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

## *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.

| VALUE ($10^{-12}$ s) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| $1.218^{+0.130}_{-0.115}\pm0.042$ | | [1] ABAZOV | 07S | D0 | Repl. by ABAZOV 12U |
| $1.22\ ^{+0.22}_{-0.18}\ \pm0.04$ | | [1] ABAZOV | 05C | D0 | Repl. by ABAZOV 07S |
| $1.16\ \pm0.20\ \pm0.08$ | | [2] ABREU | 99W | DLPH | $e^+e^-\to Z$ |
| $1.19\ \pm0.14\ \pm0.07$ | | [3] ABREU | 99W | DLPH | $e^+e^-\to Z$ |
| $1.14\ \pm0.08\ \pm0.04$ | | [4] ABREU | 99W | DLPH | $e^+e^-\to Z$ |
| $1.11\ ^{+0.19}_{-0.18}\ \pm0.05$ | | [5] ABREU | 99W | DLPH | $e^+e^-\to Z$ |
| $1.29\ ^{+0.24}_{-0.22}\ \pm0.06$ | | [5] ACKERSTAFF | 98G | OPAL | $e^+e^-\to Z$ |
| $1.20\ \pm0.08\ \pm0.06$ | | [6] BARATE | 98D | ALEP | $e^+e^-\to Z$ |
| $1.21\ \pm0.11$ | | [5] BARATE | 98D | ALEP | $e^+e^-\to Z$ |
| $1.32\ \pm0.15\ \pm0.07$ | | [7] ABE | 96M | CDF | $p\overline{p}$ at 1.8 TeV |
| $1.46\ ^{+0.22}_{-0.21}\ ^{+0.07}_{-0.09}$ | | ABREU | 96D | DLPH | Repl. by ABREU 99W |
| $1.10\ ^{+0.19}_{-0.17}\ \pm0.09$ | | [5] ABREU | 96D | DLPH | $e^+e^-\to Z$ |
| $1.16\ \pm0.11\ \pm0.06$ | | [5] AKERS | 96 | OPAL | $e^+e^-\to Z$ |
| $1.27\ ^{+0.35}_{-0.29}\ \pm0.09$ | | ABREU | 95S | DLPH | Repl. by ABREU 99W |
| $1.05\ ^{+0.12}_{-0.11}\ \pm0.09$ | 290 | BUSKULIC | 95L | ALEP | Repl. by BARATE 98D |
| $1.04\ ^{+0.48}_{-0.38}\ \pm0.10$ | 11 | [8] ABREU | 93F | DLPH | Excess $\Lambda\mu^-$, decay lengths |
| $1.05\ ^{+0.23}_{-0.20}\ \pm0.08$ | 157 | [9] AKERS | 93 | OPAL | Excess $\Lambda\ell^-$, decay lengths |
| $1.12\ ^{+0.32}_{-0.29}\ \pm0.16$ | 101 | [10] BUSKULIC | 92I | ALEP | Excess $\Lambda\ell^-$, impact parameters |

[1] Measured mean life using fully reconstructed $\Lambda_b^0\to J/\psi\Lambda$ 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 92I superseded by BUSKULIC 95L.

## $b$-baryon ADMIXTURE DECAY MODES ($\Lambda_b$,$\Xi_b$,$\Omega_b$)

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($b \to$ $b$-baryon).

The branching fractions B($b$-baryon $\to$ $\Lambda\ell^-\overline{\nu}_\ell$ anything) and B($\Lambda_b^0 \to$ $\Lambda_c^+\ell^-\overline{\nu}_\ell$ anything) are not pure measurements because the underlying measured products of these with B($b \to$ $b$-baryon) were used to determine B($b \to$ $b$-baryon), as described in the note "Production and Decay of $b$-Flavored Hadrons."

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

| | Mode | Fraction ($\Gamma_i/\Gamma$) | Scale factor |
|---|---|---|---|
| $\Gamma_1$ | $p\mu^-\overline{\nu}$ anything | ( $5.8^{+\ 2.3}_{-\ 2.0}$) % | |
| $\Gamma_2$ | $p\ell\overline{\nu}_\ell$ anything | ( 5.6± 1.2) % | |
| $\Gamma_3$ | $p$ anything | (70 ±22 ) % | |
| $\Gamma_4$ | $\Lambda\ell^-\overline{\nu}_\ell$ anything | ( 3.8± 0.6) % | |
| $\Gamma_5$ | $\Lambda\ell^+\nu_\ell$ anything | ( 3.2± 0.8) % | |
| $\Gamma_6$ | $\Lambda$ anything | (39 ± 7 ) % | |
| $\Gamma_7$ | $\Xi^-\ell^-\overline{\nu}_\ell$ anything | ( 4.6± 1.4) $\times 10^{-3}$ | 1.2 |

