Light meson spectroscopy at BESIII

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Lisboa, Portugal

22nd Particle and Nuclei International Conference

Outline

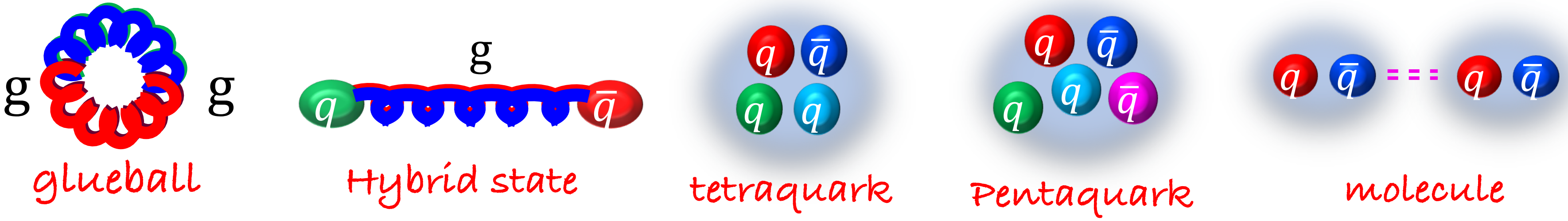
- Introduction
- Search for Glueball
  - Scalar Glueball， Tensor Glueball ， Pseudoscalar glueball
- The structure near $p\bar{p}$ threshold
- Strange quarkonium($s\bar{s}$)
- Summary

Introduction

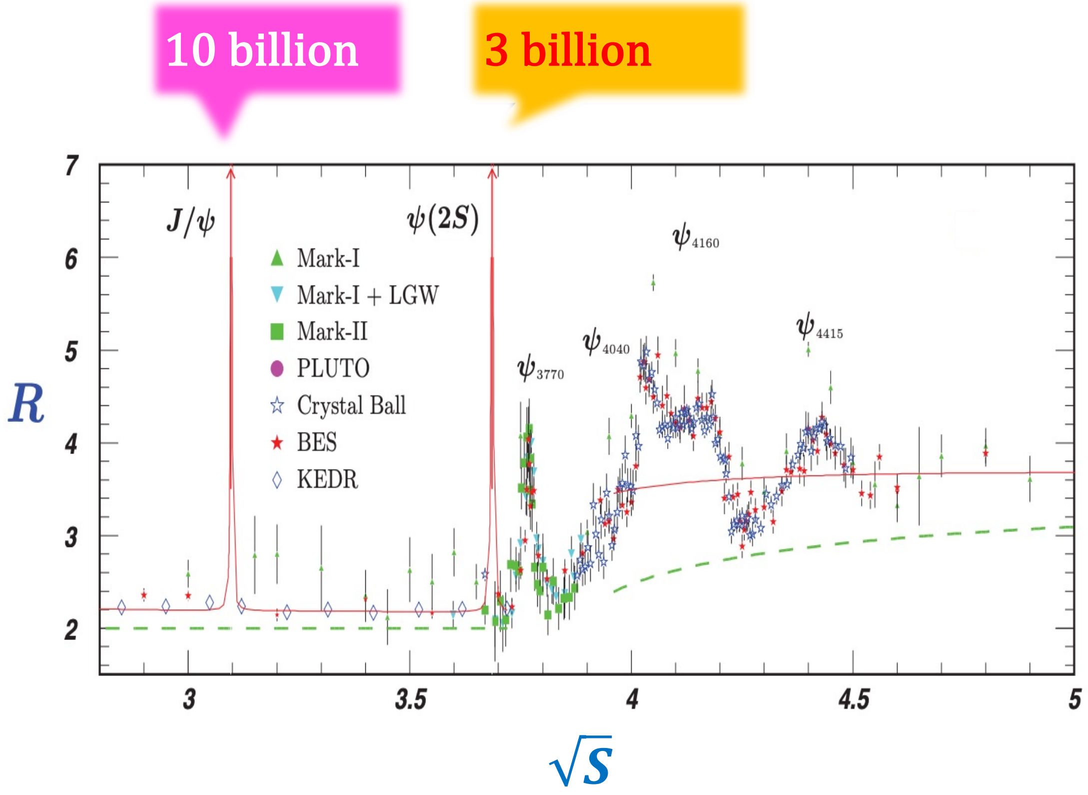
- ➢ Key tool to test QCD theory in nonperturbative region
- ➢ Understanding of the quark and gluon confinement

- ■ Conventional quark model

- ■ QCD allows for hadrons beyond Quark Model



BESIII data sets



$\sqrt{s} = 2.0 - 4.95\ GeV$
Luminosity:$1\times10^{33} cm^{-2}s^{-1}$

Largest J/ψ and $\psi(2S)$ datasets in the world!!

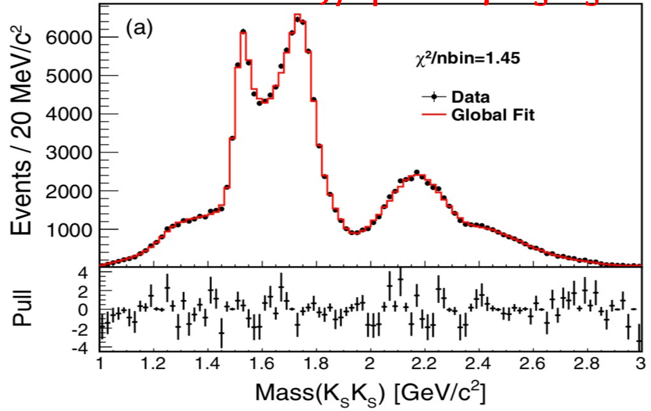
- **BESIII's advantages**
- Clean high statistics data sample
- "Gluon-rich" process
- $I(J^{pc})$ filter
  - Ideal place for study light hadron spectroscopy

Glueball

- Searching for glueball provides a direct fundamental test of the QCD theory.
- Lattice QCD predicts the low lying mass spectrum for glueballs
  - $\mathbf{0}^{++}$ ground state: 1.5-1.7 GeV/c^2
  - $\mathbf{2}^{++}$ ground state: 2.3-2.4 GeV/c^2
  - $\mathbf{0}^{-+}$ ground state: 2.3-2.6 GeV/c^2
- Low lying glueballs with ordinary quantum number , can be mixed with nearby $q\bar{q}$ states
  - Systematical study is needed in the identification

