

Determination of spin of $\Xi_c(2815)$

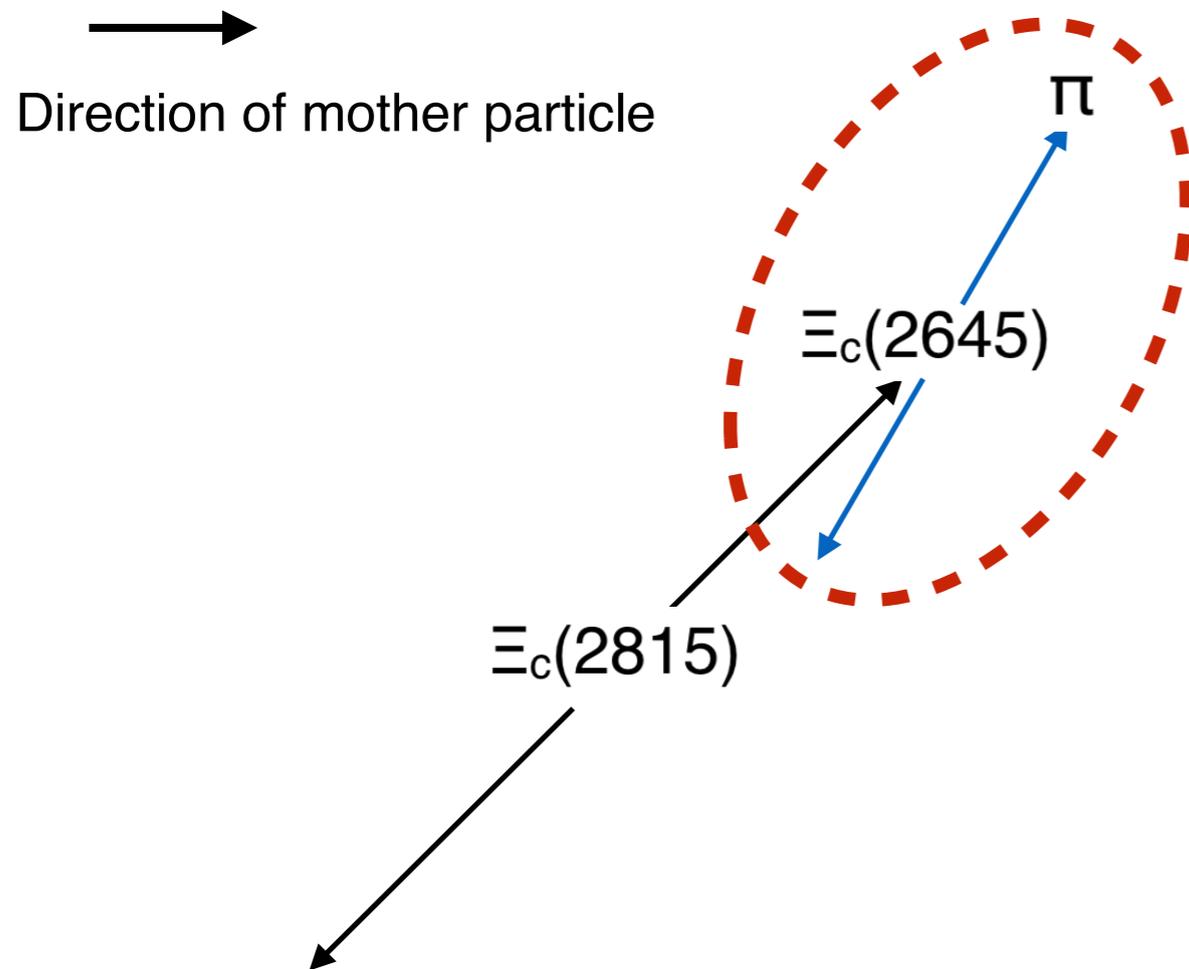
문태진

2016-12-21

$\Xi_c(2815)$

- $\Xi_c(2815) \rightarrow \Xi_c(2645) \pi$
- $\hookrightarrow \Xi_c \pi$
- $? \rightarrow 3/2 + 0$
- $\hookrightarrow 1/2 + 0$

