

IAC recommendations Overview

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中国科学院高能物理研究所

*Institute of High Energy Physics
Chinese Academy of Sciences*

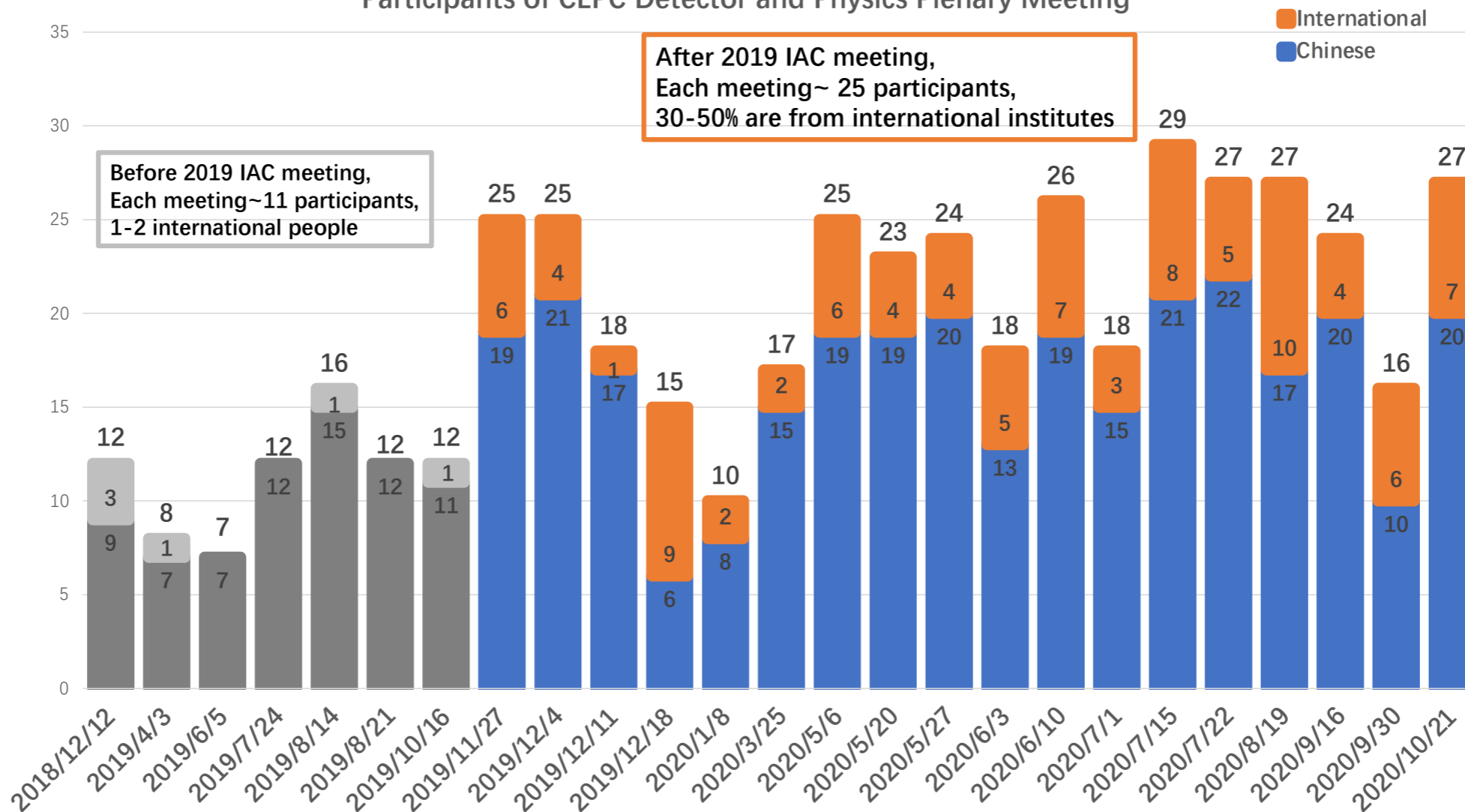


IAC Report - Observations

Detector R&D and Physics Studies

The IAC congratulates the CEPC team for the significant progress since last year on the detector and physics aspects. Following up on last year's recommendations, the IAC was pleased to see regular meetings taking place within the various topical groups and with significant participation from outside China.