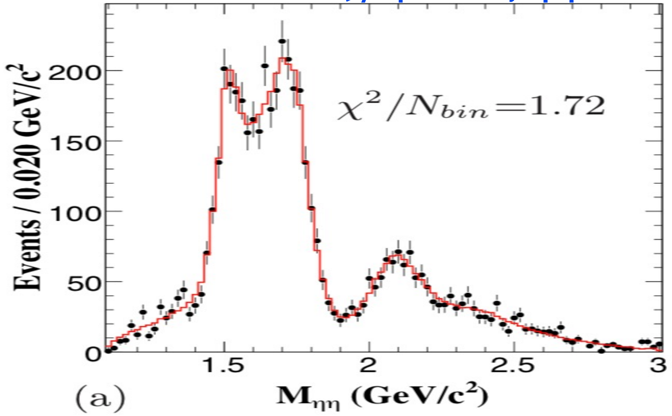
Scalar glueball

- PWA of $J/\psi \longrightarrow \gamma K_s K_s$



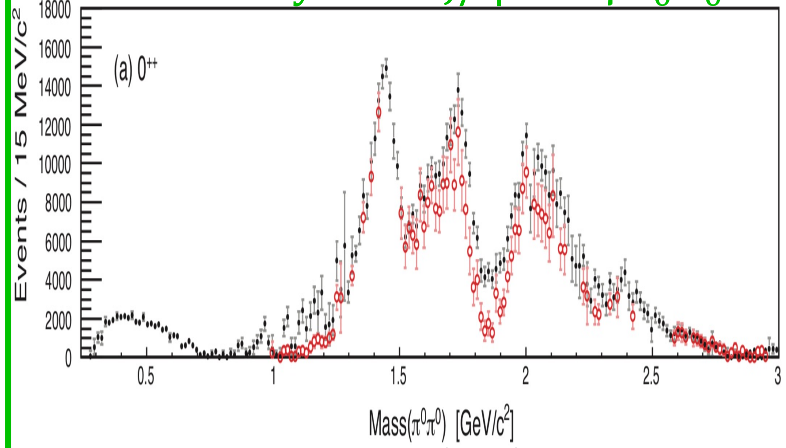
Phys. Rev. D 98, 072003 (2018)

- PWA of $J/\psi \longrightarrow \gamma\eta\eta$



Phys. Rev. D 87, 092009

- MI analysis of $J/\psi \longrightarrow \gamma\pi_0\pi_0$



Phys. Rev. D 92 (2015) 5, 052003

Result of $J/\psi \longrightarrow \gamma K_s K_s$

Resonance	M (MeV/c^2)	M_{PDG} (MeV/c^2)	Γ (MeV/c^2)	Γ_{PDG} (MeV/c^2)	Branching fraction	Significance
$K^*(892)$	896	895.81 ± 0.19	48	47.4 ± 0.6	$(6.28^{+0.16+0.59}_{-0.17-0.52}) \times 10^{-6}$	35σ
$K_1(1270)$	1272	1272 ± 7	90	90 ± 20	$(8.54^{+1.07+2.35}_{-1.20-2.13}) \times 10^{-7}$	16σ
$f_0(1370)$	$1350 \pm 9^{+12}_{-2}$	1200 to 1500	$231 \pm 21^{+28}_{-48}$	200 to 500	$(1.07^{+0.08+0.36}_{-0.07-0.34}) \times 10^{-5}$	25σ
$f_0(1500)$	1505	1504 ± 6	109	109 ± 7	$(1.59^{+0.16+0.18}_{-0.16-0.56}) \times 10^{-5}$	23σ
$f_0(1710)$	$1765 \pm 2^{+1}_{-1}$	1723^{+6}_{-5}	$146 \pm 3^{+7}_{-1}$	139 ± 8	$(2.00^{+0.03+0.31}_{-0.02-0.10}) \times 10^{-4}$	$\gg 35\sigma$
$f_0(1790)$	$1870 \pm 7^{+2}_{-3}$	...	$146 \pm 14^{+7}_{-15}$	...	$(1.11^{+0.06+0.19}_{-0.06-0.32}) \times 10^{-5}$	24σ
$f_0(2200)$	$2184 \pm 5^{+4}_{-2}$	2189 ± 13	$364 \pm 9^{+4}_{-7}$	238 ± 50	$(2.72^{+0.08+0.17}_{-0.06-0.47}) \times 10^{-4}$	$\gg 35\sigma$
$f_0(2330)$	$2411 \pm 10 \pm 7$	...	$349 \pm 18^{+23}_{-1}$	...	$(4.95^{+0.21+0.66}_{-0.21-0.72}) \times 10^{-5}$	35σ
$f_2(1270)$	1275	1275.5 ± 0.8	185	$186.7^{+2.2}_{-2.5}$	$(2.58^{+0.08+0.59}_{-0.09-0.20}) \times 10^{-5}$	33σ
$f_2'(1525)$	1516 ± 1	1525 ± 5	$75 \pm 1 \pm 1$	73^{+6}_{-5}	$(7.99^{+0.03+0.69}_{-0.04-0.50}) \times 10^{-5}$	$\gg 35\sigma$
$f_2(2340)$	$2233 \pm 34^{+9}_{-25}$	2345^{+50}_{-40}	$507 \pm 37^{+18}_{-21}$	322^{+70}_{-60}	$(5.54^{+0.34+3.82}_{-0.40-1.49}) \times 10^{-5}$	26σ
0^{++} PHSP	...	...	...	...	$(1.85^{+0.05+0.68}_{-0.05-0.26}) \times 10^{-5}$	26σ
2^{++} PHSP	...	...	...	...	$(5.73^{+0.99+4.18}_{-1.00-3.74}) \times 10^{-5}$	13σ