Spin Determination



1) $3/2 \rightarrow 1/2 + 0$

$3/2 \rightarrow 1/2 + 0$

– $\lambda=1$ (P-wave)

$J_z=3/2 \rightarrow J_z'=1/2: m=\Delta J_z=1$

$W(\theta, \varphi) \propto |Y_{11}|^2 \propto \sin^2 \theta$

$J_z=1/2 \rightarrow J_z'=1/2, -1/2: m=\Delta J_z=0,1$ (weight by C-G coefficient)

$W(\theta, \varphi) \propto \frac{2}{3}|Y_{10}|^2 + \frac{1}{3}|Y_{11}|^2 \propto 3\cos^2 \theta + 1$

– $\lambda=2$ (D-wave)

$J_z=3/2 \rightarrow J_z'=\pm 1/2: m=\Delta J_z=1,2$

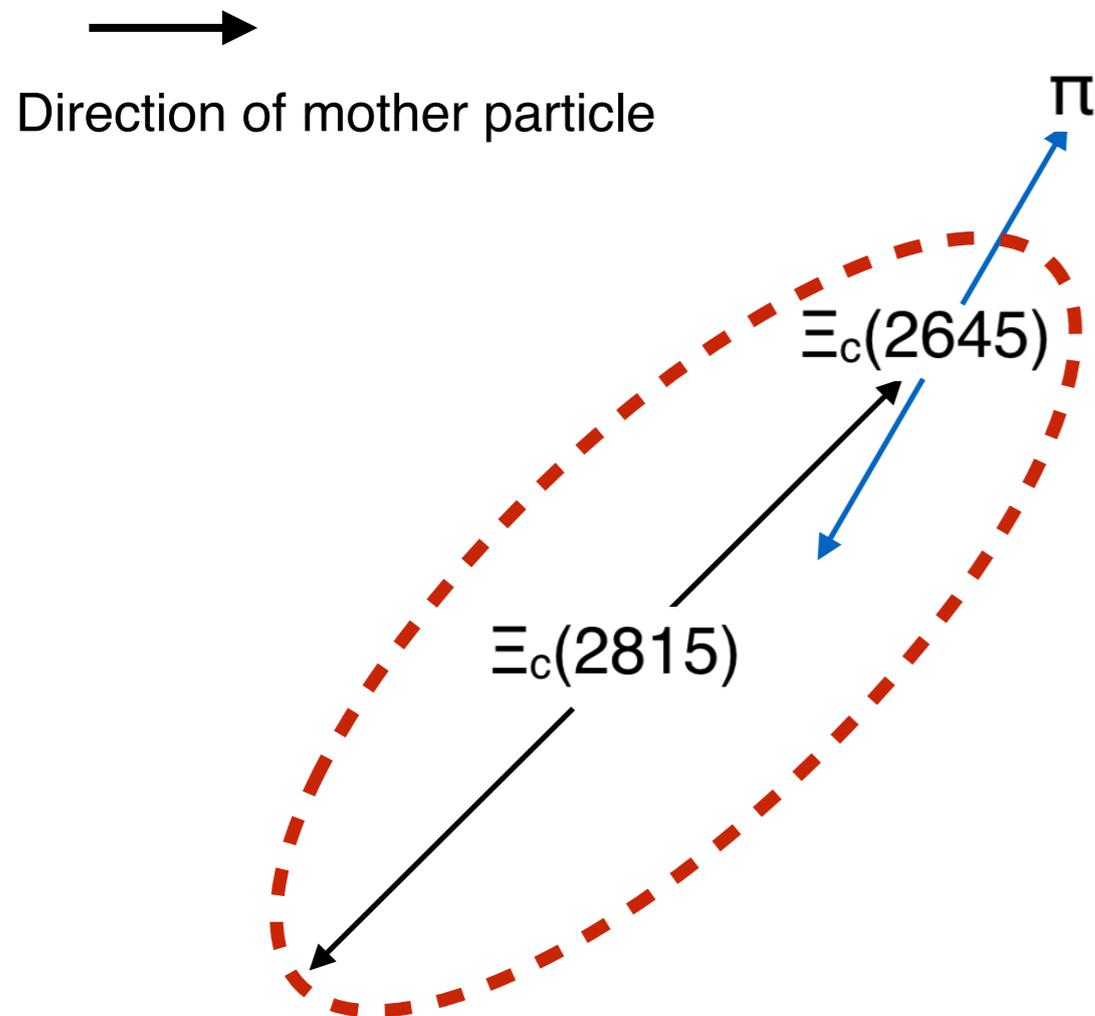
$W(\theta, \varphi) \propto \frac{1}{5}|Y_{21}|^2 + \frac{4}{5}|Y_{22}|^2 \propto \sin^2 \theta$

