

# CHARMED BARYONS ( $C = +1$ )

$$\Lambda_c^+ = udc, \quad \Sigma_c^{++} = uuc, \quad \Sigma_c^+ = udc, \quad \Sigma_c^0 = ddc,$$

$$\Xi_c^+ = usc, \quad \Xi_c^0 = dsc, \quad \Omega_c^0 = ssc$$

 $\Lambda_c^+$ 

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

$$\text{Mass } m = 2286.46 \pm 0.14 \text{ MeV}$$

$$\text{Mean life } \tau = (202.4 \pm 3.1) \times 10^{-15} \text{ s} \quad (S = 1.7)$$

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

### Decay asymmetry parameters

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

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

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

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

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

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

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

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

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

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  $\Lambda_c^+ \rightarrow pK^-\pi^+$  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>			
$pK_S^0$	( 1.59 ± 0.08 ) %	S=1.1	873
$pK^-\pi^+$	( 6.28 ± 0.32 ) %	S=1.4	823
$p\bar{K}^*(892)^0$	[a] ( 1.96 ± 0.27 ) %		685
$\Delta(1232)^{++}K^-$	( 1.08 ± 0.25 ) %		710
$\Lambda(1520)\pi^+$	[a] ( 2.2 ± 0.5 ) %		628
$pK^-\pi^+$ nonresonant	( 3.5 ± 0.4 ) %		823
$pK_S^0\pi^0$	( 1.97 ± 0.13 ) %	S=1.1	823
$nK_S^0\pi^+$	( 1.82 ± 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
$\Delta(1232)K^*(892)$	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
$pf_0(980)$	[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
$\Sigma(1385)^+\pi^+\pi^-, \Sigma^{*+} \rightarrow$	( 1.0 ± 0.5 ) %		688
$\Lambda\pi^+$			
$\Sigma(1385)^-2\pi^+, \Sigma^{*-} \rightarrow$	( 7.6 ± 1.4 ) × 10 <sup>-3</sup>		688
$\Lambda\pi^-$			
$\Lambda\pi^+\rho^0$	( 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
$\Xi(1690)^0 K^+, \Xi^{*0} \rightarrow \Lambda\bar{K}^0$	( 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 ± 0.25 ) %	S=1.3	804
$\Sigma^+ \rho^0$	< 1.7 %	CL=95%	575
$\Sigma^- 2\pi^+$	( 1.87 ± 0.18 ) %		799
$\Sigma^0 \pi^+ \pi^0$	( 3.5 ± 0.4 ) %		803
$\Sigma^+ \pi^0 \pi^0$	( 1.55 ± 0.15 ) %		806
$\Sigma^0 \pi^- 2\pi^+$	( 1.11 ± 0.30 ) %		763
$\Sigma^+ \pi^+ \pi^- \pi^0$	—		767
$\Sigma^+ \omega$	[a] ( 1.70 ± 0.21 ) %		569
$\Sigma^- \pi^0 2\pi^+$	( 2.1 ± 0.4 ) %		762
$\Sigma^+ K^+ K^-$	( 3.5 ± 0.4 ) × 10 <sup>-3</sup>	S=1.1	349
$\Sigma^+ \phi$	[a] ( 3.9 ± 0.6 ) × 10 <sup>-3</sup>	S=1.1	295
$\Xi(1690)^0 K^+, \Xi^{*0} \rightarrow$	( 1.02 ± 0.25 ) × 10 <sup>-3</sup>		286
$\Sigma^+ K^-$			
$\Sigma^+ K^+ K^-$ nonresonant	< 8 × 10 <sup>-4</sup>	CL=90%	349
$\Xi^0 K^+$	( 5.5 ± 0.7 ) × 10 <sup>-3</sup>		653
$\Xi^- K^+ \pi^+$	( 6.2 ± 0.6 ) × 10 <sup>-3</sup>	S=1.1	565
$\Xi(1530)^0 K^+$	( 4.3 ± 0.9 ) × 10 <sup>-3</sup>	S=1.1	473

