gamma(B_s^0 \rightarrow \pi^+\pi^-)/\Gamma_{total}] / [B(B^0 \rightarrow \pi^+\pi^-)] \times [\Gamma(B^+ \rightarrow B_s^0)/\Gamma(B \rightarrow B_s^0)] = 0.050 \pm 0.11 \pm 0.009 \pm 0.004$ which we multiply or divide by our best values $B(B^0 \rightarrow \pi^+\pi^-) = (5.12 \pm 0.19) \times 10^{-6}$, $\Gamma(B \rightarrow B_s^0)/\Gamma(B \rightarrow B^0) = 0.256 \pm 0.014$. Our first error is their experiment’s error and our second error is the systematic error from using our best values.

2 AALTONEN 12l reports $[\Gamma(B_s^0 \rightarrow \pi^+\pi^-)/\Gamma_{total}] / [B(B^0 \rightarrow K^+\pi^-)] \times [\Gamma(B \rightarrow B_s^0)/\Gamma(B \rightarrow B^0)] = 0.008 \pm 0.002 \pm 0.001$ which we multiply or divide by our best values $B(B^0 \rightarrow K^+\pi^-) = (1.96 \pm 0.05) \times 10^{-5}$, $\Gamma(B \rightarrow B_s^0)/\Gamma(B \rightarrow B^0) = 0.256 \pm 0.014$. Our first error is their experiment’s error and our second error is the systematic error from using our best values.

3 Uses $\gamma(10860) \rightarrow B_s^+\overline{B_s}^-$ and assumes $B(\gamma(10860) \rightarrow B_s^{(*)}\overline{B_s}^{(*)}) = (19.3 \pm 2.9)\%$ and $\Gamma(\gamma(10860) \rightarrow B_s^{(*)}\overline{B_s}^{(*)}) = (90.1^{+3.8}_{-3.4})\%$.

4 Obtains this result from $(f_s/f_d) \cdot B(B_s \rightarrow \pi^+\pi^-)/B(B^0 \rightarrow K^+\pi^-) = 0.007 \pm 0.004 \pm 0.005$, assuming $f_s/f_d = 0.276 \pm 0.034$ and $B(B^0 \rightarrow K^+\pi^-) = (19.4 \pm 0.6) \times 10^{-6}$.

5 ABULENCIA,A 06D obtains this from $B(B_s \rightarrow \pi^+\pi^-)/B(B_s \rightarrow K^+K^-) < 0.05$ at 90% CL, assuming $B(B_s \rightarrow K^+K^-) = (33 \pm 6 \pm 7) \times 10^{-6}$.

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

7 BUSKULIC 96V assumes PDG 96 production fractions for $B^0$, $B^+$, $B_s$, $b$ baryons.
\( \frac{\Gamma(\pi^0 \pi^0)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;2.1 \times 10^{-4})</td>
<td>90</td>
<td>1 ACCIARRI 95H L3</td>
<td>(e^+ e^- \rightarrow Z)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)ACCIARRI 95H assumes \(\Gamma_{B^0} = 39.5 \pm 4.0\) and \(\Gamma_{B_s} = 12.0 \pm 3.0\%\).

\( \frac{\Gamma(\eta \pi^0)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;1.0 \times 10^{-3})</td>
<td>90</td>
<td>1 ACCIARRI 95H L3</td>
<td>(e^+ e^- \rightarrow Z)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)ACCIARRI 95H assumes \(\Gamma_{B^0} = 39.5 \pm 4.0\) and \(\Gamma_{B_s} = 12.0 \pm 3.0\%\).

\( \frac{\Gamma(\eta \eta)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;1.5 \times 10^{-3})</td>
<td>90</td>
<td>1 ACCIARRI 95H L3</td>
<td>(e^+ e^- \rightarrow Z)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)ACCIARRI 95H assumes \(\Gamma_{B^0} = 39.5 \pm 4.0\) and \(\Gamma_{B_s} = 12.0 \pm 3.0\%\).

\( \frac{\Gamma(\rho^0 \rho^0)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;3.20 \times 10^{-4})</td>
<td>90</td>
<td>1 ABE 00c SLD</td>
<td>(e^+ e^- \rightarrow Z)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)ABE 00c assumes \(B(Z \rightarrow b\bar{b})=(21.7 \pm 0.1)\%\) and the \(B\) fractions \(\Gamma_{B^0} = 39.7 +1.8\)\% and \(\Gamma_{B_s} = 10.5 +1.8\)\%,

\( \frac{\Gamma(\eta' \eta')}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-5}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3.3 \pm 0.7 \pm 0.1)</td>
<td>1 AAIJ 150 LHCb &amp; (pp \text{ at } 7, 8 \text{ TeV})</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)AAIJ 150 reports \([\frac{\Gamma(B^0_s \rightarrow \eta' \eta')}{\Gamma_{\text{total}}}]/[B(B^+ \rightarrow \eta' K^+)] = 0.47 \pm 0.09 \pm 0.04\) which we multiply by our best value \(B(B^+ \rightarrow \eta' K^+) = (7.06 \pm 0.25) \times 10^{-5}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\( \frac{\Gamma(\phi \rho^0)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;6.17 \times 10^{-4})</td>
<td>90</td>
<td>1 ABE 00c SLD</td>
<td>(e^+ e^- \rightarrow Z)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)ABE 00c assumes \(B(Z \rightarrow b\bar{b})=(21.7 \pm 0.1)\%\) and the \(B\) fractions \(\Gamma_{B^0} = 39.7 +1.8\)\% and \(\Gamma_{B_s} = 10.5 +1.8\)\%.

\( \frac{\Gamma(\phi)}{\Gamma_{\text{total}}} \)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(18.7 \pm 1.5 \text{ OUR FIT} )</td>
<td>(18.5 \pm 1.4 \pm 1.0)</td>
<td>AAIJ 15AS LHCb (pp \text{ at } 7, 8 \text{ TeV})</td>
<td></td>
</tr>
<tr>
<td>(14 \pm 6 \pm 5)</td>
<td>2 ACOSTA 05J CDF</td>
<td>Repl. by AALTONEN 11AN</td>
<td></td>
</tr>
</tbody>
</table>

\(^{\bullet \bullet \bullet} \) We do not use the following data for averages, fits, limits, etc. \(^{\bullet \bullet \bullet} \)

\(<183 \pm 6 \pm 5\) | 3 ABE 00c SLD | \(e^+ e^- \rightarrow Z\) |
1 AAIJ 15AS reports \[ \frac{\Gamma(B_s^0 \rightarrow \phi\phi)}{\Gamma_{\text{total}}} / \left[ \frac{\Gamma(B^0 \rightarrow K^+(892)0\phi)}{\Gamma(B^0 \rightarrow K^0)} \right] \] = 1.84 ± 0.05 ± 0.13 which we multiply by our best value \( B(B^0 \rightarrow K^+(892)0\phi) = (1.00 \pm 0.05) \times 10^{-5} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2 Uses \( B(B^0 \rightarrow J/\psi\phi) = (1.38 \pm 0.49) \times 10^{-3} \) and production cross-section ratio of \( \sigma(B_s^0)/\sigma(B^0) = 0.26 \pm 0.04 \).

3 ABE 00c assumes \( B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\% \) and the \( B \) fractions \( f_{B_0} = f_{B^+} = (39.7 \pm 1.8)\% \) and \( f_{B_s} = (10.5 \pm 1.8)\% \).

\[ \Gamma(\phi\phi)/\Gamma(J/\psi(1S)\phi) \]

\[ \Gamma_{89}/\Gamma_{44} \]

\[ \Gamma_90/\Gamma \]

\[ \text{VALUE (units 10}^{-3}\text{)} \quad \text{DOCUMENT ID} \quad \text{TECN} \quad \text{COMMENT} \]

\[ 1.74 \pm 0.16 \quad \text{OUR FIT} \quad \text{AALTONEN} \quad 11AN CDF \quad p\bar{p} \text{ at 1.96 TeV} \]

\[ 1.78 \pm 0.14 \pm 0.20 \]

\[ \text{VALUE (units 10}^{-6}\text{)} \quad \text{CL\%} \quad \text{DOCUMENT ID} \quad \text{TECN} \quad \text{COMMENT} \]

\[ 5.6 \pm 0.6 \pm 0.3 \quad 1 \quad \text{AAII} \quad 12AR LHC \quad pp \text{ at 7 TeV} \]

\[ 5.5 \pm 0.9 \pm 0.3 \quad 2 \quad \text{AALTONEN} \quad 09c CDF \quad p\bar{p} \text{ at 1.96 TeV} \]

\[ \text{• • • We do not use the following data for averages, fits, limits, etc. • • •} \]

\[ < 26 \quad 90 \quad 3 \quad \text{PENG} \quad 10 BELL \quad e^+e^- \rightarrow \Upsilon(5S) \]

\[ < 5.6 \quad 90 \quad 4 \quad \text{ABULENCIA, A} \quad 06d \quad \text{CDF} \quad \text{Repl. by AALTONEN 09c} \]

\[ < 261 \quad 90 \quad 5 \quad \text{ABE} \quad 00c SLD \quad e^+e^- \rightarrow Z \]

\[ < 210 \quad 90 \quad 6 \quad \text{BUSHKULIC} \quad 96v \quad \text{ALEP} \quad e^+e^- \rightarrow Z \]

\[ < 260 \quad 90 \quad 7 \quad \text{AKERS} \quad 94l \quad \text{OPAL} \quad e^+e^- \rightarrow Z \]

\[ 1 \quad \text{AAII 12AR reports} \quad \frac{\Gamma(B_s^0 \rightarrow \pi^+ K^-)/\Gamma_{\text{total}}}{\Gamma(B^0 \rightarrow K^+ \pi^-)} \times \frac{\Gamma(B \rightarrow B^0)}{\Gamma(B \rightarrow B^0)} = 0.074 \pm 0.006 \pm 0.006 \text{ which we multiply or divide by our best values} \]

\[ B(B^0 \rightarrow K^+ \pi^-) = (1.96 \pm 0.05) \times 10^{-5} \text{, } \Gamma(B \rightarrow B^0)/\Gamma(B \rightarrow B^0) = 0.256 \pm 0.014. \]

Our first error is their experiment’s error and our second error is the systematic error from using our best values.

