Charmed Baryon Spectroscopy and Decay

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Contents

1. Introduction

Charmed Baryon

- Charmed baryon
  - Singly charmed baryon: One heavy charm quark and diquark structure of light quarks → Heavy quark effective theory
  - Suitable for studying the underlying baryon structure.

- Exotic charmed baryon
  - Pentaquarks with charm quarks are observed.
  - It seems that pentaquark is more stable with heavy antiquark than light one. *RPD 73, 014009 (2006)

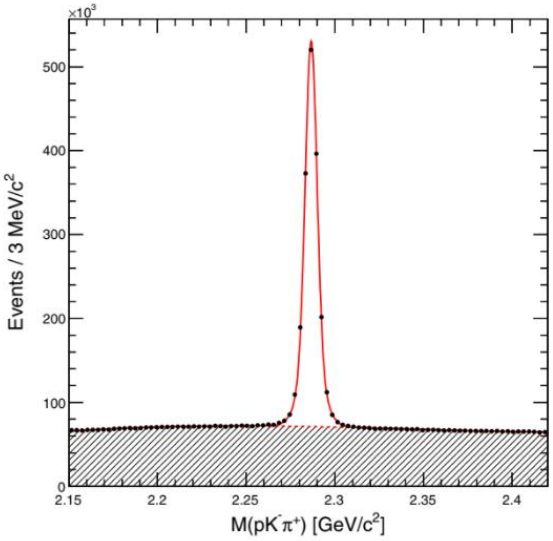
- Charmed baryon decay
  - Various weak-decay mechanisms.
  - Effective channels to study hyperons.

Recent Experiments for Charmed Baryon

- Belle
  - e^+e^- collisions at $\sqrt{s}$= ~10.6 GeV
  - From B meson decays
  - $e^+e^- \rightarrow c\bar{c}$, direct production of charmed baryons
  - Huge statistics, ~10^9 $B\bar{B}$ pairs, ~1 ab^{-1}integrated luminosity
- BESIII
  - e^+e^- collisions at $\sqrt{s}$= ~4.6 GeV
  - $e^+e^- \rightarrow \Lambda_c^+\bar{\Lambda}_c^-$ production
  - Measurement of spin and several absolute branching fractions of Λ_c^+
- LHCb
  - pp collisions at $\sqrt{s}$= ~13 TeV
  - From bottom baryons decays such as Λ_b^0 decays
  - $e^+e^- \rightarrow c\bar{c}X$ production
  - In a wide mass range, charmed baryon spectroscopy

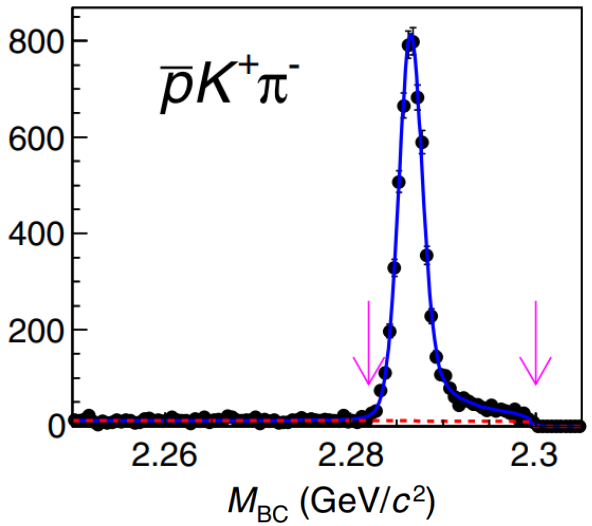
- Reconstructions of $\Lambda_c^+ \to pK^-\pi^+$ decay,

Belle, in $e^+e^- \to c\bar{c}$



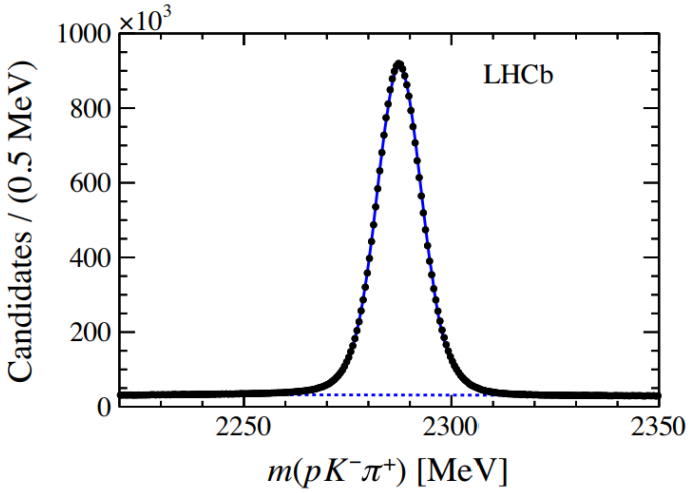
PRL 117, 011801 (2016)

BESIII, in $e^+e^- \to \Lambda_c^+\bar{\Lambda}_c^-$



PRL 121, 251801 (2018)

LHCb, in $pp \to c\bar{c}X$

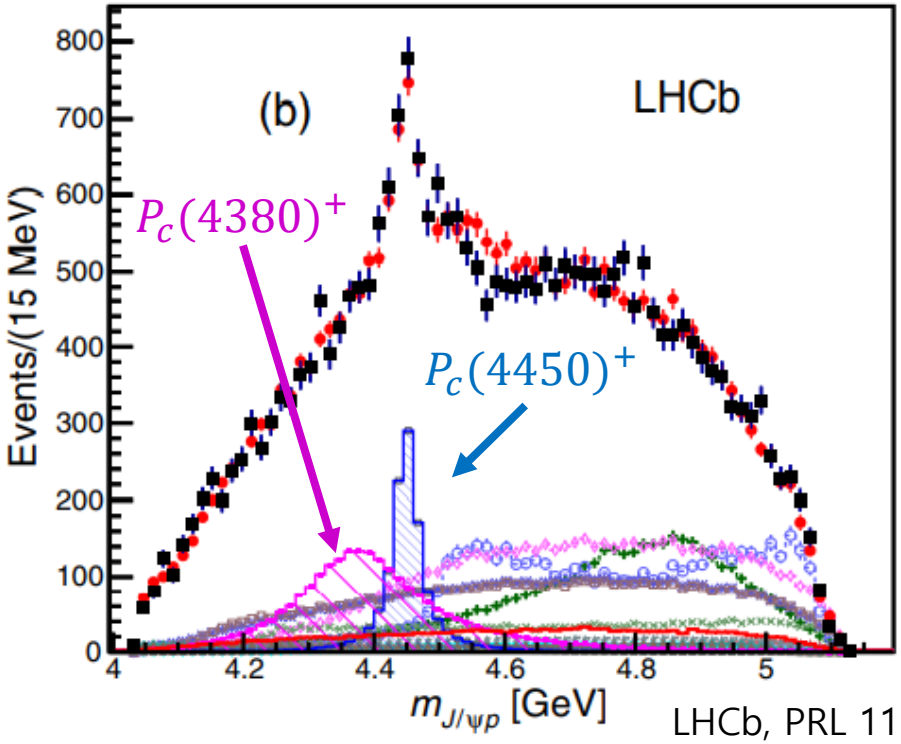


PRL 124, 222001 (2020)

2. New Charmed Baryons

Pentaquarks

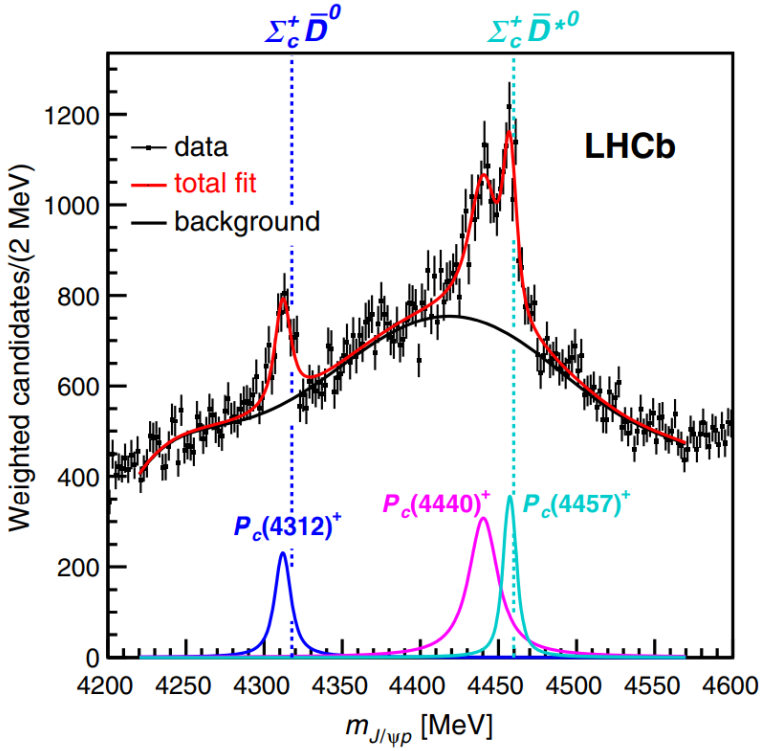
- $P_c(4380)^+$ and $P_c(4450)^+$ in 26 k $\Lambda_b^0 \to J/\psi\, K^- p$ decays
  - In 2015, LHCb reported a new type of charmed baryons, pentaquarks.
  - Amplitude analysis with 14 Λ^* states shows clear two structures of pentaquark.
  - Hadron models: "Tightly bound states of $uudc\bar{c}$", "molecular baryon-meson pentaquarks" or "peaks from triangle-diagram process (?)"



LHCb, PRL 115, 072001 (2015)

- Narrow pentaquarks states near meson-baryon thresholds
  - New analysis with 246 k $\Lambda_b^0 \to J/\psi\, K^- p$ decays
  - Backgrounds well suppressed, such as Λ^* states
  - Three narrow peak structures observed near meson-baryon thresholds
    - → molecular states of baryon-meson
    - → triangle-diagram process (?)

Resonance	Mass (MeV/c^2)	Width (MeV)
$P_c(4312)^+$	$4312.9 \pm 0.7^{+6.8}_{-0.6}$	$9.8 \pm 2.7^{+3.7}_{-4.5}$
$P_c(4440)^+$	$4440.3 \pm 1.3^{+4.1}_{-4.7}$	$20.6 \pm 4.9^{+8.7}_{-10.1}$
$P_c(4457)^+$	$4457.3 \pm 0.6^{+4.1}_{-1.7}$	$6.4 \pm 2.0^{+5.7}_{-1.9}$



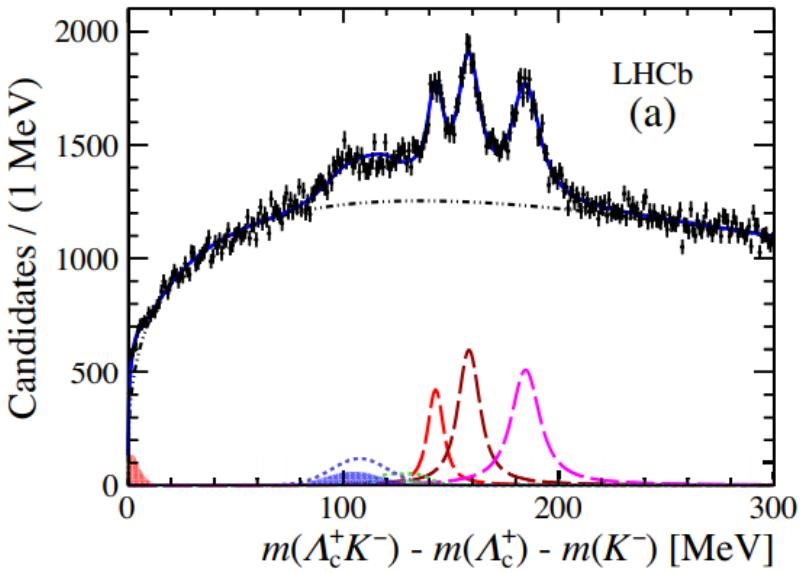
LHCb, PRL 122, 222001 (2019)

New Excited States of Ξ_c^0

- New analysis with 5.6 fb^{-1} data of pp collisions
  - Observation of three new narrow Ξ_c^0 states decaying to $\Lambda_c^+ K^-$
  - The results clean up Ξ_c^0 baryons in this mass area.
  - Satisfy the equal spacing rule

$$m[\Omega_c(3050)^0] - m[\Xi_c(2923)^0] \cong 125 \text{ MeV}$$
$$m[\Omega_c(3065)^0] - m[\Xi_c(2939)^0] \cong 125 \text{ MeV}$$
$$m[\Omega_c(3090)^0] - m[\Xi_c(2965)^0] \cong 125 \text{ MeV}$$

Resonance	Mass (MeV/c^2)	Width (MeV)	
$\Xi_c(2923)^0$	2923.04±0.25±0.20±0.14	7.1±0.8±1.8	New
$\Xi_c(2939)^0$	2938.55±0.21±0.17±0.14	10.2±0.8±1.1	New
$\Xi_c(2965)^0$	2964.88±0.26±0.14±0.14	141.±0.9±1.3	Different mass and width from $\Xi_c(2970)^0$

