Λ_b^0

$I(J^P) = 0(\frac{1}{2}^+)$ Status: ∗∗∗

In the quark model, a Λ_b^0 is an isospin-0 udb state. The lowest Λ_b^0 ought to have $J^P = 1/2^+$. None of I, J, or P have actually been measured.

Λ_b^0 MASS

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
5641± 50 OUR AVERAGE					
5640± 50±30	16	[1] ALBAJAR	91E	UA1	$p\overline{p}$ 630 GeV
5640^{+100}_{-210}	52	BARI	91	SFM	$\Lambda_b^0 \to pD^0\pi^-$
5650^{+150}_{-200}	90	BARI	91	SFM	$\Lambda_b^0 \to \Lambda_c^+\pi^+\pi^-\pi^-$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen		[2] ABE	93B	CDF	$p\overline{p}$ 1.8 TeV
∼ 5750	4	[3] ARENTON	86	FMPS	$\Lambda K_S^0 2\pi^+ 2\pi^-$
$5425^{+175}_{-\ 75}$		[4] BASILE	81	SFM	See BARI 91

[1] ALBAJAR 91E claims 16 ± 5 events above a background of 9 ± 1 events, a significance of about 5 standard deviations.

[2] ABE 93B states that, based on the signal claimed by ALBAJAR 91E, CDF should have found 30 ± 23 $\Lambda_b^0 \to J/\psi(1S)\Lambda$ events. Instead, CDF found not more than 2 events.

[3] The decay of the Λ_b^0 to the final state observed by ARENTON 86 is Cabibbo suppressed, whereas the decay of a Ξ_b^0 to this final state is allowed. ARENTON 86 thus only claims to have observed a baryon which probably has a b quark and has a D^0 among the decay products, not necessarily the Λ_b^0.

[4] The first claim to have discovered the Λ_b^0 was reported by BASILE 81. In contrast, DRIJARD 82 reported no observation of Λ_b^0, and this led to some discussion in BASILE 82 and DRIJARD 82B. Further evidence for the Λ_b^0 was again reported by the first authors in BARI 91 (see above) in a second, upgraded experiment where two different Λ_b^0 decay modes were observed.

Λ_b^0 MEAN LIFE

These are actually measurements of the average lifetime of weakly decaying b baryons weighted by generally unknown production rates, branching fractions, and detection efficiencies. Presumably, the mix is mainly Λ_b^0, with some Ξ_b^0 and Ξ_b^-.

"OUR EVALUATION" is an average of the data listed below performed by the LEP B Lifetimes Working Group as described in our review "Production and Decay of b-flavored Hadrons" in the $B^\pm$ Section of the Listings. The averaging procedure takes into account correlations between the measurements and asymmetric lifetime errors.

VALUE (10^{-12} s)	EVTS	DOCUMENT ID		TECN	COMMENT
1.14±0.08 OUR EVALUATION					
$1.46^{+0.22}_{-0.21}{}^{+0.07}_{-0.09}$		ABREU	96D	DLPH	Excess $\Lambda\ell^-\pi^+$, decay lengths
$1.10^{+0.19}_{-0.17}\pm0.09$		ABREU	96D	DLPH	Excess $\Lambda\mu^-$ impact parameters
$1.19^{+0.21}_{-0.18}{}^{+0.07}_{-0.08}$		ABREU	96D	DLPH	Excess $\Lambda_c\ell^-$, decay lengths
1.15±0.12±0.06		AKERS	96	OPAL	Excess $\Lambda\ell^-$, decay lengths
$1.21^{+0.15}_{-0.13}\pm0.10$		AKERS	96	OPAL	Excess $\Lambda\ell^-$, impact parameters
$1.27^{+0.35}_{-0.29}\pm0.09$		ABREU	95S	DLPH	Excess $p\mu^-$, decay lengths
$1.14^{+0.22}_{-0.19}\pm0.07$	69	AKERS	95K	OPAL	Excess $\Lambda_c\ell^-$, decay lengths
$1.05^{+0.12}_{-0.11}\pm0.09$	290	BUSKULIC	95L	ALEP	Excess $\Lambda\ell^-$, impact parameters
$1.02^{+0.23}_{-0.18}\pm0.06$	44	BUSKULIC	95L	ALEP	Excess $\Lambda_c\ell^-$, decay lengths

