Ξ_c^+

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

Neither of J or P has actually been measured.

Ξ_c^+ MASS

The fit uses the Ξ_c^+ and Ξ_c^0 mass and mass-difference measurements.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
2467.71± 0.23 OUR FIT Error includes scale factor of 1.3.					
2467.95± 0.19 OUR AVERAGE					
2467.97± 0.14± 0.17	3.8k	[1] AAIJ	14Z	LHCB	pp at 7, 8 TeV
2468.00± 0.18± 0.51	5.1k	AALTONEN	14B	CDF	$p\overline{p}$ at 1.96 TeV
2468.1 ± 0.4 $^{+0.2}_{-1.4}$	4.9k	[2] LESIAK	05	BELL	e^+e^-, $\Upsilon(4S)$
2465.8 ± 1.9 ± 2.5	90	FRABETTI	98	E687	γ Be, $\overline{E}_\gamma$= 220 GeV
2467.0 ± 1.6 ± 2.0	147	EDWARDS	96	CLE2	$e^+e^- \approx \Upsilon(4S)$
2465.1 ± 3.6 ± 1.9	30	ALBRECHT	90F	ARG	e^+e^- at $\Upsilon(4S)$
2467 ± 3 ± 4	23	ALAM	89	CLEO	e^+e^- 10.6 GeV
2466.5 ± 2.7 ± 1.2	5	BARLAG	89C	ACCM	π^- Cu 230 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
2464.4 ± 2.0 ± 1.4	30	FRABETTI	93B	E687	See FRABETTI 98
2459 ± 5 ±30	56	[3] COTEUS	87	SPEC	nA $\simeq$ 600 GeV
2460 ±25	82	BIAGI	83	SPEC	Σ^- Be 135 GeV

[1] AAIJ 14Z systematic error includes in quadrature the 0.14 MeV uncertainty from the m(Λ_c^+) mass value.

[2] The systematic error was (wrongly) given the other way round in LESIAK 05; see the erratum.

[3] Although COTEUS 87 claims to agree well with BIAGI 83 on the mass and width, there appears to be a discrepancy between the two experiments. BIAGI 83 sees a single peak (stated significance about 6 standard deviations) in the $\Lambda K^-\pi^+\pi^+$ mass spectrum. COTEUS 87 sees *two* peaks in the same spectrum, one at the Ξ_c^+ mass, the other 75 MeV lower. The latter is attributed to $\Xi_c^+ \rightarrow \Sigma^0 K^-\pi^+\pi^+ \rightarrow (\Lambda\gamma)K^-\pi^+\pi^+$, with the γ unseen. The *combined* significance of the double peak is stated to be 5.5 standard deviations. But the absence of any trace of a lower peak in BIAGI 83 seems to us to throw into question the interpretation of the lower peak of COTEUS 87.

Ξ_c^+ MEAN LIFE

VALUE (10^{-15} s)	EVTS	DOCUMENT ID		TECN	COMMENT
453± 5 OUR AVERAGE					
454± 5± 2	56k	[1] AAIJ	19AG	LHCB	$\Xi_c^+ \rightarrow pK^-\pi^+$
503± 47± 18	250	MAHMOOD	02	CLE2	$e^+e^- \approx \Upsilon(4S)$
439± 22± 9	532	LINK	01D	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV
340$^{+70}_{-50}$± 20	56	FRABETTI	98	E687	γ Be, $\overline{E}_\gamma$= 220 GeV

$400^{+180}_{-120}\pm100$	102	COTEUS	87	SPEC	$nA \simeq$ 600 GeV
$480^{+210}_{-150}{}^{+200}_{-100}$	53	BIAGI	85C	SPEC	Σ^- Be 135 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$410^{+110}_{-80}\pm20$	30	FRABETTI	93B	E687	See FRABETTI 98
200^{+110}_{-60}	6	BARLAG	89C	ACCM	π^- (K^-) Cu 230 GeV

[1] AAIJ 19AG reports [Ξ_c^+ MEAN LIFE] / [$D^\pm$ MEAN LIFE] $= 0.4392 \pm 0.0034 \pm 0.0028$ which we multiply by our best value $D^\pm$ MEAN LIFE $= (1.033 \pm 0.005) \times 10^{-12}$ s. Our first error is their experiment's error and our second error is the systematic error from using our best value.