\[ 2 \quad \text{AAII 09C reports} \quad \frac{\Gamma(B_s^0 \rightarrow \pi^+ K^-)/\Gamma_{\text{total}}}{\Gamma(B^0 \rightarrow K^+ \pi^-)} \times \frac{\Gamma(B \rightarrow B^0)}{\Gamma(B \rightarrow B^0)} = 0.071 \pm 0.010 \pm 0.007 \text{ which we multiply or divide by our best values} \]

\[ B(B^0 \rightarrow K^+ \pi^-) = (1.96 \pm 0.05) \times 10^{-5} \text{, } B(B \rightarrow B^0) = (10.3 \pm 0.5) \times 10^{-2}, \]

\[ B(B \rightarrow B^0) = (40.4 \pm 0.6) \times 10^{-2} \text{. Our first error is their experiment’s error and our second error is the systematic error from using our best values.} \]

\[ 3 \quad \text{Uses} \quad \Upsilon(10860) \rightarrow B^*_s \bar{B}^* \quad \text{and assumes} \quad B(\Upsilon(10860) \rightarrow B^*_s \bar{B}^*_s^{(*)}) = (19.3 \pm 2.9)\% \quad \text{and} \quad \Gamma(\Upsilon(10860) \rightarrow B^*_s \bar{B}^*_s^{(*)})/\Gamma(\Upsilon(10860) \rightarrow B^*_s \bar{B}^*_s^{(*)}) = (90.1 \pm 3.8)\%. \]

\[ 4 \quad \text{ABULENCIA, A 06D obtains this from} \quad \frac{f_s}{f_d} \quad B(B_s \rightarrow \pi^+ K^-) / B(B^0 \rightarrow K^+ \pi^-) \quad \text{< 0.08 at 90\% CL, assuming} \quad f_s/f_d = 0.260 \pm 0.039 \text{ and } B(B^0 \rightarrow K^+ \pi^-) = (18.9 \pm 0.7) \times 10^{-6} \text{.} \]

\[ 5 \quad \text{ABE 00C assumes} \quad B(Z \rightarrow b\bar{b}) = (21.7 \pm 0.1)\% \quad \text{and the } \text{B fractions} \quad f_{B^0} = f_{B^+} = (39.7 \pm 1.8)\% \text{ and } f_{B_s} = (10.5 \pm 1.8)\%. \]

\[ 6 \quad \text{BUSHKULIC 96V assumes PDG 96 production fractions for} \quad B^0, B^+, B_s, b \text{ baryons.} \]

\[ 7 \quad \text{Assumes} \quad B(Z \rightarrow b\bar{b}) = 0.217 \text{ and } B^0_b(B^0)^b_s \text{ fraction 39.5(12)\%.} \]
\[ \frac{\Gamma(K^+ K^-)}{\Gamma_{\text{total}}} \]

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.2 ± 1.7 OUR AVERAGE</td>
<td>1</td>
<td>AAIJ 12AR LHCB</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
<tr>
<td>26.1 ± 2.2 ± 1.7</td>
<td>2</td>
<td>AALTONEN 11N CDF</td>
<td>p\overline{p} at 1.96 TeV</td>
<td></td>
</tr>
<tr>
<td>38 ± 10/9 ± 7</td>
<td>3</td>
<td>PENG 10 BELL</td>
<td>e^+ e^- → \Upsilon(5S)</td>
<td></td>
</tr>
</tbody>
</table>

- We do not use the following data for averages, fits, limits, etc.
  - AAIJ 12AR reports \( [\Gamma(B^0_s \rightarrow K^+ K^-)/\Gamma_{\text{total}}] / [B(B^0 \rightarrow K^+ \pi^-)] \times [\Gamma(B \rightarrow B^0_s)/\Gamma(B \rightarrow B^0)] = 0.316 \pm 0.009 \pm 0.019\) which we multiply or divide by our best values \(B(B^0 \rightarrow K^+ \pi^-) = (1.96 \pm 0.05) \times 10^{-5}\). Our first error is their experiment's error and our second error is the systematic error from using our best values.

- AALTONEN 11N reports \( f_s/f_d \) \( B(B^0_s \rightarrow K^+ K^-) / B(B^0 \rightarrow K^+ \pi^-) = 0.347 \pm 0.020 \pm 0.021\). We multiply this result by our best value of \(B(B^0 \rightarrow K^+ \pi^-) = (1.96 \pm 0.05) \times 10^{-5}\) and divide by our best value of \(f_s/f_d\), where \(1/2 f_s/f_d = 0.130 \pm 0.008\). Our first quoted uncertainty is the combined experiment's uncertainty and our second is the systematic uncertainty from using our best values.

- Uses \( \Upsilon(10860) \rightarrow B^+_s B^-_s^* \) and assumes \(B(\Upsilon(10860) \rightarrow B^+_s B^-_s^*) = (19.3 \pm 2.9)\%\) and \(\Gamma(\Upsilon(10860) \rightarrow B^+_s B^-_s^*) / \Gamma(\Upsilon(10860) \rightarrow B^+_s B^-_s^*) = (90.1 \pm 3.8)\%\).

- ABE 00C assumes \(B(\Upsilon \rightarrow b\overline{b}) = 0.217\) and \(B^0_d(B^0_s) = 39.5\% (12)\%\).
\(\Gamma(K^*(892)^-\pi^+)/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3±1.2±0.3</td>
<td>1,2 AAIJ</td>
<td>14BM LHC B pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. AAUJ 14bm reports \(\Gamma(B_s^0 \rightarrow K^*(892)^-\pi^+)/\Gamma_{\text{total}}\) / \(B(B_s^0 \rightarrow K^*(892)^-\pi^-)\) = 0.39 ± 0.13 ± 0.05, which we multiply by our best value \(B(B_s^0 \rightarrow K^*(892)^-\pi^-) = (8.4 ± 0.8) \times 10^{-6}\). Our first error is their experiment's error and our second error is the systematic error from using our best value.

2. Uses \(f_s/f_d = 0.259 ± 0.015\).

\(\Gamma(K^0 K^{\pm}\pi^+)/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-5}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.7±1.0±0.4</td>
<td>1 AAUJ</td>
<td>13BP LHC B pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. AAUJ 13bp reports \(\Gamma(B^0 \rightarrow K^0 K^{\pm}\pi^+)/\Gamma_{\text{total}}\) / \(B(B^0 \rightarrow K^0\pi^+\pi^-)\) = 1.48 ± 0.12 ± 0.14, which we multiply by our best value \(B(B^0 \rightarrow K^0\pi^+\pi^-) = (5.20 ± 0.24) \times 10^{-5}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\(\Gamma(K^*(892)^\pm K^{\mp})/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-5}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25±0.24±0.11</td>
<td>1 AAUJ</td>
<td>14BM LHC B pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. AAUJ 14BM reports \(\Gamma(B_s^0 \rightarrow K^*(892)^\pm K^{\mp})/\Gamma_{\text{total}}\) / \(B(B_s^0 \rightarrow K^*(892)^\pm K^{\mp})\) = 1.49 ± 0.22 ± 0.18, which we multiply by our best value \(B(B_s^0 \rightarrow K^*(892)^\pm K^{\mp}) = (8.4 ± 0.8) \times 10^{-6}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

2. Uses \(f_s/f_d = 0.259 ± 0.015\).

\(\Gamma(K_S^0 K^*(892)^0 + c.c.)/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.4±3.4±2.3</td>
<td>1 AAUJ</td>
<td>16 LHC B pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. Measured relative to \(B^0 \rightarrow K_S^0\pi^+\pi^-\) using the value of \(B(B^0 \rightarrow K_S^0\pi^+\pi^-) = (4.96 ± 0.2) \times 10^{-5}\).

\(\Gamma(K^0 K^+ K^-)/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.5 \times 10^{-6}</td>
<td>90</td>
<td>1 AAUJ</td>
<td>13BP LHC B pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1. AAUJ 13BP reports \(\Gamma(B_s^0 \rightarrow K^0 K^+ K^-)/\Gamma_{\text{total}}\) / \(B(B_s^0 \rightarrow K^0\pi^+\pi^-)\) < 0.068, which we multiply by our best value \(B(B_s^0 \rightarrow K^0\pi^+\pi^-) = 5.20 \times 10^{-5}\).

\(\Gamma(K^*(892)^0 \rho^0)/\Gamma_{\text{total}}\)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-4}))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7.67 \times 10^{-4}</td>
<td>90</td>
<td>1 ABE</td>
<td>00C SLD e^+ e^- \rightarrow Z</td>
<td></td>
</tr>
</tbody>
</table>

1. ABE 00c assumes \(B(Z \rightarrow b\bar{b}) = (21.7 ± 0.1)\%\) and the \(B\) fractions \(f_{b^0} = f_{b^+} = (39.7 \pm 1.8)\%\) and \(f_{b_s} = (10.5 \pm 1.8)\%\).

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\(\Gamma(K^{*}(892)^{0} K^{*}(892)^{0})/\Gamma_{\text{total}}\)  

<table>
<thead>
<tr>
<th>VALUE (units 10^{-5})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.11 ± 0.26 ± 0.06</td>
<td>1</td>
<td>AAIJ</td>
<td>15AF</td>
<td>LHCB</td>
</tr>
</tbody>
</table>

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

2. AAIJ 15AF reports \(\Gamma(K^{*}(892)^{0} K^{*}(892)^{0})/\Gamma_{\text{total}}\) / \(B(K^{*}(892)^{0} \rightarrow K^{+}(892)^{0} \phi)\) = 1.11 ± 0.22 ± 0.12 ± 0.06 which we multiply by our best value \(B(B^{0} \rightarrow K^{*}(892)^{0} \phi)\) = (1.00 ± 0.05) \times 10^{-5}. Our first error is their experiment’s error and our second error is the systematic error from using our best value.

3. 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 \(f_{B_{s}}=(10.5^{+1.8}_{-2.2})\%\).

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

<table>
<thead>
<tr>
<th>VALUE (units 10^{-6})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.14 ± 0.29 ± 0.06</td>
<td>1</td>
<td>AAIJ</td>
<td>13BW</td>
<td>LHCB</td>
</tr>
</tbody>
</table>

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

2. 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 \(f_{B_{s}}=(10.5^{+1.8}_{-2.2})\%\).

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

Test for \(\Delta B=1\) weak neutral current. Allowed by higher-order electroweak interactions.  

