**$b$-baryon ADMIXTURE ($\Lambda_b$, $\Xi_b$, $\Sigma_b$, $\Omega_b$)**

**$b$-baryon ADMIXTURE MEAN LIFE**

Each measurement of the $b$-baryon mean life is an average over an admixture of various $b$-baryons which decay weakly. Different techniques emphasize different admixtures of produced particles, which could result in a different $b$-baryon mean life. More $b$-baryon flavor specific channels are not included in the measurement.

<table>
<thead>
<tr>
<th>VALUE ($10^{-12}$ s)</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.218^{+0.130}_{-0.115}$</td>
<td>1 ABAZOV</td>
<td>07S</td>
<td>D0</td>
<td>Repl. by ABAZOV 12u</td>
</tr>
<tr>
<td>$1.22^{+0.22}_{-0.18}$</td>
<td>1 ABAZOV</td>
<td>05C</td>
<td>D0</td>
<td>Repl. by ABAZOV 07s</td>
</tr>
<tr>
<td>$1.16^{+0.20}_{-0.08}$</td>
<td>2 ABREU</td>
<td>99W</td>
<td>DLPH</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.19^{+0.14}_{-0.07}$</td>
<td>3 ABREU</td>
<td>99W</td>
<td>DLPH</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.14^{+0.08}_{-0.04}$</td>
<td>4 ABREU</td>
<td>99W</td>
<td>DLPH</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.11^{+0.19}_{-0.18}$</td>
<td>5 ABREU</td>
<td>99W</td>
<td>DLPH</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.29^{+0.24}_{-0.22}$</td>
<td>5 ACKERSTAFF</td>
<td>98G</td>
<td>OPAL</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.20^{+0.08}_{-0.06}$</td>
<td>6 BARATE</td>
<td>98D</td>
<td>ALEP</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.21^{+0.11}_{-0.11}$</td>
<td>5 BARATE</td>
<td>98D</td>
<td>ALEP</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.32^{+0.15}_{-0.07}$</td>
<td>7 ABE</td>
<td>96M</td>
<td>CDF</td>
<td>$p\bar{p}$ at 1.8 TeV</td>
</tr>
<tr>
<td>$1.46^{+0.22}_{-0.21}$</td>
<td>8 ABREU</td>
<td>96D</td>
<td>DLPH</td>
<td>Repl. by ABREU 99W</td>
</tr>
<tr>
<td>$1.10^{+0.19}_{-0.17}$</td>
<td>5 ABREU</td>
<td>96D</td>
<td>DLPH</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.16^{+0.11}_{-0.06}$</td>
<td>5 AKERS</td>
<td>96</td>
<td>OPAL</td>
<td>$\ell^+\ell^- \rightarrow Z$</td>
</tr>
<tr>
<td>$1.27^{+0.35}_{-0.29}$</td>
<td>8 ABREU</td>
<td>95S</td>
<td>DLPH</td>
<td>Repl. by ABREU 99W</td>
</tr>
<tr>
<td>$1.05^{+0.12}_{-0.11}$</td>
<td>290 BUSKULIC</td>
<td>95L</td>
<td>ALEP</td>
<td>Repl. by BARATE 98D</td>
</tr>
<tr>
<td>$1.04^{+0.48}_{-0.38}$</td>
<td>11 ABREU</td>
<td>93F</td>
<td>DLPH</td>
<td>Excess $\Lambda\mu^-$, decay lengths</td>
</tr>
<tr>
<td>$1.05^{+0.23}_{-0.20}$</td>
<td>157 AKERS</td>
<td>93</td>
<td>OPAL</td>
<td>Excess $\Lambda\ell^-$, decay lengths</td>
</tr>
<tr>
<td>$1.12^{+0.32}_{-0.29}$</td>
<td>10 BUSKULIC</td>
<td>92I</td>
<td>ALEP</td>
<td>Excess $\Lambda\ell^-$, impact parameters</td>
</tr>
</tbody>
</table>

1 Measured mean life using fully reconstructed $\Lambda_b^0 \rightarrow J/\psi\Lambda$ decays.
2 Measured using $\Lambda\ell^-$ decay length.
3 Measured using $p\ell^-$ decay length.
4 This ABREU 99W result is the combined result of the $\Lambda\ell^-$, $p\ell^-$, and excess $\Lambda\mu^-$ impact parameter measurements.
5 Measured using $\Lambda_c\ell^-$ and $\Lambda\ell^+\ell^-$. 
6 Measured using the excess of $\Lambda\ell^-$, lepton impact parameter.
7 Measured using $\Lambda_c\ell^-$. 
8 ABREU 93F superseded by ABREU 96D.
9 AKERS 93 superseded by AKERS 96.
10 BUSKULIC 92 superseded by BUSKULIC 95L.