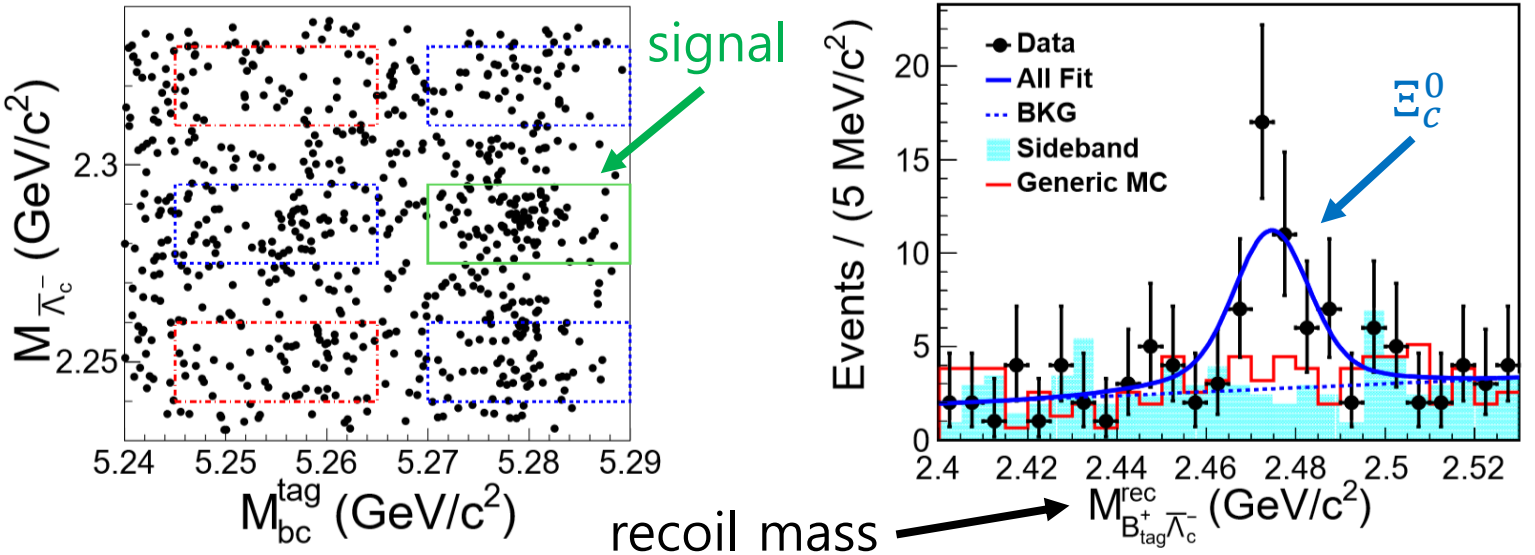


LHCb, PRL 124, 222001 (2020)

3. Charmed Baryon Decay

Absolute Branching Fractions of Ξ_c^0 Decays

- Measurements of absolute branching fraction of Ξ_c^0 Decays by using 772×10^6 $B\bar{B}$ pairs events
- Inclusive analysis of $B^- \to \bar{\Lambda}_c^- \Xi_c^0$ using a missing mass technique:
  → B^+ tag using a neural network (full hadron reconstruction algorithm).
  → $\bar{\Lambda}_c^-$ reconstruction from remaining tracks.
  → 'Recoil mass' calculation.

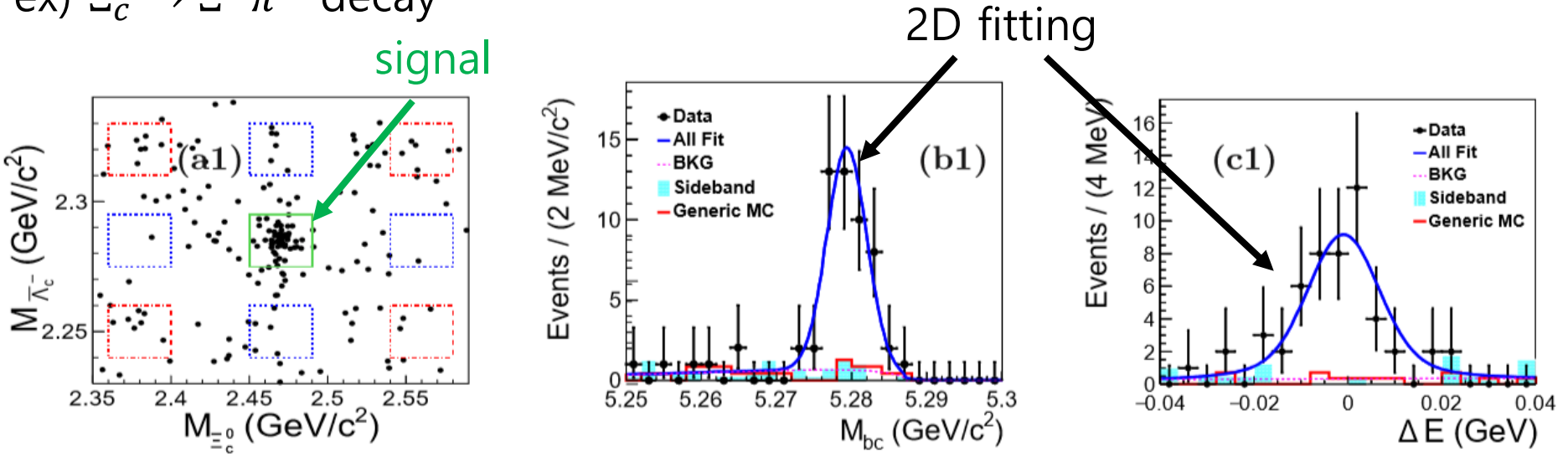


Belle, PRL 122 082001 (2019)

→ Absolute $B(B^- \to \bar{\Lambda}_c^- \Xi_c^0) = (9.51 \pm 2.10 \pm 0.88) \times 10^{-4}$.

- Exclusive analysis of $B^- \to \overline{\Lambda}_c^- \Xi_c^0$ decay & Ξ_c^0 decays:

ex) $\Xi_c^0 \to \Xi^- \pi^+$ decay



Belle, PRL 122 082001 (2019)

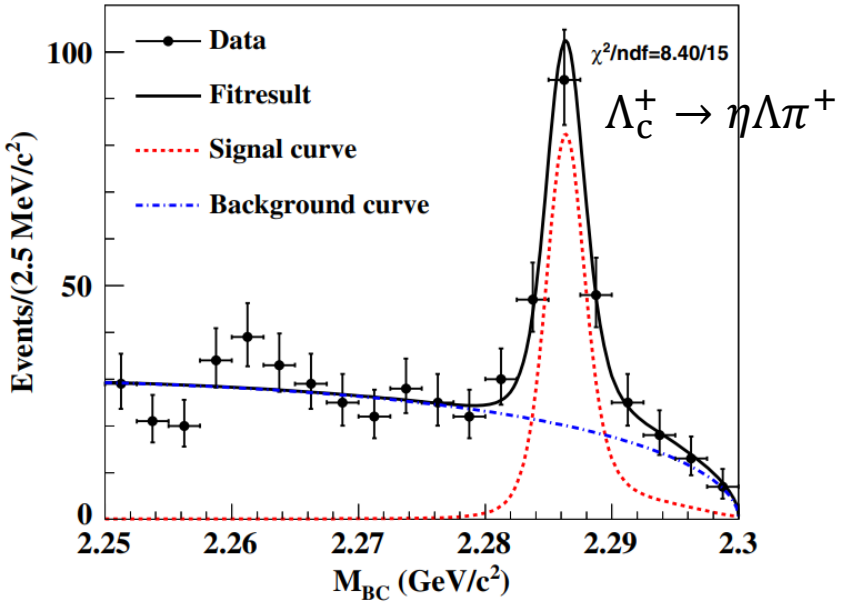
→ $B(B^- \to \overline{\Lambda}_c^- \Xi_c^0) \times B(\Xi_c^0 \to \Xi^- \pi^+) = (1.71 \pm 0.28) \times 10^{-5}$

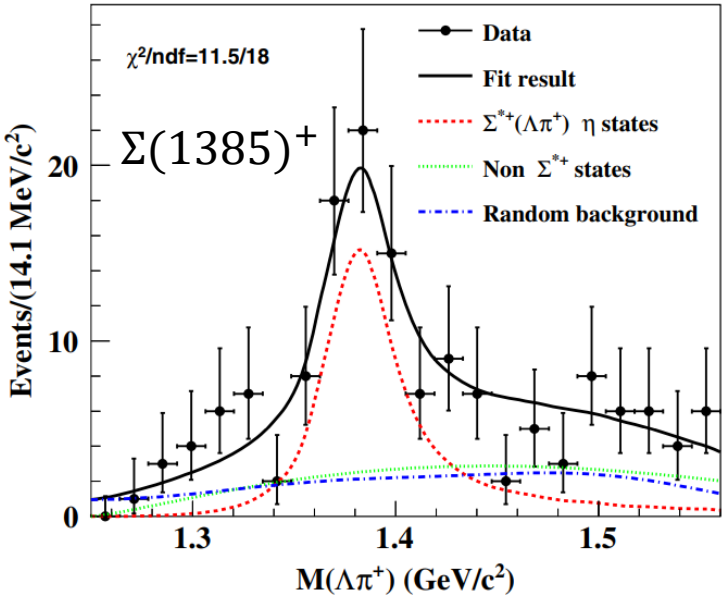
- From the inclusive and exclusive analyzes, the absolute branching fractions are determined:

$$B(\Xi_c^0 \to \Xi^- \pi^+) = 1.80 \pm 0.50 \pm 0.14\%$$
$$B(\Xi_c^0 \to \Lambda K^- \pi^+) = 1.17 \pm 0.37 \pm 0.09\%$$
$$B(\Xi_c^0 \to p K^- K^- \pi^+) = 0.58 \pm 0.23 \pm 0.05\%$$

Absolute Branching Fraction of $\Lambda_c^+ \to \eta\Lambda\pi^+$

- Measurement of absolute branching fraction of $\Lambda_c^+ \to \eta\Lambda\pi^+$ and $\eta\Sigma(1385)^+$ via $e^+e^- \to \Lambda_c^+\bar{\Lambda}_c^-$ production.
- Suitable for studying intermediate states; $\Sigma(1385)^+$, $\Lambda(1670)$, and $a(980)^+$ states
- $B(\Lambda_c^+ \to \eta\Lambda\pi^+) = (1.84 \pm 0.21 \pm 0.15)\%$
  $B(\Lambda_c^+ \to \eta\Sigma(1385)^+) = (0.91 \pm 0.18 \pm 0.09)\%$

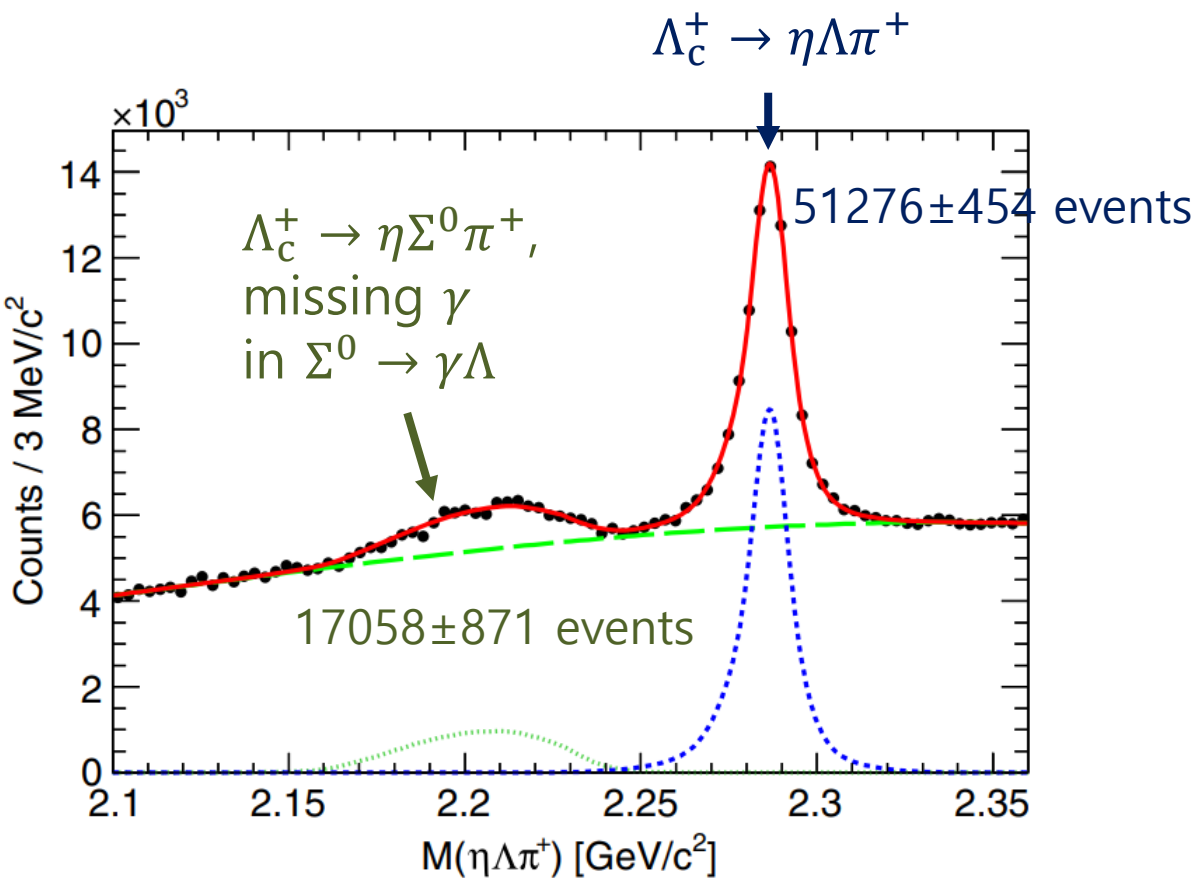




BESIII, PRD 99, 032010 (2019)