$J_z=1/2 \rightarrow J_z'=\pm 1/2: m=\Delta J_z=0,1$

$W(\theta, \varphi) \propto \frac{2}{5}|Y_{20}|^2 + \frac{3}{5}|Y_{21}|^2 \propto 3\cos^2 \theta + 1$

Secondary pion의 angular 분포를 통해 $\Xi_c(2645)$ 의 J_z 를 결정

Spin Determination



$$2) ? \rightarrow 3/2 + 0$$

$$3/2 \rightarrow 1/2 + 0$$

- $\lambda=1$ (P-wave)

$$J_z=3/2 \rightarrow J_z'=1/2: m=\Delta J_z=1$$

$$W(\theta, \varphi) \propto |Y_{11}|^2 \propto \sin^2 \theta$$

$$J_z=1/2 \rightarrow J_z'=1/2, -1/2: m=\Delta J_z=0,1 \text{ (weight by C-G coefficient)}$$

$$W(\theta, \varphi) \propto \frac{2}{3}|Y_{10}|^2 + \frac{1}{3}|Y_{11}|^2 \propto 3\cos^2 \theta + 1$$

- $\lambda=2$ (D-wave)

$$J_z=3/2 \rightarrow J_z'=\pm 1/2: m=\Delta J_z=1,2$$

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$$W(\theta, \varphi) \propto \frac{2}{5}|Y_{20}|^2 + \frac{3}{5}|Y_{21}|^2 \propto 3\cos^2 \theta + 1$$

- 앞서 결정된 $\Xi_c(2645)$ 의 J_z 값을 J_z' 으로 간주.
- 서로 다른 J_z 값들에 대해 가능한 한 분포를 얻을 수 있음.

- $\Xi_c(2815)$ 의 모멘텀 방향으로 quantization axis를 잡으면 그 방향으로서는 $L_z=0$.
- 다시 말해, $\Xi_c(2815)$ 은 $\Xi_c(2645)$ 의 spin projection과 같은 값을 갖는다.

Sensitivity

$\Lambda_c(2880)$

• $\Lambda_c(2880)^+ \rightarrow \Sigma_c(2455)^{0,++}\pi^{+,-} \rightarrow \Lambda_c \pi \pi$

