The first results from BESIII

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Flavor Physics and CP Violation
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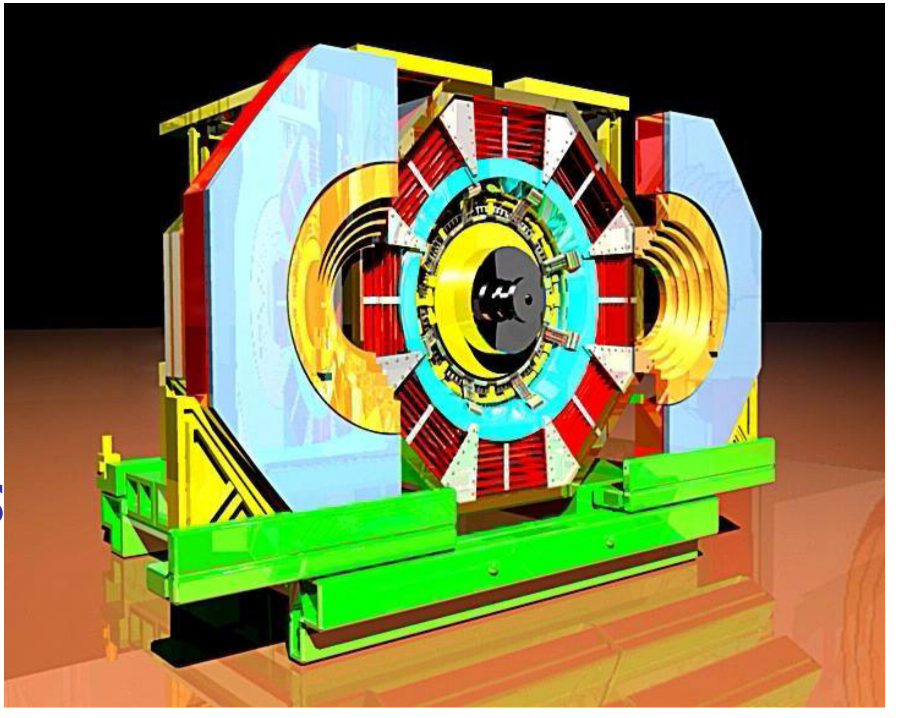
Outline

- Introduction
- BEPCII Collider
- BESIII Detector
- First physics
- Outlook for flavor physics
- Conclusion



The Landscape for open charm

B factories:
--BABAR, Belle
-- Super-B factories ?

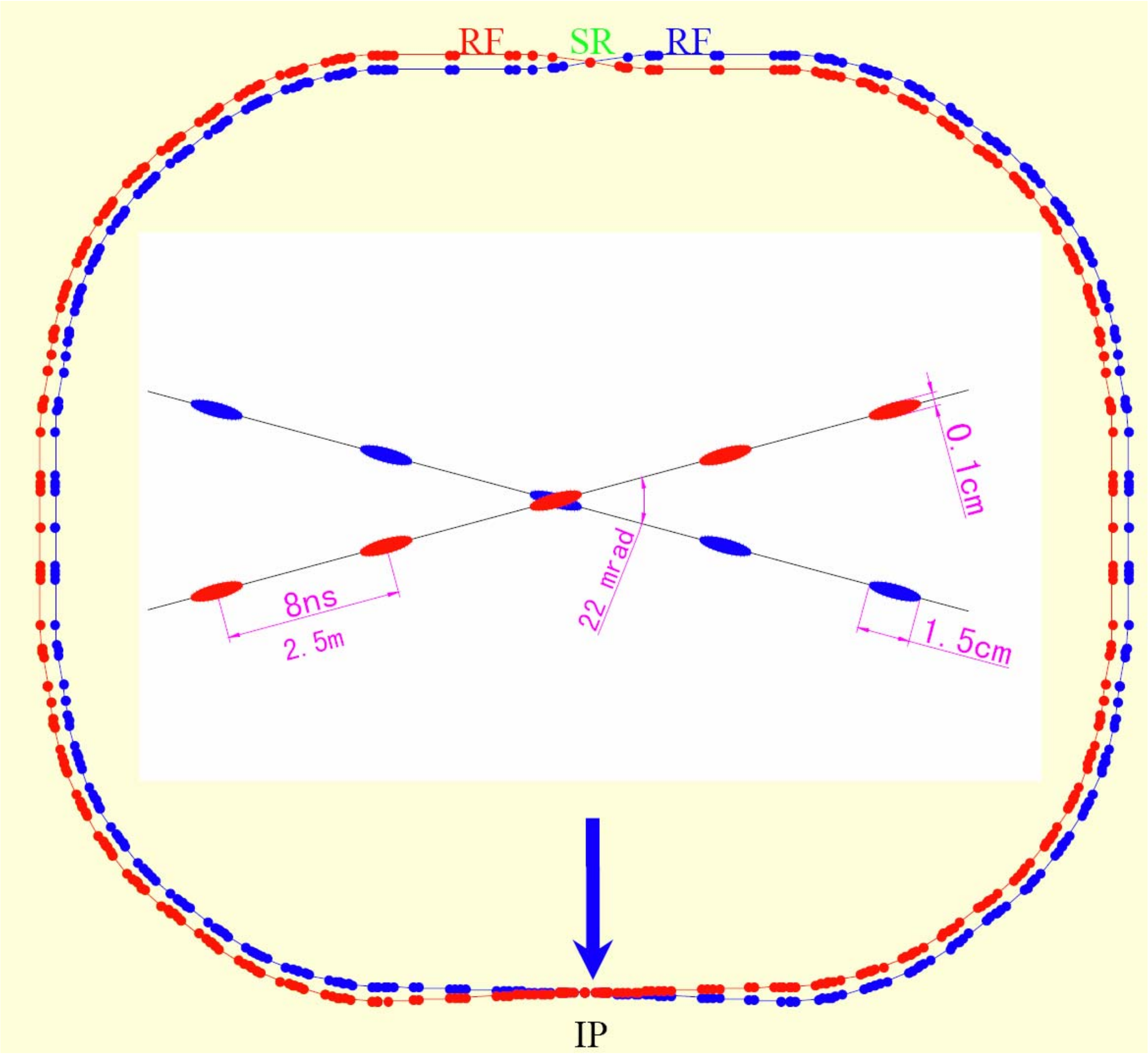
Hadronic Production:
--Fixed target: FOCUS dominates
--LHCb: on-going now!
--ATLAS and CMS

e^+e^- Colliders@threshold:
-- Precision results dominated by CLEO-c
-- Quantum correlations and CP-tagging are unique

The BEPCII machine overcomes the key limit of CLEO-c: luminosity

However, our first running @BESIII concentrates on charmonium:
very large J/ψ and $\psi(2S)$ samples. This is OK, since we need to match CLEO-c systematics for open charm!

BEPCII Storage Ring



Beam energy:
1.0-2.3 GeV
Luminosity:
$3 \sim 10 \times 10^{32}$ $cm^{-2}s^{-1}$
Optimum energy:
1.89 GeV
Energy spread:
5.16×10^{-4}
No. of bunches:
93
Bunch length:
1.5 cm
Total current:
0.91 A
SR mode:
0.25A @ 2.5 GeV

BEPCII/BESIII Commissioning milestones

Oct. 25-31, 2007: accumulation of electron/positron beams

Nov. 18, 2007: first e+e- collision without BESIII detector

Mar. 2008: Collision at 500 mA $\times$ 500 mA, Lumi.: 1 $\times 10^{32}$ cm^{-2}s^{-1}

April 30, 2008: Move the BESIII to IP

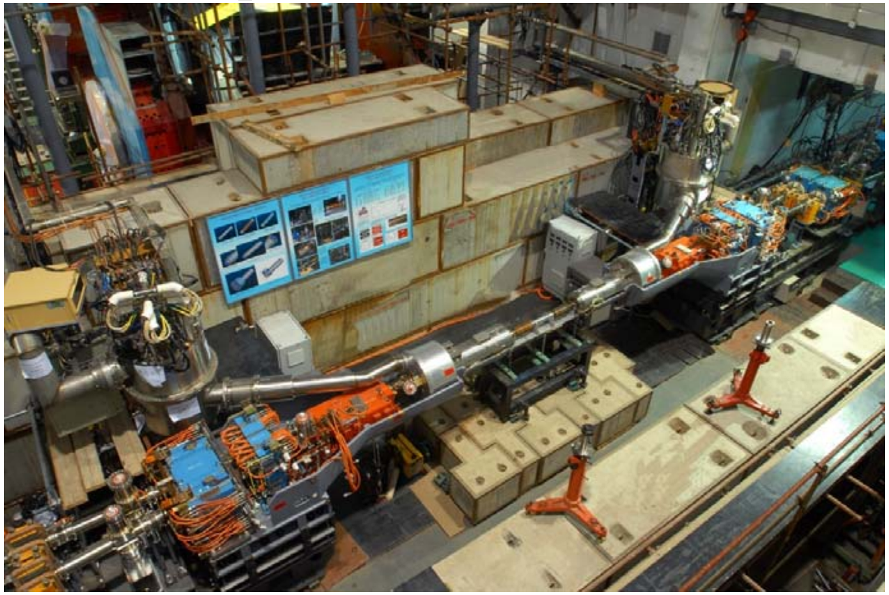
July 20, 2008: First e+e- collision event in BESIII

April 14, 2009 BESIII ~100M ψ(2S) events (~40 days)

May 14, 2009 BEPCII Lumi. ~ 3 $\times 10^{32}$cm^{-2}s^{-1}

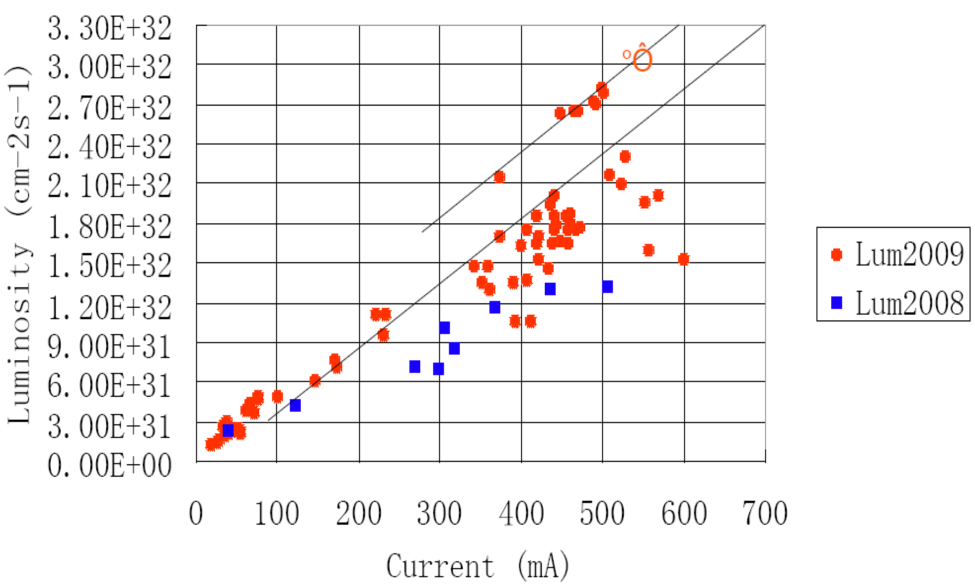
July 28th, 2009 BESIII ~230M J/ ψ events (41 days)

Jan. 16—June 27 2010, 1.0 fb^{-1} @ψ(3770) for open charm

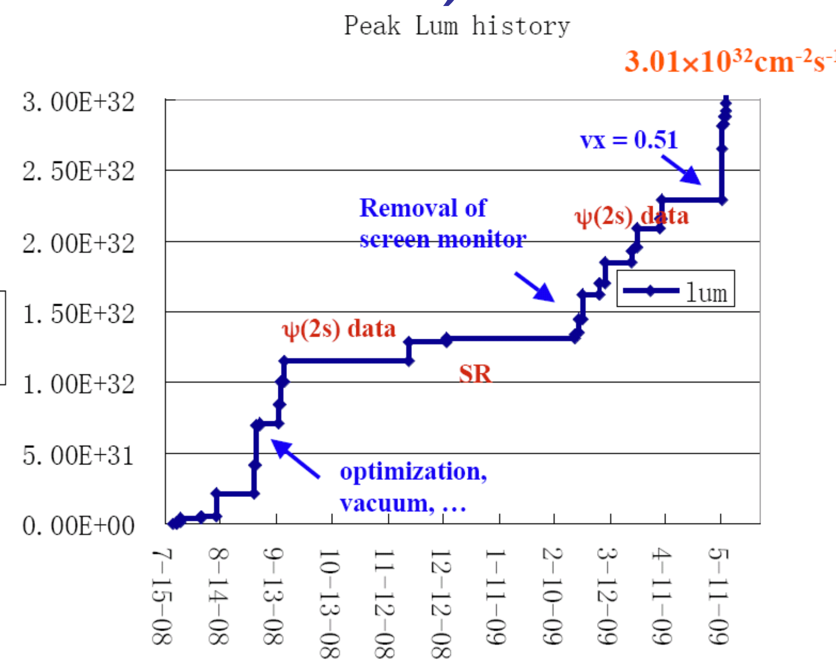


Luminosity improvement

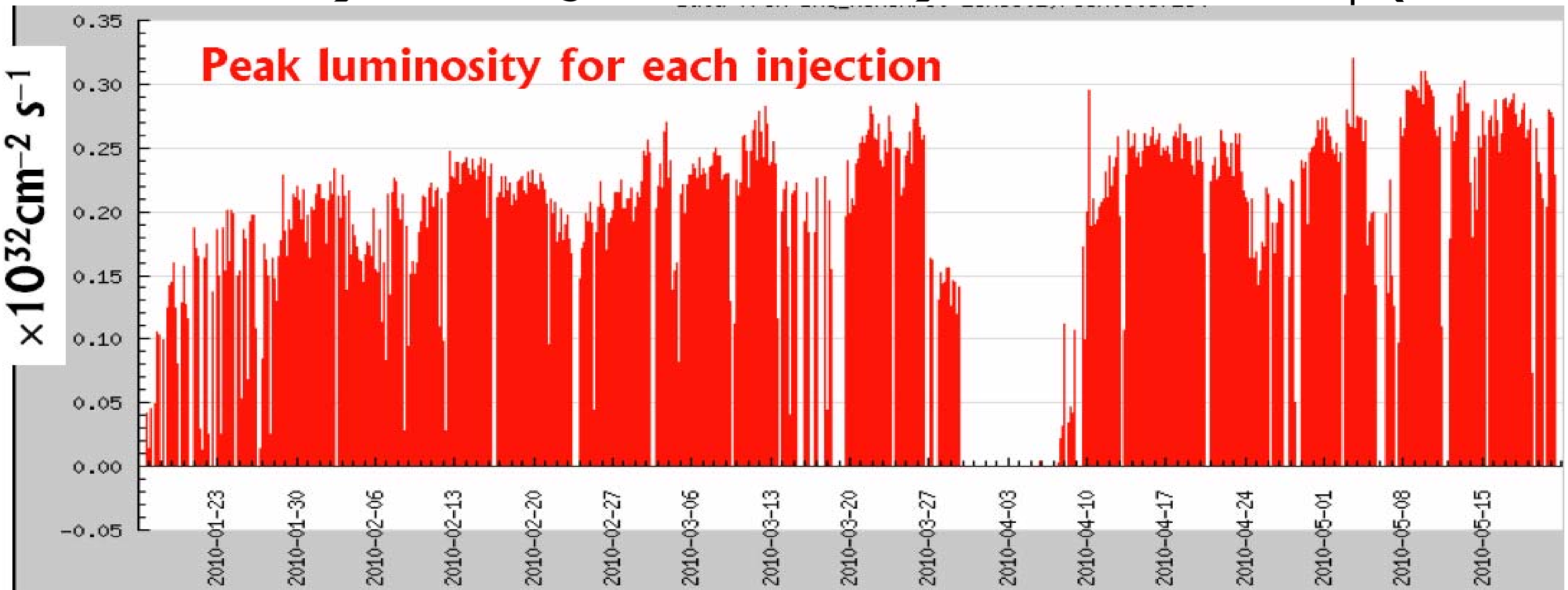
Optimization
Debug systems
Increase currents
Increase luminosity