<table>
<thead>
<tr>
<th>VALUE (units 10^{-8})</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.84 ± 2.03 ± 0.85</td>
<td>1</td>
<td>AAIJ</td>
<td>13BQ</td>
<td>LHCB</td>
</tr>
</tbody>
</table>

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

2. Uses normalization mode \(B(B^{0} \rightarrow K^{+} \pi^{-})=(19.55 \pm 0.54) \times 10^{-6}\) and \(B\) production ratio \(f(B^{0} \rightarrow B^{0} )/f(B^{0} \rightarrow B^{0} )=0.256 \pm 0.020\).

\(\Gamma(\Lambda_{c}^{-} \Lambda_{c}^{+})/\Gamma_{\text{total}}\)  

<table>
<thead>
<tr>
<th>VALUE (units 10^{-4})</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6 ± 1.1 ± 1.2</td>
<td>1 SOLOVIEVA</td>
<td>BELL</td>
<td>e^{+}e^{-} \rightarrow \gamma(4S)</td>
</tr>
</tbody>
</table>

1. The second error is the total systematic uncertainty including the \(\Lambda_{c}\) absolute branching fractions and the normalization number of \(B_{s}\) events.
\( \Gamma(\Lambda^+_c \Lambda^+_c) / \Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;8.0 \times 10^{-5})</td>
<td>95</td>
<td>1 AAIJ</td>
<td>14AA LHCB</td>
<td>(p)p at 7 TeV</td>
</tr>
</tbody>
</table>

1 Uses \(B(B^0 \to D^+ D^-_s) = (7.2 \pm 0.8) \times 10^{-3}\).

\( \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \)

Test for \(\Delta B = 1\) weak neutral current.

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt; 3.1)</td>
<td>90</td>
<td>1 DUTTA</td>
<td>15 BELL</td>
<td>(e^+ e^- \to \Upsilon(5S))</td>
</tr>
</tbody>
</table>

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

- 8.7 90 2 WICHT 08A BELL Repl. by DUTTA 15
- 34 90 3 ACCIARRI 95i L3 \(e^+ e^- \to Z\)

1 Assumes the fraction of \(B_s^{(*)} B_s^{(*)}\) in \(b\bar{b}\) events is \(f_s = (17.2 \pm 3.0)\%\).

2 Assumes \(\Upsilon(5S) \to B_s^{(*)} B_s^{(*)} = (19.5 \pm 3.0)\%\).

3 ACCIARRI 95i assumes \(f_{B_s^0} = 39.5 \pm 4.0\) and \(f_{B_s^0} = (12.0 \pm 3.0)\%\).

\( \Gamma(\phi)/\Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE (units (10^{-6}))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(35.2 \pm 3.4) OUR AVERAGE</td>
<td></td>
<td>1 DUTTA</td>
<td>15 BELL</td>
<td>(e^+ e^- \to \Upsilon(5S))</td>
</tr>
</tbody>
</table>

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

- 36 \(\pm 5 \pm 7\) 2 AAIJ 13 LHCB \(p\)p at 7 TeV
- 35.1 \(\pm 3.5 \pm 1.2\) 2 AAIJ 13 LHCB \(p\)p at 7 TeV

1 Assumes the fraction of \(B_s^{(*)} B_s^{(*)}\) in \(b\bar{b}\) events is \(f_s = (17.2 \pm 3.0)\%\). The systematic uncertainty from \(f_s\) is \(0.6 \times 10^{-5}\).

2 AAIJ 13 reports \[\Gamma(B_s^{(*)} \rightarrow \phi \gamma)/\Gamma_{\text{total}}\] / \(B(B^0 \to K^{*}(892)^0 \gamma)\) = 0.81 \(\pm 0.04 \pm 0.07\)

which we multiply by our best value \(B(B^0 \to K^{*}(892)^0 \gamma) = (4.33 \pm 0.15) \times 10^{-5}\).

Our first error is their experiment’s error and our second error is the systematic error from using our best value.

3 Measures \(B(B^0 \to K_s^{(*)} \gamma)/B(B_s \to \phi \gamma) = 1.12 \pm 0.08(\text{stat}) +0.06(\text{sys}) +0.09(\text{sys}) -0.08(\text{sys})\)

and uses current world-average value of \(B(B^0 \to K^{(*)} \gamma) = (4.33 \pm 0.15) \times 10^{-5}\).

4 Assumes \(\Upsilon(5S) \to B_s^{(*)} B_s^{(*)} = (19.5 \pm 3.0)\%\).

5 ADAM 96D assumes \(f_{B_s^0} = f_{B_s^-} = 0.39\) and \(f_{B_s^0} = 0.12\).
\[ \Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} \]

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

<table>
<thead>
<tr>
<th>VALUE (units $10^{-9}$)</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9$^{+0.7}_{-0.6}$ OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.8$^{+0.7}_{-0.6}$</td>
<td>1</td>
<td>KHACHATRYAN$^{15BE}$ LHC</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>13$^{+9}_{-7}$</td>
<td>2</td>
<td>AALTONEN 13F CDF</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
<td></td>
</tr>
</tbody>
</table>

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

1 Determined from the joint fit to CMS and LHCb data. Uncertainty includes both statistical and systematic component.

2 Uses normalization mode $B(\bar{B}^0 \rightarrow J/\psi K^+)$ = $(10.22 \pm 0.35) \times 10^{-4}$ and $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.28 \pm 0.04$.

3 Uses $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.256 \pm 0.020$ and two normalization modes: $B(\bar{B}^0 \rightarrow J/\psi K^+ \rightarrow \mu^+\mu^- K^+) = (6.01 \pm 0.21) \times 10^{-5}$ and $B(\bar{B}^0 \rightarrow K^+\pi^-) = (1.94 \pm 0.06) \times 10^{-5}$.

4 Uses $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.259 \pm 0.015$ and normalization modes $B^+ \rightarrow J/\psi K^+ \rightarrow \mu^+\mu^- K^+$ and $B^0 \rightarrow K^+\pi^-$. 

5 Uses normalization mode $B(\bar{B}^+ \rightarrow J/\psi K^+ \rightarrow \mu^+\mu^- K^+) = (6.01 \pm 0.21) \times 10^{-5}$ and $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.263 \pm 0.017$.

6 Uses $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.256 \pm 0.020$ and $B(\bar{B}^+ \rightarrow J/\psi K^+ \rightarrow \mu^+\mu^- K^+) = (6.0 \pm 0.2) \times 10^{-5}$ for normalization.

7 Uses $B$ production ratio $f(\bar{B} \rightarrow B_s^0)/f(\bar{B} \rightarrow B_d^0) = 0.256 \pm 0.020$ and $B(\bar{B}^+ \rightarrow J/\psi K^+ \rightarrow \mu^+\mu^- K^+) = (6.0 \pm 0.2) \times 10^{-5}$.
8 Uses $B$ production ratio $f(\overline{B} \to B_s^0) / f(\overline{B} \to B_d^0) = 0.267 \pm 0.021$ and three normalization modes $B(B \to J/\psi K^+) = (6.01 \pm 0.21) \times 10^{-5}$, $B(B \to K^+\pi^-) = (1.94 \pm 0.06) \times 10^{-5}$, and $B(B_s \to J/\psi \phi \to \mu^+ \mu^- K^+ K^-) = (3.4 \pm 0.9) \times 10^{-5}$.

9 Uses $B$ production ratio $f(\overline{B} \to B_s^0) / f(\overline{B} \to B_d^0) = 0.267 \pm 0.021$ and three normalization modes $B^+ \to J/\psi K^+$, $B_s^0 \to K^+ \pi^-$, and $B_s^0 \to J/\psi \phi$.

10 Uses $f_s/f_d = 0.267 \pm 0.021$ and $B(B \to J/\psi K^+ \to \mu^+ \mu^- K^+) = (6.0 \pm 0.2) \times 10^{-5}$.

11 Uses $B$ production ratio $f(\overline{B} \to B^+) / f(\overline{B} \to B_s^0) = 3.71 \pm 0.47$ and three normalization modes.

12 Uses $B$ production ratio $f(\overline{B} \to B^+) / f(\overline{B} \to B_s^0) = 3.55 \pm 0.47$ and $B(B^+ \to J/\psi K^+ \to \mu^+ \mu^- K^+) = (6.01 \pm 0.21) \times 10^{-5}$.

13 Uses $B$ production ratio $f(\overline{B} \to B^+) / f(\overline{B} \to B_s^0) = 3.55 \pm 0.42$ and $B(B^+ \to J/\psi K^+ \to \mu^+ \mu^- K^+) = (6.0 \pm 0.2) \times 10^{-5}$.

14 Uses $B$ production ratio $f(\overline{B} \to B^+) / f(\overline{B} \to B_s^0) = 3.86 \pm 0.59$, and the number of $B^+ \to J/\psi K^+$ decays.

15 Uses $B$ production ratio $f(\overline{B} \to B^+) / f(\overline{B} \to B_s^0) = 3.86 \pm 0.54$ and the number of $B^+ \to J/\psi K^+$ decays.

16 Assumes production cross-section $\sigma(B_s) / \sigma(B^+) = 0.270 \pm 0.034$.

17 Assumes production cross section $\sigma(B^+) / \sigma(B_s) = 3.71 \pm 0.41$ and $B(B^+ \to J/\psi K^+ \to \mu^+ \mu^- K^+) = (5.88 \pm 0.26) \times 10^{-5}$.

18 Assumes production cross-section $\sigma(B_s) / \sigma(B^+) = 0.100/0.391$ and the CDF measured value of $\sigma(B^+) = 3.6 \pm 0.6 \mu$b.

19 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.

20 ACCIARRI 97b assume PDG 96 production fractions for $B^+, B^0, B_s$, and $\Lambda_b$.

21 ABE 96 assumes $B^+/B_s^0$ production ratio 3/1. They normalize to their measured $\sigma(B^+, p_T(B) > 6 \text{ GeV}/c, |y| < 1) = 2.39 \pm 0.54 \mu$b.