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

### $\Gamma(p\mu^-\overline{\nu}\text{anything})/\Gamma_{\text{total}}$ $\Gamma_1/\Gamma$

| VALUE (%) | EVTS | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $\mathbf{5.8^{+2.2}_{-1.9}\pm0.8}$ | 125 | [1] ABREU | 95S | DLPH | $e^+e^- \to Z$ |

[1] ABREU 95S reports $[\Gamma(b\text{-baryon} \to p\mu^-\overline{\nu}\text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.0049 \pm 0.0011^{+0.0015}_{-0.0011}$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) = $(8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

### $\Gamma(p\ell\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}$ $\Gamma_2/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **5.6±0.9±0.7** | [1] BARATE | 98V | ALEP | $e^+e^- \to Z$ |

[1] BARATE 98V reports $[\Gamma(b\text{-baryon} \to p\ell\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = (4.72 \pm 0.66 \pm 0.44) \times 10^{-3}$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) = $(8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

## $\Gamma(p\ell\overline{\nu}_\ell \text{anything})/\Gamma(p\text{anything})$ $\Gamma_2/\Gamma_3$

| *VALUE* (%) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **8.0±1.2±1.4** | BARATE | 98V | ALEP | $e^+e^- \to Z$ |

## $\Gamma(\Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}$ $\Gamma_4/\Gamma$

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

| *VALUE* (%) | *EVTS* | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|---|
| **3.8±0.6 OUR AVERAGE** | | | | | |
| 3.9±0.5±0.5 | | [1] BARATE | 98D | ALEP | $e^+e^- \to Z$ |
| 3.5±0.4±0.5 | | [2] AKERS | 96 | OPAL | Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$ |
| 3.6±0.9±0.5 | 262 | [3] ABREU | 95S | DLPH | Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$ |
| 7.3±1.4±1.0 | 290 | [4] BUSKULIC | 95L | ALEP | Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | | |
| seen | 157 | [5] AKERS | 93 | OPAL | Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$ |
| 8.3±2.5±1.1 | 101 | [6] BUSKULIC | 92I | ALEP | Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$ |

[1] BARATE 98D reports $[\Gamma(b\text{-baryon} \to \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.00326 \pm 0.00016 \pm 0.00039$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) $= (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Measured using the excess of $\Lambda\ell^-$, lepton impact parameter.

[2] AKERS 96 reports $[\Gamma(b\text{-baryon} \to \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.00291 \pm 0.00023 \pm 0.00025$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) $= (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] ABREU 95S reports $[\Gamma(b\text{-baryon} \to \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.0030 \pm 0.0006 \pm 0.0004$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) $= (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[4] BUSKULIC 95L reports $[\Gamma(b\text{-baryon} \to \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.0061 \pm 0.0006 \pm 0.0010$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) $= (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[5] AKERS 93 superseded by AKERS 96.

[6] BUSKULIC 92I reports $[\Gamma(b\text{-baryon} \to \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.0070 \pm 0.0010 \pm 0.0018$ which we divide by our best value B($\overline{b} \to$ $b$-baryon) $= (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Superseded by BUSKULIC 95L.

## $\Gamma(\Lambda\ell^+\nu_\ell \text{anything})/\Gamma(\Lambda\text{anything})$ $\Gamma_5/\Gamma_6$

| *VALUE* (units $10^{-2}$) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| **8.0±1.2±0.8** | ABBIENDI | 99L | OPAL | $e^+e^- \to Z$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 7.0±1.2±0.7 | ACKERSTAFF | 97N | OPAL | Repl. by ABBIENDI 99L |

## $\Gamma(\Lambda\text{anything})/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

| VALUE (%) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **39± 7 OUR AVERAGE** | | | | |
| 42± 6±5 | [1] ABBIENDI | 99L | OPAL | $e^+e^- \to Z$ |
| $27^{+15}_{-9}\pm3$ | [2] ABREU | 95C | DLPH | $e^+e^- \to Z$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 47± 7±6 | [3] ACKERSTAFF | 97N | OPAL | Repl. by ABBIENDI 99L |