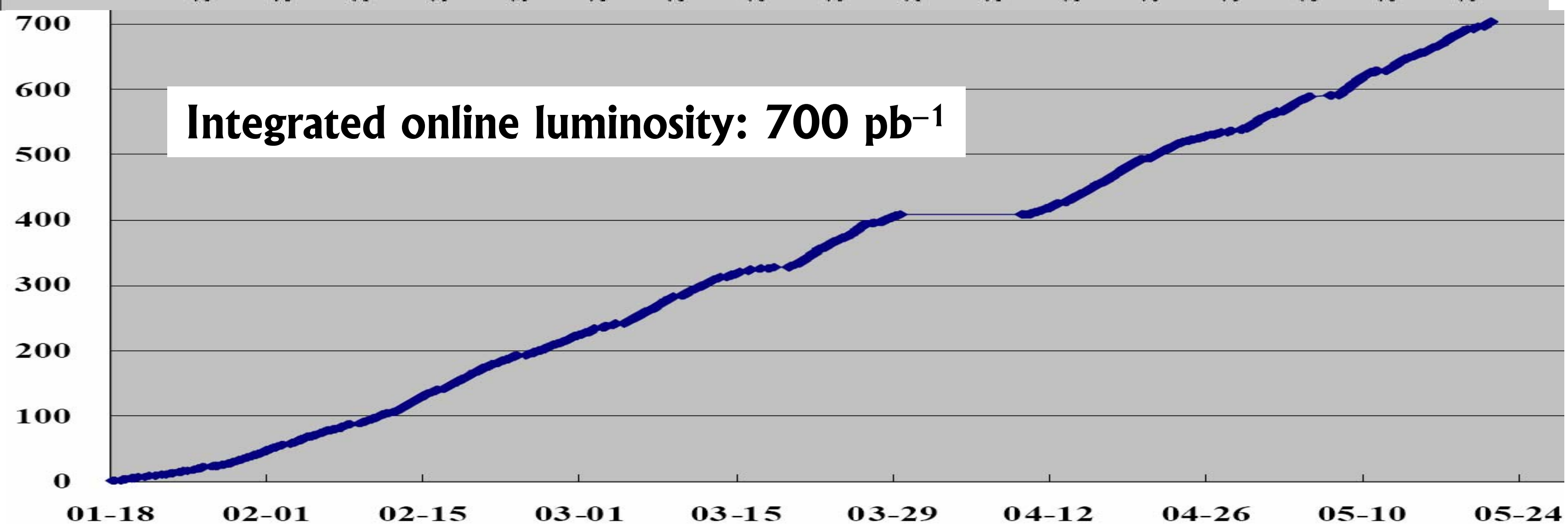


BEPCII peak luminosity trend
(2008-7-15 to 2009-5-13)
Peak luminosity of 3.0×10^{32}
achieved on May 13, 2009
at about 2×500mA, with 71 bunches.



Luminosity from Jan. 16-May 20 2010@ψ(3770)

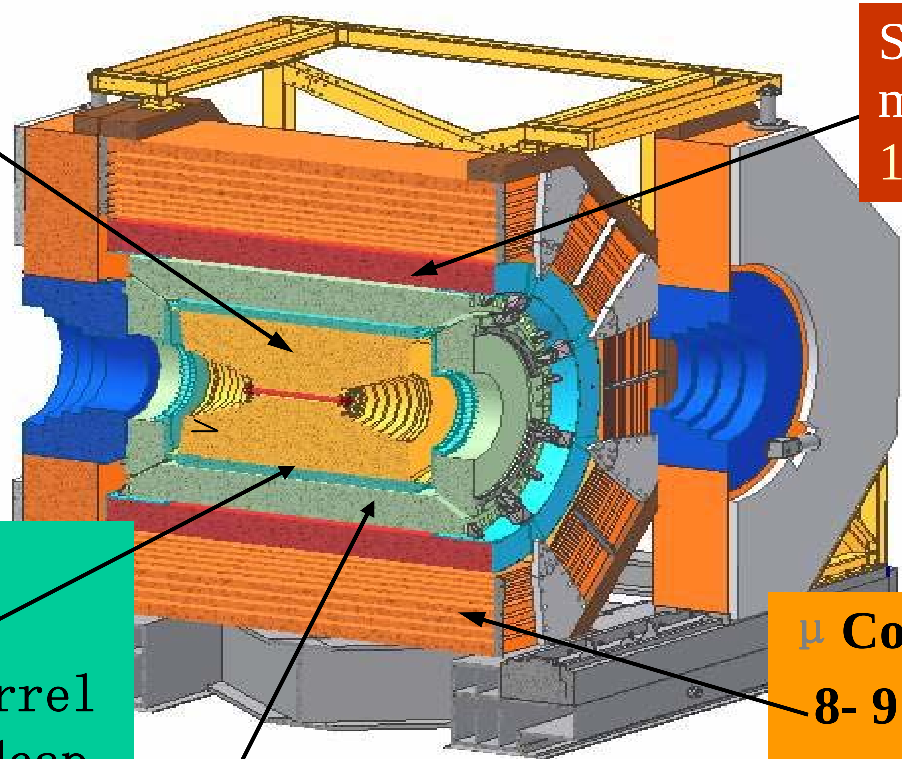




Main parameters achieved in collision mode

parameters	design	Achieved	
		BER	BPR
Energy (GeV)	1.89	1.89	1.89
Beam curr. (mA)	910	650	700
Bunch curr. (mA)	9.8	>10	>10
Bunch number	93	93	93
RF voltage	1.5	1.5	1.5
$*\nu_s$ @1.5MV	0.033	0.032	0.032
β_x^*/β_y^* (m)	1.0 / 0.015	~1.0 / 0.016	~1.0 / 0.016
Inj. Rate (mA/min)	200 e^- / 50 e^+	>200	>50
Lum. ($10^{33}cm^{-2}s^{-1}$)	1	0.30	

BESIII Detector



Main Drift Chamber (MDC)

$\triangle P/P$ $(^0/_0)$ = 0.5-0.7 %

(1 GeV）

$\sigma_{dE/dx}$ $(^0/_0)$ = 6-8%

Super-conducting magnet

1.0 tesla

Time Of Flight (TOF)

σ_T (ps)=100-120 ps Barrel

110-130 ps endcap

μ Counter

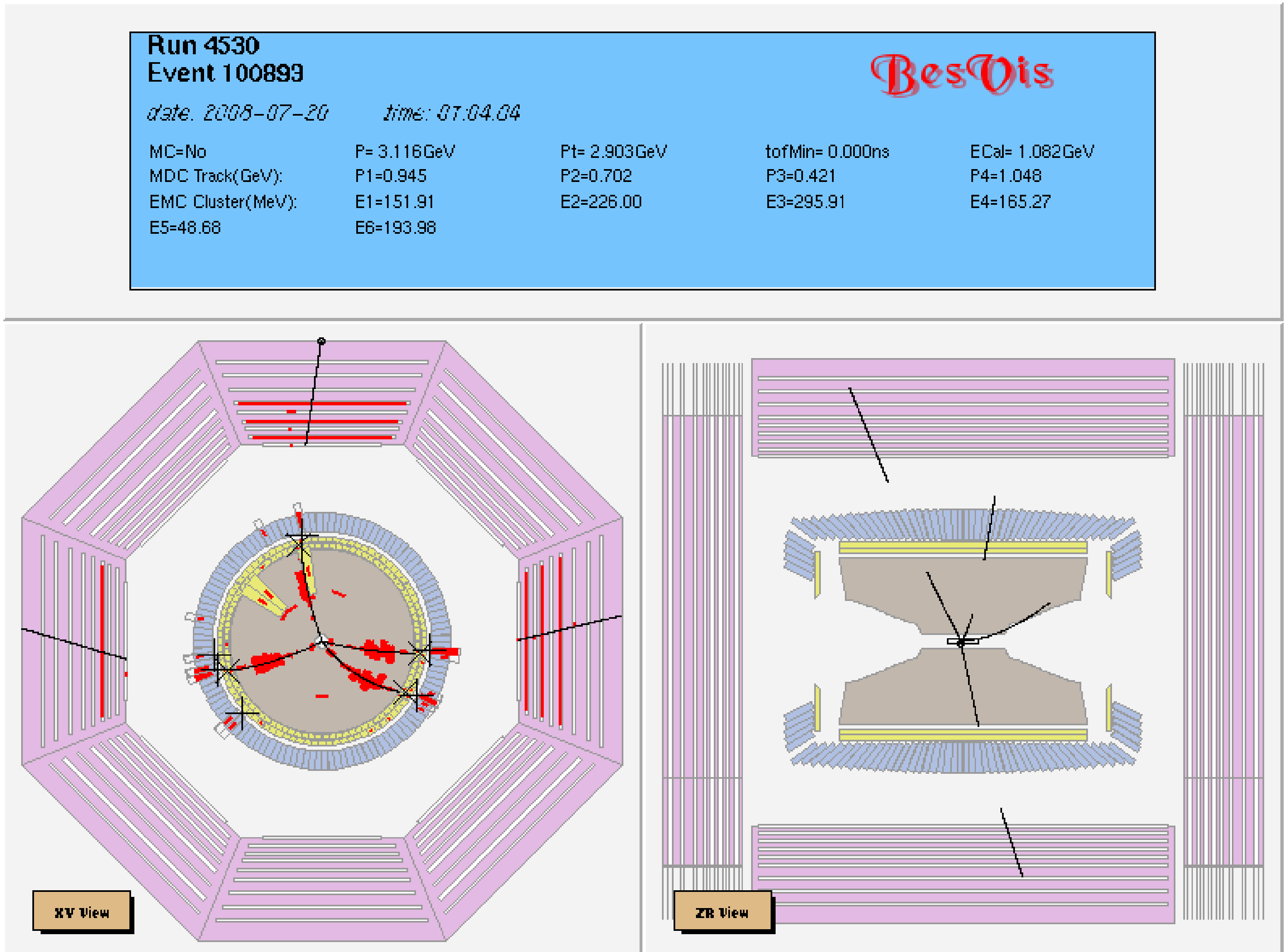
8- 9 layers

$\delta R\Phi$=1.4 cm~1.7 cm

EMC： $\triangle E/\sqrt{E}$ $(^0/_0)$ = 2.5 -3 % (1 GeV)

$\sigma_{z,\phi}$(cm) = 0.5cm-0.7 cm/ $\sqrt{E}$

First Hadronic Event on June 20, 2008



BESIII performance

Subdetectors			design	measurement
MDC	Momentum resolution （1 GeV）		0.5-0.7%	0.58 %
	dE/dx resolution		6-8%	6.0%（hadron） 5.3% (Bhabha)
EMC	Energy resolution （1 GeV）		2.5-3%	2.5 %
	Spatial resolution		5-7 mm	6.0 mm
TOF	Time resolution	Barrel	80-90 ps	80 ps (Bhabha)
		Endcap	100-110 ps	100 ps (dimuon)
μ counter	$\delta_{R\Phi}$ = 1.4 cm～1.7 cm			< 1.7 cm

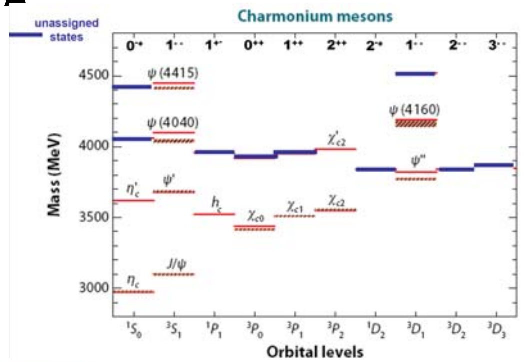
Data samples at BESIII

Type	BES-III ($\times 10^6$)	BESII ($\times 10^6$)	CLEO-c ($\times 10^6$)
J/ψ	230	58	-
$\psi(2S)$	108	14	27
DDbar	4.7(0.7fb^{-1})	0.2(0.03fb^{-1})	5.4(0.8fb^{-1})
DsDs	-	-	Scan
DsDs*	-	-	0.55(0.6fb^{-1})

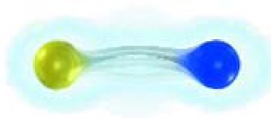
The BESIII is taking data @$\psi(3770)$ peak now, we expect about 1fb^{-1} will be collected by the end of June before summer shutdown.

A scan of $\psi(3770)$ peak is being done this summer!

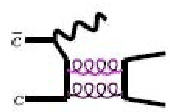
Physics program at BESIII

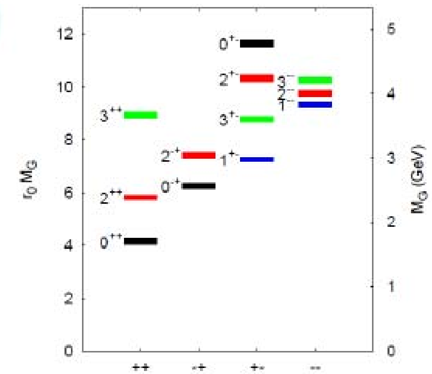


Charmonium physics
-- Spectroscopy and decays
-- New hidden charm

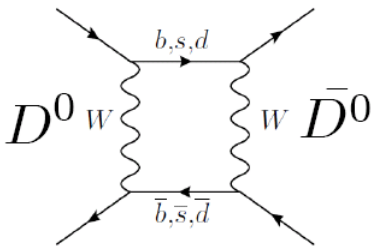


Light hadron
-- Establish spectrum of light hadrons
-- Search for non-conventional hadrons
-- Understand how hadrons are formed

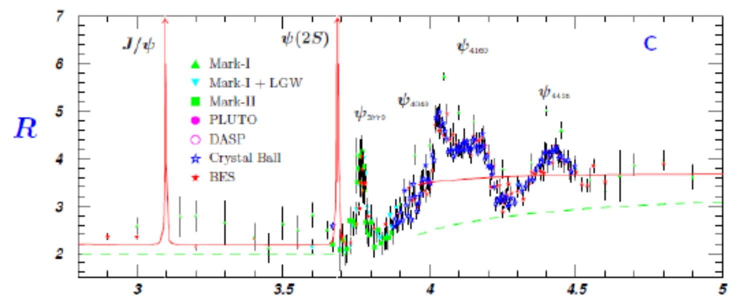




Charm physics
-- Decay constant, form factors
-- D^0 mixing and CPV
-- CKM: Vcs and Vcd



