

# CHARMED BARYONS ( $C = +1$ )

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

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

$\Lambda_c^+$

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

$J$  is not well measured;  $\frac{1}{2}$  is the quark-model prediction.

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

$$\text{Mean life } \tau = (200 \pm 6) \times 10^{-15} \text{ s} \quad (S = 1.6)$$

$$c\tau = 59.9 \text{ } \mu\text{m}$$

### Decay asymmetry parameters

$$\Lambda\pi^+ \quad \alpha = -0.91 \pm 0.15$$

$$\Sigma^+\pi^0 \quad \alpha = -0.45 \pm 0.32$$

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

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

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

Nearly all branching fractions of the  $\Lambda_c^+$  are measured relative to the  $pK^-\pi^+$  mode, but there are no model-independent measurements of this branching fraction. We explain how we arrive at our value of  $B(\Lambda_c^+ \rightarrow pK^-\pi^+)$  in a Note at the beginning of the branching-ratio measurements in the Listings. When this branching fraction is eventually well determined, all the other branching fractions will slide up or down proportionally as the true value differs from the value we use here.

| $\Lambda_c^+$ DECAY MODES   | Fraction ( $\Gamma_i/\Gamma$ )     | Scale factor/<br>Confidence level | $p$<br>(MeV/c) |
|---|------------------------------------|-----------------------------------|----------------|
| <b>Hadronic modes with a <math>p</math>: <math>S = -1</math> final states</b> |                                    |                                   |                |
| $p\bar{K}^0$  | ( 2.3 $\pm$ 0.6 ) %                |                                   | 873            |
| $pK^-\pi^+$   | [a] ( 5.0 $\pm$ 1.3 ) %            |                                   | 823            |
| $p\bar{K}^*(892)^0$   | [b] ( 1.6 $\pm$ 0.5 ) %            |                                   | 685            |
| $\Delta(1232)^{++}K^-$  | ( 8.6 $\pm$ 3.0 ) $\times 10^{-3}$ |                                   | 710            |
| $\Lambda(1520)\pi^+$  | [b] ( 1.8 $\pm$ 0.6 ) %            |                                   | 627            |
| $pK^-\pi^+$ nonresonant   | ( 2.8 $\pm$ 0.8 ) %                |                                   | 823            |
| $p\bar{K}^0\pi^0$   | ( 3.3 $\pm$ 1.0 ) %                |                                   | 823            |
| $p\bar{K}^0\eta$  | ( 1.2 $\pm$ 0.4 ) %                |                                   | 568            |

|   |                                  |     |
|---|----------------------------------|-----|
| $\rho \bar{K}^0 \pi^+ \pi^-$                  | ( 2.6 ± 0.7 ) %                  | 754 |
| $\rho K^- \pi^+ \pi^0$                        | ( 3.4 ± 1.0 ) %                  | 759 |
| $\rho K^*(892)^- \pi^+$                       | [b] ( 1.1 ± 0.5 ) %              | 580 |
| $\rho (K^- \pi^+)_{\text{nonresonant}} \pi^0$ | ( 3.6 ± 1.2 ) %                  | 759 |
| $\Delta(1232) \bar{K}^*(892)$                 | seen                             | 419 |
| $\rho K^- \pi^+ \pi^+ \pi^-$                  | ( 1.1 ± 0.8 ) × 10 <sup>-3</sup> | 671 |
| $\rho K^- \pi^+ \pi^0 \pi^0$                  | ( 8 ± 4 ) × 10 <sup>-3</sup>     | 678 |

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

|                                 |                                      |     |
|---------------------------------|--------------------------------------|-----|
| $\rho \pi^+ \pi^-$              | ( 3.5 ± 2.0 ) × 10 <sup>-3</sup>     | 927 |
| $\rho f_0(980)$                 | [b] ( 2.8 ± 1.9 ) × 10 <sup>-3</sup> | 622 |
| $\rho \pi^+ \pi^+ \pi^- \pi^-$  | ( 1.8 ± 1.2 ) × 10 <sup>-3</sup>     | 852 |
| $\rho K^+ K^-$                  | ( 7.7 ± 3.5 ) × 10 <sup>-4</sup>     | 616 |
| $\rho \phi$                     | [b] ( 8.2 ± 2.7 ) × 10 <sup>-4</sup> | 590 |
| $\rho K^+ K^- \text{ non-}\phi$ | ( 3.5 ± 1.7 ) × 10 <sup>-4</sup>     | 616 |

