北京航空航天大學
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BEPCII and BESIII Status and Plans

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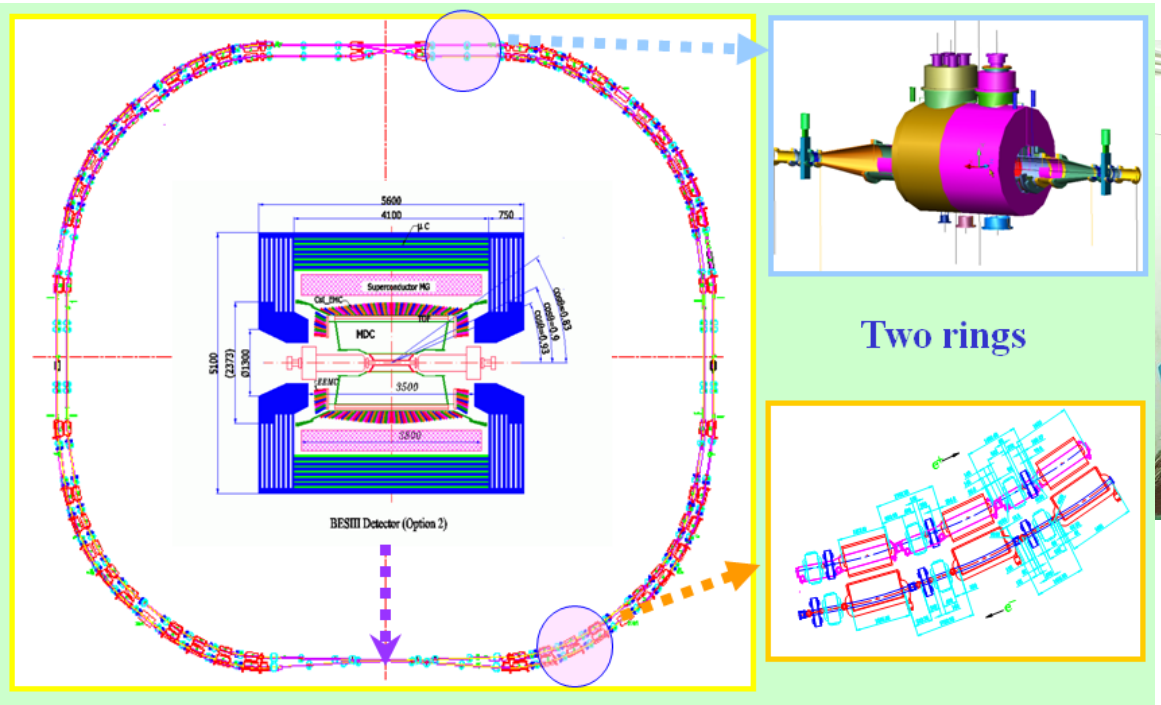
for BESIII Collaboration

The International Workshop "e+e- Collisions From Phi to Psi 2019", Novosibirsk, Russia, February 25 to March 1. 2019

BEPC

- A multi-bunch e^+ e^- collider running at the tau-charm energy range
- Double rings design
- Luminosity ($1\times10^{33}\,cm^{-2}s^{-1}$, design goal) was achieved in April, 2016



Operation schedule

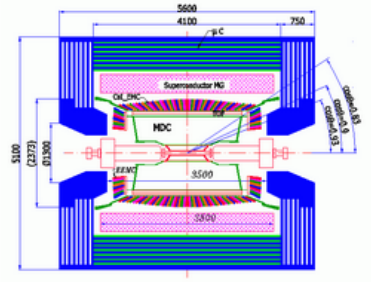
From	To	Task	Duration
2018.09.25	2018.09.30	Machine recovery	6 days
2018.10.01	2018.11.11	synchrotron radiation (SR) operation	42 days
2018.11.12	2018.11.16	Switch to collision operation	5 days
2018.11.17	**2019.02.11**	**Data taking @J/ψ**	**87 days**
2019.02.12	**2019.06.20**	**Data taking @ XYZ**	**128 days**
2019.06.21	2019.06.23	Switch to SR operation	3 days
2019.06.24	2019.07.25	SR operation	32 days
2019.07.26	2019.10.23	Summer shutdown	90 days
2019.10.24	2019.11.06	Machine recovery	14 days
2019.11.07	2019.12.12	SR operation	36 days
2019.12.13		Switch to collision operation	

- The BESIII detector finished accumulating a sample of 10 billion J/ψ events together with a continuum data sample on Feb. 11.
- Will accumulate ~3.9fb^{-1} XYZ data in 128 days. (~30 pb^{-1}/day: a challenge to the machine)
- Summer shutdown for energy upgrade: Data taking @ E_{beam}>2GeV

BESIII Accumulates 10 Billion J/ψ Events

- The 10 billion J/ψ-event sample accumulated at BESIII is the world's largest data sample produced directly from electron-positron annihilations.
- The 10 billion J/ψ-event data sample makes the measurements of exotic hadrons in much improved precision and the searches for new processes in much improved sensitivity possible.
- During the data acquisition, the peak luminosity of BEPCII reached 4.7×10^{32} $cm^{-2}s^{-1}$, which is about 100 times higher than that of BEPC.
- With the unique advantage of an unprecedented high-statistics J/ψ sample, BESIII will continue to play a leading role in research for new forms of hadronic matter in the high-precision frontier.

Highlights



BESIII Accumulates 10 Billion J/ψ Events

The BESIII detector finished accumulating a sample of 10 billion J/ψ events together with a continuum data sample on Feb. 11. The 10 billion J/ψ-event sample accumulated at BESIII is the world's...

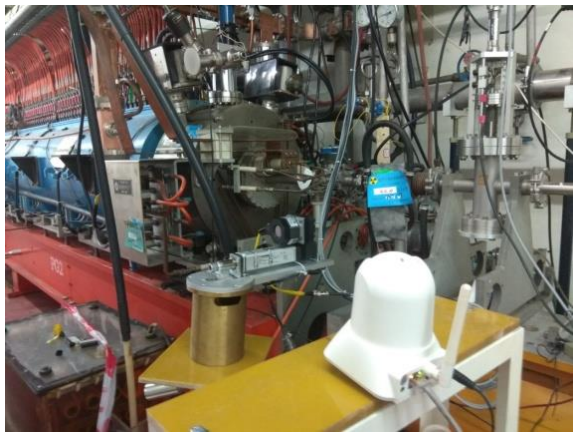
Data taking of XYZ in 2017

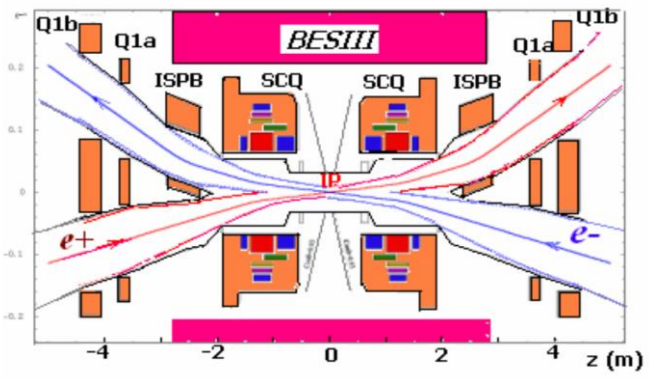
- From Dec.13, 2016 to Jan. 5, 2017 Data taking at the energy of **2.100GeV**
- From Jan. 6, 2017 to Jan. 25, 2017 Data taking at the energy of **2.105GeV**
- From Jan. 26, 2017 to Feb. 13, 2017 Data taking at the energy of **2.110GeV**
- From Feb. 14, 2017 to Mar. 4, 2017 Data taking at the energy of **2.115GeV**
- From Mar. 5, 2017 to Mar. 23, 2017 Data taking at the energy of **2.120GeV**
- From Mar. 24, 2017 to Apr. 11, 2017 Data taking at the energy of **2.125GeV**
- From Apr. 12, 2017 to May 1, 2017 Data taking at the energy of **2.140GeV**
- From May 1, 2016 to May 7, 2017 Data taking at the energy of **2.145GeV**

