

# Introductory remarks

João Guimarães da Costa

December 06, 2017



中國科學院高能物理研究所

*Institute of High Energy Physics  
Chinese Academy of Sciences*



# News

- CDR timescale agreed upon at Steering group meeting on Nov 29:
  - Similar to what we discussed at the last meeting:
    - Start harmonization of text and introduction chapters now
    - Complete draft of each chapter by Jan 2017
    - Editing and internal review: Feb-Mar 2017
    - International review: April 2018
      - Implementation of suggestions: May 2018
    - Public release: May-June 2018
- MOST 2 pre-application submitted to CAS/MOST last week
  - Total budget request: 45 MRMB
  - Tasks: accelerator; hadronic calorimeter; pixel detector



# Extra Slides

---



# International Advisory Committee Meeting

- The fourth CEPC IAC meeting:  
November 8-9
  - <http://indico.ihep.ac.cn/event/7390/overview>
  - Some overlap with the workshop on November 8
    - Activities to start at 5 pm
  - CEPC CDR Status report to be presented on November 8
  - Main goal of this meeting is the discussion on how to broaden the internationalization of the CEPC project

## International Advisory Committee

Young-Kee Kim, U. Chicago (Chair)  
Barry Barish, Caltech  
Hesheng Chen, IHEP  
Michael Davier, LAL  
Brian Foster, Oxford  
Rohini Godbole, CHEP, Indian Institute of Science  
David Gross, UC Santa Barbara  
George Hou, Taiwan U.  
Peter Jenni, CERN  
Eugene Levichev, BINP  
Lucie Linssen, CERN  
Joe Lykken, Fermilab  
Luciano Maiani, Sapienza University of Rome  
Michelangelo Mangano, CERN  
Hitoshi Murayama, UC Berkeley/IPMU  
Katsunobu Oide, KEK  
Robert Palmer, BNL  
John Seeman, SLAC  
Ian Shipsey, Oxford  
Steinar Stapnes, CERN  
Geoffrey Taylor, U. Melbourne  
Henry Tye, IAS, HKUST  
Yifang Wang, IHEP  
Harry Weerts, ANL



# Last Week's Version

## CONTENTS

Acknowledgments	iii	4.7.2 Future R&D	15
<b>1 Introduction</b>	<b>1</b>	4.8 Summary	16
1.1 The CEPC-SPPC Study Group and the CDR	1	<b>5 The silicon tracker</b>	<b>19</b>
1.2 The Case for the CEPC-SppC in China	1	5.1 Baseline design	19
1.3 The Science in the CDR	1	5.2 Sensor technologies	21
1.4 The Accelerator and the Experiment	1	5.3 Front-End electronics	21
<b>2 Overview of the Physics Case for CEPC-SppC</b>	<b>3</b>	5.4 Powering and cooling	22
2.1 New Colliders for a New Frontier	4	5.5 Mechanics and integration	22
<b>3 Experimental conditions and detector requirements</b>	<b>5</b>	5.6 tracking performance	22
3.1 New Colliders for a New Frontier	6	5.7 Critical R&D	22
<b>4 Vertex</b>	<b>7</b>	<b>6 Tracking system</b>	<b>25</b>
4.1 Performance Requirements and Detector Challenges	7	6.1 TPC tracker detector	25
4.2 Baseline design	8	6.1.1 Baseline design and mechanics	26
4.3 Detector performance studies	8	6.1.2 Simulation and estimation for the key issues	29
4.3.1 Performance of the Baseline Configurations	9	6.1.3 feasibility study of the TPC detector module and calibration system	31
4.3.2 Material Budget	9	6.2 Full-silicon tracker detector	32
4.3.3 Dependence on Single-Point Resolution	9	6.2.1 Full silicon tracker layout	33
4.3.4 Distance to IP	11	6.2.2 Toy simulation	34
4.4 Beam-induced Background in the Vertex Detector	11	6.2.3 Detector simulation and reconstruction	35
4.5 Sensor Technology Options	11	6.2.4 Tracking performance	38
4.6 Mechanics and Integration	13	6.2.5 Conclusion	43
4.7 Critical R&D	15	6.3 Drift chamber tracker detector	43
4.7.1 Current R&D activities	15	<b>7 Calorimetry</b>	<b>45</b>
	<b>v</b>	7.1 Introduction to calorimeters	45
		7.2 Electromagnetic Calorimeter for Particle Flow Approach	47
		7.2.1 Silicon-Tungsten Sandwich Electromagnetic Calorimeter	48
		7.2.2 Scintillator-Tungsten Sandwich Electromagnetic Calorimeter	54
		7.3 Hadronic Calorimeter for Particle Flow Approach	54
		7.3.1 Introduction	54
		7.3.2 Semi-Digital Hadronic Calorimeter (SDHCAL)	55
		7.3.3 Analog Hadronic Calorimeter based on Scintillator and SiPM	63
		7.4 Dual-readout Calorimetry	74
		7.4.1 Introduction	74
		7.4.2 Dual-Readout Calorimetry	75
		7.4.3 Layout and Mechanics	76
		7.4.4 DREAM/RD52 Prototype Studies	77
		7.4.5 Sensors and Readout Electronics	85
		7.4.6 Monte Carlo Simulations	88
		7.4.7 Final Remarks	90
		<b>8 Detector magnet system</b>	<b>95</b>
		8.1 General Design Considerations	95
		8.2 The Magnetic Field Requirements and Design	96
		8.2.1 Main parameters	96
		8.2.2 Magnetic field design	96