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

|  |                                      |            |
|--|--------------------------------------|------------|
| $\Lambda \pi^+$  | ( 1.07 ± 0.28 ) %                    | 864        |
| $\Lambda \pi^+ \pi^0$  | ( 3.6 ± 1.3 ) %                      | 844        |
| $\Lambda \rho^+$   | < 5 %                                | CL=95% 635 |
| $\Lambda \pi^+ \pi^+ \pi^-$  | ( 2.6 ± 0.7 ) %                      | 807        |
| $\Sigma(1385)^+ \pi^+ \pi^-, \Sigma^{*+} \rightarrow$                  | ( 7 ± 4 ) × 10 <sup>-3</sup>         | 688        |
| $\Lambda \pi^+$  |                                      |            |
| $\Sigma(1385)^- \pi^+ \pi^+, \Sigma^{*-} \rightarrow$                  | ( 5.5 ± 1.7 ) × 10 <sup>-3</sup>     | 688        |
| $\Lambda \pi^-$  |                                      |            |
| $\Lambda \pi^+ \rho^0$   | ( 1.1 ± 0.5 ) %                      | 523        |
| $\Sigma(1385)^+ \rho^0, \Sigma^{*+} \rightarrow \Lambda \pi^+$         | ( 3.7 ± 3.1 ) × 10 <sup>-3</sup>     | 363        |
| $\Lambda \pi^+ \pi^+ \pi^- \text{ nonresonant}$                        | < 8 × 10 <sup>-3</sup>               | CL=90% 807 |
| $\Lambda \pi^+ \pi^+ \pi^- \pi^0 \text{ total}$                        | ( 1.8 ± 0.8 ) %                      | 757        |
| $\Lambda \pi^+ \eta$   | [b] ( 1.8 ± 0.6 ) %                  | 691        |
| $\Sigma(1385)^+ \eta$  | [b] ( 8.5 ± 3.3 ) × 10 <sup>-3</sup> | 570        |
| $\Lambda \pi^+ \omega$   | [b] ( 1.2 ± 0.5 ) %                  | 517        |
| $\Lambda \pi^+ \pi^+ \pi^- \pi^0, \text{ no } \eta \text{ or } \omega$ | < 7 × 10 <sup>-3</sup>               | CL=90% 757 |
| $\Lambda K^+ \bar{K}^0$  | ( 4.7 ± 1.5 ) × 10 <sup>-3</sup>     | S=1.2 443  |
| $\Xi(1690)^0 K^+, \Xi^{*0} \rightarrow \Lambda \bar{K}^0$              | ( 1.3 ± 0.5 ) × 10 <sup>-3</sup>     | 286        |
| $\Sigma^0 \pi^+$   | ( 1.05 ± 0.28 ) %                    | 825        |
| $\Sigma^+ \pi^0$   | ( 1.00 ± 0.34 ) %                    | 827        |
| $\Sigma^+ \eta$  | ( 5.5 ± 2.3 ) × 10 <sup>-3</sup>     | 713        |
| $\Sigma^+ \pi^+ \pi^-$   | ( 3.6 ± 1.0 ) %                      | 804        |
| $\Sigma^+ \rho^0$  | < 1.4 %                              | CL=95% 575 |
| $\Sigma^- \pi^+ \pi^+$   | ( 1.7 ± 0.5 ) %                      | 799        |
| $\Sigma^0 \pi^+ \pi^0$   | ( 1.8 ± 0.8 ) %                      | 803        |
| $\Sigma^0 \pi^+ \pi^+ \pi^-$   | ( 8.3 ± 3.1 ) × 10 <sup>-3</sup>     | 763        |
| $\Sigma^+ \pi^+ \pi^- \pi^0$   | —                                    | 767        |
| $\Sigma^+ \omega$  | [b] ( 2.7 ± 1.0 ) %                  | 569        |