Ξ_c^+ DECAY MODES

Branching fractions marked with a footnote, e.g. [a], have been corrected for decay modes not observed in the experiments. For example, the submode fraction $\Xi_c^+ \to \Sigma^+ \overline{K}^*(892)^0$ seen in $\Xi_c^+ \to \Sigma^+ K^- \pi^+$ has been multiplied up to include $\overline{K}^*(892)^0 \to \overline{K}^0 \pi^0$ decays.

	Mode		Fraction (Γ_i/Γ)	Scale factor/ Confidence level
	Cabibbo-favored ($S = -2$) decays			
Γ_1	$p2K_S^0$		$(2.5\pm1.3) \times 10^{-3}$	
Γ_2	$\Lambda\overline{K}^0\pi^+$		—	
Γ_3	$\Sigma(1385)^+\overline{K}^0$	[a]	(2.9 ± 2.0) %	
Γ_4	$\Lambda K^- 2\pi^+$		$(9 \pm4) \times 10^{-3}$	
Γ_5	$\Lambda\overline{K}^*(892)^0\pi^+$	[a]	$< 5 \times 10^{-3}$	CL=90%
Γ_6	$\Sigma(1385)^+ K^- \pi^+$	[a]	$< 6 \times 10^{-3}$	CL=90%
Γ_7	$\Sigma^+ K^- \pi^+$		(2.7 ± 1.2) %	
Γ_8	$\Sigma^+\overline{K}^*(892)^0$	[a]	(2.3 ± 1.1) %	
Γ_9	$\Sigma^0 K^- 2\pi^+$		$(8 \pm5) \times 10^{-3}$	
Γ_{10}	$\Xi^0\pi^+$		(1.6 ± 0.8) %	
Γ_{11}	$\Xi^- 2\pi^+$		(2.9 ± 1.3) %	
Γ_{12}	$\Xi(1530)^0\pi^+$	[a]	$< 2.9 \times 10^{-3}$	CL=90%
Γ_{13}	$\Xi(1620)^0\pi^+$		seen	
Γ_{14}	$\Xi(1690)^0\pi^+$		seen	
Γ_{15}	$\Xi^0\pi^+\pi^0$		(6.7 ± 3.5) %	
Γ_{16}	$\Xi^0\pi^- 2\pi^+$		(5.0 ± 2.6) %	
Γ_{17}	$\Xi^0 e^+ \nu_e$		(7 ± 4) %	
Γ_{18}	$\Omega^- K^+ \pi^+$		$(2.0\pm1.5) \times 10^{-3}$	
	Cabibbo-suppressed decays			
Γ_{19}	$pK^-\pi^+$		$(6.2\pm3.0) \times 10^{-3}$	S=1.5
Γ_{20}	$p\overline{K}^*(892)^0$	[a]	$(3.3\pm1.7) \times 10^{-3}$	
Γ_{21}	$\Sigma^+\pi^+\pi^-$		(1.4 ± 0.8) %	

Γ_{22}	$\Sigma^- 2\pi^+$		$(5.1\pm3.4)\times10^{-3}$	
Γ_{23}	$\Sigma^+ K^+ K^-$		$(4.3\pm2.5)\times10^{-3}$	
Γ_{24}	$\Sigma^+ \phi$	[a]	$< 3.2 \times10^{-3}$	CL=90%
Γ_{25}	$\Xi(1690)^0 K^+$, $\Xi^0 \to \Sigma^+ K^-$		$< 1.3 \times10^{-3}$	CL=90%
Γ_{26}	$p\phi(1020)$		$(1.2\pm0.6)\times10^{-4}$	

[a] This branching fraction includes all the decay modes of the final-state resonance.

