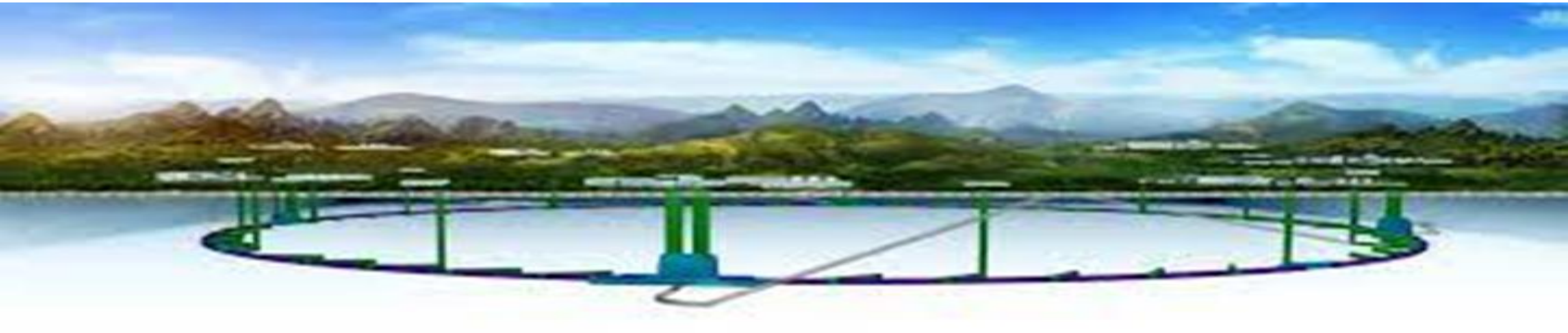
2024 LHC Days Split, October 4, 2024

Status and Perspectives
The Circular Electron Positron Collider

XinChou LOU

IHEP, Beijing



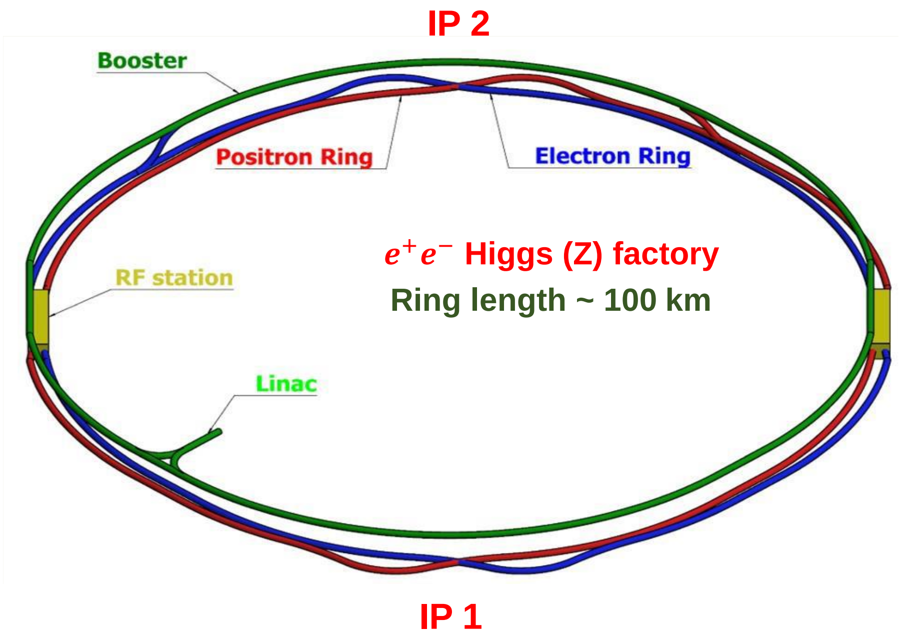
Outline

- Introduction and Reminder
- CEPC Status and Progress
- The SppC
- CEPC Plan
- Summary

Introduction

The idea of CEPC followed by a possible Super proton-proton collider(SppC) was proposed in Sep. 2012, and quickly gained the momentum in IHEP and in the world.

- **Looking for Hints@e^+e^- Collider ➔ If yes, direct search at pp collider**
- **The tunnel can be re-used for pp, AA, ep colliders up to ~ 100 TeV**



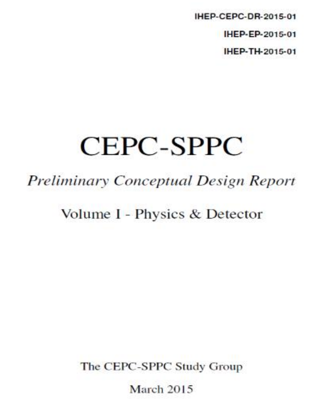
- ❑ A Higgs factory - to run at $\sqrt{s}$ ~ 240 GeV, above the **ZH** production threshold for ≥1 M Higgs; at the **Z** pole for ~Tera Z; at the **W^+W^-** pair and then $t\bar{t}$ pair production thresholds. Probes of physics BSM.
- ❑ The CEPC aims to start operation in 2030's, as a Higgs (Z / W) factory in China.

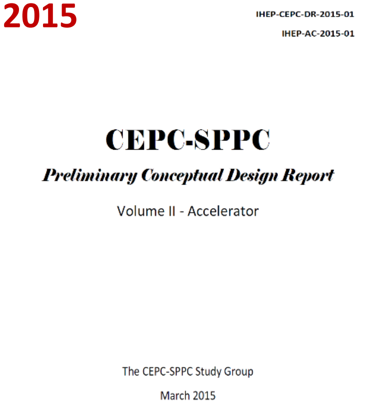
Introduction

CEPC team took steps to advance

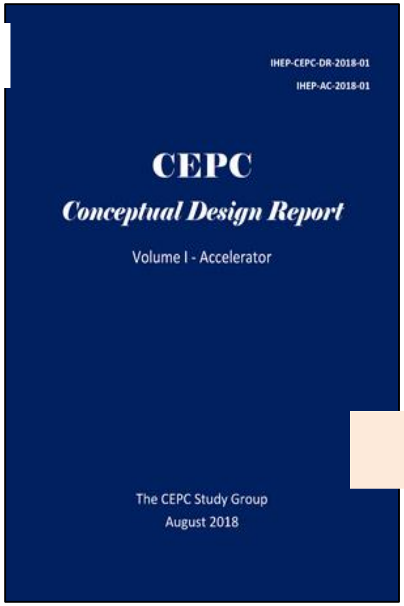
2013

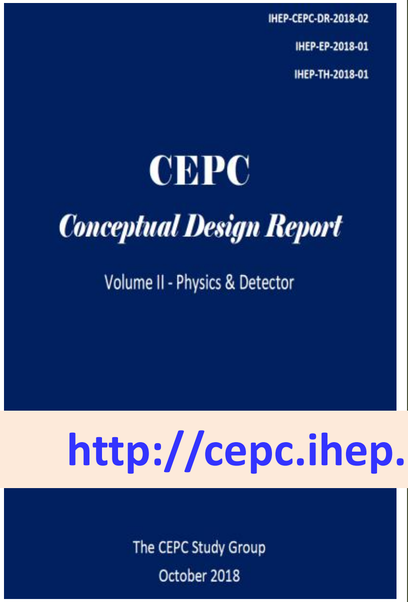
2015





2018





2023

2024

http://cepc.ihep.ac.cn

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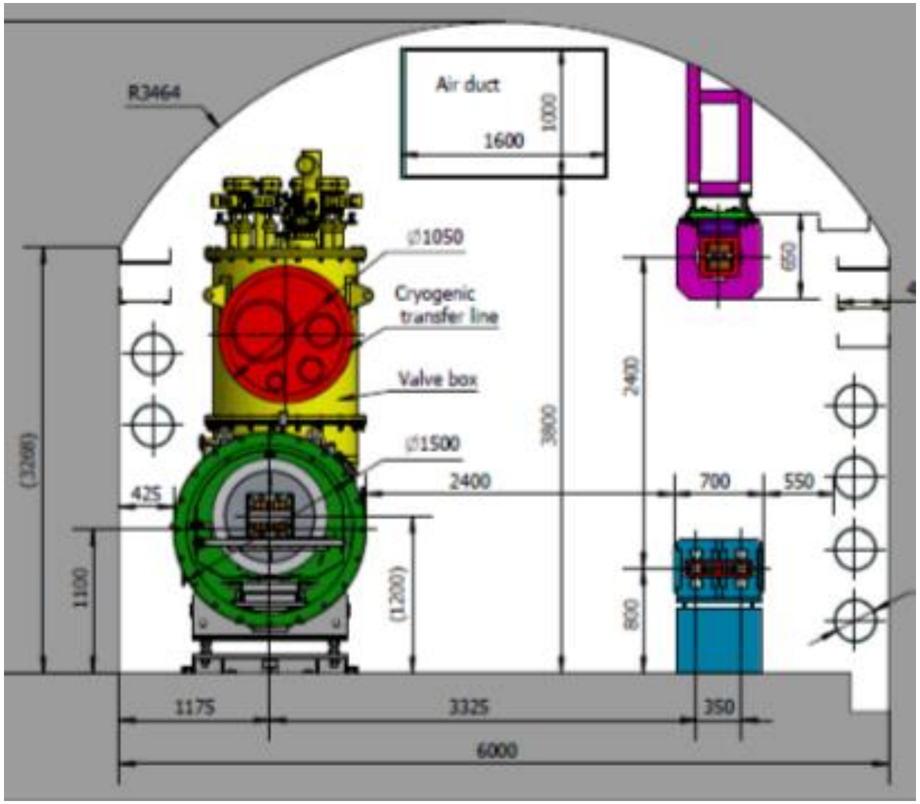
CEPC Status and Progress



