IAC recommendations

João Guimarães da Costa

September 15, 2021

中國科學院高能物理研究所

Institute of High Energy Physics
Chinese Academy of Sciences

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

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.* (to happen within 1 year)

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.

Action Item: organize a **second** International Detector R&D Review Committee meeting by May 2021 — virtual meeting and decoupled from a CEPC workshop. **Third** meeting could be coupled with October 2021 workshop.

First step: Need to finalize support documents

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.

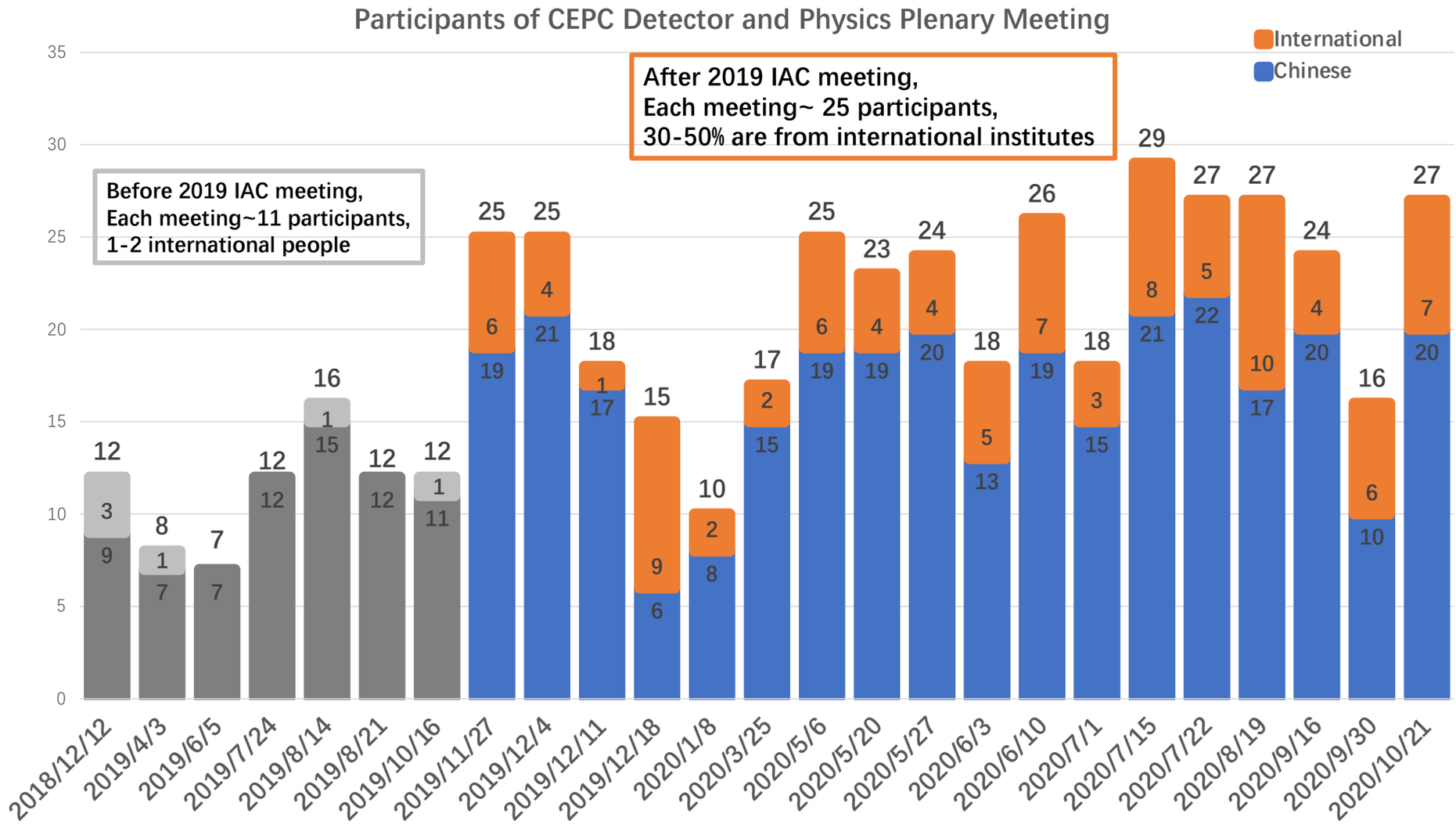
The IAC suggests further enhancement of the CEPC and FCC-ee collaboration, and building international strength though bi-lateral arrangements.

Action Item: expand our relationships with FCC-ee and LHC involvement

IAC Report - Recommendations

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.