Branching Fractions of $\Lambda_c^+ \to \eta\Lambda\pi^+$ and $\eta\Sigma^0\pi^+$

- New branching fraction measurements of $\Lambda_c^+ \to \eta\Lambda\pi^+$ and $\eta\Sigma^0\pi^+$ with 980 fb^{-1} data



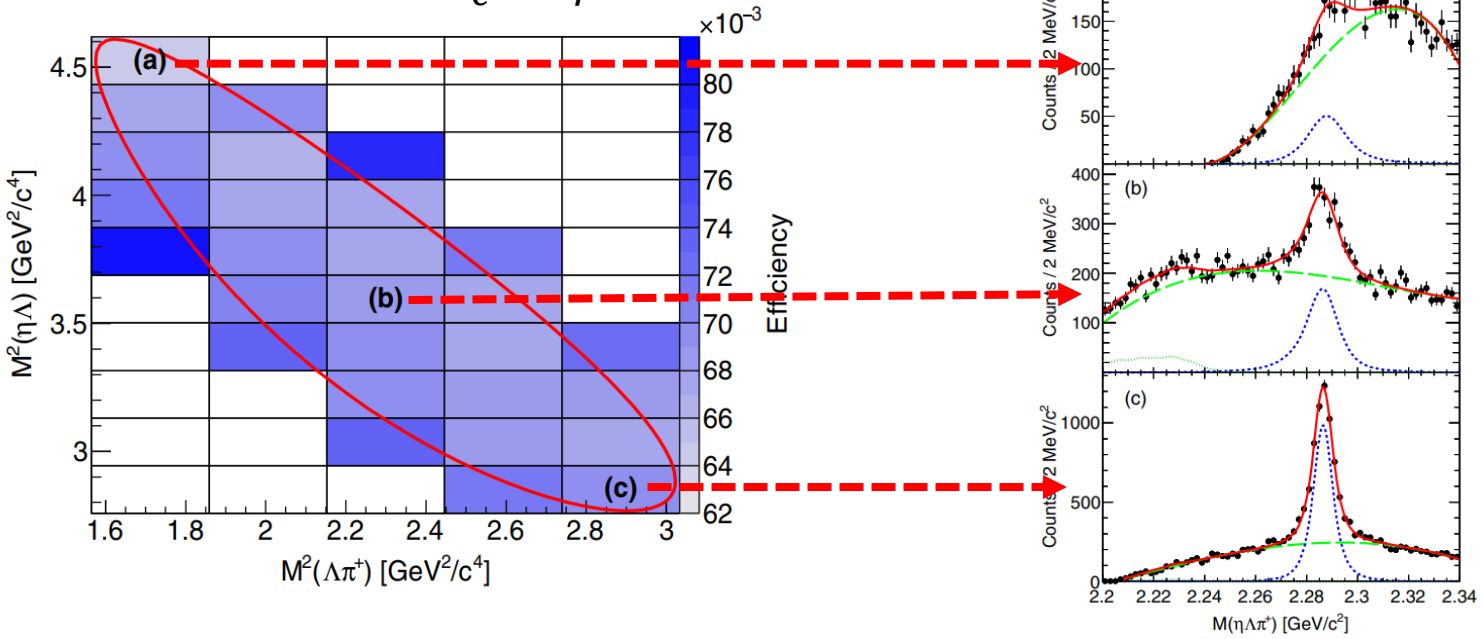
Belle, PRD 103, 052005 (2021)

- In $\Lambda_c^+ \to \eta\Lambda\pi^+$ measurement, enough events for bin-by-bin efficiency correction

→ No effects of intermediate states

Yield extractions for each bin

Efficiencies for $\Lambda_c^+ \to \eta\Lambda\pi^+$



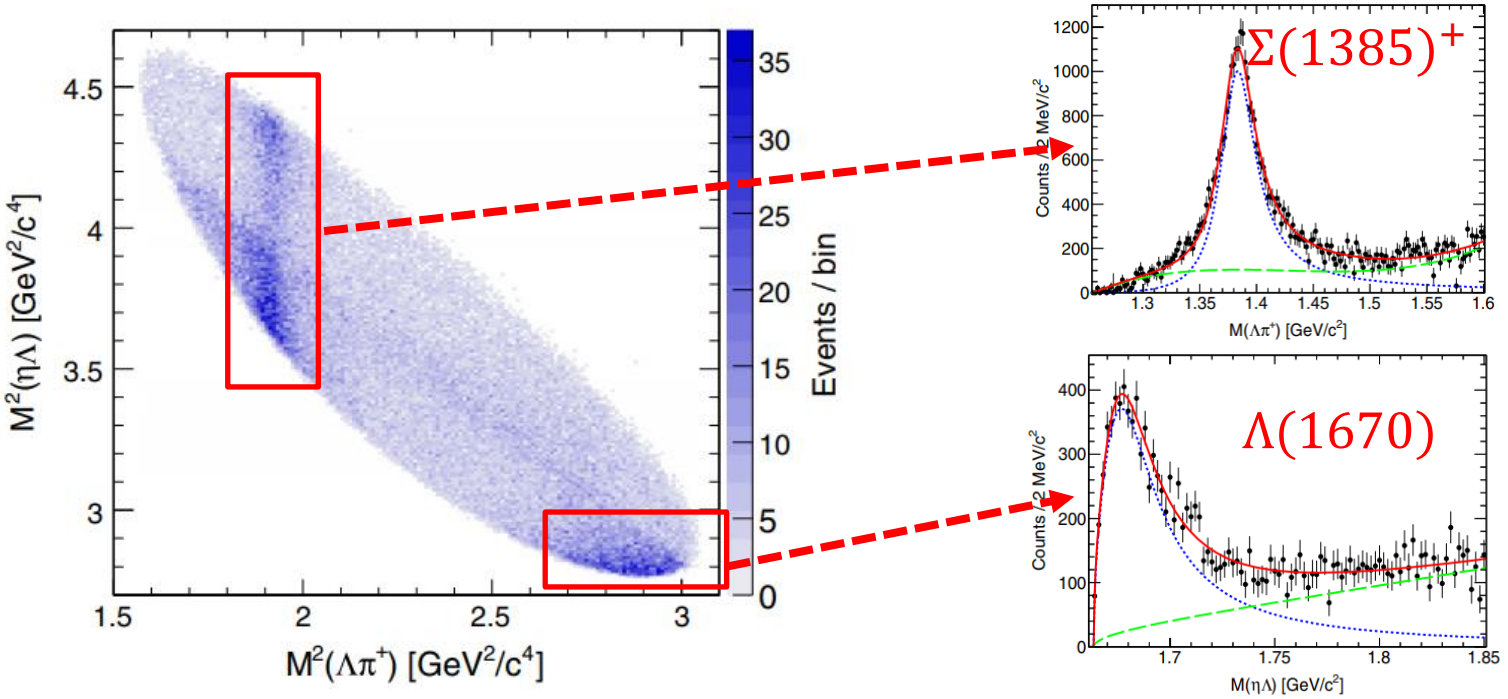
Belle, PRD 103, 052005 (2021)

- $\frac{B(\Lambda_c^+ \to \eta\Lambda\pi^+)}{B(\Lambda_c^+ \to pK^-\pi^+)} = 0.293 \pm 0.003 \pm 0.014,$

  $\frac{B(\Lambda_c^+ \to \eta\Sigma^0\pi^+)}{B(\Lambda_c^+ \to pK^-\pi^+)} = 0.120 \pm 0.006 \pm 0.010$

- Intermediate states of $\Lambda_c^+ \to \eta\Lambda\pi^+$ decay
- First study of a peak structure of $\Lambda(1670)$

Dalitz plot for $\Lambda_c^+ \to \eta\Lambda\pi^+$



Belle, PRD 103, 052005 (2021)

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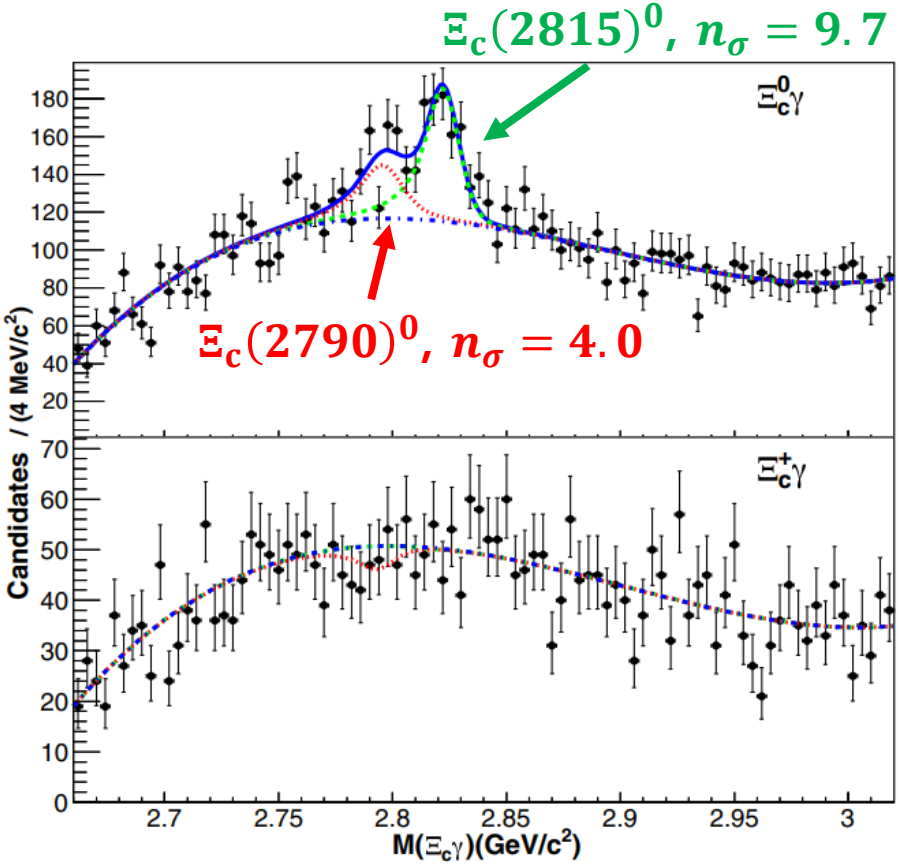
Resonance	Mass (MeV/c^2)	Width (MeV)
$\Lambda(1670)$	1674.3±0.8±4.9	36.1±2.4±4.8
$\Sigma(1385)^+$	1384.8±0.3±1.4	38.1±1.5±2.1

Electromagnetic Decays of $\Xi_c(2790)$ and $\Xi_c(2815)$

- Observation of electromagnetic decays of Ξ_c^* baryons; $\Xi_c(2790)^0 \to \Xi_c^0\gamma$ and $\Xi_c(2815)^0 \to \Xi_c^0\gamma$
- Crucial information for charmed baryon models.