CEPCAccelerator TDR Published

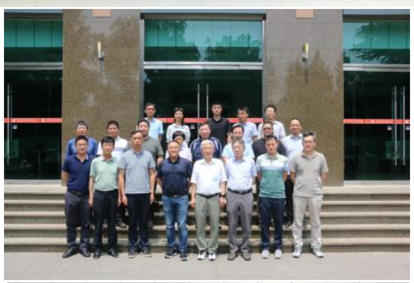
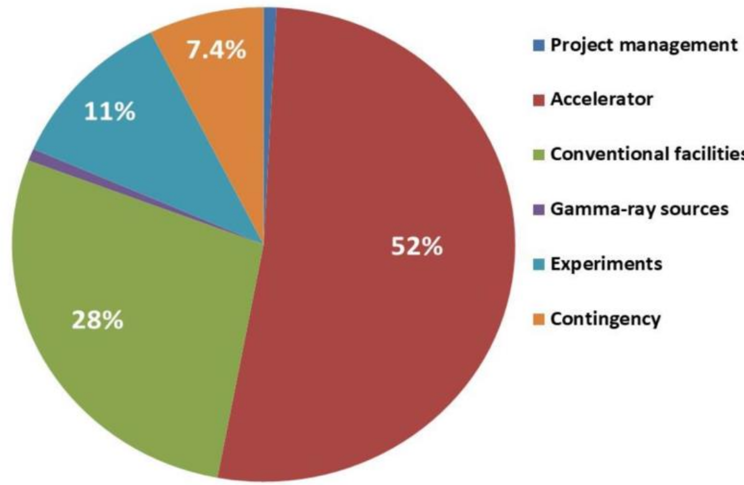


Table 12.1.2: CEPC project cost breakdown, (Unit: 100,000,000 yuan)

Total	**364**	**100%**
Project management	3	0.8%
Accelerator	190	52%
Conventional facilities	101	28%
Gamma-ray beam lines	3	0.8%
Experiments	40	11%
Contingency (8%)	27	7.4%



Distribution of CEPC Project total TDR cost of **36.4B RMB (~ 5B €)**

CEPC accelerator TDR has been completed and formally released on December 25, 2023
CEPC accelerator TDR link: （arXiv： 2312.14363）
CEPC accelerator TDR releasing news:
http://english.ihep.cas.cn/nw/han/y23/202312/t20231229_654555.html

published in
RDTM Vol.8
June 2024

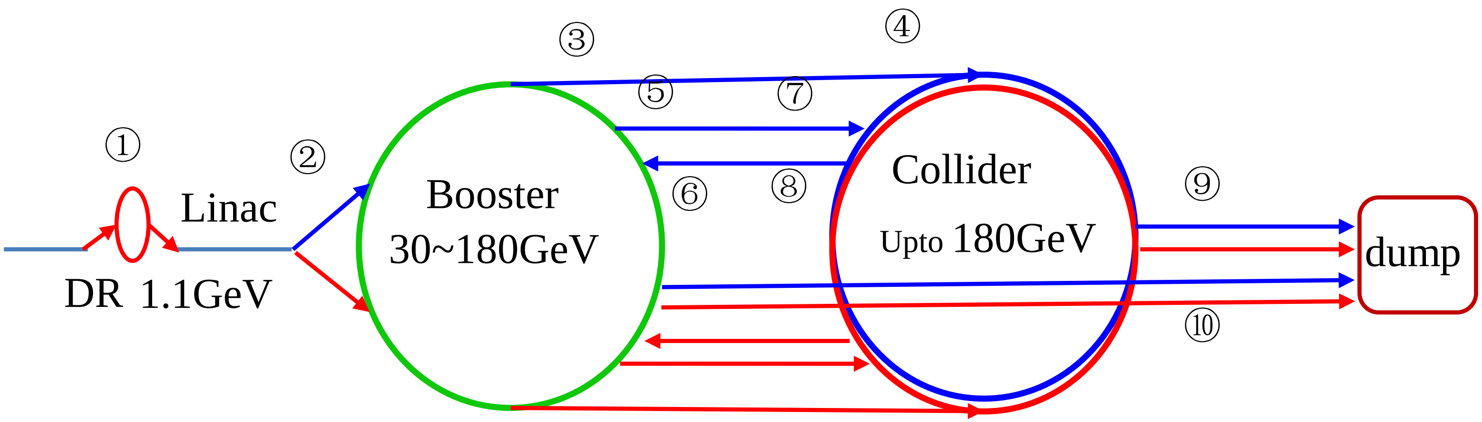
CEPC Parameters and Layout

Booster

		tt	*H*		*W*	*Z*	
		Off axis injection	Off axis injection	On axis injection	Off axis injection	Off axis injection	
Circumfer.	km	**100**					
Injection energy	GeV	**30**					
Extraction energy	GeV	**180**	**120**		**80**	**45.5**	
Bunch number		35	268	261+7	1297	3978	5967
Maximum bunch charge	nC	0.99	0.7	20.3	0.73	0.8	0.81
Beam current	mA	0.11	0.94	0.98	2.85	9.5	14.4
SR power	MW	0.93	0.94	1.66	0.94	0.323	0.49
Emittance	nm	2.83	1.26		0.56	0.19	
RF frequency	GHz	1.3					
RF voltage	GV	9.7	2.17		0.87	0.46	
Full injection from empty	h	0.1	0.14	0.16	0.27	1.8	0.8

Collider

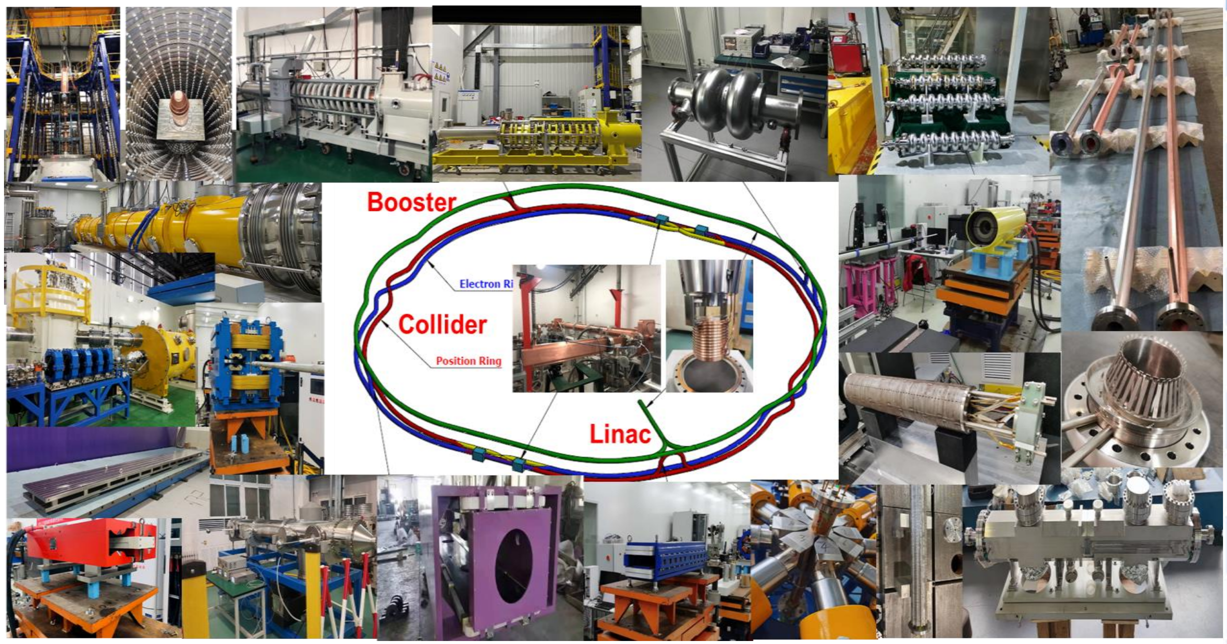
	Higgs	Z	W	$t\bar{t}$
Number of IPs	2			
Circumference (km)	**100.0**			
SR power per beam (MW)	**30**			
Energy (GeV)	**120**	**45.5**	**80**	**180**
Bunch number	268	11934	1297	35
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.64/1.3	0.27/1.4	0.87/1.7	1.4/4.7
Beam size at IP σ_x/σ_y (um/nm)	14/36	6/35	13/42	39/113
Bunch length (natural/total) (mm)	2.3/4.1	2.5/8.7	2.5/4.9	2.2/2.9
Beam-beam parameters ξ_x/ξ_y	0.015/0.11	0.004/0.127	0.012/0.113	0.071/0.1
RF frequency (MHz)	650			
Luminosity per IP (10^{34} cm^{-2} s^{-1})	**5.0**	**115**	**16**	**0.5**



