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Progress of CEPC accelerator EDR

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IHEP

On behalf of CEPC-SppC team

The 2025 International Workshop on the High Energy Circular Electron Positron Collider (CEPC2025)
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- Introduction
- CEPC accelerator EDR progress status according EDR plan with milestones and timeline
- CEPC EDR site geological study, civil engineering design, industrial preparations and international collaborations
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A Brief Historical Recall: High Energy Colliders and Factories

The era of Higgs boson started from 2012， and we entered the BEST EPOCH of High Energy Physics

In the last 60 years we have made a tremendous progress in particle physics, and we have to prepare for the next exciting and discovering years of human being

In 60's, Ada, VEP-I, VEPP-II, ACO…

Year

Next?

2018

2012

2010

2006

2002

1999

1994

1990

1988

1980

1972

SppC, FCC-hh
Muon collider
FCC-ee
(H,t, Z,W…Dark matter)
CEPC/ILC/CLIC: new e^+e^- collider
(B physics…)
SuperKEKB: $\sqrt{s} \simeq 10\ \mathrm{GeV}, \mathcal{L} \simeq 10^{35}$
LHC: $\sqrt{s} \simeq 14\mathrm{TeV}, \mathcal{L} \simeq 10^{33}$
(τ − charm,…)
BEPCII: $\sqrt{s} \simeq 2-5\ \mathrm{GeV}, \mathcal{L} \simeq 10^{33}$
(τ mass, charmonium,…)
VEPP-4: $\sqrt{s} \simeq 1.5-2.0\mathrm{GeV}, \mathcal{L} \simeq 10^{33}$; DAFNE: $\sqrt{s}$ ~1GeV , $\mathcal{L} \simeq 10^{32}$
(B-quark, CP violation, CKM…)
KEKB/PEP-II
SSC: $\sqrt{s} \simeq 40\mathrm{TeV}, \mathcal{L} \simeq 10^{33}$ 1993 stopped
(Z, W bosons,…)
LEP/CERN, SLC/SLAC
(τ −charm,…)
BEPC: $\sqrt{s} \simeq 2-5\ \mathrm{GeV}, \mathcal{L} \simeq 10^{31}$
CESR: $\sqrt{s} \simeq 10\ \mathrm{GeV}$
(J/ψ,c-quark, t …)
SPEAR&BNL: $\sqrt{s}$

(e^+e^- colliders)

Future Large Colliders:
- new paradigm/theory
- new colliders equipped with advanced detectors

Higgs,…

LHC/CERN:

Higgs boson 2012

Crab-Waist in 2014 at DAFNE

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

Top

Tevatron

Top quark 1995

HERA: ep

J. Gao, "Review of Different Colliders", **International Journal of Modern Physics A**, (2021) 2142002 (25 pages).

W, Z,…

SPS/CERN

W,Z bosons 1983

Bottom,…

PETRA: $\sqrt{s} \simeq 12\sim46.7$ GeV GeV

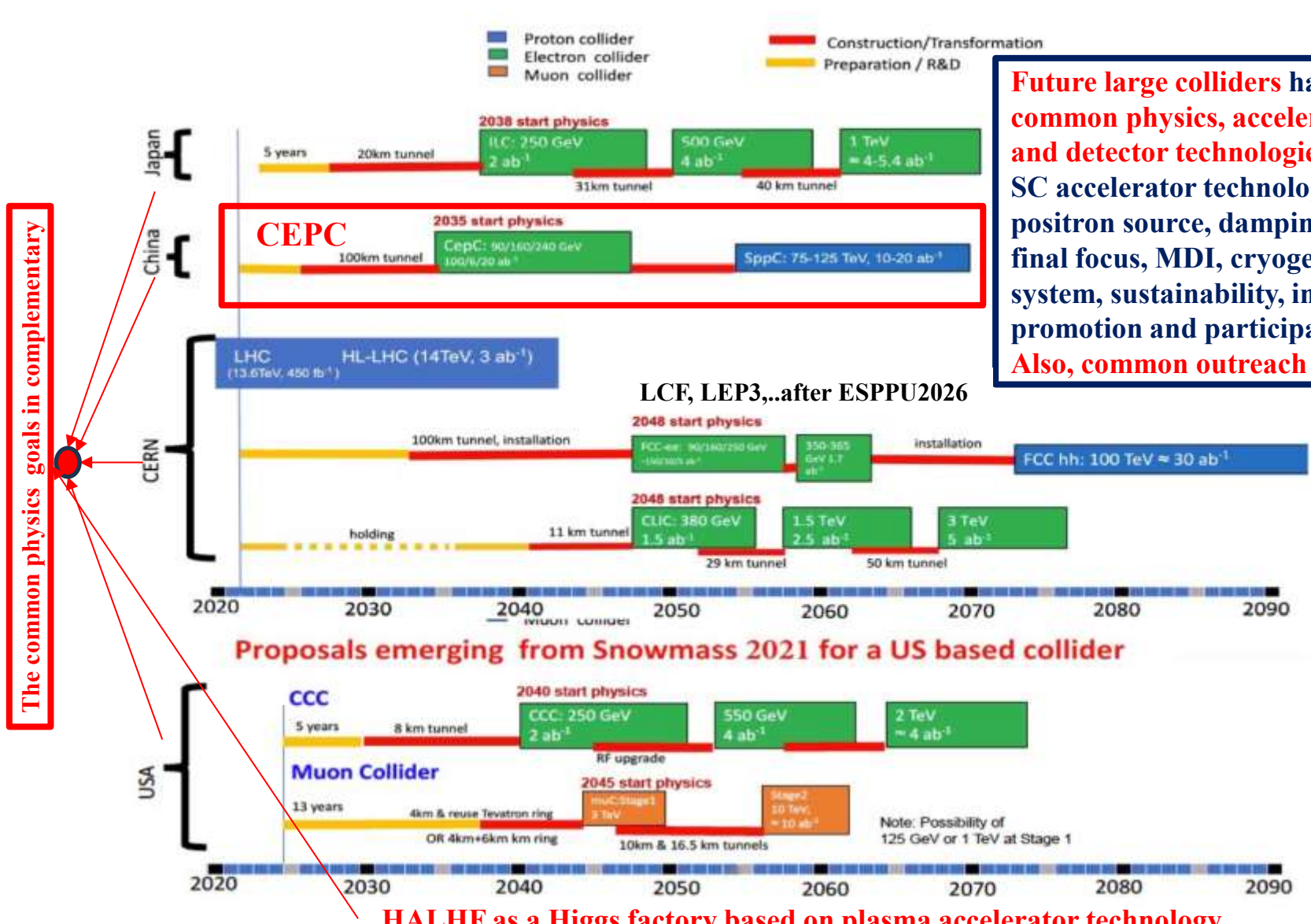
Gluon 1979

Fermilab: 400GeV p on Cu, Pt

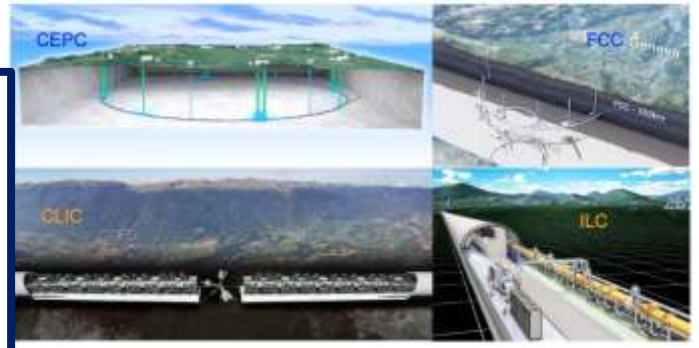
Bottom quark 1977

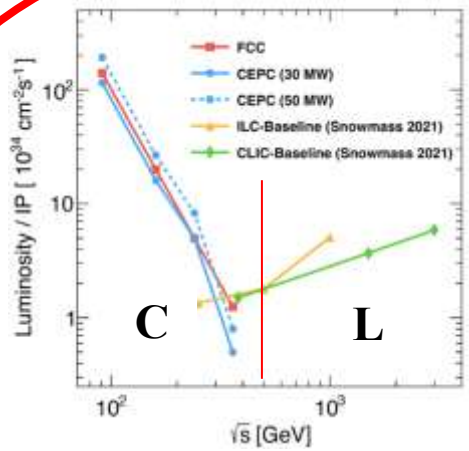
(proton accelerators)

Worldwide High Energy Physics Frontier Goals Timelines and Common Efforts



Future large colliders have the common physics, accelerator and detector technologies:
SC accelerator technologies, positron source, damping ring, final focus, MDI, cryogenic system, sustainability, industrial promotion and participation.
Also, common outreach activities





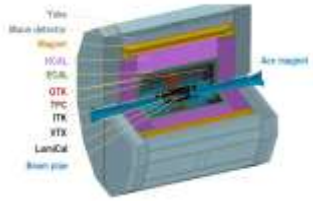
The complementarity between circular and linear Higgs factories

G. Arduini，et al, Future Colliders Comparative Evaluation - Working Group Report, ESPPU26, 2025,
https://indico.cern.ch/event/1439855/contributions/6542430/attachments/3076609/5444588/Future_Colliders_Comparative_Evaluation_WG_report.pdf

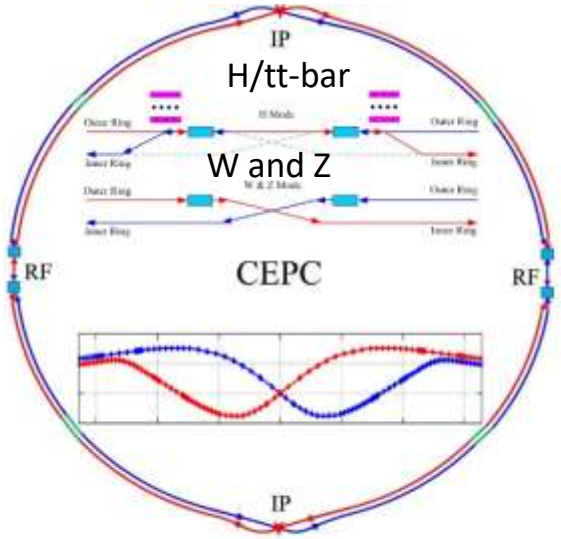
CEPC Higgs Factory and SppC Layout in TDR/EDR

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

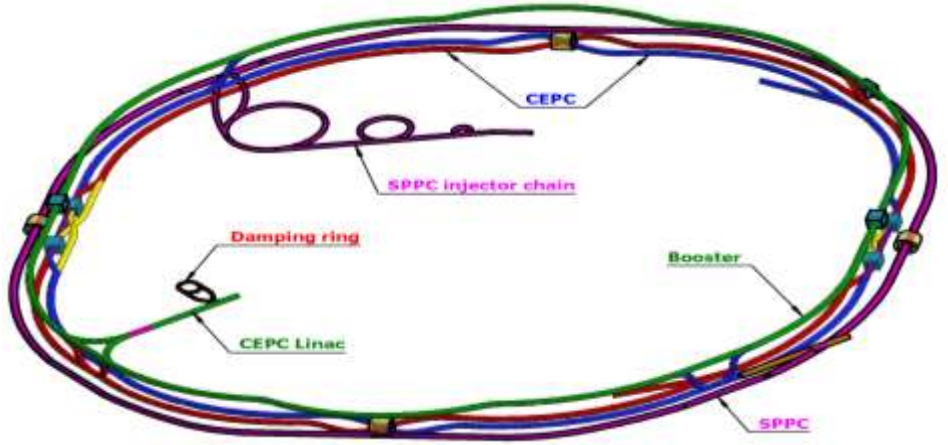
CEPC has two detectors



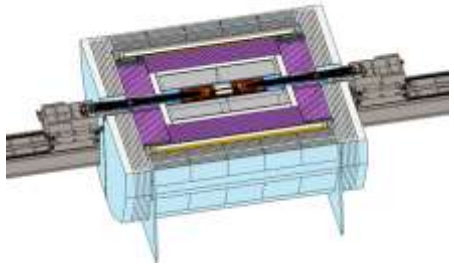
CEPC TDR cost of 36.4B RMB

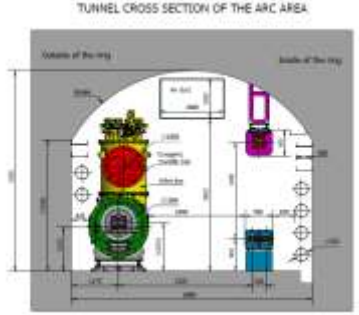


CEPC collider ring (100km)



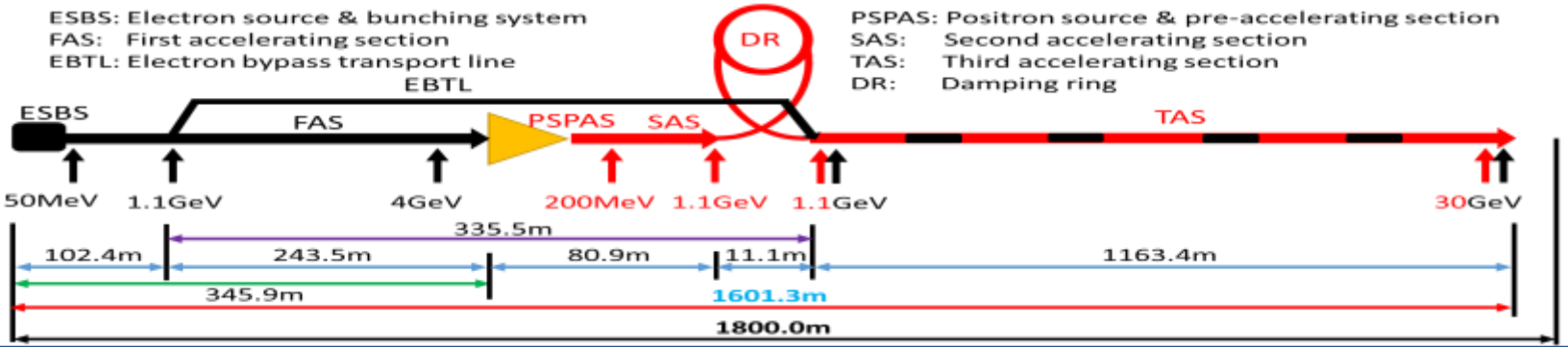
CEPC booster ring (100km)

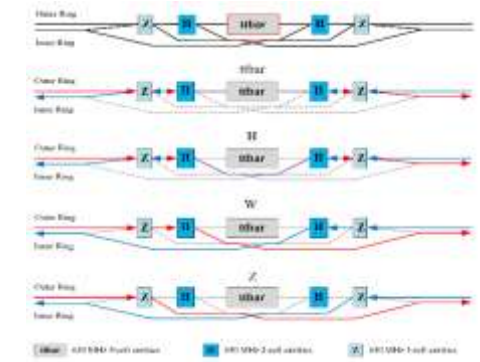




CEPC/SppC in the same tunnel

CEPC TDR S+C-band 30GeV linac injector





Z,W, Higgs and ttbar energies

J. Gao, D. Wang and Y.F. Wang, Vision for high-energy frontier particle colliders in China, **Annual Review of Nuclear and Particle Science, Volume 75**, 2025, https://doi.org/10.1146/annurev-nucl-121423-101120

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	99.955					
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

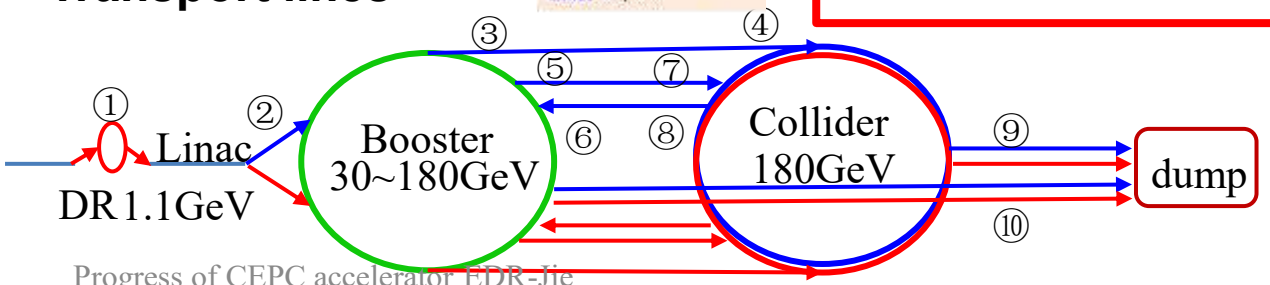
Collider

	Higgs	Z	W	$t\bar{t}$
Number of IPs	2			
Circumference (km)	99.955			
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
Luminosity per IP (10^{34} cm^{-2} s^{-1}) From J. Gao's formula below	5	115	12	0.59

Running scenarios: Higgs 10 years, Z 2 years, W 1 year, ttbar 5 years

Factory of
4 Million Higgs
4 Trillion Z bosons
200 Million W⁺W⁻ pairs
600K $t\bar{t}$ pairs

Transport lines



$$L_{max}[cm^{-2}\,s^{-1}] = 0.158\times10^{34}\,\frac{(1+r)}{\beta_y[mm]}\sqrt{\frac{R[m]}{C_\gamma[mGeV^3]N_{IP}}}\,(P_b[MW]/E[GeV]^2)\,e^{\frac{\sqrt{\Phi_p}}{3.22}}\,(1+0.000505*\Phi_p^2)$$ (J. Gao's formula)

for isomagnetic machine with crab-waist collision

CEPC Technical Design Report (TDR) includes:
1) CEPC Accelerator TDR released on Dec. 25, 2023
2) CEPC Detector ref-TDR (reference design)
has been reviewed by IDRC in April and Sept. 2025, and submitted to arXiv on Oct. 6, 2025, https://arxiv.org/abs/2510.05260

CEPC Physics Goals, Operation Plan and Goals in TDR/EDR

Operation mode		ZH	Z	W⁺W⁻	$t\bar{t}$
$\sqrt{s}$ [GeV]		~240	~91	~160	~360
Run Time [years]		10	2	1	5
30 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**5.0**	**115**	**16**	**0.5**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	13	60	4.2	0.65
	Event yields [2 IPs]	2.6×10^{6}	2.5×10^{12}	1.3×10^{8}	4×10^{5}
50 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**8.3**	**192**	**26.7**	**0.8**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	21.6	100	6.9	1
	Event yields [2 IPs]	4.3×10^{6}	4.1×10^{12}	2.1×10^{8}	6×10^{5}

* Higgs is the top priority for CEPC

** Detector solenoid field is 3 Tesla for all other energies.

CEPC physics white papers:

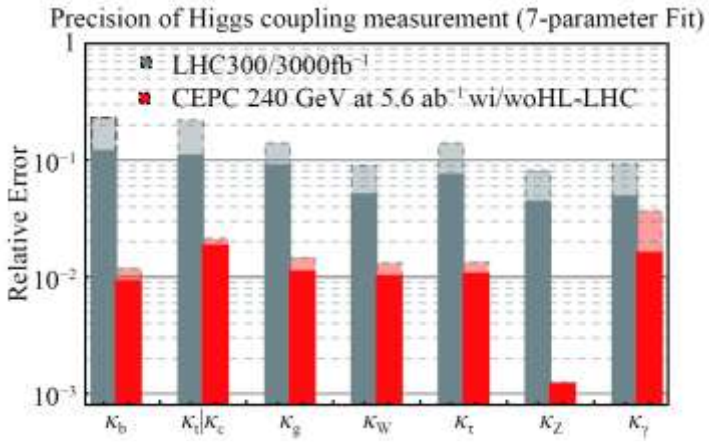
1: Higgs physics, Chinese Physics C Vol. 43, No. 4 (2019) 043002
https://arxiv.org/pdf/1810.09037

2: Flavor physics, https://arxiv.org/pdf/2412.19743 (2024)

