CEPC and SppC Proposals

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IHEP

On behalf of the CEPC-SppC team

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Contents

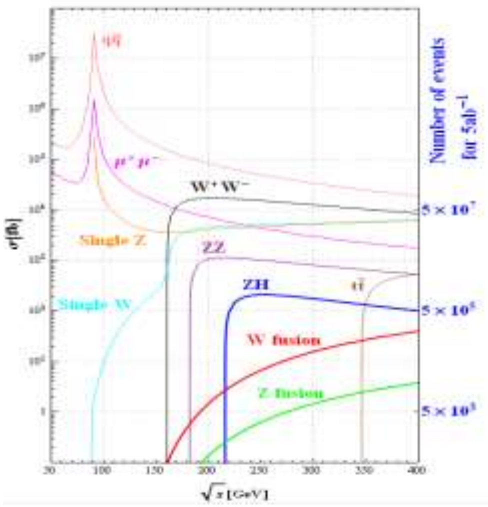
- Introduction
- CEPC accelerator design and key technologies R&D in TDR
- CEPC Detector R&D status
- SppC compatibility with CEPC
- CEPC site preparations in TDR
- CEPC accelerator TDR review (+cost) and IAC meeting
- CEPC EDR goals, plans and development towards construction
- CEPC industrial preparation and international collaborations
- Summary

Physics Goals of CEPC-SppC

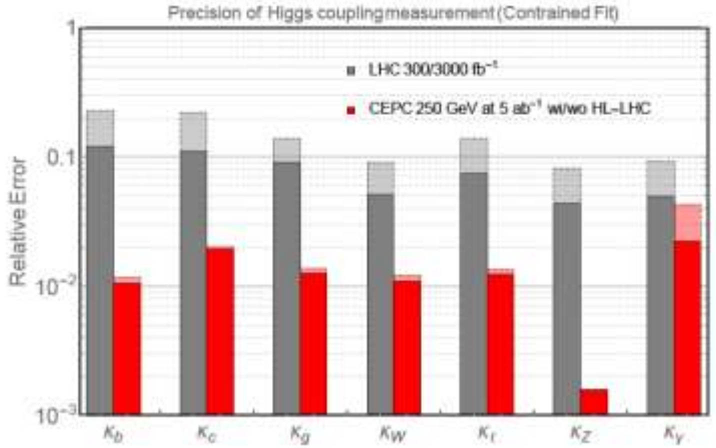
- **Circular Electron-Positron Collider (CEPC) as a Higgs Factory (91, 160, 240, 360 GeV)**
  - **Higgs Factory** (>10^6 Higgs) :
    - Precision study of Higgs(mH, JPC, couplings), complementary to Linear colliders
    - Looking for hints of new physics, DM...
  - Z & W factory (>10^10 Z0) :
    - precision test of SM
    - Rare decays ?
  - Flavor factory: b, c, t and QCD studies
- **Super proton-proton Collider(SppC) (~100 TeV)**
  - Directly search for new physics beyond SM
  - Precision test of SM
    - e.g., h3 & h4 couplings

CEPC-SppC was proposed by Chinese scientists in Sept. 2012 after Higgs Boson was discovered on July 4, 2012 at CERN

Precision measurement + Searches for new physics: complementary with each other



Cross sections for major SM physics processes at the electron positron collider



Anticipated accuracy on Higgs properties at CEPC and at LHC/HL-LHC

CEPC Operation Plan and Goals in TDR

Particle	$E_{c.m.}$ (GeV)	Years	SR Power (MW)	Lumi. per IP ($10^{34}cm^{-2}s^{-1}$)	Integrated Lumi. per year (ab^{-1}, 2 IPs)	Total Integrated L (ab^{-1}, 2 IPs)	Total no. of events
H*	240	10	50	8.3	2.2	21.6	4.3×10^6
			30	5	1.3	13	2.6×10^6
Z	91	2	50	192**	50	100	4.1×10^{12}
			30	115**	30	60	2.5×10^{12}
W	160	1	50	26.7	6.9	6.9	2.1×10^8
			30	16	4.2	4.2	1.3×10^8
$t\bar{t}$	360	5	50	0.8	0.2	1.0	0.6×10^6
			30	0.5	0.13	0.65	0.4×10^6

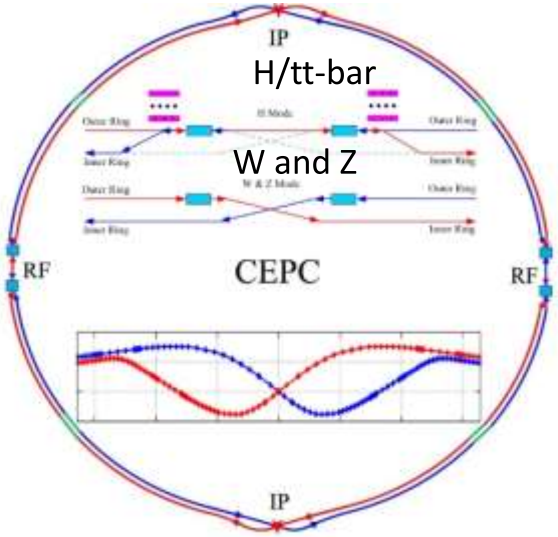
* Higgs is the top priority. The CEPC will commence its operation with a focus on Higgs.

** Detector solenoid field is 2 Tesla during Z operation, 3Tesla for all other energies.

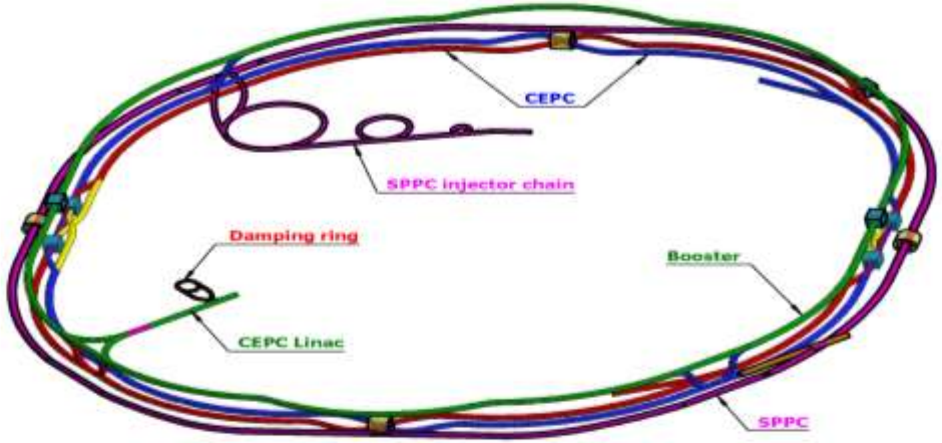
*** Calculated using 3,600 hours per year for data collection.

CEPC Higgs Factory and SppC Layout in TDR

CEPC as a Higgs Factory： H, W, Z, upgradable to ttbar, followed by a SppC (a Hadron collider) ~125TeV
30MW SR power per beam (upgradable to 50MW) , high energy gamma ray 100Kev~100MeV

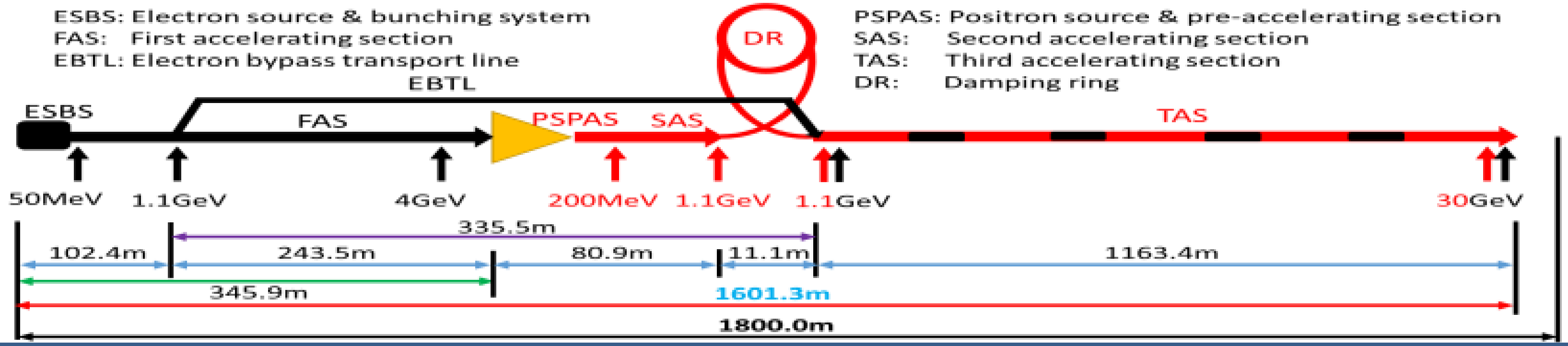


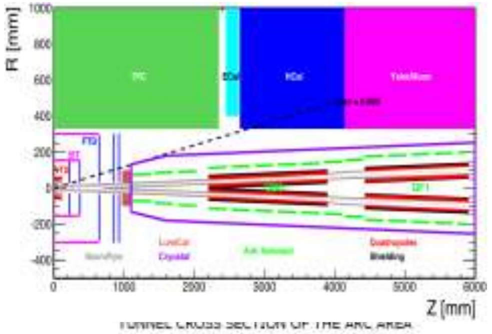
CEPC collider ring (100km)

