b-baryon ADMIXTURE (Λ_b, Ξ_b, Σ_b, Ω_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.

"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.

VALUE (10^{-12} s)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.449±0.015 OUR EVALUATION					
$1.415 \pm 0.027 \pm 0.006$		AAIJ	14E	LHCB	pp at 7 TeV
$1.449 \pm 0.036 \pm 0.017$		[1] AAD	13U	ATLS	pp at 7 TeV
$1.303 \pm 0.075 \pm 0.035$		[2] ABAZOV	12U	D0	$p\overline{p}$ at 1.96 TeV
$1.401 \pm 0.046 \pm 0.035$		[3] AALTONEN	10B	CDF	$p\overline{p}$ at 1.96 TeV
$1.290^{+0.119}_{-0.110}{}^{+0.087}_{-0.091}$		[4] ABAZOV	07U	D0	$p\overline{p}$ at 1.96 TeV
$1.593^{+0.083}_{-0.078} \pm 0.033$		[2] ABULENCIA	07A	CDF	$p\overline{p}$ at 1.96 TeV
$1.16 \pm 0.20 \pm 0.08$		[5] ABREU	99W	DLPH	$e^+e^- \to Z$
$1.19 \pm 0.14 \pm 0.07$		[6] ABREU	99W	DLPH	$e^+e^- \to Z$
$1.11\ ^{+0.19}_{-0.18} \pm 0.05$		[7] ABREU	99W	DLPH	$e^+e^- \to Z$
$1.29\ ^{+0.24}_{-0.22} \pm 0.06$		[7] ACKERSTAFF	98G	OPAL	$e^+e^- \to Z$
$1.20 \pm 0.08 \pm 0.06$		[8] BARATE	98D	ALEP	$e^+e^- \to Z$
1.21 ± 0.11		[7] BARATE	98D	ALEP	$e^+e^- \to Z$
$1.32 \pm 0.15 \pm 0.07$		[9] ABE	96M	CDF	$p\overline{p}$ at 1.8 TeV
$1.10\ ^{+0.19}_{-0.17} \pm 0.09$		[7] ABREU	96D	DLPH	$e^+e^- \to Z$
$1.16 \pm 0.11 \pm 0.06$		[7] AKERS	96	OPAL	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$1.218^{+0.130}_{-0.115} \pm 0.042$		[2] ABAZOV	07S	D0	Repl. by ABAZOV 12U
$1.22\ ^{+0.22}_{-0.18} \pm 0.04$		[2] ABAZOV	05C	D0	Repl. by ABAZOV 07S
$1.14 \pm 0.08 \pm 0.04$		[10] ABREU	99W	DLPH	$e^+e^- \to Z$
$1.46\ ^{+0.22}_{-0.21}\ ^{+0.07}_{-0.09}$		ABREU	96D	DLPH	Repl. by ABREU 99W
$1.27\ ^{+0.35}_{-0.29} \pm 0.09$		ABREU	95S	DLPH	Repl. by ABREU 99W

1.05 $^{+0.12}_{-0.11}$	±0.09	290	BUSKULIC	95L	ALEP	Repl. by BARATE 98D
1.04 $^{+0.48}_{-0.38}$	±0.10	11	[11] ABREU	93F	DLPH	Excess $\Lambda\mu^-$, decay lengths
1.05 $^{+0.23}_{-0.20}$	±0.08	157	[12] AKERS	93	OPAL	Excess $\Lambda\ell^-$, decay lengths
1.12 $^{+0.32}_{-0.29}$	±0.16	101	[13] BUSKULIC	92I	ALEP	Excess $\Lambda\ell^-$, impact parameters

