Λ_b^0

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

In the quark model, a Λ_b^0 is an isospin-0 $u\,d\,b$ 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

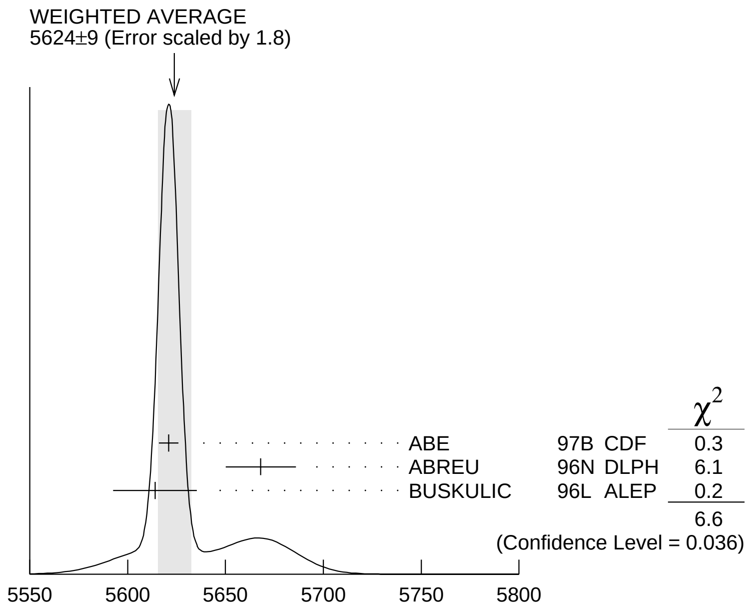
VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
5624± 9 OUR AVERAGE	Error includes scale factor of 1.8. See the ideogram below.				
5621± 4± 3		[1] ABE	97B	CDF	$p\overline{p}$ at 1.8 TeV
5668± 16± 8	4	[2] ABREU	96N	DLPH	$e^+e^- \rightarrow Z$
5614± 21± 4	4	[2] BUSKULIC	96L	ALEP	$e^+e^- \rightarrow Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
not seen		[3] ABE	93B	CDF	Sup. by ABE 97B
5640± 50±30	16	[4] ALBAJAR	91E	UA1	$p\overline{p}$ 630 GeV
5640^{+100}_{-210}	52	BARI	91	SFM	$\Lambda_b^0 \rightarrow p D^0 \pi^-$
5650^{+150}_{-200}	90	BARI	91	SFM	$\Lambda_b^0 \rightarrow \Lambda_c^+ \pi^+ \pi^- \pi^-$

[1] ABE 97B observed 38 events above a background 18 ± 1.6 events in the mass range 5.60–5.65 GeV/c^2, a significance of > 3.4 standard deviations.

[2] Uses 4 fully reconstructed Λ_b events.

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

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



Λ_b^0 mass (MeV)

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^-.

See b-baryon Admixture section for data on b-baryon mean life average over species of b-baryon particles.

"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*
1.229±0.080 OUR EVALUATION					
$1.11\ ^{+0.19}_{-0.18}\ \pm0.05$		[5] ABREU	99W	DLPH	$e^+e^- \to Z$
$1.29\ ^{+0.24}_{-0.22}\ \pm0.06$		[5] ACKERSTAFF	98G	OPAL	$e^+e^- \to Z$
$1.21\ \pm0.11$		[5] BARATE	98D	ALEP	$e^+e^- \to Z$
$1.32\ \pm0.15\ \pm0.07$		ABE	96M	CDF	Excess $\Lambda_c \ell^-$, decay lengths

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

$1.19\ ^{+0.21}_{-0.18}\ ^{+0.07}_{-0.08}$		ABREU	96D	DLPH	Repl. by ABREU 99W
$1.14\ ^{+0.22}_{-0.19}\ \pm0.07$	69	AKERS	95K	OPAL	Repl. by ACKERSTAFF 98G
$1.02\ ^{+0.23}_{-0.18}\ \pm0.06$	44	BUSKULIC	95L	ALEP	Repl. by BARATE 98D

[5] Measured using $\Lambda_c \ell^-$ and $\Lambda \ell^+ \ell^-$.