Participants of CEPC Detector and Physics Plenary Meeting





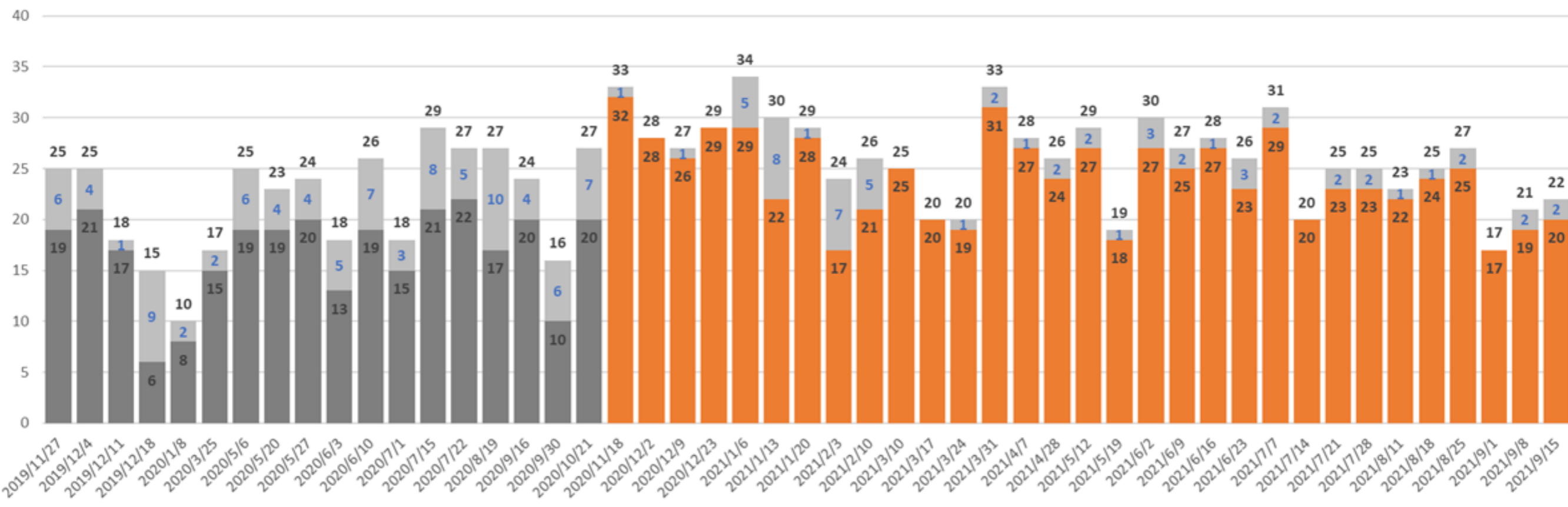
IAC Report - Observations

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Chinese International





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<https://indico.ihep.ac.cn/category/214/>

Physics and Simulations	516 events	➡
Vertex	13 events	➡
Tracker	197 events	➡
Calo&Muon	185 events	➡
MDI	58 events	➡
General	172 events	➡
100 TeV Simulation	12 events	➡
Pure Silicon Detector	8 events	➡
Offline Software	1 event	🛡️ ➡
Mechanics	10 events	➡
PID exploring	empty	➡

Observation:

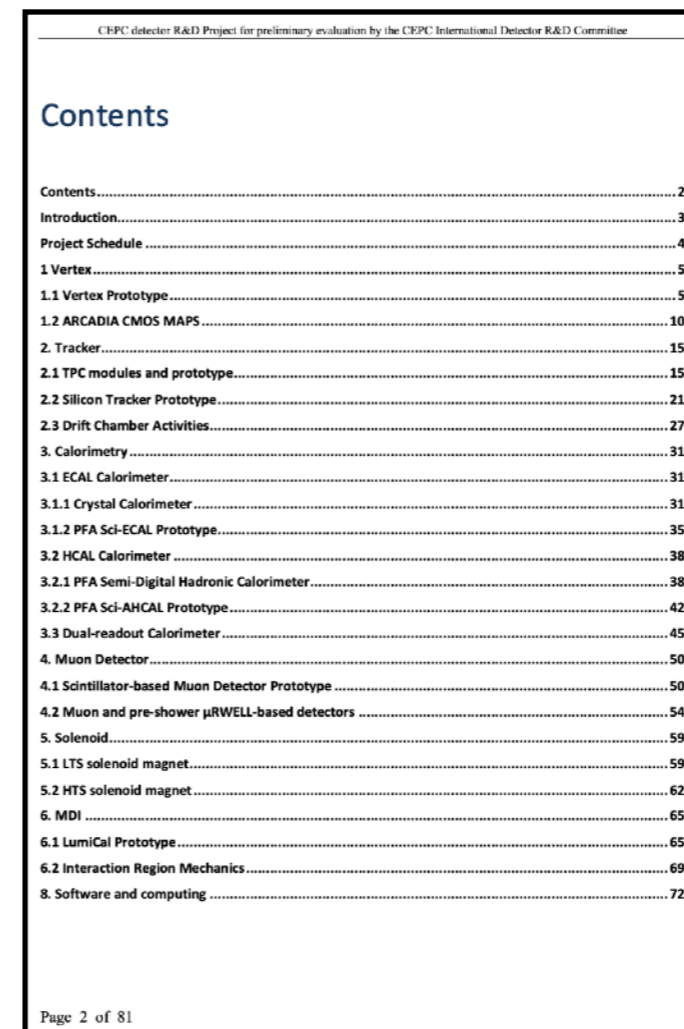
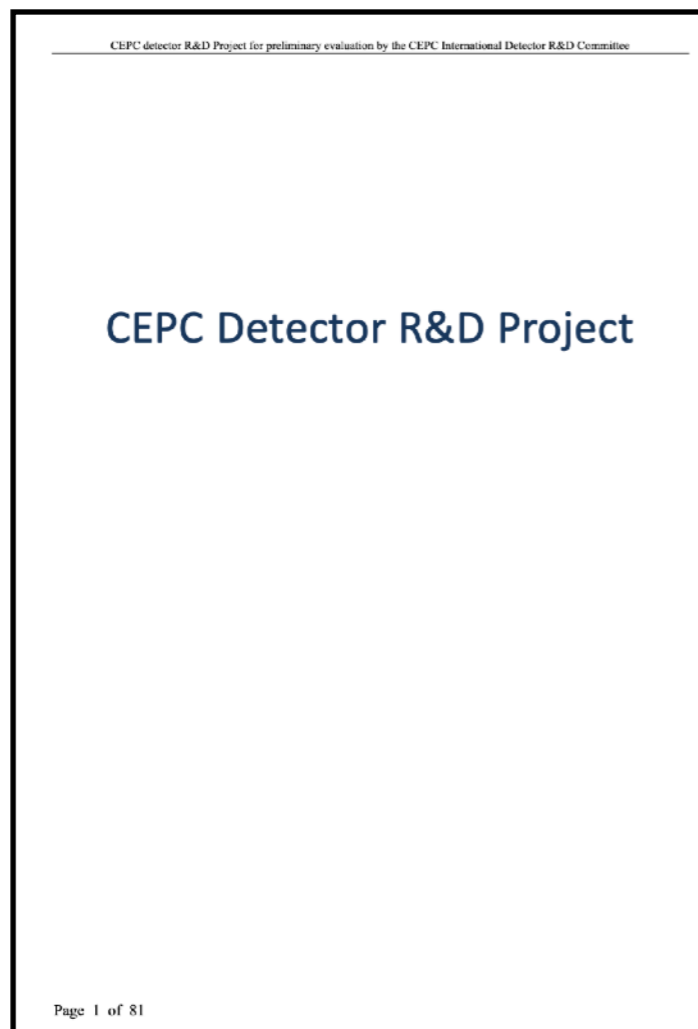
Most meeting (but not all) have continued to be organized within indico, so there is a paper trail that can be reported



IAC Report - Observations

Detector R&D and Physics Studies

The IAC noted an increase in the number of sub-detector R&D projects, many of them involving non-Chinese groups. The ongoing effort to create a summary document describing the different detector R&D activities and their current status is recognized. It will be very helpful to maintain overview and to facilitate the integration of external groups. (see next slides)