Tau and QCD
-- Tau mass and Tau decays
-- QCD: R values …



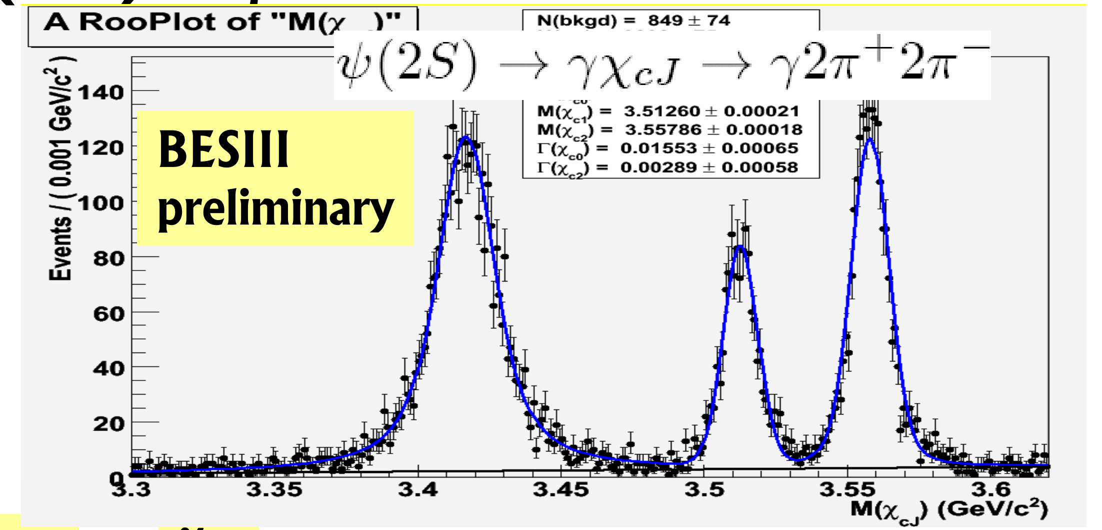
Radiative decays: $\psi(2S)\to\gamma X$

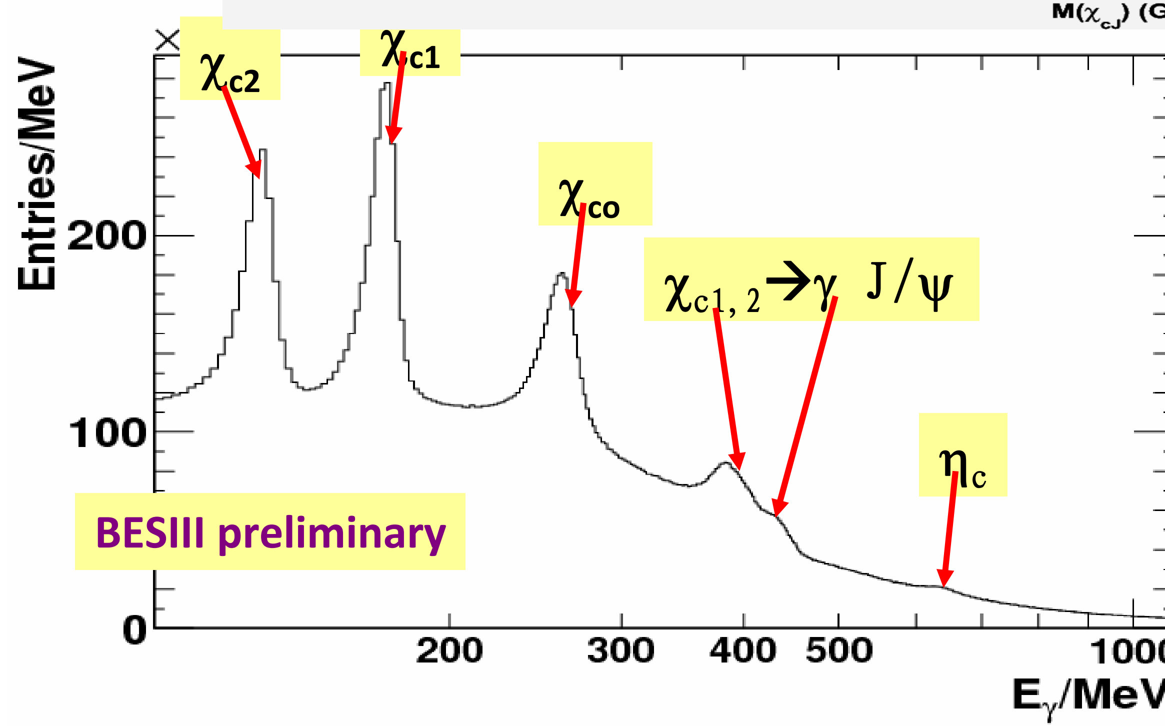
Clean exclusive signal

High statistics

Clear inclusive
photon spectrum

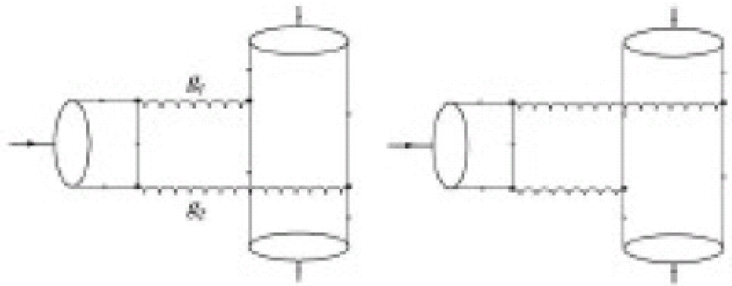
Excellent photon
resolution



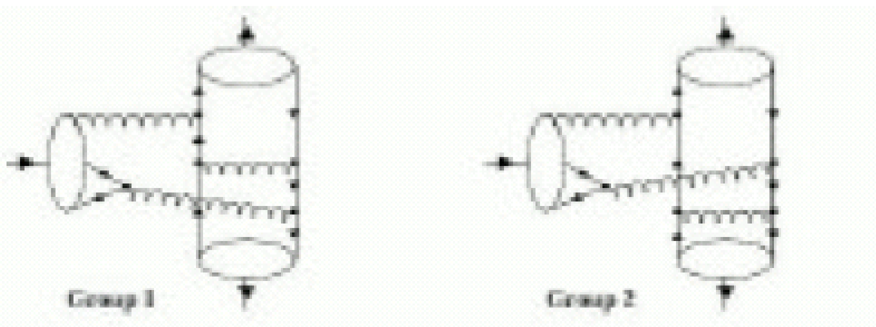


χ_{cJ} decays

Test of color singlet/octet models in χ_{cJ} decays



Probe single/double OZI suppressed decay of charmonium states



Exclusive decays of χ_{cJ} are a good laboratory to test the color-octet mechanism in P-wave charmonium decays.

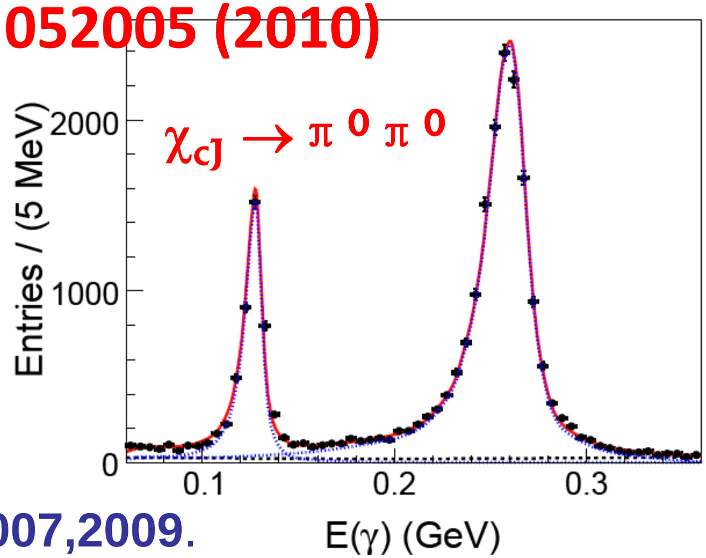
[1] G.T.Bodwin, et.al., Phys.Rev.D51,1125(1995)
[2] H.-W. Huang and K.-T. Chao, Phys. Rev.D54, 6850(1996) ）
[3] J. Bolz et. al., Eur.Phys.J. C 2:705-719(1998)

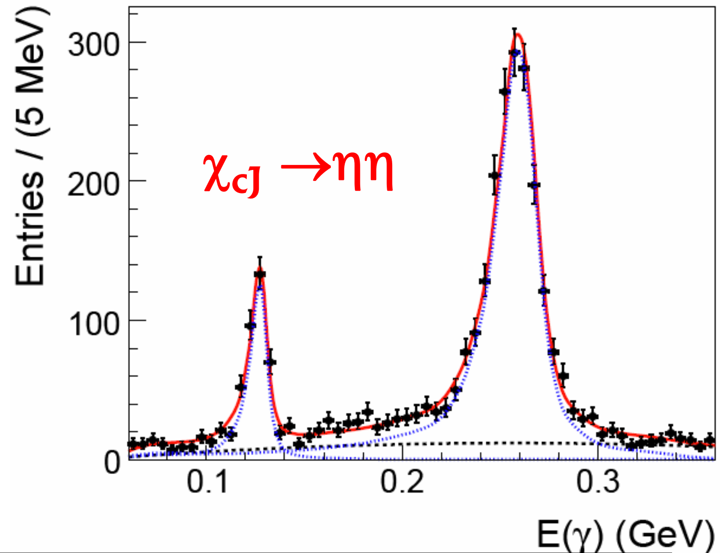
decay width	theory[3]	PDG08
$\Gamma[\chi_{c0} \to \pi^0\pi^0]$ / keV	23.5	25 ± 2
$\Gamma[\chi_{c2} \to \pi^0\pi^0]$ / keV	1.93	1.4 ± 0.2
$\Gamma[\chi_{c0} \to \eta\eta]$ / keV	32.7	25 ± 4
$\Gamma[\chi_{c2} \to \eta\eta]$ / keV	2.66	

$\chi_{cJ} \to \pi^0\pi^0$, $\eta\eta$ from $\psi \to \gamma\chi_{cJ}$ decays

BESIII PRD 81, 052005 (2010)

Radiative photon spectrum





CLEO, PRD79:072007,2009.

Decay mode		χ_{c0} (10^{-3})	χ_{c2} (10^{-3})
$\pi^0\pi^0$	BESIII	$3.23\pm0.03\pm0.23\pm0.14$	$0.88\pm0.02\pm0.06\pm0.04$
	PDG08	2.43 ± 0.20	0.71 ± 0.08
	CLEOc	$2.94\pm0.07\pm0.32\pm0.15$	$0.68\pm0.03\pm0.07\pm0.04$
$\eta\eta$	BESIII	$3.44\pm0.10\pm0.24\pm0.20$	$0.65\pm0.04\pm0.05\pm0.03$
	PDG08	2.4 ± 0.4	<0.5
	CLEOc	$3.18\pm0.13\pm0.31\pm0.16$	$0.51\pm0.05\pm0.05\pm0.03$

CLEO-c used their own measured BRs for $\psi \to \gamma\chi_{cJ}$ decays.

$\chi_{cJ} \to 4\pi^0$ from $\psi \to \gamma\chi_{cJ}$ decays

- Branching fraction excluding $Ks \to \pi^0\pi^0$

$BR(\chi_{c0} \to 4\pi^0) = (3.42 \pm 0.07 \pm 0.45)\cdot 10^{-3}$

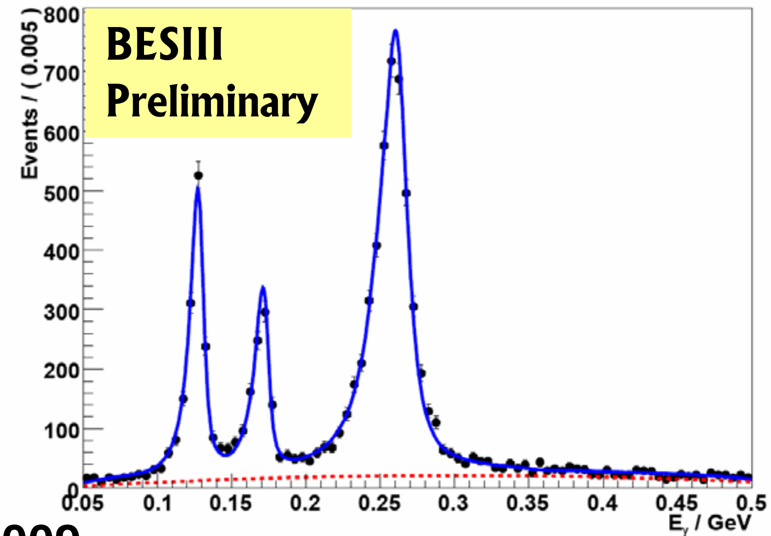
$BR(\chi_{c1} \to 4\pi^0) = (0.60 \pm 0.03 \pm 0.09)\cdot 10^{-3}$

$BR(\chi_{c2} \to 4\pi^0) = (1.13 \pm 0.04 \pm 0.15)\cdot 10^{-3}$

- Branching fraction for $\chi_{cJ} \to KsKs$

$BR(\chi_{c0} \to K_S K_S) = (4.1 \pm 0.4_{stat})\cdot 10^{-3}$

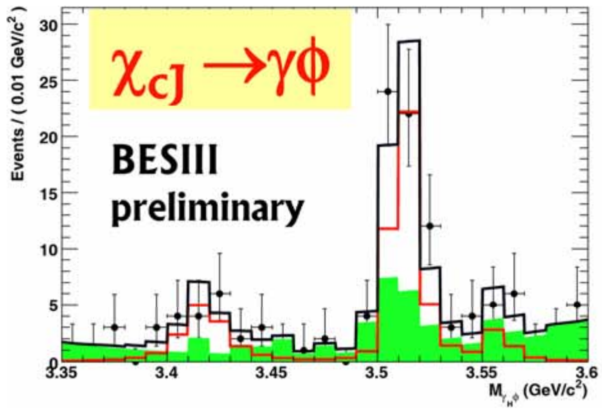
$BR(\chi_{c2} \to K_S K_S) = (0.6 \pm 0.2_{stat})\cdot 10^{-3}$

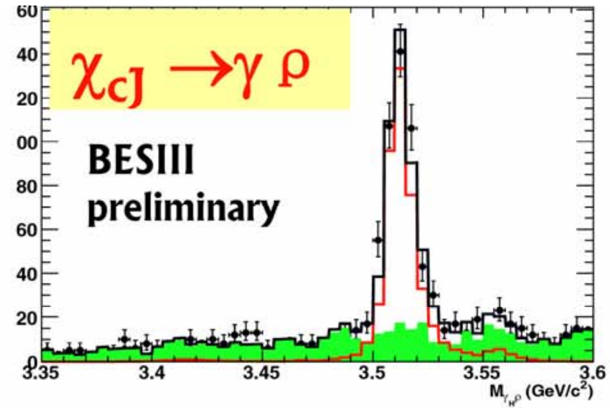


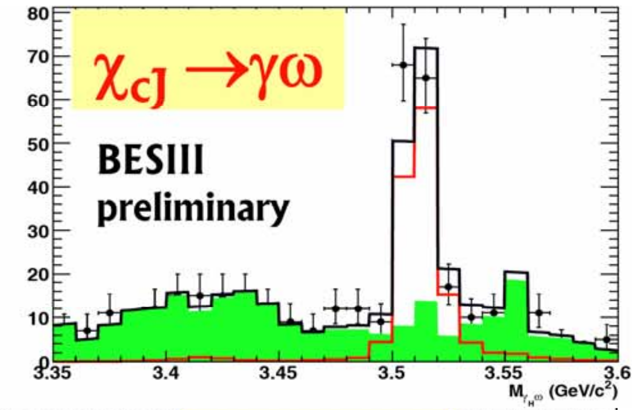
CLEO Collaboration, Phys.Rev.D79:072007,2009.

BESIII	$BR(\chi_{c0} \to K_S K_S) = (4.1 \pm 0.4_{stat})\cdot 10^{-3}$
PDG 08 :	$BR(\chi_{c0} \to K_S K_S) = (2.82 \pm 0.28)\cdot 10^{-3}$
CLEO-c :	$BR(\chi_{c0} \to K_S K_S) = (3.49 \pm 0.08 \pm 0.17 \pm 0.17)\cdot 10^{-3}$
BESIII	$BR(\chi_{c2} \to K_S K_S) = (0.6 \pm 0.2_{stat})\cdot 10^{-3}$
PDG 08 :	$BR(\chi_{c2} \to K_S K_S) = (0.68 \pm 0.11)\cdot 10^{-3}$
CLEO-c :	$BR(\chi_{c2} \to K_S K_S) = (0.53 \pm 0.03 \pm 0.03 \pm 0.03)\cdot 10^{-3}$

Measurements of $\chi_{cJ} \to \gamma V$, $V=\phi, \rho, \omega$







Decay modes	BESIII BR($\times 10^{-6}$)	CLEO-c BR($\times 10^{-6}$)	PQCD BR($\times 10^{-6}$)
$\chi_{c0} \to \gamma\phi$	<14.8	<6.4	0.46
$\chi_{c1} \to \gamma\phi$	$27.3 \pm 5.5_{stat}$	<26	3.6
$\chi_{c2} \to \gamma\phi$	<7.8	<13	1.1
$\chi_{c0} \to \gamma\rho$	<9.5	<9.6	1.2
$\chi_{c1} \to \gamma\rho$	$241 \pm 14_{stat}$	$243 \pm 19 \pm 22$	14
$\chi_{c2} \to \gamma\rho$	<19.7	<50	4.4
$\chi_{c0} \to \gamma\omega$	<11.7	<8.8	0.13
$\chi_{c1} \to \gamma\omega$	$74.5 \pm 7.6_{stat}$	$83 \pm 15 \pm 12$	1.6
$\chi_{c2} \to \gamma\omega$	<5.8	<7.0	0.50

Only statistical errors are shown

longitudinal polarization($\lambda=0$) dominated in $\chi_{c1} \to \gamma V$ decays.