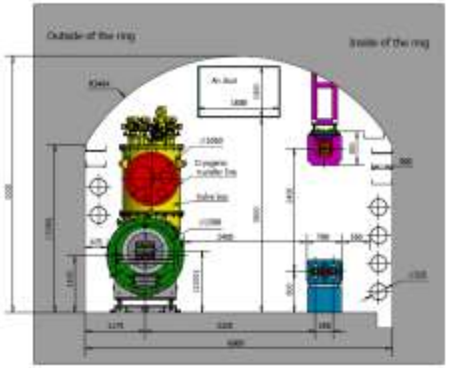


CEPC booster ring (100km)

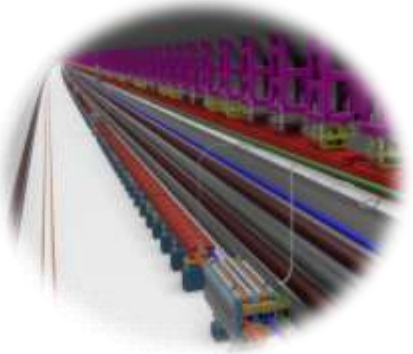
CEPC TDR S+C-band 30GeV linac injector







CEPC Civil Engineering



CEPC Accelerator System Parameters in TDR

Linac

Parameter	Symbol	Unit	Baseline
Energy	E_{e-}/E_{e+}	GeV	**30**
Repetition rate	f_{rep}	Hz	100
Bunch number per pulse			1 or 2
Bunch charge		nC	1.5 (3)
Energy spread	σ_E		1.5×10^{-3}
Emittance	ε_r	nm	6.5

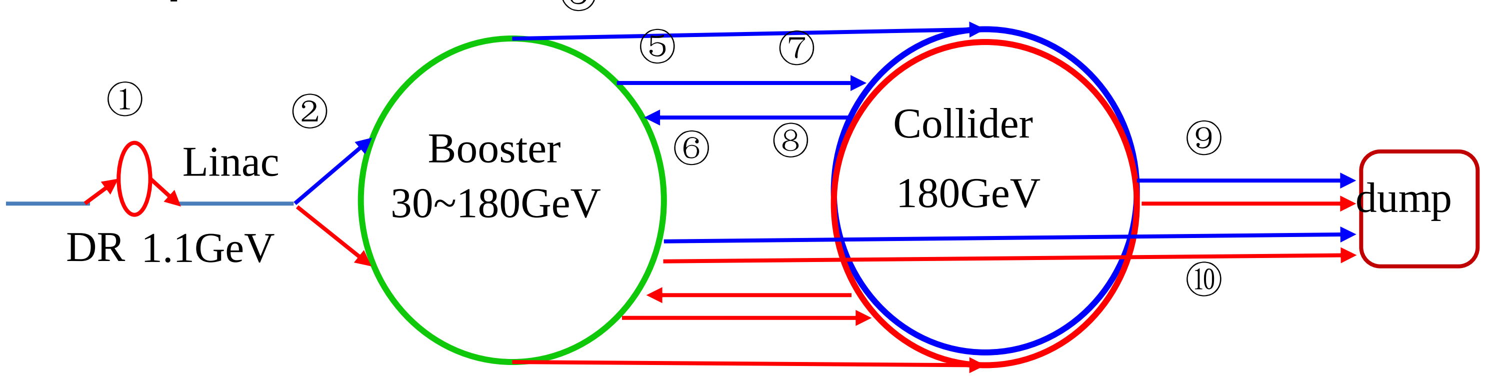
Booster

		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

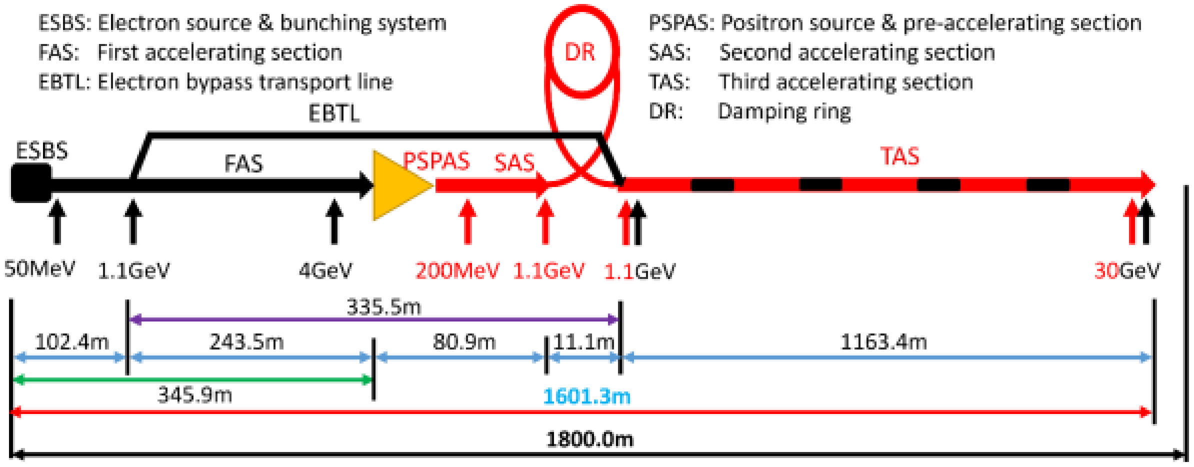
	Higgs	Z	W	$t\bar{t}$
Number of IPs	2			
Circumference (km)	**100.0**			
SR power per beam (MW)	**30**			
Energy (GeV)	**120**	**45.5**	**80**	**180**
Bunch number	268	11934	1297	35
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.64/1.3	0.27/1.4	0.87/1.7	1.4/4.7
Beam size at IP σ_x/σ_y (um/nm)	14/36	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**

Transport lines



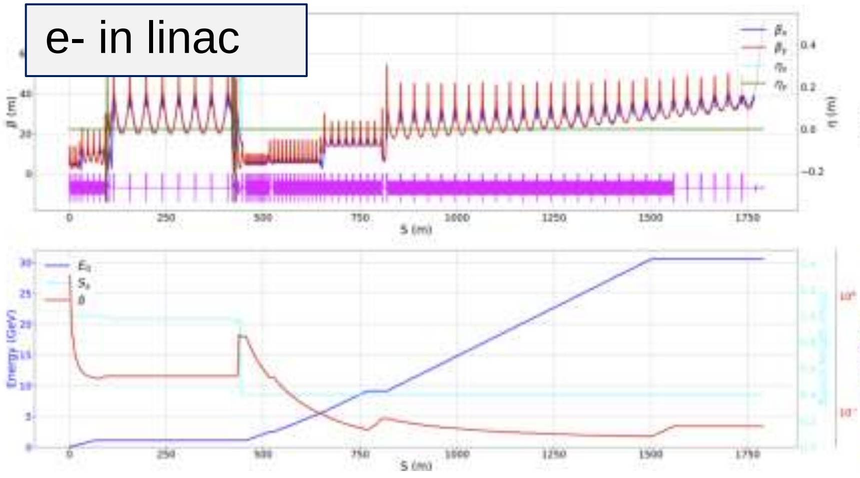
CEPC Technical Design Report (TDR) includes:
1)CEPC Accelerator TDR
2)CEPC Detector TDRrd (rd=reference design) will be completed later

CEPC e- and e+ Injection Linac Designs in TDR

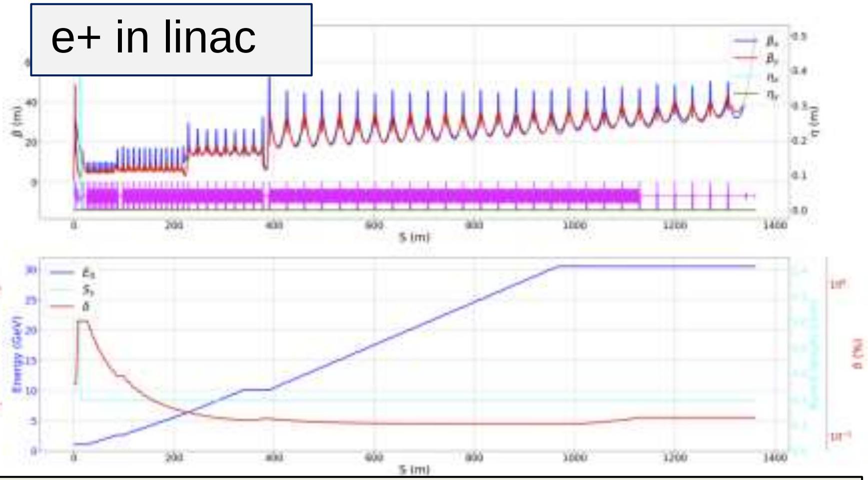


Parameter	Symbol	Unit	Design value
Energy	E	GeV	30
Repetition rate	f_{rep}	Hz	100
Number of bunches per pulse			1 or 2
Bunch charge		nC	1.5
Energy spread	σ_E		1.5×10^{-3}
Emittance	ε_r	nm	6.5
Electron energy at target		GeV	4
Electron bunch charge at target		nC	10
Tunnel length	L	m	1800