Running scenarios
Higgs 10 years
Z 3 years
W 1 year
ttbar 5 years

Key Accelerator Technology Readiness

Key Technologies for the CEPC



Specification Met ✓ Prototype Manufactured ✓

	Accelerator	Fraction
Specification Met	Magnets	27.3%
Specification Met	Vacuum	18.3%
Prototype Manufactured	RF power source	9.1%
Specification Met	Mechanics	7.6%
Specification Met	Magnet power supplies	7.0%
Specification Met	SC RF	7.1%
Specification Met	Cryogenics	6.5%
Specification Met	Linac and sources	5.5%
Specification Met	Instrumentation	5.3%
Prototype Manufactured	Control	2.4%
Prototype Manufactured	Survey and alignment	2.4%
Specification Met	Radiation protection	1.0%
Prototype Manufactured	SC magnets	0.4%
Specification Met	Damping ring	0.2%

R&D and Validation key technology R&D spans all component for CEPCready for construction by 2027-8

HEPS just completed by IHEP

Key Accelerator Technology Readiness

CEPC Booster 1.3 GHz 8 x 9-cell High Q Cryomodule

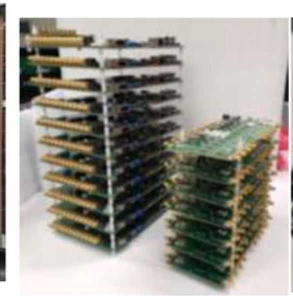
CEPC booster 1.3 GHz SRF R&D and industrialization in synergy with CW FEL projects.

Parameters	Horizontal test results	CEPC Booster Higgs Spec	LCLS-II, SHINE Spec	LCLS-II-HE Spec
Average usable CW E_{acc} (MV/m)	23.1	3.0×10^{10} @ 21.8 MV/m	2.7×10^{10} @ 16 MV/m	2.7×10^{10} @ 20.8 MV/m
Average Q_0 @ 21.8 MV/m	3.4×10^{10}			



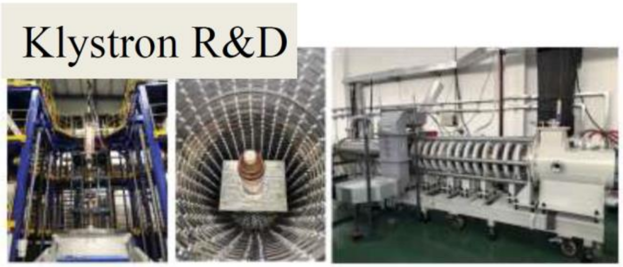




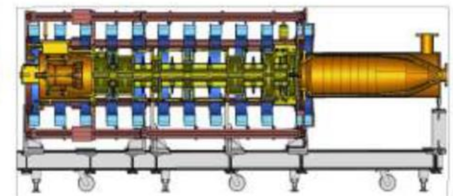




Exceeds the CEPC specifications

Key Accelerator Technology Readiness



Klystron No. 2
Efficiency 77%
(2021)



Klystron No. 1
Efficiency 65%
(2020)

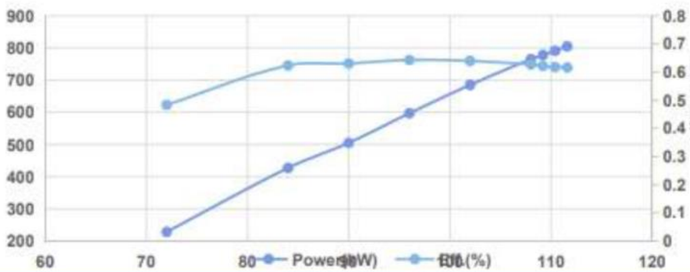
Pulsed RF Mode (30% duty factor, 60ms/5Hz)

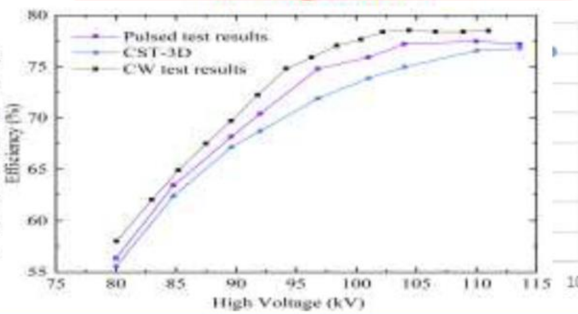
78.5%@803kW CW in 2024

Klystron No. 3 （MBK
Efficiency 80.5%

To be completed in 2024

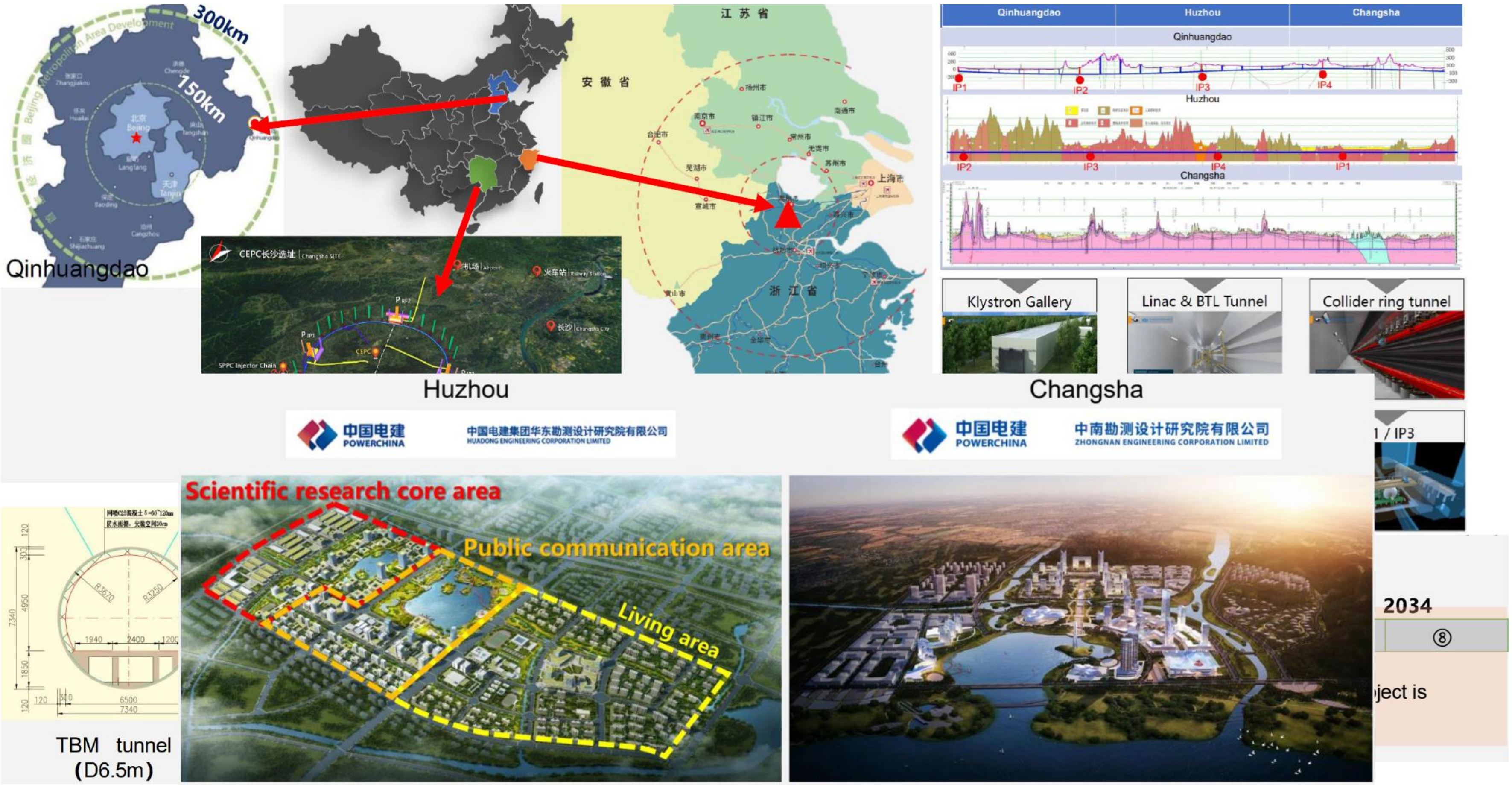
High Voltage vs. Power&Efficency





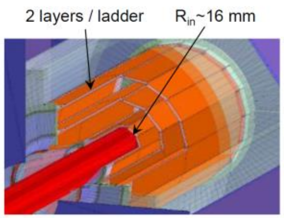
CEPC collider ring 650MHz klystron development in TDR phase