Result of $J/\psi \longrightarrow \gamma\eta\eta$

Resonance	Mass(MeV/c^2)	Width(MeV/c^2)	$\mathcal{B}(J/\psi \to \gamma X \to \gamma\eta\eta)$	Significance
$f_0(1500)$	1468^{+14+23}_{-15-74}	$136^{+41+28}_{-26-100}$	$(1.65^{+0.26+0.51}_{-0.31-1.40}) \times 10^{-5}$	$8.2\ \sigma$
$f_0(1710)$	$1759 \pm 6^{+14}_{-25}$	$172 \pm 10^{+32}_{-16}$	$(2.35^{+0.13+1.24}_{-0.11-0.74}) \times 10^{-4}$	$25.0\ \sigma$
$f_0(2100)$	$2081 \pm 13^{+24}_{-36}$	273^{+27+70}_{-24-23}	$(1.13^{+0.09+0.64}_{-0.10-0.28}) \times 10^{-4}$	$13.9\ \sigma$
$f_2'(1525)$	$1513 \pm 5^{+4}_{-10}$	75^{+12+16}_{-10-8}	$(3.42^{+0.43+1.37}_{-0.51-1.30}) \times 10^{-5}$	$11.0\ \sigma$
$f_2(1810)$	1822^{+29+66}_{-24-57}	$229^{+52+88}_{-42-155}$	$(5.40^{+0.60+3.42}_{-0.67-2.35}) \times 10^{-5}$	$6.4\ \sigma$
$f_2(2340)$	$2362^{+31+140}_{-30-63}$	$334^{+62+165}_{-54-100}$	$(5.60^{+0.62+2.37}_{-0.65-2.07}) \times 10^{-5}$	$7.6\ \sigma$

- Mass independent approach has been performed on $J/\psi \longrightarrow \gamma\pi_0\pi_0$
- The contribution around 1.5 GeV and 1.7GeV are scalar states

- **$f_0(1710)$ ~10 times larger production rate than $f_0(1500)$ in $J/\psi \longrightarrow \gamma K_s K_s$ and $J/\psi \longrightarrow \gamma\eta\eta$**

Scalar glueball

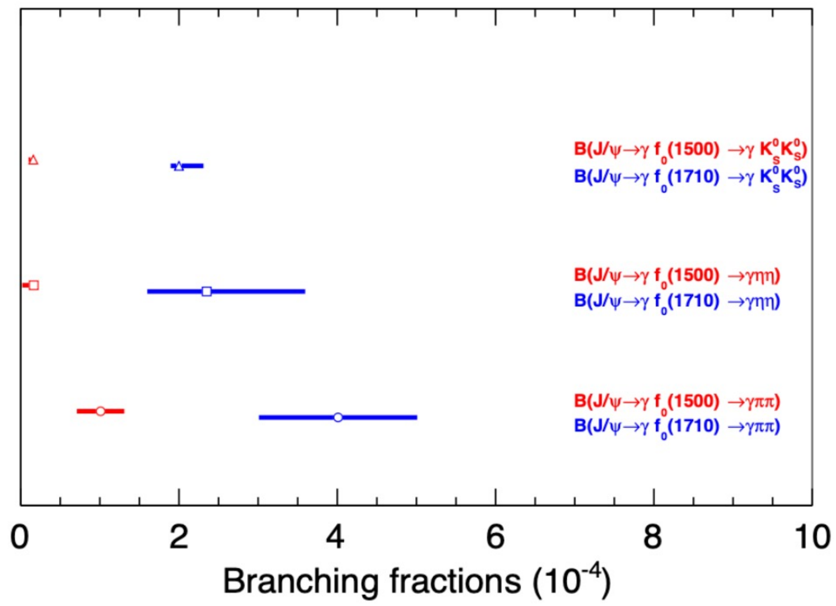
LQCD prediction of scalar glueball

- **Mass: 1.5-1.7 GeV/c^2** *Phys.Rev.Lett. 110 (2013) 2, 021601*
- $\boldsymbol{\Gamma(J/\psi \longrightarrow \gamma G_{0^+})/\Gamma_{tot} = 3.8\times10^{-3}}$

Measurement form BESIII

- $B(J/\psi \longrightarrow \gamma f_0(1710) \rightarrow \gamma K\bar{K}) = (9.62 \pm 0.29)^{+2.11}_{-1.86}\times10^{-4}$
- $B(J/\psi \longrightarrow \gamma f_0(1710) \rightarrow \gamma\pi\pi) = (4.0 \pm 0.06 \pm 1.1)\times10^{-4}$
- $B(J/\psi \longrightarrow \gamma f_0(1710) \rightarrow \gamma\omega\omega) = (3.1 \pm 0.6 \pm 0.78)\times10^{-4}$
- $B(J/\psi \longrightarrow \gamma f_0(1710) \rightarrow \gamma\eta\eta) = 2.35^{+0.13+1.24}_{-0.11-0.74}\times10^{-4}$

$\Rightarrow \boldsymbol{B(J/\psi \longrightarrow \gamma f_0(1710)) > 1.9\times10^{-3}}$



- $f_0(1710)$ has ~10 times larger production rate than $f_0(1500)$
- $f_0(1710)$ has more gluonic component than $f_0(1500)$

Tensor glueball

LQCD prediction of tensor glueball

Mass: 2.3-2.4 GeV/c^2 *Phys.Rev.Lett. 111 (2013) 9, 091601*

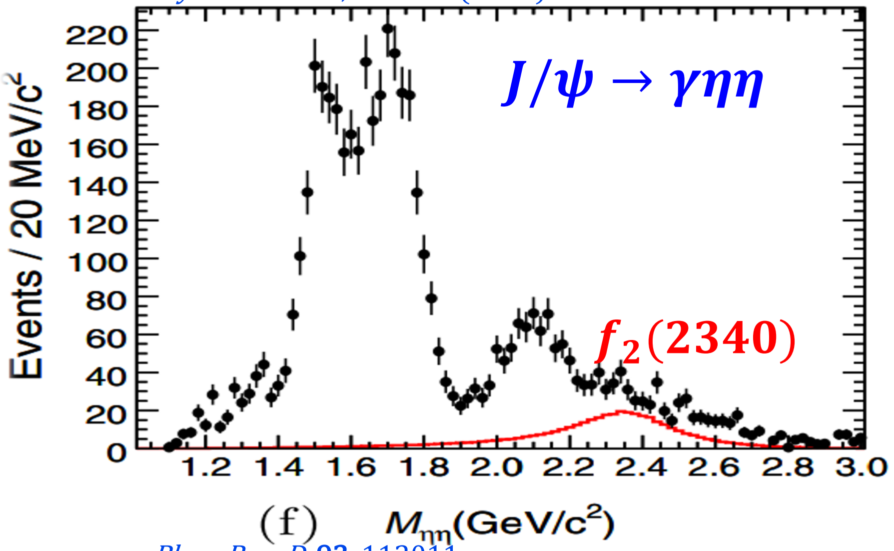
- $\Gamma(J/\psi \longrightarrow \gamma G_{2^+})/\Gamma_{tot} = 1.1\times 10^{-2}$