Integral luminosity (146 days): **3616 pb^{-1}, ~25pb^{-1}/day**

For ~3.9fb^{-1} XYZ data in 128 days. (~30 pb^{-1}/day: a challenge to the machine)

LINAC upgrades: Data taking @ 2.3~2.45GeV





Layout of the interaction region

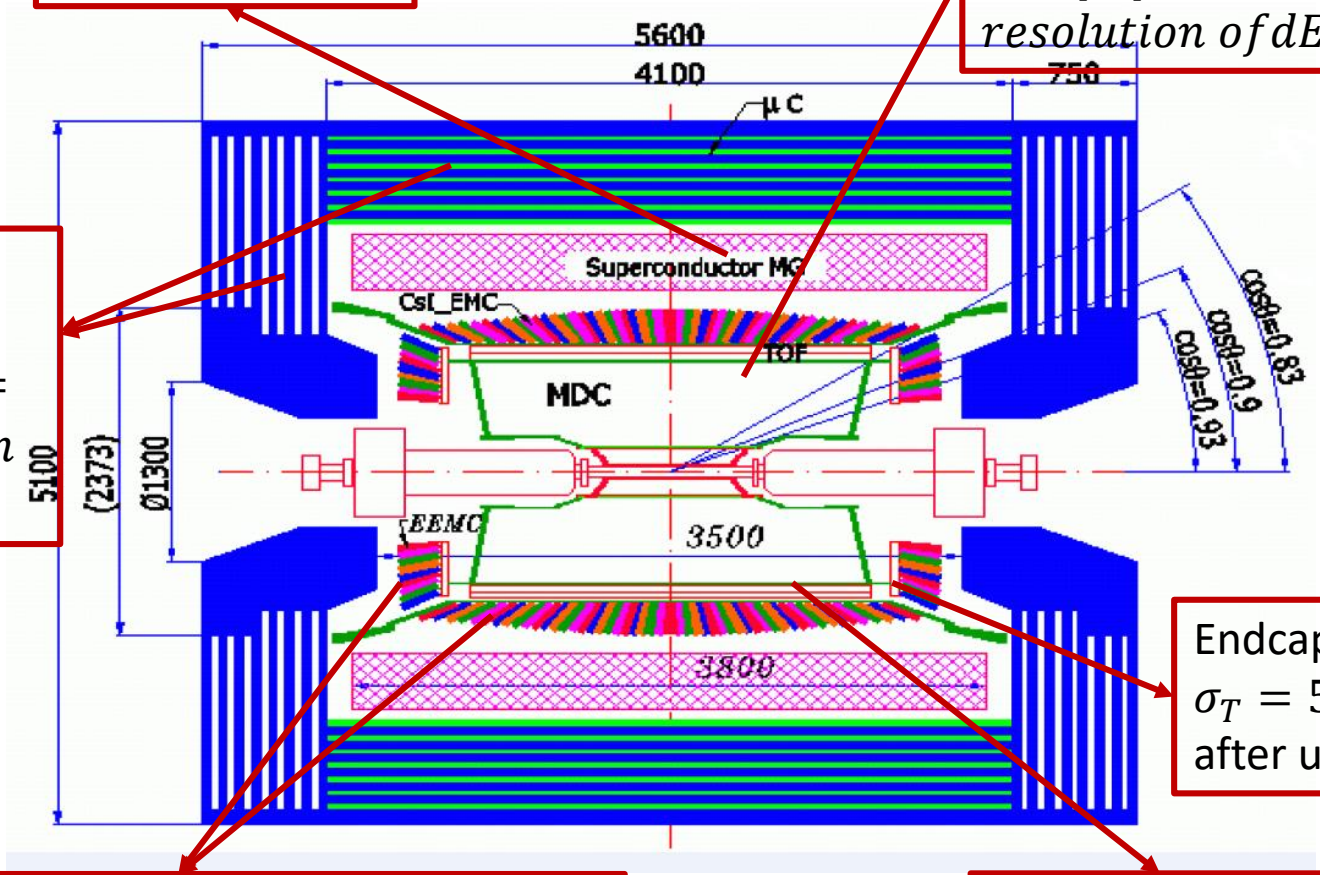
- New scheme for the e^+ source.
- The key device is testing in the tunnel of LINAC. It works well from Nov. 17 till now.
- New e^+ source device will be installed during summer shutdown of 2019
- The power supply upgrade of Bending magnets has been applied in BEPCII.
- 2.3GeV< Energy < 2.35GeV: Feasible right now
- 2.35GeV< Energy < 2.45GeV: Need to upgrade two ISPB magnets (horizontal bending magnet) , the power supply of B magnets and the air-cooling system.
- Energy> 2.45 GeV: No solution based on the existing machine

The BESIII detector

SC Magnet: 1T

MDC: $\sigma_{r\phi} = 115\mu m$
$\Delta p/p = 0.47\%@1GeV$
$resolution\ of dE/dx = 5.2\%$

Barrel and endcap Muon counter: $\sigma_{r\phi} = 14mm \sim 15mm$
$\sigma_z \sim 17mm$



Endcap TOF:
$\sigma_T = 54ps \sim 60ps$
after upgrade

Barrel and endcap EMCAL
$\Delta E/E = 2.5\%\ @1GeV\ , \sigma = 6\ mm/\sqrt{E}$

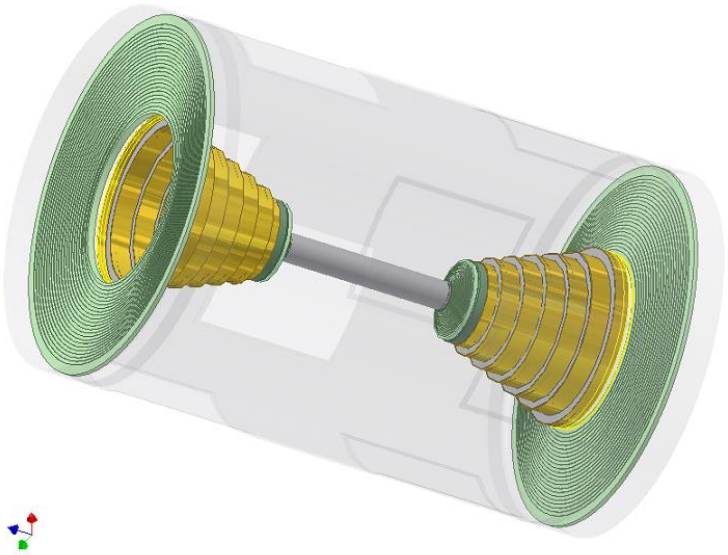
Barrel TOF:
$\sigma_T = 67 \sim 70\ ps$

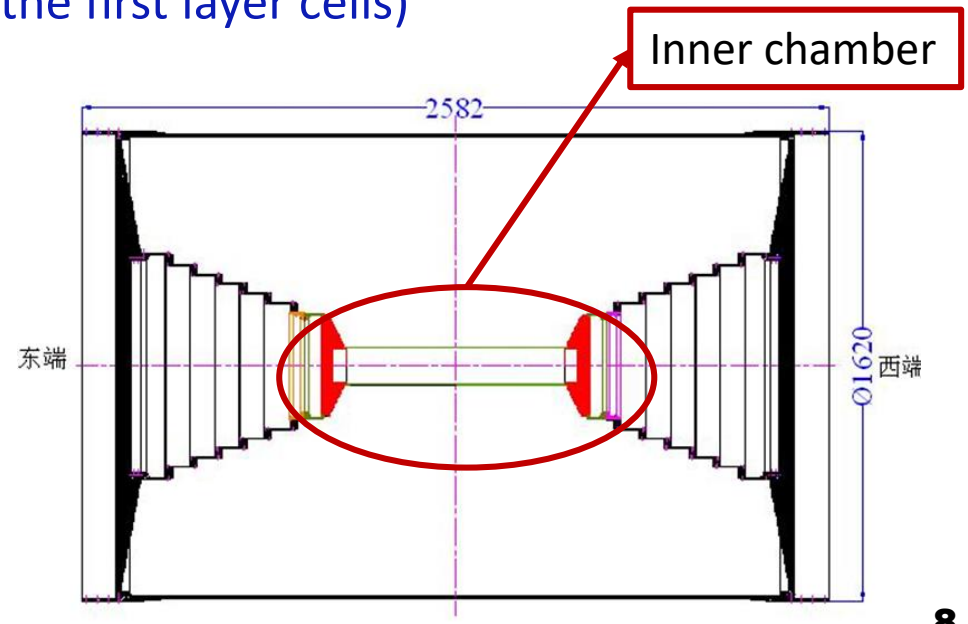
- General purpose detector at BEPCII, $E_{cm} \approx$ 2-4.6 GeV, $L_{peak} \approx 10^{33}/cm^2/s$
- Versatile researches in τ-charm physics