Ξ_c^+ BRANCHING RATIOS

Cabibbo-favored ($S = -2$) decays

$\Gamma(p2K^0_S)/\Gamma(\Xi^- 2\pi^+)$ — Γ_1/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.087±0.016±0.014	168 ± 27	LESIAK	05	BELL	e^+e^-, $\Upsilon(4S)$

$\Gamma(\Sigma(1385)^+\overline{K}^0)/\Gamma(\Xi^- 2\pi^+)$ — Γ_3/Γ_{11}

Unseen decay modes of the $\Sigma(1385)^+$ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.00±0.49±0.24	20	LINK	03E	FOCS	< 1.72, 90% CL

$\Gamma(\Lambda K^- 2\pi^+)/\Gamma(\Xi^- 2\pi^+)$ — Γ_4/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.323±0.033 OUR AVERAGE					
0.32 ±0.03 ±0.02	1177 ± 55	LESIAK	05	BELL	e^+e^-, $\Upsilon(4S)$
0.28 ±0.06 ±0.06	58	LINK	03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx 180$ GeV
0.58 ±0.16 ±0.07	61	BERGFELD	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Lambda\overline{K}^*(892)^0\pi^+)/\Gamma(\Lambda K^- 2\pi^+)$ — Γ_5/Γ_4

Unseen decay modes of the $\overline{K}^*(892)^0$ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.5	90	BERGFELD	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Sigma(1385)^+ K^- \pi^+)/\Gamma(\Lambda K^- 2\pi^+)$ — Γ_6/Γ_4

Unseen decay modes of the $\Sigma(1385)^+$ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.7	90	BERGFELD	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Sigma^+ K^- \pi^+)/\Gamma(\Xi^- 2\pi^+)$ — Γ_7/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.94±0.10 OUR AVERAGE					
0.91±0.11±0.04	251	LINK	03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx 180$ GeV
0.92±0.20±0.07		[1] JUN	00	SELX	Σ^- nucleus, 600 GeV
1.18±0.26±0.17	119	BERGFELD	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

[1] This JUN 00 result is redundant with other results given below.

$\Gamma(\Sigma^+ \overline{K}^*(892)^0)/\Gamma(\Xi^- 2\pi^+)$ — Γ_8/Γ_{11}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.81±0.15 OUR AVERAGE					
0.78±0.16±0.06	119	LINK	03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx 180$ GeV
0.92±0.27±0.14	61	BERGFELD	96	CLE2	$e^+ e^- \approx \Upsilon(4S)$

$\Gamma(\Sigma^0 K^- 2\pi^+)/\Gamma(\Lambda K^- 2\pi^+)$ — Γ_9/Γ_4

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.84±0.36	47	[1] COTEUS	87	SPEC	$nA \simeq 600$ GeV

[1] See, however, the note on the COTEUS 87 Ξ_c^+ mass measurement.

$\Gamma(\Xi^0 \pi^+)/\Gamma(\Xi^- 2\pi^+)$ — Γ_{10}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.55±0.13±0.09	39	EDWARDS	96	CLE2	$e^+ e^- \approx \Upsilon(4S)$

$\Gamma(\Xi^- 2\pi^+)/\Gamma_{total}$ — Γ_{11}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.86±1.21±0.38	24	[1] LI	19C	BELL	$e^+ e^- \approx \Upsilon(4S)$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
seen	131	BERGFELD	96	CLE2	$e^+ e^- \approx \Upsilon(4S)$
seen	160	AVERY	95	CLE2	$e^+ e^- \approx \Upsilon(4S)$
seen	30	FRABETTI	93B	E687	γBe, $\overline{E}_\gamma = 220$ GeV
seen	30	ALBRECHT	90F	ARG	$e^+ e^-$ at $\Upsilon(4S)$
seen	23	ALAM	89	CLEO	$e^+ e^-$ 10.6 GeV

[1] LI 19C report a significance of 6.8 σ for the observation of this decay mode, observed in Ξ_c^+ from $\overline{B}^0 \to \overline{\Lambda}_c^- \Xi_c^+$.

