

# CHARMED BARYONS

## ( $C = +1$ )

$$\begin{aligned}\Lambda_c^+ &= u d c, & \Sigma_c^{++} &= u u c, & \Sigma_c^+ &= u d c, & \Sigma_c^0 &= d d c, \\ \Xi_c^+ &= u s c, & \Xi_c^0 &= d s c, & \Omega_c^0 &= s s c\end{aligned}$$

 $\Lambda_c^+$ 

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

Mass  $m = 2286.46 \pm 0.14$  MeVMean life  $\tau = (202.4 \pm 3.1) \times 10^{-15}$  s ( $S = 1.7$ )

$$c\tau = 60.7 \mu\text{m}$$

### Decay asymmetry parameters

$$\Lambda\pi^+ \quad \alpha = -0.84 \pm 0.09$$

$$\Sigma^+\pi^0 \quad \alpha = -0.55 \pm 0.11$$

$$\alpha \text{ FOR } \Lambda_c^+ \rightarrow \Sigma^0\pi^+ = -0.73 \pm 0.18$$

$$\Lambda\ell^+\nu_\ell \quad \alpha = -0.86 \pm 0.04$$

$$\alpha \text{ FOR } \Lambda_c^+ \rightarrow p K_S^0 = 0.2 \pm 0.5$$

$$(\alpha + \bar{\alpha})/(\alpha - \bar{\alpha}) \text{ in } \Lambda_c^+ \rightarrow \Lambda\pi^+, \bar{\Lambda}_c^- \rightarrow \bar{\Lambda}\pi^- = -0.07 \pm 0.31$$

$$(\alpha + \bar{\alpha})/(\alpha - \bar{\alpha}) \text{ in } \Lambda_c^+ \rightarrow \Lambda e^+\nu_e, \bar{\Lambda}_c^- \rightarrow \bar{\Lambda}e^-\bar{\nu}_e = 0.00 \pm 0.04$$

$$A_{CP}(\Lambda X) \text{ in } \Lambda_c \rightarrow \Lambda X, \bar{\Lambda}_c \rightarrow \bar{\Lambda}X = (2 \pm 7)\%$$

$$\Delta A_{CP} = A_{CP}(\Lambda_c^+ \rightarrow p K^+ K^-) - A_{CP}(\Lambda_c^+ \rightarrow p\pi^+\pi^-) = (0.3 \pm 1.1)\%$$

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

$\Lambda_c^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level	$p$ (MeV/c)
<b>Hadronic modes with a <math>p</math> or <math>n</math>: <math>S = -1</math> final states</b>			
$p K_S^0$	( 1.59 $\pm$ 0.08 ) %	S=1.1	873
$p K^-\pi^+$	( 6.28 $\pm$ 0.32 ) %	S=1.4	823
$p \bar{K}^*(892)^0$	[a] ( 1.96 $\pm$ 0.27 ) %		685
$\Delta(1232)^{++} K^-$	( 1.08 $\pm$ 0.25 ) %		710
$\Lambda(1520)\pi^+$	[a] ( 2.2 $\pm$ 0.5 ) %		628
$p K^-\pi^+$ nonresonant	( 3.5 $\pm$ 0.4 ) %		823
$p K_S^0\pi^0$	( 1.97 $\pm$ 0.13 ) %	S=1.1	823
$n K_S^0\pi^+$	( 1.82 $\pm$ 0.25 ) %		821

$p\bar{K}^0\eta$	( 1.6 ± 0.4 ) %	568
$pK_S^0\pi^+\pi^-$	( 1.60 ± 0.12 ) %	S=1.1 754
$pK^-\pi^+\pi^0$	( 4.46 ± 0.30 ) %	S=1.5 759
$pK^*(892)^-\pi^+$	[a] ( 1.4 ± 0.5 ) %	580
$p(K^-\pi^+)_{\text{nonresonant}}\pi^0$	( 4.6 ± 0.8 ) %	759
$\Delta(1232)\bar{K}^*(892)$	seen	419
$pK^-2\pi^+\pi^-$	( 1.4 ± 0.9 ) × 10 <sup>-3</sup>	671
$pK^-\pi^+2\pi^0$	( 1.0 ± 0.5 ) %	678

### Hadronic modes with a $p$ : $S = 0$ final states

$p\pi^0$	< 2.7 × 10 <sup>-4</sup>	CL=90% 945
$p\eta$	( 1.24 ± 0.30 ) × 10 <sup>-3</sup>	856
$p\omega(782)^0$	( 9 ± 4 ) × 10 <sup>-4</sup>	751
$p\pi^+\pi^-$	( 4.61 ± 0.28 ) × 10 <sup>-3</sup>	927
$p f_0(980)$	[a] ( 3.5 ± 2.3 ) × 10 <sup>-3</sup>	614
$p2\pi^+2\pi^-$	( 2.3 ± 1.4 ) × 10 <sup>-3</sup>	852
$pK^+K^-$	( 1.06 ± 0.06 ) × 10 <sup>-3</sup>	616
$p\phi$	[a] ( 1.06 ± 0.14 ) × 10 <sup>-3</sup>	590
$pK^+K^- \text{ non-}\phi$	( 5.3 ± 1.2 ) × 10 <sup>-4</sup>	616
$p\phi\pi^0$	( 10 ± 4 ) × 10 <sup>-5</sup>	460
$pK^+K^-\pi^0 \text{ nonresonant}$	< 6.3 × 10 <sup>-5</sup>	CL=90% 494