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 b-baryon production fraction B($b \rightarrow$ b-baryon) and are evaluated for our value B($b \rightarrow$ b-baryon) = (11.8 ± 2.0)%.

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

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	$J/\psi(1S)\Lambda$		$(4.7\pm2.8)\times10^{-4}$	
Γ_2	$pD^0\pi^-$			
Γ_3	$\Lambda_c^+\pi^-$		seen	
Γ_4	$\Lambda_c^+ a_1(1260)^-$		seen	
Γ_5	$\Lambda_c^+\pi^+\pi^-\pi^-$			
Γ_6	$\Lambda K^0 2\pi^+ 2\pi^-$			
Γ_7	$\Lambda_c^+\ell^-\overline{\nu}_\ell$ anything	[a]	(7.7 ± 1.8) %	
Γ_8	$p\pi^-$		$< 5.0 \times10^{-5}$	90%
Γ_9	pK^-		$< 5.0 \times10^{-5}$	90%

[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 (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
4.7± 2.1± 1.9		[6] ABE	97B	CDF	$p\overline{p}$ at 1.8 TeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
152.5±93.2±25.9	16	[7] ALBAJAR	91E	UA1	$J/\psi(1S) \rightarrow \mu^+\mu^-$

[6] ABE 97B reports (0.037 ± 0.017(stat)±0.007(sys))% for B($b \to$ b-baryon) = 0.1 and for B($B^0 \to J/\psi(1S) K^0_S$) = 0.037%. We rescale to our PDG 98 best value B($b \to$ b-baryon) = $(10.1^{+3.9}_{-3.1})$% and B($B^0 \to J/\psi(1S) K^0_S$) = (0.044 ± 0.006)%. Our first error is their experiments's error and our second error is the systematic error from using our best value.

[7] ALBAJAR 91E reports 180 ± 110 for B($\overline{b} \to$ b-baryon) = 0.10. We rescale to our best value B($\overline{b} \to$ b-baryon) = (11.8 ± 2.0) × 10^{-2}. Our first error is their experiment's error and our second error is the systematic error from using our best value.

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	52	BARI	91	SFM	$D^0 \to K^- \pi^+$
seen		BASILE	81	SFM	$D^0 \to K^- \pi^+$

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	3	ABREU	96N	DLPH	$\Lambda_c^+ \to p K^- \pi^+$
seen	4	BUSKULIC	96L	ALEP	$\Lambda_c^+ \to p K^- \pi^+$, $p \overline{K}^0$, $\Lambda \pi^+ \pi^+ \pi^-$

$\Gamma(\Lambda_c^+ a_1(1260)^-)/\Gamma_{total}$ Γ_4/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
seen	1	ABREU	96N	DLPH	$\Lambda_c^+ \to p K^- \pi^+$, $a_1^- \to \rho^0 \pi^- \to \pi^+ \pi^- \pi^-$

$\Gamma(\Lambda_c^+ \pi^+ \pi^- \pi^-)/\Gamma_{total}$ Γ_5/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	90	BARI	91	SFM	$\Lambda_c^+ \to p K^- \pi^+$

$\Gamma(\Lambda K^0 2\pi^+ 2\pi^-)/\Gamma_{total}$ Γ_6/Γ

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	4	[8] ARENTON	86	FMPS	$\Lambda K^0_S 2\pi^+ 2\pi^-$

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

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

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

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.077±0.018 OUR AVERAGE					
0.073±0.013±0.012		[9] BARATE	98D	ALEP	$e^+ e^- \to Z$
$0.100^{+0.034}_{-0.028}$±0.017	29	[10] ABREU	95S	DLPH	$e^+ e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					

$0.064 \pm 0.016 \pm 0.011$	55	[11] BUSKULIC	95L	ALEP	Repl. by BARATE 98D
$0.13 \pm 0.05 \pm 0.02$	21	[12] BUSKULIC	92E	ALEP	$\Lambda_c^+ \to pK^-\pi^+$

[9] BARATE 98D reports $[B(\Lambda_b^0 \to \Lambda_c^+ \ell^- \overline{\nu}_\ell \text{anything}) \times B(\overline{b} \to b\text{-baryon})] = 0.0086 \pm 0.0007 \pm 0.0014$. We divide by our best value $B(\overline{b} \to b\text{-baryon}) = (11.8 \pm 2.0) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value. Measured using $\Lambda_c \ell^-$ and $\Lambda \ell^+ \ell^-$.