Belle, PRD 102, 071103

- Branching fractions,

Decay Mode	Branching Fraction Ratio
$\frac{B(\Xi_c(2815)^0 \to \Xi_c^0 \gamma)}{B(\Xi_c(2815)^0 \to \Xi_c(2645)^+ \pi^- \to \Xi_c^0 \pi^+ \pi^-)}$	0.41±0.05±0.03
$\frac{B(\Xi_c(2790)^0 \to \Xi_c^0 \gamma)}{B(\Xi_c(2790)^0 \to \Xi_c'^+ \pi^- \to \Xi_c^+ \gamma \pi^-)}$	0.13±0.03±0.02
$\frac{B(\Xi_c(2815)^+ \to \Xi_c^+ \gamma)}{B(\Xi_c(2815)^+ \to \Xi_c(2645)^0 \pi^+ \to \Xi_c^+ \pi^+ \pi^-)}$	<0.09
$\frac{B(\Xi_c(2790)^+ \to \Xi_c^+ \gamma)}{B(\Xi_c(2790)^+ \to \Xi_c'^0 \pi^+ \to \Xi_c^0 \gamma \pi^+)}$	<0.06

- Corresponding partial widths,

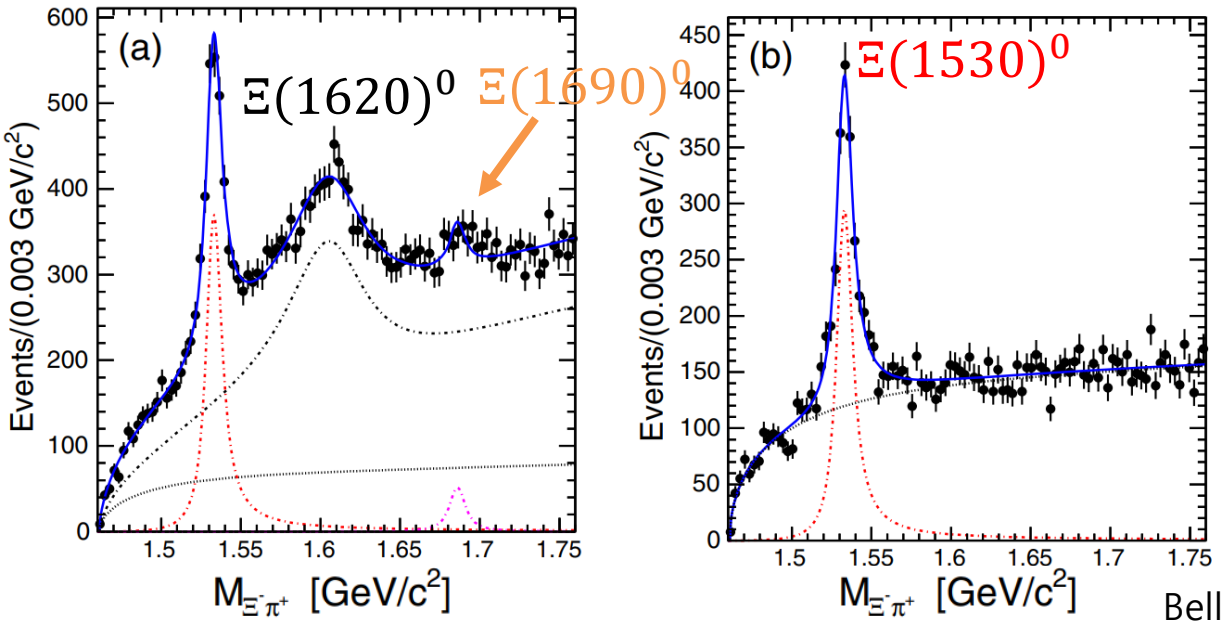
Decay Mode	Partial Width [keV/c^2]
$\Xi_c(2815)^0 \to \Xi_c^0 \gamma$	~320
$\Xi_c(2790)^0 \to \Xi_c^0 \gamma$	~800
$\Xi_c(2815)^+ \to \Xi_c^+ \gamma$	<80
$\Xi_c(2790)^+ \to \Xi_c^+ \gamma$	<350

- Consistent with charmed baryon model with orbital excitation between charm quark and spin-0 light diquark system.

Observation of $\Xi(1620)^0$ in $\Xi_c^+ \to \Xi^-\pi^+\pi^+$ decays

- Observation of $\Xi(1620)^0$ structure in $\Xi_c^+ \to \Xi^-\pi^+\pi^+$ decays,

Signal of Ξ_c^+ | Sideband of Ξ_c^+



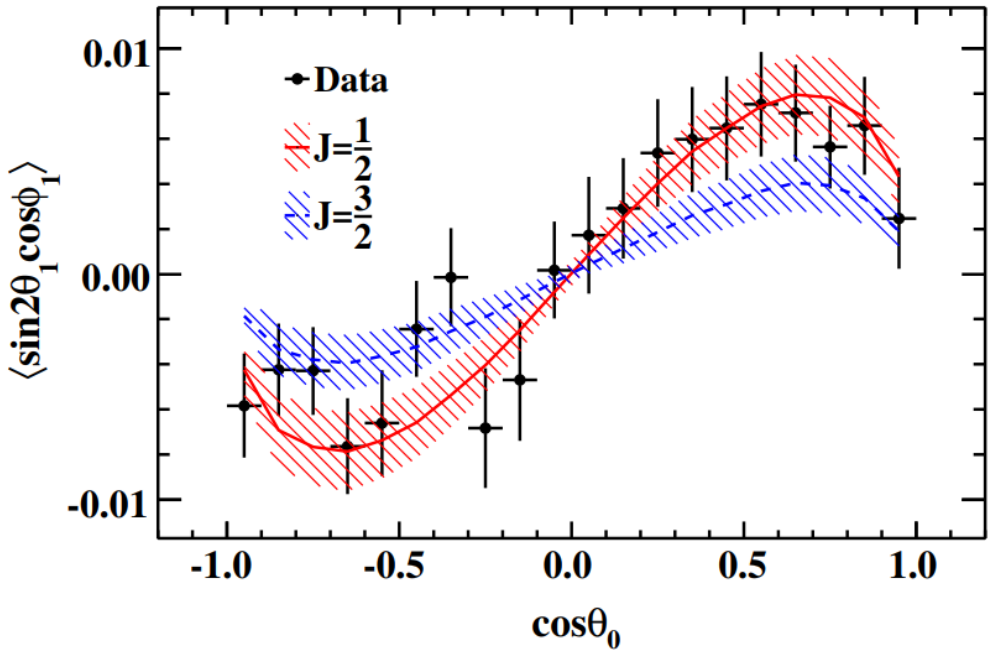
Belle, PRL 122 072501

- $\Xi(1620)^0$ Mass: $1610.4 \pm 6.0^{+6.1}_{-4.1}$ MeV/c^2, width: $59.9 \pm 4.8^{+2.8}_{-7.1}$
- Difficult to explain them by constituent quark models.
  - -Exotic hadron?
  - -Analogous to $\Lambda(1405)$, two poles in S=-2 sector?

4. Spin and Parity

Determination of Λ_c^+ Spin

- Measurements of the spin of the simplest charmed baryon, Λ_c^+
- Vis a spin-1/2 baryon + a pseudoscalar meson decays;
  pK_S^0, $\Lambda\pi^+$, $\Sigma^0\pi^+$, and $\Sigma^+\pi^0$ decays
- Joint angular distribution,



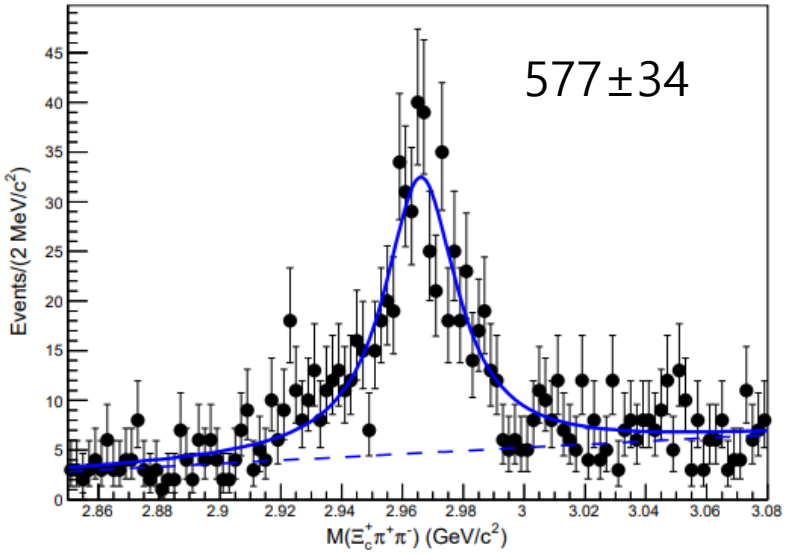
BESIII, PRD 103, L091101 (2021)

- $J = 1/2$ is preferred over $3/2$ with 6σ

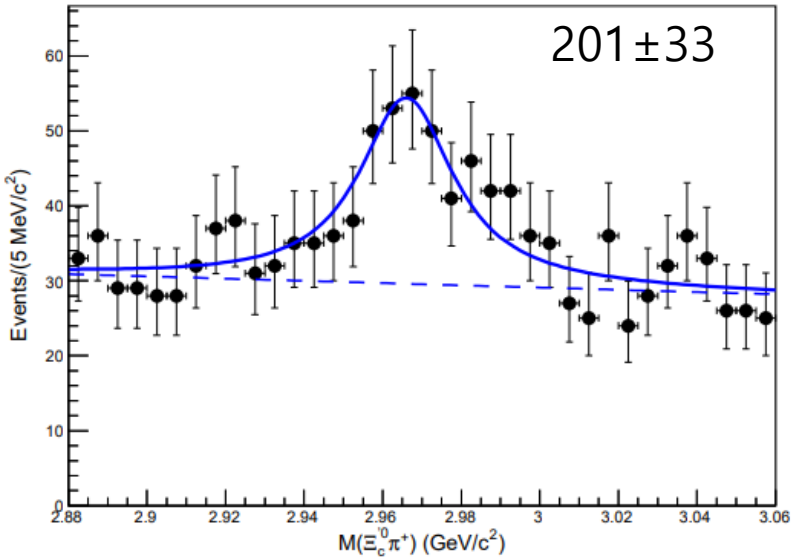
Measurement of Spin and Parity of $\Xi_c(2970)^+$

- First measurement of spin and parity of a Ξ_c baryon
- Important information for hadron model selection
- $\Xi_c(2970)^+$ reconstruction,

$\Xi_c(2970)^+ \to \Xi_c(2645)^0\pi^+$
$\to \Xi_c^+\pi^+\pi^-$ decay



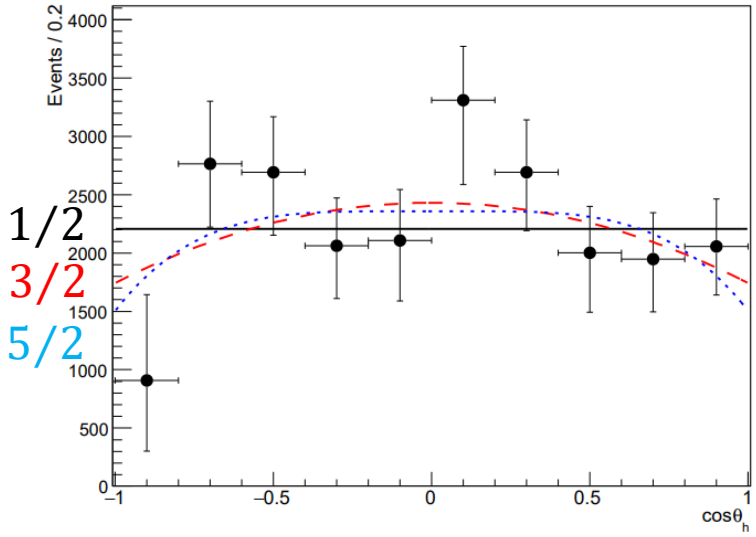
$\Xi_c(2970)^+ \to \Xi_c'^0\pi^+$
$\to \Xi_c^0\gamma\pi^+$ decay



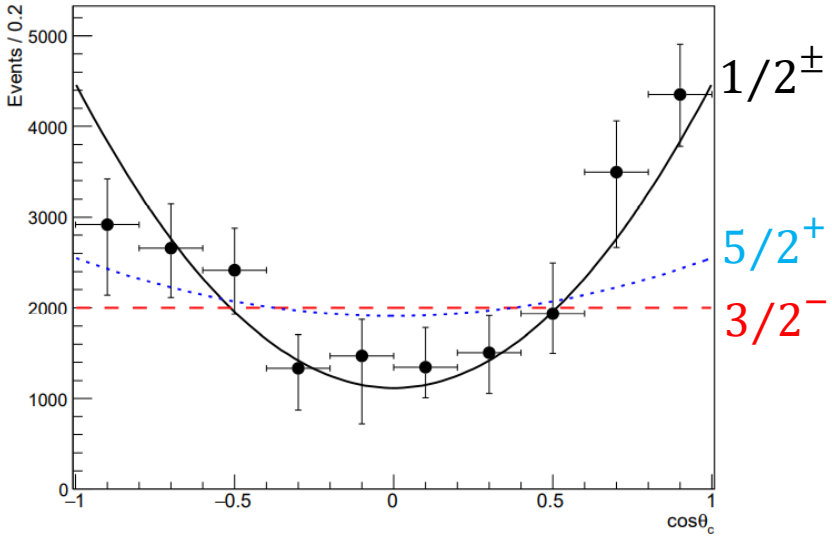
Belle, PRD accepted, arXiv: 2007.14700

- Spin determination from angular analyzes
  → Strongly favors $J = 1/2$ state

Helicity angle of
$\Xi_c(2970)^+ \to \Xi_c(2645)^0\pi^+$



Helicity angle of
$\Xi_c(2645)^0 \to \Xi_c^+\pi^-$



Belle, PRD accepted, arXiv: 2007.14700

- Parity determination from branching fraction ratio

$$\frac{B(\Xi_c(2970)^+ \to \Xi_c(2645)^0\pi^+)}{B(\Xi_c(2970)^+ \to \Xi_c'^0\pi^+)} = 1.67 \pm 0.29^{+0.15}_{-0.09} \pm 0.25(IS)$$

→ Strongly favors $J^P = 1/2^+$ state

Summary

New results of charmed baryons are reported from Belle, BESIII, and LHCb collaborations.