|   |     |                                  |                         |     |
|---|-----|----------------------------------|-------------------------|-----|
| $\Sigma^+ K^+ K^-$                      |     | $( 2.8 \pm 0.8 ) \times 10^{-3}$ |                         | 349 |
| $\Sigma^+ \phi$                         | [b] | $( 3.1 \pm 0.9 ) \times 10^{-3}$ |                         | 295 |
| $\Xi(1690)^0 K^+, \Xi^{*0} \rightarrow$ |     | $( 8.1 \pm 3.0 ) \times 10^{-4}$ |                         | 286 |
| $\Sigma^+ K^-$                          |     |                                  |                         |     |
| $\Sigma^+ K^+ K^-$ nonresonant          |     | $< 6$                            | $\times 10^{-4}$ CL=90% | 349 |
| $\Xi^0 K^+$                             |     | $( 3.9 \pm 1.4 ) \times 10^{-3}$ |                         | 653 |
| $\Xi^- K^+ \pi^+$                       |     | $( 5.1 \pm 1.4 ) \times 10^{-3}$ |                         | 565 |
| $\Xi(1530)^0 K^+$                       | [b] | $( 2.6 \pm 1.0 ) \times 10^{-3}$ |                         | 473 |

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

|                            |     |                                  |                         |     |
|----------------------------|-----|----------------------------------|-------------------------|-----|
| $\Lambda K^+$              |     | $( 5.0 \pm 1.6 ) \times 10^{-4}$ |                         | 781 |
| $\Lambda K^+ \pi^+ \pi^-$  |     | $< 4$                            | $\times 10^{-4}$ CL=90% | 637 |
| $\Sigma^0 K^+$             |     | $( 4.2 \pm 1.3 ) \times 10^{-4}$ |                         | 735 |
| $\Sigma^0 K^+ \pi^+ \pi^-$ |     | $< 2.1$                          | $\times 10^{-4}$ CL=90% | 574 |
| $\Sigma^+ K^+ \pi^-$       |     | $( 1.7 \pm 0.7 ) \times 10^{-3}$ |                         | 670 |
| $\Sigma^+ K^*(892)^0$      | [b] | $( 2.8 \pm 1.1 ) \times 10^{-3}$ |                         | 470 |
| $\Sigma^- K^+ \pi^+$       |     | $< 1.0$                          | $\times 10^{-3}$ CL=90% | 664 |

**Doubly Cabibbo-suppressed modes**

|               |  |         |                         |     |
|---------------|--|---------|-------------------------|-----|
| $p K^+ \pi^-$ |  | $< 2.3$ | $\times 10^{-4}$ CL=90% | 823 |
|---------------|--|---------|-------------------------|-----|

**Semileptonic modes**

|                           |     |                      |  |     |
|---------------------------|-----|----------------------|--|-----|
| $\Lambda \ell^+ \nu_\ell$ | [c] | $( 2.0 \pm 0.6 ) \%$ |  | 871 |
| $\Lambda e^+ \nu_e$       |     | $( 2.1 \pm 0.6 ) \%$ |  | 871 |
| $\Lambda \mu^+ \nu_\mu$   |     | $( 2.0 \pm 0.7 ) \%$ |  | 867 |

**Inclusive modes**

|                              |     |                      |       |   |
|------------------------------|-----|----------------------|-------|---|
| $e^+$ anything               |     | $( 4.5 \pm 1.7 ) \%$ |       | — |
| $p e^+$ anything             |     | $( 1.8 \pm 0.9 ) \%$ |       | — |
| $p$ anything                 |     | $( 50 \pm 16 ) \%$   |       | — |
| $p$ anything (no $\Lambda$ ) |     | $( 12 \pm 19 ) \%$   |       | — |
| $n$ anything                 |     | $( 50 \pm 16 ) \%$   |       | — |
| $n$ anything (no $\Lambda$ ) |     | $( 29 \pm 17 ) \%$   |       | — |
| $\Lambda$ anything           |     | $( 35 \pm 11 ) \%$   | S=1.4 | — |
| $\Sigma^\pm$ anything        | [d] | $( 10 \pm 5 ) \%$    |       | — |
| 3prongs                      |     | $( 24 \pm 8 ) \%$    |       | — |