Main drift chamber (MDC)

- Main tracking detector for the charged particles: position, momentum and dE/dx measurements
- Inner chamber (8 layers)+ outer chamber (35 layers)
- Operating gas: He/C_3H_8=60/40
- Cell size: 12mm×12mm for inner chamber; 16.2 mm×16.2mm for outer chamber
- Aging problems of the MDC
  - Cathode aging: Malter discharge (cured in 2012)
  - Anode aging: the gains of the cells decrease with the increase of the cell accumulated charges every year

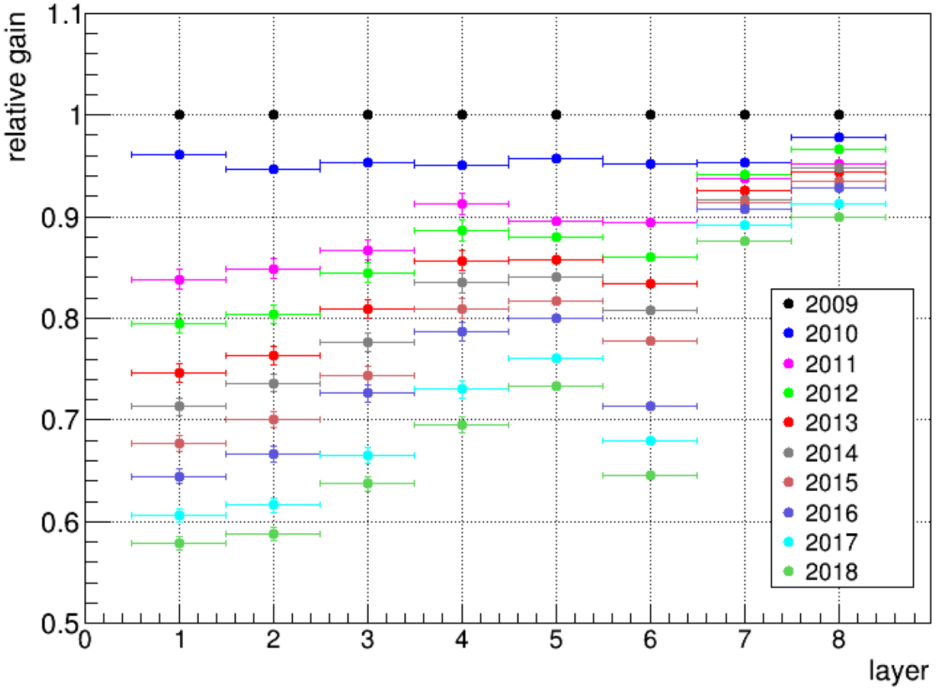
  gain dropped dramatically (42% for the first layer cells)



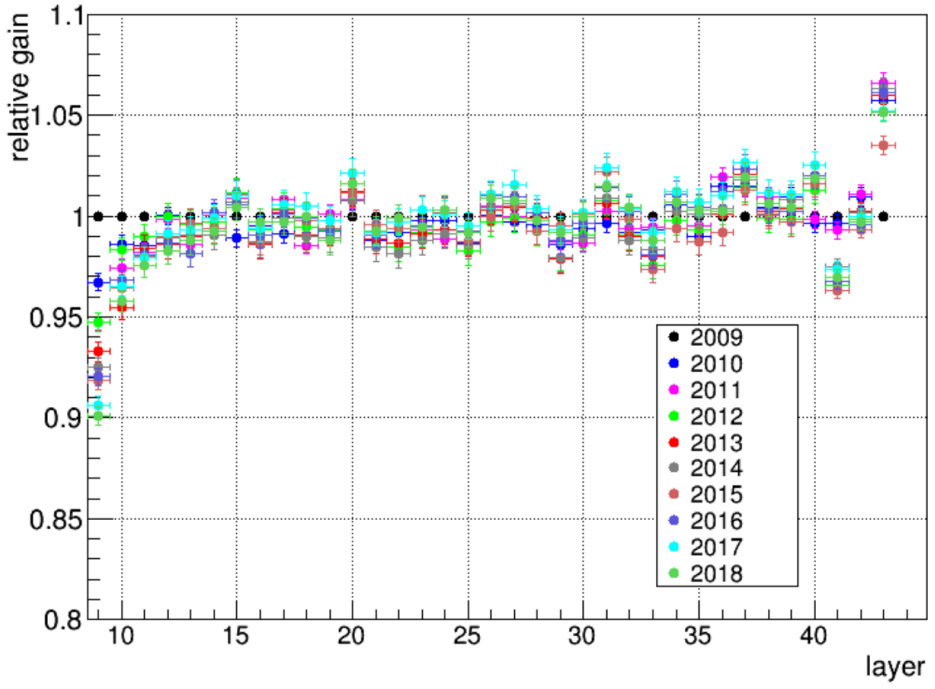


Gain decrease of the cells in each year

Relative gain of inner chamber

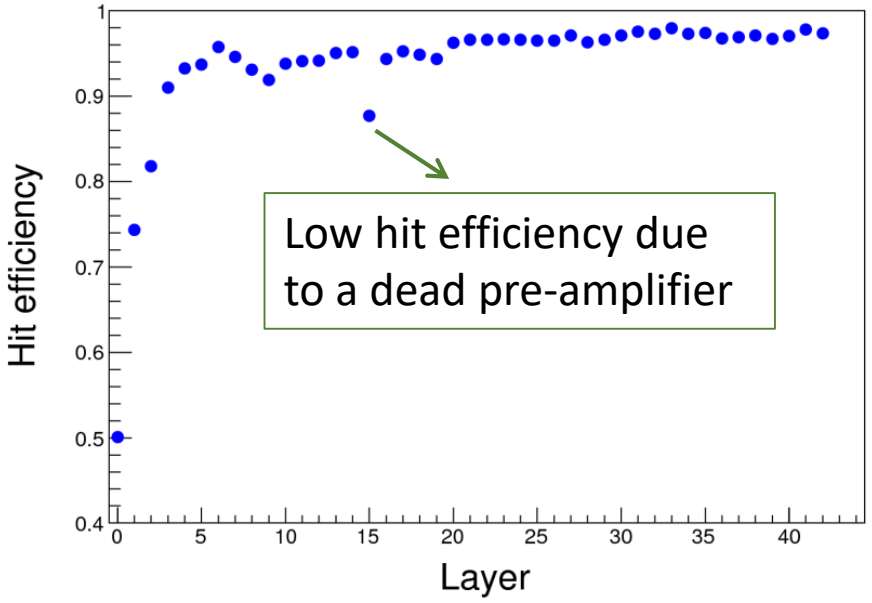


Relative gain of outer chamber

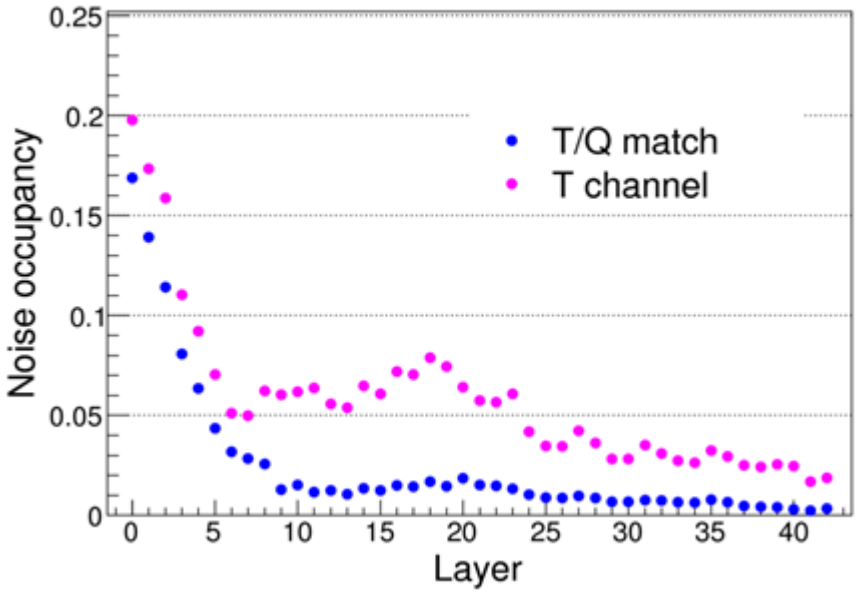


- The Q peak changes of the cells in each year are got from Bhabha events, which give the gain decrease
- The gains of the first 10 layers experience an obvious decrease, reaching a maximum decrease of about 42% for the first layer cells.
- The other layer cells of the outer chamber have almost no change

