Design and construction of the BESIII detector

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1 INTRODUCTION

1. Overview

	BEPC	BEPC II
electron-positron storage ring	single	double
luminosity	$10^{31}cm^{-2}s^{-1}$	$10^{33}cm^{-2}s^{-1}$
center-of-mass energy		2*1.89GeV

Focusing on τ-charm results: J/Ψ, Ψ(2S), τ, D, D_S (particles produced at or near the threshold)

2. BEPC II storage ring

Completed in July of 2008, data taking started in March of 2009, the instantaneous luminosity reached $0.32*10^{33}cm^{-2}s^{-1}$ at a center-of-mass energy of 2*1.89GeV

electron injection rate: 200mA/min

positron injection rate: 50mA/min

} collide at interaction point with a horizontal crossing angle of ±11mrad

Table 1
BEPCII design parameters compared with those of BEPC.

Parameters	BEPCII	BEPC
Center of mass energy (GeV)	2–4.6	2–5
Circumference (m)	237.5	240.4
Number of rings	2	1
RF frequency f_{rf} (MHz)	499.8	199.5
Peak luminosity at 2×1.89GeV ($cm^{-2}s^{-1}$)	$\sim 10^{33}$	$\sim 10^{31}$
Number of bunches	2×93	2×1
Beam current (A)	2×0.91	2×0.035
Bunch spacing (m/ns)	2.4/8	–
Bunch length (σ_z; cm)	1.5	~5
Bunch width (σ_x; μm)	~380	~840
Bunch height (σ_y; μm)	~5.7	~37
Relative energy spread	5×10^{-4}	5×10^{-4}
Crossing angle (mrad)	±11	0

3. Event rates and final states

In typical hadronic final states, the most probable momentum of charged particles produced is approximately 0.3 GeV/c, an overwhelming majority of particles have momentum below 1GeV/c, and the most probable energy of photons is about 100MeV. The average multiplicity is on the order of four for charged particles and photons in final states.

4. BESIII components

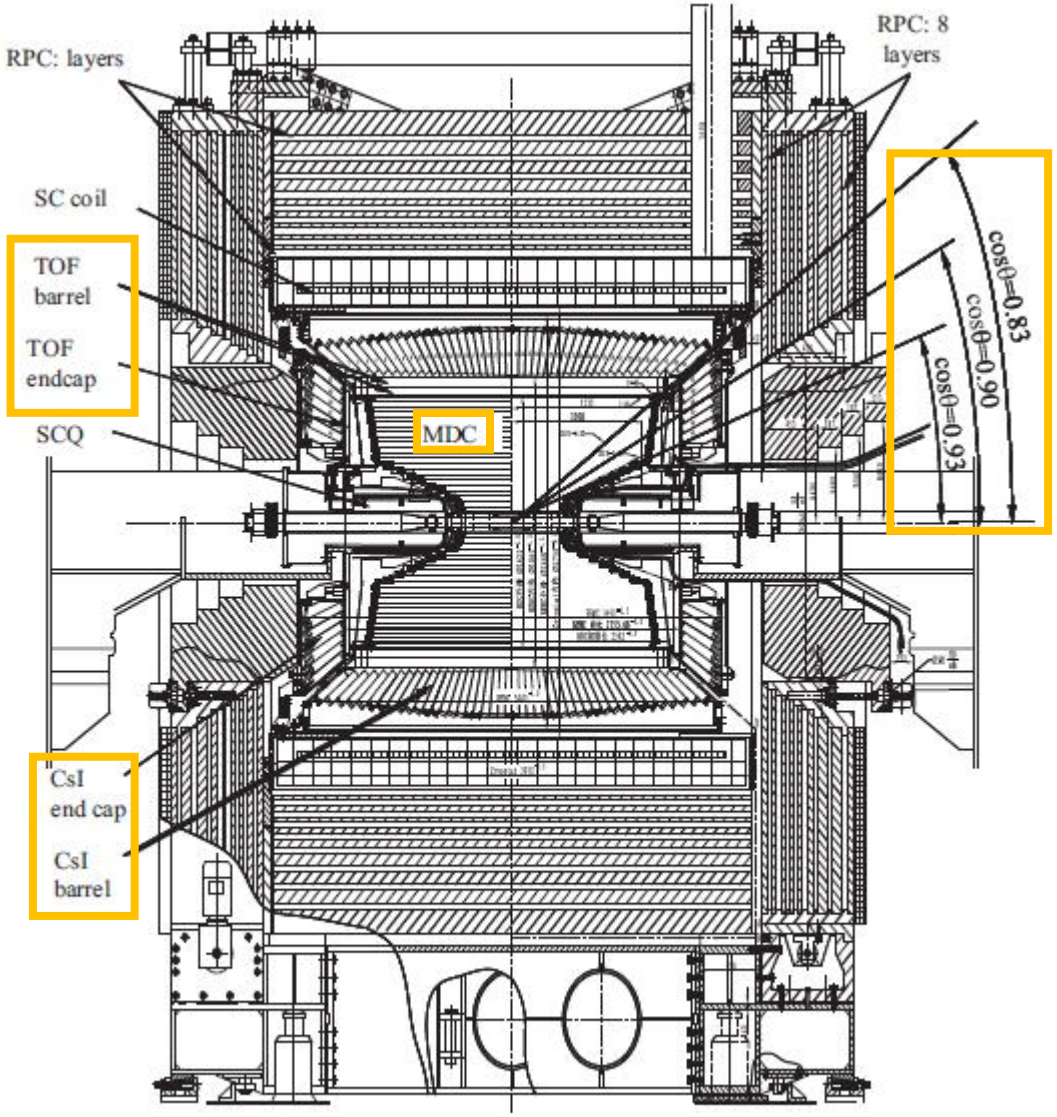

Fig. 1. Schematic drawing of the BESIII detector.

Table 3
Detector parameters and performance comparison between BESIII and BESII.

Subsystem	BESIII	BESII
MDC		
Single wire $\sigma_{r\phi}$ (μm)	130	250
σ_p/p (1 GeV/c) (%)	0.5	2.4
σ (dE/dx) (%)	6	8.5
EMC		
σ_E/E (1 GeV) (%)	2.5	22
Position resolution (1 GeV) (cm)	0.6	3
TOF		
σ_T (ps)		
Barrel	100	180
End cap	110	350
Muon		
No. of layers (barrel/end cap)	9/8	3
Cut-off momentum (MeV/c)	0.4	0.5
Solenoid magnet field (T)	1.0	0.4
$\Delta\Omega/4\pi$	93%	80% (used)

5. Luminosity determination

The luminosity will be determined based on the three main QED processes $e^+e^- \rightarrow e^+e^-$, $\mu^+\mu^-$ and $\gamma\gamma$ using the entire BESIII detector.

luminosity measurements

- a crude determination of the luminosity made in the real time L3 event filtering process using mainly the end cap EMC
- offline data analysis to further eliminate backgrounds and to apply more detailed corrections for detector efficiencies and other effects determined from Monte Carlo simulation

uncertainties

- trigger efficiency determinations
- radiative corrections
- Monte Carlo simulations
- requirements to eliminate backgrounds


THANKS!