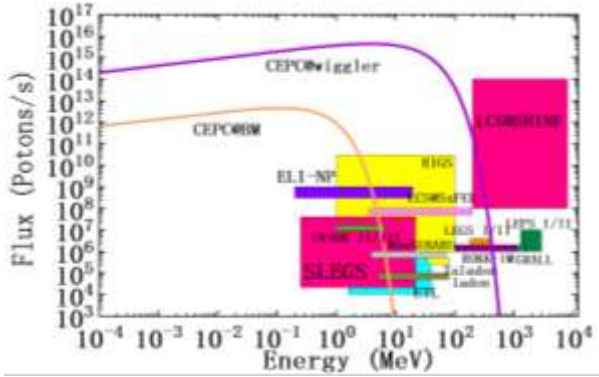
3: Electroweak physics, to be published

4: New Physics Search at the CEPC: a General Perspective
https://doi.org/10.48550/arXiv.2505.24810 （2025）

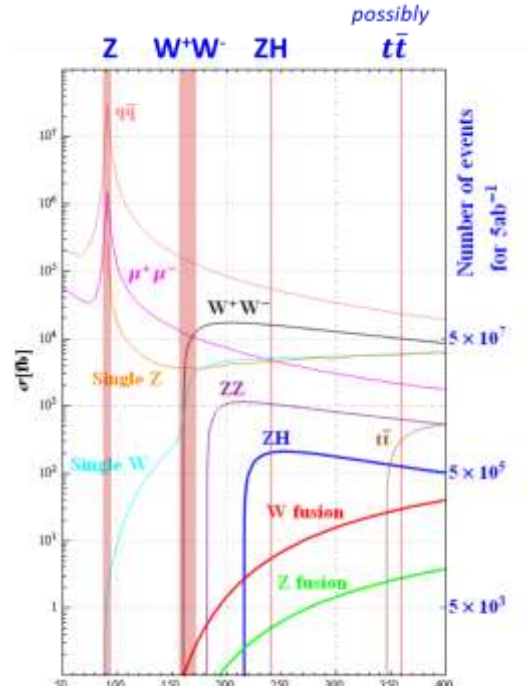
5: QCD, to be published

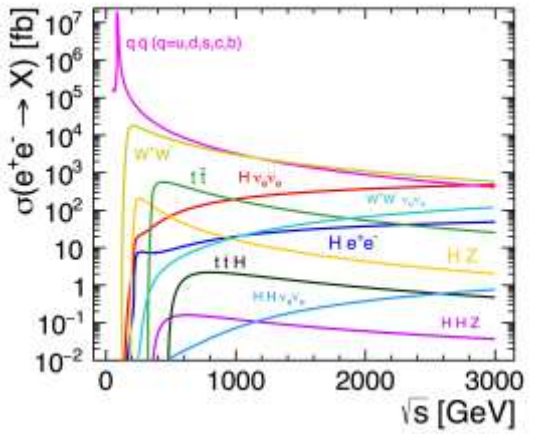


CEPC operation scenarios:
Higgs 10 years, Z-pole 2 years,
W 1 year, ttbar 5 years as upgrade



CEPC as high energy SR light source

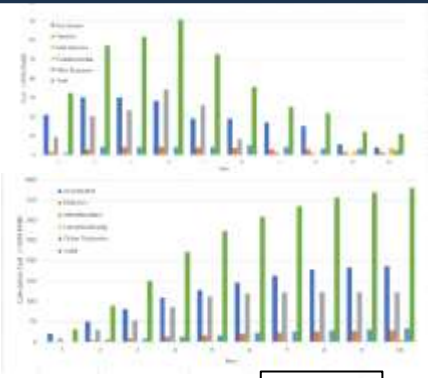




CEPC Milestones and Timeline

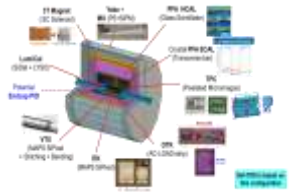
Year 2012 2013 2015 2017 2018 2023 2025 2027 ~2030's construction

Year	Accelerator human resource	Accumulated accelerator 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



CEPC kickoff meeting in Sept. 2013

CEPC detector reference design released in Oct. 2025



Proposal (2030) for CEPC entering 16th five-year-plan

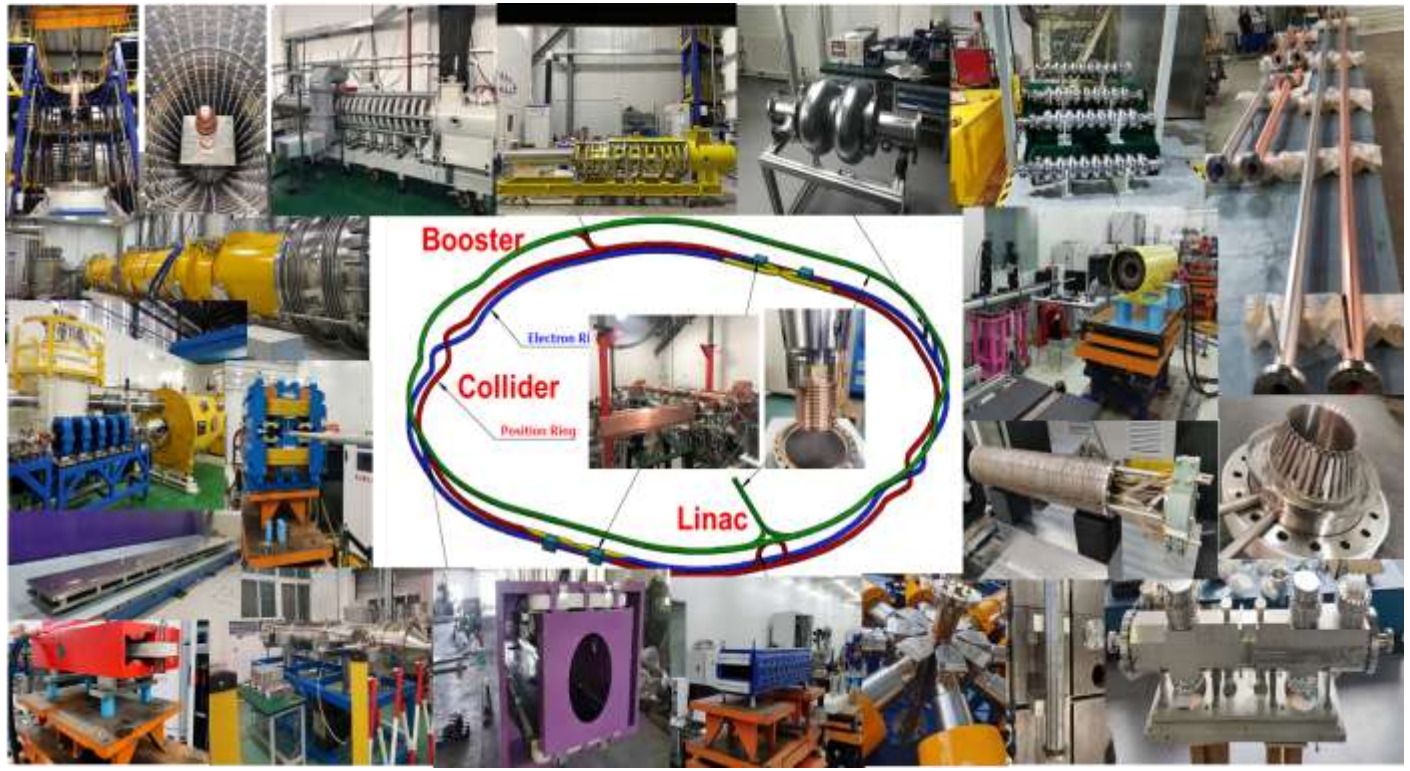
36.4B RMB
Total construction

CEPC EDR site study and civil engineering design

2012.9 CEPC proposed
2013.9 Pre-CDR
2015.3 Progress report
2017.4 CDR
2018.11 TDR
2023.12 2024 ~ 2027 EDR
~2030's construction

J. Gao, "The Status of the CEPC Project in EDR", submitted to IJMPA , 2025, arXiv:2505.04663, https://doi.org/10.48550/arXiv.2505.04663

CEPC Accelerator TDR Completed in 2023






IHEP HEPS (4th generation light source at IHEP) 6 GeV, 36 nm·rad, has been completed in Oct. 2025

CEPC Accelerator TDR was 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

✓ **Specification Met**

✓ **Prototype Manufactured**

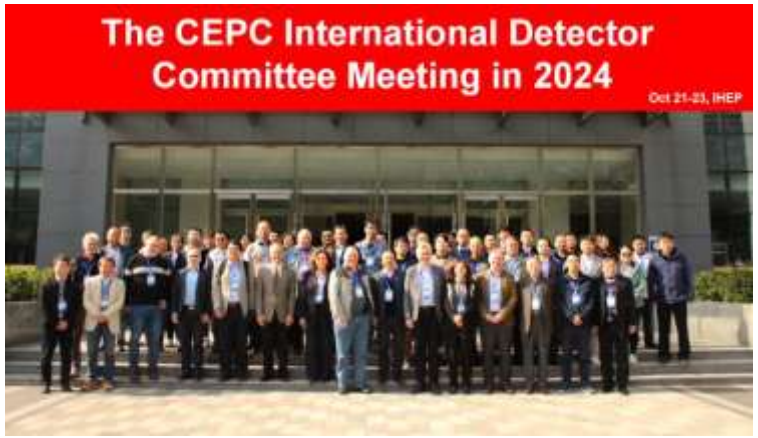
Accelerator	Fraction
✓ Magnets	27.3%
✓ Vacuum	18.3%
√ RF power source	9.1%
✓ Mechanics	7.6%
✓ Magnet power supplies	7.0%
✓ SC RF	7.1%
✓ Cryogenics	6.5%
✓ Linac and sources	5.5%
✓ Instrumentation	5.3%
✓ Control	2.4%
✓ Survey and alignment	2.4%
✓ Radiation protection	1.0%
✓ SC magnets	0.4%
✓ Damping ring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

CEPC IARC, IDRC and IAC Meetings since EDR

CEPC IARC meeting was held from Sept. 18-20, 2024

https://indico.ihep.ac.cn/event/22311/

CEPC IARC meeting was held from Sept. 16-19, 2025



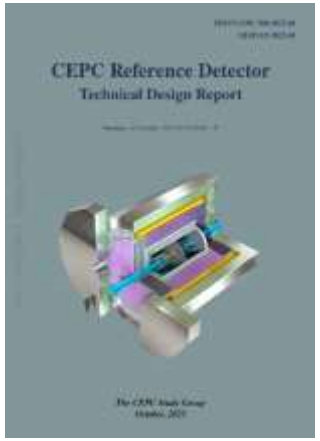
The International Detector Review Committee (IDRC) held its inaugural meeting at IHEP, Oct 21-23, 2024, to review the status and plan of Ref-TDR.

https://indico.ihep.ac.cn/event/23265/

CEPC IAC meeting in 2024 was held from Oct. 29-30, 2024

https://indico.ihep.ac.cn/event/23450/timetable/

CEPC IAC meeting will be held from Nov. 20-21, 2025



CEPC Detector Reference Design Report submitted to arXiv on Oct. 7, 2025

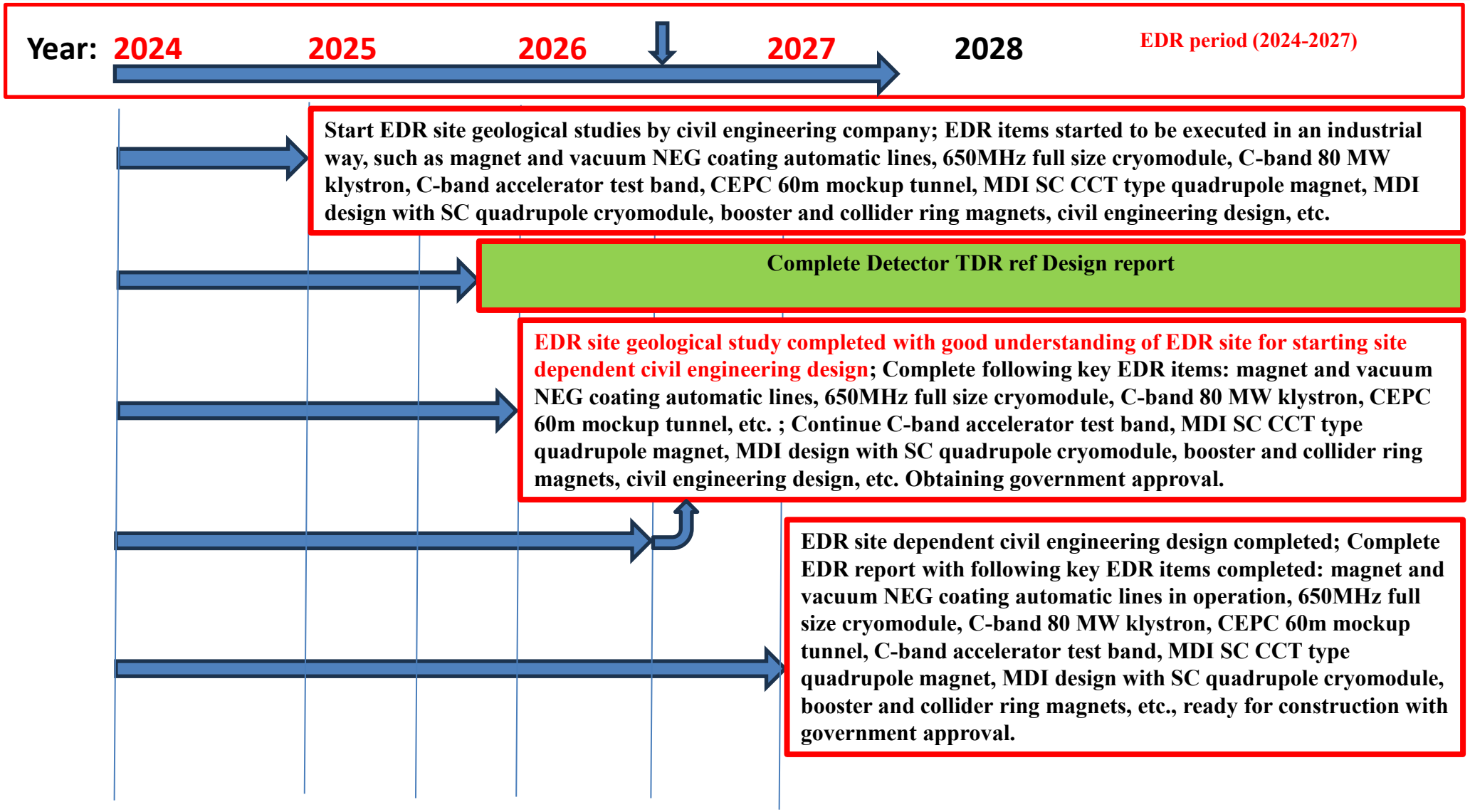
https://arxiv.org/abs/2510.05260

CEPC IDRC meeting was held from April 14-16, 2025

https://indico.ihep.ac.cn/event/25539

CEPC IDRC meeting was held on Sept. 10, 17 and 24, 2025

CEPC EDR Milestones



CEPC Accelerator Parameter in EDR-1

Table 1: CEPC parameters in EDR

	Higgs (3T)	Z (2T)		W (3T)	$t\bar{t}$ (3T)
Number of IPs	2				
Circumference (km)	99.955				
Half crossing angle at IP (mrad)	16.5				
Bending radius (km)	10.7				
SR power per beam (MW)	30	30	10	30	30
Energy (GeV)	120	45.5		80	180
Energy loss per turn (GeV)	1.8	0.037		0.357	9.1
Damping time $\tau_x/\tau_y/\tau_z$ (ms)	44.6/44.6/22.3	816/816/408		150/150/75	13.2/13.2/6.6
Piwinski angle	4.88	24.23		5.98	1.23
Bunch number	268	11934	3978	1297	35
Bunch spacing (ns)	553.9	23.1	69.2	184.6	3969.8
[× 23.08 ns]	24	1	3	8	172
Train gap [%]	55	17		17	58
Bunch population (10^{11})	1.3	1.4		1.35	2.0
Beam current (mA)	16.7	803.5	267.8	84.1	3.3
Phase advance of arc FODO (°)	90	60		60	90
Momentum compaction (10^{-5})	0.71	1.43		1.43	0.71
Beta functions at IP β_x^*/β_y^* (m/mm)	0.3/1	0.13/0.9		0.21/1	1.04/2.7
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.64/1.3	0.27/1.4		0.87/1.7	1.4/4.7
Betatron tune n_x/n_y	445/445	317/317		317/317	445/445
Beam size at IP s_x/s_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
Energy spread (natural/total) (%)	0.10/0.17	0.04/0.13		0.07/0.14	0.15/0.20
Energy acceptance (DA/RF) (%)	1.6/2.2	1.0/1.7		1.05/2.5	2.0/2.6
Beam-beam parameters x_x/x_y	0.015/0.11	0.004/0.127		0.012/0.113	0.071/0.1
RF voltage (GV)	2.2	0.12		0.7	10
RF frequency (MHz)	650				
Harmonic number	216720				
Longitudinal tune n_s	0.049	0.035		0.062	0.078
Beam lifetime (Bhabha/beamstrahlung) (min)	40/40	90/2800		60/195	81/23
Beam lifetime requirement (min)	18	77		22	18
Luminosity per IP (10^{34} cm^{-2} s^{-1})	5.0	115	38	16	0.5

Table 2: CEPC main parameters with 50 MW upgrade

	Higgs (3T)	Z (2T)	W (3T)	$t\bar{t}$ (3T)
Number of IPs	2			
Circumference (km)	99.955			
Half crossing angle at IP (mrad)	16.5			
Bending radius (km)	10.7			
SR power per beam (MW)	50			
Energy (GeV)	120	45.5	80	180
Energy loss per turn (GeV)	1.8	0.037	0.357	9.1
Damping time $\tau_x/\tau_y/\tau_z$ (ms)	44.6/44.6/22.3	816/816/408	150/150/75	13.2/13.2/6.6
Piwinski angle	4.88	29.52	5.98	1.23
Bunch number	446	13104	2162	58
Bunch spacing (ns)	277.0	23.1	138.5	2585.0
[× 23.08 ns]	12	1	6	112
Train gap [%]	63	9	10	55
Bunch population (10^{11})	1.3	2.14	1.35	2.0
Beam current (mA)	27.8	1340.9	140.2	5.5
Phase advance of arc FODO (°)	90	60	60	90
Momentum compaction (10^{-5})	0.71	1.43	1.43	0.71
Beta functions at IP β_x^*/β_y^* (m/mm)	0.3/1	0.13/0.9	0.21/1	1.04/2.7
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.64/1.3	0.27/1.4	0.87/1.7	1.4/4.7
Betatron tune ν_x/ν_y	445/445	317/317	317/317	445/445
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	2.7/10.6	2.5/4.9	2.2/2.9
Energy spread (natural/total) (%)	0.10/0.17	0.04/0.15	0.07/0.14	0.15/0.20
Energy acceptance (DA/RF) (%)	1.6/2.2	1.0/1.5	1.05/2.5	2.0/2.6
Beam-beam parameters ξ_x/ξ_y	0.015/0.11	0.0045/0.13	0.012/0.113	0.071/0.1
RF voltage (GV)	2.2	0.1	0.7	10
RF frequency (MHz)	650			
Harmonic number	216720			
Longitudinal tune ν_s	0.049	0.032	0.062	0.078
Beam lifetime (Bhabha/beamstrahlung) (min)	40/40	90/930	60/195	81/23
Beam lifetime requirement (min)	20	81	25	18
Luminosity per IP (10^{34} cm^{-2} s^{-1})	8.3	192	26.7	0.8

CEPC Accelerator Parameter in EDR-2

The Z mode running of the CEPC detector Ref Technical Design Report has been based on the 3T detector magnetic field, and TPC technology has been adopted