IDRDC Preparation: R&D Summary Document

18 documents, 95 subtasks, 80 pages

Submitted to committee IDRDC chair and waiting for feedback

PBS	Task Name	Page	Subtasks	Context	Team	Document Responsible
	CEPC Detector R&D Project					
1	Vertex					
1.1	Vertex Prototype	5	9	CEPC	China+ international collaborators	Zhijun, Ouyang
1.2	ARCADIA CMOS MAPS	6	6	Generic	INFN, Italy	Manuel Rolo
2	Tracker					
2.1	TPC Module and Prototype	6	12	CEPC	IHEP, Tsinghua	Huirong
2.2	Silicon Tracker Prototype	6	8	Generic	China, UK, Italy	Harald Fox, Meng Wang
2.3	Drift Chamber Activities	4	3	FCC-ee/CEPC	INFN, Novosibirsk	Franco Grancagnolo
3	Calorimetry					
3.1	ECAL Calorimeter					
3.1.1	Crystal Calorimeter	5	6	CEPC	IHEP, Princeton + others	Yong Liu
3.1.2	PFA Sci-ECAL Prototype	3	3	CEPC	USTC, IHEP	Jianbei Liu
3.2	HCAL Calorimeter					
3.2.1	PFA Digital Hadronic Calorimeter	4	5	CEPC	SJTU, IPNL, Weizmann, IIT, USTC	Haijun Yang, Imad Laktineh, Shikma Bressler
3.2.2	PFA Sci-AHCAL Prototype	4	4	CEPC	USTC, IHEP, SJTU	Jianbei Liu
3.3	Dual-readout Calorimeter	5	5	FCC-ee/CEPC	INFN, Sussex, Zagreb, South Korea	Roberto Ferrari
4	Muon Detector					
4.1	Scintillator-based Muon Detector	4	5	CEPC	Fudan, SJTU	Xiaolong Wang, Liang Li
4.2	Muon and pre-shower μRWELL-	5	4	FCC-ee/CEPC	INFN, LNF	Paolo Giacomelli
5	Solenoid					
5.1	LTS solenoid magnet	4	4	CEPC	IHEP+Industry	Zhu Zian
5.2	HTS solenoid magnet	4	4	CEPC	IHEP+Industry	Zhu Zian
6	MDI					
6.1	LumiCal Prototype	4	2	ILC/CEPC	AC, IHEP	Suen Hou
6.2	Interaction Region Mechanics	3	4	CEPC	IHEP	Hongbo Zhu
8	Software and Computing	7	11	CEPC	IHEP, SDU	Li Weidong, Ruan Manqi, Sun Shengsen, Li Gang

IDRDC Preparation: R&D Summary Document


Schedule of R&D activities included in document

PBS	Task Name	Start	Finish	2020		2021		2022		2023		2024		2025		2026		2027		2028		2029	
				H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
	CEPC Detector R&D Project	2020/5/7	2026/12/31	----- CEPC Detector R&D Project																			
1	Vertex	2020/5/7	2023/12/29	----- Vertex																			
1.1	Vertex Prototype	2020/5/7	2023/12/29	----- Vertex Prototype																			
1.2	ARCADIA CMOS MAPS	2020/5/7	2021/12/31	----- ARCADIA CMOS MAPS																			
2	Tracker	2020/5/7	2024/12/31	----- Tracker																			
2.1	TPC Module and Prototype	2020/5/7	2021/12/31	----- TPC Module and Prototype																			
2.2	Silicon Tracker Prototype	2020/5/7	2023/10/31	----- Silicon Tracker Prototype																			
2.3	Drift Chamber Activities	2020/5/7	2024/12/31	----- Drift Chamber Activities																			
3	Calorimetry	2020/5/7	2025/12/31	----- Calorimetry																			
3.1	ECAL Calorimeter	2020/5/7	2024/12/31	----- ECAL Calorimeter																			
3.1.1	Crystal Calorimeter	2020/5/7	2021/12/31	----- Crystal Calorimeter																			
3.1.2	PFA Sci-ECAL Prototype	2020/5/7	2024/12/31	----- PFA Sci-ECAL Prototype																			
3.2	HCAL Calorimeter	2020/5/7	2023/4/28	----- HCAL Calorimeter																			
3.2.1	PFA Digital Hadronic Calorimeter	2020/5/7	2022/12/30	----- PFA Digital Hadronic Calorimeter																			
3.2.2	PFA Sci-AHCAL Prototype	2020/5/7	2023/4/28	----- PFA Sci-AHCAL Prototype																			
3.3	Dual-readout Calorimeter	2020/5/7	2025/12/31	----- Dual-readout Calorimeter																			
4	Muon Detector	2020/5/7	2024/12/31	----- Muon Detector																			
4.1	Scintillator-based Muon Detector Prototype	2020/5/7	2023/12/29	----- Scintillator-based Muon Detector Prototype																			
4.2	Muon and pre-shower μ RWELL-based detectors	2020/5/7	2024/12/31	----- Muon and pre-shower μRWELL-based detectors																			
5	Solenoid	2020/5/7	2026/12/31	----- Solenoid																			
5.1	LTS solenoid magnet	2020/5/7	2025/12/31	----- LTS solenoid magnet																			
5.2	HTS solenoid magnet	2020/5/7	2026/12/31	----- HTS solenoid magnet																			
6	MDI	2020/5/7	2023/12/29	----- MDI																			
6.1	LumiCal Prototype	2020/5/7	2021/12/1	----- LumiCal Prototype																			
6.2	Interaction Region Mechanics	2020/5/7	2023/12/29	----- Interaction Region Mechanics																			
8	Software and Computing	2020/5/7	2024/12/31	----- Software and Computing																			