### Hadronic modes with a hyperon: $S = -1$ final states

$\Lambda\pi^+$	( 1.30 ± 0.07 ) %	S=1.1 864
$\Lambda\pi^+\pi^0$	( 7.1 ± 0.4 ) %	S=1.1 844
$\Lambda\rho^+$	< 6 %	CL=95% 636
$\Lambda\pi^-2\pi^+$	( 3.64 ± 0.29 ) %	S=1.4 807
$\Sigma(1385)^+\pi^+\pi^-$ , $\Sigma^{*+} \rightarrow \Lambda\pi^+$	( 1.0 ± 0.5 ) %	688
$\Sigma(1385)^-\pi^+$ , $\Sigma^{*-} \rightarrow \Lambda\pi^-$	( 7.6 ± 1.4 ) × 10 <sup>-3</sup>	688
$\Lambda\pi^-\rho^0$	( 1.5 ± 0.6 ) %	524
$\Sigma(1385)^+\rho^0$ , $\Sigma^{*+} \rightarrow \Lambda\pi^+$	( 5 ± 4 ) × 10 <sup>-3</sup>	363
$\Lambda\pi^-2\pi^+ \text{ nonresonant}$	< 1.1 %	CL=90% 807
$\Lambda\pi^-\pi^02\pi^+ \text{ total}$	( 2.3 ± 0.8 ) %	757
$\Lambda\pi^+\eta$	[a] ( 1.84 ± 0.26 ) %	691
$\Sigma(1385)^+\eta$	[a] ( 9.1 ± 2.0 ) × 10 <sup>-3</sup>	570
$\Lambda\pi^+\omega$	[a] ( 1.5 ± 0.5 ) %	517
$\Lambda\pi^-\pi^02\pi^+ \text{, no } \eta \text{ or } \omega$	< 8 × 10 <sup>-3</sup>	CL=90% 757
$\Lambda K^+\bar{K}^0$	( 5.7 ± 1.1 ) × 10 <sup>-3</sup>	S=1.9 443
$\Xi(1690)^0K^+$ , $\Xi^{*0} \rightarrow \Lambda\bar{K}^0$	( 1.6 ± 0.5 ) × 10 <sup>-3</sup>	286
$\Sigma^0\pi^+$	( 1.29 ± 0.07 ) %	S=1.1 825
$\Sigma^+\pi^0$	( 1.25 ± 0.10 ) %	827
$\Sigma^+\eta$	( 4.4 ± 2.0 ) × 10 <sup>-3</sup>	713
$\Sigma^+\eta'$	( 1.5 ± 0.6 ) %	391

$\Sigma^+ \pi^+ \pi^-$	( 4.50 $\pm$ 0.25 ) %	S=1.3	804
$\Sigma^+ \rho^0$	< 1.7 %	CL=95%	575
$\Sigma^- 2\pi^+$	( 1.87 $\pm$ 0.18 ) %		799
$\Sigma^0 \pi^+ \pi^0$	( 3.5 $\pm$ 0.4 ) %		803
$\Sigma^+ \pi^0 \pi^0$	( 1.55 $\pm$ 0.15 ) %		806
$\Sigma^0 \pi^- 2\pi^+$	( 1.11 $\pm$ 0.30 ) %		763
$\Sigma^+ \pi^+ \pi^- \pi^0$	—		767
$\Sigma^+ \omega$	[a] ( 1.70 $\pm$ 0.21 ) %		569
$\Sigma^- \pi^0 2\pi^+$	( 2.1 $\pm$ 0.4 ) %		762
$\Sigma^+ K^+ K^-$	( 3.5 $\pm$ 0.4 ) $\times 10^{-3}$	S=1.1	349
$\Sigma^+ \phi$	[a] ( 3.9 $\pm$ 0.6 ) $\times 10^{-3}$	S=1.1	295
$\Xi(1690)^0 K^+, \Xi^{*0} \rightarrow$	( 1.02 $\pm$ 0.25 ) $\times 10^{-3}$		286
$\Sigma^+ K^-$			
$\Sigma^+ K^+ K^-$ nonresonant	< 8 $\times 10^{-4}$	CL=90%	349
$\Xi^0 K^+$	( 5.5 $\pm$ 0.7 ) $\times 10^{-3}$		653
$\Xi^- K^+ \pi^+$	( 6.2 $\pm$ 0.6 ) $\times 10^{-3}$	S=1.1	565
$\Xi(1530)^0 K^+$	( 4.3 $\pm$ 0.9 ) $\times 10^{-3}$	S=1.1	473