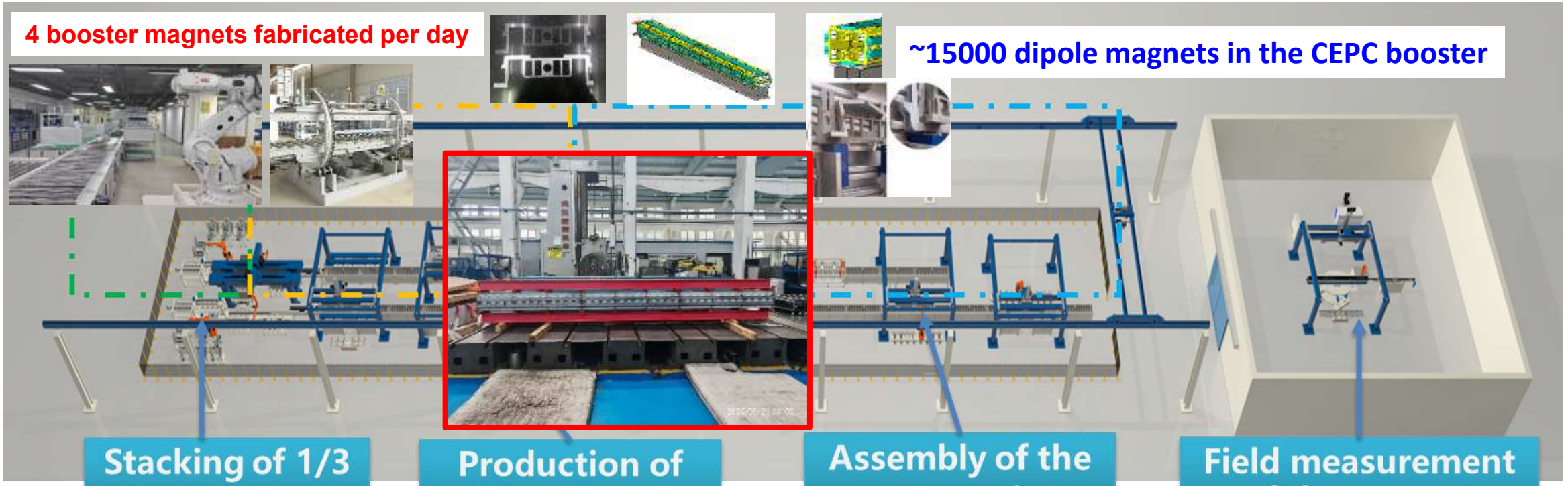
Table 3: CEPC low lum. with 3T detector @ Z for 1st stage running

	Z (3T)	
Number of IPs	2	
Circumference (km)	99.955	
SR power per beam (MW)	8.7	**12.1**
Half crossing angle at IP (mrad)	16.5	
Bending radius (km)	10.7	
Energy (GeV)	45.5	
Energy loss per turn (GeV)	0.037	
Damping time $\tau_x/\tau_y/\tau_z$ (ms)	816/816/408	
Piwinski angle	24	
Bunch number	3978	
Bunch spacing (ns)	69.2	
Bunch population (10^{11})	1.22	1.7
Beam current (mA)	233.2	325.0
Phase advance of arc FODO (°)	90	**60**
Momentum compaction (10^{-5})	0.71	1.43
Beta functions at IP β_x^*/β_y^* (m/mm)	0.2/1.0	0.13/1.0
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.092/1.7	0.27/**5.1**
Betatron tune ν_x/ν_y	445/445	317/317
Beam size at IP σ_x/σ_y (um/nm)	4/42	6/72
Bunch length (natural/total) (mm)	2.1/8.3	2.1/8.8
Energy spread (natural/total) (%)	0.04/0.11	0.04/0.15
Energy acceptance (DA/RF) (%)	1.0/1.9	1.0/2.2
Beam-beam parameters ξ_x/ξ_y	0.0065/0.11	0.0053/0.082
RF voltage (GV)	0.09	0.16
RF frequency (MHz)	650 (2 cell cavity)	
Longitudinal tune ν_s	0.021	0.041
Beam lifetime (Bhabha/beamstrahlung) (min)	120/200	150/180
Beam lifetime requirement (min)	68	
Hourglass Factor	0.97	
Luminosity per IP (10^{34} cm^{-2} s^{-1})	24	**26**

Table 4: CEPC high lum. with 3T detector @Z assuming for 2nd stage running

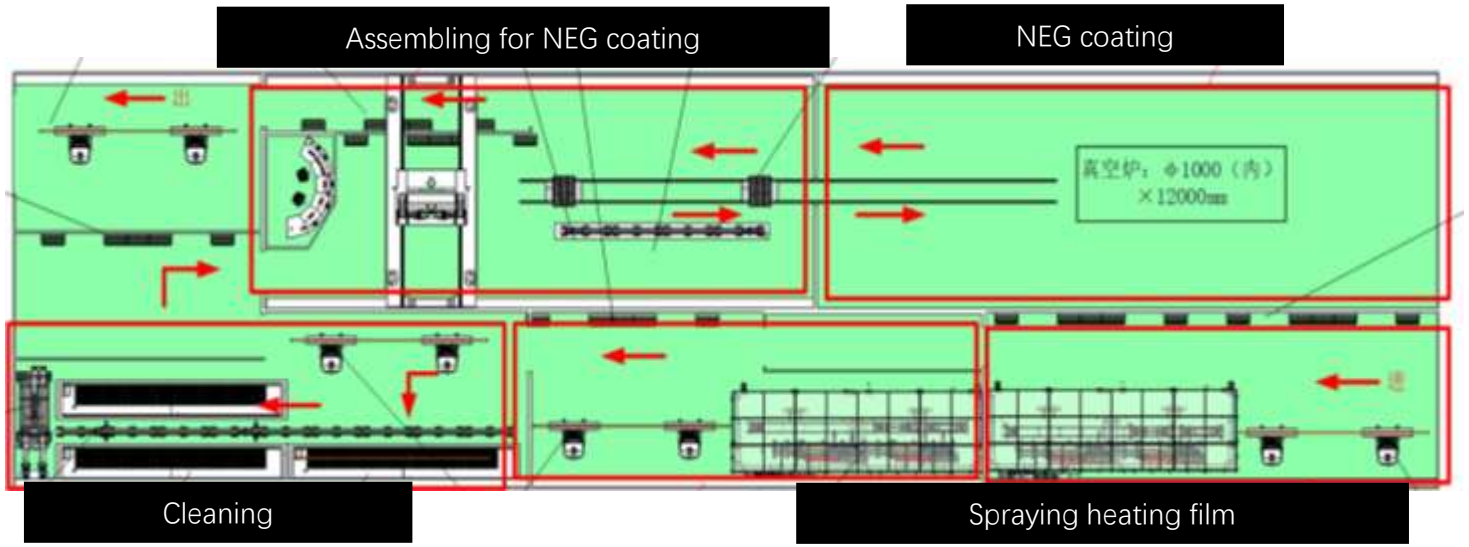
	Z	
Number of IPs	2	
Circumference (km)	99.955	
SR power per beam (MW)	**30**	50
Half crossing angle at IP (mrad)	16.5	
Bending radius (km)	10.7	
Energy (GeV)	45.5	
Energy loss per turn (GeV)	0.037	
Damping time $\tau_x/\tau_y/\tau_z$ (ms)	816/816/408	
Piwinski angle	24.2	29.5
Bunch number	11934	13104
Bunch spacing (ns)	23.1 (17% gap)	23.1 (9% gap)
Bunch population (10^{11})	1.4	2.1
Beam current (mA)	806.9	1345.2
Phase advance of arc FODO (°)	60	
Momentum compaction (10^{-5})	1.43	
Beta functions at IP β_x^*/β_y^* (m/mm)	0.13/1.0	
Emittance $\varepsilon_x/\varepsilon_y$ (nm/pm)	0.27/**5.1**	
Betatron tune ν_x/ν_y	317/317	
Beam size at IP σ_x/σ_y (um/nm)	6/72	
Bunch length (natural/total) (mm)	2.5/9.3	2.2/10.6
Energy spread (natural/total) (%)	0.04/0.15	0.04/0.15
Energy acceptance (DA/RF) (%)	1.2/1.7	1.2/2.1
Beam-beam parameters ξ_x/ξ_y	0.0045/0.069	0.0046/0.074
RF voltage (GV)	0.12	0.15
RF frequency (MHz)	650 (1 cell cavity)	
Harmonic number	216720	
Longitudinal tune ν_s	0.035	0.040
Beam lifetime (Bhabha/beamstrahlung) (min)	170/95800	120/932
Beam lifetime requirement (min)	77	81
Luminosity per IP (10^{34} cm^{-2} s^{-1})	**50.3**	95.2

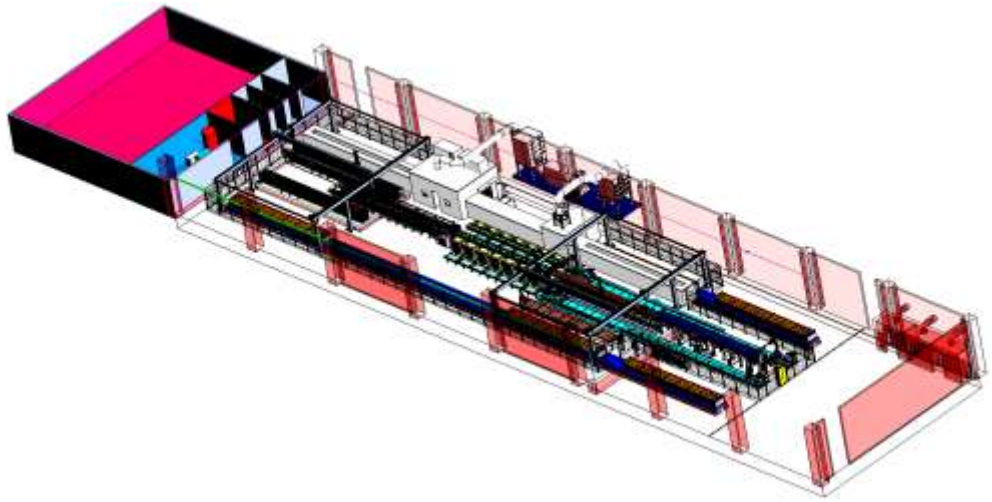
CEPC Booster Magnet Automatic Production Line in EDR



Status： construction started, to be completed in 2025~2026

CEPC NEG Coated Vacuum Chamber (200km)
Automatic Production Line in EDR



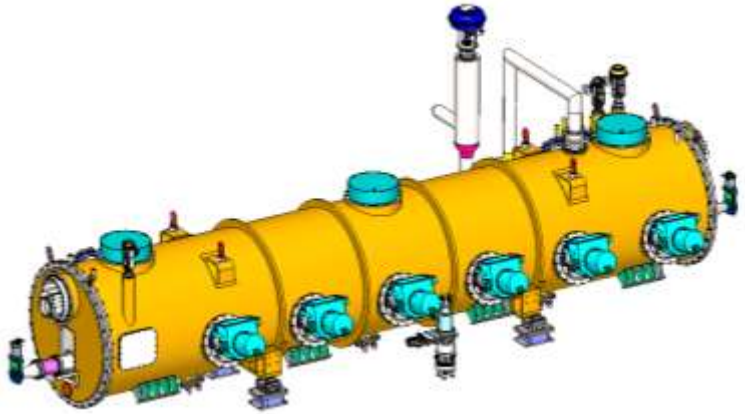


Layout of production line

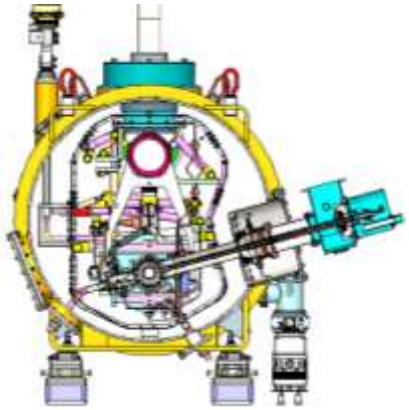
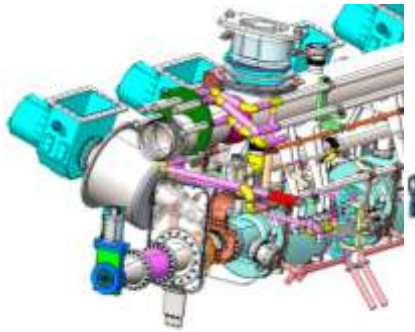
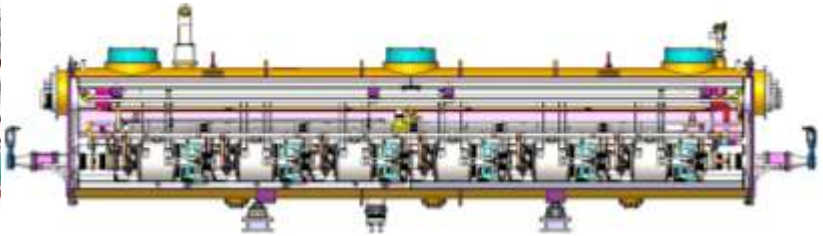
Status：construction started, to be completed in 2025~2026

CEPC 650MHz SRF Development in EDR





CEPC collider ring 650MHz 2*cell short test module has been completed in TDR phase


The collider Higgs mode for 30 MW SR power per beam will use 32 units of 11 m-long collider cryomodules will contain six 650 MHz 2-cell cavities, and therefore, a full size 650 MHz cryomodule will be developed in EDR

Status： construction started, to be completed in 2026

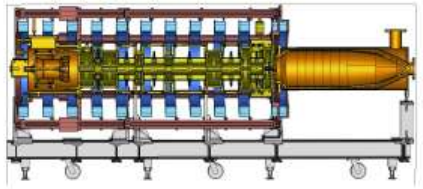
CEPC High Efficiency and High Power Klystrons

Klystron R&D

Klystron No. 1
Efficiency 65%
(2020)

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

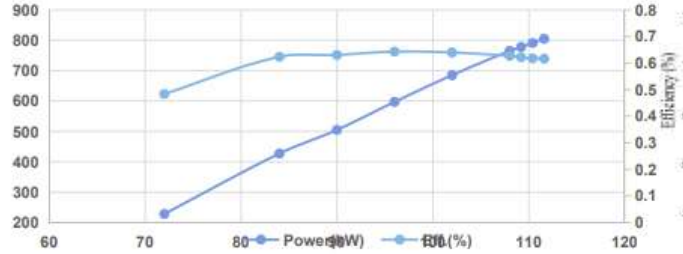
Klystron No. 2
Efficiency 77%
(2021)

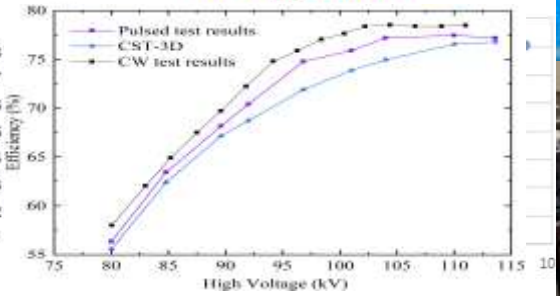


78.5%@803kW CW in 2024

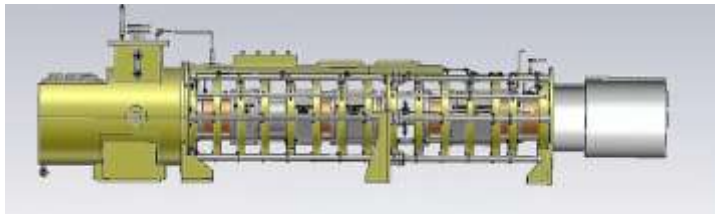
Klystron No. 3 （MBI
Efficiency 80.5%
To be completed in 2025

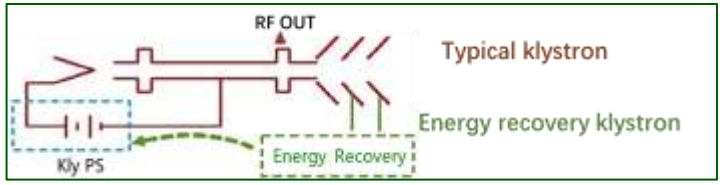
High Voltage vs. Power&Efficency





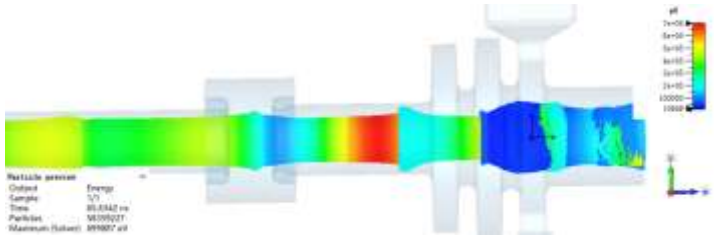
CEPC 650Mhz Energy Recovery Klystron

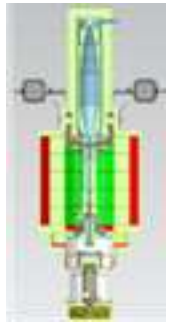




Parameter	Value
Operating frequency	650 MHz
Beam Voltage	113 kV
Efficiency	77.5%
Output power	800 kW
Beam perveance	0.25 μP
Beam current	9.5A
Efficiency (one-stage depressed collector)	85%

CEPC collider ring 650MHz klystron development in TDR/EDR phase

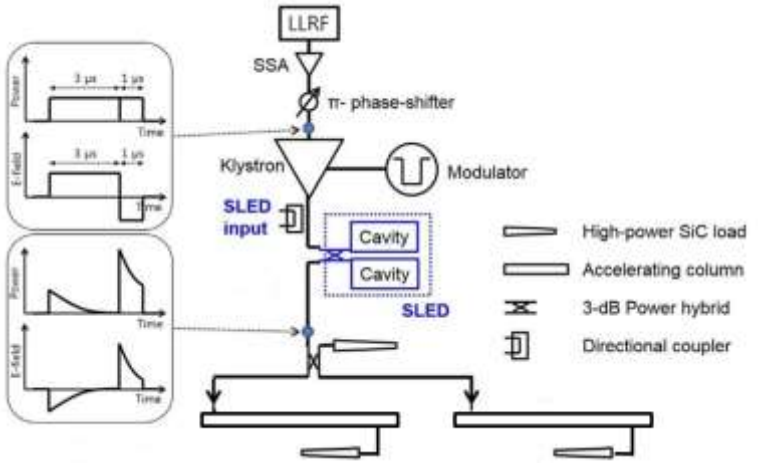


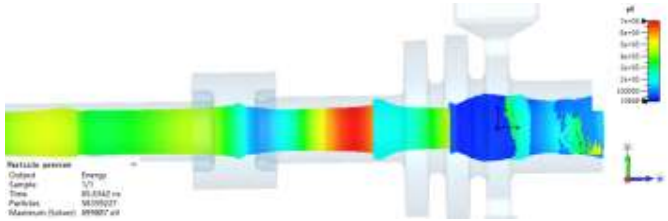


C band 5720MHz 80MW Klystron design completed to be completed on 2025

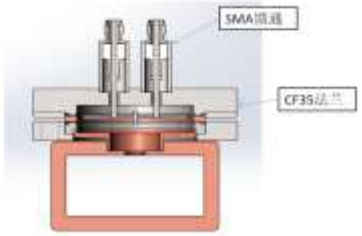
CEPC C-Band Linac Test Bench in EDR

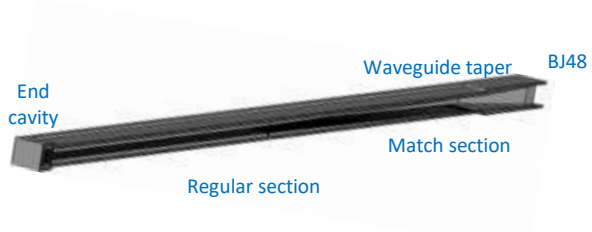
- CEPC EDR will establish the **C-band test bench** and test the components. With pulsed compressor, waveguides, directional couplers, loads, bend and straight waveguides, etc. **as a basic unit of CEPC C-band linac**
- The C-band test band is equipped with a CEPC 5720MHz 80MW power source
- The CEPC C-band test band will be completed in 2026

