BESIII实验上粲强子、QCD及新物理研讨会

Antitriplet Charmed Baryons Decays from the Pespective of Flavor Symmetry

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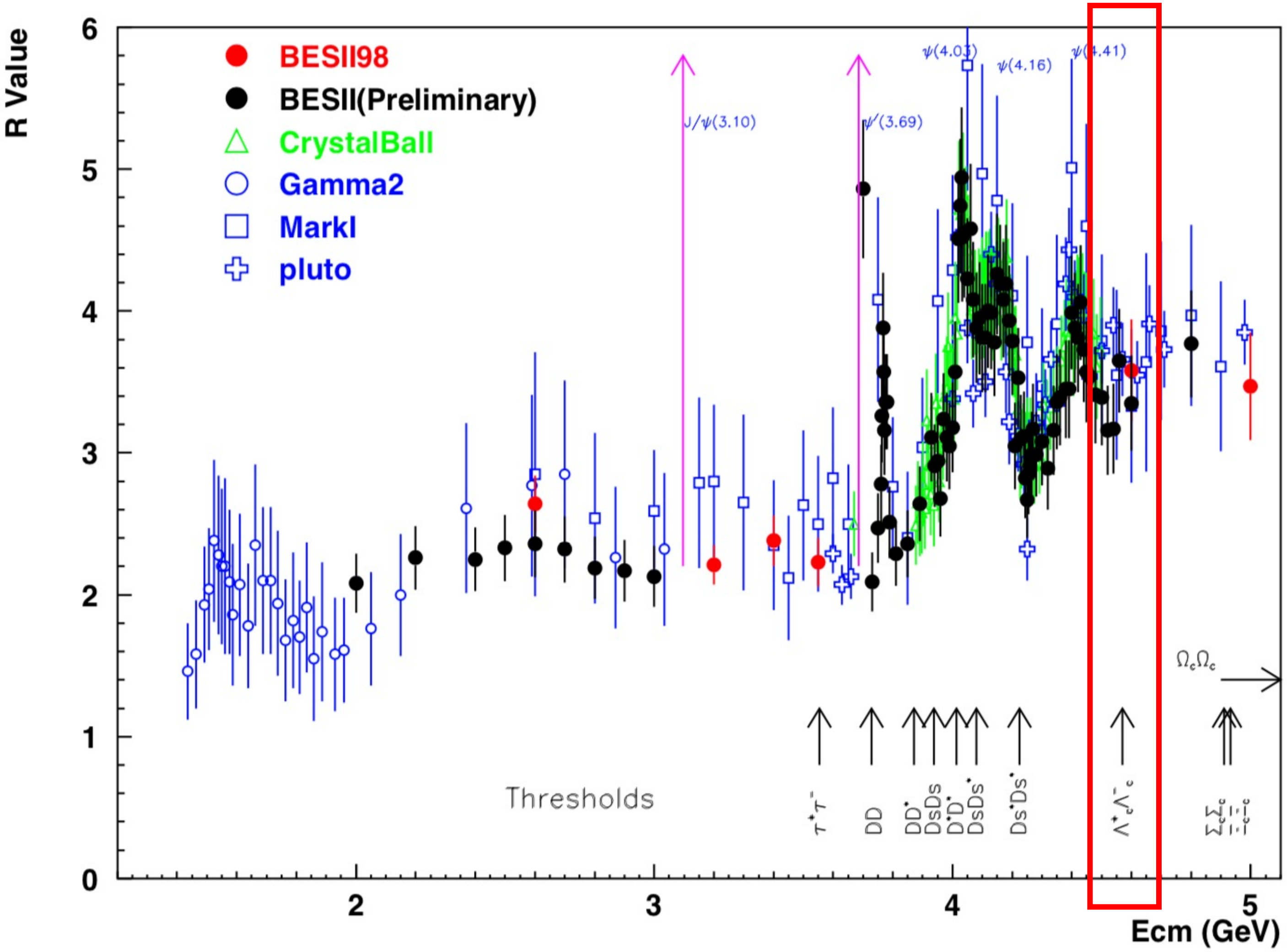
Outline

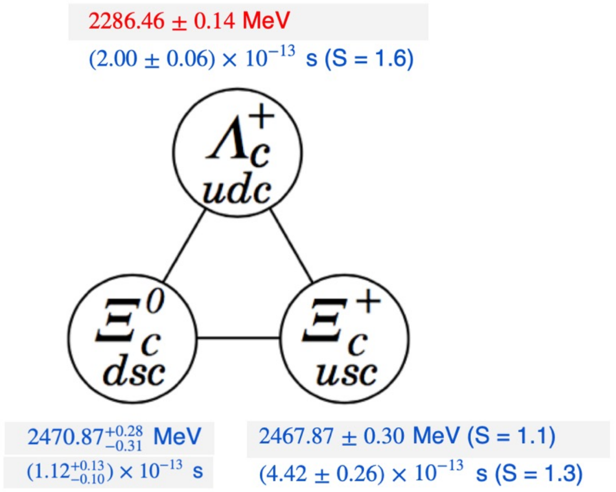
- Introduction
- Framework for Fitting
- Results and discussion
- Summary

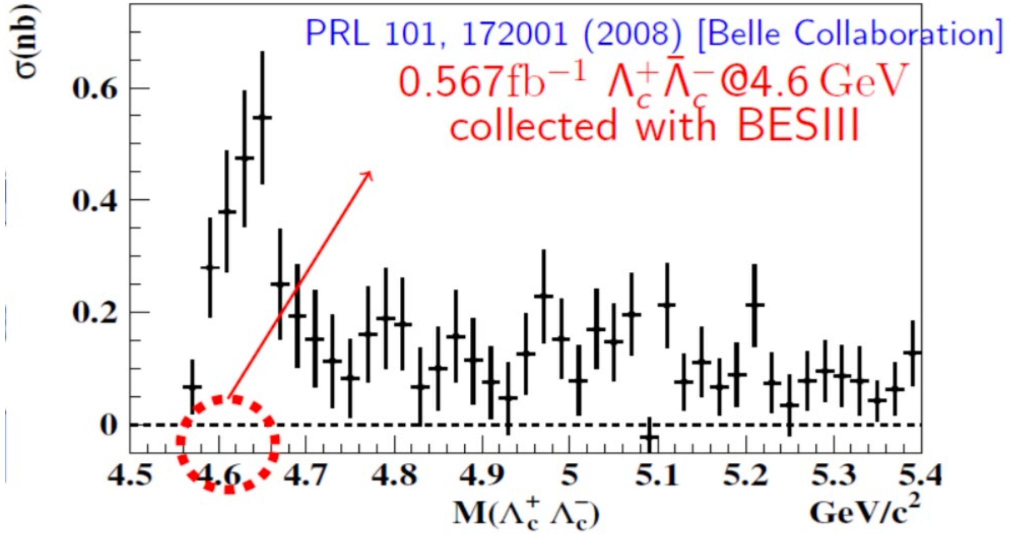
Introduction

Λ_c^+: shed the light



"Physics at BES-III", Int. J. Mod. Phys. A24 (2009)S1-794





- Beam energy
  - Ebeam = 2.3→2.35 GeV in 2019
  - Ebeam = 2.35→2.45 GeV in 2020-21