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

$1.25\pm0.11\pm0.05$		[5] ABREU	96D	DLPH	Combined result
$1.16\pm0.11\pm0.06$		[6] AKERS	96	OPAL	Combined result
$1.04^{+0.48}_{-0.38}\pm0.10$	11	[7] ABREU	93F	DLPH	Excess $\Lambda\mu^-$, decay lengths
$1.05^{+0.23}_{-0.20}\pm0.08$	157	[8] AKERS	93	OPAL	Excess $\Lambda\ell^-$, decay lengths
$1.12^{+0.32}_{-0.29}\pm0.16$	101	[9] BUSKULIC	92I	ALEP	Excess $\Lambda\ell^-$, impact parameters

[5] Combined result of the three ABREU 96D methods and ABREU 95S.
[6] Combined result of AKERS 96 impact parameter and decay length methods.
[7] ABREU 93F superseded by ABREU 96D.
[8] AKERS 93 superseded by AKERS 96.
[9] BUSKULIC 92I superseded by BUSKULIC 95L.

Λ_b^0 DECAY MODES

These branching fractions are actually an average over weakly decaying b-baryons weighted by their production rates in Z decay (or high-energy $p\overline{p}$), branching ratios, and detection efficiencies. They scale with the LEP Λ_b production fraction $B(b \to \Lambda_b)$ and are evaluated for our value $B(b \to \Lambda_b) = (13.2 \pm 4.1)\%$.

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

	Mode	Fraction (Γ_i/Γ)
Γ_1	$J/\psi(1S)\Lambda$	(1.4± 0.9) %
Γ_2	$pD^0\pi^-$	seen
Γ_3	$\Lambda_c^+\pi^+\pi^-\pi^-$	seen
Γ_4	$\Lambda K^0 2\pi^+ 2\pi^-$	
Γ_5	$p\mu^-\overline{\nu}$anything	(3.7± 1.7) %
Γ_6	$\Lambda\ell^-\overline{\nu}_\ell$anything	[a] (2.5± 0.5) %
Γ_7	$\Lambda_c^+\ell^-\overline{\nu}_\ell$anything	[a] (10.0± 3.0) %
Γ_8	$\Lambda/\overline{\Lambda}$anything	$(17\ ^{+11}_{-\ 8}\ )$ %

[a] Not a pure measurement. See note at head of Λ_b^0 Decay Modes.

Λ_b^0 BRANCHING RATIOS

$\Gamma(J/\psi(1S)\Lambda)/\Gamma_{total}$ Γ_1/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.014±0.008±0.004	16	[10] ALBAJAR	91E	UA1	$J/\psi(1S) \to \mu^+\mu^-$

[10] ALBAJAR 91E reports 0.018 ± 0.011 for $B(b \to \Lambda_b) = 0.10$. We rescale to our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(pD^0\pi^-)/\Gamma_{total}$ Γ_2/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	52	BARI	91	SFM	$D^0 \to K^-\pi^+$

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

seen		BASILE	81	SFM	$D^0 \to K^-\pi^+$

$\Gamma(\Lambda_c^+\pi^+\pi^-\pi^-)/\Gamma_{total}$ Γ_3/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	90	BARI	91	SFM	$\Lambda_c^+ \to pK^-\pi^+$

$\Gamma(\Lambda K^0 2\pi^+ 2\pi^-)/\Gamma_{\text{total}}$ Γ_4/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	4	[11] ARENTON 86	FMPS	$\Lambda K^0_S 2\pi^+ 2\pi^-$

[11] See the footnote to the ARENTON 86 mass value.

$\Gamma(p\mu^-\overline{\nu}\,\text{anything})/\Gamma_{\text{total}}$ Γ_5/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
$\mathbf{0.037^{+0.014}_{-0.012}\pm0.012}$	125	[12] ABREU 95S	DLPH	$e^+e^- \to Z$

[12] ABREU 95S reports $[B(\Lambda_b^0 \to p\mu^-\overline{\nu}\text{anything}) \times B(b \to \Lambda_b)] = 0.0049 \pm 0.0011^{+0.0015}_{-0.0011}$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\Lambda\ell^-\overline{\nu}_\ell\,\text{anything})/\Gamma_{\text{total}}$ Γ_6/Γ

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.025±0.005 OUR AVERAGE				
0.022±0.003±0.007		[13] AKERS 96	OPAL	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.023±0.005±0.007	262	[14] ABREU 95S	DLPH	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.046±0.009±0.014	290	[15] BUSKULIC 95L	ALEP	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
seen	157	[16] AKERS 93	OPAL	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$
0.053±0.016±0.016	101	[17] BUSKULIC 92I	ALEP	Excess of $\Lambda\ell^-$ over $\Lambda\ell^+$

[13] AKERS 96 reports $[B(\Lambda_b^0 \to \Lambda\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.00291 \pm 0.00023 \pm 0.00025$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[14] ABREU 95S reports $[B(\Lambda_b^0 \to \Lambda\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.0030 \pm 0.0006 \pm 0.0004$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[15] BUSKULIC 95L reports $[B(\Lambda_b^0 \to \Lambda\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.0061 \pm 0.0006 \pm 0.0010$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[16] AKERS 93 superseded by AKERS 96.

