Status of BESIII

Yifang Wang

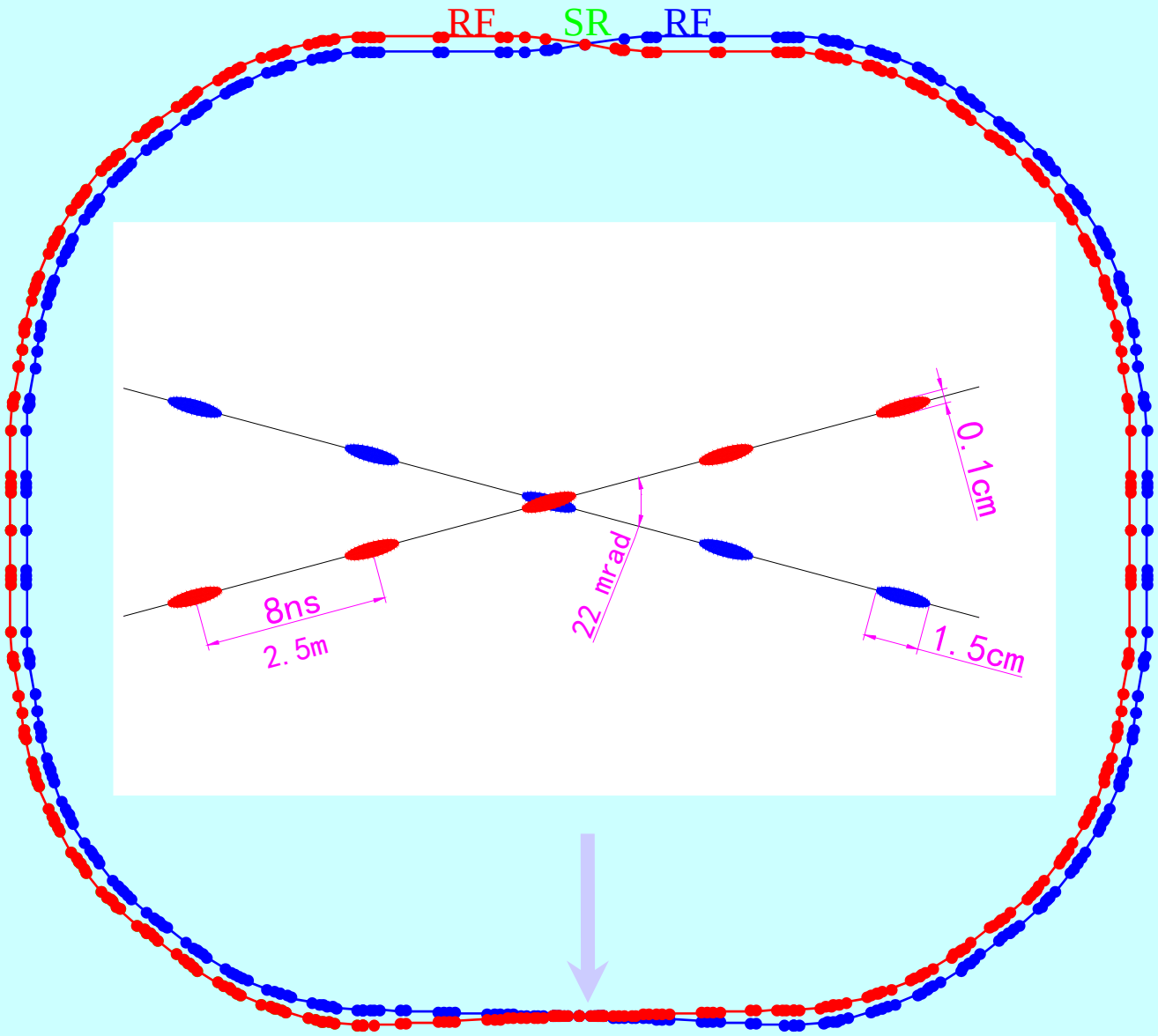
Institute of High Energy Physics

Charm09, Leimen, May 20-22, 2009

Outline

- **Commissioning of BEPCII/BESIII**
- **Performance of the BESIII detector**
- **Data taking and preliminary results**
- **Summary**

BEPC II Storage ring: Large angle, double-ring



Beam energy:
1.0-2 .3GeV
Luminosity:
1×10^{33} $cm^{-2}s^{-1}$
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 × 500 mA, Lumi.: 1 $\times 10^{32}$ cm^{-2}s^{-1}

Mar. 2008: first full cosmic-ray event in BESIII

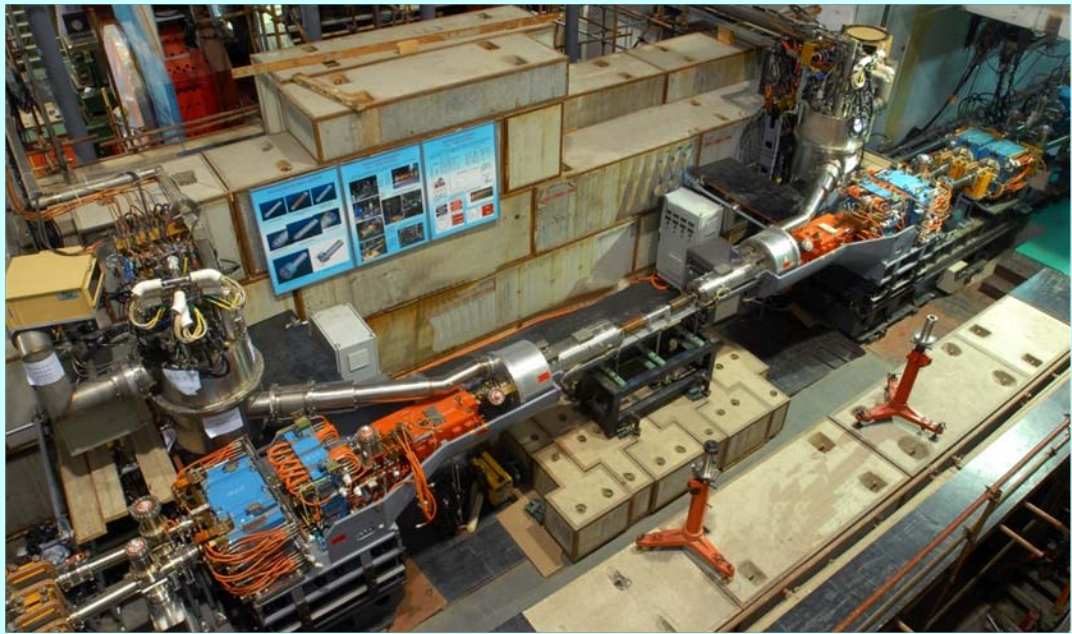
April 30, 2008: Move the BESIII to IP

July 18, 2008: First e+e- collision event in BESIII

Nov. 2008: Lumi. ~1.2 $\times 10^{32}$cm^{-2}s^{-1}, BESIII ~ 10M ψ(2S) events

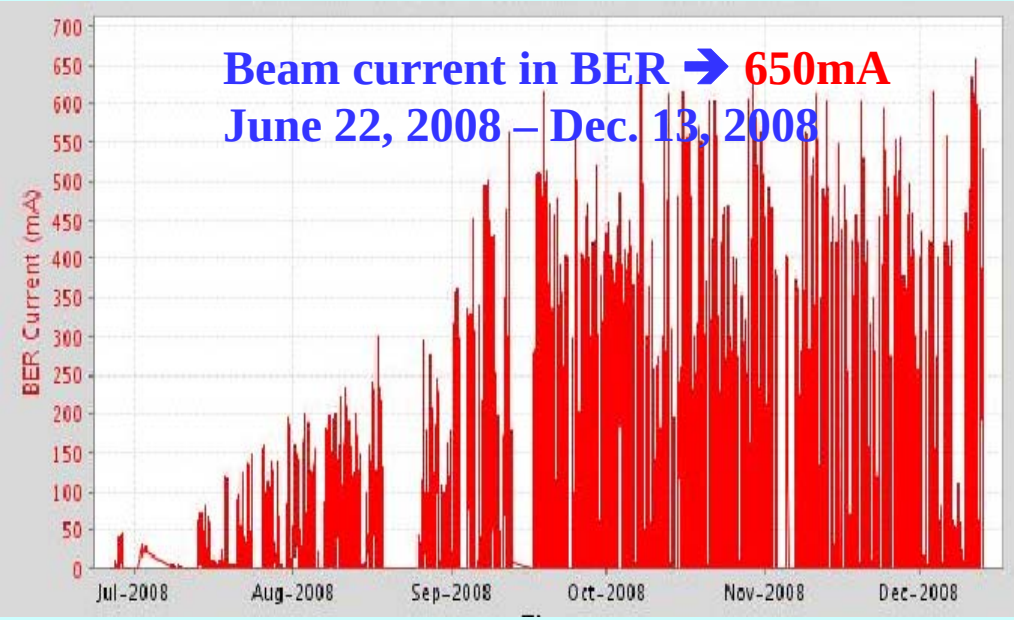
April 14, 2009 BESIII ~100M ψ(2S) events

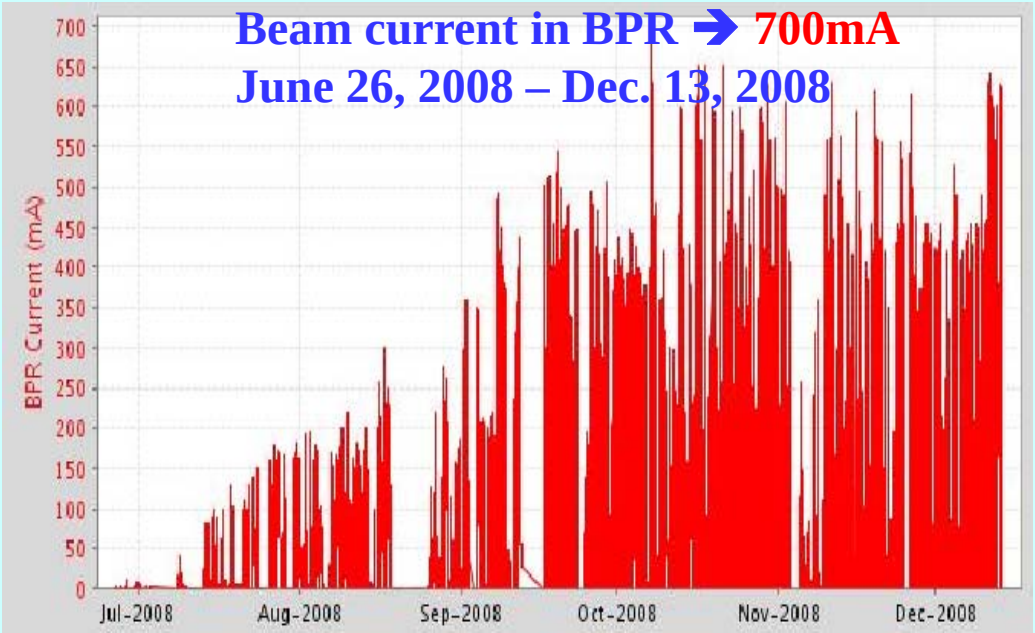
May 14, 2009 BEPCII Lumi. ~ 3 $\times 10^{32}$cm^{-2}s^{-1}



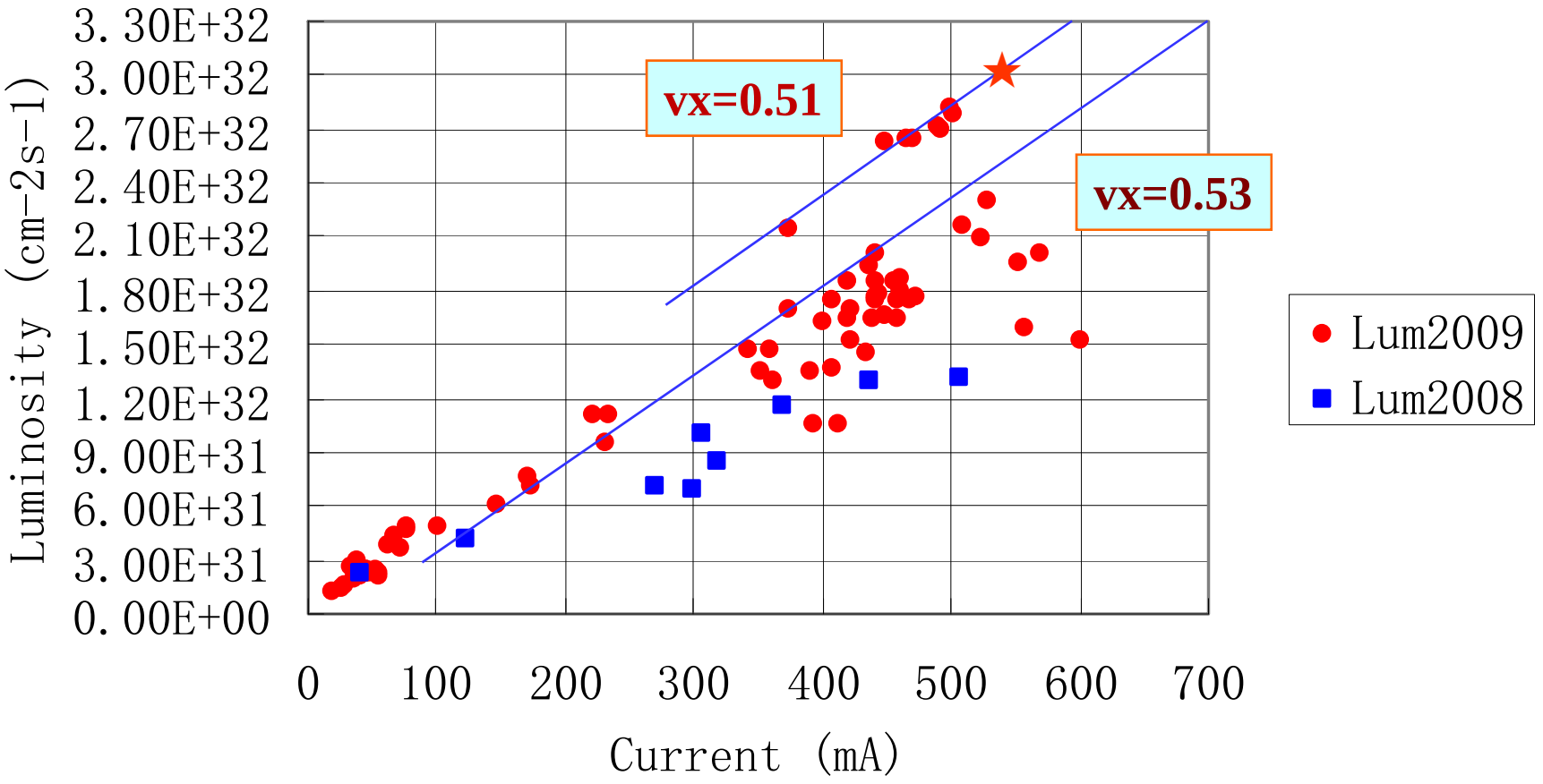
BEPCII commissioning: continual improvement

- ✓ **Lattice optimization：matching with designed values**
- ✓ **Debug systems: beam obstacles, vacuum leak, etc…**
- ✓ **Increase current gradually ： improve vacuum**
- ✓ **Increase luminosity ： Improve collision parameters**