4.95 GeV in 2022

Progress 1: experiments before 2022

- BESIII
  - absolute branching ratio of $\Lambda_c^+ \to pK^-\pi^+$, 2016
  - observation of $\Lambda_c^+ \to nK_S^0\pi^+$, 2017
  - $\Lambda_c^+ \to p\pi^0$ and $\Lambda_c^+ \to p\pi^0$, 2017
  - absolute branching fraction for $\Lambda_c^+ \to \Xi^0 K^+$, 2018
  - decay asymmetries in $\Lambda_c \to PK_S, \Lambda\pi^+, \Sigma^+\pi^0, \Sigma^0\pi^+$, 2019
  - absolute branching fraction of inclusive decay $\Lambda_c^+ \to K_S^0 X$, 2020
  - absolute branching fraction for $\Lambda_c^+ \to pK_S^0\eta$, 2021
  - …
- Bell
  - Measurement of $\Xi_c^+ \to \Xi^-\pi^+\pi^+$, 2019
  - measurement of $\Xi_c^0 \to \Xi^-\pi^+$, 2019
  - asymmetry of $\Xi_c^0 \to \Xi^-\pi^+$, 2021
  - Branchng fractions of $\Lambda_c^+ \to p\eta$ and $\Lambda_c^+ \to p\pi^0$, 2021
  - …
- LHCb
  - Branching fraction of $\Lambda_c^+ \to p\,\pi^- K^+$, 2018
  - Observation of Ξ_{cc}^{++}, 2017
  - Observation of $\Xi_{cc}^{++} \to \Xi_c^+\pi^+$,2018
  - Observation of $\Xi_c^+ \to p\phi$, 2019
  - Precision measurement of Ξ_{cc}^{++} mass, 2020
  - Search for Ξ_{cc}^+, 2020, 2021
  - Search for Ω_{cc}^+, 2021
  - …

Progress 1: experiments since 2022

- BESIII
  - First measurement
    - Branching ratio:
      $\Lambda_c^+ \to n\,\pi^+,\ \Lambda_c^+ \to p\,\eta',\ \Lambda_c^+ \to \Lambda^0\,K^+,\ \Lambda_c^+ \to \Sigma^0\,K^+$
  - Improvement
    - Branching ratio: $\Lambda_c^+ \to \Sigma^+ K_S$
- Belle
  - First measurement
    - Branching ratio: $\Lambda_c^+ \to p\,\eta',\ \Lambda_c^+ \to \Lambda^0\,K^+,\ \Lambda_c^+ \to \Sigma^0\,K^+$
    - Decay asymmetry:
      $\Lambda_c^+ \to \Lambda^0\,K^+,\ \Lambda_c^+ \to \Sigma^0\,K^+,\ \Lambda_c^+ \to \Sigma^+\,\eta,\ \Lambda_c^+ \to \Sigma^+\,\eta'$
  - Improvement
    - Branching ratio: $\Lambda_c^+ \to p\,\eta'$
    - Decay asymmetry: $\Lambda_c^+ \to \Lambda^0\,\pi^+,\ \Lambda_c^+ \to \Sigma^0\,\pi^+,\ \Lambda_c^+ \to \Sigma^+\,\pi^0$

Observation of the Singly Cabibbo Suppressed Decay $\Lambda_c^+ \to n\pi^+$
M. Ablikim *et al.* (BESIII Collaboration)
Phys. Rev. Lett. **128**, 142001 – Published 4 April 2022

Measurement of Branching Fractions of Singly Cabibbo-suppressed Decays $\Lambda_c^+ \to \Sigma^0 K^+$ and $\Sigma^+ K_S^0$
2207.10906 [hep-ex]

Measurement of the Branching Fraction of the Singly Cabibbo-Suppressed Decay $\Lambda_c^+ \to \Lambda K^+$
2208.04001 [hep-ex]

Measurement of the absolute branching fraction of the singly Cabibbo suppressed decay $\Lambda_c^+ \to p\eta'$
2207.14461 [hep-ex]

Measurement of branching fractions and decay asymmetry parameters for $\Lambda_c^+ \to \Lambda h^+$ and $\Lambda_c^+ \to \Sigma^0 h^+$ ($h = K, \pi$), and search for CP violation in baryon decays
(The Belle Collaboration)
2208.08695 [hep-ex]

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First measurement of the $\Lambda_c^+ \to p\eta'$ decay

Progress 2: theory

- Pole model + current algebra + MIT bag model
- Rescattering
- NR quark model
- QCD sum rule
- …
- Fit
  - SU(3) flavor symmetry
  - Diagrammatical approach

Framework for Fitting

Flavor symmetry

$$\mathcal{H}_{\rm eff} = \frac{G_F}{2\sqrt{2}} V^*_{q_1 c} V_{u q_2} (c_+ \mathcal{O}_+ + c_- \mathcal{O}_-) + h.c.$$

$$\mathcal{O}_+ = \mathcal{O}_1 + \mathcal{O}_2, \quad \mathcal{O}_- = \mathcal{O}_1 - \mathcal{O}_2$$

$$\mathcal{O}_1 = (\bar{q}_1 c)(\bar{u} q_2), \quad \mathcal{O}_2 = (\bar{u} c)(\bar{q}_1 q_2)$$

$$\bar{3} \times \bar{3} \times 3 = \bar{3} + \bar{3} + \boxed{6} + \boxed{\overline{15}}$$

$$H(6)_{ij} = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 2 & -2s_c \\ 0 & -2s_c & 2s_c^2 \end{pmatrix}$$

$$H(\overline{15})^{ij}_k = \left(\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & s_c & 0 \\ s_c & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & -s_c^2 & -s_c \\ -s_c^2 & 0 & 0 \\ -s_c & 0 & 0 \end{pmatrix} \right)$$

$$M = \begin{pmatrix} \frac{1}{\sqrt{2}}(\pi^0 + c_\phi \eta + s_\phi \eta') & \pi^+ & K^+ \\ \pi^- & \frac{1}{\sqrt{2}}(-\pi^0 + c_\phi \eta + s_\phi \eta') & K^0 \\ K^- & \overline{K}^0 & -s_\phi \eta + c_\phi \eta' \end{pmatrix} \quad \boldsymbol{B}_n = \begin{pmatrix} \frac{1}{\sqrt{6}}\Lambda + \frac{1}{\sqrt{2}}\Sigma^0 & \Sigma^+ & p \\ \Sigma^- & \frac{1}{\sqrt{6}}\Lambda - \frac{1}{\sqrt{2}}\Sigma^0 & n \\ \Xi^- & \Xi^0 & -\sqrt{\frac{2}{3}}\Lambda \end{pmatrix}$$

$$\mathcal{M} = \langle M \boldsymbol{B}_n | \mathcal{H}_{\rm eff} | \boldsymbol{B}_c \rangle \qquad \boldsymbol{B}_c = (\Xi_c^0, -\Xi_c^+, \Lambda_c^+)$$

$$\mathcal{M}(\boldsymbol{B}_c \to \boldsymbol{B}_n M) = i \bar{u}_f (A - B\gamma_5) u_i$$