CEPC Status – site selection



CEPC Detector R&D

Vertex detector



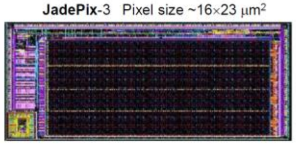
Goal: σ(IP) ~ 5 μm for high P track

CDR design specifications
- **Single point resolution ~ 3μm**
- **Low material (0.15% X_0 / layer)**
- **Low power (< 50 mW/cm²)**
- **Radiation hard (1 Mrad/year)**

Silicon pixel sensor develops in 5 series: JadePix, TaichuPix, CPV, Arcadia, CEPCPix

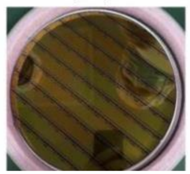
Develop **CEPCPix** for a CEPC tracke basing on **ATLASPix3** CN/IT/UK/DE
TSI 180 nm HV-CMOS process

JadePix-3 Pixel size ~16×23 μm²

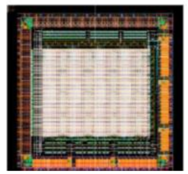


Tower-Jazz 180nm CiS process
Resolution 5 microns, 53mW/cm²

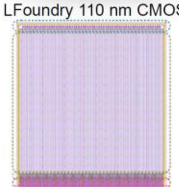
TaichuPix-3, FS 2.5x1.5 cm²
25×25 μm² pixel size



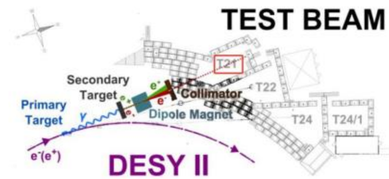
CPV4 (SOI-3D), 64×64 array
~21×17 μm² pixel size

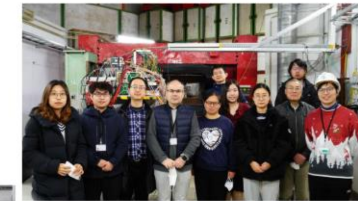


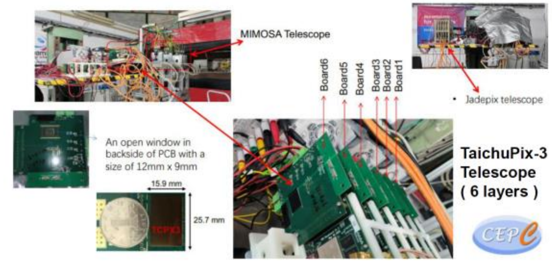
Arcadia by Italian groups
for IDEA vertex detector
LFoundry 110 nm CMOS



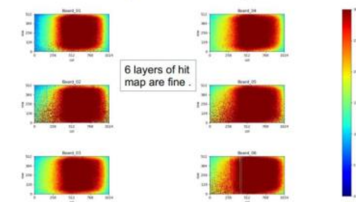
Full vertex detector prototype (TaichuPix-3, JadePix-3) has TB at DESY in Dec. 2022.





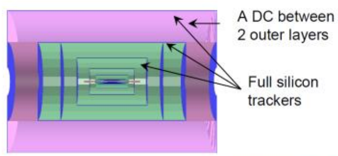


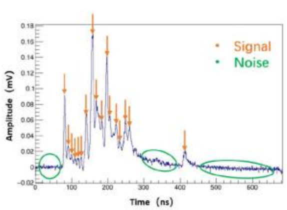
Hitmap of 4 GeV e⁺/e⁻ beam

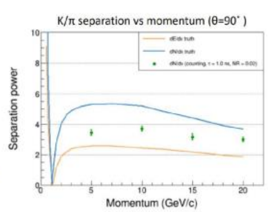


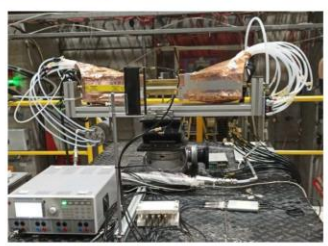
particle ID +main tracker

- **Goal: 3σ π/K separation up to ~20 GeV/c.**
- Cluster counting method, or **dN/dx**, measures the number of primary ionization
- **Can be optimized specifically for PID**: larger cell size, no stereo layers, different gas mixture.
- Garfield++ for simulation, realistic electronics, peak finding algorithm development.

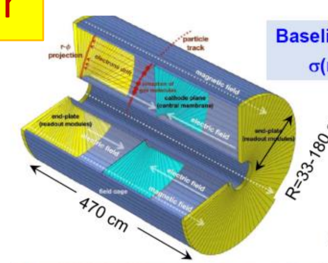




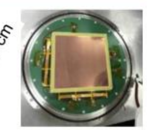


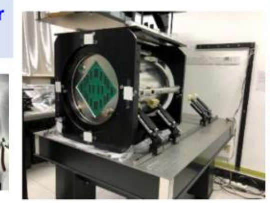


IHEP and Italian INFN groups have close collaboration and regular meetings.
IHEP joined the TB (led by INFN group) in 2021 and 2022



Baseline main tracker
σ(r-ϕ) ~100 μm

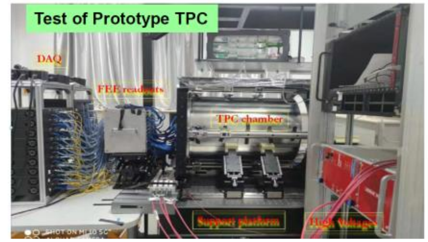




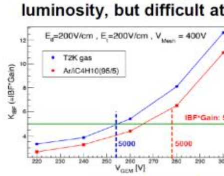
MOST 1 (IHEP+THU)

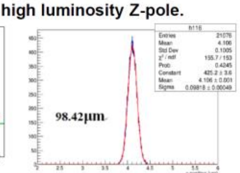
GEM-MM cathode **TPC Prototype + UV laser beams** **Low power FEE ASIC**

Test of Prototype TPC



Challenge: Ion backflow (IBF) affects the resolution. It can be corrected by a laser calibration at low luminosity, but difficult at high luminosity Z-pole.



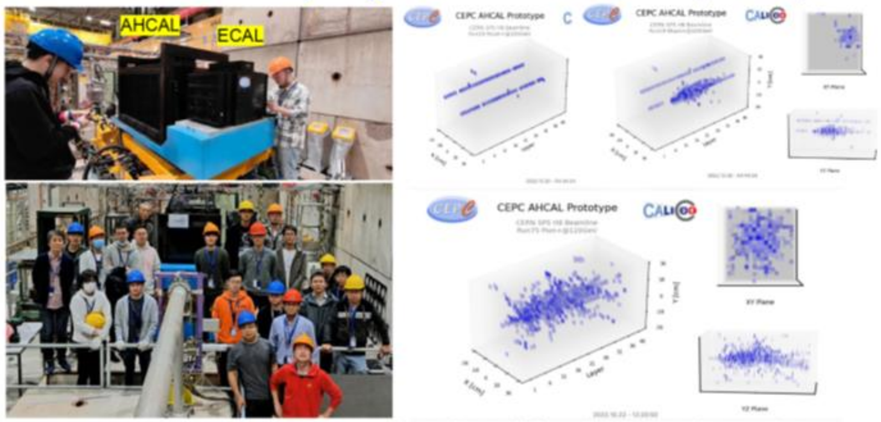


σ_x < 100 μm for drift length of 27cm

CEPC Detector R&D

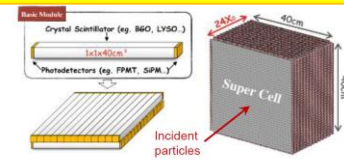
EM + hadron colarimeters： prototypes

➤ PFA ScW-ECAL & AHCAL prototypes: Test Beam at CERN SPS H8 (Oct. 2022)



USTC, IHEP, SJTU, Japanese & Israel groups have close collaboration and regular meetings

new crystal EM calorimeter for better resolution

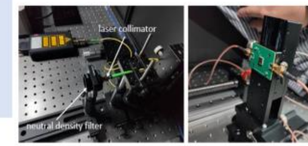


- Long bars: 1 x 40 cm, super-cell: 40x40 cm^2
- Timing at both ends for positioning along bar.
- Significant reduction of number of channels.

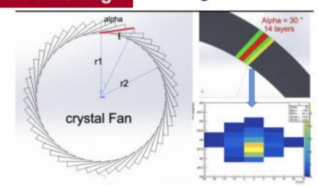
Goal

- Boson Mass Resolution < 4%
- Better BMR than ScW-ECAL
- Much better sensitivity to γ/e, especially at low energy.

