Discussion Topics

Content

- Cross section of baryon pairs
  - Baryon pairs production
  - Polarization …
- Missing excited baryons
- Parameters of baryons
  - Mass and width
  - Spin and Parity
  - Hadronic decay
- More topics …

Cross section of baryon pairs

$e^+e^- \to B\bar{B}$

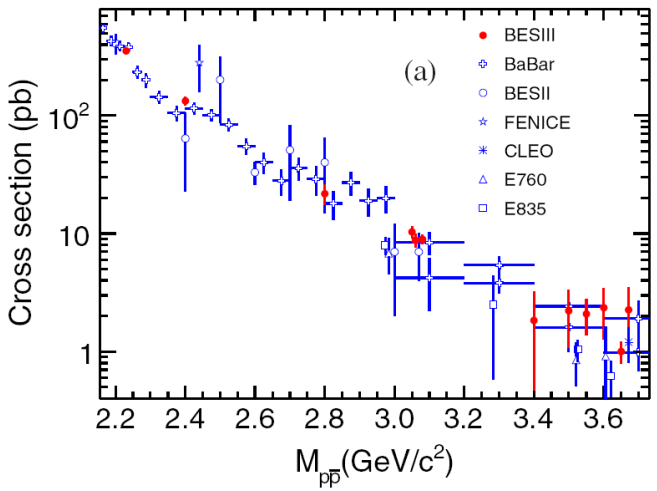
The Born cross section for the baryon pairs can be parametrized in terms of electromagnetic form factors (EMFFs), which are important observables for probing the inner structure of hadrons and for understanding the strong interaction.

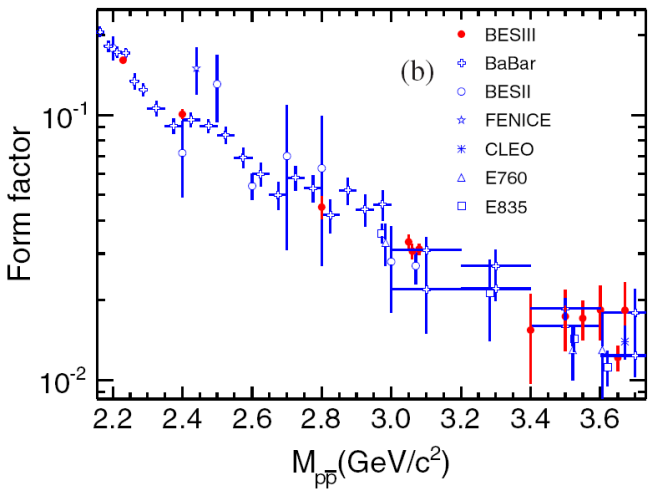
S=1/2

$$\sigma_{B\bar{B}}(s) = \frac{4\pi\alpha^2 C\beta}{3s}|G_M(s)|^2\left(1+\frac{2m_B^2c^4}{s}\left|\frac{G_E(s)}{G_M(s)}\right|^2\right).$$

Phys. Rev. D 91, 112004 (2015)