### b-baryon ADMIXTURE DECAY MODES 

\((\Lambda_b, \Xi_b, \Sigma_b, \Omega_b)\)

These branching fractions are actually an average over weakly decaying b-baryons weighted by their production rates at the LHC, LEP, and Tevatron, branching ratios, and detection efficiencies. They scale with the b-baryon production fraction \(B(b \to b\text{-baryon})\).

The branching fractions \(B(b\text{-baryon} \to \Lambda\ell^−\pi^−\text{anything})\) and \(B(\Lambda_b^0 \to \Lambda_c^\pm \ell^−\pi^−\text{anything})\) are not pure measurements because the underlying measured products of these with \(B(b \to b\text{-baryon})\) were used to determine \(B(b \to b\text{-baryon})\), as described in the note “Production and Decay of b-Flavored Hadrons.”

For inclusive branching fractions, e.g., \(B \to D^{±}\text{anything}\), 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>
</tr>
</thead>
<tbody>
<tr>
<td>(\Gamma_1)</td>
<td>(p\mu^−\pi^−\text{anything}) ((5.5^+2.2^-1.9)%)</td>
</tr>
<tr>
<td>(\Gamma_2)</td>
<td>(p\ell\pi^\pm\ell\text{anything}) ((5.3\pm1.2)%)</td>
</tr>
<tr>
<td>(\Gamma_3)</td>
<td>(p\text{anything}) ((66\pm21)%)</td>
</tr>
<tr>
<td>(\Gamma_4)</td>
<td>(\Lambda\ell^−\pi^−\text{anything}) ((3.6\pm0.6)%)</td>
</tr>
<tr>
<td>(\Gamma_5)</td>
<td>(\Lambda\ell^+\nu\ell\text{anything}) ((3.0\pm0.8)%)</td>
</tr>
<tr>
<td>(\Gamma_6)</td>
<td>(\Lambda\text{anything}) ((37\pm7)%)</td>
</tr>
<tr>
<td>(\Gamma_7)</td>
<td>(\Xi^−\ell^−\pi^−\text{anything}) ((6.2\pm1.6)\times10^{-3})</td>
</tr>
</tbody>
</table>

### b-baryon ADMIXTURE \((\Lambda_b, \Xi_b, \Sigma_b, \Omega_b)\) BRANCHING RATIOS

\[
\Gamma(p\mu^−\pi^−\text{anything})/\Gamma_{\text{total}} = \Gamma_1/\Gamma
\]

#### \(\Gamma(p\mu^−\pi^−\text{anything})/\Gamma_{\text{total}}\) \(\Gamma_1/\Gamma\)

**VALUE** \(0.055\pm0.021\pm0.017\) \(0.008\)

**EVTS** 125

**DOCUMENT ID** 11 ABREU 95s

**TECN** DLPH

**COMMENT** \(e^+e^- \to Z\)

11 ABREU 95s reports \(\Gamma(p\mu^-\pi^-\text{anything})/\Gamma_{\text{total}} \times [B(\bar{B} \to b\text{-baryon})] = 0.0049 \pm 0.0011 \pm 0.0015\) which we divide by our best value \(B(\bar{B} \to b\text{-baryon}) = (8.9 \pm 1.3) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.

\[
\Gamma(p\ell\pi^\pm\ell\text{anything})/\Gamma_{\text{total}} = \Gamma_2/\Gamma
\]