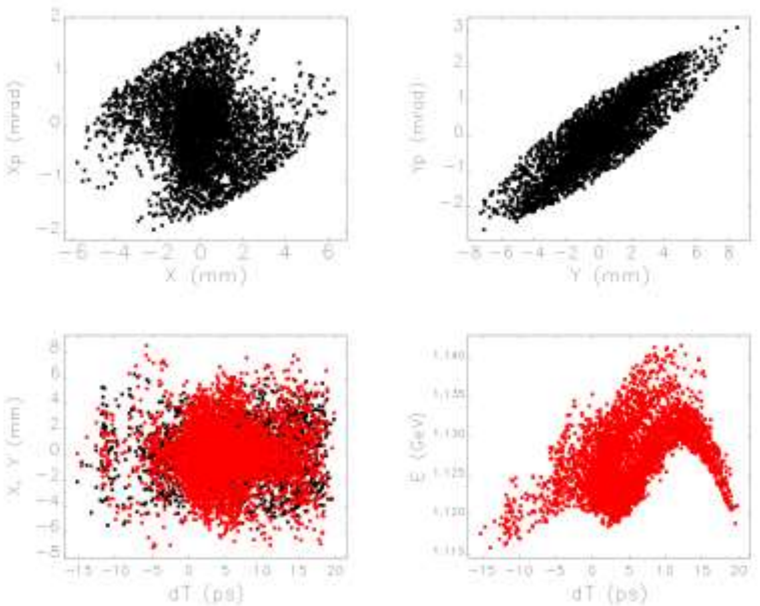
e- in linac



e+ in linac



Phase space @ SAS exit



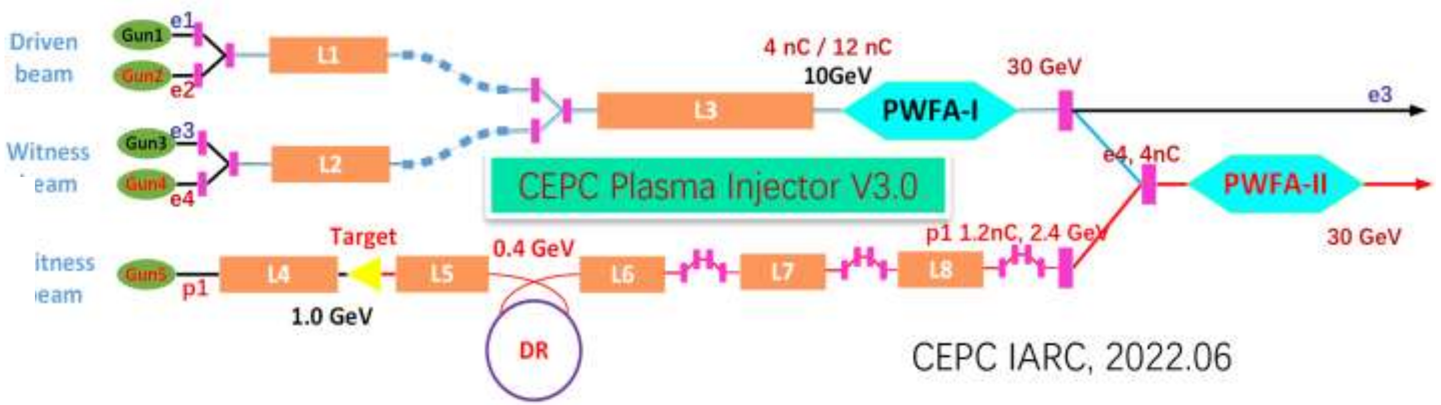
- Linac energy increases to **30 GeV**, with **S+C band** Accelerator;
- Start-to-end simulations with errors have been conducted for both electron/positron beams, with qualities satisfying design requirements.

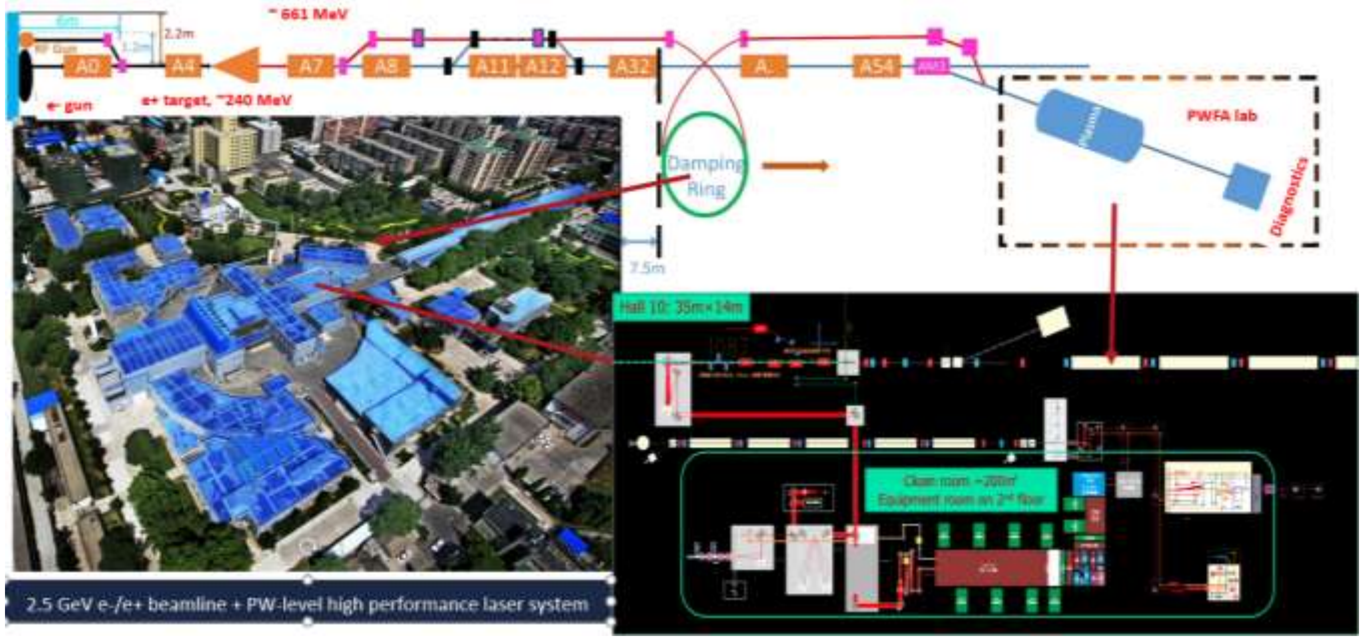
CEPC Plasma Injector (alternative option) and TF Plan

CEPC plasma injector scheme:

From 10 GeV → 30 GeV → **TR ≥ 2**

Simulation results show that it works on paper with reasonable error tolerances for both electron and positron beams injected to the booster





Phase I (Year0-Year2)

1. Re-design and install transport beamline and FF system, optimize the e- / e+ beam quality
2. Clean room and high power laser syst… TW) installation200TW
3. Beam instrumentation syste…
4. RF Gun platform constr…
5. Commissioning and … the systems

Phase II (Year3-Year…

1. Upgrade … beamlines (1PW + 20/40 TW)
2. Test… platform and install it on the

Phase III

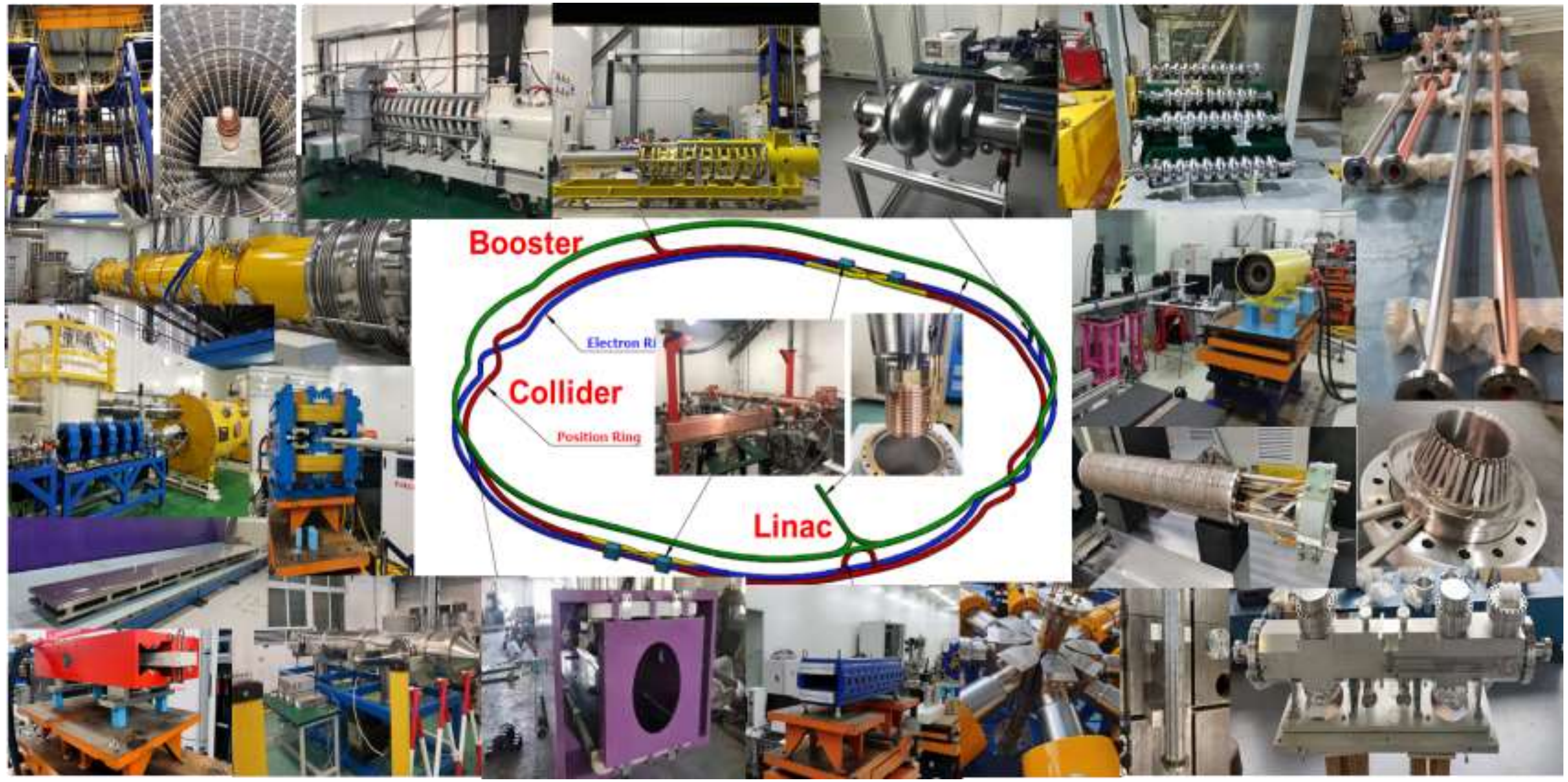
1. A… on dumping ring the bunch compression bea… ne to improve the e+ quality
2. PBA-based FEL studies