MDC performance - hit efficiency



Run 54400

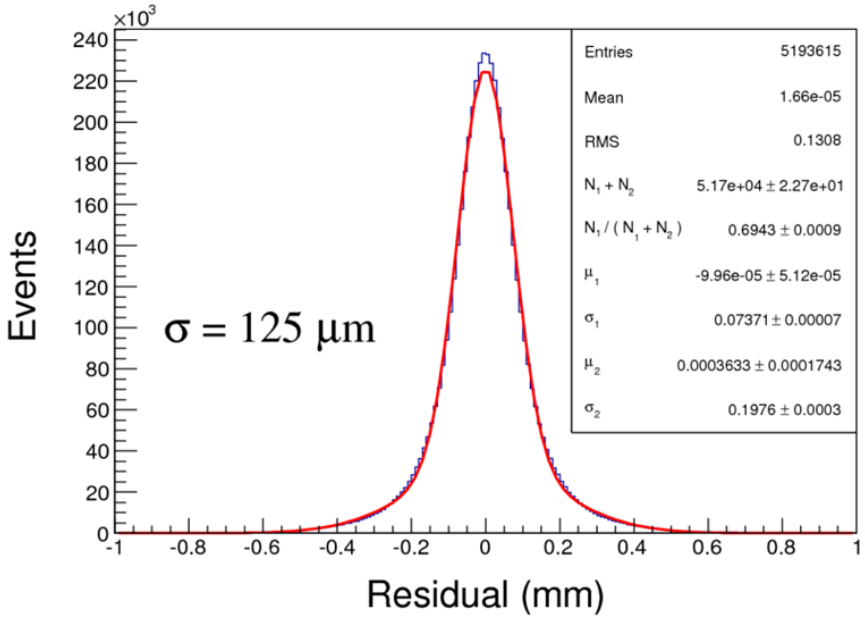


Run 54400

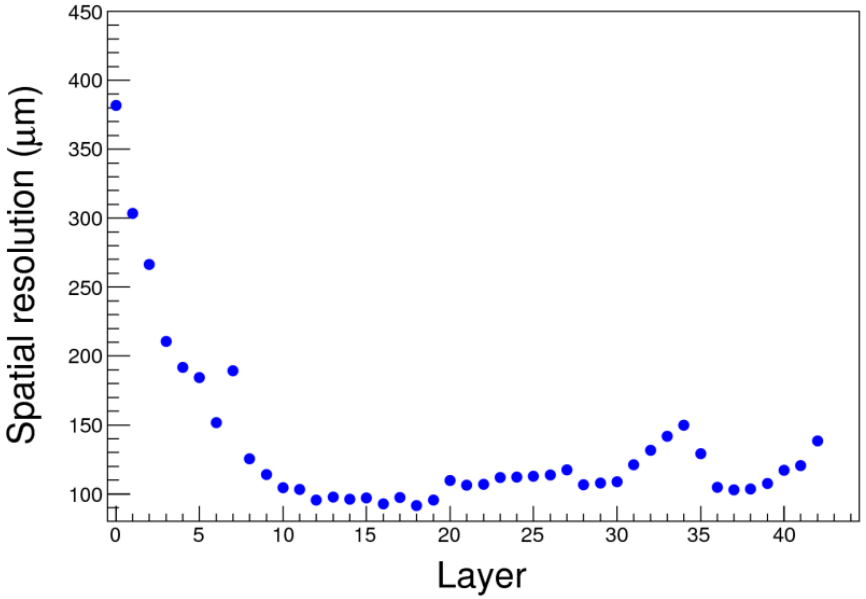
- The reconstruction hit efficiency of the first four layers drops due to the big background, while for other layers, the efficiency has no change
- The numerator of Rec hit efficiency is the number of hits which are used by reconstruction
- The impacts of gas temperature and pressure are not taken into account

Spatial resolution

Residual distribution



Spatial resolution vs layer

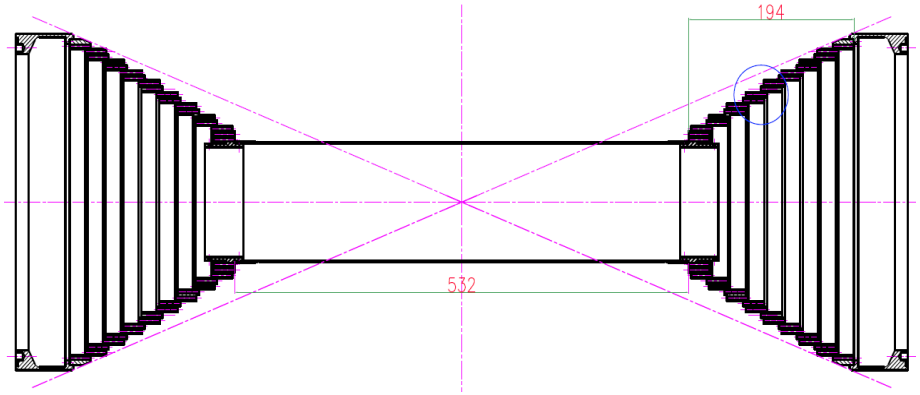


Bhabha from Run 54400

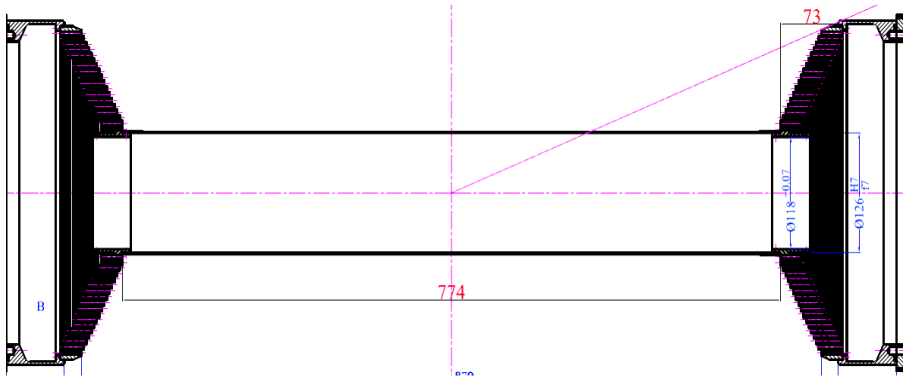
The reconstruction hit efficiency and spatial resolution are a little worse than last year