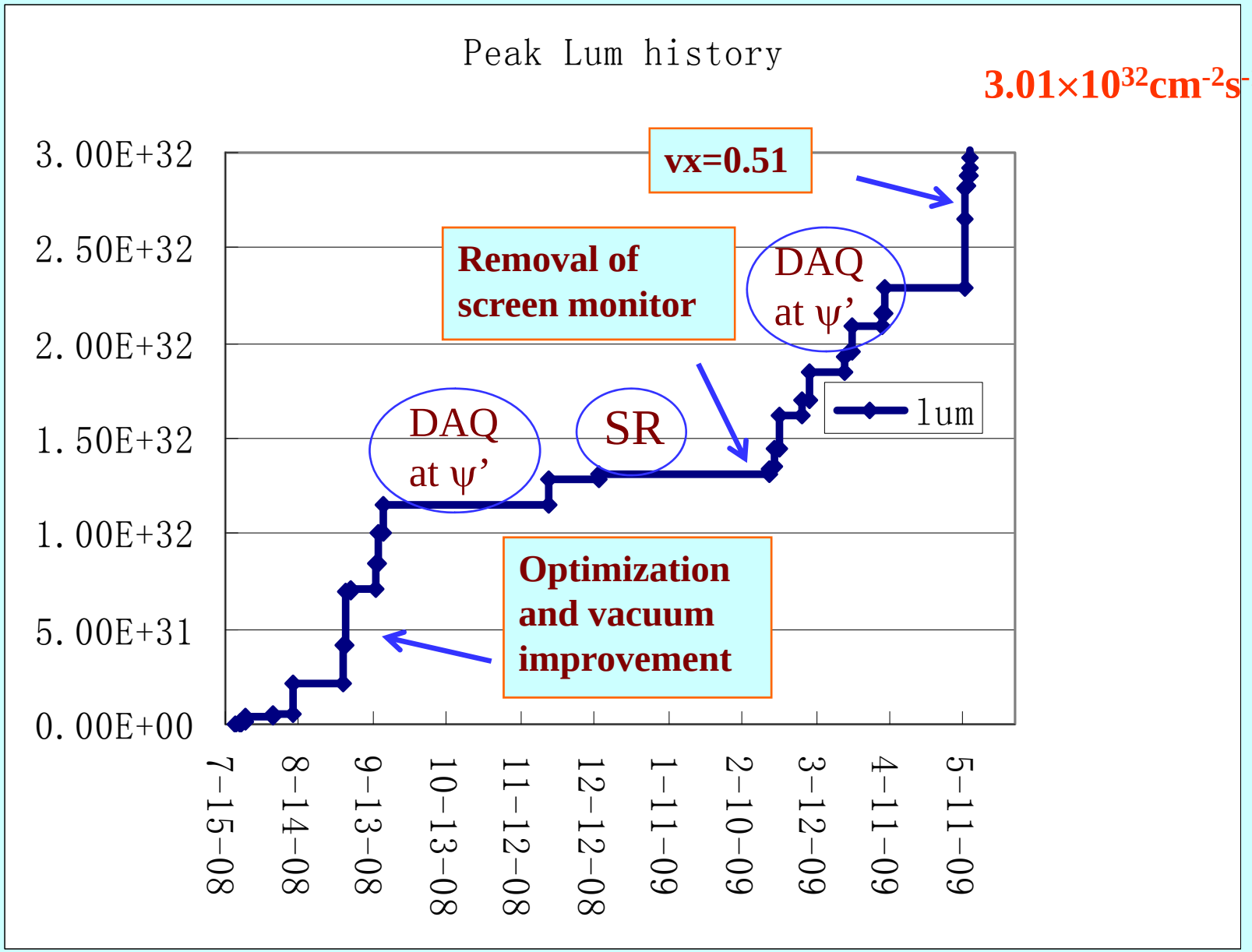




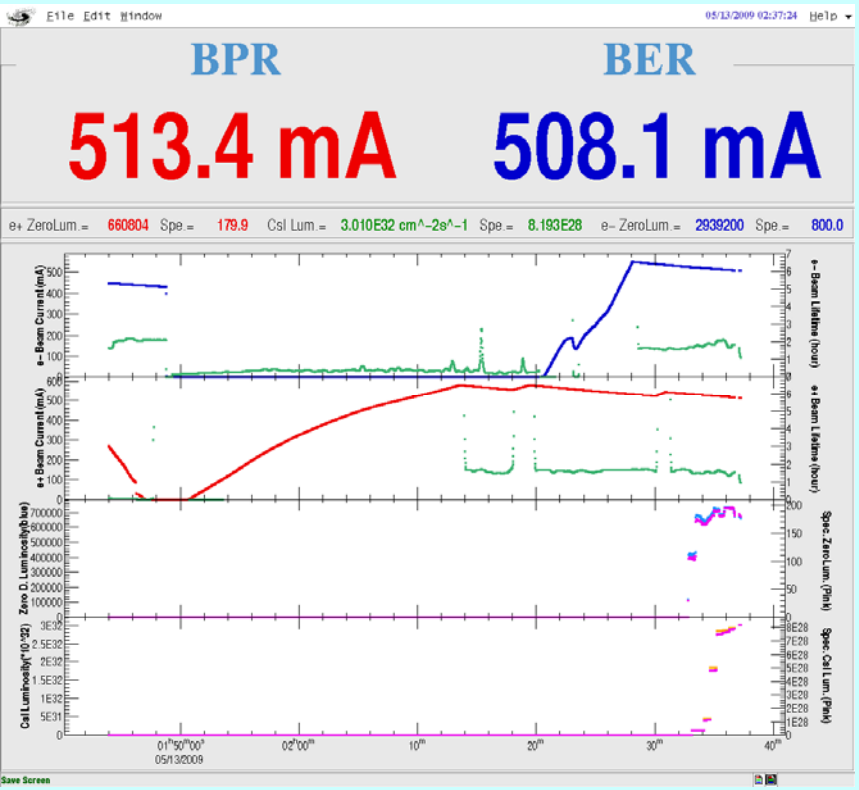
Luminosity improvement

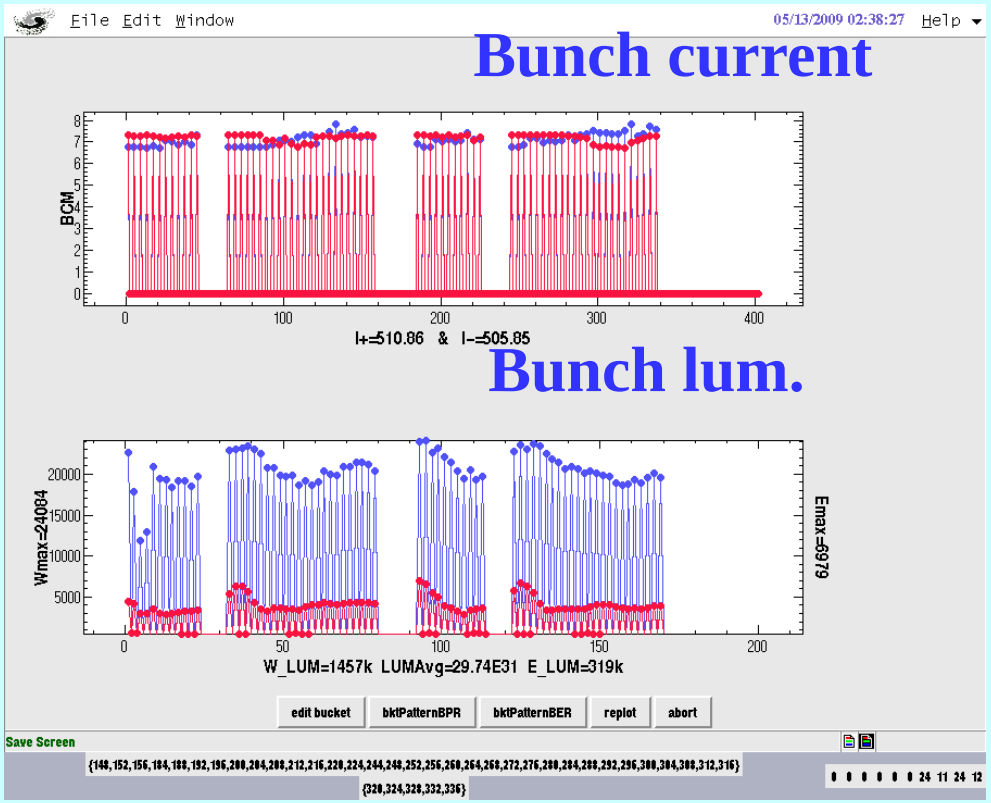


BEPCII Peak Luminosity evolution

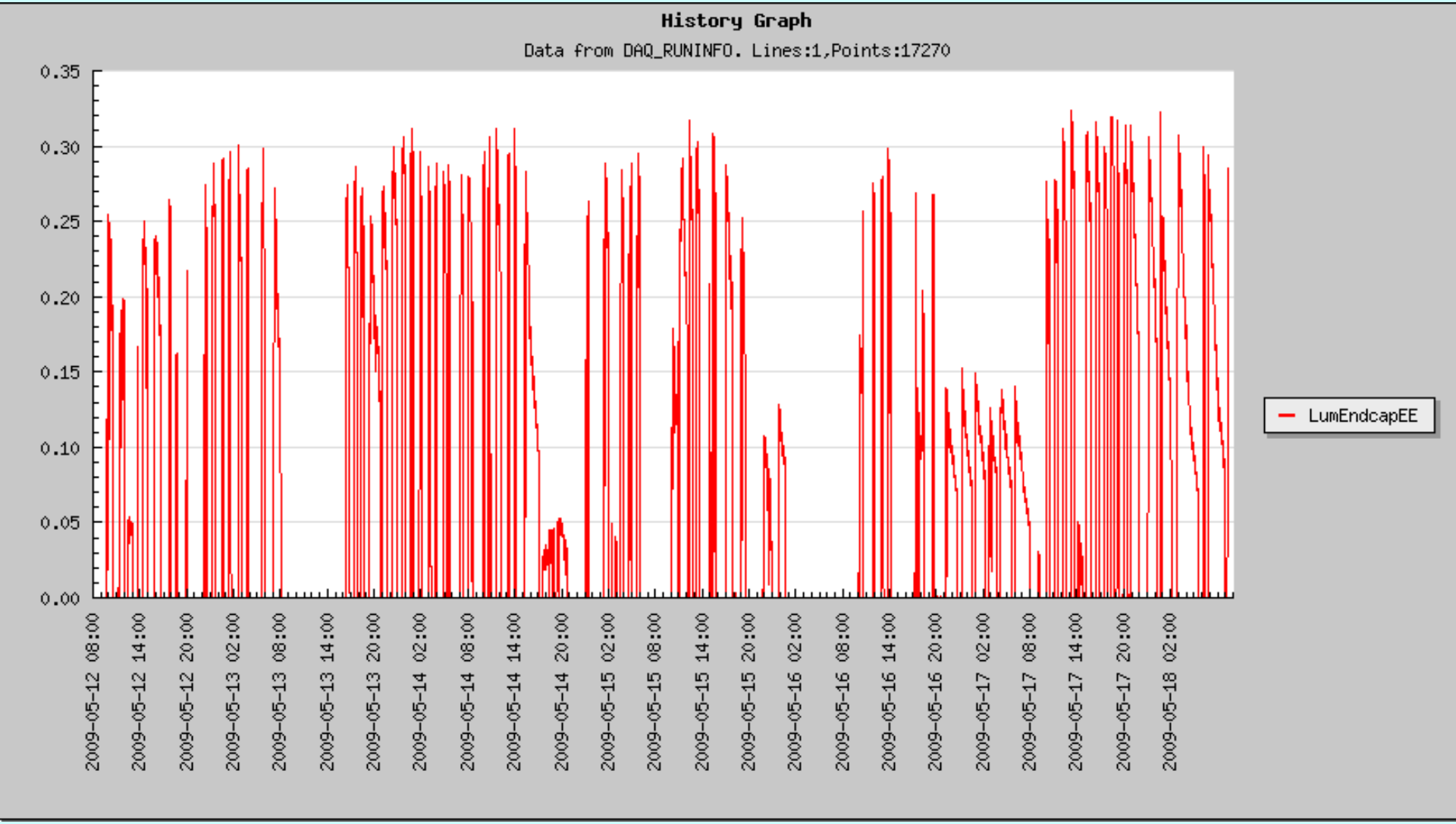


Peak Luminosity of $3.0*10^{32}$ achieved on May 13 with ~ 2×500mA and 71 bunches





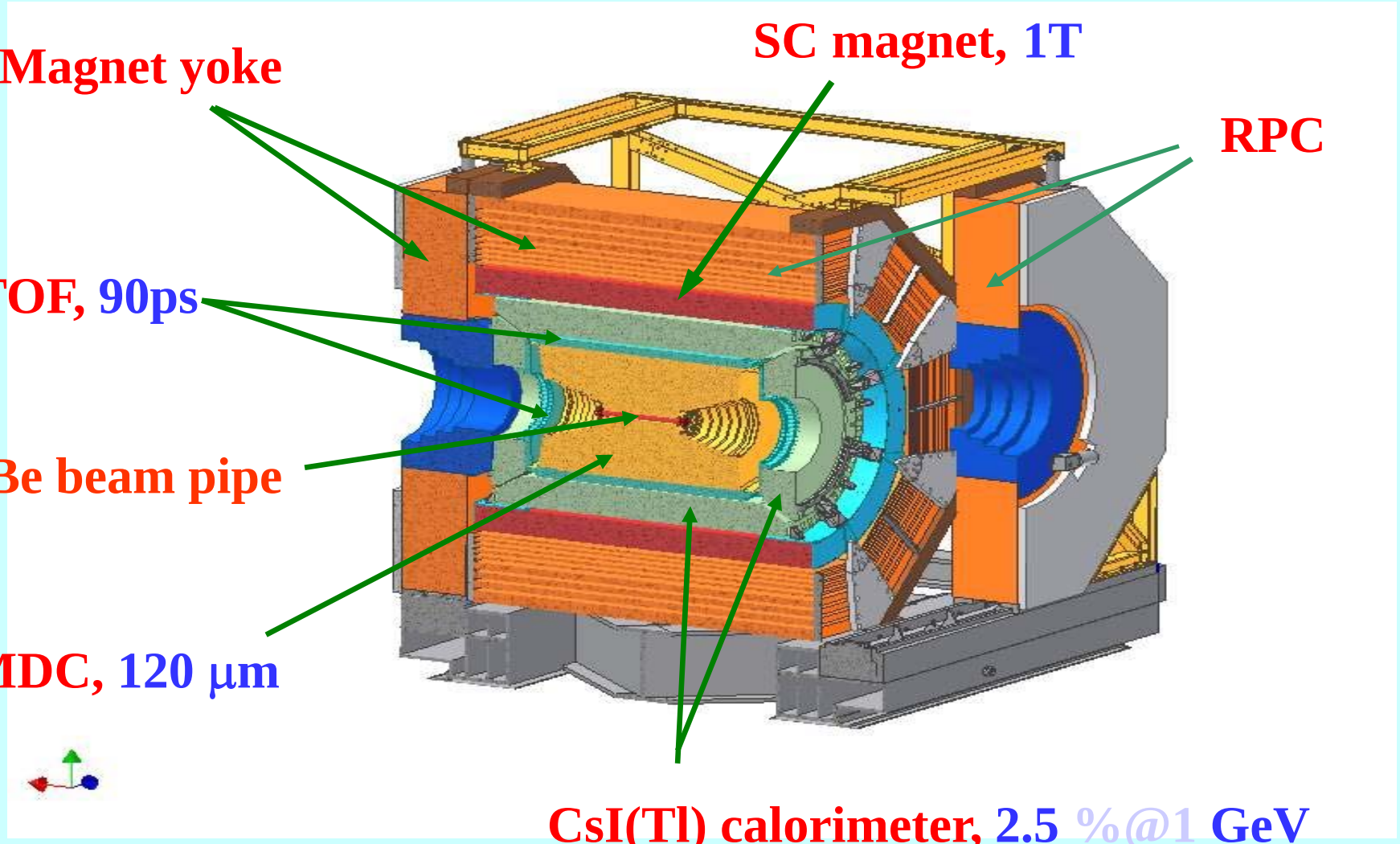
Peak luminosity during May 12-18



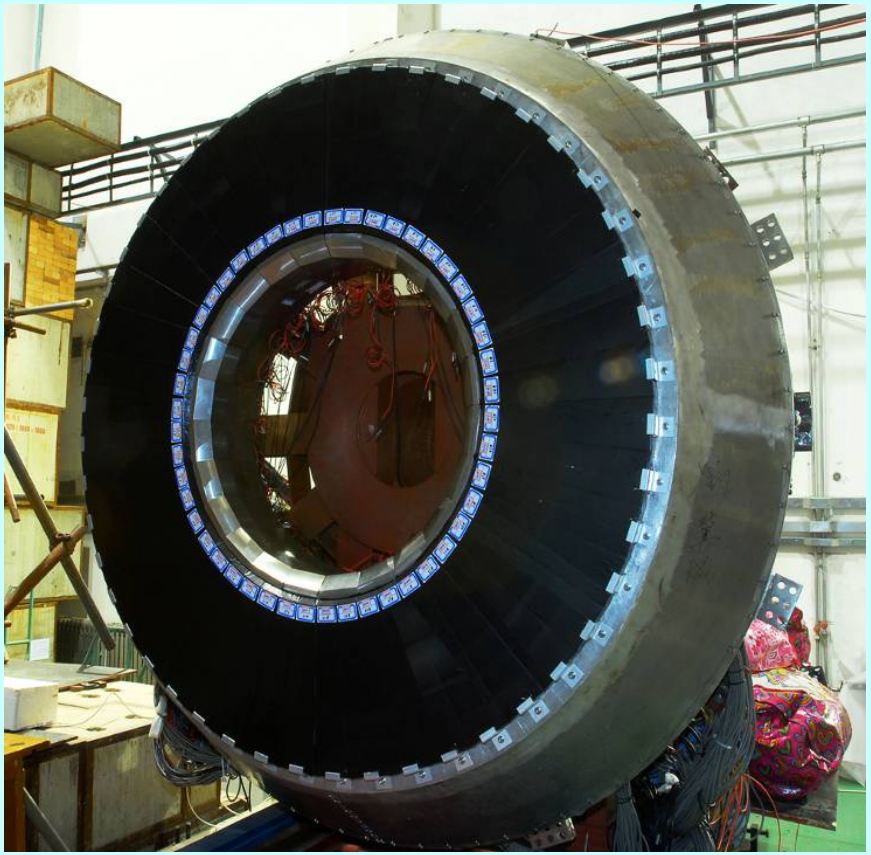
Main parameters achieved in collision mode