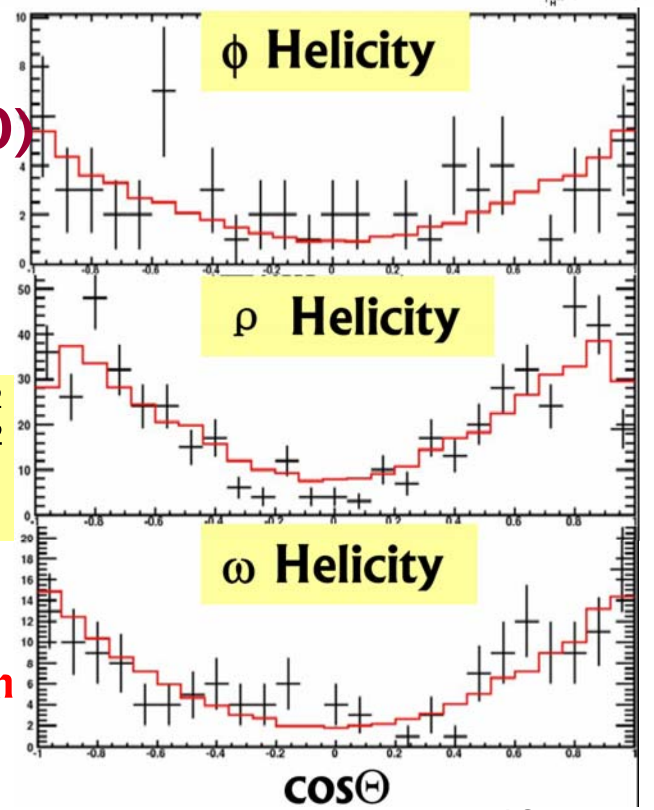
CLEO-c :

$$f_T = 0.078^{+0.048+0.002}_{-0.036-0.022}$$

$$f_T = 0.47^{+0.37+0.11}_{-0.24-0.23}$$

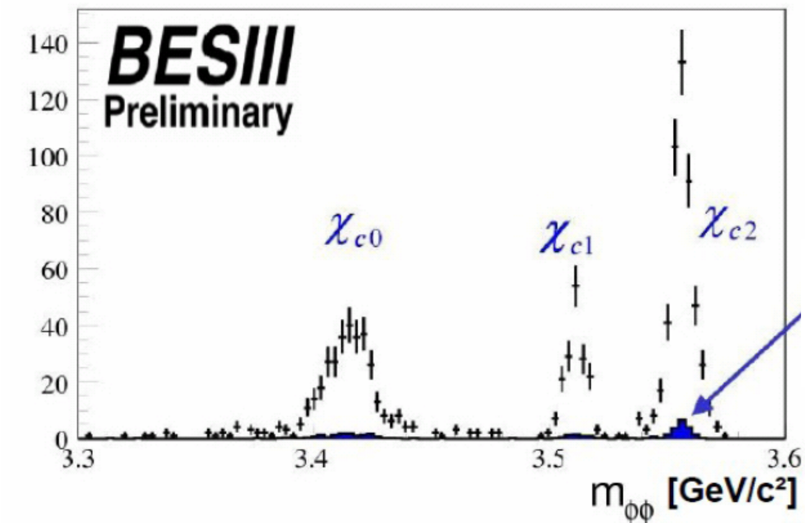
for $\chi_{c1} \to \gamma\rho$ and $\chi_{c1} \to \gamma\omega$.

Landau-Yang theorem
C.N.Yang,
PR77 (1950)242



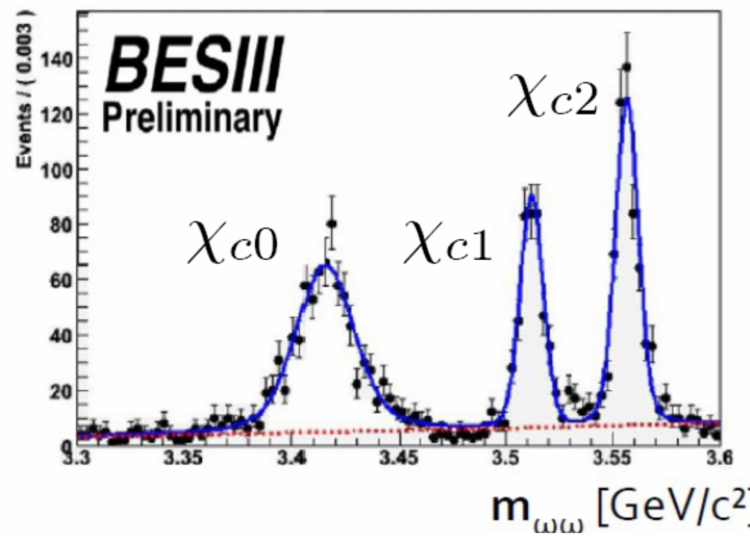
Measurements of $\chi_{cJ} \to$ VV, V = ϕ,ω

$\psi(2S) \to \gamma\phi\phi$

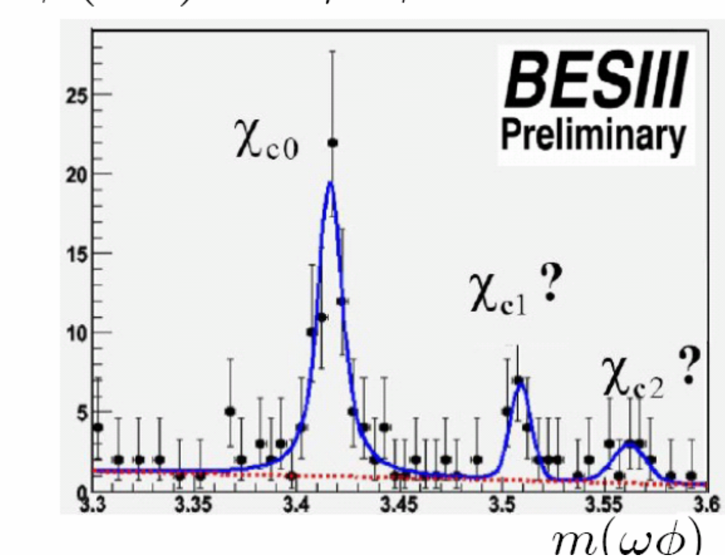


ϕ-side bands

$\psi(2S) \to \gamma\omega\omega$



$\psi(2S) \to \gamma\omega\phi$



First observation of $\chi_{cJ} \to \omega\phi$ which is a doubly OZI suppressed decay, long distance contribution may be important in charmonium decays.

h_c: spin-spin interaction

- **Spin singlet P wave (L=1, S=0)**

- **Test of QCD and potential model spin-spin-interaction tells us:**

$$\Delta M_{hf}(1P) = m(h_c) - \frac{1}{9}\left(m(\chi_{c0}) + 3m(\chi_{c1}) + 5m(\chi_{c2})\right)$$

$\Delta M_{hf}(1P) \neq 0$: **if spin-spin interaction.**

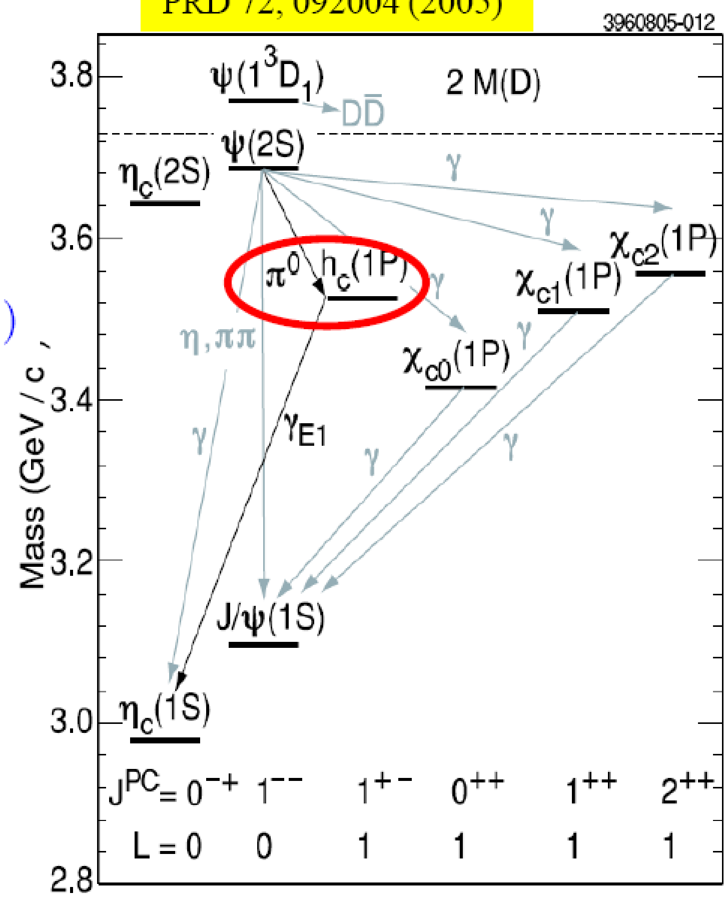
- E835: Evidence in $\bar{p}p \to h_c \to \eta_c\gamma$

- CLEO: Observation in

$$e^+e^- \to \psi(2S) \to h_c\pi^0$$
$$h_c \to \eta_c\gamma$$

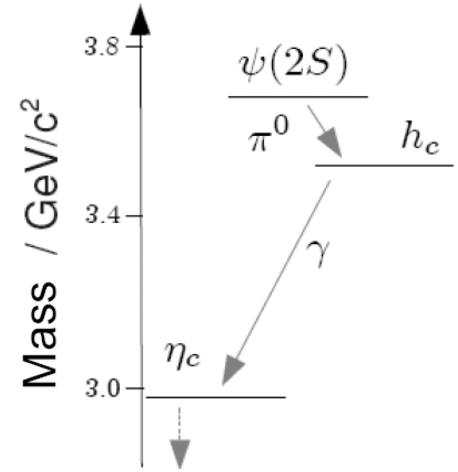
$$\Delta M_{hf}(1P) = 0.08 \pm 0.18 \pm 0.12\ \mathrm{MeV}/c^2$$

PRD 72, 092004 (2005)

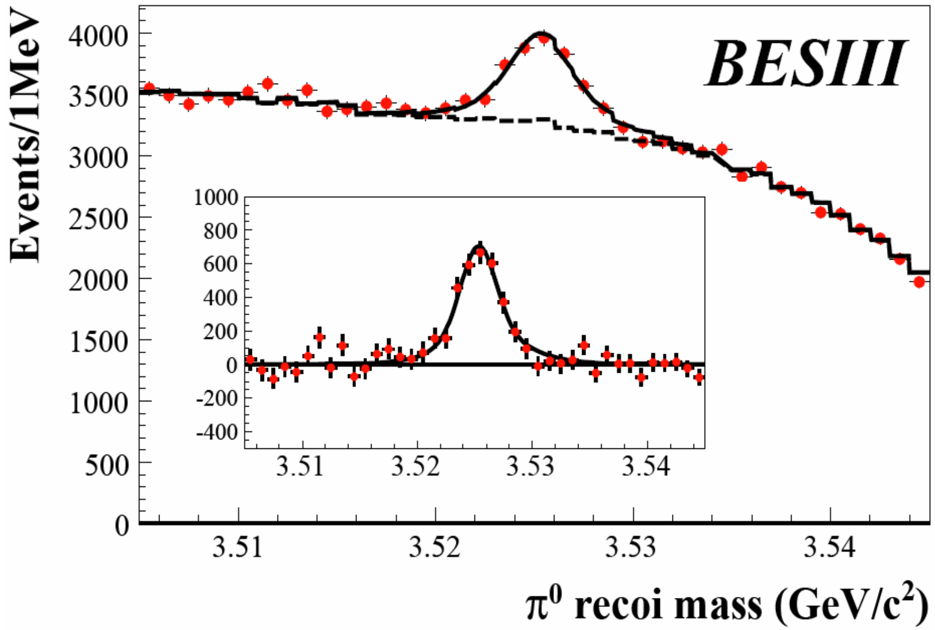


Observation of h_c : Inclusive (tagged)

- Select inclusive π^0 ($\psi' \to \pi^0 h_c$)
- Select E1-photon γ to tag $h_c \to \gamma\, \eta_c$
- Double-Gaussian $\otimes$ BW signal + E1-photon sideband background.



BES Collaboration, PRL 104, 132002 (2010)



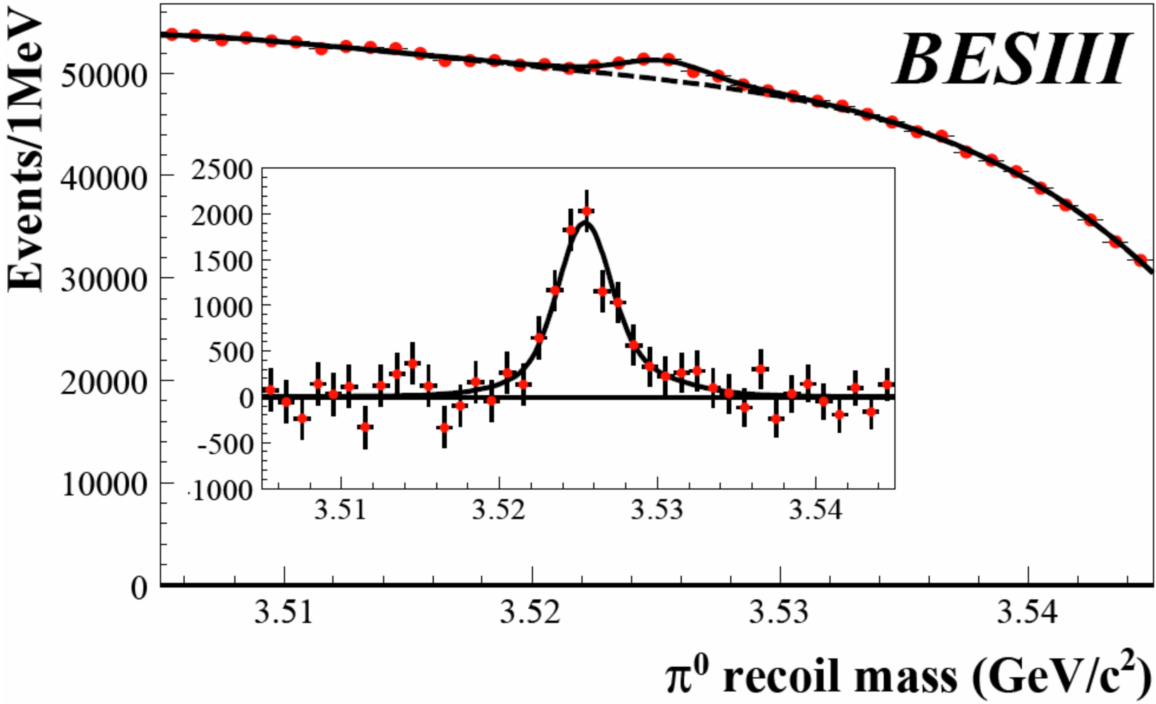
Results:

- $Br(\psi' \to \pi^0 h_c) \times Br(h_c \to \gamma\eta_c) = (4.58 \pm 0.40 \pm 0.50) \times 10^{-4}$
- $M = 3525.40 \pm 0.13 \pm 0.18$ MeV/c²
- $\Gamma = 0.73 \pm 0.45 \pm 0.28$ MeV (<1.44 MeV 90%C.L.)