$\Gamma(e^+ e^-) / \Gamma_{\text{total}}$ Test for $\Delta B = 1$ weak neutral current.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;2.8 \times 10^{-7}$</td>
<td>90</td>
<td>AALTONEN 09P</td>
<td>CDF</td>
<td>$p \overline{p}$ at 1.96 TeV</td>
</tr>
<tr>
<td>$&lt;5.4 \times 10^{-5}$</td>
<td>90</td>
<td>ACCIARRI 97B</td>
<td>L3</td>
<td>$e^+ e^- \to Z$</td>
</tr>
</tbody>
</table>

1 ACCIARRI 97b assume PDG 96 production fractions for $B^+, B^0, B_s$, and $\Lambda_b$.

$\Gamma(\mu^+ \mu^- + \mu^+ \mu^-) / \Gamma_{\text{total}}$  $\Gamma_{109}/\Gamma$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;1.2 \times 10^{-8}$</td>
<td>90</td>
<td>AAII J 13LHC</td>
<td>13AW</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Also reports a limit of $< 1.6 \times 10^{-8}$ at 95% CL.

$\Gamma(S, P \to \mu^+ \mu^-)$  $\Gamma_{110}/\Gamma$

Here $S$ and $P$ are the hypothetical scalar and pseudoscalar particles with masses of 2.5 GeV/c$^2$ and 214.3 MeV/c$^2$, respectively.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt;1.2 \times 10^{-8}$</td>
<td>90</td>
<td>AAII J 13LHC</td>
<td>13AW</td>
<td>$pp$ at 7 TeV</td>
</tr>
</tbody>
</table>

1 Also reports a limit of $< 1.6 \times 10^{-8}$ at 95% CL.
\( \Gamma(\phi(1020)\mu^+\mu^-)/\Gamma_{\text{total}} \)

Test for \( \Delta B = 1 \) weak neutral current.

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-7} ))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;32)</td>
<td>90</td>
<td>1 ABAZOYOU</td>
<td>06G</td>
<td>D0 ( p\bar{p} ) at 1.96 TeV</td>
</tr>
<tr>
<td>(&lt;4.7 \times 10^2)</td>
<td>90</td>
<td>ACOSTA02D</td>
<td>CDF</td>
<td>( p\bar{p} ) at 1.8 TeV</td>
</tr>
</tbody>
</table>

1 Uses \( B(B^0 \to J/\psi \phi) = 9.3 \times 10^{-4} \).

\( \Gamma_{\text{111}}/\Gamma \)

\( \Gamma(\phi(1020)\mu^+\mu^-)/(J/\psi(1S)\phi) \)

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-3} ))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.76 \pm 0.09 ) OUR AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.741 \pm 0.042 \pm 0.029)</td>
<td>AAIJ</td>
<td>15AQ LHC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.13 \pm 0.19 \pm 0.07)</td>
<td>AALTONEN</td>
<td>11L CDF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

\(1\) Replaced by AAIJ 15AQ.

\( \Gamma_{\text{111}}/\Gamma_{\text{44}} \)

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

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-8} ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(8.4 \pm 1.6 \pm 0.3)</td>
<td>1 AAIJ</td>
<td>15S</td>
<td>LHC</td>
</tr>
</tbody>
</table>

1 AAIJ 15S reports \( (8.6 \pm 1.5 \pm 0.7 \pm 0.7) \times 10^{-8} \) from a measurement of \( [\Gamma(B_s^0 \to \pi^+\pi^-\mu^+\mu^-)/\Gamma_{\text{total}}] / [B(B^0 \to J/\psi(1S)\phi^*(892)^0)] \) assuming \( B(B^0 \to J/\psi(1S)\phi^*(892)^0) = (1.3 \pm 0.1) \times 10^{-3} \), which we rescale to our best value \( B(B^0 \to J/\psi(1S)\phi^*(892)^0) = (1.28 \pm 0.05) \times 10^{-3} \). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\( \Gamma_{\text{112}}/\Gamma \)

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

Test for \( \Delta B = 1 \) weak neutral current.

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-3} ))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;5.4 \times 10^{-3})</td>
<td>90</td>
<td>1 ADAM</td>
<td>96D</td>
<td>DLPH</td>
</tr>
</tbody>
</table>

\(1\) ADAM 96D assumes \( f_{B_s} = f_{B^0} = 0.39 \) and \( f_{B_d} = 0.12 \).

\( \Gamma_{\text{113}}/\Gamma \)

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

Test of lepton family number conservation.

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-8} ))</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;1.1 \times 10^{-8})</td>
<td>90</td>
<td>1 AAIJ</td>
<td>13BMLHC</td>
<td>( p\bar{p} ) at 7 TeV</td>
</tr>
</tbody>
</table>

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

\(1\) Uses normalization mode \( B(B^0 \to K^+\pi^-) = (19.4 \pm 0.6) \times 10^{-6} \) and \( B \) production ratio \( f(B^0 \to B^0_s)/f(B \to B^0_d) = 0.256 \pm 0.020 \).

\(2\) AALTONEN 97B assume PDG 96 production fractions for \( B^+, B^0, B_s, \) and \( \Lambda_b \).
POLARIZATION IN $B^0_s$ DECAY

In decays involving two vector mesons, one can distinguish among the states in which meson polarizations are both longitudinal ($L$), or both are transverse and parallel ($||$), or perpendicular ($\perp$) to each other with the parameters $\Gamma_L/\Gamma$, $\Gamma_{\perp}/\Gamma$, and the relative phases $\phi_{||}$ and $\phi_{\perp}$. See the definitions in the note on “Polarization in B Decays” review in the $B^0$ Particle Listings.

$\Gamma_L/\Gamma$ in $B^0_s \rightarrow D_s^* \rho^+$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.05^{+0.08+0.03}_{-0.10-0.04}$</td>
<td>LOUVOT 10</td>
<td>BELL</td>
<td>$e^+ e^- \rightarrow \Upsilon(5S)$</td>
</tr>
</tbody>
</table>

$\Gamma_{\perp}/\Gamma$ in $B^0_s \rightarrow J/\psi(1S)\phi$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.528 \pm 0.006$ OUR AVERAGE</td>
<td>AAIJ 15I AAD 14U AALTONEN 12D ABAZOV 12D AFFOLDER 00N ABE 95Z</td>
<td>LHCb ATLS CDF D0 CDF</td>
<td>$p p at 7, 8 TeV$ $pp at 7 TeV$ $p\bar{p} at 1.96 TeV$ $p\bar{p} at 1.96 TeV$ $p p at 1.8 TeV$ $p p at 1.8 TeV$</td>
</tr>
<tr>
<td>$0.5241 \pm 0.0034 \pm 0.0067$</td>
<td>$0.529 \pm 0.0006 \pm 0.012$</td>
<td>$0.524 \pm 0.013 \pm 0.015$</td>
<td>$0.558^{+0.017-0.019}$</td>
</tr>
<tr>
<td>1 AAD</td>
<td>2 AALTONEN</td>
<td>2,3 ABAZOV</td>
<td>4 AFFOLDER</td>
</tr>
</tbody>
</table>

We do not use the following data for averages, fits, limits, etc. 1 2 3 4 5

1 Measured using the flavor tagged, time-dependent angular analysis of $B^0_s \rightarrow J/\psi\phi$ decays.
2 Measured using the time-dependent angular analysis of $B^0_s \rightarrow J/\psi\phi$ decays.
3 The error includes both statistical and systematic uncertainties.
4 AFFOLDER 00N measurements are based on 40 $B^0_s$ candidates obtained from a data sample of 89 pb$^{-1}$. The $P$-wave fraction is found to be $0.23 \pm 0.19 \pm 0.04$.
5 Measured the angular and lifetime parameters for the time-dependent angular untagged decays $D^0_{q} \rightarrow J/\psi K^{*0}$ and $B^0_s \rightarrow J/\psi\phi$.

$\Gamma_{\perp}/\Gamma$ in $B^0_s \rightarrow D_s^+ D_s^-$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.06^{+0.18}_{-0.17} \pm 0.03$</td>
<td>ESEN 13</td>
<td>BELL</td>
<td>$e^+ e^- \rightarrow \Upsilon(5S)$</td>
</tr>
</tbody>
</table>

$\Gamma_{||}/\Gamma$ in $B^0_s \rightarrow J/\psi(1S)\phi$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.224 \pm 0.010$ OUR AVERAGE</td>
<td>AAD 14U AALTONEN 12D ABAZOV 12D</td>
<td>ATLS CDF D0</td>
<td>$p p at 7 TeV$ $p\bar{p} at 1.96 TeV$ $p\bar{p} at 1.96 TeV$</td>
</tr>
<tr>
<td>$0.220 \pm 0.008 \pm 0.009$</td>
<td>$0.231 \pm 0.014 \pm 0.015$</td>
<td>$0.231^{+0.024-0.030}$</td>
<td></td>
</tr>
<tr>
<td>1 AAD</td>
<td>2 AALTONEN</td>
<td>2,3 ABAZOV</td>
<td></td>
</tr>
</tbody>
</table>

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
We do not use the following data for averages, fits, limits, etc. • • •

0.224 ± 0.010 ± 0.009 2 AAD 12CV ATLS Repl. by AAD 14u
0.244 ± 0.032 ± 0.014 4 ABAZOV 09e D0 Repl. by ABAZOV 12d
0.230 ± 0.029 ± 0.011 2 AALTONEN 08J CDF Repl. by AALTONEN 12d
0.260 ± 0.084 ± 0.013 ACOSTA 05 CDF Repl. by AALTONEN 08J

1 Measured using a tagged, time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.
2 Measured using the time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.
3 The error includes both statistical and systematic uncertainties.
4 Measured the angular and lifetime parameters for the time-dependent angular untagged decays $B^0_d \rightarrow J/\psi K^*$ and $B^0_s \rightarrow J/\psi \phi$.

$\Gamma_{\perp}/\Gamma$ in $B^0_s \rightarrow J/\psi (1S)\phi$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2504 ± 0.0049 ± 0.0036</td>
<td>AAIJ 15i LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
</tbody>
</table>

$\phi_{||}$ in $B^0_s \rightarrow J/\psi (1S)\phi$

<table>
<thead>
<tr>
<th>VALUE (rad)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.23 $^{+0.10}_{-0.14}$ OUR AVERAGE</td>
<td>AAIJ 15i LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>3.26 $^{+0.10}<em>{-0.17}$ 4 0.06 $^{+0.06}</em>{-0.07}$</td>
<td>AAIJ 15i LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>3.15 ± 0.22</td>
<td>ABAZOV 12d D0</td>
<td>$p\overline{p}$ at 1.96 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 The error includes both statistical and systematic uncertainties.