- **Positron and electron acceleration**
- **Cascading acceleration**
- **Future linear collider technologies**

PWFA TF based on BEPC-II Linac and HPL has been founded by CAS 120M RMB in Sept. 2023

CEPC Key Technology R&D Status in TDR

Specification Met ✓ Prototype Manufactured ✓



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

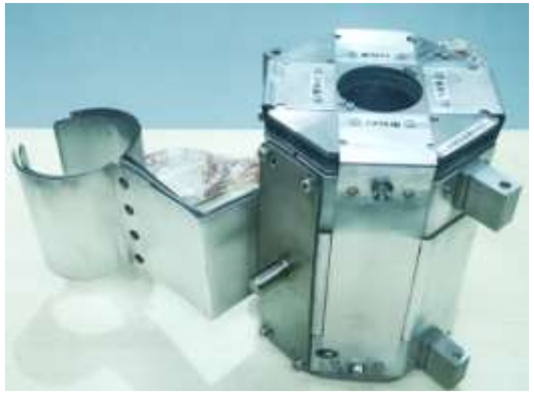
Key technology R&D in TDR spans all component lists in CEPC CDR

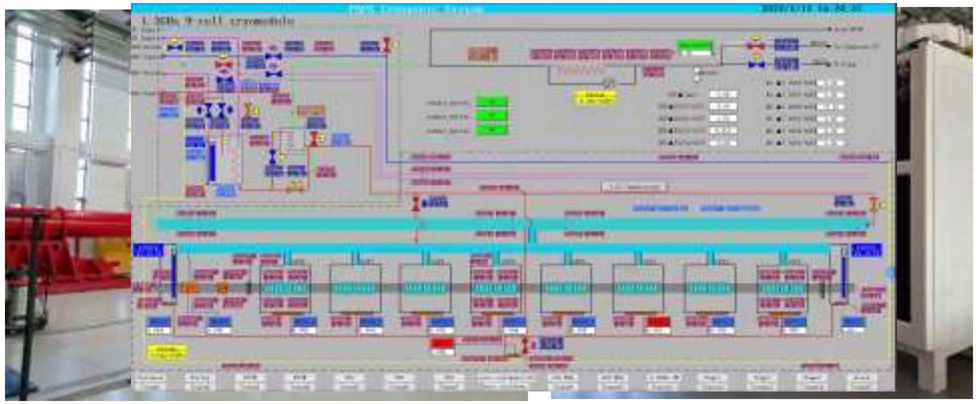
CEPC Booster 1.3 GHz 8 x 9-cell High Q Cryomodule

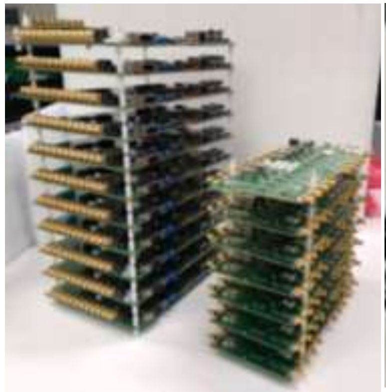
CEPC booster 1.3 GHz SRF R&D and industrialization in synergy with CW FEL projects.

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}			



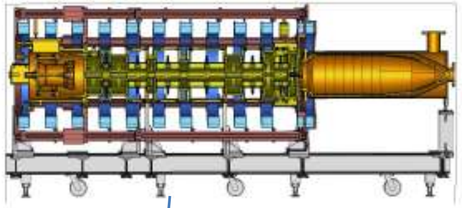






CEPC High Efficiency High Power Klystron Development and RF Power Distribution System

CEPC klystron R&D

Klystron No. 2
Efficiency 77%
(2021)



Power Supply Modulator

Klystron No. 1
Efficiency 65%
(2020)

Klystron No. 3 （MBK
Efficiency 80.5%
(under fabrication)

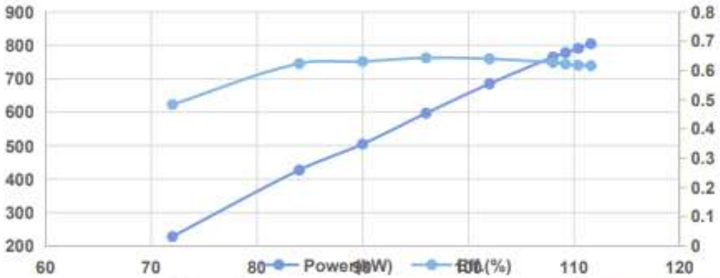
2022

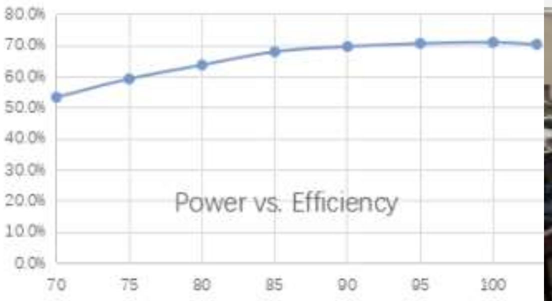
Pulsed RF Mode (30% duty factor, 60ms/5Hz)

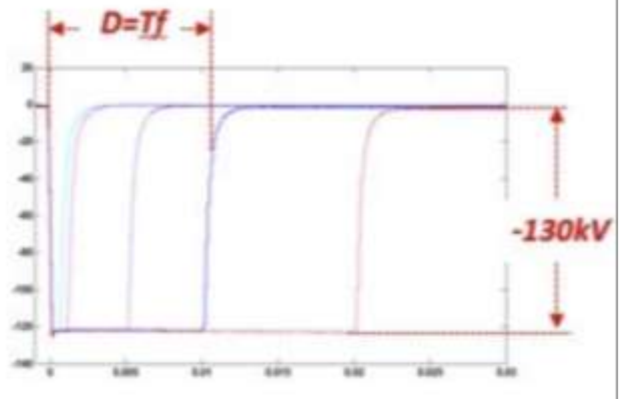
70.5% @ 630kW

To be tested at the end of 2023

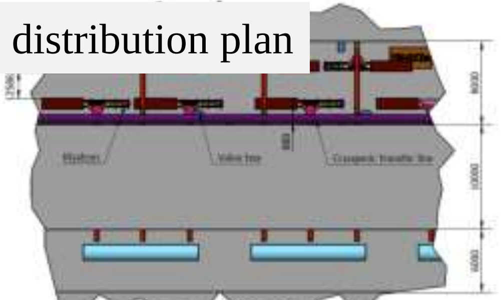
High Voltage vs. Power&Efficency

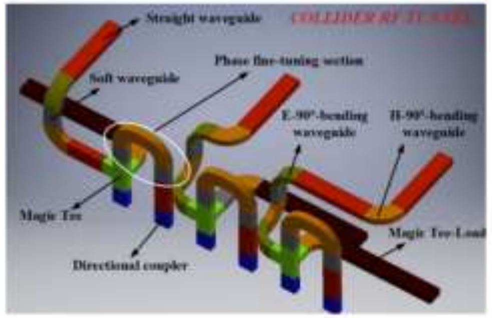






RF distribution plan





- Three prototypes of the **650MHz 800KW CW** klystrons are developed. The efficiency reaches 70%
- PSM is developed with the industrial collaboration
- RF tunnel distribution was planed

CEPC Detector R&D Status

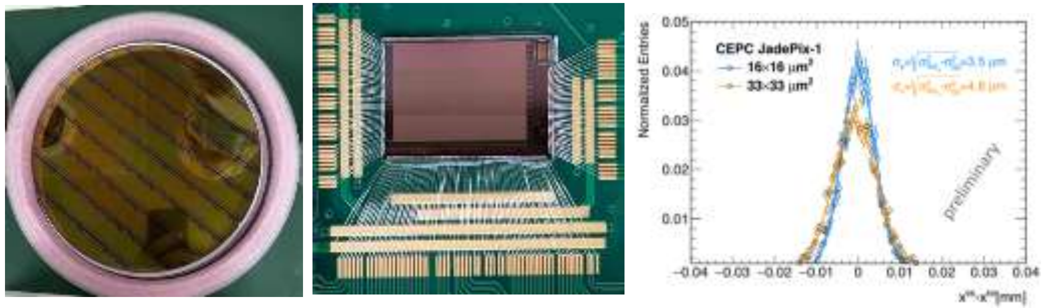
- **Lots of R&D benefitted from past experience**
  - Silicon strip detector: Experience from ATLAS upgrade
  - Drift chamber: Lots of Experience from BESIII
  - Super-conducting magnet: Experience from BESIII
- **New R&D on key technology**
  - Vertex detector
  - TPC drift chamber
  - PFA calorimeter