$$\begin{aligned} A =\ & a_0 H(6)_{ij} (\boldsymbol{B}'_c)^{ik} (\boldsymbol{B}_n)^j_k (M)^\ell_\ell + a_1 H(6)_{ij} (\boldsymbol{B}'_c)^{ik} (\boldsymbol{B}_n)^\ell_k (M)^j_\ell + a_2 H(6)_{ij} (\boldsymbol{B}'_c)^{ik} (M)^\ell_k (\boldsymbol{B}_n)^j_\ell \\ & + a_3 H(6)_{ij} (\boldsymbol{B}_n)^i_k (M)^j_\ell (\boldsymbol{B}'_c)^{k\ell} + \underline{a'_0 (\boldsymbol{B}_n)^i_j (M)^\ell_\ell H(\overline{15})^{jk}_i (\boldsymbol{B}_c)_k} + \underline{a_4 H(\overline{15})^{\ell i}_k (\boldsymbol{B}_c)_j (M)^j_i (\boldsymbol{B}_n)^k_\ell} \\ & + \underline{a_5 (\boldsymbol{B}_n)^i_j (M)^\ell_i H(\overline{15})^{jk}_\ell (\boldsymbol{B}_c)_k} + a_6 (\boldsymbol{B}_n)^j_i (M)^m_\ell H(\overline{15})^{\ell i}_m (\boldsymbol{B}_c)_j + \underline{a_7 (\boldsymbol{B}_n)^\ell_i (M)^i_j H(\overline{15})^{jk}_\ell (\boldsymbol{B}_c)_k} \end{aligned}$$

$$B = A \Big|_{a_i \to b_i}$$

Amplitudes

channel	A	channel	A
$\Lambda_c^+ \to \Lambda^0\pi^+$	$\frac{\sqrt{6}}{6}(-2a_1-2a_2-2a_3+a_5-2a_6+a_7)$	$\Xi_c^+ \to \Xi^0\pi^+$	$-2a_3-a_4-a_6$
$\Lambda_c^+ \to p\overline{K}^0$	$-2a_1+a_5+a_6$	$\Xi_c^0 \to \Lambda^0\overline{K}^0$	$\frac{\sqrt{6}}{6}(-4a_1+2a_2+2a_3-2a_5+a_6+a_7)$
$\Lambda_c^+ \to \Sigma^0\pi^+$	$\frac{\sqrt{2}}{2}(-2a_1+2a_2+2a_3+a_5-a_7)$	$\Xi_c^0 \to \Sigma^0\overline{K}^0$	$\frac{\sqrt{2}}{2}(-2a_2-2a_3+a_6-a_7)$
$\Lambda_c^+ \to \Sigma^+\pi^0$	$\frac{\sqrt{2}}{2}(2a_1-2a_2-2a_3-a_5+a_7)$	$\Xi_c^0 \to \Sigma^+K^-$	$2a_2+a_4+a_7$
$\Lambda_c^+ \to \Sigma^+\eta$	$\frac{\sqrt{2}}{6}c_\phi(-12a_0-6a_1-6a_2+6a_3+6a_0'+3a_5+3a_7)$ $+s_\phi(2a_0-a_0'-a_4)$	$\Xi_c^0 \to \Xi^0\pi^0$	$\frac{\sqrt{2}}{2}(-2a_1+2a_3+a_4-a_5)$
$\Lambda_c^+ \to \Sigma^+\eta'$	$\frac{\sqrt{2}}{6}s_\phi(-12a_0-6a_1-6a_2+6a_3+6a_0'+3a_5+3a_7)$ $-c_\phi(2a_0-a_0'-a_4)$	$\Xi_c^0 \to \Xi^0\eta$	$\frac{\sqrt{2}}{6}c_\phi(12a_0+6a_1-6a_3+6a_0'+3a_4+3a_5)$ $+\frac{1}{3}s_\phi(-6a_0-6a_2-3a_0'-3a_7)$
$\Lambda_c^+ \to \Xi^0K^+$	$-2a_2+a_4+a_7$	$\Xi_c^0 \to \Xi^0\eta'$	$\frac{\sqrt{2}}{6}s_\phi(12a_0+6a_1-6a_3+6a_0'+3a_4+3a_5)$ $-\frac{1}{3}c_\phi(-6a_0-6a_2-3a_0'-3a_7)$
$\Xi_c^+ \to \Sigma^+\overline{K}^0$	$2a_3-a_4-a_6$	$\Xi_c^0 \to \Xi^-\pi^+$	$2a_1+a_5+a_6$

channel	$s_c^{-2}A$	channel	$s_c^{-2}A$
$\Lambda_c^+ \to pK^0$	$2a_3-a_4-a_6$	$\Xi_c^+ \to \Sigma^+K^0$	$-2a_1+a_5+a_6$
$\Lambda_c^+ \to nK^+$	$-2a_3-a_4-a_6$	$\Xi_c^0 \to \Lambda K^0$	$\frac{\sqrt{6}}{6}(-2a_1+4a_2+4a_3-a_5-a_6+2a_7)$
$\Xi_c^+ \to \Lambda K^+$	$\frac{\sqrt{6}}{6}(-2a_1+4a_2+4a_3+a_5+a_6-2a_7)$	$\Xi_c^0 \to p\pi^-$	$-2a_2-a_4-a_7$
$\Xi_c^+ \to p\pi^0$	$\frac{\sqrt{2}}{2}(-2a_2-a_4+a_7)$	$\Xi_c^0 \to n\pi^0$	$\frac{\sqrt{2}}{2}(-2a_2-a_4+a_7)$
$\Xi_c^+ \to p\eta$	$\frac{\sqrt{2}}{2}c_\phi(-4a_0-2a_2+2a_0'+a_4+a_7)$ $+s_\phi(2a_0+2a_1-2a_3-a_0'-a_5)$	$\Xi_c^0 \to n\eta$	$\frac{\sqrt{2}}{2}c_\phi(-4a_0-2a_2-2a_0'-a_4-a_7)$ $+s_\phi(2a_0+2a_1-2a_3+a_0'+a_5)$
$\Xi_c^+ \to p\eta'$	$\frac{\sqrt{2}}{2}s_\phi(-4a_0-2a_2+2a_0'+a_4+a_7)$ $-c_\phi(2a_0+2a_1-2a_3-a_0'-a_5)$	$\Xi_c^0 \to n\eta'$	$\frac{\sqrt{2}}{2}s_\phi(-4a_0-2a_2-2a_0'-a_4-a_7)$ $-c_\phi(2a_0+2a_1-2a_3+a_0'+a_5)$
$\Xi_c^+ \to n\pi^+$	$-2a_2+a_4+a_7$	$\Xi_c^0 \to \Sigma^0K^0$	$\frac{\sqrt{2}}{2}(2a_1+a_5-a_6)$
$\Xi_c^+ \to \Sigma^0K^+$	$\frac{\sqrt{2}}{2}(-2a_1+a_5-a_6)$	$\Xi_c^0 \to \Sigma^-K^+$	$-2a_1-a_5-a_6$