The results of the experiment

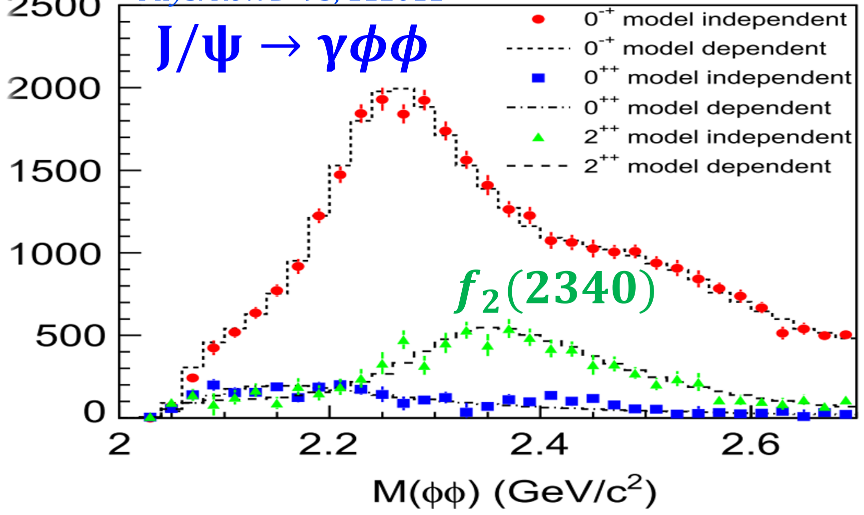
- $B(J/\psi \to \gamma f_2(2340) \to \gamma\eta\eta) = 3.8^{+0.62+2.37}_{-0.65-2.07}\times 10^{-5}$
- $B(J/\psi \to \gamma f_2(2340) \to \gamma\phi\phi) = (1.91 \pm 0.14^{+0.72}_{-0.73})\times 10^{-4}$
- $B(J/\psi \to \gamma f_2(2340) \to \gamma K_s K_s) = (5.54^{+0.34+3.82}_{-0.40-1.49})\times 10^{-5}$
- Consistent with WA102 experiment *Phys.Lett.B* 471 (2000) 429-434

⇒need to search for more decay modes

Phys. Rev. D 87, 092009 (2013)



Phys. Rev. D **93**, 112011

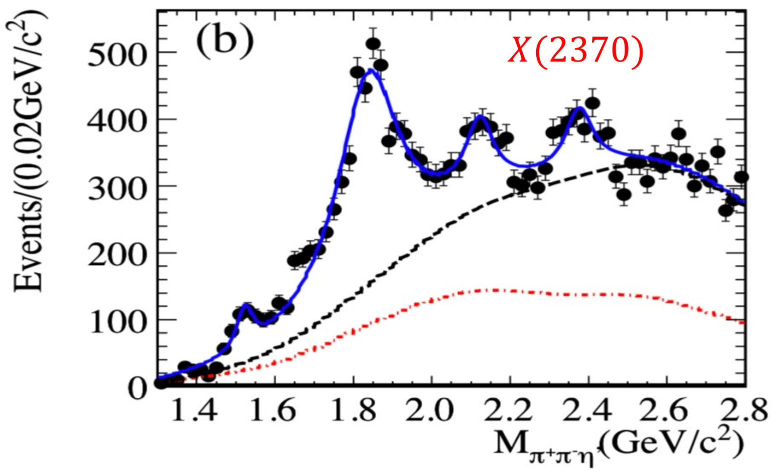


Pseudoscalar glueball

LQCD prediction of scalar glueball

- **Mass: 2.3-2.6 GeV/c^2** *Phys. Rev. D 73, 014516*
- $\boldsymbol{\Gamma(J/\psi \longrightarrow \gamma G_{0^-}) = 2.31\times10^{-4}}$

Phys. Rev. Lett. 106 (2011) 072002



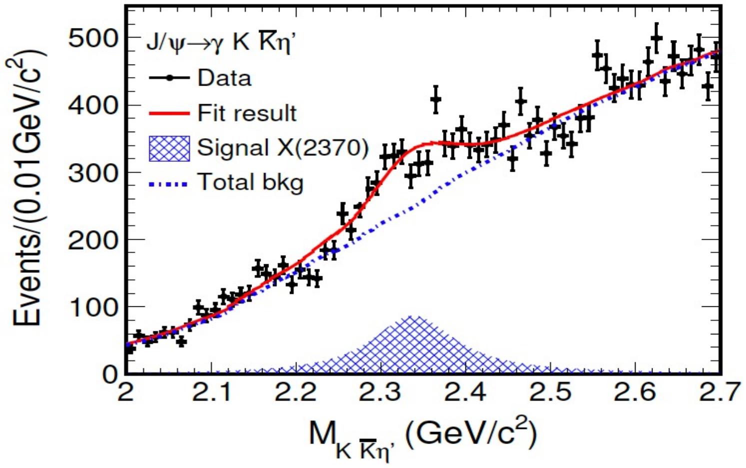
- The $X(2370)$ is first observed in the process of J/ψ → $\gamma\pi^+\pi^-\eta'$
- Based on chiral effective Lagrangian with mass of X(2370), the predicted branching ratio of pseudoscalar glueball is : $B(G \to \eta\eta\eta'):B(G \to KK\eta'):B(G \to \pi\pi\eta') = 0.00082, 0.011, 0.09$

Phys. Rev. D 87, 054036 (2013).