New inner drift chamber

New inner chamber

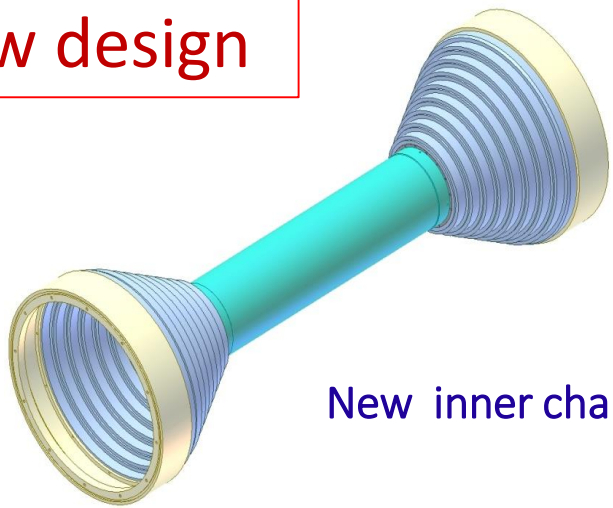


8 layers, 484 cells



Old inner chamber

New design

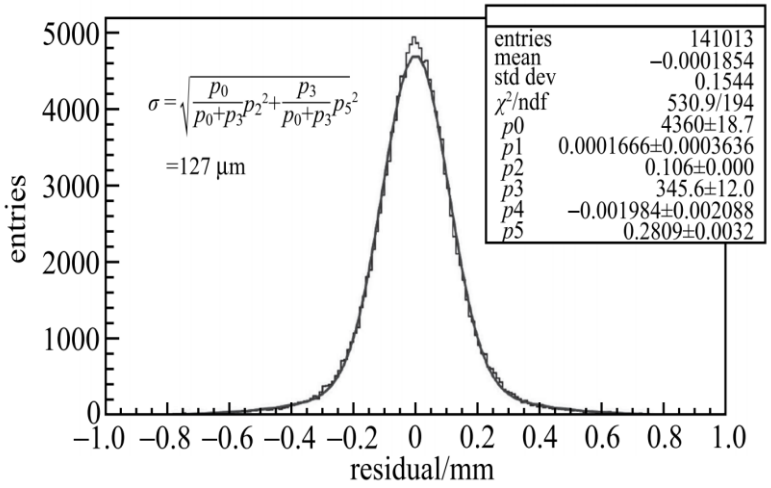


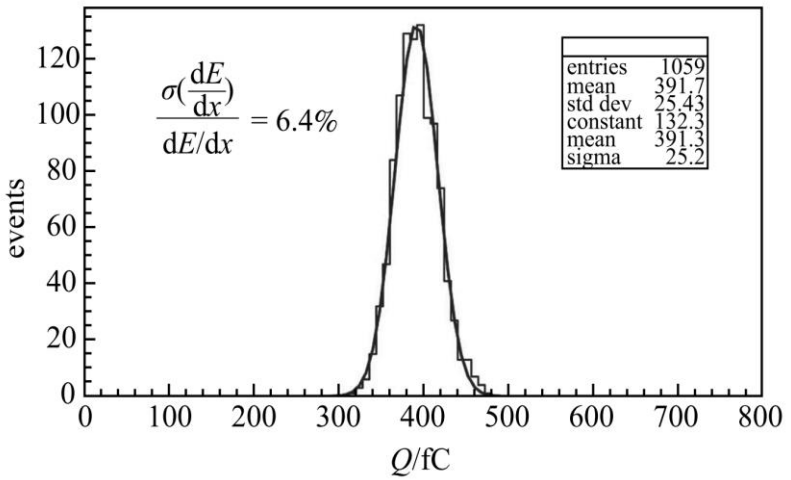
New inner chamber

- An improved new inner drift chamber with multi-stepped end-plates
- Shorten wire length exceeding the effective solid angle
- Reduce the background counting hits (currents) of a cell, decrease the risk of wire broken

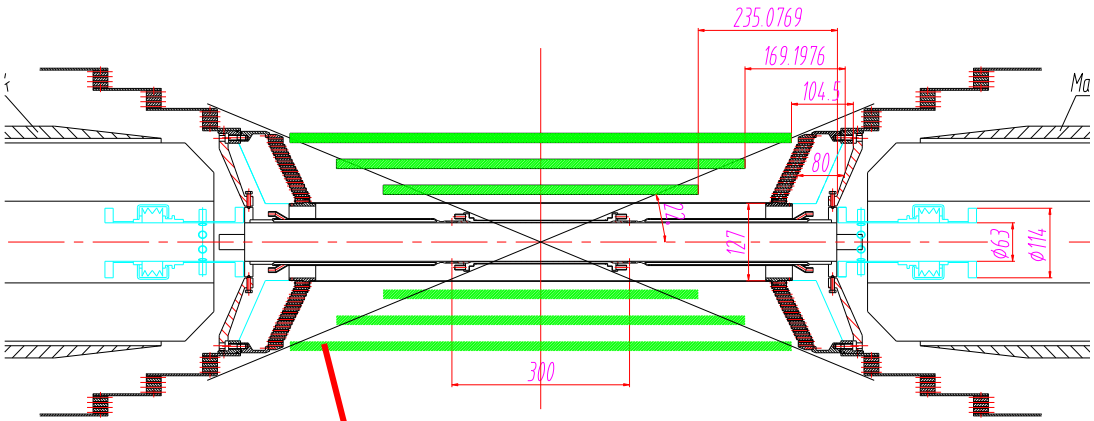
Cosmic-ray test

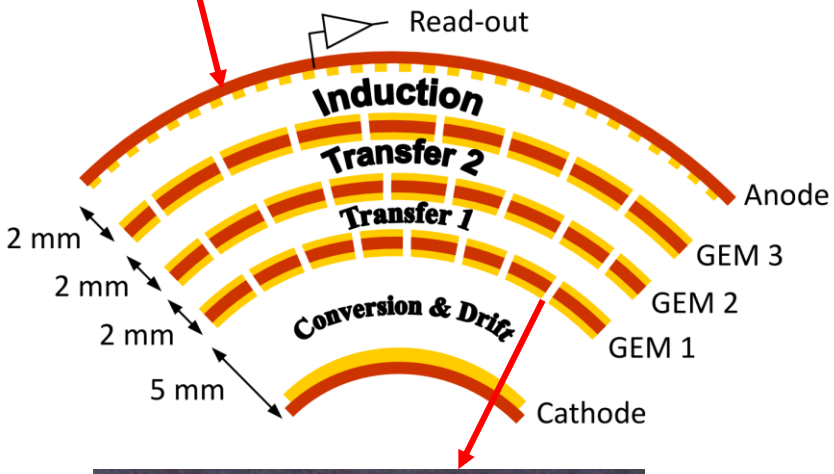
- Spatial resolution : 127μm
- dE/dx resolution : 6.4%

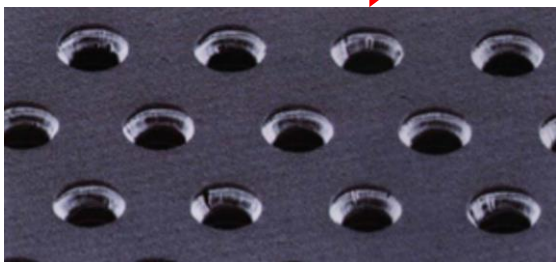




Cylindrical GEM inner tracker (CGEM)