Amplitudes

channel	$s_c^{-1}A$	channel	$s_c^{-1}A$
$\Lambda_c^+ \to \Lambda K^+$	$\frac{\sqrt{6}}{6}(2a_1 - 4a_2 + 2a_3 + 3a_4 - a_5 + 2a_6 + 2a_7)$	$\Xi_c^+ \to \Xi^0 K^+$	$2a_2 + 2a_3 + a_6 - a_7$
$\Lambda_c^+ \to p\pi^0$	$\frac{\sqrt{2}}{2}(2a_2 + 2a_3 - a_6 - a_7)$	$\Xi_c^0 \to \Lambda\pi^0$	$\frac{\sqrt{3}}{6}(-2a_1 - 2a_2 + 4a_3 + 3a_4 - a_5 - a_6 - a_7)$
$\Lambda_c^+ \to p\eta$	$\frac{\sqrt{2}}{2}c_\phi(4a_0 + a_2 - 2a_3 - 2a_0' + a_6 - a_7)$ $+s_\phi(-2a_0 - 2a_1 + a_0' + a_4 - a_5 + a_6)$	$\Xi_c^0 \to \Lambda\eta$	$\frac{\sqrt{3}}{6}c_\phi(12a_0 + 2a_1 + 2a_2 - 4a_3 + 6a_0' + 3a_4 + a_5 + a_6 + a_7)$ $+\frac{\sqrt{6}}{6}s_\phi(-6a_0 - 4a_1 - 4a_2 + 2a_3 - 3a_0' - 2a_5 + a_6 - 2a_7)$
$\Lambda_c^+ \to p\eta'$	$\frac{\sqrt{2}}{2}s_\phi(4a_0 + a_2 - 2a_3 - 2a_0' + a_6 - a_7)$ $-c_\phi(-2a_0 - 2a_1 + a_0' + a_4 - a_5 + a_6)$	$\Xi_c^0 \to \Lambda\eta'$	$\frac{\sqrt{3}}{6}s_\phi(12a_0 + 2a_1 + 2a_2 - 4a_3 + 6a_0' + 3a_4 + a_5 + a_6 + a_7)$ $-\frac{\sqrt{6}}{6}c_\phi(-6a_0 - 4a_1 - 4a_2 + 2a_3 - 3a_0' - 2a_5 + a_6 - 2a_7)$
$\Lambda_c^+ \to n\pi^+$	$2a_2 + 2a_3 + a_6 - a_7$	$\Xi_c^0 \to pK^-$	$-2a_2 - a_4 - a_7$
$\Lambda_c^+ \to \Sigma^0 K^+$	$\frac{\sqrt{2}}{2}(2a_1 - 2a_3 - a_4 - a_5)$	$\Xi_c^0 \to nK^0$	0
$\Lambda_c^+ \to \Sigma^+ K^0$	$2a_1 - 2a_3 + a_4 - a_5$	$\Xi_c^0 \to n\overline{K}^0$	$2a_1 - 2a_2 - 2a_3 + a_5 - a_7$
$\Lambda_c^+ \to \Sigma^+ \overline{K}^0$	0	$\Xi_c^0 \to nK_S^0$	$-(2a_1 - 2a_2 - 2a_3 + a_5 - a_7)/\sqrt{2}$
$\Lambda_c^+ \to \Sigma^+ K_S^0$	$(2a_1 - 2a_3 + a_4 - a_5)/\sqrt{2}$	$\Xi_c^0 \to nK_L^0$	$(2a_1 - 2a_2 - 2a_3 + a_5 - a_7)/\sqrt{2}$
$\Lambda_c^+ \to \Sigma^+ K_L^0$	$(2a_1 - 2a_3 + a_4 - a_5)/\sqrt{2}$	$\Xi_c^0 \to \Sigma^0\pi^0$	$\frac{1}{2}(2a_1 + 2a_2 - a_4 + a_5 - a_6 + a_7)$
$\Xi_c^+ \to \Lambda^0\pi^+$	$\frac{\sqrt{6}}{6}(2a_1 + 2a_2 - 4a_3 - 3a_4 - a_5 - a_6 - a_7)$	$\Xi_c^0 \to \Sigma^0\eta$	$\frac{1}{2}c_\phi(-4a_0 - 2a_1 - 2a_2 - 2a_0' - a_4 - a_5 + a_6 - a_7)$ $+\frac{\sqrt{2}}{2}s_\phi(2a_0 - 2a_3 + a_0' + a_6)$
$\Xi_c^+ \to pK^0$	0	$\Xi_c^0 \to \Sigma^0\eta'$	$\frac{1}{2}s_\phi(-4a_0 - 2a_1 - 2a_2 - 2a_0' - a_4 - a_5 + a_6 - a_7)$ $-\frac{\sqrt{2}}{2}c_\phi(2a_0 - 2a_3 + a_0' + a_6)$
$\Xi_c^+ \to p\overline{K}^0$	$2a_1 - 2a_3 + a_5 - a_5$	$\Xi_c^0 \to \Sigma^+\pi^-$	$2a_2 + a_4 + a_7$
$\Xi_c^+ \to pK_S^0$	$-(2a_1 - 2a_3 + a_4 - a_5)/\sqrt{2}$	$\Xi_c^0 \to \Sigma^-\pi^+$	$2a_1 + a_5 + a_6$
$\Xi_c^+ \to pK_L^0$	$(2a_1 - 2a_3 + a_4 - a_5)/\sqrt{2}$	$\Xi_c^0 \to \Xi^0 K^0$	$-2a_1 + 2a_2 + 2a_3 - a_5 + a_7$
$\Xi_c^+ \to \Sigma^0\pi^+$	$\frac{\sqrt{2}}{2}(2a_1 - 2a_2 + a_4 - a_5 + a_6 + a_7)$	$\Xi_c^0 \to \Xi^0\overline{K}^0$	0
$\Xi_c^+ \to \Sigma^+\pi^0$	$\frac{\sqrt{2}}{2}(-2a_1 + 2a_2 - a_4 + a_5 + a_6 - a_7)$	$\Xi_c^0 \to \Xi^0 K_S^0$	$(-2a_1 + 2a_2 + 2a_3 - a_5 + a_7)/\sqrt{2}$
$\Xi_c^+ \to \Sigma^+\eta$	$\frac{\sqrt{2}}{2}c_\phi(4a_0 + 2a_1 + 2a_2 - 2a_0' - a_4 - a_5 - a_6 - a_7)$ $+s_\phi(-2a_0 + 2a_3 + a_0' - a_6)$	$\Xi_c^0 \to \Xi^0 K_L^0$	$(-2a_1 + 2a_2 + 2a_3 - a_5 + a_7)/\sqrt{2}$
$\Xi_c^+ \to \Sigma^+\eta'$	$\frac{\sqrt{2}}{2}s_\phi(4a_0 + 2a_1 + 2a_2 - 2a_0' - a_4 - a_5 - a_6 - a_7)$ $-c_\phi(-2a_0 + 2a_3 + a_0' - a_6)$	$\Xi_c^0 \to \Xi^- K^+$	$-2a_1 - a_5 - a_6$