[17] BUSKULIC 92I reports $[B(\Lambda_b^0 \to \Lambda\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.0070 \pm 0.0010 \pm 0.0018$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. 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.

$\Gamma(\Lambda_c^+\ell^-\overline{\nu}_\ell\,\text{anything})/\Gamma_{\text{total}}$ Γ_7/Γ

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

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.100±0.030 OUR AVERAGE				
$0.089^{+0.031}_{-0.025}\pm0.028$	29	[18] ABREU 95S	DLPH	$e^+e^- \to Z$
0.11 ±0.03 ±0.04	55	[19] BUSKULIC 95L	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.23 ±0.09 ±0.07	21	[20] BUSKULIC 92E	ALEP	$\Lambda_c^+ \to pK^-\pi^+$

[18] ABREU 95S reports $[B(\Lambda_b^0 \to \Lambda_c^+\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.0118 \pm 0.0026^{+0.0031}_{-0.0021}$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[19] BUSKULIC 95L reports $[B(\Lambda_b^0 \to \Lambda_c^+\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.0151 \pm 0.0029 \pm 0.0023$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[20] BUSKULIC 92E reports $[B(\Lambda_b^0 \to \Lambda_c^+\ell^-\overline{\nu}_\ell\text{anything}) \times B(b \to \Lambda_b)] = 0.030 \pm 0.007 \pm 0.009$. We divide by our best value $B(b \to \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. 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.

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

VALUE	DOCUMENT ID	TECN	COMMENT
$\mathbf{0.17^{+0.09}_{-0.06}\pm0.05}$	[21] ABREU 95C	DLPH	$e^+e^- \rightarrow Z$

[21] ABREU 95C reports $0.28^{+0.17}_{-0.12}$ for $B(b \rightarrow \Lambda_b) = 0.08 \pm 0.02$. We rescale to our best value $B(b \rightarrow \Lambda_b) = (13.2 \pm 4.1) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

Λ_b^0 REFERENCES

ABREU	96D	ZPHY C (submitted)	+Adam, Adye, Agasi+	(DELPHI Collab.)
CERN-PPE/96-21				
AKERS	96	ZPHY C69 195	+Alexander, Allison, Altekamp+	(OPAL Collab.)
ABREU	95C	PL B347 447	+Adam, Adye, Agasi+	(DELPHI Collab.)
ABREU	95S	ZPHY C68 375	+Adam, Adye, Agasi+	(DELPHI Collab.)
AKERS	95K	PL B353 402	+Alexander, Allison, Altekamp+	(OPAL Collab.)
BUSKULIC	95L	PL B357 685	+Casper, De Bonis, Decamp+	(ALEPH Collab.)
ABE	93B	PR D47 R2639	+Amidei, Anway-Wiese, Apollinari+	(CDF Collab.)
ABREU	93F	PL B311 379	+Adam, Adye, Agasi+	(DELPHI Collab.)
AKERS	93	PL B316 435	+Alexander, Allison, Anderson+	(OPAL Collab.)
Also	92E	PL B281 394	Acton, Alexander, Allison, Allport+	(OPAL Collab.)
BUSKULIC	92E	PL B294 145	+Decamp, Goy, Lees, Minard+	(ALEPH Collab.)
BUSKULIC	92I	PL B297 449	+Decamp, Goy, Lees+	(ALEPH Collab.)
Also	92D	PL B278 209	Decamp, Deschizeaux, Goy+	(ALEPH Collab.)
ALBAJAR	91E	PL B273 540	+Albrow, Allkofer, Ankoviak+	(UA1 Collab.)
BARI	91	NC 104A 1787	+Basile, Bruni, Cara Romeo+	(CERN R422 Collab.)
ARENTON	86	NP B274 707	+Chen, Cormell, Dieterle+	(ARIZ, NDAM, VAND)
BASILE	82	NC 68A 289	+Bonvicini, Romeo+	(CERN R415 Collab.)
DRIJARD	82	PL 108B 361	+	(CERN, CDEF, DORT, HEIDH, LAPP, WARS)
DRIJARD	82B	CERN-EP/82-31	+	(CERN, CDEF, DORT, HEIDH, LAPP, WARS)
BASILE	81	LNC 31 97	+Bonvicini, Romeo+	(CERN R415 Collab.)