$\Gamma(\Xi(1530)^0 \pi^+)/\Gamma(\Xi^- 2\pi^+)$ — Γ_{12}/Γ_{11}

Unseen decay modes of the $\Xi(1530)^0$ are included.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.1	90	LINK	03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx 180$ GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.2	90	BERGFELD	96	CLE2	$e^+ e^- \approx \Upsilon(4S)$

$\Gamma(\Xi(1620)^0 \pi^+)/\Gamma_{total}$ — Γ_{13}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	SUMIHAMA	19	BELL	$e^+ e^-$ mostly at $\Upsilon(4S)$

$\Gamma(\Xi(1690)^0 \pi^+)/\Gamma_{total}$ — Γ_{14}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
seen	SUMIHAMA	19	BELL	$e^+ e^-$ mostly at $\Upsilon(4S)$

$\Gamma(\Xi^0 \pi^+ \pi^0)/\Gamma(\Xi^- 2\pi^+)$ — Γ_{15}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
2.34±0.57±0.37	81	EDWARDS	96	CLE2	$e^+ e^- \approx \Upsilon(4S)$

$\Gamma(\Xi(1530)^0\pi^+)/\Gamma(\Xi^0\pi^+\pi^0)$ Γ_{12}/Γ_{15}

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.3	90	EDWARDS	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Xi^0\pi^-2\pi^+)/\Gamma(\Xi^-2\pi^+)$ Γ_{16}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
1.74±0.42±0.27	57	EDWARDS	96	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Xi^0 e^+\nu_e)/\Gamma(\Xi^-2\pi^+)$ Γ_{17}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
$\mathbf{2.3\pm0.6^{+0.3}_{-0.6}}$	41	ALEXANDER	95B	CLE2	$e^+e^- \approx \Upsilon(4S)$

$\Gamma(\Omega^- K^+\pi^+)/\Gamma(\Xi^-2\pi^+)$ Γ_{18}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.07±0.03±0.03	14	LINK	03E	FOCS	< 0.12, 90% CL

$\Gamma(pK^-\pi^+)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
6.2 ±3.0 OUR AVERAGE	Error includes scale factor of 1.5.				
11.35±0.02±3.87	1.6M	[1] AAIJ	20AH	LHCB	pp at 13 TeV
4.5 ±2.1 ±0.7	24	[2] LI	19C	BELL	$e^+e^- \approx \Upsilon(4S)$

[1] AAIJ 20AH extracts B($\Xi_c^+ \to pK^-\pi^+$) assuming production fraction ratios $f_{\Xi_c^0}/f_{\Lambda_c^+} = (9.7 \pm 0.9 \pm 3.1) \times 10^{-2}$ (from AAIJ 19AB plus heavy quark symmetry arguments) as well as $f_{\Xi_c^0}/f_{\Xi_c^+} = 1.00 \pm 0.01$, and uses the input B($\Lambda_c^+ \to pK^-\pi^+$) = $(6.23 \pm 0.33) \times 10^{-2}$. Its correlation with B($\Xi_c^0 \to \Lambda_c^+\pi^-$), as measured in AAIJ 20AH, is 0.414.

[2] LI 19C report a significance of 4.4 σ for the observation of this decay mode, observed in Ξ_c^+ from $\overline{B}^0 \to \overline{\Lambda}_c^- \Xi_c^+$.

Cabibbo-suppressed decays

$\Gamma(pK^-\pi^+)/\Gamma(\Xi^-2\pi^+)$ Γ_{19}/Γ_{11}

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.21 ±0.04 OUR AVERAGE					
0.194±0.054	47 ± 11	VAZQUEZ-JA...	08	SELX	Σ^- nucleus, 600 GeV
0.234±0.047±0.022	202	LINK	01B	FOCS	γ nucleus
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.20 ±0.04 ±0.02	76	JUN	00	SELX	See VAZQUEZ-JAUREGUI 08

$\Gamma(p\overline{K}^*(892)^0)/\Gamma(pK^-\pi^+)$ Γ_{20}/Γ_{19}

Unseen decay modes of the $\overline{K}^*(892)^0$ are included.

VALUE	DOCUMENT ID		TECN	COMMENT
0.54±0.09±0.05	LINK	01B	FOCS	γ nucleus

$\Gamma(\Sigma^+\pi^+\pi^-)/\Gamma(\Xi^-2\pi^+)$ — Γ_{21}/Γ_{11}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.48±0.20	21 ± 8	VAZQUEZ-JA...08	SELX	Σ^- nucleus, 600 GeV

$\Gamma(\Sigma^-2\pi^+)/\Gamma(\Xi^-2\pi^+)$ — Γ_{22}/Γ_{11}

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.18±0.09	10 ± 4	VAZQUEZ-JA...08	SELX	Σ^- nucleus, 600 GeV

$\Gamma(\Sigma^+K^+K^-)/\Gamma(\Sigma^+K^-\pi^+)$ — Γ_{23}/Γ_7

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.16±0.06±0.01	17	LINK 03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(\Sigma^+\phi)/\Gamma(\Sigma^+K^-\pi^+)$ — Γ_{24}/Γ_7

Unseen decay modes of the ϕ are included.