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

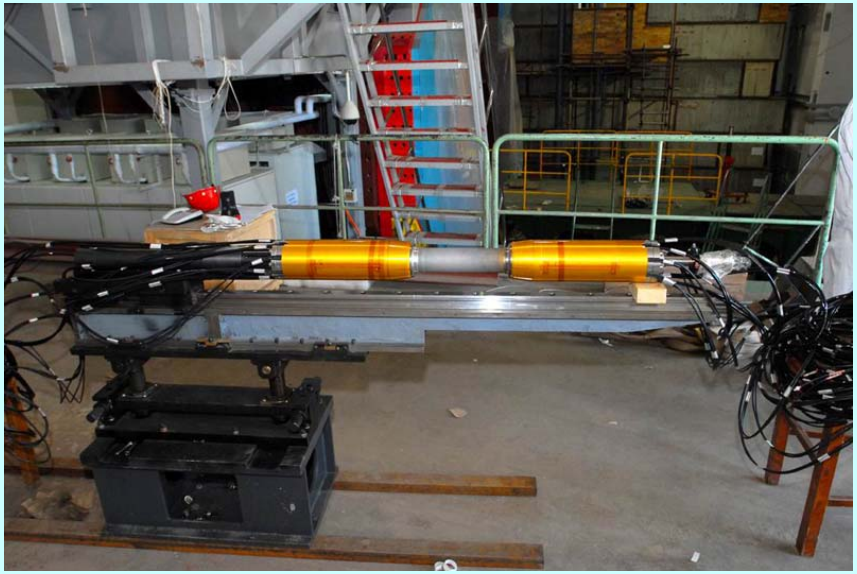


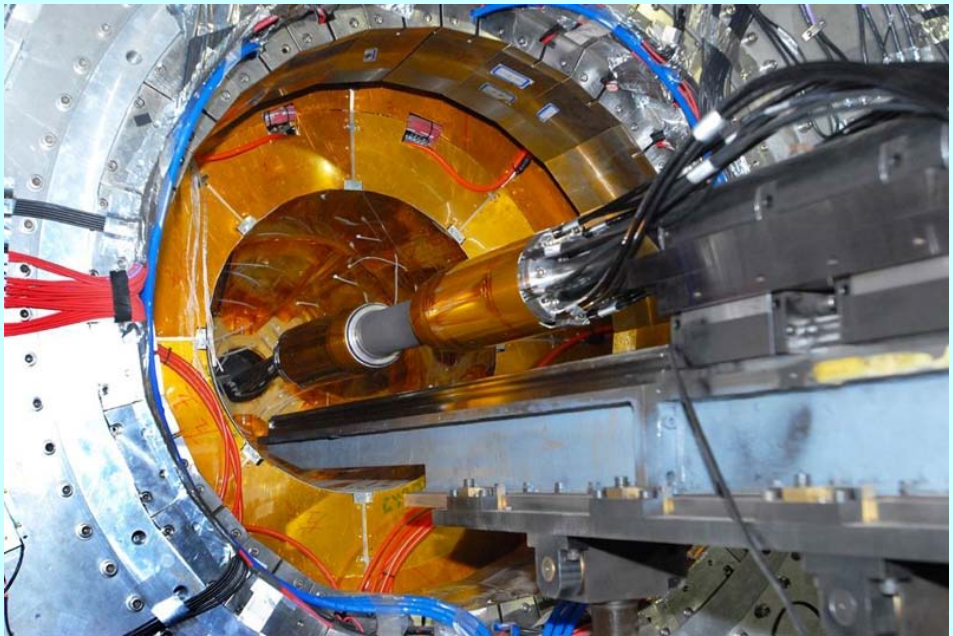
EMC installation

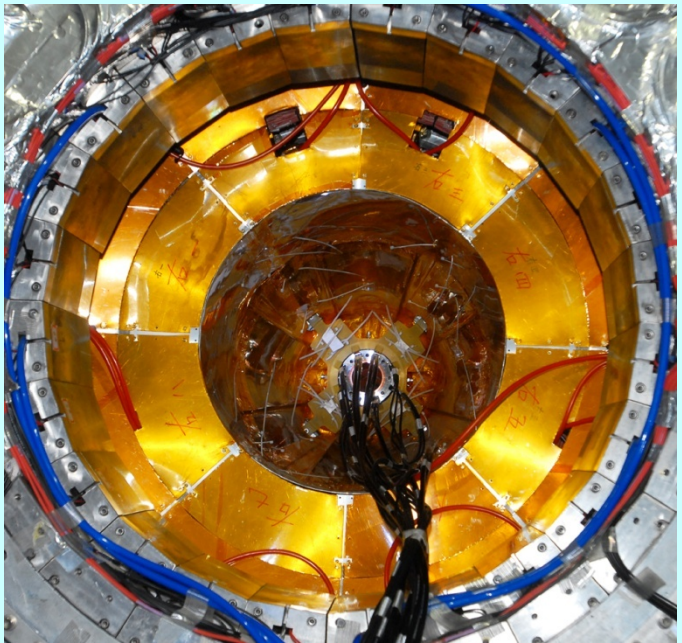


MDC and TOF installation

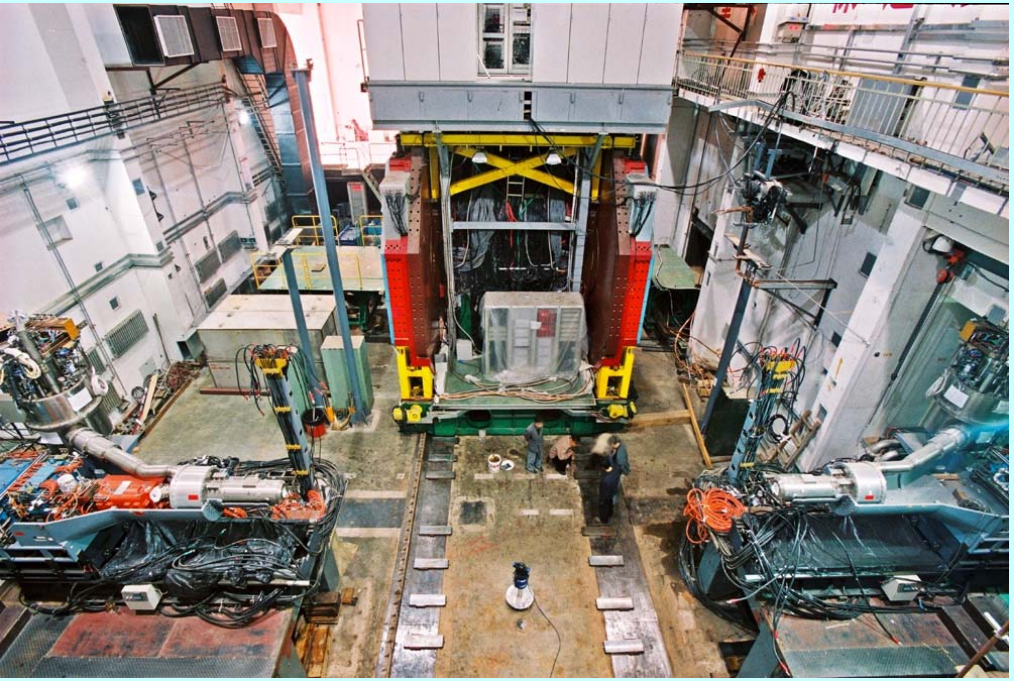
Be Beam-pipe installation

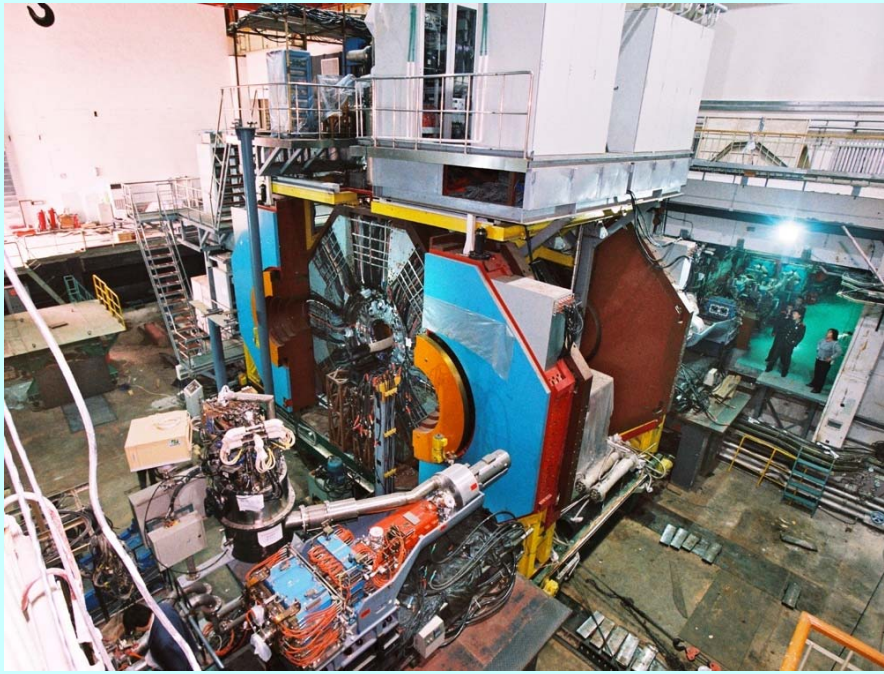


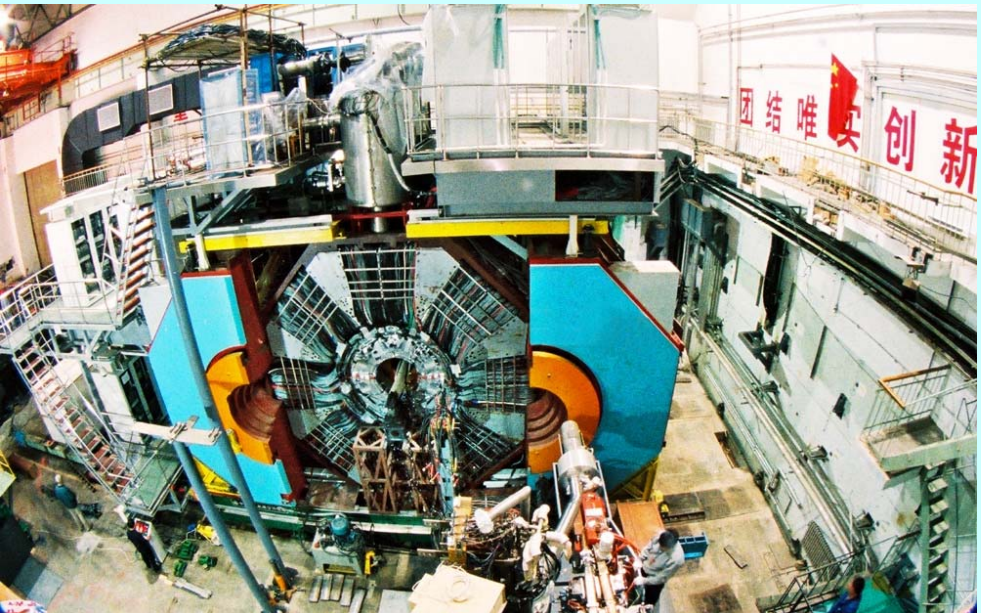


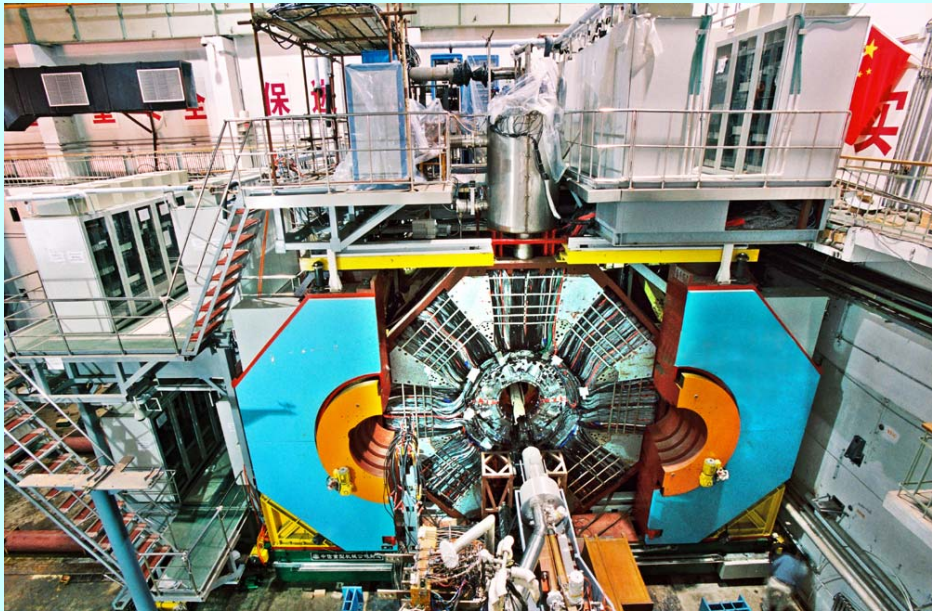


BESIII moved to IP: precision < 1 mm

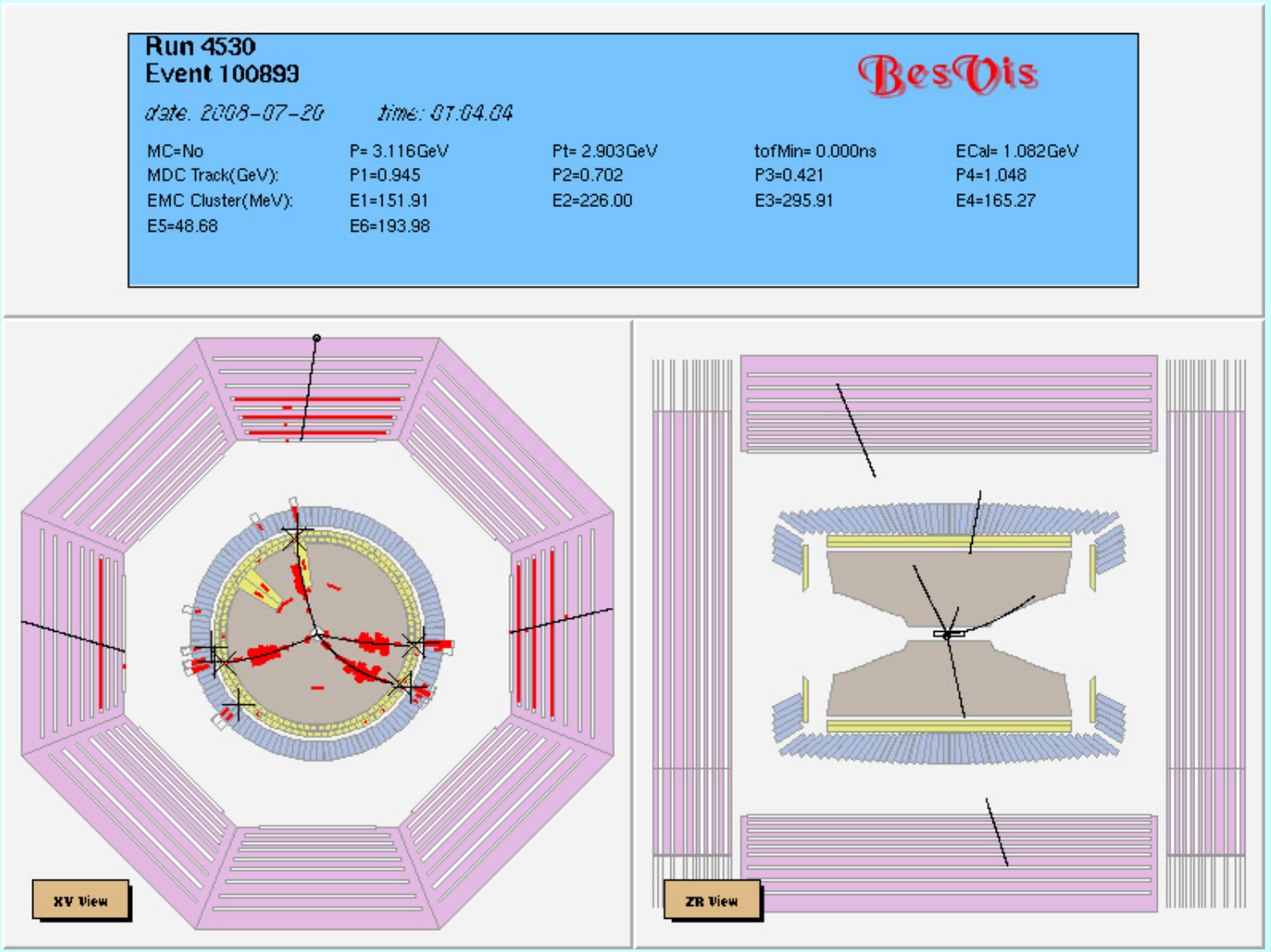








First collision event on July 19, 2008



13 M ψ' events collected in 2008

Drift chamber

- **To measure the momentum of charged particles by their curvature in the magnetic field**
- **7000 Signal wires: 25 μm gold-plated tungsten**
- **22000 Field wires: 110 μm Al**
- **Gas: He + C_3H_8 (60/40)**
- **Momentum resolution@1GeV:**

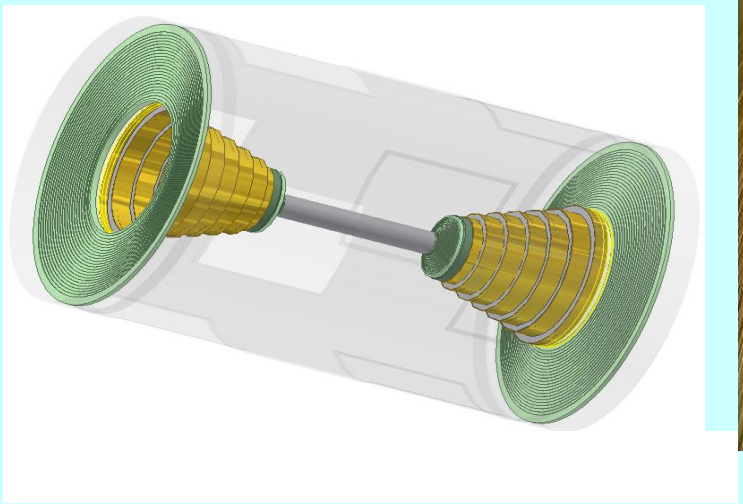
$$\frac{\sigma_{P_t}}{P_t} = 0.32\% \oplus 0.37\%$$

Babar: ~ 110 μm

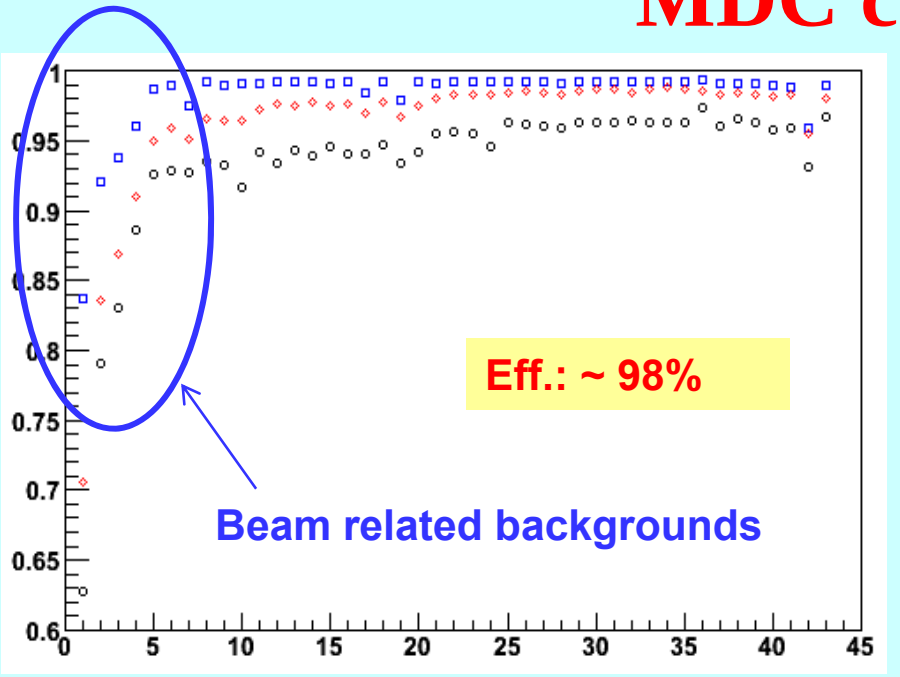
BELLE: ~ 130 μm

CLEO: ~ 110 μm

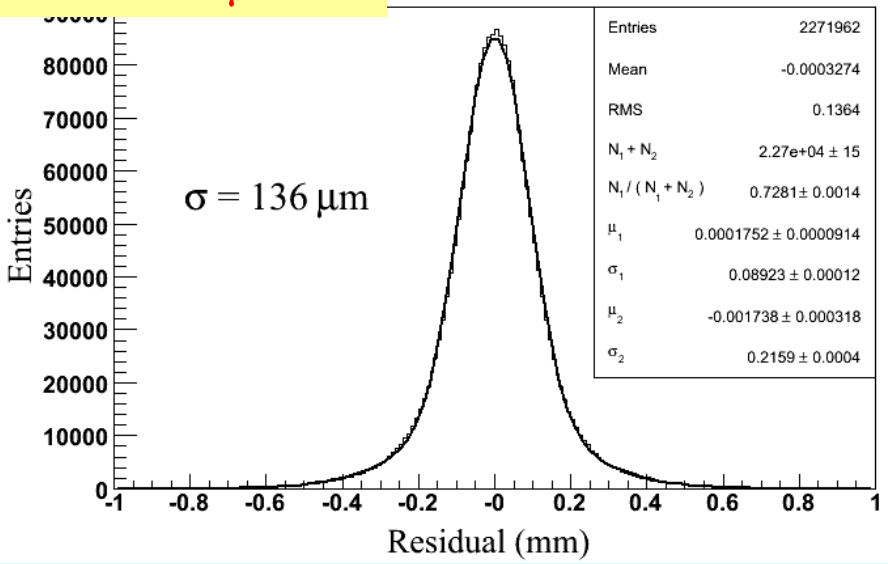
BESIII: ~ 130 μm



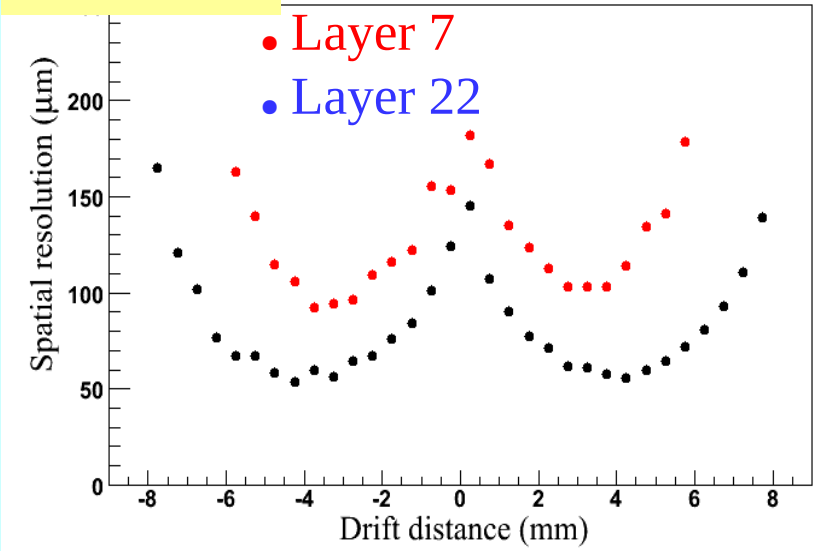
MDC calibration



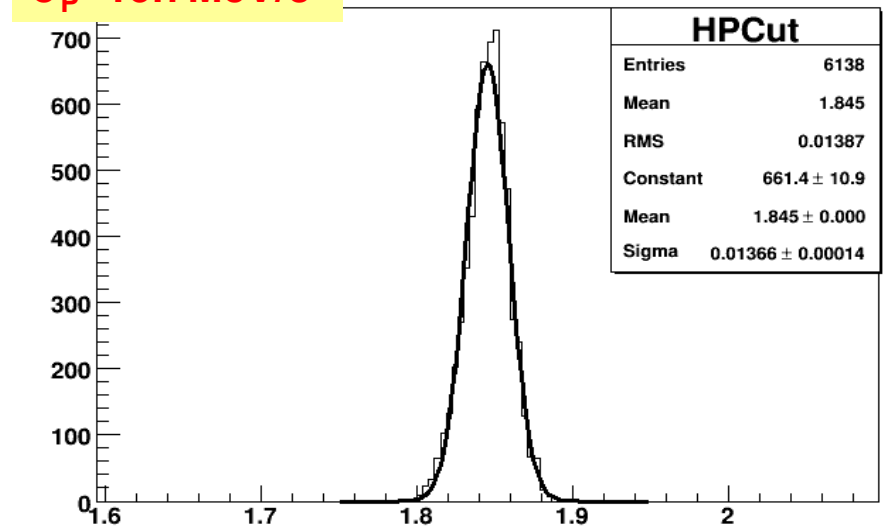
Reso. 136 μm



Wire reso.

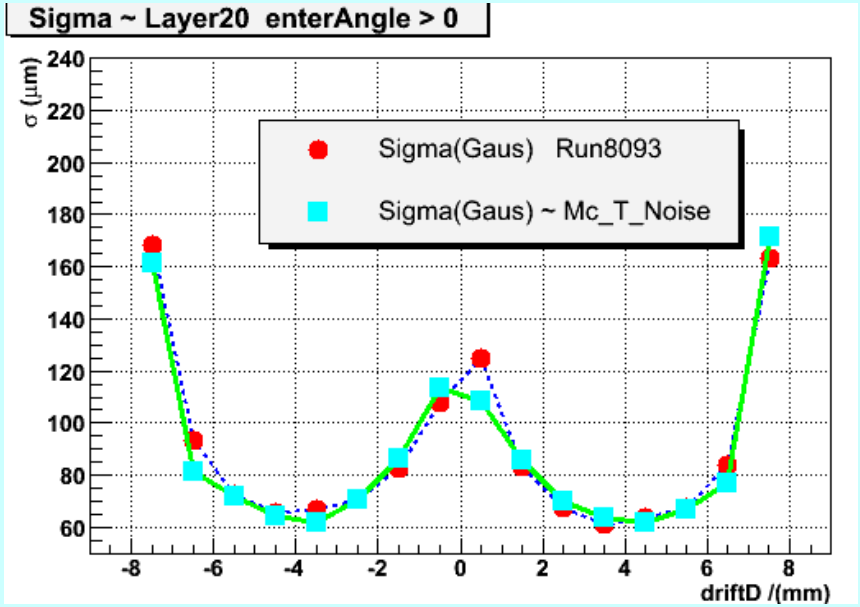


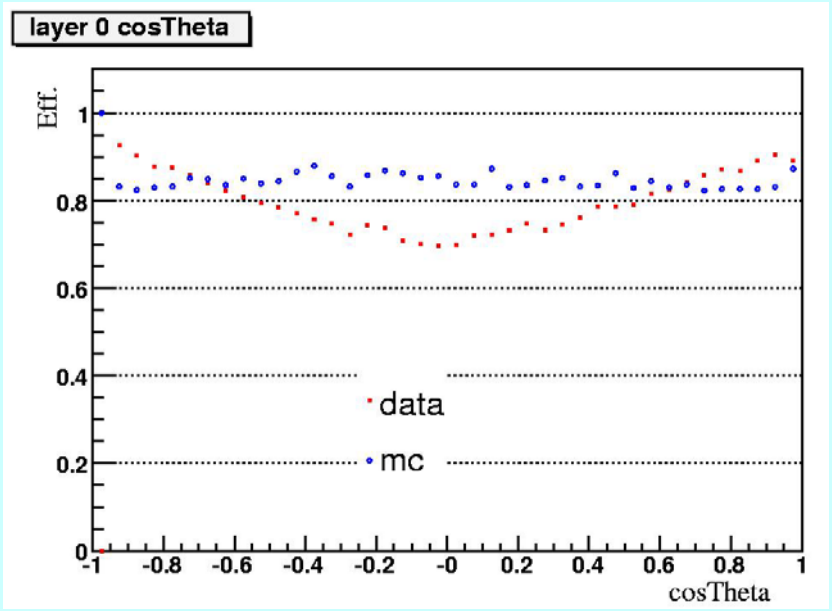
σ_P=13.7MeV/c

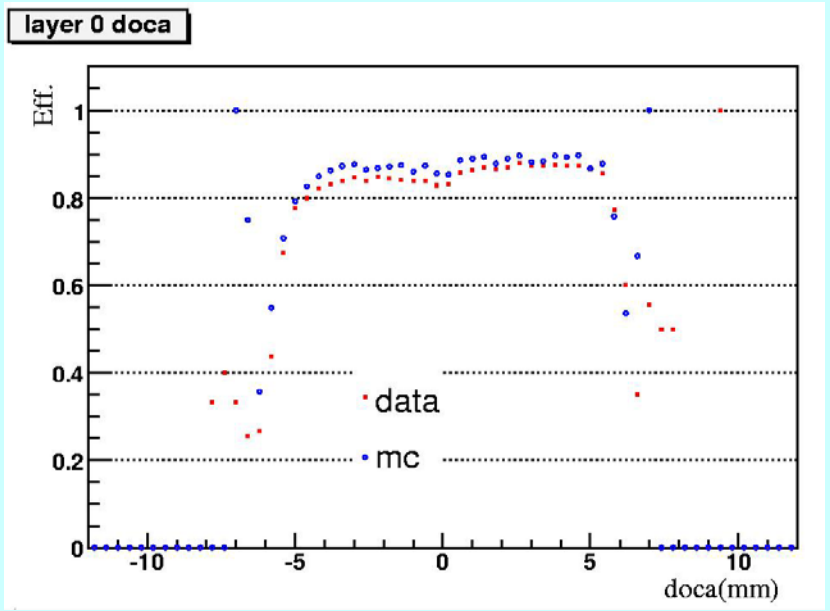


Data/MC comparison

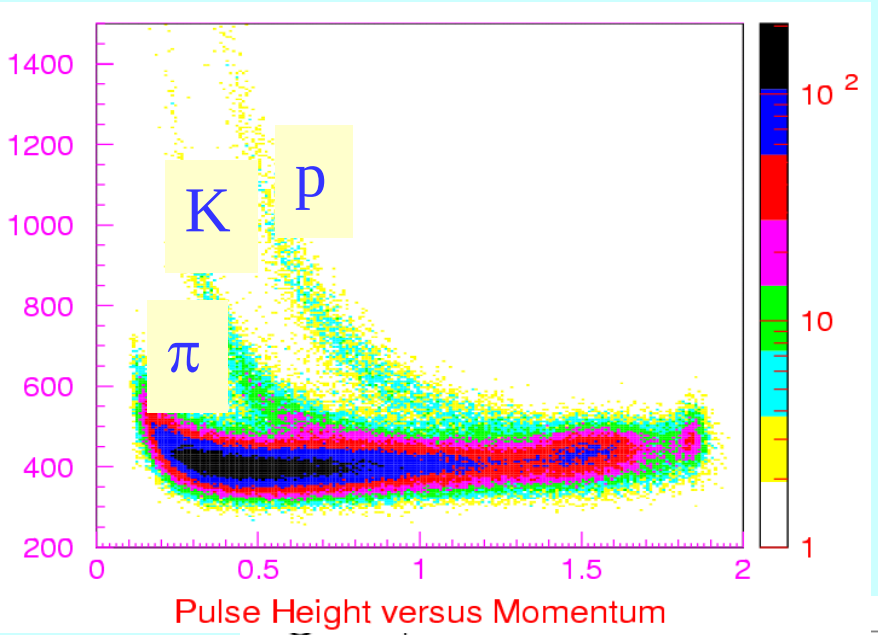
- **Detailed simulation:**
  - **Resolution/efficiency of each cell as a function of drift distance, DOCA, Q, HV, Noise, entrance angle, …**
- **Improvements: more data, better understanding, …**