**Hadronic modes with a hyperon:  $S = 0$  final states**

$\Lambda K^+$	( 6.1 $\pm$ 1.2 ) $\times 10^{-4}$		781
$\Lambda K^+ \pi^+ \pi^-$	< 5 $\times 10^{-4}$	CL=90%	637
$\Sigma^0 K^+$	( 5.2 $\pm$ 0.8 ) $\times 10^{-4}$		735
$\Sigma^0 K^+ \pi^+ \pi^-$	< 2.6 $\times 10^{-4}$	CL=90%	574
$\Sigma^+ K^+ \pi^-$	( 2.1 $\pm$ 0.6 ) $\times 10^{-3}$		670
$\Sigma^+ K^*(892)^0$	[a] ( 3.5 $\pm$ 1.0 ) $\times 10^{-3}$		470
$\Sigma^- K^+ \pi^+$	< 1.2 $\times 10^{-3}$	CL=90%	664

**Doubly Cabibbo-suppressed modes**

$p K^+ \pi^-$	( 1.11 $\pm$ 0.18 ) $\times 10^{-4}$		823
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**Semileptonic modes**

$\Lambda e^+ \nu_e$	( 3.6 $\pm$ 0.4 ) %		871
$\Lambda \mu^+ \nu_\mu$	( 3.5 $\pm$ 0.5 ) %		867

**Inclusive modes**

$e^+ \text{ anything}$	( 3.95 $\pm$ 0.35 ) %		—
$p \text{ anything}$	( 50 $\pm$ 16 ) %		—
$n \text{ anything}$	( 50 $\pm$ 16 ) %		—
$\Lambda \text{ anything}$	( 38.2 $\pm$ 2.9 ) %		—
3prongs	( 24 $\pm$ 8 ) %		—

**$\Delta C = 1$  weak neutral current ( $C1$ ) modes, or  
Lepton Family number ( $LF$ ), or Lepton number ( $L$ ), or  
Baryon number ( $B$ ) violating modes**

$p e^+ e^-$	$C1$	< 5.5	$\times 10^{-6}$	CL=90%	951
$p \mu^+ \mu^-$ non-resonant	$C1$	< 7.7	$\times 10^{-8}$	CL=90%	937
$p e^+ \mu^-$	$LF$	< 9.9	$\times 10^{-6}$	CL=90%	947
$p e^- \mu^+$	$LF$	< 1.9	$\times 10^{-5}$	CL=90%	947
$\bar{p} 2e^+$	$L, B$	< 2.7	$\times 10^{-6}$	CL=90%	951
$\bar{p} 2\mu^+$	$L, B$	< 9.4	$\times 10^{-6}$	CL=90%	937
$\bar{p} e^+ \mu^+$	$L, B$	< 1.6	$\times 10^{-5}$	CL=90%	947
$\Sigma^- \mu^+ \mu^+$	$L$	< 7.0	$\times 10^{-4}$	CL=90%	812

**$\Lambda_c(2595)^+$**

$$I(J^P) = 0(\frac{1}{2}^-)$$

The spin-parity follows from the fact that  $\Sigma_c(2455)\pi$  decays, with little available phase space, are dominant. This assumes that  $J^P = 1/2^+$  for the  $\Sigma_c(2455)$ .

Mass  $m = 2592.25 \pm 0.28$  MeV

$m - m_{\Lambda_c^+} = 305.79 \pm 0.24$  MeV

Full width  $\Gamma = 2.6 \pm 0.6$  MeV

$\Lambda_c^+ \pi \pi$  and its submode  $\Sigma_c(2455)\pi$  — the latter just barely — are the only strong decays allowed to an excited  $\Lambda_c^+$  having this mass; and the submode seems to dominate.

<b><math>\Lambda_c(2595)^+</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	[b] —	117
$\Sigma_c(2455)^{++} \pi^-$	$24 \pm 7$ %	†
$\Sigma_c(2455)^0 \pi^+$	$24 \pm 7$ %	†
$\Lambda_c^+ \pi^+ \pi^-$ 3-body	$18 \pm 10$ %	117
$\Lambda_c^+ \pi^0$	[c] not seen	258
$\Lambda_c^+ \gamma$	not seen	288

**$\Lambda_c(2625)^+$**

$$I(J^P) = 0(\frac{3}{2}^-)$$

$J^P$  has not been measured;  $\frac{3}{2}^-$  is the quark-model prediction.

Mass  $m = 2628.11 \pm 0.19$  MeV (S = 1.1)

$m - m_{\Lambda_c^+} = 341.65 \pm 0.13$  MeV (S = 1.1)

Full width  $\Gamma < 0.97$  MeV, CL = 90%

$\Lambda_c^+ \pi \pi$  and its submode  $\Sigma(2455)\pi$  are the only strong decays allowed to an excited  $\Lambda_c^+$  having this mass.

