Status of BES-III

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on behalf of the BES-III Collaboration

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The BES-III Collaboration

P.R.China: CCAST, Guangxi Normal University, Guangxi University, GUCAS, Henan Normal University, Huazhong Normal University, Hunan University, IHEP, Liaoning University, Nanjing Normal University, Nanjing University, Nankai University, Peking University, Shanxi University, Sichuan University, Shandong University, The Chinese University of Hong Kong, The University of Hongkong, Tsinghua University, USTC, Wuhan University, Zhejiang University, Zhengzhou University

Germany: Bochum University, GSI Darmstadt, Universitaet Giessen

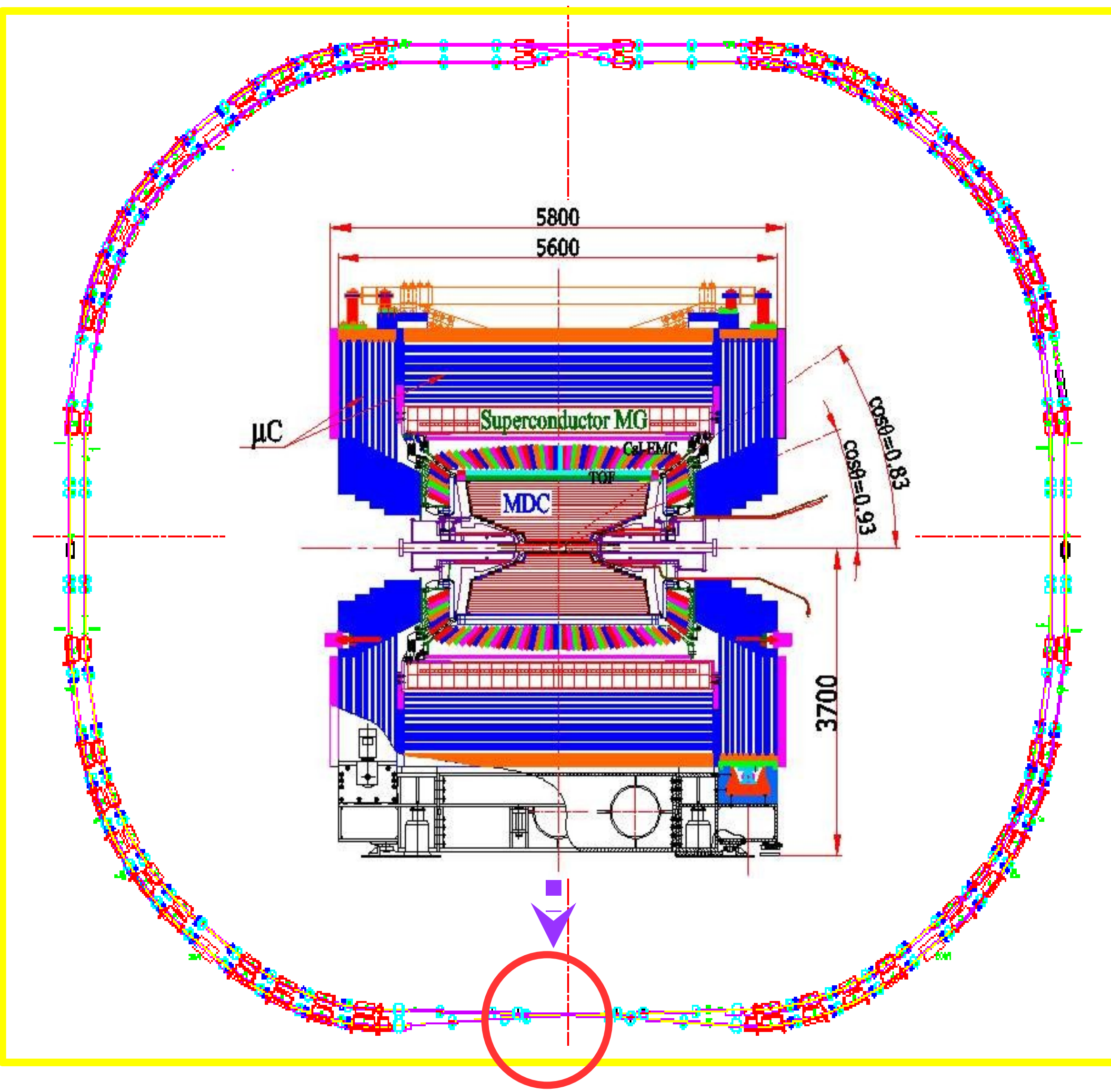
Japan: Tokyo University

Joint Institute for Nuclear Research (JINR)