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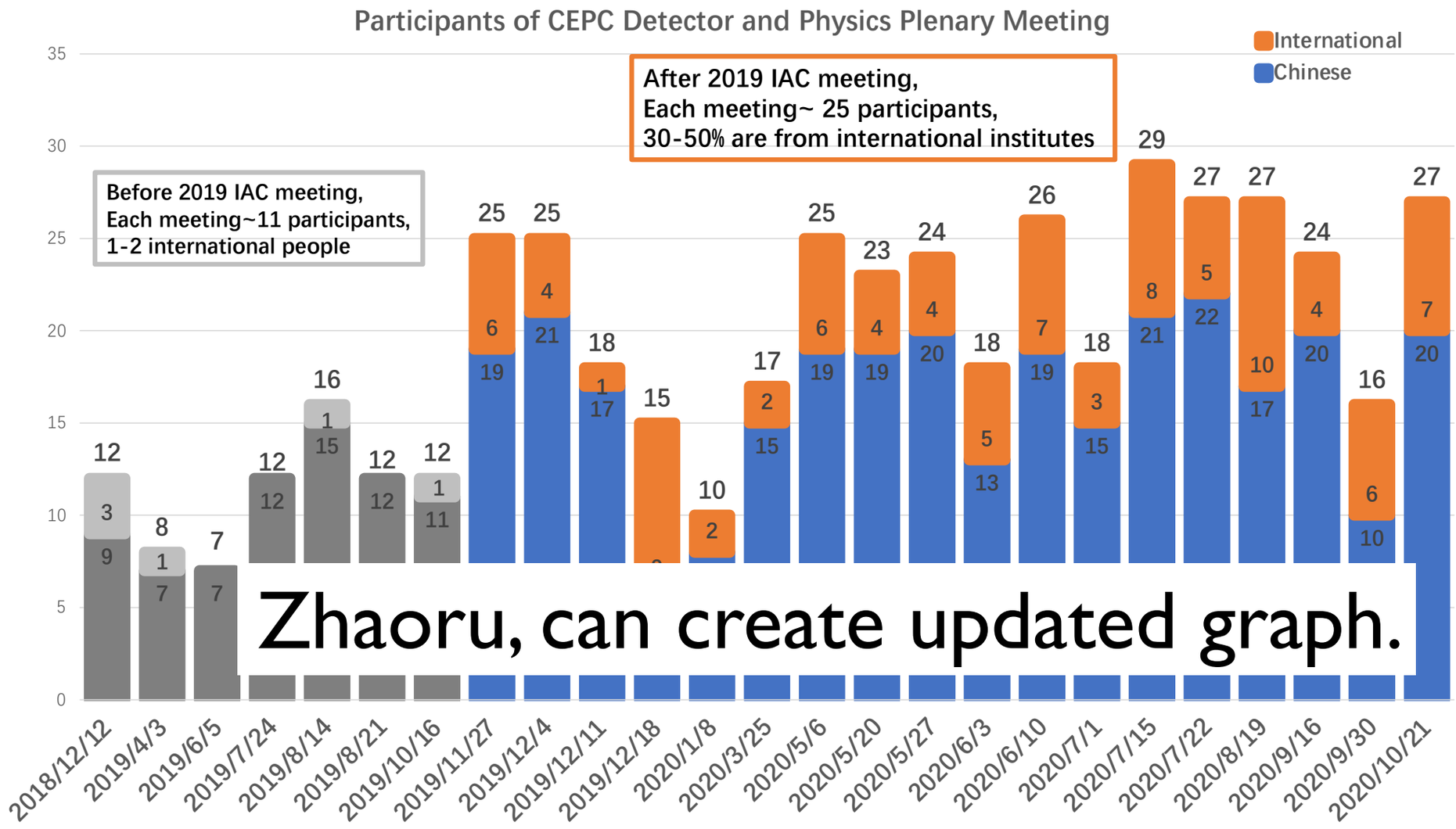