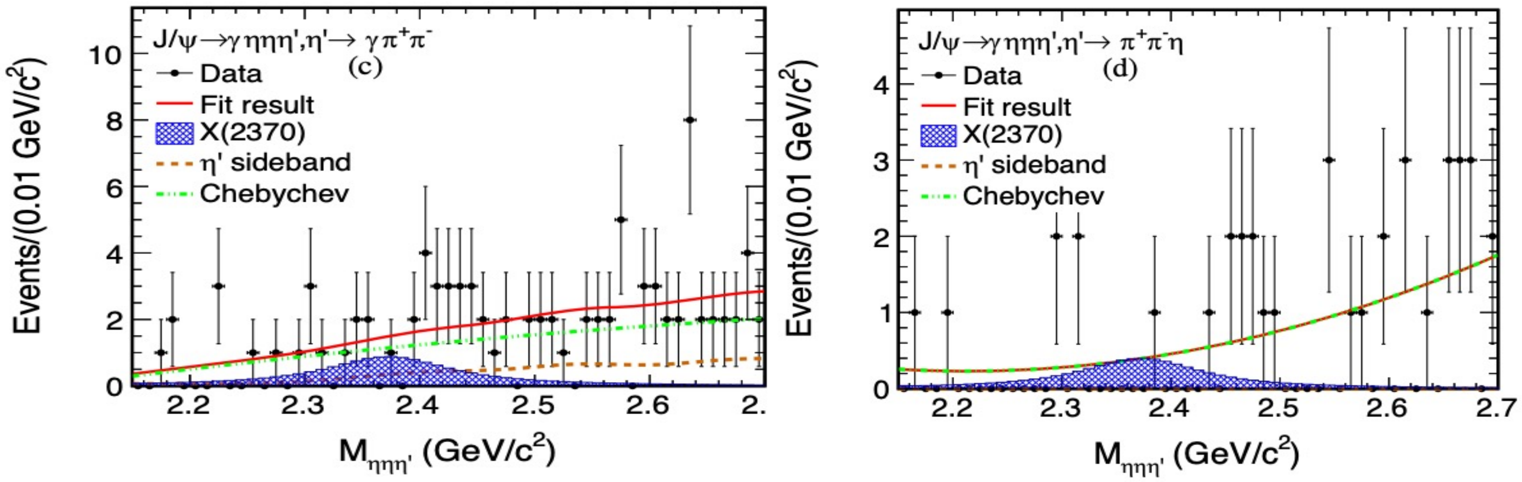
Pseudoscalar glueball

- X(2370) is observed in $J/\psi \to \gamma K\bar{K}\eta'$; $B(J/\psi \to \gamma X(2370) \to \gamma K\bar{K}\eta')$=（$1.79 \pm 0.23 \pm 0.65$）$\times 10^{-5}$
- No X(2370) signal in $J/\psi \to \gamma\eta\eta\eta'$, $B(J/\psi \to \gamma X(2370) \to \gamma\eta\eta\eta') < 9.2\times10^{-6}$ at 90% C.L.
- No contradiction to the calculation for X(2370) as 0^{-+} glueball

Eur. Phys. J. C (2020) 80:746



*Phys. Rev. D **103**, 012009*



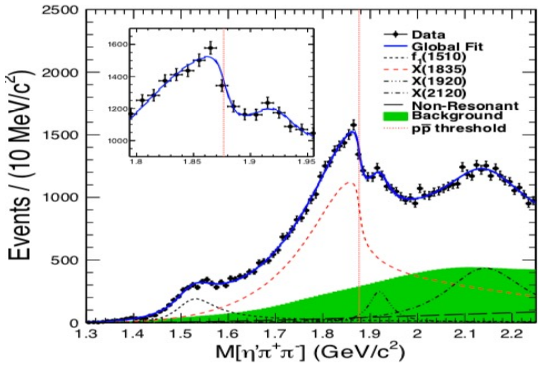
- More decay modes are needed and with high statistics J/ψ data to determine its J^{PC}

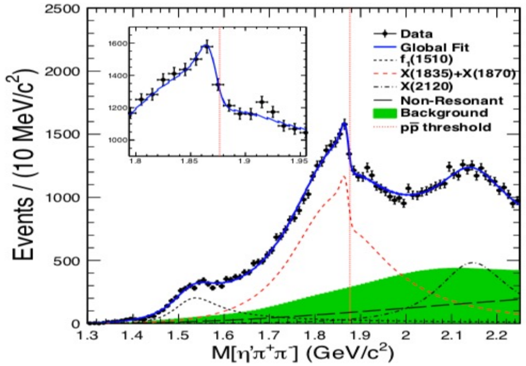
The structure near $p\bar{p}$ threshold

- The $p\bar{p}$ mass threshold enhancement was first observed in $J/\psi \to \gamma p\bar{p}$ decays *Phys. Rev. Lett. 108, 112003*
- First observation of the X(1835) in J/$\psi \to \gamma\pi^+\pi^-\eta'$ at BESII, then confirmed by BESIII , *Phys. Rev. Lett.* 106 (2011) 072002

  also observed in $J/\psi \to \gamma K_s K_s \eta$ *Phys.Rev.Lett. 115 (2015) 9, 091803*
- The spin-parity of X(1835) and $X(p\bar{p})$ is $J^{pc} = 0^{-+}$

- **Anonlmoly line shape of $X(1835)$ is observed in $J/\psi \to \gamma\eta'\pi^+\pi^-$ decay(with two hypotheses)**
  - ✓ One broad state with strong coupling to $p\bar{p}$ (flatte model)
  - ✓ One narrow state below to the $p\bar{p}$ mass threshold interfering with X(1835)





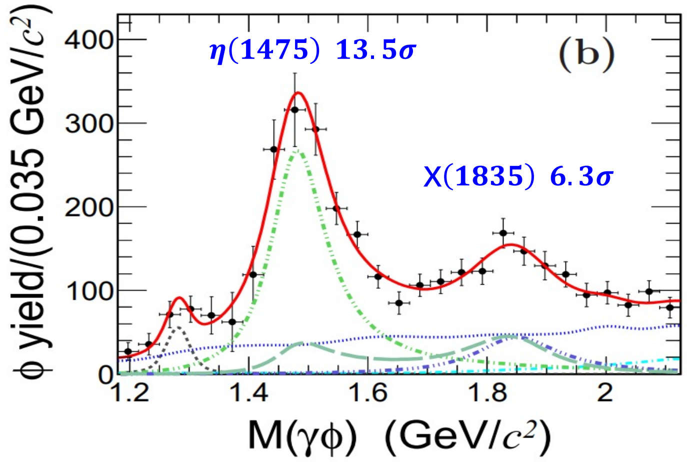
Phys. Rev. Lett. ***117***, *042002*

- **Connection between X(1835) and $X(p\bar{p})$, support the existence of a $p\bar{p}$ molecule-like state or bound state**

The structure near $p\bar{p}$ threshold

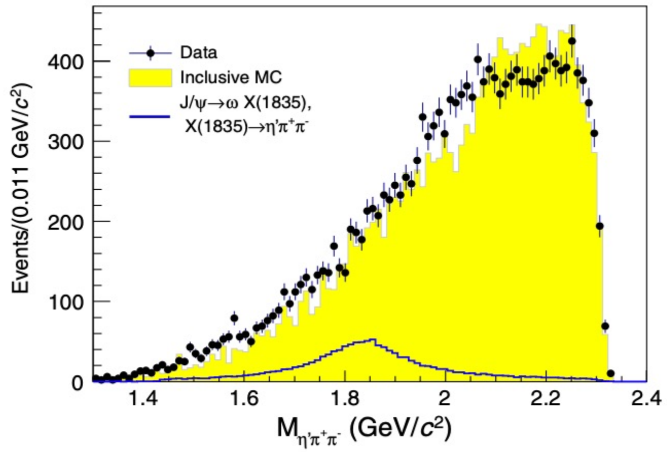
➢Study the nature of X(1835).