### Hadronic modes with a hyperon: S = 0 final states

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

### Doubly Cabibbo-suppressed modes

$\rho K^+ \pi^-$	( 1.11 ± 0.18 ) × 10 <sup>-4</sup>		823
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### Semileptonic modes

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

### Inclusive modes

$e^+$ anything	( 3.95 ± 0.35 ) %		—
$\rho$ anything	( 50 ± 16 ) %		—
$n$ anything	( 50 ± 16 ) %		—
$\Lambda$ anything	( 38.2 $\begin{smallmatrix} + 2.9 \\ - 2.4 \end{smallmatrix}$ ) %		—
3prongs	( 24 ± 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  $\Sigma_c(2455)$ .

$$\text{Mass } m = 2592.25 \pm 0.28 \text{ MeV}$$

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

$$\text{Full width } \Gamma = 2.6 \pm 0.6 \text{ MeV}$$

$\Lambda_c^+ \pi \pi$  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.

$$\text{Mass } m = 2628.11 \pm 0.19 \text{ MeV} \quad (S = 1.1)$$

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

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

$\Lambda_c^+ \pi \pi$  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

### $\Lambda_c(2860)^+$

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

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

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

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

### $\Lambda_c(2880)^+$

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

$$\text{Mass } m = 2881.63 \pm 0.24 \text{ MeV}$$

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

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

$\Lambda_c(2880)^+$ 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

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

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

$\Lambda_c(2940)^+$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$pD^0$	seen	420
$\Sigma_c(2455)^{0,++}\pi^\pm$	seen	—

### $\Sigma_c(2455)$

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

$$\begin{aligned} \Sigma_c(2455)^{++} \text{ mass } m &= 2453.97 \pm 0.14 \text{ MeV} \\ \Sigma_c(2455)^+ \text{ mass } m &= 2452.9 \pm 0.4 \text{ MeV} \\ \Sigma_c(2455)^0 \text{ mass } m &= 2453.75 \pm 0.14 \text{ MeV} \\ m_{\Sigma_c^{++}} - m_{\Lambda_c^+} &= 167.510 \pm 0.017 \text{ MeV} \\ m_{\Sigma_c^+} - m_{\Lambda_c^+} &= 166.4 \pm 0.4 \text{ MeV} \\ m_{\Sigma_c^0} - m_{\Lambda_c^+} &= 167.290 \pm 0.017 \text{ MeV} \\ m_{\Sigma_c^{++}} - m_{\Sigma_c^0} &= 0.220 \pm 0.013 \text{ MeV} \\ m_{\Sigma_c^+} - m_{\Sigma_c^0} &= -0.9 \pm 0.4 \text{ MeV} \\ \Sigma_c(2455)^{++} \text{ full width } \Gamma &= 1.89^{+0.09}_{-0.18} \text{ MeV} \quad (S = 1.1) \\ \Sigma_c(2455)^+ \text{ full width } \Gamma &< 4.6 \text{ MeV, CL} = 90\% \\ \Sigma_c(2455)^0 \text{ full width } \Gamma &= 1.83^{+0.11}_{-0.19} \text{ MeV} \quad (S = 1.2) \end{aligned}$$

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

$\Sigma_c(2455)$ DECAY MODES	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.