IAC Report - Recommendations

Introduction/General

Recommendation 1: Update the timeline and include two separate accelerator and detector roadmaps in the timeline by the next IAC meeting.  **Action Item**

Recommendation 2: Hold the International Accelerator Review Committee and the International Detector R&D Review Committee twice a year in person or virtually. The next meetings should take place within six months.



Development: Detail document on CEPC detector R&D submitted to the International Detector R&D Review Committee (as requested);
David Newbold (chair) organizing the next meeting for middle October

Next meeting: Overview of the R&D status, progress and challenges

Following meeting: ~April 2022



IAC Report - Recommendations

Management

Recommendation 3: *Explore a possibility of commissioning an economics department of a prestigious Chinese university to carry out such an economic benefits study.*

(economic benefits to China from CEPC)

Recommendation 4: *Explore the CERN-Chinese relation as much possible. The IAC would like to hear a report on this matter at the next meeting, with an evaluation of the benefits to date, the strengths and weaknesses, and how it might be further improved.*

The IAC suggests further enhancement of the CEPC and FCC-ee collaboration, and building international strength through bi-lateral arrangements.



Development: Contributions to HL-LHC have expanded; Relationship with FCC-ee has continued with several physicists participating in both projects but has not expanded. Situation with COVID does not help since it limits the personal interactions.



IAC Report - Recommendations

Detector R&D and Physics Studies

the overall optimization process for the detector still needs further in-depth studies driven by the various physics objectives. **Measurements at the different center-of-mass energies will each add specific, and sometimes competing, requirements.**

Continue effort in performant software and detector optimization

Recommendation 11: *Not to tighten the R&D towards a predefined tight schedule.* The IAC believes that R&D within a technically driven schedule is optimal. Given the longer timescale this allows, it is important to develop the best possible detector design. **Innovation and creativity** (i.e. new ideas) in the R&D leading to the development of a cutting-edge holistic detector design should be a goal.



Development: New conceptual detector

Action Item: Rework the CEPC general timeline; Keep open higher risk options that require more R&D; Invest on innovative solutions — highlight these in next report



IAC Report - Recommendations

Detector R&D and Physics Studies

Recommendation 12: Reinforce the engineering efforts related to the detector design. Engineering studies are essential and now timely, for example in the following domains: cooling integration studies for the vertex detector, the beam pipe and the PFA calorimeters; light-weight supports and integration of the vertex detector; scalability of the calorimeters.



Observation:

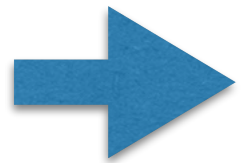
- Ji Quan already acting as project engineer overseeing many of these issues;
- Jinyu Fu working on vertex detector cooling/mechanics
- IAC likely expects to see an expansion in this effort



IAC Report - Recommendations

Detector R&D and Physics Studies

Recommendation 13: *Assess the CEPC physics potential of the 360 GeV stage in full, including a demonstration that the accelerator design optimally fits the physics objectives at this stage. Even if the 360 GeV stage is still far away in time, it is an important element to the attractiveness of CEPC as a whole. Not emphasizing it strongly in the presentation of the CEPC program may discourage potential partners.*