Russia: Budker Institute of Nuclear Physics

USA: Carnegie Mellon University, Rensselaer Polytechnic Institute, University of Florida, University of Hawaii, University of Rochester, University of Minnesota, University of Washington

The BEPCII/BESIII Project



- Luminosity

  10^{33} cm^{-2} s^{-1} @ 1.89GeV

  0.6× 10^{33} cm^{-2} s^{-1} @ 1.55GeV

- 0.6× 10^{33} cm^{-2} s^{-1} @ 2.1GeV

The project timeline

- Linac installation 2004
- Ring installation 2005
- The detector installation 2006
- BEPCII/BESIII commissioning

  autumn 2007
- Start of data taking (cosmics)

  january 2008
- Start of data taking july 2008

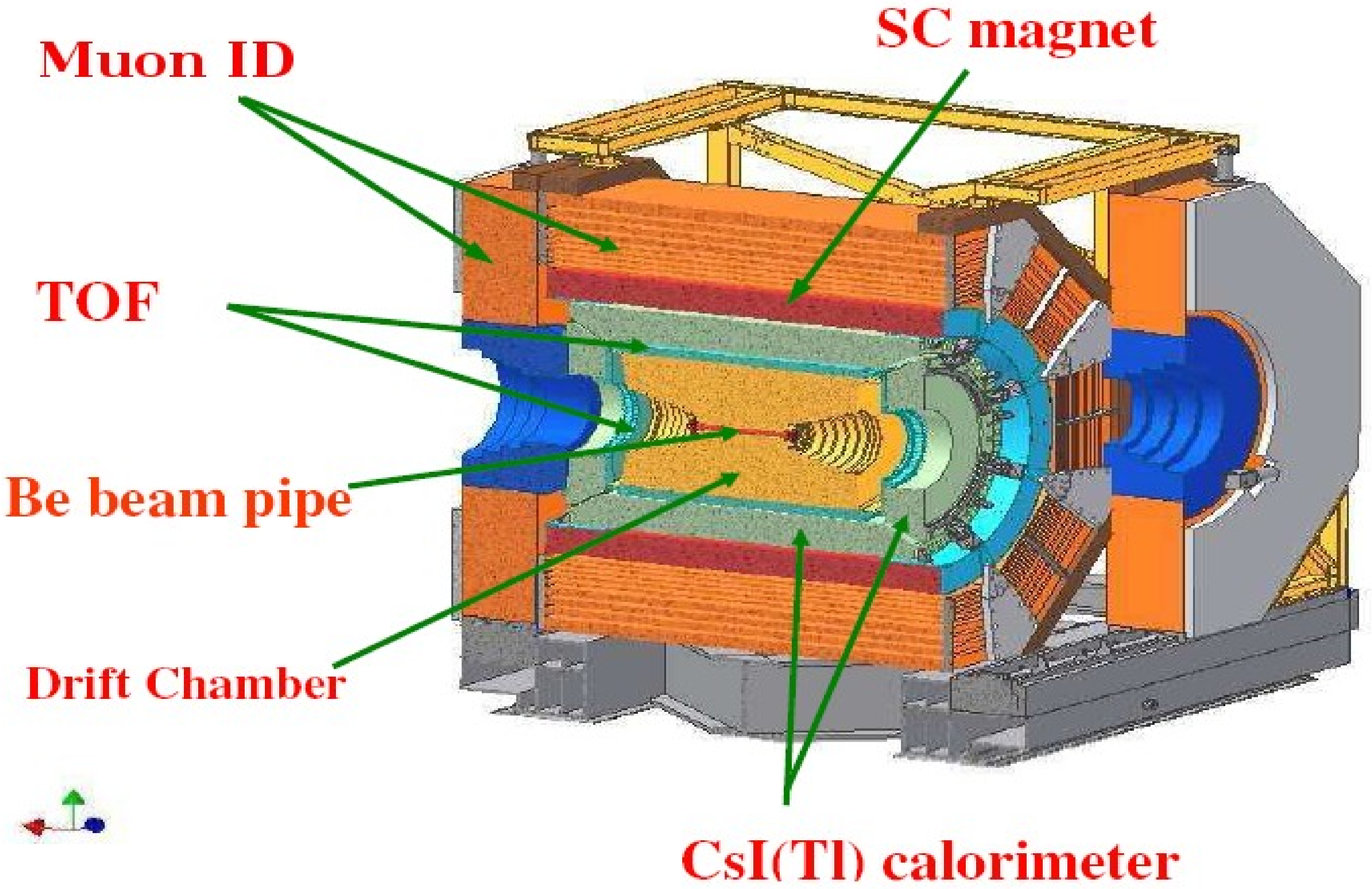
BEPCII in collision mode

Machine parameters	design	Achieved	
		BER	BPR
Energy (GeV)	1.89	1.89	1.89
Beam curr. (mA)	910	550	550
Bunch curr. (mA)	9.8	>10	>10
Bunch number	93	93	93
RF voltage	1.5	1.5	1.5
Tunes (β_x/ν_y)	6.54/5.59	6.540/5.599	6.540/5.596
Inj. Rate (mA/min)	200 e^-/ 50 e^+	>200	>50
Lum. ($\times 10^{33} cm^{-2}s^{-1}$)	1	0.1	