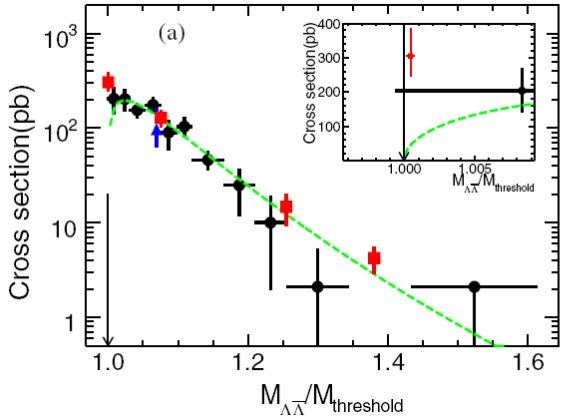
$e^+e^- \to p\bar{p}$

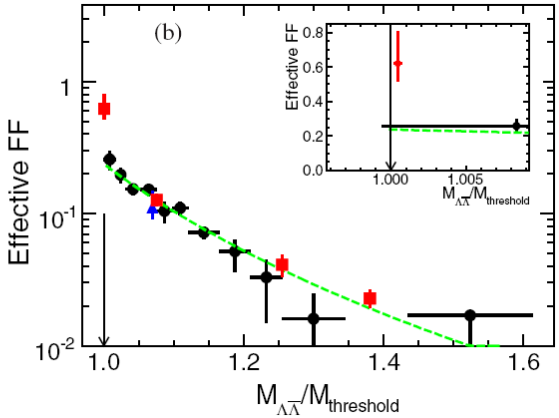




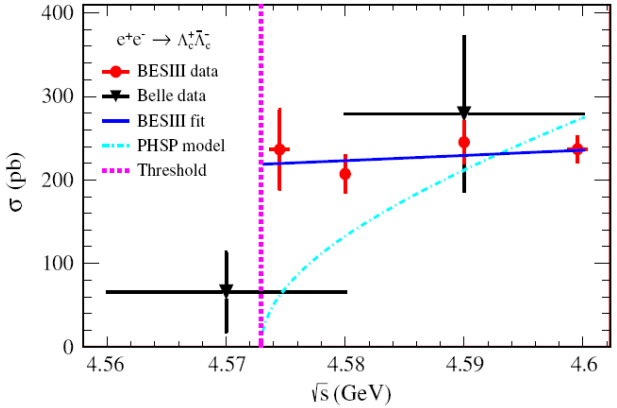
Cross section of Baryon pairs

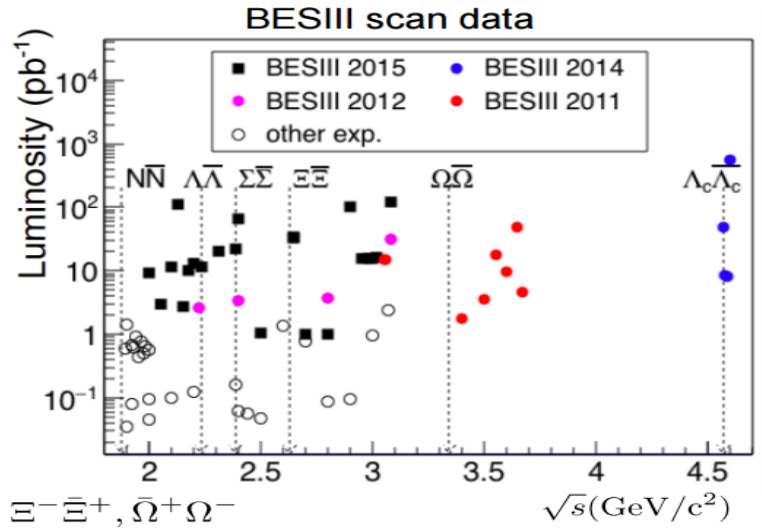
Phys. Rev. D 97, 032013 (2018)





Phys. Rev. Lett 120, 132001 (2018)



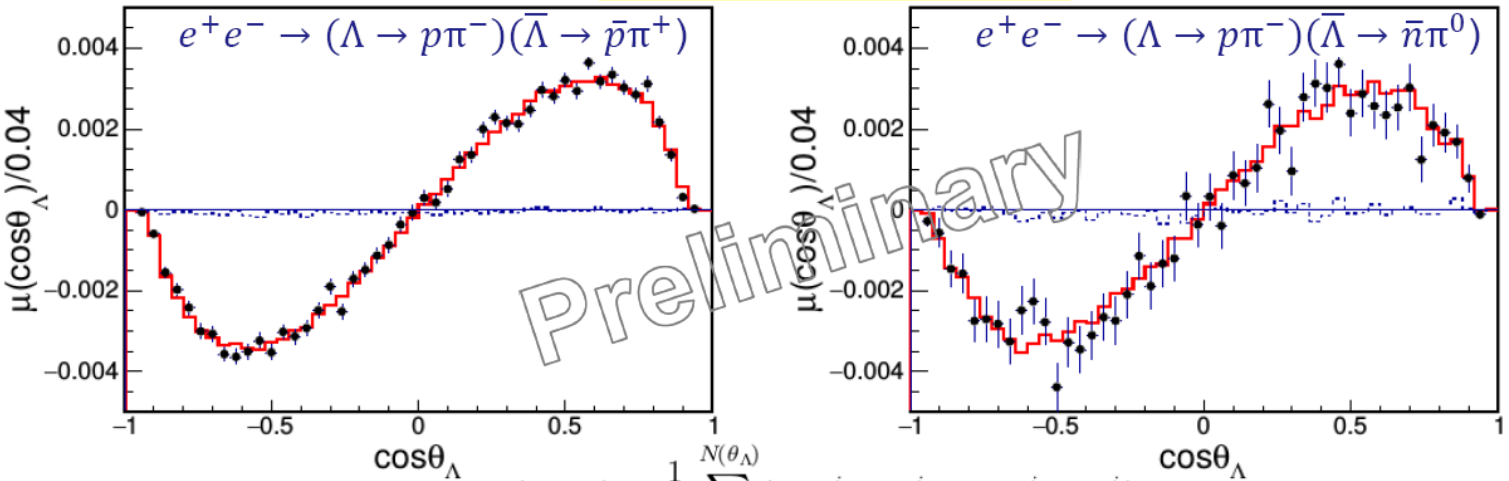


- BESIII has also measured the cross section of $\Lambda\bar{\Lambda}$ and $\Lambda_c^+\bar{\Lambda}_c^-$ in 2018.
- Ongoing measurements: $e^+e^- \to \Sigma\bar{\Sigma}$, $\Xi\bar{\Xi}$, and $\Omega\bar{\Omega}$.
- How to understand these measurements?