$\phi_{||}$ in $B^0_s \rightarrow J/\psi (1S)\phi$

<table>
<thead>
<tr>
<th>VALUE (rad)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.16 ± 0.24 OUR AVERAGE</td>
<td>AAIJ 15i LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>3.08 $^{+0.14}_{-0.15}$ 4 0.06</td>
<td>AAIJ 15i LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
<tr>
<td>3.89 ± 0.47 ± 0.11</td>
<td>AAD 14u ATLS</td>
<td>$pp$ at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 Measured using a tagged, time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.

$\Gamma_L/\Gamma$ for $B^0_s \rightarrow J/\psi (1S) \overline{K}^*(892)^0$

Longitudinal polarization fraction, equals to $f_L$ using notation of “Polarization in $B$ decays” review.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
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<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.497 ± 0.025 ± 0.025</td>
<td>AAIJ 15AV LHCB</td>
<td>$pp$ at 7, 8 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 The non-resonant $K \pi$ background contributions are subtracted. Also reports an $S$-wave amplitude $|A_S|^2 = 0.07^{+0.15}_{-0.07}$.

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

0.50 ± 0.08 ± 0.02 1 AAIJ 12AP LHCB Repl. by AAIJ 15AV

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
\[ \Gamma_\parallel / \Gamma \text{ for } B_s^0 \to J/\psi(1S)K^{*}(892)^0 \]

Parallel polarization fraction, equals to \( 1 - f_L - f_\perp \) using notation of “Polarization in \( B \) decays” review.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.179±0.027±0.013</td>
<td>AAIJ</td>
<td>15AV</td>
<td>LHCB pp at 7, 8 TeV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.19±0.10−0.08±0.02</td>
<td>1 AAIJ</td>
<td>12AP</td>
<td>LHCB Repl. by AAIJ 15AV</td>
</tr>
</tbody>
</table>

1 The non-resonant \( K\pi \) background contributions are subtracted. Also reports an \( S \)-wave amplitude \( |A_S|^2 = 0.07 \pm 0.15 \pm 0.07 \).

\[ \Gamma_\parallel / \Gamma \text{ of } K^{*}(892)^0 \text{ in } B_s^0 \to \psi(2S)K^{*}(892)^0 \]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.524±0.056±0.029</td>
<td>AAIJ</td>
<td>15U</td>
<td>LHCB pp at 7, 8 TeV</td>
</tr>
</tbody>
</table>

\[ \Gamma_\perp / \Gamma \text{ in } B_s^0 \to \phi \phi \]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.362±0.014 OUR AVERAGE</td>
<td>AAIJ</td>
<td>14AE</td>
<td>LHCB pp at 7, 8 TeV</td>
</tr>
<tr>
<td>0.364±0.012±0.009</td>
<td>AAIJ</td>
<td>14AE</td>
<td>LHCB pp at 7, 8 TeV</td>
</tr>
<tr>
<td>0.348±0.041±0.021</td>
<td>AALTONEN</td>
<td>11AN</td>
<td>CDF ( p\bar{p} ) at 1.96 TeV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.365±0.022±0.012</td>
<td>AAIJ</td>
<td>12P</td>
<td>LHCB Repl. by AAIJ 14AE</td>
</tr>
</tbody>
</table>

\[ \phi_\parallel \text{ in } B_s^0 \to \phi \phi \]

<table>
<thead>
<tr>
<th>VALUE (rad)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tr>
<td>2.55±0.11 OUR AVERAGE</td>
<td>1 AAIJ</td>
<td>14AE</td>
<td>LHCB pp at 7, 8 TeV</td>
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<td>14AE</td>
<td>LHCB pp at 7, 8 TeV</td>
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<tr>
<td>2.71±0.31−0.36±0.22</td>
<td>2 AALTONEN</td>
<td>11AN</td>
<td>CDF ( p\bar{p} ) at 1.96 TeV</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>2.57±0.15±0.06</td>
<td>3 AAIJ</td>
<td>12P</td>
<td>LHCB Repl. by AAIJ 14AE</td>
</tr>
</tbody>
</table>

1 AAIJ 14AE reports measurement of \( \phi_\perp \) and \( \phi_\perp - \phi_\parallel \), which we convert into \( \phi_\parallel \). Statistical uncertainty includes correlation between measured parameters, while systematic uncertainties are assumed uncorrelated.

2 AALTONEN 11AN quotes \( \cos \phi_\perp = -0.91 \pm 0.15 \pm 0.09 \) which we convert to \( \phi_\parallel \) taking the smaller solution.

3 AAIJ 12P quotes \( \cos \phi_\parallel = -0.844 \pm 0.068 \pm 0.029 \) which we convert to \( \phi_\parallel \), taking the smaller solution.
\[ \Gamma_L/\Gamma \text{ in } B_s^0 \rightarrow K^{*0} \bar{K}^{*0} \]

<table>
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<th>DOCUMENT ID</th>
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<td>AAIJ 12F LHCB</td>
<td>Repl. by AAIJ 15AF</td>
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We do not use the following data for averages, fits, limits, etc.

\[ \Phi \text{ in } B_s^0 \rightarrow K^{*0} \bar{K}^{*0} \]

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\[ \Gamma_{\text{L}}/\Gamma \text{ in } B_s^0 \rightarrow K^{*0} \bar{K}^{*0} \]

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\[ \Phi \text{ in } B_s^0 \rightarrow K^{*0} \bar{K}^{*0} \]

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<tr>
<td>5.31 ± 0.24 ± 0.14</td>
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\[ \Gamma_{\text{L}}/\Gamma \text{ in } B_s^0 \rightarrow \phi \bar{K}^{*0} \]

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\[ \Gamma_{\text{L}}/\Gamma \text{ in } B_s^0 \rightarrow \phi \bar{K}^{*0} \]

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\[ \phi \text{ in } B_s^0 \rightarrow \phi \bar{K}^{*0} \]

<table>
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<td>1.75 ± 0.53 ± 0.29</td>
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1 Measured in angular analysis, which takes into account S-wave contributions.

\[ F_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (0.10 < q^2 < 2.00 \text{ GeV}^2/c^4) \]

<table>
<thead>
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<th>TECN</th>
<th>COMMENT</th>
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</thead>
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<tr>
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<td>0.37 + 0.19 ± 0.07</td>
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We do not use the following data for averages, fits, limits, etc.

\[ F_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (2.00 < q^2 < 5.0 \text{ GeV}^2/c^4) \]

<table>
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<td>0.53 + 0.25 ± 0.10</td>
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<td>Repl. by AAIJ 15AQ</td>
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</table>

1 Measured in 2.0 < q^2 < 4.3 GeV^2/c^4.

HTTP://PDG.LBL.GOV  Page 47  Created: 10/1/2016 20:06
\[
\begin{align*}
\text{**F}_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (5.0 < q^2 < 8.0 \text{ GeV}^2/c^4) & \\
\text{VALUE} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
0.54^{+0.10}_{-0.09} \pm 0.02 & \quad \text{AAIJ} & \quad 15AQ \text{ LHCB} & \quad \text{pp at 7, 8 TeV} \\
\text{\textbullet} & \quad \text{\textbullet} & \quad \text{We do not use the following data for averages, fits, limits, etc. \textbullet \textbullet \textbullet} \\
0.81^{+0.11}_{-0.13} \pm 0.05 & \quad 1 \quad \text{AAIJ} & \quad 13X \text{ LHCB} & \quad \text{Repl. by AAIJ 15AQ} \\
1 & \quad \text{Measured in } 4.3 < q^2 < 8.68 \text{ GeV}^2/c^4. \\
\hline
\text{**F}_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (11.0 < q^2 < 12.5 \text{ GeV}^2/c^4) & \\
\text{VALUE} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
0.29^{0.11}_{0.04} & \quad \text{AAIJ} & \quad 15AQ \text{ LHCB} & \quad \text{pp at 7, 8 TeV} \\
\text{\textbullet} & \quad \text{\textbullet} & \quad \text{We do not use the following data for averages, fits, limits, etc. \textbullet \textbullet \textbullet} \\
0.33^{+0.14}_{-0.12} \pm 0.06 & \quad 1 \quad \text{AAIJ} & \quad 13X \text{ LHCB} & \quad \text{Repl. by AAIJ 15AQ} \\
1 & \quad \text{Measured in } 10.09 < q^2 < 12.90 \text{ GeV}^2/c^4. \\
\hline
\text{**F}_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (15.0 < q^2 < 17.0 \text{ GeV}^2/c^4) & \\
\text{VALUE} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
0.23^{+0.09}_{-0.08} \pm 0.02 & \quad \text{AAIJ} & \quad 15AQ \text{ LHCB} & \quad \text{pp at 7, 8 TeV} \\
\text{\textbullet} & \quad \text{\textbullet} & \quad \text{We do not use the following data for averages, fits, limits, etc. \textbullet \textbullet \textbullet} \\
0.34^{+0.18}_{-0.17} \pm 0.07 & \quad 1 \quad \text{AAIJ} & \quad 13X \text{ LHCB} & \quad \text{Repl. by AAIJ 15AQ} \\
1 & \quad \text{Measured in } 14.18 < q^2 < 16 \text{ GeV}^2/c^4. \\
\hline
\text{**F}_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (17.0 < q^2 < 19.0 \text{ GeV}^2/c^4) & \\
\text{VALUE} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
0.40^{+0.13}_{-0.15} \pm 0.02 & \quad \text{AAIJ} & \quad 15AQ \text{ LHCB} & \quad \text{pp at 7, 8 TeV} \\
\text{\textbullet} & \quad \text{\textbullet} & \quad \text{We do not use the following data for averages, fits, limits, etc. \textbullet \textbullet \textbullet} \\
0.16^{+0.17}_{-0.10} \pm 0.07 & \quad 1 \quad \text{AAIJ} & \quad 13X \text{ LHCB} & \quad \text{Repl. by AAIJ 15AQ} \\
1 & \quad \text{Measured in } 16.0 < q^2 < 19.0 \text{ GeV}^2/c^4. \\
\hline
\text{**F}_L(B_s^0 \rightarrow \phi \mu^+ \mu^-) (1.00 < q^2 < 6.00 \text{ GeV}^2/c^4) & \\
\text{VALUE} & \quad \text{DOCUMENT ID} & \quad \text{TECN} & \quad \text{COMMENT} \\
0.63^{+0.09}_{-0.09} \pm 0.03 & \quad \text{AAIJ} & \quad 15AQ \text{ LHCB} & \quad \text{pp at 7, 8 TeV} \\
\text{\textbullet} & \quad \text{\textbullet} & \quad \text{We do not use the following data for averages, fits, limits, etc. \textbullet \textbullet \textbullet} \\
0.56^{+0.17}_{-0.16} \pm 0.09 & \quad \text{AAIJ} & \quad 13X \text{ LHCB} & \quad \text{Repl. by AAIJ 15AQ} \\
\end{align*}
\]
**B_s^0 - B_s^0** MIXING

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

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

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

\[ x_s = \frac{\Delta m_{B_s^0}}{\Gamma_{B_s^0}} = (m_{B_s^0} - m_{B_s^0}) \tau_{B_s^0} \]

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

\[ \tau_{B_s^0} = \frac{1}{2(1+x_s^2)} \]

$\Delta m_{B_s^0} = m_{B_s^0} - m_{B_s^0}$

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

"OUR EVALUATION" is provided by the Heavy Flavor Averaging Group (HFAG) by taking into account correlations between measurements.