Bench Test

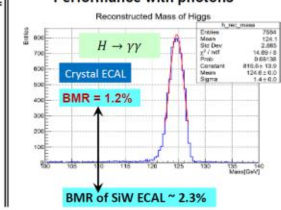


Crystal Fan Design Fine segmentation in Z, ϕ, r

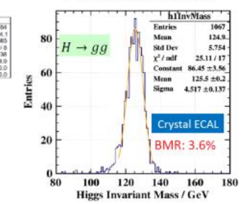


Full Simulation Studies + Optimizing PFA for crystals

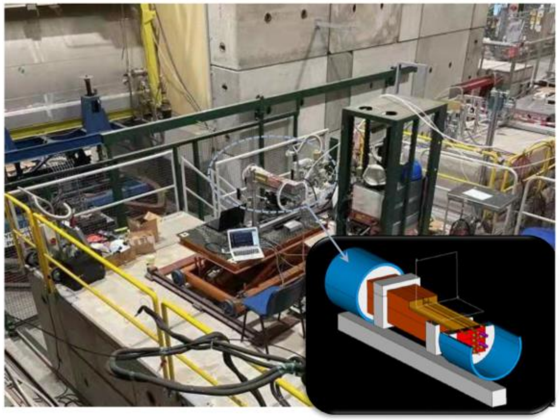
Performance with photons

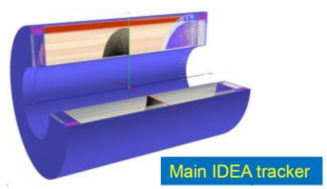


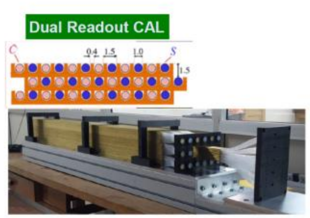
Performance with jets



Dual readout crystal calorimeter also being considered by USA and Italian colleagues







Italian groups and IHEP colleagues participated the test beam at CERN.

software

Key4hep: an international collaboration with CEPC participation
CEPCSW: a first application of Kep4hep – Tracking software
CEPCSW is already included in Key4hep software stack

https://github.com/cepc/CEPCSW

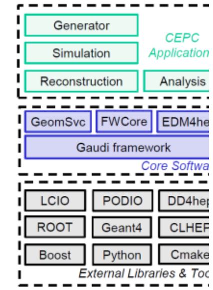
Architecture of CEPCSW

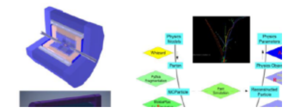
- External libraries
- Core software
- CEPC applications for simulation, reconstruction and analysis

Core Software

- Gaudi framework: defines interfaces of all software components and controls the event loop
- EDM4hep: generic event data model
- FWCore: manages the event data
- GeomSvc: DD4hep-based geometry management service

CEPCSW Structure





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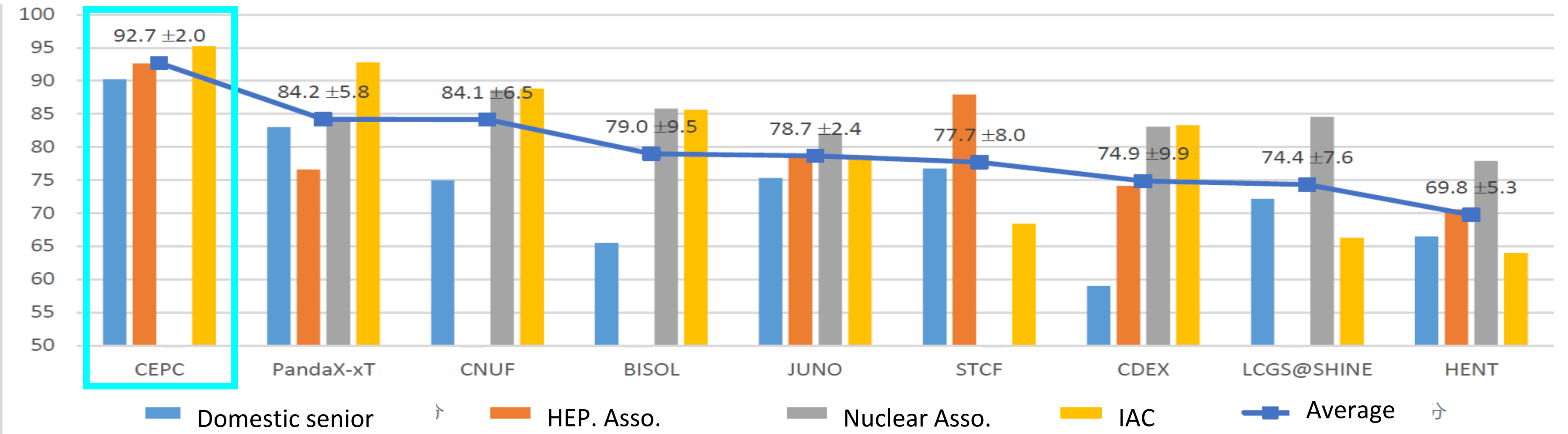
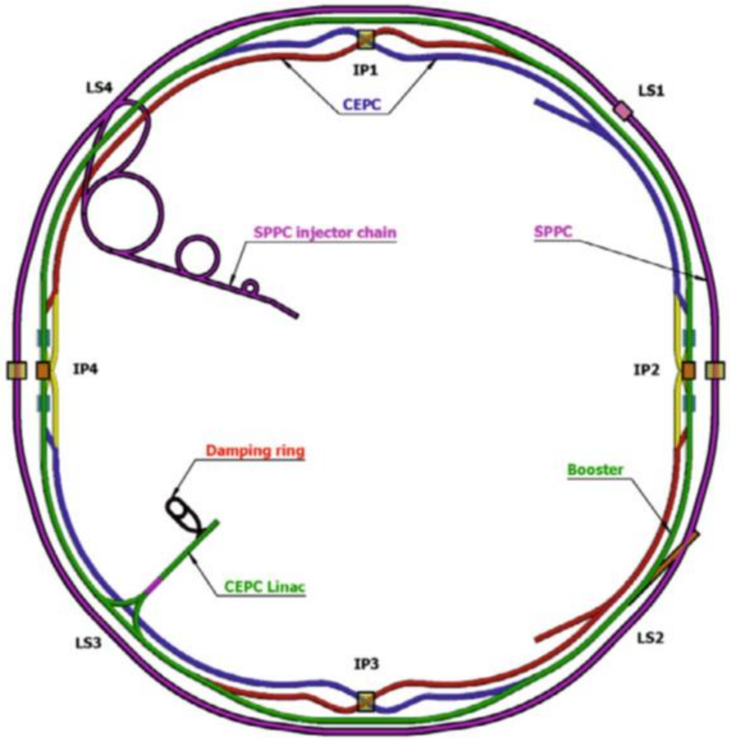
Project Development

- CAS is planning for the 15th 5-years plan for large science projects, and a steering committee has been established, chaired by the president of CAS
- **High energy physics**, as one of the 8 groups, accomplished the following:
  - Setting up rules and the standard(based on scientific and technological merits, strategic value and feasibility, R&D status, team and capabilities, etc.), established domestic and international advisory committees
  - Collected 15 proposals and selected 9, based on the above-mentioned standard
  - Evaluations and ranking by committees after oral presentations by each project
- **CEPC is ranked No. 1, with the smallest uncertainties, by every committee**
- A final report was submitted to CAS for consideration



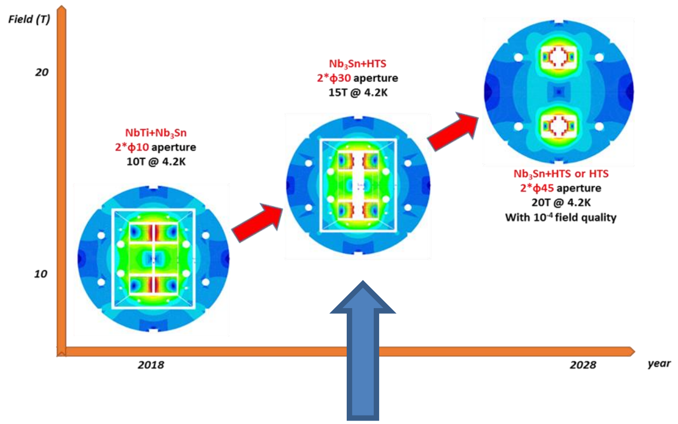
Super proton-proton Collider



SppC

Super proton-proton Collider

- E_{cm} up to 125 TeV with 100 km ring
- 2 IPs, 10^{35} $cm^{-2}s^{-1}$ per IP
- new machine after the CEPC
- can extend to heavy ion collisions
- retaining the CEPC collider
- add possible ep option