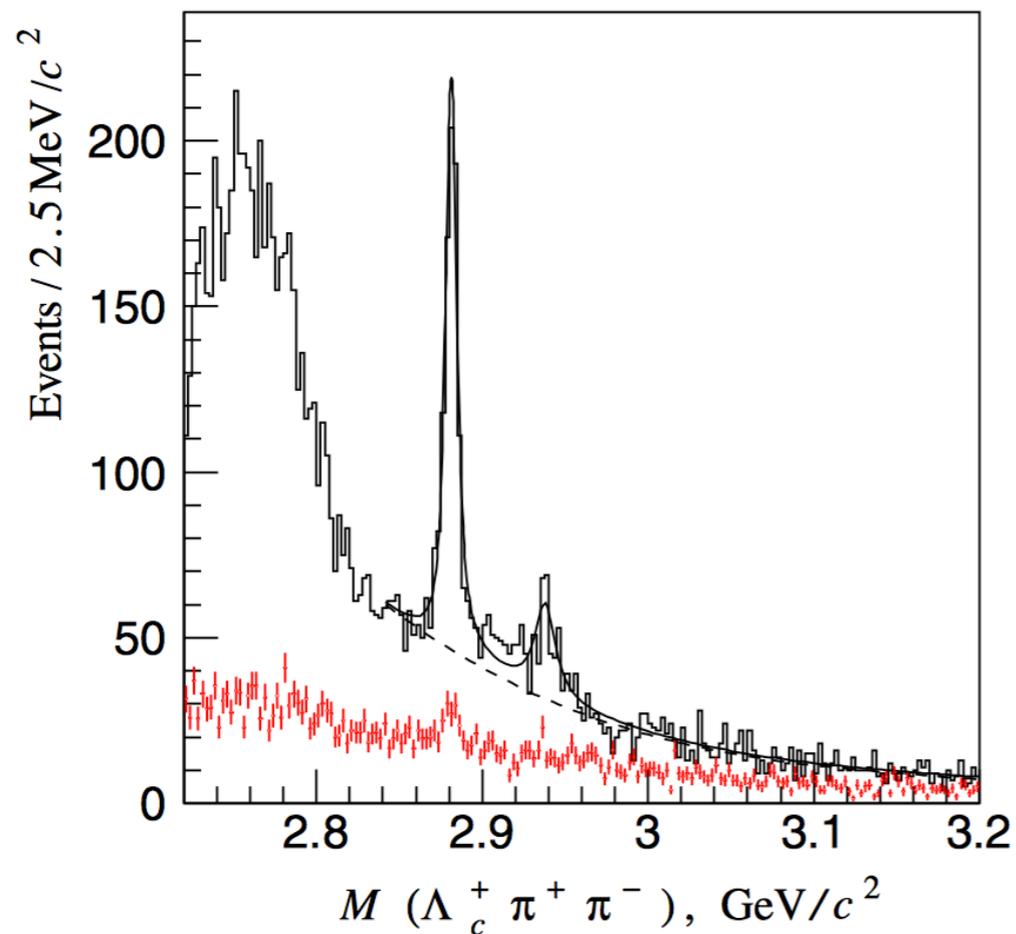


TABLE I. Signal yield, mass, and width for the $\Lambda_c(2880)^+$ and $\Lambda_c(2940)^+$. The first uncertainty is statistical, the second one systematic.

State	Yield	M (MeV/ c^2)	Γ (MeV)
$\Lambda_c(2880)^+$	690 ± 50	$2881.2 \pm 0.2 \pm 0.4$	$5.8 \pm 0.7 \pm 1.1$
$\Lambda_c(2940)^+$	220^{+80}_{-60}	$2938.0 \pm 1.3^{+2.0}_{-4.0}$	13^{+8+27}_{-5-7}

FIG. 1 (color online). The invariant mass of the $\Lambda_c^+ \pi^+ \pi^-$ combinations for the $\Sigma_c(2455)$ signal region (histogram) and scaled sidebands (dots with error bars). The fit result (solid curve) and its combinatorial component (dashed curve) are also presented.