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<td><strong>17.757 ± 0.021 OUR EVALUATION</strong></td>
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<tr>
<td>17.711 ± 0.055 ± 0.011</td>
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<td>LHCB</td>
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<td>&gt; 8.0</td>
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<td>&gt; 4.9</td>
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<td>95</td>
<td>ABREU,P</td>
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Events with a high transverse momentum lepton were removed and an inclusively reconstructed vertex was required.

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 $7.9 < \Delta m_s < 10.3 \text{ ps}^{-1}$.

Three analyses based on complementary event selections: (1) fully-reconstructed hadronic decays; (2) semileptonic decays with $D_s$ exclusively reconstructed; (3) inclusive semileptonic decays.

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.

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

Replaced by ABDALLAH 04A. Uses $D_s^- \ell^+$, and $\phi \ell^+$ vertices, and a multi-variable discriminant as a flavor tagging.

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

Uses $\ell - Q_{\text{hem}}$ and $\ell - \ell$.

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

ABE 99j uses $\phi \ell - \ell$ correlation.

BARATE 99j uses combination of an inclusive lepton and $D_s^-$-based analyses.
22 BARATE 98c combines results from $D_s h-\ell/Q_{\text{hem}}$, $D_s h-K$ in the same side, $D_s \ell-\ell/Q_{\text{hem}}$ and $D_s \ell-K$ in the same side.

23 Uses $\ell-Q_{\text{hem}}$.

24 Uses $\ell-\ell$.

25 ADAM 97 combines results from $D_s \ell-\ell/Q_{\text{hem}}$, $\ell-Q_{\text{hem}}$, and $\ell-\ell$.

26 BUSKULIC 96M uses $D_s$ lepton correlations and lepton, kaon, and jet charge tags.

27 BUSKULIC 95J uses $\ell-Q_{\text{hem}}$. 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.

\textbf{VALUE} \hspace{1cm} DOCUMENT ID

\textbf{26.81±0.10 OUR EVALUATION}

\[ \chi_s \]

This is a $B_s^0 \bar{B_s^0}$ integrated mixing parameter derived from $x_s$ above and OUR EVALUATION of $\Delta \Gamma_{B_s^0}/\Gamma_{B_s^0}$.

\textbf{VALUE} \hspace{1cm} DOCUMENT ID

\textbf{0.499308±0.000005 OUR EVALUATION}

\section*{CP VIOLATION PARAMETERS in $B_s^0$}

\[ \text{Re}(\epsilon_{B_s^0}) / (1+|\epsilon_{B_s^0}|^2) \]

$CP$ impurity in $B_s^0$ system.

“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 \url{http://www.slac.stanford.edu/xorg/hfag/}. The averaging/scaling procedure takes into account correlation between the measurements. The value has been obtained from a 2D fit of the $B_d$ and $B_s$ asymmetries, which includes the $B_s$ measurements listed below and the $B$ factory average for the $B_d$.

\textbf{VALUE} (units $10^{-3}$) \hspace{1cm} DOCUMENT ID \hspace{1cm} TECN \hspace{1cm} COMMENT

\textbf{−1.9 ±1.0 OUR EVALUATION}

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<th>Comment</th>
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<td>LHCB</td>
<td>$p\bar{p}$ at 7 TeV</td>
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<td>ABAZOV 14</td>
<td>D0</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
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<td>−2.8 ±1.9 ±0.4</td>
<td>ABAZOV 13</td>
<td>D0</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
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\textbf{−1.5 ±1.0 OUR AVERAGE}

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<td>ABAZOV 07A</td>
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<td>Repl. by ABAZOV 10E</td>
</tr>
</tbody>
</table>

\textbf{• • •} We do not use the following data for averages, fits, limits, etc. \textbf{• • •}

\textbf{• • •}
1 AAIJ 14D reports a measurement of time-integrated flavor-specific asymmetry in $B_{s}^{0} \rightarrow \mu^{+} D_{s}^{-} X$ decays $A_{s}^{8} = (-0.06 \pm 0.50 \pm 0.36\%)$ which is approximately equal to $4 \times \text{Re}(\epsilon_{B_{s}^{0}}) / (1 + |\epsilon_{B_{s}^{0}}|^{2})$.

2 ABAZOV 14 uses the dimuon charge asymmetry with different impact parameters from which it reports $A_{SL}^{s} = (-0.86 \pm 0.74) \times 10^{-2}$.

3 ABAZOV 13 reports a measurement of time-integrated flavor-specific asymmetry in mixed semileptonic $B_{s}^{0} \rightarrow \mu^{+} D_{s}^{-} X$ decays $A_{s}^{SL} = (-1.12 \pm 0.74 \pm 0.17\%)$ which is approximately equal to $4 \times \text{Re}(\epsilon_{B_{s}^{0}}) / (1 + |\epsilon_{B_{s}^{0}}|^{2})$.

4 ABAZOV 11U uses the dimuon charge asymmetry with different impact parameters from which it reports $A_{SL}^{s} = (-18.1 \pm 10.6) \times 10^{-3}$.

5 ABAZOV 10E reports a measurement of flavor-specific asymmetry in $B_{(s)}^{0} \rightarrow \mu^{+} D_{s}^{*-} X$ decays with a decay-time analysis including initial-state flavor tagging, $A_{s}^{8} = (-1.7 \pm 9.1^{+1.4}_{-1.5}) \times 10^{-3}$ which is approximately equal to $4 \times \text{Re}(\epsilon_{B_{s}^{0}}) / (1 + |\epsilon_{B_{s}^{0}}|^{2})$.

6 ABAZOV 10H reports a measurement of like-sign dimuon charge asymmetry of $A_{SL}^{b} = (-9.57 \pm 2.51 \pm 1.46) \times 10^{-3}$ in semileptonic $b$-hadron decays. Using the measured production ratio of $B_{d}^{0}$ and $B_{s}^{0}$ and the asymmetry of $B_{d}^{0} A_{SL}^{d} = (-4.7 \pm 4.6) \times 10^{-3}$ measured from $B$-factories, they obtain the asymmetry for $B_{s}^{0}$.

7 The first direct measurement of the time integrated flavor untagged charge asymmetry in semileptonic $B_{s}^{0}$ decays is reported as $2 \times A_{SL}^{s} \text{(untagged)} = A_{SL}^{s} = (2.45 \pm 1.93 \pm 0.35) \times 10^{-2}$.

$C_{KK}(B_{s}^{0} \rightarrow K^{+} K^{-})$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tr>
<td>0.14 ± 0.11 ± 0.03</td>
<td>AAIJ 13B0 LHCb</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

$S_{KK}(B_{s}^{0} \rightarrow K^{+} K^{-})$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30 ± 0.12 ± 0.04</td>
<td>AAIJ 13B0 LHCb</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

$\gamma$

For angle $\gamma(\phi_{3})$ of the CKM unitarity triangle, see the review on “CP Violation” in the Reviews section.

<table>
<thead>
<tr>
<th>VALUE (°)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 ± 7</td>
<td>OUR AVERAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>63.5 ± 7.2 ± 6.7</td>
<td>1, 2 AAIJ 15K</td>
<td>LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>115 ± 28</td>
<td>3 AAIJ 14BF LHCb</td>
<td>pp at 7 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 Obtained by measuring time-dependent CP asymmetry in $B_{s}^{0} \rightarrow K^{+} K^{-}$ and using a U-spin relation between $B_{s}^{0} \rightarrow K^{+} K^{-}$ and $B_{0}^{0} \rightarrow \pi^{+} \pi^{-}$.

2 Results are also presented using additional inputs on $B_{s}^{0} \rightarrow \pi^{0} \pi^{0}$ and $B^{+} \rightarrow \pi^{+} \pi^{-}$ decays from other experiments and isospin symmetry assumptions. The dependence of the results on the maximum allowed amount of U-spin breaking up to 50% is also included.

3 Measured in $B_{s}^{0} \rightarrow D_{s}^{\pm} K^{\mp}$ decays, constraining $-2 \beta_{s}$ by the measurement of $\phi_{s} = 0.01 \pm 0.07 \pm 0.0$ from AAIJ 13AR. The value is modulo 180° at 68% CL.
**CP Violation phase $\beta_s$**

$-2\beta_s$ is the weak phase difference between $B_s^0$ mixing amplitude and the $B_s^0 \rightarrow J/\psi \phi$ decay amplitude driven by the $b \rightarrow c \tau s$ transition (such as $B_s^0 \rightarrow J/\psi \phi$, $J/\psi K^+ K^-$, $J/\psi \pi^+ \pi^-$, and $D_s^+ D_s^-$). The Standard Model value of $\beta_s$ is $\arg\left(-\frac{V_{ts}V_{tb}^*}{V_{cs}V_{cb}^*}\right)$ if penguin contributions are neglected.

"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/scaling procedure takes into account correlation between the measurements.