$$\begin{aligned} \Sigma_c(2520)^{++} \text{ mass } m &= 2518.41^{+0.21}_{-0.19} \text{ MeV} \quad (S = 1.1) \\ \Sigma_c(2520)^+ \text{ mass } m &= 2517.5 \pm 2.3 \text{ MeV} \\ \Sigma_c(2520)^0 \text{ mass } m &= 2518.48 \pm 0.20 \text{ MeV} \quad (S = 1.1) \\ m_{\Sigma_c(2520)^{++}} - m_{\Lambda_c^+} &= 231.95^{+0.17}_{-0.12} \text{ MeV} \quad (S = 1.3) \\ m_{\Sigma_c(2520)^+} - m_{\Lambda_c^+} &= 231.0 \pm 2.3 \text{ MeV} \\ m_{\Sigma_c(2520)^0} - m_{\Lambda_c^+} &= 232.02^{+0.15}_{-0.14} \text{ MeV} \quad (S = 1.3) \\ m_{\Sigma_c(2520)^{++}} - m_{\Sigma_c(2520)^0} &= 0.01 \pm 0.15 \text{ MeV} \\ \Sigma_c(2520)^{++} \text{ full width } \Gamma &= 14.78^{+0.30}_{-0.40} \text{ MeV} \\ \Sigma_c(2520)^+ \text{ full width } \Gamma &< 17 \text{ MeV, CL} = 90\% \\ \Sigma_c(2520)^0 \text{ full width } \Gamma &= 15.3^{+0.4}_{-0.5} \text{ MeV} \end{aligned}$$

$\Lambda_c^+ \pi$  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

### $\Sigma_c(2800)$

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

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

$\Sigma_c(2800)$ 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.

$$\begin{aligned} \text{Mass } m &= 2467.94_{-0.20}^{+0.17} \text{ MeV} \\ \text{Mean life } \tau &= (456 \pm 5) \times 10^{-15} \text{ s} \\ c\tau &= 136.6 \text{ } \mu\text{m} \end{aligned}$$

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 $p$ (MeV/c)
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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 ± 0.021		767
$\Lambda \bar{K}^0 \pi^+$		—		852
$\Sigma(1385)^+ \bar{K}^0$	[a]	1.0 ± 0.5		746
$\Lambda K^- 2\pi^+$		0.323 ± 0.033		787
$\Lambda \bar{K}^*(892)^0 \pi^+$	[a]	< 0.16	90%	608
$\Sigma(1385)^+ K^- \pi^+$	[a]	< 0.23	90%	678
$\Sigma^+ K^- \pi^+$		0.94 ± 0.10		811
$\Sigma^+ \bar{K}^*(892)^0$	[a]	0.81 ± 0.15		658
$\Sigma^0 K^- 2\pi^+$		0.27 ± 0.12		735
$\Xi^0 \pi^+$		0.55 ± 0.16		877
$\Xi^- 2\pi^+$		<b>DEFINED AS 1</b>		851
$\Xi(1530)^0 \pi^+$	[a]	< 0.10	90%	750
$\Xi(1620)^0 \pi^+$		seen		—
$\Xi(1690)^0 \pi^+$		seen		644
$\Xi^0 \pi^+ \pi^0$		2.3 ± 0.7		856
$\Xi^0 \pi^- 2\pi^+$		1.7 ± 0.5		818
$\Xi^0 e^+ \nu_e$		2.3 $\begin{matrix} +0.7 \\ -0.8 \end{matrix}$		884
$\Omega^- K^+ \pi^+$		0.07 ± 0.04		399

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

$p K^- \pi^+$		0.0045 ± 0.0022		944
$p \bar{K}^*(892)^0$	[a]	0.0024 ± 0.0013		828
$\Sigma^+ \pi^+ \pi^-$		0.48 ± 0.20		922
$\Sigma^- 2\pi^+$		0.18 ± 0.09		918
$\Sigma^+ K^+ K^-$		0.15 ± 0.06		580
$\Sigma^+ \phi$	[a]	< 0.11	90%	549
$\Xi(1690)^0 K^+, \Xi^0 \rightarrow \Sigma^+ K^-$		< 0.05	90%	501
$p \phi(1020)$		(9 ± 4) × 10 <sup>-5</sup>		751



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

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

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

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

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

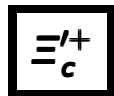
$$c\tau = 45.8 \text{ } \mu\text{m}$$



### Decay asymmetry parameters

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

$\Xi_c^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor	$p$ (MeV/c)
<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
$p K^- K^- \pi^+$ (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
$\Lambda K^+ K^-$ (no $\phi$ )	$(4.1 \pm 1.4) \times 10^{-4}$		648
$\Lambda \phi$	$(4.9 \pm 1.5) \times 10^{-4}$		621