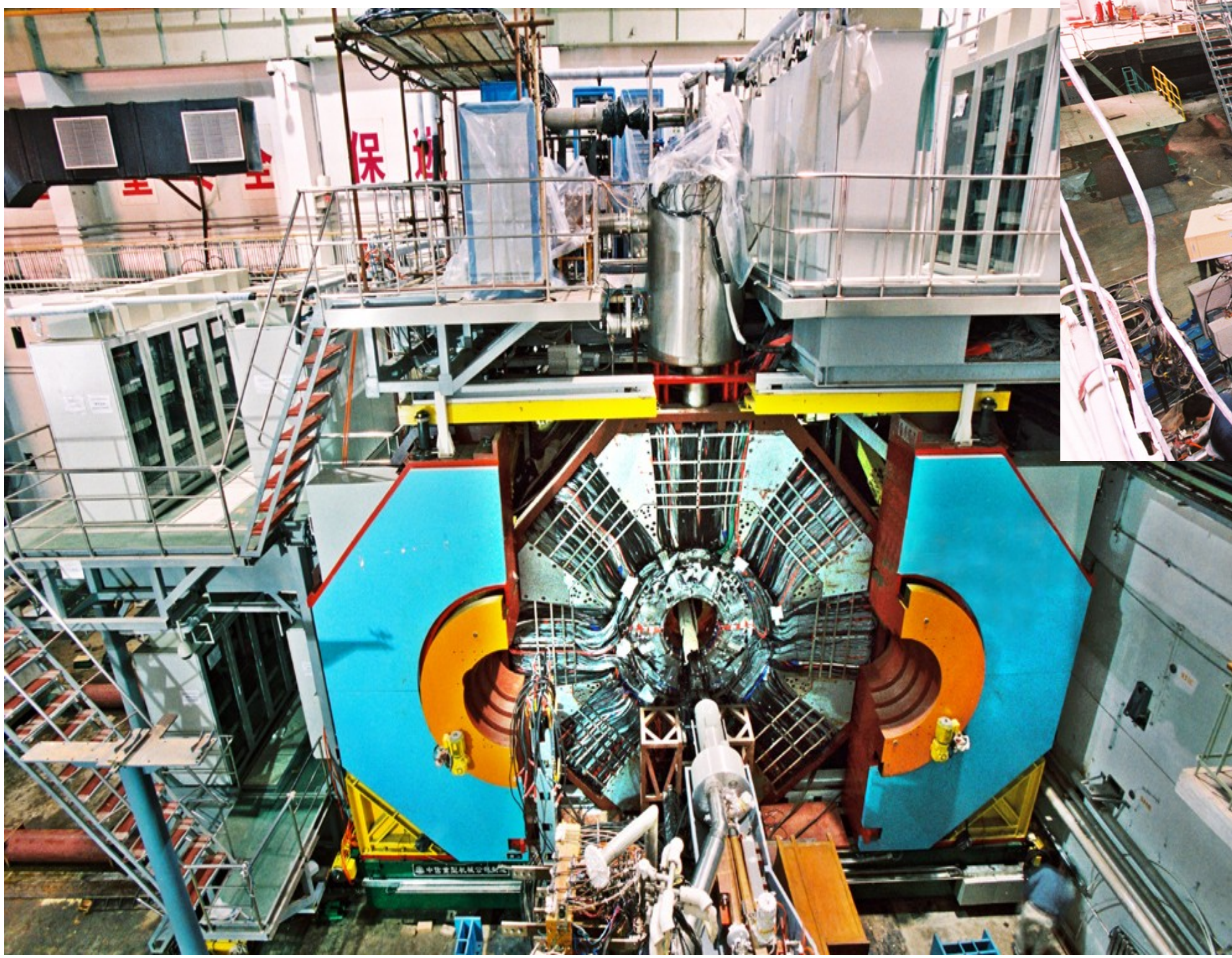
Event statistics

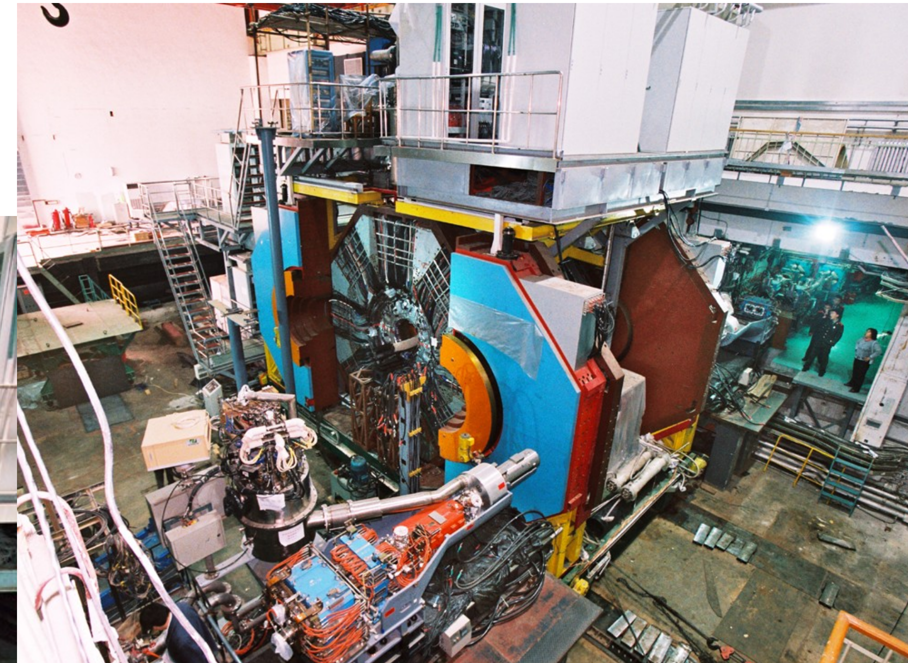
	Center-of-Mass Energy (GeV)	Peak luminosity ($10^{33}cm^{-2}c^{-1}$)	Physics cross-section (nb)	Expected number of events per year
J/ψ	3.097	0.6	~3400	1.0×10^{10}
$\tau^+\tau^-$	3.67	1.0	~2.4	1.2×10^{7}
$\psi(2S)$	3.686	1.0	~640	3.0×10^{9}
DD	3.770	1.0	~5	2.5×10^{7}
D_sD_s	4.030	0.6	~0.32	1.0×10^{6}
	4.140	0.6	~0.67	2.0×10^{6}

The BES-III detector



The BES-III detector





Installation precision is better than 1 mm

Design detector properties

Subdetector	BESIII	BESII	CLEOc
MDC	σ_{xy} = 130 um	250 um	90 um
	ΔP/P = 0.5% @ 1GeV	2.4%@1GeV	0.5% @ 1GeV
	dE/dx resolution 6-7 %	8.5%	6 %
EMC	ΔE/E = 2.5% @ 1 GeV Δ θ ~5mrad @ 1 GeV	20%@1GeV 25mrad @1GeV	2%
TOF	σ_T: barrel:100 ps end-cap:110 ps	180 ps barrel 350 ps endcap	RICH
Muon Identifier	9 layers	3 layers	----
Magnet	1.0 Tl	0.4 Tl	1.0 Tl