#### \(\Gamma(p\ell\pi^\pm\ell\text{anything})/\Gamma_{\text{total}}\) \(\Gamma_2/\Gamma\)

**VALUE** \(0.053\pm0.009\pm0.008\)

**EVTS** 125

**DOCUMENT ID** 12 BARATE 98v

**TECN** ALEP

**COMMENT** \(e^+e^- \to Z\)

12 BARATE 98v reports \(\Gamma(p\ell\pi^\pm\ell\text{anything})/\Gamma_{\text{total}} \times [B(\bar{B} \to b\text{-baryon})] = (4.72 \pm 0.66 \pm 0.44) \times 10^{-3}\) which we divide by our best value \(B(\bar{B} \to b\text{-baryon}) = (8.9 \pm 1.3) \times 10^{-2}\). Our first error is their experiment’s error and our second error is the systematic error from using our best value.
The values and averages in this section serve only to show what values result if one assumes our \( B(b \rightarrow b\text{-baryon}) \). They cannot be thought of as measurements since the underlying product branching fractions were also used to determine \( B(b \rightarrow b\text{-baryon}) \) as described in the note on “Production and Decay of \( b\)-Flavored Hadrons.”

### \( \Gamma(\rho\ell\pi\text{anything})/\Gamma(\text{anything}) \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.080±0.012±0.014</td>
<td>BARATE 98v</td>
<td>ALEP</td>
<td>( e^+e^- \rightarrow Z )</td>
</tr>
</tbody>
</table>

### \( \Gamma(\Lambda\ell^-\pi\text{anything})/\Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>EVTS</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.036±0.006</td>
<td>OUR AVERAGE</td>
<td>13 BARATE 98d</td>
<td>ALEP</td>
<td>( e^+e^- \rightarrow Z )</td>
</tr>
<tr>
<td>0.037±0.005</td>
<td></td>
<td>14 AKERS 96</td>
<td>OPAL</td>
<td>Excess of ( \Lambda\ell^- ) over ( \Lambda\ell^+ )</td>
</tr>
<tr>
<td>0.033±0.004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.034±0.008</td>
<td>262</td>
<td>15 ABREU 95s</td>
<td>DLP</td>
<td>Excess of ( \Lambda\ell^- ) over ( \Lambda\ell^+ )</td>
</tr>
<tr>
<td>0.069±0.013</td>
<td>290</td>
<td>16 BUSKULIC 95l</td>
<td>ALEP</td>
<td>Excess of ( \Lambda\ell^- ) over ( \Lambda\ell^+ )</td>
</tr>
</tbody>
</table>

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

### \( \Gamma_v/\Gamma_{\text{total}} \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.080±0.012±0.008</td>
<td>ABBENDI 99l</td>
<td>OPAL</td>
<td>( e^+e^- \rightarrow Z )</td>
</tr>
</tbody>
</table>

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

### \( \Gamma(\Lambda\ell^+\nu\ell\text{anything})/\Gamma(\text{anything}) \)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.070±0.012±0.007</td>
<td>ACKERSTAFF 97n</td>
<td>OPAL</td>
<td>Repl. by ABBENDI 99l</td>
</tr>
</tbody>
</table>

Citation: C. Patrignani et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016)
\[ \Gamma(\Lambda\text{anything})/\Gamma_{\text{total}} \]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.37 ± 0.07</td>
<td>OUR AVERAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.39 ± 0.05 ± 0.06</td>
<td>ABBIENDI 99L</td>
<td>OPAL</td>
<td>( e^+ e^- \rightarrow Z )</td>
</tr>
<tr>
<td>0.25 ± 0.14 ± 0.04</td>
<td>ABREU 95C</td>
<td>DLPH</td>
<td>( e^+ e^- \rightarrow Z )</td>
</tr>
</tbody>
</table>

\[ \Gamma_6/\Gamma \]

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

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0062 ± 0.0016</td>
<td>OUR AVERAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0061 ± 0.0015 ± 0.0009</td>
<td>BUSKULIC 96T</td>
<td>ALEP</td>
<td>Excess ( \Xi^- \ell^- ) over ( \Xi^- \ell^+ )</td>
</tr>
<tr>
<td>0.0066 ± 0.0026 ± 0.0010</td>
<td>ABREU 95V</td>
<td>DLPH</td>
<td>Excess ( \Xi^- \ell^- ) over ( \Xi^- \ell^+ )</td>
</tr>
</tbody>
</table>

\[ \Gamma_7/\Gamma \]

\[ \Gamma(\Lambda\text{anything})/\Gamma_{\text{total}} \times [B(\bar{b} \rightarrow b\text{-baryon})] \]

\[ \Gamma(\Xi^- \ell^- \nu_\ell\text{anything})/\Gamma_{\text{total}} \times [B(\bar{b} \rightarrow b\text{-baryon})] \]

\[ \Gamma_6/\Gamma \]

\[ \Gamma_7/\Gamma \]