[1] ABBIENDI 99L reports $[\Gamma(b\text{-baryon} \to \Lambda\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})] = 0.035 \pm 0.0032 \pm 0.0035$ which we divide by our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] ABREU 95C reports $0.28^{+0.17}_{-0.12}$ from a measurement of $[\Gamma(b\text{-baryon} \to \Lambda\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})]$ assuming $B(\overline{b} \to b\text{-baryon}) = 0.08 \pm 0.02$, which we rescale to our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] ACKERSTAFF 97N reports $[\Gamma(b\text{-baryon} \to \Lambda\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})] = 0.0393 \pm 0.0046 \pm 0.0037$ which we divide by our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

## $\Gamma(\Xi^-\ell^-\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma$

| VALUE (units $10^{-3}$) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| **4.6±1.4 OUR AVERAGE** Error includes scale factor of 1.2. | | | | |
| 3.6±1.2±0.5 | [1] ABDALLAH | 05C | DLPH | $e^+e^- \to Z^0$ |
| 6.4±1.6±0.8 | [2] BUSKULIC | 96T | ALEP | Excess $\Xi^-\ell^-$ over $\Xi^-\ell^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | | |
| 7.0±2.8±0.9 | [3] ABREU | 95V | DLPH | Repl. by ABDALLAH 05C |

[1] ABDALLAH 05C reports $[\Gamma(b\text{-baryon} \to \Xi^-\ell^-\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})] = (3.0 \pm 1.0 \pm 0.3) \times 10^{-4}$ which we divide by our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[2] BUSKULIC 96T reports $[\Gamma(b\text{-baryon} \to \Xi^-\ell^-\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})] = (5.4 \pm 1.1 \pm 0.8) \times 10^{-4}$ which we divide by our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[3] ABREU 95V reports $[\Gamma(b\text{-baryon} \to \Xi^-\ell^-\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \to b\text{-baryon})] = (5.9 \pm 2.1 \pm 1.0) \times 10^{-4}$ which we divide by our best value $B(\overline{b} \to b\text{-baryon}) = (8.4 \pm 1.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

## $b$-baryon ADMIXTURE ($\Lambda_b$, $\Xi_b$, $\Omega_b$) REFERENCES


| | | | | |
|---|---|---|---|---|
| ABAZOV | 12U | PR D85 112003 | V.M. Abazov *et al.* | (D0 Collab.) |
| ABAZOV | 07S | PRL 99 142001 | V.M. Abazov *et al.* | (D0 Collab.) |
| ABAZOV | 05C | PRL 94 102001 | V.M. Abazov *et al.* | (D0 Collab.) |
| ABDALLAH | 05C | EPJ C44 299 | J. Abdallah *et al.* | (DELPHI Collab.) |
| ABBIENDI | 99L | EPJ C9 1 | G. Abbiendi *et al.* | (OPAL Collab.) |
| ABREU | 99W | EPJ C10 185 | P. Abreu *et al.* | (DELPHI Collab.) |
| ACKERSTAFF | 98G | PL B426 161 | K. Ackerstaff *et al.* | (OPAL Collab.) |
| BARATE | 98D | EPJ C2 197 | R. Barate *et al.* | (ALEPH Collab.) |

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|---|---|---|---|---|
| BARATE | 98V | EPJ C5 205 | R. Barate *et al.* | (ALEPH Collab.) |
| ACKERSTAFF | 97N | ZPHY C74 423 | K. Ackerstaff *et al.* | (OPAL Collab.) |
| ABE | 96M | PRL 77 1439 | F. Abe *et al.* | (CDF Collab.) |
| ABREU | 96D | ZPHY C71 199 | P. Abreu *et al.* | (DELPHI Collab.) |
| AKERS | 96 | ZPHY C69 195 | R. Akers *et al.* | (OPAL Collab.) |
| BUSKULIC | 96T | PL B384 449 | D. Buskulic *et al.* | (ALEPH Collab.) |
| ABREU | 95C | PL B347 447 | P. Abreu *et al.* | (DELPHI Collab.) |
| ABREU | 95S | ZPHY C68 375 | P. Abreu *et al.* | (DELPHI Collab.) |
| ABREU | 95V | ZPHY C68 541 | P. Abreu *et al.* | (DELPHI Collab.) |
| BUSKULIC | 95L | PL B357 685 | D. Buskulic *et al.* | (ALEPH Collab.) |
| ABREU | 93F | PL B311 379 | P. Abreu *et al.* | (DELPHI Collab.) |
| AKERS | 93 | PL B316 435 | R. Akers *et al.* | (OPAL Collab.) |
| BUSKULIC | 92I | PL B297 449 | D. Buskulic *et al.* | (ALEPH Collab.) |