Observation of h_c : Inclusive (untagged)

- Select inclusive π^0 ($\psi' \to \pi^0 h_c$)
- D-Gaussian $\otimes$ BW signal + 4^{th} Poly. bkg
- Fit: mass and width fixed as tagged measurement

BES Collaboration, PRL 104, 132002 (2010)



Combined with tagged results, we firstly measured:

- Br($\psi' \to \pi^0 h_c$) $= (8.4 \pm 1.3 \pm 1.0) \times 10^{-4}$
- Br($h_c \to \gamma \eta_c$) $= (54.3 \pm 6.7 \pm 5.2)\%$

h_c : analysis summary

BES Collaboration, PRL 104, 132002 (2010)

	BESIII	CLEOc
$Br(\psi' \to \pi^0 h_c) \times Br(h_c \to \gamma \eta_c)$ $[10^{-4}]$	$4.58 \pm 0.40 \pm 0.50$	$4.19 \pm 0.32 \pm 0.45$
M [MeV/c^2]	$3525.40 \pm 0.13 \pm 0.18$	$3525.80 \pm 0.23 \pm 0.15$
Γ [MeV]	$0.73 \pm 0.45 \pm 0.28$ < 1.44 @ 90%CL	1.1 (NRQCD) Kuang 0.51 (PQCD) Kuang
$\Delta M_{hf}(1P)$ [MeV/c^2]	$0.10 \pm 0.13 \pm 0.18$	$0.08 \pm 0.18 \pm 0.12$

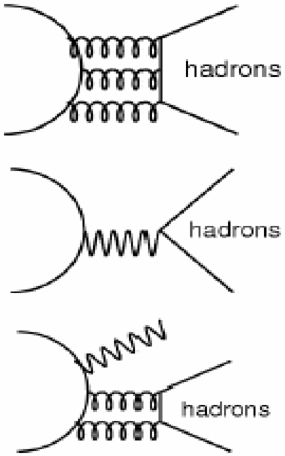
CLEO-c Collaboration, Phys.Rev.Lett.101:182003,2008

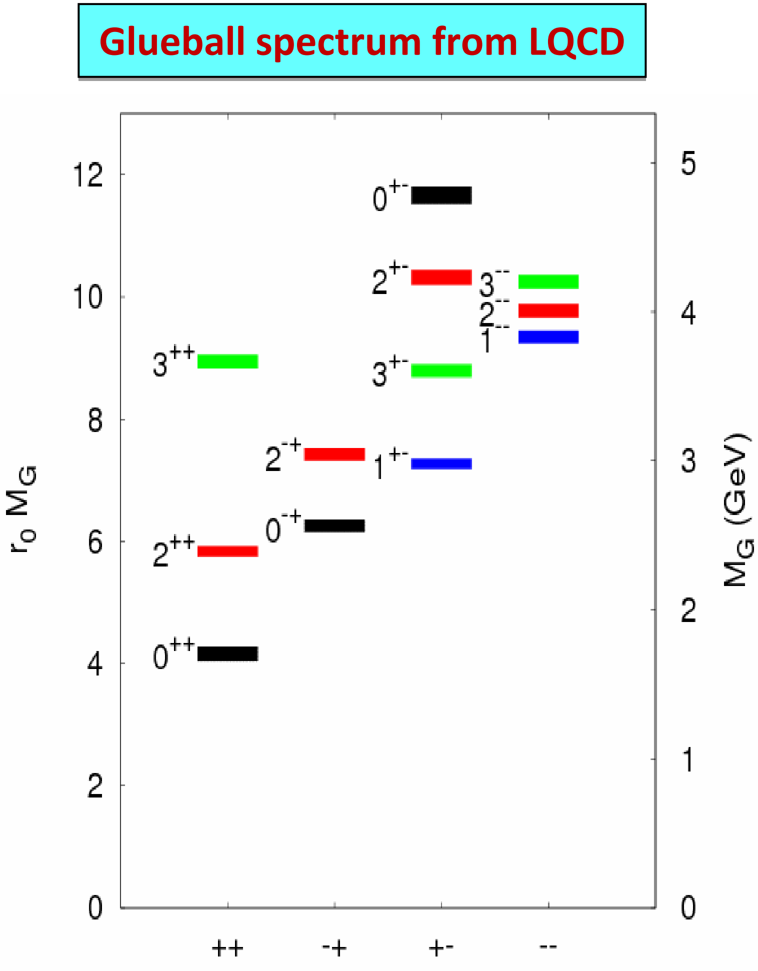
	BESIII	theoretical prediction
$Br(\psi' \to \pi^0 h_c)$ $[10^{-4}]$	$8.4 \pm 1.3 \pm 1.0$	4 - 13
$Br(h_c \to \gamma \eta_c)$	$54.3 \pm 6.7 \pm 5.2$	41 (NRQCD) Kuang 88 (PQCD) Kuang 38 Godfrey, Rosner

Theoretical predictions: PRD65, 094024 (2002) & PRD 66, 014012 (2002).

Light hadron spectroscopy

- **Motivation:**
  - Establish spectrum of light hadrons
  - Search for non-conventional hadrons
- **Why at a BESIII ?**
  - Gluon rich
  - Kinematics favorable
  - Clean environment, no combinatoric background
  - Important J^{PC} filter, and isospin filter



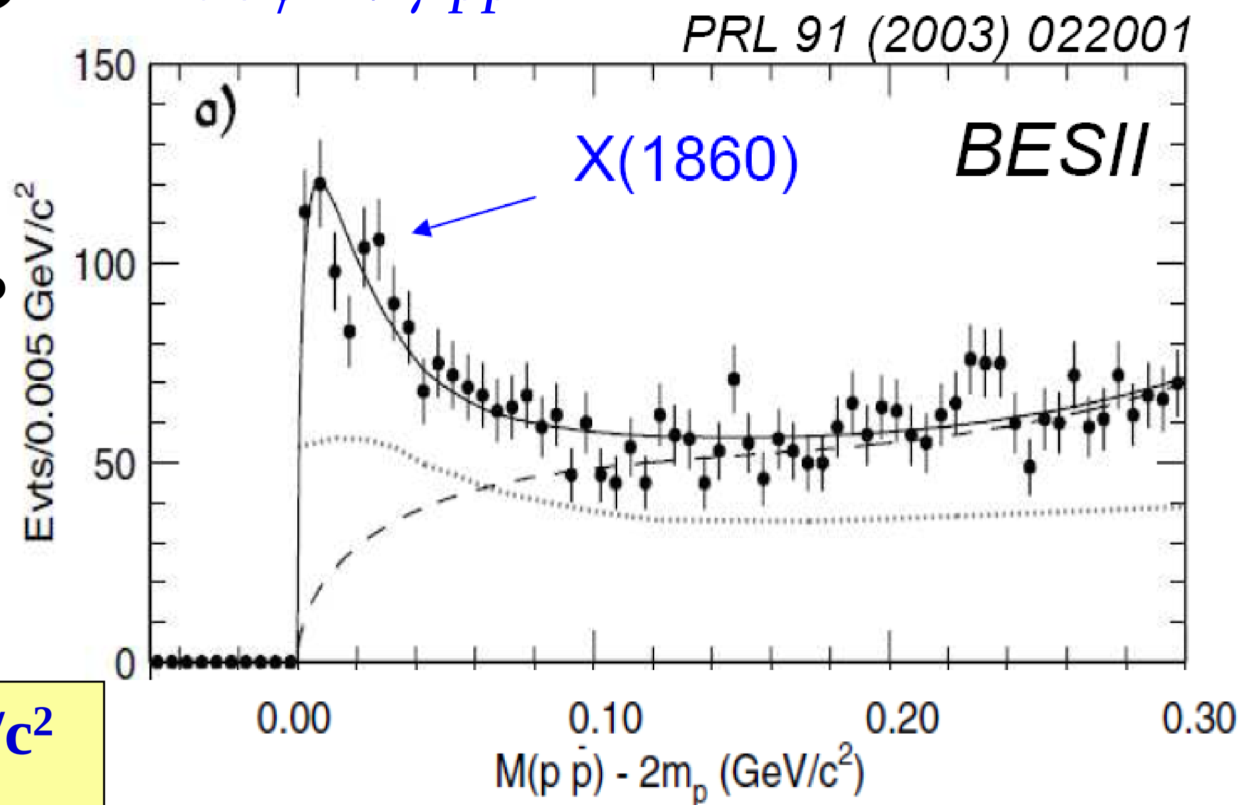


Y. Chen et al., PRD 73 (2006) 014516

$p\bar{p}$ threshold enhancement @ BESII

- **What could it be?**
  - $p\bar{p}$ bound state?
  - FSI effect?
  - or some of both?

$J/\psi \to \gamma p\bar{p}$



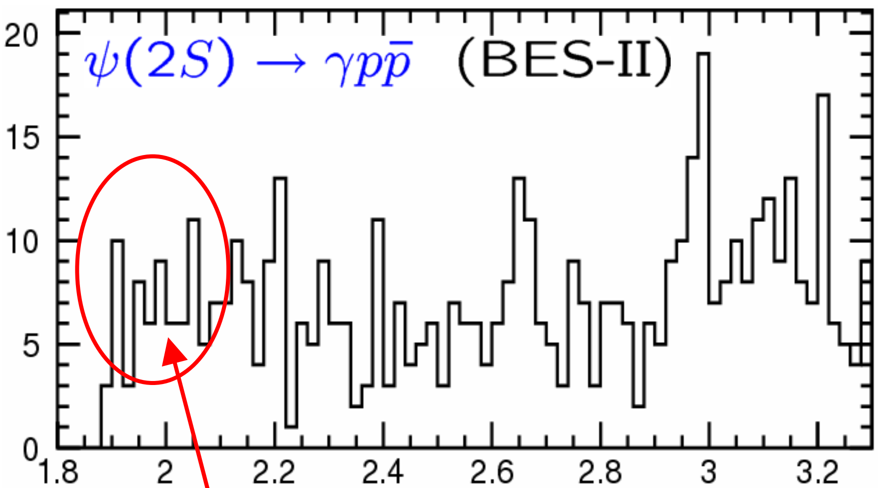
$M = 1859^{+3}_{-10}\,{}^{+5}_{-25}$ MeV/c^2

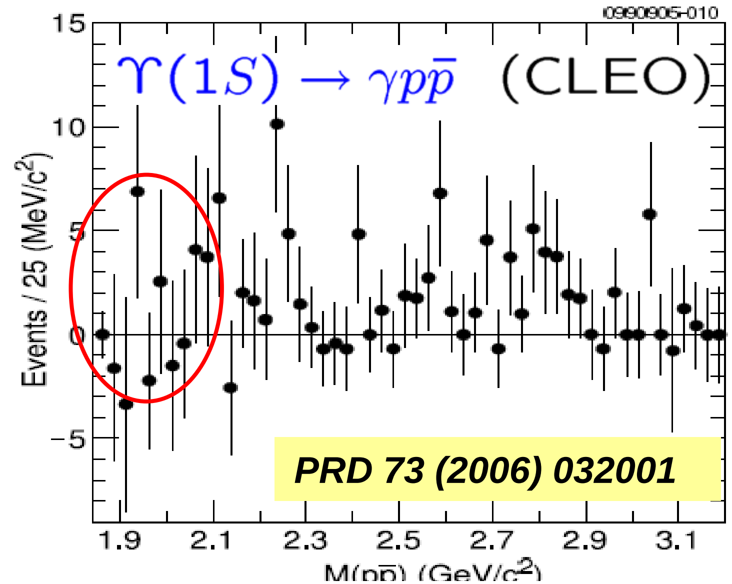
$\Gamma < 30$ MeV/c^2 (90% CL)

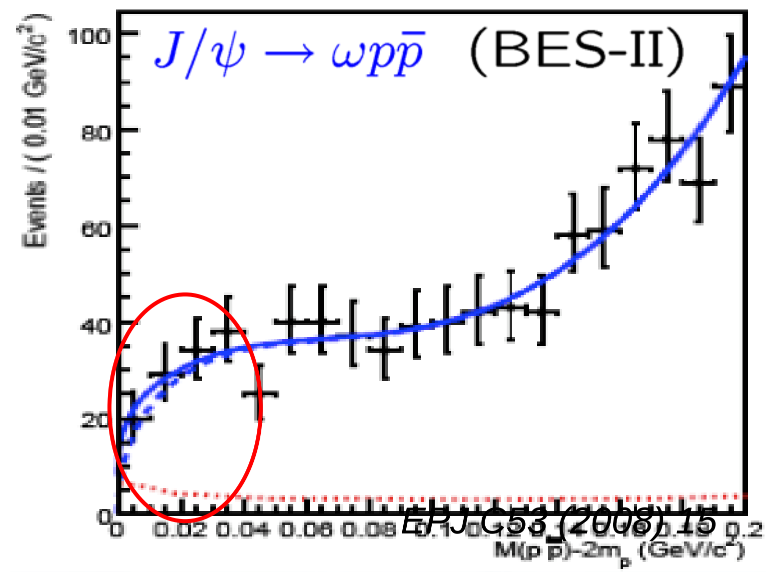
X(1860) in close to $p\bar{p}$ threshold

Several *non*-observations…

PRL 99 (2007) 011802



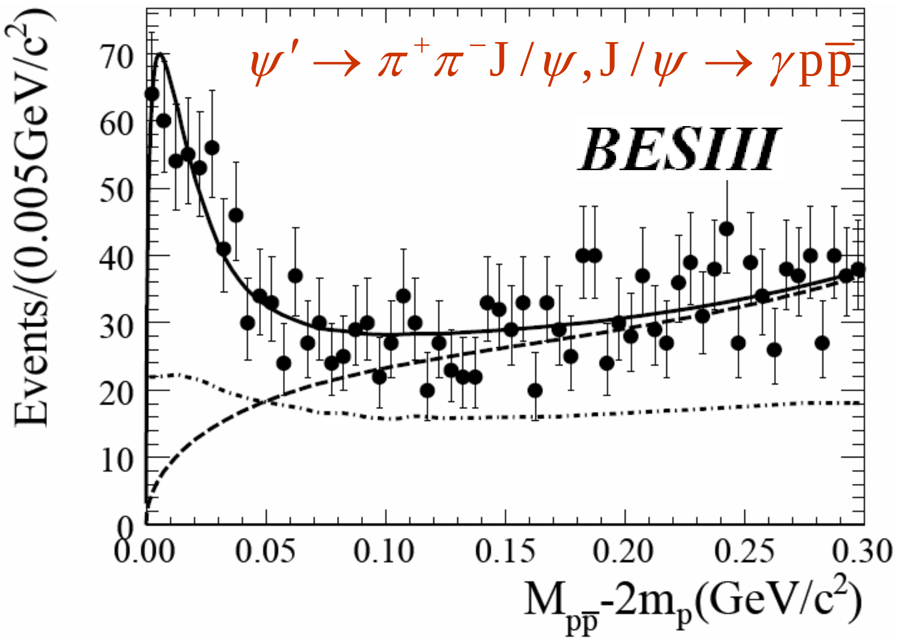


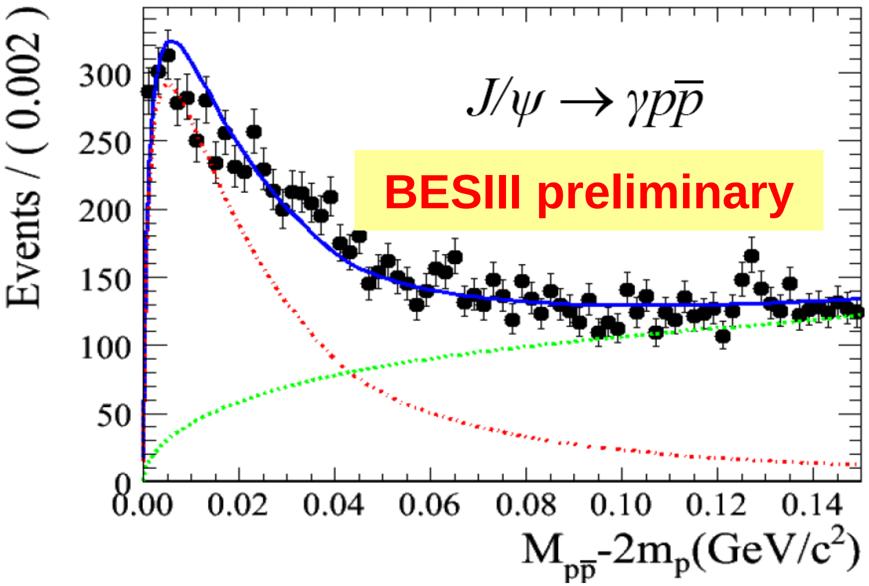


No significant signal of X(1860) found (only 2σ significance)

$p\bar{p}$ threshold enhancement @ BESIII

Published in Chinese Physics C 34(2010)421





$M = 1861\ ^{+6}_{-13}\ ^{+7}_{-26}$ MeV/c^2

$\Gamma < 38$ MeV/c^2 (90% CL)

$M = 1861.6 \pm 0.8$ MeV/c^2

$\Gamma < 8$ MeV/c^2 (90% CL)

Consistent observation by BESIII !