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

|                        |    |         |                         |     |
|------------------------|----|---------|-------------------------|-----|
| $p \mu^+ \mu^-$        | C1 | $< 3.4$ | $\times 10^{-4}$ CL=90% | 937 |
| $\Sigma^- \mu^+ \mu^+$ | 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  $\Sigma_c(2455)$ .

$$\begin{aligned} \text{Mass } m &= 2595.4 \pm 0.6 \text{ MeV} \quad (S = 1.1) \\ m - m_{\Lambda_c^+} &= 308.9 \pm 0.6 \text{ MeV} \quad (S = 1.1) \\ \text{Full width } \Gamma &= 3.6_{-1.3}^{+2.0} \text{ MeV} \end{aligned}$$

$\Lambda_c^+ \pi \pi$  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.

| $\Lambda_c(2595)^+$ DECAY MODES  | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|----------------------------------|--------------------------------|-------------|
| $\Lambda_c^+ \pi^+ \pi^-$        | [e] $\approx 67\%$             | 124         |
| $\Sigma_c(2455)^{++} \pi^-$      | $24 \pm 7\%$                   | 28          |
| $\Sigma_c(2455)^0 \pi^+$         | $24 \pm 7\%$                   | 28          |
| $\Lambda_c^+ \pi^+ \pi^-$ 3-body | $18 \pm 10\%$                  | 124         |
| $\Lambda_c^+ \pi^0$              | [f] not seen                   | 261         |
| $\Lambda_c^+ \gamma$             | not seen                       | 291         |

## $\Lambda_c(2625)^+$

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

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

$$\begin{aligned} \text{Mass } m &= 2628.1 \pm 0.6 \text{ MeV} \quad (S = 1.5) \\ m - m_{\Lambda_c^+} &= 341.7 \pm 0.6 \text{ MeV} \quad (S = 1.6) \\ \text{Full width } \Gamma &< 1.9 \text{ MeV, CL} = 90\% \end{aligned}$$

$\Lambda_c^+ \pi \pi$  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) |
|----------------------------------|--------------------------------|------------------|-------------|
| $\Lambda_c^+ \pi^+ \pi^-$        | [e] $\approx 67\%$             |                  | 184         |
| $\Sigma_c(2455)^{++} \pi^-$      | $< 5$                          | 90%              | 102         |
| $\Sigma_c(2455)^0 \pi^+$         | $< 5$                          | 90%              | 102         |
| $\Lambda_c^+ \pi^+ \pi^-$ 3-body | large                          |                  | 184         |
| $\Lambda_c^+ \pi^0$              | [f] not seen                   |                  | 293         |
| $\Lambda_c^+ \gamma$             | not seen                       |                  | 319         |

## $\Lambda_c(2880)^+$

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

There is some good evidence that indeed  $J^P = 5/2^+$

$$\text{Mass } m = 2881.53 \pm 0.35 \text{ MeV}$$

$$m - m_{\Lambda_c^+} = 595.1 \pm 0.4 \text{ MeV}$$

$$\text{Full width } \Gamma = 5.8 \pm 1.1 \text{ MeV}$$

| $\Lambda_c(2880)^+$ 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         |
| $pD^0$                          | seen                           | 316         |

## $\Lambda_c(2940)^+$

$$I(J^P) = 0(?^?)$$

$$\text{Mass } m = 2939.3^{+1.4}_{-1.5} \text{ MeV}$$

$$\text{Full width } \Gamma = 17^{+8}_{-6} \text{ MeV}$$

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

## $\Sigma_c(2455)$

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

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

$$\Sigma_c(2455)^{++} \text{ mass } m = 2454.02 \pm 0.18 \text{ MeV}$$

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

$$\Sigma_c(2455)^0 \text{ mass } m = 2453.76 \pm 0.18 \text{ MeV}$$

$$m_{\Sigma_c^{++}} - m_{\Lambda_c^+} = 167.56 \pm 0.11 \text{ MeV}$$

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

$$m_{\Sigma_c^0} - m_{\Lambda_c^+} = 167.30 \pm 0.11 \text{ MeV}$$

$$m_{\Sigma_c^{++}} - m_{\Sigma_c^0} = 0.27 \pm 0.11 \text{ MeV} \quad (S = 1.1)$$