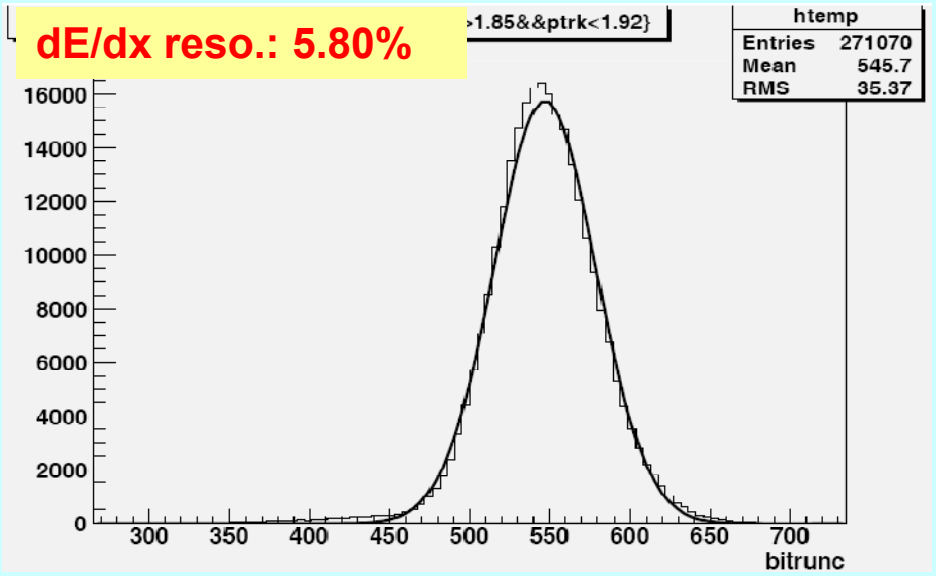


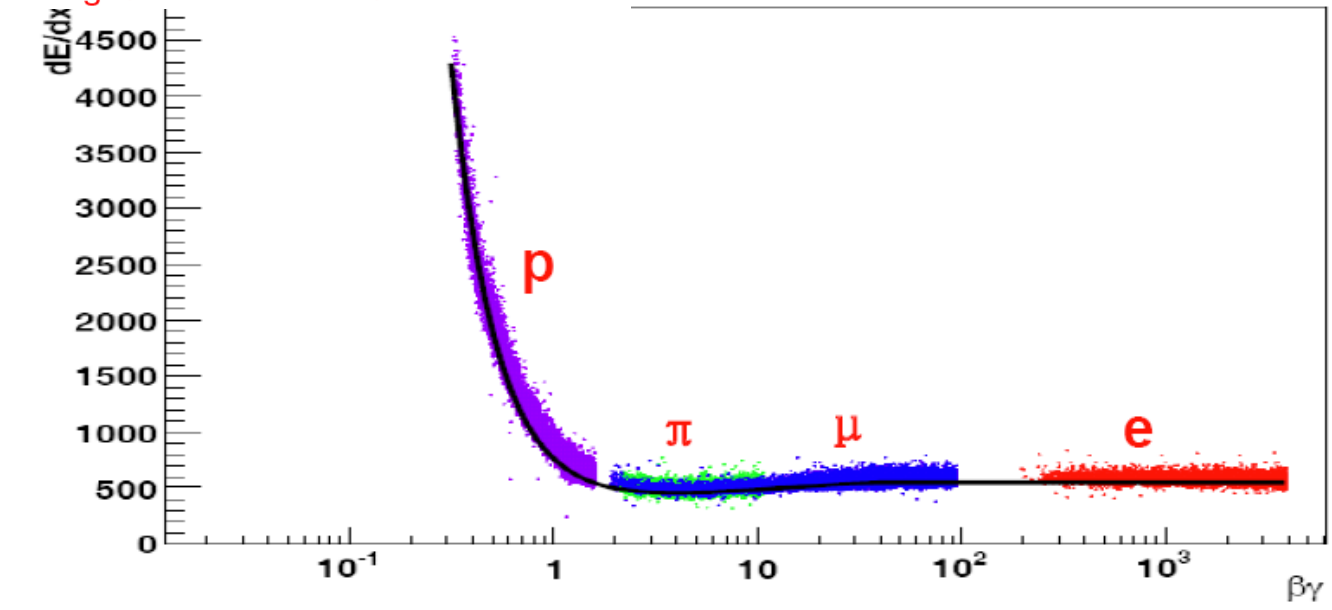




dE/dx resolution







BESIII CsI(Tl) crystal calorimeter

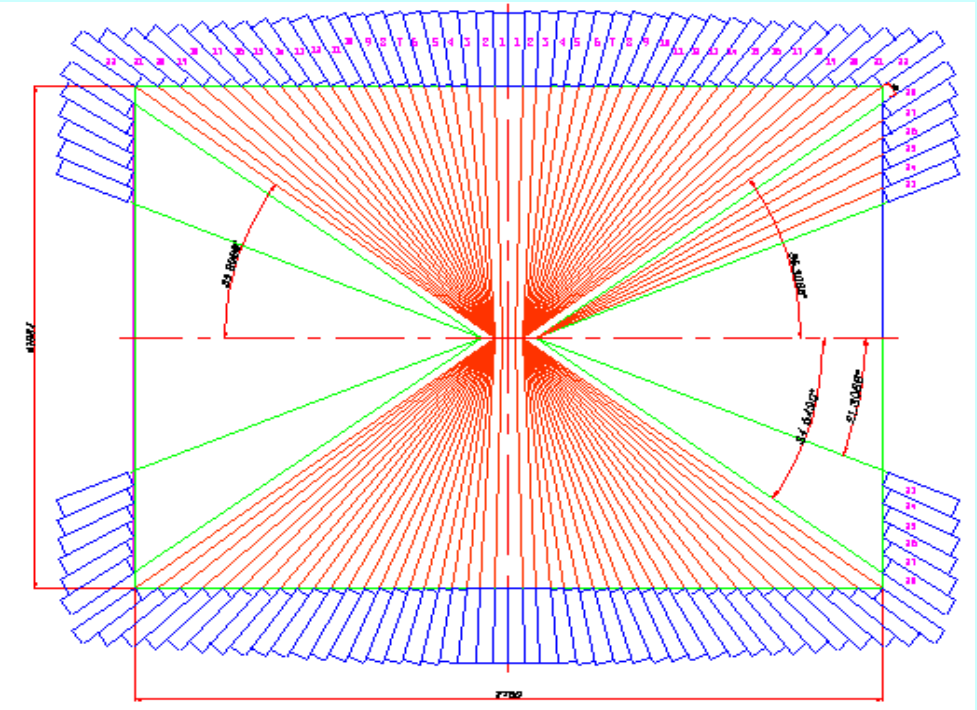
- **To measure the energy of electromagnetic particles**
- **Barrel: 5280 crystals，Endcap: 960 crystals**
- **Crystal: (5.2x 5.2 – 6.4 x 6.4) x 28cm^3**
- **Readout: 13000 Photodiodes, 1cm×2cm,**
- **Energy range：20MeV – 2 GeV**
- **position resolution: 6 mm @ 1GeV**
- **Tilt angle: theta ~ 1-3^o, phi ~ 1.5^o**