Today: talk by Xiaohu SUN

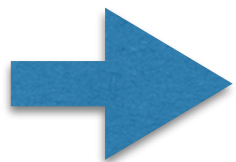


IAC Report - Recommendations

Detector R&D and Physics Studies

The purely phenomenological/theoretical work on the CEPC physics potential is in excellent shape, as shown during the Workshop. The worldwide theory community contributes to these studies as part of the global effort to expand the science impact of circular colliders. The CEPC team is a driving force behind these efforts, particularly in the context of Higgs and BSM physics. There are further opportunities, however, to exploit the particular competence of Chinese theorists in areas like flavor, hadronic spectroscopy and higher-order calculations for QCD and EW precision observables.

Recommendation 14: *Assess the CEPC physics potential for the high luminosity Z factory stage.* In particular it is important to fully develop the flavor physics program for this stage, from the perspective of weak interactions (e.g., precision measurements and rare and forbidden decays in the SM and in BSM scenarios), as well as from the perspective of strong interactions (e.g., in the area of exotic hadrons, where unique studies of doubly heavy or fully heavy tetraquarks, also including b quarks, would be possible).



Today: talk by Manqi



IAC Report - Recommendations

Detector R&D and Physics Studies

The active participation of CEPC experts, together with experts from ILC, CLIC and FCC, in the common Key4hep / EDM4hep / DD4hep software infrastructure for detector description, event simulation and event reconstruction is seen as a big step forward since last year.

Recommendation 15: Further develop close relationships with FCC-ee colleagues in detector designs.

Observation:

- IDEA colleagues already involved in both projects;
- Silicon tracker project with UK colleagues likely to be common with FCC-ee
- New concept detector uses drift chamber, collaborating with IDEA
- FCC-ee Detector R&D still starting up

Action item:

Common workshops/discussions regarding challenges of circular e^+e^- collider physics



Snowmass Letter of Intent

Can be part of our report to the IAC, as a demonstration of international collaboration

<https://indico.ihep.ac.cn/event/12410/>

Detector 14 LoI

Detector R&D	
Conveners: Joao Guimaraes Costa, WANG Jianchun, Mr. Manqi Ruan (IHEP)	
15:00	CEPC Detectors Overview LoI 1' CEPC Detector Overview LOI SNOWMASS21-EF1_EF4-IF9_IF0-260.pdf Speakers: Joao Guimaraes Costa, Mr. Manqi Ruan (IHEP), WANG Jianchun Material: Paper Slides
15:02	IDEA Concept 1' Speaker: Franco Bedeschi (INFN-Pisa) Material: Paper
15:03	Dual Readout Calorimeter 1' Speaker: Roberto Ferrari (INFN) Material: Paper
15:04	Drift Chamber 1' Speaker: Franco Gracagnolo Material: Paper
15:06	mu-RWELL (muons, preshower) 1' Speaker: Paolo Giacomelli (INFN-Bo) Material: Paper
15:08	Time Detector LoI 1' Speaker: Prof. Zhijun Liang (IHEP) Material: Slides
15:09	Key4hep 1' Speakers: Dr. Weidong Li (高能所), Dr. Tao LIN (高能所), Prof. Xingtao Huang (Shandong University), Wenxing Fang (Beihang University) Material: Slides
15:10	PFA Calorimeter 1' Speakers: Haijun Yang (Shanghai Jiao Tong University), Dr. Jianbei Liu (University of Science and Technology of China), Dr. Yong Liu (Institute of High Energy Physics) Material: Slides
15:11	High Granularity Crystal Calorimeter 1' Speaker: Dr. Yong Liu (Institute of High Energy Physics) Material: Paper Slides
15:12	Muon Scintillator Detector 1' Speaker: Dr. Xiaolong Wang (Institute of Modern Physics, Fudan University) Material: document
15:13	Vertex LoI 1' Speaker: Prof. Zhijun Liang (IHEP) Material: Slides
15:15	MDI LoI 1' Speaker: Dr. Hongbo ZHU (IHEP) Material: Slides
15:16	TPC LoI 1' Speaker: Dr. Huirong Qi (Institute of High Energy Physics, CAS) Material: Slides
15:17	Solenoid R&D LoI 1' Speaker: Dr. Felpeng NING (IHEP) Material: Slides