Spin Polarization in $J/\psi \to \Lambda\bar{\Lambda}$

$e^+e^- \to \gamma^* \to J/\psi \to \Lambda\bar{\Lambda}$

$\Delta\Phi$=42.3°±0.6°±0.5°



$$\mu(\cos\theta_\Lambda) = \frac{1}{N}\sum_{i}^{N(\theta_\Lambda)} (\sin\theta_1^i \sin\phi_1^i - \sin\theta_2^i \sin\phi_2^i)$$

Parameters	This work	Previous results	
α_ψ	$\mathbf{0.461 \pm 0.006 \pm 0.007}$	0.469 ± 0.027	BESIII
$\Delta\Phi$ (rad)	$\mathbf{0.740 \pm 0.010 \pm 0.008}$	–	
α_-	$\mathbf{0.750 \pm 0.009 \pm 0.004}$	0.642 ± 0.013	PDG
α_+	$\mathbf{-0.758 \pm 0.010 \pm 0.007}$	-0.71 ± 0.08	PDG
$\bar{\alpha}_0$	$\mathbf{-0.692 \pm 0.016 \pm 0.006}$	–	
A_{CP}	$\mathbf{-0.006 \pm 0.012 \pm 0.007}$	0.006 ± 0.021	PDG
$\bar{\alpha}_0/\alpha_+$	$\mathbf{0.913 \pm 0.028 \pm 0.012}$	–	

CP asymmetry:

$$A_{CP} = \frac{\alpha_- + \alpha_+}{\alpha_- - \alpha_+}$$

p	$1/2^+$	****	$\Delta(1232)$	$3/2^+$	****	Σ^+	$1/2^+$	****	Ξ^0	$1/2^+$	****	Λ_c^+	$1/2^+$	****
n	$1/2^+$	****	$\Delta(1600)$	$3/2^+$	***	Σ^0	$1/2^+$	****	Ξ^-	$1/2^+$	****	$\Lambda_c(2595)^+$	$1/2^-$	***
$N(1440)$	$1/2^+$	****	$\Delta(1620)$	$1/2^-$	****	Σ^-	$1/2^+$	****	$\Xi(1530)$	$3/2^+$	****	$\Lambda_c(2625)^+$	$3/2^-$	***
$N(1520)$	$3/2^-$	****	$\Delta(1700)$	$3/2^-$	****	$\Sigma(1385)$	$3/2^+$	****	$\Xi(1620)$		*	$\Lambda_c(2765)^+$		*
$N(1535)$	$1/2^-$	****	$\Delta(1750)$	$1/2^+$	*	$\Sigma(1480)$		*	$\Xi(1690)$		***	$\Lambda_c(2880)^+$	$5/2^+$	***
$N(1650)$	$1/2^-$	****	$\Delta(1900)$	$1/2^-$	**	$\Sigma(1560)$		**	$\Xi(1820)$	$3/2^-$	***	$\Lambda_c(2940)^+$		***
$N(1675)$	$5/2^-$	****	$\Delta(1905)$	$5/2^+$	****	$\Sigma(1580)$	$3/2^-$	*	$\Xi(1950)$		***	$\Sigma_c(2455)$	$1/2^+$	****
$N(1680)$	$5/2^+$	****	$\Delta(1910)$	$1/2^+$	****	$\Sigma(1620)$	$1/2^-$	*	$\Xi(2030)$	$\geq \frac{5}{2}$?	***	$\Sigma_c(2520)$	$3/2^+$	***
$N(1700)$	$3/2^-$	***	$\Delta(1920)$	$3/2^+$	***	$\Sigma(1660)$	$1/2^+$	***	$\Xi(2120)$		*	$\Sigma_c(2800)$		***
$N(1710)$	$1/2^+$	****	$\Delta(1930)$	$5/2^-$	***	$\Sigma(1670)$	$3/2^-$	****	$\Xi(2250)$		**	Ξ_c^+	$1/2^+$	***
$N(1720)$	$3/2^+$	****	$\Delta(1940)$	$3/2^-$	**	$\Sigma(1690)$		**	$\Xi(2370)$		**	Ξ_c^0	$1/2^+$	***
$N(1860)$	$5/2^+$	**	$\Delta(1950)$	$7/2^+$	****	$\Sigma(1730)$	$3/2^+$	*	$\Xi(2500)$		*	$\Xi_c'^+$	$1/2^+$	***
$N(1875)$	$3/2^-$	***	$\Delta(2000)$	$5/2^+$	**	$\Sigma(1750)$	$1/2^-$	***				$\Xi_c'^0$	$1/2^+$	***
$N(1880)$	$1/2^+$	**	$\Delta(2150)$	$1/2^-$	*	$\Sigma(1770)$	$1/2^+$	*	Ω^-	$3/2^+$	****	$\Xi_c(2645)$	$3/2^+$	***
$N(1895)$	$1/2^-$	**	$\Delta(2200)$	$7/2^-$	*	$\Sigma(1775)$	$5/2^-$	****	$\Omega(2250)^-$		***	$\Xi_c(2790)$	$1/2^-$	***
$N(1900)$	$3/2^+$	***	$\Delta(2300)$	$9/2^+$	**	$\Sigma(1840)$	$3/2^+$	*	$\Omega(2380)^-$		**	$\Xi_c(2815)$	$3/2^-$	***
$N(1990)$	$7/2^+$	**	$\Delta(2350)$	$5/2^-$	*	$\Sigma(1880)$	$1/2^+$	**	$\Omega(2470)^-$		**	$\Xi_c(2930)$		*
$N(2000)$	$5/2^+$	**	$\Delta(2390)$	$7/2^+$	*	$\Sigma(1900)$	$1/2^-$	*				$\Xi_c(2970)$		***
$N(2040)$	$3/2^+$	*	$\Delta(2400)$	$9/2^-$	**	$\Sigma(1915)$	$5/2^+$	****				$\Xi_c(3055)$		***
$N(2060)$	$5/2^-$	**	$\Delta(2420)$	$11/2^+$	****	$\Sigma(1940)$	$3/2^+$	*				$\Xi_c(3080)$		***
$N(2100)$	$1/2^+$	*	$\Delta(2750)$	$13/2^-$	**	$\Sigma(1940)$	$3/2^-$	***				$\Xi_c(3123)$		*
$N(2120)$	$3/2^-$	**	$\Delta(2950)$	$15/2^+$	**	$\Sigma(2000)$	$1/2^-$	*				Ω_c^0	$1/2^+$	***
$N(2190)$	$7/2^-$	****				$\Sigma(2030)$	$7/2^+$	****				$\Omega_c(2770)^0$	$3/2^+$	***
$N(2220)$	$9/2^+$	****	Λ	$1/2^+$	****	$\Sigma(2070)$	$5/2^+$	*						
$N(2250)$	$9/2^-$	****	$\Lambda(1405)$	$1/2^-$	****	$\Sigma(2080)$	$3/2^+$	**				Ξ_{cc}^+		*
$N(2300)$	$1/2^+$	**	$\Lambda(1520)$	$3/2^-$	****	$\Sigma(2100)$	$7/2^-$	*						
$N(2570)$	$5/2^-$	**	$\Lambda(1600)$	$1/2^+$	***	$\Sigma(2250)$		***				Λ_b^0	$1/2^+$	***
$N(2600)$	$11/2^-$	***	$\Lambda(1670)$	$1/2^-$	****	$\Sigma(2455)$		**				$\Lambda_b(5912)^0$	$1/2^-$	***
$N(2700)$	$13/2^+$	**	$\Lambda(1690)$	$3/2^-$	****	$\Sigma(2620)$		**				$\Lambda_b(5920)^0$	$3/2^-$	***
			$\Lambda(1710)$	$1/2^+$	*	$\Sigma(3000)$		*				Σ_b	$1/2^+$	***
			$\Lambda(1800)$	$1/2^-$	***	$\Sigma(3170)$		*				Σ_b^*	$3/2^+$	***
			$\Lambda(1810)$	$1/2^+$	***							Ξ_b^0, Ξ_b^-	$1/2^+$	***
			$\Lambda(1820)$	$5/2^+$	****							$\Xi_b'(5935)^-$	$1/2^+$	***
			$\Lambda(1830)$	$5/2^-$	****							$\Xi_b(5945)^0$	$3/2^+$	***
			$\Lambda(1890)$	$3/2^+$	****							$\Xi_b^*(5955)^-$	$3/2^+$	***
			$\Lambda(2000)$		*							Ω_b^-	$1/2^+$	***
			$\Lambda(2020)$	$7/2^+$	*									
			$\Lambda(2050)$	$3/2^-$	*							$P_c(4380)^+$		*
			$\Lambda(2100)$	$7/2^-$	****							$P_c(4450)^+$		*
			$\Lambda(2110)$	$5/2^+$	***									
			$\Lambda(2325)$	$3/2^-$	*									
			$\Lambda(2350)$	$9/2^+$	***									
			$\Lambda(2585)$		**									

Missing excited baryons

Table 15.5: N and Δ states in the N=0,1,2 harmonic oscillator bands. L^P denotes angular momentum and parity, S the three-quark spin and 'sym'=A,S,M the symmetry of the spatial wave function. Only dominant components indicated. Assignments in the N=2 band are partly tentative.