Calibration using cosmic rays

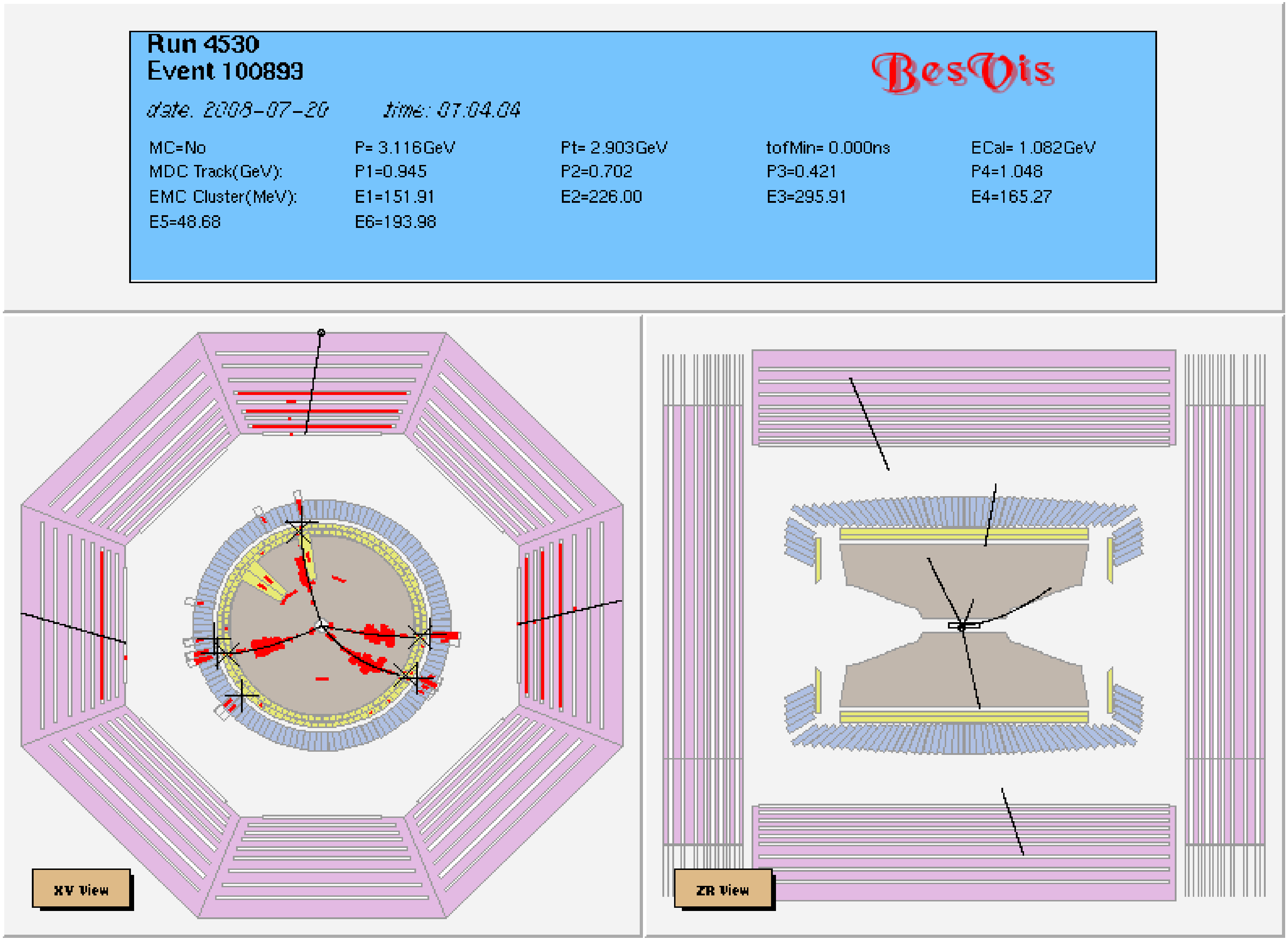
MDC single wire resolution < design spec. $\times$110%