$\Lambda_c(2625)^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	$\approx 67\%$		184
$\Sigma_c(2455)^{++} \pi^-$	<5	90%	102
$\Sigma_c(2455)^0 \pi^+$	<5	90%	102
$\Lambda_c^+ \pi^+ \pi^-$ 3-body	large		184
$\Lambda_c^+ \pi^0$	[c] not seen		293
$\Lambda_c^+ \gamma$	not seen		319

**$\Lambda_c(2860)^+$**   $I(J^P) = 0(\frac{3}{2}^+)$

Mass  $m = 2856.1^{+2.3}_{-6.0}$  MeV

Full width  $\Gamma = 68^{+12}_{-22}$  MeV

$\Lambda_c(2860)^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$D^0 p$	seen	259

**$\Lambda_c(2880)^+$**   $I(J^P) = 0(\frac{5}{2}^+)$

Mass  $m = 2881.63 \pm 0.24$  MeV

$m - m_{\Lambda_c^+} = 595.17 \pm 0.28$  MeV

Full width  $\Gamma = 5.6^{+0.8}_{-0.6}$  MeV

$\Lambda_c(2880)^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \pi^+ \pi^-$	seen	471
$\Sigma_c(2455)^0,^{++} \pi^\pm$	seen	376
$\Sigma_c(2520)^0,^{++} \pi^\pm$	seen	317
$p D^0$	seen	316

**$\Lambda_c(2940)^+$**   $I(J^P) = 0(\frac{3}{2}^-)$

$J^P = 3/2^-$  is favored, but is not certain

Mass  $m = 2939.6^{+1.3}_{-1.5}$  MeV

Full width  $\Gamma = 20^{+6}_{-5}$  MeV

<b><math>\Lambda_c(2940)^+</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$p D^0$	seen	420
$\Sigma_c(2455)^0, ++ \pi^\pm$	seen	—

 **$\Sigma_c(2455)$** 

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

$\Sigma_c(2455)^{++}$  mass  $m = 2453.97 \pm 0.14$  MeV

$\Sigma_c(2455)^+$  mass  $m = 2452.9 \pm 0.4$  MeV

$\Sigma_c(2455)^0$  mass  $m = 2453.75 \pm 0.14$  MeV

$$m_{\Sigma_c^{++}} - m_{\Lambda_c^+} = 167.510 \pm 0.017 \text{ MeV}$$

$$m_{\Sigma_c^+} - m_{\Lambda_c^+} = 166.4 \pm 0.4 \text{ MeV}$$

$$m_{\Sigma_c^0} - m_{\Lambda_c^+} = 167.290 \pm 0.017 \text{ MeV}$$

$$m_{\Sigma_c^{++}} - m_{\Sigma_c^0} = 0.220 \pm 0.013 \text{ MeV}$$

$$m_{\Sigma_c^+} - m_{\Sigma_c^0} = -0.9 \pm 0.4 \text{ MeV}$$

$\Sigma_c(2455)^{++}$  full width  $\Gamma = 1.89^{+0.09}_{-0.18}$  MeV (S = 1.1)

$\Sigma_c(2455)^+$  full width  $\Gamma < 4.6$  MeV, CL = 90%

$\Sigma_c(2455)^0$  full width  $\Gamma = 1.83^{+0.11}_{-0.19}$  MeV (S = 1.2)

$\Lambda_c^+ \pi$  is the only strong decay allowed to a  $\Sigma_c$  having this mass.

<b><math>\Sigma_c(2455)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \pi$	$\approx 100 \%$	94

 **$\Sigma_c(2520)$** 

$$I(J^P) = 1(\frac{3}{2}^+)$$

$J^P$  has not been measured;  $\frac{3}{2}^+$  is the quark-model prediction.

$\Sigma_c(2520)^{++}$  mass  $m = 2518.41^{+0.21}_{-0.19}$  MeV (S = 1.1)

$\Sigma_c(2520)^+$  mass  $m = 2517.5 \pm 2.3$  MeV

$\Sigma_c(2520)^0$  mass  $m = 2518.48 \pm 0.20$  MeV (S = 1.1)

$$m_{\Sigma_c(2520)^{++}} - m_{\Lambda_c^+} = 231.95^{+0.17}_{-0.12} \text{ MeV} \quad (\text{S} = 1.3)$$

$$m_{\Sigma_c(2520)^+} - m_{\Lambda_c^+} = 231.0 \pm 2.3 \text{ MeV}$$

$$m_{\Sigma_c(2520)^0} - m_{\Lambda_c^+} = 232.02^{+0.15}_{-0.14} \text{ MeV} \quad (\text{S} = 1.3)$$

$$m_{\Sigma_c(2520)^{++}} - m_{\Sigma_c(2520)^0} = 0.01 \pm 0.15 \text{ MeV}$$

$\Sigma_c(2520)^{++}$  full width  $\Gamma = 14.78^{+0.30}_{-0.40}$  MeV

$\Sigma_c(2520)^+$  full width  $\Gamma < 17$  MeV, CL = 90%

$\Sigma_c(2520)^0$  full width  $\Gamma = 15.3^{+0.4}_{-0.5}$  MeV

$\Lambda_c^+ \pi$  is the only strong decay allowed to a  $\Sigma_c$  having this mass.