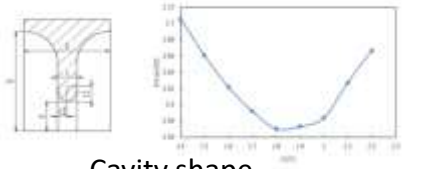




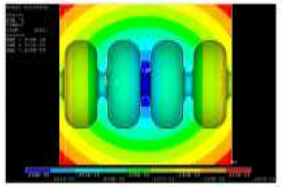
C band 5720MHz 80MW Klystron design completed, and fabrication will be completed in 2025



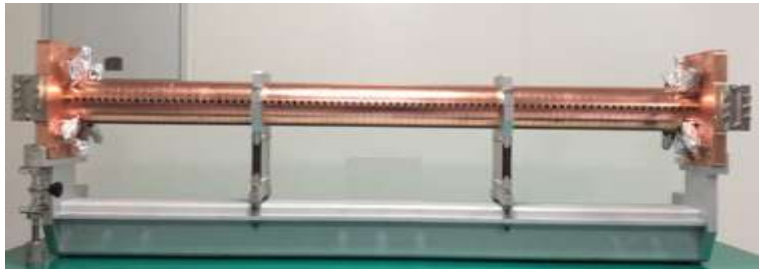


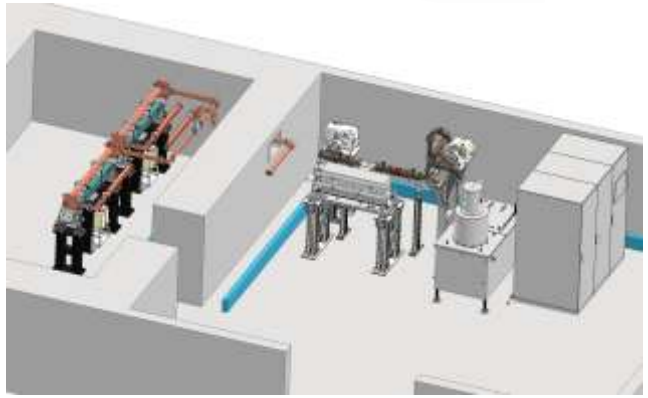


Cavity shape



The deformation caused by temperature variation

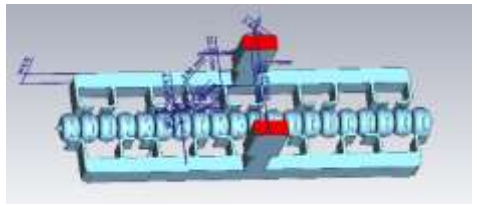


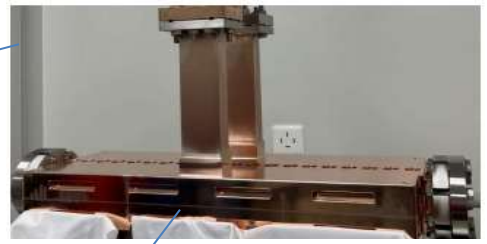


CEPC C-band linac test band will be completed in 2026

CEPC Cool Copper C-Band Linac Technology R&D

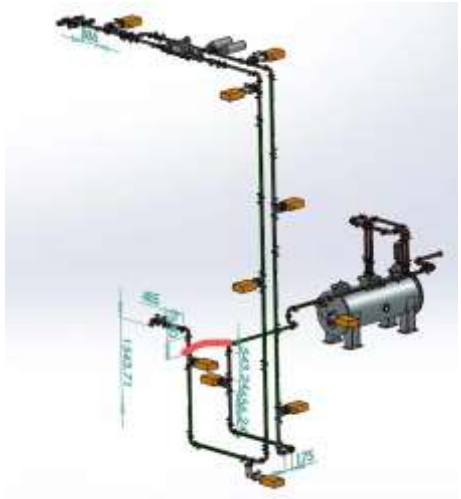
- CEPC is exploring the Cool Copper **C-band linac** technology (5712MHz is the test facility frequency)
- Two types of structures have been studied, type I and type II
- Type I has reached Eac 92.08MV/m, Q0=26162 with 20MW input (80MW input will reach Eac 199.2MV/m) (Iris diameter 5.25mm)
- Type II will reach 144MV/m with 80MW input (Iris diameter 10.49mm)



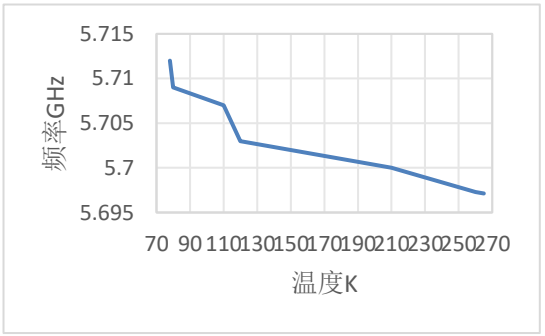


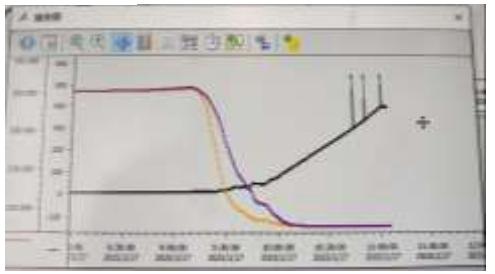
Type I: Aperture diameter 5mm, Length 0.5m

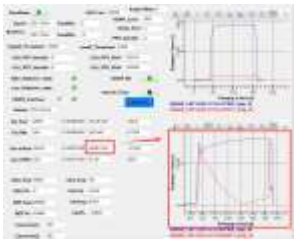
Parameters	Value
Fre (MHz)@77K	5712
Mode	Pi
Cavity numbers	20
Shunt impedance per meter(MΩ/m)@77K	303
E_s/E_0	2.42
Q_0@77K	31905

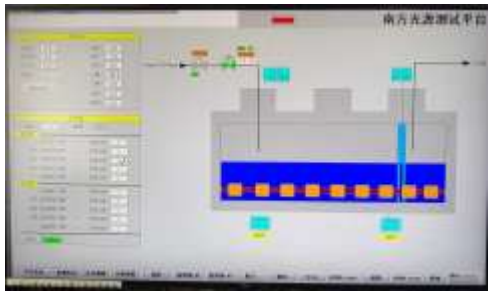


Type II: Aperture diameter 10mm, Length 1m



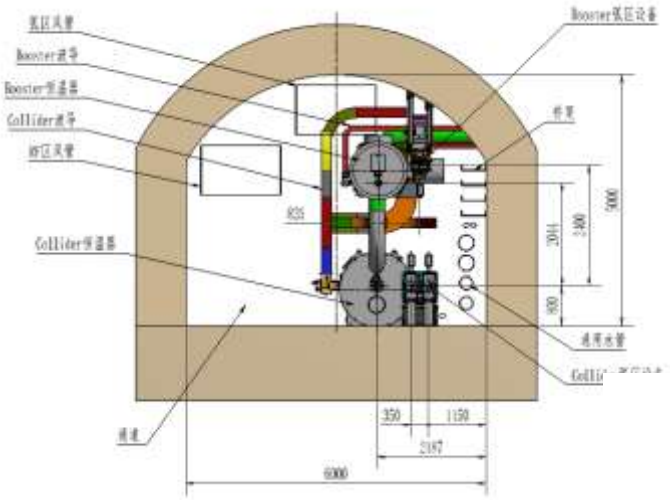


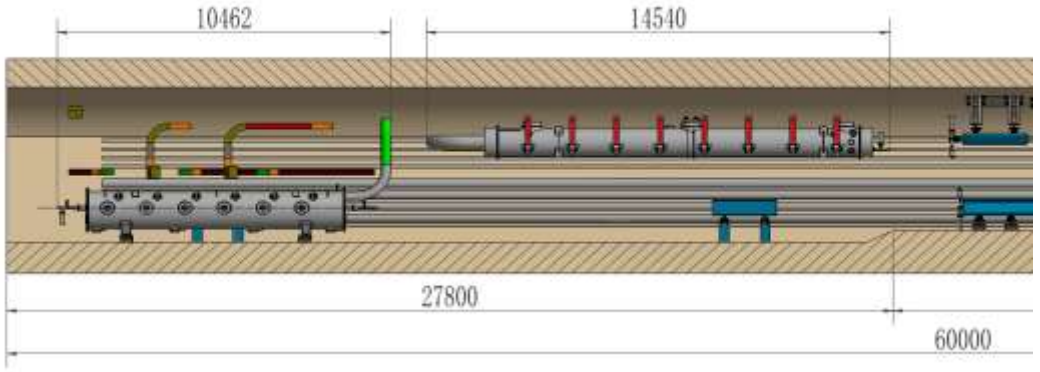


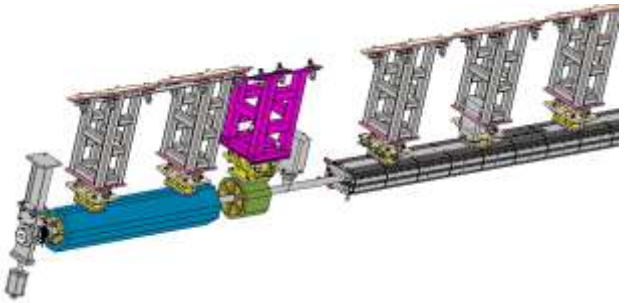


This cool coper C-band type-II structure has the potential to be applied to CEPC injector when necessary

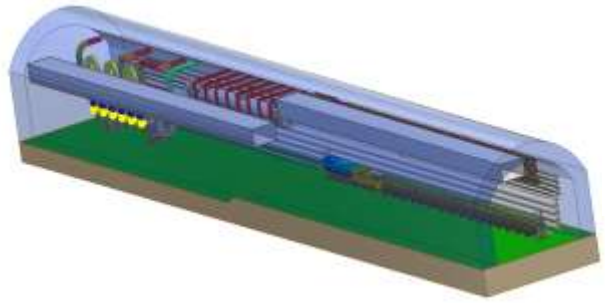
CEPC Tunnel Mockup for Installation in EDR

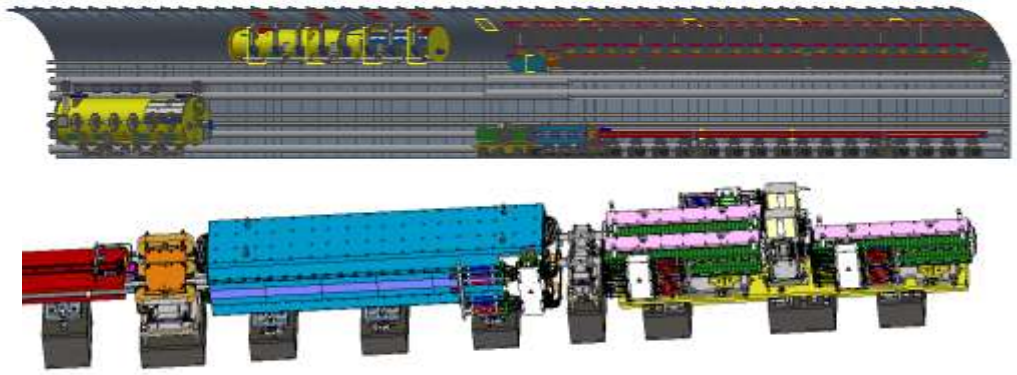


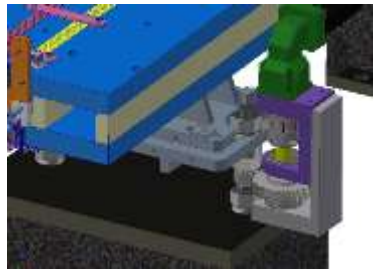


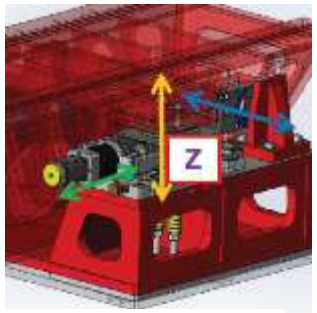


Booster magnets installation









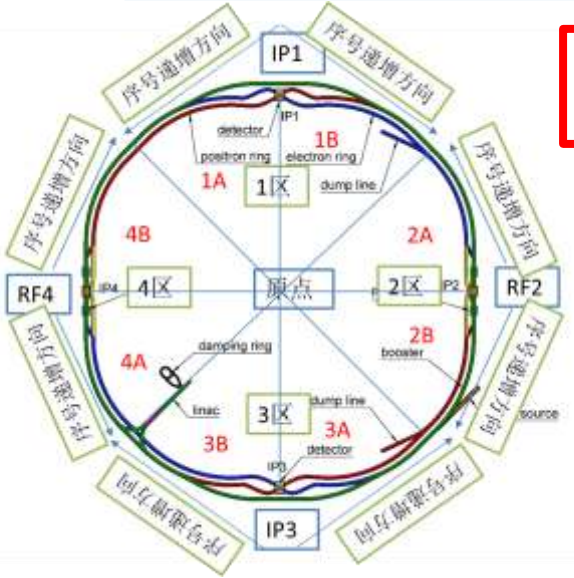
Collider ring magnets supports

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

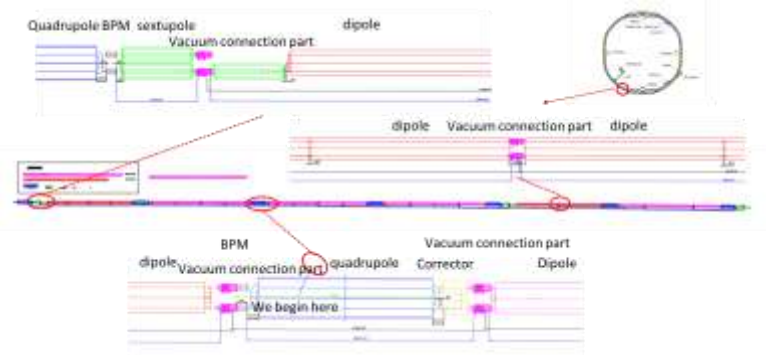
To demonstrate the inside tunnel alignment and installation, especially for booster installation on the roof of the tunnel

Plan：to be completed in 2026

CEPC Accelerator EDR: Survey and Mechanical 2D/3D Design

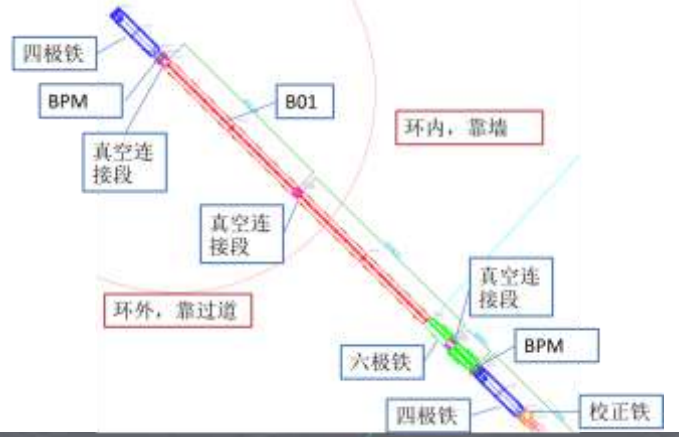


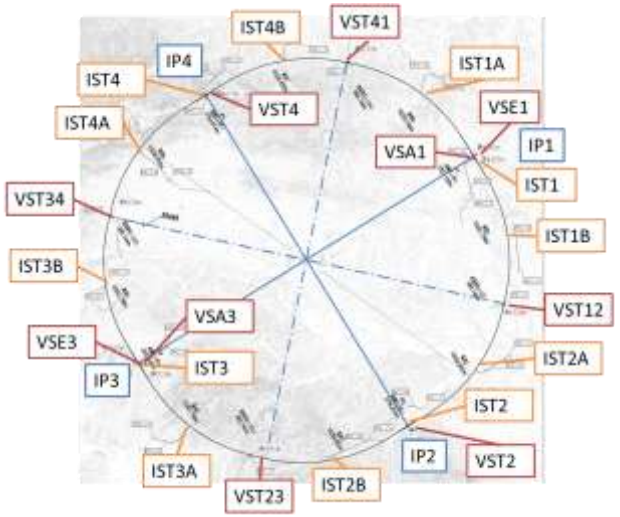
CEPC Facility components' naming sysem established



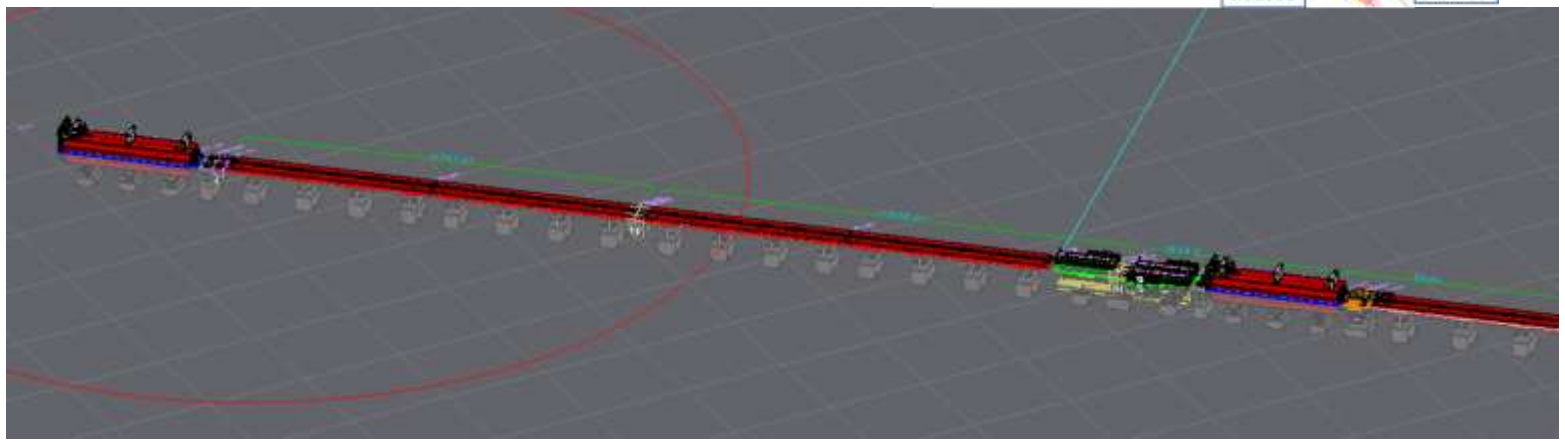
2D/3D linkage design for CEPC accelerator survey:

- If the 3D model is changed or replaced, the 2D model will be updated.
- If the 2D model is replaced or its location is changed, the 3D model will be updated.