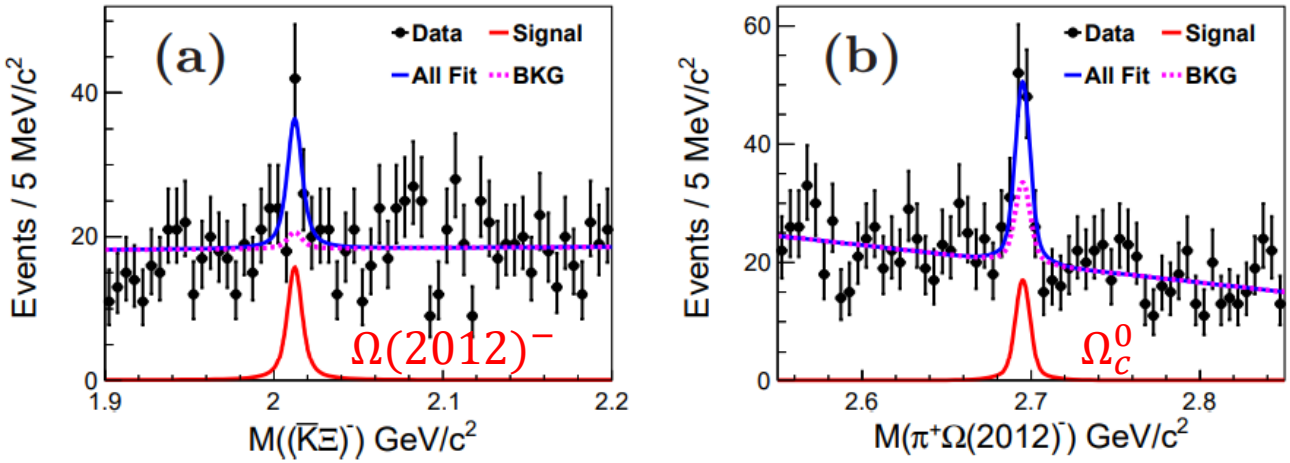
1. New charmed baryons are observed; P_c^+ states and excited states of Ξ_c^*
2. Branching fractions of charmed baryon decays are measured;
   absolute branching fractions of $\Xi_c^{0,+}$ decays and $\Lambda_c^+ \to \eta\Lambda\pi^+$,
   braching fractions of $\Lambda_c^+ \to \eta\Lambda\pi^+$ and $\eta\Sigma^0\pi^+$ decays,
   and electromagnetic decays of Ξ_c^0.
3. Λ_c^+ spin is determined to be ½ and spin and parity of $\Xi_c(2970)^+$ are also determined.
4. $\Xi(1620)^0$ is observed in Ξ_c decay.

In addition to these, there have been many interesting results, and active researches will continue.

*Backup

Evidence of $\Omega(2012)^-$ Structure in $\Omega_c^0 \to \pi^+(\bar{K}\Xi)^-$

- Evidence of $\Omega(2012)^-$ structure in $\Omega_c^0 \to \pi^+ K^- \Xi^0$ and $\pi^+ \bar{K}^0 \Xi^-$ decays
- $\Omega(2012)^- \to (\bar{K}\Xi)^-$ observed but no evidence of $\Omega(2012)^- \to (\bar{K}\Xi(1530))^-$
- $\Omega_c^0 \to \pi^+(\bar{K}\Xi)^-$ is suggested to study $\Omega(2012)^-$ *PRD 102, 076009 (2020)
- 2D fit to $M(\bar{K}\Xi)^-$ and $M(\pi^+\Omega(2012)^-)$ distributions,

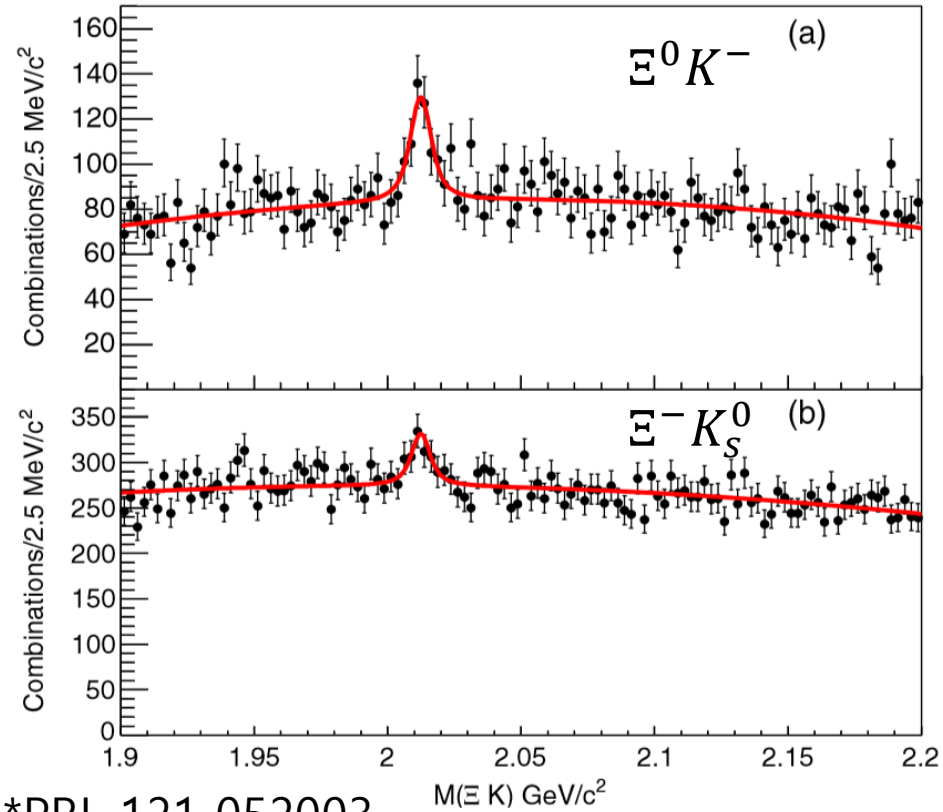


Belle, arXiv: 2106.00892

→ $\Omega_c^0 \to \pi^+\Omega(2012)^- \to \pi^+(\bar{K}\Xi)^-$ evdidence with ~4.5σ significance

Excited Ω^- baryon

- $\Upsilon(1S)$, $\Upsilon(2S)$, and $\Upsilon(3S)$ resonances data sample which contains enhanced baryon fraction.
- Large gap (~600 MeV/c^2) between Ω^- and Ω^{*-} because $\Omega^{*-} \to \Omega^-\pi^0$ is highly suppressed.
- Search Ω^{*-} by $\Omega^{*-} \to \Xi K$ decay (analogous to $\Omega_c^* \to \Xi_c^+ K^-$)



- Ω (2212):
M=2012.4±0.7±0.6 MeV,
$\Gamma = 6.4^{+2.5}_{-2.0} \pm 1.6$ MeV
- $\frac{3}{2}^-$ state in quark model?

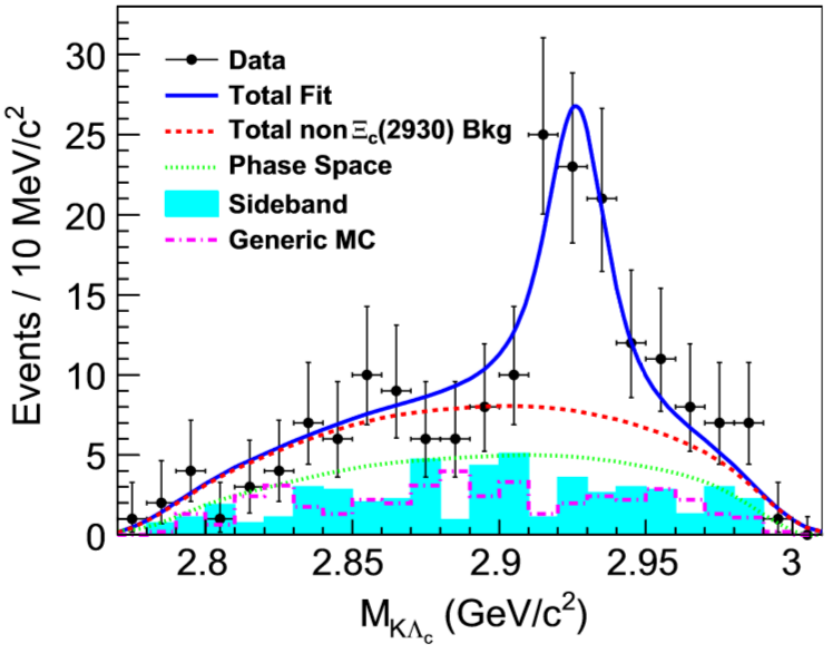
*PRL 121 052003

$\Xi_c(2930)^0$ and $\Xi_c(2930)^+$

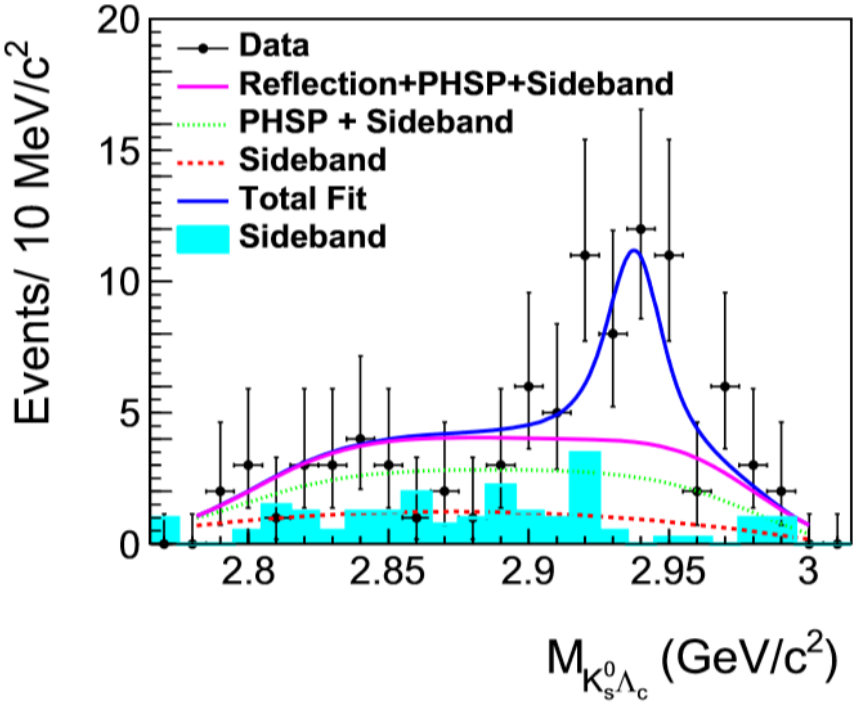
- 772×10^6 $B\bar{B}$ pairs.