$\Sigma_c(2520)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \pi^-$	$\approx 100\%$	179

 **$\Sigma_c(2800)$** 

$I(J^P) = 1(?^?)$

 $\Sigma_c(2800)^{++}$  mass  $m = 2801^{+4}_{-6}$  MeV $\Sigma_c(2800)^+$  mass  $m = 2792^{+14}_{-5}$  MeV $\Sigma_c(2800)^0$  mass  $m = 2806^{+5}_{-7}$  MeV ( $S = 1.3$ ) $m_{\Sigma_c(2800)^{++}} - m_{\Lambda_c^+} = 514^{+4}_{-6}$  MeV $m_{\Sigma_c(2800)^+} - m_{\Lambda_c^+} = 505^{+14}_{-5}$  MeV $m_{\Sigma_c(2800)^0} - m_{\Lambda_c^+} = 519^{+5}_{-7}$  MeV ( $S = 1.3$ ) $\Sigma_c(2800)^{++}$  full width  $\Gamma = 75^{+22}_{-17}$  MeV $\Sigma_c(2800)^+$  full width  $\Gamma = 62^{+60}_{-40}$  MeV $\Sigma_c(2800)^0$  full width  $\Gamma = 72^{+22}_{-15}$  MeV

$\Sigma_c(2800)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \pi^-$	seen	443

 **$\Xi_c^+$** 

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

 $J^P$  has not been measured;  $\frac{1}{2}^+$  is the quark-model prediction.Mass  $m = 2467.94^{+0.17}_{-0.20}$  MeVMean life  $\tau = (456 \pm 5) \times 10^{-15}$  s

$c\tau = 136.6 \mu\text{m}$

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

$\Xi_c^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level (MeV/c)	$p$
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**No absolute branching fractions have been measured.  
The following are branching *ratios* relative to  $\Xi^- 2\pi^+$ .**

**Cabibbo-favored ( $S = -2$ ) decays — relative to  $\Xi^- 2\pi^+$**

$p 2K_S^0$	0.087	$\pm 0.021$	767
$\Lambda \bar{K}^0 \pi^+$	—	—	852
$\Sigma(1385)^+ \bar{K}^0$	[a]	1.0 $\pm 0.5$	746
$\Lambda K^- 2\pi^+$		0.323 $\pm 0.033$	787
$\Lambda \bar{K}^*(892)^0 \pi^+$	[a]	< 0.16	608
$\Sigma(1385)^+ K^- \pi^+$	[a]	< 0.23	678
$\Sigma^+ K^- \pi^+$		0.94 $\pm 0.10$	811
$\Sigma^+ \bar{K}^*(892)^0$	[a]	0.81 $\pm 0.15$	658
$\Sigma^0 K^- 2\pi^+$		0.27 $\pm 0.12$	735
$\Xi^0 \pi^+$		0.55 $\pm 0.16$	877
$\Xi^- 2\pi^+$	<b>DEFINED AS 1</b>		
$\Xi(1530)^0 \pi^+$	[a]	< 0.10	90%
$\Xi(1620)^0 \pi^+$		seen	—
$\Xi(1690)^0 \pi^+$		seen	644
$\Xi^0 \pi^+ \pi^0$		2.3 $\pm 0.7$	856
$\Xi^0 \pi^- 2\pi^+$		1.7 $\pm 0.5$	818
$\Xi^0 e^+ \nu_e$		2.3 $\pm 0.7$	884
$\Omega^- K^+ \pi^+$		0.07 $\pm 0.04$	399

**Cabibbo-suppressed decays — relative to  $\Xi^- 2\pi^+$**

$p K^- \pi^+$	0.0045	$\pm 0.0022$	944	
$p \bar{K}^*(892)^0$	[a]	0.0024 $\pm 0.0013$	828	
$\Sigma^+ \pi^+ \pi^-$		0.48 $\pm 0.20$	922	
$\Sigma^- 2\pi^+$		0.18 $\pm 0.09$	918	
$\Sigma^+ K^+ K^-$		0.15 $\pm 0.06$	580	
$\Sigma^+ \phi$	[a]	< 0.11	90%	
$\Xi(1690)^0 K^+, \Xi^0 \rightarrow$		< 0.05	90%	
$\Sigma^+ K^-$			501	
$p \phi(1020)$	(9	$\pm 4$	) $\times 10^{-5}$	751



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

$J^P$  has not been measured;  $\frac{1}{2}^+$  is the quark-model prediction.