$J/\psi \to \gamma\gamma\phi$



Phys. Rev. D ***97***, *051101*

$J/\psi \to \omega\pi^+\pi^-\eta'$



Phys. Rev. D 99, 071101

- According to angular distribution, the J^{pc} around 1.4 and 1.8 tends to be 0^{-+}
- $J/\psi \to \gamma X, X \to \gamma V$ ($V = \omega, \phi$) : flavor filter process.

⇒X(1835) and η(1475) have sizeable $s\bar{s}$ component,

- The comparison of the production rates between $J/\psi \to \omega X(1835)$ and $J/\psi \to \gamma X(1835)$ could get information on the $q\bar{q}$ or gluon component of $X(1835)$ *Phys. Rev. D* 74 (2006) 034019; *Eur. Phys. J.* A 28, 351–360 (2006)
- No significant X(1835) is observed. $B(J/\psi \to \omega X(1835) \to \omega\pi^+\pi^-\eta')$<$6.2\times10^{-5}$ at 90% C.L.

Strangeonia spectrum

Chin. Phys. C 39 (2015) 8, 082001

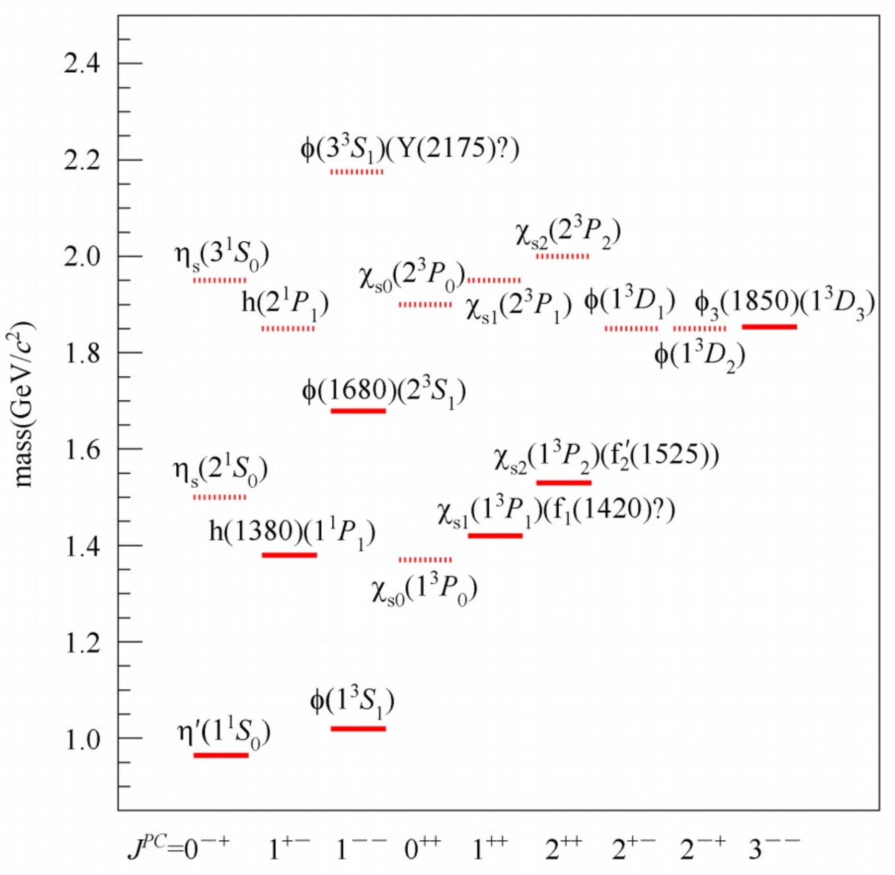
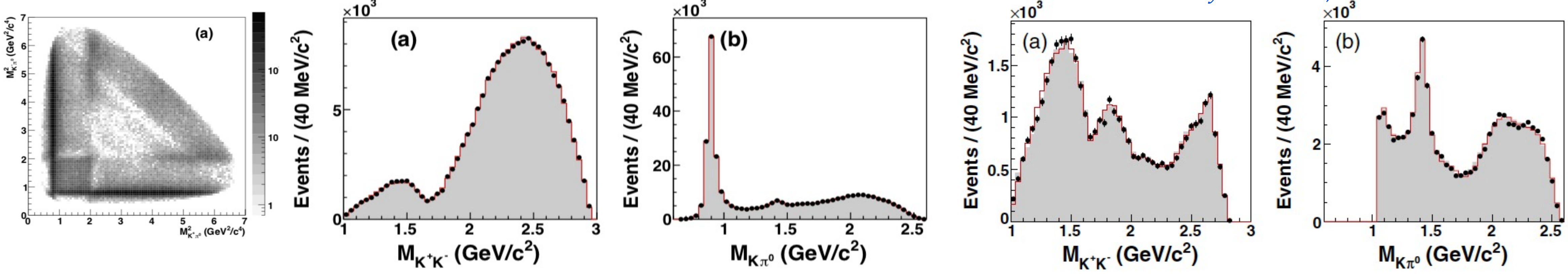


Fig. 1. The strangeonium family.

- Study of the strangeonium mesons of particular interest
  - Bridge between light u, d quark and heavy c, b quark
  - Helps to identify the exotics
- Strangeonium spectroscopy is not well understand experimentally
  - Only 7 states in the expected spectrum assigned to the observed mesons(marked with red solid lines)

Amplitude analysis of $J/\psi \rightarrow K^+K^-\pi^0$.