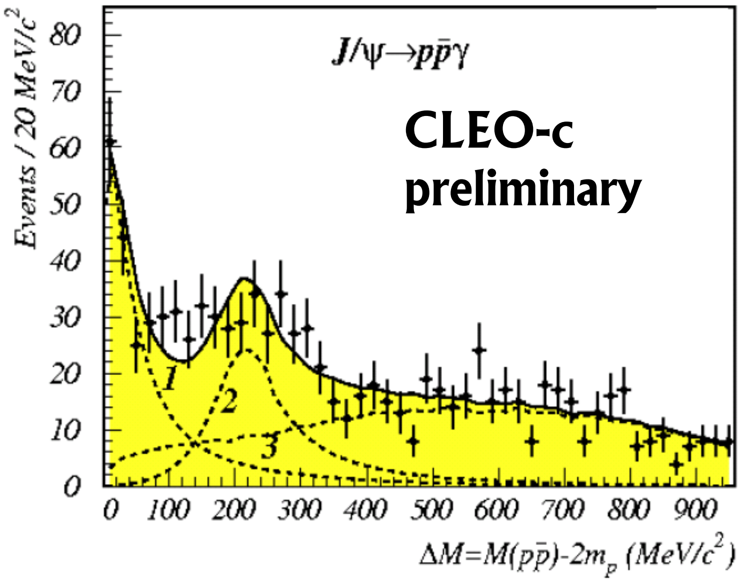
$p\bar{p}$ threshold enhancement @ CLEO-c

- **CLEO-c does the same fit as that at BES, they obtain:**

$M(R_{thr}) = 1861^{+6}_{-16}$ (MeV), $\Gamma(R_{thr}) = 0^{+32}_{-0}$ (MeV),

$B_1(J/\psi \to \gamma R_{thr}) \times B_2(R_{thr} \to p\bar{p}) = (5.9^{+2.8}_{-3.2}) \times 10^{-5}$

which agree with BESII results [PRL91(2003)022011].



- **CLEO-c fit with three contributions:**

$R_{thr} + f_0(2100) + PS$
(1) (2) (3)

$M(R_{thr}) = 1837^{+10}_{-12}{}^{+9}_{-7}$ (MeV),

$\Gamma(R_{thr}) = 0^{+44}_{-0}$ (MeV), CL = 26.1%

$B_1(J/\psi \to \gamma R_{thr}) \times B_2(R_{thr} \to p\bar{p}) = (11.4^{+4.3}_{-3.0}{}^{+4.2}_{-2.6}) \times 10^{-5}$

The central value of the mass is close to the sub-threshold resonance mass reported by BES with $M(R) = 1833.7 \pm 6.1 \pm 2.7$ (MeV), observed in $J/\psi \to \gamma R$, $R \to \pi^+\pi^-\eta'$ [PRL 95 (2005) 262001].

BES considered these (2) and (3) as systematic errors.

QWG2010
Z. Metreveli

X(1860) in $\psi(2S)$ decays (preliminary)

- Checked also for enhancement in ψ' decays (High statistics)

Confirmation of **no observation** of enhancement in $\psi(2S)$ channel!
$\Rightarrow$pure FSI effect unlikely

Fit, assuming $M(p\bar{p})=1856$MeV, $\Gamma=20$MeV from BESII $J/\psi\to\gamma p\bar{p}$:

CLEO:

$N_{ev} = 9^{+10}_{-9}$, χ^2/d.o.f. = 53/58

$B(\psi(2S)\to\gamma R)\times B(R\to p\bar{p}) = (0.66^{+0.73}_{-0.66})\times 10^{-6}$

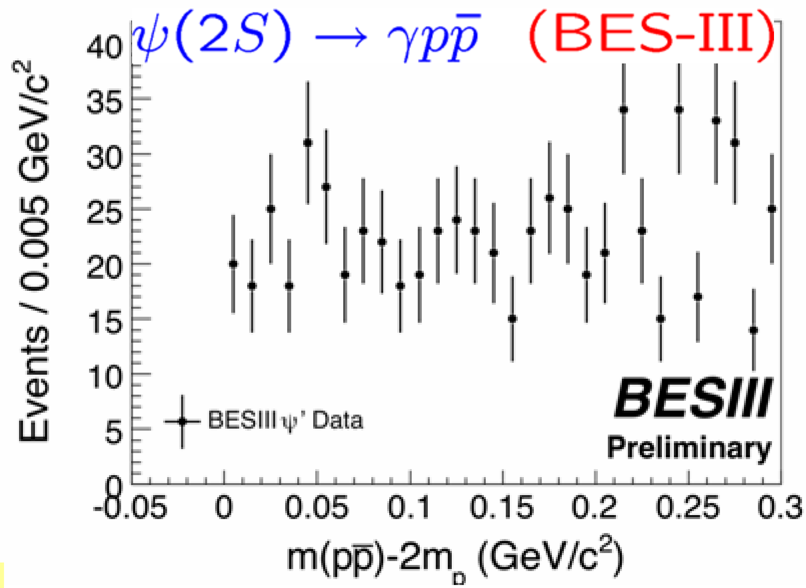
$B(\psi(2S)\to\gamma R)\times B(R\to p\bar{p}) < \mathbf{1.6 \times 10^{-6}}$ 90% CL

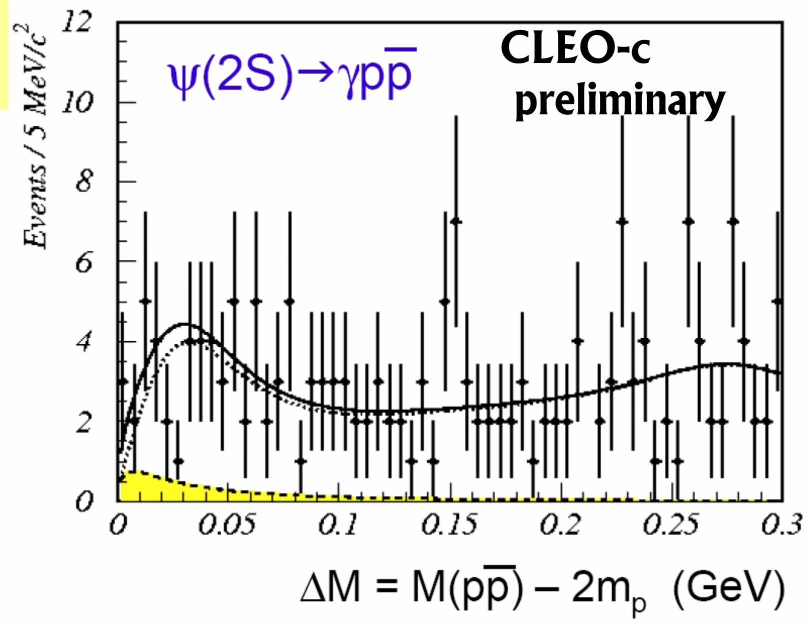
QWG2010
Z. Metreveli

BES(2007) PRL 99 (2007) 011802

$N_{ev} = 11.7 \pm 6.7$, sig.=2.0s

$B(\psi(2S)\to\gamma R)\times B(R\to p\bar{p}) < 5.4 \times 10^{-6}$

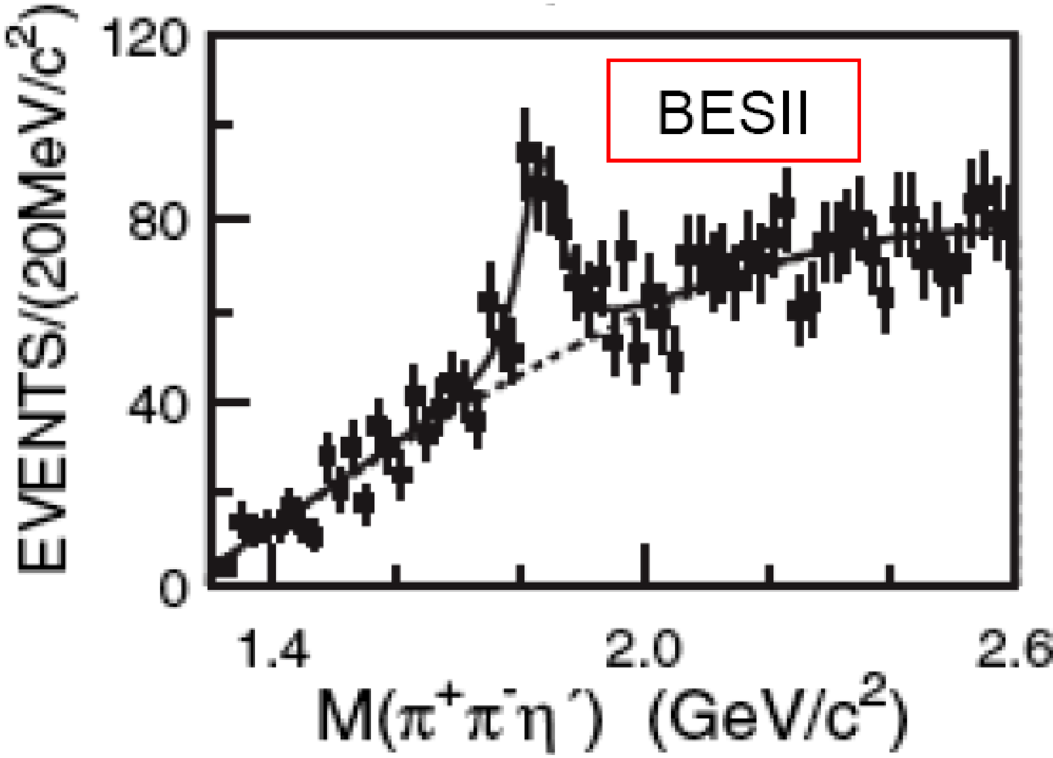




X(1835) at BESII

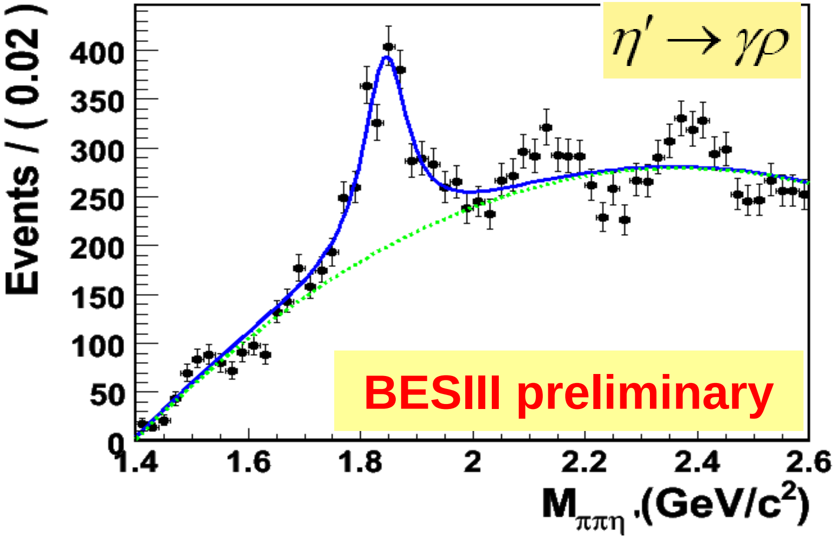
- LQCD predicts the glueball mass of 0^{-+} is ~2.3GeV.
- For 0^{-+} glueball, it may have similar property as η_c (the main decay mode is $\pi\pi\eta'$).
- Confirmation of X(1835) is necessary with BESIII ~230M J/ψ data sample

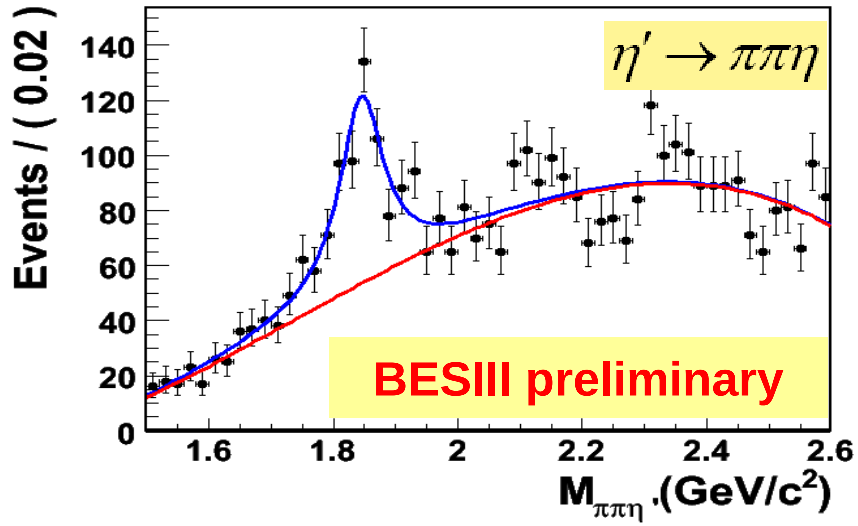
$$J/\psi \to \gamma \pi^+\pi^-\eta'$$



PRL 95,262001(2005)

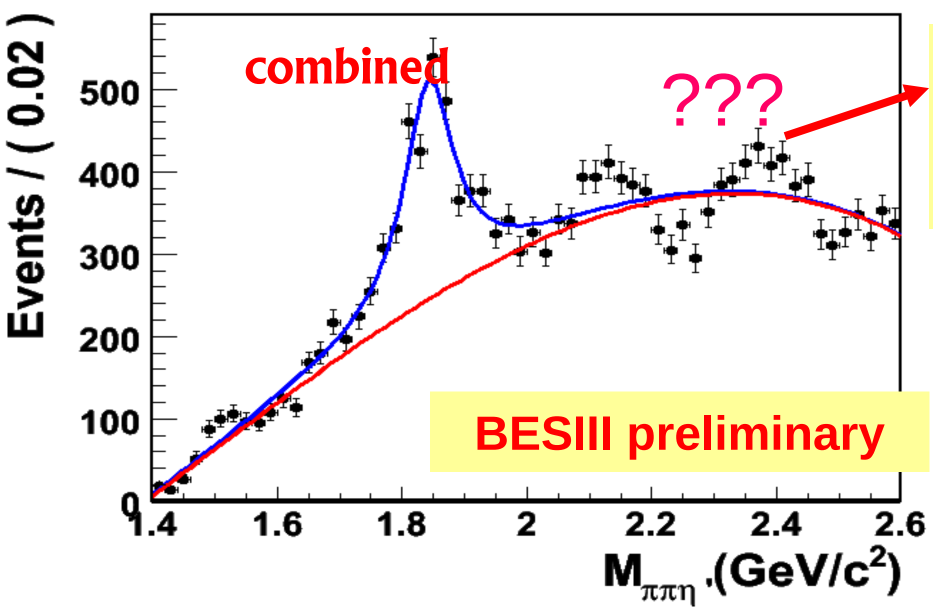
X(1835) confirmed by BESIII





Statistical significance $\sim 18\sigma$

Statistical significance $\sim 9\sigma$



The possibility that there are two new resonances is under further study.