$\Xi_c(2815)$

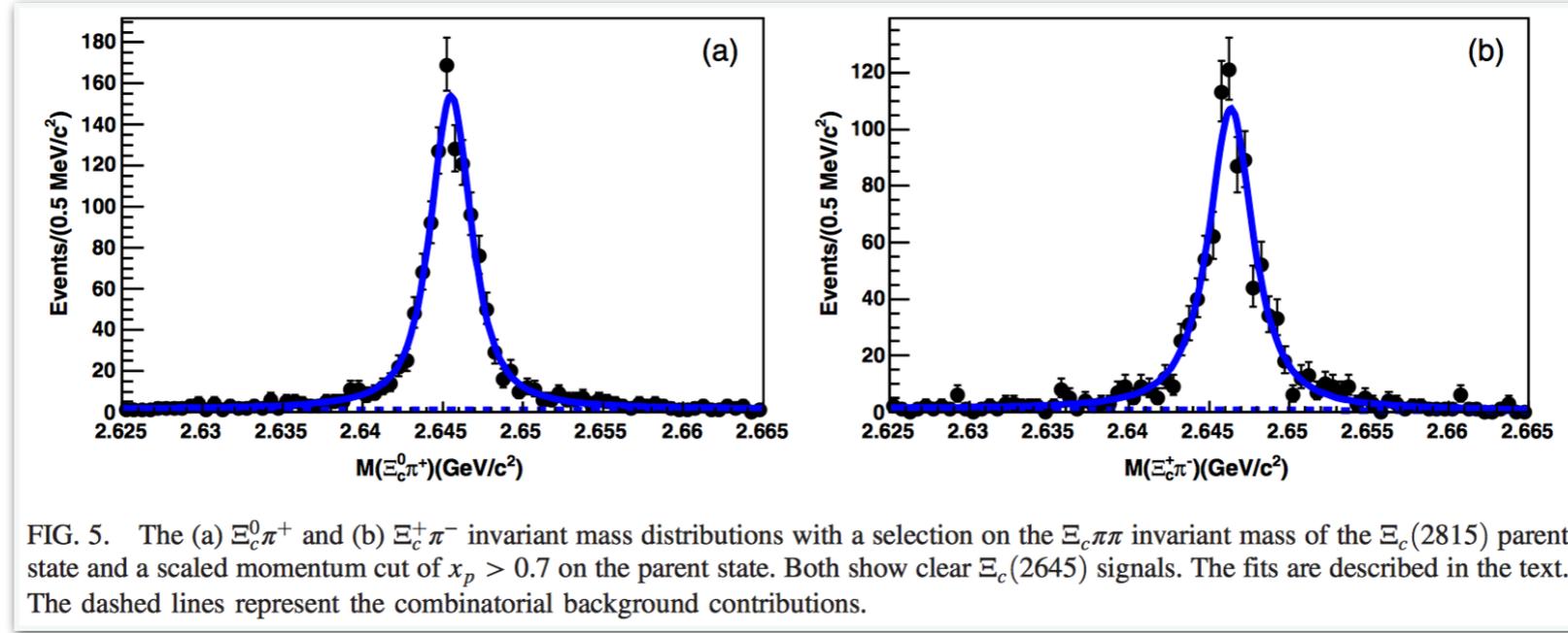


TABLE IV. The final results for the masses (in MeV/c^2) and widths (in MeV) for the five isodoublets under study. For comparison, the 2015 world averages [2] (denoted “PDG”) are also quoted. Mass differences are with respect to the daughter states.

Particle	Yield	Mass	$M - M(\Xi_c)$	$M - M(\Xi_c')$	Width
$\Xi_c(2645)^+$	1260 ± 40	$2645.58 \pm 0.06 \pm 0.07^{+0.28}_{-0.40}$	$174.66 \pm 0.06 \pm 0.07$		$2.06 \pm 0.13 \pm 0.13$
PDG		2645.9 ± 0.5	175.0 ± 0.6		$2.6 \pm 0.2 \pm 0.4$
$\Xi_c(2645)^0$	975 ± 36	$2646.43 \pm 0.07 \pm 0.07^{+0.28}_{-0.40}$	$178.46 \pm 0.07 \pm 0.07$		$2.35 \pm 0.18 \pm 0.13$
PDG		2645.9 ± 0.5	178.0 ± 0.6		< 5.5
$\Xi_c(2815)^+$	941 ± 35	$2816.73 \pm 0.08 \pm 0.06^{+0.28}_{-0.40}$	$348.80 \pm 0.08 \pm 0.06$		$2.43 \pm 0.20 \pm 0.17$
PDG		2816.6 ± 0.9	348.7 ± 0.9		< 3.5
$\Xi_c(2815)^0$	1258 ± 40	$2820.20 \pm 0.08 \pm 0.07^{+0.28}_{-0.40}$	$349.35 \pm 0.08 \pm 0.07$		$2.54 \pm 0.18 \pm 0.17$
PDG		2819.6 ± 1.2	348.8 ± 1.2		< 6.5