N	sym	L^P	S	$N(I=1/2)$				$\Delta(I=3/2)$			
2	A	1^+	1/2	$1/2^+$	$3/2^+$						
2	M	2^+	3/2	$1/2^+$	$3/2^+$	$5/2^+$	$7/2^+$				
2	M	2^+	1/2		$3/2^+$	$5/2^+$			$3/2^+$	$5/2^+$	
2	M	0^+	3/2		$3/2^+$						
2	M	0^+	1/2	$1/2^+$				$1/2^+$			
				$N(1710)$				$\Delta(1750)$			
2	S	2^+	3/2					$1/2^+$	$3/2^+$	$5/2^+$	$7/2^+$
								$\Delta(1910)$	$\Delta(1920)$	$\Delta(1905)$	$\Delta(1950)$
2	S	2^+	1/2		$3/2^+$	$5/2^+$					
					$N(1720)$	$N(1680)$					
2	S	0^+	3/2						$3/2^+$		
									$\Delta(1600)$		
2	S	0^+	1/2	$1/2^+$							
				$N(1440)$							
1	M	1^-	3/2	$1/2^-$	$3/2^-$	$5/2^-$					
				$N(1650)$	$N(1700)$	$N(1675)$					
1	M	1^-	1/2	$1/2^-$	$3/2^-$			$1/2^-$	$3/2^-$		
				$N(1535)$	$N(1520)$			$\Delta(1620)$	$\Delta(1700)$		
0	S	0^+	3/2						$3/2^+$		
									$\Delta(1232)$		
0	S	0^+	1/2	$1/2^+$							
				$N(938)$							

Table 15.6: Quark-model assignments for some of the known baryons in terms of a flavor-spin SU(6) basis. Only the dominant representation is listed. Assignments for several states, especially for the $\Lambda(1810)$, $\Lambda(2350)$, $\Xi(1820)$, and $\Xi(2030)$, are merely educated guesses. † recent suggestions for assignments and re-assignments from Ref. 37. For assignments of the charmed baryons, see the "Note on Charmed Baryons" in the Particle Listings.

J^P	$(D, L_N^P)\,S$	Octet members			Singlets
$1/2^+$	$(56,0_0^+)$ $1/2\,N(939)$	$\Lambda(1116)$	$\Sigma(1193)$	$\Xi(1318)$	
$1/2^+$	$(56,0_2^+)$ $1/2\,N(1440)$	$\Lambda(1600)$	$\Sigma(1660)$	$\Xi(1690)^\dagger$	
$1/2^-$	$(70,1_1^-)$ $1/2\,N(1535)$	$\Lambda(1670)$	$\Sigma(1620)$	$\Xi(?)$	$\Lambda(1405)$
			$\Sigma(1560)^\dagger$		
$3/2^-$	$(70,1_1^-)$ $1/2\,N(1520)$	$\Lambda(1690)$	$\Sigma(1670)$	$\Xi(1820)$	$\Lambda(1520)$
$1/2^-$	$(70,1_1^-)$ $3/2\,N(1650)$	$\Lambda(1800)$	$\Sigma(1750)$	$\Xi(?)$	
			$\Sigma(1620)^\dagger$		
$3/2^-$	$(70,1_1^-)$ $3/2\,N(1700)$	$\Lambda(?)$	$\Sigma(1940)^\dagger$	$\Xi(?)$	
$5/2^-$	$(70,1_1^-)$ $3/2\,N(1675)$	$\Lambda(1830)$	$\Sigma(1775)$	$\Xi(1950)^\dagger$	
$1/2^+$	$(70,0_2^+)$ $1/2\,N(1710)$	$\Lambda(1810)$	$\Sigma(1880)$	$\Xi(?)$	$\Lambda(1810)^\dagger$
$3/2^+$	$(56,2_2^+)$ $1/2\,N(1720)$	$\Lambda(1890)$	$\Sigma(?)$	$\Xi(?)$	
$5/2^+$	$(56,2_2^+)$ $1/2\,N(1680)$	$\Lambda(1820)$	$\Sigma(1915)$	$\Xi(2030)$	
$7/2^-$	$(70,3_3^-)$ $1/2\,N(2190)$	$\Lambda(?)$	$\Sigma(?)$	$\Xi(?)$	$\Lambda(2100)$
$9/2^-$	$(70,3_3^-)$ $3/2\,N(2250)$	$\Lambda(?)$	$\Sigma(?)$	$\Xi(?)$	
$9/2^+$	$(56,4_4^+)$ $1/2\,N(2220)$	$\Lambda(2350)$	$\Sigma(?)$	$\Xi(?)$	
	Decuplet members				
$3/2^+$	$(56,0_0^+)$ $3/2\,\Delta(1232)$	$\Sigma(1385)$	$\Xi(1530)$	$\Omega(1672)$	
$3/2^+$	$(56,0_2^+)$ $3/2\,\Delta(1600)$	$\Sigma(1690)^\dagger$	$\Xi(?)$	$\Omega(?)$	
$1/2^-$	$(70,1_1^-)$ $1/2\,\Delta(1620)$	$\Sigma(1750)^\dagger$	$\Xi(?)$	$\Omega(?)$	
$3/2^-$	$(70,1_1^-)$ $1/2\,\Delta(1700)$	$\Sigma(?)$	$\Xi(?)$	$\Omega(?)$	
$5/2^+$	$(56,2_2^+)$ $3/2\,\Delta(1905)$	$\Sigma(?)$	$\Xi(?)$	$\Omega(?)$	
$7/2^+$	$(56,2_2^+)$ $3/2\,\Delta(1950)$	$\Sigma(2030)$	$\Xi(?)$	$\Omega(?)$	
$11/2^+$	$(56,4_4^+)$ $3/2\,\Delta(2420)$	$\Sigma(?)$	$\Xi(?)$	$\Omega(?)$	