Fit result (Statistic significant~21σ):

$M = 1842.4 \pm 2.8(stat)\,MeV$

$\Gamma = 99.2 \pm 9.2(stat)\,MeV$

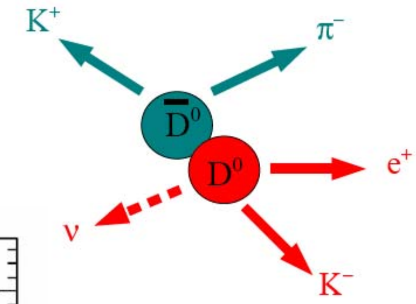
Charm meson production

- Threshold productions at 3.773, 4.03, 4.17 GeV

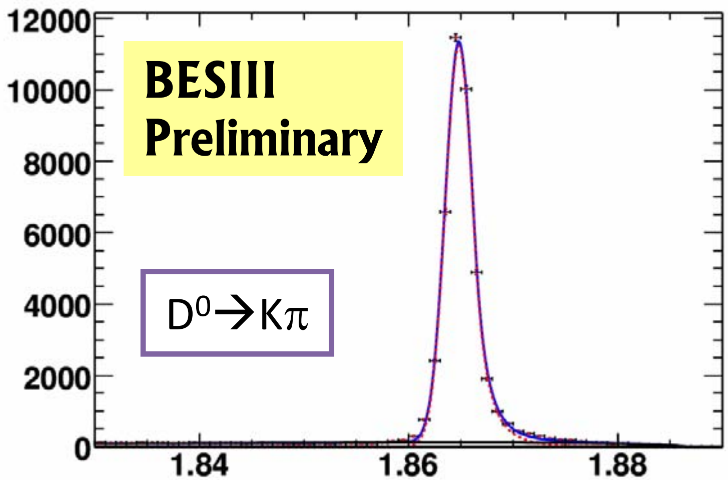
$$e^+e^- \to D\overline{D}, D_sD_s, D_sD_s^*$$

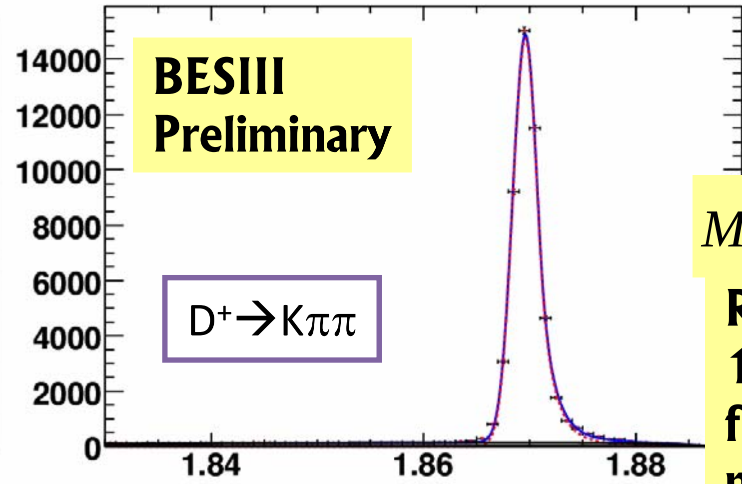
- Quantum Coherent of $D\bar{D}$ meson pair
- Double Tag techniques: (partial-) reconstruct both D mesons
- Charm events at threshold are very clean

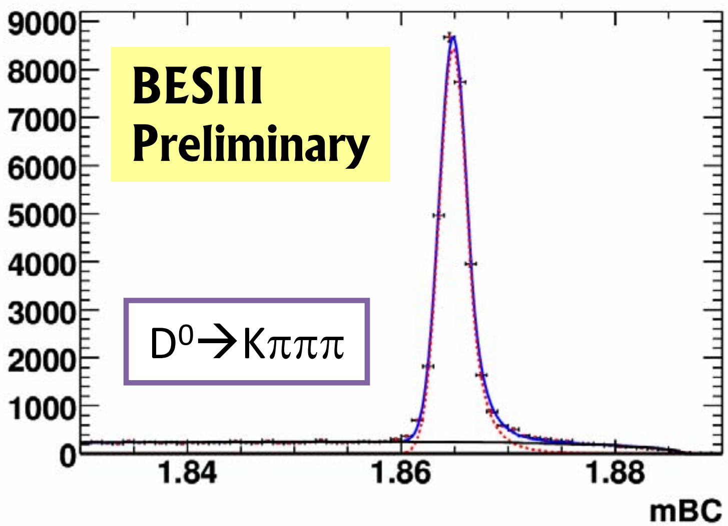
Clean single tag at BESIII

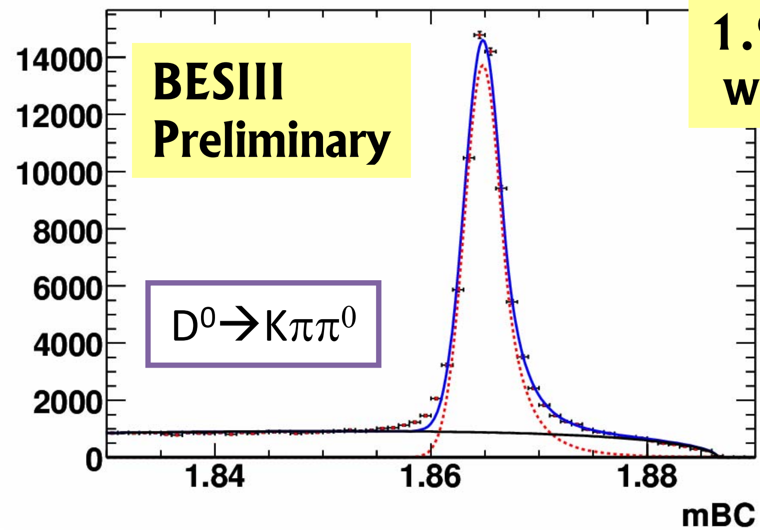


@ψ(3770) with 420pb⁻¹ first clean single tagging sample:









$$M_{BC} = \sqrt{E_{beam}^2 - |p_D|^2}$$

Resolution:
1.3 MeV for pure charged modes;
1.9 MeV for modes with one π^0.

Prospects for Charm flavor physics

Look for the size of the statistics/systematic/FSR errors for precision measurements at BESIII after CLEO-c.

CLEO-c errors for D^0 /D^+ physics with 818 pb^{-1}@3770

f_{D+} ($D^+ \to \mu^+ \nu$): $\pm$4.1% (stat.) $\pm$ 1.2% (sys.)

$f_\pi(0)$ ($D^0 \to \pi l \nu$): $\pm$5.3% (stat.) $\pm$ 0.7%(sys.)

BR($D^0 \to K\pi$): $\pm$0.9% (stat.) $\pm$ 1.8%(sys.)

BR($D^+ \to K\pi\pi$): $\pm$1.1% (stat.) $\pm$ 2.0%(sys.)

CLEO-c errors for Ds physics with 600pb^{-1}@4170

f_{Ds} ($Ds^+ \to \mu^+ \nu, \tau\nu$): $\pm$2.5% (stat.) $\pm$ 1.2% (sys.)

BR($Ds^+ \to KK\pi$): $\pm$4.2% (stat.) $\pm$ 2.9%(sys.)

Significant gains will be made with increased luminosity at BESIII even if systematic errors remain the same.

CP and D^0 mixing using quantum correlation are all statistics-starved at CLEO-c, improvement will be made at BESIII.

Proposed Running Plan at BESIII

In the next two years` running, BES-III will collect 3.2 fb^{-1} @$\psi(3770)$ which is more than 4 times larger than that at CLEO-c

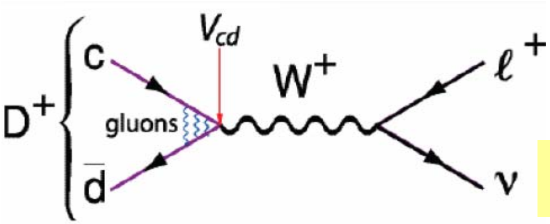
year	2009-10	2010-11	2011-12	2012-13	2013-14
				Ds physics	
$\langle L_{peak} \rangle$ (10^{33})	0.30	0.45 / 0.20	0.50	0.65	0.85
# of months	4	3 / 3	6	6	6
E_{cm}	$\psi(3770)$	ψ' / J / ψ	$\psi(3770)$	higher ψ	higher ψ
$\int Ldt$ (fb^{-1})	1.0	1.1 / 0.5	2.2	3.1	4.1
# events		10^9 / 1.6×10^9			

Including 70pb^{-1} scan of $\psi(3770)$

Scan between 3.9-4.6 GeV

- Not official plan, may be changed!
- 1.0 fb^{-1} is a start point at BESIII for charm flavor physics.
- With about 4 times larger open-charm dataset that will be available in 2012, BES-III will have able to make better informed decisions on the physics potential of a more futuristic tau-charm factory.

An example: D⁺ leptonic Decays with the first ψ(3770) sample

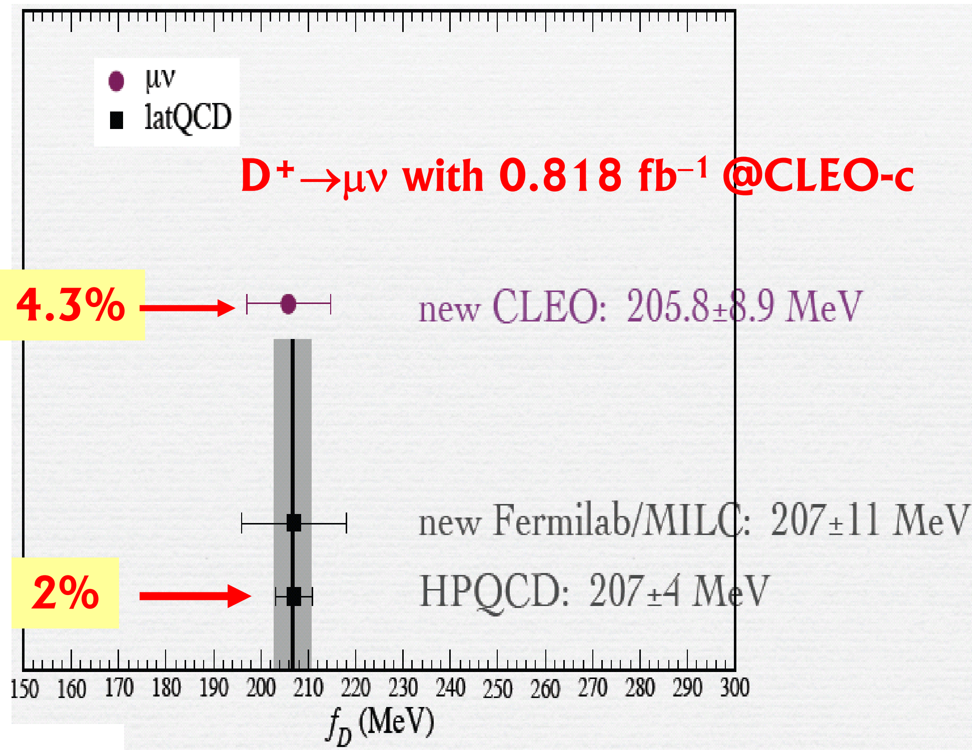


$$\mathcal{B}(D^+ \to l^+\nu) = \frac{G_F^2\, m_{D^+}\tau_{D^+}}{8\pi}\, m_l^2 \left(1 - \frac{m_{l^+}^2}{m_{D^+}^2}\right) f_{D^+}^2\, |V_{cd}|^2$$

SM predicts : $(D^+ \to l^+ \nu)$ = 2.35 10-5 : 1 : 2.65 ($l = e : \mu : \tau$)

CLEO-c [PRD 78, 052003 (2008)]:
$B(D^+ \to \mu^+ \nu) = (3.82 \pm 0.32 \pm 0.09)\times10^{-4}$
$B(D^+ \to \tau^+ \nu) < 1.2 \times10^{-3}$ ($\tau^+ \to \pi^+\nu$ only)

SM: $B(D^+ \to \tau^+ \nu) = (1.01 \pm 0.33) \times10^{-3}$



$\tau^+ \to X$	$\mathcal{B}(\tau^+ \to X)$	N_{prod}/fb^{-1}
$\pi^+\overline{\nu}$	0.1091	61
$\pi^+\pi^0\overline{\nu}$	0.2552	143
$\pi^+\pi^-\pi^+\overline{\nu}$	0.0932	52
Sum	0.4575	256

* Sensitive to measuring radiative lepton decays

	$\mathcal{B}$(Predicted) $[10^{-6}]$
$D^+ \to \mu^+\,\overline{\nu}\,\gamma$	1 - 25
$D^+ \to e^+\,\overline{\nu}\,\gamma$	1 - 82

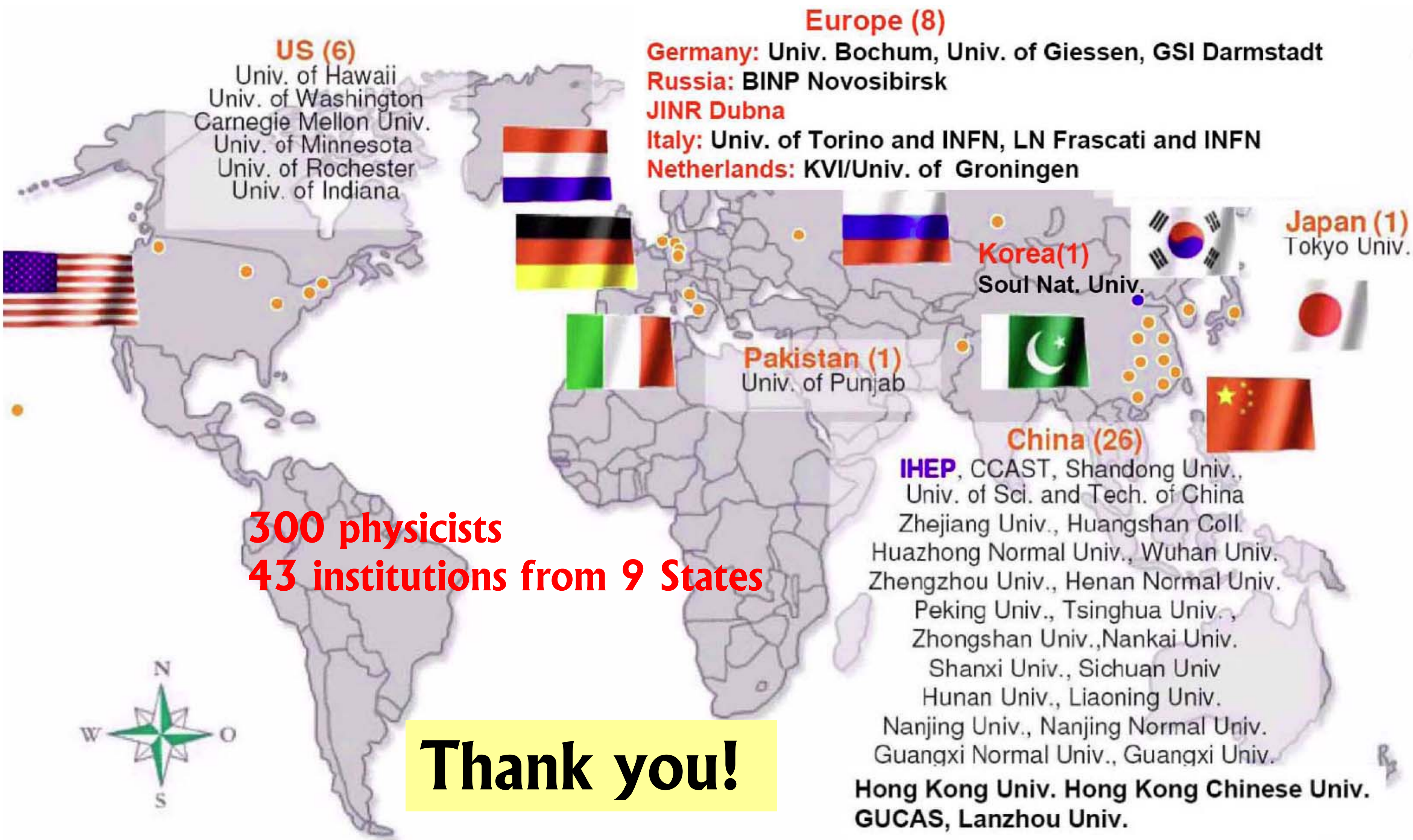
BESIII will improve it with the first Dataset @ψ(3770).

Conclusions

- BEPCII/BESIII had been successfully constructed and commissioned with excellent performance
- In particular: BEPCII reached a luminosity of $3.0\times10^{32}cm^{-2}s^{-1}$.
- 100 M $\psi(2S)$ and 230 M J/ψ events samples have been accumulated, results and preliminary results obtained.
- 700 pb^{-1} @3770 is in hand and 1000pb^{-1} will be reached this summer.
- We expect great physics results in the coming years.

Thanks to my colleagues: Roy Briere, Weidong Li and Yangheng Zheng at BESIII for collection of this talk.