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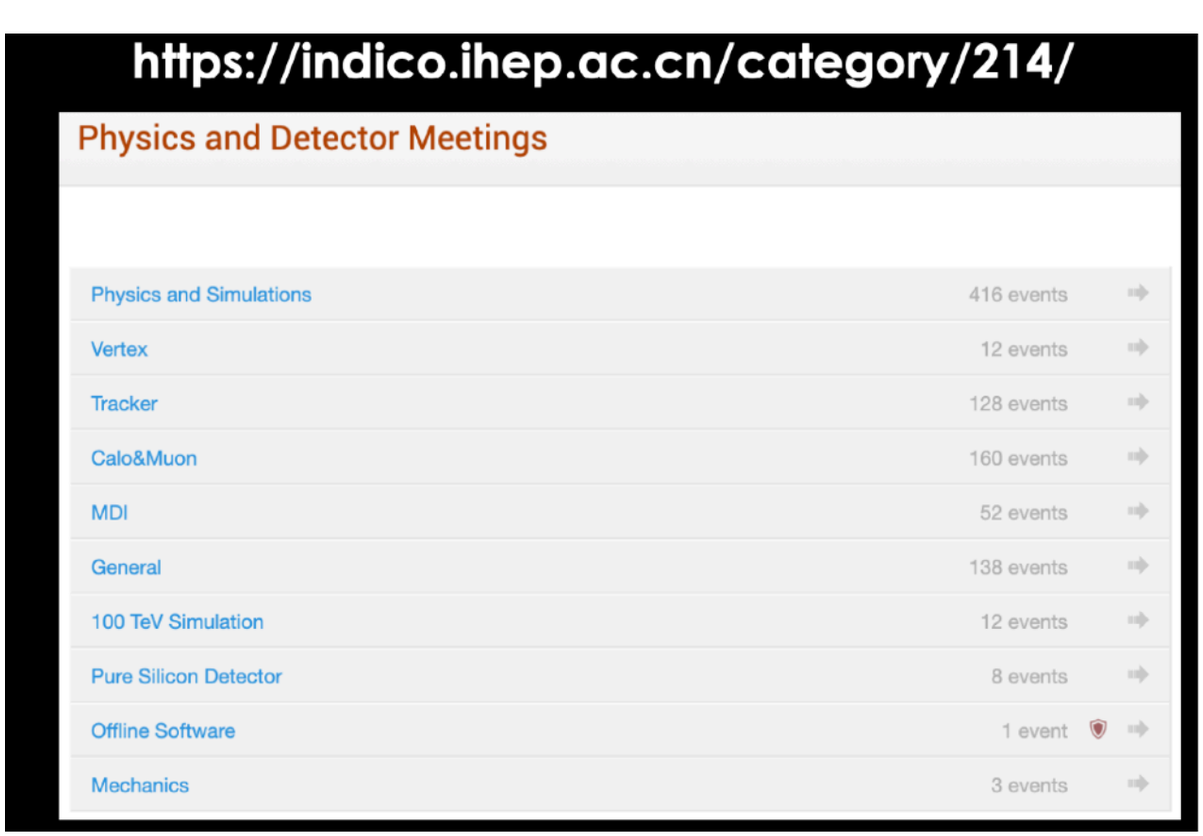

Action Item:

Organize meetings through the proper indico interface for our group

Create a proper paper trail that can be used for reporting on the progress

IAC Report - Recommendations

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)

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.

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.

IDRDC: Preparation for Next Meeting Preparation

17 documents, 95 subtasks, 80 pages

Submitted to committee chair but 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 Shengseng, Li Gang