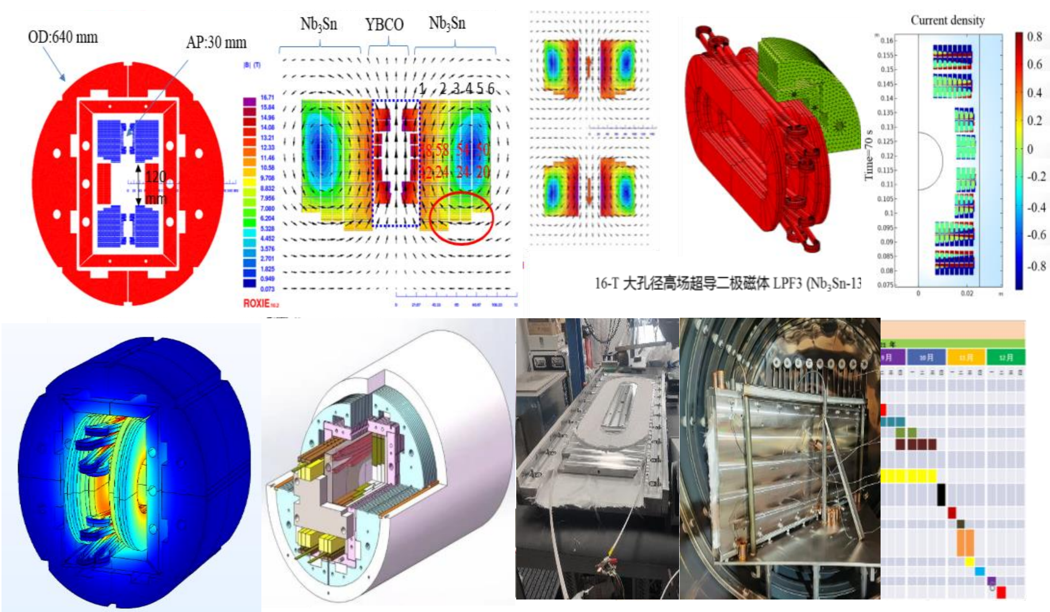


Current consideration for SppC

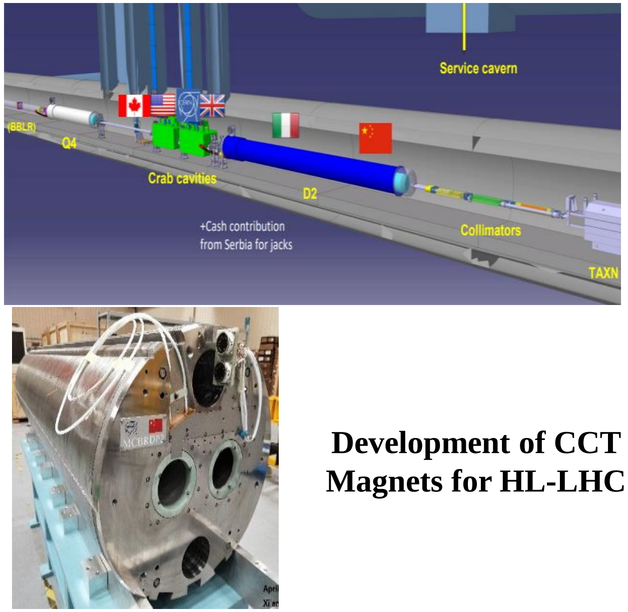
- design compatible with a future SppC layout
- 20T B field, twin-aperture magnets
- new HTS (even IBS) magnets (in 20-30 years)

SppC

- **16T model dipole magnet under development:** Nb_3Sn 12~13T + HTS 3~4T. **The highest quench field reached over 14T @4.2K in 2023. 16T @4.2K to be realized in 2024.**
- **Stainless-steel stabilized IBS tape achieved the highest J_e in 2022. Significantly reduced cost and raised mechanical properties. IBS model coils reached 60A @32T.**
- **China & CERN Collaboration on accelerator technology: development of HL-LHC CCT magnets going well. Half of 12+1 magnets have been delivered to CERN**



16T Model Dipole under development



Development of CCT Magnets for HL-LHC

CEPC Plan

- Engineering Design towards an EDR
- A reference design detector for domestic evaluation
- 15^{th} FYP

Engineering Design towards an EDR

2012.9	2015.3	2018.11	2023.10	2025	2027	15th five year plan
CEPC proposed	Pre-CDR	CDR	TDR	CEPC Proposal	EDR	Start of construction

CEPC EDR Phase General Goal (2024-2027):

CEPC accelerator will enter the Engineering Design Report (EDR) phase (2024-2027); its also the preparation phase with the aim for CEPC proposal to the Chinese government ~2025 for approval.

CEPC EDR includes accelerator and detector (TDRrd)
CEPC detector TDR reference design (rd) will be released by June 30, 2025

CEPC Accelerator EDR Phase goals, scope and the working plan (preliminary) of 35 WGs summarized in a documents of 20 pages to be reviewed by IARC in 2024

EDR Scope and Plan

Based on the CEPC TDR accelerator design, demonstrate a complete and coherent feasibility EDR design, which will guarantee the construction, commissioning, operation, and upgrade possibilities .

The CEPC EDR accelerator design should guarantee the physics goals with required energies (Higgs, W and Z pole, with ttbar as upgrade possibility) and corresponding required luminosities with 30MW synchrotron radiation power/beam as a baseline, and 50MW as upgrade possibility.

Based on the CEPC TDR accelerator key technology R&D achievement, complete the accelerator engineering design and necessary EDR R&D to be ready for industrial fabrications.

Complete
domestic a

Reviewed by IARC committee in September

In collaboration with local government, CAS and MOST (central government), CEPC sites converge from serval candidates to a EDR construction site satisfying the required geological conditions, electric power and water resources, social and environment conditions, domestic and international transportation network conditions, international science city, and sustainable development , etc.

Complete detailed construction site geological studies and corresponding site dependent civil engineering design and general utility facility design.

Complete the radiation, security, environment assessment studies and necessary documents –so called CEPC PROPOSAL, around 2025ready for the application to the central government to get the formal approval of construction in the “15th five year plan”

Make detailed analysis and preparation for the human resources needed for the completion of CEPC construction.

In the Engineering Design Phase, create and maintain a complete database, such as cost items with information regarding technology maturity (TRL), design completeness, and cost basis, to identify and prioritize areas for R&D, prototyping and industrialization.

Work out a detailed construction time line and plan in relation with industrial fabrications, measurements, transportations, storage warehouses, installation, human resource evolution, etc.

Workout details on 3% installation and 3% commissioning items of the total accelerator cost.

Improve design maturity of several systems (particularly MDI and cryogenics)

vendors and multiple production lines (for example, demonstrate automatic magnets production line and NEG coated vacuum chambers mass production facility)

Consider re-optimizing the technical design of components and systems with large electricity consumption taking into account both capital and operational expenditure

Define unambiguously what constitutes the end of the construction project.

For labour-intensive, high-volume activities, in particular the components of the collider and booster, refine and review the production model to check the availability of in-house resources.

Risk assessment and risk management

Based on TDR cost estimate, make an updated EDR cost estimate.

Carefully consider the recommendations from CEPC accelerator TDR review and TDR cost review committees, IARC and IAC, etc.

Continues efforts in green collider and sustainable development with energy saving technologies, wast heat reuse, energy recovery, and green energy utilization, etc.

Establish more international collaborations, international involvement, and industrial preparations both from domestic and international companies and suppliers.

Refine the CEPC management structure in relation with host lab. Refine the CEPC construction funding modes.

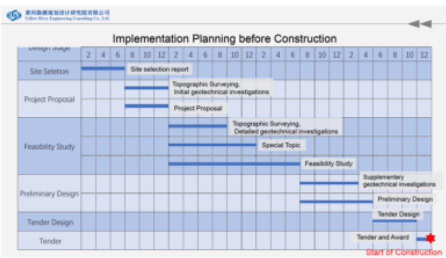
Obtain the necessary EDR plan and scope related fundings.

Complete “CEPC Proposal” around 2025 ready for application of final selection of the 15th 5-year plan, and complete EDR around 2027 before the construction.

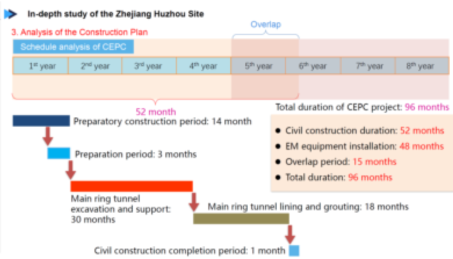
Engineering Design towards an EDR

CEPC Site Implementation and Construction Plans

CEPC site implementation plan in EDR



CEPC construction plan

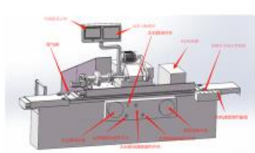


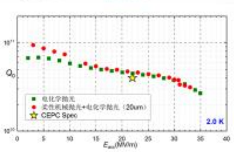
Future Plan for CEPC SRF

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034-2035	2036-2045	2046-2047	2048	2049-2053
EDR																
Civil construction																
Acc. construction & installation																
Commission & operation													H	Z	W	ttbar
SRF system engineering design	Layout, cost, module, beam-cavity, LLRF, interfaces ...															
650 MHz test module (2x2-cell)	Beam operation, replace with high Q cav & variable coupler															
650 MHz H module (6x2-cell)	Design	pCM fabrication		pCM test	Prepare	Production of 32 CM / 192 2-cell CAV for 30 MW H				Installation, Commissioning			Op & +24 CM	Operation		
1.3 GHz H module	High Q module	Mass production of modules with SCM and BPM			pCM fab	pCM test	Production of 12 CM / 96 9-cell CAV			Installation, Commissioning			Operation			
1.3 GHz Z module (high current)		Design and R&D			pCM fabrication		pCM test		Production of 4 CM / 32 9-cell CAV		Installation, Commissioning		Operation			
650 MHz HL-Z module	Conceptual design. 500 MHz high current module production.				Design and R&D							Produce and Install 60+40 1-cell CM		Op		
ttbar cavity and module	Design and R&D of high gradient high Q and new material (Nb3Sn etc.) 650 MHz and 1.3 GHz cavities and module for ttbar								pCM fabrication and test				Production and Installation of 48 CM / 192 650 MHz 5-cell CAV 32 CM / 256 1.3 GHz 9-cell CAV			Op