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

$$\Sigma_c(2455)^{++} \text{ full width } \Gamma = 2.23 \pm 0.30 \text{ MeV}$$

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

$$\Sigma_c(2455)^0 \text{ full width } \Gamma = 2.2 \pm 0.4 \text{ MeV} \quad (S = 1.4)$$

$\Lambda_c^+ \pi$  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.

$$\Sigma_c(2520)^{++} \text{ mass } m = 2518.4 \pm 0.6 \text{ MeV} \quad (S = 1.4)$$

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

$$\Sigma_c(2520)^0 \text{ mass } m = 2518.0 \pm 0.5 \text{ MeV}$$

$$m_{\Sigma_c(2520)^{++}} - m_{\Lambda_c^+} = 231.9 \pm 0.6 \text{ MeV} \quad (S = 1.5)$$

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

$$m_{\Sigma_c(2520)^0} - m_{\Lambda_c^+} = 231.6 \pm 0.5 \text{ MeV} \quad (S = 1.1)$$

$$m_{\Sigma_c(2520)^{++}} - m_{\Sigma_c(2520)^0} = 0.3 \pm 0.6 \text{ MeV} \quad (S = 1.2)$$

$$\Sigma_c(2520)^{++} \text{ full width } \Gamma = 14.9 \pm 1.9 \text{ MeV}$$

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

$$\Sigma_c(2520)^0 \text{ full width } \Gamma = 16.1 \pm 2.1 \text{ MeV}$$

$\Lambda_c^+ \pi$  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) |
|------------------------------|--------------------------------|-------------|
| $\Lambda_c^+ \pi$            | $\approx 100\%$                | 180         |

### $\Sigma_c(2800)$

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

$$\Sigma_c(2800)^{++} \text{ mass } m = 2801_{-6}^{+4} \text{ MeV}$$

$$\Sigma_c(2800)^+ \text{ mass } m = 2792_{-5}^{+14} \text{ MeV}$$

$$\Sigma_c(2800)^0 \text{ mass } m = 2802_{-7}^{+4} \text{ MeV}$$

$$m_{\Sigma_c(2800)^{++}} - m_{\Lambda_c^+} = 514_{-6}^{+4} \text{ MeV}$$

$$m_{\Sigma_c(2800)^+} - m_{\Lambda_c^+} = 505_{-5}^{+14} \text{ MeV}$$

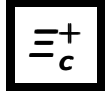
$$m_{\Sigma_c(2800)^0} - m_{\Lambda_c^+} = 515_{-7}^{+4} \text{ MeV}$$

$$\Sigma_c(2800)^{++} \text{ full width } \Gamma = 75_{-17}^{+22} \text{ MeV}$$

$$\Sigma_c(2800)^+ \text{ full width } \Gamma = 62_{-40}^{+60} \text{ MeV}$$

$$\Sigma_c(2800)^0 \text{ full width } \Gamma = 61_{-18}^{+28} \text{ MeV}$$

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



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

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

$$\text{Mass } m = 2467.8_{-0.6}^{+0.4} \text{ MeV}$$

$$\text{Mean life } \tau = (442 \pm 26) \times 10^{-15} \text{ s} \quad (S = 1.3)$$

$$c\tau = 132 \text{ } \mu\text{m}$$

| $\Xi_c^+$ DECAY MODES | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level | $p$ (MeV/c) |
|-----------------------|--------------------------------|------------------|-------------|
|-----------------------|--------------------------------|------------------|-------------|

**No absolute branching fractions have been measured.  
The following are branching *ratios* relative to  $\Xi^- 2\pi^+$ .**