[1] Measured with $\Lambda_b^0 \to J/\psi(\mu^+\mu^-)\,\Lambda^0(p\pi^-)$ decays.
[2] Measured mean life using fully reconstructed $\Lambda_b^0 \to J/\psi\Lambda$ decays.
[3] Measured mean life using fully reconstructed $\Lambda_b^0 \to \Lambda_c^+\pi^-$ decays.
[4] Measured using semileptonic decays $\Lambda_b(0) \to \Lambda_c^+\mu\nu X$, $\Lambda_c^+ \to K_S^0 p$.
[5] Measured using $\Lambda\ell^-$ decay length.
[6] Measured using $p\ell^-$ decay length.
[7] Measured using $\Lambda_c\ell^-$ and $\Lambda\ell^+\ell^-$.
[8] Measured using the excess of $\Lambda\ell^-$, lepton impact parameter.
[9] Measured using $\Lambda_c\ell^-$.
[10] This ABREU 99W result is the combined result of the $\Lambda\ell^-$, $p\ell^-$, and excess $\Lambda\mu^-$ impact parameter measurements.
[11] ABREU 93F superseded by ABREU 96D.
[12] AKERS 93 superseded by AKERS 96.
[13] BUSKULIC 92I superseded by BUSKULIC 95L.

b-baryon ADMIXTURE DECAY MODES (Λ_b,Ξ_b,Σ_b,Ω_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 (Γ_i/Γ)
Γ_1	$p\mu^-\overline{\nu}$anything	(5.3$^{+\ 2.2}_{-\ 1.9}$) %
Γ_2	$p\ell\overline{\nu}_\ell$anything	(5.1± 1.2) %
Γ_3	$p$anything	(64 ±21) %
Γ_4	$\Lambda\ell^-\overline{\nu}_\ell$anything	(3.5± 0.6) %

Γ_5	$\Lambda\ell^+\nu_\ell$ anything	
Γ_6	Λ anything	
Γ_7	$\Lambda_c^+\ell^-\overline{\nu}_\ell$ anything	
Γ_8	$\Lambda/\overline{\Lambda}$ anything	(36 ± 7) %
Γ_9	$\Xi^-\ell^-\overline{\nu}_\ell$ anything	(6.0± 1.6) × 10^{-3}

b-baryon ADMIXTURE (Λ_b, Ξ_b, Σ_b, Ω_b) BRANCHING RATIOS

$\Gamma(p\mu^-\overline{\nu}\text{anything})/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{0.053^{+0.020}_{-0.017}\pm0.009}$	125	[14] ABREU	95S	DLPH	$e^+e^-\to Z$

[14] ABREU 95S reports $[\Gamma(b\text{-baryon}\to p\mu^-\overline{\nu}\text{anything})/\Gamma_{\text{total}}]\times[\text{B}(\overline{b}\to b\text{-baryon})] = 0.0049\pm0.0011^{+0.0015}_{-0.0011}$ which we divide by our best value $\text{B}(\overline{b}\to b\text{-baryon}) = (9.2\pm1.5)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\ell\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.051±0.009±0.008	[15] BARATE	98V	ALEP	$e^+e^-\to Z$

[15] BARATE 98V reports $[\Gamma(b\text{-baryon}\to p\ell\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}]\times[\text{B}(\overline{b}\to b\text{-baryon})] = (4.72\pm0.66\pm0.44)\times10^{-3}$ which we divide by our best value $\text{B}(\overline{b}\to b\text{-baryon}) = (9.2\pm1.5)\times10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(p\ell\overline{\nu}_\ell\text{anything})/\Gamma(p\text{anything})$ Γ_2/Γ_3

VALUE	DOCUMENT ID		TECN	COMMENT
0.080±0.012±0.014	BARATE	98V	ALEP	$e^+e^-\to Z$

$\Gamma(\Lambda\ell^-\overline{\nu}_\ell\text{anything})/\Gamma_{\text{total}}$ Γ_4/Γ

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.035±0.006 OUR AVERAGE					
0.035±0.005±0.006		[16] BARATE	98D	ALEP	$e^+e^-\to Z$
0.032±0.004±0.005		[17] AKERS	96	OPAL	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.033±0.008±0.005	262	[18] ABREU	95S	DLPH	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.066±0.013±0.011	290	[19] BUSKULIC	95L	ALEP	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	157	[20] AKERS	93	OPAL	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.076±0.022±0.012	101	[21] BUSKULIC	92I	ALEP	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$

[16] BARATE 98D reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.00326 \pm 0.00016 \pm 0.00039$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Measured using the excess of $\Lambda\ell^-$, lepton impact parameter.