CEPC SRF Industrial Production Technology

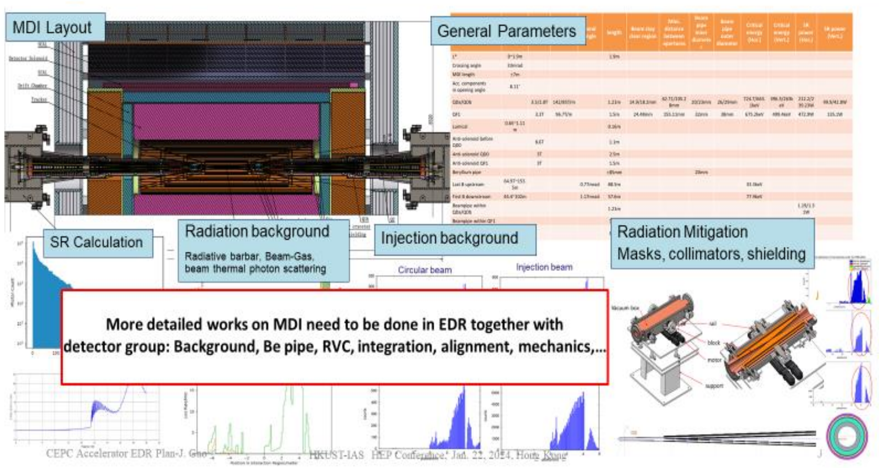
- In 2023, IHEP invented soft SRF cavity polishing equipment has been completed and it will be installed at IHEP soon, and it reached the same surface roughness as EP. CEPC 650 MHz cavity treated by the soft polishing equipment reached the CEPC specification





650 MHz SC measurement result with soft polishing technology

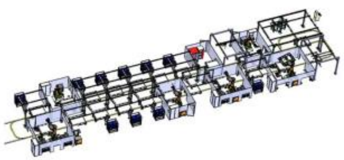
CEPC MDI in EDR



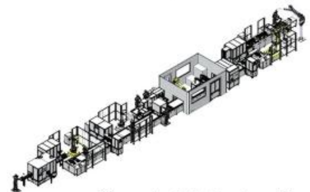
EDR - Examples

CEPC Magnets' Automatic Production Lines in EDR

To reduce the fabrication cost of the magnets of CEPC, automatic magnet production lines will be demonstrated in EDR and used during construction



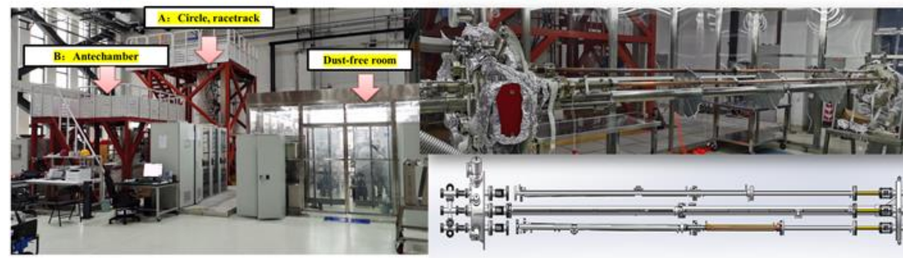
Conceptual design type-I (Booster magnet)



Conceptual design type-II (Collider ring magnet)

Massive Production Line of NEG Coating Vacuum Chambers in EDR

- The coating device A: Vacuum chambers are connected in parallel to 6 groups, each group of vacuum chambers length should be lower than 3.5m, outer diameter is about 0.47m;
- The coating device B: Antechamber are connected in parallel to 4 groups, each group of vacuum chambers length should be lower than 1.5m, due to its discharge difficulty.
- Two setups of NEG coating have been built for vacuum pipes of HEPS at IHEP Lab. And a lot of test vacuum pipes have been coated, which shows that NEG film has good adhesion and thickness distribution.
- **In EDR phase a dedicated CEPC NEG coated vacuum chamber production line is planned**



CEPC Accelerator Control and Timing in EDR

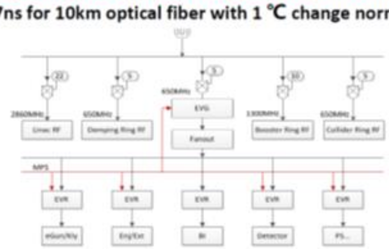
The basic structure of Timing System

- Event system and RF transmission system
- Event system: Trigger signal and Low frequency clock signal
- RF transmission system: Transmit high stability RF signal

In EDR phase CEPC high precision timing and control technology will be developed

Temperature variation induced drift compensation

0.7ns for 10km optical fiber with 1 ℃ change normally



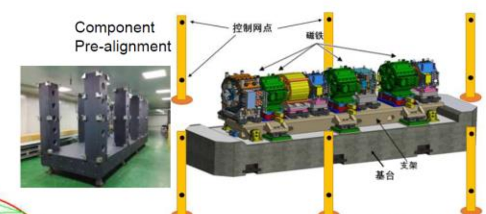
CEPC Alignment and Installation Plan in EDR

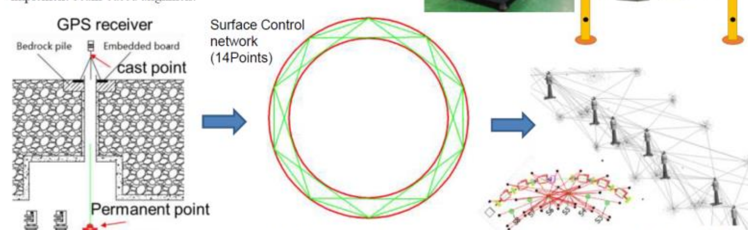
- Alignment accuracy requirement

Component	Δx (mm)	Δy (mm)	$\Delta\theta_z$ (mrad)
Dipole	0.10	0.10	0.10
Arc Quadrupole	0.10	0.10	0.10
IR Quadrupole	0.10	0.10	0.10
Sextupole	0.10*	0.10*	0.10

*implement beam-based alignment

Component Pre-alignment





Backbone Control network (short line:300m; long line 600m)

Tunnel Control network (interval of 6 meters)

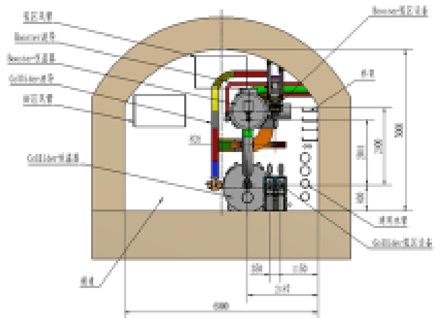
Wall Control Point

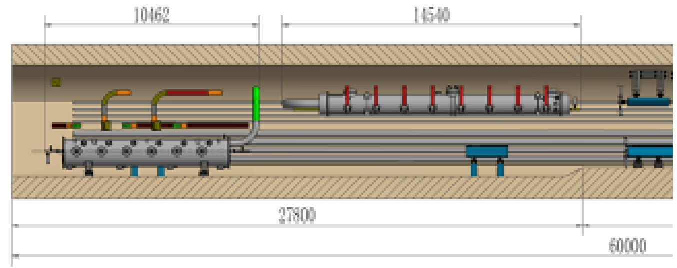
Ground Control Point

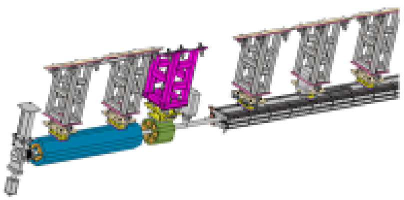
CEPC Accelerator EDR Plan-J. Gao

EDR - Examples

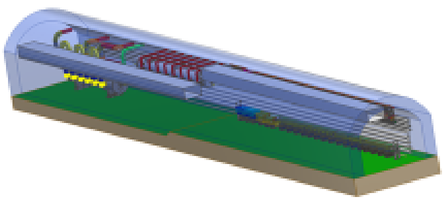
CEPC Tunnel Mockup for Installation in EDR