\textbf{b-baryon ADMIXTURE (}\Lambda_b, \Xi_b, \Sigma_b, \Omega_b\text{) REFERENCES}

<table>
<thead>
<tr>
<th>ABAZOV</th>
<th>12U</th>
<th>PR D85 112003</th>
<th>V.M. Abazov et al.</th>
<th>(D0 Collab.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABAZOV</td>
<td>07S</td>
<td>PRL 99 142001</td>
<td>V.M. Abazov et al.</td>
<td>(D0 Collab.)</td>
</tr>
<tr>
<td>ABAZOV</td>
<td>05C</td>
<td>PRL 94 102001</td>
<td>V.M. Abazov et al.</td>
<td>(D0 Collab.)</td>
</tr>
<tr>
<td>ABBIENDI</td>
<td>99L</td>
<td>EPJ C9 1</td>
<td>G. Abbiendi et al.</td>
<td>(OPAL Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>96W</td>
<td>EPJ C10 185</td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
<tr>
<td>ACKERSTAFF</td>
<td>98G</td>
<td>PL B426 161</td>
<td>K. Ackerstaff et al.</td>
<td>(OPAL Collab.)</td>
</tr>
<tr>
<td>BARATE</td>
<td>98D</td>
<td>EPJ C2 197</td>
<td>R. Barate et al.</td>
<td>(ALEPH Collab.)</td>
</tr>
<tr>
<td>BARATE</td>
<td>98V</td>
<td>EPJ C5 205</td>
<td>R. Barate et al.</td>
<td>(ALEPH Collab.)</td>
</tr>
<tr>
<td>ACKERSTAFF</td>
<td>97N</td>
<td>ZPHY C74 423</td>
<td>K. Ackerstaff et al.</td>
<td>(OPAL Collab.)</td>
</tr>
<tr>
<td>ABE</td>
<td>96M</td>
<td>PRL 77 1439</td>
<td>F. Abe et al.</td>
<td>(CDF Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>96D</td>
<td>ZPHY C71 199</td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
</tbody>
</table>

HTTP://PDG.LBL.GOV Page 4 Created: 10/1/2016 20:06
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Journal</th>
<th>Volume</th>
<th>Page Numbers</th>
<th>Reference</th>
<th>Collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AKERS</td>
<td>96</td>
<td>ZPHY C69</td>
<td>195</td>
<td></td>
<td>R. Akers et al.</td>
<td>(OPAL Collab.)</td>
</tr>
<tr>
<td>BUSKULIC</td>
<td>96T</td>
<td>PL B384</td>
<td>449</td>
<td></td>
<td>D. Buskulic et al.</td>
<td>(ALEPH Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>95C</td>
<td>PL B347</td>
<td>447</td>
<td></td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>95S</td>
<td>ZPHY C68</td>
<td>375</td>
<td></td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>95V</td>
<td>ZPHY C68</td>
<td>541</td>
<td></td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
<tr>
<td>BUSKULIC</td>
<td>95L</td>
<td>PL B357</td>
<td>685</td>
<td></td>
<td>D. Buskulic et al.</td>
<td>(ALEPH Collab.)</td>
</tr>
<tr>
<td>ABREU</td>
<td>93F</td>
<td>PL B311</td>
<td>379</td>
<td></td>
<td>P. Abreu et al.</td>
<td>(DELPHI Collab.)</td>
</tr>
<tr>
<td>AKERS</td>
<td>93</td>
<td>PL B316</td>
<td>435</td>
<td></td>
<td>R. Akers et al.</td>
<td>(OPAL Collab.)</td>
</tr>
<tr>
<td>BUSKULIC</td>
<td>92I</td>
<td>PL B297</td>
<td>449</td>
<td></td>
<td>D. Buskulic et al.</td>
<td>(ALEPH Collab.)</td>
</tr>
</tbody>
</table>