

# A new possible resonance at Belle

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# Progress

## 1. Belle Note

One chapter remaining before distribution  
(currently results are with only stat. err.)

## 2. Systematic errors are being evaluated

# Paper 1. Branching ratios

TABLE IX:  $\Gamma(\Lambda_c^+ \rightarrow \eta \Lambda \pi^+)$  and efficiency corrected yields for both  $\Lambda_c^+ \rightarrow \eta \Lambda \pi^+$  and  $\Lambda_c^+ \rightarrow p K^- \pi^+$  channels with statistical error only. For  $\Gamma(\eta \rightarrow \gamma \gamma)$ ,  $\Gamma(\Lambda \rightarrow p \pi^-)$  and  $\Gamma(\Lambda_c^+ \rightarrow p K^- \pi^+)$ , PDG 2018 [4] is referred.

Decay Mode	Yield	Efficiency Corrected Yield	$\frac{\Gamma(\Lambda_c^+ \rightarrow \eta \Lambda \pi^+)}{\Gamma(\Lambda_c^+ \rightarrow p K^- \pi^+)}$	$\Gamma(\Lambda_c^+ \rightarrow \eta \Lambda \pi^+)$
$\Lambda_c^+ \rightarrow \eta \Lambda \pi^+$	$51276 \pm 454$	$3182078 \pm 21024$	$0.294 \pm 0.003$	$1.83 \pm 0.02 \%$
$\Lambda_c^+ \rightarrow p K^- \pi^+$	$1544580 \pm 1552$	$8138064 \pm 11120$		

TABLE X:  $\Gamma(\Lambda_c^+ \rightarrow \eta \Sigma^0 \pi^+)$  and its efficiency corrected yields with statistical error only. For  $\Gamma(\eta \rightarrow \gamma \gamma)$ ,  $\Gamma(\Lambda \rightarrow p \pi^-)$  and  $\Gamma(\Sigma^0 \rightarrow \Lambda \gamma)$ , PDG 2018 [4] is referred.

Decay Mode	Yield	Efficiency	Efficiency Corrected Yield	$\frac{\Gamma(\Lambda_c^+ \rightarrow \eta \Sigma^0 \pi^+)}{\Gamma(\Lambda_c^+ \rightarrow p K^- \pi^+)}$	$\Gamma(\Lambda_c^+ \rightarrow \eta \Sigma^0 \pi^+)$
$\Lambda_c^+ \rightarrow \eta \Sigma^0 \pi^+$	$15001 \pm 534$	0.0577	$1033030 \pm 36775$	$0.106 \pm 0.004$	$0.662 \pm 0.024 \%$

$$\Gamma(\Lambda_c^+ \rightarrow \eta \Sigma(1385)^+)$$

can be determined

**$\Sigma(1385)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )	Confidence level
$\Gamma_1 \quad \Lambda \pi$	$(87.0 \pm 1.5) \%$	90%
$\Gamma_2 \quad \Sigma \pi$	$(11.7 \pm 1.5) \%$	
$\Gamma_3 \quad \Lambda \gamma$	$(1.25^{+0.13}_{-0.12}) \%$	
$\Gamma_4 \quad \Sigma^+ \gamma$	$(7.0 \pm 1.7) \times 10^{-3}$	
$\Gamma_5 \quad \Sigma^- \gamma$	$< 2.4 \times 10^{-4}$	
$\Gamma_6 \quad N \bar{K}$		

However

$$\Gamma(\Lambda_c^+ \rightarrow \Lambda^* \pi^+)$$

is difficult to determine

**$\Lambda(1670)$  DECAY MODES**

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1 \quad N \bar{K}$	20–30 %
$\Gamma_2 \quad \Sigma \pi$	25–55 %
$\Gamma_3 \quad \Lambda \eta$	10–25 %
$\Gamma_4 \quad \Sigma(1385) \pi, D\text{-wave}$	
$\Gamma_5 \quad N \bar{K}^*(892), S=1/2, S\text{-wave}$	
$\Gamma_6 \quad N \bar{K}^*(892), S=3/2, D\text{-wave}$	$(5 \pm 4) \%$