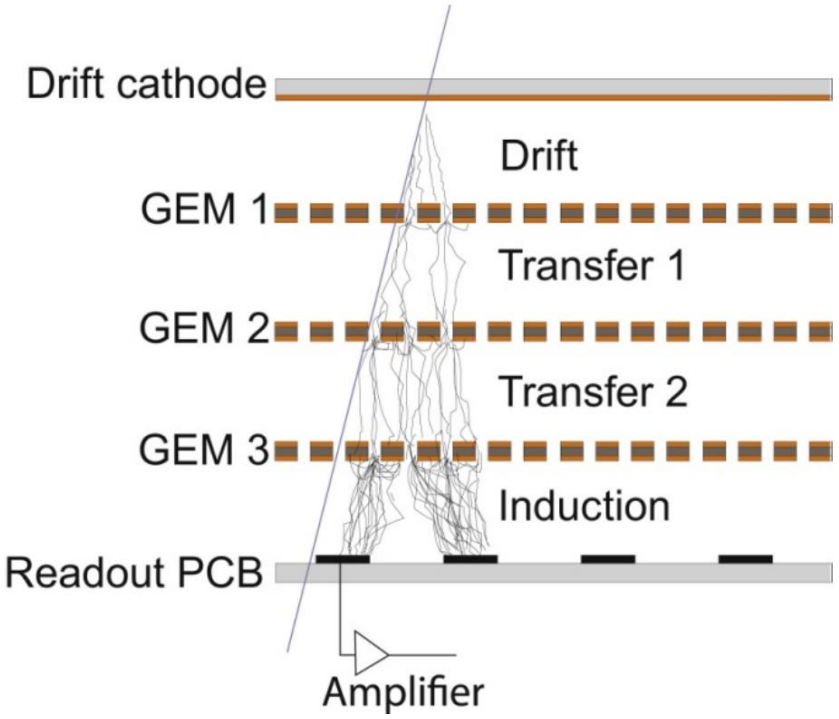




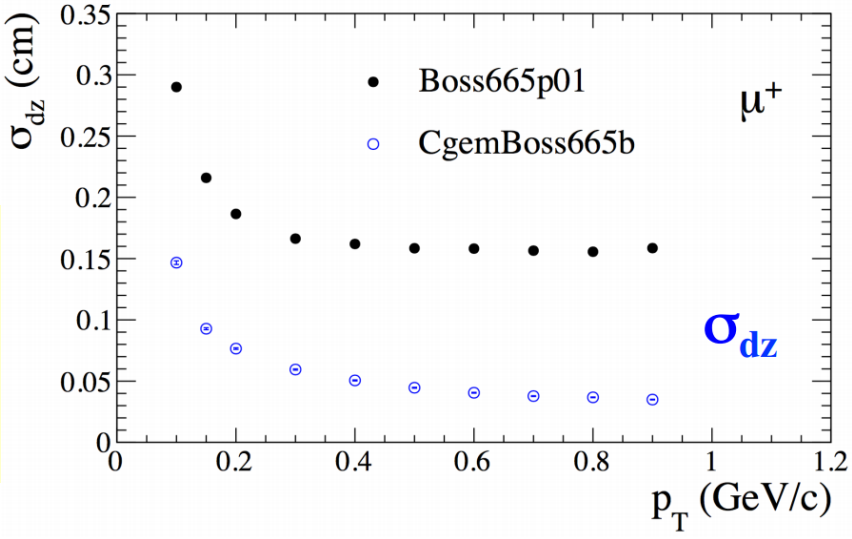


- Layout: three layers
- Low Material budget: ≤1.5% of X_0 For all layers
- Momentum resolution: σ_{Pt}/P_t = ~0.5%@1GeV
- High Rate capability: ~10^4 Hz/cm^2
- Coverage: 93%
- Spatial resolution: $\sigma_{r\varphi}$: 130 -150μm, σ_z<1mm
- 1 T magnetic filed
- Operation duration: at least 5 years
- Active area
  - – L1 length 532mm
  - – L2 length:690mm
  - – L3 length:847mm
- Inner radius:78mm
- Outer radius:178mm

Why CGEM?



- High particle rates
- Less sensitive to the aging
- Significantly improvement of σ_z
- Less background expected
  - The volume for primary ionization is 6-7 time smaller
- Improvements from Micro-TPC reconstruction [Springer Proc.Phys. 213 (2018) 116-119]



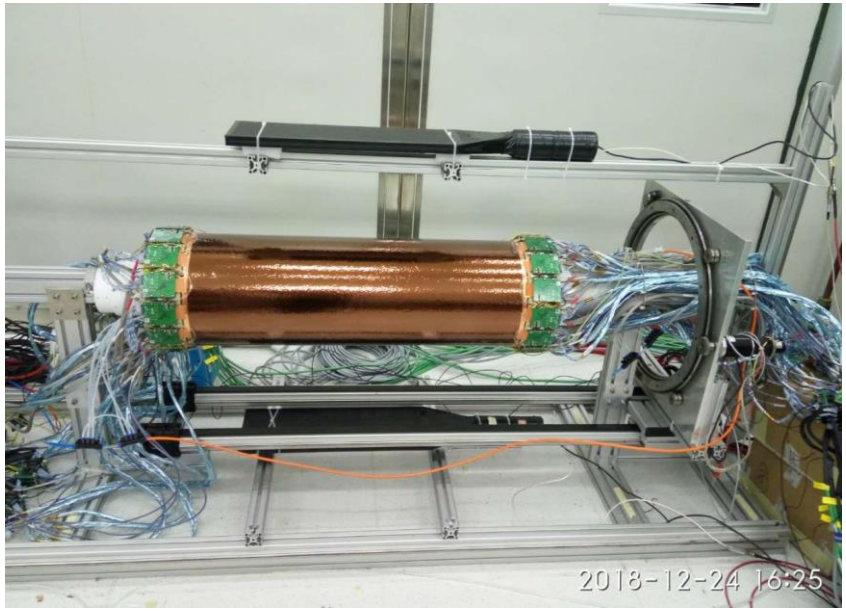
CGEM- inner tracker, new technology

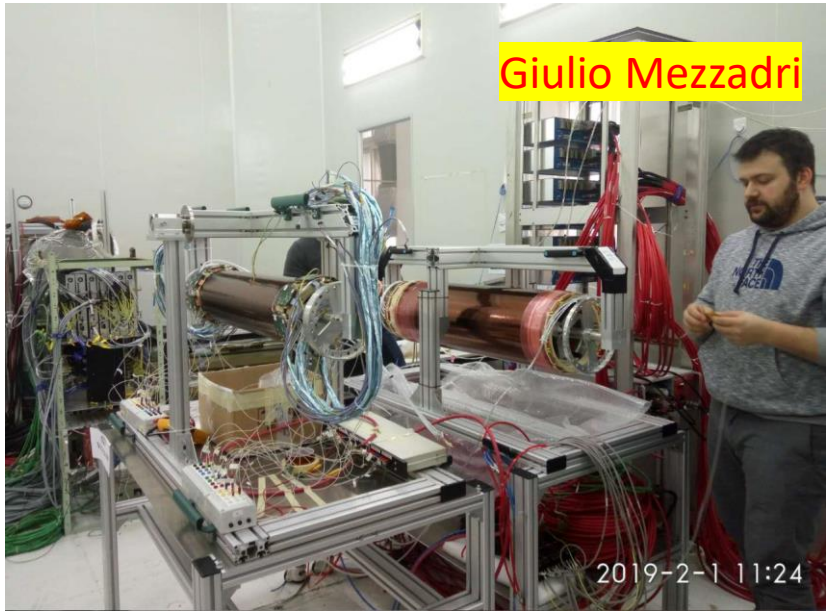
In BESIII, first used

- lower material budget: 0.4% X_0
- Analog readout, charge +time

Status of the CGEM

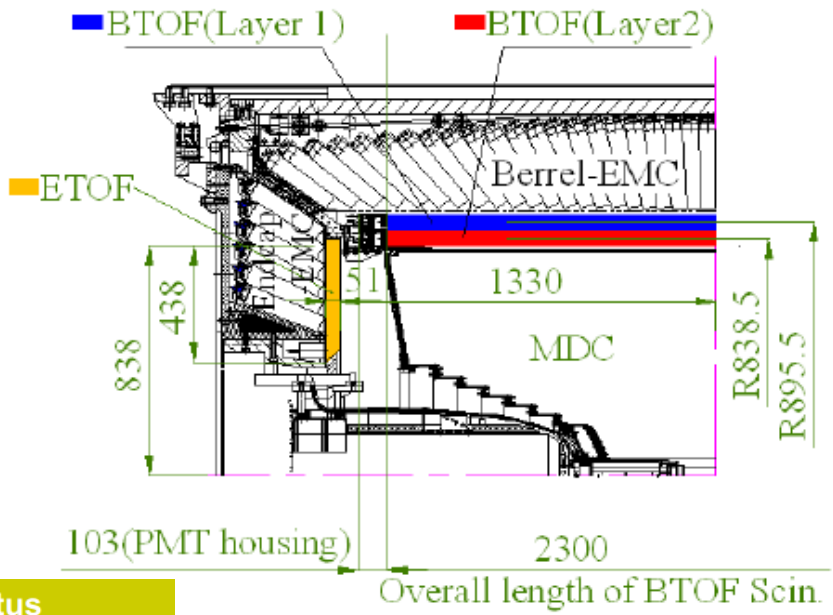
- Cooperative study with Italy, Germany and Sweden groups
- The detector was shipped to IHEP in Nov. 2018
- Assembly of the three layers has been tested
- Cosmic-ray tests for each single layer are on-going