*EPJC 78:928 and 78:252

$\Xi_c(2930)^0 \to K^-\Lambda_c^+$ in $B^- \to K^-\Lambda_c^+\bar{\Lambda}_c^-$



$\Xi_c(2930)^+ \to K_s^0\Lambda_c^+$ in $B^0 \to K_s^0\Lambda_c^+\bar{\Lambda}_c^-$

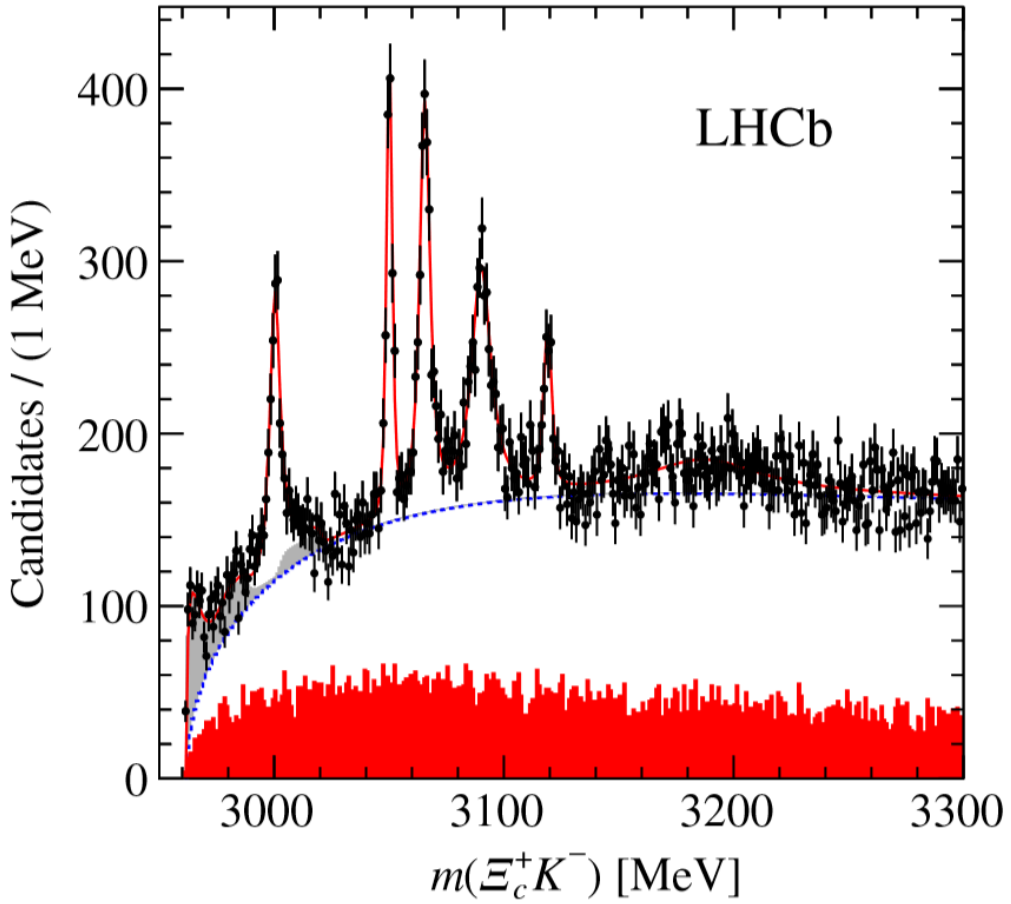


- $\Xi_c(2930)^0$: 5.1σ significance, $M = 2928.9 \pm 3.0\,^{+0.9}_{-12.0}$ MeV
- $\Xi_c(2930)^+$: larger than 3.5σ significance, $M = 2942.3 \pm 4.4$ MeV

Excited Ω_c^0 Baryons

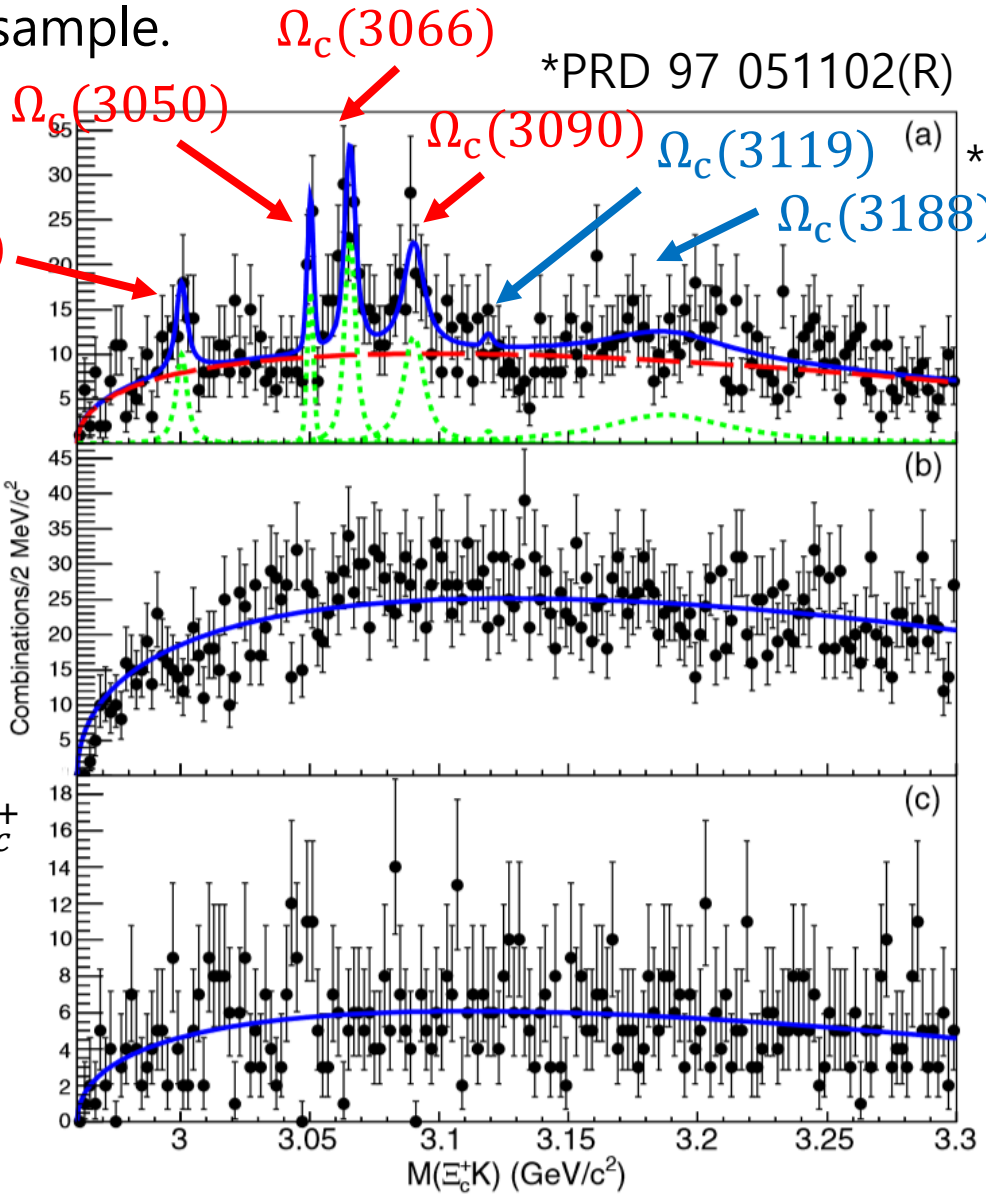
- LHCb reported 5 narrow Ω_c^* resonances in $\Omega_c^* \to \Xi_c^+ K^-$.

*LHCb Collaboration, PRL 118 182001



→ We can confirm them.

- 980 fb^{-1} data sample.



*PRD 97 051102(R)

(b) wrong-sign

(c) sidebands of Ξ_c^+

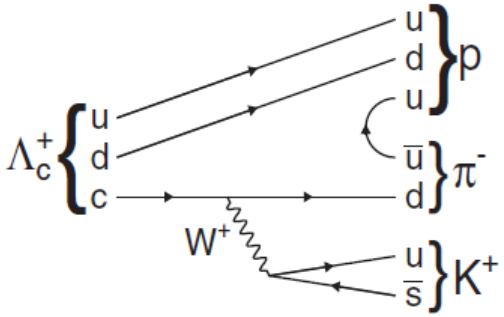
- Significant signals for $\Omega_c(3066)$ and $\Omega_c(3090)$. Less significant for $\Omega_c(3000)$ and $\Omega_c(3050)$. We cannot confirm $\Omega_c(3119)$.

Doubly Cabibbo-Suppressed Decay, $\Lambda_c^+ \to pK^+\pi^-$

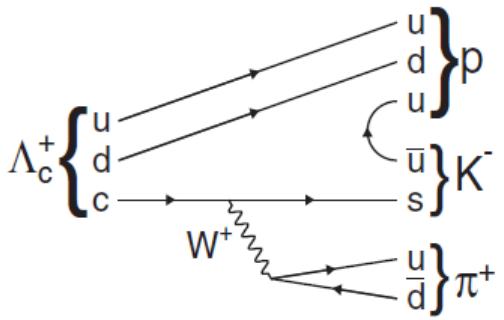
- Doubly Cabibbo-suppressed decay: $c \to d$ and $W^+ \to u\bar{s}$ at the same time.

→ $\frac{B(\Lambda_c^+ \to pK^+\pi^-)}{B(\Lambda_c^+ \to pK^-\pi^+)}$ is expected to be lower than $\tan^4\theta_C (= 0.00285)$.

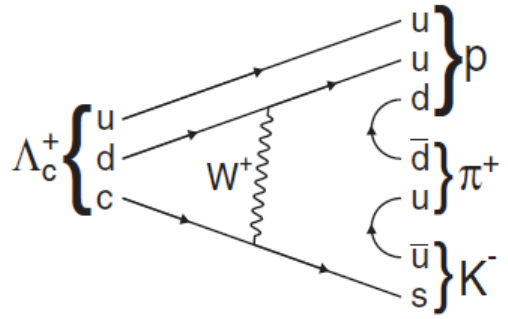
Doubly Cabibbo-Suppressed (DCS) Decay, $\Lambda_c^+ \to pK^+\pi^-$



Cabibbo-Favored (CF) Decay, $\Lambda_c^+ \to pK^-\pi^+$



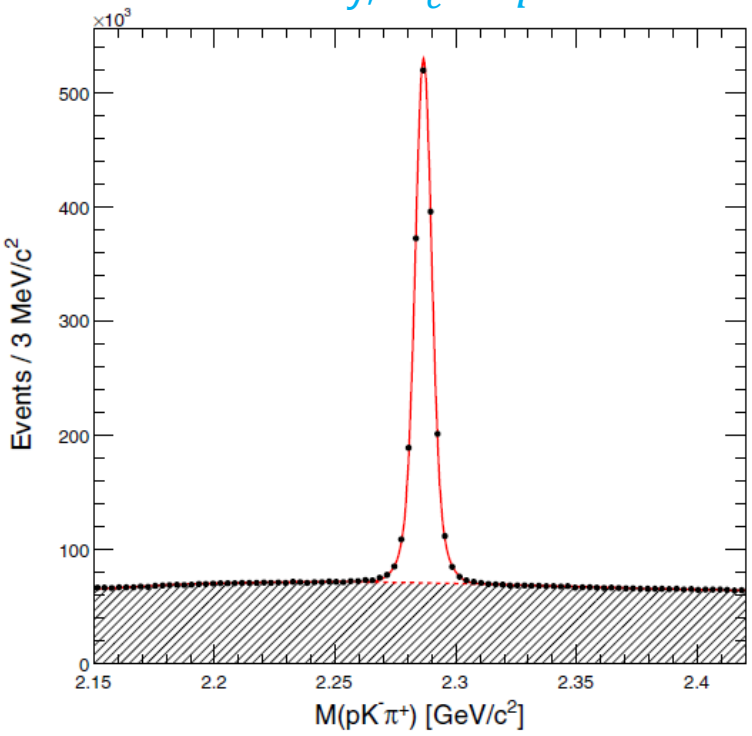
The W-exchange decay channel is forbidden in DCS.



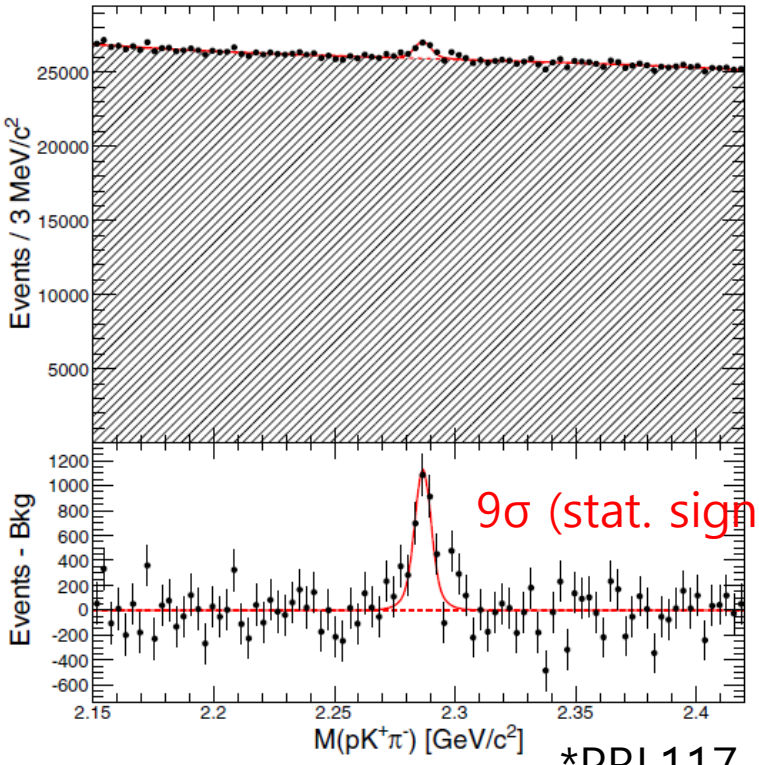
- The contribution of W-exchange channel can be extracted.

- Using the full data sample of Belle, 980 fb^{-1}, we clearly observed the DCS decay.

CF Decay, $\Lambda_c^+ \to pK^-\pi^+$



DCS Decay, $\Lambda_c^+ \to pK^+\pi^-$



9σ (stat. significance)

*PRL117, 011801

- $\frac{B(\Lambda_c^+ \to pK^+\pi^-)}{B(\Lambda_c^+ \to pK^-\pi^+)} = (2.35 \pm 0.27(Stat.) \pm 0.21(Syst.)) \times 10^{-3}$
- Comparing with the theoretical expectation (0.28%), the contribution of W-exchange channel is not large.

- The most precise measurement.