Physics 17 LoI

Open Physics Questions	
Conveners: Mr. Manqi Ruan (IHEP)	
16:00	EF01-Higgs boson CP properties at CEPC 3' Speakers: Meng Xiao, Xin Shi Material: Slides
16:03	EF01-Measurement of branching fractions of Higgs hadronic decays 3' Speaker: Yanping Huang Material: Slides
16:06	EF02-Study of Electroweak Phase Transition in Exotic Higgs Decays with CEPC Detector Simulation 3' Speaker: Shu Li Material: Slides
16:09	EF03-Feasibility study of CP-violating Phase ϕ_s measurement via $B_s \rightarrow J/\psi\phi$ channel at CEPC 3' Speaker: Mingrui Zhao Material: Slides
16:12	EF03-Probing top quark FCNC couplings tq_Y, tq_Z at future e+e- collider 3' Speaker: Peiwen Wu Material: Slides
16:15	EF03-Searching for $B_s \rightarrow \phi\nu\nu$ and other $b \rightarrow s\nu\nu$ processes at CEPC 3' Speaker: Lingfeng Li Material: Slides
16:18	EF04-Measurement of the leptonic effective weak mixing angle at CEPC 3' Speaker: Siqi Yang Material: Slides
16:21	EF04-Probing new physics with the measurements of $e+e- \rightarrow W+W-$ at CEPC with optimal observables 3' Speaker: Jiayin Gu Material: Slides
16:24	EF05-Exclusive Z decays 3' Speaker: Qin Qin Material: Slides
16:27	EF05-NNLO electroweak correction to Higgs and Z associated production at future Higgs factory 3' Speaker: Zhao Li Material: Slides
16:30	EF08-SUSY global fits with future colliders using GAMBIT 3' Speaker: Peter Athron Material: Slides
16:33	EF08-Probing Supersymmetry and Dark Matter at the CEPC, FCCee, and ILC 3' Speaker: Tianjun Li Material: Slides
16:36	EF09-Search for Asymmetric Dark Matter model at CEPC by displaced lepton jets 3' Speaker: Mengchao Zhang Material: Slides
16:39	EF09-Search for $t + j + MET$ signals from dark matter models at future e+e- collider 3' Speaker: Peiwen Wu Material: Slides
16:42	EF0910-Dark Matter via Higgs portal at CEPC 3' Speaker: Xin Shi Material: Slides
16:45	EF0910-Lepton portal dark matter, gravitational waves and collider phenomenology 3' Speaker: Ke-Pan Xie Material: Slides
16:48	RF1-Exploring new physics with $B_c \rightarrow \tau \nu_\tau$ 3' Speaker: Taifan Zheng Material: Slides



IAC Report - Recommendations

Report:

The Sixth Meeting of the CEPC-SppC International Advisory Committee

November 19, 2020





IAC Report - Recommendations

The IAC committee

Present:

- Barry Barish, Caltech
- Hesheng Chen, IHEP, Chinese Academy of Sciences
- Michel Davier, LAL
- Marcel Demarteau, ORNL
- Brian Foster, DESY/University of Hamburg & Oxford University
- Rohini Godbole, CHEP, Bangalore
- David Gross, University of California, Santa Barbara
- George Hou, Taiwan University
- Peter Jenni, CERN & Albert-Ludwigs-University Freiburg
- Young-Kee Kim (Chair), University of Chicago
- Eugene Levichev, BINP
- Lucie Linssen, CERN
- Luciano Maiani, University of Rome
- Michelangelo Mangano, CERN
- Tatsuya Nakada, EPFL
- Katsunobu Oide, CERN & KEK
- Ian Shipsey, Oxford University
- Steinar Stapnes, CERN
- Geoffrey Tayler, University of Melbourne

Apologies received:

- Joe Lykken, Fermilab
- Hitoshi Murayama, University of California, Berkeley & Kavli IPMU
- Robert Palmer, BNL
- John Seeman, SLAC



IDRDC membership

- D. Newbold (chair), J. Brau, V. Bonvicini, A. Cattai, C. Diaconu, B. Foster, L. Han, A. Schopper, A. Seiden, L. Serin, S. Stapnes, R. Tenchini, I. Villa Alvarez, H. Yamamoto, H. Newman, M. Stanitzki