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

|                                  |       |  |         |
|----------------------------------|-------|--|---------|
| $p 2K_S^0$                       | [g]   | $0.087 \pm 0.022$  | 767     |
| $\Lambda \bar{K}^0 \pi^+$        |       | —  | 852     |
| $\Sigma(1385)^+ \bar{K}^0$       | [b,g] | $1.0 \pm 0.5$  | 746     |
| $\Lambda K^- 2\pi^+$             | [g]   | $0.323 \pm 0.033$  | 787     |
| $\Lambda \bar{K}^*(892)^0 \pi^+$ | [b,g] | $< 0.2$  | 90% 608 |
| $\Sigma(1385)^+ K^- \pi^+$       | [b,g] | $< 0.3$  | 90% 678 |
| $\Sigma^+ K^- \pi^+$             | [g]   | $0.94 \pm 0.11$  | 810     |
| $\Sigma^+ \bar{K}^*(892)^0$      | [b,g] | $0.81 \pm 0.15$  | 658     |
| $\Sigma^0 K^- 2\pi^+$            | [g]   | $0.29 \pm 0.16$  | 735     |
| $\Xi^0 \pi^+$                    | [g]   | $0.55 \pm 0.16$  | 877     |
| $\Xi^- 2\pi^+$                   | [g]   | DEFINED AS 1   | 851     |
| $\Xi(1530)^0 \pi^+$              | [b,g] | $< 0.1$  | 90% 750 |
| $\Xi^0 \pi^+ \pi^0$              | [g]   | $2.34 \pm 0.68$  | 856     |
| $\Xi^0 \pi^- 2\pi^+$             | [g]   | $1.74 \pm 0.50$  | 818     |
| $\Xi^0 e^+ \nu_e$                | [g]   | $2.3 \begin{smallmatrix} +0.7 \\ -0.9 \end{smallmatrix}$ | 884     |
| $\Omega^- K^+ \pi^+$             | [g]   | $0.07 \pm 0.04$  | 399     |

#### Cabibbo-suppressed decays

|                        |       |                 |     |
|------------------------|-------|-----------------|-----|
| $p K^- \pi^+$          | [g]   | $0.21 \pm 0.03$ | 944 |
| $p \bar{K}^*(892)^0$   | [b,g] | $0.12 \pm 0.02$ | 828 |
| $\Sigma^+ \pi^+ \pi^-$ | [g]   | $0.48 \pm 0.20$ | 922 |

|   |                 |         |
|---|-----------------|---------|
| $\Sigma^- 2\pi^+$                                       | [g] 0.18 ± 0.09 | 918     |
| $\Sigma^+ K^+ K^-$                                      | [g] 0.15 ± 0.07 | 579     |
| $\Sigma^+ \phi$   | [b,g] < 0.11    | 90% 549 |
| $\Xi(1690)^0 K^+, \Xi(1690)^0 \rightarrow \Sigma^+ K^-$ | [g] < 0.05      | 90% 501 |



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

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

$$\text{Mass } m = 2470.88^{+0.34}_{-0.80} \text{ MeV} \quad (S = 1.1)$$

$$m_{\Xi_c^0} - m_{\Xi_c^+} = 3.1^{+0.4}_{-0.5} \text{ MeV}$$

$$\text{Mean life } \tau = (112^{+13}_{-10}) \times 10^{-15} \text{ s}$$

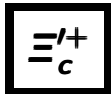
$$c\tau = 33.6 \text{ } \mu\text{m}$$

### Decay asymmetry parameters

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

No absolute branching fractions have been measured. Several measurements of ratios of fractions may be found in the Listings that follow.

| $\Xi_c^0$ DECAY MODES                  | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|--|--------------------------------|-------------|
| $pK^- K^- \pi^+$                       | seen                           | 676         |
| $pK^- \bar{K}^*(892)^0$                | seen                           | 413         |
| $pK^- K^- \pi^+$ no $\bar{K}^*(892)^0$ | seen                           | 676         |
| $\Lambda K_S^0$                        | seen                           | 906         |
| $\Lambda \bar{K}^0 \pi^+ \pi^-$        | seen                           | 787         |
| $\Lambda K^- \pi^+ \pi^+ \pi^-$        | seen                           | 703         |
| $\Xi^- \pi^+$                          | seen                           | 875         |
| $\Xi^- \pi^+ \pi^+ \pi^-$              | seen                           | 816         |
| $\Omega^- K^+$                         | seen                           | 522         |
| $\Xi^- e^+ \nu_e$                      | seen                           | 882         |
| $\Xi^- \ell^+$ anything                | seen                           | —           |