CEPC Detector TDRrd (rd=reference design) will be completed later

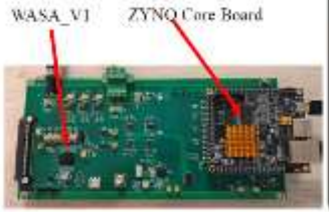
Prototype Manufactured

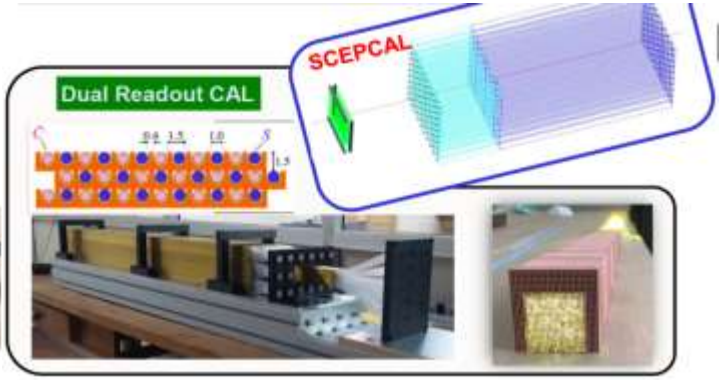
Sub-detector	Specification	Requirement	World-class level	CEPC prototype
Pixel detector	Spatial resolution	$\sim 3\ \mu m$	$3-5\ \mu m$ [12, 13]	$3-5\ \mu m$ [14–16]
TPC/drift chamber	dE/dx (dN/dx) resolution	$\sim 2\%$	$\sim 4\%$ [17, 18]	$\sim 4\%$ [19–21]
Scintillator-W ECal	Energy resolution Granularity	$< 15\%/\sqrt{E(\mathrm{GeV})}$ $\sim 2\times 2\ \mathrm{cm}^2$	12.5% [22]	Prototype built to be measured $0.5\times 0.5\ \mathrm{cm}^2$
4D crystal ECal	EM energy resolution 3D Granularity	$\sim 3\%/\sqrt{E(\mathrm{GeV})}$ $\sim 2\times 2\times 2\ \mathrm{cm}^3$	$2\%/\sqrt{E(\mathrm{GeV})}$ [23, 24] N/A	Prototyping [25] $\sim 3\%/\sqrt{E(\mathrm{GeV})}$ $\sim 2\times 2\times 2\ \mathrm{cm}^3$
Scintillator-Steel HCal	Support PFA, Single hadron σ_E^{had}	$< 60\%/\sqrt{E(\mathrm{GeV})}$	$57.6/\sqrt{E(\mathrm{GeV})}\%$ [26]	Prototyping
Scintillating glass HCal	Support PFA Single hadron σ_E^{had}	$\sim 40\%/\sqrt{E(\mathrm{GeV})}$	N/A	Prototyping $\sim 40\%/\sqrt{E(\mathrm{GeV})}$
Low-mass Solenoid magnet	Magnet field strength Thickness	2 T – 3 T < 150 mm	1 T – 4 T [27–29] > 270 mm	Prototyping

Vertex detector R & D (3- 5 μm reso.)



TPC prototype (low power electronics)





4,5 prototypes, 15⁺ years of R&D, all [to be] tested

Si-W ECAL	(ALICE FoCAL)	[Scint-W ECAL]	AHCAL	SDHCAL

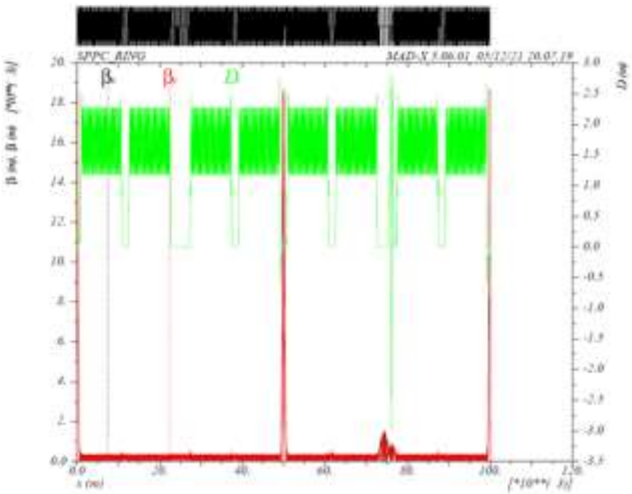
Si-W ECAL	(ALICE FoCAL)	[Scint-W ECAL]	AHCAL	SDHCAL
0,5×0,5 cm² ×15 (→30) Si layers + W	0,003×0,003 cm² × 24 MIMOSA layers + W	0,5×4,5 cm² ×30 Scint+SiPM lay. + SS	3×3 cm² × 38 Scint+SiPM lay. + SS	1×1 cm² × 48 layers GRPC + SS

SppC Collider Parameters in TDR

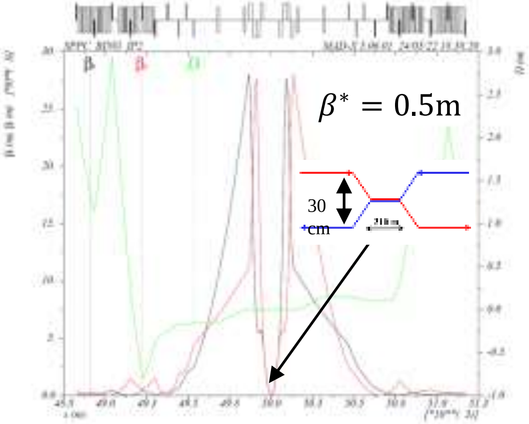
-Parameter list (updated Feb. 2022)

Main parameters		
Circumference	100	km
Beam energy	62.5	TeV
Lorentz gamma	66631	
Dipole field	20.00	T
Dipole curvature radius	10415.4	m
Arc filling factor	0.780	
Total dipole magnet length	65442.0	m
Arc length	83900	m
Total straight section length	16100	m
Energy gain factor in collider rings	19.53	
Injection energy	3.20	TeV
Number of IPs	2	
Revolution frequency	3.00	kHz
Revolution period	333.3	μs
Physics performance and beam parameters		
Initial luminosity per IP	4.3E+34	$cm^{-2}s^{-1}$
Beta function at initial collision	0.5	m
Circulating beam current	0.19	A
Nominal beam-beam tune shift limit pe	0.015	
Bunch separation	25	ns
Bunch filling factor	0.756	
Number of bunches	10080	
Bunch population	4.0E+10	
Accumulated particles per beam	4.0E+14	

Lattice of SPPC



Whole ring



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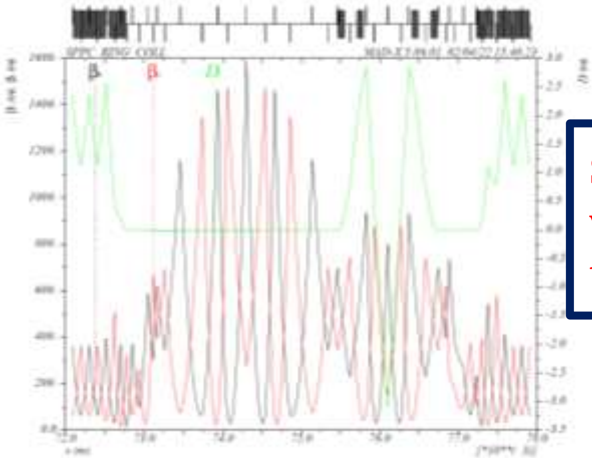
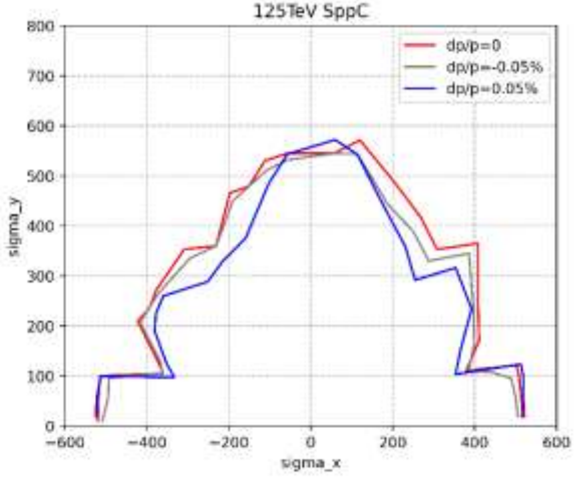


Collimation



Dynamic Aperture

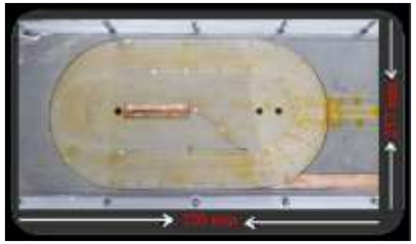
SppC is compatible with CEPC in the same tunnel

Ecm=125TeV with dipole field of 20T

IBS Technology for High Field Magnets

R&D under way

Z. Zhao
IBS (T_c 55K)



IBS solenoid at 32 T
Racetrack at 10 T
1.3 kA transposed cable
J_e > 450 A/mm²
@ 10 T, 4.2 K