Parameters of baryons

			Status as seen in								
Particle	J^P	overall	$N\gamma$	$N\pi$	$N\eta$	$N\sigma$	$N\omega$	ΛK	ΣK	$N\rho$	$\Delta\pi$
N	$1/2^+$	****									
$N(1440)$	$1/2^+$	****	****	****		***				*	***
$N(1520)$	$3/2^-$	****	****	****	***					***	***
$N(1535)$	$1/2^-$	****	****	****	****					**	*
$N(1650)$	$1/2^-$	****	****	****	***			***	**	**	***
$N(1675)$	$5/2^-$	****	****	****	*			*		*	***
$N(1680)$	$5/2^+$	****	****	****	*	**				***	***
$N(1700)$	$3/2^-$	***	**	***	*			*	*	*	***
$N(1710)$	$1/2^+$	****	****	****	***		**	****	**	*	**
$N(1720)$	$3/2^+$	****	****	****	***			**	**	**	*
$N(1860)$	$5/2^+$	**		**						*	*
$N(1875)$	$3/2^-$	***	***	*			**	***	**		***
$N(1880)$	$1/2^+$	**	*	*		**		*			
$N(1895)$	$1/2^-$	**	**	*	**			**	*		
$N(1900)$	$3/2^+$	***	***	**	**		**	***	**	*	**
$N(1990)$	$7/2^+$	**	**	**					*		
$N(2000)$	$5/2^+$	**	**	*	**			**	*	**	
$N(2040)$	$3/2^+$	*		*							
$N(2060)$	$5/2^-$	**	**	**	*				**		
$N(2100)$	$1/2^+$	*		*							
$N(2120)$	$3/2^-$	**	**	**				*	*		
$N(2190)$	$7/2^-$	****	***	****			*	**		*	
$N(2220)$	$9/2^+$	****		****							
$N(2250)$	$9/2^-$	****		****							
$N(2300)$	$1/2^+$	**		**							
$N(2570)$	$5/2^-$	**		**							
$N(2600)$	$11/2^-$	***		***							
$N(2700)$	$13/2^+$	**		**							

			Status as seen in								
Particle	J^P	overall	$N\gamma$	$N\pi$	$N\eta$	$N\sigma$	$N\omega$	ΛK	ΣK	$N\rho$	$\Delta\pi$
$\Delta(1232)$	$3/2^+$	****	****	****	F						
$\Delta(1600)$	$3/2^+$	***	***	***	o					*	***
$\Delta(1620)$	$1/2^-$	****	***	****	r					***	***
$\Delta(1700)$	$3/2^-$	****	****	****	b					**	***
$\Delta(1750)$	$1/2^+$	*		*	i						
$\Delta(1900)$	$1/2^-$	**	**	**		d			**	**	**
$\Delta(1905)$	$5/2^+$	****	****	****			d		***	**	**
$\Delta(1910)$	$1/2^+$	****	**	****				e	*	*	**
$\Delta(1920)$	$3/2^+$	***	**	***				n	***		**
$\Delta(1930)$	$5/2^-$	***		***							
$\Delta(1940)$	$3/2^-$	**	**	*	F						
$\Delta(1950)$	$7/2^+$	****	****	****	o				***	*	***
$\Delta(2000)$	$5/2^+$	**			r						**
$\Delta(2150)$	$1/2^-$	*		*	b						
$\Delta(2200)$	$7/2^-$	*		*	i						
$\Delta(2300)$	$9/2^+$	**		**		d					
$\Delta(2350)$	$5/2^-$	*		*			d				
$\Delta(2390)$	$7/2^+$	*		*				e			
$\Delta(2400)$	$9/2^-$	**		**				n			
$\Delta(2420)$	$11/2^+$	****	*	****							
$\Delta(2750)$	$13/2^-$	**		**							
$\Delta(2950)$	$15/2^+$	**		**							