Mass  $m = 2470.90^{+0.22}_{-0.29}$  MeV

$m_{\Xi_c^0} - m_{\Xi_c^+} = 2.96 \pm 0.22$  MeV

Mean life  $\tau = (153 \pm 6) \times 10^{-15}$  s ( $S = 2.4$ )

$c\tau = 45.8$   $\mu\text{m}$

**Decay asymmetry parameters**

$$\Xi^-\pi^+ \quad \alpha = -0.6 \pm 0.4$$

$\Xi_c^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor (MeV/c)	$p$
<b>Cabibbo-favored (<math>S = -2</math>) decays</b>			
$p K^- K^- \pi^+$	$(4.8 \pm 1.2) \times 10^{-3}$	1.1	676
$p K^- \bar{K}^*(892)^0, \bar{K}^{*0} \rightarrow K^- \pi^+$	$(2.0 \pm 0.6) \times 10^{-3}$		413
$p K^- K^- \pi^+ (\text{no } \bar{K}^{*0})$	$(3.0 \pm 0.9) \times 10^{-3}$		676
$\Lambda K_S^0$	$(3.0 \pm 0.8) \times 10^{-3}$		906
$\Lambda K^- \pi^+$	$(1.45 \pm 0.33) \%$	1.1	856
$\Lambda \bar{K}^0 \pi^+ \pi^-$	seen		787
$\Lambda K^- \pi^+ \pi^+ \pi^-$	seen		703
$\Xi^- \pi^+$	$(1.43 \pm 0.32) \%$	1.1	875
$\Xi^- \pi^+ \pi^+ \pi^-$	$(4.8 \pm 2.3) \%$		816
$\Omega^- K^+$	$(4.2 \pm 1.0) \times 10^{-3}$		522
$\Xi^- e^+ \nu_e$	$(1.8 \pm 1.2) \%$		882
<b>Cabibbo-suppressed decays</b>			
$\Xi^- K^+$	$(3.9 \pm 1.2) \times 10^{-4}$		790
$\Lambda K^+ K^- (\text{no } \phi)$	$(4.1 \pm 1.4) \times 10^{-4}$		648
$\Lambda \phi$	$(4.9 \pm 1.5) \times 10^{-4}$		621

$\Xi_c'^+$

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

$J^P$  has not been measured;  $\frac{1}{2}^+$  is the quark-model prediction.

Mass  $m = 2578.4 \pm 0.5$  MeV

$$m_{\Xi_c'^+} - m_{\Xi_c^+} = 110.5 \pm 0.4 \text{ MeV}$$

$$m_{\Xi_c'^+} - m_{\Xi_c^0} = -0.8 \pm 0.6 \text{ MeV}$$

The  $\Xi_c'^+ - \Xi_c^+$  mass difference is too small for any strong decay to occur.

$\Xi_c'^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ \gamma$	seen	108

$\Xi_c^0$

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

$J^P$  has not been measured;  $\frac{1}{2}^+$  is the quark-model prediction.

Mass  $m = 2579.2 \pm 0.5$  MeV

$$m_{\Xi_c^0} - m_{\Xi_c^+} = 108.3 \pm 0.4 \text{ MeV}$$

The  $\Xi_c'^0 - \Xi_c^0$  mass difference is too small for any strong decay to occur.

$\Xi_c'^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^0 \gamma$	seen	106

### $\Xi_c(2645)$

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^+)$$

$J^P$  has not been measured;  $\frac{3}{2}^+$  is the quark-model prediction.

$$\Xi_c(2645)^+ \text{ mass } m = 2645.56^{+0.24}_{-0.30} \text{ MeV}$$

$$\Xi_c(2645)^0 \text{ mass } m = 2646.38^{+0.20}_{-0.23} \text{ MeV} \quad (S = 1.1)$$

$$m_{\Xi_c(2645)^+} - m_{\Xi_c^0} = 174.66 \pm 0.09 \text{ MeV}$$

$$m_{\Xi_c(2645)^0} - m_{\Xi_c^+} = 178.44 \pm 0.10 \text{ MeV}$$

$$m_{\Xi_c(2645)^+} - m_{\Xi_c(2645)^0} = -0.82 \pm 0.26 \text{ MeV}$$

$$\Xi_c(2645)^+ \text{ full width } \Gamma = 2.14 \pm 0.19 \text{ MeV} \quad (S = 1.1)$$

$$\Xi_c(2645)^0 \text{ full width } \Gamma = 2.35 \pm 0.22 \text{ MeV}$$

$\Xi_c \pi$  is the only strong decay allowed to a  $\Xi_c$  resonance having this mass.