Phys. Rev. D **100**, 032004



With K*(892) cut in $M(K\pi^0)$

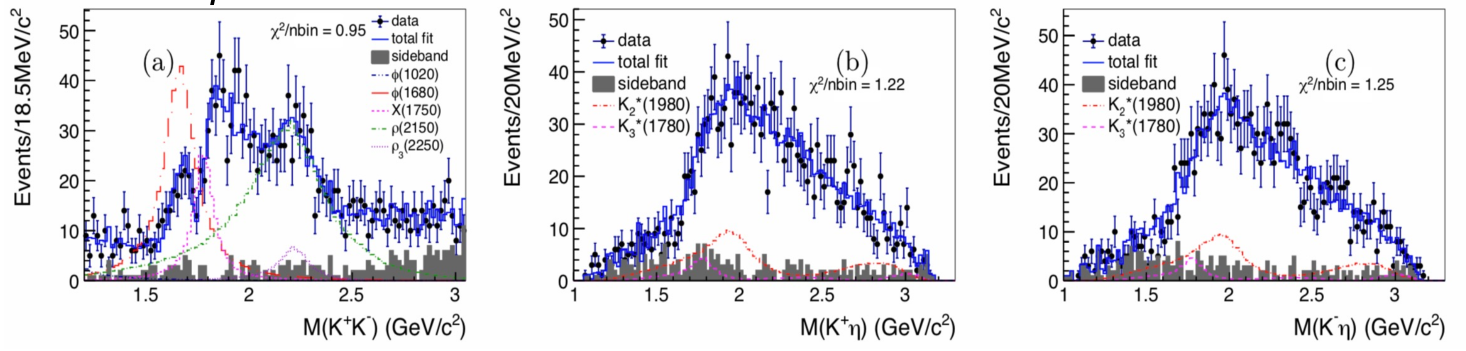
➢ $K\pi^0$
- The dominant contribution is from K*(892)
- First observation of $K^*_2(1980)$ and $K^*_4(2045)$ in J/ψ decays

➢ K^+K^-
- Two broad 1^{--} structures were observed in K^+K^- mass spectrum, possibly contributed from $\omega(1650)$ and $\rho(2150)$
- Further studies on $J/\psi \rightarrow K_sK^-\pi^+$ and $J/\psi \rightarrow K^+K^-\eta$ are needed

Amplitude analysis of $\psi' \to K^+K^-\eta$

$448M\,\psi'$

•*Phys. Rev. D* 101 (2020) 3, 032008



Resonance	This work M (MeV/c^2)	This work Γ (MeV)	PDG [23] M (MeV/c^2)	PDG [23] Γ (MeV)
$\phi(1680)$	1680^{+12+21}_{-13-21}	185^{+30+25}_{-26-47}	1680 ± 20	150 ± 50
$X(1750)$	1784^{+12+0}_{-12-27}	106^{+22+8}_{-19-36}	$(1720 \pm 20)_{\rho(1700)}$ $(1753.5 \pm 1.5 \pm 2.3)_{X(1750)}$ [15]	$(250 \pm 100)_{\rho(1700)}$ $(122.2 \pm 6.2 \pm 8.0)_{X(1750)}$ [15]
$\rho(2150)$	2255^{+17+50}_{-18-41}	$460^{+54+160}_{-48-90}$	$(2153 \pm 27)_{\rho(2150)}$ [31] $(2175 \pm 15)_{\phi(2170)}$	$(389 \pm 79)_{\rho(2150)}$ [31] $(61 \pm 18)_{\phi(2170)}$
$\rho_3(2250)$	2248^{+17+59}_{-17-5}	$185^{+31+17}_{-26-103}$	2232 [33]	220 [33]
$K_2^*(1980)$	2046^{+17+67}_{-16-15}	408^{+38+72}_{-34-44}	$1973 \pm 8 \pm 25$	$373 \pm 33 \pm 60$
$K_3^*(1780)$	1813^{+15+65}_{-15-16}	191^{+43+3}_{-37-81}	1776 ± 6	159 ± 21

- The discrepancy of the $\phi(1680)$ in its production
  - •$\phi(1680)$ (e^+e^- annihilation)
  - •X(1750) (photoproduction)

  reported by FOCUS (Phys. Lett. B 545, 50)

- The simultaneous observation of the X(1750) and $\phi(1680)$ may explain the previous discrepancy in $\phi(1680)$ decays.

- ρ(2150)/$\phi(2170)$ is also observed
  - isospin is undetermined
  - combined analysis with other channels is needed

Summary

Glueball

- The BR of a $f_0(1710)$ is one order of magnitude higher than that of $f_0(1500)$
  - $f_0(1710)$ has more gluonic component than $f_0(1500)$
- X(2370) was observed in $J/\psi \to \gamma\pi^+\pi^-\eta'$, $\gamma K\bar{K}\eta'$ and no signal in $J/\psi \to \gamma\eta\eta\eta'$

Structure near $p\bar{p}$ threshold

- X(1835) observed in $J/\psi \to \gamma\gamma\phi$
  - have sizeable $\boldsymbol{s\bar{s}}$ component
- No X(1835) signal in $J/\psi \to \omega\pi^+\pi^-\eta'$

Strangeonium

- Two 1^{--} structures, possibly ω(1650) and ρ(2150), observed in $J/\psi \to K^+K^-\pi^0$
- X(1750) and $\phi(1680)$, $\rho(2150)/\phi(2170)$ have been observed in $\psi(3686) \to K^+K^-\eta$.

- BESIII collected 10 billions of J/ψ from 2019 and will continue to run for ~ 10 more years. Data with unprecedented statistical accuracy provides great opportunities to map out light meson spectroscopy and study QCD exotics

- Back Up

TABLE I. Mass, width, $\mathcal{B}(J/\psi \to \gamma X \to \gamma\phi\phi)$ (B.F.) and significance (Sig.) of each component in the baseline solution. The first errors are statistical and the second ones are systematic.