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

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

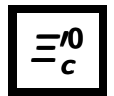
Mass  $m = 2578.4 \pm 0.5$  MeV

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

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

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



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

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

Mass  $m = 2579.2 \pm 0.5$  MeV

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

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

$\Xi_c^{\prime 0}$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^{\prime 0} \gamma$	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.

$$\begin{aligned} \Xi_c(2645)^+ \text{ mass } m &= 2645.56^{+0.24}_{-0.30} \text{ MeV} \\ \Xi_c(2645)^0 \text{ mass } m &= 2646.38^{+0.20}_{-0.23} \text{ MeV} \quad (S = 1.1) \\ m_{\Xi_c(2645)^+} - m_{\Xi_c^0} &= 174.66 \pm 0.09 \text{ MeV} \\ m_{\Xi_c(2645)^0} - m_{\Xi_c^+} &= 178.44 \pm 0.10 \text{ MeV} \\ m_{\Xi_c(2645)^+} - m_{\Xi_c(2645)^0} &= -0.82 \pm 0.26 \text{ MeV} \\ \Xi_c(2645)^+ \text{ full width } \Gamma &= 2.14 \pm 0.19 \text{ MeV} \quad (S = 1.1) \\ \Xi_c(2645)^0 \text{ full width } \Gamma &= 2.35 \pm 0.22 \text{ MeV} \end{aligned}$$

$\Xi_c \pi$  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.

$$\begin{aligned} \Xi_c(2790)^+ \text{ mass} &= 2792.4 \pm 0.5 \text{ MeV} \\ \Xi_c(2790)^0 \text{ mass} &= 2794.1 \pm 0.5 \text{ MeV} \\ m_{\Xi_c(2790)^+} - m_{\Xi_c^0} &= 213.20 \pm 0.22 \text{ MeV} \\ m_{\Xi_c(2790)^0} - m_{\Xi_c^+} &= 215.70 \pm 0.22 \text{ MeV} \\ m_{\Xi_c(2790)^+} - m_{\Xi_c(2790)^0} &= -1.7 \pm 0.7 \text{ MeV} \\ \Xi_c(2790)^+ \text{ width} &= 8.9 \pm 1.0 \text{ MeV} \\ \Xi_c(2790)^0 \text{ width} &= 10.0 \pm 1.1 \text{ MeV} \end{aligned}$$

$\Xi_c(2790)$ 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  $\Xi_c(2980)$

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

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

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

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

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

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

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

$\Xi_c(2970)$ DECAY MODES	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

$\Xi_c(3055)$ DECAY MODES	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

$\Xi_c(3080)$ DECAY MODES	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)
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**No absolute branching fractions have been measured.  
The following are branching *ratios* relative to  $\Omega^- \pi^+$ .**

**Cabibbo-favored ( $S = -3$ ) decays — relative to  $\Omega^- \pi^+$**

$\Omega^- \pi^+$	<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.

$$\text{Mass } m = 2765.9 \pm 2.0 \text{ MeV} \quad (S = 1.2)$$

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

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

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

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

$$\text{Mass } m = 3000.41 \pm 0.22 \text{ MeV}$$

$$\text{Full width } \Gamma = 4.5 \pm 0.7 \text{ MeV}$$

$\Omega_c(3000)^0$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Xi_c^+ K^-$	seen	181

 **$\Omega_c(3050)^0$** 

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

Mass  $m = 3050.20 \pm 0.13$  MeVFull 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

 **$\Omega_c(3065)^0$** 

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

Mass  $m = 3065.46 \pm 0.28$  MeVFull 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

 **$\Omega_c(3090)^0$** 

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

Mass  $m = 3090.0 \pm 0.5$  MeVFull 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

 **$\Omega_c(3120)^0$** 

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

Mass  $m = 3119.1 \pm 1.0$  MeVFull 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  $\Lambda_c^+$ .