Parameters of baryons

Particle	J^P	Overall status	Status as seen in — $N\overline{K}$	$\Lambda\pi$	$\Sigma\pi$	Other channels
$\Lambda(1116)$	1/2+	****		F		$N\pi$(weakly)
$\Lambda(1405)$	1/2−	****	****	o	****	
$\Lambda(1520)$	3/2−	****	****	r	****	$\Lambda\pi\pi, \Lambda\gamma$
$\Lambda(1600)$	1/2+	***	***	b	**	
$\Lambda(1670)$	1/2−	****	****	i	****	$\Lambda\eta$
$\Lambda(1690)$	3/2−	****	****	d	****	$\Lambda\pi\pi, \Sigma\pi\pi$
$\Lambda(1800)$	1/2−	***	***	d	**	$N\overline{K}^*, \Sigma(1385)\pi$
$\Lambda(1810)$	1/2+	***	***	e	**	$N\overline{K}^*$
$\Lambda(1820)$	5/2+	****	****	n	****	$\Sigma(1385)\pi$
$\Lambda(1830)$	5/2−	****	***	F	****	$\Sigma(1385)\pi$
$\Lambda(1890)$	3/2+	****	****	o	**	$N\overline{K}^*, \Sigma(1385)\pi$
$\Lambda(2000)$		*		r	*	$\Lambda\omega, N\overline{K}^*$
$\Lambda(2020)$	7/2+	*	*	b	*	
$\Lambda(2100)$	7/2−	****	****	i	***	$\Lambda\omega, N\overline{K}^*$
$\Lambda(2110)$	5/2+	***	**	d	*	$\Lambda\omega, N\overline{K}^*$
$\Lambda(2325)$	3/2−	*	*	d		$\Lambda\omega$
$\Lambda(2350)$		***	***	e	*	
$\Lambda(2585)$		**	**	n		
$\Sigma(1193)$	1/2+	****				$N\pi$(weakly)
$\Sigma(1385)$	3/2+	****		****	****	
$\Sigma(1480)$		*	*	*	*	
$\Sigma(1560)$		**		**	**	
$\Sigma(1580)$	3/2−	*	*	*		
$\Sigma(1620)$	1/2−	**	**	*	*	
$\Sigma(1660)$	1/2+	***	***	*	**	
$\Sigma(1670)$	3/2−	****	****	****	****	several others
$\Sigma(1690)$		**	*	**	*	$\Lambda\pi\pi$
$\Sigma(1750)$	1/2−	***	***	**	*	$\Sigma\eta$
$\Sigma(1770)$	1/2+	*				
$\Sigma(1775)$	5/2−	****	****	****	***	several others
$\Sigma(1840)$	3/2+	*	*	**	*	
$\Sigma(1880)$	1/2+	**	**	**		$N\overline{K}^*$
$\Sigma(1915)$	5/2+	****	***	****	***	$\Sigma(1385)\pi$
$\Sigma(1940)$	3/2−	***	*	***	**	quasi-2-body
$\Sigma(2000)$	1/2−	*		*		$N\overline{K}^*, \Lambda(1520)\pi$
$\Sigma(2030)$	7/2+	****	****	****	**	several others
$\Sigma(2070)$	5/2+	*	*		*	
$\Sigma(2080)$	3/2+	**		**		
$\Sigma(2100)$	7/2−	*		*	*	
$\Sigma(2250)$		***	***	*	*	
$\Sigma(2455)$		**	*			
$\Sigma(2620)$		**	*			
$\Sigma(3000)$		*	*	*		
$\Sigma(3170)$		*				multi-body