$\Xi_c(2645)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^0 \pi^+$	seen	102
$\Xi_c^+ \pi^-$	seen	106

### $\Xi_c(2790)$

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^-)$$

$J^P$  has not been measured;  $\frac{1}{2}^-$  is the quark-model prediction.

$$\Xi_c(2790)^+ \text{ mass} = 2792.4 \pm 0.5 \text{ MeV}$$

$$\Xi_c(2790)^0 \text{ mass} = 2794.1 \pm 0.5 \text{ MeV}$$

$$m_{\Xi_c(2790)^+} - m_{\Xi_c'^0} = 213.20 \pm 0.22 \text{ MeV}$$

$$m_{\Xi_c(2790)^0} - m_{\Xi_c'^+} = 215.70 \pm 0.22 \text{ MeV}$$

$$m_{\Xi_c(2790)^+} - m_{\Xi_c(2790)^0} = -1.7 \pm 0.7 \text{ MeV}$$

$$\Xi_c(2790)^+ \text{ width} = 8.9 \pm 1.0 \text{ MeV}$$

$$\Xi_c(2790)^0 \text{ width} = 10.0 \pm 1.1 \text{ MeV}$$

$\Xi_c(2790)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi'_c \pi$	seen	160

 **$\Xi_c(2815)$** 

$$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$$

$J^P$  has not been measured;  $\frac{3}{2}^-$  is the quark-model prediction.

$$\Xi_c(2815)^+ \text{ mass } m = 2816.74^{+0.20}_{-0.23} \text{ MeV}$$

$$\Xi_c(2815)^0 \text{ mass } m = 2820.25^{+0.25}_{-0.31} \text{ MeV}$$

$$m_{\Xi_c(2815)^+} - m_{\Xi_c^+} = 348.80 \pm 0.10 \text{ MeV}$$

$$m_{\Xi_c(2815)^0} - m_{\Xi_c^0} = 349.35 \pm 0.11 \text{ MeV}$$

$$m_{\Xi_c(2815)^+} - m_{\Xi_c(2815)^0} = -3.51 \pm 0.26 \text{ MeV}$$

$$\Xi_c(2815)^+ \text{ full width } \Gamma = 2.43 \pm 0.26 \text{ MeV}$$

$$\Xi_c(2815)^0 \text{ full width } \Gamma = 2.54 \pm 0.25 \text{ MeV}$$

The  $\Xi_c \pi \pi$  modes are consistent with being entirely via  $\Xi_c(2645)\pi$ .

$\Xi_c(2815)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi'_c \pi$	seen	188
$\Xi_c(2645)\pi$	seen	102

 **$\Xi_c(2970)$** 

$$I(J^P) = \frac{1}{2}(?)$$

was  $\Xi_c(2980)$

$$\Xi_c(2970)^+ m = 2966.34^{+0.17}_{-1.00} \text{ MeV}$$

$$\Xi_c(2970)^0 m = 2970.9^{+0.4}_{-0.6} \text{ MeV}$$

$$\backslashquad m_{\Xi_c(2970)^+} - m_{\Xi_c^+} = 498.40^{+0.27}_{-0.90} \text{ MeV}$$

$$\backslashquad m_{\Xi_c(2970)^0} - m_{\Xi_c^0} = 500.0^{+0.4}_{-0.6} \text{ MeV}$$

$$m_{\Xi_c(2970)^+} - m_{\Xi_c(2970)^0} = -4.6^{+0.4}_{-0.6} \text{ MeV}$$

$$\Xi_c(2970)^+ \text{ width } \Gamma = 20.9^{+2.4}_{-3.5} \text{ MeV} \quad (S = 1.2)$$

$$\Xi_c(2970)^0 \text{ width } \Gamma = 28.1^{+3.4}_{-4.0} \text{ MeV} \quad (S = 1.5)$$

<b><math>\Xi_c(2970)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \bar{K} \pi$	seen	228
$\Sigma_c(2455) \bar{K}$	seen	128
$\Lambda_c^+ \bar{K}$	not seen	412
$\Xi_c 2\pi$	seen	383
$\Xi'_c \pi$	seen	—
$\Xi_c(2645) \pi$	seen	275

 **$\Xi_c(3055)$** 

$I(J^P) = ?(??)$

Mass  $m = 3055.9 \pm 0.4$  MeV  
 Full width  $\Gamma = 7.8 \pm 1.9$  MeV

<b><math>\Xi_c(3055)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Sigma^{++} K^-$	seen	—
$\Lambda D^+$	seen	316

 **$\Xi_c(3080)$** 

$I(J^P) = \frac{1}{2}(??)$

$\Xi_c(3080)^+ m = 3077.2 \pm 0.4$  MeV  
 $\Xi_c(3080)^0 m = 3079.9 \pm 1.4$  MeV ( $S = 1.3$ )  
 $\Xi_c(3080)^+ \text{width } \Gamma = 3.6 \pm 1.1$  MeV ( $S = 1.5$ )  
 $\Xi_c(3080)^0 \text{width } \Gamma = 5.6 \pm 2.2$  MeV

<b><math>\Xi_c(3080)</math> DECAY MODES</b>	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Lambda_c^+ \bar{K} \pi$	seen	415
$\Sigma_c(2455) \bar{K}$	seen	342
$\Sigma_c(2455)^{++} K^-$	seen	342
$\Sigma_c(2520)^{++} K^-$	seen	239
$\Sigma_c(2455) \bar{K} + \Sigma_c(2520) \bar{K}$	seen	—
$\Lambda_c^+ \bar{K}$	not seen	536
$\Lambda_c^+ \bar{K} \pi^+ \pi^-$	not seen	144
$\Lambda D^+$	seen	362

 **$\Omega_c^0$** 

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

$J^P$  has not been measured;  $\frac{1}{2}+$  is the quark-model prediction.