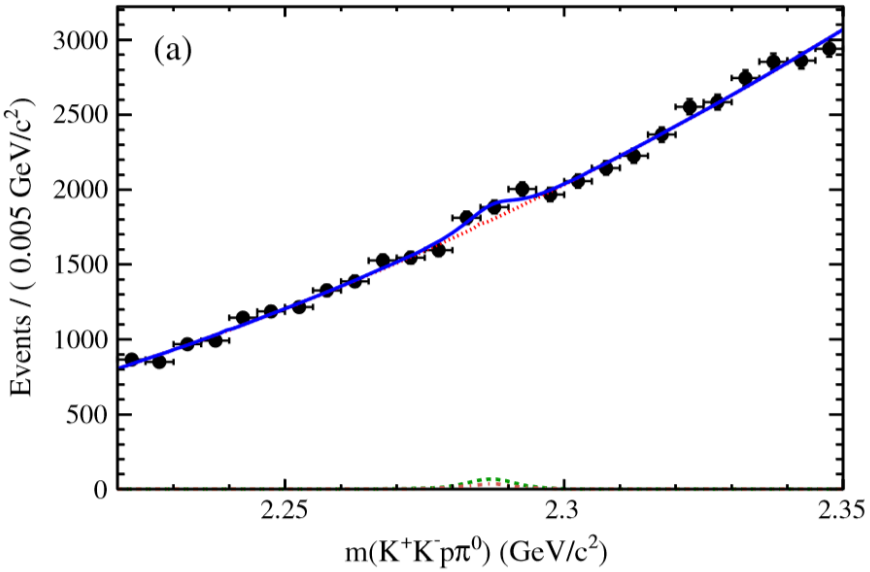
*PRD 98, 112006

Decay Ratio	Branching Fraction Ratio
$\frac{B(\Lambda_c^+ \to \Sigma^+\pi^-\pi^+)}{B(\Lambda_c^+ \to pK^-\pi^+)}$	0.719±0.003±0.024 *First measurement
$\frac{B(\Lambda_c^+ \to \Sigma^0\pi^+\pi^0)}{B(\Lambda_c^+ \to pK^-\pi^+)}$	0.575±0.005±0.036
$\frac{B(\Lambda_c^+ \to \Sigma^+\pi^0\pi^0)}{B(\Lambda_c^+ \to pK^-\pi^+)}$	0.247±0.006±0.019

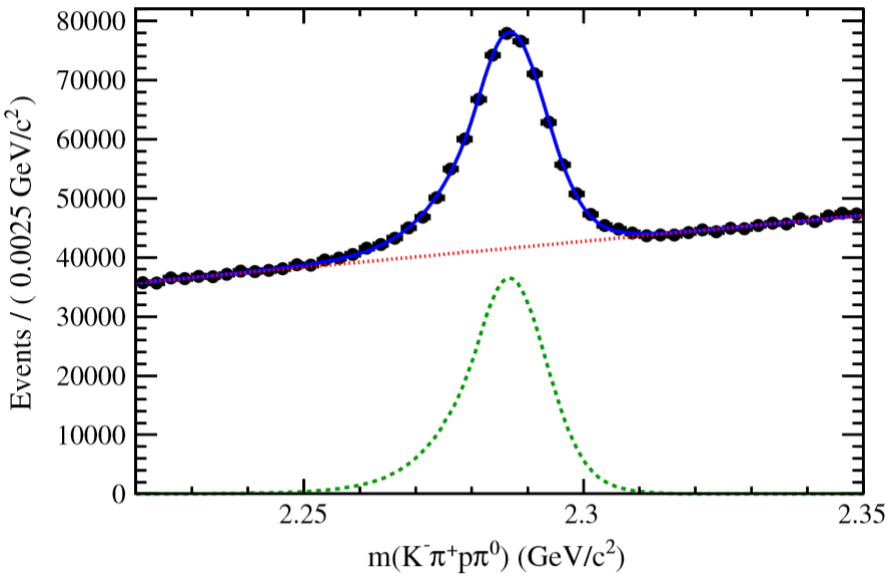
$\Lambda_c^+ \to K^-K^+p\pi^0$ and $\Lambda_c^+ \to pK^-\pi^+\pi^0$

- Hidden-strangeness pentaquark, $P_s^+(uuds\bar{s})$, search.
- 915 fb^{-1} data sample at or near the $\Upsilon(4S)$ and $\Upsilon(5S)$.

$\Lambda_c^+ \to K^-K^+p\pi^0$



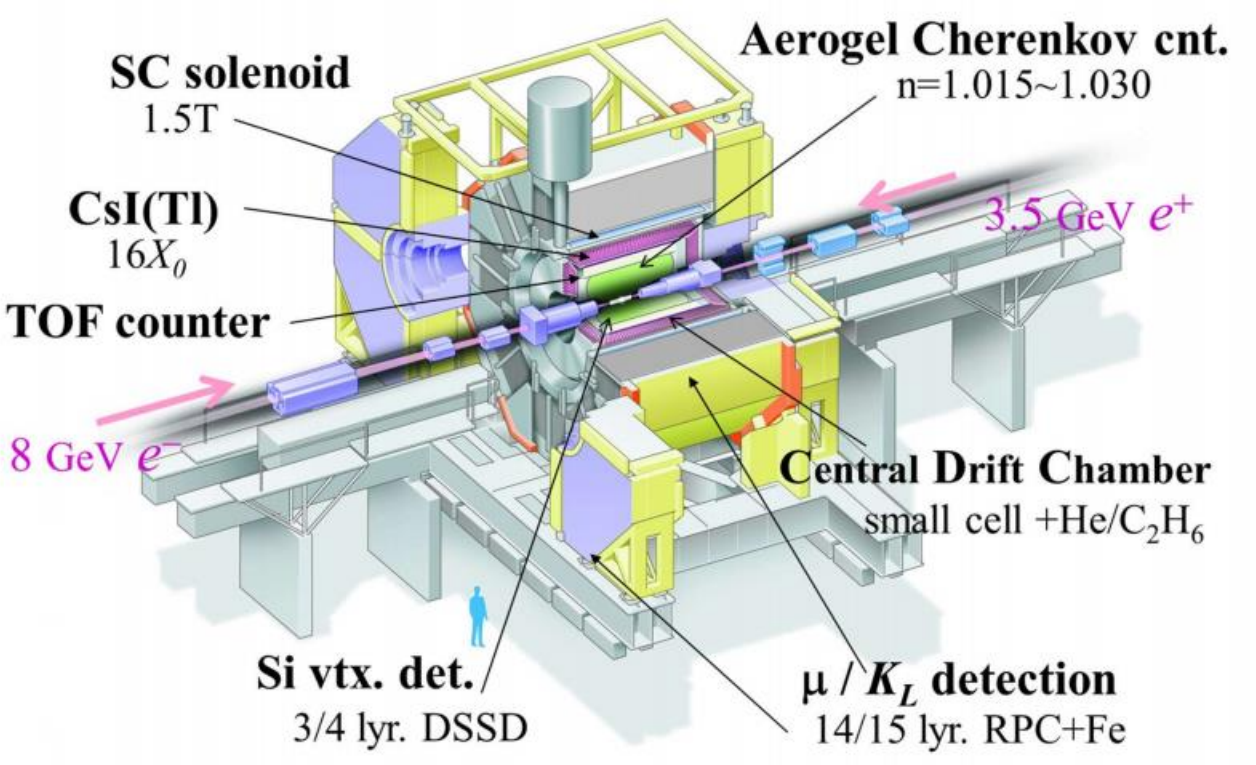
$\Lambda_c^+ \to pK^-\pi^+\pi^0$



*PRD 96, 051102(R)

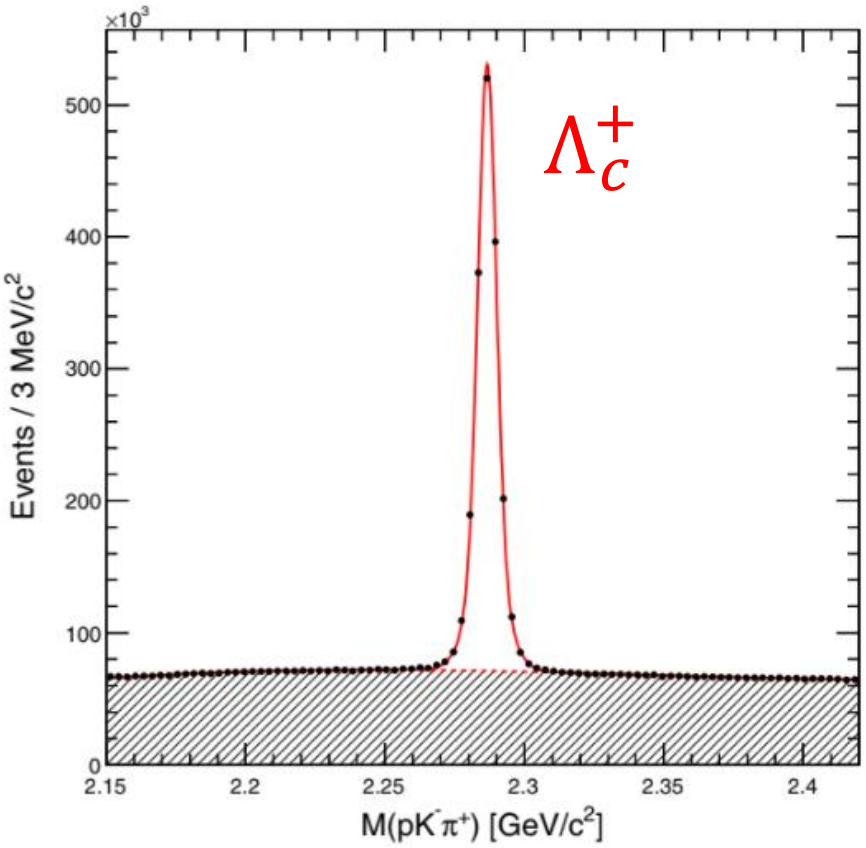
- $B(\Lambda_c^+ \to K^-K^+p\pi^0)_{NR} < 6.3 \times 10^{-5}$, first upper limit report (less than 3σ significance).
- $\frac{B(\Lambda_c^+ \to pK^-\pi^+\pi^0)}{B(\Lambda_c^+ \to pK^-\pi^+)}$ =0.685±0.007±0.018, the most precise measurement.

Belle Experiment



- Physics beamtime: 1999~2010 years
- $\sqrt{s}$= ~10.6 GeV
- Huge statistics, ~10^9 $B\bar{B}$ pairs, ~1 ab^{-1}integrated luminosity
- Charmed baryon production at Belle
  - B meson decay.
  - $e^+e^- \rightarrow c\bar{c}$, direct production of charmed baryons.

- Reconstruction of $\Lambda_c^+ \to pK^-\pi^+$ decay, huge statistics, ~1.5 M events
- Very high S/N ratio



→ Suitable and powerful data sample for charmed baryon study

- After 2019, several research results of charmed baryons are also reported.

Title	Address
Λ_c^+ Study	
Measurement of branching fractions of $\Lambda_c^+ \to \eta\Lambda\pi^+, \eta\Sigma^0\pi^+, \Lambda(1670)\pi^+$, and $\eta\Sigma(1385)^+$	Phys. Rev. D **103**, 052005 (2021)
Measurements of the branching fractions of $\Lambda_c^+ \to p\eta$ and $\Lambda_c^+ \to p\pi^0$ decays at Belle	Phys. Rev. D **103**, 072004 (2021)
$\Xi_c^{(*)}$ Study	
First Measurements of Absolute Branching Fractions of the Ξ_c^0 Baryon at Belle	Phys. Rev. Lett. **122**, 082001 (2019)
First Measurements of absolute branching fractions of the Ξ_c^+ baryon at Belle	Phys. Rev. D **100**, 031101(R) (2019)
First determination of the spin and parity of a charmed-strange baryon, $\Xi_c(2970)^+$	To appear in PRD, arXiv: 2007.14700
Study of Electromagnetic Decays of Orbitally Excited Ξ_c Baryons	Phys. Rev. D **102**, 071103(R) (2020)
Measurement of the Resonant and Non-Resonant Branching Ratios in Ξ_c^0 to $\Xi^0 K^+ K^-$	To appear in PRD, arXiv: 2012.05607
Measurements of the branching fractions of semileptonic decays $\Xi_c^0 \to \Xi^- l^+ \upsilon_l$ and asymmetry parameter of $\Xi_c^0 \to \Xi^- \pi^+$ decay	Submitted to PRL, arXiv: 2103.06496
Measurements of branching fractions and asymmetry parameters of $\Xi_c^0 \to \Lambda \bar{K}^{*0}$, $\Xi_c^0 \to \Sigma^0 \bar{K}^{*0}$, and $\Xi_c^0 \to \Sigma^+ \bar{K}^{*-}$ decays at Belle	To appear in JHEP, arXiv: 2104.10361
Hyperon Study in Charmed Baryon Decay	
Observation of $\Xi(1620)^0$ and evidence for $\Xi(1690)^0$ in $\Xi_c^+ \to \Xi^- \pi^+ \pi^+$ decays	Phys. Rev. Lett. **122**, 072501 (2019)
Charmed Baryon in B Decays	
Measurements of the branching fractions $\mathrm{B}(B^- \to \bar{\Lambda}_c^- \Xi_c'^0)$, $\mathrm{B}(B^- \to \bar{\Lambda}_c^- \Xi_c(2645)^0)$, and $\mathrm{B}(B^- \to \bar{\Lambda}_c^- \Xi_c(2790)^0)$	Phys. Rev. D **100**, 112010 (2019)