EMC energy resolution < design spec. $\times$140%

TOF time resolution < design spec. $\times$130%

MUC efficiency ~ design spec. $\times$100%

To be improved by further calibration using Bhabha and dimuon events


Run 4530
Event 100899
BesVis
date. 2008-07-20
time: 07:04.04
MC=No
P= 3.116GeV
Pt= 2.903GeV
tofMin= 0.000ns
ECal= 1.082GeV
MDC Track(GeV):
P1=0.945
P2=0.702
P3=0.421
P4=1.048
EMC Cluster(MeV):
E1=151.91
E2=226.00
E3=295.91
E4=165.27
E5=48.68
E6=193.98
XY View
ZR View

τ physics program

- τ mass measurement
- Branching ratio measurement
- Study of Lorentz structure of the weak charged current

τ mass measurement

- Discussed in detail at Tau'06 by Mo X.H

- Expected accuracy 5 X 10^{-5} or 0.09 MeV

- Few days of data taking are enough to get necessary statistics (one week of data taking gives statistical uncertainty ~0.017 MeV)

- Absolute energy scale calibration system would allow to eliminate most significant contribution to the systematics

Branching ratio measurement

- $e\mu$ final state
- hadronic final states
- spectral functions

Study of eμ and hadronic final states near τ threshold at BESIII

$\tau^- \to e^-\nu\nu$, $\tau^+ \to \mu^+\nu\nu$
@3.6GeV

Statistic error	L (pb^{-1})	t (day)
10^{-2}	196	2.3
10^{-3} (PDG: 0.3%)	1.96×10^4	227.3

$\tau^+\tau^- \to \pi^+\pi^-\nu\nu$
@3.554GeV

Statistic error	L (pb^{-1})	t (day)
10^{-1}	1.96×10^2	2.27
10^{-2} (PDG: 0.6%)	1.96×10^4	227.3

$\tau^+\tau^- \to K^+K^-\nu\nu$
@3.554GeV

Statistic error	L (pb^{-1})	t (day)
10^{-1}	4.8×10^4	551.8
10^{-2} (PDG: 3.3%)	4.8×10^6	55176

(More detailed studies, including Kπ, are in progress)

Hadronic τ decays & spectral functions

ALEPH

Statistics

- No tagging;
- Tau decay selected: ~327000
- $\tau \to \pi\pi^0$ selected: **~81000**

ALEPH measurement
$Br(\tau \to \upsilon\pi\pi^0)$:

25.924 +/- 0.097 +/- 0.085

BES-III

Statistics (3 month of dedicated run at energy slightly below $\psi(2S)$):

- Total statistic expected: $3*10^6$
- Single (lepton) tag: ($\tau^+ \to l^+\upsilon$, $\tau^- \to$ hadrons)
  - ~$2*10^6$ tagged tau decay (0.35x2x3e6)
  - ~$1.4*10^6$ tagged hadronic tau decay
  - ~$0.5*10^6$ tagged $\tau \to \pi\pi^0$ decays
- Assuming
  - geometrical efficiency: 80% (4x0.95)
  - lepton selection efficiency 80%
  - π^0 registration efficiency within acceptance ~90% (all gamma registered in EMC)

Finally we expect $\tau \to \pi\pi^0$ statistic: **290,000**

Systematics:	ALEPH	BES-III
External background	1.2	<<1% (very clean)
Mass reconstruction accuracy	~80 Mev	better (~40-50 MeV)
Decay mode misidentification (Ex. $\pi\pi^0\pi^0$ as $\pi\pi^0$)	~ 13%	the same or better

One more BES3 advantage: good kaon identification allows to measure strange spectral function (in ALEPH only statistical K/π separation was possible (by dE/dx, ~3.5σ)

Study of Lorentz structure of the weak charged current (1)

- In general case, the tau decay can be caused by different types of interaction: scalar, vector, tensor, left-handed, right-handed
- These possibilities are parameterized in terms of Michel parameters (ρ, η, ξ, $\xi\delta$), which were extensively studied at LEP and CLEO
- An extension of the Michel parametrization - an anomalous tensor interaction which requires derivatives in the Lagrangian, can be looked for. Such possibility was never considered before.
- The anomalous tensor interaction was measured in DELPHI (together with the “standard” Michel parameters), but with a large statistical error and only under the assumption that the “standard” Michel parameters take exactly the Standard Model values