Babar: 2.67% @1GeV

BELLE: 2.2% @1GeV

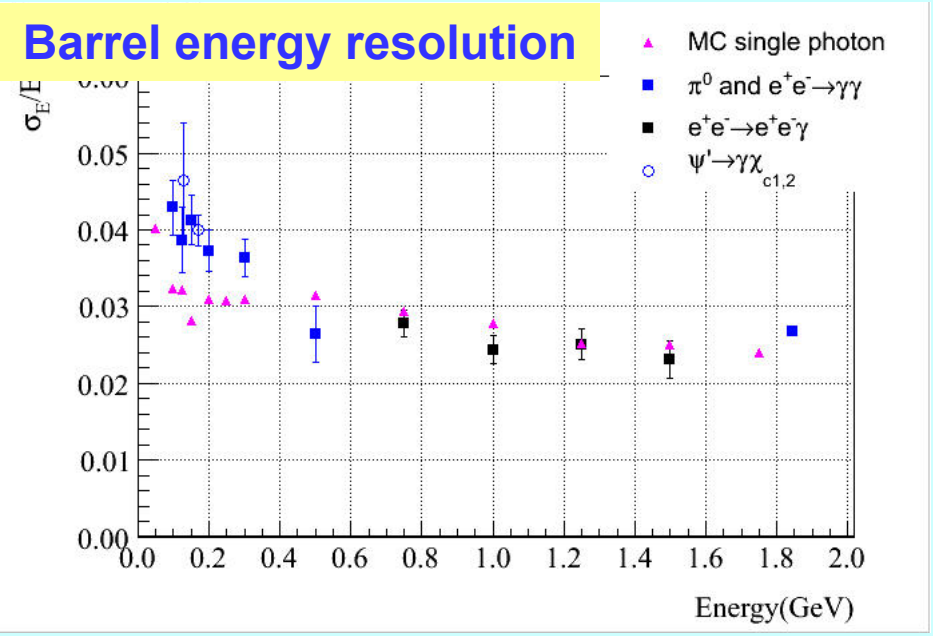
CLEO: 2.2% @1GeV

BESIII: 2.5%@1GeV

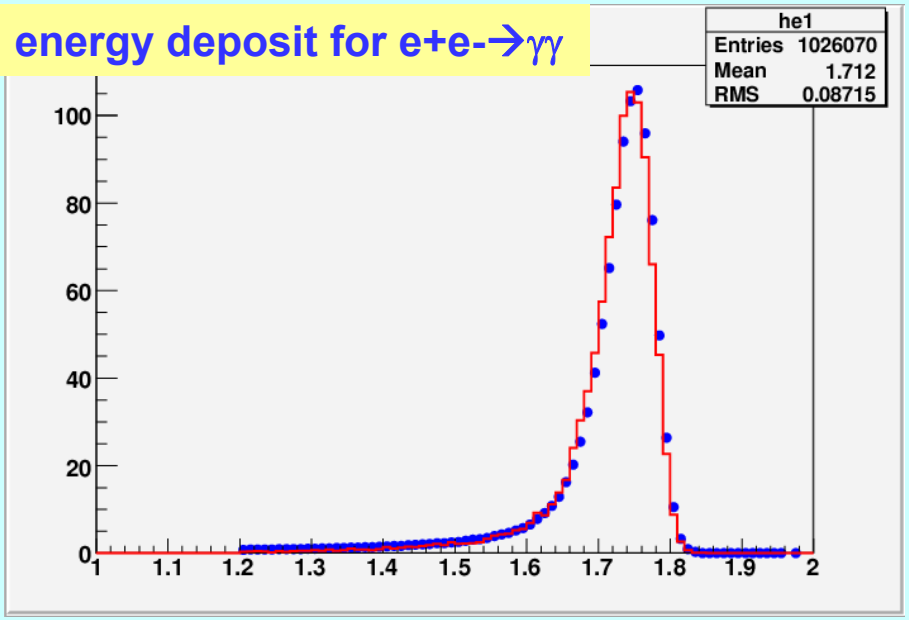


EMC calibration

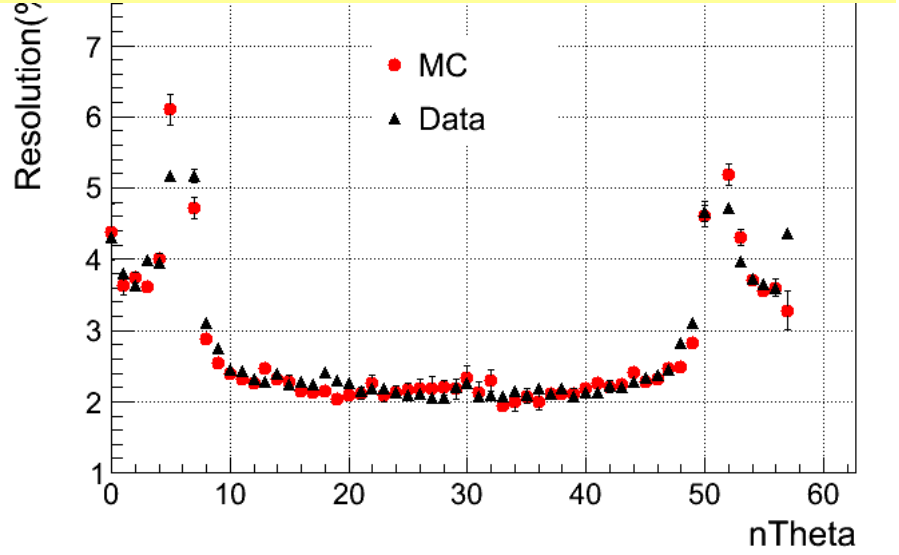
Barrel energy resolution



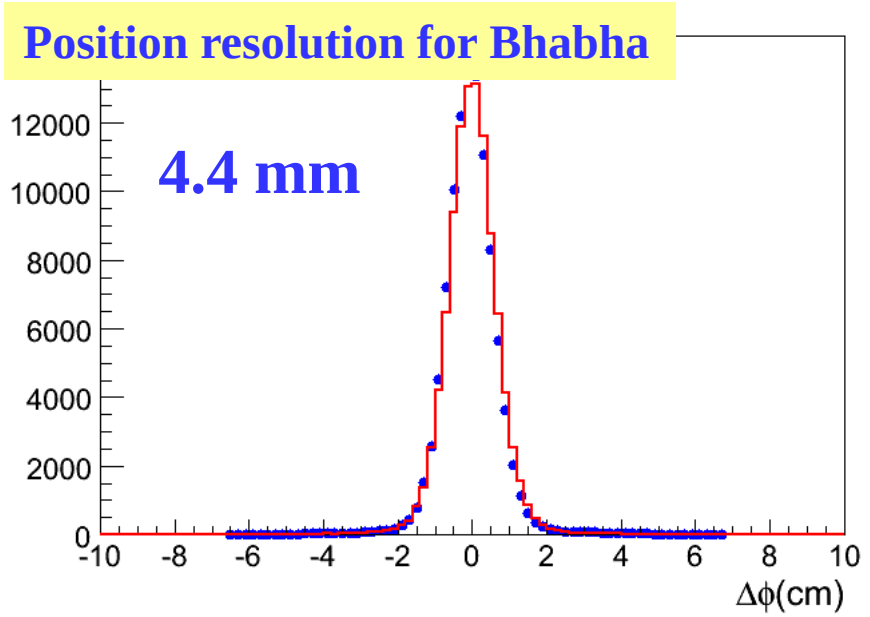
energy deposit for e+e-→γγ



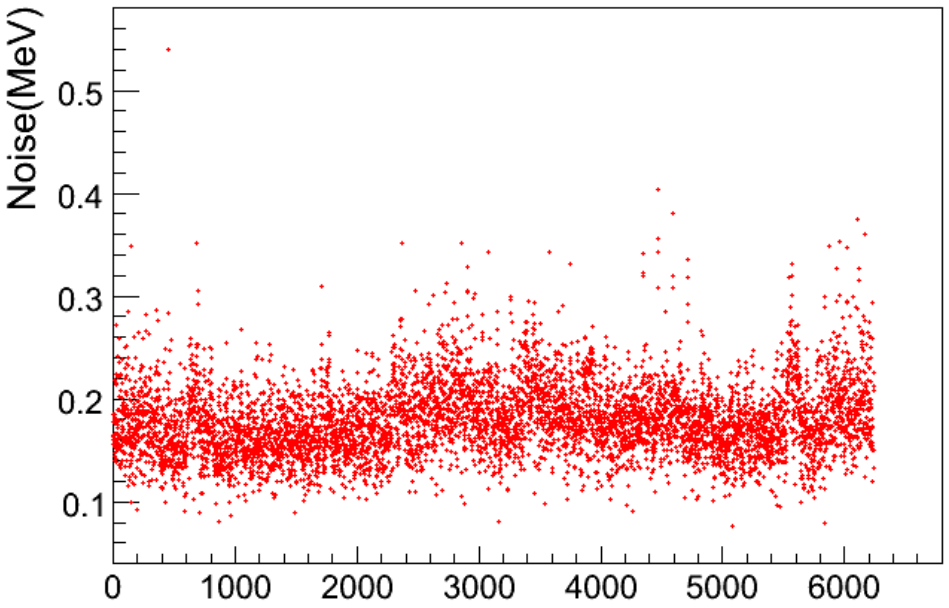
energy resolution for Bhabha events

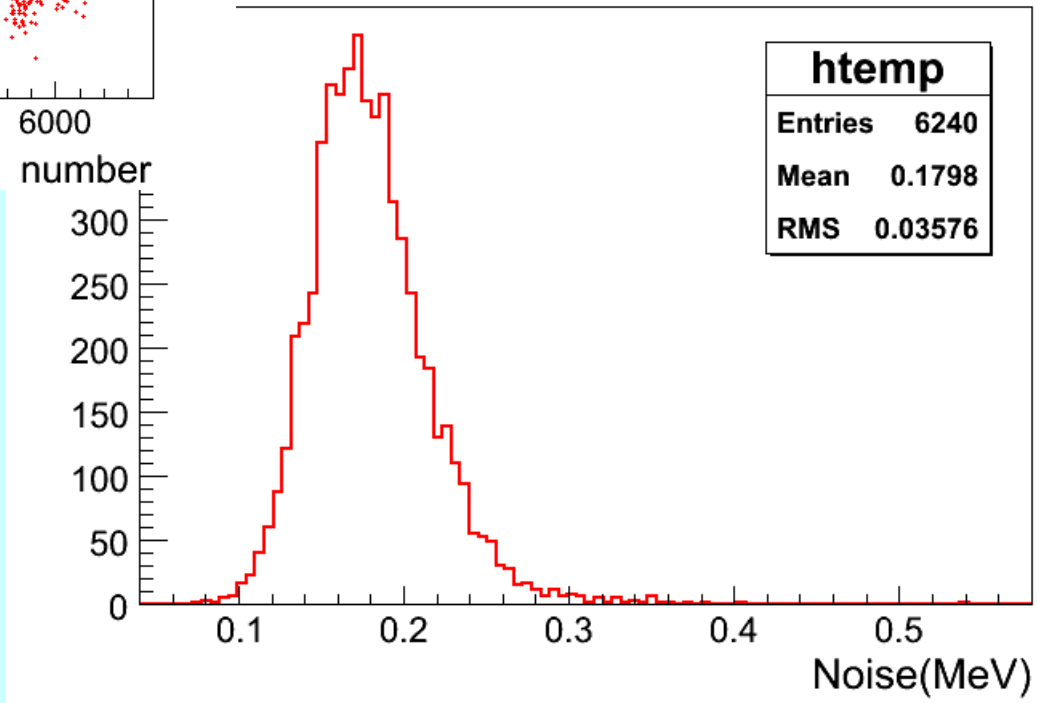


Position resolution for Bhabha

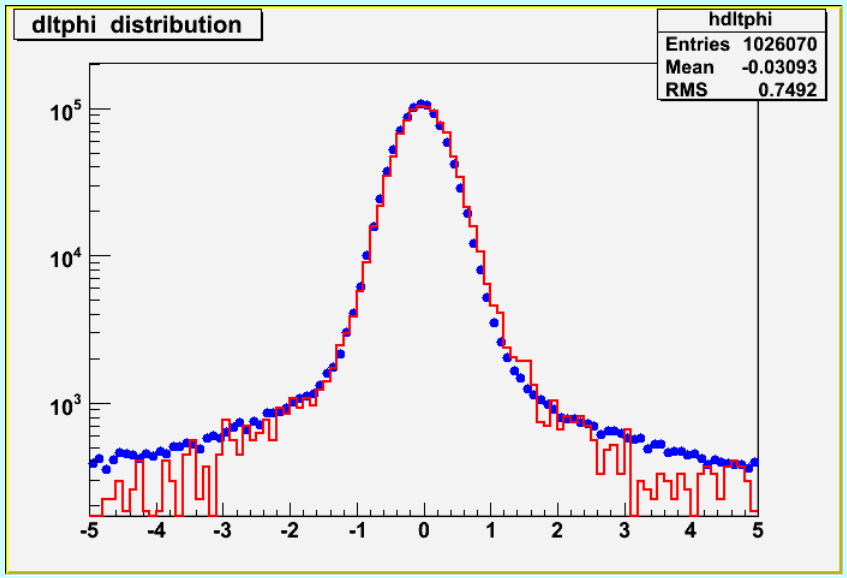


Very low electronics noise

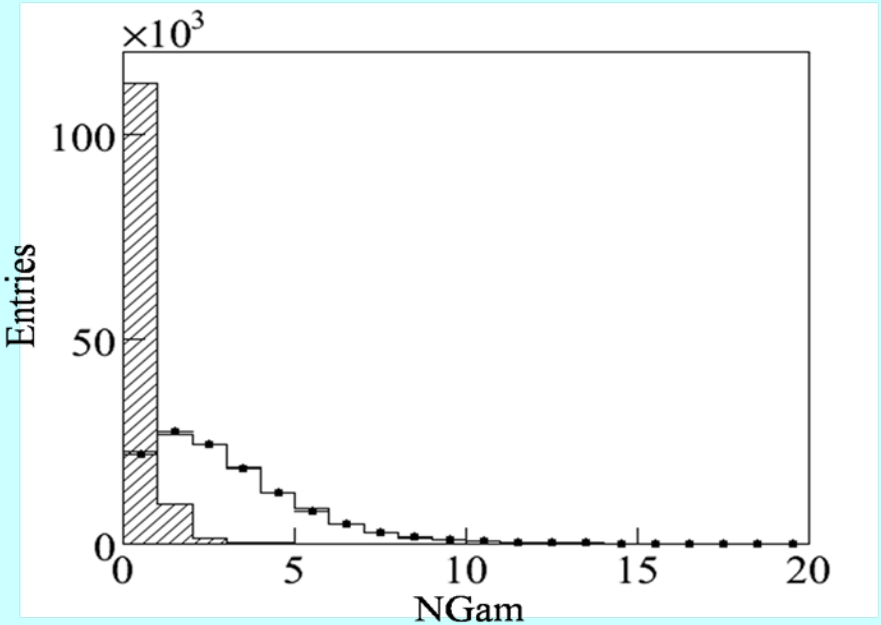


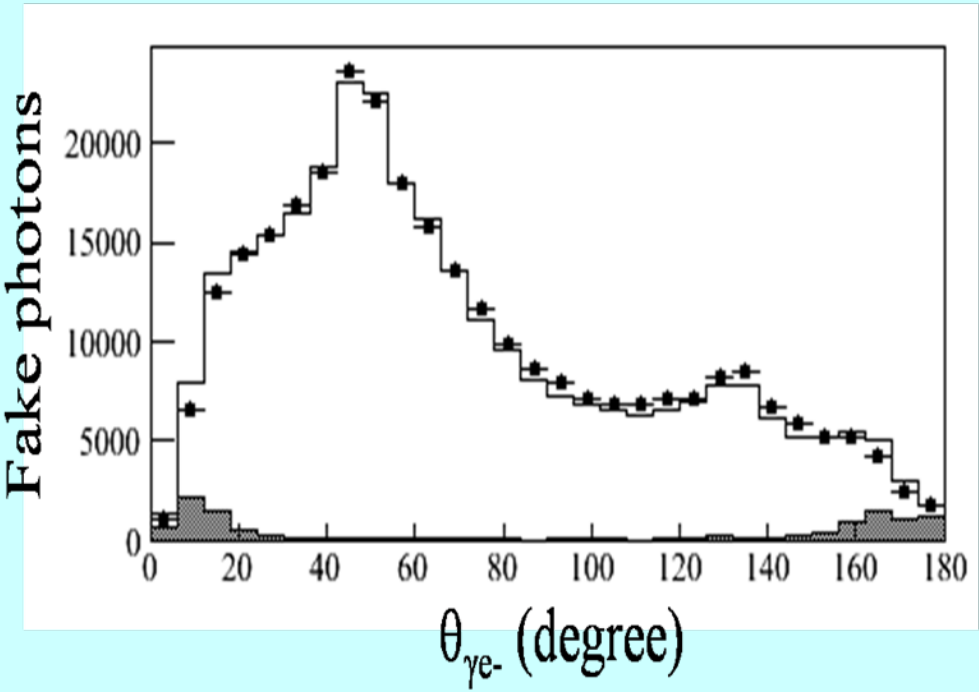


Data/MC comparison for Bhabha events



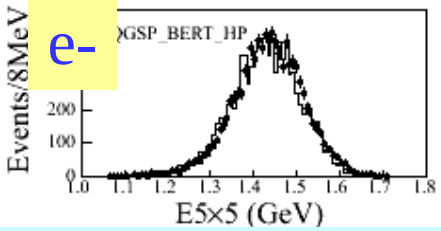
Dots: data
Solid line: MC with background mixing
Dash line/shade: MC without background mixing

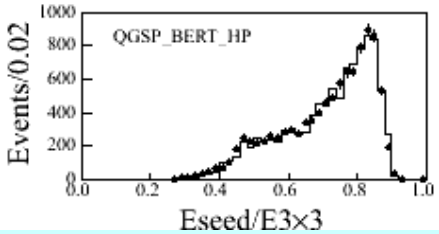


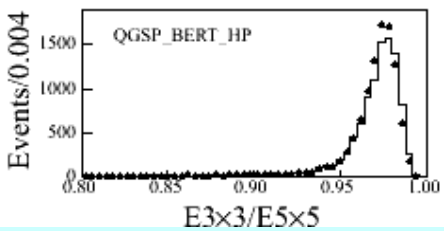


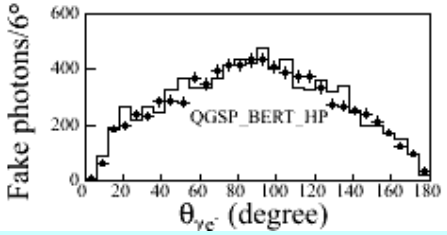
Data/MC comparison

e-

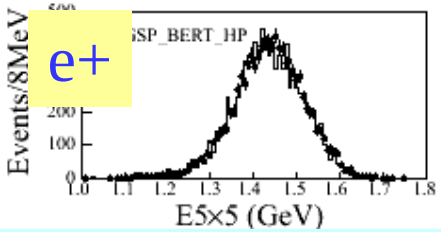


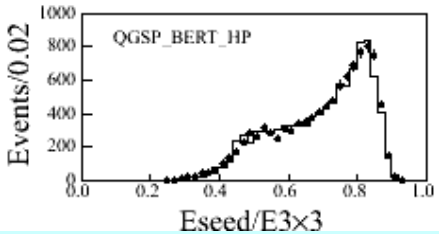


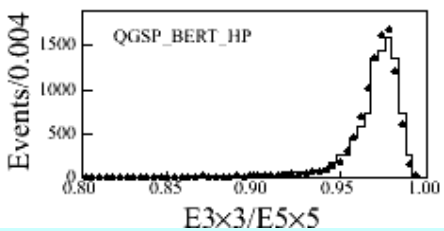


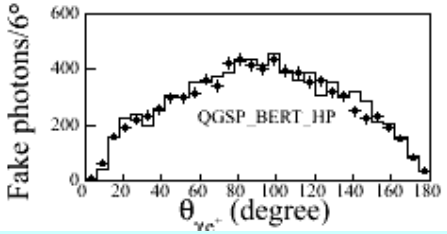


e+

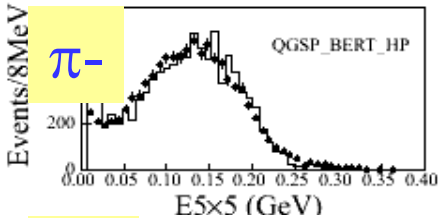


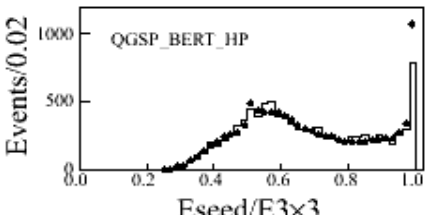


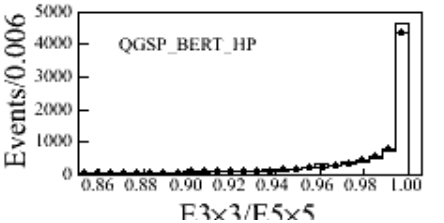


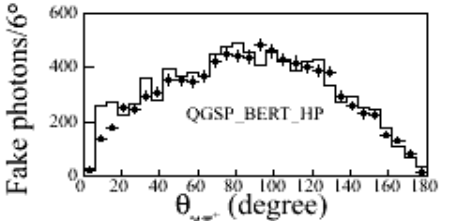


π-

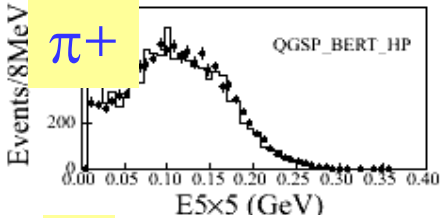


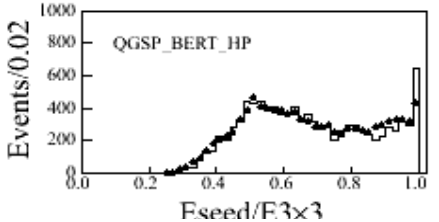


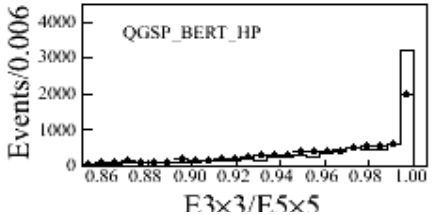


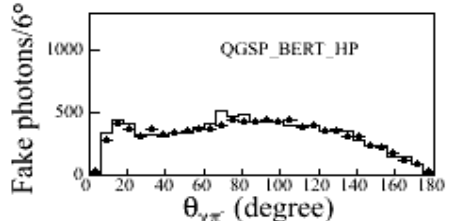


π+

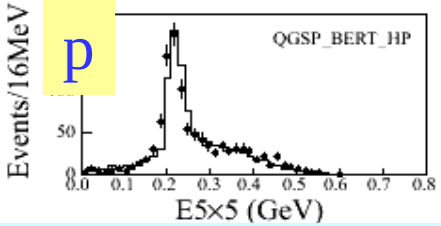


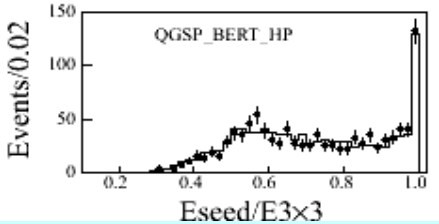


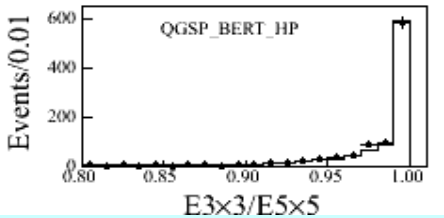


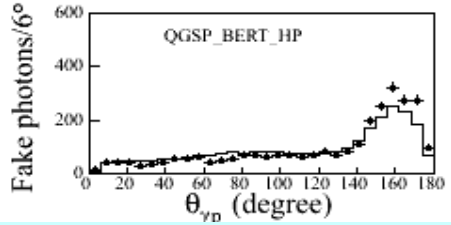


p





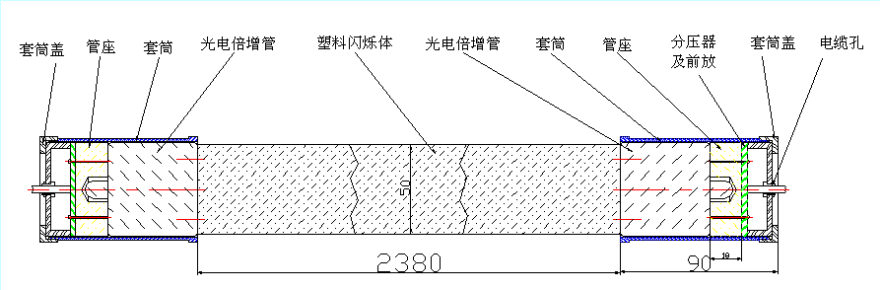


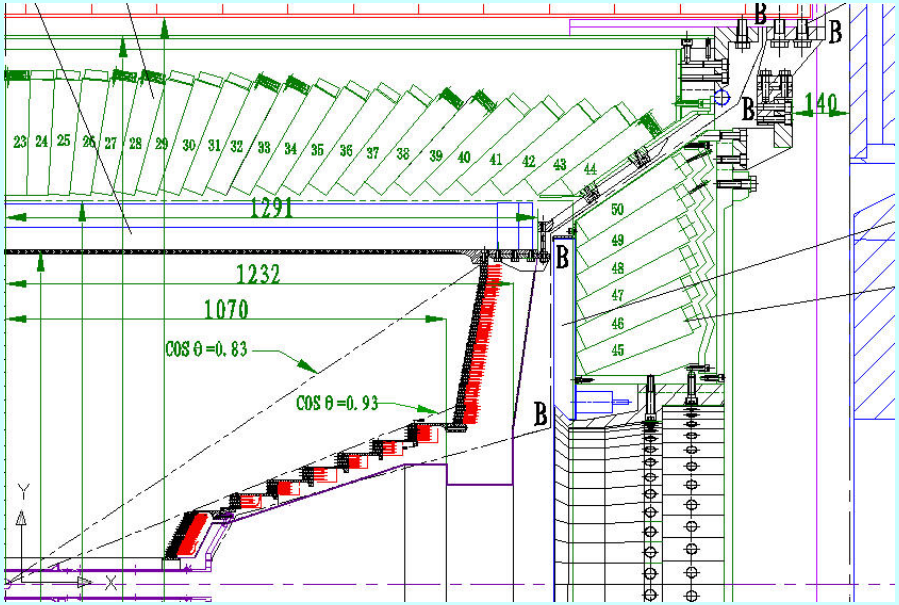


PID: TOF system

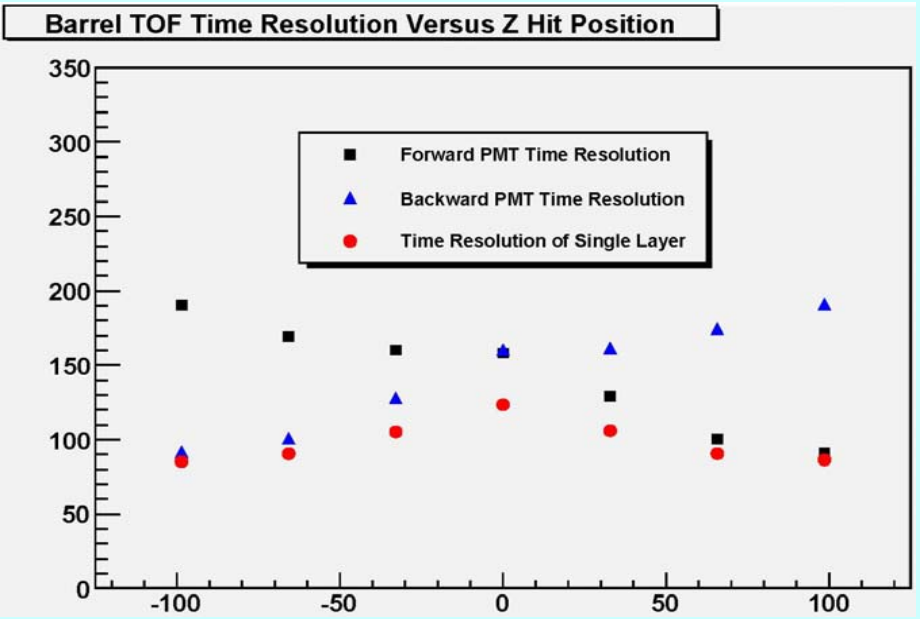
- **Barrel: 2*88 BC408, 2.4 m long, 5cm thick**
- **Endcap： 2* 48 BC 408**
- **PMT: Hamamatzu R5942**

探测器	长(cm)	本征分辨
BESIII	**240**	**90 ps**
CLEOII	**280**	**139 ps**
OBELIX	**300**	**170 ps**
BELLE	**255**	**90~100 ps**
CDFII	**279**	**100 ps**
HARP	**180-250**	**160 ps**