100-m 7-core IBS tape fabricated
J_e= 100 A/mm²
@ 10 T, 4.2 K

2008.02 — Discovery of IBS

2008.04

2008.09 — Discovery of 122 phase IBS

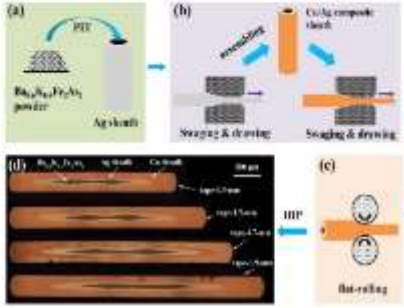
2016

2018

2020

2022

H. Hosono
IBS (T_c 26K)



IBS solenoid at 24 T
Racetrack at 8 T
J_e= 300 A/mm²
@ 10 T, 4.2 K

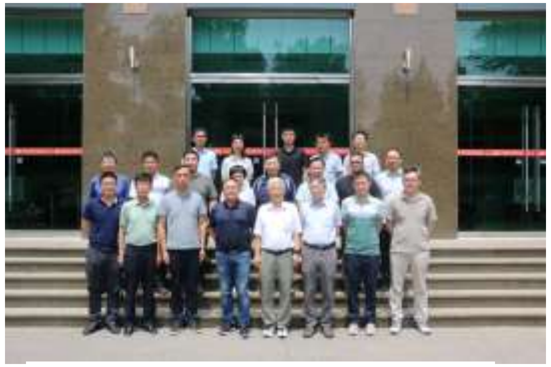
J_e of IBS expected to be similar as ReBCO in 2020s with better mechanical properties and lower cost, ready for mass applications in ultra high field magnets

CEPC Site Preparations (three candidates in TDR)

CEPC Accelerator International TDR Review and Cost Review
June 12-16, and Sept. 11-15, 2023, in HKUST-IAS, Hong Kong

CEPC Accelerator TDR Review
June 12-16, 2023, Hong Kong

CEPC Accelerator TDR Cost Review
Sept. 11-15, 2023, Hong Kong

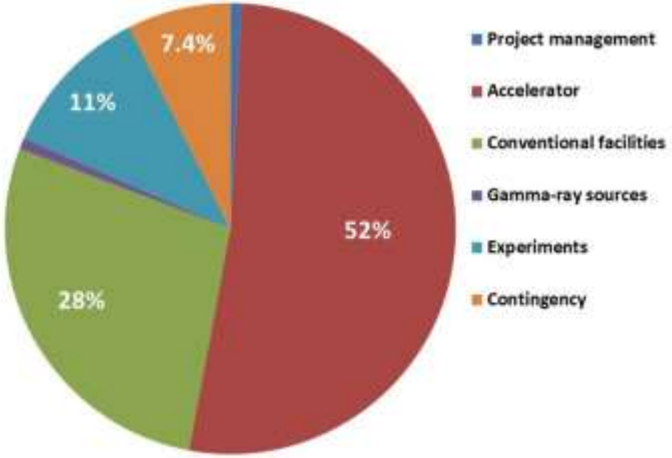


Domestic Civil Engineering
Cost Review, June 26, 2023, IHEP

9th CEPC IAC 2023 Meeting
Oct. 30-31, 2023, IHEP

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**

CEPC accelerator TDR has been completed and to be released formally soon at the end of December of 2023

CEPC accelerator TDR link (draft): CEPC TDR draft

CEPC Accelerator TDR International Reviews and CEPC IAC Meeting Endorsement

June 12-16, 2023, in HKUST-IAS, Hong Kong

Chaired by Frank Zimmermann

Phase 1 CEPC TDR Review Report

CEPC TDR Technical Review Committee

15 July 2023

The CEPC Study Group, hosted by the Institute of High Energy Physics (IHEP), has been working on the design and development of a forefront e^+e^- collider as a Higgs factory that can extend to energies corresponding to the Z, WW and the top-quark pairs, with the upgrade potential to a high-energy pp collider. The CEPC represents a "grand plan" proposed, studied, and to be constructed by Chinese scientists in close collaboration with international partners. Since the release of the CEPC Conceptual Design Report in 2018, the CEPC Study Group has devoted significant effort to the design optimisation, the R&D of key technologies and the study of the technical systems of the CEPC.

The CEPC Study Group has produced a draft Technical Design Report (TDR). The International Review Committee, chaired by Dr. Frank Zimmermann (CERN), was asked to conduct a first phase review of this TDR draft. This first phase review shall cover all but the cost and site aspects of the CEPC.

The Phase 1 CEPC TDR Review Committee meeting was held in person at HKUST from 12 to 16 June 2023.

https://indico.ihep.ac.cn/event/19262/timetable/

Sept. 11-15, 2023, in HKUST-IAS, Hong Kong

Chaired by Loinid Rivkin

CEPC Accelerator TDR Cost Review

The CEPC Accelerator TDR Cost Review committee examined the cost estimate of the TDR of accelerator systems for the first stage of the CEPC project operated as a Higgs factory with synchrotron radiation power up to 30 MW per beam (including all infrastructure that is not easily upgradeable and is already designed to operate up to the ttbar energy and at 50 MW). The cost estimate under review does not include the civil engineering, the detectors at the IPs with their technical services, and the central computing services.

In the opinion of the committee the cost estimate presented is sufficiently complete to form a proper basis for the next iteration that will be done during the EDR stage.

https://indico.ihep.ac.cn/event/19262/timetable/

Oct. 30-31, 2023, in IHEP

Chaired by Brian Foster

The Ninth Meeting of the CEPC-SppC International Advisory Committee

IAC Committee
M. E. Biagini, Y.-H. Chang, A. Cohen,
M. Davier, M. Demarteau, B. Foster (Chair),
B. Heinemann, K. Jakobs, L. Linssen,
L. Maiani, M.L. Mangano, T. Nakada, S. Stapnes,
G. N. Taylor, A. Yamamoto, H. Zhao

November 14th, 2023

https://indico.ihep.ac.cn/event/20107

The IAC also supports another key conclusion in the TDR Review Report, that the accelerator team is well prepared to enter the EDR phase.

-The IAC also support another conclusion in the TDR Review Report that the accelerator team is well prepared to **enter the EDR phase**

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CEPC Engineering Design Report (EDR) Goal

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

After completion CEPC accelerator TDR in 2023, CEPC accelerator will enter into the Engineering Design Report (EDR) phase (2024-2027), which is also the preparation phase with the aim for CEPC PROPOSAL to be presented to and selected by Chinese government around 2025 for the construction start during the ”15th five year plan (2026-2030)” (for example, around 2027) and completion around 2035 (the end of the 16th five year plan).

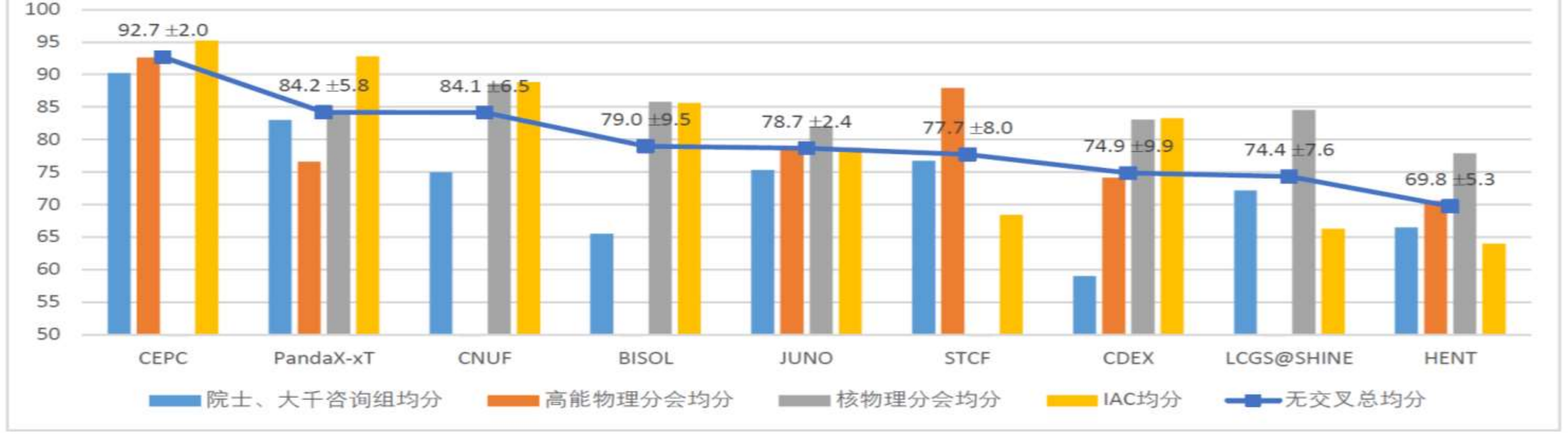
CEPC EDR includes accelerator and detector (TDRrd)

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

The total CEPC EDR funding requirement (including site selection, civil engineering design, accelerator, detector, computing, management, etc. is about 1Billion RMB.