8.2.3	Coil mechanical analysis	97
8.2.4	Preliminary quench analysis	102
8.3	HTS/LTS Superconductor Options	105
8.3.1	HTS plan background	105
8.3.2	The latest development of high temperature superconducting cable	109
8.3.3	HTS magnetic design	111
8.3.4	Future work of HTS plan	112
8.4	Solenoid Coil Design	114
8.4.1	Solenoid Coil Structure	114
8.4.2	R&D of Superconducting Conductor	114
8.4.3	Coil fabrication and assembly	116
8.5	Magnet Cryogenics Design	116
8.5.1	Preliminary Simulation of the Thermosyphon Circuit	116
8.5.2	Preliminary results for 10:1 scale model	118
8.5.3	Experiment of a small-sized He thermosiphon	119
8.5.4	Cryogenic Plant Design	120
8.6	Quench Protection and Power supply	123
8.6.1	power supply	123
8.6.2	control and safety systems	123
8.7	Iron Yoke Design	124
8.7.1	The Barrel Yoke	124
8.7.2	The Endcap Yoke	124
8.7.3	Yoke assembly	124
8.8	Dual Solenoid Scenario	125
<b>9</b>	<b>Muon system</b>	<b>135</b>
9.1	The $\mu$ RWell technology	135
9.1.1	Prototypes performance	137
9.1.2	Large size $\mu$ RWell detectors	138
9.1.3	$\mu$ RWell performances in test beams	138
9.1.4	The double-resistive layer detector	143
9.1.5	Applications for a Muon detection system for a CepC experiment	144
9.2	New Colliders for a New Frontier	144
<b>10</b>	<b>Readout electronics and data acquisition</b>	<b>147</b>
10.1	New Colliders for a New Frontier	148
<b>11</b>	<b>CEPC interaction region and detector integration</b>	<b>149</b>
11.1	Interaction region layout	149
11.2	Final focusing magnets	150
11.3	Detector backgrounds	150
11.3.1	Beam-beam interactions	151
11.3.2	Synchrotron radiation	151
11.3.3	Beam-gas interactions	151
11.4	Luminosity instrumentation	151
11.4.1	Systematic effects in the luminosity measurement	152
11.4.2	Luminosity detector options	154
11.4.3	Tracking of Bhabha electrons to $10^{-4}$ precision	155

**viii** CONTENTS

11.4.4	Boost by beam-crossing to Bhabha electrons	158
11.4.5	Shower leakage of LumiCal to tracking volume	158
11.5	Detector integration	161
<b>12</b>	<b>Physics performance</b>	<b>163</b>
12.1	Introduction	163
12.1.1	Higgs discovery and Physics at Post-Higgs era	163
12.1.2	The physics requirement and detector design at the CEPC	165
12.2	Simulation Geometry & Samples	166
12.3	Arbor Algorithm & Strategy to the object reconstruction	167
12.4	Leptons	170
12.5	Kaon Identification	171
12.6	Photons	172
12.7	Taus	173
12.8	Jet-clustering	176
12.9	Jet flavor tagging	180
12.9.1	Base line	180
12.9.2	Deep learning	180
12.9.3	Gluon identification	180
12.9.4	Geometry scan & recommendations	180
<b>13</b>	<b>Futruue plans and R&amp;D prospects</b>	<b>183</b>
13.1	New Colliders for a New Frontier	184