The TOF

- Barrel (2layers)+ 2 end caps
- BC408 and BC404 scintillator
- Hamamatsu R5924 PMT



The performances of BTOF

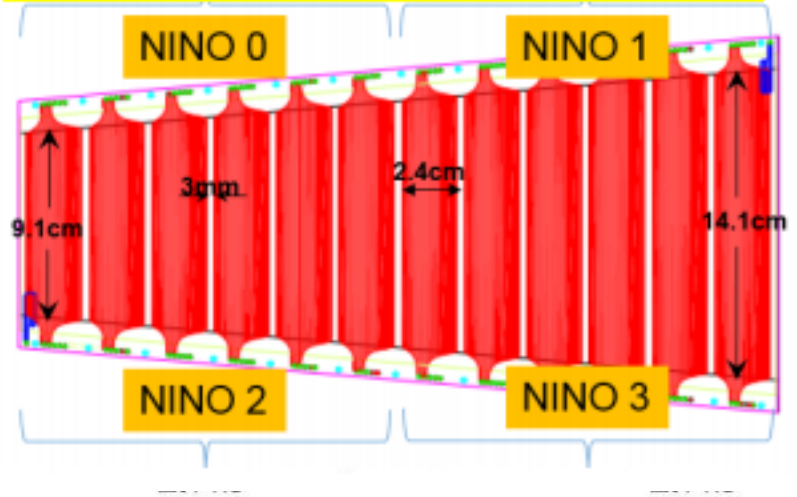
Year(data)	Resolution	Efficiency\%	Status
2009(jpsi/psip)	67ps	~97	HV of PMTs is the same
2010(psi3770)	70ps	~96	
2011(psi3770)	70ps	~94	
2012(psip/jpsi)	67ps	~97	HV adjusted in 2012 and 2016
2013(4260/4360)	68ps	~96	
2014(R scan)	70ps	~94	
2015(R scan)	67ps	~92	No dead channels in Barrel TOF
2016~2017	72ps	~94	
2018(jpsi)	69ps	~93	

- The table show the results of double layers using Bhabha events
  - The time resolution is almost stable
  - The efficiency decrease slightly if PMT HV is not changed

The status of ETOF

- New ETOF was installed into BESIII successfully in summer 2015
  - MRPC detector
  - Two layers at each end cap
  - Two 72 modules
- Work stably during the past three years

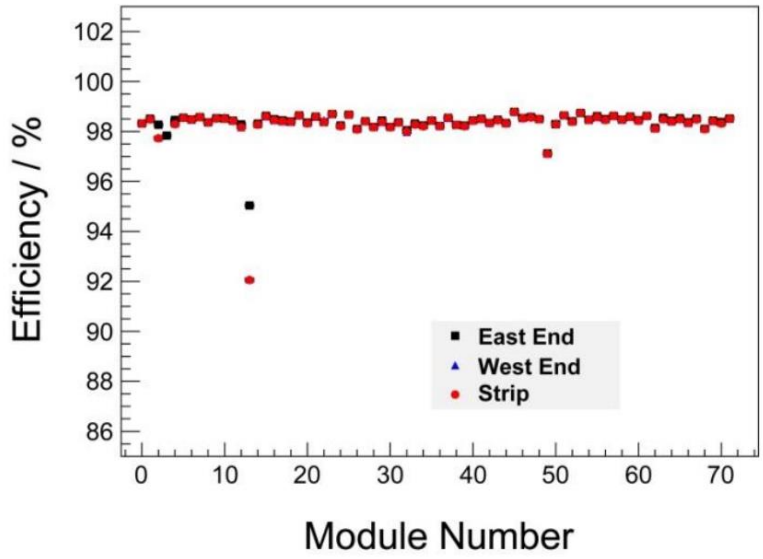
For one module:
4 NINO chips, 12 strips with two end readout



Detector performance

Year	Resolution(ps)	Efficiency
2016	60	~98%
2017	58	~98%
2018	54	~98%

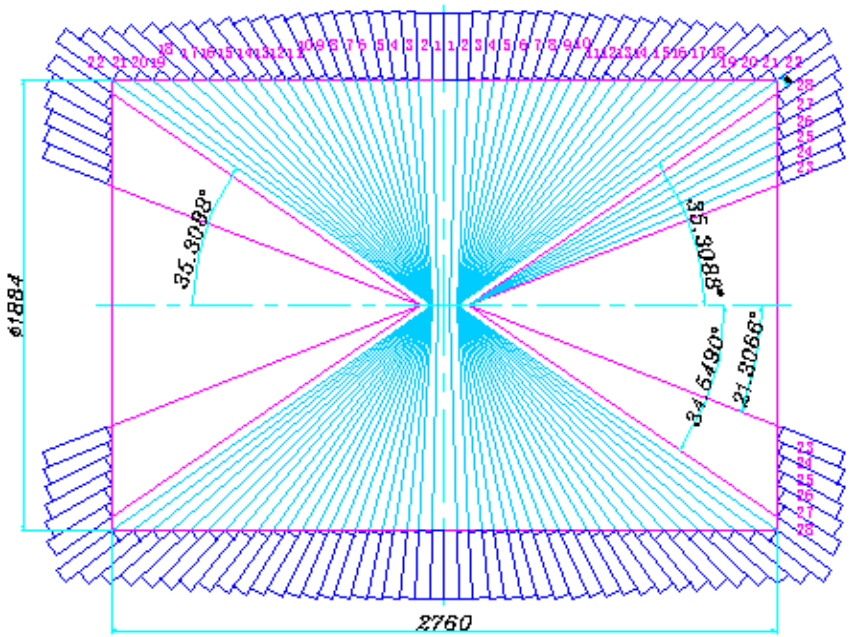
The resolution change is related to energy point, bunch length etc.



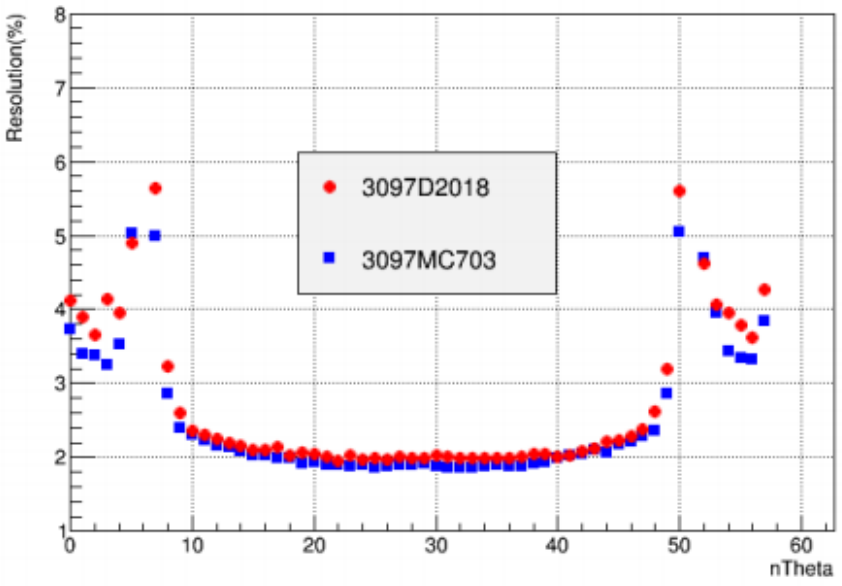
The EMC

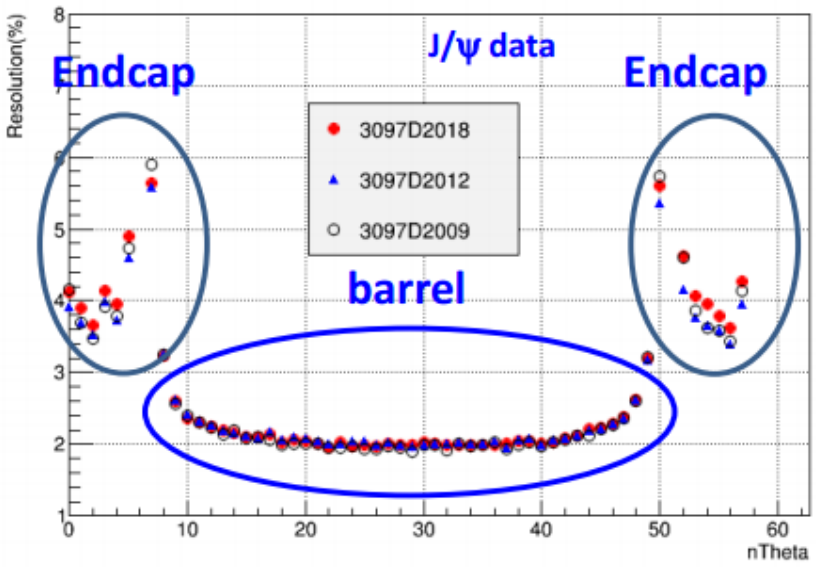
- Barrel + 2 end caps
- 5280 + 960, Total 6240 CsI(Tl) crystal modules