Resonance	M(MeV/c^2)	Γ(MeV/c^2)	B.F.($\times 10^{-4}$)	Sig.
$\eta(2225)$	$2216^{+4}_{-5}{}^{+21}_{-11}$	$185^{+12}_{-14}{}^{+43}_{-17}$	$(2.40 \pm 0.10^{+2.47}_{-0.18})$	28 σ
$\eta(2100)$	$2050^{+30}_{-24}{}^{+75}_{-26}$	$250^{+36}_{-30}{}^{+181}_{-164}$	$(3.30 \pm 0.09^{+0.18}_{-3.04})$	22 σ
$X(2500)$	$2470^{+15}_{-19}{}^{+101}_{-23}$	$230^{+64}_{-35}{}^{+56}_{-33}$	$(0.17 \pm 0.02^{+0.02}_{-0.08})$	8.8 σ
$f_0(2100)$	2101	224	$(0.43 \pm 0.04^{+0.24}_{-0.03})$	24 σ
$f_2(2010)$	2011	202	$(0.35 \pm 0.05^{+0.28}_{-0.15})$	9.5 σ
$f_2(2300)$	2297	149	$(0.44 \pm 0.07^{+0.09}_{-0.15})$	6.4 σ
$f_2(2340)$	2339	319	$(1.91 \pm 0.14^{+0.72}_{-0.73})$	11 σ
0^{-+} PHSP			$(2.74 \pm 0.15^{+0.16}_{-1.48})$	6.8 σ

TABLE I. Fit results of using Flatté formula. The first errors are statistical errors, the second errors are systematic errors; the branching ratio is the product of $\mathcal{B}(J/\psi \to \gamma X)$ and $\mathcal{B}(X \to \eta'\pi^+\pi^-)$.

The state around 1.85 GeV/c^2	
$\mathcal{M}$ (MeV/c^2)	$1638.0 \pm 121.9^{+127.8}_{-254.3}$
g_0^2 ((GeV/c^2)^2)	$93.7 \pm 35.4^{+47.6}_{-43.9}$
$g_{p\bar{p}}^2/g_0^2$	$2.31 \pm 0.37^{+0.83}_{-0.60}$
M_{pole} (MeV/c^2)	$1909.5 \pm 15.9^{+9.4}_{-27.5}$
Γ_{pole} (MeV/c^2)	$273.5 \pm 21.4^{+6.1}_{-64.0}$
Branching Ratio	$(3.93 \pm 0.38^{+0.31}_{-0.84}) \times 10^{-4}$

TABLE II. Fit results using a coherent sum of two Breit-Wigner amplitudes. The first errors are statistical errors, the second errors are systematic errors; the branching ratio is the product of $\mathcal{B}(J/\psi \to \gamma X)$ and $\mathcal{B}(X \to \eta'\pi^+\pi^-)$.

$X(1835)$	
Mass (MeV/c^2)	$1825.3 \pm 2.4^{+17.3}_{-2.4}$
Width (MeV/c^2)	$245.2 \pm 13.1^{+4.6}_{-9.6}$
B.R. (constructive interference)	$(3.01 \pm 0.17^{+0.26}_{-0.28}) \times 10^{-4}$
B.R. (destructive interference)	$(3.72 \pm 0.21^{+0.18}_{-0.35}) \times 10^{-4}$
$X(1870)$	
Mass (MeV/c^2)	$1870.2 \pm 2.2^{+2.3}_{-0.7}$
Width (MeV/c^2)	$13.0 \pm 6.1^{+2.1}_{-3.8}$
B.R. (constructive interference)	$(2.03 \pm 0.12^{+0.43}_{-0.70}) \times 10^{-7}$
B.R. (destructive interference)	$(1.57 \pm 0.09^{+0.49}_{-0.86}) \times 10^{-5}$

TABLE II. List of components for solution II. For the reported states in the $K\pi$ channel [$K^*(892)^\pm$, $K_2^*(1430)^\pm$, $K_2^*(1980)^\pm$ and $K_4^*(2045)^\pm$] and the reported signals in the K^+K^- channel ($J^{PC} = 1^{--}$ signals with masses around 1650 and 2050 MeV$/c^2$) the first uncertainty is statistical and the second is systematic. In the $K\pi$ channel the decay fraction is given for both charged conjugated modes (b) and for the contribution of one charged mode [$b^{+(-)}$], so that their interference can be determined. As the $K^*(1410)^\pm$, $K^*(1680)^\pm$ and $K_3^*(1780)^\pm$ contributions are not reliably identified (see the main text), their masses and widths are fixed (marked with *) and only statistical uncertainties are given for their decay fractions.

$K^\pm\pi^0$ channels						
J^{PC}	PDG	M (MeV$/c^2$)	Γ (MeV$/c^2$)	b (%)	$b^{+(-)}$ (%)	ΔNLL
1^-	$K^*(892)^\pm$	$893.6 \pm 0.1^{+0.2}_{-0.3}$	$46.7 \pm 0.2^{+0.1}_{-0.2}$	$93.4 \pm 0.4^{+1.8}_{-5.8}$	$42.5 \pm 0.1^{+0.5}_{-1.7}$	...
1^-	$K^*(1410)^\pm$	$1380^\star$	$176^\star$	0.26 ± 0.04	0.11 ± 0.02	80
1^-	$K^*(1680)^\pm$	$1677^\star$	$205^\star$	0.20 ± 0.03	0.08 ± 0.01	56
2^+	$K_2^*(1430)^\pm$	$1432.7 \pm 0.7^{+2.2}_{-2.3}$	$102.5 \pm 1.6^{+3.1}_{-2.8}$	$9.4 \pm 0.1^{+0.8}_{-0.5}$	$4.2 \pm 0.1^{+0.3}_{-0.2}$	...
2^+	$K_2^*(1980)^\pm$	$1868 \pm 8^{+40}_{-57}$	$272 \pm 24^{+50}_{-15}$	$0.38 \pm 0.04^{+0.22}_{-0.05}$	$0.15 \pm 0.02^{+0.08}_{-0.02}$	192
3^-	$K_3^*(1780)^\pm$	$1781^\star$	$203^\star$	0.16 ± 0.02	0.07 ± 0.01	105
4^+	$K_4^*(2045)^\pm$	$2090 \pm 9^{+11}_{-29}$	$201 \pm 19^{+57}_{-17}$	$0.21 \pm 0.02^{+0.10}_{-0.05}$	$0.09 \pm 0.01^{+0.04}_{-0.02}$	212
3^-	Nonresonant	...	...	~1.5%	~0.6%	629

K^+K^- channel					
J^{PC}	PDG	M (MeV$/c^2$)	Γ (MeV$/c^2$)	b (%)	$\Delta \ln L$
1^{--}		$1651 \pm 3^{+16}_{-6}$	$194 \pm 8^{+15}_{-7}$	$1.83 \pm 0.11^{+0.19}_{-0.17}$	796
1^{--}		$2039 \pm 8^{+36}_{-18}$	$196 \pm 23^{+25}_{-27}$	$0.23 \pm 0.04^{+0.07}_{-0.06}$	102