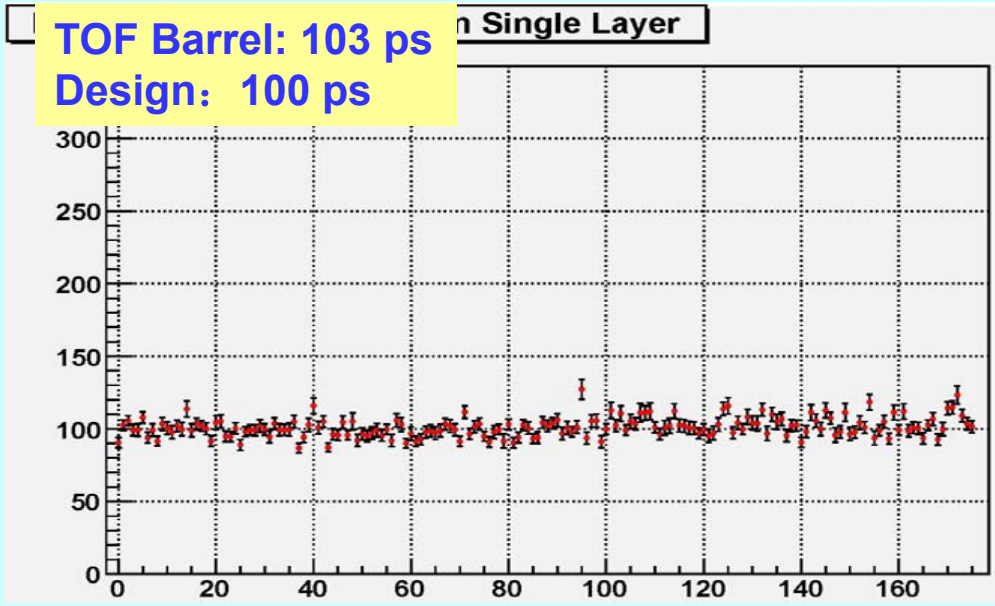


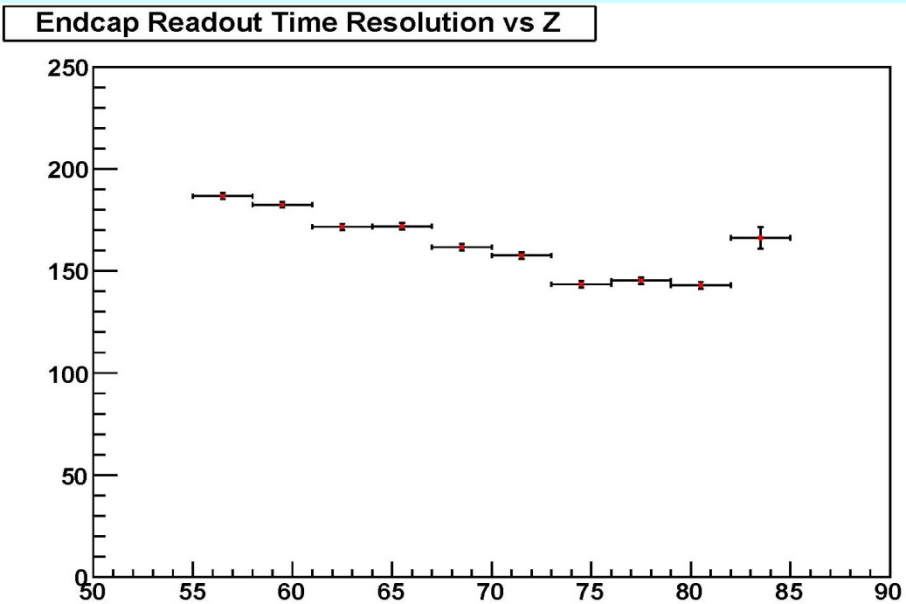


TOF calibration

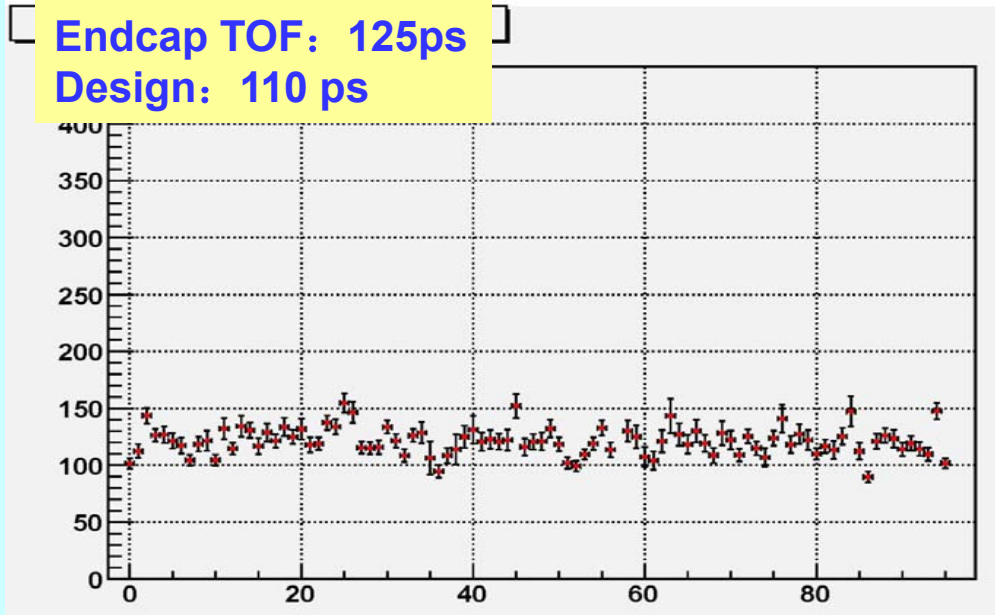


TOF Barrel: 103 ps
Design：100 ps



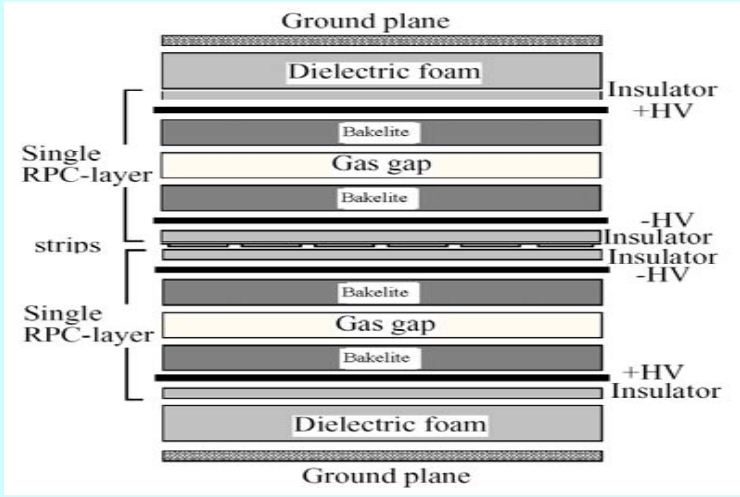


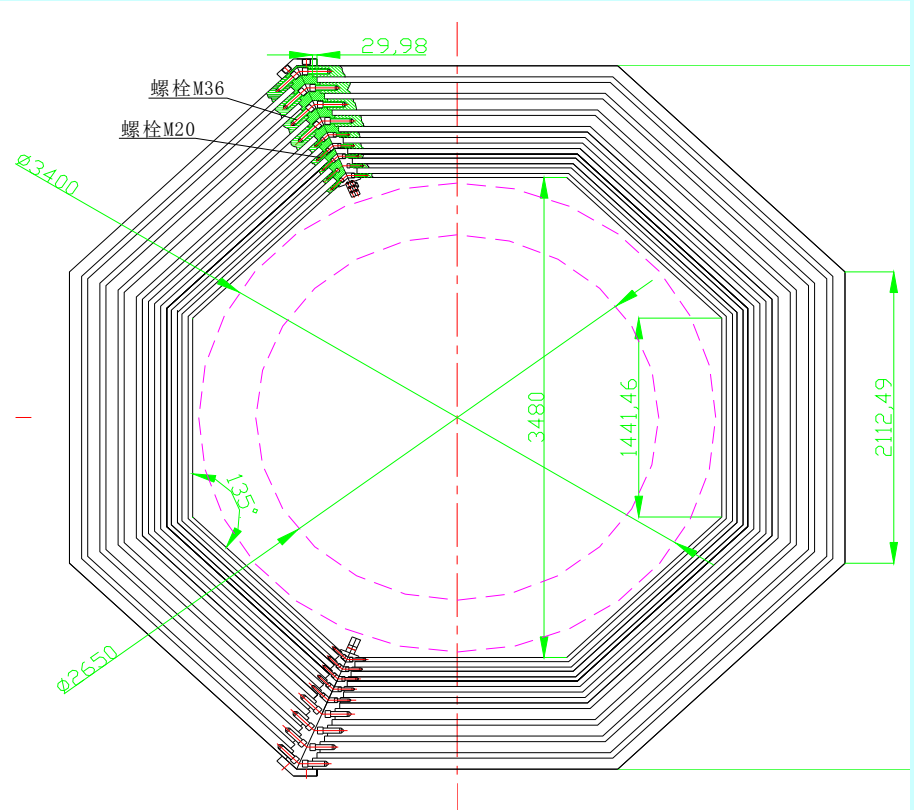
Endcap TOF：125ps
Design：110 ps

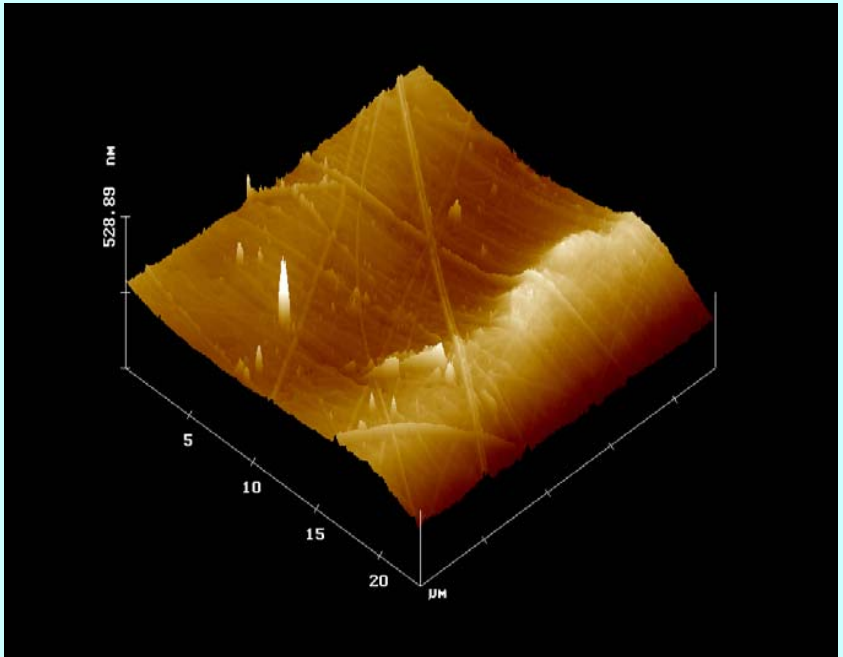


μ system : RPC

- 9 layer, 2000 m^2
- Special bakelite plate w/o lineseed oil
- 4cm strips, 10000 channels
- Noise less than 0.1 Hz/cm^2

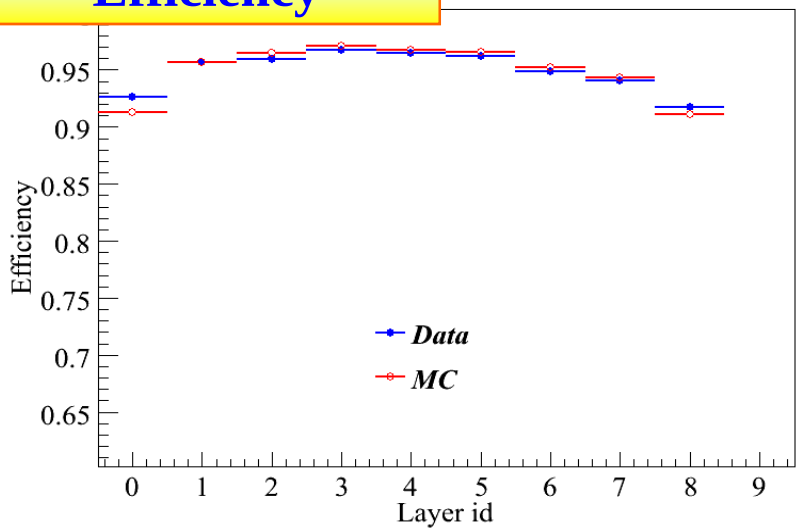




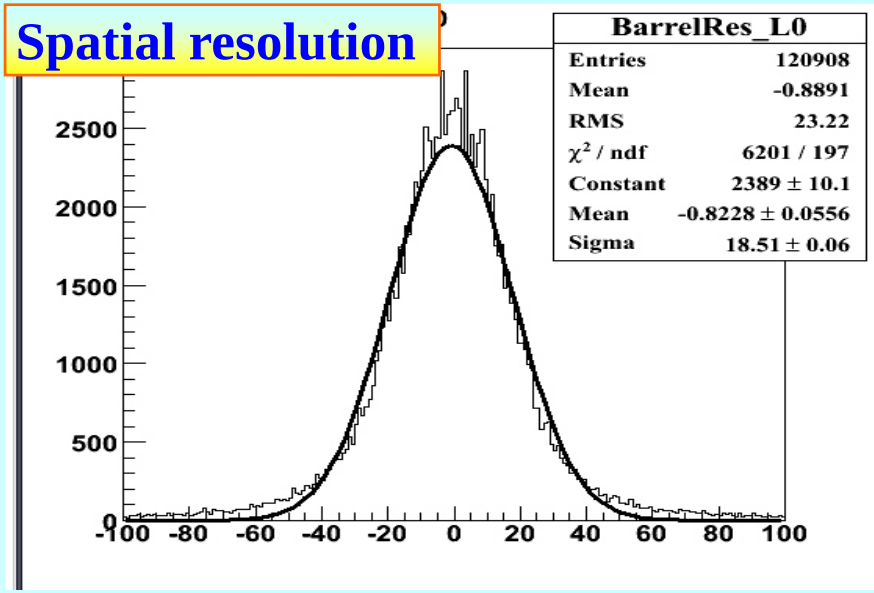


MUON Chamber

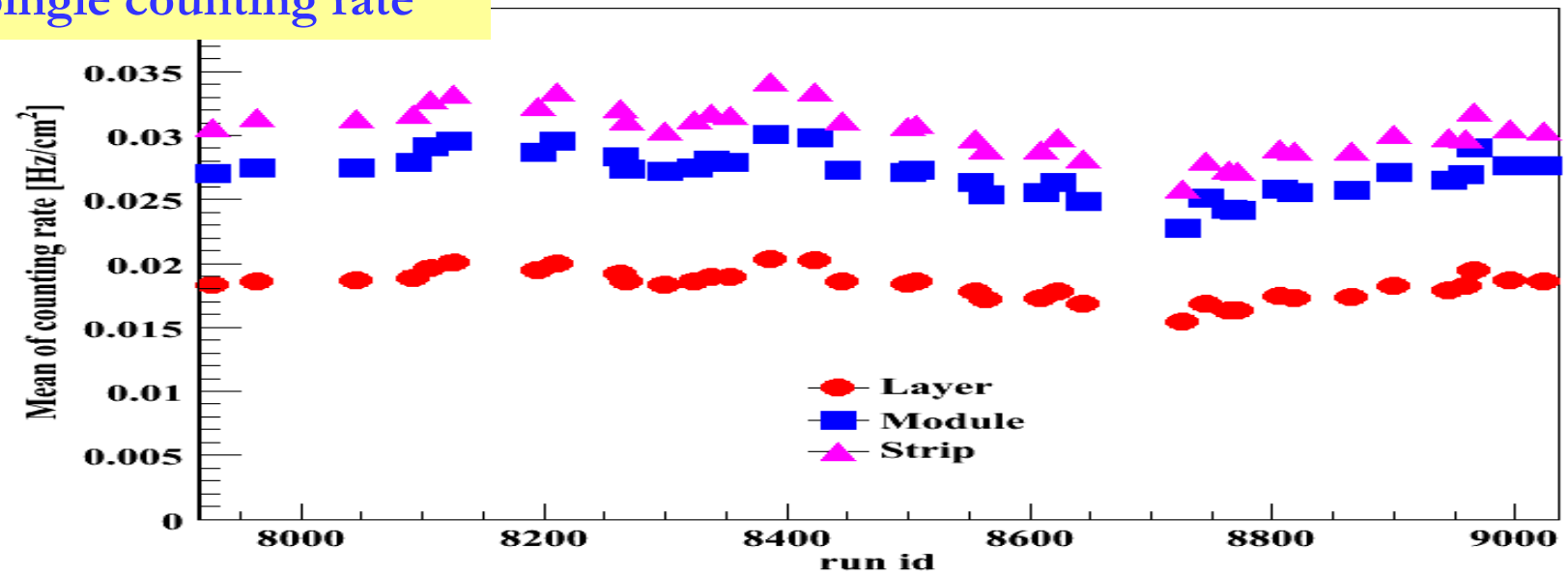
Efficiency



Spatial resolution



Single counting rate

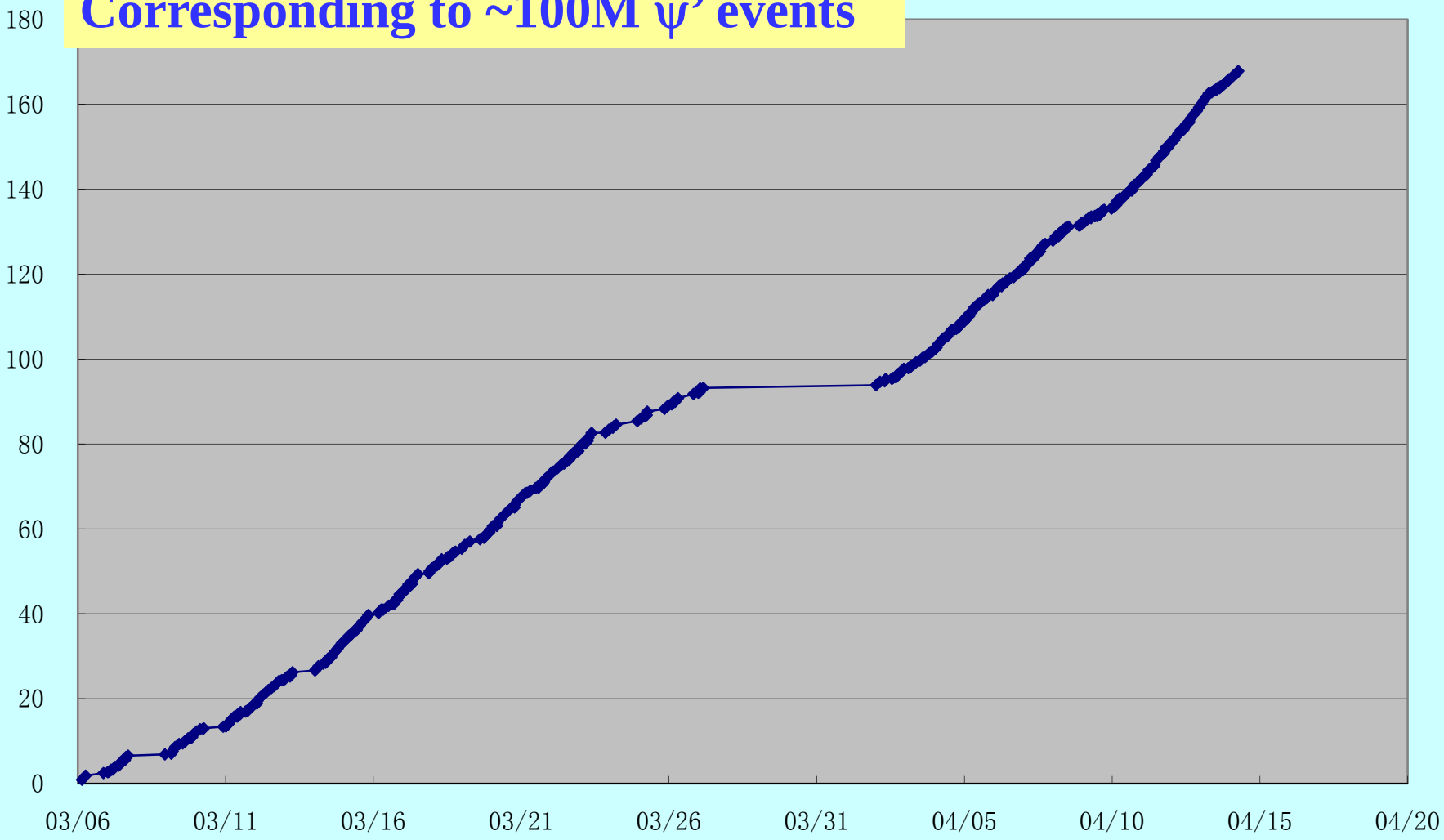


Data Taking plan in 2009

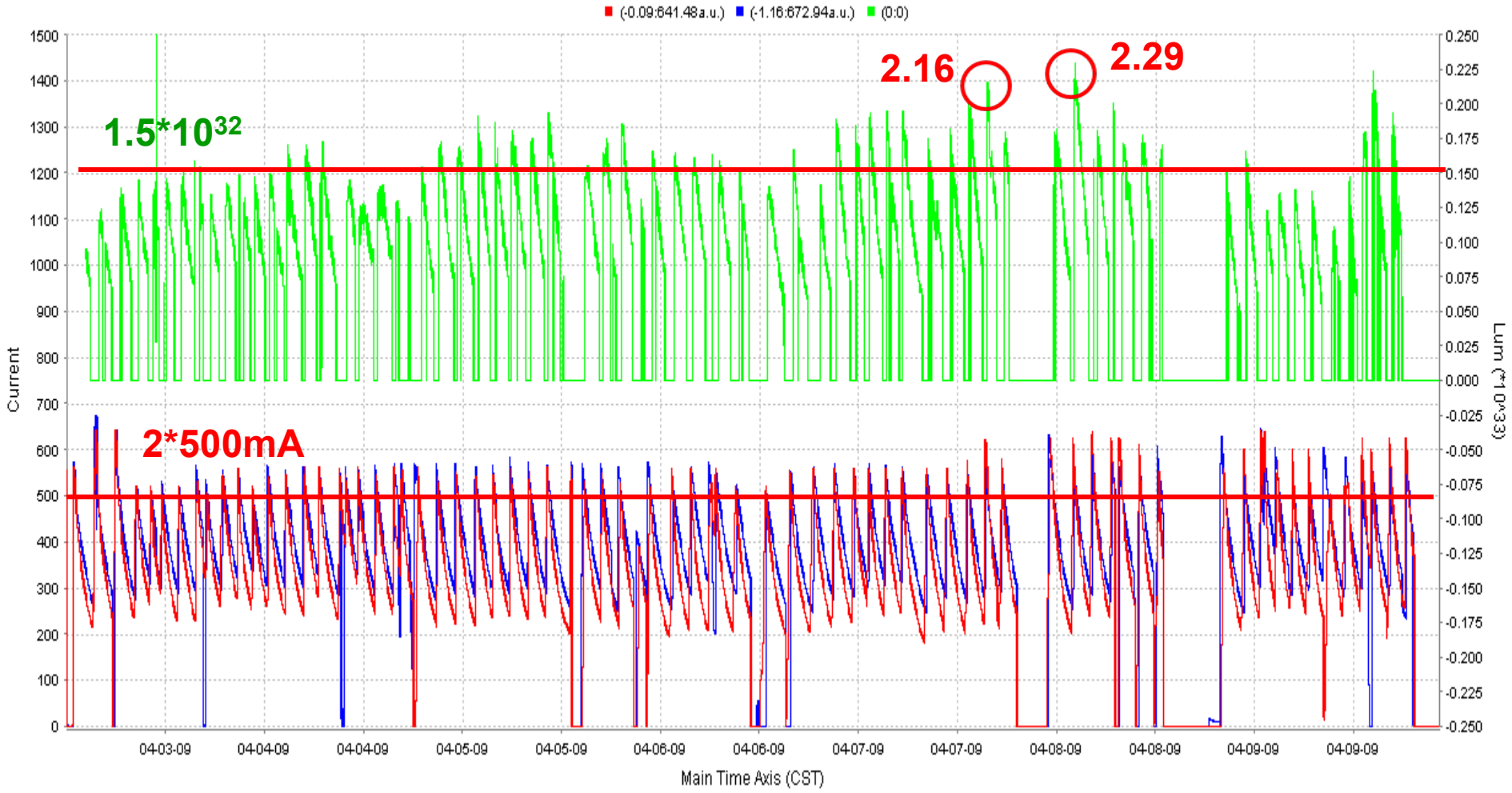
- **March – April:**
  - **~ 100 M : ψ' events = 4*CLEOc = 7*BESII**
- **June-July:**
  - **~ 500 M J/ψ events = 8*BESII**
  - **a few days at 3.0 & 3.65 GeV**
- **After summer:**
  - **ψ(3770) line shape scan**