IDRDC: Preparation for Next Meeting Preparation

Waiting for feedback

PBS	Task Name	Finish
	CEPC Detector R&D Project	**26/12/31**
1	**Vertex**	**23/12/29**
1.1	Vertex Prototype	23/12/29
1.2	ARCADIA CMOS MAPS	23/12/29
2	**Tracker**	**24/12/31**
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4	**Muon Detector**	**24/12/31**
4.1	Scintillator-based Muon Detector Prototype	23/12/29
4.2	Muon and pre-shower µRWELL-based detectors	24/12/31
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5.1	LTS solenoid magnet	25/12/31
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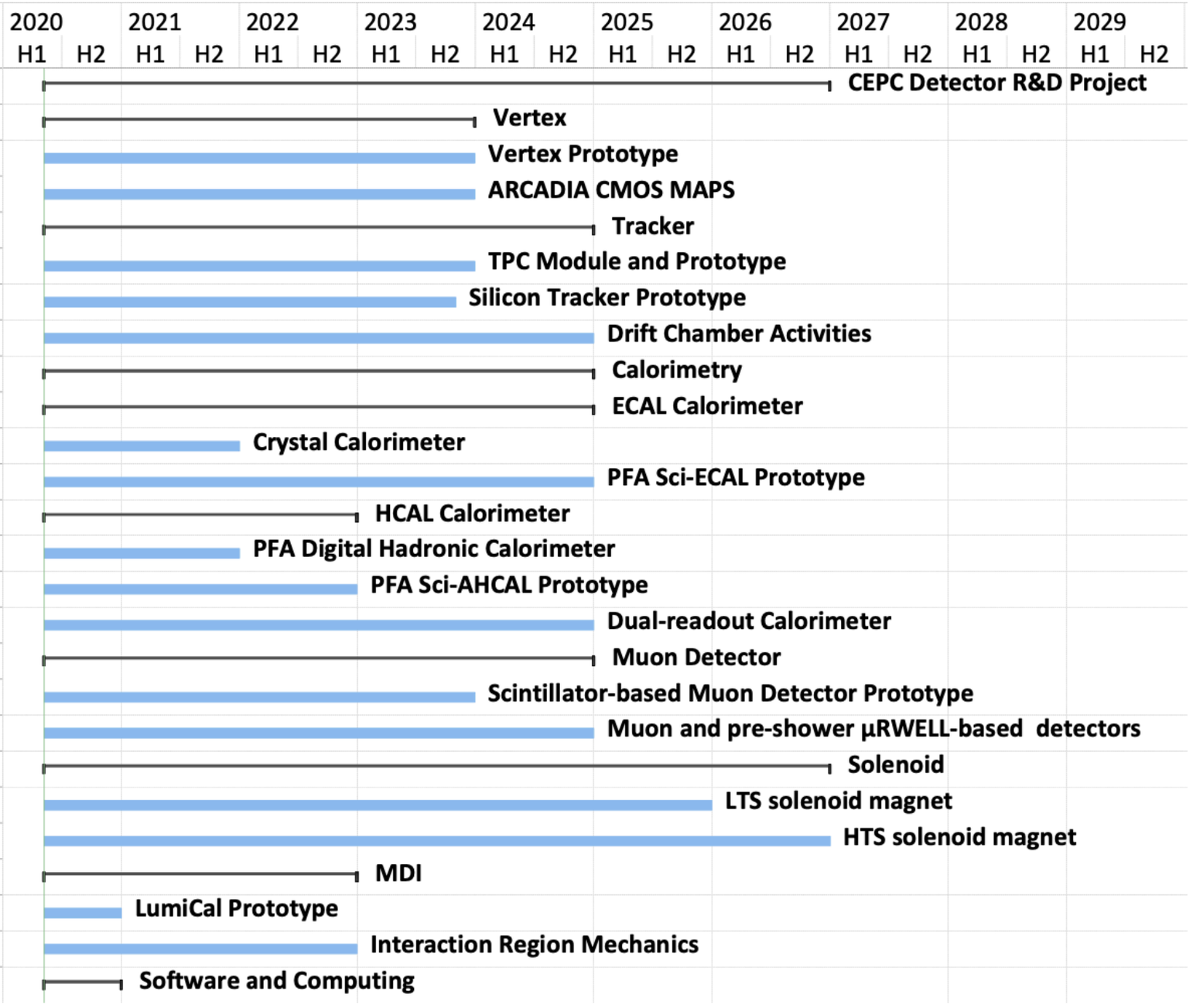

IAC Report - Recommendations

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.

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.

Action Item: Ji Quan already acting as project engineer overseeing many of these issues.

Identify more engineers involved at the detector level and ensure that the communication is optimized

Try to get international participation at this level as well

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.

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).

Action Item: Continue to expand the team working on flavor physics and strong interactions

Promote engagement from university physicists

IAC Report - Recommendations

Detector R&D and Physics Studies

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

Action Item: IDEA colleagues already involved in both projects, but expand beyond that to include common detector R&D projects. Some of these already starting.

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

3. *In light of the new global reality, how should we carry out international collaboration with the CEPC?*

The IAC believes it is important to engage more frequently with the experienced scientists that serve on the International Detector R&D Committee. A meeting next Spring, as proposed, is desirable. In future these should be regular meetings perhaps on a cadence of every six months. See Recommendation 1.

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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 Grancagnolo
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. Feipeng NING (IHEP)
Material: Slides

Physics
17 LoI

Open Physics Questions
Convener: 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 ϕs measurement via Bs → J/Ψϕ channel at CEPC** *3'*
Speaker: Mingrui Zhao
Material: Slides

16:12 **EF03-Probing top quark FCNC couplings tqγ, tqZ at future e+e- collider** *3'*
Speaker: Peiwen Wu
Material: Slides

16:15 **EF03-Searching for Bs → ϕνν and other b → sνν 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- → W+W- at CEPC with optimal observables** *3'*
Speaker: Jiayin Gu
Material: Slides

16:24 **EF05-Exlusive 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 Bc →τ ν_τ** *3'*
Speaker: Taifan Zheng
Material: Slides