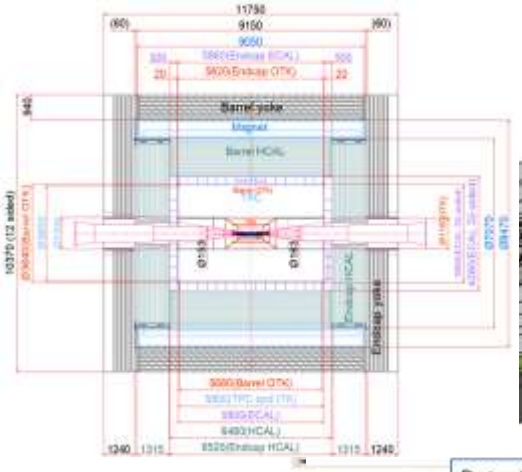


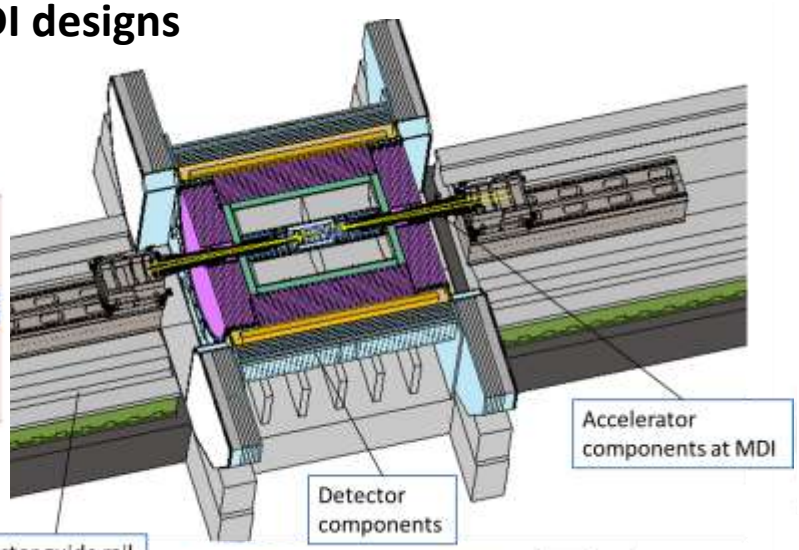
CEPC 10 vertical shafts and 12 horizontal access tunnel distribution

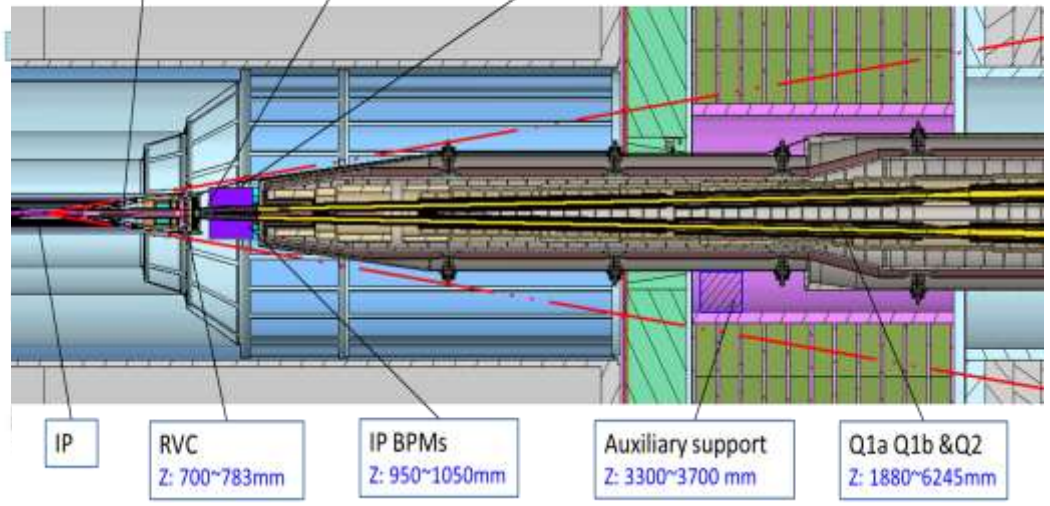


Other CEPC Accelerator and MDI EDR Activities

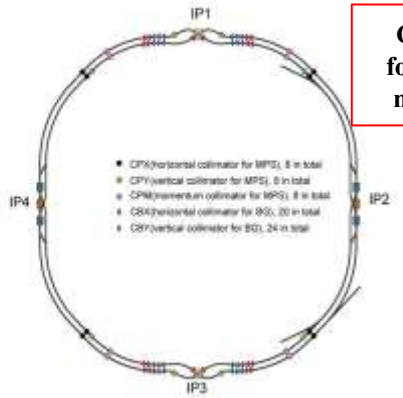
CEPC MDI designs





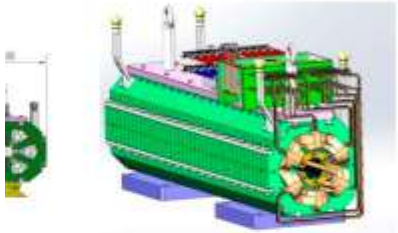


CEPC Collider Ring Magnets in EDR



CEPC Collimators for background and machine protection

Correctors: mechanical design completed



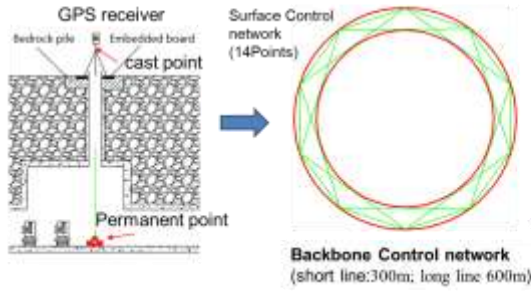
Sextupole magnets under design

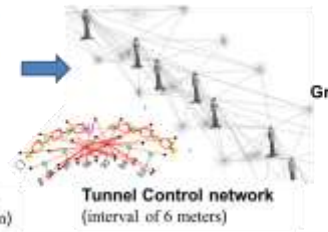
CEPC Alignment and Installation Plan in EDR

- Alignment accuracy requirement

Component	Δx (mm)	Δy (mm)	Δθz (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



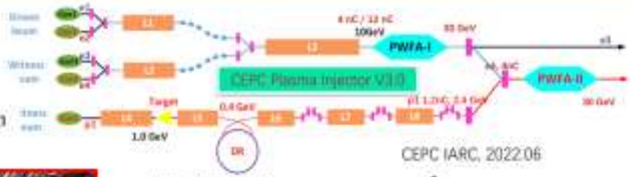


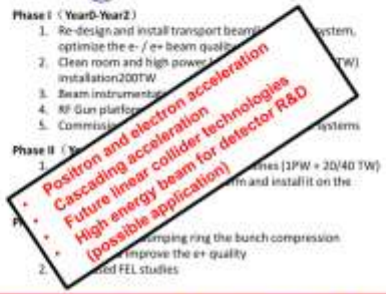
BEPCII-based PWFA Test Facility Development Status

CEPC Plasma Injector (alternative option) and TF Plan

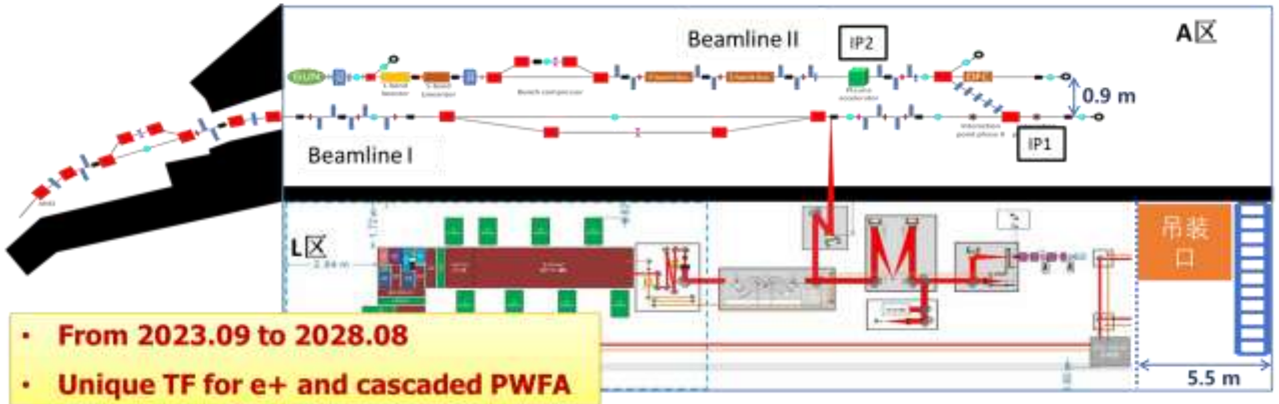
CEPC plasma injector scheme:
From 10 GeV → 30 GeV → TR ≥ 2

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





PWFA/LWFA TF based on BEPC-II Linac and HPL has been founded by CAS 90M RMB in Sept. 2023
Under development in the experimental hall #10 of BEPC-II

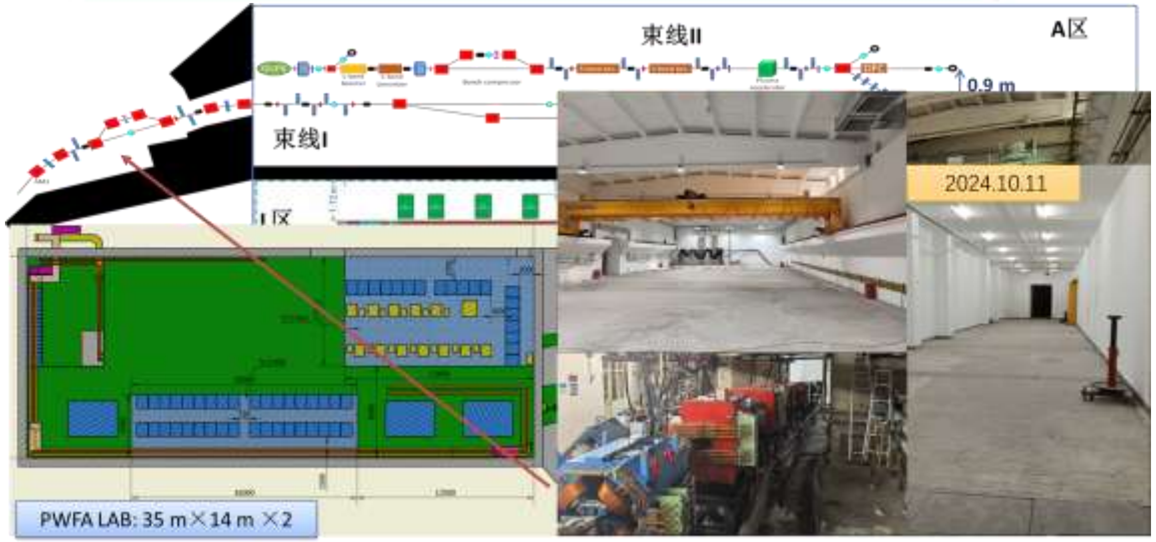


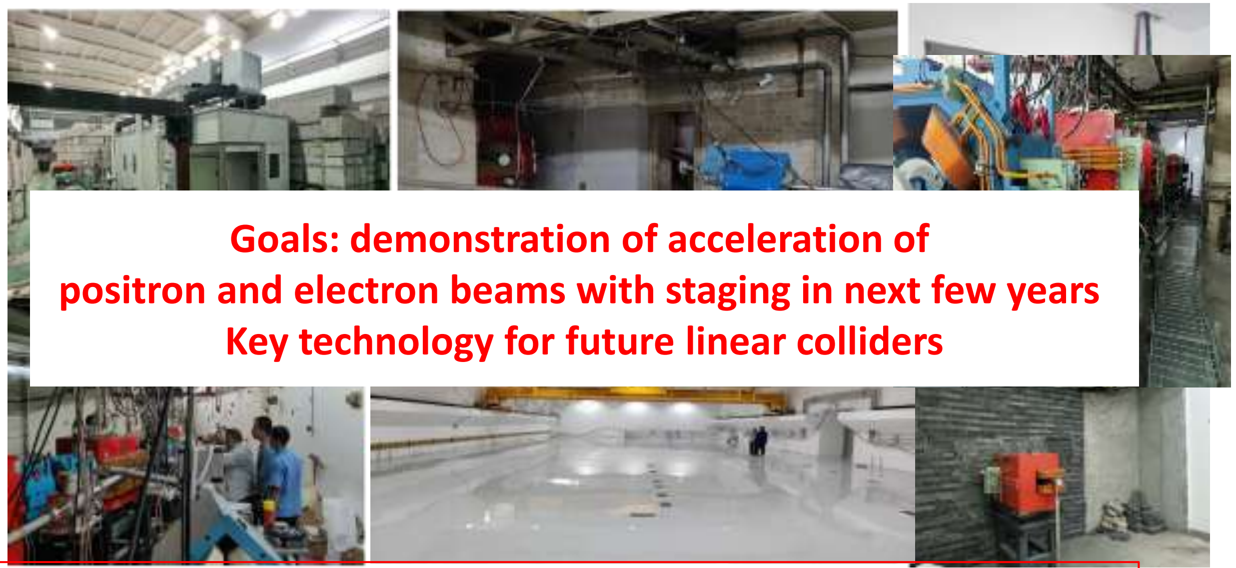
- From 2023.09 to 2028.08
- Unique TF for e+ and cascaded PWFA

Beam quality → Beamline I

Parameters	Unit	BL-I e- (AM3)	BL-I e- (IP1)	BL-I e+ (AM3)	BL-I e+ (IP1)	BL-I e- (IP1, block)	BL-I e+ (IP1, block)
Energy	GeV	2	2	2	2	2	2
Charge	pC	2000	2000	100	100	9.4	0.2
bunch length	ps	10	1	10	1	~1	~1
Geo. emittance	mm-mrad	0.1/0.1	0.1/0.1	0.4/0.4	0.4/0.4	0.011/0.005	0.04/0.02
RMS beam size	μm	-	150/150	-	300/300	30/40	54/76

33





Goals: demonstration of acceleration of positron and electron beams with staging in next few years
Key technology for future linear colliders

Dazhang Li, Wei Lu and Jie Gao, Research highlights on plasma-based acceleration at IHEP, AAPPS Bulletin (2025) 35:3, https://doi.org/10.1007/s43673-025-00143-z

BEPCII-based PWFA Test Facility - beamline installation

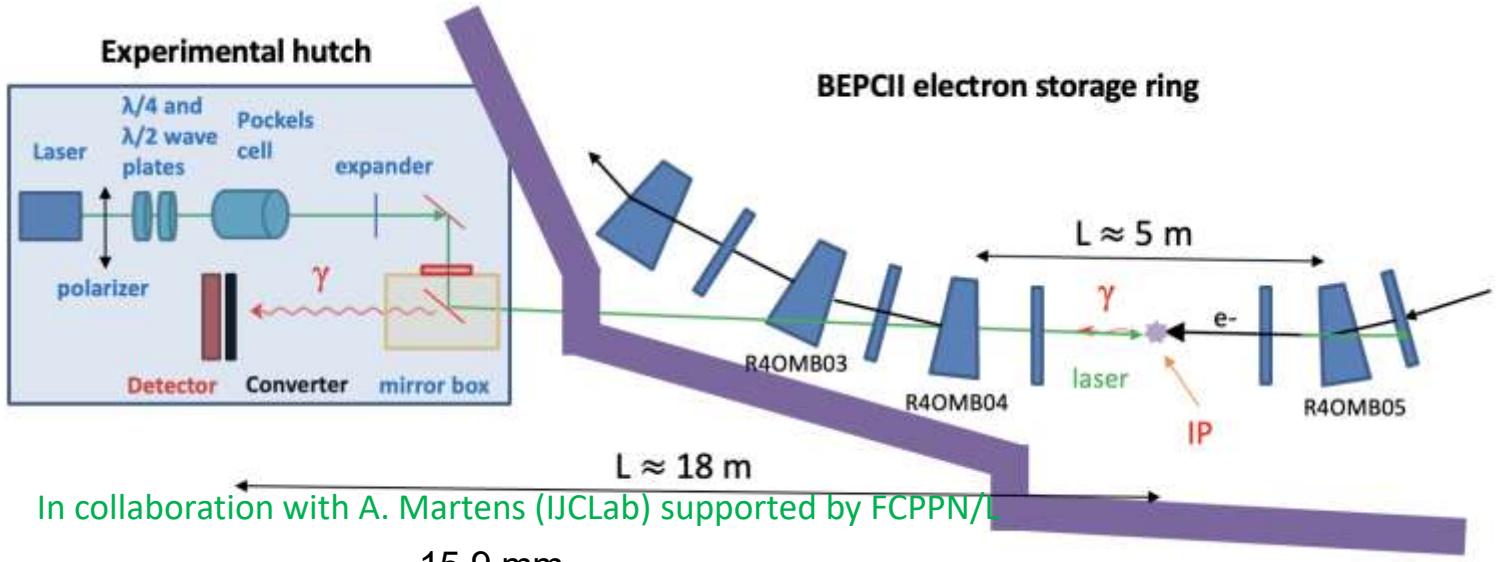
PWFA-BL 1 from BEPCII

PWFA-BL 2 from L-Band RF gun

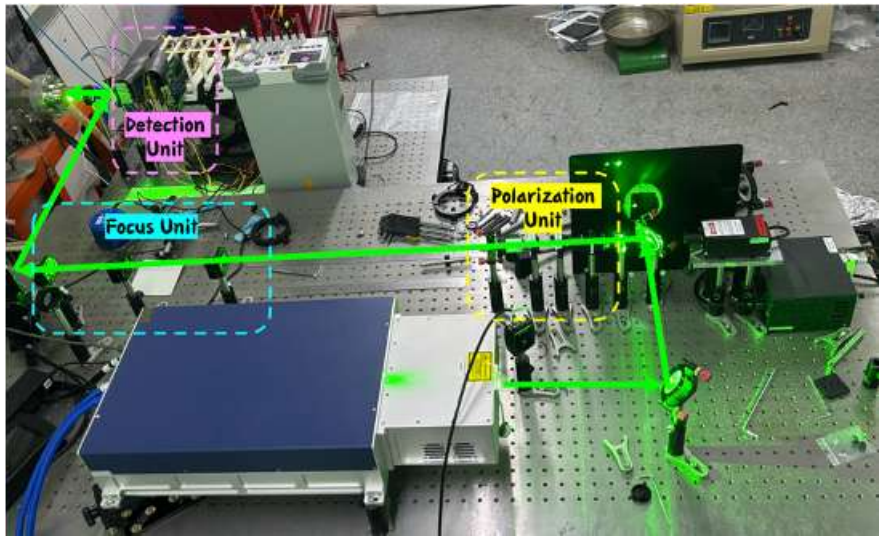
CEPC Polarization in Preparation Study

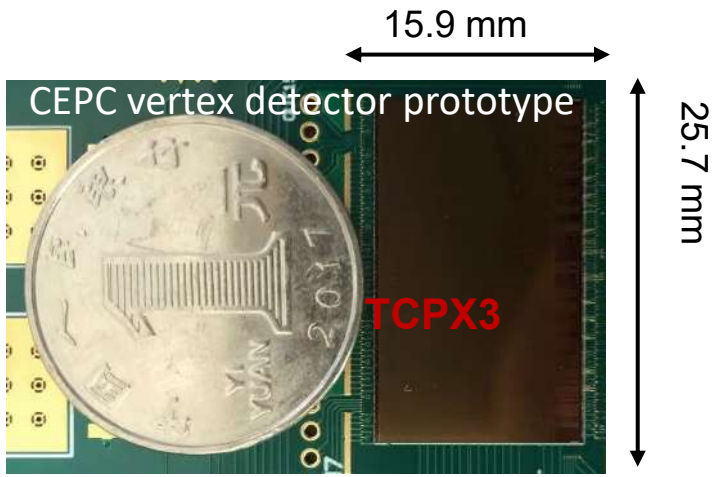
-Compton Polarimeter at BEPCII-U

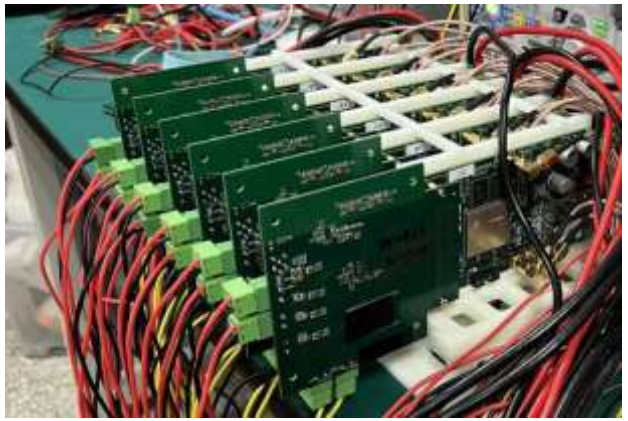
- A Compton polarimeter is now under commissioning at BEPCII-U
  - simulated performance: ~1% stats uncertainty within 20 second
  - Ready for tuning of laser-electron collision-> backscattered gamma signal from laser-electron collision has been observed