Integral luminosity accumulated

Corresponding to ~100M ψ' events

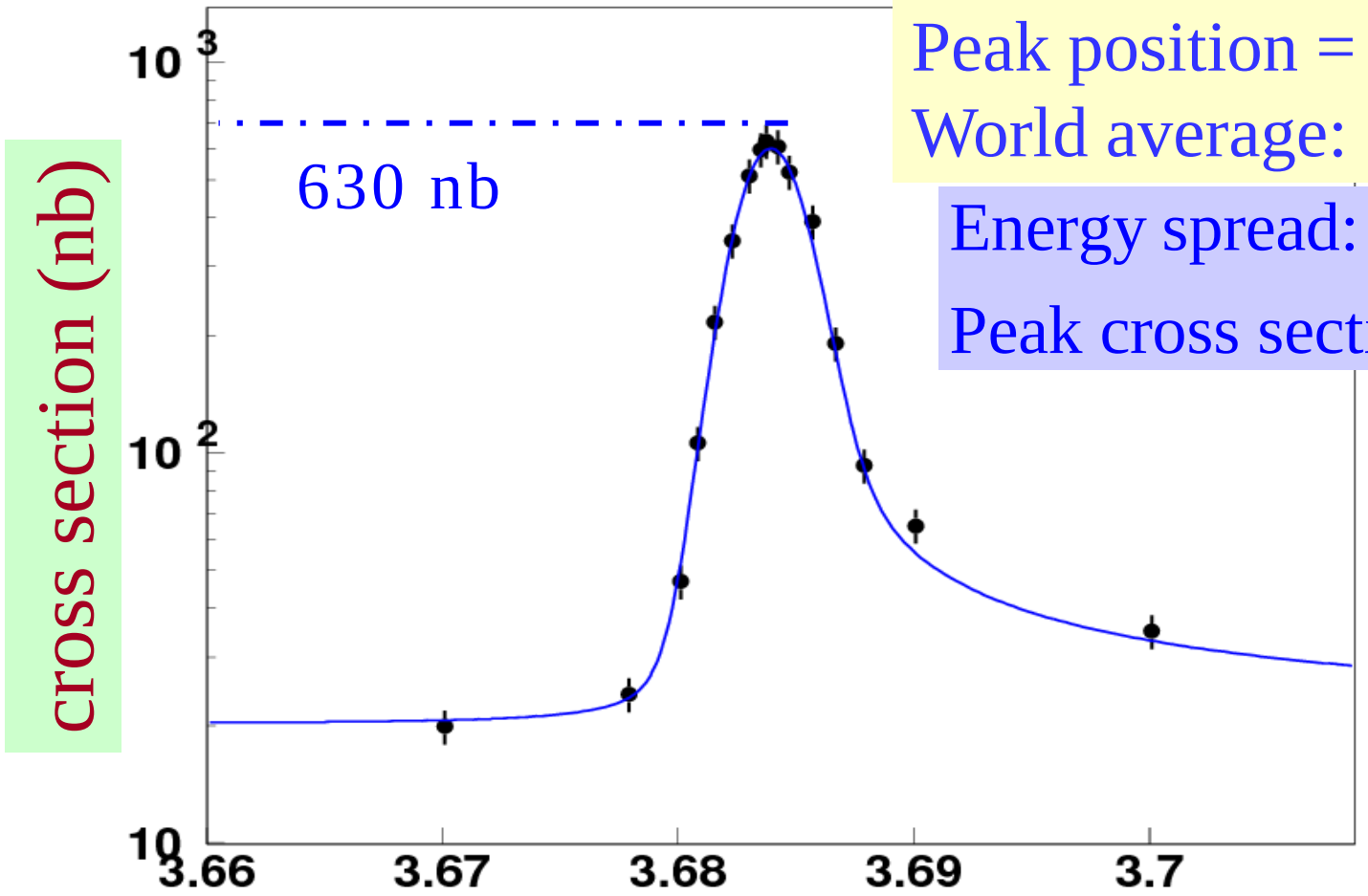


Luminosity vs beam current during the ψ(2s) Run



Machine is stable, with data taking efficiency is 15 times higher than BEPC. The peak luminosity keeps steadily increasing.

ψ' energy scan



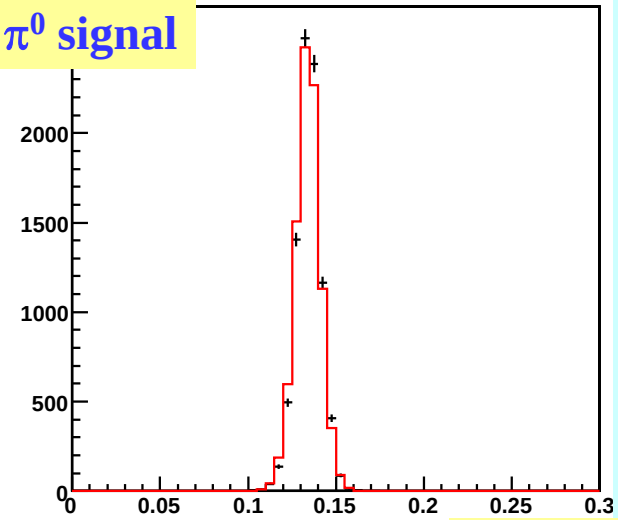
Peak position = 3.684 GeV
World average: 3.686 GeV

Energy spread: 1.45 MeV

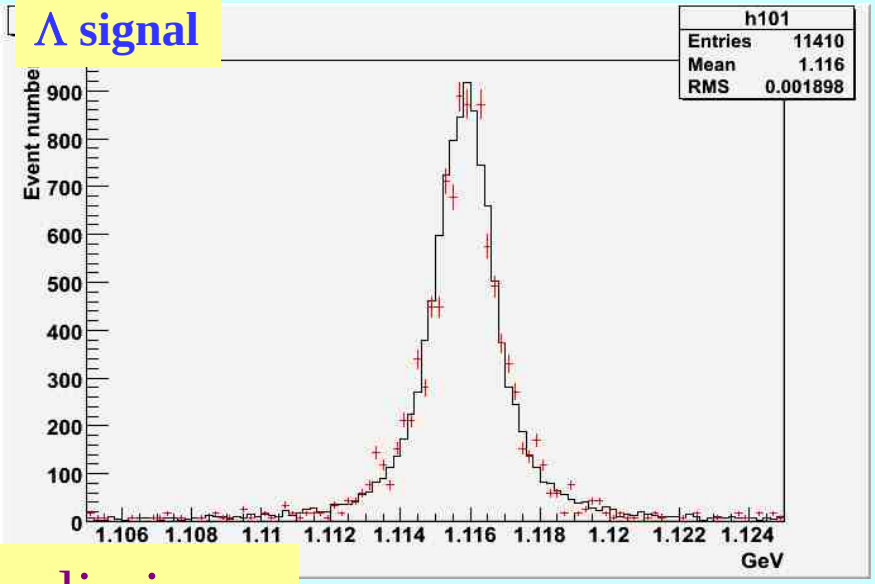
Peak cross section: 630 nb

Some physics signals

π^0 signal

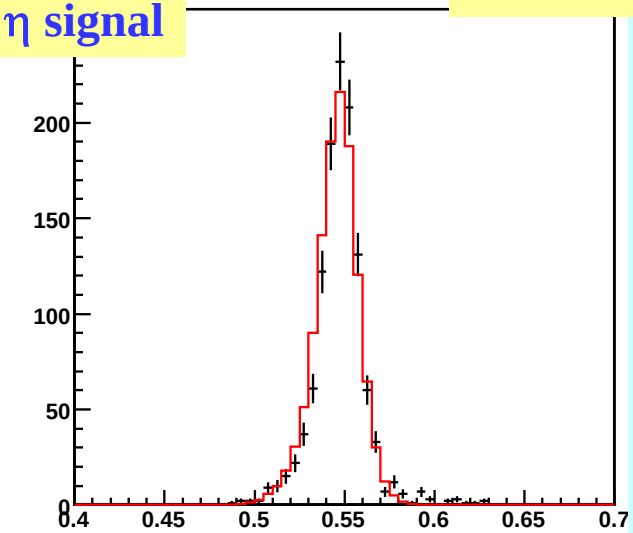


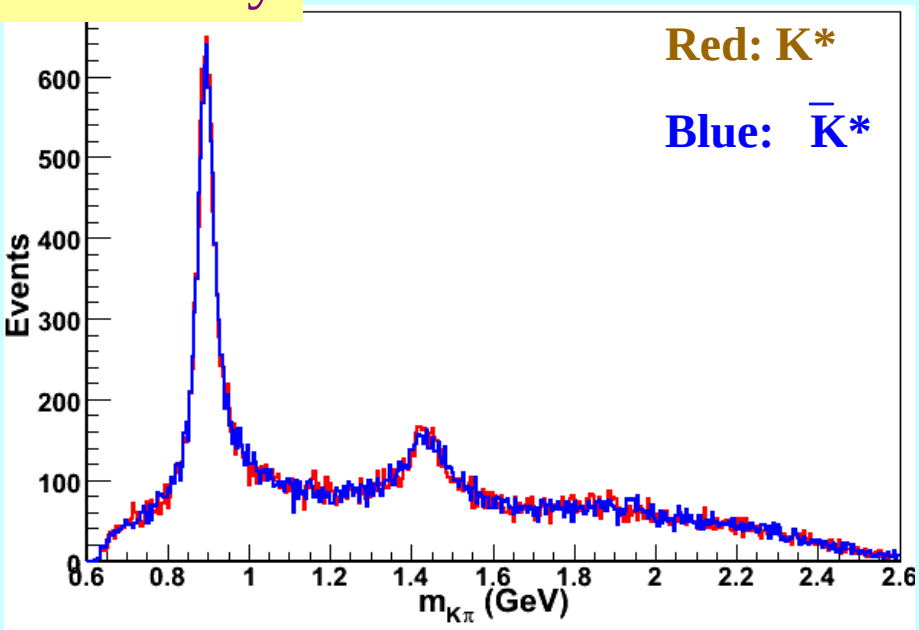
Λ signal



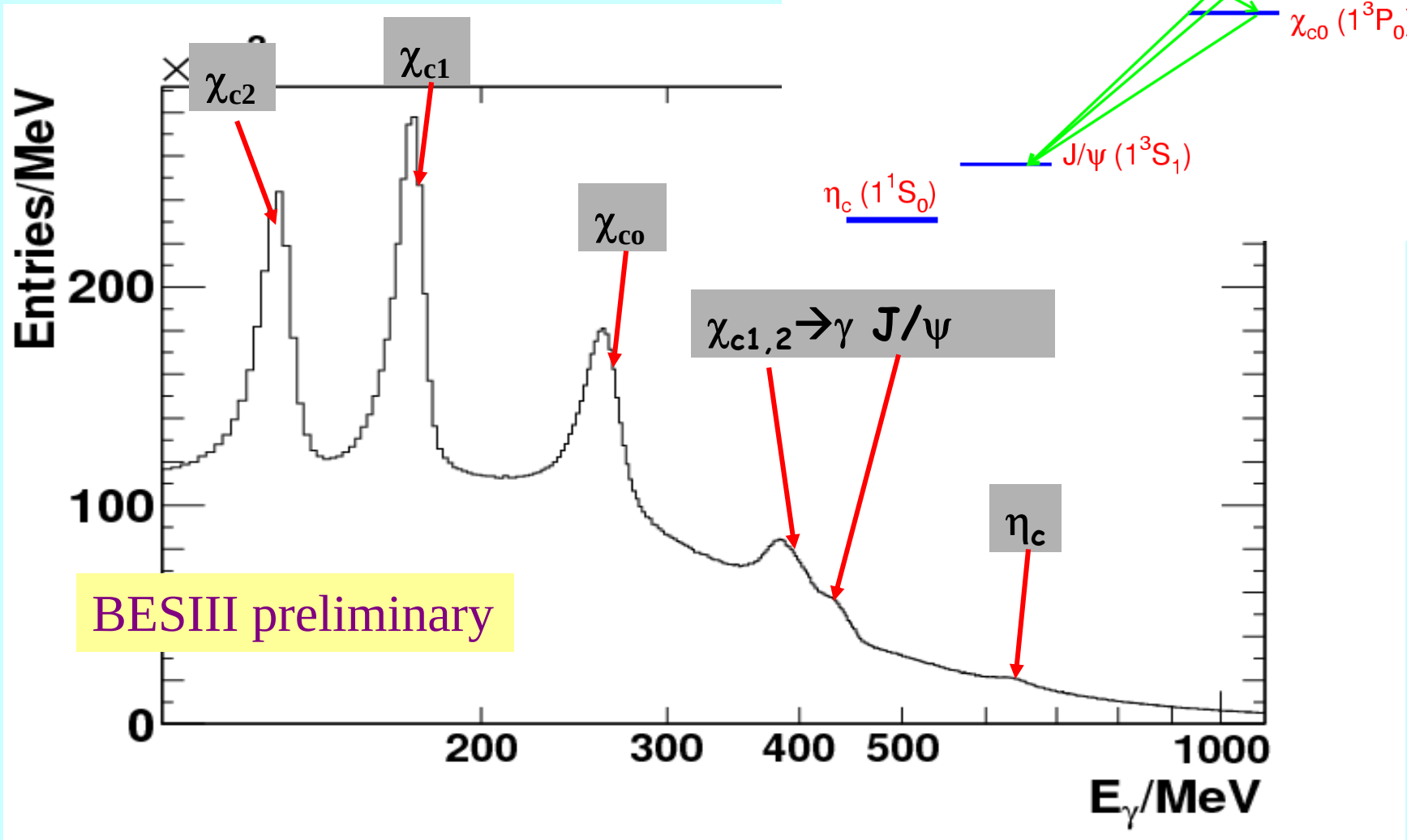
BESIII preliminary

η signal

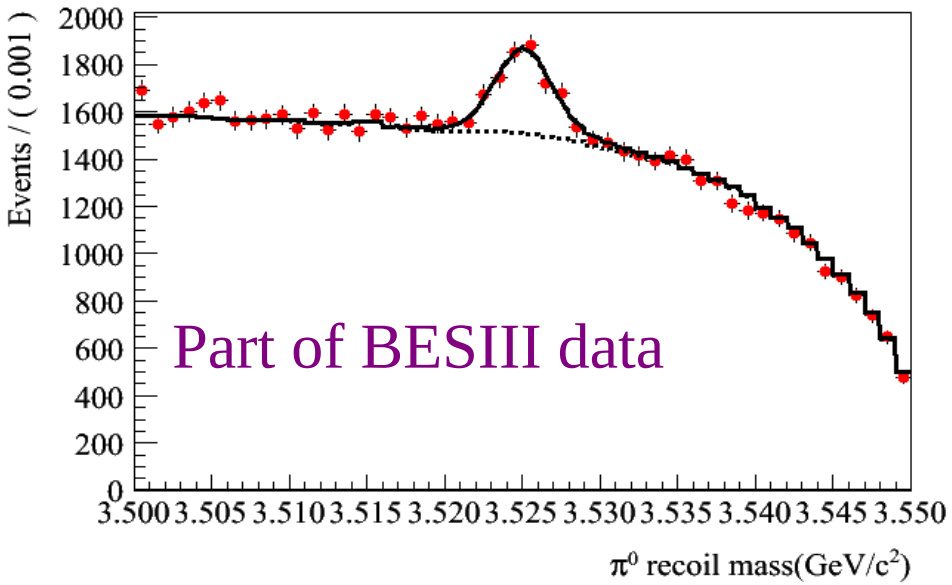


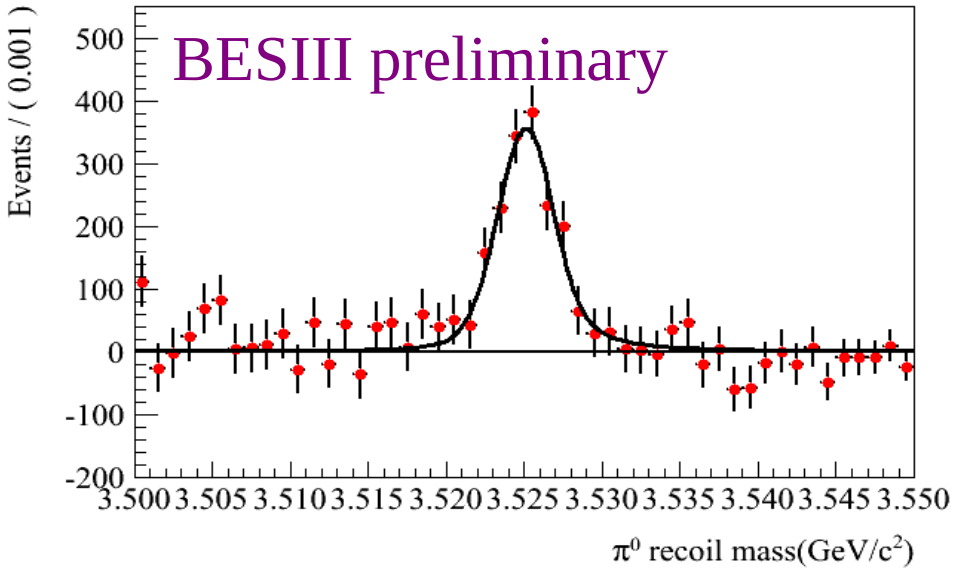


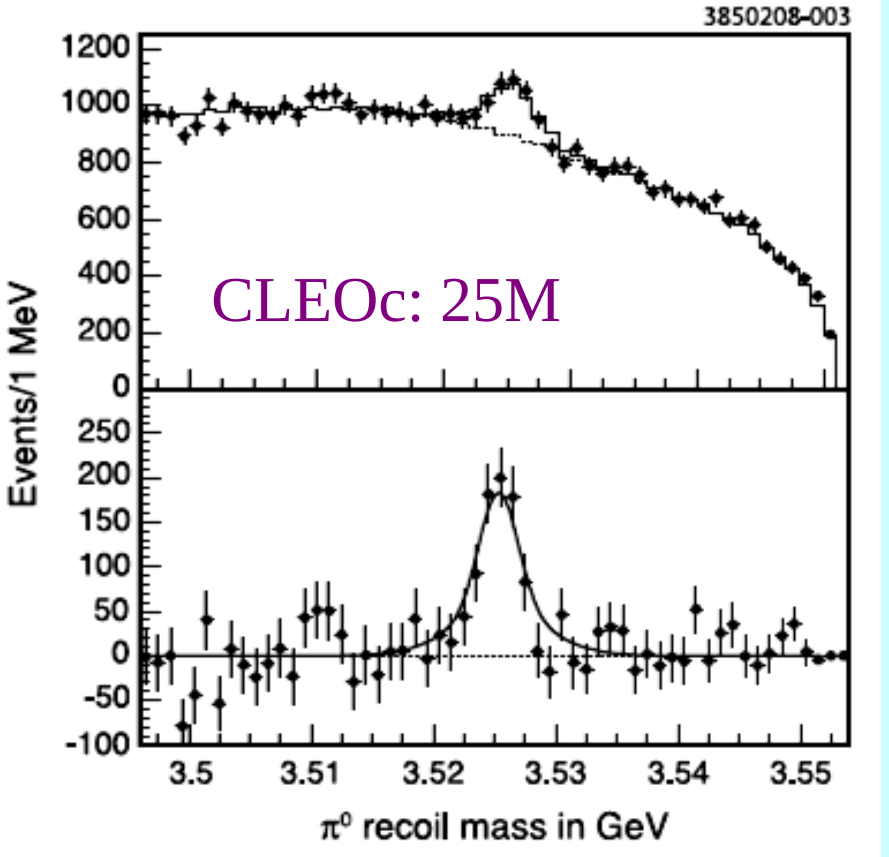
E1 transitions: inclusive photon spectrum