Amplitudes connections

$$\mathcal{M}(\Lambda_c^+ \to \Sigma^0\pi^+) = -\mathcal{M}(\Lambda_c^+ \to \Sigma^+\pi^0)$$
$$\mathcal{M}(\Lambda_c^+\Sigma^+K^0) = \mathcal{M}(\Xi_c^+ \to p\overline{K}^0$$
$$\mathcal{M}(\Lambda_c^+ \to \pi^+) = \mathcal{M}(\Xi_c^+ \to \Xi^0K^0)$$
$$\mathcal{M}(\Xi_c^0 \to n\overline{K}^0) = -\mathcal{M}(\Xi_c^0 \to \Xi^0K^0)$$
$$\mathcal{M}(\Lambda_c^+ \to nK^+) = \sin^2\theta\mathcal{M}(\Xi_c^+ \to \Xi^0\pi^+)$$
$$\mathcal{M}(\Xi_c^+ \to n\pi^+) = \sin^2\theta\mathcal{M}(\Xi_c^+ \to \Xi^0\pi^+)$$
$$\mathcal{M}(\Xi_c^+ \to \Sigma^+K^0) = \sin^2\theta\mathcal{M}(\Lambda_c^+ \to p\bar{K}^0)$$
$$\mathcal{M}(\Xi_c^+ \to \Sigma^+\bar{K}^0) = -\frac{1}{\sin^2\theta}\mathcal{M}(\Lambda_c^+ \to pK^0)$$
$$\mathcal{M}(\Xi_c^0 \to \Sigma^-K^+) = -\sin^2\theta\mathcal{M}(\Lambda_c^+ \to p\overline{K}^0) = \sin\theta\mathcal{M}(\Xi_c^0 \to \Xi^-K^+) = -\sin^2\theta\mathcal{M}(\Xi_c^0 \to \Xi^-\pi^+)$$
$$\mathcal{M}(\Xi_c^0 \to p\pi^-) = \sin\theta\mathcal{M}(\Xi_c^0 \to pK^-) = -\sin\theta\mathcal{M}(\Xi_c^0 \to \Sigma^+\pi^-) = -\sin^2\theta\mathcal{M}(\Xi_c^0 \to \Sigma^+K^-)$$

Fitting scheme

$$\chi^2 = \sum_i \frac{(\mathcal{B}_i^{\rm th} - \mathcal{B}_i^{\rm exp})^2}{\delta_i^2} + \sum_i \frac{(\alpha_i^{\rm th} - \alpha_i^{\rm exp})^2}{\sigma_i^2}$$

- branching fractions (20):

  $\Lambda_c^+ \to \Lambda\pi^+, pK_S^0, \Sigma^0\pi^+, \Sigma^+\pi^0, \Sigma^+\eta, \Sigma^+\eta', \Xi^0 K^+, p\eta, p\eta', p\pi^0, \Lambda K^+, \Sigma^0 K^+, n\pi^+, \Sigma^+ K_S^0,$
  $\Xi_c^0 \to \Xi^-\pi^+, \Xi^- K^+, \Lambda K_S^0, \Sigma^0 K_S^0, \Sigma^+ K^-,$
  $\Xi_c^+ \to \Xi^0\pi^+$

- decay asymmetries (4):

  $\Lambda_c \to \Lambda\pi^+, \Sigma^0\pi^+, \Sigma^+\pi^0$
  $\Xi_c^0 \to \Xi^-\pi^+$

Results

Coefficients of irreducible rep.

This fit				Alternative fit			
parameters	values	parameters	values	parameters	values	parameters	values
a_0	$8.31^{+0.56}_{-0.77}$	b_0	$40.44^{+2.32}_{-8.88}$	a_0	$11.59^{+0.53}_{-0.69}$	b_0	$9.34^{+2.61}_{-9.60}$
a_1	$-2.80^{+0.19}_{-0.20}$	b_1	$8.92^{+0.92}_{-0.97}$	a_1	-3.24 ± 0.22	b_1	$7.24^{+0.80}_{-0.85}$
a_2	$1.06^{+0.23}_{-0.25}$	b_2	$1.57^{+0.85}_{-0.82}$	a_2	$-0.26^{+0.25}_{-0.26}$	b_2	$-2.28^{+0.81}_{-0.76}$
a_3	$-0.98^{+0.27}_{-0.28}$	b_3	-0.28 ± 1.04	a_3	$-1.29^{+0.38}_{-0.37}$	b_3	$-1.44^{+0.90}_{-0.84}$
a_0'	$10.84^{+1.55}_{-1.11}$	b_0'	$84.79^{+17.72}_{-4.66}$	a_0'	$14.70^{+1.38}_{-1.05}$	b_0'	$14.33^{+19.20}_{-5.23}$
a_4	$-1.03^{+0.60}_{-0.56}$	b_4	$-2.85^{+2.92}_{-2.24}$	a_4	$-0.38^{+0.57}_{-0.65}$	b_4	$0.80^{+2.12}_{-2.47}$
a_5	$2.79^{+0.38}_{-0.40}$	b_5	$-1.82^{+1.93}_{-1.85}$	a_5	$2.94^{+0.43}_{-0.46}$	b_5	$-0.36^{+1.69}_{-1.61}$
a_6	$0.51^{+0.41}_{-0.44}$	b_6	$5.16^{+1.47}_{-1.52}$	a_6	$1.03^{+0.39}_{-0.40}$	b_6	$8.67^{+1.91}_{-1.96}$
a_7	$0.09^{+0.41}_{-0.46}$	b_7	$-7.94^{+1.77}_{-1.58}$	a_7	$3.69^{+0.49}_{-0.54}$	b_7	$5.05^{+1.53}_{-1.61}$

$\chi^2_{\rm min} = 5.66, \chi^2_{\rm min}/ndf = 0.81$ with $ndf = 7$.

$\alpha(\Lambda_c^+ \to pK_S^0)$,
Witout $B(\Lambda_c^+ \to p\pi^0)$,

$\chi^2_{\rm min} = 10.24,\ ndf = 7,\ \chi^2_{\rm min}/ndf = 1.46$

If all observables included:

$\chi^2_{\rm min} = 30.83, \chi^2_{\rm min}/ndf = 2.06$

Λ_c^+ decay

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Lambda_c^+ \to \Lambda\pi^+$	$0.30^{+0.06}_{-0.06}$	-1.65 ± 0.21	1.30 ± 0.28	$-0.84^{+0.10}_{-0.11}$
$\Lambda_c^+ \to p\overline{K}^0$	0.89 ± 0.07	$-1.45^{+0.20}_{-0.31}$	$3.15^{+0.51}_{-0.53}$	$-0.91^{+0.08}_{-0.09}$
$\Lambda_c^+ \to \Sigma^0\pi^+$	0.60 ± 0.07	$-0.64^{+0.30}_{-0.29}$	1.26 ± 0.30	$-0.61^{+0.23}_{-0.22}$
$\Lambda_c^+ \to \Sigma^+\pi^0$	-0.60 ± 0.07	$0.65^{+0.30}_{-0.29}$	1.27 ± 0.30	$-0.61^{+0.23}_{-0.22}$
$\Lambda_c^+ \to \Sigma^+\eta$	0.04 ± 0.11	-1.35 ± 0.89	$0.38^{+0.50}_{-0.49}$	-0.21 ± 0.59
$\Lambda_c^+ \to \Sigma^+\eta'$	$-0.84^{+0.33}_{-0.32}$	$-0.97^{+3.07}_{-3.08}$	$1.03^{+0.80}_{-0.79}$	0.35 ± 1.06
$\Lambda_c^+ \to \Xi^0 K^+$	-0.31 ± 0.09	$-1.39^{+0.38}_{-0.32}$	$0.53^{+0.21}_{-0.19}$	$0.998^{+0.026}_{-0.024}$
$\Lambda_c^+ \to \Lambda K^+$	-0.15 ± 0.02	$-0.01^{+0.10}_{-0.09}$	$0.064^{+0.020}_{-0.019}$	$0.05^{+0.42}_{-0.36}$