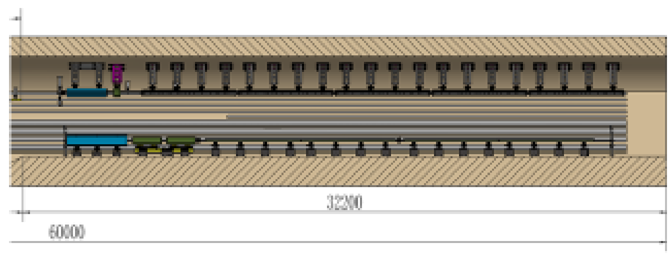


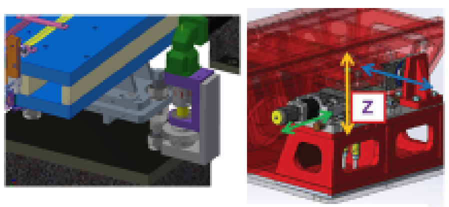




Booster magnets installation







Collider ring magnets supports

A 60 m long tunnel mockup, including parts of arc section and part of RF section

To demonstrate the inside tunnel alignment and installation, especially for booster installation on the roof of the tunnel

Accelerator EDR Plan - Review

CEPC International Accelerator Review Committee (IARC) Meeting was held from Sept. 18-20, 2024 at IHEP

The CEPC International Accelerator Review Committee (IARC) members visited IHEP 4th Generation 6GeV HEPS light source in Huairou campus of IHEP on Sept. 20, 2024 at IHEP

The CEPC International Accelerator Review Committee (IARC) members in the control room Of HEPS, and 30mA stored beam current have been reached during storage ring commissioning in Sept. 2024

Industrial Partners and Suppliers

	System
1	Magnet
2	Power supplier
3	Vacuum
4	Mechanics
5	RF Power
6	SRF/ RF
7	Cryogenics
8	Instrumentation
9	Control
10	Survey and alignment
11	Radiation protection
12	e-e+Sources

CEPC Industrial Promotion Consortium (CIPC, established in Nov. 2017)

Potential international collaborating suppliers and partners worldwide

CEPC in synergy with other accelerator projects in China

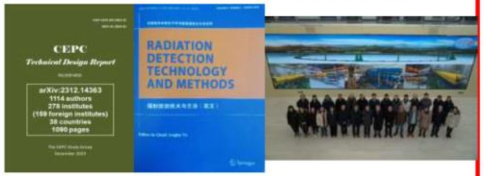
Project name	Machine type	Location	Cost (B RMB）	Completion time
CEPC	Higgs factory Upto ttar energy	Led by IHEP, China	**36.4 (where accelerator 19)**	Around 2035 (starting time around 2027)
BEPCII-U	e+e-collider 2.8GeV/beam	IHEP (Beijing)	**0.15**	2025
HEPS	4th generation light source of 6GeV	IHEP (Huanrou)	**5**	2025
SAPS	4th generation light source of 3.5GeV	IHEP (Dongguan)	**3**	2031 (in R&D, to be approved)
HALF	4th generation light source of 2.2GeV	USTC (Hefei)	**2.8**	2028
SHINE	Hard XFEL of 8GeV	Shanghai-Tech Univ., SARI and SIOM of CAS (Shanghai)	**10**	2027
S3XFEL	S3XFEL of 2.5GeV	Shenzhen IASF	**11.4**	2031
DALS	FEL of 1GeV	Dalian DICP	**-**	(in R&D, to be approved,)
HIAF	High Intensity heavy ion Accelerator Facility	IMP, Huizhou	**2.8**	2025
CIADS	Nuclear waste transmutation	IMP, Huizhou	**4**	2027
CSNS-II	Spallation Neutron source proton injector of 300MeV	IHEP, Dongguan	**2.9**	2029

The total cost of the accelerator projects under construction:39B RMB more than CEPC cost of 36.4B RMB

International Collaborations

CEPC attracts significant International participation and collaborations

Accelerator TDR report: 1114 authors from 278 institutes (including 159 International Institutes, 38 countries) Published in **Radiation Detection Technology and Methods (RDTM)** on June 3, 2024:
DOI: 10.1007/s41605-024-00463-y
https://doi.org/10.1007/s41605-024-00463-y



- More than 20 MoUs have been signed with international institutions and universities
- CEPC International Workshop since 2014
- EU-US versions of CEPC WS since 2018
- Annual working month at HKUST-IAS (mini workshops and HEP conference) since 2015

- **Strong participations by international scientists for CDR and TDR**
- **Reviews and guidance by many overseas experts**

- **Workshops and conf. at overseas sites**
- **Many Zoom meetings too**

HKIAS23 HEP Conference, Feb. 14-16, 2023
https://indico.cern.ch/event/1215937/

The 2024 HKUST IAS Mini workshop and conference were held from Jan. 18-19, and Jan. 22-25, 2024, respectively.
https://indico.cern.ch/event/1335278/timetable/?view=standard

The 2025 HKUST IAS HEP conference: Jan. 13-17, 2025.

CEPC Workshop EU Edition (Barcelona, Spain), May 5-8, 2024

The 2023 International Workshop on Circular Electron Positron Collider, EUEdition,University of Edinburgh, July 3-6, 2023
https://indico.ph.ed.ac.uk/event/259/overview

The 2024 international workshop on the high energy Circular Electron Positron Collider (CEPC) will be held from Oct. 23-27, 2024, Hangzhou, China
https://indico.ihep.ac.cn/event/22089/

The 2023 international workshop on the high energy Circular Electron Positron Collider (CEPC)
https://indico.ihep.ac.cn/event/19316/

Professor Peter Higgs passed away on **April 8, 2024**. We miss him.

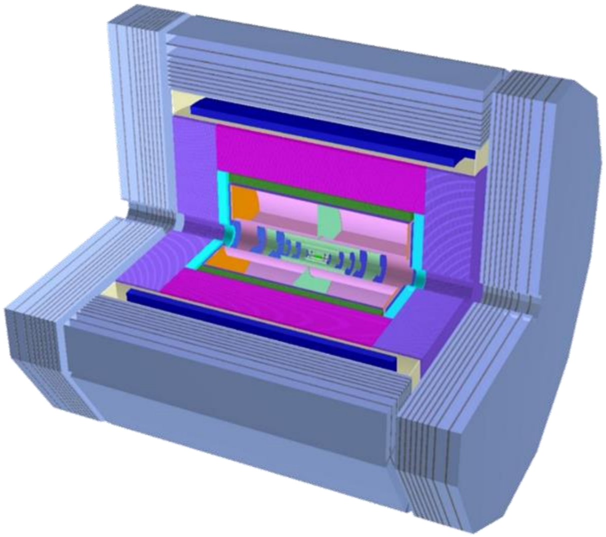
The 2024 international workshop of CEPC, EU-Edition were held in Marseille, France, April 8-11, 2024.
https://indico.in2p3.fr/event/20053/overview

FCPPNL, Bordeaux, France, June 10-14, 2024

TDR of a Reference Detector

- The CEPC study group is in process to produce TDR of a reference detector (ref-TDR) by June 2025, aiming mainly for domestic endorsement
- An international review committee has been formed to guide and review the design
- CEPC will continue to adopt better technologies; final detectors will be determined by international detector collaborations

System	Technologies	
	Baseline	For comparison
Beam pipe	Φ20 mm	
LumiCal	SiTrk+Crystal	
Vertex	CMOS+Stitching	CMOS Pixel
Tracker	CMOS SiDet ITrk	
	Pixelated TPC	PID Drift Chamber
	AC-LGAD OTrk	SSD / SPD OTrk
		LGAD ToF
ECAL	4D Crystal Bar	PS+SiPM+W, GS+SiPM, etc
HCAL	GS+SiPM+Fe	PS+SiPM+Fe, etc
Magnet	LTS	HTS
Muon	PS bar+SiPM	RPC
TDAQ	Conventional	Software Trigger
BE electr.	Common	Independent



Foundations:

- CEPC Instrumentation R&D
- LHC detector upgrade projects
- other HEP experiments
- progress in HEP worldwide R&D
- development in industry

CEPC Plan – 15th FYP

Preparation for China's 15th Five Year Plan (2026-30)

- Preparation is beginning….
- Procedure not clear yet
- The overall funding not known yet
- Coordination among IHEP, CAS, local-national governments expected
- CEPC aims at a start date in 2027-8, in the middle of the 15th FYP

CEPC team will complete the detector TDR_rd, well into the EDR, and make ready the necessary documents for the proposal

Summary

CEPC

- is on the path to converge into a complete package
- EDR process will reduce the cost and benefit the community
- is committed to strive to maximize international collaboration
- great help from international scientists and labs which are essential for CEPC
- is making strong effort to complete a proposal to the government for approval
- will offer the HEP community an early Higgs factory if successful

Acknowledgements

- CEPC team’s hard work, very fruitful international and CIPC collaborations have been critical to the CEPC program
- Special thanks to CEPC IB, SC, IAC, IARC and TDR review (+cost) Committee for their critical advices, suggestions and supports
- Funding agencies, CAS and IHEP for their financial supports