# Paper 2. Total Width of Lambda\*

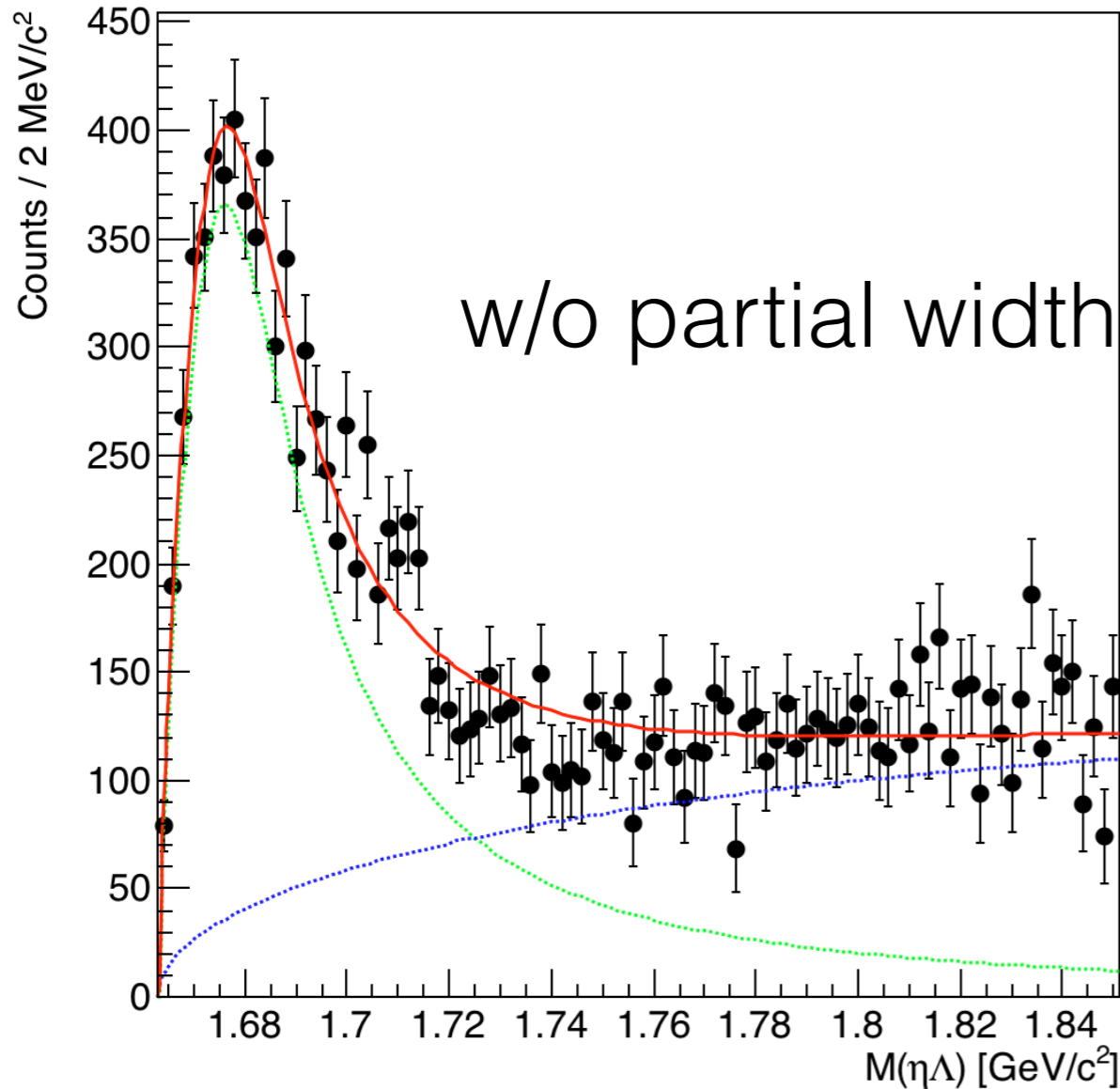
## $\Lambda(1670)$ WIDTH

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>25    to 50 (<math>\approx 35</math>) OUR ESTIMATE</b>			

## $\Lambda(1670)$ DECAY MODES

Mode		Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$	$N\bar{K}$	20–30 %
$\Gamma_2$	$\Sigma\pi$	25–55 %
$\Gamma_3$	$\Lambda\eta$	10–25 %
$\Gamma_4$	$\Sigma(1385)\pi$ , $D$ -wave	
$\Gamma_5$	$N\bar{K}^*(892)$ , $S=1/2$ , $S$ -wave	
$\Gamma_6$	$N\bar{K}^*(892)$ , $S=3/2$ , $D$ -wave	$(5\pm 4)\%$