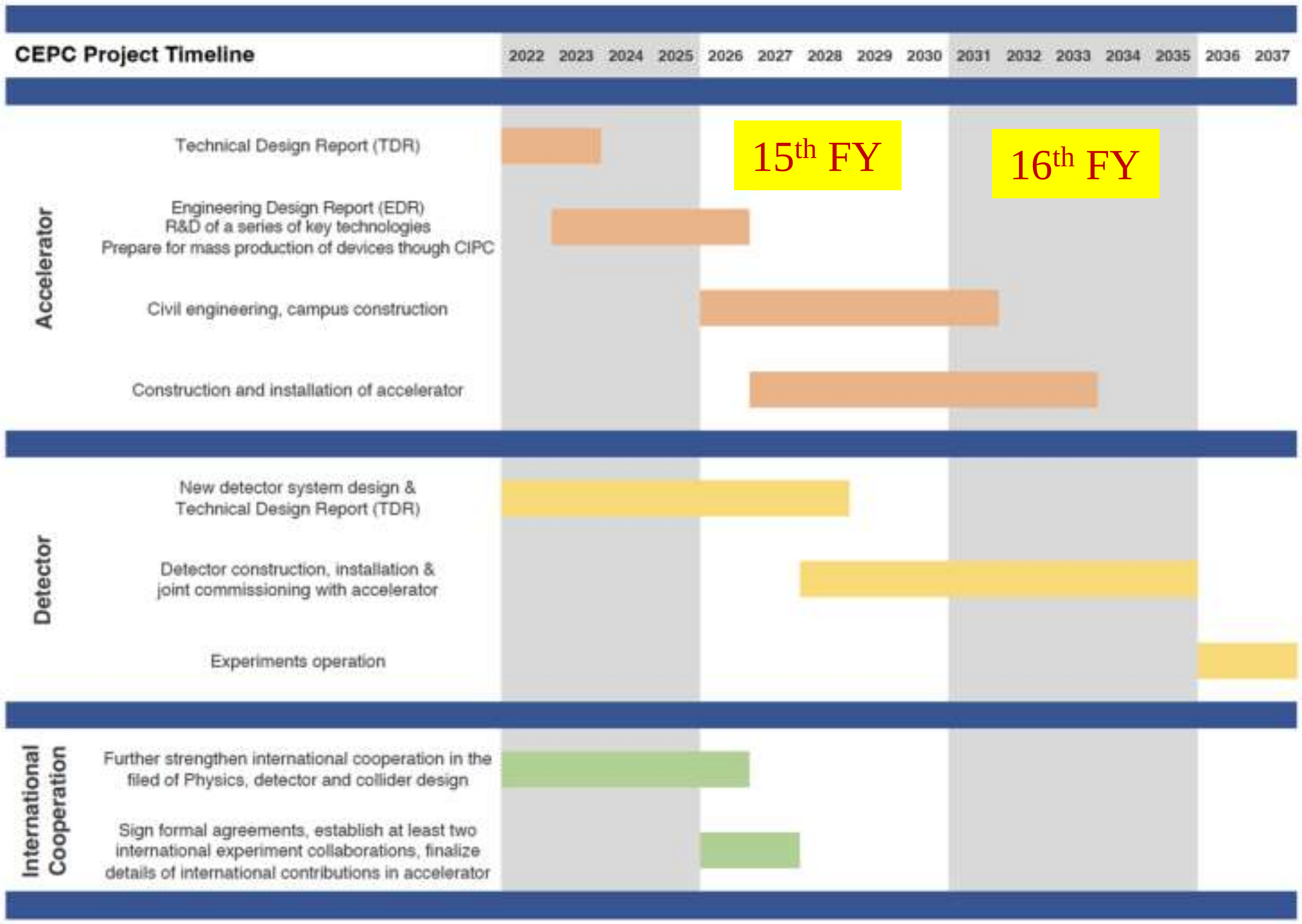
CEPC Project Development towards Construction

- **TDR has been completed** (review + revision) to be **formally released at the end of Dec. 2023**
- **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 and nuclear physics**, as one of the 8 groups, has been working on this for a year:
  - 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 has been submitted to CAS for consideration**



CEPC Planning and Schedule

TDR (2023), EDR(2027), start of construction (2027-8)



Participating and Potential Collaborating Companies in China and Worldwide

	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 International Collaborations

CEPC attracts significant International participation and collaborations

- Conceptual design report: 1143 authors from 221 institutes (including 140 International Institutes)
- More than 20 MoUs have been signed and executed
- Intensive collaboration on Physics studies
- Oversea scientists made substantial contributions to the R&D, especially the detector system
- 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

Invitation to co-sign CEPC Accelerator TDR

CEPC accelerator TDR is scheduled to be formally released at the end of December of 2023, and we invite you to read the latest version of CEPC TDR draft: (https://docs.ihep.ac.cn/anyshare/zh-cn/link/AA9FC882F906714CE1BC59DAF3BB048A60?_tb=none&expires_at=2023-12-30T15%3A28%3A28%2B08%3A00&item_type=&password_required=false&title=CEPC-TDR-draft-v4.pdf&type=anonymous) (This version is almost converged to the final one, but we will make the necessary adjustments and polishing later.)

We sincerely inquire if you would be willing to co-sign the TDR authorship. Your continued support and recognition would greatly contribute to the future development of the CEPC.

If you agree to co-sign, please fill in your information in TDR Authorship Collection (https://indico.ihep.ac.cn/event/20817/registrations/1668/) **page.**

We will also appreciate if you could kindly help to invite people from your institutes or collaboration group, please also update information in
TDR Authorship Collection (https://indico.ihep.ac.cn/event/20817/registrations/1668/) **page.**
The Deadline for collection is before the 7th of December of 2023.

Remind again: CEPC Accelerator TDR to be formally released at the end of December of 2023 (please stay tunned).

Thanks for your cooperation. We greatly appreciate your support and dedication to CEPC Project.

Summary

- The CEPC TDR parameter and design optimizations with high luminosities (**30MW and 50MW**) operations, for all four energies (**Higgs, W/Z and ttbar**) have been studied. The results demonstrate that the accelerator design satisfies the scientific goals.
- A comprehensive key technology R&D program has been carried out in TDR with CEPC key technplogies in hands ready for industrialization preparation in EDR.
- CEPC accelerator **TDR international review and cost review** were held from **June 12-16, 2023 and Sept. 11-15, 2023**, respectively, and endorsed by **IAC meeting** held from **Oct. 30-31, 2023**. **TDR will be released formally soon at the end of December of 2023.**
- Detailed preparation of **CEPC EDR** phase (**2024-2027**) before construction working plan and beyond have been established (preliminary), with the aim for **CEPC PROPOSAL** to be presented to and selected by Chinese government around **2025** for the construction start during the "**15th five year plan (2026-2030)"** (for example, around **2027**) and completion around **2035** (the end of the 16th five year plan).
- **International collaboration and participation are warmly welcome.**

Acknowledgements

Thanks go to CEPC-SppC accelerator team's hard works, international and CIPC collaborations

Special thanks to CEPC IB, SC, IAC, IARC and TDR review (+cost) committee's critical advices, suggestions and encouragement

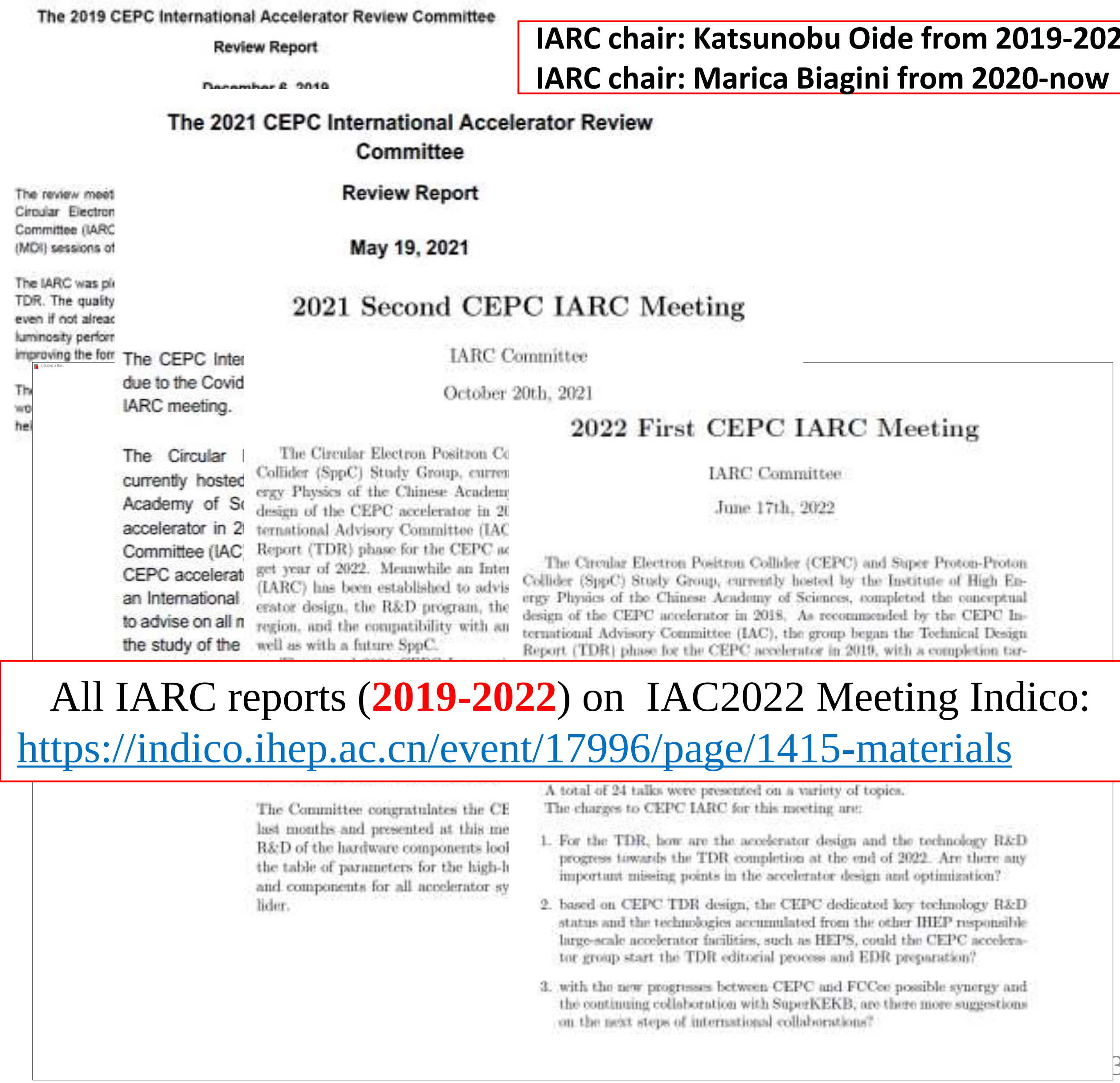
Thanks for your attention

Backup Slides

CEPC Accelerator IARC Meeting 2019-2022

International Accelerator Review Committee (IARC) under IAC

IARC chair: Katsunobu Oide from 2019-2020
IARC chair: Marica Biagini from 2020-now