[17] AKERS 96 reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.00291 \pm 0.00023 \pm 0.00025$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[18] ABREU 95S reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.0030 \pm 0.0006 \pm 0.0004$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[19] BUSKULIC 95L reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.0061 \pm 0.0006 \pm 0.0010$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[20] AKERS 93 superseded by AKERS 96.

[21] BUSKULIC 92I reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda\ell^-\overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.0070 \pm 0.0010 \pm 0.0018$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Superseded by BUSKULIC 95L.

$\Gamma(\Lambda\ell^+\nu_\ell \text{anything})/\Gamma(\Lambda \text{anything})$ Γ_5/Γ_6

VALUE	DOCUMENT ID		TECN	COMMENT
0.080±0.012±0.008	ABBIENDI	99L	OPAL	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.070±0.012±0.007	ACKERSTAFF	97N	OPAL	Repl. by ABBIENDI 99L

$\Gamma(\Lambda/\overline{\Lambda} \text{anything})/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.36±0.07 OUR AVERAGE				
0.38±0.05±0.06	[22] ABBIENDI	99L	OPAL	$e^+e^- \rightarrow Z$
$0.24^{+0.13}_{-0.08}\pm0.04$	[23] ABREU	95C	DLPH	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.43±0.06±0.07	[24] ACKERSTAFF	97N	OPAL	Repl. by ABBIENDI 99L

[22] ABBIENDI 99L reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda/\overline{\Lambda} \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.035 \pm 0.0032 \pm 0.0035$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[23] ABREU 95C reports $0.28^{+0.17}_{-0.12}$ from a measurement of $[\Gamma(b\text{-baryon} \rightarrow \Lambda/\overline{\Lambda} \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})]$ assuming $B(\overline{b} \rightarrow b\text{-baryon}) = 0.08 \pm 0.02$, which we rescale to our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[24] ACKERSTAFF 97N reports $[\Gamma(b\text{-baryon} \rightarrow \Lambda/\overline{\Lambda} \text{anything})/\Gamma_{\text{total}}] \times [B(\overline{b} \rightarrow b\text{-baryon})] = 0.0393 \pm 0.0046 \pm 0.0037$ which we divide by our best value $B(\overline{b} \rightarrow b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\Xi^- \ell^- \overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.0060±0.0016 OUR AVERAGE				
0.0059±0.0015±0.0010	[25] BUSKULIC	96T	ALEP	Excess $\Xi^- \ell^-$ over $\Xi^- \ell^+$
0.0064±0.0025±0.0010	[26] ABREU	95V	DLPH	Excess $\Xi^- \ell^-$ over $\Xi^- \ell^+$

[25] BUSKULIC 96T reports $[\Gamma(b\text{-baryon} \to \Xi^- \ell^- \overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.00054 \pm 0.00011 \pm 0.00008$ which we divide by our best value $\text{B}(\overline{b} \to b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[26] ABREU 95V reports $[\Gamma(b\text{-baryon} \to \Xi^- \ell^- \overline{\nu}_\ell \text{anything})/\Gamma_{\text{total}}] \times [\text{B}(\overline{b} \to b\text{-baryon})] = 0.00059 \pm 0.00021 \pm 0.0001$ which we divide by our best value $\text{B}(\overline{b} \to b\text{-baryon}) = (9.2 \pm 1.5) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

b-baryon ADMIXTURE (Λ_b, Ξ_b, Σ_b, Ω_b) REFERENCES

AAIJ	14E	JHEP 1404 114	R. Aaij *et al.*	(LHCb Collab.)
AAD	13U	PR D87 032002	G. Aad *et al.*	(ATLAS Collab.)
ABAZOV	12U	PR D85 112003	V.M. Abazov *et al.*	(D0 Collab.)
AALTONEN	10B	PRL 104 102002	T. Aaltonen *et al.*	(CDF Collab.)
ABAZOV	07S	PRL 99 142001	V.M. Abazov *et al.*	(D0 Collab.)
ABAZOV	07U	PRL 99 182001	V.M. Abazov *et al.*	(D0 Collab.)
ABULENCIA	07A	PRL 98 122001	A. Abulencia *et al.*	(FNAL CDF Collab.)
ABAZOV	05C	PRL 94 102001	V.M. Abazov *et al.*	(D0 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.)
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.)