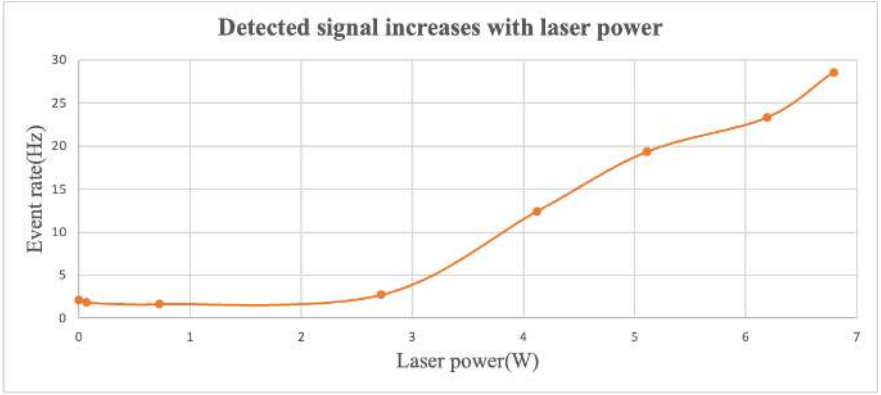


In collaboration with A. Martens (IJCLab) supported by FCPPN/L





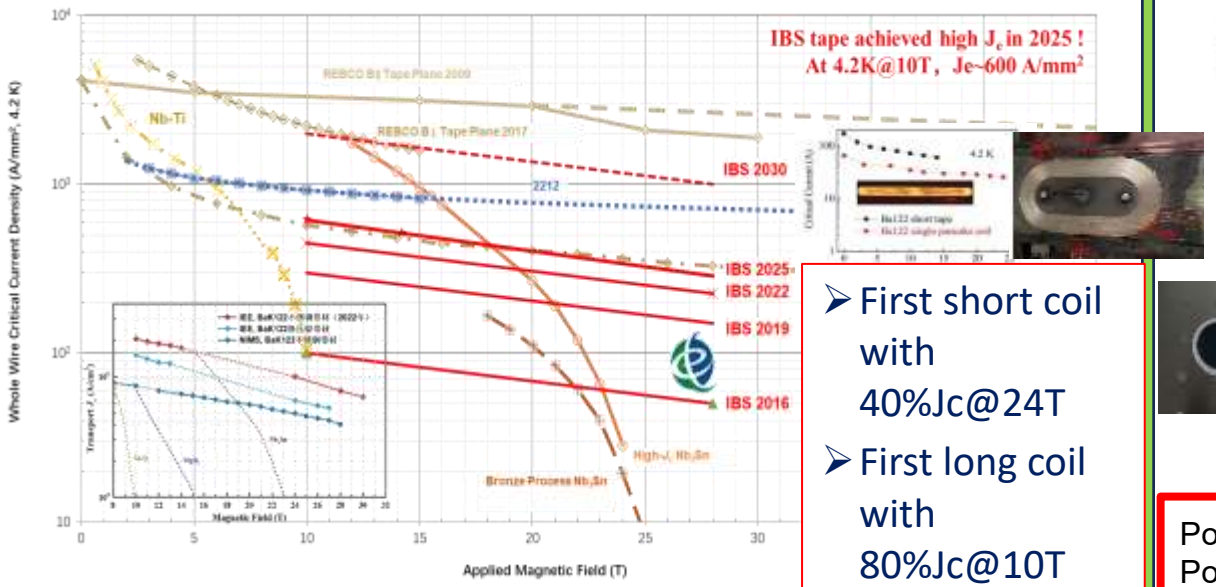




Advanced Technologies Development in Progress

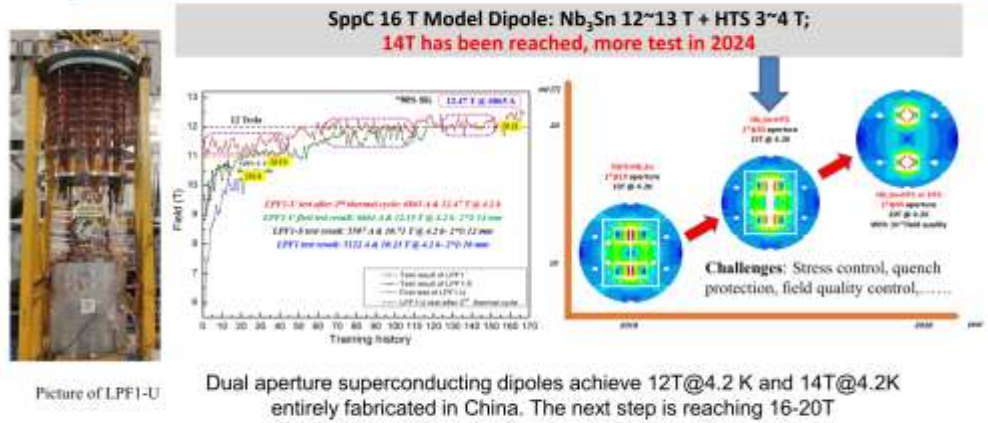
IBS Technology for High Field Magnets

J_e of IBS expected to be similar as ReBCO in 5 years with better mechanical properties and lower cost



- First short coil with 40%Jc@24T
- First long coil with 80%Jc@10T

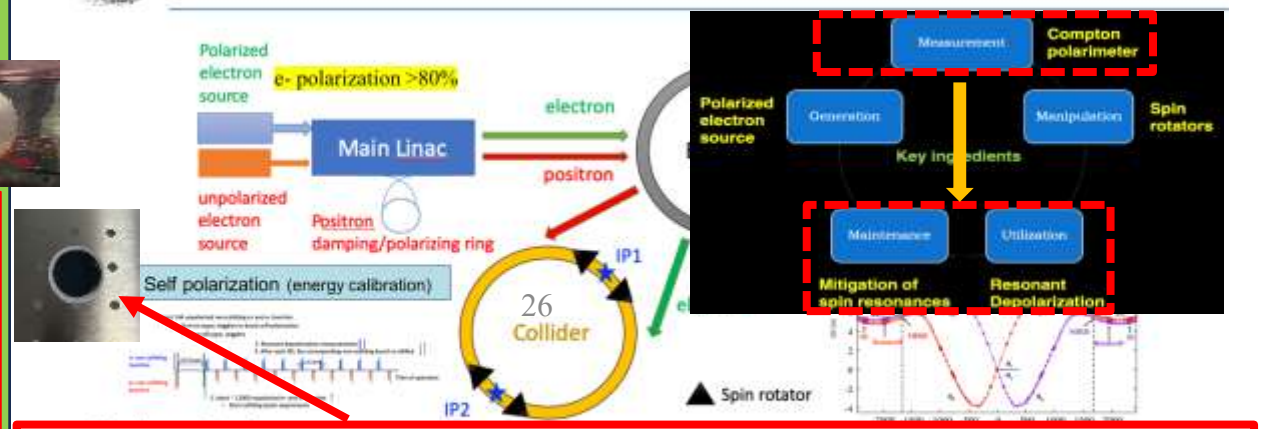
SppC HF Magnet Development



Picture of LPF1-U

Dual aperture superconducting dipoles achieve 12T@4.2 K and 14T@4.2K entirely fabricated in China. The next step is reaching 16-20T

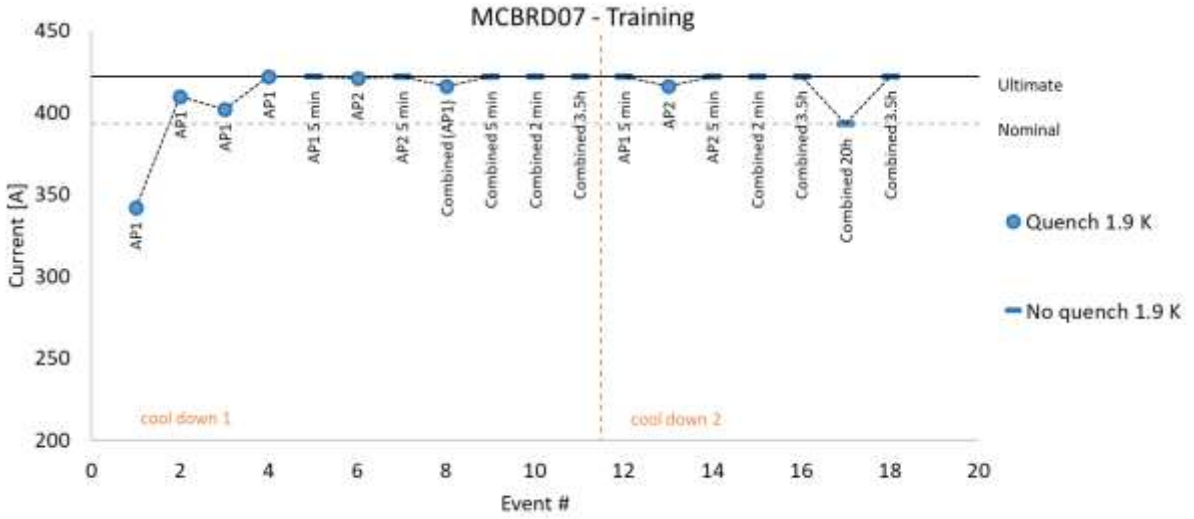
CEPC Polarized Beam Studies(alternative option)

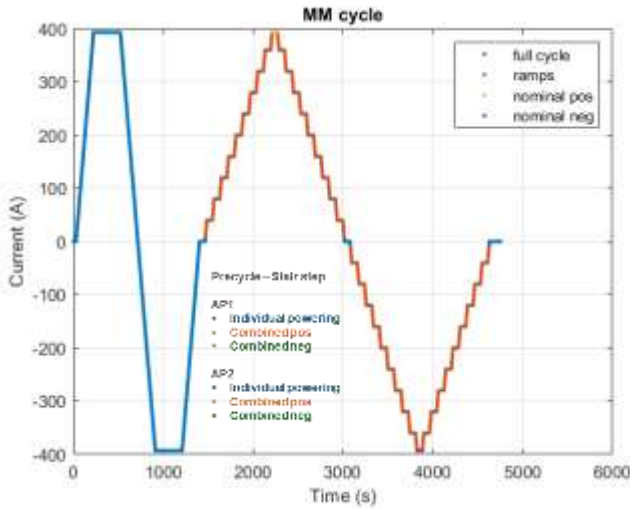


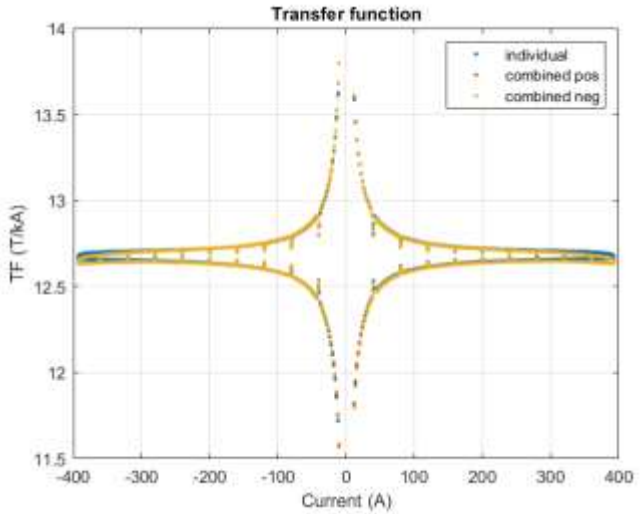
Polarized electron cathode chip (diameter ~5cm) has been fabricated in June 2025: Polarization of 85%, for 1ns laser (780nm) pulse length, several nC polarized electron charge will be obtained with the expected cathode lifetime ~6 months

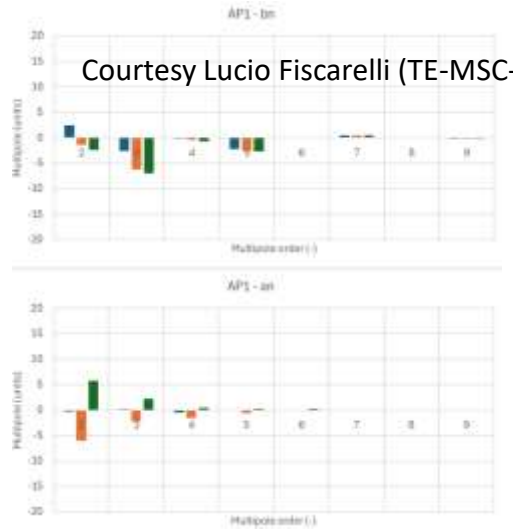
Status of HL-LHC CCT Magnets

- The 8 CCT magnets have been delivered to CERN, final 2 magnets will be delivered at the end of 2025. Magnets delivered have been successfully tested and reached the design goals at CERN.





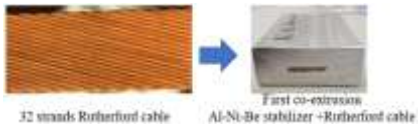




Courtesy Lucio Fiscarelli (TE-MSC-MMM)

CEPC Detector Reference TDR Design

3T Magnet
(SC Solenoid)



Yoke +
MU (PS+SiPM)

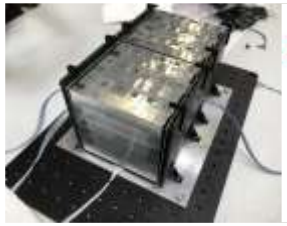
PFA HCAL
(Glass Scintillator)

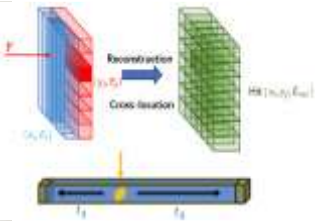
$\gamma - \gamma$ separation for 5 GeV photons

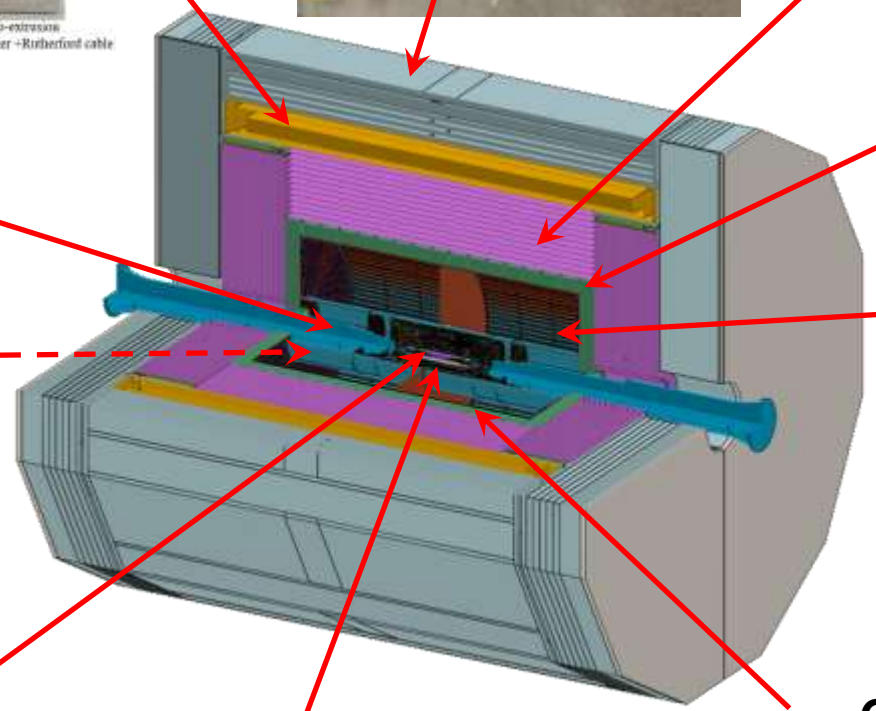
55*55*320mm^3

LumiCal
(SiDet + LYSO)

Crystal **PFA ECAL**
(Transverse bar)



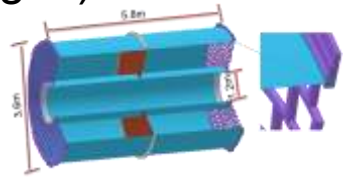


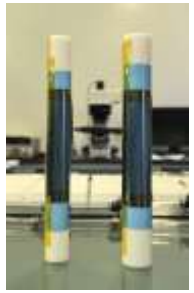


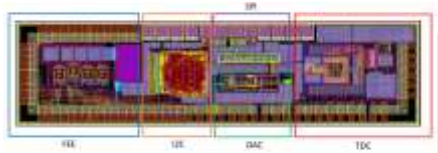
Potential
Endcap PID

TPC (3T)
(Pixelated Micromegas)

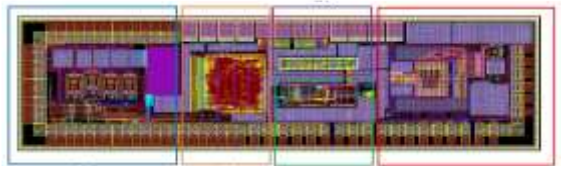
Readout ASIC



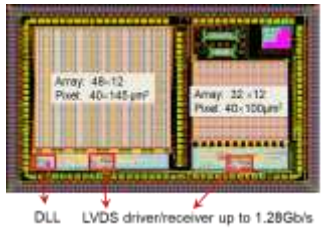




VTX
(MAPS SiPixel
+ Stitching + Bending)

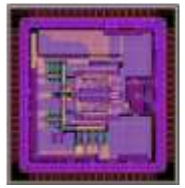


ITK
(MAPS SiPixel)

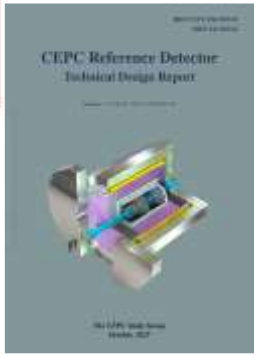


DLL LVDS driver/receiver up to 1.28Gb/s

OTK
(AC-LGAD strip)



TDC delay line layout



CEPC Detector Reference Technical Design Report reviewed by IDRC in April and Sept. 2025, and submitted to arXiv on Oct. 6, 2025.
https://arxiv.org/abs/2510.05260

Ref-TDR is based on this configuration

CEPC TDR-ref Detector Specifications

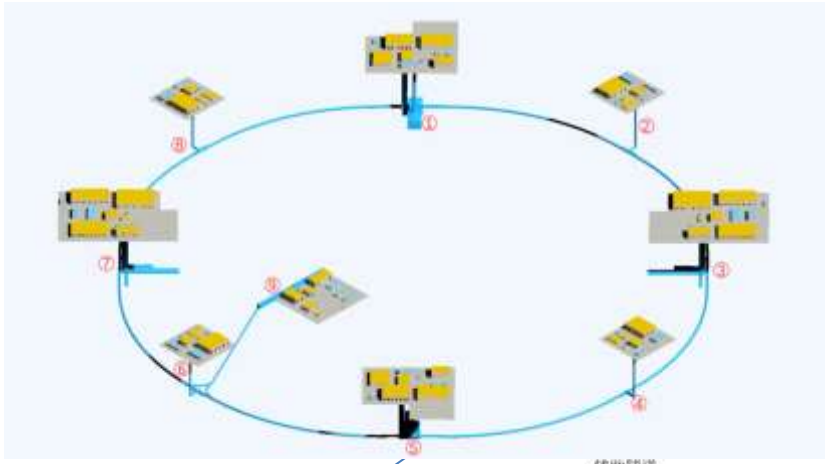
Sub-system	Key technology	Key Specifications
Vertex	6-layer CMOS SPD	$\sigma_{r\phi}$ ~ 3 μm, X/X_0 < 0.15% per layer
Tracking	CMOS SPD ITK, AC-LGAD SSD OTK, TPC + Vertex detector	$\sigma\left(\frac{1}{P_T}\right) \sim 2\times10^{-5} \oplus \frac{1\times10^{-3}}{P\times sin^{3/2}\theta}(GeV^{-1})$
Particle ID	dN/dx measurements by **TPC** Time of flight by AC-LGAD SSD	Relative uncertainty ~ 3% σ(t) ~ 30 ps
EM calorimeter	High granularity crystal bar PFA calorimeter	EM resolution ~ $3\%/\sqrt{E(GeV)}$ Effective granularity ~ 1×1×2 cm^3
Hadron calorimeter	Scintillation glass PFA hadron calorimeter	Support PFA jet reconstruction Single hadron $\sigma_E^{had} \sim 40\%/\sqrt{E(GeV)}$ Jet $\sigma_E^{jet} \sim 30\%/\sqrt{E(GeV)}$