Mass  $m = 2695.2 \pm 1.7$  MeV ( $S = 1.3$ )  
 Mean life  $\tau = (268 \pm 26) \times 10^{-15}$  s  
 $c\tau = 80 \mu\text{m}$

$\Omega_c^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level	$p$ (MeV/c)
<b>No absolute branching fractions have been measured. The following are branching <i>ratios</i> relative to <math>\Omega^- \pi^+</math>.</b>			
<b>Cabibbo-favored (<math>S = -3</math>) decays — relative to <math>\Omega^- \pi^+</math></b>			
$\Omega^- \pi^+$	<b>DEFINED AS 1</b>		821
$\Omega^- \pi^+ \pi^0$	$1.80 \pm 0.33$		797
$\Omega^- \rho^+$	$>1.3$	90%	532
$\Omega^- \pi^- 2\pi^+$	$0.31 \pm 0.05$		753
$\Omega^- e^+ \nu_e$	$2.4 \pm 1.2$		829
$\Xi^0 \bar{K}^0$	$1.64 \pm 0.29$		950
$\Xi^0 K^- \pi^+$	$1.20 \pm 0.18$		901
$\Xi^0 \bar{K}^{*0}, \bar{K}^{*0} \rightarrow K^- \pi^+$	$0.68 \pm 0.16$		764
$\Xi^- \bar{K}^0 \pi^+$	$2.12 \pm 0.28$		895
$\Xi^- K^- 2\pi^+$	$0.63 \pm 0.09$		830
$\Xi(1530)^0 K^- \pi^+, \Xi^{*0} \rightarrow$	$0.21 \pm 0.06$		757
$\Xi^- \bar{K}^{*0} \pi^+$	$0.34 \pm 0.11$		653
$\Sigma^+ K^- K^- \pi^+$	$<0.32$	90%	689
$\Lambda \bar{K}^0 \bar{K}^0$	$1.72 \pm 0.35$		837

 **$\Omega_c(2770)^0$** 

$I(J^P) = 0(\frac{3}{2}^+)$

$J^P$  has not been measured;  $\frac{3}{2}^+$  is the quark-model prediction.

Mass  $m = 2765.9 \pm 2.0$  MeV ( $S = 1.2$ )

$$m_{\Omega_c(2770)^0} - m_{\Omega_c^0} = 70.7^{+0.8}_{-0.9}$$
 MeV

The  $\Omega_c(2770)^0 - \Omega_c^0$  mass difference is too small for any strong decay to occur.

$\Omega_c(2770)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Omega_c^0 \gamma$	presumably 100%	70

 **$\Omega_c(3000)^0$** 

$I(J^P) = ?(?)$

Mass  $m = 3000.41 \pm 0.22$  MeV

Full width  $\Gamma = 4.5 \pm 0.7$  MeV

$\Omega_c(3000)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	181
$\Omega_c(3050)^0$		$J(P) = ?(?)$
Mass $m = 3050.20 \pm 0.13$ MeV		
Full width $\Gamma < 1.2$ MeV, CL = 95%		
$\Omega_c(3050)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	278
$\Omega_c(3065)^0$		$J(P) = ?(?)$
Mass $m = 3065.46 \pm 0.28$ MeV		
Full width $\Gamma = 3.5 \pm 0.4$ MeV		
$\Omega_c(3065)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	303
$\Omega_c(3090)^0$		$J(P) = ?(?)$
Mass $m = 3090.0 \pm 0.5$ MeV		
Full width $\Gamma = 8.7 \pm 1.3$ MeV		
$\Omega_c(3090)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	339
$\Omega_c(3120)^0$		$J(P) = ?(?)$
Mass $m = 3119.1 \pm 1.0$ MeV		
Full width $\Gamma < 2.6$ MeV, CL = 95%		
$\Omega_c(3120)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	379

## NOTES

- [a] This branching fraction includes all the decay modes of the final-state resonance.
- [b] See AALTONEN 11H, Fig. 8, for the calculated ratio of  $\Lambda_c^+ \pi^0 \pi^0$  and  $\Lambda_c^+ \pi^+ \pi^-$  partial widths as a function of the  $\Lambda_c(2595)^+ - \Lambda_c^+$  mass difference. At our value of the mass difference, the ratio is about 4.
- [c] A test that the isospin is indeed 0, so that the particle is indeed a  $\Lambda_c^+$ .