$\psi(2S)\rightarrow\pi^0 h_c,\ h_c\rightarrow\gamma\eta_c$

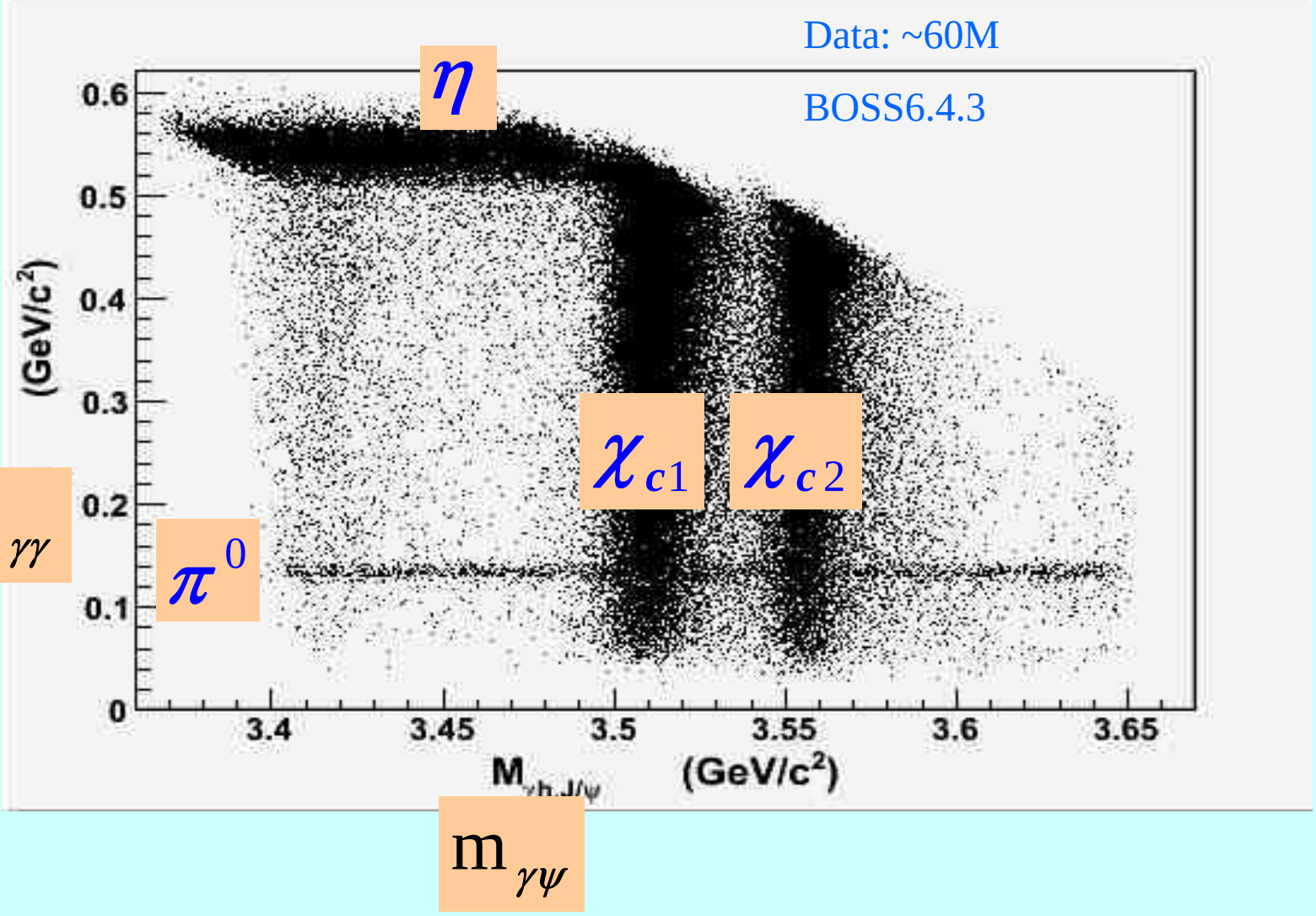






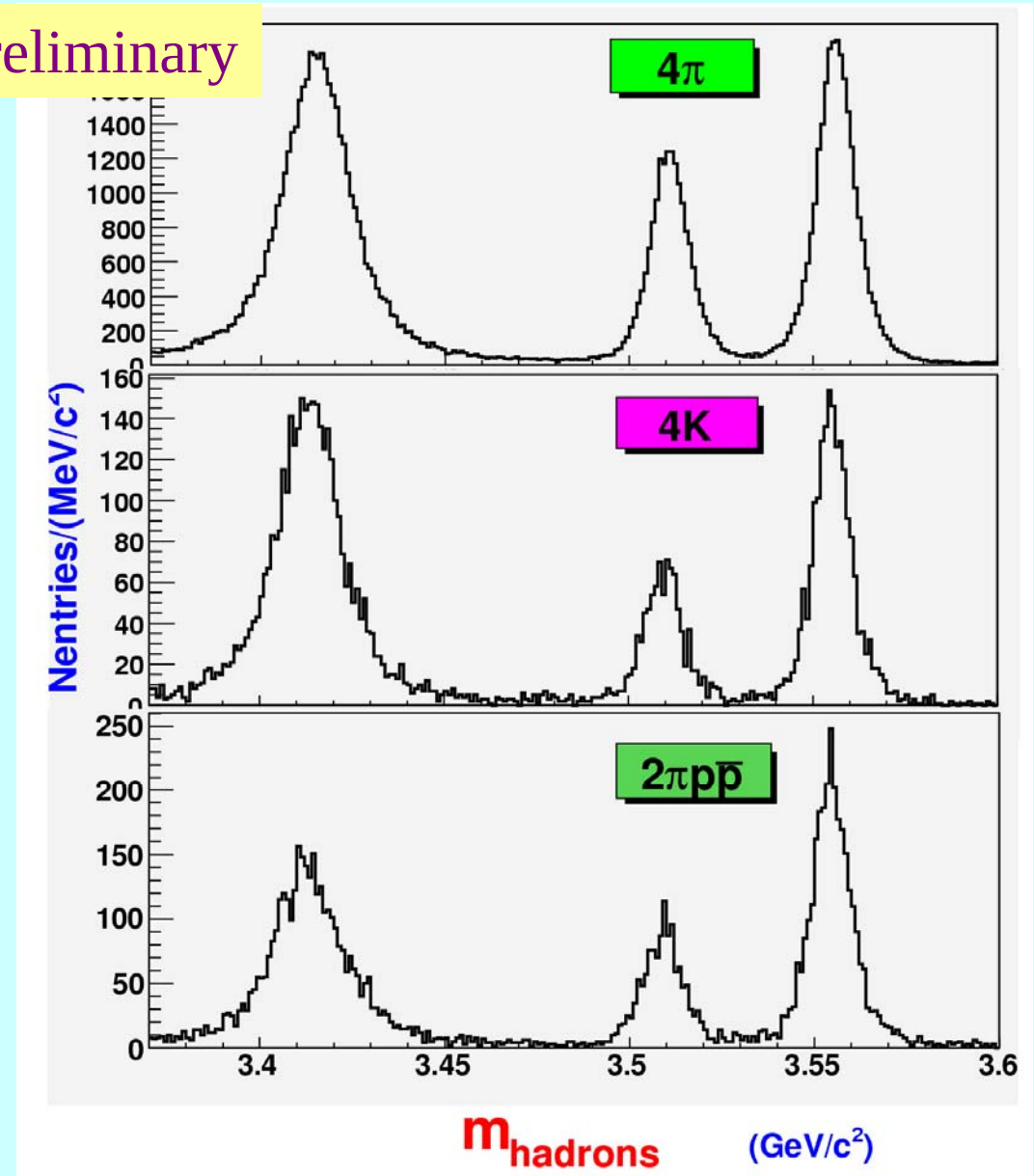
BES confirms the CLEOc observation & will improve the precision of the h_c properties.

$\psi' \rightarrow \gamma\gamma\, l^+l^-$: signals of χ_{cJ}, π^0 and η

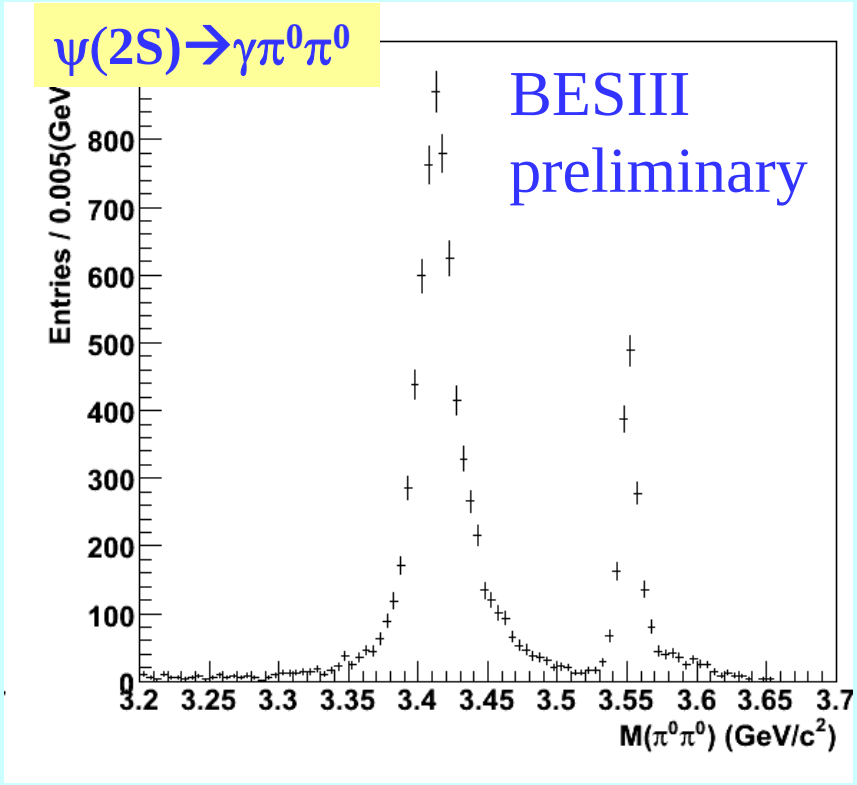


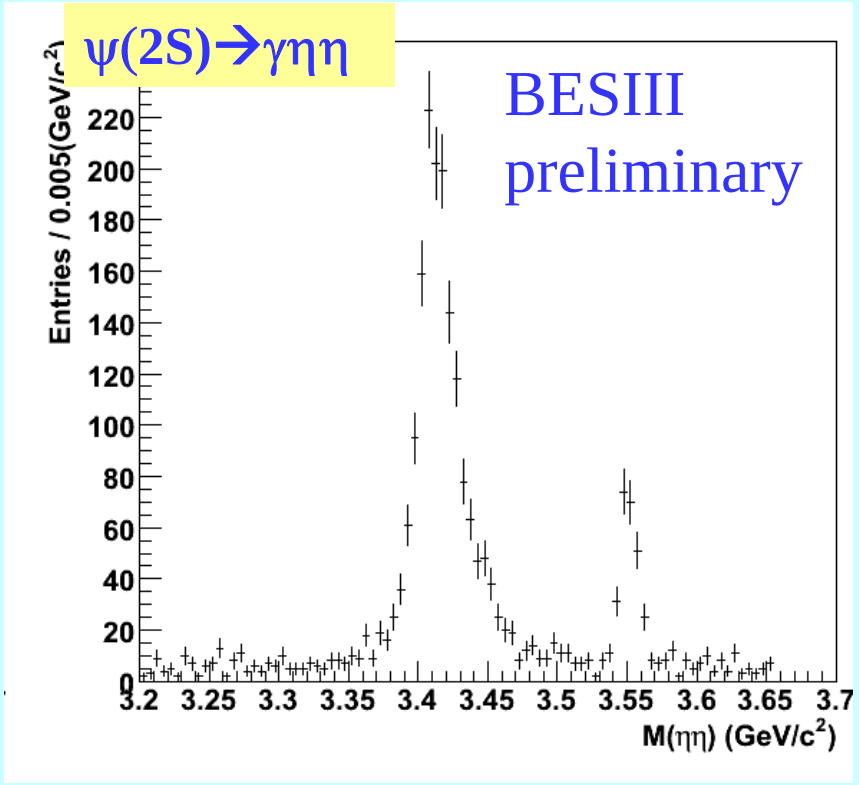
$\psi(2S) \rightarrow \gamma\chi_{cJ}$

BESIII preliminary



Study of $\psi(2S) \rightarrow \gamma\pi^0\pi^0$, $\gamma\eta\eta$ ($\eta \rightarrow \gamma\gamma$, $\pi^0 \rightarrow \gamma\gamma$)





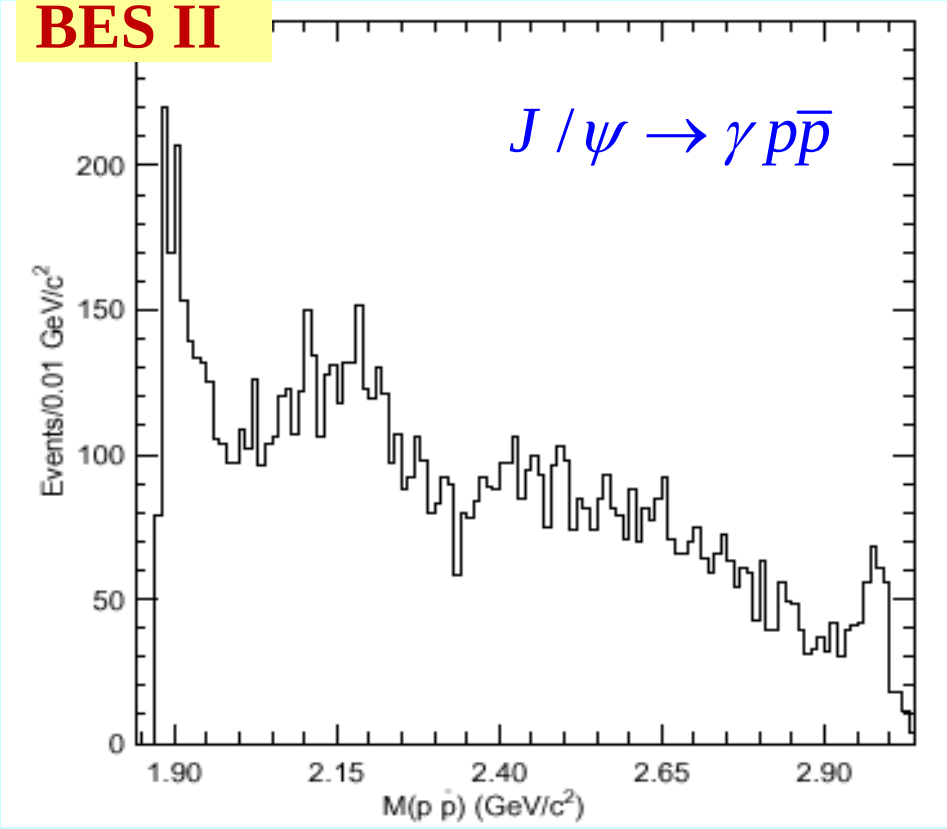
Branching fractions (10^{-3})

* CLEO-c arxiv:0811.0586

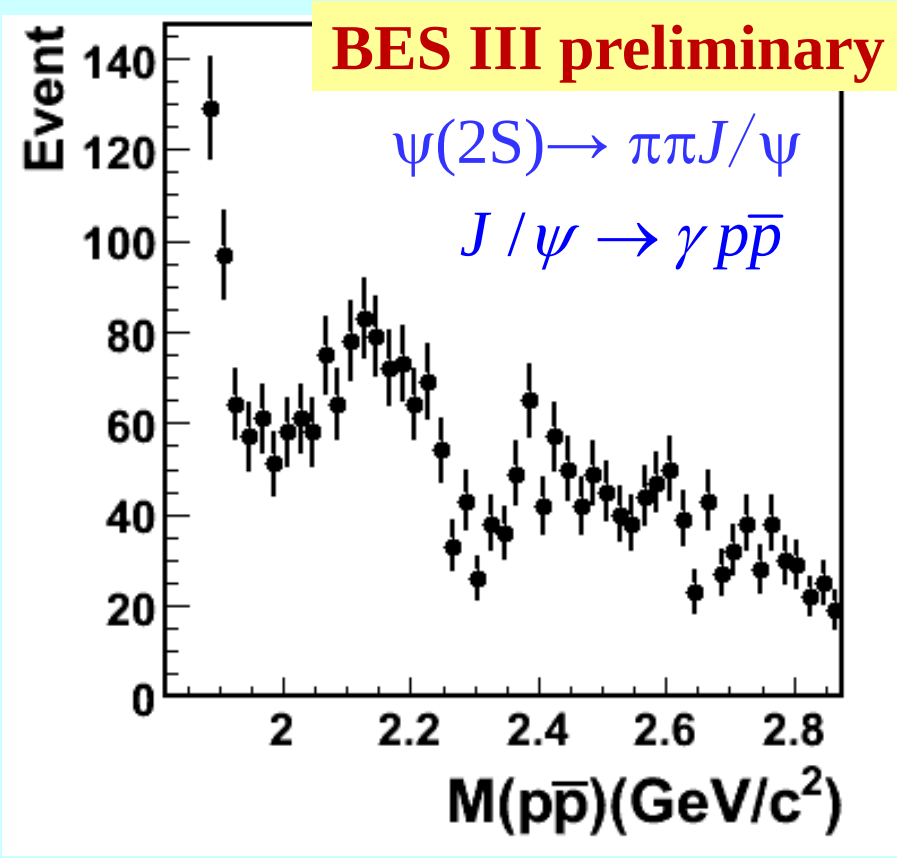
		χ_{c0}	χ_{c2}
$\pi^0\pi^0$	PDG	2.43 ± 0.20	0.71 ± 0.08
	CLEO-c*	$2.94 \pm 0.07 \pm 0.35$	$0.68 \pm 0.03 \pm 0.08$
$\eta\eta$	PDG	2.4 ± 0.4	<0.5
	CLEO-c*	$3.18 \pm 0.13 \pm 0.35$	$0.51 \pm 0.05 \pm 0.06$

Confirmation of the BESII observation: $p\bar{p}$ threshold enhancement

BES II

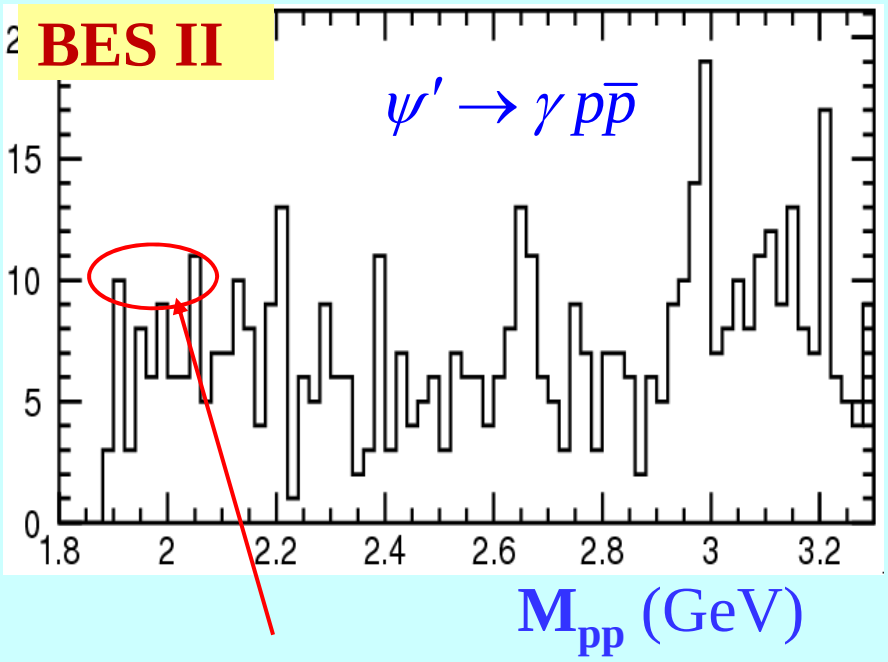


BES III preliminary



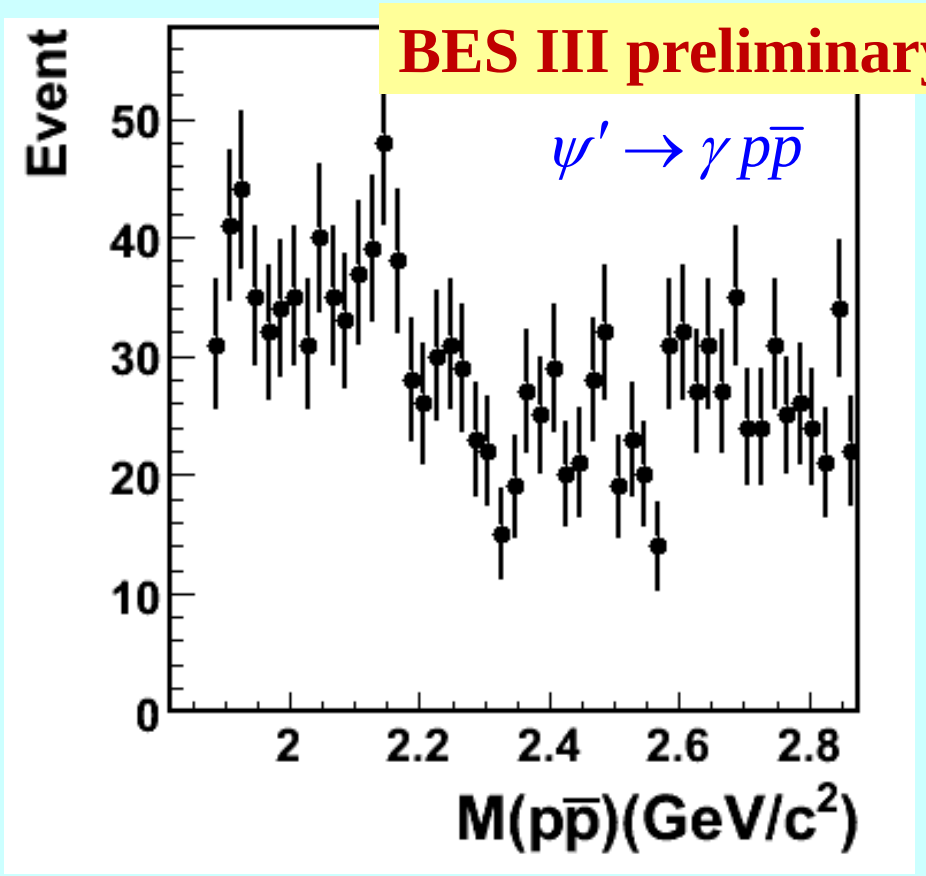
PRL 91 (2003) 022001

Confirmation of BESII observation: $p\bar{p}$ threshold enhancement



No significant narrow strong enhancement near threshold (~2σ if fitted with X(1860))

PRL 99 (2007) 011802



- FSI unlikely

Summary

- **BEPCII & BESIII were successfully constructed with very high quality**
- **BEPCII achieved a luminosity of $3\times10^{32}cm^{-2}s^{-1}$, sufficient to pass government review & shift from the construction phase to the operation phase**
- **The performance of the BESIII detector is up to expectations**
- **100 M ψ' events have been accumulated; the data quality is good & preliminary results are being obtained**
- **A 300-500 M J/ψ event data run will start next week**
- **We expect great physics results in the coming months**