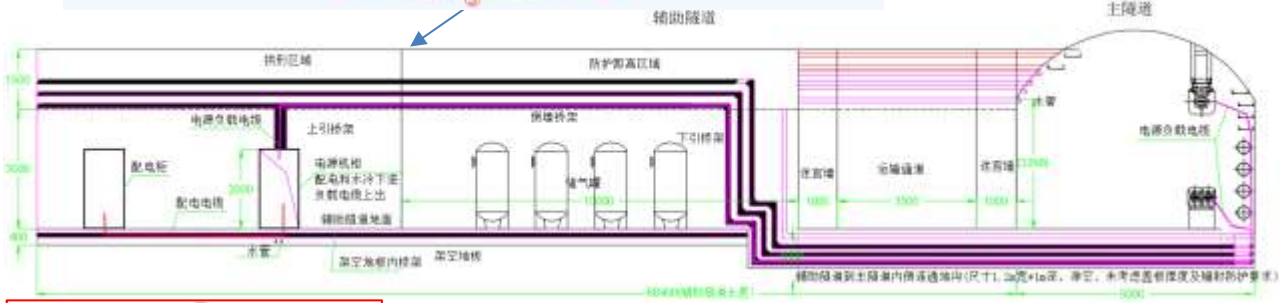
- **CEPC Detector reference TDR authorship collection invitation page:** https://indico.ihep.ac.cn/event/27252/registrations/2378/
- **CEPC Detector reference TDR has been submitted to arXive on Oct. 6, 2025,** https://arxiv.org/abs/2510.05260

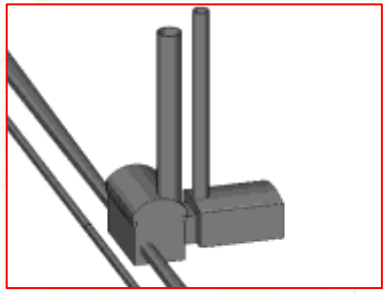
  and be published in RDTM as CEPC accelerator TDR published in RDTM in 2024

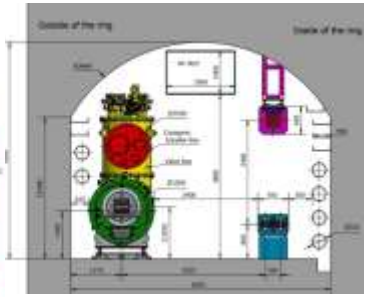
CEPC Civil Engineering and Conventional Facilities in EDR-1

CEPC general layout and auxiliary tunnel /500m along 100km

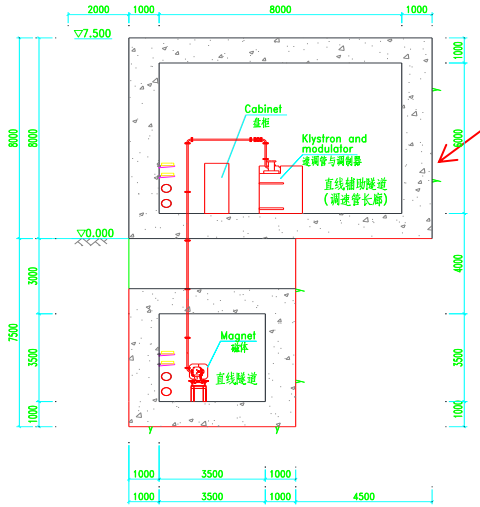


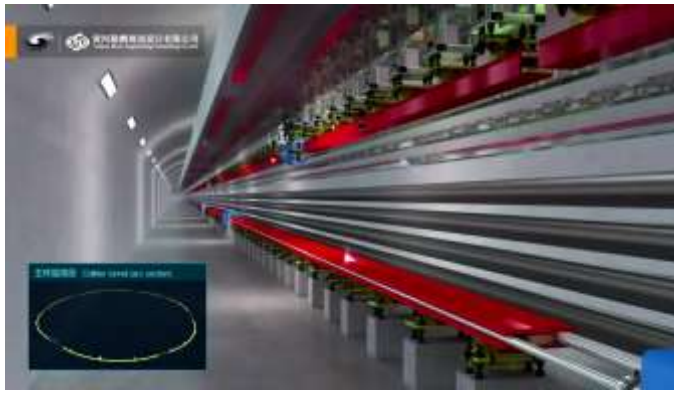


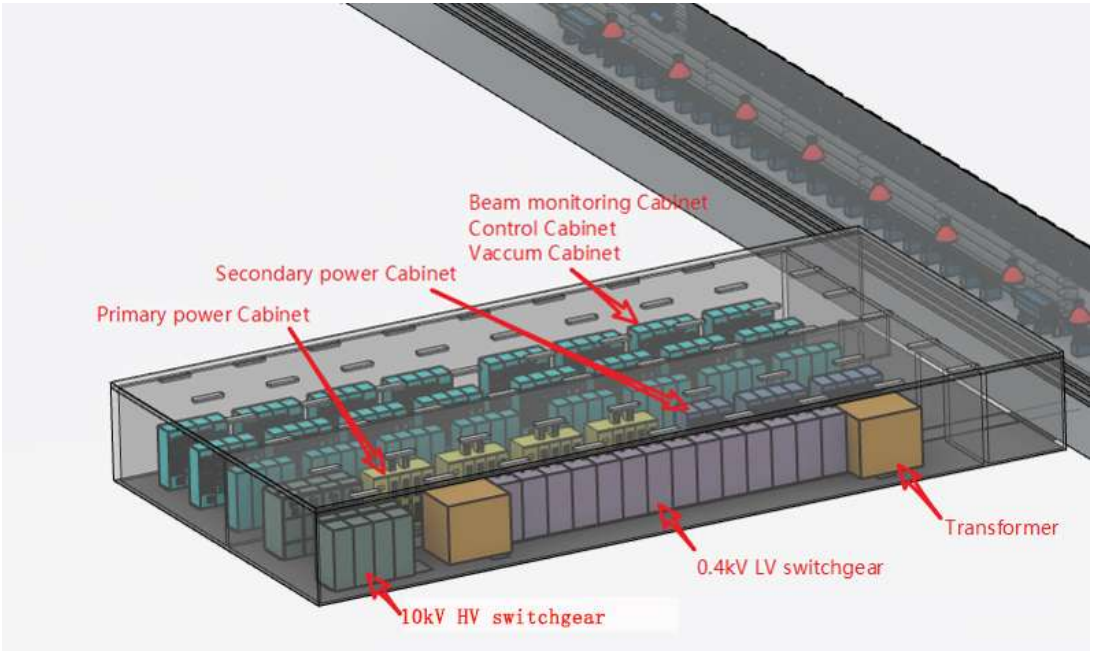




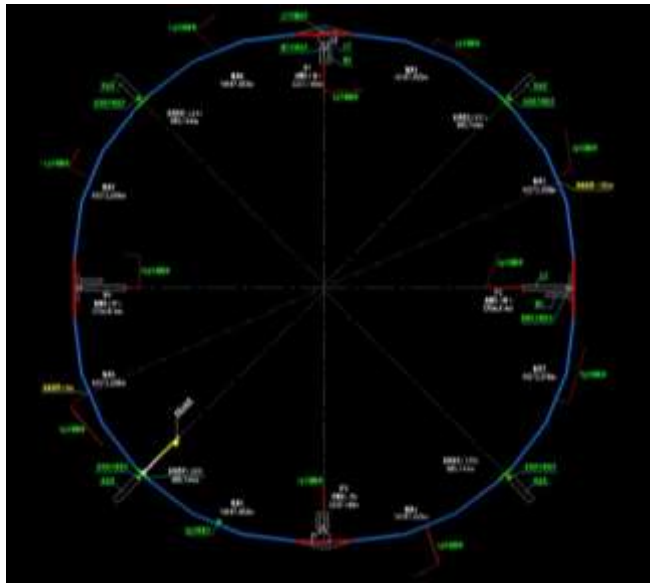
CEPC linac cross section



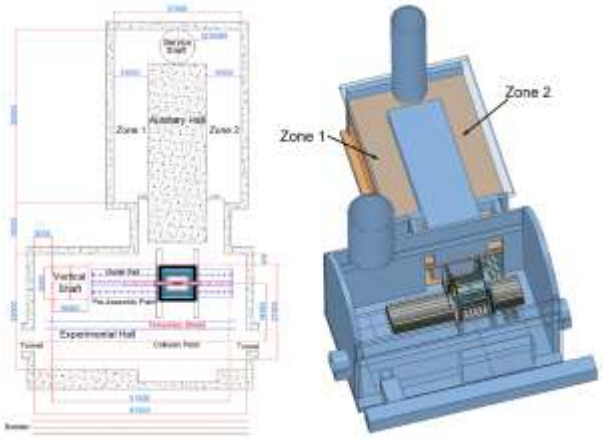




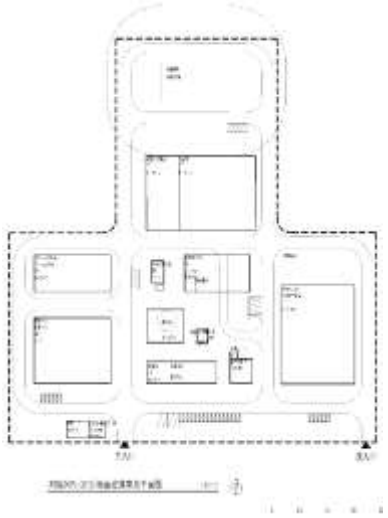
CEPC Civil Engineering and Conventional Facilities in EDR-2



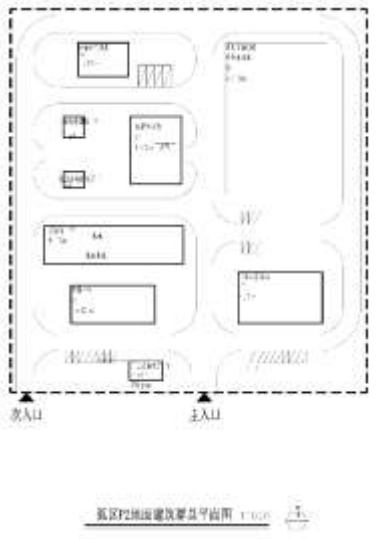
CEPC general layout 100km



CEPC detector hall design

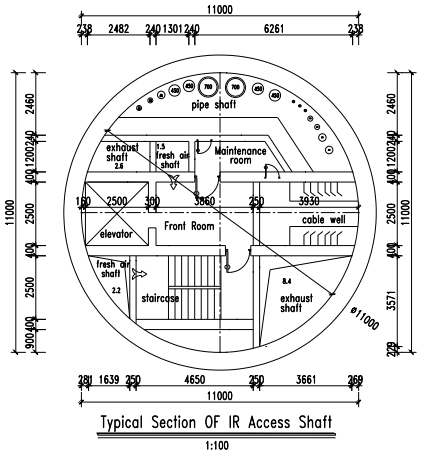


IP-1 surface building

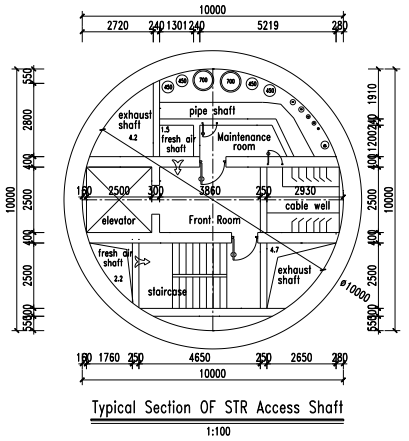


Arc shaft surface building

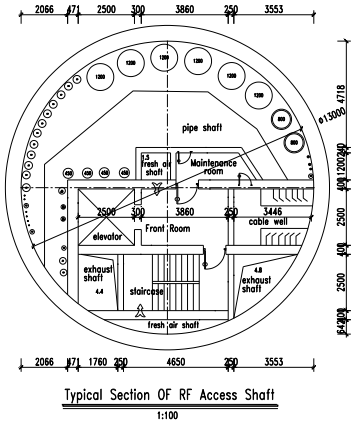
SRF shaft surface building



IP-1 auxiliary hall shaft



Arc shaft hall shaft



SRF shaft

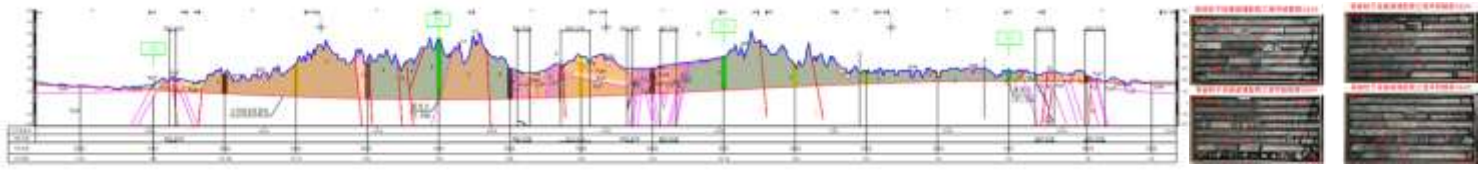
CEPC EDR Site Investigation

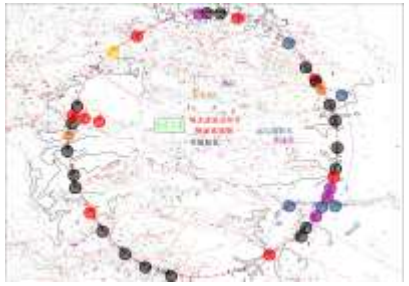
CEPC EDR site implementation plan

Design Stage	2024						2025						2026						2027					
	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
Preliminary Site Selection	Preliminary Site Selection																							
	Preliminary Site Selection Report																							
Feasibility Study (including Site Seletion & Project Proposal)				Site Selection																				
				Feasibility Study																				
										Project Proposal														
Preliminary Design																								
Tender Design																								
Tender																								

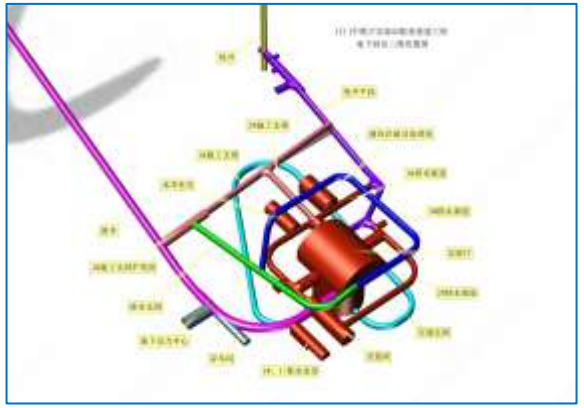
CEPC EDR site geological study has been started and the geological feasibility study will be completed in 2025

CEPC construction plan





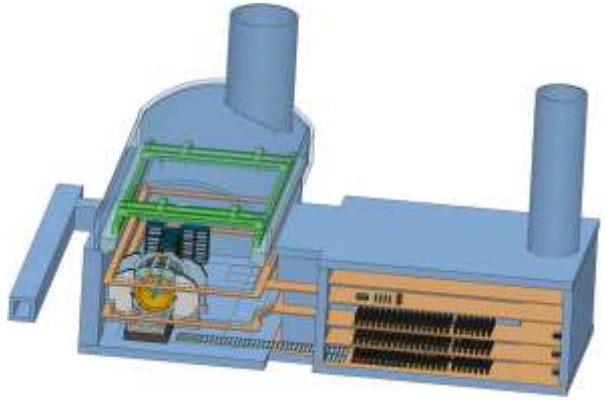
JUNO and CEPC in Synergy on Civil Engineering



JUNO shaft

JUNO has been successfully put into operation on August 26, 2025

CEPC detector hall



JUNO detector hall:
56.25m×49m×27m
CEPC detector hall:
55.5m×31.5m×41.25m

Green CEPC and Sustainability Efforts

- **SR power per beam: 30 MW** (CEPC-TDR p965)
  - Total electricity consumption: 262 MW
    - RF power (109 MW)
    - Magnet (58 MW)
    - Utilities (44 MW)
    - Cryogenics (11.6 MW)
    - Other auxiliary power combined (29 MW)

  } Need to improve these

- **SR power per beam: 50 MW** (CEPC-TDR p967)
  - Total electricity consumption: 340 MW
    - RF power (177 MW)
    - Magnet (58 MW)
    - Utilities (54 MW)
    - Cryogenics (11.1 MW)
    - Other auxiliary power combined (29 MW)

  } Need to improve these

Participated the 4th edition of the Sustainable High Energy Physics (HEP) workshop, May 12-15, 2025, with green CEPC and sustainability presentation and Panel discussions https://indico.global/event/4745/

On-going sustainability projects:

- High efficiency klystron:
  - 650 MHz
  - 80 MW C-band
- Permanent magnets transport lines
- High Q-factor SRF cryogenic-modules
- Recovery of waste heat (HEPS)
- Recovery and recycling of Helium
- Photovoltaic (PV) power generation systems (HEPS)

Permanent quadrupole's prototypes for CEPC collider rings

Prototypes have been developed addressing green collider technologies

Power efficiency, energy recycling, and clean energy generation are being addressed as comprehensive measures for sustainable operation

Publication: Dou Wang; Jie Gao; Yuhui Li; Jinshu Huang; Song Jin; Manqi Ruan; Mingshui Chen; Shanzhen Chen, "The carbon footprint and CO2 reduction optimization of CEPC", *RDMT*, https://doi.org/10.1007/s41605-025-00535-7 (2025).

Participating and Potential Collaborating Companies in China (CIPC) 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 worldwide

CEPC Industrial Preparation

Large-scale Cryogenic Refrigeration & Liquefaction Equipment 中科富海 (CIPC member)

First 18kW@4.5K helium refrigerator fabricated in in China passes inspection

-It was developed by the Institute of TIPC,CAS, and integrated and manufactured by Fullcryo.

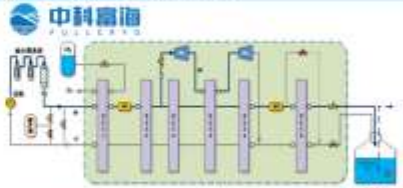
-The super large horizontal cold box with a length of 28m and a diameter of 4.2m achieves ultra-high vacuum and extremely low leakage.

-The horizontal cold box at megawatt-level is the largest of its kind in China and even in the world.

-The horizontal cold box system has exceeded the set targets.

-On-site testing: 1. The airtightness test of each internal channel revealed a pressure drop of 0, surpassing the target value of 0.02 bar. 2. The overall leakage rate is 9.1×10^{-10} Pa.m³/s, surpassing the target value of 1×10^{-7} Pa.m³/s.

-Expected Goals: Achieving 3 operational mode adjustments: the cooling capacity ≥ 18kW@4.5K; the cooling capacity in the superfluid helium temperature range ≥4kW@2K.