BESIII Collaboration



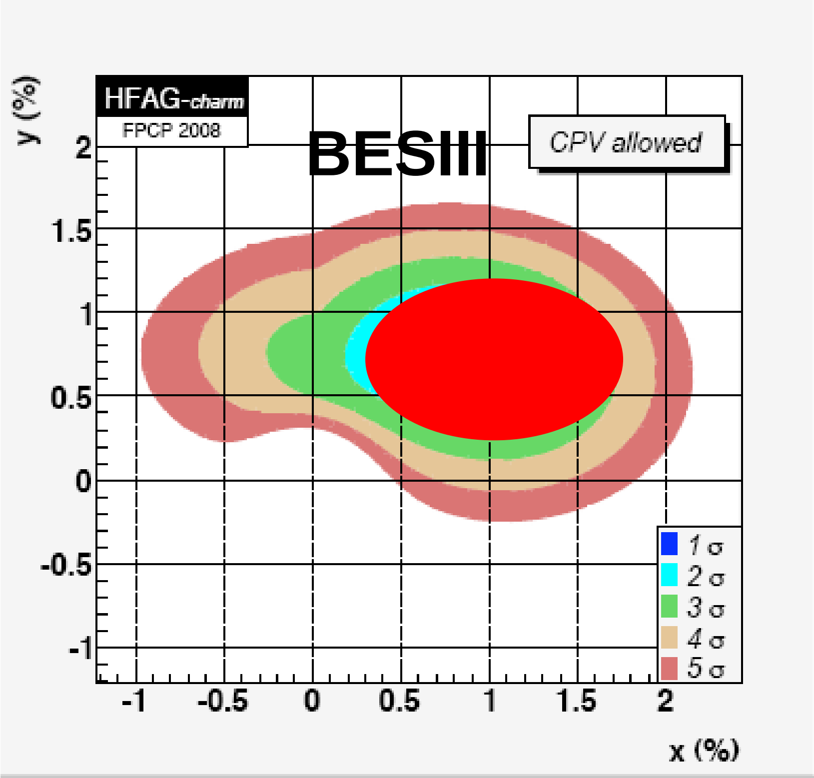
Back up slides

Precise test of CKM in D decays at BESIII

Observable	CKM	QCD	Lattice	Exp meas	Exp err
$Br(D \to \ell\nu)$	$\lvert V_{cd}\rvert$	f_D	2%	$f_D\lvert V_{cd}\rvert$	1.1%
$Br(D_s \to \ell\nu)$	$\lvert V_{cs}\rvert$	f_{Ds}	1.5%	$f_{Ds}\lvert V_{cs}\rvert$	0.7%
$\frac{Br(D_s\to\ell\nu)}{Br(D\to\ell\nu)}$	$\left\lvert\frac{V_{cs}}{V_{cd}}\right\rvert$	$\frac{f_{Ds}}{f_D}$	1%	$\left\lvert\frac{V_{cs}f_{Ds}}{V_{cd}f_D}\right\rvert$	0.8%
$d\Gamma(D^0 \to \pi^-)$	$\lvert V_{cd}\rvert$	$F_{D\to\pi}(0)$	4%	$\lvert V_{cd}\rvert F_{D\to\pi}(0)$	0.6%
$d\Gamma(D^0 \to K^-)$	$\lvert V_{cs}\rvert$	$F_{D\to K}(0)$	3%	$\lvert V_{cs}\rvert F_{D\to K}(0)$	0.5%
$d\Gamma(D_s \to K)$	$\lvert V_{cd}\rvert$	$F_{D_s\to K}(0)$	2%	$\lvert V_{cd}\rvert F_{D_s\to K}(0)$	1.2%
$d\Gamma(D_s \to \phi)$	$\lvert V_{cs}\rvert$	$F_{D_s\to\phi}(0)$	1%	$\lvert V_{cs}\rvert F_{D_s\to\phi}(0)$	0.8%

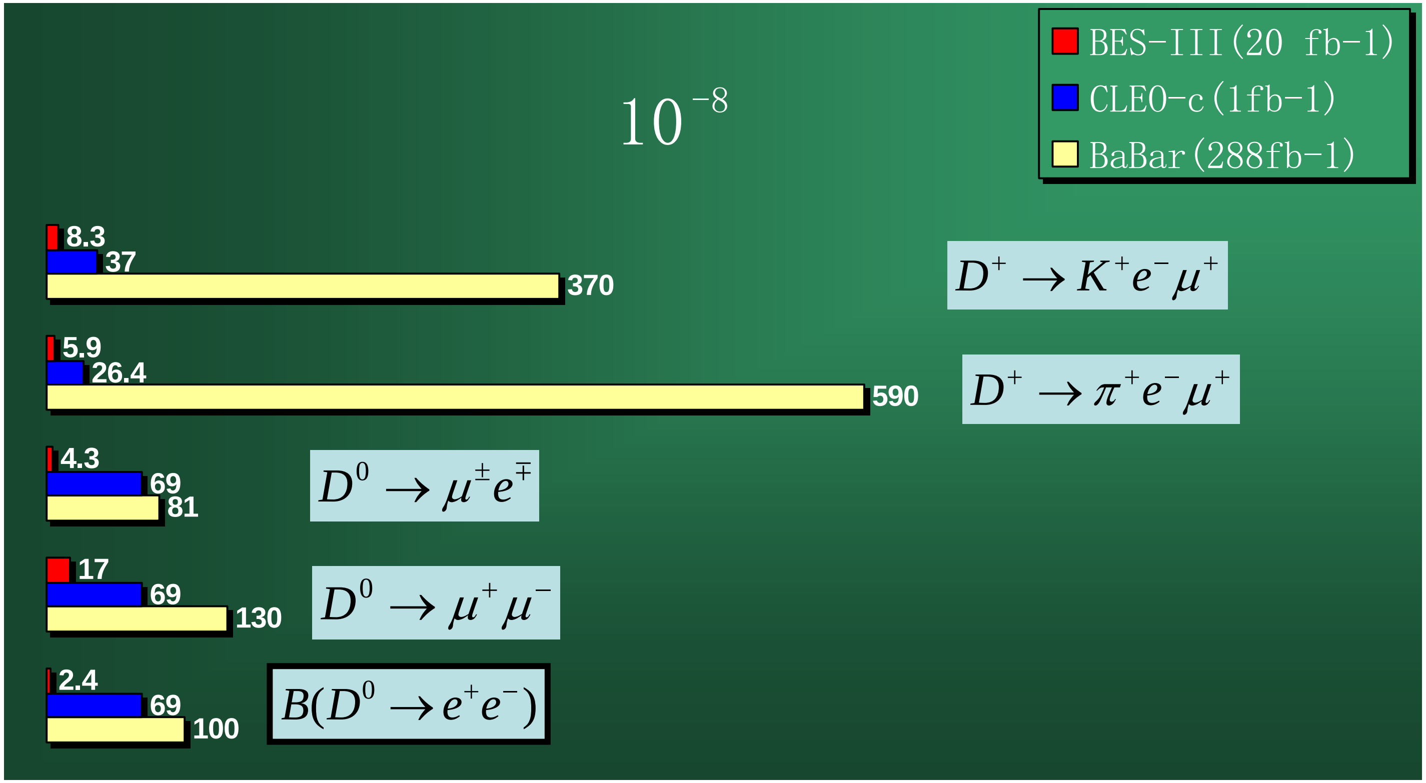
Sensitivities (20 fb^{-1} at $\psi(3770)$ peak)

- Mixing parameters
  - $R_M = (x^2 + y^2)/2 \sim 10^{-4}$ in $K\pi$ and $Ke\nu$ channels
  - Probe y: $\Delta y_{CP} < 0.7\%$,
  - $\Delta\cos\delta_{K\pi} < 0.06$
- CP Violation
  - $\Delta A_{CP} \sim 10^{-3}$ in D^+ decays (direct CPV),
- Improvement to ϕ_3/γ measurement in $B \rightarrow D^{(*)}K < 2^o$ (CLEO-c: $\sim 2^o$)



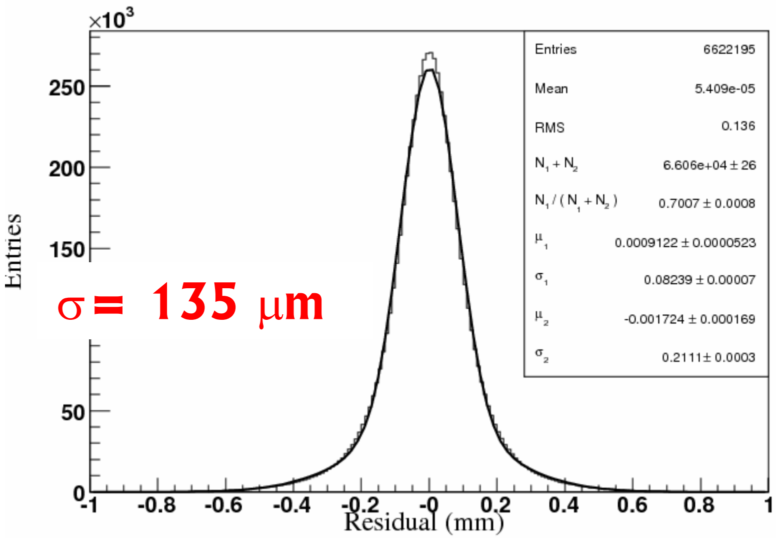
Sensitivity of LFV

Improve the limits by more than order magnitude!

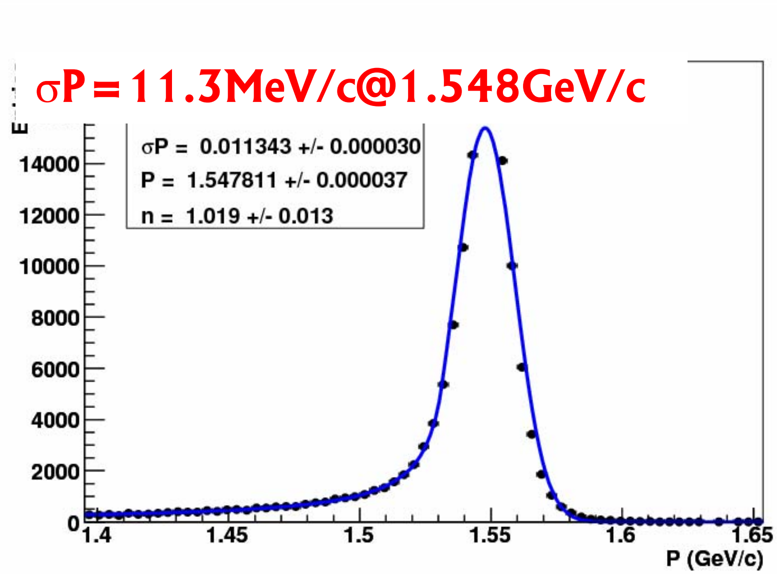


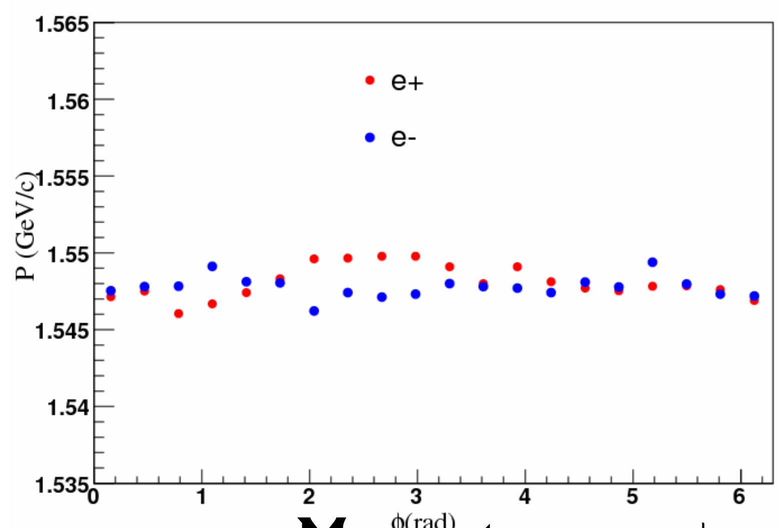
LFV and LNV are "smoking gun", any indication of deviation from zero will indicate New Physics (NP).

MDC performance—BhaBha events



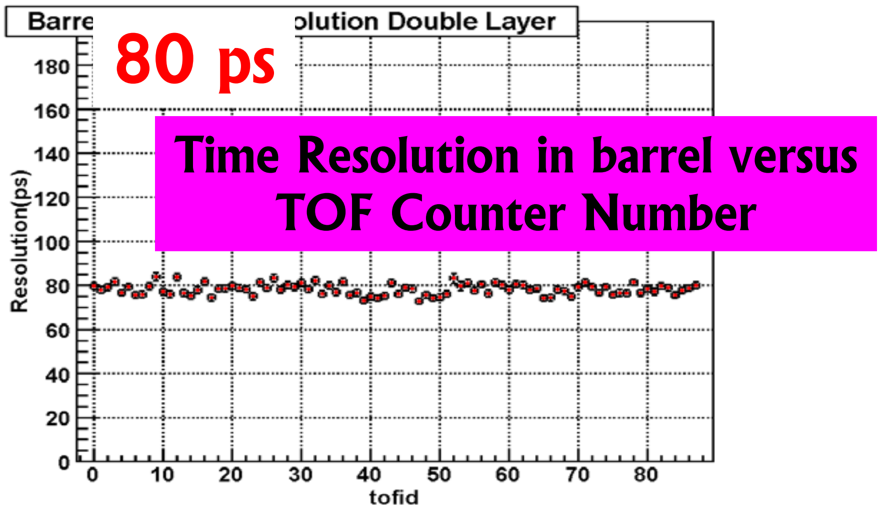
For Bhabhas in J/ψ data, spatial resolution is135μm and σP is 11.3MeV/c

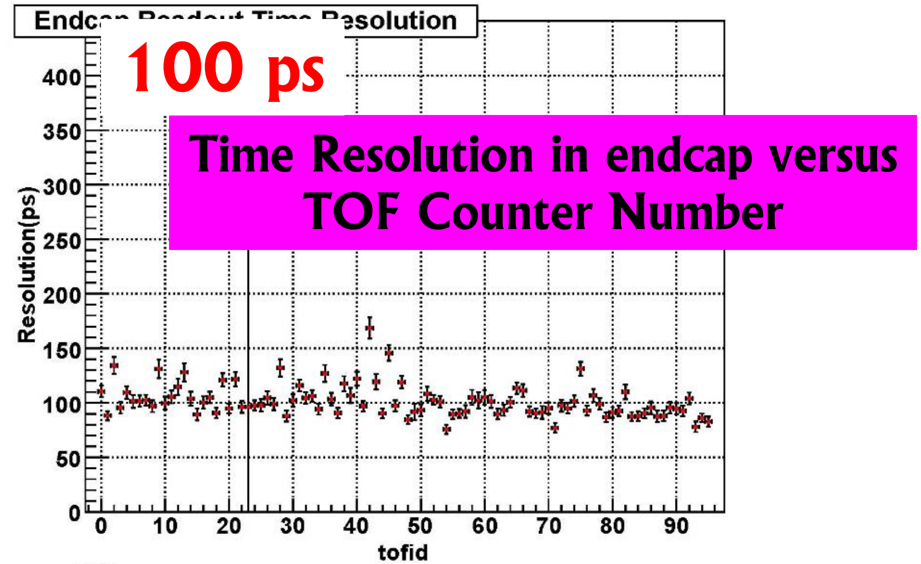


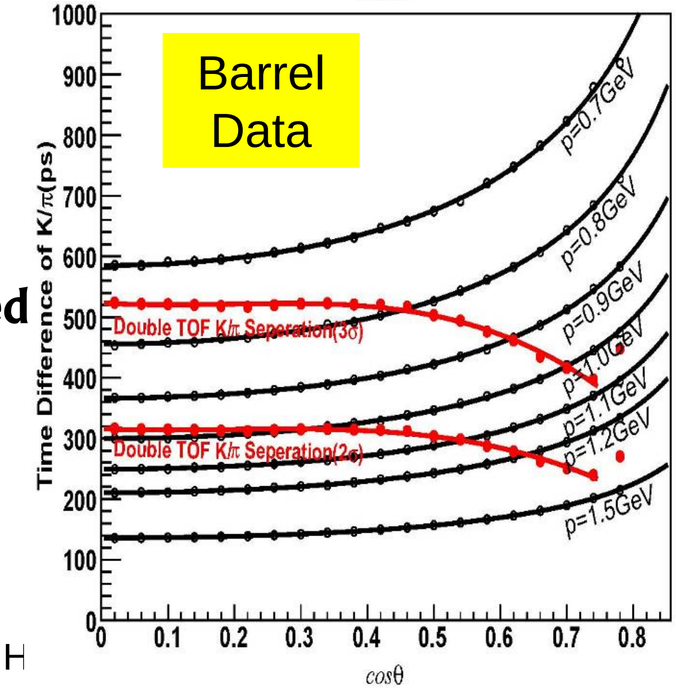


Momentum .vs. φ

PID: time resolution in TOF







The momentum of 2σ K/π separation achieved 0.96GeV/c for barrel double layers TOF

Energy Resolution in EMC from $\psi(2S)$ data

- Bhabha：2.4%
- 2Gamma ： 2.7%