[10] ABREU 95S reports $[B(\Lambda_b^0 \to \Lambda_c^+ \ell^- \overline{\nu}_\ell \text{anything}) \times B(\overline{b} \to b\text{-baryon})] = 0.0118 \pm 0.0026^{+0.0031}_{-0.0021}$. We divide by our best value $B(\overline{b} \to b\text{-baryon}) = (11.8 \pm 2.0) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[11] BUSKULIC 95L reports $[B(\Lambda_b^0 \to \Lambda_c^+ \ell^- \overline{\nu}_\ell \text{anything}) \times B(\overline{b} \to b\text{-baryon})] = 0.00755 \pm 0.0014 \pm 0.0012$. We divide by our best value $B(\overline{b} \to b\text{-baryon}) = (11.8 \pm 2.0) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

[12] BUSKULIC 92E reports $[B(\Lambda_b^0 \to \Lambda_c^+ \ell^- \overline{\nu}_\ell \text{anything}) \times B(\overline{b} \to b\text{-baryon})] = 0.015 \pm 0.0035 \pm 0.0045$. We divide by our best value $B(\overline{b} \to b\text{-baryon}) = (11.8 \pm 2.0) \times 10^{-2}$. 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.

$\Gamma(p\pi^-)/\Gamma_{\text{total}}$ Γ_8/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<5.0 \times 10^{-5}$	90	[13] BUSKULIC	96V	ALEP	$e^+e^- \to Z$

[13] BUSKULIC 96V assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons.

$\Gamma(pK^-)/\Gamma_{\text{total}}$ Γ_9/Γ

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$<5.0 \times 10^{-5}$	90	[14] BUSKULIC	96V	ALEP	$e^+e^- \to Z$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.6 \times 10^{-4}$	90	[15] ADAM	96D	DLPH	$e^+e^- \to Z$

[14] BUSKULIC 96V assumes PDG 96 production fractions for B^0, B^+, B_s, b baryons.

[15] ADAM 96D assumes $f_{B^0} = f_{B^-} = 0.39$ and $f_{B_s} = 0.12$.

Λ_b^0 REFERENCES

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.)
PDG	98	EPJ C3 1	C. Caso *et al.*	
ABE	97B	PR D55 1142	F. Abe *et al.*	(CDF Collab.)
ABE	96M	PRL 77 1439	F. Abe *et al.*	(CDF Collab.)
ABREU	96D	ZPHY C71 199	P. Abreu *et al.*	(DELPHI Collab.)
ABREU	96N	PL B374 351	P. Abreu *et al.*	(DELPHI Collab.)
ADAM	96D	ZPHY C72 207	W. Adam *et al.*	(DELPHI Collab.)
BUSKULIC	96L	PL B380 442	D. Buskulic *et al.*	(ALEPH Collab.)
BUSKULIC	96V	PL B384 471	D. Buskulic *et al.*	(ALEPH Collab.)
PDG	96	PR D54 1	R. M. Barnett *et al.*	
ABREU	95S	ZPHY C68 375	P. Abreu *et al.*	(DELPHI Collab.)
AKERS	95K	PL B353 402	R. Akers *et al.*	(OPAL Collab.)

BUSKULIC	95L	PL B357 685	D. Buskulic *et al.*	(ALEPH Collab.)
ABE	93B	PR D47 R2639	F. Abe *et al.*	(CDF Collab.)
BUSKULIC	92E	PL B294 145	D. Buskulic *et al.*	(ALEPH Collab.)
ALBAJAR	91E	PL B273 540	C. Albajar *et al.*	(UA1 Collab.)
BARI	91	NC 104A 1787	G. Bari *et al.*	(CERN R422 Collab.)
ARENTON	86	NP B274 707	M.W. Arenton *et al.*	(ARIZ, NDAM, VAND)
BASILE	81	LNC 31 97	M. Basile *et al.*	(CERN R415 Collab.)