### Values (10^{-2} rad)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 ± 1.9 OUR EVALUATION</td>
<td>1 AAIJ</td>
<td>15I LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>1.1 ± 1.9 OUR AVERAGE</td>
<td>2 AAIJ</td>
<td>15K LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>2.9 ± 2.5 ± 0.3</td>
<td>3 AAD</td>
<td>14U ATLS</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>6 ± 8</td>
<td>4 AAD</td>
<td>14Y LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>-6 ± 13 ± 3</td>
<td>5 AAIJ</td>
<td>14Y LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>-1 ± 9 ± 1</td>
<td>6 AAIJ</td>
<td>14S LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>-3.5 ± 3.4 ± 0.4</td>
<td>7 AALTONEN</td>
<td>12AJ CDF</td>
<td>p(\bar{\tau}) at 1.96 TeV</td>
</tr>
<tr>
<td>28 ± 18</td>
<td>8, 9 ABAZOV</td>
<td>12D D0</td>
<td>p(\bar{\tau}) at 1.96 TeV</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>-17 ± 15 ± 3</td>
<td>10 AAIJ</td>
<td>14AE LHCb</td>
<td>pp at 7, 8 TeV</td>
</tr>
<tr>
<td>-0.5 ± 3.5 ± 0.5</td>
<td>11 AAIJ</td>
<td>13AR LHCb</td>
<td>Repl. by AAIJ 15I</td>
</tr>
<tr>
<td>-0.5 ± 3.5 ± 0.5</td>
<td>12 AAIJ</td>
<td>13AY LHCb</td>
<td>pp at 7 TeV</td>
</tr>
<tr>
<td>-11.0 ± 20.5 ± 5.0</td>
<td>13 AAD</td>
<td>12CV ATLS</td>
<td>Repl. by AAD 14U</td>
</tr>
<tr>
<td>22 ± 22 ± 1</td>
<td>14 AAIJ</td>
<td>12B LHCb</td>
<td>Repl. by AAIJ 12Q</td>
</tr>
<tr>
<td>-8 ± 9 ± 3</td>
<td>15 AAIJ</td>
<td>12D LHCb</td>
<td>Repl. by AAIJ 13AR</td>
</tr>
</tbody>
</table>

1 Measured in $B_s^0 \rightarrow D_s^{\mp} K^{\pm}$ decays, constraining $-2\beta_s$ by the measurement of $\phi_s = 0.01 \pm 0.07 \pm 0.0$ from AAIJ 13AR. The value is modulo 180° at 68% CL.
<table>
<thead>
<tr>
<th>AAIJ 15I reports $\phi_s = -2 \beta_s = -0.058 \pm 0.049 \pm 0.006$ rad. that was measured using a tagged, time-dependent angular analysis of $B^0_s \rightarrow J/\psi K^+ K^-$ decays. It also combines this result with that of AAIJ 14S and quotes $\phi_s = -2 \beta_s = -0.010 \pm 0.039$ rad.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAIJ 15K reports $-2 \beta_s = -0.12^{+0.14}_{-0.16}$ rad. The value was obtained by measuring time-dependent CP asymmetry in $B^0_s \rightarrow K^+ K^-$ and using a U-spin relation between $B^0_s \rightarrow K^+ K^-$ and $B^0 \rightarrow \pi^+ \pi^-$.</td>
</tr>
<tr>
<td>Results are also presented using additional inputs on $B^0 \rightarrow \pi^0 \pi^0$ and $B^+ \rightarrow \pi^+ \pi^0$ decays from other experiments and isospin symmetry assumptions. The dependence of the results on the maximum allowed amount of U-spin breaking up to 50% is also included.</td>
</tr>
<tr>
<td>AAD 14u reports $\phi_s = -2 \beta_s = 0.12 \pm 0.25 \pm 0.05$ rad. that was measured using a tagged, time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.</td>
</tr>
<tr>
<td>AAIJ 14AV reports $\phi_s = -2 \beta_s = 0.02 \pm 0.17 \pm 0.02$ rad. in tagged, time-dependent fit to $B^0_s \rightarrow D_s^+ D_s^-$, while allowing CP violation in decay.</td>
</tr>
<tr>
<td>AAIJ 14S reports $\phi_s = -2 \beta_s = 0.070 \pm 0.068 \pm 0.008$ rad. and $</td>
</tr>
<tr>
<td>AALTONEN 12AJ reports $-\pi/2 &lt; \beta_s &lt; -1.51$ or $-0.06 &lt; \beta_s &lt; 0.30$, or $1.26 &lt; \beta_s &lt; \pi/2$ rad. at 68% CL. Measured using the time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.</td>
</tr>
<tr>
<td>Measured using fully reconstructed $B_s \rightarrow J/\psi \phi$ decays. A single error includes both statistical and systematic uncertainties.</td>
</tr>
<tr>
<td>Reports $\phi_s$ which equals to $-2 \beta_s$.</td>
</tr>
<tr>
<td>Measured in $B^0_s \rightarrow \phi \phi$ decays. This is a $b \rightarrow s \overline{s}s$ transition with a decay amplitude phase different from that of $b \rightarrow c \overline{s}s$ transition.</td>
</tr>
<tr>
<td>AAIJ 13AR reports $\phi_s = -2 \beta_s = 0.01 \pm 0.07 \pm 0.01$ rad. obtained from combined fit to $B^0_s \rightarrow J/\psi K^+ K^-$ and $B^0_s \rightarrow J/\psi \pi^+ \pi^-$ data sets. Also reports separate results of $\phi_s = 0.07 \pm 0.09 \pm 0.01$ rad. from $B^0_s \rightarrow J/\psi K^+ K^-$ decays and $\phi_s = -0.14^{+0.17}_{-0.16} \pm 0.01$ rad. from $B^0_s \rightarrow J/\psi \pi^+ \pi^-$ decays.</td>
</tr>
<tr>
<td>AAIJ 13AV uses $B^0_s \rightarrow \phi \phi$ mode, and reports the 68% CL interval of $\phi_s = -2 \beta_s$ as $[-2.46, -0.76]$ rad.</td>
</tr>
<tr>
<td>AAD 12CV reports $\phi_s = -2 \beta_s = 0.22 \pm 0.41 \pm 0.10$ rad. that was measured using a time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.</td>
</tr>
<tr>
<td>Reports $\phi_s = -2 \beta_s = -0.44 \pm 0.44 \pm 0.02$ rad. that was measured using a time-dependent fit to $B^0_s \rightarrow J/\psi f_0(980)$ decays.</td>
</tr>
<tr>
<td>Reports $\phi_s = -2 \beta_s = 0.15 \pm 0.18 \pm 0.06$ rad. that was measured using a time-dependent angular analysis of $B^0_s \rightarrow J/\psi \phi$ decays.</td>
</tr>
</tbody>
</table>
16 Reports $\phi_s = -2 \beta_s = -0.019^{+0.173+0.0004}_{-0.174-0.003}$ rad. which was measured using a time-dependent fit to $B^0_s \to J/\psi \pi^+\pi^-$ decays, with the $\pi^+\pi^-$ mass within 775–1550 MeV. Searches for, but finds no evidence, for direct $CP$ violation in $B^0_s \to J/\psi \pi\pi$ decays.

17 Reports $0.02 < \phi_s < 0.52$ or $1.08 < \phi_s < 1.55$ rad. at 68% C.L. confidence regions in the two-dimensional space of $\phi_s$ and $\Delta\Gamma$ $B^0_s$ from $B^0_s \to J/\psi \phi$ decays.

18 Reports $0.32 < 2\beta_s < 2.82$ rad. at 68% C.L. and confidence regions in the two-dimensional space of $2\beta_s$ and $\Delta\Gamma$ from the first measurement of $B^0_s \to J/\psi \phi$ decays using flavor tagging. The probability of a deviation from SM prediction as large as the level of observed data is 15%.

19 Reports $\phi_s = -2 \beta_s$ and obtains 90% CL interval $-0.03 < \beta_s < 0.60$ rad.

20 The first direct measurement of the $CP$-violating mixing phase is reported from the time-dependent analysis of flavor untagged $B^0_s \to J/\psi \phi$ decays.

21 Combines D0 collaboration measurements of time-dependent angular distributions in $B^0_s \to J/\psi \phi$ and charge asymmetry in semileptonic decays. There is a 4-fold ambiguity in the solution.

| $|\lambda|$ ($B^0_s \to J/\psi(1S)\phi$) | DOCUMENT ID | TECN | COMMENT |
|-----------------------------------|-------------|------|---------|
| $0.964\pm0.019\pm0.007$          | AAIJ 15i    | LHCB | pp at 7, 8 TeV |

| $|\lambda|$ | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
| $1.02\pm0.07$ OUR AVERAGE         | 1 AAIJ 14AE | LHCB | pp at 7, 8 TeV |
| $1.04\pm0.07\pm0.03$              | 2 AAIJ 14AY | LHCB | pp at 7, 8 TeV |
| $0.91\pm0.18\pm0.02$              |            |      |         |

1 Measured in $B^0_s \to \phi\phi$ decays.

2 Measured in $B^0_s \to D^+_s D^-_s$ decays.

A, $CP$ violation parameter

$A = -2 \text{Re}(\lambda) / (1 + |\lambda|^2)$

| $0.49^{+0.77}_{-0.65}\pm0.06$ | 1 AAIJ 15AL | LHCB | pp at 7, 8 TeV |

1 Measured in $B^0_s \to J/\psi K^0_S$ decays.

C, $CP$ violation parameter

$C = (1 - |\lambda|^2) / (1 + |\lambda|^2)$

| $-0.28\pm0.41\pm0.08$ | 1 AAIJ 15AL | LHCB | pp at 7, 8 TeV |

1 Measured in $B^0_s \to J/\psi K^0_S$ decays.

S, $CP$ violation parameter

$S = -2 \text{Im}(\lambda) / (1 + |\lambda|^2)$

| $-0.08\pm0.40\pm0.08$ | 1 AAIJ 15AL | LHCB | pp at 7, 8 TeV |

1 Measured in $B^0_s \to J/\psi K^0_S$ decays.
$A_{\text{CP}}(B_s \rightarrow J/\psi K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.048 \pm 0.057 \pm 0.020$</td>
<td>AAIJ</td>
<td>15AV</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$A_{\text{CP}}(B_s \rightarrow J/\psi K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.171 \pm 0.152 \pm 0.028$</td>
<td>AAIJ</td>
<td>15AV</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$A_{\text{CP}}(B_s \rightarrow J/\psi K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.049 \pm 0.096 \pm 0.025$</td>
<td>AAIJ</td>
<td>15AV</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$A_{\text{CP}}(B_s \rightarrow \pi^+ K^-)$