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Lambda_c^+ \to p\pi^0$	$-0.007^{+0.015}_{-0.016}$	$0.085^{+0.056}_{-0.055}$	$0.0041^{+0.0052}_{-0.0051}$	$-0.38^{+0.79}_{-0.82}$
$\Lambda_c^+ \to p\eta$	0.23 ± 0.03	$-0.08^{+0.21}_{-0.20}$	0.14 ± 0.04	-0.27 ± 0.66
$\Lambda_c^+ \to p\eta'$	0.13 ± 0.07	0.32 ± 0.69	0.049 ± 0.089	0.97 ± 0.48
$\Lambda_c^+ \to n\pi^+$	$0.013^{+0.021}_{-0.022}$	0.35 ± 0.08	$0.067^{+0.030}_{-0.029}$	$0.18^{+0.29}_{-0.30}$
$\Lambda_c^+ \to \Sigma^0 K^+$	-0.086 ± 0.015	$0.37^{+0.07}_{-0.06}$	$0.052^{+0.014}_{-0.013}$	-0.98 ± 0.05
$\Lambda_c^+ \to \Sigma^+ K^0$	-0.17 ± 0.02	$0.39^{+0.10}_{-0.09}$	0.11 ± 0.03	-0.92 ± 0.10
$\Lambda_c^+ \to pK^0$	-0.0073 ± 0.0046	$-0.014^{+0.020}_{-0.017}$	$(2.40^{+3.10}_{-2.87})10^{-4}$	$0.97^{+0.35}_{-0.31}$
$\Lambda_c^+ \to nK^+$	0.013 ± 0.005	$-0.0088^{+0.0195}_{-0.0172}$	$(4.76^{+3.56}_{-3.49})10^{-4}$	$-0.52^{+0.99}_{-0.88}$

Ξ_c^0 decay

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Xi_c^0 \to \Lambda\overline{K}^0$	0.26 ± 0.06	-1.32 ± 0.26	0.67 ± 0.22	$-0.85^{+0.13}_{-0.14}$
$\Xi_c^0 \to \Sigma^0\overline{K}^0$	$0.018^{+0.067}_{-0.070}$	$-0.74^{+0.25}_{-0.24}$	0.14 ± 0.09	$0.15^{+0.55}_{-0.57}$
$\Xi_c^0 \to \Sigma^+K^-$	0.12 ± 0.09	$-0.77^{+0.38}_{-0.32}$	$0.18^{+0.15}_{-0.13}$	$-0.77^{+0.45}_{-0.42}$
$\Xi_c^0 \to \Xi^0\pi^0$	-0.013 ± 0.069	-1.32 ± 0.26	$0.45^{+0.21}_{-0.19}$	0.06 ± 0.33
$\Xi_c^0 \to \Xi^0\eta$	1.02 ± 0.11	8.69 ± 0.89	$14.77^{+2.60}_{-2.59}$	0.73 ± 0.07
$\Xi_c^0 \to \Xi^0\eta'$	$4.67^{+0.33}_{-0.32}$	$27.90^{+3.07}_{-3.08}$	61.07 ± 8.15	0.999 ± 0.007
$\Xi_c^0 \to \Xi^-\pi^+$	-0.23 ± 0.07	$2.12^{+0.30}_{-0.31}$	$1.19^{+0.31}_{-0.32}$	$-0.63^{+0.16}_{-0.17}$
$\Xi_c^0 \to \Lambda\pi^0$	-0.045 ± 0.015	$-0.17^{+0.07}_{-0.06}$	$0.016^{+0.009}_{-0.008}$	$0.94^{+0.16}_{-0.15}$
$\Xi_c^0 \to \Lambda\eta$	0.35 ± 0.03	2.04 ± 0.24	1.45 ± 0.28	0.79 ± 0.07
$\Xi_c^0 \to \Lambda\eta'$	1.27 ± 0.09	$7.77^{+0.84}_{-0.85}$	10.30 ± 1.7	0.87 ± 0.06
$\Xi_c^0 \to pK^-$	-0.026 ± 0.020	$0.17^{+0.09}_{-0.07}$	$0.014^{+0.013}_{-0.011}$	$-0.64^{+0.45}_{-0.42}$
$\Xi_c^0 \to n\overline{K}^0$	-0.069 ± 0.023	0.48 ± 0.09	0.11 ± 0.04	$-0.60^{+0.18}_{-0.19}$
$\Xi_c^0 \to \Sigma^0\pi^0$	$-0.00090^{+0.01260}_{-0.01274}$	0.10 ± 0.05	$(0.31^{+0.34}_{-0.31})10^{-2}$	$-0.05^{+0.72}_{-0.73}$

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Xi_c^0 \to \Sigma^0\eta$	-0.16 ± 0.02	-1.18 ± 0.14	0.38 ± 0.08	0.71 ± 0.09
$\Xi_c^0 \to \Sigma^0\eta'$	-0.74 ± 0.05	-4.48 ± 0.49	2.66 ± 0.41	0.94 ± 0.04
$\Xi_c^0 \to \Sigma^+\pi^-$	0.026 ± 0.020	$-0.17^{+0.09}_{-0.07}$	$0.011^{+0.10}_{-0.008}$	$-0.74^{+0.45}_{-0.43}$
$\Xi_c^0 \to \Sigma^-\pi^+$	$-0.052^{+0.015}_{-0.016}$	0.48 ± 0.07	0.077 ± 0.021	$-0.57^{+0.15}_{-0.16}$
$\Xi_c^0 \to \Xi^0K^0$	0.069 ± 0.023	-0.48 ± 0.09	0.052 ± 0.017	$-0.81^{+0.18}_{-0.19}$
$\Xi_c^0 \to \Xi^-K^+$	$0.052^{+0.015}_{-0.016}$	-0.48 ± 0.07	0.46 ± 0.012	$-0.68^{+0.16}_{-0.17}$
$\Xi_c^0 \to \Lambda K^0$	$0.0058^{+0.0038}_{-0.0039}$	$-0.066^{+0.015}_{-0.014}$	$(13.56^{+5.80}_{5.63})10^{-4}$	-0.47 ± 0.29
$\Xi_c^0 \to p\pi^-$	$-0.0059^{+0.0045}_{-0.0044}$	$0.039^{+0.019}_{-0.016}$	$(8.40^{+7.61}_{-6.41})10^{-4}$	$-0.62^{+0.44}_{-0.41}$
$\Xi_c^0 \to n\pi^0$	0.012 ± 0.003	$-0.0070^{+0.0136}_{-0.0114}$	$(3.60^{+2.09}_{-1.99})10^{-4}$	$-0.50^{+0.86}_{-0.72}$
$\Xi_c^0 \to n\eta$	-0.070 ± 0.006	$-0.31^{+0.05}_{-0.04}$	0.051 ± 0.012	0.83 ± 0.08
$\Xi_c^0 \to n\eta'$	-0.23 ± 0.02	$-1.44^{+0.15}_{-0.16}$	0.58 ± 0.10	0.74 ± 0.06
$\Xi_c^0 \to \Sigma^0K^0$	$-0.012^{+0.002}_{-0.003}$	0.039 ± 0.011	$(6.99^{+2.47}_{-2.53})10^{-4}$	$-0.998^{+0.020}_{-0.021}$
$\Xi_c^0 \to \Sigma^-K^+$	$0.012^{+0.003}_{-0.004}$	-0.11 ± 0.02	$(31.09^{+8.24}_{-8.36})10^{-4}$	$-0.60^{+0.16}_{-0.17}$