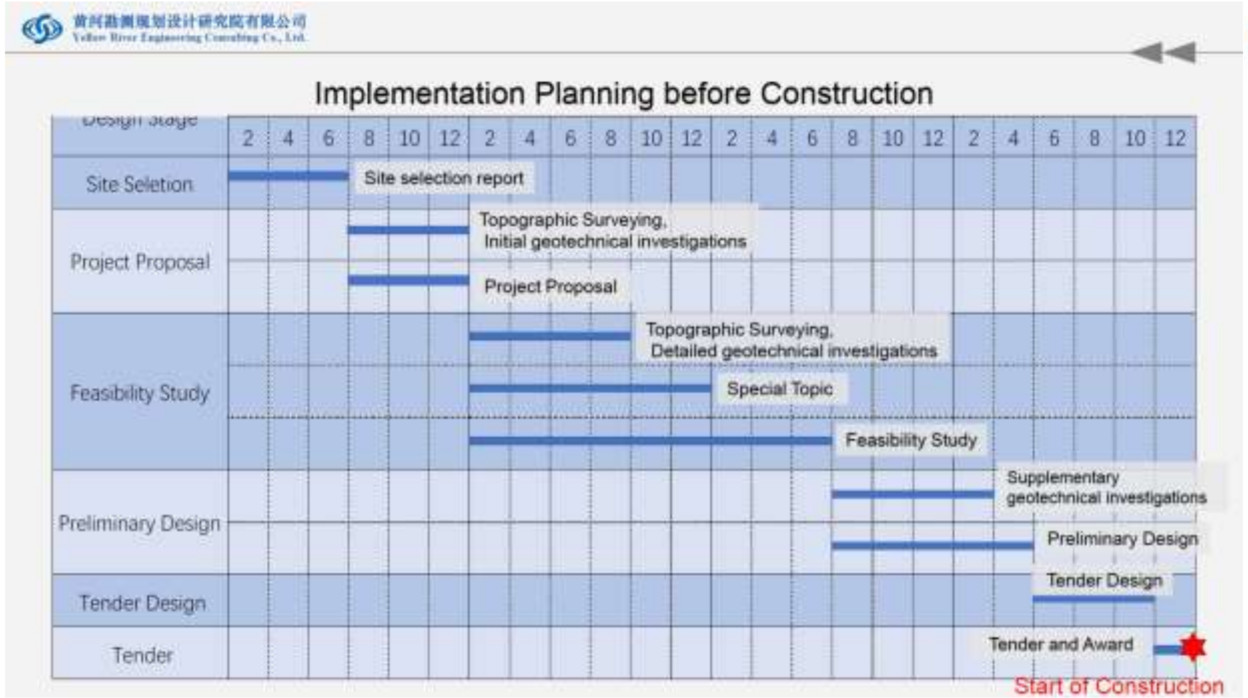
Nov. 2019: https://indico.ihep.ac.cn/event/9960/
May, 2021: https://indico.ihep.ac.cn/event/14295
October, 2021: https://indico.ihep.ac.cn/event/15177
June, 2022: https://indico.ihep.ac.cn/event/16801/

All IARC reports (**2019-2022**) on IAC2022 Meeting Indico: https://indico.ihep.ac.cn/event/17996/page/1415-materials

After the completeion of CEPC CDR in Nov. 2018, since the first CEPC IARC meeting in **2019**, there has been **toally 4 IARC meetings till 2022**, with each meeting a carefully written IARC report, which are very helpful for CEPC accelerator in TDR phase and beyond.

CEPC Site Implementation and Construction Plans

CEPC site implementation plan in EDR

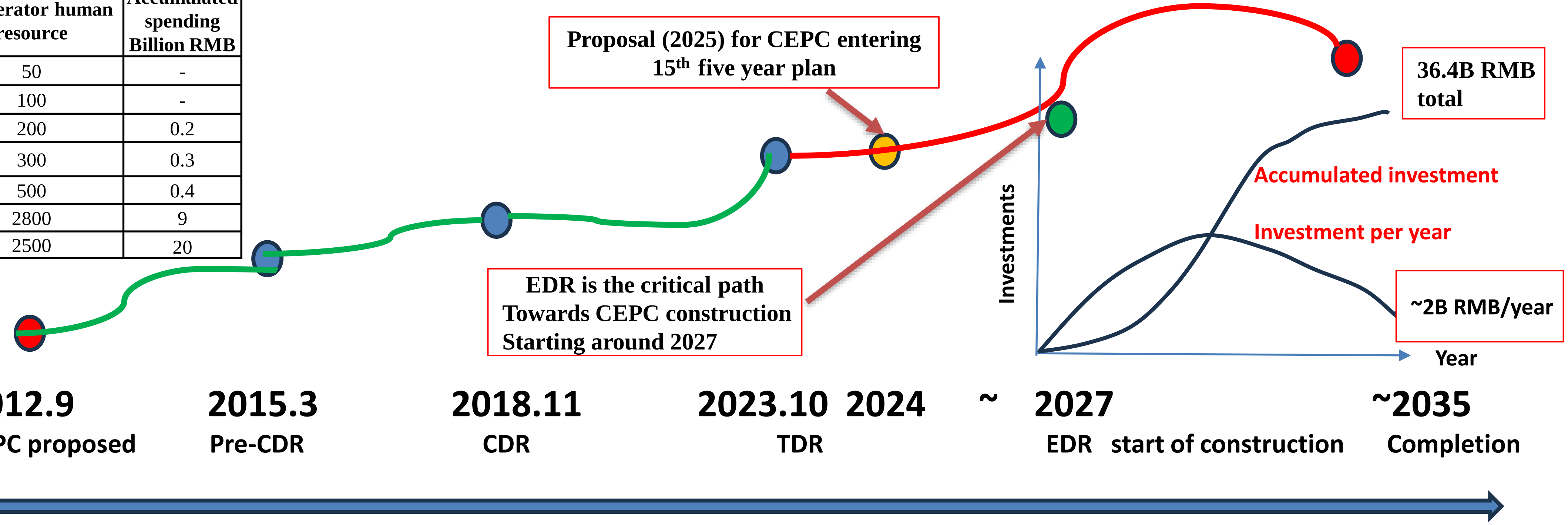


CEPC construction plan

CEPC Evolution Milestones with Human Resources

Year	2015	2018	2023	2025	2027	2030	2035
Human resource	~50	~100	~200	~300	~500	~2800	~2500

Year	Accelerator human resource	Accumulated spending Billion RMB
2015	50	-
2018	100	-
2023	200	0.2
2025	300	0.3
2027	500	0.4
2031	2800	9
2035	2500	20



Power Consumption of CEPC @ Higgs

SN	System	Higgs 30MW							Higgs 50MW						
		Collider	Booster	Linac	BTL	IR	Surface building	Total	Collider	Booster	Linac	BTL	IR	Surface building	Total
1	RF Power Source	96.90	1.40	11.10				109.40	161.60	1.73	14.10				177.40
2	Crygenic system	9.72	1.71			0.14		11.57	9.17	1.77			0.14		11.08
3	Vacuum System	5.40	4.20	0.60				10.20	5.40	4.20	0.60				10.20
4	Magnet Power Supplies	44.50	9.80	2.50	1.10	0.30		58.20	44.50	9.80	2.50	1.10	0.30		58.20
5	Instrumentation	1.30	0.70	0.20				2.20	1.30	0.70	0.20				2.20
6	Radiation Protection	0.30		0.10				0.40	0.30		0.10				0.40
7	Control System	1.00	0.60	0.20				1.80	1.00	0.60	0.20				1.00
8	Experimental devices					4.00		4.00					4.00		4.00
9	Utilities	37.80	3.20	1.80	0.60	1.20		44.60	46.40	3.80	2.50	0.60	1.20		54.50
10	General services	7.20		0.30	0.20	0.20	12.00	19.90	7.20		0.30	0.20	0.20	12.00	19.90
	Total	204.12	21.61	16.80	1.90	5.84	12.00	262.27	276.87	22.60	20.50	1.90	5.84	12.00	339.71

Various measures will be studied and implemented towards a green collider

J_e of IBS conductor: Status and Outlook