$A_{\text{CP}}$ is defined as

$$B(B_s \rightarrow f) - B(B_s \rightarrow \bar{f}) \over B(B_s \rightarrow f) + B(B_s \rightarrow \bar{f})$$

the CP-violation asymmetry of exclusive $B^0_s$ and $\bar{B}^0_s$ decay.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.263 \pm 0.035$ Ours Average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$0.22 \pm 0.07 \pm 0.02$</td>
<td>AALTONEN</td>
<td>14P</td>
<td>CDF $p\bar{p}$ at 1.96 TeV</td>
</tr>
<tr>
<td>$0.27 \pm 0.04 \pm 0.01$</td>
<td>AAIJ</td>
<td>13AX</td>
<td>LHCb $pp$ at 7 TeV</td>
</tr>
<tr>
<td>$0.39 \pm 0.15 \pm 0.08$</td>
<td>AALTONEN</td>
<td>11N</td>
<td>CDF $p\bar{p}$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.27 \pm 0.08 \pm 0.02$</td>
<td>AAIJ</td>
<td>12V</td>
<td>LHCb Repl. by AAIJ 13AX</td>
</tr>
</tbody>
</table>

$A_{\text{CP}}(B_s^0 \rightarrow [K^+ K^-]_D K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.04 \pm 0.07 \pm 0.02$</td>
<td>AAIJ</td>
<td>14BN</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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</thead>
<tbody>
<tr>
<td>$0.04 \pm 0.16 \pm 0.01$</td>
<td>AAIJ</td>
<td>13L</td>
<td>LHCb Repl. by AAIJ 14BN</td>
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</table>

$A_{\text{CP}}(B_s^0 \rightarrow [\pi^+ K^-]_D K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-0.01 \pm 0.03 \pm 0.02$</td>
<td>AAIJ</td>
<td>14BN</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

$A_{\text{CP}}(B_s^0 \rightarrow [\pi^+ \pi^-]_D K^*(892)^0)$

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.06 \pm 0.13 \pm 0.02$</td>
<td>AAIJ</td>
<td>14BN</td>
<td>LHCb $pp$ at 7, 8 TeV</td>
</tr>
</tbody>
</table>

**CPT Violation Parameters**

In the $B_s^0$ mixing, propagating mass eigenstates can be written as

$$|B_{sL}\rangle \propto p \sqrt{1 - \xi} |B_s^0\rangle + q \sqrt{1 + \xi} |\bar{B}_s^0\rangle$$

$$|B_{sH}\rangle \propto p \sqrt{1 + \xi} |B_s^0\rangle - q \sqrt{1 - \xi} |\bar{B}_s^0\rangle$$

where parameter $\xi$ controls CPT violation. If $\xi$ is zero, then CPT is conserved. The parameter $\xi$ can be written as

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\[ \xi = \frac{2(M_{11} - M_{22}) - i(f_{11} - f_{22})}{-2\Delta m_s + i\Delta \Gamma_s} \approx \frac{-2\beta \mu \Delta a_\mu}{2\Delta m_s - i\Delta \Gamma_s}, \]

where \( M_{ii}, \Gamma_{ii}, \Delta m_s, \) and \( \Delta \Gamma_s \) are parameters of Hamiltonian governing \( B_s \) oscillations, \( \beta \mu \) is the \( B^0_s \) meson velocity and \( \Delta a_\mu \) characterizes Lorentz-invariance violation.

\[
\Delta a_\perp
\]

Case specific data for \( \Delta a_\perp \):

<table>
<thead>
<tr>
<th>VALUE (GeV)</th>
<th>CL%</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.2 \times 10^{-12}</td>
<td>95</td>
<td>ABAZOV 15L</td>
<td>D0</td>
<td>( p\bar{p} ) at 1.96 TeV</td>
</tr>
</tbody>
</table>

1 Measured in semileptonic \( B^0_s \rightarrow D^- \mu^+ X \) decays. Also extracts limit on time and longitudinal components \(-0.8 < \Delta a_T - 0.396 \Delta a_Z < 3.9 \) \( 10^{-13} \) GeV.

### PARTIAL BRANCHING FRACTIONS IN \( B_s \rightarrow \phi \ell^+ \ell^- \)

\[ B(\ell^+ \ell^-) \] for various \( q^2 \) intervals:

#### \( 0.1 < q^2 < 2.0 \text{ GeV}^2/c^4 \)

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-7} ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.14 ( \pm 0.16 ) ( \text{OUR AVERAGE} )</td>
<td>AAIJ 15AQ LHCB</td>
<td>pp at 7, 8 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 Measured in \( B^0_s \rightarrow \phi \mu^+ \mu^- \) decays.

#### \( 2.0 < q^2 < 5.0 \text{ GeV}^2/c^4 \)

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-7} ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.77 ( \pm 0.12 ) ( \pm 0.06 )</td>
<td>AAIJ 15AQ LHCB</td>
<td>pp at 7, 8 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 Measured in \( B^0_s \rightarrow \phi \mu^+ \mu^- \) decays.

2 Measured in \( 2 < q^2 < 4.3 \text{ GeV}^2/c^4 \).

#### \( 5.0 < q^2 < 8.0 \text{ GeV}^2/c^4 \)

<table>
<thead>
<tr>
<th>VALUE (units ( 10^{-7} ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.96 ( \pm 0.13 ) ( \pm 0.08 )</td>
<td>AAIJ 15AQ LHCB</td>
<td>pp at 7, 8 TeV</td>
<td></td>
</tr>
</tbody>
</table>

1 Measured in \( B^0_s \rightarrow \phi \mu^+ \mu^- \) decays.

2 Measured in \( 4.3 < q^2 < 8.68 \text{ GeV}^2/c^4 \).
### $B(B_s \to \phi \ell^+ \ell^-)$ (11.0 $< q^2 < 12.5$ GeV$^2$/c$^4$)

<table>
<thead>
<tr>
<th>VALUE (units 10$^{-7}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.71±0.10±0.06</td>
<td>1 AAIJ</td>
<td>15AQ LHCb</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
<tr>
<td>1.18±0.22±0.14</td>
<td>1,2 AAIJ</td>
<td>13X LHCb</td>
<td>Repl. by AAIJ 15AQ</td>
</tr>
<tr>
<td>2.98±0.95±0.95</td>
<td>2 AALTONEN</td>
<td>11AI CDF</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

1 Measured in $B_s^0 \to \phi \mu^+ \mu^-$ decays.
2 Measured in 10.9$<q^2<$12.86 GeV$^2$/c$^4$.

### $B(B_s \to \phi \ell^+ \ell^-)$ (15.0 $< q^2 < 17.0$ GeV$^2$/c$^4$)

<table>
<thead>
<tr>
<th>VALUE (units 10$^{-7}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90±0.11±0.07</td>
<td>1 AAIJ</td>
<td>15AQ LHCb</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
<tr>
<td>0.76±0.19±0.087</td>
<td>1,2 AAIJ</td>
<td>13X LHCb</td>
<td>Repl. by AAIJ 15AQ</td>
</tr>
<tr>
<td>1.86±0.66±0.59</td>
<td>2 AALTONEN</td>
<td>11AI CDF</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

1 Measured in $B_s^0 \to \phi \mu^+ \mu^-$ decays.

### $B(B_s \to \phi \ell^+ \ell^-)$ (17.0 $< q^2 < 19.0$ GeV$^2$/c$^4$)

<table>
<thead>
<tr>
<th>VALUE (units 10$^{-7}$)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.79±0.11±0.07</td>
<td>1 AAIJ</td>
<td>15AQ LHCb</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
<tr>
<td>1.06±0.23±0.12</td>
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<td>13X LHCb</td>
<td>Repl. by AAIJ 15AQ</td>
</tr>
<tr>
<td>2.32±0.76±0.74</td>
<td>2 AALTONEN</td>
<td>11AI CDF</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
</tr>
</tbody>
</table>

1 Measured in $B_s^0 \to \phi \mu^+ \mu^-$ decays.
2 Measured in 16$<q^2<$19 GeV$^2$/c$^4$.

### $B(B_s \to \phi \ell^+ \ell^-)$ (1.0 $< q^2 < 6.0$ GeV$^2$/c$^4$)

<table>
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<th>COMMENT</th>
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<tbody>
<tr>
<td>1.28±0.18</td>
<td>OUR AVERAGE</td>
<td></td>
<td></td>
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<tr>
<td>1.29±0.16±0.10</td>
<td>1 AAIJ</td>
<td>15AQ LHCb</td>
<td>$pp$ at 7, 8 TeV</td>
</tr>
<tr>
<td>1.14±0.79±0.36</td>
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<td>11AI CDF</td>
<td>$p\bar{p}$ at 1.96 TeV</td>
</tr>
<tr>
<td>1.14±0.25±0.13</td>
<td>1 AAIJ</td>
<td>13X LHCb</td>
<td>Repl. by AAIJ 15AQ</td>
</tr>
</tbody>
</table>

1 Measured in $B_s^0 \to \phi \mu^+ \mu^-$ decays.

### $B(B_s \to \phi \ell^+ \ell^-)$ (0.0 $< q^2 <$ 4.3 GeV$^2$/c$^4$)

<table>
<thead>
<tr>
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<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.30±1.09±1.05</td>
<td>AALTONEN</td>
<td>11AI</td>
<td>CDF</td>
</tr>
</tbody>
</table>

http://PDG.LBL.GOV
PRODUCTION ASYMMETRIES

\[ A_P(B_s^0) = \frac{\sigma(B_s^0) - \sigma(B_s^0)}{\sigma(B_s^0) + \sigma(B_s^0)} \]

\[ A_P(B_s^0) = \frac{\sigma(B_s^0) - \sigma(B_s^0)}{\sigma(B_s^0) + \sigma(B_s^0)} \]

\[ 1.09 \pm 0.21 \pm 0.66 \]

\[ \text{Based on time-dependent analysis of } B_s^0 \rightarrow D_s^- \pi^+ \text{ in kinematic range } 4 < p_T < 30 \text{ GeV/c and } 2.5 < \eta < 4.5. \]

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