Ξ_c^+ decay

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Xi_c^+ \to \Sigma^+\overline{K}^0$	-0.14 ± 0.09	$-0.29^{+0.39}_{-0.34}$	$0.21^{+0.25}_{-0.23}$	$0.91^{0.56}_{-0.50}$
$\Xi_c^+ \to \Xi^0\pi^+$	0.25 ± 0.09	$-0.18^{+0.39}_{-0.34}$	0.50 ± 0.36	$-0.41^{+0.84}_{-0.74}$
$\Xi_c^+ \to \Lambda\pi^+$	$0.0013^{+0.0211}_{-0.0206}$	$0.32^{+0.10}_{-0.08}$	$0.11^{+0.07}_{-0.06}$	$0.02^{+0.35}_{-0.34}$
$\Xi_c^+ \to p\overline{K}^0$	-0.17 ± 0.02	$0.39^{+0.10}_{-0.09}$	$0.39^{+0.11}_{-0.10}$	-1.0 ± 0.0002
$\Xi_c^+ \to \Sigma^0\pi^+$	$-0.171pm0.02$	$0.17^{+0.08}_{-0.07}$	0.26 ± 0.05	$-0.62^{+0.22}_{-0.20}$
$\Xi_c^+ \to \Sigma^+\pi^0$	0.16 ± 0.02	$-0.10^{+0.08}_{-0.07}$	0.20 ± 0.05	$-0.42^{+0.30}_{-0.27}$
$\Xi_c^+ \to \Sigma^+\eta$	-0.047 ± 0.027	0.23 ± 0.20	0.051 ± 0.067	-0.91 ± 0.40
$\Xi_c^+ \to \Sigma^+\eta'$	0.20 ± 0.07	0.24 ± 0.69	0.20 ± 0.16	$0.52^{+1.30}_{-1.31}$

channel	$A(10^{-1}G_F)$	$B(10^{-1}G_F)$	$10^2\mathcal{B}$	α
$\Xi_c^+ \to \Xi^0K^+$	$0.013^{+0.021}_{-0.022}$	0.35 ± 0.08	$0.067^{+0.030}_{-0.029}$	$0.26^{+0.42}_{-0.43}$
$\Xi_c^+ \to \Lambda K^+$	0.019 ± 0.004	$0.013^{+0.015}_{-0.014}$	$(2.59^{+1.05}_{-1.08})10^{-3}$	$0.48^{+0.47}_{-0.45}$
$\Xi_c^+ \to p\pi^0$	$-0.0036^{+0.0032}_{-0.0031}$	$-0.029^{+0.014}_{-0.011}$	$(1.39^{+1.21}_{-1.02})10^{-3}$	$0.51^{+0.44}_{-0.42}$
$\Xi_c^+ \to p\eta$	-0.042 ± 0.006	0.035 ± 0.045	0.014 ± 0.005	-0.63 ± 0.63
$\Xi_c^+ \to p\eta'$	-0.030 ± 0.016	-0.077 ± 0.155	$(8.97^{+17.40}_{-17.42})10^{-3}$	0.997 ± 0.157
$\Xi_c^+ \to n\pi^+$	$-0.015^{+0.005}_{-0.004}$	$-0.070^{+0.019}_{-0.016}$	$(9.17^{+4.18}_{-3.54})10^{-3}$	$0.79^{+0.19}_{-0.18}$
$\Xi_c^+ \to \Sigma^0K^+$	$0.028^{+0.002}_{-0.003}$	-0.088 ± 0.011	0.011 ± 0.002	-1 ± 0.003
$\Xi_c^+ \to \Sigma^+K^0$	$0.045^{+0.003}_{-0.004}$	$-0.073^{+0.015}_{-0.016}$	0.018 ± 0.003	$-0.83^{+0.10}_{-0.11}$

Comparison: Branching fraction

channel	This work	GLT[1]	HXH[2]	ZWHY[3]	ZXMC[4]	exp. values
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Lambda\pi^+)$	1.30 ± 0.28	1.30 ± 0.07	1.307 ± 0.069	1.32 ± 0.34	1.30	1.30 ± 0.07
$10^{-2}\mathcal{B}(\Lambda_c^+ \to pK_S^0)$	1.58 ± 0.27	1.57 ± 0.08	1.587 ± 0.077	1.57 ± 0.05	1.06	1.59 ± 0.08
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Sigma^0\pi^+)$	1.27 ± 0.30	1.27 ± 0.06	1.272 ± 0.056	1.26 ± 0.32	2.24	1.29 ± 0.07
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Sigma^+\pi^0)$	1.27 ± 0.30	1.27 ± 0.06	1.283 ± 0.057	1.23 ± 0.17	2.24	1.25 ± 0.10
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Sigma^+\eta)$	$0.38^{+0.50}_{-0.49}$	0.32 ± 0.13	0.45 ± 0.19	0.47 ± 0.22	0.74	0.44 ± 0.20
						0.314 ± 0.044[5]
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Sigma^+\eta')$	$1.03^{+0.80}_{-0.79}$	1.44 ± 0.56	1.5 ± 0.60	0.93 ± 0.28	-	1.50 ± 0.60
						0.416 ± 0.085[5]
$10^{-2}\mathcal{B}(\Lambda_c^+ \to \Xi^0K^+)$	$0.53^{+0.21}_{-0.19}$	0.56 ± 0.09	0.548 ± 0.068	0.59 ± 0.17	0.73	0.55 ± 0.07
$10^{-3}\mathcal{B}(\Lambda_c^+ \to p\eta)$	1.45 ± 0.37	1.15 ± 0.27	1.27 ± 0.24	1.14 ± 0.35	1.28	1.42 ± 0.12
$10^{-4}\mathcal{B}(\Lambda_c^+ \to p\eta')$	4.94 ± 8.93	24.5 ± 14.6	27 ± 38	7.1 ± 1.4	-	4.73 ± 0.97[6]
						$5.62^{+2.46}_{-2.04} \pm 0.26$[7]
$10^{-4}\mathcal{B}(\Lambda_c^+ \to \Lambda K^+)$	$6.44^{+1.95}_{-1.93}$	6.5 ± 1.0	6.4 ± 1.0	5.9 ± 1.7	10.7	6.21 ± 0.61[8]
						6.57 ± 0.40[9]
$10^{-4}\mathcal{B}(\Lambda_c^+ \to \Sigma^0 K^+)$	$5.03^{+1.37}_{-1.29}$	5.4 ± 0.7	5.04 ± 0.8	5.5 ± 1.6	7.2	4.7 ± 0.95[10]
						3.58 ± 0.28[9]
$10^{-4}\mathcal{B}(\Lambda_c^+ \to n\pi^+)$	$6.74^{+3.02}_{-2.94}$	8.5 ± 2.0	3.5 ± 1.1	7.7 ± 2.0	-	6.6 ± 1.26[11]
$10^{-4}\mathcal{B}(\Lambda_c^+ \to \Sigma^+ K_S^0)$	$5.59^{+1.34}_{-1.29}$	5.45 ± 0.75	1.03 ± 0.42	9.55 ± 2.4	7.2	4.8 ± 1.4[10]
$10^{-4}\mathcal{B}(\Lambda_c^+ \to p\pi^0)$	$0.41^{+0.52}_{-0.51}$	1.2 ± 1.2	44.5 ± 8.5	$0.8^{+0.9}_{-0.8}$	1.26	< 2.7[12]
						< 0.80[13]
$10^{-2}\mathcal{B}(\Xi_c^0 \to \Xi^-\pi^+)$	$1.19^{+0.31}_{-0.32}$	2.21 ± 0.14	1.21 ± 0.21	1.93 ± 0.28	6.47	1.43 ± 0.32
$10^{-3}\mathcal{B}(\Xi_c^0 \to \Xi^- K^+)$	0.46 ± 0.12	0.98 ± 0.06	0.47 ± 0.083	0.56 ± 0.08	3.90	0.38 ± 0.12
$10^{-3}\mathcal{B}(\Xi_c^0 \to \Lambda K_S^0)$	3.37 ± 1.08	5.25 ± 0.3	3.34 ± 0.65	4.16 ± 2.51	6.65	3.34 ± 0.67
$10^{-3}\mathcal{B}(\Xi_c^0 \to \Sigma^0 K_S^0)$	$0.69^{+0.46}_{-0.45}$	0.4 ± 0.4	0.69 ± 0.24	3.96 ± 0.25	0.2	0.69 ± 0.24
$10^{-3}\mathcal{B}(\Xi_c^0 \to \Sigma^+ K^-)$	$1.79^{+1.54}_{-1.32}$	5.9 ± 1.1	2.21 ± 0.68	22.0 ± 5.7	4.6	1.8 ± 0.4
$10^{-2}\mathcal{B}(\Xi_c^+ \to \Xi^0\pi^+)$	0.50 ± 0.36	0.38 ± 0.20	0.54 ± 0.18	0.93 ± 0.36	1.72	1.6 ± 0.8