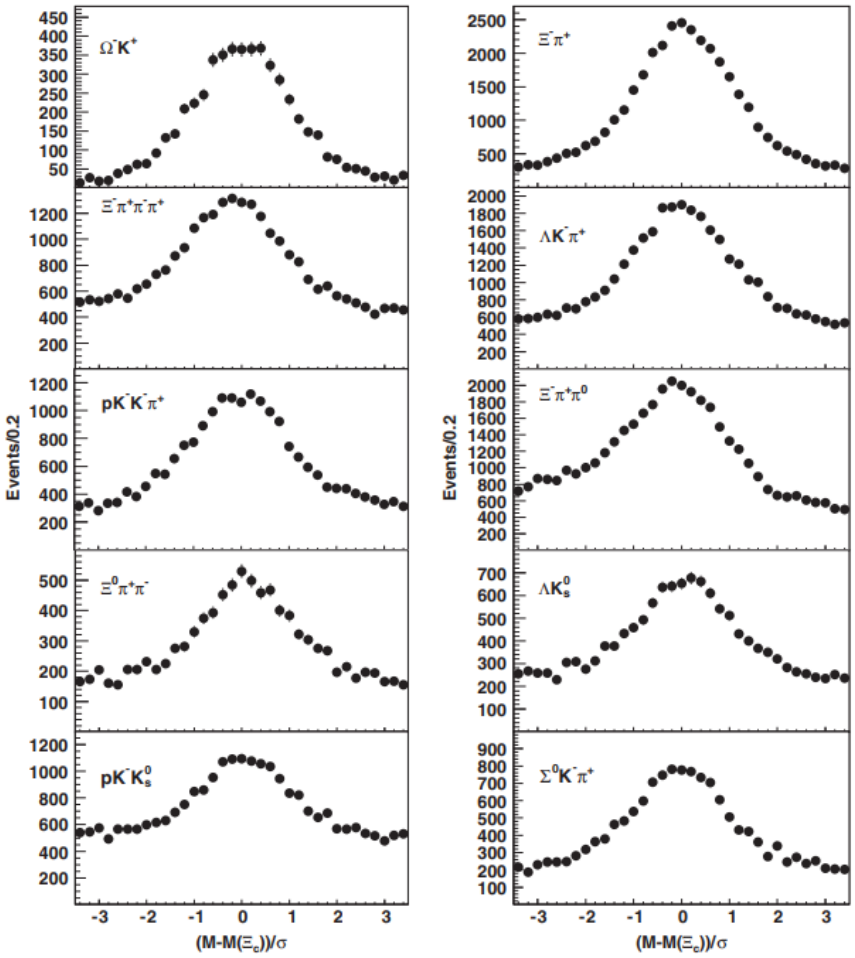
- Branching fraction measurements

Decay Mode	$\frac{B(\text{Decay Mode})}{B(\Lambda_c^+ \to pK^-\pi^+)}$
$\Lambda_c^+ \to \eta\Lambda\pi^+$	0.293±0.003±0.014
$\Lambda_c^+ \to \eta\Sigma^0\pi^+$	0.120±0.006±0.010
$\Lambda_c^+ \to \Lambda(1670)\pi^+$; $\Lambda(1670) \to \eta\Lambda$	$(5.54 \pm 0.29 \pm 0.73) \times 10^{-2}$
$\Lambda_c^+ \to \eta\Sigma(1385)^+$	0.192±0.006±0.016

Electromagnetic Decays of $\Xi_c(2790)$ and $\Xi_c(2815)$

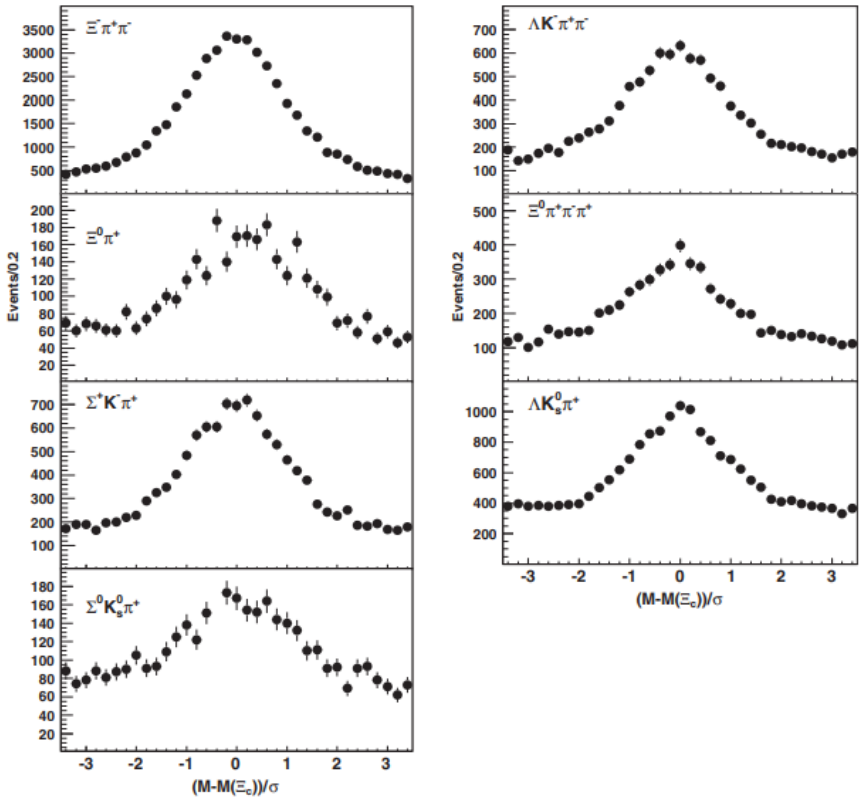
- Ξ_c reconstruction from various decay modes

Ξ_c^0 Reconstruction



Total: 101 K events

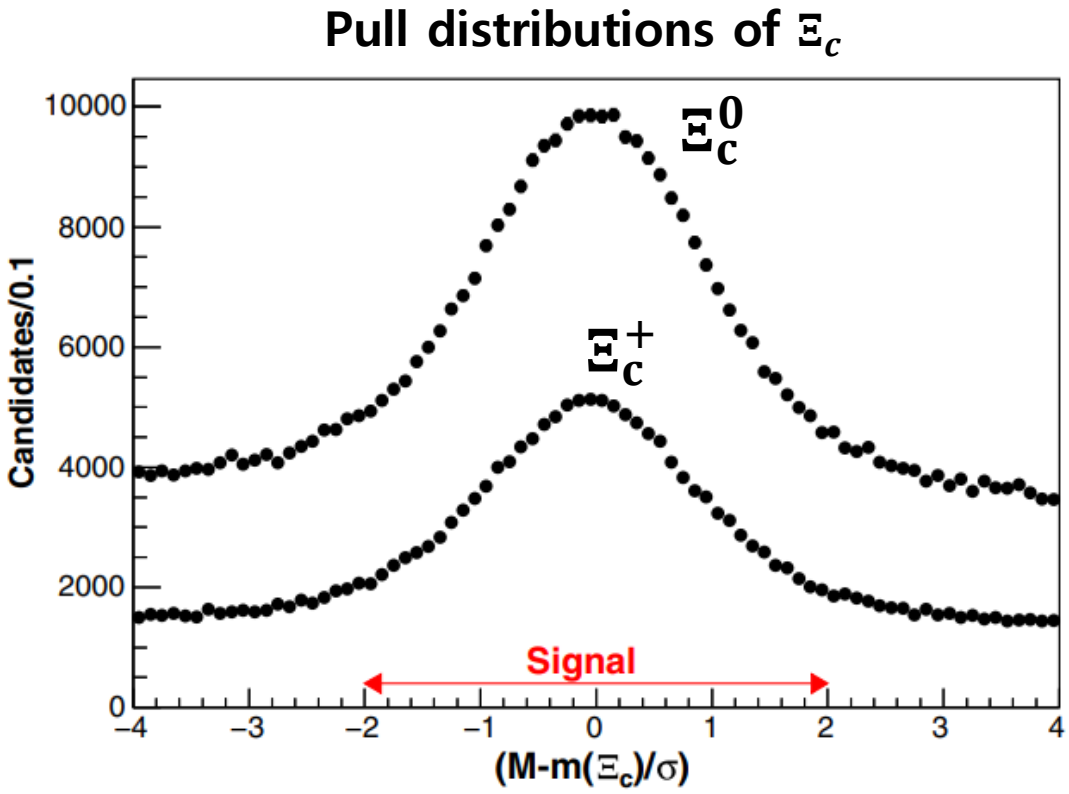
Ξ_c^+ Reconstruction



Total: 56 K events

*PRD 94, 052011

- Sum of all Ξ_c modes and Ξ_c selection range for $\Xi_c\gamma$



*PRD 102, 071103

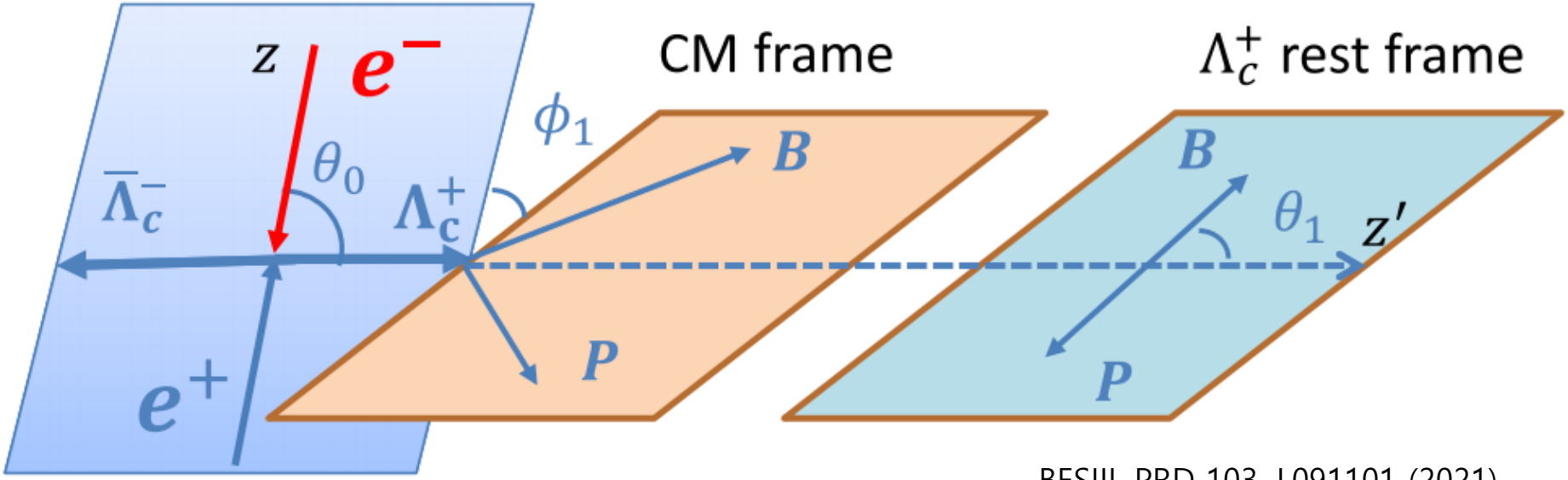
Branching Fractions of Ω_c^0 Decays

- Precise measurements of Ω_c^0 decay branching fractions.
- Using 980 fb^{-1} data sample.

*PRD 97 032001(R)

Decay Ratio ($/B(\Omega_c^0 \to \Omega^-\pi^+)$)	Branching Fraction Ratio
$B(\Omega_c^0 \to \Omega^-\pi^+\pi^0)$	2.00±0.17±0.11
$B(\Omega_c^0 \to \Omega^-\pi^+\pi^-\pi^+)$	0.32±0.05±0.02
$B(\Omega_c^0 \to \Xi^-\pi^+K^-\pi^+)$	0.68±0.07±0.03
$B(\Omega_c^0 \to \Xi^-K^-\pi^+)$	1.20±0.16±0.08
$B(\Omega_c^0 \to \Xi^-\bar{K}^0\pi^+)$	2.12±0.24±0.14
$B(\Omega_c^0 \to \Xi^0\bar{K}^0)$	1.64±0.26±0.12
$B(\Omega_c^0 \to \Lambda\bar{K}^0\bar{K}^0)$	1.72±0.32±0.14
$B(\Omega_c^0 \to \Sigma^+\mathrm{K}^-K^-\pi^+)$	<0.32

- Definition of helicity angles for Λ_c^+ spin



BESIII, PRD 103, L091101 (2021)