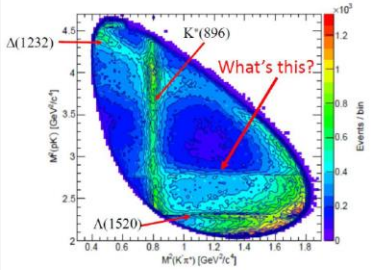
Particle	J^P	Overall status	Status as seen in — $\Xi\pi$	ΛK	ΣK	$\Xi(1530)\pi$	Other channels
$\Xi(1318)$	1/2+	****					Decays weakly
$\Xi(1530)$	3/2+	****	****				
$\Xi(1620)$		*	*				
$\Xi(1690)$		***		***	**		
$\Xi(1820)$	3/2−	***	**	***	**	**	
$\Xi(1950)$		***	**	**		*	
$\Xi(2030)$		***		**	***		
$\Xi(2120)$		*		*			
$\Xi(2250)$		**					3-body decays
$\Xi(2370)$		**					3-body decays
$\Xi(2500)$		*		*	*		3-body decays

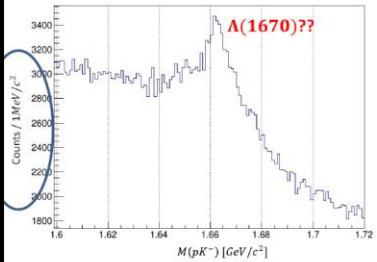
Particle	J^P	status	ΛK	ΞK	$\Xi(1530)K$	Other
$\Omega(1672)$	3/2−	****				
$\Omega(2250)$		***		√	√	
$\Omega(2380)$		**		√	√	ΞK^*
$\Omega(2470)$		**				$\Omega\pi\pi$

Chengping Shen's talk

A new Λ excited states ?

Dalitz plot: $\Lambda_c^+ \to pK^-\pi^+$ [PRL117.011801]





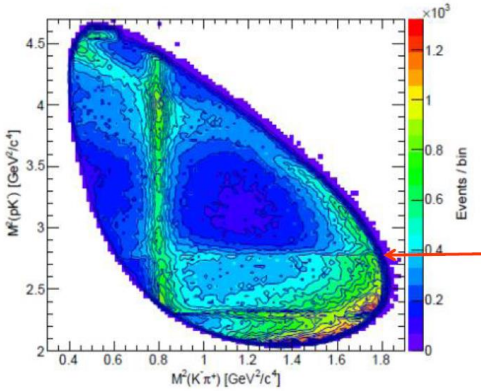
- The peak position is ~1663 MeV, near the Λη threshold (1663.5 MeV)
- Width is ~10 MeV, significantly narrower than Λ, Σ resonances in this region
  - Λ(1670): 25-50 MeV
  - Σ(1660): 40-200 MeV
  - Σ(1670): 40-80 MeV
  - Λ(1690): ~60 MeV
- 2 independent groups claim there is a new narrow Λ* resonance at this energy with J=3/2
  - Kamano et al. [PRC90.065204, PRC92.025205] $J^P=3/2^+$ (P_{03}), M=1671+2-8 MeV, Γ=10+22-4 MeV
  - Liu & Xie [PRC85.038201, PRC86.055202] $J^P=3/2^-$ (D_{03}), M=1668.5±0.5 MeV, Γ=1.5±0.5 MeV
- The reason is the same
  - From K⁻p → Λη measurement near the threshold by Crystal Ball collaboration at BNL [PRC64.055205]
  - Especially the angular distribution → Model independent
- There is no state in quark models
  - It must be an exotic
  - $uds\bar{s}s$ pentaquark??

8

Bingsong Zou's talk

new Λ*(1670)3/2⁻ with width of 1.5 MeV [ud]{ss} $\bar{s}$

from K⁻p → Λη **Liu&Xie, PRC86(2012)055202**



Belle: $\Lambda_c^+ \to p K^- \pi^+$, PRL117 (2016) 011801

May be checked by BelleII & BESIII on $\Lambda_c^+ \to \Lambda\eta\pi^+$

What's that?

- The peak position is ~1663 MeV, near the ηΛ threshold (1663.5 MeV)
- Width is ~10 MeV, significantly narrower than Λ* resonances in this region
  - Λ(1670): 25-50 MeV
  - Λ(1690): ~60 MeV

Jujun Xie's talk

- Maybe due to interference with BG amplitude?

There is many explanations for this very narrow peak. How to determine it? There is no PWA result of $\Lambda_c^+ \to pK^-\pi^+$. What about other data sets for studying this state? Such as J/ψ,$\psi(3686)$ data at BESIII. Which processes can study this state directly?

Discussion

- How can we understand the cross section measurements of baryon pairs and the corresponding EMFFs? What about other measurements of baryons pairs, such as the baryon pairs with 3/2 spin?
- What can we do for the missing excited baryons?
- Determination of the parameters of baryons.
- ……