Comparison: decay asymmetries

channel	This work	GLT[1]	HXH[2]	ZWHY[3]	ZXMC[4]	exp. values
$\alpha(\Lambda_c^+ \to \Lambda\pi^+)$	$-0.82^{+0.10}_{-0.11}$	-0.87 ± 0.10	-0.841 ± 0.083	-	-0.93	-0.84 ± 0.09
$\alpha(\Lambda_c^+ \to pK_S^0)$	$-0.91^{+0.08}_{-0.09}$	$-0.89^{+0.26}_{-0.11}$	0.19 ± 0.41	-	-0.75	0.18 ± 0.45
$\alpha(\Lambda_c^+ \to \Sigma^0\pi^+)$	$-0.61^{+0.23}_{-0.22}$	-0.35 ± 0.27	-0.605 ± 0.088	-	-0.76	-0.73 ± 0.18 -0.463 ± 0.018[9]
$\alpha(\Lambda_c^+ \to \Sigma^+\pi^0)$	$-0.61^{+0.23}_{-0.22}$	-0.35 ± 0.27	-0.603 ± 0.088	-	-0.76	-0.55 ± 0.11 -0.48 ± 0.03[5] -0.755 ± 0.006[9]
$\alpha(\Xi_c^0 \to \Xi^-\pi^+)$	$-0.64^{+0.16}_{-0.17}$	$-0.98^{+0.07}_{-0.02}$	-0.56 ± 0.32	-	-0.95	-0.64 ± 0.05
$\alpha(\Lambda_c^+ \to \Sigma^+\eta)$	-0.21 ± 0.59	-0.40 ± 0.47	0.3 ± 3.8	-	-0.95	-0.99 ± 0.06[5]
$\alpha(\Lambda_c^+ \to \Sigma^+\eta')$	0.35 ± 1.06	$1.00^{+0.00}_{-0.17}$	0.8 ± 1.9	-	-	-0.46 ± 0.07[5]
$\alpha(\Lambda_c^+ \to \Lambda K^+)$	$0.05^{+0.42}_{-0.36}$	0.32 ± 0.32	-0.24 ± 0.15	-	-0.96	-0.585 ± 0.052[9]
$\alpha(\Lambda_c^+ \to \Sigma^0 K^+)$	-0.98 ± 0.05	$-1.00^{+0.06}_{-0.00}$	-0.953 ± 0.040	-	-0.73	-0.55 ± 0.201[9]
$\alpha(\Lambda_c^+ \to \Xi^0 K^+)$	$0.998^{+0.026}_{-0.024}$	$0.94^{+0.06}_{-0.11}$	0.866 ± 0.090	-	0.90	

Discussion 1

- Λ_{c}^{+}
  - Except $\Lambda_c^+ \to n\, K^+$, all the decays of Λ_c^+ have been measured .
  - Decay asymmetries of several modes need to be confirmed
- Ξ_c
  - There are still several channels yet to be measured, including CF modes: $\Xi_c^0 \to \Xi^0\pi^0, \Xi^0\eta, \Xi^0\eta'$
  - Wish BESIII good luck after 2024!

Discussion 2

- Branching fractions
  - Consistent well: almost all the measured channels
  - Not consistnet: $\Xi_c^+ \to \Xi^0\pi^+$
    - All the fitting results indicate a smaller value than Belle measured value.
- Decay asymmetries
  - 5 channels consistent well: $\Lambda_c^+ \to \Lambda\pi^+, \Sigma^0\pi^+, \Sigma^+\pi^0, \Sigma^0K^+; \Xi_c^0 \to \Xi^-\pi^+$
  - 3 channels not consistent: $\Lambda_c^+ \to pK_S^0, \Sigma^+\eta', \Lambda K^+$
    - $\Lambda_c^+ \to pK_S^0$, whether taking it as input or not, the prediction is negative, pole model calculation is negative, while BESIII gave positive sign.
    - $\Lambda_c^+ \to \Sigma^+\eta'$ fit: positive; Belle: negative
    - $\Lambda_c^+ \to \Lambda K^+$ fit: positive or negative; pole model: negative; Belle: negative
  - 1 channel unclear:
    - $\Lambda_c^+ \to \Xi^0K^+$ fit: positive; pole model calculation: positive; BESIII: ?

Summary

- More data emerge during the summer of 2022.
- Fit at current stage:
  - Providing complementary information to model calculations and experiments;
  - Providing predictions for unmeasured modes;
  - Checking SU(3) symmetry in charmed baryon decays.
- A fit incorporating all current data does not work well.
- We find a fitting scheme by opting for most of the measured values.
- Ways to solvoe the inconsistent problems for several observables:
  - Experimental values will be changed with more precise measurement;
  - SU(3) symmetry breaking effect;
  - The improved theoretical calculations.