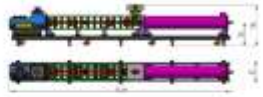


北京中科富海低温科技有限公司
Beijing Sinoscience Fullcryo Technology CO., Ltd. (CIPC member)

CEPC cryogenic system need four 14kW@4K cryogenic refrigerators. SppC needs 18kW@4.5K helium refrigerator as well

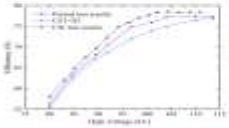
CEPC 650MHz 800kW CW High Efficiency Klystrons

国力研究院 GUOLI INSTITUTE (CIPC member)



Preliminary mechanical design for UHFKP8001

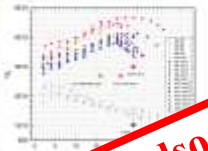
78.5%@803kW CW in August 18, 2024



Kunshan National Research Institute has successively developed **650MHz/800KW klystron sample tubes, 650MHz/800KW high-efficiency klystron sample tubes, 648MHz pulse klystron tubes, 650MHz/800KW multi-injection klystron beam tubes**, and the latest 3245MHz pulse klystron tubes Electro vacuum products for 50 years. Provide high power thyristor of GL1536A in batches for BEPCII in 2012.

HE-RACING Technology and OTIC on SRF Technologies (CIPC members)

高能锐新 (CIPC member)



1.3GHz cryomodule assembly

东方钽业 OTIC (CIPC member)

2011 DESY - XFEL

2017 INFN and STFC - ESS

2019 IBS - RISP, CERN - HL-LHC, Fermilab - PIP-II, Shanghai - SHINE

RRR300 niobium material procurement in progress

We had built the business relationship with many great customers such as DESY, MSU, Fermilab, IJLAB, INFN, STFC, CERN, TRIUMF, RI, ZANON, IHEP, IBS, RRCAT etc.

High RRR Nb sheet

High RRR Nb ingod

High RRR large grain Nb

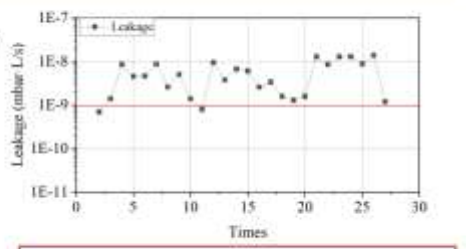
CEPC booster and colliders: 2GeV 1.3GHz and 650MHz SRF accelerators (Higgs); 10GeV 1.3GHz and 650MHz SRF accelerators (ttar)

The Key industries also for ILC and LCF

RF Shielding all Metal Gate Vacuum Valve

日扬科技 SHZK

- Two prototypes of RF shielding All metal [illegible]en developed, and the leakage of one of them have been tested.
- The delivery inspection leakage test results for two valves , conducted by the manufacturer, were found to be < 1×10^{9} mbar ·L/s (30 times open and closed).
- The difference of leakage by IHEP & manufacture will be checked and retested in next.



- Tested by IHEP
- Expectation leakage < 1×10^{-9} mbar ·L/s

CEPC needs ~1700 all metal valves

CEPC Collaborations in China

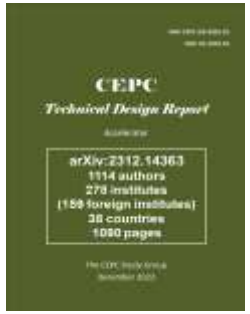
上海交通大学 Shanghai Jiaotong University (SJTU)
中国科学技术大学 (USTC)
四川大学 Sichuan University
中国原子能科学研究院China institute of atomic energy
中国科学院近代物理研究所 Institute of Modern Physics
中国科学院高能物理研究所 IHEP
哈尔滨工业大学Harbin Institute of Technology
华北电力大学North China Electric Power University
中国科学院空天信息创新研究院The Aerospace Information Research Institute
中国科学院近代物理研究所
复旦大学Fudan University
中国科学院大学University of Chinese Academy of Sciences
浙江大学Zhejiang University
深圳技术大学Shenzhen Technology University
南开大学Nankai University
南华大学University of South China
山西大学Shanxi University
北京大学Peking University
西北有色金属研究院Northwest Institute for Non-ferrous Metal Research
国科大杭州高等研究院的英文名称是National University of Science and Technology Hangzhou Advanced Research Institute
东南大学Southeast University
山东大学Shandong University
武汉大学Wuhan University
清华大学Tsinghua University
南京大学 Nanjing University
广西大学Guangxi University
华东理工大学ECUST (East China University of Science and Technology)
香港科技大学The Hong Kong University of Science and Technology，HKUST
台湾中央研究院Academia Sinica
华中师范大学Central China Normal University; Huazhong Normal University; CCNU

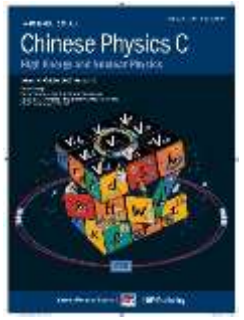
CEPC International Collaboration-1

CEPC attracts significant International participation and collaborations

CEPC 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





CEPC Detector Reference TDR report has been reviewed by IDRC in April 14-16, and Sept. 10, 17 and 24, 2025, and has been submitted to arXiv on Oct. 7, 2025, with >1470 authors, >30% international authors, >384 institutes, >63% international institutes, >43 countries. https://arxiv.org/abs/2510.05260

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

CEPC International Collaboration-2

HKUST IAS23 HEP Conference, Feb. 14-16, 2023, Hong Kong

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 fundamental physics conference: Jan. 14-17, 2025, Hong Kong
https://indico.cern.ch/event/1454867/overview

CEPC Workshop EU Edition (Barcelona, Spain) June 16-19, 2025
https://indico.ifae.es/event/2054/overview

The 2026 HKUST IAS fundamental physics conference: Jan. 12-16, 2026, Hong Kong

CEPC Workshop EU, April 7-10, 2026, Lisbon, Portugal

The 2023 International Workshop on Circular Electron Positron Collider, EU Edition, 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) was held from Oct. 23-27, 2024, Hangzhou, China
https://indico.ihep.ac.cn/event/22089/

The 2025 international workshop on the high energy Circular Electron Positron Collider (CEPC) will be held from Nov. 6-10, 2025, Guangzhou, China

https://indico.ihep.ac.cn/event/25300/

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

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

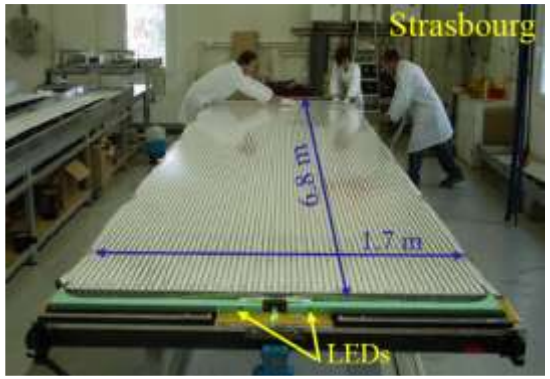
FCPPNL, Bordeaux, France, June 10-14, 2024
https://indico.in2p3.fr/event/20434/overview

FCPPNL, Qingdao, China, July 21-25, 2025
https://indico.ihep.ac.cn/event/25400/

CEPC International Collaboration- examples

INFN/Italy collaboration on JUNO and BEPCII-U

IN2P3/France collaboration on JUNO



CEPC in ESPPU 2026

Physics Preparatory Group

Karl Jakobs (chair)	**Xinchou Lou (IHEP)**
Gianluigi Arduini	Fabio Maltoni
Thomas Bergauer	Jocelyn Monroe
Tommaso Boccali	Hugh Montgomery
Anadi Canepa	Rogerio Rosenfeld
Cristinel Diaconu	Mike Seidel
Pilar Hernandez	Yuji Yamazaki
Gino Isidori	

Open Symposium on the European Strategy for Particle Physics
June 23-27, Venice, Italy
June 24
14:30 - 15:05 **Yifang Wang (IHEP Beijing)**
Status and plans for the realisation of the Circular Electron Positron Collider (CEPC) and other large-scale projects in China
Sala Perla, Palazzo del Casinò

https://agenda.infn.it/event/44943/overview

CEPC-SppC participate actively in the 2026 update of the European Strategy for Particle Physics (ESPPU 26) with two input documents:

1) **The Circular Electron Positron Collider (CEPC)**
An input to the European Strategy for Particle Physics - 2026 update
Contact persons: **Jie Gao, Miao He, Dou Wang, and Jianchun Wang**

2) **High Performance and Cost Effective Superconducting Accelerator Magnet R&D at IHEP**
Contact persons: **Chengtao Wang, Rui Kang, Chunyan Li, Yingzhe Wang, Juan Wang and Qingjin Xu**

On July 6, 2025, **China Association for Science and Technology (CAST)** delivered publicly the top ten frontier scientific questions, where "Higgs particle properties and the origine of masses" are among the top ten questions (the second) and CEPC is mentioned in association with replying this question
https://www.cast.org.cn/xw/BWTJ/art/2025/art_0f20c8a62cfe4584b13a53271ae73837.html

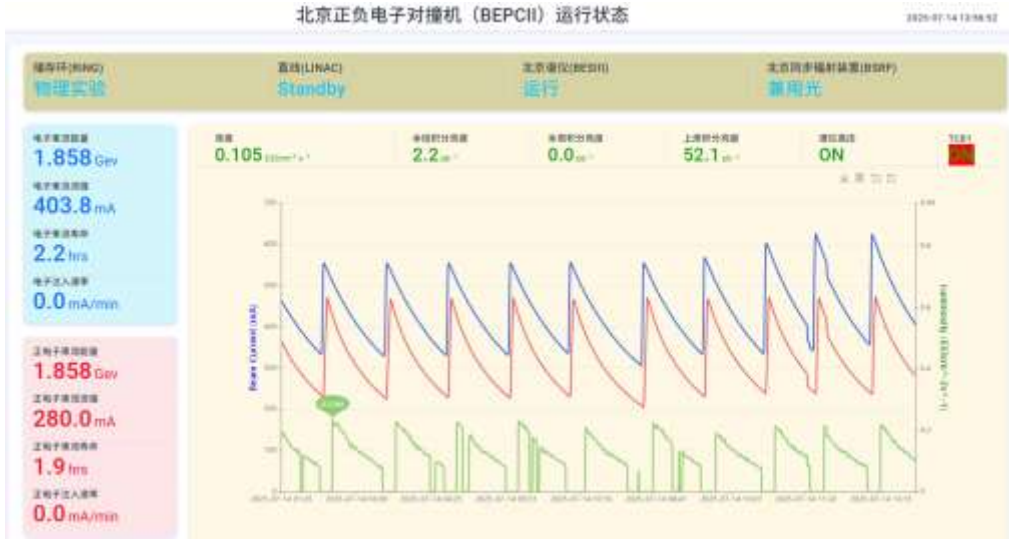
CEPC in Synergy with other Accelerator Projects in China

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

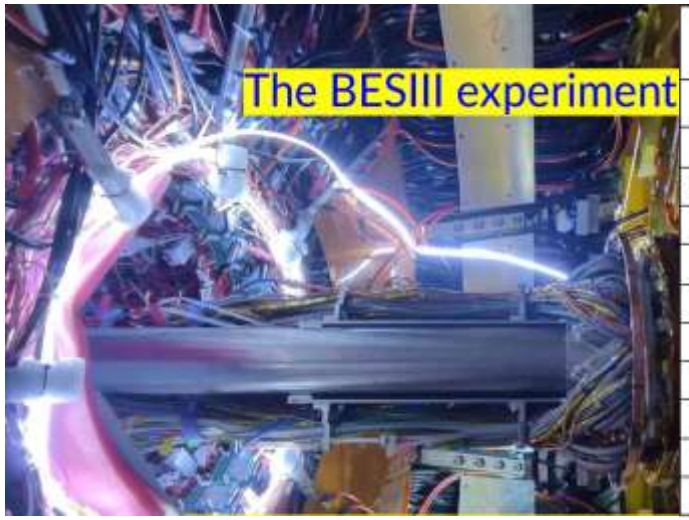
The total cost of the accelerator projects under construction:39B RMB more than CEPC cost of 36.4B RMB

Relevant accelerator human resources and industrial capabilities in China could be measured in relation with these massive investments

BEPCII-U under Commissioning in 2025



BEPCII-U started commissioning in March 2025



	BEPCII @ 2.35GeV	BEPCII-U @ 2.35GeV	BEPCII-U @ 2.8GeV
L $[10^{32}cm^{-2}s^{-1}]$	3.5	11	3.7
β_y^* [cm]	1.5	1.35	3.0
Beam current [mA]	400	900	450
SR Power [kW]	110	250	250
$\xi_{y,lum}$	0.029	0.033	0.043
Emittance [nmrad]	147	152	200
Couping [%]	0.53	0.35	0.5
Bucket Height	0.0069	0.011	0.009
$\sigma_{z,0}$ [cm]	1.54	1.07	1.4
σ_z [cm]	1.69	1.22	1.6
RF Voltage [MV]	1.6	3.3	3.3

J. Gao, “BEPCII and CEPC”, Proceedings of eeFACT 2025, arXiv:2505.02401, https://doi.org/10.48550/arXiv.2505.02401

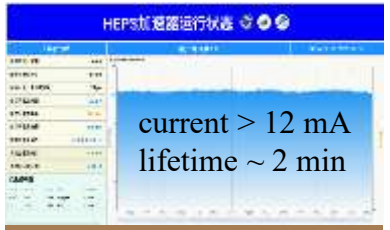
IHEP HEPS Completed in Oct. 2025

Commissioning Commenced

2024.07.23

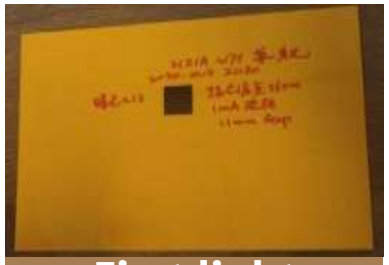
circulation >10 turns

2024.07.29



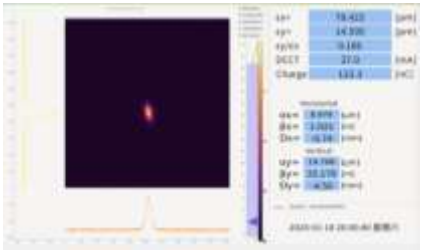
beam current reaches 12mA

2024.08.18



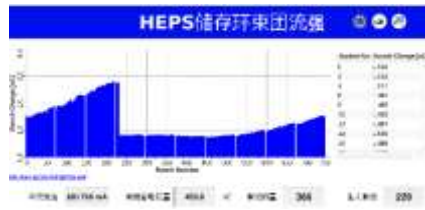
First light @ ID21

2024.09.22



Emittance better than 100pm

2025.01.02

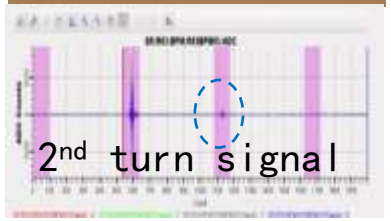


beam current reaches 100mA

2025.09.12

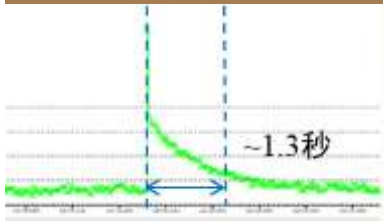
1st complete turn

2024.07.23



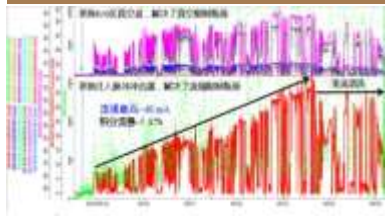
First stored beam

2024.07.29



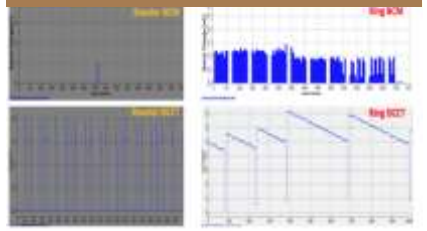
beam current reaches 40mA

2024.08.18



injection scheme demonstrated

2024.10.12



Emittance result passed review

2025.01.12

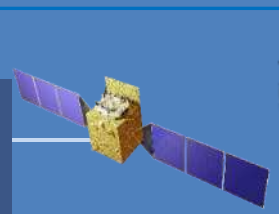
- HEPS SR has achieved a beam current > 100 mA (Sept.12, 2025), an emittance of < 100pm and served beamline tunings.
- **HEPS accelerator and SR light lines has reached the design goals on Sept. 29, Oct. 14, 2025, respectively. HEPS project has been completed on Oct. 29, 2025.**

CEPC Host Lab IHEP and its Large Science Facilities

HERD (2027) on Chinese Space Station

45

HXMT
Insight Hard X-ray Modulation Telescope



GECAM
Gravitational wave EM Counterpart All-sky Monitor

Huairou Campus

HEPS High Energy Photon Source

YBJ (retired)
International Cosmic Ray Observatory

IHEP, Beijing Campus

BEPC Beijing Electron-Positron Collider

IHEP Plasma Accelerator Test Facility

Jinan Campus

HUNT, underwater in south China Sea

AliCPT
Ali CMB Polarization Telescope

LHAASO
Large High-Altitude Air Shower Observatory

Daya Bay (retired)
Daya Bay reactor Neutrino Experiment

JUNO
Jiangmen Underground Neutrino Observatory

Dongguan Campus

CSNS China Spallation Neutron Source

The main duty and task of IHEP is to pursue the energy frontier explorations through advanced colliders

Summary

- CEPC accelerator full spectrum EDR activities including EDR site geological investigation and civil engineering design have progressed well according to EDR plan
- CEPC detector reference design report has been submitted to arXiv on Oct. 6, 2025, https://arxiv.org/abs/2510.05260
- CEPC will complete EDR and continue to prepare and apply 16th five year plan apply for construction around 2030's
- International efforts towards Higgs factories are common endeavors of human beings, and the final goals should be and could be reached with persistence and endurance.




IHEP will always be one of the climbing teams towards energy frontiers and among the teams to reach the goal

Acknowledgements

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

Special thanks to CEPC IB, SC, IAC, IARC and IDRC committee's advices, suggestions and supports

Thanks for your attention

CEPC in China

1. China's economy: 9.3% of the world, 62.3% of USA, the second in the world after USA
2. China's Industry production: >1/3 (35%) of the world, the first in the world
3. China's Electricity production: 1/3 of the World, the first in the world
4. China STEM students: graduate each year >5 Million, the first in the world
5. Creative index of China: ranked 10th of the world (2025)
6. CEPC has the potential and the capability to answer the most fundamental scientific questions on our Universe (among the top ten scientific questions listed by China Association for Science and Technology in 2025, https://www.cast.org.cn/xw/BWTJ/art/2025/art_0f20c8a62cfe4584b13a53271ae73837.html)
7. China has favorable conditions to host CEPC as a Higgs factory and has big room to make significant scientific contributions to the world and peaceful collaborations with the world through CEPC development
8. CEPC is a scientific Olympic Games, which will have a long-lasting impacts on China's scientific and general developments, and worldwide development also

Global Innovation Index 2025 rankings

GII rank	Economy	Score	Income group rank	Region rank
1	Switzerland	66.0	1	1
2	Sweden	62.6	2	2
3	United States	61.7	3	1
4	Republic of Korea	60.0	4	1
5	Singapore	59.9	5	2
6	United Kingdom	59.1	6	3
7	Finland	57.7	7	4
8	Netherlands (Kingdom of the)	57.0	8	5
9	Denmark	56.9	9	6
10	China	56.6	1	3
11	Germany	55.5	10	7
12	Japan	53.6	11	4
13	France	53.4	12	8
14	Israel	52.3	13	1
15	Hong Kong, China	51.5	14	5
16	Estonia	51.1	15	9
17	Canada	51.1	16	2
18	Ireland	50.4	17	10
19	Austria	50.1	18	11
20	Norway	49.2	19	12
21	Belgium	48.5	20	13
22	Australia	48.0	21	6
23	Luxembourg	47.3	22	14
24	Iceland	47.0	23	15
25	Cyprus	45.5	24	2