# Eta + Lambda Channel Fitting

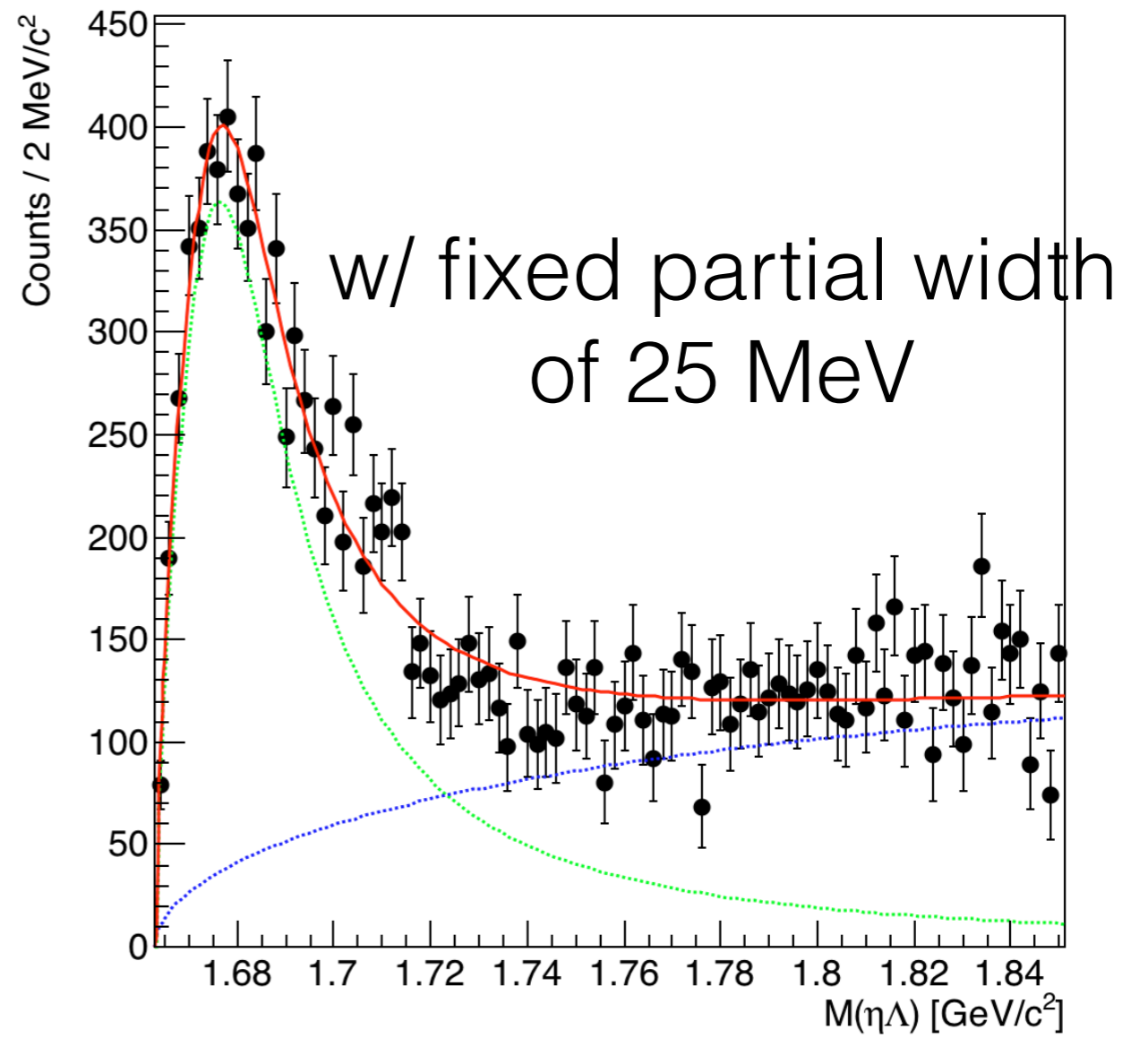


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RooFitResult: minimized FCN value: 97.8989, estimated
covariance matrix quality: Full, adequate
Status : MIGRAD=0 HESSE=0

Floating Parameter      FinalValue +/-      Error
-----
bg1_y                   7.4973e+03 +/-      3.00e+02
mean                    1.6809e+00 +/-      5.30e-04
sig1_y                  7.9425e+03 +/-      2.60e+02
width                   3.8506e-02 +/-      2.28e-03

reduced chi2 value directly:1.09692
chi2 from chi: 97.8989 nparam: 4 nbin: 94
reduced chi2: chi/(nbin-nparam+1) = 1.07581
[#1] INFO:Eval -- RooRealVar::setRange(rdE) new range
[#1] INFO:Eval -- RooRealVar::setRange(rdE) new range
[#1] INFO:NumericIntegration -- RooRealIntegral::init
[#1] INFO:NumericIntegration -- RooRealIntegral::init
late Int(rdE)
yield: 8742.54 error: 285.92
    
```



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RooFitResult: minimized FCN value: 97.2338, estimated
covariance matrix quality: Full, adequate
Status : MIGRAD=0 HESSE=0

Floating Parameter      FinalValue +/-      Error
-----
bg1_y                   7.6100e+03 +/-      2.90e+02
mean                    1.6764e+00 +/-      4.47e-04
sig1_y                  7.8275e+03 +/-      2.47e+02
width                   1.6569e-02 +/-      7.88e-04

reduced chi2 value directly:1.08218
chi2 from chi: 97.2338 nparam: 4 nbin: 94
reduced chi2: chi/(nbin-nparam+1) = 1.0685
[#1] INFO:Eval -- RooRealVar::setRange(rdE) new range
[#1] INFO:Eval -- RooRealVar::setRange(rdE) new range
[#1] INFO:NumericIntegration -- RooRealIntegral::init
[#1] INFO:NumericIntegration -- RooRealIntegral::init
late Int(rdE)
yield: 8763.98 error: 276.939
    
```