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

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

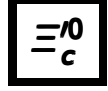
$$\text{Mass } m = 2575.6 \pm 3.1 \text{ MeV}$$

$$m_{\Xi_c^{'+}} - m_{\Xi_c^+} = 107.8 \pm 3.0 \text{ MeV}$$



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

| $\Xi_c^{\prime+}$ DECAY MODES | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|-------------------------------|--------------------------------|-------------|
| $\Xi_c^{\prime+} \gamma$      | seen                           | 106         |



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

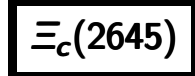
$J^P$  has not been measured;  $\frac{1}{2}^+$  is the quark-model prediction.

Mass  $m = 2577.9 \pm 2.9$  MeV

$$m_{\Xi_c^{\prime 0}} - m_{\Xi_c^0} = 107.0 \pm 2.9 \text{ MeV}$$

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                           | 105         |



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

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

$$\Xi_c(2645)^+ \text{ mass } m = 2645.9_{-0.6}^{+0.5} \text{ MeV} \quad (S = 1.1)$$

$$\Xi_c(2645)^0 \text{ mass } m = 2645.9 \pm 0.5 \text{ MeV}$$

$$m_{\Xi_c(2645)^+} - m_{\Xi_c^0} = 175.0_{-0.6}^{+0.8} \text{ MeV} \quad (S = 1.2)$$

$$m_{\Xi_c(2645)^0} - m_{\Xi_c^+} = 178.1 \pm 0.6 \text{ MeV}$$

$$m_{\Xi_c(2645)^+} - m_{\Xi_c(2645)^0} = 0.0 \pm 0.5 \text{ MeV}$$

$$\Xi_c(2645)^+ \text{ full width } \Gamma < 3.1 \text{ MeV, CL} = 90\%$$

$$\Xi_c(2645)^0 \text{ full width } \Gamma < 5.5 \text{ MeV, CL} = 90\%$$

$\Xi_c \pi$  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                           | 107         |

### $\Xi_c(2790)$

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

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

$$\begin{aligned} \Xi_c(2790)^+ \text{ mass} &= 2789.1 \pm 3.2 \text{ MeV} \\ \Xi_c(2790)^0 \text{ mass} &= 2791.8 \pm 3.3 \text{ MeV} \\ m_{\Xi_c(2790)^+} - m_{\Xi_c^0} &= 318.2 \pm 3.2 \text{ MeV} \\ m_{\Xi_c(2790)^0} - m_{\Xi_c^+} &= 324.0 \pm 3.3 \text{ MeV} \\ \Xi_c(2790)^+ \text{ width} &< 15 \text{ MeV, CL} = 90\% \\ \Xi_c(2790)^0 \text{ width} &< 12 \text{ MeV, CL} = 90\% \end{aligned}$$

| $\Xi_c(2790)$ DECAY MODES | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|---------------------------|--------------------------------|-------------|
| $\Xi_c^+ \pi^-$           | seen                           | 159         |

### $\Xi_c(2815)$

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

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

$$\begin{aligned} \Xi_c(2815)^+ \text{ mass } m &= 2816.6 \pm 0.9 \text{ MeV} \\ \Xi_c(2815)^0 \text{ mass } m &= 2819.6 \pm 1.2 \text{ MeV} \\ m_{\Xi_c(2815)^+} - m_{\Xi_c^+} &= 348.8 \pm 0.9 \text{ MeV} \\ m_{\Xi_c(2815)^0} - m_{\Xi_c^0} &= 348.7 \pm 1.2 \text{ MeV} \\ m_{\Xi_c(2815)^+} - m_{\Xi_c(2815)^0} &= -3.1 \pm 1.3 \text{ MeV} \\ \Xi_c(2815)^+ \text{ full width } \Gamma &< 3.5 \text{ MeV, CL} = 90\% \\ \Xi_c(2815)^0 \text{ full width } \Gamma &< 6.5 \text{ MeV, CL} = 90\% \end{aligned}$$