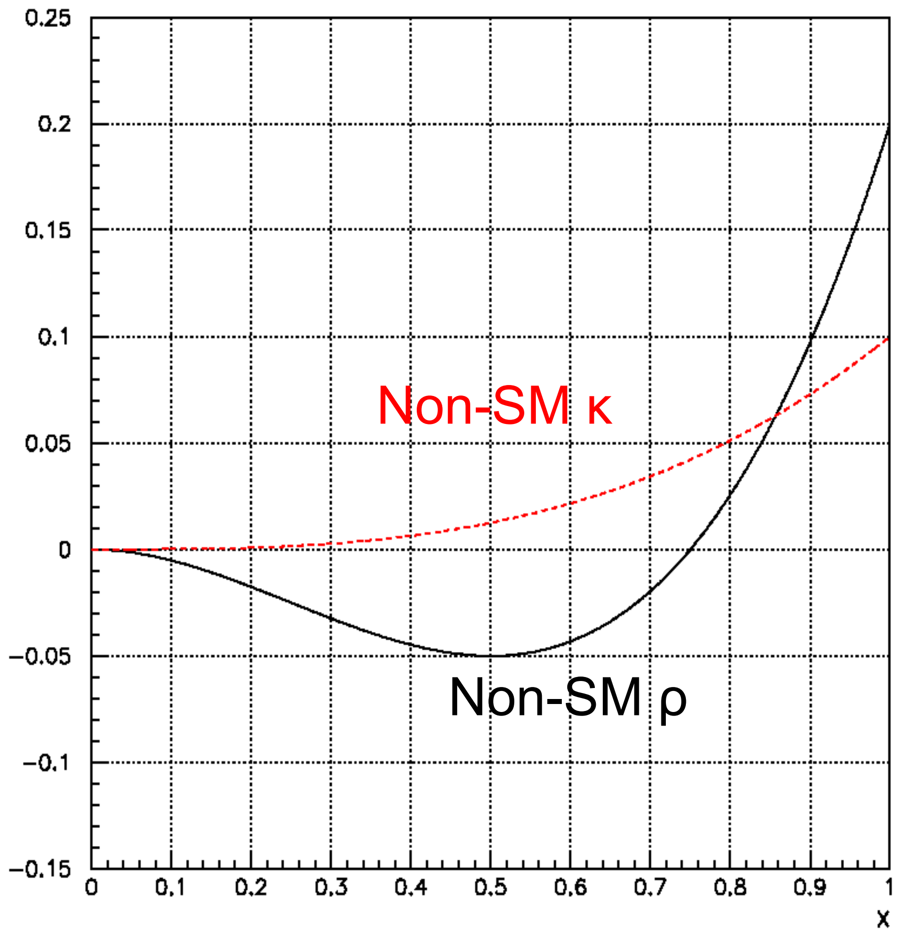
Study of Lorentz structure of the weak charged current (2)

- Both the Michel parameters and the constant of the anomalous tensor interaction can be measured from the energy spectrum of the tau decay:

$$d\Gamma/dx \sim x^2(3(1-x)+\rho(8x/3-2)+\kappa x)$$

- Here x=E/Emax is the normalized energy of the tau decay product
- The non-SM values of the Michel parameters and of the tensor interaction result in different distortions of the spectrum, which allows a simultaneous measurement of both (provided the statistics is sufficient)

Distortions of the energy spectrum



Study of Lorentz structure of the weak charged current (3)

- Preliminary Monte-Carlo studies show that the BESIII statistics and the detector performance are sufficient to improve the precision of the current results by a significant factor:
  - ρ : by factor of 2
  - η : by factor of 5
  - κ : by factor of 10
- The large statistics also makes it possible to measure all parameters simultaneously, without assumption that all other parameters take the SM values

Summary

- Construction and installation of BEPCII and BESIII completed successfully. Commissioning is ongoing.
- Current machine luminosity is 10% of design value. It is expected to reach 30% by the end of the year
- Detector properties after preliminary calibration using cosmic rays are close to design ones. No major hardware problems found.
- τ physics program is prepared.
- Data taking plan is not fixed for the forthcoming years yet. However dedicated run for tau physics is unlikely until 2010.