- The performance of EMC is stable during the past eleven years.
- The energy resolution of most modules did not change obviously.
- All of the 6240 CsI(Tl) crystal modules worked well. No dead channel was found



E5x5 energy resolution with Bhabha data(J/ψ)

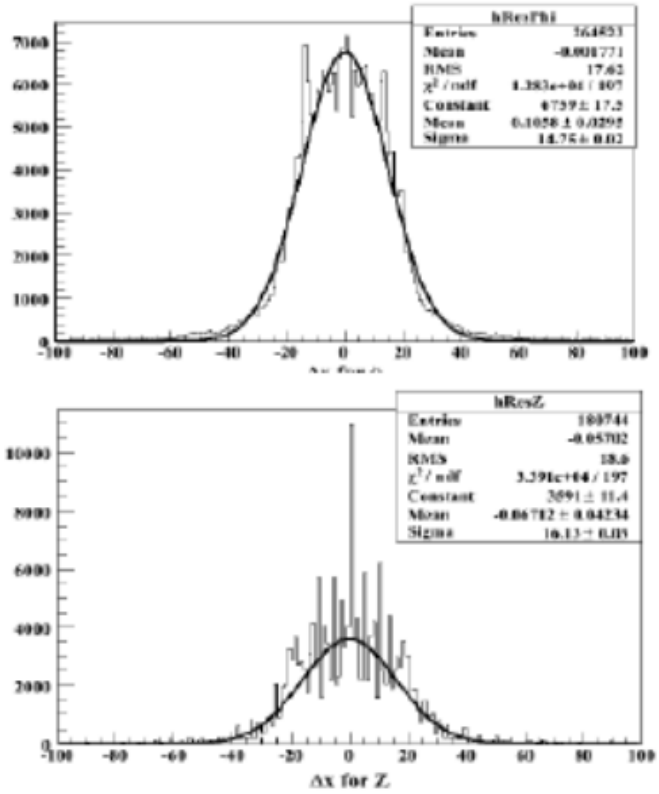


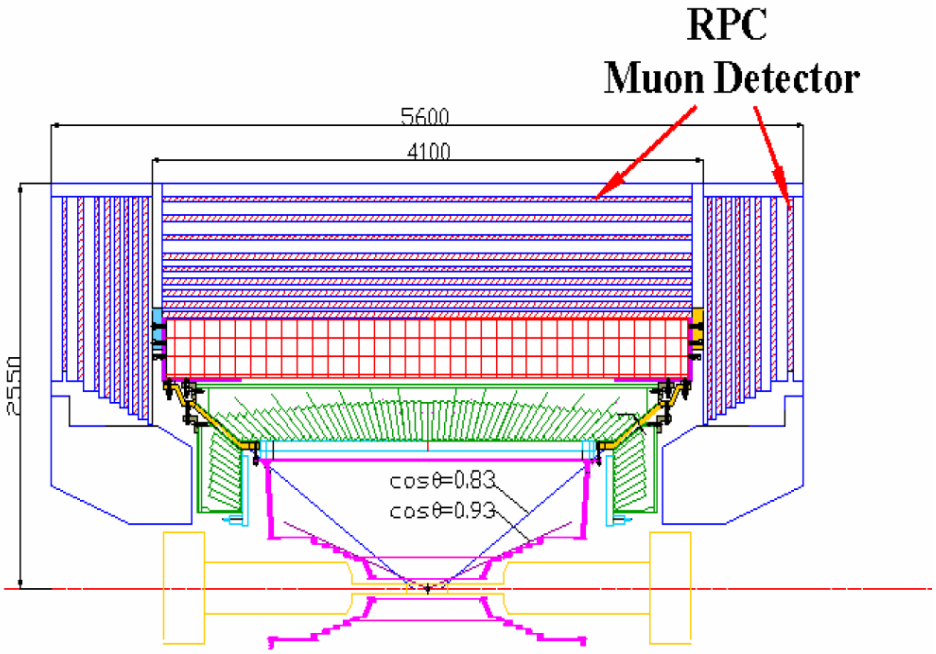


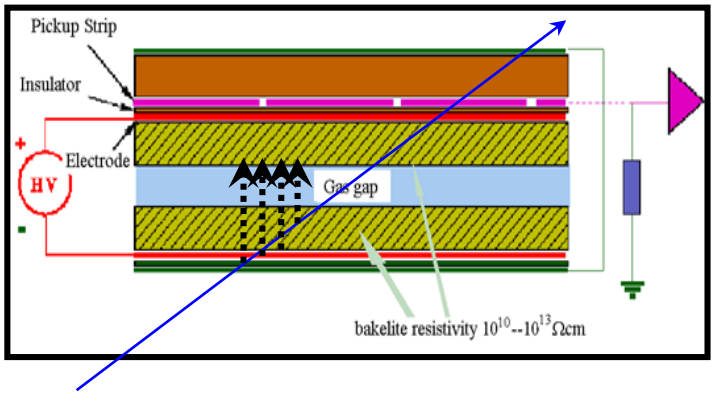
- The 5x5 energy resolutions with J/ψ data in 2009, 2012, and 2018 are similar

The Moun Counter

- **Barrel (9layers)+ two end cap (8 layers)**
- **2000 m^2 RPC**
- **4cm read out strips,**
- **~9000 channels**
- $\sigma_{r\phi} = 14mm \sim 15mm, \quad \sigma_z \sim 17mm$







Electronics system worked well in 2018.

Muon Counter worked stable in 2018.

White Paper on the Future Physics Programme of BESIII

The BESIII collaboration[¶]

and

L. Calibbi[c], J. Charles[a], H. Y. Cheng[d], S. I. Eidelman[b,g],
S. Descotes-Genon[f], F.-K. Guo[c,i],
A. A. Petrov[j], J. L. Rosner[h], Z.-Q. Zhang[e]

- BESIII White Paper is ready and will be released soon.
- With much larger data samples and stable running of BEPCII and BESIII, there is still very rich program ahead.

Summary

- From now to summer shutdown, ~3.9fb^{-1} XYZ data will be taken
- The upgrade to take data at the energy 2.3~2.45GeV is undergoing. It will be feasible after the summer shutdown of 2019.
- For MDC, after 9 years running, the gains of the first 10 layers decrease obviously with a maximum of 42% for the first layer, while the other layer cells of the outer chamber have almost no change
- CGEM-inner tracker: new technology used at BESIII. The detector was shipped to IHEP in Nov. 2018. Assembly of the three layers. Preparation for cosmic-ray test.
- For BTOF, the time resolution is almost stable
- For ETOF, new ETOF work stably for three years since 2016
- For EMC, during the past 11 years, the energy resolution is changed very little.
- Muon Counter and Electronics system worked well in 2018. The performance did not change.

More talks from BESIII:

- Charmonium Studies at BESIII -- Lianjin Wu
- Baryon form factors at BESIII – Kai Zhu
- XYZ states at BESIII -- Zhentian Sun
- Light hadrons spectroscopy -- Tianjue Min
- R measurement -- Haiming Hu
- New physics BSM – Minggang Zhao
- Two-photons physics -- Christoph Florian Redmer
- Charm physics at BESIII -- Peter Weidenkaff
- tau mass measurement -- Ivan Nikolaev