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) |
|---------------------------|--------------------------------|-------------|
| $\Xi_c^+ \pi^+ \pi^-$     | seen                           | 196         |
| $\Xi_c^0 \pi^+ \pi^-$     | seen                           | 191         |

### $\Xi_c(2980)$

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

$$\begin{aligned} \Xi_c(2980)^+ m &= 2971.4 \pm 3.3 \text{ MeV} \quad (S = 2.1) \\ \Xi_c(2980)^0 m &= 2968.0 \pm 2.6 \text{ MeV} \quad (S = 1.2) \\ \Xi_c(2980)^+ \text{ width } \Gamma &= 26 \pm 7 \text{ MeV} \quad (S = 1.5) \\ \Xi_c(2980)^0 \text{ width } \Gamma &= 20 \pm 7 \text{ MeV} \quad (S = 1.3) \end{aligned}$$

| $\Xi_c(2980)$ DECAY MODES | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|---------------------------|--------------------------------|-------------|
| $\Lambda_c^+ \bar{K} \pi$ | seen                           | 231         |
| $\Sigma_c(2455) \bar{K}$  | seen                           | 134         |
| $\Lambda_c^+ \bar{K}$     | not seen                       | 414         |
| $\Xi_c 2\pi$              | seen                           | —           |
| $\Xi_c(2645) \pi$         | seen                           | 277         |

### $\Xi_c(3080)$

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

$\Xi_c(3080)^+ m = 3077.0 \pm 0.4$  MeV  
 $\Xi_c(3080)^0 m = 3079.9 \pm 1.4$  MeV ( $S = 1.3$ )  
 $\Xi_c(3080)^+ \text{ width } \Gamma = 5.8 \pm 1.0$  MeV  
 $\Xi_c(3080)^0 \text{ width } \Gamma = 5.6 \pm 2.2$  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         |
| $\Sigma_c(2455) \bar{K} + \Sigma_c(2520) \bar{K}$ | seen                           | —           |
| $\Lambda_c^+ \bar{K}$                             | not seen                       | 536         |
| $\Lambda_c^+ \bar{K} \pi^+ \pi^-$                 | not seen                       | 143         |

### $\Omega_c^0$

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

$J^P$  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  $\tau = (69 \pm 12) \times 10^{-15}$  s  
 $c\tau = 21$   $\mu\text{m}$

No absolute branching fractions have been measured.

| $\Omega_c^0$ DECAY MODES     | Fraction ( $\Gamma_i/\Gamma$ ) | $p$ (MeV/c) |
|------------------------------|--------------------------------|-------------|
| $\Sigma^+ K^- K^- \pi^+$     | seen                           | 689         |
| $\Xi^0 K^- \pi^+$            | seen                           | 901         |
| $\Xi^- K^- \pi^+ \pi^+$      | seen                           | 830         |
| $\Omega^- e^+ \nu_e$         | seen                           | 829         |
| $\Omega^- \pi^+$             | seen                           | 821         |
| $\Omega^- \pi^+ \pi^0$       | seen                           | 797         |
| $\Omega^- \pi^- \pi^+ \pi^+$ | seen                           | 753         |

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

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

$J^P$  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          |

### NOTES

- [a] See the note on " $\Lambda_c^+$  Branching Fractions" in the  $\Lambda_c^+$  Particle Listings.
- [b] This branching fraction includes all the decay modes of the final-state resonance.
- [c] An  $\ell$  indicates an  $e$  or a  $\mu$  mode, not a sum over these modes.
- [d] The value is for the sum of the charge states or particle/antiparticle states indicated.
- [e] Assuming isospin conservation, so that the other third is  $\Lambda_c^+ \pi^0 \pi^0$ .
- [f] A test that the isospin is indeed 0, so that the particle is indeed a  $\Lambda_c^+$ .
- [g] No absolute branching fractions have been measured. The value here is the branching *ratio* relative to  $\Xi^- 2\pi^+$ .