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.12	90	LINK 03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

$\Gamma(p\phi(1020))/\Gamma(pK^-\pi^+)$ — Γ_{26}/Γ_{19}

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	COMMENT
19.8±0.7±0.9±0.2	3.4k	[1] AAIJ 19I	LHCB	pp at 8 TeV

[1] The last uncertainty is due to the uncertainty in the $\phi \to K^+K^-$ branching fraction.

$\Gamma(\Xi(1690)^0K^+ \times B(\Xi(1690)^0 \to \Sigma^+K^-))/\Gamma(\Sigma^+K^-\pi^+)$ — Γ_{25}/Γ_7

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
<0.05	90	LINK 03E	FOCS	γ nucleus, $\overline{E}_\gamma \approx$ 180 GeV

Ξ_c^+ REFERENCES

AAIJ	20AH	PR D102 071101	R. Aaij *et al.*	(LHCb Collab.)
AAIJ	19AB	PR D99 052006	R. Aaij *et al.*	(LHCb Collab.)
AAIJ	19AG	PR D100 032001	R. Aaij *et al.*	(LHCb Collab.)
AAIJ	19I	JHEP 1904 084	R. Aaij *et al.*	(LHCb Collab.)
LI	19C	PR D100 031101	Y.B. Li *et al.*	(BELLE Collab.)
SUMIHAMA	19	PRL 122 072501	M. Sumihama *et al.*	(BELLE Collab.)
AAIJ	14Z	PRL 113 032001	R. Aaij *et al.*	(LHCb Collab.)
AALTONEN	14B	PR D89 072014	T. Aaltonen *et al.*	(CDF Collab.)
VAZQUEZ-JA...	08	PL B666 299	E. Vazquez-Jauregui *et al.*	(SELEX Collab.)
LESIAK	05	PL B605 237	T. Lesiak *et al.*	(BELLE Collab.)
Also		PL B617 198 (errat.)	T. Lesiak *et al.*	(BELLE Collab.)
LINK	03E	PL B571 139	J.M. Link *et al.*	(FNAL FOCUS Collab.)
MAHMOOD	02	PR D65 031102	A.H. Mahmood *et al.*	(CLEO Collab.)
LINK	01B	PL B512 277	J.M. Link *et al.*	(FNAL FOCUS Collab.)
LINK	01D	PL B523 53	J.M. Link *et al.*	(FNAL FOCUS Collab.)
JUN	00	PRL 84 1857	S.Y. Jun *et al.*	(FNAL SELEX Collab.)
FRABETTI	98	PL B427 211	P.L. Frabetti *et al.*	(FNAL E687 Collab.)
BERGFELD	96	PL B365 431	T. Bergfeld *et al.*	(CLEO Collab.)
EDWARDS	96	PL B373 261	K.W. Edwards *et al.*	(CLEO Collab.)
ALEXANDER	95B	PRL 74 3113	J. Alexander *et al.*	(CLEO Collab.)
Also		PRL 75 4155 (erratum)	J. Alexander *et al.*	(CLEO Collab.)
AVERY	95	PRL 75 4364	P. Avery *et al.*	(CLEO Collab.)
FRABETTI	93B	PRL 70 1381	P.L. Frabetti *et al.*	(FNAL E687 Collab.)
ALBRECHT	90F	PL B247 121	H. Albrecht *et al.*	(ARGUS Collab.)
ALAM	89	PL B226 401	M.S. Alam *et al.*	(CLEO Collab.)
BARLAG	89C	PL B233 522	S. Barlag *et al.*	(ACCMOR Collab.)
COTEUS	87	PRL 59 1530	P. Coteus *et al.*	(FNAL E400 Collab.)
BIAGI	85C	PL 150B 230	S.F. Biagi *et al.*	(CERN WA62 Collab.)
BIAGI	83	PL 122B 455	S.F. Biagi *et al.*	(CERN WA62 Collab.)